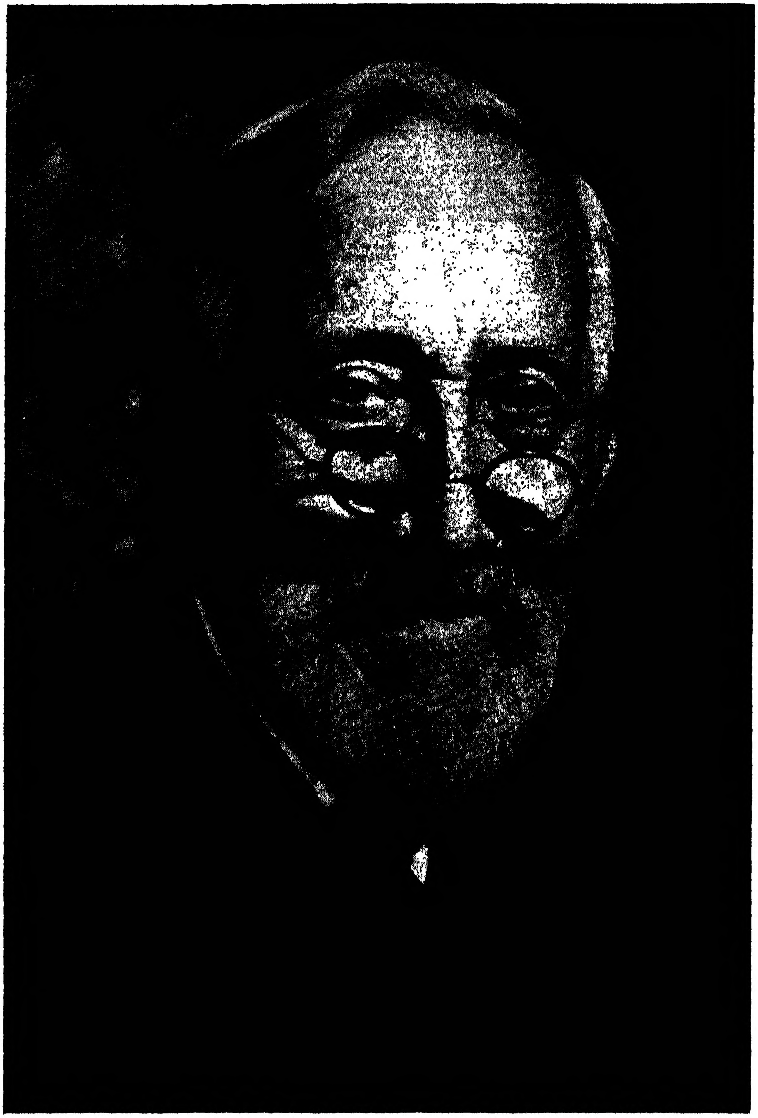
THE PROFITABLE CULTURE OF
VEGETABLES



[D. H. Thurger

THOMAS SMITH

Forty years after the first edition of this book appeared

THE PROFITABLE CULTURE OF VEGETABLES

FOR

Market-Gardeners, Small-holders and Others

By

THOMAS SMITH

Sometime Manager of the Fels Fruit Farm and the Mayland French Garden
Author of "French Gardening"

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FULLY ILLUSTRATED

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THIS BOOK
IS DEDICATED BY THE AUTHOR
TO HIS FRIEND
JOSEPH FELS,
IN ADMIRATION OF THE GALLANT FIGHT
HE IS MAKING
THROUGHOUT THE WORLD
TO BREAK DOWN
THE MONOPOLY IN LAND

PREFACE TO THE THIRD EDITION

ON February 14th, 1950, at the 146th Annual General Meeting of the Royal Horticultural Society the President, Lord Aberconway, referred to Thomas Smith's book *The Profitable Culture of Vegetables*, saying that since it first appeared in 1911 it had been wonderfully helpful to generation after generation of gardeners. The Society commemorated the book by presenting to Mr. Smith the Veitch Memorial Medal, which is awarded by the Council of the Society to those who have helped in the advancement and improvement of the science and practice of horticulture.

Many gardeners and growers can echo Lord Aberconway's praise for this book, and I appreciate the honour of being asked to undertake its revision. The passage of nearly half a century brings changes in methods, materials and the varieties of crops grown and provides the reason for the revision; yet in the course of reading and re-reading this book I have been repeatedly impressed by the shrewd soundness of the original text and am very pleased to say that the book still holds a large part of Mr. Smith's counsel and instruction. Certain additional chapters have been included and the layout slightly altered so as to present a suitable sequence of the story of vegetable production.

By its title the book proclaims that it was addressed to market-gardeners, but its past readers have included cultivators of every type. It is hoped that the student and home gardener may still find it of use, no less than the commercial producer.

One of the outstanding features of the first edition was Mr. Smith's masterly handling of the subject of French gardening. The coming of the machine to the land and the shortage and high cost of labour led to the passing of the French garden, so the space allotted to it in this edition has been reduced; Mr. Smith advised that it should be cut out altogether. Elsewhere are given the reasons for the retention of this section, and it is gratifying to note that each person to whom this has been mentioned agrees that the exclusion of some account of French gardening could not have been done without serious loss to the book. The French light has been superseded by the cheaper Dutch light and the true cloche or bell-jar by the continuous cloche; an account of the use of these newcomers shows something of the modern picture of intensive cultivation.

For the illustrations in the new edition a small number of the original diagrams have been retained. It is noteworthy that Mr. Thomas Smith, at well over 90, has given assistance in the preparation of some of the new drawings. Several friends and colleagues have kindly loaned photographs for reproduction, as also have various makers of horticultural equipment. The tools for the illustration of Dutch dibbers, etc., were kindly loaned by Mr. G. I. Keen.

To my colleagues Dr. H. E. Croxall and Dr. M. Cohen thanks are due for helpful criticisms and suggestions for the sections on pests and diseases. Our industry has seen in recent years a great pooling and interchange of knowledge, and today we all owe much to one another: indirectly many growers and colleagues have from time to time provided information now recorded in this book.

Mr. Thomas Smith and his son Mr. Bertram Smith have been most helpful with the proof-reading, and the latter has kindly offered to undertake the indexing.

To all who in any way have helped I acknowledge my indebtedness, not least to my wife for her care and suggestions in reading the manuscript and proofs.

J. RHODES

Gosforth,
Newcastle upon Tyne
August, 1953.

EXTRACT FROM PREFACE TO THE FIRST EDITION

MANY years of practical work in connection with market-gardening and small-holdings, both in actually cultivating the soil and in directing the work of others, have made me familiar with many of the needs and difficulties of those who gain their living from the cultivation of small areas of land, as well as having given me an insight into the factors which lead to success.

Amongst the greatest difficulties inexperienced men have to contend with are the want of directions as to general procedure and precise advice on points of detail. Even those who may fairly lay claim to experience often find themselves in doubt on subjects outside the usual routine. In many such instances collections of handbooks and periodicals on gardening matters are cursorily consulted, but it is seldom that any enlightenment can be discovered just at the moment it is needed, and as the matter is usually urgent such vague ideas as are already possessed constitute the only guide. As a consequence, many of the operations carried out under such circumstances come to an unsatisfactory conclusion.

The purpose of this book is to supply such information as the grower of vegetables is likely to require in connection with the productive part of his business, from the preparation of the soil to the marketing of the produce. Both ordinary and intensive culture are dealt with. I have endeavoured to convey the information clearly, in full detail but free from superfluities, and it is my earnest hope that it will be found of real help.

It was not without hesitation that I decided to add another to the long list of books on horticultural subjects, but I have made the venture because, in spite of their number and variety and the great value of some of them, I have hitherto failed to find one which satisfies me as being just the book those engaged in the culture of vegetables for a livelihood are in need of. The result may easily prove that I also have failed to produce what is required, but I shall at least know that I have tried, to the best of my ability, to do work which needed doing.

Throughout the production of the book practical friends have been very helpful, and I have consulted on numerous points a large array of authoritative works, the titles of which would need too much space to enumerate.

THOS. SMITH

Fels Fruit Farm,
Mayland, Essex,
April, 1911.

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PART I

CHAPTER I

INTRODUCTION

THE ultimate success of the man who undertakes market-gardening as a means of obtaining a livelihood largely depends upon his fitness for the work. It is an occupation which calls for judgment, foresight, resourcefulness, untiring industry, and unfailing optimism. If he is endowed with these qualities his prospects of success will then depend upon his aims, a thorough understanding of the manner in which he intends to realise them, and the means at his command.

Before embarking upon the serious business of cultivating the soil for a living, a man ought to have in hand not only enough capital to provide for rent, tools and appliances, manure, seeds, and possibly livestock, but also sufficient for his family's maintenance for at least one year. Although the average yields from well-cultivated land may be calculated with a near approach to accuracy when taken over a sufficient number of years, the yields in any given year are very uncertain because of irregular climatic conditions. If the holding is a newly formed one the first year's occupation of it is sure to be beset with innumerable unforeseen items of expense; if fruit trees are planted upon a portion of the holding these will be several years before yielding any appreciable return for the capital and labour expended upon them, and the cultivated land will probably require a season or two to bring it into good condition. In addition, there is always the possibility that the first season may be an exceptionally cold or wet one, with the returns from crops much lower than was calculated upon, and if this should be the case disaster will not be far away unless there is some reserve fund to fall back upon. Even if success is attained in the end, lack of sufficient capital must entail much unnecessary privation and toil in the early years.

Few townsmen have any conception of the labour required to make a small-holding successful. Given a strong constitution the work is healthful and adds to length of years, besides being pleasant enough when one's mind and body have become accustomed to it; but it is never other than laborious. No one should undertake to cultivate the soil for a living for the first time after middle age, and at no time is the work suitable for men of poor physique. The long hours of labour and the exposure necessary to success—for marketing must be done regardless of weather and summer planting may be done during rain—must tell heavily against a feeble constitution.

Still, when all has been said there still remains the undeniable truth that the most potent factor in the whole situation is *the man himself*. Many a one has started in a very modest way and by concentrating his energies upon only so much of his holding as the means at his command would enable him to do well, and adding to his income by working for others in his spare time, has extended his operations as his experience and profits have grown, until at last he has attained an assured position. It must therefore suffice to utter a grave warning to those who contemplate such an undertaking that it should not be entered upon without the fullest and most careful consideration.

In any circumstances the best must be constantly striven for if lasting success is to be achieved. Spasmodic effort will not do; industry and attention to the work in hand must be unremitting, and every operation carefully studied. The man who means to prosper must learn and put in practice the principles underlying the production of profitable crops—soil management, manuring, the rotation of crops, the manipulation of tools and appliances, the methods of combating plant pests, besides the general routine of work in the garden; last, but by no means least, he must learn the best methods of marketing his crops after he has produced them.

Intensive culture should also receive serious attention. It yields remarkable results as compared with ordinary culture, and its special value to the small-holder lies in the fact that its principles can be more readily and less expensively applied on a small than on a large scale. It is a system in which *personal* care is an extremely important factor of success, and it is just this personal attention which the small-holder is in a position to give. Furthermore, so many of the green crops and roots are grown on an extensive field scale that a grower with a small area of land can usually only obtain a satisfactory income by the use of intensive methods.

CHAPTER II

SELECTION OF A MARKET-GARDEN

THE first condition of success in a small-holding is that it should be in a suitable situation. Mistakes in this matter may cause failure even when all other conditions are favourable. The best position is undoubtedly one within a few miles of the market which is to be supplied, and this is especially necessary when the main produce consists of bulky green vegetables or quickly perishable articles, or when it is intended to develop a connection with shops, hotels, and restaurants.

Land near a large town will probably be highly rented, but a few extra pounds a year for rent is a small matter in comparison with the constant saving in cartage and charges for railway carriage, besides the great convenience of being able to take produce to its destination by road at any time most suitable to the grower or his customer. It also frequently happens that owing to scarcity or unusual demand prices in the markets are much higher on some days than on others and when the holding is situated within a few miles these increased rates can be taken advantage of. Besides this, manure can sometimes be drawn back on the return journey.

If a holding cannot be secured near a populous centre a site should be chosen which in itself is ideal for cultivation and is served by good transport facilities. It may be near a railway station or have good access to a main road for transport by motor van or lorry. A grower may have his own transport or he may arrange for his produce to be carried by a haulage contractor. Such a position, although not so good as one near a large town, has usually the recompense of a much better atmosphere and cheaper land.

The aspect of the land is of great importance, as it may make the difference of a week or more in the maturing of a crop even in the same locality, and it is surprising what a few days' difference will effect in the prices realised for early produce. A rectangular and fairly level piece of ground is the best for general purposes, as it is the most convenient form for ease and economy of working and the soil is not liable to be washed away by heavy rains, but for intensive work a gentle slope towards the south will greatly assist in securing early produce both from frames and from the open. Providing there is protection from cold winds a slight slope towards the south-east has some advantages over a full south aspect; the morning sun will then get sooner into frames in the early part of the year, and during the heat of summer the full glare of the sun is off the frames earlier in the afternoon, thus giving the plants more time to recover from intense heat. Failing either, a slope to the south-west is not to be despised. The worst aspects are those where the whole or greater part of the land has a decided inclination towards the north, north-east, or north-west, but where the ground is undulating such slopes can be turned to good account. In such a case the warmest spots would be selected for the earliest crops, the main crops would be put in a good open position, and the crops which stand in the open through the winter would go on the northerly slopes; in this position they would be more likely to pass safely through a severe winter, because if they get frozen they can then thaw out gradually before coming under the full power of the sun, the sudden thaw which comes when the sun's rays strike the plant doing more damage than the actual freezing. In addition, during summer and autumn a succession may be obtained by growing late varieties on the northern slopes.

Protection from cold winds is very necessary if forcing and the production of early vegetables is to form part of the business; this may be obtained by rising ground or a belt of trees at a little distance on the north and east, or by a wall, fence, or hedge. The erection of a wall could not be considered nowadays, but it is at times possible to take advantage of exisiting shelter. Protection against strong winds, particularly from the south-west, is sometimes needed and hedges *through* the holding may be planted. Such hedges may provide saleable produce. Lilac and in some coastal districts *Pittosporum tenuifolium* make valuable contributions to the income. Protection does not imply a position hemmed in and overshadowed by tall trees or buildings, where sunlight is obstructed and the atmosphere is stagnant. For the production of good vegetables full sunlight and a buoyant moving air are essential, besides which many insect and fungoid pests, particularly the latter, often flourish most in dull confined places.

Good sound fences round the holding are often desirable and sometimes absolutely necessary, and if not already in existence will mean a serious item of expense.

The best soil for general purposes combined with intensive culture is a moderately light loam of good depth. It may not be easy to secure a holding with such soil and all other essentials conditions; therefore one must be content with the nearest approach to it. Most soils, however unpromising, can be brought into fertile condition by draining, frequent deep working, liming, and the addition of heavy dressings of animal manure, but any substantial improvement can only be brought about slowly and is frequently a very costly business. Avoid thin shallow soils, very open and dry sandy or gravelly soils, and heavy undrained clays. Run-down derelict land which is frequently little else than a nursery ground for twitch, thistles, briars, and rabbits, would sometimes cost too much to be worth bringing it into good condition.

Whatever may be the type of soil it should be deep and have good drainage, either natural or artificial. If it is in need of drainage and that expensive operation has to be undertaken there should be some important advantage present as a compensation. When draining has to be done care must be taken to see that there is fall enough to enable the water to get away easily; drain-pipes in the land are of no use without a proper outfall. Low damp situations and waterlogged soils which cannot easily be drained should always be avoided, no matter how cheap or well-situated the land may be. Low-lying sites are usually frost pockets and tender plants may have their season shortened by late spring or early autumn frosts.

An unlimited supply of good water is essential, especially where intensive work is to be carried on, as copious waterings must often be given. Much water is also used in the washing of crops before marketing. This may be obtained from river, stream, or pond, from wells or from public water mains. In a few areas well water may be brackish owing to the presence of salt and quite unsuitable for applying to crops. Water used for washing crops must not be contaminated.

High cultivation and early crops must usually be accompanied by a plentiful use of manure, therefore the possibility of obtaining a cheap and abundant supply must be carefully enquired into. The quantity required will depend upon the kind of culture undertaken. Although some crops are grown on the residues left from the previous year's cropping others need generous treatment and a dung supply of some 25 to 30 tons per acre should be available; on many sandy soils much higher rates may be given with advantage for some crops. All the land will not need dung each year, so the applications are worked in rotation around the holding.

Too much land should not be taken. Capital which is sufficient to the proper working of five or six acres would be totally inadequate for ten or fifteen acres in the same branch of culture, and whilst success might be attained on the small area the attempt to work the larger plot with insufficient capital would probably end in failure. Development on the holding must depend on the labour available, so care must be taken in planning to restrict activities to a scale which can be coped with.

Finally, when renting a holding, care should be taken that the tenure is secure and properly safeguarded.

CHAPTER III

DISPOSAL OF PRODUCE

HAVING secured a suitable and well-situated holding, the next step is to decide upon the particular branch of market-gardening to be undertaken, and this matter requires much thought and careful calculation before a decision is reached.

What is to be grown depends on where the produce is to be sold, and there are various channels by which the crops can be transferred from the grower to the consumer.

In London and the larger provincial towns there are public wholesale markets at which commission salesmen and wholesale merchants handle the grower's produce. Some growers are themselves wholesalers, the actual selling being done by the grower, a member of his family, a partner in the business, or an employee, but it is usually only the larger, well-established growers who follow this system. The grower who sends his produce to a commission salesman or wholesaler can devote his attention almost entirely to the work upon his holding, with very obvious advantages. Having chosen a salesman the new grower should seek his advice on such points as varieties suited to his market and should loyally send a steady supply to one salesman only in a given market.

In growing for public markets the crops from any particular place are limited in number, and are individually much larger in extent than when grown for private trade, the aim being to produce at stated times large supplies of those things for which the land is best adapted or for which the situation is most convenient, e.g. Cornwall and winter broccoli; Fenland and celery. In many districts predominating crops are a very noticeable feature, and this is also the case with many individual market-gardens worked on a large scale—certain main lines are made a specialty, and this method is found to be the most profitable. Crops in which bulk is small in relation to value, or those which need not be put on the market immediately they have matured, are frequently grown in favourable situations remote from the markets, providing there is convenient access by railway or good road service, but most bulky green vegetables are grown comparatively near the great centres of population, where labour is easier to get, and the produce is conveyed to market by road.

With specialisation the varieties of crops are fewer in number and therefore easier to cultivate and to handle, nor is the skill required so great or so varied as when more numerous varieties in smaller quantities have to be raised in regular succession; besides which neither time nor ability is called for in effecting sales, as this is done by the regular commission salesman or wholesaler in the markets. In most cases the produce must be sent when ready, no matter what the state of supply and demand may be, and it is sold for whatever it will bring. If it should arrive on a glutted market, the prices realised may be entirely unremunerative or, as sometimes happens, there may be no price at all.

In a few districts a wholesaler arranges to collect the produce from the holding, and this system of sale solves a transport problem for the grower, but it is only developed where there are sufficient growers to make it worth while for the wholesaler.

The grower may decide to handle his own sales. This is usually done by working up a "round" to supply shops, hotels, restaurants, etc., though sometimes a retail trade is developed as a stall or shop.

When direct sale is adopted it is necessary to produce a wide range of varieties, combined with uniform and regular supplies. The grower may be unable to restrict his crops to those for which his soil and situation are best adapted; to create and maintain a thriving business he may attempt to supply a wide range of the vegetables and possibly flowers and fruits, and to grow these well on soil which in the case of some of the crops is not the most suitable calls for considerable skill and resourcefulness. Additional time and ability are also needed to find and secure regular customers. It is obvious that a considerable amount of time must be occupied in disposing of the produce in this manner and, of course, this seriously curtails the amount of work which the grower can do upon the land, and unless he has help within his family circle, he will have to engage paid labour. This all tends either to decrease the output or to increase the cost of production. As a recompense this outlet for the produce is free of the ruinously low returns which may come from a glutted market, and the grower is usually able to obtain prices which are fairly steady and remunerative. However, far too many holdings all over England show the detrimental effects of the competition between the growing and selling aspects of the business. Wherever possible the selling should be deputed unless there is good supervision of the holding during the grower's absence. One system of sale which has from time to time proved successful is that of direct supply to the retail customer. Delivery is either by post, rail, or van; packages of prearranged price being supplied weekly or twice a week.

The particular branch which will be adopted by the smallholder may be decided by circumstances over which he has little or no control. In many cases he is obliged to take whatever land is offered him either to rent or to purchase, or go without a holding. Although such land may not exactly conform to his ideal either as regards quality or situation, it may yet be good in many respects and capable of being worked to profit along some lines, although not those desired. If a holding is taken under such circumstances and it is situated in a locality where market-gardening is already carried on it would be wise to be guided by the practice of the neighbourhood, at any rate until experience is gained and personal initiative is safe.

It is obviously impossible to indicate any particular branch of the market-gardening business which would be the most suitable in all circumstances, but it is certain that beginners on small areas at a distance from markets will find it difficult to compete successfully with growers who work large areas with every advantage in the way of labour-saving appliances.

Much attention has been given to the possibilities of co-operative sales organisations. A number of such bodies have been founded; many are still serving their members—some have failed. The successful ones are mainly those which serve a fairly compact group of producers at a distance from a consuming centre. In recent years the Agricultural Co-operative Association, Ltd. has given much help to groups of growers who have sought guidance as to the prospects of co-operative ventures.

The growing of crops on contract is a system which has developed in recent years. Most contract-grown crops are destined for processing—e.g. canning, drying (in the case of herbs), and "quick-freezing". These channels must not be regarded as emergency outlets for surpluses. The various processes need specific varieties grown at specific times in order to maintain a steady flow through the works. Often the factory concerned has a fieldman who gives guidance to the growers on the crop needs and advises the factory manager on the progress of the crops. The crops should not be grown for processing without first making a contract with the factory.

FOR FURTHER READING

MINISTRY OF AGRICULTURE AND FISHERIES. *Co-operative Marketing of Horticultural Produce.* Economic Series, No. 49. H.M.S.O.

CHAPTER IV

SOIL AND ITS TREATMENT

ORIGIN

SOIL is the raw material from which the cultivator gets his living. It is a mantle of varying thickness covering the earth and the rocks from which it has been derived. It is a product of the breakdown of rocks which may either immediately underlie the soil or be at a distant source from which fragments have been transported, usually by water. Varied aspects of the weather play their parts in rock destruction—alternation of heat and cold causes expansion and contraction of the rocks; expansion of ice in crevices of the rocks causes shattering; minerals exposed to the air are oxidised; rainwater, with its dissolved carbon dioxide, is a solvent of the rock minerals—these and other influences are continually releasing rock fragments. The colonisation of the weathered rock particles by living organisms—bacteria, algæ, higher plants, and varied animal forms—helps still further to alter their character and results in the production of soil. The process is a long one and a deep fertile soil is the product of many thousands of years, particularly when the resultant soil has remained *in situ* over its parent rock. The weathering agents which helped to produce the soil continue to affect it and modify its properties.

COMPOSITION

Soil is a very complex material. Except in the case of peaty soils the greater portion of a soil is *mineral* in composition. *Organic matter* is present in forms varying from the fresh remains of crops to humus, the advanced breakdown product of plant material. Between the solid particles of the soil are pore spaces which may be occupied by *air* or *water*; both are essential to a fertile soil. One other feature, *life*, is also essential, and good soil is teeming with a vast population of bacteria which are responsible for the breakdown of organic matter to simpler forms.

The Mineral portion of the soil comprises every range of particle size from visible gravel and coarse sand through fine sand

and silts to the clays which have particles less than 0·002 mm. in diameter. Some kinds of clay have particles molecular in size. The proportions of the minerals vary widely but are basic to the site and are practically unalterable so far as the average cultivator is concerned. One thing should be noted—that *all* soils contain some sand, some silt, some clay; the proportions of these may vary through every possible range. The properties of the soils resulting from the varying combinations of these components need to be understood if their assets are to be fully utilised and their limitations appreciated.

Soils consisting principally of sand are easily worked. Provided that the drainage is good, rainwater passes through easily and cultivations can often be carried out soon after heavy rain has fallen. The work needed to produce good seed-bed conditions is eased. Sandy soils are usually well aired and thus "warm up" easily in spring. For these reasons light, easily worked soils are usually much sought by the intensive grower. Against the advantages one must recognise that good natural drainage is often accompanied by poor water-holding capacity, and easy passage of water usually means that soluble plant foods are easily lost or leached from the upper levels of the soil. However, provided that there is a fair depth the faults of a sandy soil can, to a large extent, be overcome by cultural practice.

Clay soils are the opposite to sands in their properties. The extremely fine nature of clay particles makes the passage of water difficult and their colloidal* nature causes a wet clay soil to be a sticky one. The physical features of a wet clay make the passage of implements more difficult than is the case with a sandy soil. Wet soils are colder than drier, well-aired ones, thus as winter passes clays do not warm up so readily as do sands. The water-holding capacity of the clay colloids makes for better drought resistance. These colloids also help the retention of certain plant foods, e.g. lime, potash, and magnesium. Clays shrink as they dry and this results in the surface of a clayey soil cracking. This in turn is followed by more rapid drying of the lower parts of the soil. The heavier clay soils are usually avoided by market-gardeners.

Loams are mixtures of sands and clays and vary from light sandy loams to heavy clay loams according to the proportions of

* Colloids are substances which are more or less gelatinous in character. Clay colloids expand and contract with the intake and loss of water.

the components. A " medium loam " combines ease of working with good retention of plant food.

Clay soils and loams, when in good condition, have a " crumb-structure " which to some extent offsets the worst features of a clay. "Aggregates" of the fine particles are more or less tightly held together, a condition which is encouraged by a satisfactory lime content, the drying out of the soil, or severe freezing. The two latter conditions need a word of qualification—a wet clay clod which dries out completely is extremely hard and it is only on re-wetting that it shatters and crumbles, and similarly the thawing after a frost produces the good tilth. On the other hand, if a clay soil is worked when wet the crumbs break down, aggravating the sticky nature of the clay. Such a soil becomes hard and difficult to work on drying. Good drainage is needed for the retention of a good soil structure.

Silts, which are much finer than sands, do not permit such free drainage and are somewhat sticky when wet. They do not respond to frost as do the clays and improvement in working condition is usually only effected by the maintenance of a good humus content. Heavy rain causes the particles of a silty soil to pack firmly together at the surface of the ground. On drying this packed soil forms a hard cap which makes hoeing, etc., difficult, and, by sealing the surface causes bad aeration, particularly during hot weather.

Under natural conditions **organic matter** in the soil is derived from plant remains, but cultivated land loses to the market much of the organic matter which it produces and replenishment is needed. Comparatively fresh strawy manure has an "opening" effect on the soil and helps to aerate and improve clay soils. The decay of organic matter produces a dark brown, spongy material, *humus*, which like a sponge is retentive of water. It is this substance which normally gives the dark colour to top-soil. Humus, like clay, is colloidal in character and acts as a store-house of mineral nutrients; it is generally considered to be superior to clay in this respect. Light sandy soils need generous applications of well-rotted dung in order to maintain fertility, as under conditions of good aeration bacterial activity is encouraged and the decay of organic matter is accelerated. The loss of organic matter is further stimulated by well-limed conditions, which also encourage bacterial action; over-liming leads to waste of organic matter which is "burnt up" by the process of oxidation.

Soil water is of three kinds: free water, film water, and hygroscopic water. After heavy rain the pore space of the surface soil is filled with free water, or gravitational water as it is sometimes called. This water must be removed, as waterlogged conditions are detrimental to most cultivated crops. The speed with which this is removed depends on the natural texture of the soil and its drainage. As this water descends to the drains or to the water table* each soil particle and crumb remains covered with a film of water, which is only reduced as water is absorbed by the roots or by evaporation into the air spaces of the soil. Removal of any of this film water results in the remaining water being more tightly held by the surface tension of the film, and a point is reached at which the plant can withdraw no more; this stage is called the wilting point. When dry air can cause the evaporation of no more water what remains is the hygroscopic water, but this is mainly of academic interest; it is entirely unavailable to the crop.

Apart from absorption by the crop and evaporation, the only movement of water in most soils is the descent of free water in response to gravity. The upward movement by capillarity from a free water table to a dry soil† is limited to a height of about three feet in heavy clays and one foot in coarse sands, and is probably only of importance as a source of supply to a crop where the water table is about eight feet below the level of the surface. A water table is unstable and one which is much nearer the surface than eight feet during the summer is probably so high as to cause serious waterlogging for a good deal of the year. Some soils with a higher summer water table may give good results for summer crops but be unworkable during winter. In any case if the water rises to within two or three feet of the surface for a few days during the growing period it is detrimental to most crops.

It is thus clear that in the management of a soil any necessary steps should be taken to remove excess water, to cultivate to

* *Water Table.* Free water passing downwards in the soil and subsoil eventually reaches some impervious material above which it accumulates or along which it moves. This may be fairly near the surface of the soil or at a great depth in the rock. The uppermost limit of this underground water is known as the water table.

† There is no water movement *from moist soil to dry soil.* Every gardener recognises the truth of this when re-potting plants. The plants which are to be moved to larger pots must have their soil moistened before being moved. If this is not done and the dry "ball" of soil is placed in a larger volume of moist soil the central ball is difficult to wet and will certainly not be wetted by mere contact with the moist soil.

conserve moisture, and in some instances, where a worthwhile response is expected, to correct deficiencies by the addition of water. Irrigation will be dealt with in a later chapter.

The soil water is not pure but contains in solution salts derived from rock particles, from the breakdown of organic matter, or from fertilisers. This solution is very dilute; a strong concentration induced by too liberal an application of fertilisers would be detrimental to the crops.

Well-aired soil conditions are needed for the healthy root development of most crops and for good bacterial activity. Removal of excess water by drainage, and such cultivations as digging, ploughing, hoeing, etc., all help to improve and maintain the aeration of the soil.

There is a vast and ever-changing population of minute forms of **life** in the soil—many kinds of bacteria which live on dead organic matter and cause its breakdown to simpler forms; minute animals, protozoa, which feed on the bacteria; fungi which live on dead organic matter and others which are parasites on plants; bacteria which live in partnership with certain plant roots, as seen in the case of the swellings or *nodules* on the roots of peas, beans, and other legumes, Fig. 1; and various other forms of life.

Warm, well-aired soil conditions are needed for what are often called the beneficial bacteria, which break down organic matter. Several groups of these are concerned in the change from fresh plant remains to the production of simple salts which can be taken up by the roots of the living plant. Some release ammonia from the protein of dead plants, others change this to nitrites, and others effect a further change to nitrates, the form in which most plants take up nitrogen. These changes in the form which nitrogen takes are part of the Nitrogen Cycle (see Fig. 1). Another phase is seen in the case of the nodule-inhabiting bacteria which can take free gaseous nitrogen from the soil air and use it directly for their own food. In time, as they die, the nitrogen is used by the host plant, which on death again contributes to the cycle of change.

The soil population is at its lowest level at the end of winter and the numbers increase rapidly as the soil gets warmer. In early spring poor growth of over-wintered crops is often due to a shortage of nitrogen as most of the nitrates are washed from the soil in the course of the winter. Natural replenishment is slow until the soil warms up. Intense activity on the part of the living organisms of the soil results in the production of much carbonic acid;

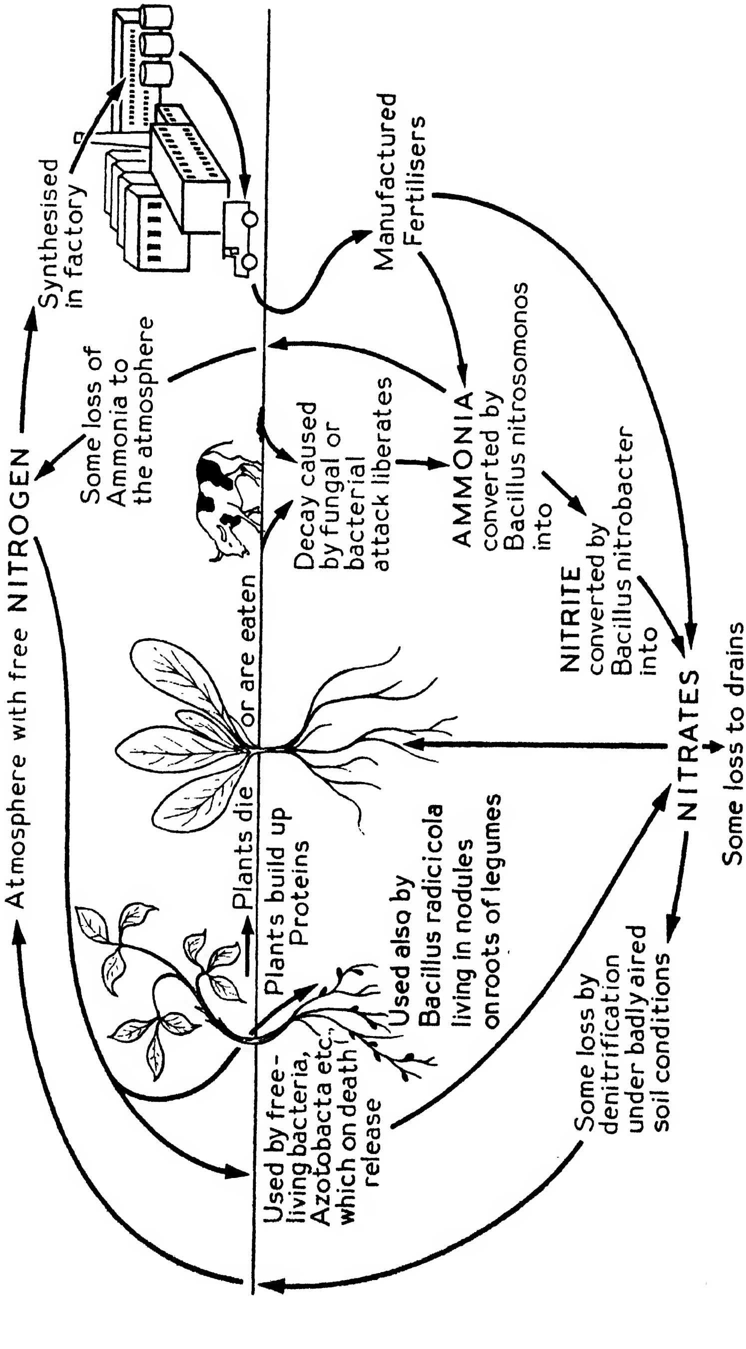


FIG. 1. The Nitrogen Cycle

a supply of lime and good aeration is needed to help correct this condition. The "capping" of a fine-textured soil by heavy rain may be followed by poor growth of the crop, particularly if the weather is hot. This is due to the acceleration in the production of carbon-dioxide which is injurious to the roots of the crop. As soon as possible after the rain the surface should be broken by hoeing.

The greatest concentration of bacteria is in the top few inches of soil. Further down, where the aeration is not so good, the numbers rapidly diminish. It is not good practice to cultivate in such a manner that the subsoil, with its low humus content and small bacterial population, is brought to the surface in quantity.

SOIL TYPES

There is a very wide range of soils which, apart from differing in texture, e.g. sandy soils, loams, clayey soils, vary also in depth. Many soils have been formed from the rocks which immediately underlie them and show a gradation from the unchanged parent rock, through the subsoil, to the top-soil; the upper zones being more weathered and having a higher humus content as shown by their darker colour. In many shallow soils an unsatisfactory subsoil or even the rock comes very close to the surface, and such soils are to be avoided for market-gardening. Other soils, however, are not only deep but overlie deep subsoils of similar texture and if well drained are very fertile.

Some soils have been formed by rivers, which, when in flood, transport soil, sands, clays, etc., often in considerable quantity. These materials when deposited in the flood plain have formed alluvial soils. Much land of this character is in use as highly productive market-garden land, provided that the drainage is good and the risk of flooding does not exist.

TREATMENT AND IMPROVEMENT OF SOILS

Cultivation of the soil has two main objects—to prepare a satisfactory seed or plant bed and to maintain the soil between growing plants in a well-aired condition and reasonably free from competitive weeds. The preparation of a site to receive a crop may involve a variety of operations, but all will be directed to providing a firm, level site, the surface of which has a good "tilth"—a good "crumb structure"—suitable for the operations of sowing or planting. Good preparation before cropping can greatly facilitate subsequent cultural operations.

On the sandier soils cultivations alone will often provide good planting and sowing conditions, but on heavier soils co-operation with the weather is needed. Clays and heavy loams which have been frozen and then thawed work more easily than do similar soils on which no weathering has occurred. In the latter case planting conditions can sometimes be effected by frequent cultivations with harrows (or fork and rake according to scale of operation), but a "forced" tilth is never so good as one induced by the weather.

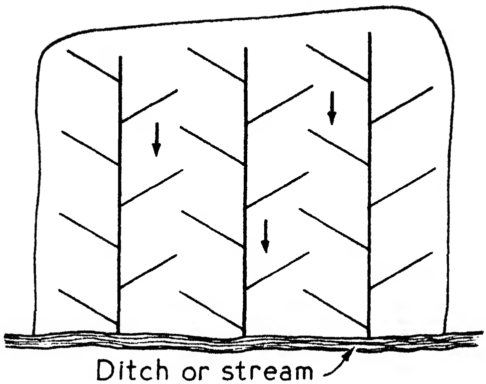
Soil improvement will be seen to involve *operations carried out* and the *addition of materials.*

OPERATIONS

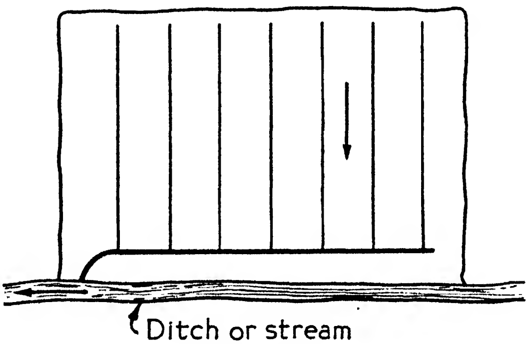
Draining. The drainage of the land should be given prime consideration. Waterlogged soils must lose much of their free water by evaporation, the effect of which is to cool the soil. Ideally, the site selected for a market-garden should be one with a soil possessing good *natural* drainage, yet many other soils can be greatly improved and made fertile by correct drainage.

Two methods may be considered—one known as "thorough" drainage and the other a system of interception. In the former the lines of the drains are placed uniformly over the area to be drained and the system consists of a series of many "minors" leading to a few "mains". A well-laid system of this kind keeps the field more or less uniformly free from excess water. In adopting a system of thorough drainage for a uniform slope there is a choice of the "grid" and the "herring-bone". If there is a heavy volume of water to be moved the herring-bone should be used, but for a light volume the grid should be adequate. For a field with irregular contours the plan of the drains cannot be uniform, but some adaptation of the herring-bone is usual, Fig. 2*c*.

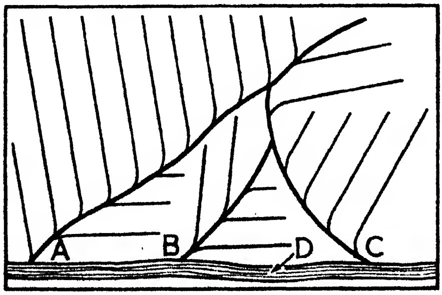
The interceptor system involves the careful location of the source of trouble, as for example a spring, and by laying a drain from that point, removing the water, and keeping lower land free with a minimum of outlay on tiles and labour. Similarly, seepage of water from a free-draining soil on to a more impervious soil lower down a slope may sometimes be prevented by an interceptor drain. It is very important that a correct diagnosis of the trouble be made or the work may be to no purpose.



a. Herring bone



b. Grid



c. Drainage on uneven ground

FIG. 2. Methods of Drainage

The most widely used field drain-pipe is the "clay tile" of round section. Tiles of 4 in. internal diameter are recommended for the minors and smaller mains according to the water they are expected to carry.

The depth and distance apart for the minors depend on local circumstances, particularly the depth and permeability of the soil. They should never be shallower than the bottom of the soil unless it is very deep and should rarely be deeper than three feet, but should, of course, be deep enough to be clear of cultivation operations. Generally speaking, in open-textured soils the drains may be twenty feet apart and placed deeper than in clay soils, where a spacing of fifteen feet would be the maximum. Give the widest spacing which is compatible with good improvement.

It is impossible to give firm recommendations as to the "fall" at which tiles should be laid, as this varies with circumstances and in low-lying, level districts there are drains working efficiently with no fall. It is important to avoid variations in gradient with consequent variation in speed of flow. A fall of 1 in 100 is widely adopted. In planning a grid for thorough draining on a gentle slope the minors may go with the natural fall of the land and thus get an even fall and even depth, but if the slope is considerable it will probably be better to lay them across the slope.

Generally speaking the minors should not enter the mains at right angles but at an acute angle, so that their contents may converge without causing eddies, which slow down the flow and induce silting. Care must also be taken at any unions to cover the joint with broken tile and turf so as to give an efficient check to the entry of soil. The outfalls to the ditches must be kept clear, as any choking which causes water to be held in the pipes readily leads to silting.

When laying the tiles every care must be taken to ensure correct alignment and even grading on a firm base. In cutting the trenches for the tiles always begin at the outfall, which should be at least 6 in. above the bottom of the ditch. Proper draining tools should be used and the bottom of the trench be cut only just wide enough to lay the pipes easily without side play. Keep a plan of the layout of any drains, as if any choking occurs they may then be readily located.

Drainage is a costly operation and should not be undertaken without good guidance. The advice of the County Drainage

Officer should be sought. At the time of writing a Government grant is available to help meet the cost of tiles and labour.

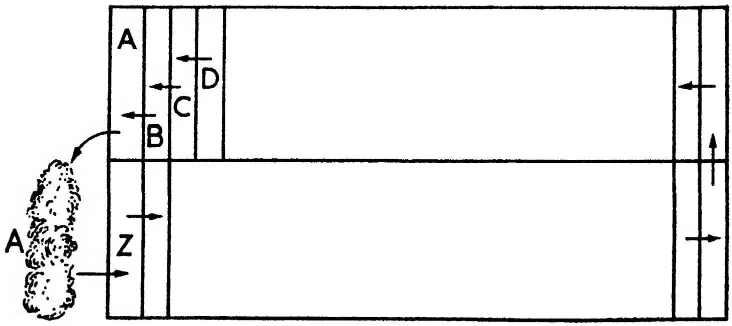
Deep Cultivation. The objects of deep cultivation are to bury weeds and crop remains and to incorporate dung into the land. The organic matter helps to hold moisture. By improving the subsoil the root range is extended and by exposing more surface soil to the action of the weather a good surface tilth is obtained. Digging and ploughing in autumn and early winter should leave a rough surface to take advantage of weathering. Breaking a firm surface also helps in the penetration of rainfall, and, particularly on sloping ground, helps to check the run-off of rainwater.

The time to carry out deep cultivations will depend on the preceding crop and the nature of the soil, but most work of this character is done during the autumn and winter, when the greatest area of land is uncropped. As much soil as possible should be exposed in the early winter in order that the full effects of the weather may be gained; this is particularly important on the heavier soils. Light, easily worked soils can often be worked the year round, and on intensively cropped holdings land coming vacant at any season is promptly prepared for the next crop, though during severe drought even some of the lighter loams are not easy to cultivate without first being irrigated.

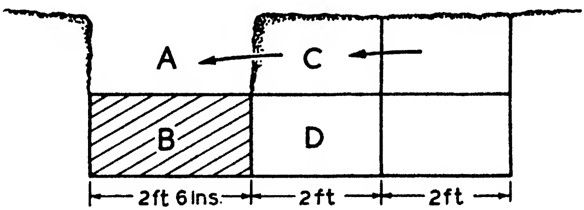
The depth of cultivation will vary. In many cases simply digging to the full depth of the spade or ploughing 8–10 in. deep meets general requirements, but at times deeper work is demanded. Repeated ploughing at one depth may lead to a packing of the soil at the base of the plough, producing a soil condition known as a "plough pan". Such closely packed soil is not easily penetrated by roots and it may also lead to drainage troubles. Deeper cultivation can be effected by subsoiling, a good system being the fitting of the subsoiling attachment to a two-furrow tractor plough. In this case, after opening the ridge with one plough, the subsoiler is fitted in the place of the first plough and works along the existing furrow, whilst the rear plough follows opening another furrow.

With horse-ploughing subsoiling can be done by a second team (of two or three horses in tandem) following the first plough along the same furrow, using a plough with the mould-board removed or a special subsoil plough.

On most market-gardens of today little digging is practised and the deeper operation of double-digging still more rarely. Where either is done, for neat disposal of weeds and dung a good trench should be taken out, the soil being placed in a pile where the work will finish. The work is eased if the plot to be dug is divided in two lengthwise and the first trench is opened only halfway across the plot, the soil from it being placed near where the work will finish (see Fig. 3*a*). The work proceeds down one-half the plot and when



a. Plan



b. Section

FIG. 3. Double-digging

that is finished the last trench is filled with soil obtained by opening another trench in the second half and the final trench is filled with the soil from the first.

When double-digging the first trench should be 2 ft. 6 in. wide and all successive trenches 2 ft. wide; this enables neater work than is possible if the first trench is the same width as the rest (see Fig. 3*b*).

Shallow Cultivation. On weedy land repeated surface cultivations are needed to clean up the area. For perennial weeds like couch grass, the roots, etc., are worked to the surface to be killed by drying or collected and burnt; this may be done either by hand-forking or by using tractor-drawn cultivators. Seeds of annual weeds are encouraged to germinate by disturbance of the surface soil and when a little growth has been made, ploughing or cultivating destroys the seedlings and encourages further germination of seeds which would otherwise remain buried too deeply.

Seed- and Plant-bed Preparation. The objects are to obtain the right conditions for germination and to provide a good rooting medium; the preparations involved are interrelated. In order to germinate, a viable seed needs a supply of air and moisture, the right temperature, and a resting-place—the aim of the cultivator is to make the resting-place a suitable one.

Deep cultivations, which help to extend the root range of a crop, are also of assistance in the preparation of a seed-bed. Such work done in early winter on the heavier loams needs in spring to be followed by light harrowing, or forking and raking to destroy small seedlings and to prepare a level surface of fine even tilth.

When ploughing has to be done in spring or summer the loose soil should be immediately refirmed by a light roller. This can be done by fitting one to run behind the plough, and this in turn can be followed by a light harrow to avoid leaving a smooth, compact surface. The air space of a loose soil is much greater than in a well-firmed one and a free interchange of air leads to a rapid drying of the soil during dry weather if measures like those suggested are not adopted.

From the earlier remarks on soil preparation the importance of co-operation with the weather will be appreciated. On all but the lightest sands a good deal of work is needed to prepare a tilth immediately after ploughing. When it is necessary to force a tilth, repeated harrowing, discing and the use of a scrubber are the usual aids; the latter is an implement much used in the north of England (Fig. 4). On a smaller scale the rotary cultivators prove useful. The disc harrow and the Cambridge roller are also of assistance in clod-crushing whilst at the same time firming the lower soil.

The use of a one-way plough, e.g. the balance plough, enables the preparation of an even surface, unbroken by ridge and furrow. Any cultivations that lead to a surface tilth which permits the smooth, easy passage of the seed drill help also in subsequent operations, for any erratic movement of the seed drill entails the risk of loss of crop when hoeing.

Inter-row Cultivations. When the crop is established some cultivation between the young plants is usually necessary. Weeds must be prevented from competing with the crop and the smaller the plant the greater is the injury caused by the competition for water and nutrients. An established crop can usually hold its own against very small weed seedlings, which are weakened by the shade from a good cover of dense foliage.

It is a feature of clay that on drying shrinkage occurs, and the

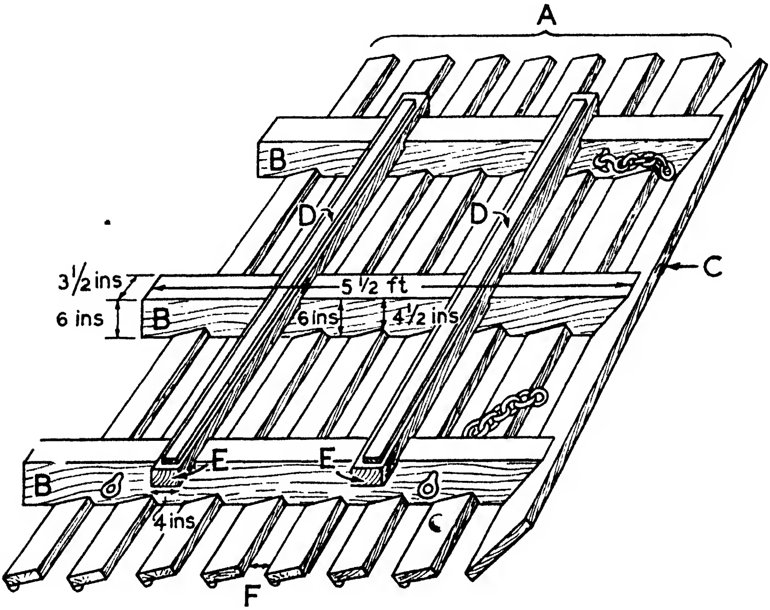


FIG. 4. Scrubber

A. Splines 8 ft. × 6 in. × 2 in. shod on under-rear face with 1 in. half-round iron strip
B. Baulks
C. Plank 8 ft. × 10 in. × 1½ in.
D. Metal tyre on cross-pieces for drawing scrubber sideways on its back
E. Cross-pieces 6 ft. × 3 in. × 2 in.
F. Distance between splines = 2 in.

Whole implement in oak

cracking of heavy soils is due to this property of clay. Such cracks, by increasing the access of air to lower soil levels, speed up the loss of water from the soil. Timely disturbance of the surface soil can check or prevent this cracking, and hoeing between the crop is an important operation on soils liable to cracking.

As has been shown earlier, the lifting of water by capillarity rarely brings it near the surface. Loosening of the surface does not check the action of capillarity, as has frequently been claimed. Nevertheless, hoeing, either by hand or mechanical means, is an important operation for the reasons stated above. After sowing a crop, hoeing should be done as soon as the rows can be seen. At this stage many seedling weeds which are only just breaking the ground are destroyed. Furthermore, on the heavier soils the worst cracking occurs on an undisturbed surface and if hoeing be delayed and the surface becomes very hard, hoeing may then become impracticable or impossible.

The decision as to frequency of hoeing must rest with the individual cultivator, but a time comes when hoeing must cease or damage will be done to the crop, apart from which, most well-developed crops can hold their own against competition.

The essentials of cultivation are to provide a reasonable seed- or plant-bed; prevent weed competition in the early stages of the crop's life; subsequently keep in check the worst of the weeds and ensure good surface aeration. Avoid unnecessary work, which may not only be wasteful but harmful.

ADDITIONS TO THE SOIL

Materials added to the soil to improve and maintain fertility are "lime", bulky manures, and more concentrated fertilisers. The two latter groups will be dealt with in the next chapter.

Lime. In this country the soils of certain areas are naturally well supplied with lime. These are soils derived from the chalk of southern and eastern England or those derived from some of the limestone formations. Most of the other soils are naturally deficient in lime. The chalk and limestone rocks consist principally of calcium carbonate. Calcium is a plant food, though a few plants, notably the heather and rhododendron family, do not thrive where it is present. For some of our vegetables lime is particularly important, all plants of the cabbage family, peas, beans, spinach and lettuce.

As already stated when discussing clays, calcium is an important factor in maintaining a good crumb structure and thus helping to preserve a good tilth.

Soils vary in their degree of acidity, and this variation is measured by what is known as the *p*H scale. Neutrality is indicated by the expression *p*H 7; figures progressively higher than this up to *p*H 14 show increasing alkalinity, and figures lower than *p*H 7 increasing acidity. Alkaline soils are rare in this country, whilst acid conditions, down to approximately *p*H 5, are very common under natural conditions on non-calcareous soils. Applications of lime to a soil cause a decrease in acidity. Most market-garden crops do best on soils which are slightly acid to neutral—approximately *p*H 6·5—but some tolerate more acid conditions.

Another part played by lime in the soil is that of a base on which some fertilisers may react.

The calcium may exist in the soil as free calcium carbonate or may combine temporarily with the colloids of the clays or humus. Eventually carbon dioxide from the roots of plants, from the decay of organic matter, and from the respiration of the living organisms of the soil combines with the calcium carbonate to form calcium bicarbonate, in which state it is washed to the drains. On all soils there is thus a constant loss of lime, partly by removal by the crop and partly by leaching to the drains.

Several forms of "lime" are available to the cultivator. The natural chalk or limestone is sometimes offered in a finely ground condition—this is often sold as *ground carbonate of lime.* The natural material is sometimes burnt at a high temperature, when carbon dioxide is driven off and the resulting material is *quicklime,* containing a high precentage of calcium oxide. If purchased in this form it must first be slaked by the addition of water, when it falls to a powder. It can be purchased ready slaked as *hydrated lime.* The quicklime is sometimes ground and sold as *ground lime,* but this must be distinguished from ground carbonate, as its properties are different. If stored in bags the *ground lime* takes up moisture from the air, swells, and bursts the bags.

The relative values of these forms of lime are:

36 cwt. of ground limestone or chalk are approx. equal to 20 cwt. quicklime.

26 cwt. of hydrated lime or chalk are approx. equal to 20 cwt. quicklime.

The quantity of lime to apply cannot be stated without knowledge of the site in question. Soil-testing equipment is available, based on chemicals which show varying colour reactions according to the *p*H, but these tests give only a general indication of the condition. An accurate assessment of the lime needed by the top-soil can be made by a soil chemist, and a free soil analysis service is available to all market-gardeners through advisory officers of the Ministry of Agriculture, who will also give guidance as to the most suitable forms to apply.* If lime is needed, it should be broadcast over the surface after ploughing. Lime ploughed in and buried can have no immediate influence on the soil above it.

FOR FURTHER READING

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* The soil analysis will also give guidance on the need for phosphate and potash.

CHAPTER V

MANURES AND FERTILISERS

COMPOSITION OF PLANTS

EVERY plant has a living, organised body, built up of materials extracted partly from the air and partly from the soil. These materials form cellulose, protoplasm, and many other organic compounds, most of which consist principally of water and carbon. The supply of water needs no explanation. Carbon is derived from the carbon dioxide of the atmosphere, absorbed through the agency of the leaves. The rest of the elements which contribute to the composition of the plant are taken from the soil. They may be used by the plant in relatively large quantities, i.e. nitrogen, phosphorus, potassium, calcium, magnesium, sulphur, and iron, or may be used in very small amounts, e.g. manganese, boron, copper, molybdenum, and others, which are often called "minor" or "trace" elements. The term "minor" must be understood to refer to the relative quantity used and not to the real importance of the elements to the plant—unsatisfactory growth may result from a shortage of a very minute quantity of one of them. Many of these elements are present in almost all soils in more or less abundance, but there are some which are frequently present in insufficient quantity to produce profitable crops; some of these may be present but in a form which is unavailable to plants. Those which commonly need regular replenishment are nitrogen, phosphorus, potash, and calcium (calcium has already been referred to in the previous chapter). It is the knowledge of how to make good any deficiency of these nutrients, in a way most likely to secure full crops economically, without impairing the continued production of the soil, which constitutes the science of manuring.

The appearance of a growing crop may tell us much about the nutrient status of the soil. A full crop, of even vigour throughout, promising an average or more than average return, may be regarded as indicative of a satisfactory balance of plant nutrients. With a knowledge of what has been given to that crop one may assume that a "standard" manuring programme may be followed for the succeeding crop. Patchy or unsatisfactory growth, other than ill-health caused by pest or disease, may be due to faulty nutrition and the condition of the crop may give a clue to the weak link. Soil analysis, particularly a comparison of samples from the better and worse areas of crop, may give a more certain confirmation, perhaps helped by the more modern development of tissue tests from the plants themselves. The mere analysis of soil from a plot of land gives but a limited guide to the manurial needs of the following crop, as it is normally limited to a measurement of the soil reaction (*p*H), its lime requirements, and an assessment of available phosphoric acid and potash. (In cases of crop failure the grower should not hesitate to consult the Horticultural Advisory Officer for his area.)

Some of the "food" reserve in the soil is in due course released; some insoluble phosphates become available and organic matter is broken down by bacterial action. To this extent such soil reserves may be regarded as locked-up capital, but it must be borne in mind that much plant food is unavailable to our crops, and even when soil analysis shows a soil to be fertile with a good nutrient status, yet for the majority of crops some manurial or fertiliser treatment is needed in order to get satisfactory returns. As the nutritive salts from the soil reserves, or the applied manures or fertiliser, are dissolved in the soil water they are absorbed by the plant through the minute root hairs. A few words are needed on the parts played by some of the elements in the nutrition of plants.

Nitrogen is of major importance in the composition of some of the principal plant substances. The plant uses it freely in the formation of protoplasm (the living substance of plant cells), proteins, and chlorophyll. Inadequate supplies of nitrogen lead to stunted growth; undersized leaves are evidence of nitrogen shortage. Chlorophyll is the substance which gives the leaves their green colour and nitrogen deficiency induces a paler green than normal. This yellowing of the leaves is usually seen in the older ones, from which nitrogenous compounds may be transferred to the growing points.

Nitrogen is normally taken by the plant from the soil as nitrates, which are easily washed from the soil; hence over-wintered crops, e.g. spring cabbages, usually respond to applications of nitrogenous fertiliser towards the end of winter. Similarly most leafy crops respond to top dressings of nitrogen when they are well established.

Excessive applications may cause soft sappy growth and delay the maturity of some crops. Nitrogen should be used with caution in late summer, or crops which are to stand into or through the winter may be rendered less hardy. In referring to an "excessive application" one considers not only the actual quantity given but also its relation to the supply of phosphoric acid and potash. The *balance* between these three plant nutrients is very important.

Phosphorus, like nitrogen, is used by the plant in relatively large amounts and a shortage of it limits growth. It is of importance in encouraging root development and inducing early maturity. It exists in the soil in many forms; some water-soluble forms may become temporarily unavailable. Some soils may "fix" phosphates and render them totally unavailable. A high proportion of the phosphate in the soil is fixed and never becomes available to crops. There is practically no loss of phosphate by washing from the soil in the drainage water. Unless analysis has shown that the soil has a high amount of available phosphate the grower should give a light dressing to each crop.

Potassium is well known to be of importance to the satisfactory growth of plants, but it is not a constituent of the major plant products; e.g. it is not a component of the carbohydrates, yet it is assumed to be of great importance in their formation by the plants. It probably aids other plant processes. It is of importance in the nutrition of all vegetable crops; root crops, potatoes, and tomatoes make heavy demands on the supplies.

In many plants shortage of potash is often shown by the leaf margins becoming yellow and finally brown and shrivelled. Light soils contain lower potash reserves than do heavier ones.

Calcium, apart from correcting the acidity of the soil, as mentioned in the previous chapter, is a plant food. The Brassica family uses it freely. Within the plant it is a constituent of the cell wall and provides a base for neutralising organic acids.

Magnesium is a constituent of chlorophyll and a deficiency is shown by a yellowing (chlorosis) of the leaves. This element is usually present in most soils in adequate quantity, but in recent years many instances of deficiency have been recorded in a wide range of crops. This may be due to the supplies having been rendered unavailable—sometimes by excessive application of potash. It may be leached from sandy soils by heavy rain.

MATERIALS APPLIED

Animal wastes supply some plant nutrients, usually in very low proportions. They also supply in the dung and any accompanying litter a considerable amount of organic matter which in the course of its breakdown contributes to the humus of the soil. The litter present in these manures not only supplies organic matter but is also an absorbent medium for urine. The bulky dressings of farmyard or stable manure, etc., may be regarded primarily as supplying organic matter and of importance in helping to maintain the soil in a good physical condition. The importance of soil structure was stressed in the previous chapter and the bulky organic manures contribute to this. Where the supply of natural manure is inadequate other alternatives must be found. Natural manures are often unbalanced and need supplementing with more concentrated fertilisers. Variations in the balance of nitrogen, phosphorus, and potash present in farmyard manure may be associated with the kind of animal, age of animal, the feeding or the type of litter.

Farmyard Manure is usually predominantly cow dung, with varying amounts of litter, but some horse or pig manure may be present.

Stable Manure, as its name implies, is the dung from horses with the addition of litter. Manure from racing stables has usually a very high straw content. Consignments of manure with a very high content of fresh straw need to be stacked to ferment in order that the initial breakdown of the straw may be done away from the soil. Similarly, if the manure comes from stables which have been liberally littered with sawdust or wood shavings stacking is needed. If it is necessary to use such manure before it is rotted, additional applications of nitrogen or sulphate of ammonia may be desirable, as during the early stages of the breakdown of the cellulose in fresh straw or in the wood shavings, the ammonifying bacteria may temporarily withdraw nitrogen from the nitrates of the soil.

Pig Manure may be used alone, but it is often rather wet and not easy to handle. If liberally supplied with straw as a litter the pig can provide a useful supply of dung. These three types of animal waste, farmyard manure, stable manure, and pig manure, are usually used fairly liberally on market-gardens. For crops needing such materials they should be used at 20–30 tons per acre. On the heavier soils they should be ploughed in during late autumn or early winter and if not too well rotted they help to open up the soil. For any late winter or spring application well-rotted manure should be used; in fact for very light soils such late applications are desirable, as early winter manuring may lead to a loss of plant food from a too freely draining soil.

"Spent" dung from Mushroom beds is a useful material when it is available. It is easy to work into the soil with a rotary cultivator. There sometimes exists a prejudice against its use, but the only growers who need have any apprehension about using it are those who are themselves growers of mushrooms, as then any mushroom diseases present in the dung will be retained on the holding.

An average sample of farmyard manure may contain 0·6% N, 0·3% P_2O_5, 0·5% K_2O, or for each ton of manure about 9–15 lb. N, 4-7 lb. P_2O_5, 9–15 lb. K_2O. The nutrients added to an acre in a 20-ton application of dung are therefore of appreciable value, but as has already been stated the supply of organic matter is the most important feature of these bulky manures and the value of this cannot be assessed. The prices asked for stable manure, etc., vary over a wide range and the cost is sometimes very high. The steady decline in the horse population (with the increase of motor-cars) and the increased arable acreage on farms since 1939 has focused attention on the need for possible alternatives to stable manure, etc.

Sewage Sludge is used, but it is very different in character and action to farmyard manure. It is a very variable commodity and contains some slowly available nitrogen and phosphate but very little potash. Owing to their nature many sewage sludges are unfit for application on sites near to houses. For ease of transport the sludge should be dry—stacking for some months after removal from the settling-beds usually makes the sewage better to handle. Wet sewage is a useful material to add to a straw compost. The heap should be well aired, the straw should be put down in loose layers about a foot deep and well wetted with sludge as each successive layer is added. Keep the heap not wider than about 6 ft. so as to have good aeration. As with all compost it is helpful if the heap can be turned once or twice, but this adds considerably to the cost.

Compost. Well-managed compost heaps of vegetable waste rot down to produce a useful organic material which is of great value to the soil. To get the best results turning is desirable and this is very laborious; under the conditions prevailing in most market-gardens the labour is not available for turning more than once. The actual waste refuse from a given cultivated area is insufficient to provide for the manurial needs of that area. In a large compost heap which heats up well during fermentation much in the way of pest and disease gets destroyed, but one cannot be sure that all is so treated and seriously infected material is better burnt.

Where straw is available cheaply it provides a good medium for composting. One ton of dry straw will need 1 cwt. nitro-chalk (or 1 cwt. sulphate of ammonia and 1 cwt. ground limestone or chalk) as an accelerator of the decay and about 800 gallons of water. The straw should be put down in layers about a foot deep, each in turn well wetted and sprinkled with nitro-chalk, or if sulphate of ammonia is used then alternate layers will receive the sulphate and the ground limestone. Only about half the water should be given at the first making of the heap, the remainder being given some days later when breakdown has started, at which stage the straw will prove more absorptive.

Bracken cut and stacked when green in early July rots down in the course of the winter to a very useful compost.

The grower whose holding is very close to the sea-coast may find that local supplies of sea-weed are sufficiently abundant to be worth collecting. It decays readily and may be ploughed in at once or composted, possibly with straw. Up to 40 tons per acre may be given.

Green Manuring. This is usually understood to be the growing of a rapidly maturing crop and ploughing or digging it in whilst still green. Many of the crops used produce little fibre and thus add but a small amount of organic matter to the soil, but they do help to hold nutrients from being leached from the soil. Examples of such crops are mustard or rape sown at 12–15 lb. per acre after early potatoes or peas and ploughed in before winter; or rye sown in August at 2 bushels per acre and ploughed in in November to February. Leguminous crops like lupins or tares add nitrogen to the soil.

Leys. A short-term ley is a much better soil-improver than other green crops and for the grower who can introduce this into his rotation it is a helpful feature. Where livestock are kept a good rotation can be worked out using one-year leys (see p. 53). The roots of the grass prove of value in helping to retain or recover a good soil structure. Even for a short period of eight or ten weeks during late summer, a heavy seeding (60 lb. per acre) of Italian ryegrass may be a useful soil improver and such a practice is possible on quite small holdings.

FERTILISERS

A considerable number of materials are sold as fertilisers: some are salts obtained from the earth; some are synthetic products; some are by-products, and of these many are organic in character, but none of these contribute in the same way to the humus reserve of the soil as do the bulky animal manures and composts. Many fertilisers supply only one nutrient, but some provide two, though in these cases one element is usually the principal one. The following brief notes refer to some of the more popular fertilisers —the list is not exhaustive.

Nitrogenous Fertilisers

Sulphate of Ammonia, 20·6% N. A readily soluble salt and one which is quickly available to the crops, although the ammonia has to be converted into nitrate. It is a good form of nitrogen for adding to mixtures of fertilisers. Where it is being used the soil needs to have a good lime content, as 1 cwt sulphate of ammonia removes from availability about 1 cwt of calcium carbonate. Sulphate of ammonia should usually be applied before the crop goes in, using 1–2 cwt per acre.

Nitrate of Soda, 15·5% N. This contains all its nitrogen as nitrate and is very quick-acting. It is therefore applied as a top-dressing to growing crops, using 1 to 2 cwts. per acre. The sodium is of some use to certain root crops, notably beet. The action of this fertiliser is independent of lime in the soil. This salt is obtained from natural deposits in Chile. Chilean potash nitrate is a salt of similar origin which consists of a mixture of nitrogenous and potassic salts with variable analysis; grades commonly offered have about 15% N and 10% K_2O.

Nitro-chalk, 15·5% N. A useful quick-acting top dressing which contains its nitrogen half as nitrate and half as ammonia, in addition to 48% of calcium carbonate.

Calcium Cyanamide, 20·6% N. This contains no readily available nitrogen and is in fact injurious to plant tissue, hence it should be applied to the soil at least a week before sowing so that the toxicity of the material may have passed and nitrification may have started by the time the plants roots are active. It has proved useful for helping to rot down green manure, particularly when grown as a smother crop for weeds, in which case as much as 3–4 cwt. per acre may be given when ploughing in.

Soot may contain from 1% to 6% N as sulphate of ammonia. It should not be used fresh, as other wastes from coal may be toxic to plants. Storage for some months renders it safe for use.

Dried Blood, about 11% N. Of all the organic fertilisers blood contains its nitrogen in the most readily available form. It is a useful top dressing but is often very dear.

Hoof and Horn, about 13% N. Speed of action depends upon fineness of grinding. In any case some nitrogen is fairly soon available, but the coarser particles give up their nitrogen as they decay over a period of weeks or even months. May be used at 6 to 8 cwt. per acre before sowing or planting. It is usually very expensive.

Shoddy. A by-product from the woollen mills, the samples of this vary widely from 2% to 15% N, though the higher-quality samples are but few. Applications of from 1 to 2 tons per acre are ploughed in during the winter. The nitrogen becomes available over a long period.

Other Waste Organic Residues

Fish Meal. Contains a fair quantity of nitrogen and phosphate but very little potash.

Castor Meal, about 5% N. A useful material to add to a home-made mixture, as it helps to prevent "caking" in the bags.

Hair Waste and *Feathers* are sometimes available; the former is usually slow to decay, the latter may be fairly rapidly broken down.

Meat and Bone Meal (sometimes known as *Tankage*). According to the proportion of meat to bone in this material it may have a high nitrogen/low phosphate ratio or *vice versa*. It is a popular fertiliser with market-gardeners but is usually very highly priced. It is particularly useful where a steady supply of nutrients are needed over a period of many weeks. Use 6–8 cwt. per acre.

Poultry Manure was not mentioned earlier, as its use in bulk is not advised as a soil improver like farmyard manure. By its nature it does not open up the soil in the same way as the more bulky animal manures and as it is richer in plant foods it cannot be used at the same rate. When fresh it may contain 1·75% N, 1·00% P_2O_5, 0·54% K_2O. A good sample of dried poultry dung may contain 4·3% N, 2·9% P_2O_5, and 1·28% K_2O, and such material may be offered as raw guano. To give a balance dressing this will need the addition of extra phosphate and potash.

Potassic Fertilisers

Muriate (or Chloride) of Potash, 50% K_2O. This is a quite suitable form of potash for most vegetables, but where intensive cropping is practised and high fertiliser applications are given sulphate of potash is usually preferred. For a holding where soft fruits are grown it is wise to avoid using muriate, as the chlorides are apt to build up in the soil and prove injurious, particularly to strawberries. Use 1–3 cwt. per acre.

Sulphate of Potash, 48% K_2O. Rather more expensive than muriate—use at the same rates.

Phosphatic Fertilisers

Superphosphate, 18% water-soluble P_2O_5. This is a readily soluble fertiliser and a widely used one. Apply before sowing or planting, giving 2–4 cwt. per acre. Even on soils where the analysis shows a good reserve of phosphoric acid it is often wise to give a light dressing of superphosphate before sowing to help the establishment of the seedlings. Superphosphate is a good form in which to add phosphates to most fertiliser mixtures.

Bones may be used in various forms, most of which are slow acting—particularly so if not finely ground. Bone meal contains some residue of nitrogen even after treatment; a good sample contains about 25% insoluble P_2O_5 and 4% N. The phosphate present in bones is *insoluble in pure water* but soluble in the weak acid of the soil water.

Steamed Bone Flour will usually have 30% insoluble P_2O_5 and only 1% N. It is useful for adding to mixtures as a "drier" to prevent caking.

"Dissolved" Bones are somewhat similar to superphosphate. The bone fertilisers have long been popular with market-gardeners on account of their slow action. For long-standing crops they are useful because they release the phosphoric acid over a long period. The keen demand for them has led to their being very highly priced.

Minor Elements

Such elements as magnesium, manganese, and boron do not fall into the class of fertilisers, but in cases where they are lacking in the soil they may need to be applied—sometimes as a spray to the affected crop. Such applications will normally only be given following consultation with an Advisory Officer. They should only be given in cases of proved deficiency, as some of these elements may cause trouble if present in excess.

Compound Fertilisers

For most crops it is necessary to give a mixture containing nitrogen, phosphate, and potash. Such mixtures can be made up by the grower. Sulphate of ammonia, superphosphate, and sulphate or muriate of potash are fertilisers which may safely be mixed together to provide the three principal elements of nutrition. If stored for some time, particularly in a not too dry shed, they are apt to "set" hard. For this reason the addition of steamed bone flour or castor meal is often practised, as these substances act as "driers" and help to check the caking.

To get an even mixture it is necessary to turn thoroughly several times on a level floor. Many growers prefer to use a proprietary mixture and thus save themselves the trouble of mixing. Some very concentrated fertilisers are prepared in granular form in such a way that each granule contains the nitrogen, phosphate and potash in constant proportion.

Do not mix sulphate of ammonia with any form of lime, with basic slag, or with wood ashes. Don't mix superphosphate with nitrate of soda, with lime, or with basic slag.

Storage

The sheds used for storing fertilisers should be quite dry and capable of being closed against access of damp air. If the floor is not of wood the sacks should be raised on boards or straw. Keep sulphate of ammonia away from machinery and concrete, as it is liable to corrode these.

Application

When putting fertilisers on the land it is essential that they should be evenly distributed. If applied by hand particular care is needed to achieve this. Various mechanical distributors are available for this work. When not in use these should be well cleaned to prevent residues of fertilisers from caking brushes and corroding ironwork.

Applications made before sowing or planting should normally be broadcast and lightly worked into the surface. Top dressings to a growing crop should be applied with care, as any of the salts falling on the leaves of the crop will cause scorching. The granular forms of fertiliser are advantageous for use as top dressings, as they readily fall from the leaves. Apply top dressings only when the foliage is dry.

Comparisons between Mixtures

When referring to the three elements nitrogen, phosphorus, and potassium in a compound fertiliser, the forms in which these are present are implied to be nitrogen, phosphoric acid, and potash, and their percentages are placed in that order. This sequence is generally known as the NPK ratio, e.g. a mixture which contains 7% N, 7% P_2O_5, and 10½% K_2O, has an NPK ratio of 7 : 7 : 10½. The NPK ratio enables a grower to compare two similar compounds on the basis of price and rate at which to apply.

It is sometimes convenient to refer to the Plant Food ratio or P.F. ratio, a formula which is useful in demonstrating the suitability of a mixture or compound for a given purpose, as it shows up more clearly the ratio between the components. To find the P.F. ratio divide each of the figures in the NPK ratio by the percentage of nitrogen; thus the mixture quoted above, with NPK ratio of 7 : 7 : 10½, has a P.F. ratio of 1 : 1 : 1½.

VALUING FERTILISERS

When fertilisers are purchased they must always be accompanied by a guaranteed analysis, according to the Fertilisers and Feeding Stuffs Act, 1926. This analysis must be given in terms and percentages of nitrogen, N, soluble phosphoric acid, insoluble phosphoric acid, P_2O_5, and potash, K_2O.

In calculating the value of a manure from analysis all equivalents should be ignored, and a judgment formed solely upon the nitrogen, soluble phosphoric acid, insoluble phosphoric acid, and potash.

It is very desirable that the purchaser should have some guidance as to the comparative values of different samples of ready-mixed fertilisers, as well as to be able to calculate what an equal fertilising-value in materials would cost if bought separately and mixed at home. This is done by ascertaining the cost of a unit of each of the different fertilising constituents and adding these costs together. The unit is the one-hundredth part of a ton, and the cost of a unit is known as the "unit-value". The cost of a unit is arrived at by dividing the market price of a ton of material by the percentage it contains of the particular fertilising constituent required.

For instance, supposing it is desired to find the fair price of a mixed mineral fertiliser containing:

Nitrogen . .	8%
Soluble Phosphates	6%
Potash . . .	10%

What has to be decided is, what is a fertiliser containing the above ingredients worth? The percentages shown here have nothing to do with the unit-value; the item "nitrogen, 5%" means that the mixed fertiliser in question contains that amount of nitrogen, and the object is to ascertain what that amount of nitrogen would cost if brought in the form, say, of sulphate of ammonia.

The nitrogen in this fertiliser may be derived from sulphate of ammonia, which contains ammonia equal to 20·6% nitrogen, and costs at the time of writing about £16 per ton; the unit-value is ascertained by dividing £16, the price of a ton of sulphate of ammonia, by 20·6, the percentage of the nitrogen it contains; the result is 15*s.* 6*d.* which represents the unit-value of nitrogen derived from sulphate of ammonia.

The phosphate ingredient will probably be derived from superphosphates, costing £15 per ton, and containing 18% soluble phosphoric acid. The unit-value is ascertained by dividing the price, £15, by 18, the percentage of soluble phosphates; the result is 16*s.* 8*d.*, which is the unit-value.

The potash ingredient will be derived from muriate of potash (unless sulphate of potash is specifically stated), which contains 50% pure potash and costs £18 per ton. By dividing £18 by 50 we arrive at 7*s.* 2*d.* as the unit-value of potash derived from muriate of potash.

We can now form a clear judgment of the fair price of the mixed fertiliser, thus:

	£	*s.*	*d.*
Nitrogen, 8%, at 15*s.* 6*d.* for each unit—8 times 15*s.* 6*d.* = ...	6	4	0
Soluble phosphoric acid, 6%, at 16*s.* 8*d.* for each unit—6 times 16*s.* 8*d.* = ...	5	0	0
Potash, 10%, at 7*s.* 2*d.* for each unit—10 times 7*s.* 2*d.* = ...	3	11	8
	£14	15	8

Some allowance must be made to cover mixing, bags, waste, carriage, and profit.

It will thus be seen that, at the above prices, it should be possible to prepare a manure of the fertilising value of that under examination, when compounded of *mineral* ingredients, at a cost for materials of about £15 per ton. When the fertiliser is compounded of *organic* ingredients the unit-values will be higher.

In judging the money-values of manures it must be constantly borne in mind that the unit-values will vary as the market prices of the materials fluctuate. They do not include the cost of carriage, and they are based on the price of materials when bought in quantity.

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CHAPTER VI

MECHANICAL AIDS TO CULTIVATION

THE second quarter of the twentieth century saw a great development in the mechanisation of the market-garden. The horse has largely been replaced by the tractor and even on small areas where horses would not normally have been used small market-garden cultivators are helping with the work. There are, however, those who think that it may yet be shown that the horse, as a medium for draught, causes less damage to soil structure than does the tractor.

The mechanisation of horticulture should not be regarded simply as a means of saving labour but rather as releasing man-power for other work on the holding—to improve growing techniques and to carry out operations which may give improved quality of produce. The machine is an aid to greater efficiency if wisely used and versatility is to be sought in it, as the more operations which can be done with one piece of equipment the better. Most tractors do have a good range of tools which they can operate, e.g. plough, roller, discs, harrows, and hoes, but too many small tractors are expected to be able to plough when they are only suited to surface cultivations.

The tractor may haul its tools, or it may carry them before, behind, or underslung. When carrying the tools there is better manœuvrability than when hauling, and this is particularly the case when they are underslung. With the tools in front there is an uninterrupted view of all hoes, etc., and the driver may see any blockages at once. Some of the 4-wheel tractors are fitted with hydraulic linkage for the attachments, which is of great assistance when raising or lowering them for operation and enables good work in small areas with the minimum of headland.

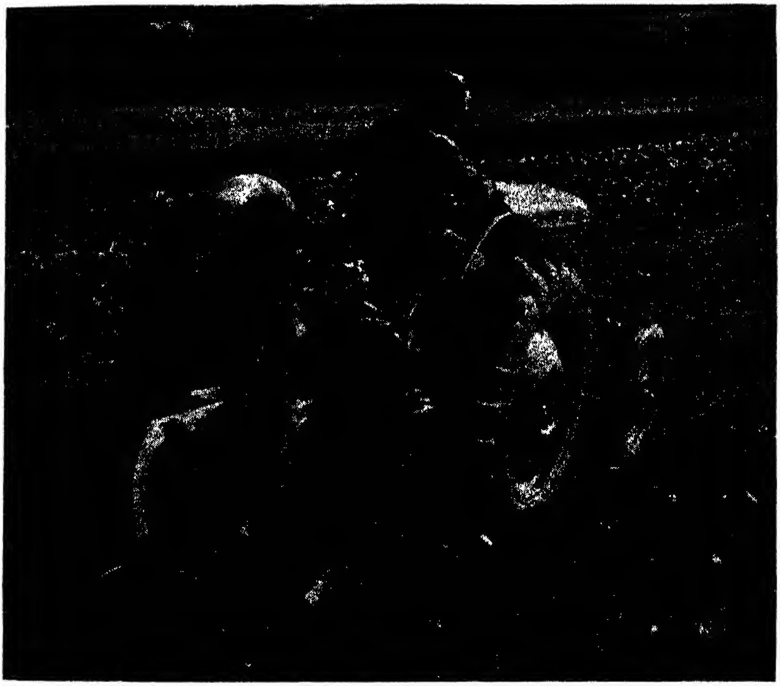
The tractor may be four-wheeled, three-wheeled, or track-laying with the driver riding or may be two-wheeled with the operator walking behind. The power of the tractor selected for use depends on the work expected from it. A good four-wheeled market-garden tractor should be fitted with rubber tyres. It must

FIG. 5. Monarch tractor; hoeing with underslung tool-bar; fitted with rear wheel-track eliminator

[*By courtesy of Messrs. Allen & Simmonds (Auto Culto) Ltd.*

FIG. 6. Auto Culto, 5 h.p., carrying a foward attached tool-bar

be capable of ploughing two furrows and of subsoiling, as well as a range of surface cultivations. On the larger holdings it may be used for drawing a transplanting machine. It will also be useful for haulage, particularly where no horses are kept.



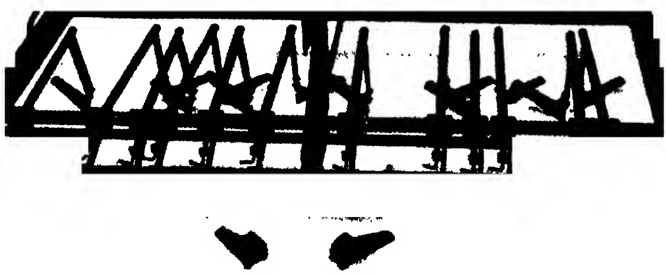
[*By courtesy of Messrs. Harry Ferguson Ltd., Coventry*

FIG. 7. Ferguson 19 h.p. drawing a two-furrow plough. This machine has hydraulic linkage

For surface cultivations there are excellent machines, some with a fair range of versatility, from 8 h.p. down to small motor hoes of 1 h.p. which do good hoeing in narrow rows. These very small hoes should be regarded as complementary to other larger equipment, as they are obviously one-purpose tools. A 6 or 8 h.p. tractor will manage a one-furrow plough.

One machine which is best described as a self-propelled tool-bar has an 8-h.p. engine and will drill up to six rows at once, hoe the same number, spray, and drill fertilisers as top dressings to the growing crops (Figs. 8*a*, 8*b*, 43). It is a most valuable piece of equipment for any large-scale vegetable-grower. Its most satisfactory work is performed on land which is free from ridges and

FIG. 8*a*

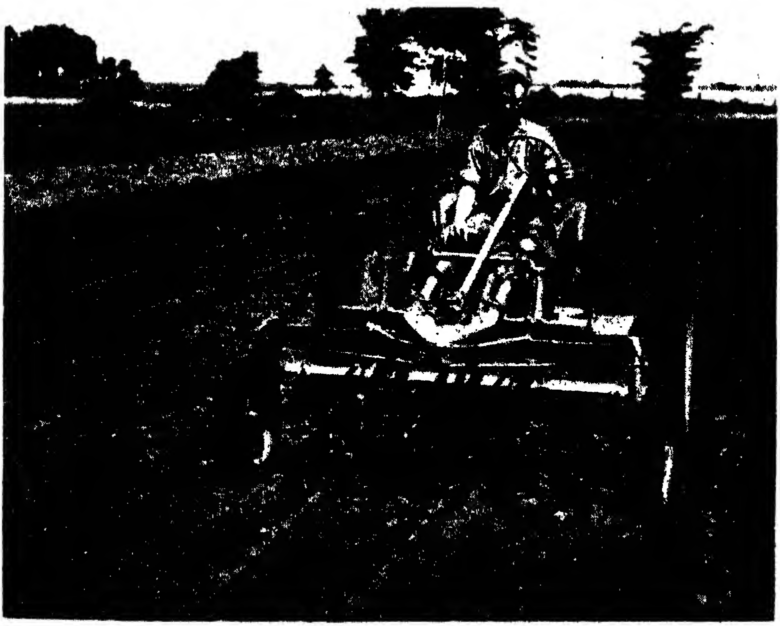


[*Photographs by courtesy of "The Grower"*

FIG. 8*b*

FIGS. 8*a*, 8*b*. Bean, 8 h.p., self-propelled tool-bar. All the tools are in front of the driver. The various tool-bars lift out as in 8*b*

FIG. 9. Trusty 5·5 h.p. fitted for one-way ploughing



[*By courtesy of Allis-Chalmers Mfg. Co., Milwaukee, U.S.A.*

FIG. 10. Allis Chalmers. The picture shows an American model (not at present available in this country) with extended axles for work in market garden crops

furrows, a condition which is best attained by ploughing with a one-way plough.

Whilst the larger holdings will have several tractors, with some used for specific purposes, the smaller grower will probably only have a single machine and particular care must be exercised in its choice. If it is possible to make satisfactory arrangements for the deep cultivations of ploughing and subsoiling to be carried out

[*By courtesy of Messrs. J. Gibbs Ltd., Bedfont*

FIG. 11. Ransome M.G. 7 h.p. fitted with steerage hoe

on contract, the machine for the small-holding should be one which is capable of a good range of surface operations. One of the two-wheeled market-garden tractors of 5 to 8 h.p. should be considered. They will do cultivations on uncropped land in preparation for sowing and planting (discing, rolling, etc.), hoeing, and, if necessary, ploughing, though not so deeply as the larger machines.

Seed-drilling and inter-row hoeing are closely connected, in that good-quality work with the sowing makes for close, accurate work with the hoes. Where multiple seed-drills are used the same number of rows should be hoed in the same series, so that any inaccuracies in sowing may be followed on all rows at the same time. The row width needs careful thought; it may be advantageous to increase the width from the traditional 12 in. for onions and root crops to 14 in., so that the wheels of the larger market-garden tractors are more readily accommodated. To use a constant row width for a wide range of crops is an advantage, as the time taken on the adjustment of the hoes is reduced or eliminated.

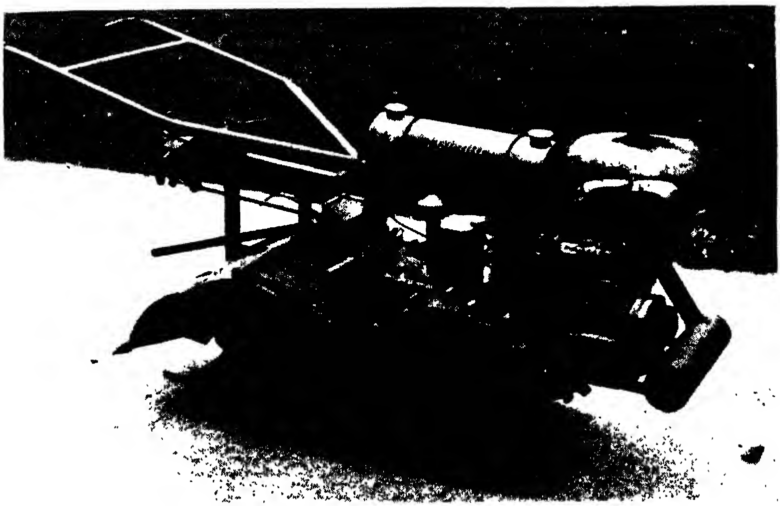


FIG. 12. Howard Rotavator Gem 6 h.p.

Another measure which may be adopted is to adjust row width to allow for the omission of certain rows in order to provide passage for the tractor wheels, e.g. using 14-in. rows in blocks of five rows, then missing one row, which system provides alleys to take the wheels of a tractor set with a wide wheel spacing of 76 in. This last-mentioned practice may give a slightly reduced crop, but it may be considered that the efficiency is increased and thus provides a satisfactory compensation.

Hoes may be fixed to the tractor and entirely under the control of the driver or they may be "steerage" hoes and pulled by the tractor, yet steered by a separate operator. Such an arrangement can give extremely accurate work and greatly reduce the amount of handwork which need be done along the rows.

Where a rotary hoe is used wider rows are essential. These implements can do very good work, not only in hoeing between crops but also in the preparation of land for sowing or planting. They are particularly useful for the intensive cultivator who needs to prepare land for sowing or planting immediately following the clearance of the preceding crop. By rotary cultivation many soils can often be forced to a tilth which could not be otherwise attained during summer without some delay. Rotary cultivators should not be used for winter cultivations, as they leave the surface too fine and in consequence the winter rains beat down the soil and damage its structure. Rotary tines break up the soil more finely than do hoes.

Sound and adequate shed accommodation should be provided for all machinery, and ideally this should be associated with a good work-shop for dealing with maintenance and overhauls.

When considering the purchase of a new machine the grower should arrange with the agent for it to be demonstrated on his holding. The comments of friends who may be using similar machines should be noted.

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CHAPTER VII

ROTATIONS OF CULTIVATION, MANURING, AND CROPPING

ONE of the first principles of agriculture is that one crop shall not be allowed to follow another of the same kind on the same soil. The basis of this principle is that although all cultivated plants extract the same foods from the soil, there is a considerable variation in the quantities they use of any given kind. Undue depletion of any one nutrient is checked by practising a rotation. Some crops, e.g. peas and beans, actually help to add nitrogen to the soil.

Perhaps the most important reason for the rotation of horticultural crops is that a change of crop assists to keep in check the soil-borne insect and fungus pests with which most cultivated plants are afflicted.

Not only does a rotation help to preserve a proper balance between the plant foods in the soil, and to keep in check the numerous pests, but as different crops need widely varying methods of cultivation, manuring, and tillage, by moving them about so as gradually to apply the different operations to the whole area the soil is kept in a sweet and wholesome condition, it is more easily kept free of weeds, and the cultivator is enabled to maintain its texture and fertility on a much smaller outlay for manure and labour.

But a perfect rotation is practically impossible to the gardener who is obliged to produce a large variety of crops in constant succession from a small area. Not only may he intercrop in order to make the most of the space at his command—and intercropping practically means that distinct classes of plants are standing together on the same bed—but the most carefully planned scheme is liable to disarrangement by unsuitable weather, the attacks of birds or of insects, and other unforeseen circumstances which may make it necessary at short notice to discard one crop and substitute another of an entirely different kind. With mechanical cultivation less intercropping is possible.

There are also difficulties in the way of arranging a perfect rotation arising from the fact that the gardener must grow the various classes of crops in very unequal proportions to suit the demand. The brassica family contributes the greatest bulk of produce to the vegetable markets and occupies a larger area of most market-gardens than do any of the other crops. In fact, there are many instances of cabbages or savoys being taken from the same site for several years in succession. On calcareous soils this may be quite permissible, but elsewhere there is a high risk of a build-up of club-root if a rotation is not followed.

Fortunately, whilst he cannot altogether ignore rotations the market-gardener is not bound to them to nearly the same extent as is the farmer. By deep and thorough cultivation and by systematically fertilising the soil he can make it capable of continuously carrying crops in a way which cannot be done under shallow culture. A deeply worked and well fertilised soil will yield good crops in any season, even if a strict rotation is not followed, whereas on a shallow soil in a dry season many crops may fail in spite of a rotation. The fact, however, still remains that the productiveness of the soil and the health and vigour of the crops are better maintained when a rotation of cultivating, manuring, and cropping is carried out.

The vegetable holding may be divided into three or four approximately equal areas. Any potatoes grown should work round the holding in rotation and, subject to the cropping policy of the grower, an attempt should be made to confine any green crops to about one-third or one-quarter of the total arable area in any one year. Potato-root eelworm, club-root diseases of brassicas, and white-rot of onions are three of the most important troubles for which a rotation is the best means of control.

In preparing for deep-rooting crops the land may be subsoiled, (or double-dug in the case of a small area), thus deeply working the whole area in the cycle of the rotation. Similarly on soils tending to be acid any dressings of lime would be given before taking a crop of brassicas and possibly peas and beans. Dressings of dung would be given to potatoes and the leafy vegetables, any residue carrying on for the root crops and salads.

The crops should be so arranged that they systematically follow the rotation of cultivation, placing them, as far as is practicable, on the sections which have been treated most in accordance with their requirements. Their positions would, however, be

THREE COURSE ROTATION FOR A GARDEN

1st year	*2nd year*	*3rd year*
Potatoes	Roots, etc.	Brassicas
Brassicas	Potatoes	Roots, etc.
Roots, etc.	Brassicas	Potatoes

(*a*)

FOUR COURSE ROTATION FOR A GARDEN

1st year	*2nd year*	*3rd year*	*4th year*
Potatoes	Roots and Salads	Legumes	Brassicas
Brassicas	Potatoes	Roots and Salads	Legumes
Legumes	Brassicas	Potatoes	Roots and Salads
Roots and Salads	Legumes	Brassicas	Potatoes

(*b*)

FIG. 13

regulated largely by the necessity for a regular succession and constant supplies.

For garden use a good three-year rotation is shown in Fig. 13*a* and a four-year rotation in Fig. 13*b*. In a kitchen garden it may be

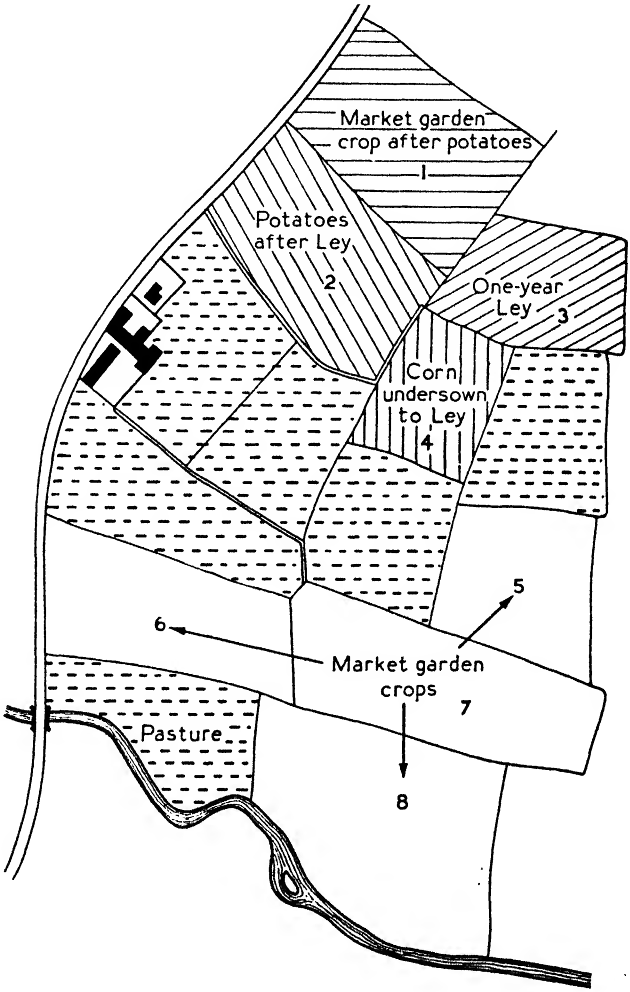


FIG. 14. Plan of a mixed farm. The numbers show the sequence by which the one-year ley is taken over the arable land

politic to devise a strict rotational system which allows for a given area having a prescribed treatment whilst carrying small sections of a number of separate crops. In such cases the slow rate of clearance of some of these crops and the fact that some may only occupy single rows often prevents a close succession, as the plot has to be treated as a whole and may have to await complete clearance before digging may be done. On a large market-garden a single crop may occupy a considerable area, often several acres, and the site can then be treated individually. It is then possible to work out cropping sequences for a given area, although, as already indicated, it may not be considered practicable to allow long rests between two related crops. The more intensive the cropping, with, say, two crops per year from the land, the more difficult it becomes to give two or three years' rest between brassica crops. A rotation which might be used by those market growers for whom green salads are important crops could be based on a division of the holding into three approximately equal areas which at any one time were being cropped with brassicas, roots, and salads.

For most of southern England early potatoes form a good preparatory crop for winter brassicas, or for an autumn crop of turnips or carrots. On light soils a well-dunged crop of leeks cleared in mid-winter is a good preparation for the earliest lettuce crop.

On a mixed holding flower crops or strawberries are very useful features of a rotation. A bed of the latter crop put down for three or four years gives a good rest between vegetables.

On a farm scale the introduction of short-term leys is good, being particularly useful in helping to maintain fertility. A one-year ley may give a cut of hay in spring or early summer and if the aftermath is disced (and possibly dunged), then ploughed-in in August or September, the soil is in excellent condition for carrying a heavy feeding crop by the next spring. Potatoes, peas, and most brassicas do well on such land. Lettuce and onions should not be put on land newly broken from grass.

Fig. 14 shows the layout of about 100 acres of arable land on a farm which has also much pasture carrying a dairy herd. The arable land each year includes about 12 to 15 acres of corn and a similar area of one-year ley which is treated as mentioned in the foregoing paragraph. The balance of the arable land is under vegetable production.

Intercropping is seldom a good policy for the market grower, but from time to time one sees examples which suit particular circumstances. In early districts Brussels sprouts are occasionally intercropped with early runner beans, the sprout rows being four feet apart with one row of beans between. The latter are not staked and are cleared early. Similarly savoys planted in three-feet rows may be intercropped with dwarf peas. In gardens the late green crops are often intercropped with short-term salads. Planting Brussels sprouts amongst potatoes is a practice to be condemned. On a large area of Brussels sprouts, late savoys, or spring broccoli, particularly on heavy soil, it is a good practice to plant "lanes" of early savoys to be cleared in autumn and thus give easy access with a cart through the field. This is very helpful with a broccoli crop. Intercropping is, of course, a special feature of French gardening and is dealt with in the chapter on that subject.

The grower must always be ready to take the opportunity of catch-cropping. Here a short-term crop is taken when ground may be unexpectedly clear, perhaps following a crop failure, and the site is planned for a particular crop which will be planted late enough to permit clearance of an extra crop which will not seriously interfere with the principal one.

CHAPTER VIII

SEEDS, SOWING, THINNING-OUT, AND TRANSPLANTING

GOOD seed is one of the essential conditions of success in growing vegetables. For this reason great care should be exercised in selecting the source of supply, for although cheap seeds *may* be good they may also prove very dear in the end, and it is far safer to pay a little more to an established firm with a good reputation to uphold, and so obtain seeds of assured strain and high vitality, than to risk having only a partial crop or one of very poor quality.

Whenever possible, seeds should be purchased some time before they are required, not only to have them ready to hand but also to allow time to test for germinative power, if there should be any doubt on the subject. Testing the seeds is especially useful as a help in determining seeding rates and the setting of seed drills.

Some seeds retain their vitality for many years, whilst others lose it quickly (see table at end of book), but in any case it is safest and most likely to be productive of good results if fresh and thoroughly ripened seed is always used.

The choice of varieties is a matter which largely depends upon local conditions, some doing better in one situation than in another; these peculiarities can be best ascertained by enquiry from growers in the neighbourhood, or by actually growing several kinds and selecting that which does the best. As a general rule, old-established varieties should always be preferred, particularly for main-crops, for the fact that they have been long in favour of itself proves that they have some sterling merit or growers, being free to choose, would have discarded them long ago.

Novelties should be tried, but on a small scale only, and never for the main crop; by this means the gardener can keep well informed regarding new varieties without risking his crop.

The Royal Horticultural Society is constantly conducting trials of vegetable varieties at the Society's gardens at Wisley in Surrey.

During the course of the trials the crops are inspected from time to time by a committee of growers and seedsmen. Awards are made to varieties or strains showing outstanding performance. The results are reported in the *Journal* of the Royal Horticultural Society. Other trials are conducted by the National Vegetable Research Station at Wellesbourne in Warwickshire, by the Ministry of Agriculture and Fisheries at its Experimental Horticulture Stations and by the National Institute of Agricultural Botany, not only at the Institute's station at Cambridge but also in many parts of the country under widely differing soil and climatic conditions. Growers should always note the results of these various trials, as they form a useful guide to the performance of the subjects under observation. It may also be possible to visit some of the trials whilst the crops are growing.

Seed Testing. A simple way to test the seed for percentage of germinative power is as follows: Put upon a plate a folded piece of clean blotting-paper, damped with warm water, and upon the blotting-paper put a counted number of seeds. Stand the plate in a warm dark place and keep the blotting-paper damp. In a short time (from one to several days, according to the variety) those containing life will sprout, and can then be counted. At the same time it should be remembered that this is no test of the actual number which will have strength to grow into good plants when sown under ordinary conditions in the open garden or field. In such circumstances there will be many losses through weakness, besides those which will occur through too deep or too shallow planting, too great extremes of temperature or moisture, or for many other reasons.

Lower survival rates may be expected from very early sowings in cold soil or at any time if the seed-bed is not in ideal condition. If, for a crop of onions, it is intended to sow thinly enough to leave the seedlings unthinned, then about 8 to 15 seedlings per foot of row may be considered desirable. A sowing rate of 16 to 24 seeds per foot of row would probably be a good policy for seeds a sample of which showed 75% germination when tested. This would allow for non-viable seed and also for a few casualties during or after germination.

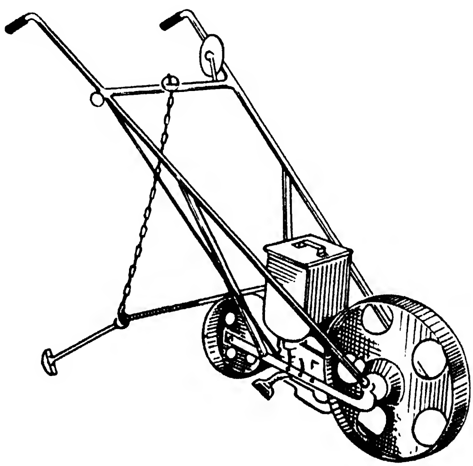
The Seed-Bed. Before seeds are sown it is necessary to prepare the soil properly for their reception. A sufficient amount of warmth, moisture, and air are the requisites of germination, and these conditions can best be provided when the surface soil is fine and crumbly and free from large lumps. When it is rough and cloddy some of the small seeds fall into crevices or are buried under large pieces, and either fail to germinate or do so very irregularly. Heavy soil should be prepared some time beforehand, especially when intended for small seeds, so that the action of the weather, and particularly of frost, will have the chance to produce a tilth which no amount of labour can equal. This introduces air, dries the surface, and makes the soil warmer. Early aeration of the soil assists germination, and promotes vigorous growth by encouraging the nitrifying bacteria.

When soil can be ploughed or dug and left for a few weeks before sowing, one or two crops of weeds may be encouraged to germinate in the top soil and be destroyed by raking or harrowing two or three times with ten to fourteen days' rest between such workings.

Seed Sowing. Having prepared a loose warm surface, the soil should be raked down fine and the seed sown either broadcast or in drills. The depth at which it is covered depends upon the size and variety of the seed, the condition of the soil, and the period of the year. It may be sown shallower in the spring, when the ground is moist, than in the summer, when the ground is dry. Very small seeds should, as a rule, be barely covered, whilst large seeds, such as peas or beans, may be put in from two to four inches deep. Where good seed, light yet accurate seeding rate, linked with good preparation of the seed-bed, result in an even stand of thinly and evenly spaced seedlings the operation of thinning may be avoided.

The garden is not only more attractive but the work of cultivation is much easier when the plants are grown in straight evenly spaced lines, therefore be careful to make a perfectly straight mark for the first row as a guide, then use a marker on the drill, and all the rows will be straight and at equal distances apart. If the sowing is done by hand, first mark out the rows and open the drills to the depth required, then taking the receptacle for seed in the left hand, walk along the row and drop the seed evenly from the right hand which is held close to the ground. The seed is held against the palm by the fingers, from whence it gradually works down, being evenly dropped by a slight rubbing motion of the thumb against the first and second fingers.

After sowing by hand cover up the seed, either by raking, by pulling soil into the drills, or by shuffling the soil along either side of the row and then raking the bed. The soil above the seed must then be compacted, particularly when it is likely to become drier, rather than moister, as is the case in the spring and summer. On heavy soil considerable discretion must be used over this operation, as the soil will be liable to cake if it should happen to be too moist, and at all times on such soils pressing should be done gently. On light soils the rows should be trodden down, or rolled. The reason for this is to bring the moisture of the soil into contact with the seed.

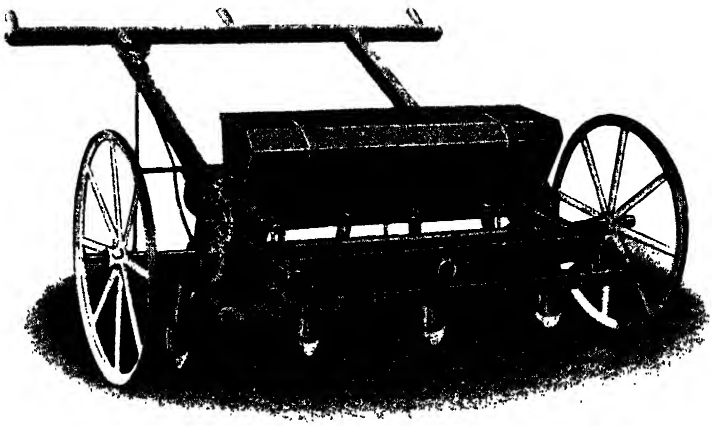


[*By courtesy of Humberside Agricultural Products*

FIG. 15. "Bean" hand seed drill. Seed flow is maintained by a metal agitator. Sows all sizes of seed

On any but a very small scale of working the seed will be sown from a drill. This implement is provided with a hopper for the seed and some activating device—commonly a rotating brush—which brings a supply of seed to an outlet hole. This latter is adjustable for various sized seeds and seeding rates, but whatever the scale on the outlet shows it is necessary to give a few test runs over a sheet of white paper or clean smooth concrete in order to be satisfied that the seed is actually being dropped at the desired rate. The condition of the brush should be watched, as old worn brushes make for inefficiency. For large-scale work much more precise drills are available in the "cup-drills" which pick up the seed in small cups and tip it into the coulter of the drill. Drills may range from single-row hand-pushed ones to multiple-row horse- or power-drawn drills.

To sum up, the factors which make for even drilling and good germination are as follows. Even ploughing—one-way ploughing avoids ridges and furrows; even firming; a fine surface tilth with no obstacles to cause coulter jump; use of the right drilling aperture; drilling at a constant speed and at the right depth. Keep record of the seeding rates—apertures used, quantities used on



[*By courtesy of Messrs. J. Gibbs, Ltd., Bedfont*

FIG. 16. The "Bedford" brush drill, adjustable for drilling 3 or 4 rows

given areas (linked with germination rates whenever possible), and if practicable record the speed of drilling. The greater the speed at which the drill travels the fewer seed are dropped for the distance travelled.

Seeds which germinate very slowly, such as parsnips, carrots, onions, when sown in the open ground may have mixed with them a few quickly germinating seeds, such as radish or turnip. These serve to mark the rows, so that the soil may be hoed and stirred about before the main-crop seeds are up, and so prevent weeds from getting too far ahead. In this way a catch-crop of radishes can be obtained before they inconvenience the main crop.

Thinning Out. For some crops like onions and carrots the ideal is to sow at a rate which will give a stand of plants that will not need thinning. With others—turnips, beet, lettuce—it is desirable to have the plants spaced 4 in., 8 in., or even 12 in. apart; the minimum sowing rates for these give more plants than are needed so when the seedlings are well through the ground unwanted ones are removed, otherwise all the plants will speedily become drawn and weak. It is a great mistake to let young plants stand together too thickly; without a sufficient amount of light, air, and moisture, it is impossible for them to develop properly.

Therefore, *as soon as the seedlings can be handled*, proceed to remove the weakest plants. Thinning should be a process of selection, the best being allowed to remain. At the first thinning the plants may be allowed to stand at half the distance apart it is ultimately intended to leave them for the main crop; by doing so not only will a full plant be assured, but in the case of such crops as beet, onions, and carrots, which may be left until they attain a moderate size without overcrowding, a gathering of choice young roots can be made which will add materially to the profit of the crop. At the same time never delay the final thinning until the plants are unduly crowded, or the main crop will be sure to suffer.

Pricking-out and Transplanting. Although many kinds of vegetable seeds are sown where they are to mature, some others are sown in nursery conditions, e.g. seed-beds in the open are used for brassicas and leeks; cold frames are used for lettuce, early cauliflowers, and celery; greenhouses or heated frames for tomatoes. Some of these crops are transplanted direct from seed-bed to their final quarters, but some, e.g. celery or September-sown cauliflowers, have an intervening stage when they are pricked out to a second nursery bed.

Pricking-out should be done as soon as the seed leaves are large enough to be taken between finger and thumb. The longer the delay the greater the check. The soil in which the seedlings stand is loosened, then they are gently drawn and laid side by side in a small heap on a piece of board and carried to the nursery bed, the soil of which may consist of finely sifted old hot-bed manure or a prepared compost. In this soil a hole is made with the first finger, or by a small dibber about the size of the finger, but a little more tapered. The seedling is taken by the leaves, and lowered into the hole up to the leaves, care being taken that the roots are not turned upward; then the soil is gently pressed to the stem. These tender seedlings require delicate handling, and must not be bruised in any way. Only good strong seedlings are used, sufficient seed having been sown to allow all weaklings to be discarded. For a few days shade from bright sunshine is given.

Where the seedlings have been raised under glass they should be well hardened before being transferred to the open.

The site to which the seedlings are finally transplanted should, when possible, be prepared some time in advance. If, however, the work has to be done speedily following the recent clearance of the preceding crop it should be well rolled in order that by

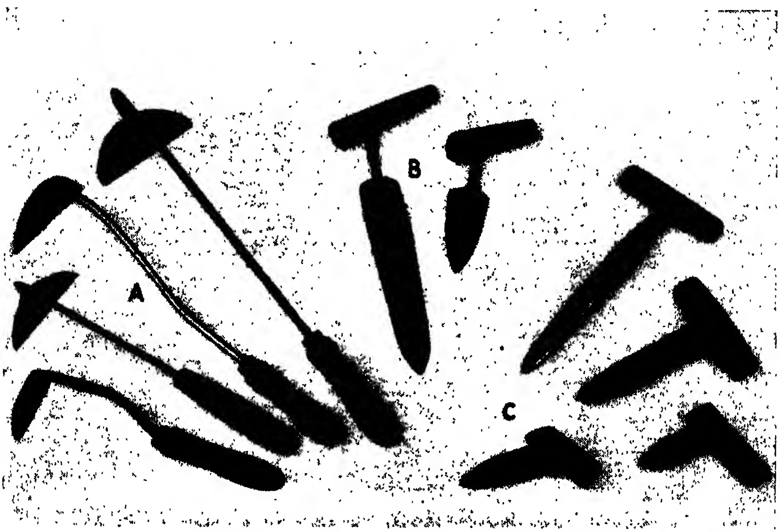


FIG. 17. A collection of small tools used by Dutch market gardeners

A. Hoes.
B. Trowels, long blade for cauliflowers, short blade for lettuce.
C. Dibbers.

consolidation the soil particles may be brought closely together so that when planted the seedling roots are in contact with moist soil. The few inches of top-soil should have a good tilth and the lower part of the soil be firm.

The best time to plant is in dull cloudy or showery weather. If planting must be done when the weather is hot and dry, irrigation of the site is invaluable. For soil that has been ploughed some weeks the water may be given the day before planting. If the new crop is following on one which has just been cleared the water is best given before ploughing is done. Where brassicas are being planted and irrigation is not possible a "puddle" may be made of soil, cow dung, and water into which the roots are dipped as they are planted. By drawing a furrow about 4 in. deep and planting in the bottom of this the roots are placed lower into the moist soil than would be the case with planting on the level; this is a very useful practice with brassicas.

The day before the plants are lifted, the bed in which they stand should be soaked with water. The soil should then be loosened with a fork, when the plants will draw easily with the roots un-

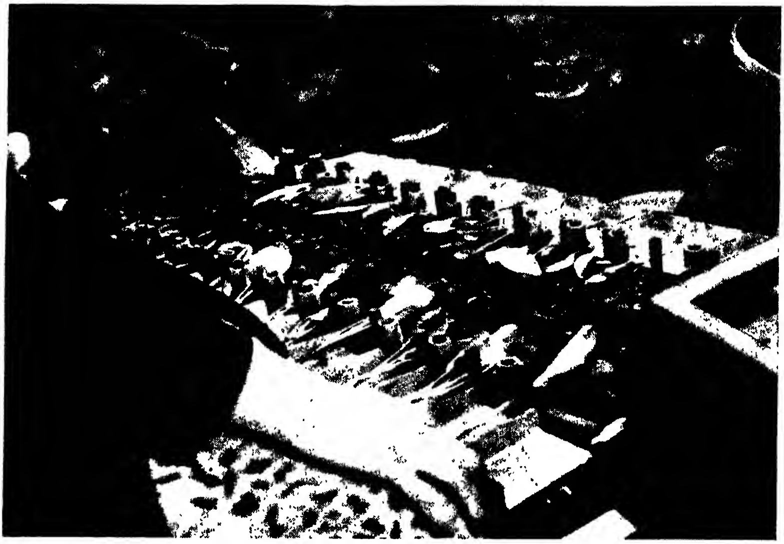


FIG. 18. The "Robot" transplanting machine

broken. Whilst the plants are out of the ground they should be kept moist, both roots and tops, and until ready for planting they should be covered with a wet sack.

If the plants are rather large, and particularly if the weather is dry, it is a good plan to shorten the large leaves to half their length. In transplanting onions and leeks the roots may with advantage be cut off to within an inch of the base, and the tops shortened by one-third their length; the advantage of this treatment is that the plants are more convenient to handle and so the work of setting them out proceeds more quickly. Apart from convenience, onion and leek plants do not need to have all their old roots retained, as after severe injury to the roots by lifting from the seed-bed entirely new roots are sent out by the root-plate.

When transplanting, it is sometimes customary for a boy to carry the plants in a covered basket and to drop them at the right distances apart just ahead of the planters. Usually one boy will drop plants for two men; he should not drop faster than the plants are required.

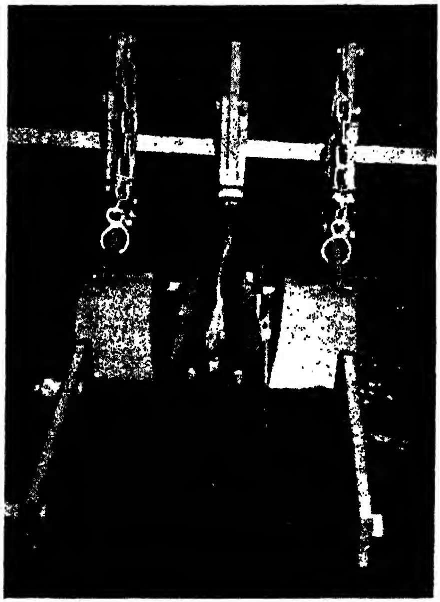
To plant, hold the dibber in the right hand and the plant in the left; push the dibber straight downward into the soil with a half turn, so that it will enter more easily; lower the plant into the hole and see that the roots enter easily and are not turned upward; set the plants to their appropriate depth; then again insert the dibber, a short distance away from the plant, and with it press the soil firmly against the root. The plant should be *fixed so tightly in the soil that a leaf will break off before the plant will draw.*

Another good transplanting practice is for the plants to be put out on the field in boxes covered by damp sacks, the planters drawing from the nearest box as needed. Skilful workers can hold a bundle of seedlings in one hand, constantly selecting with the fingers a seedling and holding it in a position where it can readily be inserted in the hole made by the dibber held in the other hand. A good planter can put in 1,000 leek plants per hour.

In a market-garden, instead of planting to a line it is usual to mark out the field by dragging across it a "marker" which has several teeth that make shallow furrows. The teeth may be set at any distance, e.g. 12 in., 18 in., 24 in. If the field is cross-marked planting may then be done "on the square" and cross-cultivation is possible when hoeing. (This cross-cultivation will not be possible when planting is done by a machine.)

Transplanting Machines. There are on the market two distinct types of transplanting machines. One has a series of rubber-protected "fingers", fixed to an endless chain. Operators sitting on either side the table of the machine feed plants to the fingers, which are carried to the underside of the table and there release the plants to a furrow which is prepared as the machine passes along. Covering the roots is done simultaneously with the release of the plant and this is followed by consolidation. It is possible to have a watering device fitted.

Another pattern opens a furrow with a plough, on either side of which sits a planter, one planting with the left hand, the other with the right. They are "fed" with small bundles of neatly arranged plants by another operator from a supply in boxes on a platform over the plough. The planters each in turn hold a plant in the furrow ready to be covered by the machine. A somewhat similar machine has a pair of spongy rubber discs which hold the plants—tops inwards, roots outwards—and which in the course of their rotation carry the plants into position for planting, the operators feeding into the discs, Fig. 19.



[*By courtesy of Messrs. A. M. Russell Ltd.*

FIG. 19. "Multiplanter" fitted with "Ritchie" Easy Feed rubber discs

All the machines are tractor-drawn. They need to move slowly —possibly no more than $1\frac{1}{2}$ m.p.h. A skilled team can do very fine work on a well-prepared site. High rates of planting are claimed when working under ideal conditions. With one particular machine it may be that when starting the training of a new team the planting rate for the machine would be 6,000 or more plants per hour, or an average of over 1,200 plants per man-hour for each member of the team. As the team get skilled at the work the rate per machine might approach 10,000 plants per hour.

Soil Blocks. When raising some plants in greenhouses or frames, the seedlings, instead of being pricked out in boxes, pots, or direct into frames, may be planted in soil blocks. These consist of potting compost compressed into hexagonal blocks. For this purpose the compost should be just moist enough for the blocks to hold together. The blocks are particularly useful for tomatoes and for cauliflowers which are being wintered in frames. Do not allow the blocks to become dry; should they do so they may crumble and in any case are difficult to rewet.

FOR FURTHER READING

MERCER, S. P. *Farm and Garden Seeds.* Crosby Lockwood & Son, Ltd., 1948.

JOHN INNES LEAFLET NO. 12. *Soil Blocks.* Oliver & Boyd, 1953.

CHAPTER IX

DEVICES FOR FORCING, FORWARDING, AND PROTECTING

EVERY intensive grower of vegetables, no matter how small his garden may be, needs some means of raising, growing-on, and hardening-off plants so as to have them ready for setting out in their permanent quarters in the open as soon as the weather conditions permit with safety. This need is even more imperative when crops are intended to be ready for use some time, whether it be long or short, before those which are produced under normal conditions. By the use of various protective appliances the gardener becomes, in a measure, independent of season and climate.

Amongst the numerous devices which are used for this purpose nearly all have glass interposed between the plant and the natural weather conditions. Frames with "lights" of various types, bell-jars, and continuous cloches are all used; some admit a greater proportion of light than do others. The glass itself cuts out a small percentage of light even when clean; dirty glass is a serious barrier to the full and free access of daylight to the plants under protection. Such hindrance to the light increases the difficulty of producing a really first-class sample of early green vegetables.

The "frame" is one of the most serviceable appliances the intensive gardener can use. The plants in them can be kept near the light, within a few inches of the glass, where they grow practically as robust and sturdy as they do later in the open air, and their needs can be easily attended to, whether it be watering, ventilating, or transplanting. In frames crops can be forced, forwarded, or protected to perfection. Frames can be kept in use the year round and they can be easily moved from place to place. In the form of Dutch lights they are probably the cheapest means of covering the ground with glass.

Three principal types of frame-light have been used, English, French, and Dutch. The most widely used **English lights** measure 6 ft. by 4 ft. and have four rows of panes which are bedded in putty. They are heavy and need two people to handle them; the thick styles, together with the sash bars, cut out an undue amount of light; and above all they are the dearest of the lights.

The French lights are of a size which makes it possible for one man, whenever necessary, to move them from place to place, and where much of the work has frequently to be done single-handed the advantage of this is at once apparent. These French garden lights are made with narrower styles than English ones, and have tee-iron sash bars, both of which features have the effect of admitting more light.

The light takes four rows of 24-oz. glass, 10 in. wide by 12 in. deep, with ½ in. overlap; this gives sixteen panes to a light, and allowing for the wood gives a light 3 ft. 11 in. wide and 4 ft. 3 in. deep. The glass must be bedded in putty, and should also have top putty, so as to prevent "drip".

The "horn" or projecting wood at each corner of a light, which is left to strengthen the mortice and tenon joint, should not be more than 1 in. long, otherwise it interferes unduly with the pathway between the frames.

Two handles are fixed on each light, one at the top and one at the bottom, on the upper surface, about 1 in. from the edge. These are made of ¼-in. round iron, and fit into galvanised screw-eyes. In putting on the handles the "eyes" are first screwed into position and the handle is bent a little in the middle so as to get the ends into the eyes, when a sharp tap with a hammer in the middle of the handle makes it secure; when not in use the handle lies flat on the frame. This light is rarely seen in England today.

The frame or "box" for use on hot-beds is made of unplaned 1-in. yellow or red pine boards. It is made to take three lights, which touch each other when on the frame, having no "runners" to divide them, and they come flush with the outsides of the frame all round; allowing for three lights of the size given the frame will therefore be 11 ft. 9 in. long by 4 ft. 3 in. wide, outside dimensions. The back is 9 in. high and the front 7 in., whilst the ends are, of course, cut to slope from 9 in. to 7 in.

At each corner of the frame, inside, is an oak leg, 2½ in. by 2½ in., to which the boards are firmly nailed or screwed. This leg comes within ½ in. of the top of the frame and projects 1½ in. below it.

Two movable wooden cross-bars, or supports, 2 in. by 2 in., on which the sides of the lights rest, divide the frame into three equal parts.

Six iron "stops" are fixed to the top of the front board of the

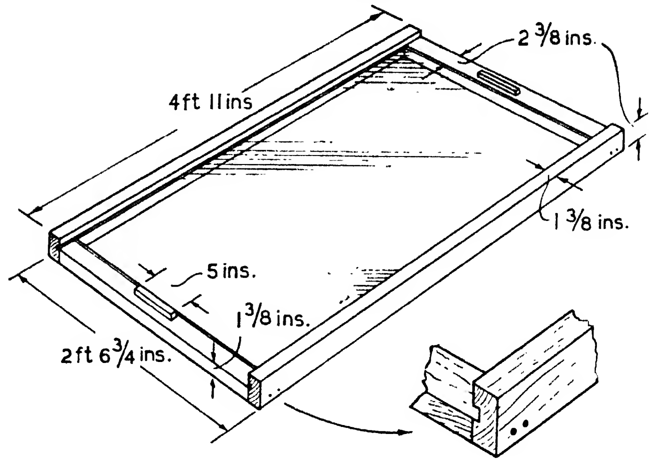


FIG. 20. A Dutch light

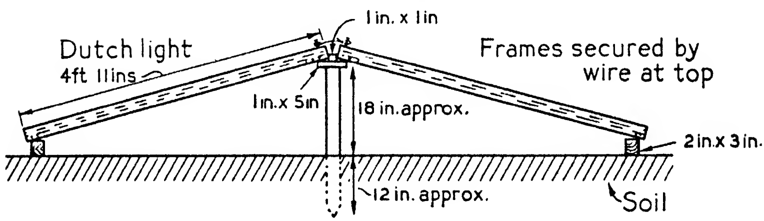


FIG. 21. Double-light span frame

FIG. 22. Double-light span range prepared for receiving the lights. Note the low earth ridge

frame, two for each light. The purpose of these is to prevent the light from slipping when it is held up at the back while attending to the plants—all work in the frames whilst the lights are on being done from the back.

It will be noticed that this frame is much shallower than the ordinary garden frame, and is very little higher at the back than at the front. This enables the plants to be grown near the light and so kept sturdy; as they become in danger of touching the glass the frame is raised from the bed a little at a time, with hooks made for the purpose. A tight wad of manure is placed under each leg to give it a solid base to rest upon, and the space between the bottom of frame board and bed is filled up with fresh manure.

The Dutch Light has become increasingly popular since about 1930 and is now the most important kind used in this country. It is very simple in construction and consists of two styles and two end-pieces forming a frame with over-all dimensions of 4 ft. 11 in. by 2 ft. 6¾ in. Slight modifications in detail are sometimes seen but Fig. 20 illustrates the light made with nailed joints (as in B.S. 1612). The nails should be 4-in., 8-gauge, corrosion-resisting. The light is glazed with a single pane of 24-oz. glass, 56 in. by 28¾ in., which is slid into the grooves of the styles and held by the wooden stops which are fixed to the end plates.

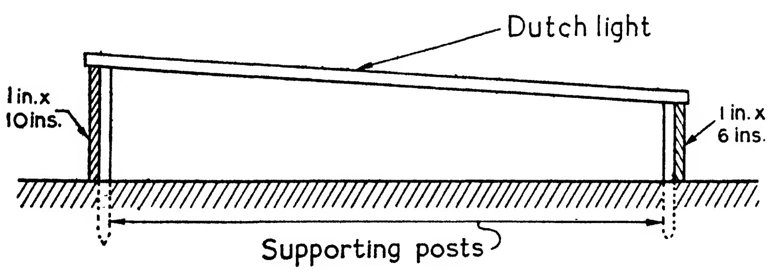


FIG. 23. Single-light span frame

In Holland the light is mainly used on span frames, as seen in Fig. 21, an arrangement which is economical in its use of supporting materials. The central ridge is supported by posts 2 ft. 6 in. long and 2 in. by 2 in. thick which are driven into the ground for half their length at intervals of about 5 ft. The height of these should be carefully checked to ensure uniformity. On top of these posts a strip of wood 5 in. by 1 in. is nailed and along the centre of this a strip of 1 in. by 1 in. is fixed. This latter provides a stop when the light is opened for work in the frame. When placed in position two lights, one on each side of the ridge, are held by wire

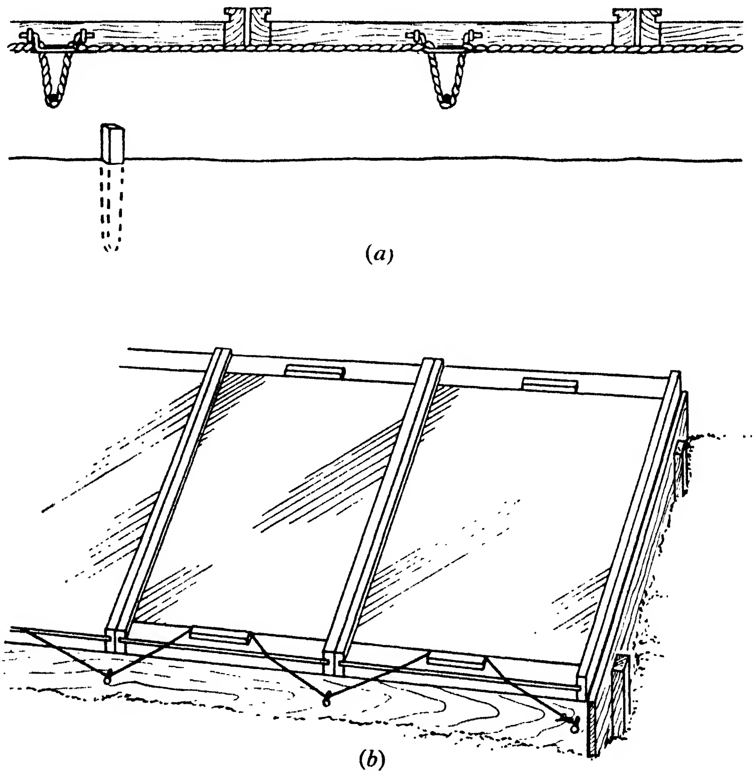


FIG. 24. Light Securing

(a). For the rear of single-light range.
(b). Used at base of double- or single-light range.

twisted round a nail fixed in each upper end-plate. The lower end of the light may rest on a strip of wood 3 in. by 2 in. pegged into the ground, although in the interests of economy it may merely rest on a low ridge of soil, Fig. 22. Occasionally a span frame includes an irrigation line as seen in Fig. 47, and this is of great assistance to many crops.

A narrower frame of single-light span is seen in Fig. 23. This is often used but in erection needs more material in proportion to the area covered. Instead of the boxes described on page 69 two continuous rows of parallel boards, nailed to stakes driven into the ground at convenient distances apart, give good support for the lights. The height of the boards depends upon the crops to be grown in the frame, 9–12 in. at the back and 6–9 in. at the front being the usual range. Instead of boards concrete slabs may be used, see Fig. 60.

Adequate protection must be given against wind damage. The use of a cord as shown in Fig. 24 is very easy to manage. On a single-light range one end is secured to a nail in the end of the frame, runs over the corner of the end light and downwards through a handle (or ring), being looped firmly under a nail driven

[*By courtesy of " The Grower "*

FIG. 25. Wire peg for base of light

into the back-board. The fixing of this can be quite speedy and to adjust the light the loosening of one end of the cord permits all loops to be unhitched. The lower end of the light may be held down by a slender iron rod, bent at the top, pushed well into the soil, as shown in Fig. 25, or by a short stake driven in on the slope.

The supporting frame-work that is used depends to some extent on the crops to be grown and with a little ingenuity the grower can soon devise the appropriate structure to carry adaptable units. The lights may be used for covering a skeleton structure some 6 ft. high and in that manner provide a comparatively cheap glasshouse. Various clamps are on the market for holding the lights without the erection of a framework.

Lights with unpainted woodwork may be reckoned as having a life of eight to ten years, but by suitable treatment this can be considerably extended. It is not customary to paint them, as closely fitting lights admit very little water by way of "drips" owing to the wood swelling on wetting. Creosote or other tar-oil preservatives should not be used, as volatile toxic "fumes" are given off for many months. Certain proprietary preservatives are available which have given very satisfactory results, particularly when applied, before glazing, by pressure treatment in suitable tanks. This treatment can sometimes be provided by the firms supplying the lights. Cuprinol, Celcure and Wolman salts are good materials for this purpose.

FIG. 26. A good range of cloches or bell-jars at Hexham, Northumberland, in 1952

The Cloche or bell-jar is an essential feature of the French market-gardens, where it has been in use for many generations and where at one time there were several millions in use. Its use was adopted in the gardens started in this country on French lines and there are still a good many to be seen lingering on in a few market-gardens. For the sake of those who may still be called on to use true cloches an account of their use is retained in this book, but there is little likelihood of seeing an extension to their number. The cloche forms a complete little frame in itself and for purposes connected with forwarding, protecting, and raising early seedlings is unsurpassed. Though not so useful as a frame for general purposes it is even better for some things, notably cos lettuce. It is always ready for use, it is never the worse for wear, and with care breakages seldom occur. The size most generally used is 16¾ in. across the bottom, 15½ in. high, and weighs about 5½ lb., Fig. 26.

They were usually made with a knob on the top, but before being sold this was removed, as the knob sometimes causes damage to the plants by acting as a lens in the sunshine; without the knob they also pack better for travelling and store away better and safer when out of use.

Cloches should be lifted by pressing a hand to each side. They are carried about the garden on a contrivance called a "cloche-carrier", which is a framework of wood with a space at each end on which to place six cloches, three and three, back to back, or twelve in all. There is a space in the middle for the workman to

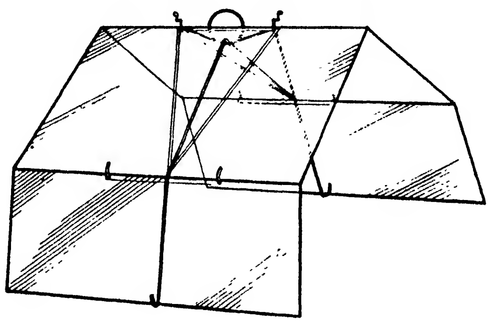


FIG. 27. Continuous cloche, "Barn" type

stand in and he raises the carrier by a handle on each side.

When a cloche is in use it is necessary to tilt it frequently on one side or another, according to the direction of the wind, for the purpose of ventilation. To enable this to be done a "cloche-peg" always accompanies a cloche in use. It is made from a piece of wood about 1 ft. long, 1½ in. wide, and ⅜ in. thick; it is pointed at one end to push into the soil easily, and has two or three notches cut in the upper part for the cloche to rest upon at the height required.

When cloches are not in use they should be stacked away, four or five one above the other, standing upright, with a small square piece of thin wood, about 2½ in. by 2½ in. and ½ in. thick, put between each, on the top, to prevent their touching. They should never be packed away on their sides, for many get broken or cracked through jarring, or if they are laid outside the rainwater which collects in them may freeze and break the glass.

When cloches get broken, providing they are not shattered, they may be repaired by rubbing a mixture of white lead and gold size on the broken edges, pressing them together, and binding them by running along the joint a strip of broad tape well smeared with the mixture. Cloches repaired in this way are almost as good as new ones.

When cloches are used in large numbers, twenty-seven may be calculated as occupying the same space as one three-light frame of the size for French lights. They are placed in beds of three rows, with a narrow path between each bed, arranged with the

[By courtesy of Messrs. Poultmure

FIG. 28. The "S.C.F." Cloche, a large metal framed pattern

cloches in the middle row falling between those in the two outer rows, as shown in the diagram on page 98.

In the Evesham district of Worcestershire the **hand-light** or "cap-glass" was developed and is still used to a limited extent. These cap-glasses consist of eight tapering, glazed sides. The framework is of zinc and each side has three or four panes. The width at the base is about 20–22 in. and the height is 15 in. A hole at the top provides ventilation and also enables a finger to be placed inside to carry the glass. The principal use for these glasses is for protecting the earliest marrows and cauliflowers.

The true cloche never became really popular in England, but in due course the use of what came to be known as the **continuous cloche** developed widely. This cloche consists of two, three, or four panes of glass which according to the particular make may be variously held together by wire, wood, or metal strips. The sizes vary, but a useful pattern for intensive vegetable growing, the barn type, consists of four panes, has a span of about 23–24 in. and stands 16–18 in. high. When placed end to end these give protection to a long strip of ground and to check draughts from sweeping through, a pane of glass or piece of wood is placed at each end. Ventilation is provided at the junctions of glass and the junctions of cloches; in very hot weather more air is admitted by spacing out the cloches.

To speak of these structures as *cloches* may seem wrong, as they are most certainly not *bells*, but the word is now firmly rooted in horticultural practice. More recently it has been applied to even larger glazed metal structures which span some 4 ft. of ground, cropping in which demands a management more nearly approaching that of the frame, as under such protection the plants do not benefit from the rain to the same extent as with the true cloche or the continuous cloche, Fig. 28.

Mats were formerly regarded as indispensable protection for frames and cloches during severe weather, for giving light protection to early crops in the open during March and April frosts, and for shading during periods of intense sunlight. Small seedlings of lettuce can be successfully overwintered in frames without the help of mats, the use of which is probably most appreciated in late winter and early spring for checking loss of heat by radiation frosts. At such times they may give valuable protection to partly grown crops in frames.

At one time imported Archangel mats were used in kitchen gardens. Reed mats are used in Holland and are sometimes used in this country. It was at one time customary for French gardeners to make their own mats of straw, their manufacture providing a useful occupation for slack periods in winter.

Mat Making. Two World Wars prevented the import of mats and the use of this method of protection has largely disappeared. As a record of this work and for the sake of those who may care to try making their own mats the following account gives directions for the construction of a simple mat frame and for the making of the mats. The frame illustrated in Fig. 29 is made of four pieces of wood 3 in. broad and 1 in. thick. The size of the mat to be made regulates the size of the frame. For use with French lights a frame 5 ft. 6 in. long and 4 ft. 6 in. broad is used. Along the middle of the top and bottom boards five stout nails must be driven in at 10 in. apart, leaving them projecting about 2 in.

Tarred string is tied to each nail at the top, then brought down tightly and tied to the corresponding nail at the bottom. To each bottom nail a further piece of string, 12 ft. long, is attached, each piece being wound round a short piece of green wood with a slit in one end, in which the string is fixed to keep it from unwinding.

Long straight straw should be used, and having shaken out of

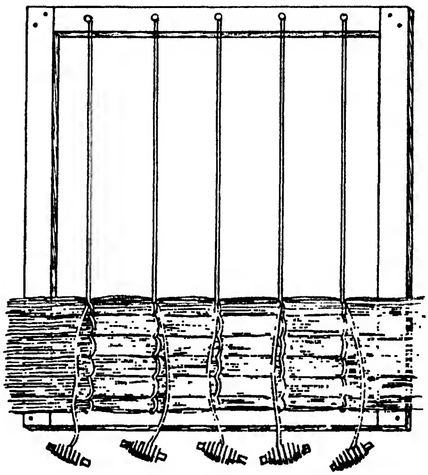


FIG. 29. Mat frame

it any small and broken pieces, lay a bundle at each side of the frame arranged straightly, with the butt-ends all one way. Then take as much as can be held between finger and thumb, and lay it on the lower board, resting on the nails, with the butt-ends level with one outer-edge; repeat this with another bunch but place the butt-ends level with the opposite edge. Hold the straw near the middle with the left hand and with the right pass the centre ball of string over the straw and under the upright string, bringing it back under itself so that it will draw up and hold tight. Repeat this with all the other strings. Lay on more straw, as before, and repeat the tying, always taking the middle string first. Lay the straw in equal bunches and draw each firmly upon the previous one so that the mat will be made of an even thickness of about 1 in. throughout. When the top row of nails is reached the mat is finished off by firm knots, and the sides are then trimmed level with shears, leaving it about 5 ft. 6 in. by 4 ft. 6 in. One ton of straw should make about 250 mats of this size.

If before using the mats are dipped in a solution of copper sulphate (7 lb. to 25 gallons of water) this toughens the straw, retards decay, and destroys any spores of fungi which may be present. The dipping should be repeated each season. After dipping, the mats should be thoroughly dried. When not in use they should be dried, rolled up, and stored under cover.

Frame Yard. The site chosen for the frames and cloches should be well drained and have good shelter. If the latter is provided by existing trees or hedges the frames should be far

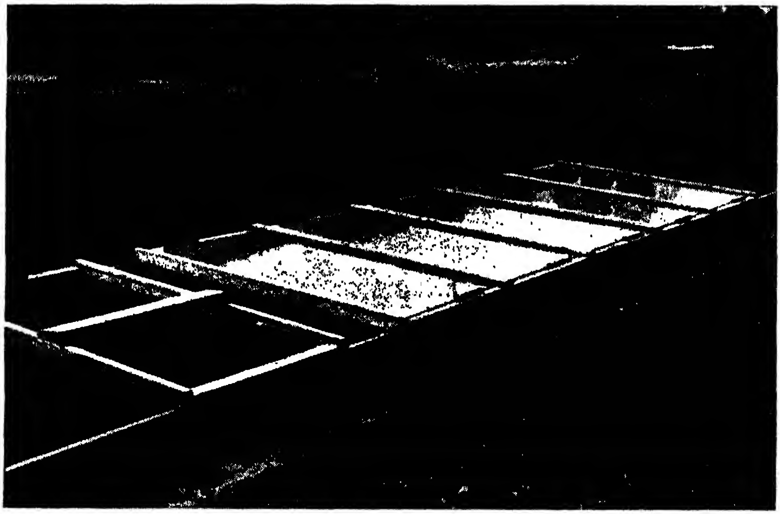


FIG. 30. Straw bales used for temporary shelter
(Note the unglazed light with loose rail across for kneeling on when pricking off seedlings or weeding.)

enough away to avoid being overshadowed and to avoid competition of tree roots. On an open site good temporary shelter may be provided by baled-straw walls, as seen in Figs. 30 and 65.

The paths between the frames and cloches should permit comfortable access: 10 in. was all that was allowed between the ranges of frames in the older French gardens, but most people like more room than that spacing permits and 24 in. is fairly common.

With single-light frames the ranges run east to west and face south. With double-light span frames it is usual to run the ranges north and south.

The frames may be erected on level ground, growing the crops in the soil of the site; they may be erected on "hot-beds", or they may be used on sloping banks pitched to the south as in Fig. 65. This latter system is often used, particularly around London, for the over-wintering of lettuce seedlings, which are all at a uniform distance from the glass.

Hot-beds. These have long been used by skilled gardeners for early cropping and for early raising of plants for outside planting. Traditionally they are made of fermenting dung or leaves and the whole system of French gardening was based on the successful management of such hot-beds. Other methods of warming the soil include buried hot-water pipes, drainage pipes with steam injected, and more recently electricity. Each of these systems differs to some extent from the "natural" hot-bed of fermenting material, which provides not only heat but some plant nutrients. Furthermore, one of the principal products of decomposition is water and from a hot-bed this condenses in the overlying soil, thus keeping it moist for a long time. In contrast to this, hot-water pipes or electric wires buried in the soil actually accelerate the loss of water. To compensate for such loss the subsoil should be well soaked before cropping starts and the top-soil should have a good humus content. Hot-water pipes are expensive and once installed not easily moved; uneven growth may result, as the soil is not uniformly warmed.

Where dung is used it should contain plenty of urine-soaked litter. The addition of half its bulk of dry tree-leaves will contribute towards a steady and lasting heat, and this end may also be attained by mixing in a proportion of unused manure which has been stored to keep dry and cool in narrow high-pitched stacks (see pages 91, 92). In an emergency a third portion of cow manure containing plenty of litter may be well mixed with the fresh horse manure. The object in view is the production of a uniform and steady heat throughout the bed. Fermentation may be started by making a large heap, shaking out the manure as the work proceeds. If the straw is very dry liberal watering may be done. As soon as fermentation has well begun, as may be seen by the issue of "steam", the heap must be turned and thoroughly mixed, throwing that which was outside to the middle and breaking all hard lumps. If the weather is cold and fermentation is slow to begin, the provision of shelter from the wind will often put matters right. When it is warm uniformly throughout the heap it is ready for making into the bed. From first to last, the preparation of the manure usually occupies about two weeks.

Before beginning to make the bed, mark out accurately the space it has to occupy, allowing, if very early in the year and manure is plentiful, sufficient margin for it to project 18 in. beyond the lights all round, but if manure is scarce less margin must suffice, though it must never be less than 9 in., or it will be found impossible to keep up the heat on the outsides of the frame. Use the longest stuff for the outsides of the bed, and keep this part a little higher than the remainder until the full height is reached. Except for the outside, lay down alternate forkfuls of new manure and that which has been stacked (or of leaves) in layers about 6 in. deep all over the bed, shaking it out so as to mix it well and break any lumps. Beat it down with the back of the fork as the work proceeds, and when it reaches the full height tread it all down firmly and evenly. Finish by filling up any hollow places with a little more manure. A bed made in this way will "hold together", and will retain heat on the outsides longer than when manure is laid down indiscriminately.

The thickness of the bed depends upon the time of the year it is made and the purpose for which it is intended—the earlier the bed is made the thicker it should be. As a general rule, for the early forcing of salads, it will give good results if made 15 in. thick in January, reducing the thickness about 3 in. for each month it is made later. If made in March for cucumbers or melons 2 ft. is the minimum, and this can be gradually reduced to 1 ft. as the season advances.

When the bed is finished it should be covered with 4–6 in. of fibrous soil, consisting either entirely of sifted old hot-bed manure as used in the French garden, or of a mixture of half that material and half good garden loam; then put on the frame, thrust a soil thermometer into the manure, and shut down the lights. For a few days the heat will probably rise very high, though this depends upon the thickness and composition of the bed. Neither sowing nor planting must be done whilst the heat is rising, but when it is falling, and has reached 85 deg. F., cucumber, tomato, and similar seed may be sown, and when it passes below 75 deg. it is ready for any other subjects.

From the time seeds or plants of tender kinds are put in the frame it must be covered up closely each night with mats, to keep out frost and to prevent the loss of heat by radiation.

When the bed begins to cool, or if the weather becomes severe, hot manure must be put all round the outside of the frame, from the top edge of the bed to the level of the lights, and this lining must be renewed whenever any cooling takes place; if the lowering in the temperature is serious, pull down the sides of the bed all round to the level of the frame, and build it up again with fresh hot manure.

The Management of the Hot-bed. The proper management of a hot-bed is only acquired by experience. Beginners are often impatient, and sometimes make the bed at too early a date, or do not give the manure enough preparation, or sow or plant before the heat is steady and so waste time and material. The thing to aim at is to secure sturdy plants which make a steady and healthy growth. This result is only to be secured by maintaining the proper temperature; by giving ventilation but avoiding draughts and chills; by never permitting the soil to get too dry whilst being careful never to get it very wet and cold by over-watering; by watering early in the day so that the leaves of the plants are dry when the lights are closed in the afternoon; by keeping the plants near the light and at the same time shading from a too hot sun; by never overcrowding, and by thoroughly hardening plants before transplanting to the open. By carefully observing these principles even a beginner may expect a reasonable amount of success, and experience will soon convert expectation into comparative certainty.

A specially heated pit for the forcing of seakale is described in the section dealing with this crop on page 234 and the use of fermenting dung for the forcing of chicory is explained on page 171.

Electrically heated Hot-beds. Early work on electrical heating of the soil involved the use of high-voltage soil-heating cables which were dear to install, had a maximum life of five years, and were easily damaged by digging. The most recent work favours the use of low voltages, obtained by installing a small transformer. A maximum of 30 volts is used, 12 to 20 is more usual, but sometimes the voltage is as low as 6 or 8.

Bare galvanised wire of gauge 17 is used. Fencing wire may be used but this is springy; annealed wire is better and this may be obtained—electrically tested—at a cost only a little dearer than fencing wire. The wires should be 6 in. apart and 6 in. below the surface. They should be stretched at good tension along the length of the frame and in this way permit digging with a fork.

Moisture must not get at the terminals of the transformer. The terminals on the mains side of the transformer must be completely away from the danger of shorts arising through contact by spades, etc. The fitting of the transformer and connection to the main should be done by a competent electrician.

For early salad crops in frames the loading is 2 watts per square foot or 2½ watts for a cold exposed position. Though some early crops may need a higher loading, yet summer melons do well on the above loading.

Cold-frames. The cold-frame is in many respects similar to a hot-bed, both as regards management and uses, except that as there is no bottom heat it is not available for tender subjects in the cold months of the year. It is much used for carrying autumn-sown plants safely through the winter; for protecting parsley, winter spinach, late endive, violets, and similar subjects; for hardening off plants which have been started early in hot-beds or cool houses and for raising early plants from seed. It has a special value for use in forwarding numerous standing crops such as strawberries, mint, bulbs, etc. to early maturity. Peas, beans, radishes, carrots, turnips, lettuces, etc., can all be grown to perfection in the cold-frame, although not so early as from hot-beds.

Where a large number of lights are to be used in single-light span ranges it will be found economical to have two continuous rows of parallel boards, nailed to stakes driven into the ground at convenient distances apart. The size of the light regulates the width between the boards. The height of the boards depends upon the crops to be grown in the frames, 9–12 in. at the back and 4–9 in. at the front (according to size of light) being suitable for most purposes. The length is regulated by the circumstances of the case, and the ends are enclosed by boards cut to the required slope. A range 30 lights long (76 ft. in the case of Dutch lights) is about the maximum for convenient working conditions.

For cold-frame cropping the soil needs to be in a high state of fertility and generous manuring is practised. The dung should be well decayed and well worked in. Where the same site is used for a long period the soil in the frames may be cultivated by hand or with a rotary cultivator or the frames may be cleared annually to enable the site to be ploughed.

For the production of melons and cucumbers in frames a mild hot-bed is sometimes arranged by digging a trench along the centre of the range of cold-frames and in this placing about 9–12 in. of fresh stable manure, which is then covered by some of the soil from this trench. In this way the young plants may be given a good start during their first few weeks in the frames.

FOR FURTHER READING

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CHAPTER X

FRENCH GARDENING

"While science devotes its chief attention to industrial pursuits, a limited number of lovers of nature and a legion of workers whose very names will remain unknown to posterity have created of late a quite new agriculture, as superior to modern farming as modern farming is superior to the old three fields system of our ancestors . . . They smile when we boast about the rotation system having permitted us to take from the field one crop every year, or four crops each three years, because their ambition is to have six and nine crops from the same plot of land during the twelve months. They do not understand our talk about good and bad soils because they make the soil themselves. . . ."

KROPOTKIN, *Fields, Factories, and Workshops.*

KROPOTKIN'S work was published in 1899, and it was not until then that much attention had been given in Britain to the intensive cultivations of the Paris *maraîcher* whose system has since become popularly known as French Gardening.

Cultivation on similar lines had been carried on for generations in many English gardens to a very limited extent and for special purposes, but French gardeners had elaborated the culture into a system which embraced the whole garden and the year round, until it developed into an important national industry which produced both for home production and for export.

As a result of the interest aroused by Kropotkin's book a body of English horticulturists visited the Paris gardens to enquire into the matter for themselves, and following this gardens were laid out and equipped for French gardening, in 1905 at Evesham in Worcestershire and in 1906 at Mayland in Essex. Others were established from time to time, but few have survived to the present day.

The cropping under this system was based on skilled inter-cropping and successional cropping to a pitch which regularly yielded six or seven crops per year from the same site with the crops standing thickly on the ground. Thus, the production could be very high, but the expenditure, particularly on labour, was also very high, and the supplanting of the horse by the internal-combustion engine cut down the supplies of horse manure on which French gardening depended. It is probable that French gardening as known at the beginning of this century is passing into history and will not be revived, but today there are many successful commercial undertakings which have built into their management some of the best practices of the traditional British, French, and Dutch cultivations. Some account of modern intensive cultivation is given in a later chapter, but to retain a record of French gardening at its best is felt to be justified.

The wonderful crops obtained by the *maraîchers* could not be ascribed to their climate, neither could their natural soil be held accountable, because after a garden had been in operation for a few years the original soil was scarcely brought into use at all. In old-established gardens the whole of the open ground was practically a mass of light vegetable mould, a foot or more in depth, which was known as *terreau.* This mould was originally introduced into the garden as straw manure for hot-beds, but time and use broke it up and decomposed it so thoroughly that it became a light, rich, porous soil, and the use of this material for all cultural purposes made the *maraîchers* quite independent of the natural soil. So systematic did the manufacture of this artificial soil become that it was a regular stipulation that each might, on quitting his tenancy, carry his terreau to a certain depth away with him.

The Paris gardens were, as a rule, comparatively small, varying from half an acre to two acres in extent. Each was surrounded by stone walls which reflected the light and heat of the sun and kept out the cold biting winds of spring. For the earliest crops the soil was warmed by beds of slowly fermenting manure which retained some degree of warmth until the sun gained power in the spring. The plants on these warm beds were protected by frames or bell-jars which retained the heat and moisture. On cold nights and during hard weather these appliances were covered closely with straw mats to conserve the heat and to keep out frost. Later in the season the plants were grown entirely in the open air, but whether in the open or under glass they were never allowed to receive a check; they were kept steadily and rapidly moving from the time they were set out until the crop was gathered.

In these gardens it was an almost invariable rule to grow together on the same bed two or more crops, one of which was quickly ready whilst the other matured more slowly; by careful management this intercropping was accomplished without overcrowding and with very little inconvenience.

One of the most important factors of success in securing numerous and abundant crops consisted in giving the plants all the water they required during the growing season. Under ordinary cultivation very few plants get anything like the quantity of water they need to bring them to perfection, but in the French garden their requirements in this respect were most assiduously attended to. The earliest crops on hot-beds seldom needed watering, enough moisture being present in the manure to supply them, but later crops and those which stood in the open during the summer months were watered systematically; not in driblets, just to keep them alive during a drought, but in daily soaking showers. This watering was persisted in unless the weather set in really wet, occasional slight falls of rain being disregarded. The result was continuous and rapid growth.

It will thus be seen that the whole system was based on the provision of shelter and protection, warm and rich soil, abundant moisture and good drainage, with a careful arrangement of inter- and successional cropping.

Only a limited range of crops was grown in one garden, and by devoting himself entirely to these the gardener became super-skilled in producing them. In the particular kind of French garden which was imitated in so many places in England the production of early salad crops, followed in summer by cantaloup melons or cucumbers, was made the principal feature.

The arrangement of the garden was planned so that the whole area was used to its utmost capacity for the production of crops in regular sequence, without waste of time, labour, or space. It was divided into equal sections, each of which would accommodate a certain number of frames or bell-jars. On some of the sections these appliances were placed over hot-beds, on others they covered cold-beds, whilst the remaining sections were planted with open-air crops. The hot-beds were put on a fresh section each winter, so that they passed regularly round the garden enriching the ground by their presence.

Large quantities of good straw stable manure, often as much as five hundred tons per acre, were used annually. In some of the larger gardens a light tramway was laid to facilitate the removal of manure, soil, and produce from place to place.

(The remainder of this chapter gives recommendations for the management of a French garden which, with slight modifications, are condensed from the original edition of this book. From this the grower may gain some insight of the art of the older intensive producers.—Ed.)

Water. A practically unlimited supply of good water is essential to French gardening. The numerous and abundant crops which are produced by this system depend for their rapid and perfect growth upon ample supplies of moisture—indeed, the close planting and intercropping which is so marked a feature of the system could not possibly be brought to a successful issue without the assistance of regular and copious waterings. To make this possible, a system of pipes is laid in the earth for the conveyance of water, with hydrants or stand-pipes at suitable intervals, so that every part of the garden can be conveniently watered. In very hot dry weather it is not unusual to use as much as 20,000 gallons of water per acre of garden in one day.

Preparation.

The French gardener's year has been said to begin in September, when seed is sown for the lettuce and cauliflower plants which are wintered in frames and under cloches, and by that time all the preparatory work should be either completed or in a very forward condition. Actually, work on the land should have been in hand for many weeks or even months. The right management of the previous crop is often part of the preparation. For instance, thorough manuring of land, with liming if necessary, before taking two or three crops of radishes in succession, is a good preparation for the beds which are to carry the seedling crops in frames through the winter. The repeated cultivations in summer between crops of radishes give a good incorporation of the manure.

It is very risky to start this intensive work on land freshly broken from pasture without taking at least one preparatory crop and such measures as may be needed to clear the site of wireworms, which are most likely to be present on new land.

Instructions for the preparation of seed-beds, sowing, and transplanting, will be found in Chapter VIII, to which the reader is referred. Some of the seedlings are transferred to cold-beds, where they are enabled to pass safely through the rigours of winter under the protection of frames or cloches, which in periods of severe cold may be covered by straw mats. There is no particular difficulty in successfully raising and wintering plants suitable for forcing, but care and attention to detail must be continually exercised. The beds, both for sowing and transplanting, must be in proper condition and the dates of these operations duly observed. Overcrowding must never be permitted. Diseased, weak, or doubtful plants must be rigidly excluded, and all faded or decayed leaves removed as soon as seen. The plants must be grown as hardily as possible and whilst being protected from sharp frosts must not be allowed to suffer from want of daylight through any protective covering being left over them too long.

Plant Raising.

A. **Cauliflower.** Two or three sowings of cauliflower are made from the end of August to about the end of September. For these earliest batches, which are used for setting out in warm and cold frames after cabbage lettuce and on the cloche bed after the first batch of cos lettuce, a quick-heading compact variety should be selected, the large kinds not only taking longer to mature but for the earliest supplies are not appreciated on the market so much as the medium-sized ones.

Good strains of All the Year Round, Early London, and Feltham Forcing suitable for this autumn sowing are available. The seed may be sown in the open ground or in frames where the lights can be placed in position if the weather is cold and wet. About 1 oz. of seed is used for the area covered by six lights.

Before the seed is sown, the seed-bed may need to be watered to encourage even germination and strong growth.

Early in October the first lot of plants will be ready to prick out into their winter quarters. For this purpose a bed must be got ready to take as many frames as may be necessary to hold the required number of plants at 3 in. apart.

The site should not have been dunged for some time and any residue of manure should by cultivation have been well mixed into the soil to help form a good rooting medium. Superphosphate and sulphate of potash, each at 1 oz. per sq. yard, may be broadcast over the surface and lightly forked in before the final raking. When level press with the firming board, after which prick out the plants. If the soil is moist, as it should be, no watering will be necessary, but if dry, water lightly to give the plants a start. When they have got root-hold they will require no more water all through the winter; in fact, the grower must strive by all the means in his power to prevent unduly moist conditions, as damp is more harmful than cold, and must be carefully guarded against.

It is the practice with some growers to prick off into pots. The site in the frames for these is levelled and 60-size pots are stood close together and filled with screened soil. After removing all surplus soil from the surface of the pots by lightly stroking with a board the seedlings are put out, one per pot. This avoids root disturbance when planting time comes round.

As soon as the plants are pricked out put the lights on and keep close for a few days. After this give all possible ventilation when the weather is suitable, even to the extent of removing the lights during mild fine periods. Keep covered when rain threatens, but admit plenty of air by ventilation at the bottom of the light. Grow plants as hardy as possible and do not coddle.

If from any cause there are any serious losses amongst the wintered plants, sow again in January, on a hot-bed. As soon as the seedlings can be handled, prick out on a bed with a mild warmth, and gradually harden.

B. **Cos Lettuce and Forcing Cabbage Lettuce.** During the first week in October sow both cos and cabbage lettuce for growing on warm manure beds. Use Lobjoit's Green Cos and Gotte à forcer cabbage lettuce. In this case the seed is sown under cloches,* in the following manner: a seed-bed is prepared, care being taken that the terreau is moist, because lettuce plants should, if possible, be raised without watering. As many cloches as are necessary for the seed to be sown are put on the bed, gently pressed, and lifted away again. Each will have made a circular depression, and within this ring the seed is sown, thinly, lightly covered with compost, pressed down with the firming board, and the cloche replaced. Although late in the season, the sun is still hot in the middle of the day, and the cloches must be covered with mats from about 11 to 2 o'clock or the soil may get too dry and the sowing prove a failure.

In four or five days the seedlings will appear. About three or four days afterwards—just as soon as they can be handled—they are pricked out under cloches, thirty plants to each, taking care to keep them quite 2 in. from the rim, so that the leaves as the plants grow, may not touch the glass and get frozen, Fig. 31.

Forcing cabbage lettuce remains under the cloches, without air, until wanted for the hot-beds. Cos must be given air on all

* In this section on French Gardening the term cloche refers to a bell-jar.

mild days, and should be transplanted again towards the end of November, fifteen to a cloche.

c. **Hardy Cos and Cabbage Lettuce.** Seed of hardy lettuce, which are intended to stand unprotected in open beds through the winter, is sown about September 14th. As soon as the seedlings can be handled they are pricked out 2 in. apart on a nursery bed covered with terreau. About the end of October they are planted out at 1 ft. apart in a sheltered and well-drained position. Slugs and birds must be guarded against. When the ground is dry in February or March hoe well. The cabbage lettuce should be ready in April and the cos early in May.

FIG. 31. Lettuce pricked out under bell-jars

Lettuce Mildew and the Preference for Cloches. Cloches have one big advantage over frames for protecting lettuce during winter, in that these plants are liable, especially under damp, cold conditions, to be attacked by mildew. When this disease gets amongst the plants it is very destructive, often sweeping away an entire batch. When cloches are used the area of attack is kept within much narrower limits than if the plants are in a frame.

Protecting the Plants from Frost. Every care must be taken to protect from frost the seedlings which have been set out in their final quarters on hot-beds or in the cold-frames. When severe frost threatens, dry litter should be scattered, three or four inches deep around and amongst the cloches, and up to the top of the frame board, and the mats should be laid on so that they not only cover the top but also reach the ground on either side. In laying on the mats, particularly if the weather is stormy, they should overlap with the exposed edge facing to leeward, or in the direction opposite to that from which the wind blows. Laid in this way and fastened down on the windward side high winds do not disturb them, whereas if these precautions are neglected the gardener may some morning find the mats scattered about the garden. The litter amongst the cloches must be removed as the weather gets milder, otherwise it would tend to hold excessive moisture, besides being an obstruction to light. In very keen frost the mats must only be removed for a few hours in the middle of the day. Constant watchfulness is required to ensure that the plants escape freezing and yet are grown hardily.

With seedling lettuce and cauliflower in cold-frames which are being held for planting in spring, whilst giving full protection against rain and snow, some ventilation is an advantage. In frames on raised beds good plants have come through severe spells of frost with a crack of air all the time at the bottom of the light, supplemented by extra air at the top when the days were sunny. Take care to close the lights if the snow is drifting.

Intercropping is an essential feature of French gardening, and it is by this means that the numerous crops which are so marked a feature of the system are obtained. But the experienced grower recognises that the possibilities of intercropping have strict limitations, and whilst striving to get the utmost which the soil is capable of yielding, he is very careful to avoid overcrowding. His ideal is to get not only quantity but quality also. It may appear to be a simple matter to grow together quickly and slowly maturing crops, and so obtain two or more from the space usually occupied by one, but this kind of thing is easily overdone. When too many plants are contending together for light and air, as well as for food and moisture, the gardener will find, in spite of care and attention, that the produce will not develop into the choice specimens he is anxiously hoping for, but comes poor and weedy and of comparatively little value.

For this reason beginners are urged carefully to carry out in their entirety the directions which follow as to times for sowing and planting, distances between the plants, and other similar details. There is no claim made that these instructions cannot be improved upon—the experienced gardener must use his own judgment in the matter—but as every detail has been tested and proved to work successfully it is advisable that the beginner should follow the instructions very closely.

Hot-beds may be started at various times throughout the winter months, but it has been found, by practical experience, that the second week in January is a good time to begin, and the dates of sowing have been arranged with this time in view.

Manure for making hot-beds should be brought into the garden at convenient times from the end of September until the beds are started. It is stacked in long, narrow, high ridges, with a sharp-pitched top to throw off rain. When the hot-beds are made equal quantities of the newest manure and that which had been stacked the longest are mixed together, and it is found that the heat produced by this mixture is milder and more lasting than when fresh manure is used alone. Where tree-leaves are easy to obtain in quantity they may be substituted for about half the quantity of manure in making the hot-beds, and will give equally good results.

The quantity of manure required for the early hot-beds on ½ acre of French garden, and for raising seedlings in spring, is about 70 to 80 tons. Of this, about one-half should be accumulated by the end of December, and the remainder brought in during January, but if there is any uncertainty about getting the fresh manure when it is wanted, it would be much better to have the whole quantity stacked beforehand than to run the risk of the beds being delayed through waiting for the manure. A further 30 to 40 tons will be required by the beginning of April, if hot-beds are to be used for cucumbers and melons.

The manure from stables where corn-fed horses are bedded with straw is preferred, though the former prejudice against peat, sawdust and shavings is not justified.

In an established French garden the soil which is solely used for making seed-beds, covering hot-beds, and for surfacing all beds before plants are set out is made from exhausted hot-bed manure. This is repeatedly turned, beaten about and broken up, and finally passed through a screen to free it from lumps. It has then somewhat of the appearance and character of fine leaf-mould. The results from the use of this material are all that can be desired. Seeds germinate in it quickly, evenly, and strongly; seedlings lift with a mass of fibrous roots, and plants grow quickly and mature early.

After the first season the old hot-beds will put sufficient of this material at the disposal of the gardener, but as a preliminary it will be necessary to procure some substitute. Where manure from old mushroom beds can be obtained it would answer the purpose admirably.

The mixture or terreau, if suitably moist throughout, should be made into a large ridge, with a sharp-pitched top to throw off rain. If rather dry it should be left spread out until well moistened by rain, then ridged up. It will then be ready to use at any time for the purposes mentioned above.

Hot-beds for Frames. In mid-November the prepared decayed manure or terreau for topping the beds should be laid

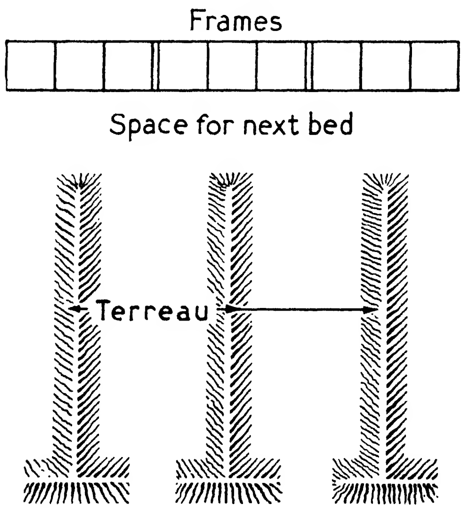

FIG. 32. Preparation of hot-beds

on the section they are to occupy, in ridges about 3 ft. wide and 2 ft. 6 in. high, each ridge coming opposite the centre of the position to be occupied by a frame. The ridges should stop 6 ft. from the north end of the section, so as to leave room for making the first bed, and extra compost should be put at the south end of the ridges to afford sufficient to cover the last bed. If there is any likelihood of frost when the compost is wheeled out long manure should be laid over it.

A week or two previous to commencing the hot-beds, the section intended for them should be covered a few inches deep with long manure, so as to prevent the ground from getting frozen. Before the bed is begun all necessary material should be collected and placed close at hand, so that when a start is made the work can proceed expeditiously.

In beginning to make the bed, lay across the north end of the section two rows of manure—one of new and one of that which has been stacked for the longest time. Alternate forkfuls of each of these rows is shaken out, and laid in position about 9 in. thick; this is beaten down with the back of the fork and then another 6 in. or 9 in. is put on top of it and also beaten down. As the work

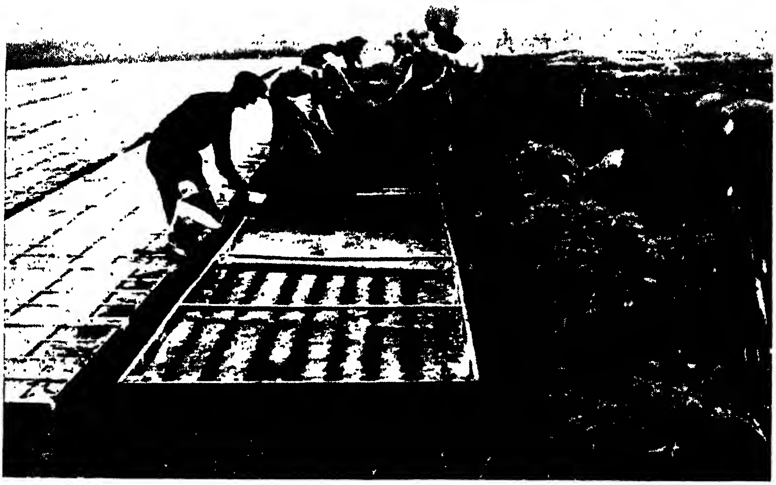

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FIG. 33. Preparation of hot-beds. Note stacks of terreau to right

proceeds the manure is trodden down firmly and evenly, and hollow places are levelled by laying in a little more manure. In January the manure bed should be finished at about 15 in. deep. In February 12 in. and in March 9 in. will be sufficient. These are minimum depths, calculated for economy in the use of manure.

The first portion of the bed laid down should be of such a length and width as will allow the manure to extend 9 in. beyond the frames all round. As soon as the first strip is ready the first row of frames should be put on, straight and level, and perfectly square with the section. Some trouble should be taken over this, as the first row forms a guide to the remainder, and no margin is allowed for careless fixing. When all are on the bed they should be true and square with one another. The same pains should be taken in levelling the frames, by standing on each corner to get them solid, and packing manure under the feet of the frame until the level is satisfactory. When finished the whole should present an even surface, and if properly placed on the bed they will retain this level to the end, but if insufficient care is exercised they will sink in some places and rise in others, which besides having a slovenly appearance will often cause rainwater to drip inside the frame, and so spoil the crop.

Having fixed the frames, throw inside terreau from the ridges, until there is a depth of about 4 in. all over the manure; then make all level with a fine rake, and remove all lumps. Put on the lights and cover with mats, then proceed to lay down the manure for the next row of frames. This is joined up to the first bed of manure, no gap intervening, so that when finished one large bed covers the whole section. This keeps the heat in better and allows the frames to be set closer together, 10 in. only being allowed for walking space between two rows of frames.

The work should be so contrived that the portion of the bed for one row of frames is finished and covered before being left at night. This is of importance at this time of the year, when there may be rain or snow for days together; if this occurs when the beds are left uncovered they will be spoiled.

Sowing and Planting. In two or three days after the first bed is covered the manure will begin to get warm, as may be seen by the moisture on the glass. Then is the time to sow and plant. Take off the lights and sow radish seed broadcast, *very thinly and evenly*, all over the bed. Use the variety Short-top Forcing. Follow this by sowing carrot seed, Amsterdam Forcing, on the same bed and in the same way. Cover thinly with dry sifted terreau, and press all over evenly with the firming board. Then plant the forcing cabbage lettuce from under the cloches on the same bed, five rows under each French light and five plants to a row. The row at the south side of the frame should be set further away from the board than that at the opposite side so as to enable sufficient direct sunlight to reach the plants. Do not use plants with dead or damaged leaves.

The beds are sown and planted as they are made and become warm; by this method the crops mature in regular succession.

When all the section is filled, and the beds are all sown and planted, the outsides of the frames must be banked up and the pathways between filled with fresh manure, almost to the level of the lights.

Routine Work. Cover the lights each night with mats and uncover each morning. In performing this operation roll up each mat tightly and lay it along the woodwork where two lights join. Here the mats are out of the way and cause very little obstruction to light. As soon as the radishes show, give air by raising the lights slightly on the side opposite that from which the wind blows. If the radishes near the outsides of the bed move slowly it is due to the cooling of the manure at that part, and when this occurs pull down the manure on the outside and bank up with some fresh. If the radishes in any part appear to be drawn it will be caused through too much heat, and a little more air must be given, but this must be done with caution, as much ventilation is not good for the forcing cabbage lettuce. Look through the frames occasionally and remove any decayed leaves which may be seen amongst them.

Some radishes should be fit for gathering about four weeks after sowing; if the bed is warm the whole should be cleared away by the end of the fifth week, and this will be to the advantage of the carrots, which by this time will be showing all over the bed. So far no watering has been necessary, the manure having given off sufficient moisture for all the requirements of the plants, but after the radishes are gone the bed may need watering, unless the weather has been wet, in which case it will be damp enough. If water is needed choose a mild, dull day, and about midday lift off the lights separately, give water through a fine rose, and replace at once. Try to avoid watering until the lettuce is cut. The lettuce should be ready for market about six weeks after planting.

When the lettuce are gone, clean the beds well, removing any weeds, leaves, or old roots which may have been left behind; thin the carrots in any places where they may stand too thickly. Then plant the cauliflowers, four to each light, so that they stand about 2 ft. apart both ways; water thoroughly, put on the lights, and keep closed for two or three days.

From this time forward air and water must be given in constantly increasing quantities. The beds must never be allowed to get dry and ventilation must be gradually increased until the plants are thoroughly hardened. Early in April the frames and lights can be removed altogether to the section intended for melons or cucumbers.

The carrots should be ready for market early in May. Pulling should not be begun until the bulk are ready and then the bed should be cleared as the pulling proceeds, no small ones being left to get larger, as they would be in the way and would probably only make useless fibrous roots. Those too small for market should be thrown away.

When the carrots are gone hoe the bed all over and water well. The cauliflowers need careful watching, and whenever a head appears break a leaf over it to keep it clean and white. Water freely. Cut as soon as ready, as if overlooked only one day they may get too open and become spoiled, especially if the weather is warm. They should be cleared about the middle of June, when the bed is immediately hoed over and planted with other crops, as described later.

Alternative Methods. The foregoing scheme of cropping has been much used for this class of produce, and with proper attention to details found comparatively simple and easy to work. There may, however, be special circumstances which would make it advisable to get a particular crop earlier or in greater abundance than is here provided for, and where this is so the work must be arranged accordingly. If carrots are wanted in the early part of April the bed should be made up in the middle of December and the same routine followed, except that radishes should be omitted, lettuces planted a little further apart, and cauliflowers not set out until the beginning of March. Another method is to make up the bed on the first of January, take a crop of radishes, and after clearing the bed sow with Half-long Forcing turnips, which in turn would be followed by early self-blanching celery and endive. Turnips usually sell well and realise good prices early in the season; it is also wise to include turnips in the series, because if the soil is cropped continuously with carrots it will, after a few years, begin to yield inferior crops. For sowing the turnips make a square lattice of laths, forming 4 in. squares, just large enough to fit easily into the frame under one light. In the middle of each place where two laths cross fix a peg or cork to project one inch. Lay this frame or lattice on the soil, pegs downward, and press down. In each hole made by the pegs drop two or three turnip seeds. Rake gently to fill the holes, water, close the lights, and keep close until the seedlings show, then thin to single ones and give plenty of air. Keep the soil moist; in fact it is necessary to water daily. Take the lights off entirely whenever the weather is favourable. The turnips will be ready for sale about the end of April.

Another combination is to sow with carrots in mid-January and over-plant with lettuce from a mid-October sowing. Two weeks before the lettuce is due to be cut turnips, Half-long Forcing, are sown 10 in. apart between the lettuce. Two seeds are dropped in each hole made in the centre of a square of four lettuces. Five cauliflowers are then planted to each light, which then has four crops in it. After the lettuce has been cut the frames are watered and kept well aired. Watering may be needed about every three days. After mid-April the frames may be removed altogether. The turnips are the next crop to be cleared, followed by the carrots. Keep the cauliflowers well watered. They should clear in early June, when the beds may be cleaned for taking a crop of lettuce or self-blanching celery or both may be used interplanted.

Hot-beds for Cloches. Hot-beds for cloches are begun as soon as those for frames are finished—about the last week in January. All the operations are the same as for the frame beds, except that compost is spread on the manure 3–4 in. deep before the cloches are put in position. A garden line is used so that the cloches are set out neatly, true and straight. Arrange in three rows with the cloches in the middle row falling between those in the two outer rows, the rims about 1 in. apart, and a path about 18 in. wide between each three rows.

As soon as the first bed is ready the three rows of cloches are placed upon it and the next bed is proceeded with, in the same way as for frames. By the time the third bed is finished the first will be warm and ready for planting.

Remove the cloches, then sow carrot seed only *very thinly*, cover lightly, and press down with the firming board; set a cos lettuce in the centre of each cloche, and three cabbage lettuces at equal distances apart, around the cos. On one side of each cloche a depression is made in the soil to give air to the plants, and this will suffice until the weather becomes warmer; then air must be given by tilting the cloche on the cloche-peg. Water will be required as the plants increase in size and the need for it becomes evident. *For the production of good cos lettuce air must be given freely on every occasion that the weather will permit.*

As soon as planting is finished on the last bed cos lettuce are set in the open in the spaces between the cloches. This is shown in Fig. 34 below, where the cos under the cloche is numbered "1" and those between the cloches "2" and "3". The protection of the cloches combined with the warmth of the bed preserves these plants in the open from injury. The whole are covered closely with mats each night.

The cabbage lettuce should be ready for market by the second week in March. Then the carrots are thinned where they stand too thickly, and the south side of each cloche is whitened to prevent the unimpeded rays of the sun from scorching the tips of the cos leaves under the cloches.

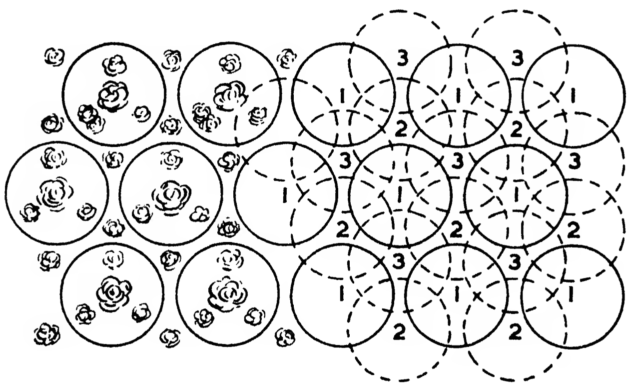


FIG. 34

The first batch of cos, numbered "1", should be ready early in April. When these are gone the cloches are put over those numbered "2" (shown by dotted lines in Fig. 34) and a cauliflower is set where "1" stood in the first and third rows, leaving the middle row free. When those numbered "2" are gone the cloche is put over "3". When this last batch are gone, which should be early in May, remove the cloches to the sections where they are required for covering French beans, tomatoes, vegetable marrows, etc. Clean up the bed and water thoroughly and frequently.

The carrots should be ready early in June and the cauliflowers towards the latter part of the month, and immediately afterwards the bed is lightly forked over and replanted with lettuce or radish.

A much earlier crop of cauliflowers can be obtained if a cauliflower is planted under each cloche instead of a cos lettuce. Three cabbage lettuces are planted round it, and the general treatment is the same as in the preceding scheme. The cauliflower crop finishes in the open.

Cold-beds or Cold-frames form a connecting link between the hot-beds and the open-air beds, and ensure a continuous succession of supplies. They are manipulated in much the same way as the hot-beds and may be used for similar crops, but these of course come later. Cold-beds are extremely useful where it is difficult to obtain sufficient manure to make up many hot-beds, or where the demand for very early and high-priced produce is limited. But on the whole, although the gross returns are lower, the comparative net profits are higher than from hot-beds, and this is a very important consideration to those with a small working capital.

For this work the ground should be dug and left rough in the early part of winter. On the 1st of January, or as soon afterwards as the ground is clear of frost and snow, level the soil, set the frames in position, and, if the land has not been worked into a high state of fertility, old mushroom-bed manure or a prepared compost of loam and peat or well-rotted dung may be spread in the frame and levelled.

If kept closely matted up for a few days, it will be found that the temperature in the frames is sensibly warmer than that outside. Then is the time to sow and plant. Cabbage lettuce, cauliflowers, stump-rooted carrots, radishes, turnips, and peas will all give very satisfactory results, under this treatment.

Warm-beds for Melons and Cucumbers. During April the cauliflowers and carrots growing on hot-beds under frames are gradually hardened, until by the middle of the month the frames are removed entirely and the crops are left standing in the open. The frames thus released are taken to the section intended for melons or cucumbers. Here warm-beds are made by putting hot manure in shallow trenches and covering with soil; the frames are put on these beds and the plants set out at once, yielding fruits during the summer. The frames are removed from the melons about the end of July or early in August, according to the weather, and cauliflower plants are then set on the beds amongst the vines, thus giving an autumn crop of cauliflowers to follow melons. Cauliflowers are not planted on the cucumber beds unless the crop shows signs of being over early.

Open-air Crops. As soon as the last of the forced crops are gone, the hot-beds—now cold—are cleared of all roots and leaves, lightly forked over, raked level, and at once planted with crops which will mature before the following winter. These consist in the main of self-blanching celery, celeriac, endive, cos lettuce, carrots, and cauliflowers, any of which may be intercropped with such quickly maturing subjects as radishes, spinach, cabbage lettuce, or turnips.

In addition to those grown on hot-beds and on cold-beds under glass, and those which follow these on the same beds in the open air, there are crops grown on ordinary well-manured soil entirely in the open.

The following account gives some idea of the cropping which is possible in a well-managed French garden. The yields were obtained from one such unit of a quarter of an acre during one season. The land was divided into ten interchangeable sections each 36 ft. by 30 ft. 6 in.

In calculating the quantity of saleable produce obtained from the garden a sufficient allowance has been made for waste. The average crop per light from frames is four bunches each of radishes and carrots when these are grown with lettuces, or eight bunches of radishes when carrots are omitted. When they stand thicker than this the lettuces are injured. Turnips grown alone yield seven bunches per light. The number of roots to a bunch is twelve each of radishes and turnips, and fifty of carrots, in two "half-bunches" of twenty-five, tied together.

No. 1 Section. Open-air bed, planted at the end of October with hardy cos lettuce, 1 ft. between the rows, 10 in. between the plants in the row. About the middle of February radishes are sown thinly between the rows of lettuce, every fifth row being left vacant for convenience in gathering. There are 96 doz. lettuces planted, of which 80 doz. may be expected to pass through the winter successfully. The radishes should yield 50 doz. bunches. After the bed is cleared of lettuce it must receive a good dressing of manure from section 5 (where some of the hot-beds are by this time done with); this is forked in and the section is planted at the beginning of June with early celery, in rows 12 in. apart, by 8 in. apart in the rows. This should be ready for sale in the latter part of August, and there should be 110 doz. saleable sticks. When the celery is gone clear the ground of rubbish, hoe well, and sow radishes, which will be ready in October, and should yield 140 doz. bunches.

No. 2 Section. Open-air bed, planted at the end of October with hardy cabbage lettuce, at the same distances apart as cos on No. 1. Radishes also same as No. 1. This section will be cleared early in May, and in the middle of the month well-prepared forward tomato plants are set out in double rows 2 ft. apart, 3 ft. between the double rows, and 18 in. between the plants in the rows, which run north and south. Each plant is covered with a cloche as it is set out. The section will accomodate 252 plants, which will, if properly treated, bear ripe fruit early in July, and should yield, at a low average, 4 lb. per plant.

No. 3 Section. Open-air bed, planted at the end of January with hardy cabbage lettuce (from cloches) 14 in. apart in each direction. Early in March cos are planted in each direction between the cabbage lettuce. The latter should be ready to cut towards the end of April and the cos by the latter part of May; they should each yield 47 doz. saleable heads. When the section is cleared of lettuce, manure from the hot-beds on section 5 is spread, the soil is forked over and levelled, and endive is planted in rows 15 in. apart, 1 ft. between the plants in the row. A fortnight afterwards, late celery is set between the rows of endive, 9 in. from plant to plant. The saleable yield should be 55 doz. endive and 86 doz. celery.

No. 4 Section. On this section four pits are made in November, for forcing rhubarb, seakale, and chicory. Each pit is 34 ft. long and 4 ft. wide. Two and a half pits are used for rhubarb, one for seakale, and a half one for chicory, which proportion roughly represents the comparative demand. Planting is begun at the end of November, one quarter of the space allotted to each being planted every week so as to secure a regular succession. Six weeks may be reckoned as the time necessary to complete each crop, and if the warmth of the bed is maintained by renewal of the fermenting material at each fresh planting, three crops can be taken before the end of April. The number of roots required for the season are—1,500 rhubarb (set as closely as they will stand), 3,600 seakale (4 in. apart), and 750 chicory (6 in. apart). The produce to be expected is 600 doz. bundles rhubarb, 900 lb. seakale, and 750 lb. chicory. This is a fair average yield when good roots are well grown. Each quarter of the pits should be boarded up so as to prevent light getting to the other parts when one is being manipulated. At the end of April the pits are dismantled, the ground levelled, and manure spread and dug in. About the end of May early celery plants are set out as described for section 1. Immediately the celery is cleared away fork the soil over and plant Batavian or other winter endive 15 in. apart each way. These would produce 40 doz. saleable.

No. 5 Section. This section is used for hot- and warm-beds on which all the tender spring-sown plants are raised in frames. As the plants grow and need more room this can be provided by removing some of the frames from the cold-beds on section 8, early in April. The frames are removed from early celery plants early in May, but protection is given at night by a covering of mats, laid over a framework of laths. When tomatoes are planted out, the manure of the beds on which they stood is taken to No. 1 section. All vacant frames are taken to sections 9 or 10, to be used for cucumbers or melons. As soon as all plants are gone spread remainder of manure, dig in, and plant celeriac, 1 ft. apart each way. These will give say, 76 doz. roots.

No. 6 Section. This section is covered at the beginning of February with a hot-bed for cloches, made and planted in accordance with the detailed instructions given on pages 97, 98. It should produce 100 doz. cabbage lettuce, 100 doz. cos lettuce, 14 doz. bunches carrots, and 22 doz. cauliflowers. After these are all cleared away the bed is forked over and planted with second early celery, 1 ft. between the rows, 10 in. apart in the rows. There should be 90 doz. saleable sticks. After celery, clear and hoe the bed and sow radishes, which will yield as No. 1 section.

No. 7 Section. The hot-bed on this section, which is commenced in the middle of January, accommodates 18 frames, in 6 rows of 3 frames each. Four rows are manipulated in accordance with the detailed instructions given on pages 94, 95 and produce 12 doz. bunches radishes, 12 doz. bunches carrots, 70 doz. cabbage lettuce, and 11 doz. cauliflowers. On two rows there are no carrots, and turnips are sown after lettuce; these produce 12 doz. bunches radishes, 34 doz. cabbage lettuce, and 16 doz. bunches turnips. After all these, second early celery is planted, as on section 6. When celery is gone the manure is removed, broken up and sifted. The soil is then forked over so as to be in readiness for wintering next season's plants, and seed for them is sown on beds made at one end of the section.

No. 8 Section. Cold-bed made early in January for 18 frames. Sow with radish and plant with cabbage lettuce, 25 to a light; as lettuce come ready plant cauliflowers, 5 to a light. These should produce 18 doz. bunches radishes, 104 doz. cabbage lettuce, and 21 doz. cauliflowers. As soon as cauliflowers are off, lightly fork over and sow broadcast short horn carrots on 4-ft beds, with 1-ft. paths between. On one corner of this section the Batavian endive plants should be raised for setting out on section 4. The yield of carrots should be 18 doz. bunches.

No. 9 Section. Here cauliflower and lettuce plants intended for the earliest crops of the following season pass through the winter on cold-beds, protected by frames and cloches. As soon as the plants are removed, the section is prepared with warm-beds and planted with melons, according to the directions given on page 195. About the middle of July cauliflowers are planted amongst the melon vines, four to a light. There should be about 180 good melons and 15 doz. cauliflowers. The cauliflower plants for this section can be grown on No. 2 section, at the foot of the tomato plants.

No. 10 Section. Radishes are sown on this section in the middle of February on 4 ft. beds, protected by a light covering of litter. This is removed as soon as the seed has germinated, but replaced each night and when the weather is severe. The yield should be 120 doz. bunches. As soon as the radishes are cleared warm-beds are prepared and planted with cucumbers, according to the directions on page 175. The yield should be 80 doz.

For full detailed instructions respecting the intensive culture of any of the crops mentioned above, and not already fully dealt with, the reader is referred to Part II of this book, "Details of the Cultivation of Vegetables", where every item is treated separately under its own head.

FOR FURTHER READING

QUARRELL, C. P. *Intensive Salad Production.* Crosby Lockwood, 1934.

CHAPTER XI

MODERN INTENSIVE CULTIVATION WITH THE AID OF DUTCH LIGHTS AND CONTINUOUS CLOCHES

MODERN intensive horticulture has seen the Dutch light grow in popularity as a cheaper medium for covering ground than the older English and French lights and in a similar way the continuous cloche has virtually ousted the bell-jar.

The Dutch-light cultivation, which developed in the Westland in Holland, was introduced to the East Riding of Yorkshire about 1933 by Dutch settlers and has now become a feature of the horticulture of that area. Other parts of the country have also seen the development of intensive cultivation based on the use of Dutch lights. The Dutch growers who settled in Yorkshire first used the range of crops with which they were familiar, but of these some, like early spinach and endive, found a slow market and they are now little grown there. Systems of intercropping which some had used gave way to ranges of single crops. The foundation of the industry is early lettuce, May King, in frames, in the open or in unheated Dutch-light structures, in the latter case to be followed by a summer crop of tomatoes. Cauliflowers and, to a less extent, Dutch red cabbages also play an important part in the cropping of some holdings. Other crops, including flowers, are also grown.

The Dutch almost invariably use a double-light span. In many parts of the South of England where the Dutch light has replaced the French light in intensive cultivations the lights are more often used on single-light span ranges. Fig. 35 gives some idea of the relation between the systems of cover used and the quantity of lights needed on a given area.

The Dutch light is a versatile subject, being used on movable frames, on fixed frames, alternating between frames ("flat glass") and structures, or being clamped together to erect temporary structures. It is used for propagating seedlings, to nurse young crops which will be finished in the open, or to protect early crops of vegetables, flowers, or strawberries. Its fullest use is seen in the "structure", which is probably the cheapest glasshouse which can be erected, and there the alternation between a spring crop of lettuce (mid-winter planted and grown cold) and a summer crop of tomatoes cleared by late September or October is a widely used standard cropping, though many growers have other useful alternative crops.

The original "skeletons" of the structures were of wood, but shortages of this material led to the use of concrete (which has the disadvantage of thick, light-obstructing members) and metal. Fig. 36 shows such a wooden structure, but as this book is not

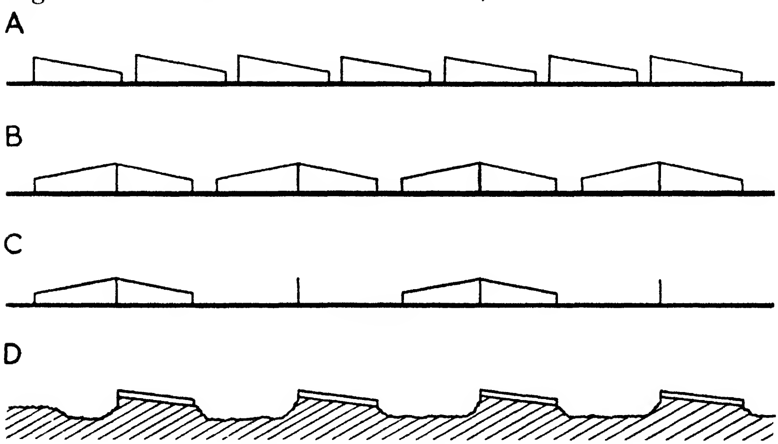


FIG. 35

A. Single-light span ranges; 24 in. paths; approx. 2,400 lights per acre
B. Double-light span ranges; 24 in. paths; approx. 2,800 lights per acre
C. Double-light span ranges; alternate range cropping; approx. 1,400 lights per acre
D. Raised earth banks; 13 ft. from rear of one range to rear of next; approx. 1,300 lights per acre

primarily concerned with crops in greenhouses the use of these houses will not be taken further here.

Whether used solely on frames, or alternating between frame and structure, it is essential that the fullest use be made of the lights—they cost money and when stacked unused they represent money lying idle. Excessive handling should also be avoided. If a given area of land is fully covered with lights (Fig. 35B), then as a crop is finished it is usually necessary to clear the lights in order to work the frames for the next crop. (They may, of course, be moved to a structure as part of a policy for full use.) Where a system of cropping alternate ranges is adopted (Fig. 37), then a considerable saving may be effected, as the clearance of lights from one crop simply entails their transfer to an adjacent strip across the alley.

The pathways between the frames should be not less than 24 in. wide; many growers prefer them to be 27 in. wide. Principal roadways must permit ease of access for conveying dung, lights, produce, etc. Provision must be made for the transport of the lights and for this a special barrow or truck may be used; it is desirable that these should have pneumatic tyres. Sometimes a light tramway is run through the holding and this is probably ideal for the larger grower. For a small place a strong stretcher is a useful piece of equipment; it should have legs 9 in. to 12 in. high.

[*By courtesy of West Dock Timber Co. Ltd.*

FIG. 36. A well-planned Dutch pattern holding. Note central roadway and outside land to which glass may be transferred

With a double-light span it is usual to have a long prop for the lights, which when in use permits work to be done in the frame without lifting the light away. In order that work may proceed during inclement weather it is possible to erect a structure covered by tarpaulin, to protect the worker. Such shelter is easier to erect for a single-light range than for a double-light range, but a light triangular wind shield may be rested alongside a propped-up light.

CROPS FOR DUTCH-LIGHT CULTIVATION

A section of the frame ground will be used for nursery purposes, raising lettuce and cauliflowers for transplanting to other frames or the open. One ounce of lettuce seed will sow 25 Dutch lights and the plants from these will stock about 600 lights. For cauliflowers sow 1 oz. to about 16 to 20 lights.

Lettuce. Good varieties are May King, for growing to maturity under glass, and Attractie or the very similar variety

Northern Queen, to grow until partly mature under cover and finish in the open. Plant out 9 in. by 9 in., 20 plants per light, or 9 in. by 8 in., 24 plants per light. Should intercropping with cauliflowers be intended plant only 18 plants of lettuce per light. The planting is done in December and January.

Water may be needed to finish the crop in good condition under glass and for this sprinkler irrigation (see p. 126) from the ridge of the frames is very useful.

[By courtesy of West Dock Timber Co. Ltd.

FIG. 37. Alternate range cropping

Lettuce *Attractie* which is maturing in the open has been forwarded under lights which are now finishing an earlier crop of *May Queen*

Cauliflowers. These are sown in September or October and pricked out. The final quarters may be as an intercrop amongst lettuce, 5 or 6 plants per light or in the open. *Varieties*—Snowball, Early London, Pioneer, Veentje, Remme, Lecerf. 6 oz. of seed will provide plants for one acre of open land.

Radish. Sow under lights from the end of January, using about 4 oz. seed to 25 Dutch lights. Give no water during growth or secondary roots may give the crop a "hairy" appearance. On warm sunny days give plenty of ventilation. *Varieties*—Short-top Forcing, French Breakfast Forcing, Sparkler.

Carrots. Sow January or February, using 1 oz. seed to about 16 or 18 Dutch lights. Some growers sow in November, but there is little gain over a January sowing and under some conditions rapid growth of a "blanket" of algæ may prevent the seedlings pushing through. *Varieties*—Primo, Ideal, Early Nantes.

Turnips. Sow in February or March (not earlier), drilling in rows 4 in. apart, and thin out to stand 4 in. apart in the row or space out with a marker as directed on p. 96 or broadcast 1 oz. to 30 Dutch lights. *Variety*—White Milan.

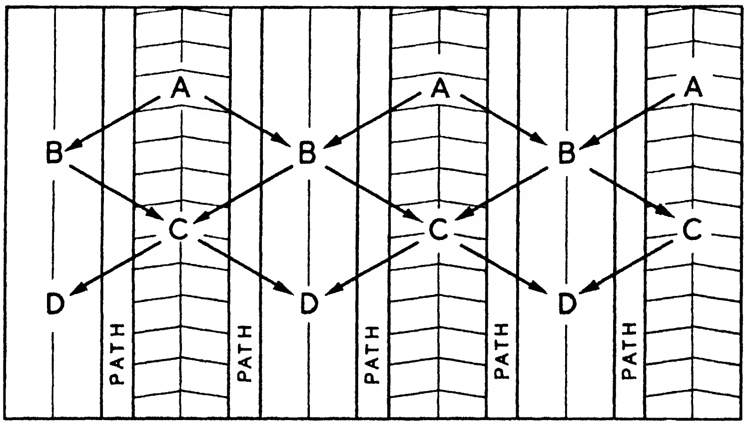


FIG. 38. Alternate range cropping, showing the movement of the lights between crops of:

A. Lettuce
B. Self-blanching celery
C. Cucumbers
D. Late lettuce

Spinach. This may be sown broadcast, using 1 lb. seed to 20–25 lights. The crop from this thick sowing must be cleared quite young when only a few leaves have been made. *Variety*—Reliance.

Self-blanching Celery. If the weather is right, seed may be sown in the frames in early March, or if heated glass is available, sow in boxes the third week in March. Prick out by mid-April and plant out in the frames at the earliest opportunity 9 in. by 8 in. The lights nurse the crop for five or six weeks and then the crop is finished in the open. Give abundant water. 1 oz. of seed will provide enough plants for ⅓rd acre.

Dwarf French Beans may be sown in early April and nursed until the lights may be removed, or sow in early July, covering in September to finish the crop. *Varieties*—Masterpiece, The Prince.

Sweet Corn. Sow late March or early April amongst a lettuce crop. When the latter is clear, clean up the frames, lift the lights as the corn needs more head-room, and remove altogether when safe from frost.

Marrows. Sow in gentle heat in mid or late March, sowing in boxes. Plant out one or two per light after clearing over-wintered seedlings. *Variety*—Green Bush.

Melons	see p. 195
Cucumbers	,, 172
Tomatoes	,, 244

Mint. Plant as directed on p. 198 in beds suitable for covering with a range of lights which are placed in position the following January.

Flowers and strawberries may also enter into the cropping scheme.

CROPPING SEQUENCES

Radishes or spring lettuce may be followed by melons, cucumbers, marrows, or possibly tomatoes.

An intercrop of lettuce and cauliflowers may be followed by an autumn crop of lettuce.

Nursery frames may be used for a crop of celery, which in turn may be succeeded by a late crop of lettuce.

Intercropping of cauliflowers amongst radish or carrots, or lettuce amongst carrots, demands land in a very high state of fertility. The single crops are easier to handle.

The steady succession of crops needs careful working out, but timetables must not be too rigid, as weather is unpredictable and a late winter can upset one's plans very considerably.

Fig. 38 gives an example of how the alternate range system of cropping keeps the lights in use with the minimum of labour in moving the lights.

That part of the frame ground which is to be used for the winter nursery should be quite clear of crop by July in order that work may go ahead in preparation of the land for the seed-bed, If dung has been given to the earlier crops rotary cultivation will mix this well into the soil for the seed-beds.

CONTINUOUS CLOCHES

As with Dutch lights, the cloches may be used for growing crops to maturity or for forwarding some which will finish in the open, as well as providing nursery protection for beds of seedlings.

The more practical patterns of continuous cloches have a span of about 2 ft. The grower has a choice of several forms and in making a decision should bear in mind the ease with which they may be assembled and erected, as well as convenience of handling when in use.

The glass fits close to the soil, so some mud-splashing is inevitable, and this, together with the growth of algæ, will exclude much light if the glass is not cleaned as and when necessary.

[*By courtesy of "The Grower"*

FIG. 39. Intensive cropping on a Land Settlement Association estate, using cloches, Dutch lights, Dutch light houses and permanent houses

Alternate-strip cropping is a feature of cloche work and is the basis of economical use of time and labour. Strips of ground, wide enough to accommodate two lines of cloches, are marked out with 24-in. paths between. One strip is covered with cloches, whilst

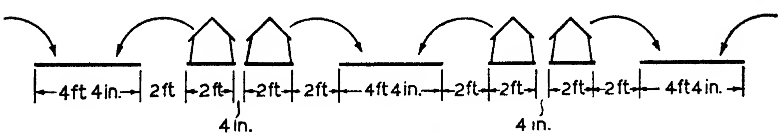


FIG. 40. Alternate-strip cropping with continuous cloches

the other is either being prepared for cropping or is finishing in the open a crop which has been started under the cloches. This alternate strip system allows for the minimum of handling of the cloches, as removal from one crop simply entails their transfer across the path to the next site. For some cropping sequences it may be necessary to use three strips.

It may be that a strip is planned to receive unused cloches, stacked on end, for some time during the summer. Such stacking strips are apt to become weedy if left for any length of time, so see that the site is clean before stacking is done. With cloche cropping it is imperative that high standards of cultivation be maintained, as weeding is not easy amongst crops under cloches.

Cultivation of uncovered strips may be done by spade or by small market-garden tractor. The rotary cultivators are particularly useful for this work.

If the soil has a good supply of water before the cloches are placed in position, the crop, whether sown or planted, should get

[*By courtesy of Messrs. Harry Ferguson Ltd., Coventry*

FIG. 41. Tractor cultivation between strips of continuous cloches

well established and in most cases be sending roots beyond the sides of the cloches before there is need for extra water. Once the roots grow beyond the glass the crop will benefit from either rain or overhead irrigation, the latter applied right over the cloches.

The range of crops mentioned as being suited to Dutch-light cropping can be grown under continuous cloches. Full use of the cloches throughout the summer, by growing cucumbers and melons, is possible, but the work entailed with these crops often limits their production on a commercial scale. It may at times be more economical to stack the cloches unused for a few weeks.

In the home garden the cloche may find a wide range of uses, not only in the vegetable garden but also with flowers and strawberries. In urban areas they are useful in keeping clean some of the autumn and winter vegetables—endive, parsley, and spinach beet.

Fig. 42 illustrates a good example of the benefit derived by a crop of lettuce from the protection of cloches in N.E. England.

As mentioned on p. 75, wider glazed structures covering strips of ground up to 4 ft. wide are sometimes called cloches. These may

FIG. 42 Lettuce, two rows on left *Attractie*, rest of crop *May Queen*

Sown under cloches: 12 October 1951. Planted: 6 March 1952. Cloched: early April. Photographed: 17 May 1952

not lend themselves so easily to alternate-strip cropping and when using them it may be wise to allow for a full cover of the ground, apart from the paths. Under these larger cloches water is needed to bring most crops to maturity, as rain is of little benefit when such a wide span is covered.

A number of cropping combinations may be worked out. The grower should keep record of times of sowing and planting, periods when covered by cloches, and times of harvesting, so as to assist in adjusting the programme in future years. The following is an example of a cropping sequence for use on two adjacent strips. It will, of course, be necessary to have provision for raising the crops which are planted and not sown where they are to crop.

	Strip A		*Strip B*
Aug.	Lettuce — sow		Lettuce — sow early in month
Sept.	,, — cover with cloches		,,
Oct.	,, — cut	Stack	,, — cut in open
Nov.	Cultivate		Cultivate
Dec.			Cover ground with cloches
Jan.			Lettuce — plant as soon as weather permits
Feb.			,,
Mar.			,,
Apr.	Tomatoes—plant and cover with cloches		,, — cut
May	,,		Cultivate
June	,,		Cucumbers or melons — plant and cover
July	,,		,,
Aug.	,,		,,
Sept.	,, — finish under cloches		,,
Oct.			

The broken line shows the use of the cloches

The intensive use of land with the help of either Dutch lights or cloches demands an adequate staff of trained labour so that the work may be done at the right time. If certain operations are missed they are missed for a whole year. Make out a programme but one which is not too rigid; departure from the programme should be caused only by crop failure or unusually severe weather.

CHAPTER XII

WEEDS AND THEIR CONTROL

WEEDS compete with the crop for water, food, and light. This competition is very important in the early stages of a plant's life and every effort should be made to keep the crop clean during the first stages of growth; later in life most crops will hold their own against the weeds and even suppress their growth. Some weeds are hosts for the troubles of some economic crops, e.g. shepherd's purse for club-root disease; many weeds for aphides; and groundsel for lettuce mosaic.

Some kinds of weeds are widespread in their distribution whilst others may be only locally serious. The perennial weeds are usually only serious troubles to the vegetable grower when he is faced with the problem of cleaning some neglected land, though some deep-rooted weeds may seek to encroach from neighbouring hedgerows or waste land. Some of the commoner perennial weeds are Couch Grass, *Triticum repens*; Bind weed,*Convolvulus arvensis*; Common Horsetail, *Equisetum arvense*; and Dock, *Rumex crispus*. Of the many annual weeds Chickweed, *Stellaria media*; Groundsel, *Senecio vulgaris*; Annual Nettle, *Urtica urens*; Black Nightshade. *Solanum nigrum*; Red shank, *Polygonum persicaria*; and Fat Hen *Chenopodium album*, are all widespread; Spurrey, *Spergula arvensis*, can be very troublesome on soils deficient in lime.

If steps are not taken to control weeds before seeding, the subsequent build-up can be very rapid, and on intensively cropped land the opportunities for cleaning between crops are often inadequate. The population of dormant weed seeds in the soil may be vast—on some fields sample counts have shown the presence of over 100,000,000 seeds per acre in the top six inches of soil. This is more than 2,000 per sq. foot. Following the shedding of the seed it is distributed by cultivation to various depths in the soil, and there it may lie dormant for various periods until brought close enough to the surface to germinate.

Cultivations are the most important agencies for weed control, such perennials as couch grass or docks may be worked to the surface and allowed to dry, when they may be collected together by harrows and burnt. With annual weeds every opportunity should be taken in the interval between two crops to encourage weed seeds to grow. Before the seedlings flower they should be ploughed under, bringing other seed to the surface to germinate. The longer the fallow which is possible between crops the fewer weeds which should be found. Where the cropping is not intensive, possibly only one crop per year, weeds should not be a serious problem, as there is ample opportunity to keep them in check. Some weeds, e.g. annual nettles and chickweed, produce viable seeds at a very early stage of growth, and some very hardy weeds like groundsel and annual meadow-grass may produce viable seed throughout the winter if the weather is mild.

Once the crop is sown or planted cultivations between the rows may be done by hand or mechanical hoes. For market-garden work the wheeled push-hoe is a valuable help. Hand-hoeing is necessary between the plants in the rows and for this the short-handled "onion" hoe is useful (Fig. 7A.).

For some early-sown, slow-germinating crops it is at times the practice to mix the seed with that of a quick-germinating crop like lettuce, in order that the rows may show up quickly and permit early cultivations.

WEED-KILLERS.

Non-selective. On very neglected land *Sodium Chlorate* is often useful. Applied as a 10% solution it kills all growing plants, but persists in the soil for some time, so it is necessary to rest the site after treating—at least three months, or six months if little rain falls for some time. Apply dry at 2 cwt. per acre or more for a bad infestation of deep-rooted weeds like bindweed or horse-tail. Sodium chlorate is not poisonous, but clothing and similar materials which have been wetted with a solution of this, then dried, are rendered highly inflammable.

Selective. *Sulphuric Acid* (Brown Oil of Vitriol, 77% H_2SO_4) is recommended for use as a spray before the emergence of the seedlings through the soil. This may be on seed-beds of root crops and any others where the weeds have appeared well in advance of the crop. Use 13 galls. B.O.V. and 1 pint of a "wetter" to 87 galls. water, making 100 galls. dilute acid. After the crop is through the ground most crops are as susceptible to the acid as the weeds, but onions, after they are 3–4 in. high, may be safely sprayed. The growing point is well sheathed by the older leaves and is unharmed and the upright waxy leaves shed most of the acid. Similarly, leeks which are at least 3 in. high in the seed-bed may be sprayed, and after being planted they will, *whilst still small*, stand one application. The weeds charlock, black nightshade,

[*By courtesy of "The Grower"*

FIG. 43. Application of sulphuric acid to onions by the "Bean" (see Fig. 8)

spurrey, and veronica are killed by a spray at 7–9% concentration; chickweed, fat hen, groundsel, and annual nettle need a concentration of 10–13%. To get a good kill of mayweed, fumitory, and knapweed use a 10% spray with the addition of a "wetter". About 100–200 galls. are needed for an acre. B.O.V. is corrosive to metal, clothing, and skin, and must not be used carelessly. When using beware of spray drift on to nearby areas of susceptible crops. According to the scale of working the acid may be applied with a knapsack sprayer, with a hand-operated barrel-pump, or by a larger mechanically operated pump. A barrel-pump mounted on a tractor drawn trailer with a spray-bar of 10–12 ft. is particularly useful for most market-gardeners. The operators should be provided with protective clothing, cream or vaseline for hands and face, and goggles for use when handling the concentrated acid. Provide good washing facilities. ALWAYS ADD ACID TO WATER, NOT WATER TO ACID.

Carrots and parsnips are tolerant of certain *light oils* when they have developed two to three true leaves; carrots are the more tolerant; parsnips are less so. *Tractor vaporising oil* is used in this way, but there is a risk of the crop being tainted if the roots are thicker than a pencil. When the carrots are to be pulled young for bunching one of the proprietary *white oils* which are sold as weed-killers should be used. Where the sprayer can be adjusted to spray only the actual rows 30–40 galls. per acre should be enough; the inter-row spaces may then be hoed. If it is desired to spray all the area 60–80 galls. will be needed.

DNBP is a dye with the full title of 2 : 4-dinitro-6-secondary-butyl-phenol, which, whilst toxic to many weeds, has been found to cause little injury to some varieties of peas if used at the right stage—i.e. when the crop is about 4 in. high.

Use $1\frac{1}{2}$–2 lb. DNBP per 100 galls., applying with a temperature over 55° F.; if temperature is over 60° F. use the weaker solution. About 80–100 galls. per acre are needed. The most susceptible weeds are charlock and shepherd's purse; the most resistant are annual nettle and "red shank". The variety of pea Lincoln is most resistant to the spray; most varieties for picking green are somewhat susceptible and any which are making soft growth may suffer some injury. For most market-garden cultivation it is probably best to grow peas in wide-spaced rows and rely on cultivation for control of weeds.

Certain other weed-killers are widely used on corn crops and for controlling weeds in lawns. These include the growth-regulating substances or so-called hormones. At the time of writing there is none which can be advised for use on vegetable crops.

Whilst appreciating all the help which may be obtained from weed-killers the grower must not overlook the importance of thorough cultivations at the right time. With any uncropped land take all opportunities to get rid of weeds which may be present, and on any cropped land control weeds before they compete with the crop.

FOR FURTHER READING

LONG, H. C., and BRENCHLEY, W. E. *Suppression of Weeds by Fertilisers and Chemicals.* Crosby Lockwood & Son, Ltd., 1946.

H.M.S.O. *Weed Control in Onions and other Horticultural Crops by Sulphuric Acid Sprays;* Leaflet 309.

CHAPTER XIII

IRRIGATION

THE grower who is independent of natural rain for the water supply to his crops has a distinct advantage during periods of drought. The intensive cultivator who chooses a well-drained site on account of the facilities offered for early work will find that crops on such sites are liable to suffer during periods of drought unless extra water is available. Without an irrigation supply the grower who is clearing a crop in summer is often unable to prepare the site for the following crop if the weather is very dry, or if the ground can be worked it may be too dry for the new crop to get well established. Thus, irrigation can help in the cultivation of the land, help the germination of the seed, and help to grow the crop.

Irrigation can also help in the harvesting of some crops—it may be impossible to pull salad onions and carrots from some soils in dry weather without breaking them, but by watering the land twenty-four hours before pulling it will be found that they come cleanly from the soil. (Do not water carrots more than twenty-four hours before pulling or many of them may split.)

In this country it is generally accepted that overhead sprinkling is the most satisfactory way of applying water. The actual application may be by spray lines or rotary sprinklers. The lines apply the water in a series of rectangles and the rotary sprinklers in a series of overlapping circles. The former method is the more popular.

Water Supply. Assess the quantities of water which are likely to be needed in the course of the summer. Some areas will need none. Some are likely to need several applications. Water to the equivalent of 1 in. of rainfall is 22,622 galls. per acre, and such a quantity is for most crops needed at one application. A really adequate supply should be available before the planning of an irrigation system is considered.

In many districts water is taken from an adjacent river or pond, but care must first be taken to ascertain that river water is free from injurious industrial effluents. Where no surface supplies can be used and underground water is known to exist a well can sometimes be sunk, possibly a shallow one, though it may need to go to a considerable depth. The advice of the Geological Survey*

(a)

(b)

FIG. 44. Overhead irrigation

(a). Spray lines
(b). Rotary sprinkler

should be sought for guidance as to possible supplies. Also consult the local authority, as it may be necessary to obtain permission before a deep well can be sunk.

Where no other supply is available it is at times possible to purchase water from a water company; this can prove expensive. If the water pressure from such a source is low it will be necessary

* H.M. Geological Survey, Exhibition Road, London, S.W.7.

to provide a large storage tank on the holding which can be filled at off-peak periods, and from the tank the water is passed to the land with the help of a pump.

Pumps. Where water is taken from a pond or river a portable pump is often used, though many growers prefer to build a permanent pump-house, if this can be done clear of floods. Where the holding borders a stream for some distance the use of a portable pump reduces the amount of distribution mains which are needed.

Fig. 45. Portable diesel engine and pump taking water from dammed-up stream to serve sprinkler in Fig. 44*b*

With a short lift of 15 ft. or less a centrifugal pump is most frequently used. Its power will depend on the work to be done; for a small area a single-stage pump is likely to be satisfactory, but it will be necessary to fit a larger one, say up to four stages, where very large volumes of water must be moved. For deep wells it is most likely that a submersible pump will be used. Consult an engineer who specialises in water supplies for guidance on what equipment is best suited to a particular case.

For a very small portable outfit taking water from a pond or stream the portable pump and motor are mounted on a small trailer. Some such outfits have piston pumps, which are quite satisfactory where there are no valves on the distribution system and the operation of the spray lines is controlled simply by the engine and pump.

Whatever the pump it should maintain an adequate pressure at all parts of the lines. At the stand-pipes there should be a minimum pressure of 40 lb.; more is desirable—up to 80 lb. per sq. in. on a large system.

The Power Supply is usually provided by an internal-combustion engine, and the diesel engine is the cheapest to run. Where a supply is near to hand the use of electricity may be considered; it is more convenient than other fuels. Electric motors are usually cheaper to install but more costly to run than are diesel engines.

FIG. 46. Diaphragm valves taking water from 4 in. main
Two valves are being used to enable a spray line to work on each side the main

Distribution. On a large holding permanent mains are usually laid down. In such cases careful attention should be given to their layout so as to provide efficient use of the spray lines. In a few instances it may be practicable to clear hedges so as to enable an orderly layout of pipes, but consider the drainage before deciding on this. Whenever possible place the permanent pipes above ground on concrete "dollies"; in this way leaks are easily detected and the system should be easy to drain before winter. These mains should be about 500 ft. apart, which allows for spray lines 250 ft. long.

Portable mains are sometimes used and in fact are usually an essential part of a system using rotary sprinklers.

Water is taken from the mains through valves which are connected to the spray lines by a short length of hose. The diaphragm valve is a good drip-free type.

The actual spray lines are provided in lengths of about 16 ft. They are galvanised. For use in lines of 200 ft. or more they should have an internal diameter of not less than 1 in. The lines are usually spaced about 40 ft. apart. This allows for a 20-ft. throw on either side of the spray line and, with a pressure of 40 to 80 lb. per sq. inch, gives a satisfactory cover of the ground. With the higher pressures the spray is broken up into fine droplets and is not thrown quite so far as with lower pressures.

Nozzles. Most irrigation lines for general use on field crops have nozzles fitted at 24-in. spacing and this is satisfactory for slow applications. At times, when there is a full cover of the ground with foliage, say for a crop like self-blanching celery, a speedy application may be practicable and lines with more closely spaced nozzles, spraying in various directions, are sometimes used.

Filtering the Water. Fine nozzles are easily blocked by sand or other small "foreign bodies", so adequate provision must be made to ensure that the water reaching the nozzles is free from such obstructions. In drawing water from a pond, etc., the water may be filtered by a screen at the end of the suction pipe. If the pipe is supported by a raft with the suction end about a foot below the surface it is clear of the mud and below the zone of duckweed and other floating objects. Water from a storage tank or reservoir may be filtered as it enters the mains. The spray lines may have cone filters fitted at the feed end and at their extremities may be fitted with flushing valves. By opening the latter for a few moments whilst the lines are in operation, any grit, etc. is flushed out.

Oscillators of various types are available. They are operated by the flow of water and rock the line from side to side, gradually watering over a rectangular strip. With very long spray lines they are less satisfactory and many growers prefer to rely on hand adjustment, moving the spraying position at intervals of about twenty minutes. An oscillator which stops working may cause flooding and puddling of the soil.

Use of Spray Irrigation in the Open. It is obvious that any crop which may be suffering during a drought will benefit from irrigation, but some, the leafy crops, need an adequate supply throughout their growth, whilst others do not need much water at certain stages and certainly should not then receive anything to supplement the natural supplies. That splitting of carrots is usually associated with heavy rainfall as they approach maturity is well recognised. Observant growers consider that cauliflowers which have started to curd should not receive irrigation—this crop does, however, need ample supplies of water whilst growing.

The salad crops are particularly responsive to irrigation. High-quality salads are crisp and this condition is only possible when the cells of the plant tissue are turgid through having an adequate

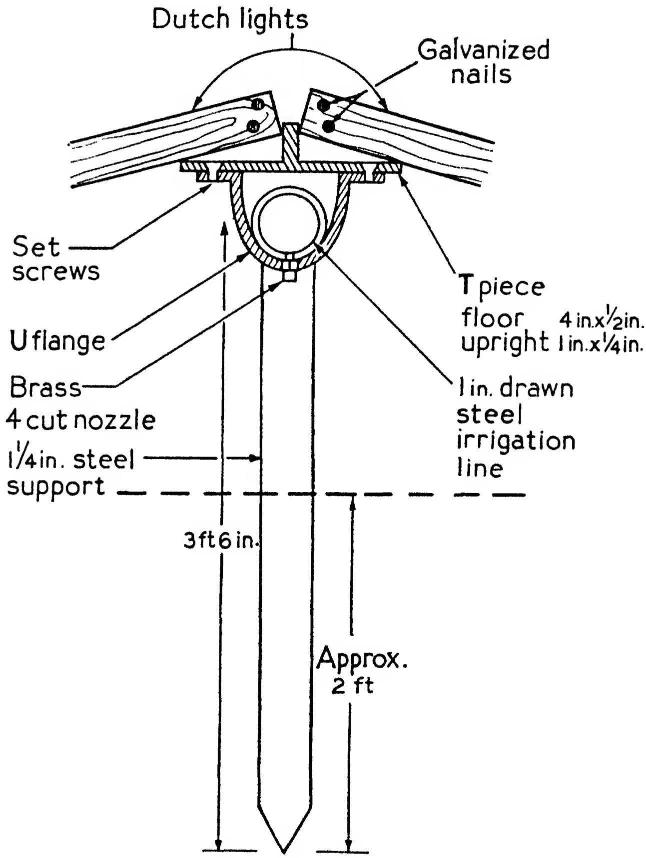


FIG. 47. Support for central ridge of double-light span frame, fitted with irrigation line

water supply. A crop like self-blanching celery needs copious supplies of water, and for such a crop it is well worth while to erect the spray lines and leave in position until the crop is cleared.

An example of intensive cropping which could be possible in many years only with the help of irrigation is the following:—Lettuce planted in February was cut in mid-May. It was interplanted with Primo cabbage in mid-April. Following the clearance of the lettuce the cabbage was irrigated; it was cleared in mid-June, with the land being irrigated, ploughed, prepared, and sown to lettuce again by the end of June.

The rates and frequency of watering have been entirely empirical for a long time, but work at Rothamsted research station is providing a scientific basis on which the grower may rely in order to determine the application of water.

When a soil has all the water which it can retain against gravity it is at "field capacity" and is in that condition at the end of winter. That water reserve in the soil may be regarded as a "bank balance". During the summer months the loss of moisture by evaporation from the soil and transpiration from the crop usually exceeds the gain from rainfall. From weather records over a long period the "average potential transpiration" has been calculated and mapped for this country. Sunshine is the predominant factor affecting this loss. From the "average potential transpiration" and corrections based on the actual sunshine record for a given area and period the estimated irrigation need can be calculated and so, for given intervals, say monthly, the depletion of the "bank balance" may be worked out and the correct amount of water added in irrigation. The rainfall of the same period is reckoned as an addition to the account.

At some period in most summers when the losses by transpiration exceed the gains from rainfall the water reserve falls to such an extent that if extra water is not given the crop will suffer. Much land in the south-east of England has an "expected need for irrigation" in nine years out of ten. In the cooler and moister areas of the north-west the demands on an irrigation system may not be so great, but in all the important market-gardening areas an irrigation system is likely to be used in most years. The keen grower should watch the developments in the investigations on this work.

In the majority of cases a slow or moderately slow rate of application is desirable so as to minimise the "run-off". Coarse, open sands take the water most readily, but even for them the application is better if slow. An inch of water in about eight hours is a satisfactory rate of watering and for use on bare soil or very small seedlings should rarely be exceeded. With a full cover of the ground by foliage it may be reasonable to give the water more quickly. Water to the equivalent of one inch of rainfall

(22,622 galls. per acre) will saturate about 10–12 in. of dry soil.

Use of Spray Irrigation in Frames. Fig. 47 shows how double-light frames may be fitted with an irrigation line in the supporting ridge. The nozzles for this work differ from those used in the open ground. They are "4-cut" nozzles and give a circular spray. They are spaced at 7-ft. intervals along the line and the circles of watered ground overlap. There is usually some irregularity in the distribution over the area watered by one nozzle, but the overlap may be expected to make up for much of this. Such a method of watering is unsatisfactory as soon as the crop reaches a height which interferes with the throw of water.

FOR FURTHER READING

MINISTRY OF AGRICULTURE AND FISHERIES. Bulletin 138: *Irrigation.*

MINISTRY OF AGRICULTURE AND FISHERIES. Technical Bulletin No. 4: *The Calculation of Irrigation Need.*

RUSSELL, E. J., revised by RUSSELL, E. W. *Soil Conditions and Plant Growth.* Longmans, Green & Co., 1950 (see Chapter XX).

PART II

DETAILS OF THE CULTIVATION OF VEGETABLES

IN the following section when giving recommendations for cultivation, the manuring rates are usually in tons or cwts. per acre for all crops which are widely cultivated on a field scale. For the less popular crops rates per square yard may be given for the fertilisers. The conversion tables on p. 308 should be consulted where necessary. The recommended rates are generally suited to land which is in reasonably good heart. Analysis may suggest the need to increase or even decrease some of the applications.

Where seed rates are given they are invariably at rates per acre, though the number of yards of row to be sown with an ounce of seed may sometimes be mentioned.

On the subject of varieties no attempt has been made to give comprehensive lists with descriptions of characters. There are many synonyms of variety names in use today. Sometimes in the hands of a careful selector a strain of a variety may be developed in such a way as to justify the use of a new varietal name. The varieties given here have proved satisfactory over a wide area.

For some crops the systems of planting and training may vary in different parts of the country. The methods described should give general satisfaction.

ARTICHOKE (GLOBE)

Cynara scolymus

THE Globe Artichoke is a handsome and imposing plant. It is grown for the flower heads, which form large scales, with thickened, fleshy bases, and when young are used as a vegetable. As it is not much in demand in this country very little space in the garden need be given to it. It should not be grown commercially unless there is fair certainty of selling the crop. It is perennial, but may be grown as an annual or biennial at discretion. A deep rich, moist soil, with full exposure to sunshine, is necessary for the production of the finest flower heads. In summer it needs plenty of moisture, but a well-drained soil is necessary for successful over-wintering in severe seasons.

Although the globe artichoke is readily raised from seed this method of propagation is seldom followed, because of the loss and disappointment occasioned through many of the seedlings coming poor and worthless. For this reason suckers are generally used in forming a new plantation; these are shoots produced underground around the neck of the old stool, and their use is the only means by which the different varieties can be relied upon to come true to their proper character.

[*By courtesy of P. Clarke*

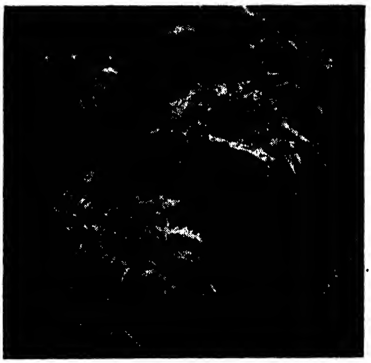
FIG. 48. A good plot of globe artichokes

Should seed be used it may be sown in the open in March, but it is best to sow in gentle heat in February, pot the seedlings singly, and grow on in a cold-frame, hardening them off so that they can be planted out in April. In due course select the best plants to use for sucker production.

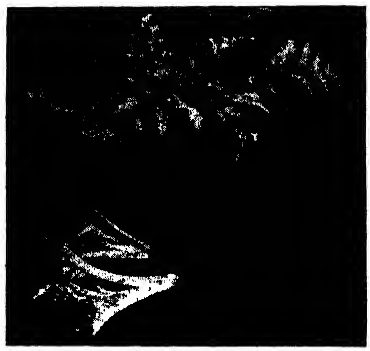
When the plantation is to be formed in the customary way from suckers, a batch should be planted in March, and for succession again in May; by this means, if there is already a batch of established plants, a supply of heads can be had in succession for several months. The season extends from July to October.

Strong suckers are taken off with a strong sharp knife when about 9 in. high, having a bit of root or heel of the old stool attached. These are planted singly, 4 in. deep, in rows, 2 ft. between the plants and 4 ft. between the rows. The soil should previously have been prepared by ploughing or deep digging and liberal manuring. After planting, the suckers should be trodden in firmly and well watered. Afterwards the ground should be kept thoroughly clean, by hoeing or cultivating. Whilst the plants are making growth a quickly maturing catch-crop may be taken from the ground about them.

The heads must be cut as soon as fully developed, whilst still young and tender; if left on the plant too long they get hard. If they cannot be used immediately, instead of letting them remain on the plant the heads should be cut with a long stem and stood



(*a*)



(*b*)

[*By courtesy of "The Grower"*

FIG. 49

(*a*). Spring growth appearing from plants which have been protected during winter by a mound of earth
(*b*). Shoots dug out for propagation; best shoots left to flower

in water in a cool shady place, where they will keep for a considerable time if the bottom of the stem is cut off as it shows signs of decay. The main heads will grow much larger if the laterals, or side heads, are taken off by the time they are an inch through. However, if the main head is cut as soon as ready, the side heads will make a saleable size. If when cutting the heads of the earliest batch the stems also are cut to the ground a number of new suckers will appear; the weakest of these should be removed, and the remainder will then produce a late crop. A late planting in June will crop in September or early October.

The plants will continue productive in good soil for five or six years, but as a rule three or four years is long enough for a plantation to stand without renewal. After the first year or two the number of growing shoots should be reduced in spring. The shoots removed may be used for replanting.

Chards. These are the summer suckers of the artichoke when blanched, and are then scarcely to be distinguished from cardoons. Early in July the plants in a bed which is to be scrapped and which have already produced a crop of heads are cut down to within a few inches of the ground, the surface soil is stirred and mulched, and copious waterings given. Numerous shoots will spring up, the weakest of which are removed, and by the end of September those remaining will be ready for blanching. For this operation chooses a fine day when the leaves and soil are dry. Draw the stems together and tie them with strong raffia; then put some dry hay or straw round the base of each plant and wrap up the stems with hay or straw bands, finishing by earthing up in the same way as celery. The blanching will take five or six weeks. Before hard weather sets in any still unused must be protected by litter, or may be lifted and packed in sand in a dry cellar. This practice of blanching is only to be adopted in the last year of the bed's existence.

Manures. A liberal dressing of stable manure and plenty of moisture are the principal requisites for the production of good heads; supplemented by fertilisers as follows: 1 oz. sulphate of potash, 2 oz. superphosphate, per sq. yard; 1 oz. sulphate of ammonia per sq. yard, applied when growth is beginning in the spring.

Varieties. The Purple Globe and the Green are the two most popular varieties in British gardens, the former being perhaps the more popular of the two.

ARTICHOKE (JERUSALEM)

Helianthus tuberosus

ALTHOUGH this vegetable is more generally grown than the globe artichoke, and is more popular with the public, it usually meets with very indifferent treatment in the garden. It is very accommodating and will grow practically anywhere, and for this reason is all too often relegated to odd corners. Good marketable tubers can only be obtained by giving good cultivation. A well-drained open soil is needed. Harvesting the tubers in winter from a wet heavy soil is most unsatisfactory.

Jerusalem artichokes should be planted any time from February to April—the sooner the better, as the tubers begin to grow early and the plant is quite hardy. Set in rows 30–36 in. apart according to cultivation equipment, and 12 in. between the tubers, in ground which has been manured for a previous crop or has been given 20–25 tons dung per acre. The tubers increase in size as long as the tops are green. They are ready for use as soon as the tops die down in the autumn, and may then be lifted as required, being better flavoured when left in the ground than when lifted and stored. When lifting, care must be taken to clear the ground completely, as any left in will be troublesome.

Manures. 2 oz. sulphate of potash, 3 oz. superphosphate, per sq. yard before planting, and 1½ oz. sulphate of ammonia or 2 oz. nitrate of soda when the growth is a few inches high.

Varieties. The purple variety which was once the most generally grown has now been replaced by a white-skinned variety which is a distinct improvement on the old purple. There is also a smoother, less rugged form known by the name Fuseau.

ASPARAGUS

Asparagus officinalis

ASPARAGUS is a profitable crop when well grown. Under proper treatment it will thrive in any well-cultivated and moist soil, though a deep rich loam, inclining to sandy, is easier to work. At the same time excellent asparagus can be grown even on heavy clay soil, providing it is deeply worked and well *drained.* It is a crop which will pay for extra trouble at the outset, as it may then be expected to remain in profitable bearing for many years. The small-holder should not undertake to plant a large breadth without serious consideration, because several years must pass before any appreciable return for the initial outlay can be expected. A few beds may, however, be planted without much expense or any great encroachment upon the other work of the garden, and as these come into profitable bearing the area could be extended with safety, should the grower be satisfied with the results.

An asparagus plantation may be made by sowing the seeds where they are to remain, but it is more usual to transplant roots either at one or two years old. Growers raising their own seedlings usually plant one-year-old roots. Nurserymen often grow on to sell two- or three-year-old roots for planting in private gardens. Sowing on the site where cropping is to be done is wasteful of ground.

Raising the Plants. The ground in which the seed is to be sown should be rich and well prepared by deep working during the previous winter. This should be done early so that wind, rain, and frost may have full effect in rendering it mellow and friable. Previous to sowing, which should take place in March or early in April, when the surface soil is dry, the soil should be worked to destroy germinating weed seeds, and raked level and smooth. Seed should be sown very thinly in drills from 1 in. to 1½ in. deep and 1 ft. apart. After sowing, the seed is covered and firmed by treading or rolling. As the seed is slow to germinate it is a good plan to sow with it a few radish seeds; these soon appear and by marking the rows enable cultivation to be begun at once, so that weeds, which must not be tolerated at any time, have no chance to make headway before the seedlings show. After the seedlings are well up they should, where necessary, be thinned out by removing the weakest and leaving the strongest standing about 3 in. apart. When they are growing freely they should be dressed with a balanced fertiliser at 2 oz. per sq. yard.

During the summer, water should be given copiously in dry weather and the surface soil kept loose by hoeing, but this must be done carefully so as not to injure the roots of the plants, which run close to the surface. If the seedlings are treated in the manner indicated they will make good strong plants the first year and be ready to set out permanently the following spring. Strong, healthy plants of one year's growth, when transplanted, establish themselves readily and with more certainty and give better results than those of two years, whilst they are ready for cutting quite as soon.

Essential Points to be Observed in Forming a Plantation. The ground intended for the permanent plantation must be very thoroughly prepared in the preceding autumn or winter by double digging or subsoil ploughing and the addition of 25 to 30 tons to the acre of good manure, according to the class of soil. If it is very heavy its condition would be much improved by previously taking off a crop requiring manure and good cultivation, such as potatoes. It is of great importance that the field should be cleared of weeds, particularly perennial ones, before planting.

In most districts where asparagus is grown there are special local customs in the matter of planting, though in all districts some growers have their individual preferences. It is recognised that too close planting soon becomes unprofitable. It is possible at first to get more bundles per acre from close than from wide planting, but the sticks are neither so early nor so large; the whole ground soon becomes a solid mass of roots for which both moisture and nutriment are insufficient, and after a few years the shoots become gradually smaller and tougher, until finally the plantation has to be broken up because it has become unprofitable.

There are three common methods of culture. The older system of growing in beds of three rows is now rarely seen on commercial holdings. It involves planting in beds 3–4 ft. wide with 2-ft. wide alleys between. The second spit of the bed is liberally dunged. Three rows of asparagus roots are planted, so that the crowns are 9–12 in. apart in all directions. Soil from the alleys is thrown on the beds each spring, usually after the surface has been dressed with decayed dung.

Most asparagus is now grown in single rows and the following Evesham method is to be recommended even in private gardens. This practice is to plant in shallow trenches, 4–6 ft. apart. The crowns are spaced 12–14 in. apart in the row and are covered by 4–6 in. of soil. For two years the land is kept clean and well cultivated and in the third season, well before growth starts, soil from between the rows is thrown up into ridges over the crowns. These ridges are retained permanently, being renewed each spring.

A more recent development in Norfolk is to plant in furrows 15–18 in. deep and 4–8 ft. apart. The plants are set out 18–24 in. apart, or more for strong varieties. Only a little soil is placed over the roots in the first year. In the second year the trenches are filled so that the field is level. In the third year the rows are earthed-up.

In order to obtain the finest shoots wide planting should be the rule. In this case extra care should be taken in the selection of the roots, and when this is done and the plantation is supplied with sufficient moisture and assisted by judicious manuring, the effect of wide planting upon the size and number of the sticks is marvellous.

Asparagus tends to produce plants the flowers of which are predominantly "male" or predominantly "female". It has been shown that male plants usually give heavier yields than do the female plants, yet the latter often produce top-quality large-sized shoots. In England the plants rarely flower in the first year, so that selection according to sex is not usual.

Planting. When the plants are raised at home in the manner previously described only strong healthy yearlings which have three or four buds should be used, but when plants are purchased it is better to get them two years old unless there is some certainty that younger plants are strong and well grown. Planting should be begun at the time when growth is just beginning to show, at the end of March or early in April, a mild day when the surface soil is dry being the most suitable. The furrow where the plants are to stand should be about 9 in. wide and at least 6 in. deep. On the bottom of the trench fine mixed compost or old hot-bed manure may be spread about 1 in. thick and raised into a gentle mound about 4 in. high at each station for a plant, or a mound may be made of soil from the furrow. On each mound the roots of a plant are spread out, so that the crown is about 4 in. or 5 in. below the ordinary level, and the plant is at once covered up with 2 in. of fine weathered soil. When the whole of the trench is planted, the soil is sprinkled with superphosphate at the rate of 3 cwt. and sulphate of potash 1 cwt. to the acre, and it is then filled level with soil and pressed down moderately. The proper arrangement of the roots is one of the most important points in the planting of asparagus, as the ultimate success and duration of the plantation depends very largely upon the manner in which this is done. Most other mistakes may be remedied by after-treatment, but faulty planting it is impossible to alter.

The roots should never be allowed to become dry or exposed to parching winds whilst the work is proceeding; only a few at a time should be set in the trench before they are covered with soil, the remainder being kept covered with a damp sack.

When the planting is finished put a stake at each end of each row as a guide in cultural operations, and then rake the ground level. As growth becomes active 2 cwt. nitrate of soda to the acre should be given in two or three applications.

After-treatment and General Routine. Cultural work on the asparagus plantation during the first season consists in frequently stirring the soil, especially as soon as it is dry after rain, and keeping it free from weeds. Smaller crops, such as lettuce, onions, or radishes may be grown between the rows, but these catch-crops must never be of such a kind nor occupy the ground in such a way as to interfere with the welfare of the main crop.

If it is found that any of the plants are not showing above ground by the middle of June they should be replaced by strong growing plants of the same age, some being kept for this purpose in a reserve bed. These must be lifted carefully so as not to damage the roots, and on a cloudy day, watering in well afterwards unless it is rainy.

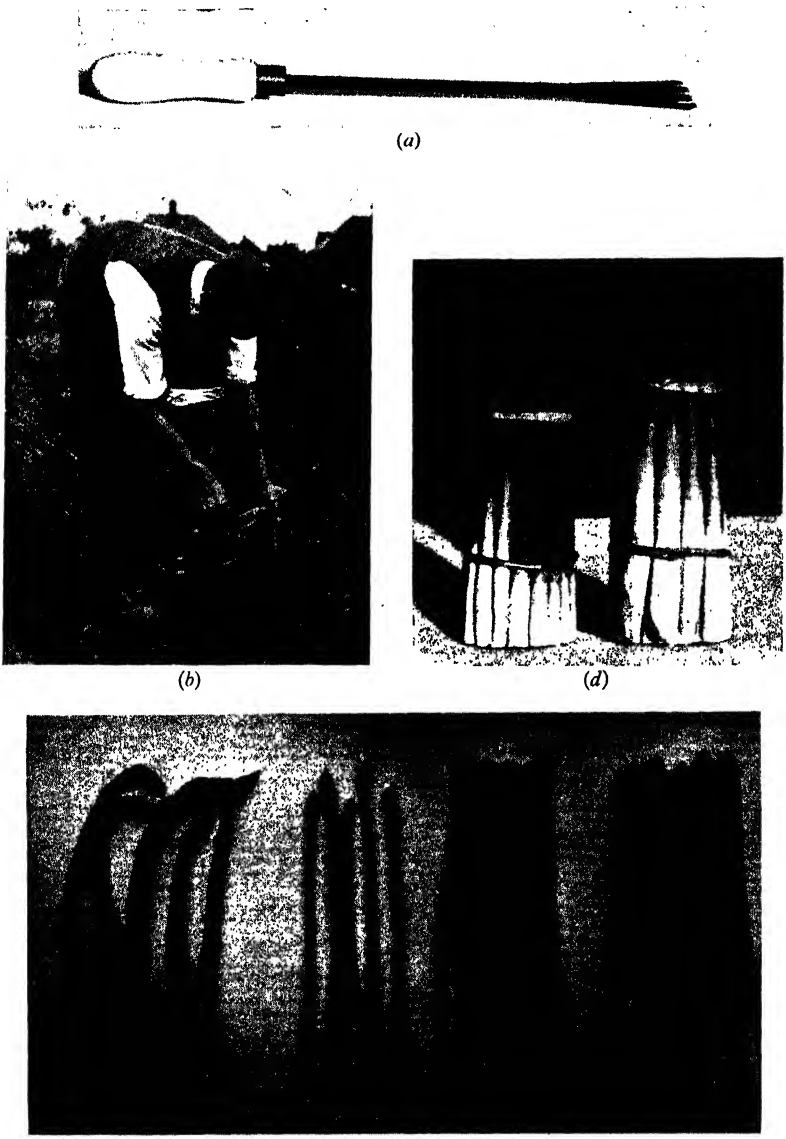
When the foliage begins to change colour in the autumn it should be at once cut down close to the ground. If left standing longer the berries ripen and the seed drops, with the result that the ground gets filled with seedling plants, which are more obstinate and difficult to get rid of than weeds. As soon as the foliage is cut it should be removed to an open place and burned, so as to destroy any injurious insects or fungi which may be present.

Even with the most careful planting blanks will probably be seen in a few places where the plants have died. The rows should be carefully examined in the autumn and all such blank spaces marked with a stake; in the spring these dead plants should be replaced. It is not an uncommon occurrence even in the best kept plantations for these blank places to occur here and there even amongst established plants, and if replacements are neglected for a few years the shortage of crop will form a considerable item; therefore a small bed of plants should be raised periodically for the especial purpose of replacements.

In the second season the treatment is practically the same as in the first. The ground is dressed with fertilisers and kept well hoed.

It is recommended that the spring application of fertiliser should be sulphate of ammonia at 2 cwt., muriate of potash 1 cwt., and superphosphate 4 cwt. per acre, harrowed in before growth starts. Many growers give 20 to 30 tons of well-decayed dung each autumn. During the summer the crop is kept clear of weeds. In the third and subsequent springs the fertiliser dressing should be 2 cwt. of sulphate of ammonia or 3 cwt. nitrate of soda, 6–8 cwt. superphosphate, and 1–2 cwt. muriate of potash per acre.

Where beds are being used, at the end of February all loose litter should be raked off, all weeds cleared, and the beds covered 3 in. deep with soil taken from the alleys; if the ground is heavy this soiling is best done in November, so that it will become friable by the influence of the weather through the winter. When cutting is finished the soil which was put on the beds is thrown back again into the alleys, and a dressing of suitable fertiliser given to encourage strong growth. The tops are then allowed to grow as they will, but weeds are kept down.



(c) [*Photographs by courtesy of L. F. Clift*

FIG. 50.

a. Asparagus knife, Worcestershire pattern
b. Cutting the crop
c. The grades—crooks, sprue, special, giant
d. Bundles

Where single rows are grown the soil between the ridges should be worked to a good tilth in early spring and in March or April earthed up over the ridges. These ridges weather down during the year and this spring work is an annual re-making. This earthing up may be by hand for the small grower or by plough on a large scale.

It must be appreciated that cutting asparagus involves clearing all young shoots as they develop, over a period of several weeks each spring. Extension of cutting too late into summer seriously weakens the crowns. Generous dressings of manure and fertilisers must be given annually in order that all possible growth may be encouraged after cutting ceases. An abundance of good foliage is needed to help maintain strong crowns.

Cutting and Bunching. If the plants have made strong, vigorous growth, cutting may begin in the third year, but for the first cutting not more than two or three shoots should be taken from a plant, and none after the beginning of June. In the following years cutting should finish by the second or third week in June at the latest; if the cutting is prolonged to a later period than this the crop of the following season is sure to feel the effect of it, and fewer sticks of poorer quality will be obtained than would otherwise be the case. When the crop is being harvested every shoot should be removed, no matter how small it may be. If these small shoots are left to grow they reduce the quality of the larger sticks by taking strength from the roots.

Cutting begins when the strong brownish-green tips of the shoots are observed to have pushed 3–4 in. above the soil. The asparagus knife is pushed into the soil obliquely and the shoot cut about 4 in. below the surface. This must be done with great care, so as not to injure the new shoots rising from the crown. The knife depicted in Fig. 50*a* is a pattern in common use in Worcestershire; other districts favour other patterns. Avoid cutting the shoots close to the crown.

The shoots are graded into four groups—"giant", "special", and "sprue", diminishing in thickness in that order, and "crooks", which though possibly of fair size are misshapen.

The market bundles vary with the district. Rectangular bundles of "hundreds" or "half-hundreds" are often used in Worcestershire, whilst Kent favours a round bundle weighing 1½ lb. in the early part of the season and about 2 lb. later on.

The "cradle" depicted in Fig. 51 is one of many similar devices used for making up the bundles quickly and neatly. The heads are laid in the recessed part of the front board, the stalks resting in the two curved boards, and the bundle is secured with two pieces of strong raffia. The base of the bundle is then trimmed off straight with a sharp knife, though sometimes only the longest of the sticks are thus shortened. Asparagus should be marketed immediately after cutting, as it soon deteriorates.

Forcing. There are numerous ways of forcing asparagus, all of which entail considerable expense and a long period of preparation of the crowns. Some systems involve lifting the crowns,

[By courtesy of L. F. Clift

FIG. 51. Preparing bundles using cradle

which are then packed closely on hot-beds, in pits, or in glasshouses. If forced entirely in the dark the shoots are white. Should it be necessary to market the shoots green, provision must be made for the admission of light.

Forcing on hot-beds depends on a liberal supply of fermenting dung and is rarely possible today. Forcing in pits, e.g. seakale pits, with hot-water pipes beneath a floor of tiles, is an old practice which may still be followed where such equipment exists, but to construct such pits would now prove costly (see p. 234).

To use a glasshouse which for most of the year is used for other crops is more practicable, and some growers have developed a good system of glasshouse forcing. Bottom heat should be provided either by hot-water pipes or by low-voltage electric wires.

For forcing lifted crowns well prepared three-year-old roots are used. These are ploughed out in late September or early October, using a digger plough. Half an acre of roots can be packed on to about 1,000 sq. ft. of floor space. After housing the crowns are covered with a few inches of soil. Housing is done by instalments—a portion of the crop being brought in weekly so as to obtain a succession. Maintain a damp atmosphere and a temperature of 70° F. The first cutting may be expected in two to three weeks from housing; the season usually starts at the end of October.

Roots for forcing may be lifted some time before they are wanted, with plenty of soil about each, care being taken not to injure them. They should be stored in a cool shed and covered with damp earth or sand to keep them moist. A little frost will do them no harm.

Other systems of forcing involve growing the plants in beds of a width which permits them to be covered by a range of frames. The roots must be three or four years old before forcing is done. This forcing of undisturbed roots usually gives finer shoots than may be expected from lifted ones.

The plants are set three rows to a bed, one down the middle and the other two 1 ft. from each side, with the plants 1 ft. apart in the rows. During November the beds are covered 2 in. deep with fine compost or sifted old hot-bed manure. At the beginning of January the frames are set on the beds, which are then covered with another 3 in. of fine soil. The lights are put on and covered closely with mats. The spaces between the frames and round the ends are then filled with fresh hot manure, which should come almost up to the level of the light when well trodden down. It is a great help to cover the beds with 6 in. or so of fresh strawy manure the week previous to putting the frames on; this warms up the soil and keeps the frost out. When the frames are put on the bed this litter can be thrown into the alleys and mixed with the hot manure. When the shoots have pushed through the soil about 2 in. the mats should be rolled up in daytime and the lights slightly raised, so that the tops will become green by the admission of light and air. If the manure gets cool before the crop is cleared, part of it must be removed and the remainder well shaken up and mixed with some fresh. When cutting is finished the frames and added soil are removed, then a little manure from the trench is scattered over the beds to keep out frost and the remainder is taken away. Forcing of open-air beds must only take place in alternate years, and therefore two plantings are required. The beds in one year's forcing should be started in rotation, so as to keep up a succession until the ordinary supplies come in. In France these beds may have hot-water pipes running beneath them. These are connected to boilers, which may be portable for use on other beds if necessary.

Varieties. Varieties of asparagus are but few and the differences between some of them are not well marked. Connover's Colossal and Argenteuil are old varieties but still popular. Martha Washington is a variety of American origin which is resistant to rust.

BEAN (BROAD)

Vicia faba

THE Broad Bean is a very accommodating and easily grown plant, which will thrive in almost any kind of soil but is most partial to one which is strong, deep, and moist. For a heavy crop of fine pods deep cultivation and generous manuring are necessary. It is quite hardy and may be sown in the autumn with safety.

These earliest sowings may only mature a little before those sown in the New Year, but a few days may be of great importance with this crop, which is not widely popular and usually sells slowly once other vegetables compete freely. The earliest sowings are made during the first half of November using Seville Long-Pod or one of its forms. The aim should be to have the plants just breaking the ground about the New Year. If they are too forward they may get severely damaged at soil level during a hard frost. For market purposes this November sowing is usually the only one, but if the soil is unfit for working at that date then the first opportunity in January or February should be taken. Later sowings can be made and in a severe winter may be necessary, but sowings made after the end of March are usually not so satisfactory. For the earliest sowings a light, well-drained soil is preferable, though heavier crops may be expected from the stronger soils. The soil should not be acid.

In market-gardens drills may be drawn 24–30 in. apart, using the tip of a ridging plough on a light tractor. The seeds are sown by hand, dropping them about 4 in. apart. The drills may be covered by harrows or with hand-hoes and lightly rolled.

In gardens sow in double rows, 6 in. wide and 2 ft. 6 in. between the double rows; the seed should be 9 in. apart in the row, those in one row falling between those in the next. On heavy soil the seed should be sown in drills 3 in. deep, but on light soil 4 in. deep.

When the plants are a few inches high draw the soil to the stems on each side. Keep the soil stirred and clean by frequent hoeing. As soon as the blooms are set pinch out the tops; this will cause the pods to fill more quickly and will check the ravages of the black-fly. When this pest is present the tops should be put in a pail as they are removed and burnt or buried.

The pods must be picked before the hilum (the scar where the seed joins the seed stalk in the pod) blackens. As soon as the pods are gathered the plants should be pulled up or ploughed in.

Manures. On land manured for the preceding crop no further natural manure is required or the growth may run to leaf. Before sowing 4 cwt. superphosphate and 1 cwt. muriate of potash may be given, followed in March by a dressing of sulphate of ammonia at 1½ to 2 cwt. per acre. Take care to keep the top-dressing off the foliage.

Varieties.

For November sowing: Seville Improved Long-pod.

For spring sowing: Aquadulce, Johnson's Wonderful Long-pod, Giant Four-Seeded Windsor (white seeded), Green Windsor, Green Gem—a small-seeded, fan-podded variety for home use.

BEAN (DWARF FRENCH)

Phaseolus vulgaris

When French Beans can be got early they are a profitable market crop to grow, but the demand for them usually falls away as soon as runners become plentiful, and every effort should therefore be made to get them in full bearing well before the earliest pickings of runner beans. They do best on a rather light soil, but any ordinary loam will yield a paying crop if it is well prepared and is given a fair dressing of manure.

A cold wet soil at sowing time should be avoided; a site exposed to cold winds is also unsuitable. In many parts of the north-east the climate is too cool for profitable crops.

For the earliest crops some provision must be made to protect the plants from frost, as they are very tender. They may be grown in cold-frames or under continuous cloches. The seed may be sown where the plants are to remain, about the middle of March, in a light rich compost. For frames sow in rows 1 ft. apart, 3 in. between the seed, and thin out to 6 in., using some of the surplus plants to fill up blanks. Give no air until the seed has germinated. Exclude frost by covering closely each night with mats. When the plants are up give air on all favourable occasions, but carefully guard against cold draughts. As growth advances gradually treat them more hardily, until by the middle of May they may be completely exposed during the day but must be covered at night for a week or two longer. Plenty of water is necessary. Picking should commence soon after the middle of June.

Continuous cloches are useful in helping to start this crop. They may be placed in position a few days before sowing so as to protect the soil from getting too wet, moving them aside to sow and then replacing them. After germination the cloches may be left in position until the plants are touching the glass if particularly early crops are wanted, otherwise, after giving some protection they may be moved at an earlier date to other crops.

Sowing in the open may be done in the last week of April and the first week of May, and for a late crop in the middle of July in southern England.

Sow by hand in drills 2 ft. apart and 2 in. deep. It is common practice to place two seeds together at 6 in. spacing along the rows. Where both seeds germinate the weaker is pulled out.

When the plants are 8 in. or 9 in. high they may be carefully earthed-up. This not only gives support to the stem and protection from the winds but eases the work of picking, as the pickers walk in the furrows and have not so far to stoop.

Gathering the pods must be attended to systematically; if they are left on the plants too long they get tough and useless and the plants soon stop bearing. To obtain a long-continued supply of green and tender pods they must be picked closely as they come ready.

Manures. French beans pay for liberal treatment. The soil in which they are planted should be given plenty of well-rotted stable manure, as not only does this provide plant foods but it serves to keep the soil open and rich in humus, a condition of things in which these plants revel. Fresh manure is not suitable and perhaps the best crops may be obtained from ground which has been deeply worked and heavily manured for a previous crop, followed, if necessary, by a dressing of lime. Shortly before sowing superphosphate should be given at 4 cwt. and sulphate or muriate of potash at 2 cwt. per acre.

Varieties

Spring sowing in frames or cloches: The Prince, Ne Plus Ultra, Masterpiece, Feltham Prolific.

Spring sowing in the open: Bounteous, Masterpiece, The Wonder.

Summer sowing: The Prince.

Spring sowing—for shelling to use the half-ripe seeds as flageolets: Chevrier Vert.

BEAN (HARICOT)

THESE are a specialist crop for a few commercial growers who produce them on contract for canning firms. For home use they prove a very useful crop in districts where they do well. Warm, dry autumn conditions are needed for the successful harvesting of good seed. The cultivation is very similar to that given for dwarf French beans, but the ground should not be rich, as early ripening is helped if the soil is not too liberally supplied with nitrogen. On light soils they may follow a crop of winter cauliflower or Brussels sprouts.

When the pods are ripe the plants are pulled up and tied near the roots in bundles. They are then put to dry, either spread out on a hard bottom or hung on a fence or over a rail. If the weather is wet they may be spread out thinly in a shed or in frames to dry. They may then be threshed or hung in a dry airy place until winter or such other time when threshing can be undertaken.

Varieties. Comtesse de Chambord, Brown Dutch, Everbearing.

BEAN (RUNNER)

Phaseolus multiflorus

RUNNER BEANS are easily grown, prolific, and popular. They always meet with a steady sale when young and tender, and when well grown are usually a profitable crop.

The scarlet runner will do well in any good soil, though a rather light loam suits it best. Clay soils are the least suitable, though good crops may be taken from well-drained clay soils providing they have a thorough winter preparation, accompanied by liming if necessary.

[*By courtesy of "The Grower"*

FIG. 52. Runner beans growing up tripods formed by canes

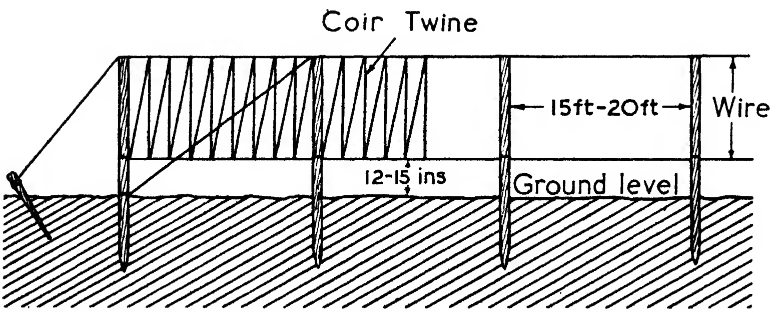


FIG. 53. Semi-permanent support for runner beans (not to scale)

Runner beans are less hardy than dwarfs, and to sow earlier than the first week of May in the southern counties is to take a risk.

In the north this is not a widely grown market crop. In the north-east it is only successful in the most sheltered gardens, though in the north-west good crops may be obtained from most sites if not too windswept.

To obtain a crop of beans with uniformly straight pods some support is needed. For this, slender poles or "bean rods" 6–8 ft. long may be used in districts where they can be bought cheaply. They are erected in various ways—a good method is to insert the sticks in double rows 15 in. to 18 in. apart, the sticks in one row alternating with those in the other. Three sticks are tied together at the top, thus forming a tripod. Other methods may have a lattice of coir yarn stretched between horizontal wires which are supported by stout posts, or wide-meshed wire netting may be hung from posts. These systems are expensive to erect and many growers prefer to grow the crop unsupported, a practice which is often followed for the earliest crop even by growers who may have the main crop on poles or string. With an unsupported crop the plants have the tops removed when they are about 18 in. high, after which for several weeks all shoots are pinched (or slashed) at ten-day intervals, thus giving the plants a bushy habit. The economy effected by using no support is offset by having some soiled and slug-damaged pods during wet weather and many twisted ones. This unsupported crop is variously spoken of as bush-, pinched-, stopped-, or ground-beans.

The land for the runner beans should have been ploughed and dunged during the winter. In the few weeks before sowing the surface should have been worked to get a good tilth and to obtain control of many annual weeds.

Sowing should not be done unless the soil is in good condition and the weather dry. The earliest sowings are made in late April in the south; May is the main period for this work, but late sowings can be made into the first days of June, though the crop from these is light. For bush-beans the rows should be 3 ft. apart; a shallow furrow is drawn and the seeds sown by hand about 6 in. apart; they should be buried 3 in. deep. Early sowings which run the risk of a late May frost can be given some protection if frost threatens by having soil drawn over them. When the plants are out of danger of frost some growers thin out to stand about 12 in. apart.

For a supported crop it is usually best to erect the stakes, etc., and sow by dibbling-in either at the base of the bean rods or along the line of the posts, spacing the seed about 6 in. apart. Such rows are 5–6 ft. apart.

Hot dry weather, particularly as the first flowers are opening, often causes many flowers to drop without setting. Overhead irrigation is a help in countering this trouble and also helps in the production of good well-grown pods.

The pods should be gathered as soon as they are a fair size, and gathering should afterwards be continued regularly two or three times a week. If the pods are allowed to become too old not only are they worthless but the plants soon cease to bear. Any old pods that have been missed in a previous gathering should be thrown away or they will spoil the sample. If the pods should be gritty with earth they must be washed; they should be despatched to their destination as soon as possible after gathering, whilst they are still fresh and plump, as they soon lose in value if kept standing about.

Manures. For a good crop of scarlet runners it is necessary that the ground should be deeply worked and well supplied with farmyard manure. If this has been given to the previous crop, 4 cwt. superphosphate and 2 cwt. muriate or sulphate of potash to the acre, harrowed in some time previous to sowing the seed, will give satisfactory results. If no manure was given to the previous crop, or if the land is poor, plough or dig in well-decayed manure at the rate of 15 tons to the acre, and in addition give the fertilisers mentioned above.

Varieties. There are many good sorts, amongst the best of which are: Princeps (early), Best of All, Scarlet Emperor, The Czar, Painted Lady, Prizewinner, Kelvedon Wonder, and Streamline.

BEET

Beta vulgaris

BEET may be grown on any ordinary soil, though one of a rather light and sandy nature produces the neatest and best-shaped roots. Good beet can be grown on strong clay soil if carefully prepared by deep working and ridging in the winter so as to get it thoroughly weathered. On clay the seed should be sown a fortnight later than the usual time or the roots are apt to grow too large and coarse, especially if the season should happen to be wet. The only kind of roots likely to realise a profit are those of moderate size and good shape, and to produce these, no matter of what nature the soil may be, it should be well and deeply worked, in good tilth, and free from recent dressings of manure.

The earliest sowings are made in mid-April using the round beet Detroit or one of its variations. The main crop is sown in early May (or the second or third week in May on strong land). If sown too early and the seedlings receive a check many are likely to bolt and run to seed.

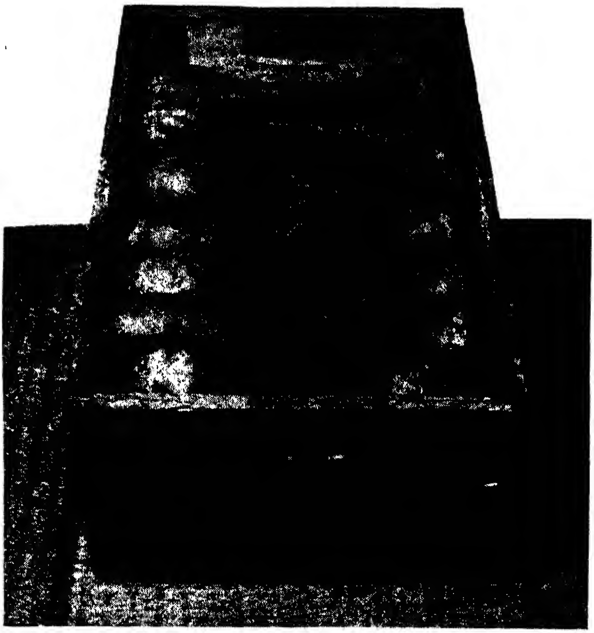
The "seed" as purchased is really a fruit, being a collection of several seeds in a cluster. It is therefore very important to sow thinly. The drills should be 12–18 in. apart according to the cultivation equipment to be used—the narrower spacing for the early summer crop. Rows for the long-rooted sorts should be 16–18 in. apart. Earlier sowings on well-settled soil should be 1 in. deep, later sowings, particularly if on recently ploughed land should be about 2 in. deep.

Thin out early to 4 in. apart for the summer crop and 6 in. apart for the main crop. Throughout the summer the ground should be kept clean and the surface soil loose by frequent hoeing.

Pulling and bunching of the early beet starts in June. The main crop should be lifted during a spell of dry weather in October. Great care must be taken to avoid damaging them in any way or they will be spoiled. To this end, if the soil is not light enough or moist enough to permit them to be drawn by the tops, a trench should be thrown out close alongside one row, and then by using a spade behind the roots but well away from them, the soil may easily be loosened and the roots lifted without injury. On a field scale they may be ploughed out. The long-rooted forms will nearly always need to be ploughed or dug out if the roots are to be lifted without injury. When trimming the leaves off do not cut very close to the crown of the root.

The roots may be stored in an ordinary clamp in the same way as potatoes are stored, that is, they should be laid on a dry bottom in a round or oblong heap, about 4 ft. through at the base, then covered with straw and the straw in turn covered with about 4 in. of earth. Or they may be stored in dry earth or sand in a shed. Wherever the storing is done it is essential that the place be dry and cool, as damp may cause decay and warmth will induce growth.

Manures. It is important that freshly manured ground should be avoided, though the soil should be in good heart by having been manured for the preceding crop. Before sowing the land should be given a complete fertiliser dressing, e.g. 2 cwt. sulphate of ammonia, 4 cwt. superphosphate, and 1½ cwt. muriate of potash per acre.



[*By courtesy of Messrs. A. L. Tozer Ltd.*

FIG. 54. Beet, Cheltenham Green Top

Varieties. There are distinct market preferences for certain types of beet and a grower should be careful to grow the kind needed by his market. The London market takes round beet (bunched) during the summer, but by August is usually demanding the longer Cheltenham beet. Most northern markets show a preference for the round beet all the time and in some cases long beet are unsaleable.

Round beet: Detroit Improved Globe.

Long beet: Cheltenham Green Top, Cobham Early, a new variety with a root rather like Cheltenham but the seed may be sown much earlier for summer use with little risk of bolting.

BROCCOLI

Brassica oleracea botrytis

See Cauliflower

BRUSSELS SPROUTS

Brassica oleracea gemmifera

Brussels Sprouts are indispensable to the grower engaged in supplying a retail shop or business, and a well-managed crop usually shows satisfactory profits either to him or to the grower for market. They form one of the best green vegetables for autumn and winter use, and at that time are always in good demand by all classes of the community.

The main requirements for success in the cultivation of Brussels sprouts are a deeply worked rich and *firm* soil, room for development, and a long season of growth. The disregard of any or all of these conditions frequently results in disappointment—loose rich soil produces over-luxuriant plants with soft open sprouts which are practically useless, overcrowded plants yield sprouts few in number and only partially developed, whilst plants raised late in the spring rarely give a good crop. As with all brassicas, it is important that the soil should be well limed.

Sow in February, March, or April. If the soil or weather is unsuitable for making the earliest sowings in the open the seed may be sown thinly broadcast in frames—transplanting early or the plants soon get "leggy". The main sowings should be completed in March. For early picking a sowing may be made about the 20th August in the north or mid-September in the south, leaving the plants in the seed rows all winter and transplanting in April.

To sow an acre of seed-bed 6 lb. of seed is required if 12-in. rows are used. This should give plants sufficient for 10 acres at a planting of 3 ft. square. The site of the seed-bed should not have carried a brassica crop for at least a year. It should have a dressing of 2 cwt. superphosphate and 1 cwt. sulphate of potash per acre a few weeks before sowing and lime if necesssary.

Set out the plants in their final stations during May, if possible, and never later than the early part of June. Sometimes these plants are put between rows of potatoes, but this practice is to be discouraged, as crowding by the potato haulms has a tendency to cause the stems to become drawn instead of retaining that sturdy short-jointed character which is so desirable. Set the plants out in an open situation, 2 ft. 6 in. to 3 ft. apart in each direction, according to variety—all but the dwarf sorts need 3 ft. in each direction.

In gardens single lines of quick-growing catch-crops may be sown between the rows as soon as planting is finished. After-cultivation consists in keeping the ground free of weeds and the surface soil loose by occasional hoeing.

Some growers remove the head of the full-grown plant under the impression that doing so makes the sprouts develop earlier, but the practice is of doubtful value. The head of leaves is not only required to assist the plant in the formation of the sprouts, but it also serves to a certain extent to protect them during sharp frosts. The sprouts should be gathered as they come ready.

Manuring. The soil for Brussels sprouts should always be deeply worked and contain a fair amount of organic matter, and if the sprouts are following a crop which has made heavy demands on the soil, dung at about 25–30 tons per acre should be given. With a fair residue of organic matter from a previous crop the sprouts may be taken without an application of a bulky manure. Where dung is given it should be followed by a base dressing of 1 cwt. sulphate of ammonia, 3–4 cwt. superphosphate, and 1–2 cwt. sulphate of potash, supplemented by one or two top-dressings of nitrate of soda totalling 1–2 cwt. per acre, which should not be given later than early August. If no dung is given then the nitrogen is probably best given in an organic form and hoof and horn at about 6–8 cwt., superphosphate at 4–5 cwt., and sulphate of potash 2 cwt. may be given followed by a top-dressing of nitrate of soda at 1 cwt. per acre.

Varieties

Tall: Brown's Premier, Clucas No. 1, Sutton's Universal.

Medium: Bretforton, Rous Lench, Evesham Special, Cambridge No. 1, Cambridge No. 3, Cambridge No. 5 (the three last-named varieties mature in the order of the numbers).

Dwarf: Cambridge Special (this has small hard sprouts suitable for a high-class trade).

With Brussels sprouts the strain is of great importance and having obtained a variety and strain suited to a particular soil and purpose it is wise to continue to use seed from the same source. Some growers save their own strains, selecting good plants at cropping time (all of the same type), and seeding them together in isolation to avoid any risk of cross-pollination by other stocks of sprouts or other brassicas.

CABBAGE

Brassica oleracea capitata

THE Cabbage is one of the most important vegetables in the garden; in fact, next to the potato, it may be said to be the most important vegetable grown in this country, as it supplies green food unfailingly in constant succession throughout the year, and is popular with all classes of the community. It can be grown almost anywhere, but like most of its tribe it gives the most satisfaction on a moist retentive loam, deeply worked to provide it with an ample root-run, supplied generously with manure and with adequate lime content.

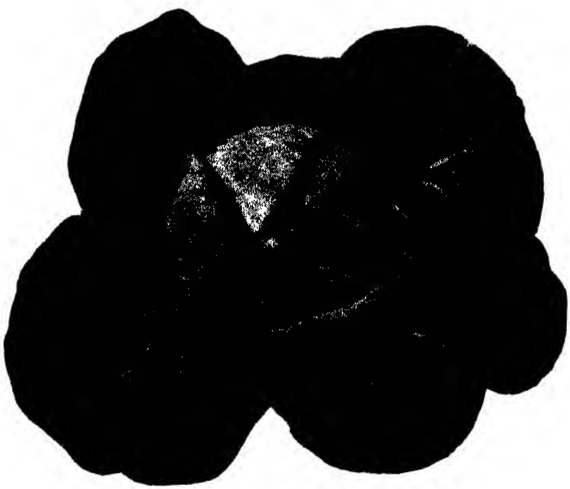
The grower who does a general trade should seldom be without cabbages, and so must use a range of varieties and sow over an extended period.

Spring Cabbage and Spring Greens. The exact time for sowing needs careful consideration. Strong plants are wanted before the cold weather comes, but they should not be too advanced or they may suffer severely from prolonged frosts, and there is also a tendency for plants which are too forward to "bolt" as soon as growth begins in the spring. On the other hand if the sowing is too late winter comes before the plants are well established, with the result that many fall victims to excessive wet or sharp frosts, whilst those which survive mature late the following spring and so miss the best prices.

From the middle of July to early August is the usual time for this sowing, the exact date depending upon the season, the soil, and the locality. The earlier dates are for the north of the kingdom, gradually getting later towards the south. The seed-bed should be light and not too rich. After raking down to a fine tilth, the seed should be sown very thinly, in shallow drills 9–12 in. apart. The plants should be set out in August in the north and September to November in the south, choosing a rainy period when possible for the early planting. For these plants the soil should be in a firm condition; if it is loose they do not heart up so well. The site for spring cabbages should be well drained and have been well manured for the previous crop, e.g. potatoes or onions. The land should be ploughed as soon as possible after it is clear of the preceding crop.

[*By courtesy of Messrs. A. L. Tozer Ltd.*

FIG. 55. Spring cabbage, Myatt's Offenham



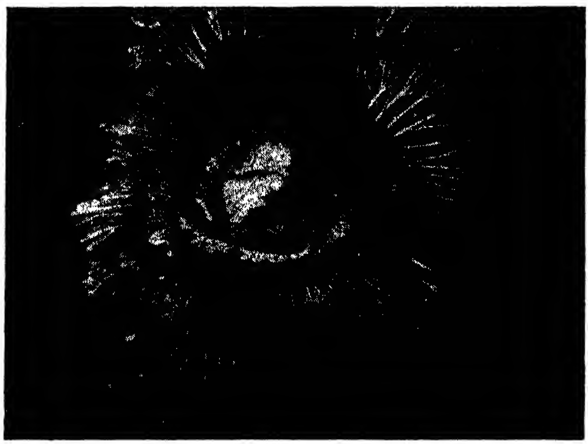
[*By courtesy of Messrs. A. L. Tozer Ltd.*

FIG. 56. Summer cabbage, June Giant

Planting distances vary with district and according to the stage at which the crop is to be cut. For hearted cabbages the spacing may be 18 in. by 18 in. or 18 in. by 24 in. Spring greens may be spaced 12 in. by 15 in. or even as close as 10 in. by 12 in.

In February or March, according to the weather, the crop should have a top dressing of 2 to 3 cwt. of nitrate of soda or potash nitrate, which should be hoed in, an operation that will also keep down the weed seedlings which will then be developing.

Spring cabbage provides crops from February to June, depending on the stage of cutting and the district where grown. Cutting of immature loose heads as "spring greens" may start in February (or even December in a very mild winter) or March–April after severe weather. Hearted cabbage is cut in April and May or into June in the north.



[*Dr. M. Cohen*

FIG. 57. Winter cabbage, January King

Summer and Autumn Cabbage. The earliest cuttings of summer cabbage are from sowings made in cold-frames or cool greenhouses in January, the plants being hardened off and planted as soon as possible in March or April. They should crop in late June and early July. Where it is noted that spring cabbage is wintering badly it is wise to make such an early sowing of a summer variety. The outdoor sowings are made in March and April, planting being done in May as soon as the plants are ready.

The land should be in good heart, having been dunged and ploughed some time before it is needed for planting. The rows are 20–27 in. apart according to cultivation equipment, and the plants 15–18 in. apart in the row for earlies and 24 in. for later ones. On land in a high state of fertility the early plants which have been raised under glass may be interplanted amongst early lettuce which is approaching maturity. In districts where planting may not be easy during the drought, particularly on heavy soils, the seed may be drilled thinly on the site where the crop is to mature, the plants being cut out to stand 18–24 in. apart.

Winter Cabbage. The crop which is to mature in late autumn and winter is sown in late April and early May for planting in June and early July. The site for this crop should preferably have been dunged for the previous one. The soil should be firm and any fertilisers should be given before planting, avoiding so far as possible the need to give a top-dressing of nitrogen which may lead to the plants suffering from frost during severe weather, particularly for the late crop which is to stand into the New Year. A good planting distance is 24 in. by 24 in.

Manures and Fertilisers. Cabbages are gross feeders and the soil must receive liberal quantities of farmyard manure either directly or to the previous crop if their cultivation is to be conducted successfully. The presence of lime in the soil is essential to their healthy growth. For the seed-bed a dressing of superphosphate at 1 oz. per sq. yard is helpful in providing well-rooted plants.

For spring cabbages give a base dressing of superphosphate at 3–4 cwt. and sulphate or muriate of potash at 2 cwt. per acre; it should rarely be necessary to give much nitrogen in the autumn. In spring as growth starts, a top-dressing is needed and this may be either nitrate of soda or potash nitrate at 2–3cwt. per acre. Summer cabbage should have farmyard manure at 20–30 tons per acre and a dressing of sulphate of ammonia 2 cwt., superphosphate 3–4 cwt., sulphate of potash 1–2 cwt. per acre, followed as needed by a top-dressing of nitrate of soda at 1–2 cwt. per acre.

Winter cabbage needs similar treatment to summer cabbage, but 2 cwt., or possibly more, of sulphate of potash is needed to ensure sturdy plants for the winter.

Varieties

Spring cabbage: Myatt's Early Offenham (there are early strains of this which are well suited for spring greens), Durham Early, Early Market, Flower of Spring, Harbinger.

Summer: Primo, Roundhead, Golden Acre, June Giant, Standby, Enkhuizen Glory, all of which are round cabbages; Greyhound (early), Winnigstadt (late), both pointed cabbages.

Autumn: Christmas Drumhead.

Winter: January King.

Red Cabbage, for pickling, is grown for general sale to the public in most northern districts but is less popular in the south. It is also grown to a limited extent on contract for the pickle manufacturers, though much is imported for this purpose from Holland. Sowing may be in August, with the plants left to stand in the seed rows during the winter, being planted in spring. Other sowings may be made under glass in January or in the open in March. The red cabbage has a long growing season and needs to be planted early on well-manured land; its general treatment is as for summer cabbage.

Varieties. Blood Red, Langendijker (Dutch Red), Lydiate Red.

CARDOONS

Cynara carduncullus

THE Cardoon is a close relation of the globe artichoke, and has much the same appearance when growing. It is not much cultivated in this country, but as it is occasionally in demand it has been thought best that its culture should be described.

Whilst the artichoke is usually propagated from offsets, the cardoon, on the contrary, is always grown from seed. Trenches are prepared as for celery, 18 in. wide, 1 ft. deep, and 4 ft. from centre to centre. The soil at the bottom of the trench is well mixed with 3 in. of good rotten manure. At intervals of 18 in. a patch of fine soil is prepared, or if the tilth is poor, a light compost may be laid down, and in each of these patches, at the end of April, three or four seeds are sown, well watered in, and covered with a flower-pot until the seedlings are up, when the pots are removed, and the plants thinned out to the strongest one at each station. Some light feathery branches should be put over the trench to protect the plants from the sun for a few days after the pots are removed, and each night until the beginning of June, to protect them from frost.

During the summer the cardoons must have frequent and copious waterings. By about the middle of September growth will be completed, and they will be ready for blanching. For this operation choose a fine day when the foliage and the soil are dry. Then draw the leaves together and tie them firmly with strong raffia. Each plant is then covered from the base to the tips of the leaves with dry hay or staw, 3 in. thick, kept in position by raffia, and the whole is then covered with soil from the sides of the trench, in the same way as celery is earthed up. Blanching is completed in about a month. Put litter over the tops of the ridges to protect from frost.

CARROT

Daucus carota

EXCELLENT crops of Carrots can be grown on any well-cultivated garden soil, though a deep sandy loam suits them best, and it is on this class of soil that the most handsome roots are produced. On soil of a heavy nature the varieties grown should be confined to those which are short or stump-rooted, and if before sowing it has a good tilth, crops quite as satisfactory and profitable can be obtained as on lighter soil. Extensive commercial production is invariably on light soil. Whatever its nature may be the soil should always be free of fresh manure near the surface or the roots will fork badly. It is always better to select ground which was deeply cultivated and manured for some other crop at least six months previously.

Soaking the seed before sowing hastens the germination by several days early in the season and carrot-growers may take advantage of this in two ways. For cold-frame cultivation the sowing may be delayed with confidence if the weather is unsatisfactory and for the spring sowings in the open the more speedy emergence of the seedlings enables the rows to be seen and hoeing to start sooner than would otherwise be possible. According to the weather this saving of time may be a matter of five to ten days.

Soak the seed (in a loosely filled bag) for twenty-four hours, then spread out in layers 2–3 in. deep in a warm greenhouse or shed. Cover with a wet sack and keep moist until the seed "chits", when most of the seed just show the white root tips through the seed-coat. Care must be taken to avoid drying which may develop in the centre of the heap if it is made too deep. If mixed with a little dry sand the seed may be drilled.

The culture of the carrot may be divided into three well-defined sections—forcing in frames, early crops on sheltered sites, and main crops, but in addition to these the intensive gardener will find it profitable to have a few beds of tender young carrots ready for use in the autumn, when the main-crop roots are getting large and coarse.

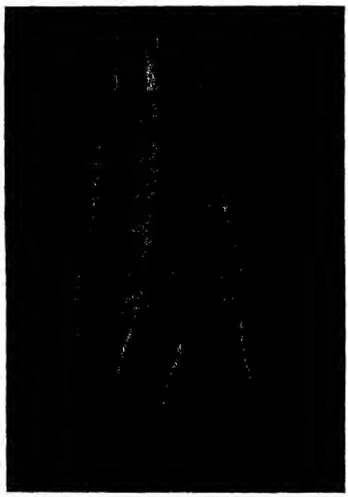
Forcing in Frames. Mild hot-beds for forcing carrots may be made at any time from the middle of November to the end of

February. Full particulars respecting the preparation for and making of these will be found in pages 78 & 92. After the frame is put on the bed the manure is covered with about 4 in. of light rich soil, or preferably with the finely sifted, thoroughly decayed manure described on page 79, this is raked down smooth and fine and all lumps removed, then the frame is shut up closely for a few days. When the bed is nicely warm sow seed of one of the forcing varieties broadcast, very thinly, cover lightly with dry finely sifted soil and press down evenly with the firming board. Sow 1 oz. of seed to about 16 or 18 Dutch lights. French gardeners, after sowing carrot (and possibly radish), also set lettuce plants on the same bed, and as soon as the lettuce are ready for cutting follow these up by planting cauliflowers amongst the carrots. These additional crops, whilst in no way injuring the quality or quantity of the carrots on the bed, have a decided effect in retarding their growth, and when carrots are wanted early all additional crops are best omitted.

As soon as the seed is sown the frames are shut up closely and covered with mats until germination has taken place, after which the mats are removed in the daytime, but replaced each night to conserve the warmth and protect from frost. If the manure and soil are in the right condition no water will be needed, but if the soil gets dry give a little through a fine rose. If the heat of the bed rises above 60 deg. by day or 50 deg. by night a little air must be given, and in any case air should be given on all favourable occasions as soon as the plants have made three or four leaves. At this stage, too, the plants should be thinned out to 1 in. apart. Air must be given whenever the weather is mild and water when the soil appears dry. Ventilation must be gradually increased until by the beginning of April the lights may be removed completely on fine warm days, and by the middle of the month the frames can be removed altogether, and the crop left standing in the open. It is a good practice to work a little fine soil amongst the tops of the roots to prevent them becoming green.

Good early crops can also be obtained from cold-frames. The bed is made up and managed in a precisely similar way to that on the hot-bed, except that no hot manure is used. The frame should face south and the seed should normally be sown in January or February. A few growers make an early sowing in November. This crop will come in just before the earliest one from sheltered beds in the open.

Early Crops from Protected Beds and Warm Borders. The earliest open-air sowing may be made with one of the stump-rooted varieties, such as Amsterdam Forcing and Ideal, any time after the beginning of March, on a warm dry site. The soil should be in a dry and crumbly condition or the seed will not germinate well. If it is wet and cold a change of weather should be waited for. Sow in drills 9–12 in. apart, using 1 oz. to 500 ft. of drill. If rain threatens do not sow until the weather clears, for if a heavy rain beats on a new-sown bed the seed will probably fail to germinate, and will have to be re-sown, thus causing delay and loss. No thinning should be needed. Further sowings may be made on beds in the open from the beginning of April.



[By courtesy of Messrs. A. L. Tozer Ltd.

FIG. 58. Carrot, Ideal

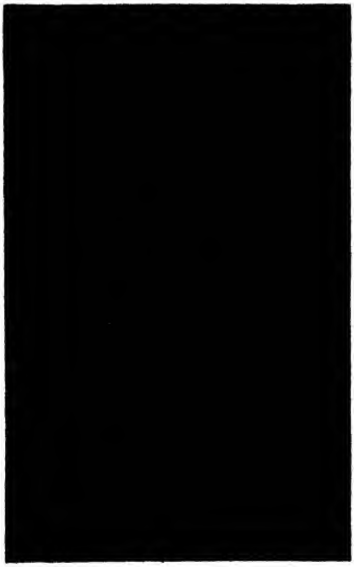
All the early carrots are tied in bunches of varying sizes, according to the requirements of the respective markets; they are always washed before being packed, so as to present a bright and attractive appearance.

Main Crops. The land for the main-crop carrots should be well drained and have been deeply worked some time previously, so as to get it into a mellow and friable condition. It is useless to put this crop into cloddy, ill-worked or wet land. Seed should not be sown unless the soil is in a good tilth.

Sow from the middle of April to early June in drills 12–18 in.

apart and ½ in. deep. Sow 4 lb. of seed per acre. The variety Early Market will be found suitable for all soils. Thinning should never be necessary for a market crop unless the seed rate has been too heavy.

Further cultivation during the summer consists in keeping the plants free of weeds by hoeing whilst the crop permits. Steady growth does much to prevent the splitting of the roots which takes place when a drought is followed by a period of wet. For the control of weeds by oils, see p. 117.



[By courtesy of Messrs. Watkins & Simpson Ltd.

FIG. 59. Carrot, Early Market

Choice young roots can be had in autumn and the early part of winter from a sowing of one of the early varieties on good rich soil in the first or second week of July. They must not be allowed to suffer from lack of water.

Early in October, in fine weather, the main-crop roots are lifted, cleared of soil, and the leaves cut off to ½ in. of the top. When the quantity is only moderate they may be stored in a dry shed or cellar. Here a foundation of dry earth or sand is laid down on which the roots are placed in regular layers, with earth or sand between each layer until they are about 3 ft. deep. The tops of one layer alternate with the bottoms of the next. A few rough boards are fixed at the front and ends of the heap to keep them in position. When the quantity to be dealt with is large, the roots are stored in clamps; the site for the clamp should be dry, the heap not more than 3 ft. wide at the bottom and 2½–3 ft. high, with the roots laid carefully and the outer ones arranged so that the tops are turned to the outsides. Some growers cover the roots with 4 in. of straw and the straw with 4 in. of earth, which may be taken from outside the site of the clamp so as to form an open drain and so help to keep the interior dry. On heavy soil, along the ridge, at intervals of 6 ft., ventilation shafts should be made by building the earth round a drain-pipe or a tuft of straw. On a light sandy soil there should be no need for a ventilation shaft and in field practice it is customary on such soils to cover the roots in the clamp with soil without a layer of straw; 4–6 in. of soil is adequate protection and the light soil permits aeration.

Manures. Lime is important to this crop and the soil's lime requirement should be checked from time to time.

For early sowings on land well dunged in the previous year give 2 cwt. sulphate of ammonia (or 3–4 cwt. hoof and horn), 4 cwt. superphosphate, and 2 cwt. sulphate of potash per acre. For the main crop a similar dressing may be given, though on fen soils the carrots follow a well-dunged crop and often no further dressing of fertiliser is given. Any fertilisers should be broadcast and worked into the land a few days before sowing. A nitrogenous top-dressing is needed if the young central leaves look dark in contrast to the outer ones.

Varieties

Frames, hot-bed or cold: Amsterdam Forcing, Primo, Broadcast, Ideal. In gardens the smaller varieties Early Frame and Early Horn are often grown, but they are not popular market kinds.

Open ground, for bunching: early, Amsterdam Forcing, Primo, Ideal; *later:* Early Market; *main crop:* Early Market, Chantenay, St. Valery, James's Scarlet Intermediate.

The long-rooted kinds, e.g. Altrincham, are only grown in gardens and for show; they need a very deep soil.

CAULIFLOWER, including BROCCOLI

Brassica oleracea botrytis

THE Cauliflower is one of the most important crops grown in the market-garden. It is a vegetable which is always appreciated by the consumer, and a good sample usually commands a ready sale.

It can be grown successfully on almost any class of soil if its requirements are attended to, and although these are simple they are imperative, especially for summer varieties. They consist of abundant food supplies and sufficient moisture, with conditions which will permit growth to proceed rapidly, without any check. The land on which cauliflowers are to be planted should be well drained, deeply worked, and rich with manure, though this should not be fresh, and the purpose is best served when the land is dressed with thoroughly decayed manure or when it has been applied to a preceding crop.

Sowing resolves itself into three periods, early autumn in the open or in frames or houses; midwinter, also in frames or houses; and spring outdoor sowings. The first sowings are for the earliest frame cultivations and first outdoor plantings; the last sowings are for the autumn and winter cauliflowers or broccoli, the latest of which have a very long growing season, often occupying the land for nearly a year. There is a good deal of variation in the actual dates according to local climate and light conditions. For the autumn sowings the more southerly the situation the later the operation.

To provide plants for the hot-beds and cold-frames the seed should be sown during the last few days of August. Sow 1 oz. to 16–20 Dutch lights. A second sowing about the 10th September will provide plants for putting out in the open in March or early April. These sowings are made in the open, possibly on beds which can be covered with lights in the event of very wet weather. The soil should not be freshly manured but have a fair residue from the previous crop and be in a good tilth from thorough cultivation. A light dressing of superphosphate is advised. If the weather is very dry the bed should be watered the day before sowing. The land should be free from club-root infection. Give lime if needed.

For the winter quarters of the plants prepare a range of frames in a sheltered position. This should be raised 6–9 in. above the general level so that it will be well drained. The soil should be in good condition and have a fair residue of organic matter to help hold water. Before planting, the bed should be given superphosphate at 1 oz. and sulphate of potash at ½ oz. per sq. yard. The soil should be moist so that no watering is required for many months. The plants should be pricked out here as soon as they can be handled, about three weeks after sowing; set them 3 in.

apart, then put on the lights, and shade lightly for a few days. In a few days the roots will begin to work, then raise the lights at at each corner so that a current of air can blow right through. The plants must be grown as hardily as possible all through the winter, the frames being kept fully ventilated during mild weather, the lights possibly removed altogether on bright sunny days. Driving rains must be excluded by keeping the lights down on the windward side. In times of frost the lights must be closed, and when it is severe they should be covered with mats or litter.

The first batch of plants is used to set out early in March in frames in which they can receive protection for a few weeks. In the French garden they are usually set out four or five to a light in the shallow frames standing on beds of warm manure; here they are planted amongst carrots immediately after cabbage lettuce are cleared (see page 95) and are ready for cutting about the beginning of June. They are also set out on a similar warm bed amongst the cloches (but not covered by them) at the end of March or early in April, to follow the earliest cos lettuce (see page 98) and are ready for cutting towards the end of June. Much earlier supplies can be had by planting in February on a bed of warm manure under cloches. In this case one cauliflower plant is set in the centre and surrounded with three or four cabbage lettuce of small forcing type.

The plants from the second autumn sowing are set out in sheltered positions in the open as soon as genial weather comes towards the end of March or beginning of April. They may be set about 2 ft. apart each way amongst the cabbage or cos lettuce which will be cleared before they seriously interfere with the cauliflowers; or they may be planted alone, in rows 2 ft. apart, 18 in. between the plants in the row.

Other ways of over-wintering the young plants for the March open-air planting include sowing in cold greenhouses and pricking out to 3-in. pots or to soil blocks.

Summer and autumn supplies are provided for by the plants raised in frames in January, February and March, and those raised in the open in April. As stronger-growing sorts are employed for summer than for spring, and still stronger for autumn, they must be planted at proportionately greater distances apart, 2 ft. by 2 ft. 6 in. in the former case and 2 ft. 6 in. by 3 ft. in the latter being none too much. In gardens intercropping may be practised with advantage, the ground to be occupied by summer cauliflowers being previously sown with rows of summer spinach, and the autumn varieties may be intercropped with French beans, lettuces, etc.

A copious supply of moisture during the growing period is an essential part of the successful cultivation of cauliflowers. If the weather is dry planting must be preceded by a good soaking from the irrigation system. If the dry weather continues the cauliflowers will need watering about every week if the crop is to mature to perfection. Overhead irrigation should cease by the time the first curds begin to appear.

When a head shows, a large leaf should be broken over it to keep it clean and white. At this time the plants should be examined frequently and cut as soon as ready, as if overlooked for a day or two they may be quite spoiled through getting them too open, especially if the weather is warm. Cutting should always be done in the early morning, as soon as possible, and they should be taken under cover at once. If cut under a hot sun the quality will deteriorate.

All cauliflowers are liable to produce blind seedlings and these should be carefully sought at planting time to avoid putting out useless plants. Blindness may develop later in the life of the plant, sometimes being associated with a condition known as whip-tail and being caused by a deficiency of molybdenum.

Broccoli

The broccoli is for all practical purposes a hardy winter cauliflower. It is particularly valuable to certain specialist market growers, e.g. Cornish and Devon growers along the south-west coastal districts, where the midwinter Roscoff strains are of great importance; some of the coastal districts of north-east Kent; and many market-gardeners of the West Riding of Yorkshire, for whom it takes a place in the rotation of the land which is used for the preparation of rhubarb roots for forcing.

The best crops of broccoli are taken off a rather heavy loam inclining to clay, providing it is in a suitable condition for the crop. It should have been well manured, or it may be a site recently broken from ley. In the latter case the ploughing should be done sufficiently early to enable the land to be well settled down.

Under such conditions fine close compact heads are produced. When the soil is rich and loose the heads come open and ill-shaped.

When broccoli is grown on light land a dressing of fresh manure may be given, supplemented with fertilisers, and if the soil is well rolled afterwards a satisfactory crop will usually be obtained.

The seed should be sown on a seed-bed in shallow drills, 9–12 in. apart, from March to the middle of May, according to the variety and the time it is required to be fit for use; for autumn cutting sow from the end of March to mid-April, for winter sow in April, for spring in April and the beginning of May, and for summer up to the middle of May. It is of great importance that the plants should be short-legged and sturdy.

The soil for the seed-bed should not be too rich and care should be taken to see that it is not deficient in lime. In some coastal districts sea sand with a high lime content is used as a source of lime and helps to improve the condition of the soil. A dressing of superphosphate should be given at about 1 to 1½ oz. per sq. yard. If the weather is very dry at planting time the seed-bed should be soaked so as to enable the lifting of the plants with good roots. Take care to select good plants free from blindness.

On the mixed market-garden broccoli follows upon some crop which has been cleared in the spring or early part of the summer, such as peas, early potatoes, or dwarf beans. Plant out at 2 ft. apart in the rows and about 2 ft. 6 in. between the rows, choosing for the operation dull showery weather when possible, so that watering-in will be unnecessary.

The size of head can to some extent be controlled by the planting distance; if fairly large heads are desired give a wide spacing up to 2 ft. 9 in. in the rows. During the growing season the land should be kept clear of weeds by occasional cultivations, and before the plants get too large they should be earthed-up. This not only gives support against the wind but helps provide good drainage.

Whether or not to give a top-dressing of nitrogen will depend on the growth of the crop, but care must be taken not to get the winter growth too soft. For midwinter varieties which may have to travel a long distance potash helps to improve the quality. With late spring varieties if grown too soft there may be severe winter killing during hard or prolonged wind frost and potash helps to give some degree of increased hardiness.

An open exposed situation may be selected for the latest batches, as this ensures hardiness and tends to prevent premature heading.

As the heads begin to form the mid-rib of a large leaf should be broken and the leaf bent down over the heart of the plant; this helps to keep the head clean and white and prevents injury by frost.

Sprouting broccoli yields a heavy and useful crop during late winter and early spring. In mild open seasons the prices obtained are low, but at times when other vegetables are scarce this crop is eagerly sought after, and in such circumstances proves very remunerative. It should be given the same treatment as for the late varieties of winter cauliflowers.

Cape broccoli is another hardy form which gives white to purple heads (though not of a fine-grained even texture) in late March or April and also needs cultivation similar to winter cauliflowers. Sowing should be in April and the plants may be 18 in. apart in the rows.

Manures. It is useless attempting to grow summer cauliflowers on poor land; it should be rich with manure, preferably by a heavy dressing given to a preceding crop. When applied specially for cauliflowers the manure should be well-rotted, 20 tons to the acre on good land and double that quantity on poor land being none too much, supplemented by 1–2 cwt. sulphate of ammonia, 4 cwt. superphosphate and 1½–2 cwt. sulphate of potash per acre. Steady—even rapid—unchecked growth is needed for the earliest crops. A top-dressing of nitro-chalk, nitrate of soda, or potash nitrate at 2 cwt. per acre is usually required.

For winter cauliflowers much depends on the climate of the district and the season of cutting. For the midwinter varieties in the south-west no organic manure is given if the land is in good heart, but if any be needed farmyard manure at about 10 tons per acre or a similar application of seaweed compost is given. Before planting give sulphate of ammonia 1–2 cwt., superphosphate 3 cwt., and sulphate of potash 2 cwt. Top-dress with quick acting nitrogenous fertilisers at about 1½ cwt. in June or July for the midwinter sorts, followed by a further application in spring for the late kinds. In most other districts farmyard manure will usually be needed at about 20–30 tons per acre, supplemented by sulphate of ammonia 1–2 cwt., superphosphate 2–3 cwt., and sulphate of potash 2–3 cwt., plus a top-dressing of 1–2 cwt. nitrate of soda, etc. The late varieties will probably need a further top-dressing in spring, particularly after a very wet winter.

"Ricy" curds may be caused by an excess of nitrogen.

Varieties

Summer cauliflowers

Sow autumn: All the Year Round, Early London, Feltham Forcing, Cambridge No. 5, Remme, Mechelse.

Sow Jan.–Feb.: Pioneer, White King, Early Snowball, Remme, Lecerf.

Sow in open March–May: All the Year Round, Eclipse, Goliath, Orion, Novo, Autumn Giant.

Winter cauliflowers or broccoli

Michaelmas White .	Oct.–Nov.	
Roscoff Early . .	Dec.–Jan.	only in mild coastal districts
,, No. 1 . .	Jan.	only in mild coastal districts
,, No. 2 . .	Feb.	only in mild coastal districts
,, No. 3 / ,, No. 4 .	March–April.	
,, No. 5 . .	May	
Leamington . .	March	
St. George. . .	April	
Late Queen / Whitsuntide / Royal Oak . .	May–June	

With all winter and spring varieties the time of cutting is liable to vary from year to year according to weather and it may be generally reckoned that in the milder areas they will mature two to four weeks earlier than in the later northern districts.

Sprouting Broccoli: Of this there are two forms, the white and the purple. Calabrese may be considered as a summer form of sprouting broccoli, needing the same treatment as spring-sown summer cauliflowers.

Cape Broccoli: Purple Cape Heading.

CELERY

Apium graveolens

THERE are two distinct forms of celery: (*a*) those which naturally have a green leaf and leaf stalk, the latter being in some varieties tinged with pink; the varieties in this group need blanching at the end of the growing season in order to produce white leaf-stalks in the heart of the plant, such blanched leaves being crisp and forming a popular salad; (*b*) the so-called "self-blanching" varieties, which naturally produce pale green leaves with white or cream leaf-stalks; the plants are usually encouraged to produce paler growth by close planting, but the crop when grown unblanched never has the tenderness of the other group; it is normally eaten cooked.

The best *main-crop celery* is grown on soil which is deep, rich, and moisture-holding but well drained, for although celery is a moisture-loving plant—being in fact a semi-aquatic—it will not thrive in a water-logged soil. The principal areas of commercial production are on the Fen soils of the Wash counties and the moss soils of Lancashire.

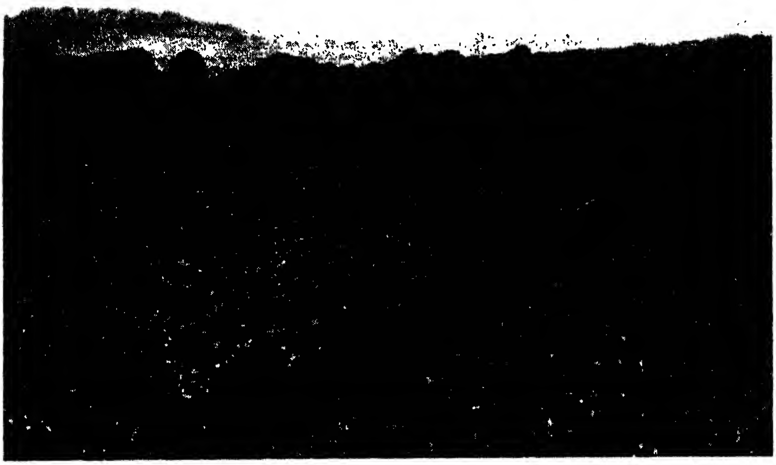
A serious trouble of celery is leaf spot and the only satisfactory method of control lies in a clean source of seed (see p. 292). Sowing may be done in gentle heat in a greenhouse; for this the J.I. seed compost can be used (see p. 307). Sow thinly in boxes, from the middle of February to mid-March, lightly covering with compost. Sowing may also be done in frames either on hot-beds in February or cold in March. Sow about ¼ oz. seed per Dutch light, lightly raking or covering with sifted compost. A good soil on which to stand the frames is a loam which has been well dunged for the previous crop.

As soon as the seedlings can be handled they are pricked out, either in cold houses or in frames. They are spaced at 2 in. square. The soil for these beds should have a good humus content from generous dressings of well-rotted dung and should have a light dressing of a complete fertiliser at about 1 oz. per sq. yard. The seedlings must always receive abundance of water, so as to keep them growing steadily, a check at any period of their growth, either in seed-bed, plant-bed, or permanent quarters, being detrimental and causing them to run to seed.

The first planting in the field will be started about the end of May or early June. When the plants are ready for lifting a sharp spade is run between the rows of seedlings and if necessary the beds should then be watered. The next day, lifting may be done to trays on which the plants are carried to the field. If the plants are well advanced in growth it is a good plan to cut off part of the larger leaves and thus reduce the demands on water.

Preparation of the Land. The site to be planted should be deeply worked in early winter and when dry enough, in March or April, should be freely cultivated on the surface to clear the seedling weeds which will have developed. In some districts a furrow is ploughed along the line for each row of celery and in this is placed a dressing of dung, after which the ground is levelled again. These rows may be 5–5½ ft. apart as in Lincolnshire or up to 7 ft. apart as in Lancashire where they are usually intercropped with other vegetables. Shortly before planting the land should be given a dressing of complete fertiliser or, if dung is given along the rows, a dressing of 3 parts of superphosphate and 2 parts muriate of potash.

Planting. The plants are dibbled-in, often very closely at 8 plants per yard of row, though some growers favour more room at 5 plants per yard.



[*By courtesy of "The Grower"*

FIG. 60. Self-blanching celery in frames

Summer Work. Constant cultivation will be needed between the rows, as weeds grow rapidly; careful hand-hoeing is needed between the plants in the rows. Though care must be taken to avoid feeding with too much nitrogen (which may cause hollow leaf-stalks) it is often necessary to give a top-dressing after the plants get well established.

Blanching. This operation extends over several weeks and usually starts in July, when a first furrow is ploughed towards the plants with the object of keeping the leaves upright. Two or three weeks later when the plants are about 18 in. high more soil is ploughed up to the plants. (Before this it may be necessary to work the soil between the rows to a good tilth by repeated cultivations.) At this stage soil is worked between the plants with boards or spades. The final earthing usually takes place about three weeks later, and for this the specialist celery producers have ploughs with high mould-boards. The finishing touches are given by hand.

Lifting is preceded by cutting down the ridge as close as possible to the celery. This makes the heads more accessible.

Garden Production. In gardens it is customary to plant celery in single or double rows in trenches which have received a good dressing of dung. By planting in trenches some 6–8 in. below the surface level of the soil a narrower spacing of the rows is possible, as sufficient earthing-up may be done without having a wide alley to provide the soil. Trenches for single rows may be 15 ins. wide and 3 ft. apart; for double rows use trenches 26 in. wide and 4 ft. apart. Space the plants in a single row 9 in. apart and in a double row 12 in. apart.

Self-blanching or Doré Celery

The seed of this crop is sown about the first or second week in March in a similar manner to that already described. It is usual to prick out, particularly for open ground planting, but if an early crop is being grown in frames it is sometimes possible to set out directly where the crop is to stand.

In the French garden this crop is grown on the spent hot-beds and may be intercropped with lettuce; it may be grown in rich soil in frames, the lights being removed when the plants need head-room; or it may be planted out in the open field. The final planting distance is usually 9 in. by 9 in. or 10 in. by 10 in.; the wider spacing is necessary if it is to be intercropped with lettuce. In the open field a wide area may be fully planted, leaving only narrow tracks for access with irrigation lines. Copious applications of water will be needed during dry weather.

One or two applications of a top-dressing will usually be needed. Hand-hoeing will be needed during the first few weeks after planting, but as the foliage meets across the rows the crop smothers all weeds.

Lifting will be done, according to the sowing date, from mid-August to October or even later, though the crop is cleared before severe frosts are expected.

The former practice of covering a small area of the bed with light mats about ten days before lifting, in order to give extra blanching, is rarely followed today.

Manures. For the main crop 25 tons of farmyard manure should be given in late winter or early spring. It is particularly advantageous to apply this to a deep furrow along the line of each row, as already mentioned. Before planting the land should be given a mixture of 1 cwt. sulphate of ammonia, 4 cwt. superphosphate, and 2 cwt. sulphate of potash. When well established give one or two side-dressings of nitrate of soda or potash nitrate at 1 cwt. per acre.

Self-blanching celery needs land in good heart. Give 30–40 tons farmyard manure per acre, ploughed in well in advance of the crop. Before planting give 6–8 cwt. per acre hoof and horn, 4 cwt. superphosphate, and 2 cwt. sulphate of potash. When established give two applications of nitrate of soda or potash nitrate at 1 cwt. per acre each time.

Varieties

White: Waring's Dwarf, Bibby's Defiance, White Perfection.
Pink: Standard Bearer, Clayworth Prize, Resistant Pink.
Self-blanching: Golden Self-Blanching, White Plume.

CELERIAC, or Turnip-rooted Celery

Apium graveolens rapaceum

CELERIAC is a very similar plant to celery, the principal difference between them being that in this case the root is developed into a mass resembling a turnip, and is the part used as a vegetable, whilst the stems are rejected. As celeriac is grown on the flat, and does not need blanching, it is much easier to grow than celery, though as the demand for it is limited it should not be grown for market unless the salesman advises that he is likely to clear it. Well-manured ground, an abundance of water, and a long season of growth are the requisites for the production of fine roots. Seed is sown in a gentle heat about the middle of March and the seedlings are treated in the same manner as celery. As soon as suitable ground is at liberty after the beginning of June plant out, 12 in. by 12 in. or 12 in. by 15 in. apart. The plants must be carefully trimmed before planting, all lateral shoots being removed; they must be set as shallow as possible and watered in well. During the summer never allow them to stand still for want of water and keep the ground clean by frequent hoeing. All old sprawling leaves and lateral shoots must be removed once or twice during growth.

The largest roots will be ready for use from the middle of

September onward. Early in October the crop may be lifted and trimmed of the thongs and outer leaves, then stored in sand or earth in a dry cool shed or cellar.

CHICORY

Cichorium intybus

WHEN forced and blanched, Chicory makes a very wholesome and acceptable salad for the winter and early spring months. It is easy to grow but it has never become one of the more popular crops.

As good strong roots should be available for forcing, the soil for this crop should be well manured and deeply cultivated so that a free growth may be obtained. Seed should be sown in the latter part of May or early in June, in rows 1 ft. apart, and the plants thinned out to 9 in. apart in the row. The only attention needed during growth is hoeing and, if the season is exceptionally dry, occasional watering, though chicory, being deep-rooted, is better able to thrive in a drought than most plants.

When the leaves have died down, about the beginning of November, the roots can be lifted. They should then be about 2 in. through at the top. Trim off any remaining leaves to within ½ in. of the top, and rub off all small shoots, leaving only the main crown. Cut all the roots at the bottom to bring them to one uniform length of from 8 in. to 10 in. They can then be stored away until wanted for forcing, in fine moist soil or sand, and as a very little increase of temperature is sufficient to excite growth, they should be put in a position which although safe from hard frost is still cold, such as the foot of a wall or in an open shed, or in a trench in the open covered with 6 in. of ordinary soil.

Forcing can be carried on from the time the roots are lifted, and with good management an unbroken supply can be maintained from November to May. The operation may be done in numerous ways, according to the quantity to be handled, always remembering that whatever method is adopted, absolute darkness is essential.

Forcing may be done in the open air as follows:—On light well-drained soil make a trench 16 in. deep and 4 ft 6 in. wide. Partly fill this with light fine dryish soil. Set roots in this at 1 in. apart in the rows and 2 in. between the rows with the tops 8 in. below ground level. Water in after planting. Fill up over the roots to ground level with similar light dry soil to a depth of 6–7 in., then build over the trench a hot-bed, 1 ft. wider than the trench, 2 ft. deep, and as long as will cover a week's supply of heads. Each succeeding week cover a further length of the trench, joining up to the preceding hot-bed. Each lot will be ready about a month after covering. If no horse manure is available the beds may be covered with a range of Dutch lights or with corrugated iron sheets and over these scatter a thick layer of straw.

The roots may also be forced in sheds or greenhouses, being placed in beds of soil, watered, and covered with dry soil, sand, or peat. Filling must be done by instalments if a succession is required. The sheds should have a temperature of about 65° F.

As growth proceeds the leaves are held together in a large firm bud or chicon as it is called. When these buds begin to break the surface of the soil they are cut immediately below the leaves. Damaged or discoloured leaves are removed.

Manures. After a liberal dressing of manure in the autumn a complete fertiliser is given just before sowing. This may be 1 cwt. sulphate of ammonia, 3 cwt. superphosphate, and 1 cwt. sulphate of potash.

Variety. The variety Witloof is the only one which is widely grown in this country.

COLEWORT or COLLARD

Coleworts or Collards are a small distinct variety of cabbage, hardy and quick to mature, but they do not form a close, compact head. They may be used for late summer or autumn supply, but on the markets at that season have been almost entirely superseded by the hearted cabbages. Similarly the spring greens of the Offenham and other cabbages have replaced the use of collards and in fact are sometimes spoken of as collards.

Seed should be sown in April or May, and the crop grown as for summer cabbage.

Variety. Hardy Green.

CUCUMBER (FRAME)

Cucumis sativus

By far the greater part of the cucumbers sold in the public markets are grown in glasshouses specially adapted to this culture, but in many gardens they are grown in frames, in some cases on quite a large scale. We shall confine our remarks to a description of their cultivation and management in frames.

The site selected for the frames, especially for those which are to be planted early, should be sheltered from cold winds, free from shade, and facing the south. The ground should be well drained, so that the water, of which they need copious supplies, will pass away freely; on ill-drained soil the base of the bed becomes sodden with stagnant moisture and under such circumstances the bed soon gets cold and the plants become unhealthy. It will seldom be found profitable to start the beds before the beginning of April, and for ordinary purposes the end of April will be found quite soon enough. At this date less manure will be required for the hot-beds and the plants will grow away more freely and be easier of management, whilst frames which have been used in the production of early salads and similar crops will be empty by the middle of April and will then be available for growing cucumbers.

Sowing. Seed should be sown four weeks before the beds are ready for planting, so that by the time the beds have got warmed through there will be good strong plants ready to set out. When there are a good number of frames to fill, the seed may be sown in small batches every two or three days, so that they may be planted in regular succession as they become ready, otherwise some may get pot-bound before they can be planted, and this must be avoided if possible, because the best results are always obtained when the plants never experience any check, particularly in the early stages.

Where a heated greenhouse is available, this should be taken advantage of for raising the plants, but where there is none a small hot-bed must be made for this purpose. Even in a greenhouse it is a good plan to make up a small hot-bed in which to plunge the pots, so as to afford a moist bottom heat of about 75 degrees. The hot-bed in the open should be made in the last week of March, in a sheltered position. It should be at least 3 ft. thick, and large enough to accommodate the number of plants required after they are potted up. It should project 18 in. beyond the frame all round. (Full instructions for the making and management of hot-beds will be found on pages 78-80.) When the bed is made, put on the frame and stack fresh manure all round it to the level of the lights; then put inside 4 in. of light rich compost and plunge in a soil thermometer. Put on the lights, leaving them open about 1 in. at the top to allow for the escape of strong heat, and cover all up with mats to ground level. For a few days the heat will probably rise to a considerable height; as soon as it has fallen to 80 degrees the seed may be sown. This may be done directly in the bed, at 2 in. apart, or separately in "60" pots, well crocked and half filled with soil. The advantage of sowing separately directly in the pot consists in the avoidance of any check which the seedling may receive when it is lifted from the seed-bed for potting up. In either case the soil must be moist, so that no watering is needed until after the seed has germinated.

Management of the Young Plants. As soon as the seedlings show give them all the light possible, removing the mats during the day but replacing them at night. In eight or ten days they should be growing strongly; if they are in pots fill these with soil to within half an inch of the rim; if they are in the bed lift them carefully without hurting the roots and pot them up to the seed leaves in large 60's. The soil used for this purpose should be moist and should have stood in the frame or greenhouse for a few days previously so as to get warm. After potting plunge the pots up to the rims in the same bed, water with tepid water, and shut up closely. For a few days, until the roots begin to work again freely, scatter a little light litter over the lights to break the direct rays of the sun, after which they must be grown in full light, near the glass, so as to keep them dwarf and stocky.

No effort should be spared to avoid everything which is likely to check the growth of the young plants. A fine still day should be chosen for the transplanting operations and a screen of mats should be fixed round the frame to shield the plants from cold draughts. If the heat in the frame is found to decline below 65 degrees F. the manure stacked round the sides should be pulled down and replaced with fresh. Keep the plants evenly moist but not wet, and raise the lights slightly at the top for a few hours in the middle of the day, but take careful precautions against cold draughts. As soon as the first two rough leaves are well formed, pinch out the tip or centre of the plant above the second leaf. This will cause two lateral shoots to break away, one from the axil of each leaf.

Preparing the Beds. By the second week of April make preparations for the beds on which the plants are to be set out permanently. The materials should be at hand, consisting of equal parts of fresh stable manure and of leaves, or if no leaves are available, then of old hot-bed manure or rotted stable manure.

Throw these roughly together in a compact heap, sprinkling plenty of water upon them during the process, if at all dry. In a few days the heap will be very hot, when it must be turned and thoroughly mixed again, giving more water if still on the dry side. Unless more than half the heap consisted of fresh manure it will need no futher turning, but will be ready for use in the course of three or four days.

The ground having been well dug and manured some time previously, set one row of frames exactly in position, then mark out down the middle of the frames, from end to end of the row, the position for a trench 2 ft. wide. Dig out the trench in the first frame a good spit deep, wheeling the soil to the other end of the section. Then fill the trench with the prepared manure, shaking it out well. Tread it in evenly and firmly, filling the trench a little above ground level. Then take out the second trench, and throw the soil from this on the manure inside the first frame. Repeat this operation until the section is finished, the soil from the first trench being used to put inside the last frame.

The soil in the frames must be well broken up and levelled; in the centre under each light open a space, about 9 in. across, and fill it with light rich compost. As each bed is finished put on the lights and cover with mats. Paths between the frames should be 12–15 in. wide.

Planting. A few days after covering the soil will be warm, and then the plants can be set out in the compost, one plant under each light, with one lateral directed towards the back and the other towards the front of the frame. Care must be taken that the roots are not disturbed. After planting, water gently with tepid water, then shut down the lights closely for three or four days, cover with mats at night, and shade from strong sunshine during the day by scattering litter over the lights. When growth has started freely, give air and water, very little at first but gradually increasing with the growth of the plants. The soil should be kept moist but never sodden, and if the weather should become very dull and cold, watering should cease altogether or be given in great moderation. If, as sometimes happens, severe weather returns late in spring, the spaces between the frames and round the ends should be filled with warm manure. Covering with mats at night should never be omitted until well into June.

Training and General Management. If the laterals are strong when the plants are set out they should be stopped at the second leaf, or if not strong enough at that time then about a week after planting. This will cause four shoots to break away, which can be trained one to each corner of the light. Let them go until within 9 in. of the corner, when they must be stopped. These will throw out shoots which must be regulated according to the space available, being stopped or removed altogether when there is danger of over-crowding. Fruit will now begin to show; none should be allowed on the main stems. Pick off male flowers. The lateral shoots should be stopped one leaf beyond the first fruit. The fruit is cut as soon as it is ready so that the plants may continue vigorous, and producing fruit of good quality.

Keep the growths well thinned out and evenly disposed over the soil, never allowing them to become a tangled mass. Cut out shoots which have fruited and train new ones in their place. When the leaves are crowded a few of the oldest may be removed, so that all may get a full exposure to sunlight, but remember that whilst it is courting failure to allow the plants to become a jungle of growth, it is equally bad to overdo the thinning, as a sufficiency of healthy foliage is necessary to the well-being of the plant and the production of fruit.

The next matters of importance are the ventilation, the temperature, and the watering. The temperature to be desired is 70 degrees by day (which may rise 15 degrees higher by sun heat without injury) and 60 degrees by night. For the first few weeks there should be no difficulty in maintaining the necessary warmth by the aid of the manure under and the linings round the frames, assisted by the covering of mats at night. By the middle of June the heat in the manure will have passed away, and the best will have to be made of the natural weather conditions. As a rule there is little to fear in this respect, though if the weather should prove cold, ventilation and water must both be given sparingly.

With free growth and genial weather water must be given without stint each morning to the plants requiring it, but those already moist need only a sprinkling. As they gain strength more air must be given, by raising the lights a little in the morning and increasing the opening as the day advances. Once before noon and again in the middle of the afternoon the plants and the whole of the inside of the frame should be well syringed or watered through a fine rose. Immediately after the second damping the lights should be shut down close; this will raise the temperature and give the plants the moist atmosphere which is so congenial to them.

Weak soot water may be occasionally substituted for the clear water used in damping down. When red spider is at work it is easily detected by the rusty appearance of the leaves, in which case remove and burn the worst and syringe thoroughly underneath the remainder with a proprietary wash containing Derris extract or petroleum emulsion. Should the summer be very hot and bright it will be very helpful to the plants if the lights are shaded a little; this can be done most economically as regards labour by splashing thin whitening over them, but do not brush the glass all over.

By the middle of August the crop on the beds made first will be failing. Those planted at the beginning of May will carry on into September. Cucumbers may be grown in frames without the use of a hot-bed but in a cool spring are less successful.

Manures. Providing the soil used for the bed was previously treated to a liberal dressing of well-decayed stable manure and a light dressing of superphosphate has been added, no other fertiliser is likely to be wanted until about five weeks after planting, when a mixture of equal parts dried blood, superphosphate, and sulphate of potash may be given at 2 oz. per sq. yard at 14-day intervals. Keep the fertiliser off the plants.

Varieties. Of the numerous varieties for frame culture Butcher's Disease Resister, Conqueror, and Telegraph are all good.

CUCUMBER (RIDGE)

RIDGE CUCUMBERS are often a useful salad in the south of England. Their flavour is distinct from that of their relative and often slightly bitter.

To prepare good plants for the earliest crop sow the first seed in early April in gentle heat and handle the plants precisely as for frame cucumbers, except that during the week before planting they must be given plenty of air to get them well hardened.

A moisture-holding yet well-drained soil is suited to this crop.

After the plants are hardened off put them out in rows 5 or 6 ft. apart and 18 in. apart in the rows. Cover with continuous cloches till danger of frost is gone. The earliest planting will be from the middle of April where cover can be provided, but if no protection is available the open ground planting will not be safe until May or June and the sowing should be proportionately later.

Seed may also be sown in the open in rows spaced as before, placing two seeds at 18-in. intervals and later thinning to leave single plants.

In hot dry periods the plants will respond to liberal watering.

Gather the fruit three times a week, never leaving any to become old or yellow unless specially wanted for seed.

Manures. Dung may be ploughed or dug in along the line for the plants; this helps to retain moisture.

Shortly before sowing or planting give superphosphate 3 cwt. and sulphate of potash 1 cwt. per acre. When the crop starts to flower give a top-dressing of nitrate of soda at 1 cwt. per acre.

Varieties. Perfection and Cheltenham Long Ridge give fair-sized fruit; Japanese Climbing and Stockwood Ridge are smaller-fruited.

ENDIVE

Cichorium endivia

ENDIVE is not widely popular in this country as a salad plant and it should only be grown for market when there is a known demand.

It is chiefly used as an autumn and winter salad, the demand for spring supplies being very small, and therefore, unless there is some special call for it, cultivation should usually be restricted to the autumn and winter supplies. Any sowings made before the longest day are very liable to "bolt".

For general purposes a small sowing of one of the fine curled varieties should be made in late June, another of a similar variety about the middle of July, and two others of hardy varieties at the beginning and in the middle of August. The seed-bed, which should consist of good rich soil, must have the surface made firm after sowing. Unless the seed-beds are quite moist they should be thoroughly watered before sowing.

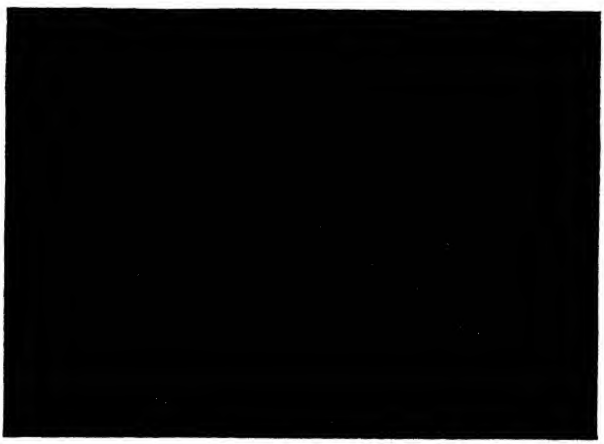
The soil for endive should be rich but not too heavy. The earlier plantings are best made in a moist position at 1 ft. apart each way. The later varieties, which are of stronger growth, should have 15 in. space each way.

The seed may also be sown where the crop is to mature, sowing thinly and thinning out to the required distance. Seedlings from a September sowing may be transplanted to frames, placing them 10 in. apart in each direction. Keep out severe frost and this should give early spring crops.

Blanching. Endive is useless unless it is properly blanched. This operation is easy in the case of the earlier supplies. On a day when the plants are quite dry the leaves are gathered together

[By courtesy of Messrs. Watkins & Simpson Ltd.

FIG. 61. Endive, Batavian



[By courtesy of Messrs. Watkins & Simpson Ltd.

FIG. 62. Endive, Moss-curled

and tied round with raffia. They are fit for use in a week or ten days in the summer, but as winter approaches and growth becomes slower the time required for blanching may be extended to three weeks. The latest supplies may be blanched as they stand in the bed, either by tying or by covering with pieces of slate, boards, or litter, or by any other means which will effectually exclude light from the hearts, but in wet seasons this method has disadvantages, as decay quickly sets in when the heart gets wet after being covered, and the plant is then spoiled. A good plan for the latest supplies is to lift and store them packed closely together in cold-frames. On a day when the plants are quite dry they are carefully tied up, lifted with a good ball of earth at the roots, and planted in the frames as closely as possible. Moist soil should be used, into which the endive soon pushes fresh roots. As soon as the frames are filled the ties are removed, and the lights are put on, raised a little at each corner to allow a current of air to pass through. The plants are blanched in batches, as required, by covering the lights with litter. In severe weather frost must be excluded by covering up the frames with mats. The hardy varieties of endive should be selected for storing and with care will keep sound until well past the turn of the year. When sufficient frames are not available the plants will keep a considerable time if stored in a similar manner in a dry shed. Under any method of storing the plants should be dry when lifted and free from any bruising or decay.

Manures. The soil should be rich following a well-dunged crop. Before sowing or planting a dressing of a mixture of sulphate of ammonia 1 part, superphosphate 2 parts, sulphate of potash 1 part, at 3 oz. per sq. yard may be given.

Varieties. For late summer and autumn, Rouen or Stag's Horn; for winter, Ruffec Green Curled, Broad Leaved Batavian; for wintering in frames to mature in spring, Moss Curled.

GARLIC

Allium sativum

GARLIC has a limited sale and most of the produce seen in the shops is imported. It may be grown successfully in the south of England and grows well on many soils, but for ease of harvesting the heavier soils should be avoided.

The bulbs which are lifted consist of clusters of "cloves" which at planting time are separated and planted singly. They may be planted in November in very mild districts or in early spring—February or March. Plant in rows 12 in. apart and 6 in. apart in the row, placing the cloves 1½–2 in. deep so that the new bulbs develop under the ground.

Hoe as necessary to keep down weeds. The bulbs should be ready for lifting by the end of July or early August. Allow to dry thoroughly and then store—small quantities may be hung in bunches in a dry airy shed; larger quantities may be kept in small sacks or on trays.

There are two types—one with a purple or mauve skin; the other is white-skinned and this kind is the more popular.

HERBS

THOSE gardeners who do a direct trade will often be asked to supply small quantities of various herbs for flavouring and other purposes, and it is therefore advisable to have a bed containing a small collection. A selection can be made from the following:

Basil, Sweet (*Ocimum basilicum*). Tender annual dwarf-growing. Sow in heat in April and transplant to the open, in light rich soil, 8 in. apart, at the beginning of June. Water until well established. As soon as the plants come into bloom cut them down within a few inches of the ground, tie up in small bunches, and so dry in the shade. After cutting stir the soil and fresh growth will be made. If potted up in September and put in a greenhouse a supply of green leaves may be had far into the winter. The leaves are aromatic and are used for seasoning.

Borage (*Borago officinalis*). Hardy annual. This plant requires no trouble in culture; it will grow in any odd corner and when once established self-sown plants come almost as freely as weeds. It is a strong grower and should be thinned to about 15 in. apart. Used in summer drinks and in claret cup, and is a favourite flower with bee-keepers.

Chervil (*Anthriscus cerefolium*). Annual, dwarf. May be sown frequently for a regular supply, at any time when the ground is fit, and is grown in rows like parsley. In hot weather it should be sown in a shady position, and needs frequent watering. The leaves may be cut from six weeks to two months after sowing, according to the season. It is aromatic, and is used for salads, garnishing, and seasoning. The "curled" variety should be used.

Chives (*Allium schœnoprasum*). Perennial, dwarf. Often grown as an edging plant and does well in that position. It grows in thick tufts or clumps. and is propagated by lifting and dividing these, which should be done every three or four years. To maintain a supply of young and tender leaves the clumps should be cut down regularly with a knife. Used as a mild substitute for onions in salads and soups.

Fennel (*Fœniculum vulgare*). Hardy perennial. Very easy to cultivate and will thrive almost anywhere. Sow in April and thin out to 1 ft. apart. It should be renewed by fresh sowing every two or three years. The feathery leaves are used for garnishing and for flavouring fish sauces.

Marjoram, Pot (*Origanum onites*). Perennial. May be grown from seed sown in April, but a stock is usually obtained from purchased roots. Plant at 10 in. apart each way. The leaves are used for flavouring, both in the green state and when dried.

Marjoram, Sweet or Knotted (*Origanum majorana*). This plant is a perennial in the countries of which it is a native, but in Europe is grown as an annual. Sow in March or April in warmth, or early in May in the open, and thin to 10 in. apart. Leaves may be gathered for using green in June. When the flowers appear cut the plants down, tie in bunches and dry. Fresh growth will be made after cutting down, and if necessary the plants can be potted up to supply green leaves through the winter. Used for the same purposes as the preceding.

Mint. *See article under this head.*

Parsley. *See article under this head.*

Sage (*Salvia officinalis*). Perennial. This plant can easily be raised from seed sown in the open in April or May, and when so raised is often satisfactory; sometimes, however, the leaves of such plants are narrower than a good sample should be, and to obtain a stock it is considered wiser to buy a few good plants in the autumn and propagate them. To do this, take cuttings of young soft growths during spring and early summer, and insert them in sandy soil, in a frame or under a cloche. When rooted, transplant, 15 in. apart, to permanent quarters, which should be well drained and rather dry. In the spring, just as growth commences, old plants may sometimes be divided. The plants raised in this way will last several years. If raised from seed they last only one, or at most two years. When in full leaf cut and dry. Used principally for flavouring sausages and similar meats.

Savory, Summer (*Satureia hortensis*). Annual. Sow in the middle of April, in a warm and well-drained situation, in drills 10 in. apart, and thin out to 8 in. apart. The leaves, which are aromatic, are used for flavouring, either in a green state or when dried. For the latter purpose cut the plant down when in flower.

When wanted fresh in winter sow at the beginning of September and pot up for the greenhouse.

Savory, Winter (*Satureia montana*). Perennial. A hardy dwarf shrub, which can be propagated either from seed sown in spring, from cuttings, or from division of the roots. The plants should stand from 14 in. to 16 in. apart, and should be cut down in spring to within 4 in. of the ground so as to induce a crop of fresh young shoots. The soil and situation required are the same as for summer savory, and the leaves are also used for similar purposes.

Tarragon (*Artemisia dracunculus*). Perennial, but although established plants will stand for several years without any particular attention, it is much more satisfactory when propagated annually, either by division in March or April or by cuttings inserted in sandy soil in frames early in summer. The plants need about 1 ft. space in each direction. The leaves are generally used green, for steeping in vinegar, or for flavouring and similar purposes. When wanted in winter it can be lifted and forced in a gentle heat, either in a greenhouse or on a hot-bed.

Thyme, Common (*Thymus vulgaris*). Perennial. This plant can be easily raised from seed sown in April, or it can be propagated by division of the roots in March or April. It does well in a soil which is fairly dry and well-drained, but should be taken up and re-planted in fresh soil every three or four years. About 4 in. space should be allowed between the plants. It is a general favourite for its fragrance and flavour, and no vegetable garden can be considered complete without it. It is used in various ways for seasonings, both fresh and when dried; for the latter purpose, cut and bunch when in flower.

Thyme, Lemon (*Thymus citriodorus*). All that has been said in the preceding paragraph regarding common thyme applies equally to this, its near relative. The chief practical difference between them is that lemon thyme has the more delicate aroma of the two, and for that reason is preferred by some people.

HORSE-RADISH

Cochlearia armoracia

HORSE-RADISH is not a subject of particular importance to the average grower for market. The trade in it has for a long time been mainly in the hands of Continental growers.

The plant delights in deep rich, moist soil; a light soil is an advantage at lifting time. It is propagated from pieces of the root of a pencil thickness, 6 in. to 9 in. long. The planting material is obtained when lifting and trimming for market.

These planting roots should be straight and unbranched, any secondary roots being rubbed off. The soil should be well dunged, well worked, and put up in ridges about 27 in. apart just before planting. A light rolling is advised.

[*By courtesy of "The Grower"*

FIG. 63. Horse-radish roots prepared for market

The planting is done in early spring and for this an extra long dibber is used. The holes are spaced 10 to 15 in. apart in the ridges and may be made sloping so that the roots are not vertical; this facilitates lifting in the autumn and also the practice which is sometimes followed in Germany whereby the ridges are opened in dull weather in June and shoots other than those at the top of the plant, and any branching roots on the upper 6 or 8 in. of main root are rubbed off. The top of the root-cutting should be just buried and kept buried, in order to prevent the greening of the upper portion of the root.

Lifting starts in autumn and may continue all winter or roots may be stored for use as required.

When the roots are taken up the whole bed should be cleared thoroughly, as any pieces left in may become a nuisance. To keep up a regular supply a fresh bed should be made each year.

Roots for sale should be straight, 8 in. or 10 in. long, and from $1\frac{1}{2}$ in. to 2 in. in diameter. When not to be disposed of immediately they can be kept in good condition for several weeks in moist sand.

KALE

Scotch and Cottager's—Brassica oleracea varieties,
Hungry Gap—Brassica × *napus*

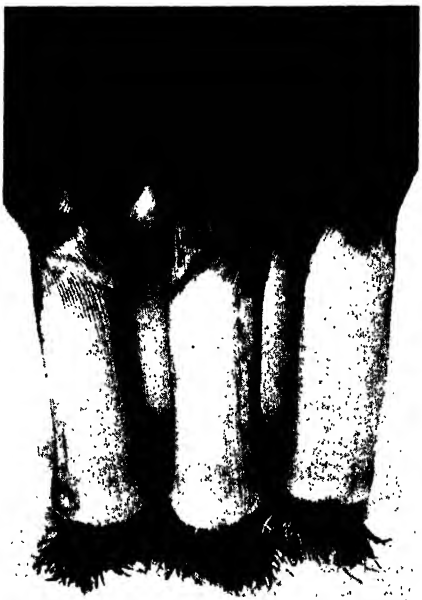
KALES are of importance in any garden where a supply of green vegetables must be maintained during the winter. For market they always sell readily enough in cold weather, though the returns in a mild season may be so low as to leave very little, if any, profit. When, however, severe frost cuts down most other things the hardier kinds of kale stand unharmed—indeed a sharp frost improves their quality for the table—and in such a case, when there is a scarcity of other green vegetables, a breadth of kale has often realised a handsome profit. They will provide a serviceable crop on almost any soil, but like all brassicas a strong, deeply worked loam suits them best of all.

Seed should not be sown too early, the beginning of April being quite soon enough. Sow thinly on a seed-bed. Transplanting should be done as opportunity occurs, choosing showery weather when possible. The distance apart depends upon the variety grown, some being much more spreading than others, but as a general rule they should be set from 2 ft. between the rows and 2 ft. between the plants. It is generally possible to snatch a quick-growing crop, such as lettuce, spinach or turnips, from between the rows before the kale needs all the space. Set out the last batch in the most exposed and northerly aspect, so that they will not be inclined to bolt so early in the spring.

Hungry Gap kale often suffers severely from winter-killing if it is transplanted. It should be drilled thinly in the rows where it is to mature, the rows being 18–24 in. apart and the seedlings thinned to stand 18 in. apart.

Manures. Whilst starved and stunted specimens are of very little use, on the other hand luxuriant and soft growth must be avoided or the plants will not have that hardiness which constitutes the especial value of Scotch and Cottager's kales. This indicates that whilst well-cultivated fertile soil is essential, that which has received recent dressings of strong manure should be avoided. Give 4 cwt. superphosphate and 1½ cwt. sulphate of potash per acre. Use caution with the nitrogen—1 cwt. sulphate of ammonia should be given before planting or possibly 2 cwt. if the land is considered to need it.

Varieties. There are two main groups of kales. One includes the Cottager's Kale and the "curly greens" or Scotch Kale, of which there are several forms, and the other the Asparagus and Hungry Gap kales.



[By courtesy of Messrs. Watkins & Simpson Ltd.

FIG. 64. Leek, Walton Mammoth

LEEK

Allium porrum

LEEKS are very hardy, being uninjured when standing in the open in the severest winter. They can be grown successfully on almost any kind of soil, but are worthy of and pay well for generous treatment. To produce the best and most profitable crops the ground should be deeply worked and receive a good dressing of well-decayed manure, and above all it should be well drained, for although leeks require plenty of moisture until their growth is completed, the water in the soil must never be stagnant. Given suitable conditions, leeks are remarkably free from insect or fungoid attacks.

For general purposes, sow in seed-beds about the middle of March, in drills 12 in. apart.

The land for growing the crop should be in a good state of fertility. If well dunged for the leeks it then forms a good preparation for a following crop of lettuce.

Planting is done in May, June, and early July. The seedlings are lifted and trimmed, the roots being cut to about 1 in. in length, and the leaves are cut so as to make the plants easy to handle. The planting is usually on level ground but may be in shallow drills; this latter method is helpful if planting in dry weather when watering is not possible. The rows are 12–18 in. apart according to the cultivation equipment which is to be used and the plants are spaced 6–8 in. apart in the rows. The dibber hole need only be 4 in. deep and the plants should be pressed in but not too firmly.

Keep the land clean during the summer by repeated hoeing. If irrigation is available this crop gives a good response to watering during periods of drought.

Marketing may start in September, but the chief period of demand is during the winter. Lifting is done with forks. The leeks are trimmed and washed before marketing.

Manuring. Dung at 20–30 tons per acre, ploughed in during winter, followed by a base dressing of 1 cwt. sulphate of ammonia, 2–3 cwt. superphosphate, and 1 cwt. sulphate of potash just before planting. A top-dressing of 1 cwt. nitrate of soda.

Varieties. Musselburgh, Lyon, Walton Mammoth, and Liege Late.

LETTUCE

Lactuca sativa

LETTUCE is the most important salad crop grown in Britain. For many years its popularity has been steadily increasing. Without the help of any glass, supplies may be had from May until October, or even November and December on sheltered sites in mild districts. With the protection of frames or cloches the season may be advanced into April and extended with certainty into early winter. With the additional help of heated glass cuttings may be made all the year round.

Care must be taken in the selection of varieties, as though some are good "general-purpose" sorts others are better used for specific reasons. There are two main types grown in this country, cabbage lettuce and cos; the former may be crisp-leaved or "buttery-headed", and for most markets, particularly in the south, the last-named group is the better seller. Some of the crisp-leaved types are very brittle and do not travel well, though they may be very popular for home use.

Almost any kind of soil may be so prepared that it will grow good lettuces, but for ease of working light sandy loams are to be sought. Whatever the type of soil employed, it is essential that for really good results it is rich with manurial residue from a previous crop; it is well drained, yet well supplied with moisture during the warm summer months, so that all the conditions favour quick growth; and that there be an adequate lime and potash supply. To grow high-quality cos lettuce the land must be in a high state of fertility.

Cabbage Lettuce. The earliest spring cuttings from plants grown entirely without protection are obtained from sowings made on a well-prepared seed-bed in late August or early September. Drill the seed in rows 12 in. apart using 4–5 lb. per acre; 1 oz. will sow about 500 ft. of drill. From the seed-bed the plants are transferred to their final quarters during October and early November, choosing a time when the soil is in the right condition. (In most seasons this work can only be carried out on light soils.) Land which has carried potatoes is in good condition for this crop. Plant 12 in. apart, in rows 12 in. apart. Avoid planting too deeply; keep the cotyledons clear of the ground; if buried too deeply the heads are unshapely with "peaked" bases. During open weather hoe to keep weeds in check. Further hoeing will be needed in spring before the crop is mature. There are usually a number of casualties during the winter, particularly from Botrytis. Cutting should start in May or early June and good crops may be obtained, but they compete with those from the late frame-grown plants or spring-transplanted ones, which usually are of higher quality.

The next open ground sowing will be made in the New Year, usually in March (occasionally in February). Sowing is actually done as soon as the soil is in the right condition—it should have been ploughed for some time, be well firmed, and have a good surface tilth. Don't sow to the calendar—wait for the right conditions. The rows should be about 12 in. apart (variations will depend on any particular cultivation systems which are adopted for hoeing). These plants should not normally be transplanted but thinned out, so a lighter seeding is followed than for the previous sowing; 3 lb. per acre should be ample. The thinning-out should be done as soon as the plants can be handled, reducing them to stand 12 in. apart. Hoe as required to keep weeds in check. The crop from this first spring sowing will mature in June or July.

Further successional sowings may be made until the end of July. Under optimum conditions for germination the seed rate may be reduced to 1–1½ lb. per acre. Under the very best growing conditions the crop matures rapidly; with a good moisture content in the soil May or June sowings can be ready in eight or nine weeks from being drilled. After midsummer the growth begins to slow down and July sowings usually stand well into the autumn. All the summer sowings need the cultivations directed towards maintaining a good water supply. Work the land some time before sowing or if the lettuce is following a recently cleared crop the land may be irrigated (if necessary) twenty-four hours before ploughing. Roll and harrow immediately after ploughing. During very dry weather further irrigation may be needed when the crop is part grown. From a late June or early August sowing plants may stand late into the autumn and may be protected by continuous cloches.

The most important early crop from the open is from sowings under frames or cloches in October and early November, the seedlings being planted out in early spring. For this crop considerable attention should be paid to getting the seed-bed in good condition. It should not be cropped for some weeks prior to sowing but have *well-rotted* dung worked into the soil, if it has not a residue from a previously well-dunged crop. Spent mushroom-bed compost is a good material to apply or two or three successive summer radish crops make a good preparation—dung (and lime if needed) being given to the first of the radish crops. Repeated cultivations, possibly with a rotary cultivator, prepare an excellent seed-bed, with any organic matter being well mixed in. In a very dry autumn it may be necessary to irrigate the site before making up the beds, as, ideally, the land should at sowing time hold sufficient moisture to last until planting time.

The seed-beds may be level or on raised banks with a slope to the south. The double-light span frame (Fig. 21) is generally used by Dutch growers and gives good results. It may be erected after the land is prepared, or if the frames are being left down for several years the soil is then worked in the frames, being dug or worked with a rotary cultivator. The raised beds have been used by the market-gardeners of the London area for a very long time. Fig. 35*d*

[*Reproduced from Ministry of Agriculture & Fisheries Film Strip* 48, *by permission of the Controller, H.M. Stationery Office*

FIG. 65. Fining the surface of soil in frames on raised banks before sowing lettuce

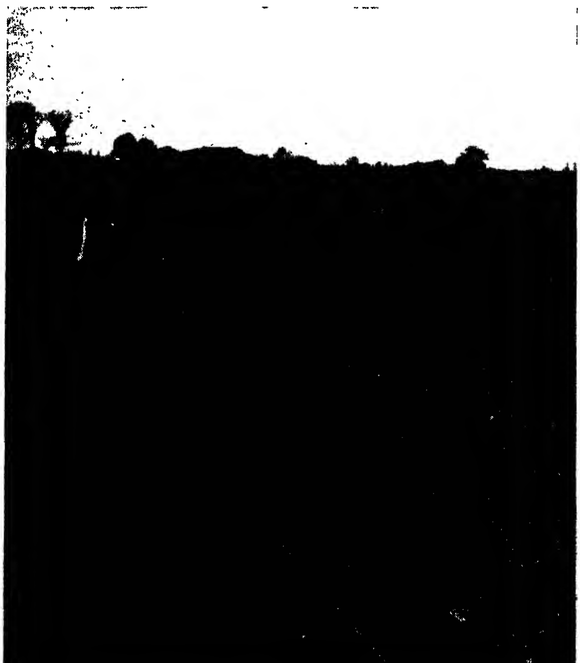
shows a section of a frame ground with such raised banks. With either system a fine surface tilth must be obtained and a smooth level bed before sowing. Similar preparation would be given for seed to be sown under continuous cloches. These are excellent for over-wintering seedlings. Seed is sometimes raked in after sowing, but a more uniform germination results from covering by sifting soil over the seed so as to just cover it. Where a quantity of lettuce is grown three sowings should be made between about the 10th October and 5th November. This enables not only a succession of cuttings in spring but a succession of work. The plants from the first sowing are usually pricked off about 2 in. square as soon as they can be handled. Where pricking-off is to be done sow 1 oz. seed to 4 Dutch lights; where no pricking-off is to be done sow

1 oz. to 25 lights. Try to space the seeds at least ½ in. apart and if it is considered that the seedlings are too thick they may be thinned out a little. Should planting-out be delayed into March or even April owing to bad planting conditions, crowded seedlings soon spoil in the frames—they get long and "rabbit-eared" and are liable to be attacked by Botrytis.

Keep the frames close after sowing. In some districts sparrows are troublesome and it may be desirable to run a few strands of black cotton along the frame in order to check them. Fasten this to nails tacked into the end boards. As soon as the seedlings are through the soil abundant air should be given, as it is necessary to keep the seedlings sturdy. It is here that the single-light ranges on the raised beds are of advantage, as the lights can be completely drawn back, giving the plants full air. Cover the frames when rain threatens but give bottom air at all times unless snow is drifting.

The planting-out to the open takes place as soon as the soil is workable in February or March; January planting is not unknown. The site should be in good heart but not freshly manured. Where leeks are grown in quantity they leave the land in excellent condition for lettuces. If the land has only recently been ploughed it should be rolled and worked to an even tilth with a very level surface. Reference has already been made to the importance of avoiding deep planting. Growers resort to various methods to achieve this. Most growers who specialise in this particular crop refrain from using the usual drag markers to mark the lines before planting, in order that the planters may avoid planting in the bottom of a drill. Sometimes a line is stretched taut across the plot, and if a boy walks along this, the line leaves a mark as it cuts into the soil. Two boys working with two lines can cover the ground fairly quickly. Planting should follow immediately afterwards. The rows are 12 in. apart and the plants placed 12 in. in the row. It sometimes happens that worms are very troublesome, as, by pulling the leaves into the ground they pull *out* the roots. This is only liable to happen in the first few days after planting and may be discouraged by dusting the field with hydrated lime. Hoe to keep weeds in check. The crop should be mature in May or early June. Lettuce is sometimes sown in cool greenhouses in December or January for planting out in March.

Cos Lettuce. Cos lettuce may be grown from outdoor sowings in spring, from autumn sowings in cold-frames for March planting, or from February sowings in cold-frames to plant out as soon as large enough. It needs more room than does cabbage lettuce and should be 14–15 in. apart in each direction when finally spaced out. It is highly intolerant of drought conditions and in the south should not be sown late in the open. If the



[*Reproduced from Ministry of Agriculture & Fisheries Film Strip 48, by permission of the Controller, H.M. Stationery Office.*

FIG. 66. Two boys, one each end of the field, stretch two lines taut. They walk along one until they meet, turn, and walk back along the other

weather is too dry as the crop matures the plants fail to heart properly. In Lancashire on the moss land it is usually grown as an intercrop between the celery before earthing-up starts.

Lettuce under Glass. To mature under glass two sowings may be mentioned. An August sowing, put out in frames on soil in good heart, planted 9 in. by 9 in., gives a crop which matures in November or December. Cloches may also be used for this purpose and for the next-mentioned crop. Plants from the October sowing described on p. 190 may be matured under frames, under Dutch-light structures or under cloches, or they may be nursed for part of their time by frames or cloches and finally finished in the open.

The seedlings are planted out in their final quarters in December, January, or February as weather permits. For most varieties 9 in. by 9 in. is a good planting distance, but if Cheshunt Early Ball is being grown the distance may be as close as 7 in. by 7 in.

With lettuce in cold-frames see that there is adequate water in the soil before sowing, pricking-out, or planting. Ensure ample supplies whilst growth is active until hearting starts, when little more, if any, should be needed until cutting time.

For cultivation on hot-beds, whether under lights or cloches, little need be added here to what has been said on p. 94. It is probable that the bell-jars on a hot-bed provide the best means of growing high-quality cos lettuce, but the market for such produce is limited and the skilful producers of such produce are but few today.

Manuring. As already stated lettuce needs land in good heart, but it is advisable to give liberal manurial dressings to the previous crop. If it be necessary to give dung to the lettuce crop it should be well rotted; imperfectly buried straw is a possible host for Botrytis and it is obviously undesirable to have such centres of infection scattered through a lettuce crop.

Lettuce which is over-wintering in the open should have 4 cwt. superphosphate and 2 cwt. sulphate of potash per acre when preparing the land and be given a top-dressing of 1–1½ cwt. potash nitrate as growth starts in spring.

Spring sown or planted crops should have 1–2 cwt. of sulphate of ammonia (or 4–6 cwt. hoof and horn), 3 cwt. superphosphate, and 2 cwt. sulphate of potash.

For seed-beds in frames superphosphate at 2 oz. per sq. yd. is useful. For a crop in cold-frames there should be a good residue of humus from previous crops or a dressing of something like spent mushroom-bed compost worked in. In addition give sulphate of ammonia 2 oz., superphosphate 4 oz., and sulphate of potash 4 oz. per sq. yd.

At all times make certain that the land is well limed. For seedlings under glass in winter this is particularly important. The soil should have a reaction of not less than *p*H 6·5.

Varieties.

Cabbage

(*a*) To over-winter in the open—Arctic King, Winter Crop, Imperial, Stanstead Park.

(*b*) Spring sowings in the open—Feltham King, Market Favourite (syn. Unrivalled, Improved Trocadero, Borough Wonder).

Summer sowings—Market Favourite, Cobham Green (good dark green in hot weather), Iceberg, Webb's Wonderful, Sutton's Favourite (the last three are crisp-heading types).

Late summer sowing to mature in autumn—Feltham King.

(*c*) October sowing in frames and cloches—May King (syn. May Queen); Gloria is almost identical with May King but

[*By courtesy of Messrs. Watkins & Simpson Ltd.*

FIG. 67. Cos lettuce, Lobjoit's Green

does not develop the pink tinge on the outer leaves during cold weather as does May King; Feltham King, Attractie (syn. Northern Queen).

(*d*) To crop in cold-frames or cloches in autumn—Feltham King, Trocadero.

(*e*) To crop in cold-frames or cloches in spring—May King, Cheshunt Early Ball, Early French Frame (the strain of this known as Blackpool is resistant to mildew), Northern Queen (may be finished in open).

(*f*) To crop on hot-beds—Gotte à forcer.

With the exception of the three crisp-heading summer lettuces mentioned above all these varieties are butter-heads, which are the most popular for market. If, for a market which does not involve a long journey, it is found that crisp varieties may be grown, Iceberg or Webb's Wonderful should be tried.

Cos. Lobjoit's Green is the best market variety and does well either in the open or under bell-jars. Paris White, Balloon, Vaux's Self Folding.

Half Cos. Winter Density, Little Gem. These are of very good flavour and excellent for home use, but of little value for market.

MELON

Cucumis melo

WHILST Melons cannot be classed as vegetables, they generally form, in gardens where early salads are grown in frames, a part of the rotation of crops, and it would therefore be absurd to omit a description of their culture on the plea that they are classed as fruits.

The English Netted Melon can be successfully grown in frames provided with a bottom heat of not less than 65 degrees, but on the whole it is not sufficiently hardy to constitute a reliable market-garden crop except in glasshouses, in which its commercial culture is almost entirely carried on.

The Cantaloup Melon, also known as the Rock Melon, lends itself much more readily to frame culture.

A succession of cropping may be obtained by making a series of sowings from early March to Mid-April; the principal sowing is usually in mid-March. The earlier crops must be grown on some sort of hot-bed, and though such help is always advantageous, in the south of the country the main crop may be grown successfully in cold-frames.

Sowing should be done in heat. The seed may be sown in boxes, spaced 2 in. apart, and when germinated the seedlings are moved to 3½-in. pots, using a J.I.P. compost (see p. 307).

Single-light frames should run east to west; double-light span ranges run north to south. If hot manure is to be used the frames should not be erected intil the manure is in the ground.

About six weeks before planting, fresh stable manure should be stacked near the frame ground and a month later a trench 18 in. wide and 9 in. deep is taken out along the centre of the site of each range. Carry out the work as for cucumber (see p. 175). A mixture of new and old dung is shaken into the trenches, filling them almost to the top. This is pressed down and covered with soil from the trench to a depth of 6–7 in., forming a low ridge. The frames are then erected and the lights placed on. The soil should warm up to about 60° F. and is usually ready to receive the plants about a week after the dung is in the ground.

If no hot-bed is made the soil should be in very good heart from the manuring for previous crops and should also be given a further liberal dressing of stable manure. Where supplies are short a forkful of the manure may be buried at the point where each melon plant is to be placed.

Planting is at the rate of one melon plant in the centre of each light. It is usually done in early May on hot-beds and late May in cold-frames. All plants are stopped at the fifth or sixth leaf. About ten days later four good shoots are selected on each plant; the others are removed. The selected shoots are trained towards the corners of the lights—when they reach the limits permitted by the space they are stopped. Lateral branches arise and it is on these that fruit may be allowed to develop.

The female flowers may be distinguished from the male by the small fruit which is formed beneath them. For the early crops it will be necessary to pollinate the female blooms to ensure the fruit developing properly. This is best done about noon on a clear bright day, when several bold female blooms stand fully open. A well-developed male flower is taken and after removing the outer petals its pollen-laden stamens are inserted within the female flower and a slight turn gently given. One male flower will serve for all the female flowers on each plant.

It is not necessary to fertilise the blooms on the main-crop plants; perfect fertilisation takes place naturally owing to the fact that pollen forms more readily under the influence of increased sun-heat, and the free admission of air to which the plants are subjected causes it to be freely distributed by bees.

When the female flowers appear, look over the plants carefully and remove any fruits which may have formed on either of the main stems. When fruit has formed on the sub-laterals to the size of a pigeon's egg select and retain the best-shaped one on each main shoot and remove all the others. No more than four fruits to a plant should be retained at any time and then only on those of mid-season crops. With a sharp knife cut away all extra shoots which may have formed, and as soon as the fruit has attained the size of a golf-ball, stop the shoot which bears it at the first leaf past the fruit.

Try to get each fruit at least 12 in. from the centre of the plant so as to avoid overcrowding. When the fruit is set the frames need less ventilation and liberal watering. Keep the growths thinned out; the non-fruiting laterals are stopped at one leaf.

As the fruits grow large they are turned and stood on the stigma end (or cushion as some growers call it). An even coloration thus develops around the fruit.

Watering. After planting, about two weeks may elapse with

[*By courtesy of " The Grower"*

FIG. 68. Melon, Dutch Net

nothing more than a light spraying if the weather is very hot. Then a liberal application is given. From then until the fruit is set only light watering may be needed. Water should always be well away from the centre of the plant to avoid wetting the stem at soil level to discourage collar-rot. After the fruit is set more water is needed to give good-sized fruit, but do not continue watering right up to fruit ripening.

It requires some judgment and experience to know the exact time when the melons should be cut. The indications of approaching ripeness are a change in the colour of the fruit to a more or less yellow tinge; a softening of the part of the fruit surrounding the eye, which yields slightly under pressure from the fingers; a number of cracks in and around the stalk, as if the fruit were about to separate from the plant; and lastly a slight perfume, which grows stronger as the fruit gets more fully ripe. The fruit should not be left until it is perfectly ripe before gathering it, but it should be cut just as it is on the turn and, for local sale, be laid in a dry place, where it will ripen in a short time, slowly or quickly according to the temperature maintained; when it cannot conveniently be disposed of for a few days during warm weather the storage place should be cool, so that ripening may be somewhat retarded.

Varieties. Prescott Early Frame, Westland Net, Tiger.

MINT

Mentha viridis

MINT, known also as Spear-mint, is a very popular herb; it can be made a source of considerable profit when grown and forced for market, and its culture should never be omitted by the grower who does a direct trade.

The plant, which is a perennial, will grow in almost any soil, but thrives best in one which is cool and fairly rich. It may be propagated by division of the creeping roots in October or March, or commercially by cuttings dibbled in during March or April. In the latter case set the "cuttings", which are really rooted shoots or suckers about 6 in. long, 6 in. apart in the row and 1 ft. between the rows. Water well in dry weather. The soil should be quite free from weeds, as a plantation is difficult to clean when the mint begins to grow freely, and when choked with weeds it soon becomes useless. In the autumn cut down and burn the tops with a little straw to keep rust in check.

In a garden a bed, if properly attended to, will last in good condition for several years, but where growing of mint for market is made a regular feature it should form part of the regular rotation. If a fresh bed is laid down each year, one can be lifted for forcing at the end of the second or third season, and each year afterwards. This system is often practised, cutting the naturally grown crop for market during summer. Such plantings get weedy in their last year, particularly if any top-dressing with dung has been given. Actually, if the land is in good heart and the new bed is established early in spring good plants suitable for forcing may be lifted in the first autumn. If forcing in heat is not to be adopted the roots standing in the open may be cropped naturally or may be forwarded by covering with cold-frames. In the latter case it is best to plant beds of a width suited to the frames which are to be used. Cover the beds in January and protect with mats until growth starts and each night afterwards.

Commercial forcing needs heated glasshouses. The roots are lifted in October or November or even later. The floor of the house should have been forked over; the roots are spread out and covered with an inch or so of soil and watered. Keep a temperature of 60–65° F.

[*By courtesy of " The Grower"*

FIG. 69. Mint being cut by horse-mower for despatch to drier

ONION

Allium cepa

ONIONS in one form or another are in general demand. Fortunately, they will grow and do fairly well on almost any soil, although one of medium texture, inclining to sandiness, yields the best and most profitable crops; but even a clay soil, with good preparation, may be made to produce a very satisfactory crop of onions. To obtain well-ripened bulbs the right climate is needed—sunny weather in August and September. The production of onions may be considered under two main groups: those which are grown for ripe bulbs and those which are grown for sale when young as "spring" or salad onions. Within these groups the treatment and times of sowing may vary.

Bulb Onions. The main sowing is in the open in spring; other sowings may be in the open in autumn or under glass in January.

Preparation of the Soil. Adequate preparation of the soil is necessary to the production of a good crop of onions. With proper treatment almost any kind of soil may be brought into suitable condition.

As a preliminary, see that drainage is good, because where there is stagnant moisture success is impossible. Next, work the soil deeply, incorporating a good dressing of manure. This should, if possible, be in a well-decayed condition, but if such is not available the manure may be given fresh, providing it is put into the ground in autumn for spring sowing. In any case all ploughing should be finished in good time in winter in order to get good weathering of the surface soil and a good tilth for the seed-bed. Some harrowing of the surface will be needed before sowing in order to destroy young weeds which will be appearing.

Spring-sown Onions. When the ground has been prepared as indicated, seed may be sown at the first favourable opportunity after the end of February, but it is very unwise to hurry this operation by putting in the seed before the soil is in the proper condition; the surface should be dry, friable and free from stickiness; it is better to defer sowing for several weeks if necessary to get a really good seed-bed.

Drill the seeds in rows 12 in. apart; $4\frac{1}{2}$–6 lb. of seed per acre will be needed. On a small scale one ounce of seed will sow about 400 feet of drill and give a good stand of plants. If sown thinly no thinning out should be necessary. The seed should be only just covered by soil. If the land has been ploughed or dug for several weeks it should be quite firm, but if there is any doubt it should be lightly rolled after sowing.

For early control of weeds, sulphuric acid before emergence of the seedlings saves a great deal of labour (see Chapter XII). Onions may also be sprayed at a later stage once the seedlings are 3–4 in. high. Where sulphuric acid is not used hoeing must be started as soon as the rows can be seen and will have to be repeated several times during the growing season.

Harvesting. In a normal season the onions will begin to ripen soon after the middle of August, which is seen by the tops changing colour, but if the weather is cool and moist ripening may be considerably delayed, in which case growth should be checked by bending over the tops at the necks. This may be done with a wooden rake, held teeth upwards. When the tops are yellow and the necks shrunken, usually by the middle of September, they should be pulled, and laid out to dry. If the quantity is not large they will finish off better if carried to a piece of hard dry ground, but when a large breadth is grown they must be ripened where they grew. After a few days, when thoroughly dry, they should be topped, cleared of loose skins, and stored in a dry, cool, airy place. They should never be laid more than a few inches deep and placed in trays or on shelves having a bottom of narrow laths with spaces between, so that a current of air can play freely around them. Damp must be carefully guarded against or they will not keep. On a small scale a good way to keep onions sound through the winter is to bunch or rope them. When bunched they may be strung on poles, and in this way a large quantity may be stored overhead in a comparatively small shed without interfering with the floor space; or they may be hung on pegs on an outside dry wall. Even severe frost will not harm them.

Autumn-sown Onions. For these the plants are over-wintered in a seed-bed and transplanted the following spring. Prepare a firm seed-bed on land which is not too rich and sow about the second week in August. For the final bed prepare the land as advised for spring-sown onions and as soon as the soil is in a suitable condition in March the seedlings may be lifted and transplanted. Plant in rows 12 in. apart and the plants may be 4 in. apart in the rows for general purposes or 6 in. if large onions are needed.

Spring-sown under Glass. Seed should be sown in gentle heat in January. Sow in boxes in John Innes Compost (see p. 307). Sow very thinly, as it should not be necessary to prick out before the final planting. Harden-off the seedlings in frames and plant out in April.

For all transplanted seedlings avoid planting too deeply. The root-plate at the base of the young bulb should be only just in the soil.

Onions from Sets. Seed sown in mid-May, broadcast, very thickly, matures in August as a crop of very small bulbs. From these, sets no more than ½ in. in diameter may be planted in early March. (For fuller details of the preparation of the sets see Bulletin 69, *Onions*, published by H.M.S.O.)

Spring or Salad Onions. For this crop the soil needs to be in good heart, but for the autumn-sown crop avoid over-feeding with nitrogen; potash helps the seedlings to over-winter.

For spring harvesting the seed is sown in late July or early August. The land should be as clean and weed-free as possible to ease the work of keeping the crop clean. Sow in drills 12 in. apart, using a much heavier seed rate than for bulb onions. About 40 lb. of seed per acre is needed.

For the spring sown crop the land should be prepared somewhat as for spring-sown bulb onions, though much more generous manuring may be practised. A lighter seeding rate—about 30 lb. per acre—can be adopted. Early weed control may be undertaken with the help of sulphuric acid (see p. 115). The spring-sown crop is sold during May, June, and early July. In periods of drought it responds well to irrigation. A light watering twenty-four hours before harvesting makes the plants much easier to lift than would be the case from dry soil.

Pickling Onions. The growing of onions for pickling is a specialised operation, always done on contract for the canning factory. Similar preparation to that given for the main bulb onion crop is needed but the manuring should give high nitrogen. A heavy seeding is practised—up to 16 lb. per acre being sown. The competition resulting from a full stand of plants prevents the bulbs from getting too large.

Manures

Bulb Onions. 15 to 20 tons of farmyard manure per acre should be worked in when preparing the land during winter and before sowing or planting a base dressing of a complete fertiliser should be given. This may be 1 cwt. sulphate of ammonia, 3 cwt. superphosphate, and 2 cwt. sulphate or muriate of potash. When the plants are well established a top-dressing of 2 cwt. per acre nitrate of soda may be given, but take care that this is not delayed beyond early May. Late applications, particularly if not well washed into the land, may cause late growth and "bull-necked" onions which do not ripen well.

Salad Onions. For these the base dressing should be 2–3 cwt. superphosphate and 1–2 cwt. muriate of potash for the autumn-sown crop, followed by a top-dressing of 1–1½ cwt. nitrate of soda in March. The spring-sown crop may receive the same potassic and phosphatic dressing, plus 4–5 cwt. of hoof and horn or 2 cwt. sulphate of ammonia.

For all the onions make certain that the soil has adequate lime.

Varieties

Bulb Onions. *Main-crop:* Best of All, Bedfordshire Champion, James' Long Keeping, Up-to-Date, Giant Zittau, Ailsa Craig. *Autumn sowing:* Reliance.

Salad Onions. For both autumn and spring sowing White Lisbon is the best variety.

Pickling. Best of All, White Sweet Spanish, and Silverskin.

PARSLEY

Carum petroselinum

If the soil is suitable and there is a reasonable prospect of a good market, parsley can be grown as a special crop to occupy large breadths, and can be made to pay well, but it must be good, well-grown, clean stuff, or it will often be found that a consignment does not clear the cost of carriage. On small-holdings a good method of culture is to plan so as to have a supply all the year round.

To grow this plant really well the soil should be inclining to heavy, deeply worked, well manured, and free from stagnant moisture. Light soil should be made as firm as possible before the seed is sown.

Seed should be sown in February or March, for summer supplies, and about six weeks later for winter and for the following spring. Before sowing, the surface soil should be brought to a fine tilth. Sow thinly, ½ in. deep, in rows 12 in. apart, and thin out to 4–6 in. apart. The seed is slow to germinate, often from five to six weeks. In order that the soil may be stirred and the weeds kept down before the parsley appears, a little cabbage lettuce or radish seed may be sown with the parsley; this germinates quickly and serves to mark the rows so that hoeing may be proceeded with, and if thinned out well and promptly will give a light catch-crop without injuring the main crop. A frequent practice, particularly with those who do not grow in large quantities, is to sow parsley as an edging to beds occupied by other plants, and it does well in such places and takes up very little room, but the position should be well considered or it may interfere with the cultivation of the ground later on. The crop which has to pass through the winter for use the following spring, should be sown in an open situation but sheltered from northerly and easterly winds. It should have all the largest leaves removed during

August or early September, so that a fresh crop of leaves will be made before the winter.

To make sure of good, fresh, clean leaves during winter a sowing may be made in beds so that some form of protection can be given in hard weather. Where frames are available, the beds should be such a size as can be conveniently covered by them, but the lights should not be put on until hard weather comes, and then a little air should be given unless the weather is very severe.

Manures. Dung should be ploughed in when preparing the land for sowing and a base dressing of fertiliser given before sowing. A good one would be 1 cwt. sulphate of ammonia, 3 cwt. superphosphate, and 1 cwt. muriate of potash per acre. If lettuce seed is sown with the parsley as a marker and allowed to mature as a catch-crop the bed should be given a further dressing when cleared of the lettuce: 2 cwt. potash nitrate would be good for this. It may be desirable to irrigate at this stage.

Varieties. Perennial Moss Curled, Imperial, Champion Curled.

PARSNIP

Pastinaca sativa

THE Parsnip is perfectly hardy, easy to grow, yields a heavy crop, and may be quite profitable. It is not popular in certain districts; therefore the salesman should be consulted before sowing this crop. Nevertheless, there is often a steady if not a very large sale for it.

The parsnip will do well on almost any soil which has been properly prepared, and this implies thorough working to a good depth, so that the long root can descend straightly and without obstruction. The soil should be in good fertile condition, but not necessarily rich; no manure should be applied directly to the crop, or the roots are liable to become fanged and cankered. The best results are obtained from a soil of medium texture which has been manured for a preceding crop.

About the beginning of March, as soon as the ground is dry enough for working, work down the surface fine and level. If the state of the ground is not suitable for working it is better to wait for a few weeks rather than sow when the soil is too wet. Sow in drills ½ in. deep and 12–18 in. apart. After sowing, cover with fine soil and roll lightly. Care should be taken to use only good new seed, as old will frequently fail to germinate. When the seedlings are well up thin out to 6–8 in. apart. The culture afterwards consists in an occasional hoeing to keep the bed free of weeds. The roots will be ready for use in October, and may be lifted and stored in November. They may be left in the ground with safety,

[*By courtesy of Messrs. Watkins & Simpson Ltd.*

FIG. 70. Parsnip, Offenham

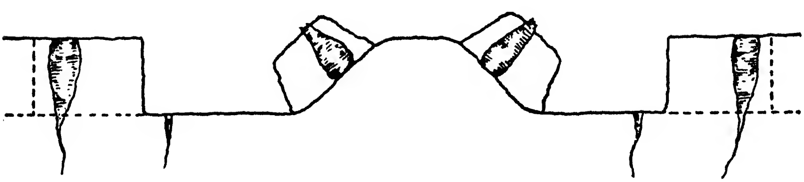


FIG. 71. Parsnips being lifted by ploughing-out. Two rows in the centre of the plot are lifted by hand. Ploughing is done around this strip, the roots being left partly exposed and easily picked up by hand.

to be lifted as required, and are then of a better flavour than when stored, but as the ground needs preparing for spring crops this is not often practicable. The roots may be stored in clamps, like potatoes, or they may be stored in layers in damp soil or sand in a cool shed.

Manures. Give no fresh dung. On rich land give no fertilisers, but if any should be required give 1 cwt. of sulphate of ammonia, 2 cwt. superphosphate, and 1 cwt. muriate or sulphate of potash.

Varieties. Many stocks show a good deal of variation in shape. Offenham (when true) produces wide-shouldered roots and is a popular market variety. Improved Marrow and Tender and True have long tapering roots.

PEAS

Pisum sativum

PEAS are favourites with almost everyone, and are always in great demand so long as they can be supplied fresh and young. They are not a crop for every market grower. Many small producers with a general trade find them useful, but the large quantities which come into the principal vegetable markets are from very large growers who specialise in peas as a farm crop. The production on contract of green peas for canning and peas for drying is also in the hands of large specialist growers, particularly in the eastern and east midland counties.

For the small grower peas play an important part in any well-arranged system of rotation and cultivation; since they collect and leave behind them nitrogenous matter in the soil, their occupation of it increases rather than decreases its fertility (Fig. 1).

Soil. Any ordinary soil which has received proper preparation will grow peas fairly well. For the earliest crops a warm, dry, and rather sandy soil is to be preferred, though on heavier soils good early crops can be obtained by growing on ridges. For the main crops the ideal soil is a rich and rather retentive loam, deeply worked and well drained. It is not desirable to apply heavy dressings of manure directly to the crop, as this would have a tendency to cause the peas to run too much to leaf, the best conditions being secured when peas follow a crop for which the soil was liberally manured. All further plant-foods necessary would be best supplied by suitable concentrated fertilisers. When the soil is in poor condition, some manuring is absolutely necessary to a good crop, though only well-decomposed manure should be used.

Preparation of the Land. This should be taken in hand in autumn, when it should be ploughed or dug and left with a rough finish so that as much surface as possible will be exposed to the frost. It should be firm yet worked to a good surface tilth before sowing. Lime in the soil is essential to the healthy growth of peas, and where this is lacking or is present in insufficient quantity it should be spread on the surface as soon as the soil is turned over, at such rate as may be indicated by the results of a soil analysis.

Sowing. The practice of making an early sowing in November is seldom followed today and has little to commend it. There is only a very slight gain in time over a well-managed spring sowing and the losses during the winter usually result in a light crop.

When the climate is mild it is often possible to make a sowing in January but on many holdings March is the earliest time at which it is safe to sow. These winter sowings need to have very well-drained soil. If continuous cloches are available they may be used for nursing the earliest sowings. In any case the soil must be in good condition before any seed is sown. Slow-germinating seeds are often attacked by various fungi, resulting in a poor stand of plants. It is worth while to treat the seed for the earlier sowings with one of the dressings mentioned on p. 277. If these are not used then a rather heavier seed rate must be adopted than for the main spring sowings.

A regular succession of fresh plump pods is of great importance. To secure this there should be successive sowings from March to June. Prior to March frequent sowings will not accomplish the object aimed at, the best way to obtain a succession from earlier sowings being to put in seed of early, mid-season, and late varieties about the same time, and they usually bear in succession. From April to June a good plan is to make another sowing when the preceding one is just showing through the ground. For the last sowings, made in the first or at the very latest in the second week of June, first early varieties are generally used, because when grown under identical conditions they come into bearing quicker than main-crop or late varieties.

From a sowing in March or April a first early variety will mature in eleven or twelve weeks; a main-crop variety will take fifteen to seventeen weeks. From the earliest protected sowings the first crop may be expected in early June or in exceptional seasons late May. The last crops from June sowings will not crop until September or early October. In the southern parts of the country the late crop is often spoilt by mildew unless checked in time by dusting with sulphur.

Seeding rates vary greatly—with local custom, variety, type of seed drill, and the cultivation equipment. For comparatively small areas the grower will be well advised to work with rows 18–24 in. apart. A seed drill is sometimes used for the sowing, but where this is not done the rows should be prepared and the seed sown by hand. The rows may be drawn by the point of a ridging plough (or with a hoe on a very small scale). With the row distances just suggested about 1 cwt. of seed per acre will be needed for the main-crop sowings; for early sowings a slightly heavier seeding is advisable.

On a large scale, though wider planting is sometimes seen, rows may be as close as 9 in. in some cases for the early, dwarf kinds. A heavier seeding rate—up to 2 cwt. per acre—is needed. For such close spacing it is imperative that the land be very clean, as the plants very soon reach the stage when hoeing is impossible. Wide rows make cleaning much easier.

In gardens, allow 1 pint of seed to 60 ft. of row for the early kinds and 1 pint to 80 ft. of row for the main crop.

To protect the seed against damage by mice red lead is used. Place the seed in a box and just moisten with water (or a *very small quantity* of paraffin) and add a little red lead. Shake or stir until all the peas show some lead deposited on them. The seed may be sown at once.

General Cultivation. As soon as the rows can be seen, hoeing should be done and every opportunity taken to keep down weeds until the plants lie over and stop further cultivations. From then on to the end of the crop the weeds will grow unchecked and thus peas have got the reputation of being a "dirty" crop. The wider rows permit hoeing of the land for a longer period than is the case with the closer spacing, but weeds will still grow to seeding stage in the rows.

Sticking. Peas in market-gardens are usually grown without sticks, the haulm being allowed to rest upon the ground. For this reason the tall-growing sorts are rarely employed in field work. At the same time the gardener and the grower who does a private trade and depends more upon a moderate quantity in constant succession throughout the season than upon a large quantity for a short period, will find it to his advantage to use sticks (*when they can be got cheaply*), because then the pods are finer and the peas bear a better crop. The dwarf varieties do well and crop abundantly without any support. The sticks should be placed to the rows soon after the crop is through the soil. They are usually inserted in the ground about 6 in. away from the peas, about 1 ft. apart, inclined at an angle of 45 degrees, each side being inclined in a reverse direction, and each row parallel. Small stuff, cut from the tops of the longest sticks, is inserted in the gaps at the base of the sticks to help the young plants to climb upwards. Before putting in the sticks hoe the ground well and then draw the loose soil, 3 in. deep, to the stems of the plants on each side of the row. When the haulm grows long, and no sticks are used, it is laid over on one side of the row; in this way the flowers, by getting more light and air, set better and so are more productive, and the pods can be more easily gathered.

Gathering. It is the custom where peas are grown in large breadths for picking green, to defer gathering until the bulk of the crop appears ready; then a large number of "pickers"—principally women—are turned into the fields, and clear the ground as they go. A handful of haulms are pulled up by the roots, and being held in the left hand, roots upwards, are stripped of the pods with the right hand. This appears a wasteful method, but it results in a large saving in the labour bill and the ground becomes much sooner available for other crops. The haulm is dried on the ground as it lies, and then is carted away and made into stacks of "pea straw", which when cut into chaff and mixed with other materials is a valuable food for cattle.

In the garden where peas are grown up sticks, the picking may be extended over a longer period and the crop is more fully utilised. Pick early and do not allow the pods to get over-ripe.

Peas spoil rapidly once they are picked and placed in bags; they should be marketed without delay.

Manures. For a good crop of peas it is essential that the soil contains an abundance of plant foods, but it should not be overloaded with manure or the crop will be likely to run to leaf instead of pods. When a good dressing of manure has been given to the preceding crop, very satisfactory results can be obtained from concentrated fertilisers alone, and in any case manure alone should not be relied on, as a better crop is obtained when it is supplemented with fertilisers. When manure is given to this crop it should be at the rate of about 10 tons per acre on heavy soils, up to from 15 to 20 tons on thin sandy soils. This should be applied, if possible, in the autumn, remembering that the nearer the time of sowing the greater the necessity that it should be in a thoroughly decayed condition. The next point is to ensure that sufficient lime is present in the soil.

For the main crop, shortly before sowing, give 3 cwt. superphosphate and 1 cwt. sulphate or muriate of potash per acre. Only on poor soils or for early sowing, particularly after a wet winter, should it be necessary to consider applications of nitrogen, and in that case nitro-chalk is a good form in which to apply—give 1 cwt. per acre.

Varieties

Round-seeded (better able to establish themselves from autumn or very early spring sowings): Foremost, 3 ft.; Feltham First, 1½ ft.; Pilot, 3 ft. From February sowings these should be ready in June.

Wrinkled-seeded. First early: Little Marvel, 1½ ft.; Kelvedon Wonder, 1½ ft.; Peter Pan, 1½ ft. *Second early:* Laxton's Superb, 2 ft.; Onward, 2½ ft.; The Lincoln, 2½ ft. *Main crop:* Alderman, 5 ft.; Admiral Beatty, 5 ft. *Late:* Autocrat, 4 ft.

For a late crop from a June sowing: Onward, Kelvedon Wonder, Lincoln.

Edible podded or Sugar Peas: Paramount, 5 ft.

For fuller details of the field production of peas for canning and drying the reader is referred to the Ministry of Agriculture Bulletin No. 81, *Peas.*

POTATO

Solanum tuberosum

Of all cultivated vegetables the Potato is in the greatest demand, and as a consequence enormous areas are devoted to its cultivation. It is best regarded as a farm crop, but it may also be a useful, and for the early crop a valuable, part of the market-gardener's production. It can be grown more or less profitably on many diverse soils. It is especially suitable as a cleansing crop for newly broken-up land, particularly when such land is foul with weeds. The potato crop plays a valuable part in any well-considered system of market-garden rotation, as the cultivation and manuring which it needs form one of the best preparations for any other crop which may follow. It needs to have at least a four-year rotation in order to keep potato-root eelworm in check.

Soil and Situation. Abundant crops of potatoes can be grown on almost any soil which has received adequate preparation. Damp, badly drained, or low-lying land should be avoided, as although such situations may be productive of good and sound crops when the summer is hot and dry, they are always the first to be attacked by blight in an average season and seldom escape it when the summer is wet, besides being very liable to serious damage from late spring frosts. Situations which are very confined or overhung by large trees are also unsuitable.

The ideal conditions for producing heavy crops of good sound potatoes are an open, sunny, slightly elevated situation and a deep, well-drained, medium soil. At the same time the fact cannot be overlooked that excellent crops are often taken off well-worked clays, poor sandy soils, thin chalky soils, and newly reclaimed bog lands if given right cultivation. In fact, a friable clay soil will so frequently produce crops good both in quantity and quality that the only serious objection to its more extensive use for potato culture is that its condition depends too much upon the state of the weather, as it often becomes practically unworkable in wet periods, both at planting and harvesting times, whilst if it is poached about when wet it sets so hard when dry as to be impossible of proper summer cultivation and is very difficult to work when the time has arrived for the crop to be lifted.

Preparation of the Soil. The best preliminary preparation is deep working, and for all but the very lightest soils this should generally be done in the autumn, leaving it rough so that frost, air, and rain can penetrate and sweeten it. In field work this will, of course, be done with the plough, but in gardens it is accomplished by digging. The autumn, too, is the best time to apply manure to most soils, especially when it is not much decayed. On some light soils it is better to apply the manure in the spring. The land should be ploughed in the autumn; then after spring cultivation furrows are drawn out with a ridging plough and if the land has not been dunged well-rotted manure is spread evenly along these previous to laying in the sets. A suitable mixture of fertilisers is also given at the same time, before the ridges are split, either on the manure in the furrows or broadcast over the whole area. Whatever the nature of the soil may be, it should be worked about as soon as the surface is sufficiently dry to bear cultivation after the beginning of March, and this working should be repeated, if necessary, until the surface is brought to a fine tilth for a good depth.

The "Seed" and its Preparation. Potatoes are subject to several virus diseases, e.g. Leaf Roll, which may seriously reduce the weight of crop. Once a plant is infected all its progeny are infected. These viruses are spread by aphids and some districts with cool climates and high winds discourage aphis migration.

Some such areas have become noted for the production of healthy seed potatoes. In the warmer and drier parts of the country potato stocks are liable to become infected with virus and to deteriorate rapidly. New seed should be purchased from time to time, from Scotland, North-west England, Wales, or Ireland. Under the present English certification scheme the highest grade is "S.S." (Special Stock), to secure which the stock must be grown in a special area, usually at an altitude of over 400 ft., on a field free from potato root eelworm, be true to type, and have not more than four plants per acre showing obvious symptoms of leaf roll, severe mosaic, or wildings, and not more than 0·25% of mild mosaic at the time of inspection of the growing crop. For the "A" certificate the standards are slightly less rigorous, whilst those for the "H" certificate are still less exacting. In all cases it is necessary for the stocks to be true to type. The regulations governing the issue of the certificates cover other points as well as the above and are modified from time to time. For up-to-date details the interested enquirer should consult the Ministry of Agriculture and Fisheries.

The ideal size for planting sets or seed tubers is about the size of a hen's egg. Each shoot that grows from the tuber becomes an individual plant. Very small "chat" tubers usually produce only one shoot; such tubers are likely to give crops with large tubers (owing to lack of competition) but a comparatively light crop. Large "ware" tubers with many "eyes" and producing many shoots are likely to give the heaviest crops but with a higher proportion of small tubers.

Should it prove necessary to use for planting tubers of ware size they may be successfully cut and made into smaller pieces. Cut them lengthwise, taking care that each portion has at least two eyes. It is important that the wound made by the knife should heal rapidly. If the ground is moist and the tubers are cut and planted at once they often heal readily. If the ground is at all dry or if planting must be delayed, then cut the tubers and keep them warm and moist for forty-eight hours. Cut, spray with water, cover with wet sacks and keep in a warm place; this encourages speedy development of a cork layer over the wound.

Boxing and Sprouting. There are numerous ways of storing seed potatoes through the winter, all of which to be effective must provide for the exclusion of frost. The worst way is to allow the tubers to remain in an ordinary outdoor clamp until planting time.

The best method is to sort out the seed as soon as it is dry after lifting and place directly into boxes or trays; but whilst this has much to recommend it, and may be considered indispensable for the early crops, it is a rather serious business when large areas have to be planted, particularly when the amount of frost-proof storage space is limited. As a matter of fact excellent crops can be grown from seed carefully kept in store in a dry cool place, without any preliminary preparation whatever, either of sprouting or disbudding. At the same time there is no doubt whatever as to the great value of boxing and sprouting seed potatoes. The tubers are stood "rose" end (that is, the end containing most eyes and opposite to the end which was attached to the parent plant) upward, close together in rows across the tray until it is quite full. The trays are then stood one above the other in any cool, light, airy place where they are safe from frost, such as a loft, barn, or shed or special chitting house. When stood above each other a large quantity of trays can be stored in a small space, whilst a free circulation of air throughout the entire mass is ensured by the spaces formed by the handles, which are as wide as the box and stand 3 in. above each end. These conditions keep disease at bay and prevent premature growth, so that when planting time arrives the tubers are sound, with one or more dark-coloured sturdy shoots. When thus stored they should be looked over occasionally, especially after the turn of the year, and if the sprouts appear to be getting "drawn" move the trays into a position where they will get more light and air, or if they appear too backward arrange for the surrounding atmosphere to be kept slightly warmer. When several shoots rise from the same tuber, all but two or three of the strongest may be rubbed off. The seed should be carried in the trays to the field, and carefully placed in the furrows without breaking off the shoots, or all the care and trouble spent upon them will be thrown away. The advantages gained by sprouting are threefold. The crop from sprouted seed is ready for lifting earlier than that from seed which is unsprouted. When at planting time the soil is wet and cold that operation can be deferred until the conditions are more favourable and yet no time is lost because growth is still proceeding; this is a great advantage where the soil is of a heavy nature. Plants from sprouted seed ultimately yield a crop noticeably heavier than that from unsprouted seed.

Distances Apart and Depth for Planting. The distances apart at which the sets are planted depend upon the variety and the cultivation equipment. In favoured spots, where soil, situation, and climate conduce to the production of very early supplies, sprouted seed is planted in rows about 18 in. apart by 9 in. to 1 ft. apart in the rows, but this is exceptionally close and only suited to short-topped varieties which are to be lifted before the tubers are fully grown. In a garden, as a general rule, first earlies should be in rows 2 ft. apart by 12 in. apart in the row, second earlies 2 ft. 3 in. to 2 ft. 6 in. by 12 in. to 15 in. apart, and main-crop and late varieties from 2 ft. 6 in. to 3 ft. by 14 in. to 18 in. apart. On a field scale the equipment usually decides the width of row; 2 ft. 6 in. is general. In no case ought the sets to be covered with more than 4 in. of soil (apart from that which is added in earthing-up) and for early sorts about 3 in. is sufficient, because then the roots are more under the influence of the sun's warmth. The distance between the sets is a matter of great importance, for if the crop is overcrowded the majority of the tubers will be small, whilst on the other hand if the spaces are wider than necessary the total crop will be less than it might have been.

Planting and General Culture. The time of planting varies with the district and the condition of the soil. In favoured places with a kindly soil planting is commenced in January, whilst in others, when the circumstances have been unfavourable, it is often deferred until as late as the middle of May.

Open weather in coastal districts often sees some planting done in February. The main planting season is March and early April.

The system of planting in ridges is the most generally practised in the field, and is the one most likely to give satisfaction. In ordinary field culture, when the soil has been brought into suitable condition, furrows are made with a double-breasted plough and well-rotted manure (if that is the time chosen for applying it) is spread in the furrows. The seed is then dropped at the required distance apart and another plough follows which splits the ridges and throws the soil over the seed in the furrows on either side. When all are covered the seed lies under the ridges and the furrows now are where the ridges stood before. The work is then finished by rolling. On weedy land harrowing with a saddle-back harrow is beneficial both before and after the plants show through the ground. As soon as the foliage shows plainly the land between the rows is hoed. If there is any fear of frost, soil should be lightly drawn over the tops at the same time. Hoeing is repeated if the state of the ground requires it, as weeds must be kept down and the soil maintained in a loose condition. When the haulms are about half grown earthing-up is done with a double-breasted plough. Too much earth must not be given, 6 in. in depth being ample. Frequent and thorough stirring of the soil until earthing-up is necessary to produce a good tilth for the ridges. In gardens the earthing-up is done by hand with a hoe.

Planting on the flat is done in gardens on light land. The land is previously manured. The rows are marked out at the required distance apart. Shallow holes are then dug along the first line, one for each set, which another person following drops in the holes. The soil from the second row of holes is used to cover up the sets in the first row, and so on to the end of the plot.

Forcing in Frames. The forcing of early potatoes in frames is still occasionally practised by the private gardener,.

The crop can be grown either on mild hot-beds or in cold-frames; in the former case the tubers are ready for lifting in the early part of May, and in the latter about the end of May or the beginning of June. The frames should be about 18 in. deep. The hot-bed is made in the second week of February, about 1 ft. thick, as described on page 78, then the frame is put on, and about 9 in. compost is put inside. A few days afterwards, when the soil is warmed through, well-sprouted sets are planted 4 in. deep and 9 in. apart, this giving twenty-five to each light. The frames are kept closely covered with mats until the tops begin to show, when the mats are removed each morning but replaced each night. Ventilation is given daily, from an inch on rough cold days to three or four inches when the weather is mild, removing the lights altogether during the daytime as the weather becomes genial. When the haulms reach the glass, the frames are raised on a brick at each corner. If the tubers show through the soil or there is any danger of their becoming greened, another 2 in. of moist compost must be spread all over the surface. Great judgment is required in giving water; if the weather is wet or dull probably none will be required, whilst if it is dry and bright several waterings may be needed. In any case, every care must be taken to keep the soil nicely moist but not sodden.

For cold-frame work, when the equipment of ordinary frames and lights is insufficient, two rows of parallel boards and such lights as are available will answer very well. For cold-frame work it is necessary to lay down a bed of rich compost, 9 in. deep, on top of the ordinary soil, and to plant well-sprouted sets at the beginning of March.

Spraying. Potato blight is present every year and in warm wet summers can be very serious. In most districts early varieties are lifted in time to avoid the worst period of attack. Protective spraying with Bordeaux mixture keeps the foliage healthy for a longer period and can increase the crop. Killing the foliage with sulphuric acid protects the tubers from infection (see p. 299).

Lifting and Storing. Lifting begins with early potatoes, which are dug "green" for the early market as soon as the tubers have grown to a saleable size. If this work can be done on a fine dry day, when the soil is in a nice workable condition, the tubers turn out clean and bright, and look more attractive than when there is a lot of soil adhering to them. Potatoes should not be lifted for storing until the haulm has died down, when they will be grown to their full size and have firm skins. When the crop is intended for seed purposes, a certain degree of immaturity is desirable, in which case the crop would be lifted whilst the tops are still green. Small crops are, of course, lifted with the fork, but on large areas potato ploughs or potato diggers are used for lifting.

The tubers may be graded into "ware", "seed", and "chats", or simply into ware and chats if no seed size tubers are needed for planting or sale. The size of seed tubers may vary from year to year, but approximates to a sample which will pass through a riddle with a 2-in. mesh but not through one with a 1½-in. mesh. The chats, the small and damaged tubers, are used for pig-feeding. The potatoes not sold directly from the field are stored for disposal as opportunity and prices dictate. On some places where sprouting is made a feature, the home saved seed is placed directly into sprouting trays on the field, and then needs no rehandling after being carted to the store.

The usual position for a potato clamp is the headland of the field in which the crop grew, providing there is a gate conveniently near and a good road leading from it; such a position saves a lot of unnecessary carting. The ground on which the clamp is to stand should be, if possible, slightly higher than the general level; in no case should it be lower, as the potatoes must be kept dry, and the tendency should be for rainwater to run away from and not towards the clamp. Before clamping, the potatoes must be fairly dry and all showing any trace of disease carefully picked out; when affected tubers are mixed with sound ones the disease often spreads through the whole. They are piled up in a long ridge-shaped heap, from 3 ft. to 5 ft. wide at the base, according to the quantity to be stored, the height being regulated by the width, as they are piled up as high as they will lie. They are then covered about 6 in. deep with straw, bracken, or other dry litter, which is held in place by a few spadefuls of earth. For two or three weeks the tubers are allowed to "sweat", then over the straw a 6 in. covering of soil is put in a trim and regular ridge form, the surface being made firm and smooth with the spade so that rain will run off. Soil for covering is taken from the ground outside the clamp, and in the operation a trench is cut all round to carry away water and so keep the contents dry. As the clamp is being covered with earth, ventilating holes are left along the top of the ridge, about 6 ft. apart. A tuft of straw is pulled through each hole and allowed to project, or a drain-pipe is inserted. In case of a spell of severe weather the ventilating holes should be closed to keep out frost, and as an additional safeguard when frost is very severe, it is advisable to put a covering of straw or litter over the clamp.

When there is enough room in good dry buildings, these may be used for storing the potatoes instead of clamping, as the labour is less and they can be more conveniently handled in any condition of the weather. A good thickness of straw or litter should be put between the potatoes and the outside walls and they should be well covered over the top to protect them from frost and to exclude light.

Manures. Farmyard manure should be given at 15–20 tons per acre, except in the case of ploughed-out grassland. On soils of average fertility give sulphate of ammonia 3 cwt., superphosphate 3 cwt., sulphate of potash 2 cwt. per acre. On soils known to be low in fertility, increase the sulphate of ammonia and superphosphate by 1 cwt. each and the sulphate of potash by ½ cwt. per acre.

Varieties

First early: Arran Pilot, Home Guard, Ulster Chieftain.

Second early: Dunbar Rover, Great Scot.

Early maincrop: Arran Banner, Arran Peak, Gladstone, Majestic, Redskin, Stormont Dawn.

Late main crop: Arran Victory, Dunbar Standard, Golden Wonder, Kerr's Pink.

All the above varieties are immune to Wart Disease (see p. 300).

Good, popular, non-immune kinds are :

First early: Epicure, Ninetyfold, Duke of York.

Second early: Eclipse.

Main crop: King Edward.

RADISH

Raphanus sativus

THE Radish is one of the most useful and popular of salad crops. It is very simple of cultivation, quick to mature, and may be had without any great difficulty all the year round. What the public wants are the crisp, tender, delicate-flavoured roots, in regular succession, and the secret for getting these is by quick growth, making sowings on rich moist soil at frequent intervals. Poor soil should be avoided. The best soil for the purpose is a porous, easily-worked one, rich in humus from previous generous dressings of manure, and brought to a fine tilth.

The seed is sown broadcast in frames and occasionally in the open. On a large scale special radish drills are used which drill the seed in rows about 4 in. apart.

The seed should always be sown thinly and not covered with more than ½ in. of soil, made firm on the surface after sowing, as the roots do not bulk up well when the soil is too loose. Draw the radishes immediately they are large enough for use, as they quickly get hollow and woody. During summer, if the need for water is anticipated, the irrigation should be applied to the land before ploughing; enough should be given to last until the crop is mature. Watering the growing crop may encourage very leafy tops.

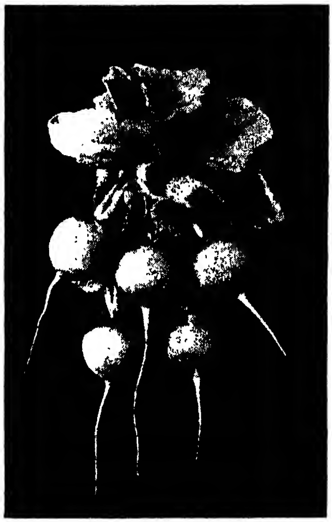
Crops from Hot-beds. The earliest crops of radishes are grown in frames on hot-beds. It is seldom that a frame is used exclusively for them, sufficient early supplies being usually taken when they are sown with other crops. In this way, owing to the quickness with which they form, a profitable catch-crop of radishes can be had without in any way interfering with the more slowly-moving occupants of the frame. This method is described in detail on pages 78 and 94, and can be easily applied to most crops grown early in frames, either warm or cold. A frequent mistake, however, in trying to grow early radishes in this way is in sowing too thickly. This is fatal to success as it is impossible for useful roots to form under such conditions, and the other occupants of the frame are injured by overcrowding. When grown with other crops, radishes should not stand closer than 3 in. apart on the average, and when it is seen that they come up closer they should be at once thinned to this distance, but thick sowing under such circumstances is wasteful of both seed and labour. Another frequent mistake, attributable solely to carelessness, is to omit properly clearing the bed of all small immature radish plants when the bulk of the crop is taken; these should never be allowed to remain, or they quickly make large tops which overshadow and injure the other crops. They may also be grown as a single crop in cold-frames using 4 oz. seed to 25 Dutch lights. Give plenty of ventilation on all possible occasions.

Early Crops from the Open. It is useless attempting to get very early crops of radishes from land of a heavy sticky nature unless special preparation is made to get rid of excess moisture and to make the surface friable. In addition to being well drained, for early work such soil should be laid in raised beds and, if available, the surface should be covered with 4 in. of light compost. Naturally light, warm, well-drained soils need no special preparation beyond reducing the surface to as fine a tilth as possible before the seed is sown, though even these are all the better for having sunk pathways between the beds to take excess water away quickly.

The earliest sowings are made from December to February, in the most sheltered and sunny positions available, which are generally found between rows of fruit trees and bushes or at the foot of walls or fences. The beds are made from 4 ft. to 5 ft. wide, as is most convenient, the crop being gathered from the pathways, without treading on the beds. Seed is sown broadcast, thinly, raked in with a wooden rake, and then slightly covered with fine soil. After sowing, the bed is covered with long litter, 3 in. or 4 in. thick. This is left on until the seed has germinated, after which it is raked off into the alleys daily, but immediately replaced on the appearance of frost or snow. Some thinning of the seedlings will probably be necessary, 1½-in. apart each way being about the right distance for the small-topped varieties, which should be used for the earliest crops. When the plants have become fairly strong, coverings are dispensed with if the weather is mild, but the litter is kept close at hand, to be used again in case there is a return of frost.

Successional Sowings are made in open situations in March and April. From May to August the seed must be sown in cool moist soil, as radishes do not succeed well if fully exposed to the sun in hot dry weather unless irrigation is available. Being so quickly off the ground they can, in gardens, often be advantageously sown between rows of lettuces, cauliflowers, peas, French beans, and similar crops, the shade afforded being an advantage, provided they are sown thinly.

Where there is no irrigation sowing on open ground recommences at the end of August, after the soil has been moistened with a few good showers, and goes on to September. Suitable ground will be found where crops which have required heavy manuring have been recently cleared, such as early celery, French beans, and vegetable marrows, the soil being ploughed and levelled and the surface brought to a fine tilth.



[*By courtesy of Messrs. Watkins & Simpson Ltd.*

FIG. 72. Radish, Short-top Forcing

The winter varieties of radish are sown in July or August in rows 9–12 in. apart and thinned out to about 3 in. apart. The Round Black Spanish gets quite big and can be pulled and stored for use during the winter. The demand for winter radishes is extremely limited. They should never be grown unless there is a known outlet for the crop.

Manures. The radish likes a rich soil but dung is best given to the previous crop, or if given direct to the radishes it should be well rotted.

Where crops are taken repeatedly from the same plot during one season a good dressing of an organic nitrogenous fertiliser is to be advised for the first crop—8–10 cwt. of hoof and horn may be given and this should last through the summer. In addition give 2 or 3 cwt. superphosphate and 1 cwt. muriate of potash.

To take several radish crops in quick succession is a good way of clearing weeds as, during the summer, the rapid growth of the radishes—21 to 24 days—usually prevents seed production by the weeds before the land is being ploughed for the next crop.

Varieties. Consult the salesman as to the type to grow, as markets differ in their varietal likes and dislikes.

French Breakfast and Scarlet Globe are good varieties particularly for early work in the open. Saxa and Sparkler are also popular. Short-top Forcing is good for frame culture and for open ground culture during hot weather when some of the others make too much top. Wood's Early Frame is a good early kind for those markets which like a long radish as in some of the northern towns.

Black Spanish (long or round), Icicle and China Rose (both long) are winter varieties that mature slowly and keep well, but are mainly seen in gardens.

RHUBARB

Rheum rhaponticum

RHUBARB is in such general use that it would be difficult to find an old-established kitchen garden without a bed. It will grow well in most kinds of soil which have received a reasonable amount of preparation. Its culture frequently forms an important part of general market-gardening, whilst in some districts the forcing of early supplies has become a specialised industry with an enormous output. The demand for rhubarb during the early part of the season is constant and steady. It is a crop which takes up a comparatively large area of land when worked for market, and where the holding is small this is a matter needing serious consideration, because a limited area (if it is subjected to good culture) may be made to yield a much greater profit when cropped with other vegetables. Another matter of great importance is the weight and bulk of the crop, which cause heavy expenses for carriage when the garden is situated at a considerable distance from the market. At the same time, when the crop can be disposed of locally, or when markets are within a reasonable distance, rhubarb, either forced or grown naturally, is well worth considering.

Preparation of the Soil. The ideal soil for rhubarb is a deep rich loam, cool and moist, and well-drained. Where such a soil does not exist steps should be taken to make the conditions answer to this description as nearly as possible, because the deeper and richer the soil the finer will be the quality and size of the produce. The land should be double-dug or sub-soiled in the autumn, and well enriched with a liberal dressing of manure, as the plants have to stand in the ground for a number of years, and top-dressings afterwards will not compensate for neglect to enrich the soil before planting.

Propagation. The most common method of propagating rhubarb is by root division, and when the grower's object is to get a thrifty, vigorous plantation in a short time this is the best method to adopt. Strong old roots are cut with a sharp knife or spade into as many portions as there are good crowns; each slice forms a set for planting. These sets should be carefully trimmed up, removing any parts that may be broken or mangled, but leaving to each set as much root as possible. Where a stock of old roots is not easily procurable, sets ready for planting may be obtained from most of the large growers.

Rhubarb is occasionally raised from seed; the variety Glaskin's Perpetual is most generally used for this purpose and gives a fairly even stock. The seeds should be sown thinly in rich soil, in February or March as soon as the conditions of weather and soil are favourable. Sow in rows 1 ft. apart, and thin the seedlings early to 6 in. apart in the rows, afterwards thinning again to about 12 in. apart by removing the least vigorous or those which are untrue to character. Through the following summer the surface soil must be kept loose and free of weeds by frequent hoeing, and the plants will then be ready to set out in their permanent quarters in the following spring.

Planting. The work of setting out the plants in their permanent positions should be done whilst growth is dormant; it is best done after the leaves have died down in late autumn, but what cannot be done then is left to the end of winter or early in spring. The distance apart at which the plants are set depends upon the sorts grown, the more vigorous late varieties needing much more space than the smaller early varieties.

For pulling green or "natural" rhubarb plant in rows 2 ft. 6 in. apart with the roots 1 ft. 9 in. or 2 ft. apart in the rows. For preparing forcing crowns more room should be allowed; 32 in. by 32 in. is a commonly used spacing, though some growers favour a little wider distance than that. Planting on the square facilitates cross-cultivation. If the planting is to be done by hand the lines are first marked out at right angles and holes are dug for the roots at the intersection of the lines.

Where the plough is to be used for planting it will be necessary to mark out the position of the lines and then throw out a furrow with the plough. The depth of the furrow is regulated by the size of the roots, the topmost crown of which should be covered with about 2 in. of soil. After planting press the soil firmly round the roots. A warm, well-drained position, protected from cold winds and facing south, should, when possible, be given to the early varieties for pulling green, as gatherings may be made a week or more earlier from such a position than from a cold, exposed field, and early gatherings usually mean better prices. Later varieties should be given the more open positions and heavier soil. Rhubarb needs an abundance of moisture all through the growing season, and although a low badly drained situation is unsuitable, a very dry soil is practically useless for this culture.

Routine of Cultivation. The object sought is to secure the largest possible growth, and to this end tillage and feeding must be thorough. The larger the leaves, the stronger will be the crowns for the following season. As soon as planting is finished the surface of the soil should be hoed to prevent caking, and hoeing to check the growth of weeds and to keep the surface soil loose should be persisted in during the summer.

As the leaves meet across the rows, particularly in cool districts with a good rainfall, all weeds are suppressed. In dry districts, once pulling starts from an established bed, weeds are likely to be troublesome.

Natural Rhubarb. Each winter, as soon as time can be spared, during a spell of open weather the ground between the rows should be forked over and each crown covered a few inches deep with littery manure; this will help to feed the roots and hasten the formation of early stalks, which will come along, clean and crisp through the litter, and better altogether than if none was used. When the rhubarb is in bearing, surface cultivation should begin as soon as gathering is finished. All flower stems should be removed as soon as they appear, as the formation of seed is very exhausting to the plant.

Gathering. When to gather, how to gather, and when to cease gathering are all matters worthy of more attention than they usually receive. No stalks whatever should be pulled in the first season after planting, and in the second season the gathering should be very moderate; when the roots are to be forced none should be gathered in the second season, and possibly for a third season, as the removal of any leaf from the plant tends to weaken it. The proper method of pulling is to give the leaf-stalk a half-turn and a sudden jerk outward and downward at the same moment. When pulling is done carelessly the crown is often torn off at the base of the stalk. Too many leaves should not be pulled from a plant at one time; if there are a dozen leaves to a plant not more than six should be taken, and time allowed for new leaves to form before any more are pulled. Gathering should cease by the early part of August at the latest, and for the rest of the season the plants should be left to grow as they will. This allows quite little enough time for the last crop of leaves to make good crowns for the next season's crop. Where rhubarb is grown on a large scale for pulling green it is a good plan to leave at intervals in the field spaces wide enough to allow a waggon to be drawn down for convenience in loading.

Forcing. Rhubarb forcing is comparatively easy but when done on a large scale the work needs special sheds and to be carefully planned. If three-year-old crowns are to be forced then each year there must be a planting on a scale large enough to stock the forcing shed for a season and an additional area to provide planting sets to replant a similar bed to that which is being cleared annually. The normal area of rhubarb in the open in summer will thus be more than three times the area which can be forced during one winter.

When the leaves have died down in autumn, if the roots are lifted and taken into a warm shed there is a ready response and growth recommences. This response to an increased temperature is even more marked and vigorous when the roots have been frozen before being introduced into heat. Darkness is not essential, but the stalks come longer, straighter, and of a better colour and appearance when grown in complete darkness, and therefore in forcing for market light is carefully excluded. On a small scale for the earliest supplies, roots may be put in a shed or under a green-house bench, or in fact in any place where the necessary protection, warmth, and darkness can be obtained. When forcing is done on a large scale, specially constructed houses, warmed by hot-water pipes, are employed. Rhubarb is also forwarded as it stands in the ground, without disturbing the roots, and though it cannot be got so early in this way as when the roots are lifted, the stalks come much finer and are generally of better quality.

Forcing may therefore be divided into two distinct methods—(1) lifting the roots and placing them in artificially heated structures; (2) applying to the roots where they grow a covering to protect from the weather and exclude light, with linings of fermenting materials to generate warmth and excite growth. Both systems are good when properly carried out. In either system it is useless to expect profitable results from unsuitable roots—either

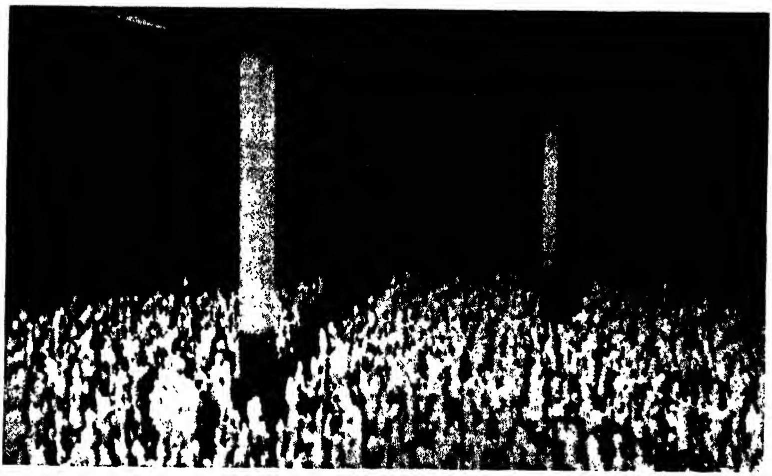


FIG. 73. Interior of a Yorkshire rhubarb forcing shed

those which lack maturity and strength or those which are enfeebled by age and too close pulling—they should be grown three years, have had good cultivation and an abundant supply of rich food, and few or no leaves should have been pulled from them in the preceding season. For lifted crowns to force in heat it is particularly important that no green pullings should have been made.

Lifted roots usually occupy, after trimming, a space of from 9 in. to 1 ft. square. They are packed as closely together as they will stand on a few inches of moist soil, and similar soil is worked into the spaces between them, up to the level of the crowns.

After the crowns are in position they should be given a light watering. Raise the temperature to about 40–45 deg. F. and after about 8 to 10 days to 50–55 deg. F., but at no time let it go above 60 deg. F. The soil about the roots should be kept in a nicely moist but not wet condition. The stalks should be gathered immediately they are ready or they soon become soft and spongy. Remove all small or damaged stalks which may rot and spread Botrytis. Little or no ventilation is needed in the early part of the forcing but the later crop may require ventilation in order to prevent the temperature rising too high. When the crop is over the roots are best treated by drying and burning. Forcing weakens them severely and only in extreme cases should the crowns be replanted.

When forcing the crowns where they grow, they may be covered with boxes or tubs. Extra heat may be provided by banking fresh manure around them. When the forced crop has been gathered the protecting shelter is removed, the manure is spread in the alleys and the crop allowed to grow naturally during the summer. If the spring pulling is not too drastic this forwarding may be repeated annually for several years, but it is better to allow for it in alternate years.

Manures. Abundant supplies of farmyard manure or similar material are necessary in rhubarb culture. Beds of "natural" rhubarb may stay down for three to five years' cropping, being stripped of their leaves as fast as they are made, so it is obvious that they require a large amount of rich food to stand the strain and maintain productiveness year after year. If forced crowns are to yield heavily they must be well prepared.

For any rhubarb crop 30 tons per acre or more of dung may be ploughed in when preparing the land.

For "natural" rhubarb give an annual spring dressing of sulphate of ammonia. This should be at 2 cwt. per acre for the first two years whilst the crowns are being prepared. When the roots are old enough for pulling this should be increased to 3 cwt. and a similar dressing be given at the end of the pulling season.

Potash may be given as 2 cwt. of muriate of potash and 4 cwt. superphosphate will also be needed. These may be given in spring at the same time as the first nitrogenous dressing.

Each winter the alleys between the crowns should be dug over, working in some well-rotted dung. Early in the new year give a good littering with straw to nurse the young leaves as they grow; in due course this material will be trodden into the soil whilst pulling is in progress.

For forcing crowns a dressing should be given each spring, using 2–3 cwt. sulphate of ammonia, 3–4 cwt. superphosphate and 2 cwt. muriate of potash per acre.

Varieties. *Open ground:* Dawes Champion, Hawkes Champagne, Prince Albert, Linnaeus, Timperley Early. *Forcing:* Prince Albert (early), Victoria, The Sutton, Linnaeus.

SALSIFY

Tragopogon porrifolius

SALSIFY (also known as the oyster-plant) is a root which is practically unknown to the general public of this country, and there is practically no demand for it on the market. Those who have direct dealings with good shops and hostels might occasionally have a request for it. Properly cooked, it is wholesome and possesses an agreeable flavour, and should form a welcome addition to the somewhat restricted list of winter vegetables.

The best roots of salsify are grown in a deep, moist soil of rather light texture, although a heavy soil will produce good roots providing it is deeply and well worked and made friable throughout. It should be in good fertile condition but free from recently applied manure. Fresh manure in the soil causes the roots to grow fanged; good specimens should be long, tapering, and straight. The best preparation for the soil is to double-dig it in the autumn.

Seed should be sown in April, in drills 10 in. apart and 1 in. deep, afterwards lightly rolling, if the surface of the soil is dry, as it should be. As soon as the seedlings can be handled, thin out to a few inches apart, and when they have grown a little stronger thin finally to 8 in. apart.

No weeds must be allowed to grow with the crop, and through the summer the surface soil must be kept well hoed.

The roots are ready for use by the middle of October. They are treated in the same way as parsnips; they may be stored in a clamp, or in moist sand or earth in a shed, or they may be left in the ground to be lifted as required, and this is the best method when the ground they occupy is not required. Great care should be taken not to damage the roots in lifting, or they will bleed from the broken parts and loose flavour.

Varieties. Sandwich Island Mammoth, Giant French.

SCORZONERA

Scorzonera hispanica

SCORZONERA and salsify are usually classed together, but this must not be taken to imply anything more than convenience, as they are quite distinct in appearance, and each belongs to a different genus. The salsify root is of a pale yellowish colour, and the leaves are long and narrow and of a greyish green. The root of scorzonera is of a dark purplish colour, whilst the leaves are broader and shorter than those of salsify. Both plants are grown and treated in exactly the same way and have the same uses but, when necessary, scorzonera may be left in the ground for a second season, when the root, although much increased in size, will be equally fit for use.

Variety. Giant Russian.

SAVOY

Brassica oleracea bullata

Of the green vegetables which are available throughout the winter, the Savoy Cabbage is one of the most useful. It has a milder flavour and is hardier than the ordinary cabbage; indeed, the savoy is not at its best until it has been subjected to frost. The ordinary cabbage has smooth leaves, whereas in the savoy they are more or less deeply crinkled.

The soil for savoys should be somewhat heavy, deeply cultivated, rich, and firm. Ground which has previously been well prepared and cropped with early peas would carry this crop well, if assisted with suitable fertilisers.

Where double-cropping is not practised it is best to prepare the ground before winter, so as to secure the good effect of the weather in rendering the soil mellow and friable, but whether prepared in autumn or spring it should receive heavy dressings of manure and be ploughed deeply. The manure should not be in a fresh, rank condition, particularly when given in spring, or a soft loose growth, instead of firm compact heads, will probably be the result. When ploughing is done in dry weather, clods must be reduced by rolling, then disc and harrow well to obtain a fine tilth.

For a long succession make sowings from the middle of April to the middle of May and use two or three varieties. Sow thinly, on well-prepared ground, in drills 8–12 in. apart. To keep flea beetle away dress as advised on p. 286. Keep the soil free of weeds.

Plant out during June and July, and to make a succession plant the early varieties first. For this work choose dull, cloudy days, when the ground is moist; if the planting must be done in hot, dry weather irrigate the day before planting or the roots should be "puddled" (see page 61). The smaller varieties are set out 15 in. apart in rows and 18 in. between the rows, the larger sorts are planted 2 ft. apart each way.

Manures. Farmyard manure, at the rate of from 20 to 25 tons per acre, according to the nature and condition of the soil, is the most suitable fertiliser for this crop, possibly applied to the preceding spring crop. When, however, the soil is in good heart from previous manuring, the quantity may be reduced by one-half. Give also 1–2 cwt. sulphate of ammonia, 3 cwt. superphosphate and 2 cwt. muriate or sulphate of potash. On very fertile land a little extra potash may help late varieties to stand the winter.

Varieties. *Early:* Best of All; *mid-season:* Ormskirk Medium; *late:* Ormskirk Late; *very late:* Omega.

SEAKALE

Crambe maritima

SEAKALE is a very popular winter vegetable for many people. It is easy to grow, simple to force, and is a very wholesome vegetable to consume.

There are few soils in which seakale cannot be satisfactorily grown if it receives proper attention. A well-cultivated, deep, and rather heavy soil will grow the finest roots, but an easily worked sandy loam will be found the best all round, because much of the work of lifting roots has to be done in winter, when the ground is wet. A light soil is also necessary where "natural" seakale is grown. In any case, the soil must be deep, rich, well-drained, in an open situation free from trees, and with a sunny aspect.

Preparation of the Soil. Thorough preparation and liberal manuring of the soil are absolutely necessary to the production of strong crowns suitable for forcing. Although seakale is not particular as to the conditions under which it grows, this must not be allowed to influence the treatment it receives. The leaf-stalks when bleached should be large, thick, and crisp, or they are practically useless, and the grower should set out to do all necessary to obtain such produce or he will be well advised not to enter the business. To this end the ground should, in the first instance, be double-dug or subsoil ploughed, if deep working has not been done recently; but where the soil has received such treatment within the past three years ordinary digging or ploughing will be sufficient. Abundant supplies of farmyard manure are essential in every case, assisted judiciously by concentrated fertilisers. This work of preparation should be done before winter, so as to get the full benefit of weather influences. About the first week of March, if the weather conditions permit, the soil should be levelled by harrowing, after which it may be marked out both ways with lines 15 in. or 18 in. apart, every point where the lines cross being the position for a plant to be set, and all will then be in readiness for the work of planting out.

Propagation by Seed. Raising seakale plants from seed is not often practised in market-gardens, as it takes two years' growth from seed to obtain crowns large enough to force satisfactorily, whereas one season is sufficient to obtain them from "thongs", or root cuttings. Seedlings are variable and before they are used for root propagation poor-type plants should be removed. On a bed of rich, clean soil, in a fine tilth, sow the seed in March, in drills 1 in. deep and 12 in. apart, gently rolling afterwards. When the seedlings are well up, thin out, and leave only the best standing about 6 in. apart in the rows. During the summer hoe frequently to keep weeds down and to promote growth. One or two light sprinklings with nitrate of soda will be amply repaid by the increased vigour of the plants; indeed, under such treatment, if given more space for development, some of the crowns would be found large enough to force at the end of the first season. In the following March the plants may be set in their permanent quarters, first cutting off the top just below the crown to prevent flowering.

Propagation from "Thongs". New plantations of seakale are usually made from "thongs". These are clean straight pieces selected from the side roots, which are cut away from the main root when that is trimmed up for forcing. The best are selected, from the thickness of a lead pencil upwards, and cut up into pieces 5 in. to 6 in. long. The top, or thickest end of the thong, is cut across level, and the bottom, or thin end, is cut slanting. Use only clean sound roots. They are then tied in bundles and stood in layers in damp sand or fine soil, with about 3 in. space between each layer, and there they remain until planting time. Some growers prefer to make up a bed in the open, about 4 ft. wide and raised about 8 in. above the general level to keep the thongs free from excessive wet, and after laying them thickly all over the surface, cover with about 3 in. of soil. In either case, when the thongs are uncovered for planting, each will be found to have made several "eyes", all of which must be rubbed off except the strongest one at the top.

Forming a Plantation. The methods of obtaining blanched heads of seakale may be classed under two divisions, (1) lifting the roots for forcing in heat, and (2) leaving the roots in the ground and either forcing growth with hot manure or letting them grow naturally, blanching the heads by coverings of soil or other materials. Both methods are necessary to obtain a succession over the longest period, and this must be kept in view in arranging a plantation.

When growing to lift for forcing the plants should be set 15 in. apart in rows 18 in. apart (or wider if better suited to the cultivation equipment). If the crowns are to be earthed-up for "natural seakale" the crops will be better in double rows, 12 in. apart, the plants 10 in. in the rows and 4 ft. alleys between the double rows, as earthing is then easier.

In smaller plantations the plants may be set in clumps, to be covered with seakale pots or boxes. In each clump set three or four plants 4 in. apart, leave 2 ft. between each clump, and leave 3 ft. between each row of clumps.

About the third week in March the thongs are dibbled-in in rows 18 in. apart and 15 in. apart in the row, the crowns being put about 1 in. below the surface and the soil closed quite firmly around them. The culture through the summer consists of hoeing frequently and thoroughly, and cutting out all flower stems as soon as they are seen, as if allowed to bloom and form seed much of the strength of the crown will be lost.

Forcing under Cover. Seakale is very easy to force; the crowns begin to move as soon as they are subjected to a slight rise of temperature. The best samples are produced when grown slowly, a steady temperature of from 50 to 55 degrees being sufficient for really satisfactory work, and 60 degrees should never be exceeded at any time, or the stalks will come thin and without substance. The heat, which may be supplied either by hot-water pipes or by fermenting manure, should be a moist one, and acts best when applied underneath the roots, although forcing may be done without bottom heat, if necessary. Absolute darkness is essential, or the heads will not be perfectly blanched, and in no other condition can they be considered as marketable. By observing these conditions seakale may be forced in all sorts of places—frames, mushroom houses, glasshouses or cellars—any of which

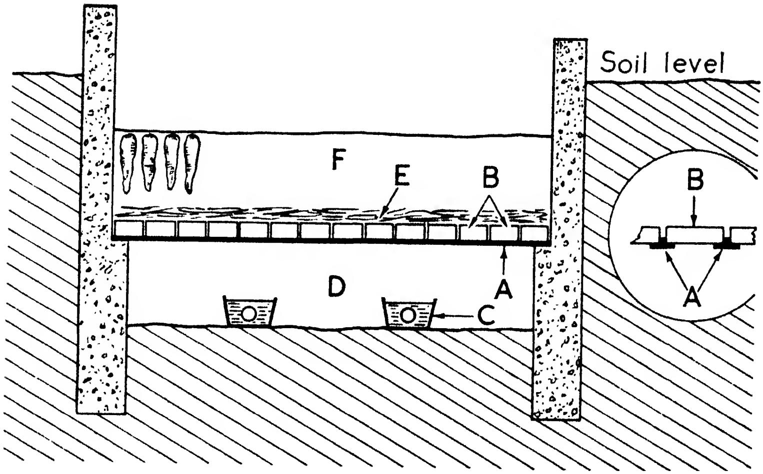


FIG. 74. Section across seakale forcing pit

A. T-irons B. 9-in. tiles
C. 2 in. hot-water pipes running through open gutters
D. Chamber providing even distribution of heat
E. Straw F. Soil

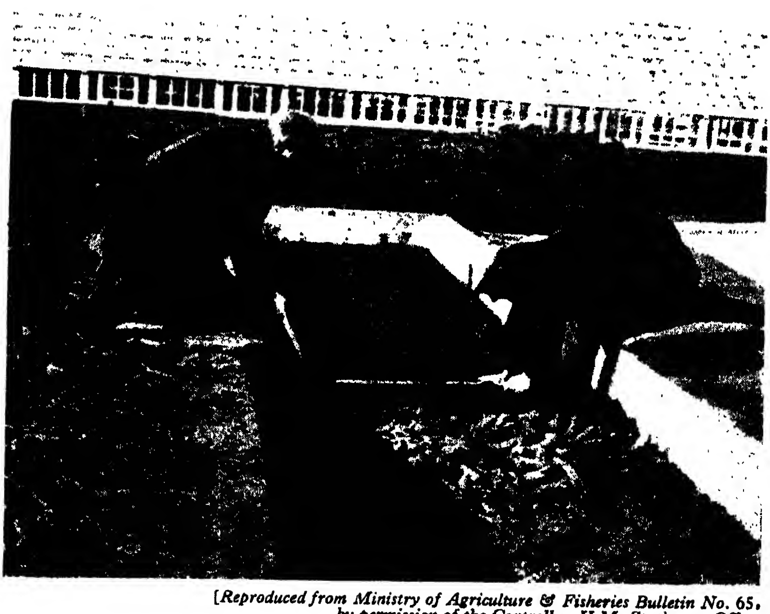


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FIG. 75. Planting seakale crowns for forcing

may be pressed into service with satisfactory results. Regular forcing begins about the middle of November, and for the earliest batches the very best and strongest crowns are selected.

As soon as the leaves die down in the autumn the roots are lifted and trimmed, leaving only about 5 in. of the main root with the crown on top. Those not immediately wanted are packed away in moist sandy soil either in a shed or in a trench in the open,

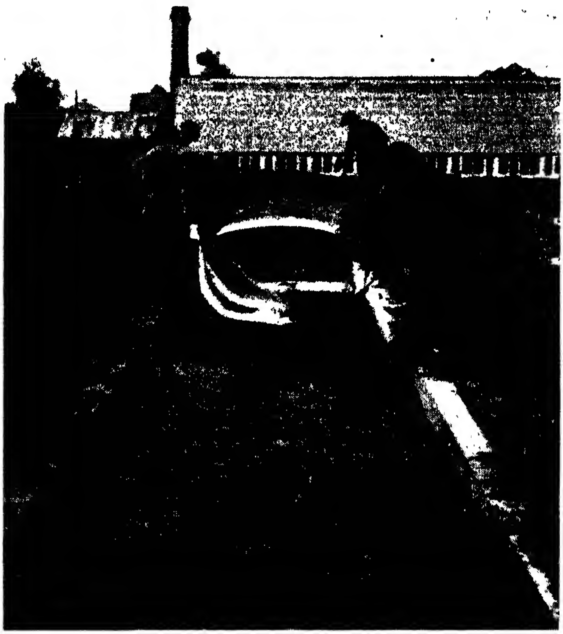

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FIG. 76. Covering seakale crowns for forcing

with a layer of dry litter over the crowns to protect them from frost. Light, fine, rich soil should be specially prepared for forcing operations some time beforehand. This soil should be laid down to the depth of 8 in. or 10 in. in the position in which the crowns are to be forced. These are then placed in the soil 3 in. apart, and with the crowns level with the surface. Moisten the bed with tepid water, taking care not to make it too wet, then cover the crowns with 3 in. of fine dry soil, coconut fibre, or similar material. When the stalks begin to grow through give another light watering. If there is certainty of no light getting to the stalks they need no further covering, but where there is any doubt on the subject a further 4 in. layer of material should be added. If the details are properly carried out, perfectly blanched heads should be ready to cut in four or five weeks from the time the roots were planted. The heads are cut when about 6 in. long, or as soon as the tips begin to push through the covering material; the cut is made below the crown so that a small piece of root is attached.

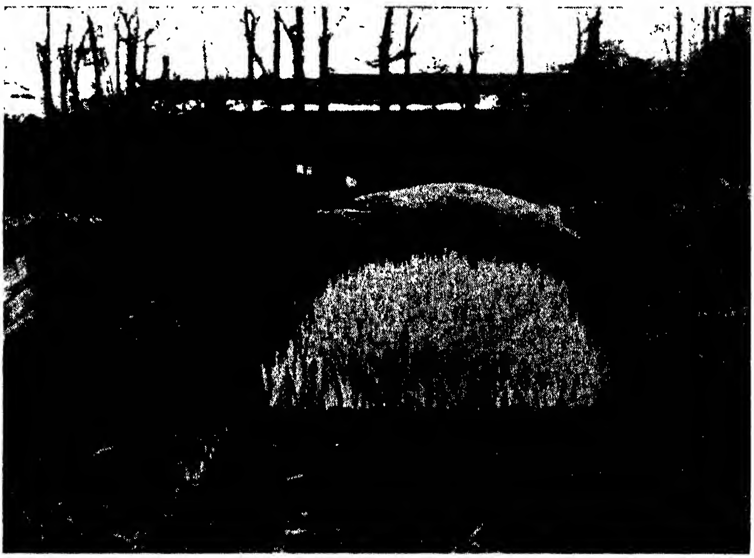

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FIG. 77. Forced seakale ready for cutting

Special forcing pits providing moist bottom heat are still occasionally used but would be expensive to construct today. These have a bottom chamber fitted with two 2 in. hot-water pipes (each is a flow) to provide even distribution of heat in each pit. These pipes run through open-topped gutters filled with water. Over these is a "roof" of 9-in. tiles supported on T-irons. The water evaporates into the chamber. Before use a layer of straw is placed on the tiles and then about 12 in. of light, fine soil. The crowns are planted in this, packing them thickly in rows 3 in. apart. A thin covering of straw is placed over the beds, but as growth starts this is replaced by hessian. A temporary light-proof shelter is then erected over the pits, e.g. iron hoops to support wooden frames or hurdles which are thickly "thatched" with loose straw.

To force the crowns which were planted in clumps, each is covered with litter a few weeks before a start is intended, to keep frost out of the soil. Then at starting time the litter is removed and each clump covered with a box with a movable lid or with a seakale pot. These are surrounded with hot manure, and litter should be put over the tops to conserve the warmth and to prevent any light getting in. In the course of a few weeks well-blanched heads will be ready for cutting.

"Natural" Seakale. The beds are cleaned up in autumn and the soil in the alleys well worked to a good tilth. Soil is banked on to the bed, covering the crowns 8 in. deep, with the sides sloped a little to prevent soil from slipping. This work must not be done in wet weather and the soil must be fine and crumbly. Cutting begins from the middle to the end of March, according to the earliness of soil and season, and continues to the end of April. When cracks are seen in the surface of the soil, owing to the growth of the shoots, or the tips are just showing through, cutting may begin. If the beds are of any extent and likely to be delayed in cutting, those coming last should be covered with a few inches of short litter to exclude light. Cutting is done with a sharp flat spade, the heads being cut about $\frac{1}{2}$ in. below the crown. The soil is thrown into the alley, but about 1 in. is returned to the bed to cover up the cut stumps. When cutting is finished, the alleys are given a 3-in. coat of well-rotted manure. A bed of this kind will last for about five or six years.

Manures. Seakale is a crop which needs plenty of rich food and moisture-holding humus, and this is best supplied by heavy dressings of well-decayed farmyard manure, particularly for the sandy soils on which this crop is often grown. For soil in good heart and not too light 15 tons per acre would be enough, but on light land or that which is not in really good condition 30 tons would be none too much. In either case the manure should be supplemented before planting with 2 cwt. muriate of potash and 4 cwt. superphosphate. After growth has begun 2 cwt. nitrate of soda per acre may be given with advantage.

Varieties. There are very few varieties of seakale in cultivation. Lily White and Ivory White are improvements upon the common stock.

SHALLOT

Allium ascalonicum

THE Shallot is very generally grown in cottage gardens, but has rarely a place in the market-garden. It is sometimes used part-grown as a salad or, more commonly, as a mature bulb for pickling. Many shallots are imported, but a few growers produce bulbs for sale to seedsmen who retail to private gardeners.

The shallot is subject to a virus disease which causes weak, spindly, yellowish growth and small bulbs, therefore care should be taken to remove all weak plants from the bed during the growing season.

The shallot is easy to grow and gives very little trouble if its requirements are provided. It needs an open, sunny position and a rather light soil, deeply-worked and well-drained. To obtain good crops the soil should be prepared and manured in the same way as for onions, with the difference that it does not need to be quite so rich.

The true shallot is grown from bulbs. The so-called shallot for which seed is sometimes offered is really an onion. Provided that the bulbs have been saved from healthy stock it will be found that planting the largest sized bulbs will give the heaviest yield, whilst the small bulbs yield fewer but very large bulbs.

Early planting is essential; the bulbs of the red varieties begin to go soft very early in the spring and are then comparatively useless for planting. Planting may be done at the first opportunity, in a spell of open weather, during January or early in February and in any case by the end of March, in rows 9–12 in. apart, with 4–6 in. between the bulbs in the row, according to the richness of the soil. Before planting, the soil should be lightly rolled, and the bulbs then inserted to half their depth, either by the aid of a dibber or, if the soil is free enough, by simply pressing them in. It is an advantage if dry, loose skins and dead tops can be removed, as worms, by trying to draw these parts into their holes, will often pull the bulbs out of the ground. The soil should be closed firmly around the bulbs or the growth of the roots will sometimes lift them out. In any case, the bed should be examined frequently for a few weeks after planting, and any which have been disturbed replaced.

During growth keep the weeds down by frequent hoeing, but take care not to cut into the soil deeply or to bury the bulbs, which should grow on the surface.

Ripening will begin in July, and may be seen by the leaves turning yellow; by the middle of the month these will have withered considerably, and the bulbs may then be lifted. Spread them on the ground to dry in the sun for a few days, turning them over two or three times: then divide and top them, and store in a cool dry place.

Manures. If this crop follows one which has been well dunged no other organic matter need be given. It it be considered necessary then give 12–15 tons per acre of rotted dung. For fertilisers give 1 cwt. sulphate of ammonia, 1 cwt. muriate of potash per acre, and 1 cwt. nitrate of soda as a top-dressing.

Varieties

Yellow or Dutch Shallots: the bulbs are light brown or golden in colour and keep hard and firm quite late into the new year. Growth starts late after planting.

Large Red or Russian: when ripe the bulbs are reddish-brown on the outer scales and the inner ones are tinged purple. Does not keep well; starts growth soon after planting.

SPINACH

Spinacia oleracea

ALTHOUGH Spinach cannot be regarded as a staple crop in the market-garden it is nevertheless a very useful one for many growers. It cannot be included amongst the vegetables very popular with the general public, and therefore the demand for it is not great. It is produced easily and quickly, and in gardens the summer crops are often grown in the spaces between rows of other vegetables, where it only requires a few weeks from sowing to gathering, and is cleared away before its presence can injuriously affect its neighbours. For this reason it is there regarded as one of the indispensable catch-crops, as it enables a return to be obtained from spaces which would otherwise be wasted for some time after planting the main crop.

Spinach is not very exacting in its requirements, but like most other things it pays for a certain measure of attention. What is wanted is a quick growth and a few heavy pickings of large succulent leaves, and to obtain these, ample supplies of moisture and quick-acting manures are necessary. Ground well prepared and manured may be depended upon to yield satisfactory crops of spinach, but on badly worked, dry, scantily manured soils the leaves will be small and of poor quality, and the plants will quickly run to seed.

Spinach is a "long-day" flowering plant and if sown late in spring it bolts and runs to seed, giving very few leaves.

Summer Spinach. An early broadcast sowing may be made in cold frames. Sow at the rate of 1 oz. of seed to two Dutch lights. The crop is cleared when the plants have developed two or three true leaves. The first sowing in the open is made towards the end of February, on warm soil in a sheltered sunny position; a regular succession of supplies is secured by sowing further batches every two or three weeks until the end of April or early May. Except when used as an inter-crop, spinach is sown in drills 1 in. deep and 1 ft. apart. When the seedlings are well up they should be thinned to 4–8 in. apart, according to the vigour of the variety and the richness of the ground. The proper thinning of spinach is often neglected, under the impression that the closer the plants stand the heavier will be the yield of leaves. This is a great mistake, as overcrowding seriously reduces production, the leaves coming much smaller and thinner than when afforded proper space, as can be readily understood when it is remembered that each plant when given room will measure at least 1 ft. across; some very vigorous varieties take up considerably more space even than this.

Winter Spinach. To provide a succession of pickings from October to May (by which time the spring-sown crop will be ready) three sowings should be made, at intervals of a fortnight, from the first week in August to the middle of September. The ground for this purpose should be deeply worked and have been well enriched with manure for the previous crop. If the soil is heavy the site may be laid up in raised beds, 5–6 ft. wide, to enable the rainwater to pass away quickly and the crop to be gathered without treading on the soil. In this case the plants may stand closer together, say 9 in. between the rows by 4 in. in the rows, because the growth is naturally less vigorous in winter than in summer. Where any quantity is grown the rows should be 12 in. apart as for the summer crop and thinning to 4 in. is adequate.

Of these autumn sowings, the earlier ones will provide some pickings in early winter, particularly where some shelter can be given. Cold-frames can be useful for this. Mid-winter cuttings are very light.

The later sowings stand the winter to give a spring crop. To ensure a good stand of plants through the winter superphosphate before sowing helps the plants to develop a good root system and potash helps with winter hardiness.

General Culture. This, in the main, consists of keeping the soil free of weeds and the surface frequently stirred, especially in the early stages, so as to encourage rapid growth. As the weather gets warm and dry the effect of indifferent preparation will at once be seen by the plants bolting, and the crop thus completely lost; the only way to ensure an abundant growth of large succulent leaves in the hot weather being by deep working of the soil, assisted by mulches and frequent waterings. In a cool, wet season, spinach makes an abundant growth without much help; in such circumstances, apart from keeping weeds down, it may be left to take its own course, but in hot, dry periods it responds to irrigation.

Manures. The whole culture of spinach should be directed towards obtaining a quick growth of large fleshy leaves. To secure this result the soil must be made rich and retentive of moisture but well drained. Work the soil deeply, adding at the same time generous dressings of farmyard or stable manure. Deep working combined with the manure enables the soil to hold more available moisture, provides an ample root-run, and supplies an abundance of plant food, all of which are necessary to vigorous leaf growth, and their provision is the best means of preventing plants running prematurely to seed in dry weather.

For summer crops the manure should be applied at the rate of 20–30 tons per acre if it is considered that there is insufficient residue from the previous crop. When the crop is through and about 3 in. high it should be given a top-dressing of nitrate of soda or potash nitrate at 1 or 2 cwt. per acre. On soils where the fertility is known to be low or where dung supplies are limited give 2 cwt. of hoof and horn *or* 1 cwt. sulphate of ammonia, 2 cwt. superphosphate, and 1 cwt. muriate of potash per acre.

For the winter crop, follow a well-dunged crop and give 2 cwt. superphosphate and 1 cwt. muriate of potash before sowing. In February or March give 2 cwt. nitrate of soda.

Varieties. For summer the round-seeded varieties are used, Victoria being a favourite amongst market growers; but there are several other sorts equally good, if not better, amongst which may be mentioned King of Denmark, Monstrous Viroflay, Reliance, and Nobel. For winter and spring Large Prickly is the favourite, because of its supposed superior hardiness. Giant Leaved Prickly is a good sort. Actually, many round-seeded kinds will winter well and, conversely, prickly seeded sorts are sometimes sown in spring.

[*By courtesy of P. Clarke*

FIG. 78. New Zealand Spinach

NEW ZEALAND SPINACH

Tetragonia expansa

THE difficulty of getting a continuous supply of spinach in the hot summer months is easily overcome in the south by substituting New Zealand Spinach, which grows to perfection under such conditions. The plant will not bear frost, and for supplies early in the summer seed should be sown under glass in gentle heat about the end of March, the plants potted singly or pricked out to soil blocks (see p. 64), and set out, after hardening, at the end of May. Or seed may be sown out of doors at the beginning of May. The plants should be set in rows 3 ft. apart in each direction, or even 4 ft. on good land. In good soil they soon cover this space. Each plant makes a number of spreading stems with side shoots, and bears numerous small, thick, fleshy leaves; many of these rambling stems, if allowed to grow unchecked, will attain a length of 2–3 ft. Overcrowding stunts the growth of the plants and prevents them exhibiting their true character and capabilities. The leaves may be picked singly, as those of the true spinach are, or the tender shoots may be pinched off. Growth is rapid and continuous throughout the summer, and the plant needs no attention beyond watering, which should be frequent and copious.

Manure. Grow on a site well manured for the previous crop and give 5–6 cwt. of meat and bone meal per acre before planting.

This crop is of limited popularity and should only be grown for market after consulting the salesman.

SPINACH BEET

Beta vulgaris cicla

THE Perpetual Spinach, or Spinach Beet, is grown for its leaves, of which it produces a continuous supply in the hottest summer, when true spinach is difficult to obtain. The leaves are boiled and sieved like spinach, for which it makes a very satisfactory substitute. It is grown in the same way as the ordinary beet, except that the soil should be richer, to promote an abundant leaf growth. The seed is sown in March or April, and again at the end of July to ensure a supply until late in the season and early the following spring. Sow in rows 15 in. apart, and thin out 6–8 in. from plant to plant. No further attention is then required beyond hoeing, occasional watering, and top-dressing with nitrate of soda at 1 cwt. per acre. As soon as the leaves are large enough they must be gathered, even if not then wanted, so as to have a supply always young and tender. The plants are quite hardy, and therefore continue to yield in the open ground until late in the season. When a supply is wanted through the winter the July sowing may be made in beds of a width which permits them being covered with cold-frames.

SWEDE

Brassica napus

THE Swede is hardier than most varieties of turnip. In some districts it is much more popular as a vegetable than is the turnip. The soil conditions and preparation needed by this crop are similar to those described for turnips, but when sowing more room should be given. Rows should be 24 in. apart and the plants thinned to 10–12 in. apart, though it should be remembered that if the soil is in very good condition wide spacing may lead to the roots growing too large for market. Sow in late May or early June, or a little earlier in the north.

The crop is ready to lift in November. Unless they have been grown soft with too much nitrogen, the roots should stand a good deal of frost and may be lifted as required.

The variety Purple-Top is a good one.

SWEET CORN

Zea mays var. *saccharata*

Sweet Corn is a form of maize, the seeds of which have a high sugar content. The dry seeds are markedly wrinkled in contrast to the plump seeds of true maize with their high starch content. For many years sweet corn has been a favourite vegetable with some people, but more recently its cultivation on a commercial scale has extended considerably.

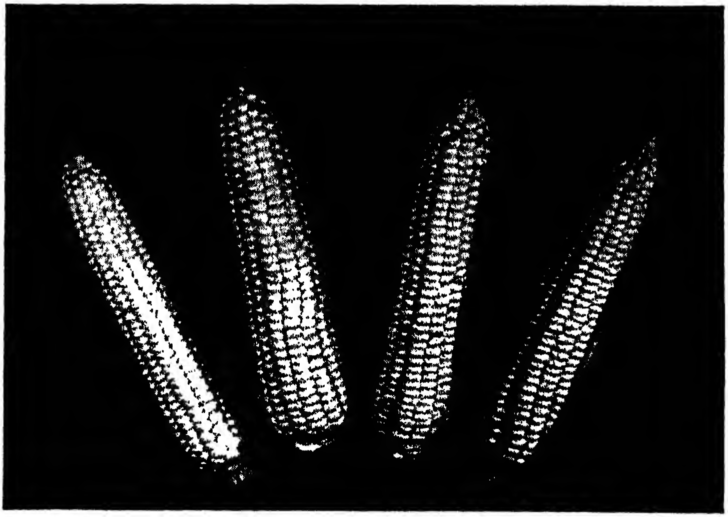
Sweet corn will give good crops on a wide range of soils, but for easy working the soil should not be too heavy. The land should be in good heart, but avoid highly nitrogenous manuring. Choose an open, sunny site and if early sowing in the open is to be practised avoid frost pockets.

The male and female flowers are borne on different parts of the plant, the male flowers in a "tassel" at the end of the main stem and the female flowers in a "cob" lower down the plant. From the top of the cob appear numerous long, silky stigmas. When the pollen in the male flower is ripe it is shed and dispersed by the wind, some falling on to the "silks". This crop should never be grown in single isolated rows, but in blocks, as then there is greater likelihood of an even dispersal of pollen amongst the plants and the production of good cobs. Uneven cobs result from bad pollination. Poor pollination and fertilisation may also result from cold, wet weather about flowering time. This crop is not suited to cool, wet districts.

Sow in rows 2 ft. apart, dropping two or three seeds together at 12–18 in. spaces. When the seedlings are well through reduce them to single plants. The seed should be 1–1½ in. deep. For unprotected cultivation the middle of May is soon enough to sow, but if sowing is done under lights or cloches the sowing may be two to four weeks earlier.

Early plants may be started in pots, sowing singly in $3\frac{1}{2}$-in. pots in late April. Germinate in gentle heat, and when ready harden off. Take care not to give the plants a check by keeping them in the pots too long—they soon get pot-bound. Pot-raised plants often miss attack by frit fly, a pest which may cause much damage to the main shoot of the young seedlings.

Hoe the land as required to keep down weeds, but avoid deep working, which damages the roots.



[*By courtesy of Messrs. A. L. Tozer Ltd.*

FIG. 79. Sweet Corn, Canada Cross

The cobs are ready for picking about three to four weeks after flowering. An indication of readiness is the withering and browning of the "silks". It is very important to learn to judge the right stage for marketing, as if the cobs are not in the right condition they are unpalatable. If picked too soon the seeds are watery; if too late they are tough. If on pressing a seed with the thumb-nail it bursts and shoots out its contents in a thick creamy condition it is just right. Many unwary buyers of cobs have been discouraged from further purchases by being supplied with inferior produce. Pull the cobs from the stems.

Manures. Grow either on land dunged for the previous crop or give 12–15 tons farmyard manure when ploughing the land. Before sowing give 1 cwt. sulphate of ammonia, 3 cwt. superphosphate, and 1 cwt. muriate of potash.

Varieties. Extra Early Bantam, John Innes Hybrid, or Canada Cross. The hybrid forms are early and vigorous.

TOMATO

Lycopersicon esculentum

THE Tomato now takes an important place in the diet of the nation, and during the Second World War its cultivation in the open was developed on a large scale, supplementing the early and main-crop supplies from glasshouses. It may be cultivated successfully throughout southern England and in favoured places much further north, particularly in the milder western counties and with the help of continuous cloches. For successful commercial production the drier climate of the south and south-eastern parts of the country has led to the main concentration of outdoor tomatoes in those districts. (The author of this book was a pioneer cultivator of the open-ground tomato crop in Essex.—*Ed.*)

It must be remembered that the tomato is a sub-tropical plant, and needs for its healthy growth a moderately high temperature, a dry atmosphere, abundance of air, and full exposure to sunlight. The climate of Great Britain, from its humidity, changeableness, and frequent lack of sunshine, is a very unreliable one for this crop. Even in the best circumstances very little more than four months is the whole extent of the season when it can be grown in the open air, and this limited period is frequently shortened by cold, cutting winds at the beginning and rain or mists, which encourage disease, at the end. Under such conditions tomato-growing in the open air is undoubtedly a speculative business. In a warm, dry season it yields good profits, even though the ripe fruit has to be put on markets more or less glutted, when prices are often low, but if the summer is cold or the autumn should prove to be wet the crop may be disappointing.

The fruits of outdoor tomatoes are liable to attack by Potato Blight in the wetter areas or in cold wet seasons. This disease can cause much loss if routine protective spraying or dusting is not adopted.

Situation and Soil. The site should be sheltered from cold and strong winds. Particular attention should be paid to this point.

The tomato will crop well on a wide range of soils, but it is wise to select, if possible, the medium-textured loams. Too light a soil may suffer badly from drought during dry periods and if irrigation is not available much cracked fruit may result. Heavy clays may be waterlogged for a time during wet weather and the tomato is intolerant of excessive water at the roots.

Planting of the crop in the open is not done until frosts are over, so the preceding crop may be one cleared in late winter. If it was well dunged and it is considered that there is a good residue for the tomatoes, no more need be given, but if necessary some well-rotted material may be given when ploughing.

Raising the Plants. Seed is sown at the end of March and the plants are grown on for planting out eight to ten weeks later, when danger from frost is past. The best plants may be obtained by sowing in seed trays of J.I.P. compost (see p. 307), sowing about 200 seeds per standard seed tray. As soon as the seedlings can be handled they are pricked off to 3½-in. pots. During germination and for some time after pricking off, they are kept in a greenhouse with a night temperature about 55 deg. F. and in due course hardened off in cold-frames. This will be some time during May, and mats or straw should be available to wrap up the frames should frost threaten. Instead of pricking out to pots, soil blocks (see p. 64) may be used, and with the larger blocks it is possible to obtain better plants than with pots, as the plant has more soil in which to grow.

Where space is limited, large numbers are sometimes grown by pricking out in boxes, allowing about 3 in. between the plants. Such plants receive a greater check at planting time than do those in pots or blocks.

Whilst the young plants are being grown on, keep a sharp look-out for rogues—bushy, short-jointed plants which will not crop or will give a few small chats.

PLANTING SYSTEM

A number of methods have been adopted for planting and training. In single rows 3 ft. apart, with plants 18 in. apart in the rows, about 9,500 plants per acre will be needed. In double rows, two at 18 in. with 3 ft. alleys between, nearly 13,000 plants per acre will be needed. With the latter system the plants may be grown up stakes and three of these tied together at the top form a tripod, giving good rigidity. Or two wires may be strung overhead on cross-bars fitted to stakes along the row, and the plants grown on strings, but this must only be done on a very sheltered site.

The single row has the advantage of enabling good protection to be given to early plantings by covering with cloches, or at the end of the season the plants may be loosened from their canes, laid along the ground, and covered with cloches to help ripen.

Planting. This will be done about the end of May or early June according to weather. There should be no hurry about planting. If the weather is warm and settled the work may begin in late May, but it is better to defer a week or more rather than plant when the ground is cold and the wind hard and biting. Cloches enable the planting time to be less dependent on the weather. If they are placed on the ground in good time the soil warms up more readily.

Before planting, care must be taken that the ball of soil about the roots is moist throughout. Holes may be made with a trowel, a spade or a tomato "planting tool". The plant is placed in position—not too deeply—and the soil firmed around the ball of roots. Should the soil be dry at planting time the plants must be watered in.

The stakes or other supporting media should be erected soon after planting, if not already done.

Training and Culture. As soon as planting is finished the soil should be lightly hoed over and should be maintained weed-free throughout the season. As the plants begin to grow freely they must be systematically relieved of side-shoots; these grow apace and their removal whilst still small must not be neglected. An exception to this rule might be made during very wet weather, when to leave the side-shoots enables the plant to get rid of some of the excess water.

Stopping. In the first week in August the plants should be "stopped" (that is, the main stem is cut off and no further growth permitted) at two leaves beyond the last fully developed truss of flowers. This is usually the fourth truss in south-eastern England. When growth has been slow it may be at the third truss. In a cold, wet autumn the last truss will even then fail to mature, but on the other hand in a warm, genial autumn or "Indian" summer most of the fruit on the last truss will ripen in the south of England.

Thinning the Foliage. That an abundance of healthy foliage is necessary to the production of a heavy crop of fruit is beyond question. The green leaves should not be removed until the crop is well developed. Then from plants grown in double rows some thinning of the foliage will help admit air and light to the centre of the rows. As the first truss ripens some of the basal leaves may be yellowing and these may be cleared. In September, with cooler conditions, a few leaves may be removed to let the sun shine more fully on the fruit.

Disease Control. Spraying or dusting with a suitable copper preparation must be a routine precaution against Potato Blight. This must be first done as the fruits start swelling and may be repeated two or three times (see p. 302).

Stem Canker (*Didymella lycopersici*) can cause serious trouble, not only to the stems but as a rot on the fruit, which fall to the ground and turn black. Destroy infected fruit and plants and do not re-use old canes, etc., for supports without sterilising by soaking in a 2% solution of formaldehyde for fifteen minutes.

Gathering the Fruit. The general temperature and the possibility of damage by birds are the two principal factors to be taken into account in deciding when to gather the fruit. Blackbirds, and in a lesser degree thrushes, may become troublesome to the open-air tomato grower, as indeed they are throughout the summer to all growers of fruit. Where these birds are troublesome, the fruit on the bottom bunches should be gathered and carried under cover to finish as soon as it shows the first faint signs of colour. Beyond the point where they can peck the fruit whilst standing on the ground the birds do no serious damage, and it should then be left on the plant until ready for market. The prevailing temperature and the destination of the fruit should be taken into consideration in deciding when to gather. In the heat of the summer it ripens very quickly after it is packed, and if left on the plant until fully ripe it would arrive at its destination too soft, and much depreciated in value. The proper degree of under-ripeness of the fruit when packed therefore calls for a considerable amount of judgment; when the weather is very warm, and particularly when the packages are likely to be delayed before being exposed for sale, the colour should not be deeper than pink; as the weather gets cooler ripening proceeds more slowly, and therefore the colour should be allowed to get more and more advanced before packing, the object being to ensure that it shall be firm, well-coloured, and attractive in appearance when offered to the purchaser.

About the end of September the fruits still hanging may be destroyed by sharp frosts, but if they then escape they will probably be safe for several weeks longer. After September it is useless to expect them to ripen well in the open air, and they should then be gathered green, but full-grown, and ripened under cover. No fruit which is not fully developed (and mere size is no criterion of this) should be taken indoors for ripening, as although immature ones may colour they do so with a tough shrivelled skin and are really useless. The green fruit may be ripened in the dark, in boxes or trays or on benches, in a temperature of not less than 50 degrees. If spread out in a greenhouse or frame the fruit should be shaded with paper during periods of bright sun to check shrivelling.

Early Tomatoes. Where Dutch lights or cloches can be used for nursing the young plants, cropping may be extended. Sowing may be done three or four weeks earlier than in the method just described and planting in final quarters done in early May. Protection must be given at nights if there is risk of frost, by covering the lights or cloches with mats or straw. As the plants grow to the glass the cloches or lights may be removed or sometimes the stems may be trained horizontally under Dutch lights. The extra work entailed by this additional training can rarely be justified commercially. Bush varieties such as Puck and Amateur are good for this early work.

Setting Aids. If cool conditions, particularly cold nights, prevail following planting the first truss may be poor or even fail to set. The use of a growth-promoting substance, beta-naphthoxy-acetic acid (sold under various proprietary names), may be helpful. It is used in an extremely dilute form—about 40–60 parts per million of water—and is sprayed on the truss as the last flowers are opening. Give no more than one application or hollow, mis-shapen fruit may result.

Manures. In addition to any dung which may have been added when ploughing or digging, a base-dressing of fertilisers should be worked in before planting. A good dressing is sulphate of ammonia 1 cwt., superphosphate 3–4 cwt., sulphate of potash 2 cwt. per acre. Following this, one top-dressing of potash nitrate at 1 cwt. per acre may be considered necessary at the end of July. If instead of sulphate of ammonia 2–3 cwt. of hoof and horn are given in the base-dressing no further top-dressing need be given.

Varieties. Most varieties will grow and crop in the open.

Some may not give good-quality fruit, developing skin blemishes if the weather is not good.

Harbinger and Hundredfold are very good in the open. Essex Wonder, Histon Ideal, and Money Maker are good.

The dwarf tomatoes give good crops but the fruit is on the small side—Dwarf Gem, First in the Field, Fargo.

Puck is a bush tomato which branches freely. It produces shapely fruit. Amateur is similar but earlier.

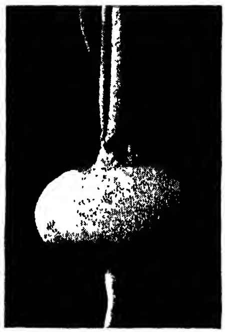
TURNIP

Brassica rapa

TURNIPS as a market-garden crop are practically indispensable; being quick in growth they form one of the most useful subjects for catch-crops, and in one way or another afford supplies all the year round. The earliest supplies are produced on mild hot-beds, and for these there is usually a steady demand at good, and sometimes high, prices. Immediately following these come the tender young roots from sheltered situations in the open which can also be depended upon to sell readily at good prices. Then follow the ordinary spring and summer crops, grown either in beds by themselves or in rows between other slower-growing vegetables, and a crop is thus taken from spaces which would otherwise be wasted; these supplies sell well at the beginning but usually meet with a gradually slackening sale as the summer advances. The demand revives with the advent of cold weather and continues fairly steady all through the winter, the round of the year being finished by the production of turnip-tops early in the spring. These are sold as bag greens, and as they come at a time when green vegetables are scarce, especially if the winter has been a severe one, they are often welcome and sell at very fair prices, particularly in southern England.

The Soil. Where it is possible to make a choice, a light sandy soil is to be preferred for very early or late crops, but a cool retentive loam will be found to give more satisfactory results in warm weather. The difficulty which arises in connection with turnip-growing on light sandy soils in summer is that these are liable to suffer from drought, and in consequence the seedlings are often destroyed by the flea beetle, and such plants as pass safely through this ordeal may run to seed before making useful roots. On such soils success may be assured by the addition of plenty of well-decomposed manure, which has the effect of retaining moisture and pushing the growth of the young plants quickly into the rough leaf, when they are comparatively safe from the flea beetle. An irrigation system is of great assistance to this crop during hot dry weather.

Early Crops. The earliest sowings of turnips are made on hot-beds from the end of January to the end of February. In cold-frames don't sow before March. A very gentle warmth at the roots is all that is necessary, as turnips will not stand hard forcing, and from the time the seedlings show until the roots are ready for pulling the plants must be given *plenty of air and moderate waterings* as needed. This method is the one followed in French gardens,



[By courtesy of Messrs. Watkins & Simpson Ltd.

FIG. 80. Turnip, White Milan

where the production of early turnips is part of the regular routine. In this case, when spare frames are available, beds 15 in. thick are made specially, or beds which have already served to produce a crop of radishes and lettuces are turned over and remade about the end of February, then trodden down well and covered with 3 in. of light rich terreau or prepared compost, which is also made firm. The seed may be sown broadcast, but this is wasteful of seed and a method usually preferred is to make holes 1 in. deep and about 4½ in. apart into each of which two or three seeds are dropped and the holes closed up. To make the holes, a framework of laths is constructed of a size which will fit the frame easily in the space occupied by one light; the laths are nailed together in a kind of square lattice-work, about 4½ in. from centre to centre at the places where they cross, and at each of these points a peg or cork is fixed, which projects 1 in. By laying this contrivance on the soil and pressing down, all the holes necessary under one light are made at one operation. When the seedlings appear, all but one at each place are removed. When the seed is sown broadcast the seedlings must be thinned to about 4 in. apart as soon as they can be handled.

In similar ways sowing may be done in cold-frames in February.

Ensure plenty of light and air, and adequate water. If kept too close there is too much top growth; if too dry the roots are woody.

General Culture. Turnips always repay good cultivation, whether early or late in the season. For the earliest open-air crops the warmest and most sheltered spots at command should be selected. In February or the early part of March, as soon as the surface of the ground is dry enough for working on, it should be brought to a fine tilth. The seed should be sown in drills 18–24 in. apart, using 2–3 lb. of seed per acre. If sown thinly little or no thinning of the seedlings may be needed for the earliest crop, as the roots are marketed when three parts grown whilst still tender.

For succession, sowings may be made in more open situations. In gardens advantage may be taken of spaces between rows of peas and other vegetables, from which catch-crops of a fast-growing variety of turnips can be taken before either crop is inconvenienced. These later sowings should always be thinned to 4–6 in. apart in the row. A sowing in May is usually the last for summer supplies. If the soil gets dry, and is allowed to remain so, many of the plants will "bolt" without "bulking", and such roots as do swell will be hot and stringy. By irrigation before ploughing a good supply of water may be put into the land so as to give the crop a good start, and if necessary a further application when the plants are part-grown should help to finish the crop successfully. At all times the surface soil should be kept loose and free from weeds; this checks competition for soil moisture and assists growth.

Seed is sown for autumn and winter crops from the middle of July to the end of August (peas and early potatoes are good preceding crops), in drills 18 in. apart, the plants being thinned to 6 in. apart in the rows; the roots intended to stand in the ground through the winter should be left at 1 ft. apart, each alternate root having been removed by a first pulling in the late autumn. When "tops" are required in the spring a special sowing is made early in September, in rows 2 ft. apart, sowing thinly and leaving the plants unthinned.

Storing. Storing turnips is not very generally practised in market-gardens except where there is a necessity for maintaining a regular supply. Then storing is a useful procedure, for apart from the possibility of damage to roots in the open during a sharp frost, there is the probability of the ground sometimes being frozen so hard that they cannot be lifted. When storing is resorted to, the tops should first be cut off, leaving ½ in. on the neck, but the tap root must not be cut; then lay the roots in small heaps and cover, first with straw and then with soil, in the same way that a potato clamp is covered.

Manures. In growing turnips care should be taken that lime in some form is present in the soil, and that the crop is not repeated on the same land without a sufficient interval, fresh soil not only producing roots of a better flavour, but also reducing the possibility of trouble from pests and diseases. In manuring, the aim should be to secure quick healthy growth whilst avoiding coarseness. When the turnips are not following a well-manured crop the ground should have been given a dressing of well-decayed manure at 20–30 tons per acre. For the earliest sowing it is particularly desirable that the soil should be in a very high state of fertility. Before sowing a complete fertiliser should be broadcast and worked in. Organic fertilisers are popular as a source of nitrogen and hoof and horn may be given at 3–4 cwt. per acre; this should be balanced with superphosphate at 3 cwt. and 1–2 cwt. sulphate of potash. A cheaper form of nitrogen would be sulphate of ammonia at 1½–2 cwt.

Varieties

For hot-beds and cold-frames: Half-long Forcing and Early Long White Frame.

Cold-frames: White Milan (flattened root).

Outside, early: White Milan, Snowball, Model White; *maincrop:* Green-top Stone.

Over-wintered for "tops": Green Globe.

VEGETABLE MARROW

Cucurbita pepo ovifera

LARGE quantities of Marrows are grown for market, and as the culture is simple and the plant productive, in a favourable season the supply often overruns the demand, with the result that the market becomes glutted and prices rule extremely low, especially after the middle of the summer. In the early part of the summer, however, supplies are limited, prices high, and the demand good. An effort should therefore be made to get them on the market as early as possible. With proper care the plants continue to bear until the middle of September.

The earliest crop is obtained by sowing bush marrows in " 60 " pots in a cool greenhouse in mid-April. The plants are set out in frames in early May. Two plants are placed in each Dutch light in opposite corners. As the plants grow up to the glass the lights are raised on boxes and finally removed for cropping to finish in the open.

The flowers are male and female, easily recognised by the fact that the female ones have an ovary—like a diminutive marrow behind the petals and sepals. For the earliest crop hand pollination may be necessary. In this case a male flower is picked and after removing the petals the stamens are stroked across the stigma of the female in order to transfer the pollen. (In the open there is no need to take these measures.)

Cropping from these earliest plants starts in June.

Preparation of the Land. Marrows will grow and fruit abundantly in any good well-drained soil, if provided with plenty of manure and moisture at the root, accompanied by an abundance of sunshine. As a main-crop, they generally follow one for which a liberal manuring has been given and which is cleared off the ground by the beginning of May; this allows time, if the work is done immediately, to prepare the land for planting in the latter part of the month.

Before sowing or planting an application of about 4–6 cwt. per acre of a good general fertiliser may be given. The distance between the rows in the field depends on the variety to be grown, whether the bush or the trailing marrow. Between rows of the former the space allowed is 4 ft., and of the latter, 5 ft. or 6 ft.

Sowing in the Open. The seed may be sown in the position where the plants are to remain, but this method is only suited to the late crop. There is certainly a great saving of time and labour, and the plants grow vigorously and crop abundantly, but there is the great drawback that they do not begin to bear until the markets are well supplied and prices are low. The seed should be sown in the middle of May, three in a triangle, 2 in. apart and 1 in. deep, at intervals of 3 ft. along the rows. Covering each patch of seeds with a cloche will give earlier growth. As soon as it is clear which plants are taking the lead reduce them to one at each patch.

Plants and Planting. A better method is to set out strong plants; these will come into bearing three weeks earlier, which will make a great difference in the returns. To raise the plants, a hot-bed, about 2 ft. deep may be made, in the second week of April, and covered with 4 in. of fine soil. Fill sufficient large "60" pots with a mixture of good turfy loam, well chopped up, and spent manure, half of each, and put a seed in each pot, 1 in. deep, then plunge the pots up to the rim in the soil on the hot-bed. Keep the frame close and covered with mats until the seedlings are through the soil, then remove the mats during the day but cover at night for another week or so. Give air gradually, increasing the quantity with the growth. The seed may also be grown in pots in a cool greenhouse. Keep the soil moist, but be careful not to over-water. In the first week of May remove the plants to a cold-frame to harden off.

At the first opportunity after the third week of May, when the weather is mild and the ground dry, the plants may be set out in their permanent positions. Water the plants well the day before and set them a yard apart, turning each out of the pot without breaking the ball of soil. Bring about 1 in. of new soil over that from the pot, then press the soil gently but firmly round. Each plant should be protected at night for a week or more, according to the weather; this may be done by covering them with hand-lights, cloches or pots.

The after-treatment consists in keeping the ground free from weeds by hoeing until the growth covers the ground. When the plants of trailing varieties begin to run and have extended about 18 in., it is a good plan to pinch out the end of each leader to cause them to branch. Plenty of moisture is necessary to enable them to bear continuously; in fact, if the plants' requirements in this respect are attended to they will continue to bear until cut down by frost, but if allowed to become dry they soon become spent.

The marrows should be cut as soon as they are fit for sale—from half to three-parts grown. This matter should be strictly attended to, as it means doubling or trebling the crop compared with what it would be if the plants were allowed to become exhausted by producing seed in fruits which have developed to their full size.

For a time during August, if the crop should prove unsaleable, it often pays to cut the marrows, leaving them on the land. In consequence the younger fruit continue to develop and generally find a ready sale.

Varieties. The varieties of vegetable marrows grown in market-gardens are practically limited to two—the Bush and the Trailing Marrow, and of these there are again two types—the Green and the White. The Bush Marrow is favoured by many because the plant, although a prolific bearer, is compact, and does not occupy nearly so much space as the Trailer for the same amount of crop. Where a high-class trade is done the Pen-y-Byd may prove a useful variety; this is an abundant bearer of small, oval-shaped, cream-coloured fruits, of first-class flavour. Before deciding on a variety the grower should consult his salesman on the subject of colour, as some markets show a distinct preference for green whilst others favour white.

FOR FURTHER READING

The Vegetable Garden, by MM. Vilmorin-Andrieux: John Murray. Gives an account of a very wide range of the vegetables grown in Europe.

Bulletins of the Ministry of Agriculture and Fisheries, published by H.M. Stationery Office:

Bulletin	No.	55	*Outdoor Salad Crops*
,,	,,	60	*Asparagus*
,,	,,	65	*Crop Cultivation in Frames and Cloches*
,,	,,	69	*Onions and Related Crops*
,,	,,	71	*Manuring of Vegetable Crops*
,,	,,	76	*Herbs (Culinary and Medicinal)*
,,	,,	81	*Peas*
,,	,,	87	*Beans*
,,	,,	94	*Potatoes*
,,	,,	113	*Rhubarb*
,,	,,	120	*Root Vegetables*
,,	,,	131	*Cauliflowers*
,,	,,	132	*Cabbages, Sprouts and Miscellaneous Green Crops*
,,	,,	136	*Watercress*

The Commercial Storage of Vegetables, Food-marketing Leaflet No. 15, of the Department of Scientific and Industrial Research, H.M.S.O.

PART III

GRADING, PACKING AND MARKETING

THE work of the market-gardener is by no means finished with the harvesting of the crops he has grown. The motive behind all his operations is to obtain a reasonable return in net profit on the skill, labour, and capital expended. In order to secure such a return his produce must be sold at remunerative prices, and the knowledge of how to go to work to get such prices is quite as important as the ability to raise the crops.

An attractive appearance is one of the most potent factors in inducing ready sales. It does not need a very keen faculty of observation to be aware of the favourable effect which a good appearance has upon the general public. This may be seen in every department of life, but in nothing is it more noticeable than in the purchase of foodstuffs. An article of only moderate or even of poor quality if attractive in appearance will sell much more readily and often at a higher price than one of superior quality which is offered in an untempting or repellent way.

The first point, therefore, which the grower needs to get firmly fixed in his mind in connection with marketing is that *a good appearance has a distinct cash value.*

Imported produce of many kinds has now gained a commanding position in our markets, and in many cases, even in competition with the same variety of home-grown produce buyers show a decided preference for it. The cause of the preference does not lie in the superior quality of the importations, because often the advantage in that respect is on the side of the home productions; nor is attractiveness the only reason. There are several causes, of which attractive packing is certainly one, but another and an equally important cause is *reliability*. When a certain weight, number, or quantity is specified, or when a number of packages are sold by the sample of the top layer of one, the purchaser of imported produce is fairly certain in the great majority of cases of getting what he pays for, both in quantity and quality. With home-grown produce the reverse is still all too often the case—weight or quantity may be deficient or grading badly done, whilst "topping" with a layer or two of a sample superior to that of the bulk is still frequently resorted to.

The quality is, however, greatly improved and some finely graded produce is put on the market. Quality grading should be the rule for all market produce; grading to size will depend on the grower and his customer. For many crops sizing will be essential to the preparation of a neat, attractive pack, but for some produce grading to size is less important, e.g. where a grower sells tomatoes direct to a retailer.

The third point of importance in connection with successful marketing is so to arrange the crops that *regular and continuous supplies* of a given product can be sent all through the season when it is usually in demand. A sound position in the market can never be established if produce is sent in to a given salesman only by fits and starts. Whether the grower be in a large or small way—whether the consignment amounts to a motor-lorry load at once or only half a dozen boxes—every effort should be made to send supplies with regularity. It is very probable that the salesman would be inclined to consider this as the most important point of all in connection with successful marketing. He desires to know, as nearly as he can, the kind and quantity of the produce he has to deal with on any given day, so that he can make arrangements accordingly. He has his regular customers just as the shopkeeper himself has. In many cases some kinds of produce on which reliance can be placed is sold in advance, and never enters the market at all. If these customers buy produce which suits their trade and finds a ready sale they desire to continue dealing in it, and it must be very inconvenient and annoying to both salesman and customer to find the supply of an article of which both approve suddenly cease in the height of the season, or only come in erratically. When this happens the price obtained is lower in consequence. Not only that, but the salesman naturally places a higher value upon a sender whose supplies he can rely upon, and takes more interest in his consignments, with the result that he usually does his utmost to realise the best prices so as to keep the sender satisfied and so retain him as a regular client.

Of course, when the grower is a beginner at the business he very properly desires to feel his way, both with regard to the crops he grows and the salesmen to whom he consigns them, but this experimental period ought not to be too prolonged. In all large markets there are many salesmen with a reputation for fair dealing, and the grower who has entrusted his produce to a firm with good credentials would be well advised not to change, at any rate until he has personal knowledge or some good recommendation. Then he ought to decide as soon as possible upon the particular crops he means to specialise in, a decision in which he wi no doubt be influenced by the character of the soil, the situation, the demand in the most accessible markets, and his personal preference or skill. He should also consult his salesman for guidance on crops needed by the market. Whatever the character and number of the subsidiary lines may be, he ought to produce some main crops in quantity with his utmost skill, so that he will become known as a grower of those particular products, who may always be depended upon for quality and regular supplies.

An occasional walk through the market, and a chat with some of the salesmen after the rush of business is over for the day, is very advisable; the grower will then be able to compare the quality of the produce exposed for sale with that of his own, and so get an idea of the general standard expected, as well as an insight into the various methods of packing. The salesmen are generally courteous and obliging, and quite ready to give valuable advice which the grower will do well to profit by; not only that, but if a salesman is not in a position to deal with any produce offered him he will usually recommend one or two reliable men who can handle it.

To summarise, the essential points necessary to permanent success in placing produce for sale on a public market are: (1) To place the article before the buyer in as attractive a manner as possible; this implies washing, trimming, and neat bunching of the common vegetables quite as much as the smart packing of those of greater relative value. (2) To guarantee reliability; this implies accuracy in weights, measures and counts, as well as careful grading to ensure a parcel being of even quality throughout. (3) To ascertain the size of packages or weights and quantities most in favour with buyers, and as far as possible to adhere to them without variation. The Ministry of Agriculture and Fisheries will supply a Marketing Guide which gives recommended grades and packs for the whole range of home-grown vegetables. (4) To specialise in the production of a limited number of staple crops, and to consign supplies to the same market regularly and continuously throughout the season when such produce is usually in demand. (5) Having found a satisfactory salesman, or one who is as satisfactory as can reasonably be expected in the circumstances, to continue regular business relations with him, and not to change the salesman without sufficient cause. If these methods are followed, and are supported by good quality in the articles offered, success in marketing should be certain in spite of any competition, foreign or otherwise.

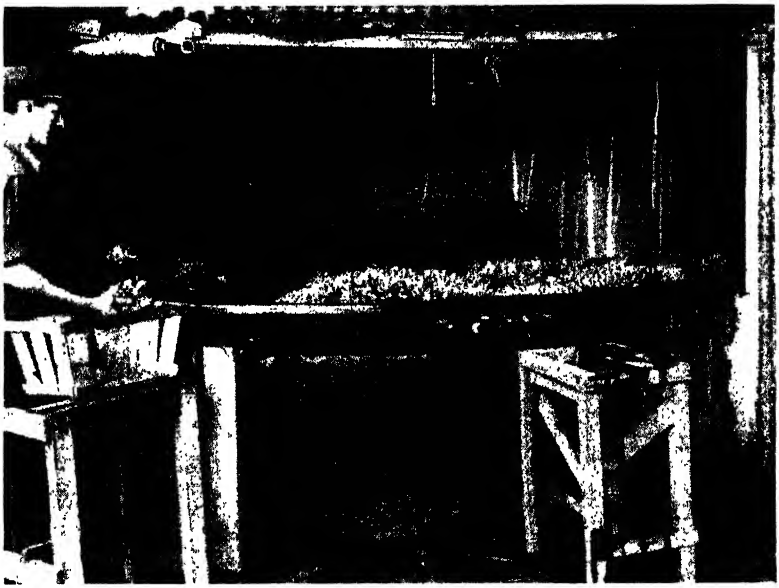


FIG. 81. Vegetable washing

Equipment fitted up from a children's hand operated roundabout.
The crop as it comes from the field is loaded on to the wire platform and as it is turned through the washing chamber it is sprayed from above and below.

Washing may increase the value of the produce out of all proportion to the cost of the operation. Clean, bright produce looks attractive and may sell when an unwashed sample does not.

In its simplest form the washing may be no more elaborate than rinsing in a stream or tank, but where water is available under pressure more effective cleaning of muddy root-crops is possible. The bunches of carrots, etc., may be laid out on a concrete floor or duck-board and hosed, but some promising modern developments have concentrated on the use of moving platforms of wire mesh carrying the produce through a chamber where it is sprayed whilst in transit. Fig. 81 shows an example of a useful washing plant fitted up by a grower.

When root crops are to be washed this should be done as soon as possible after pulling and before the soil dries on the roots. The washing is then easier.

Washed produce should be sold without delay, as the keeping quality may be impaired; injuries which occur during the washing provide centres where decay may set in. The pressure of the spray used for the washing should not exceed 15 lb. per sq. in. During hot weather the wet foliage of bunched root crops may heat up in transit and become yellowed, so drain well and arrange for speedy disposal.

For such crops as lettuce, spinach, parsley and mint, dipping and rinsing in tanks is all that is needed; in fact, spraying with a hose during hot weather to keep fresh in transit should be all that is needed if the crop comes clean from the field. Cauliflowers are also dipped if necessary.

No more need be said except that the grower can generally obtain from the salesman such empties—bags, boxes, or other receptacles—as may be necessary for the proper packing of his produce, as well as printed labels with which to address it. In some cases it will be found more advantageous for the grower to possess his own empties for certain lines, and the use of "non-returnables" may be found preferable for some of the more valuable products, but experience will prove the best guide in these matters.

Over the country as a whole there are many kinds of package used for marketing vegetables, though the range is less extensive than formerly. Certain commodities, particularly when sent a great distance, are packed in containers considered to be most appropriate, e.g. cauliflower crates, but the use of one standard package for many vegetables is adopted whenever possible, e.g. the bushel box, lettuce crate, Cheshire box, bag and half-bag.

Artichokes (Globe). The heads of globe artichokes are cut as soon as they are fully grown but before the scales begin to open; they are then tender and of good flavour. Each head is cut with an inch or so of stem. They are packed in baskets in regular layers, a little soft material being put between each layer and over the top. They should be marketed in as fresh a condition as possible, and the number of heads in the box should be marked clearly on the label.

Artichoke (Jerusalem). Lifting may begin in October and continue throughout the winter. Lifting should be finished by February, or fresh growth will take place. The tubers are sorted over, the smallest being rejected. After washing they are packed in bushel boxes or bags.

Asparagus. Cutting of asparagus begins when the tips of the shoots have grown 3 in. or 4 in. above the soil. It is usually cut about 4 in. below the surface of the soil, so that the total length of each shoot is 8–9 in. The portion above the soil is green and tender, whilst that below is white, tough, and uneatable. All the shoots long enough are cut, whether thick or thin, and are then sorted into four grades, "giant" "special", "sprue", and "crooks"—the thickness, length, and general appearance of the sticks being the guide. They are then tied up into bundles or bunches. The size of the bundle has varied with the season, the market to which it is sent, and the custom of the district in which it is grown. It is recommended that the "Extra Selected" grade should be packed in bundles of a minimum diameter of 3½ in. and have a maximum of 25 shoots; the bundles for the "Selected" grade should have a minimum diameter of 3½ in. and have a maximum of 50 shoots. Tie the bundles with raffia, linen tape, or osier twigs.

Various devices are used for arranging the sticks into bundles neatly and expeditiously; one of the simplest but most useful of these contrivances is the cradle illustrated at page 138. In making the bundles the heads of the sticks are kept level, and the bottoms are trimmed level with a sharp knife. The lower part of each is wrapped in semi-transparent paper, etc. Pack for market in boxes or special asparagus crates with wood wool or similar material placed over the top to protect the contents from being bruised. The produce should be sent to market as soon as possible after cutting, as it quickly deteriorates. Different qualities must be packed separately, and the label on each basket should be plainly marked with the quantity and quality of the contents.

Beans (Broad). The beans must be gathered as soon as the pods reach maturity, choosing a dry day for the purpose. All old or dirty pods must be rejected. Gathering should be done twice a week to prevent over-ripe pods developing. The pods should be put in bushel boxes or bags. The beans should be sent to market as soon as possible after gathering.

Beans (Dwarf, or French). On good land in a favourable season French beans mature very quickly. The plants must therefore be closely watched, and the pods picked the moment they are ready. If allowed to hang too long the plants cease to bear and the pods become stringy and worthless. The plants should be gone over two or three times a week, as the oftener the beans are gathered the better the quality and the greater the yield. The pods of the main-crop are packed 8 lb. in a 12 lb. chip. Each package should be marked with the weight of the contents and all should be uniform.

Beans (Runner). Scarlet runners, like the dwarfs, must be gathered very frequently, or the pods become tough, stringy, and worthless. When packing it is necessary to examine the produce to see that the beans are clean, free from leaves or rubbish, and that no old pods are mixed in. They are put in half-bushel or bushel boxes. Send them to market promptly so that they will arrive in fresh, plump condition.

Beet. The marketing of bunched beet usually begins in June and continues to August when topped beet takes its place. Sales of this continue throughout the autumn and winter, the roots being taken from the clamp as required. Only medium-sized roots of even shape, and none that are broken or damaged in any way should be sent to market. The roots are packed in bags or bushel boxes.

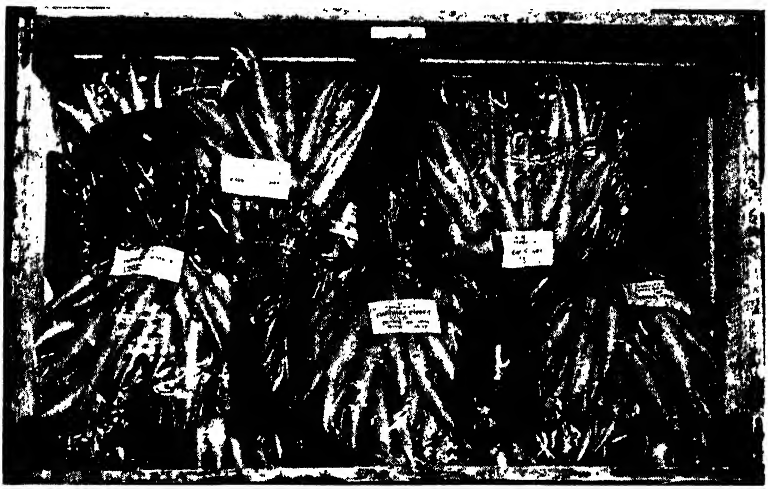
Borecole, or Kale. There is not much sale for kale until late winter or early spring; then the demand usually becomes good. For this reason the crop should, if possible, be allowed to stand until wanted. When picked, only the young growths with perfect leaves should be packed, decaying and discoloured foliage being rejected. The "greens" are packed in boxes, according to the requirements of the salesman, and care should be taken to pack as tightly as possible, as when the receptacles are only partly filled dissatisfaction is caused and low prices realised.

Broccoli. The cutting of broccoli begins with the cold weather, as soon as autumn cauliflowers are over, and continues to the beginning of the following summer, according to the district, the season, the successional sowings made, and the varieties grown. Away from the specialist areas of the south-west the crop is usually arranged so that the bulk of the supplies are placed on the market from March onwards. The heads are cut so as to be surrounded with a fringe of leaves, and these in turn are trimmed so as to expose the flower, but projecting a little beyond it to afford a slight protection. They are graded for size and quality. The heads should be of even size in each container, clean, compact and white. Discoloured or damaged heads, or those which are overgrown and open, should not be sent to market. Pack in cauliflower crates or other boxes.

Sprouting Broccoli—season: February to April. The sprouting heads are broken off with a small piece of the stem attached, and packed firmly in bags or bushel baskets. Care should be taken only to pack young growths with tender stems, old and tough stems being very objectionable.

Brussels Sprouts. The picking of Brussels sprouts usually begins in October, though a few may start earlier, and continues through the winter months until about February, by which time the crop is generally finished. The plants are, as a rule, gone over two or three times, the largest only being removed each time. Several methods of marketing sprouts are employed; in some markets wicker pots are used, in others, they are sold in 28-lb. bags, but for the most part they are packed in half-bushel boxes of 20 lb. early in the season and in bushel boxes of 40 lb. later. After the sprouts are cleared the tops may be cut off and sent to market in bags.

Cabbages. The cutting of spring greens usually begins in February in mild winters. At this time choice greenstuff is getting rather scarce and these spring greens or small unhearted cabbages meet with an excellent demand at good prices. Following these, marketing of larger heads should be begun as soon as possible, the field being gone over and those selected which have made firm hearts. The earlier they are marketed the higher is the price obtained. They are marketed in crates, boxes, bags or nets.



[*By courtesy of "The Grower"*

Fig. 82. Choice bunched carrots protected by cellophane

Carrots. The pulling of young carrots from frames starts as soon as the young roots are from ½ in. to ¾ in. through at the thickest part. They are at once bunched, then washed and packed, and sent to market. When crowded the crop is thinned early to the proper distance apart, before they have attained any size, and then left until the bulk are ready, when the whole bed is cleared. The size of the bunch varies with the season and the custom of different markets—in some cases a dozen roots will be sufficient whilst in others fifty may be required, and the price obtained varies in proportion. The bunches in one consignment should be uniform. The tops are left on, each bundle is tied up neatly with raffia, and they are packed in crates, boxes, or "pots", according to market. They should be consigned in even numbers, with

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Beet. The marketing of bunched beet usually begins in June and continues to August when topped beet takes its place. Sales of this continue throughout the autumn and winter, the roots being taken from the clamp as required. Only medium-sized roots of even shape, and none that are broken or damaged in any way should be sent to market. The roots are packed in bags or bushel boxes.

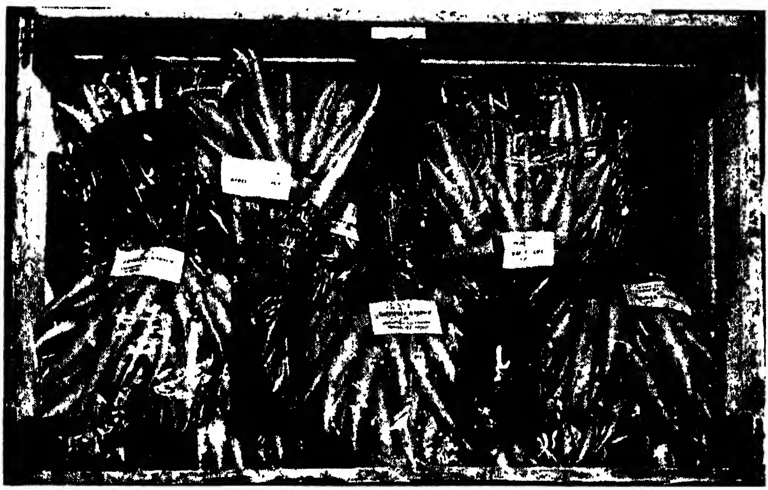
Borecole, or Kale. There is not much sale for kale until late winter or early spring; then the demand usually becomes good. For this reason the crop should, if possible, be allowed to stand until wanted. When picked, only the young growths with perfect leaves should be packed, decaying and discoloured foliage being rejected. The "greens" are packed in boxes, according to the requirements of the salesman, and care should be taken to pack as tightly as possible, as when the receptacles are only partly filled dissatisfaction is caused and low prices realised.

Broccoli. The cutting of broccoli begins with the cold weather, as soon as autumn cauliflowers are over, and continues to the beginning of the following summer, according to the district, the season, the successional sowings made, and the varieties grown. Away from the specialist areas of the south-west the crop is usually arranged so that the bulk of the supplies are placed on the market from March onwards. The heads are cut so as to be surrounded with a fringe of leaves, and these in turn are trimmed so as to expose the flower, but projecting a little beyond it to afford a slight protection. They are graded for size and quality. The heads should be of even size in each container, clean, compact and white. Discoloured or damaged heads, or those which are overgrown and open, should not be sent to market. Pack in cauliflower crates or other boxes.

Sprouting Broccoli—season: February to April. The sprouting heads are broken off with a small piece of the stem attached, and packed firmly in bags or bushel baskets. Care should be taken only to pack young growths with tender stems, old and tough stems being very objectionable.

Brussels Sprouts. The picking of Brussels sprouts usually begins in October, though a few may start earlier, and continues through the winter months until about February, by which time the crop is generally finished. The plants are, as a rule, gone over two or three times, the largest only being removed each time. Several methods of marketing sprouts are employed; in some markets wicker pots are used, in others, they are sold in 28-lb. bags, but for the most part they are packed in half-bushel boxes of 20 lb. early in the season and in bushel boxes of 40 lb. later. After the sprouts are cleared the tops may be cut off and sent to market in bags.

Cabbages. The cutting of spring greens usually begins in February in mild winters. At this time choice greenstuff is getting rather scarce and these spring greens or small unhearted cabbages meet with an excellent demand at good prices. Following these, marketing of larger heads should be begun as soon as possible, the field being gone over and those selected which have made firm hearts. The earlier they are marketed the higher is the price obtained. They are marketed in crates, boxes, bags or nets.

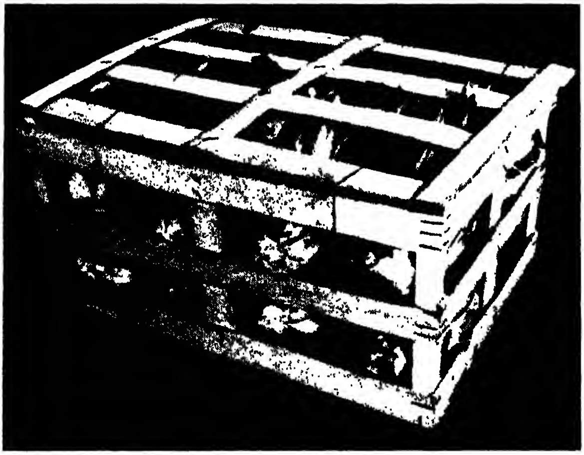


[*By courtesy of " The Grower"*

FIG. 82. Choice bunched carrots protected by cellophane

Carrots. The pulling of young carrots from frames starts as soon as the young roots are from $\frac{1}{2}$ in. to $\frac{3}{4}$ in. through at the thickest part. They are at once bunched, then washed and packed, and sent to market. When crowded the crop is thinned early to the proper distance apart, before they have attained any size, and then left until the bulk are ready, when the whole bed is cleared. The size of the bunch varies with the season and the custom of different markets—in some cases a dozen roots will be sufficient whilst in others fifty may be required, and the price obtained varies in proportion. The bunches in one consignment should be uniform. The tops are left on, each bundle is tied up neatly with raffia, and they are packed in crates, boxes, or "pots", according to market. They should be consigned in even numbers, with the quantity in each receptacle marked plainly on the label. The early crop from the field is treated similarly.

Main-crop carrots are lifted in October. The tops are cut off, leaving ½ in. or so above the crown. Those not immediately sent to market are then stored in sand or in clamps (see page 160), and are sent to market through the winter, as required, in boxes or bags. These mature roots are marketed both washed and unwashed, but a clean and even sample makes by far the best price.



[*By courtesy of "The Grower"*

FIG. 83. Cauliflower crate

Cauliflowers. With no help from glass, cutting of cauliflowers begins in August and continues to the end of October, but under intensive culture cutting begins early in June. When the heads begin to come ready the plantation should be gone over every two or three days so as to cut them just at the right time. They quickly get past their best by becoming too open in the flower, which should be allowed to develop to its full size but be cut whilst it is still quite firm, close, and compact, and the flower should have been kept white and clean by breaking the midrib of one of the large leaves and bending this over it when it is half formed. Each head is cut with a fringe of large leaves and these are shortened so as to reveal the flower but standing about an inch higher so as to afford a slight protection. The heads are graded for size and quality. Reject all woolly or ricy curds. Pack in cauliflower crates or boxes.

Celery. The marketing of celery begins as soon as the earliest plants have made white, crisp, and solid hearts, and continues with successional supplies until well into the new year. All loose leaves and stems are removed, the roots trimmed off, and the stems washed; they may then be made up into bundles or "rolls", each containing from eight to twelve sticks, according to size. They should be graded to size and be of high quality, and the number of sticks in the bundles kept uniform. The use of boxes or crates is more satisfactory than the bundle —declare the count in multiples of three.

Celeriac. The largest roots of celeriac are ready to send to market by the middle of September; by the middle of October the whole of the crop is lifted and that which is not marketed at once is stored in sand or earth. Before packing, all the outer leaves are removed and the thongs trimmed off the root, which is then washed. They are packed in baskets or bushel boxes.

Chicory. The heads (or chicons) are cut with about ½ in. of root attached, when they are 6–8 in. long and perfectly blanched; in a suitable temperature this will be about four weeks after the roots are started. The salad is in season throughout the winter and early spring months. Before packing, the heads should be washed and drained. They are packed in No. 6 chips or 6-lb. tomato boxes, lined with blue tissue paper. Chicory is sold by the pound, the weight in each container being specified on the label.

Cucumbers (Frame). Cucumbers grown in frames are seldom ready for cutting in any quantity before the middle of June, but from then onward the supply is continuous until frost brings it to an end. The fruit should be cut immediately it is full-grown, but not until it reaches that point; this is as soon as the wrinkles have smoothed out of the skin. The fruit should be gathered two or three times each week so that none is allowed to remain on the plants too long. The fruit should be unfertilised, reasonably straight, uniformly grass green and free from blemishes.

A single layer tray is popular and many take nine to sixteen fruit, which should be even in size and should weigh not less than 9 lb. Two layer trays may also be used, or wicker flats holding four layers. Pack with dry sweet hay using enough to prevent the fruit from bruising. Where flats are used the method of packing is to put a layer of grass or soft hay at the bottom of the flat and cover this with a sheet of blue tissue paper, upon which a layer of "cues" is placed side by side. These are covered with tissue paper, a little soft hay to fill up the hollows and make all level, another sheet of tissue paper and another layer of "cues," and so on until the flat is full, covering the last layer with paper, then with hay on top and down the sides, so that the whole contents are packed firmly and secure from movement.

Cucumbers (Ridge). Cutting of ridge cucumbers begins early in July. The plants should be gone over and the fruit gathered about three times a week, as they grow very quickly in a good season. All yellow, stunted, distorted, or "seedy" fruit should be removed from the plants and discarded. They are packed in bushel boxes, counted by dozens. A little hay is put at the bottom and round the sides of the basket, and a little over the top to keep all firm, but nothing approaching the trouble of packing frame cucumbers is taken with these.

Endive. The demand for endive is not great. There is a very moderate sale for it all through spring, the greatest demand being from September on through the autumn months. Only sound well-blanched heads should be sent to market. They are packed in lettuce crates arranged in layers so that the blanched faces come together. Each box should contain a specified number, marked plainly on the label.

Herbs. With the exception of mint and parsley, which appear under separate heads, and in a lesser degree of sage and thyme for which there is a moderate sale, the culture of herbs for market, except in some few special cases, is not worth the grower's attention. When there is any sale the various herbs are in the majority of cases made into small bunches and sold by the dozen.

Horse-radish. As indicated in the article on the culture of this root the trade in it is almost entirely in the hands of Continental growers. Still, there is a steady though limited demand, and there is no good reason why the grower who can produce a good sample should not enter into competition. The roots should be straight, 8–12 in. long and $\frac{3}{4}$–2 in. in diameter. They must be washed and tied in bundles of about a score. It is useless to send to the market thin or badly-shaped roots. Those not marketed immediately after lifting can be kept in moist sand, where they will remain in good condition for a considerable time.

Leeks. The plant is quite hardy, and the crop can be left in the ground to be lifted as required. The outer leaves may be stripped off or the roots are left on according to market, then they are graded into sizes and tied together into flat fan-shaped bunches containing six or eight heads, according to size, but the average is usually seven. The tie is made just at the bottom of the green portion, so that the white stems will spread out and display themselves. The leaves are then shortened to one uniform length, and the bunches well washed to improve their appearance. They are sometimes trimmed, tied in bundles and wrapped in cellophane. They are packed in crates or boxes, and the number of fans or bundles in each package should be plainly marked on the label. They may also be packed loose in crates or boxes.

Lettuces (Cabbage). The earliest consignments of lettuces sent to market are the cabbage lettuces grown in glass-houses and in frames, and these are followed by those grown in sheltered situations in the open in market-gardens generally throughout the country. The earliest cutting in any appreciable quantity from the open begins in May and continues increasingly through June and July. There continues, however, to be a steady demand throughout the season as long as they are available. The slackest sales are from June to August when garden lettuce is about. Lettuces should be cut as soon as they have good firm hearts, and then graded to size. If the lower leaves of those grown in the open are much discoloured they should be removed, otherwise the root is the only portion cut away. They are packed in light wooden lettuce crates in layers, the bottom layer being put root part downward, the next layer root end up. They should be packed in even numbers, with the quantity and quality in each package marked plainly on the label. In hot weather a light spraying after packing helps to keep the lettuce fresh in transit.

Lettuce (Cos). The earliest cos lettuces, grown under cloches or handlights, or in cold-frames, begin to come ready about the middle of April, and when they are well-grown, with good solid hearts, realise very good prices. The roots and broken outer leaves are trimmed off. These early supplies should be graded into three sizes, all of good quality, and they are packed on their sides in lettuce crates in even dozens or half-dozens. Later in the season the open ground crop is gathered by simply clasping the head with both hands and giving a twist. Remove unsightly, damaged outer leaves. Pack in lettuce crates or bushel boxes.

Melons (Cantaloup). The first cutting of Cantaloup melons from frames is made in July, and supplies continue from then onward to September. Great care is required to cut the fruit just at the right time; for one or two weeks after it is full-grown, according to the general temperature, it does not appear to change, but the ripening processes are at work in the interior. At the end of that time cracks begin to appear round the stalk, then the rind assumes a yellowish tinge and the fruit gives off a slight but unmistakable perfume which gets stronger as the ripeness advances. At this stage it is in perfect condition for eating, and can be left to ripen for local customers to whom it can be delivered by hand, but it would be a great mistake to allow it to get to this stage of ripeness before cutting for market, as it would go soft in places and probably begin to decay before reaching the consumer. On the other hand it must not be cut too soon or it will never ripen satisfactorily, and the interior will be more like a turnip than a ripe melon. The proper time to cut is when the cracks appear round the stalk and the other indications of approaching ripeness are present but still faint. If sent to market at that stage it will usually be in perfect condition when it reaches the consumer, but some further discrimination must be used according to the season—when it is very hot the fruit can be cut a day or two earlier and when cold it can remain on the plant a little longer. The plants should be examined frequently, so that no fruits are allowed to remain on too long. When they cannot conveniently be sent to market at once, as at the end of the week and especially if it is hot weather, they should be put for a day or two in a cool place, so that ripening may be retarded. The fruit is cut with about 2 in. of stem attached, and in handling and packing the greatest care must be exercised not to break this off or the selling value will be seriously lowered. The fruit is graded for size and quality. In packing, each is first wrapped in tissue paper, then bedded in and surrounded by wood wool. Boxes are generally used in which to send them, holding from two to five, according to the grade.

Mint. Mint is marketed in bunches varying in size with the season; a bunch of forced mint during winter usually contains from twenty to thirty shoots, but as the season advances the size is increased until it is as large as can be comfortably held in one hand. They are packed in crates, boxes, or chips. If grown for drying the work is on contract and cutting and despatch will be according to the factory instructions.

Onions. Autumn-sown bulb onions are disposed of as opportumity occurs, from the time they are harvested to the end of the summer, as they do not keep well. Spring-sown onions may be put on the market from harvesting throughout the autumn and winter, according to demand and prices. It is, however, usual to clear the English crop early before imported bulbs come in. They should be firm, sound, and clean, cleared of loose skins, graded into two or three sizes, and packed in bags containing $\frac{1}{4}$ cwt. or $\frac{1}{2}$ cwt.

The marketing of spring or green onions lasts from early in March to late autumn according to the sowing. The size of the bunches varies in different districts. In many places they are tied in small bunches containing twelve, and twelve of these are tied together to make a large bunch; in other districts the large bunch contains a score of small ones. Before tying into large bunches they are well washed. They are despatched to market in boxes or crates and may be put in these loose and unbunched.

Parsley. The demand for parsley continues practically all the year round. The plants are sometimes pulled up by the roots and bunched in that condition, but it is much better to make the bunches of foliage only, which should always be clean and bright. The size of the bunch varies with the season, being as much as can be held in one hand during the summer when it is plentiful, and not more than a quarter that size in winter when it is scarce. It is sent to market in boxes, crates, or baskets. If grown on contract for drying prepare according to instructions from the factory.

Parsnips. These are ready for use in October and supplies are sent to market continuously throughout the winter, either from store or lifted fresh from the ground, as required. In the latter case the roots are in better condition and of superior flavour, but it is not always convenient for the grower to allow them to continue occupying the ground. They are often sent to market in a very rough and dirty condition, but this is a bad practice and should be condemned. They should be washed and graded into two even samples. whilst the rough, ill-shaped, or cankered roots should be disposed of for cattle feeding. They are sent to market in bushel boxes or bags.

Peas. Picking of the earliest peas should begin as soon as the pods give evidence that the enclosed seed has developed to a useful size. The pods should be firm and well filled, free from damage by disease or insects. For the main crop on an extensive scale the haulm is pulled and all saleable pods gathered, the work being done by gangs of pickers. On a small scale the crop may be picked over two or three times.

High-grade early pickings may be sent to market in chip baskets. The main crop is marketed in bushel boxes or half-bags.

Potatoes. From most market-gardens these are sold direct from the field, whether as earlies or main-crop. They are marketed in 1-cwt. bags. They should be graded to size, "ware" for market, small or "chats" and damaged ones for pig feed, and possibly an intermediate "seed" size if planting sets are being saved for another year. Where seed is not being saved these tubers can go with the chats.

Radishes. Radishes mature very quickly, and as soon as they are seen to be swelling the beds should be examined frequently and pulling should start as soon as possible. They should not be allowed to get too large. It is useless to grow big, coarse, strong-flavoured radishes, the demand being for small, crisp, delicate-flavoured roots. They are bunched for market, the size of the bunch varying with the season; in the early spring months twelve or fourteen roots go to a bunch, but later in the season they contain from twenty to thirty roots. Long radishes are made up into flat bunches, and olive-shaped or turnip radishes into round bunches. The roots in each bunch should be, as far as possible, of equal size, and the bunches should be carefully washed before packing. They are sent to market in bushel boxes or lettuce crates.

Rhubarb. Forced rhubarb may be made up into small bundles containing from two or three sticks or packed direct into boxes; the latter is now the more common practice. The sticks should be pulled as soon as ready, when they are about 20 in. long. The pulling of outdoor produce begins when the sticks are from 6 in. to 8 in. long, and these are made up into bundles weighing about 3 lb.; later, as the crop gets more plentiful, the bundles are made to weigh 5 or 6 lb. When the leaves get well developed they are cut off to within about 2 in. of the stalks, which are then laid with the heads reversed alternately, so as to make a neat and even bundle, secured by two ties, one near each end. The sticks may be packed direct in boxes.

Salsify and Scorzonera. These roots are lifted in November, care being taken not to injure them. They may be marketed at once or stored and marketed in small quantities through the winter.

The roots are graded into even sizes and tied up in bundles of about a dozen. They are packed in boxes, with a little soft hay at top and bottom to prevent damage.

Savoy Cabbages. The cutting of savoys usually begins in October and continues to February or March, the largest and firmest heads being selected at each cutting until the field is cleared. They are sent to market in cauliflower crates or bags.

Seakale. Seakale is in season from November to the following spring. The heads are cut when about 6 in. long, with a small piece of root attached. None should be sent to market which has become coloured by exposure to light, as then the flavour is very strong and the quality inferior. After cutting, the heads should if necessary be washed. In packing, line the container with blue tissue paper. Pack in seakale boxes, $18 \times 12 \times 4$ in. (internal dimensions), holding 8 lb., or in 12 lb. chips which hold 7 lb. seakale. Place the seakale in orderly layers. The package should not be loose, as the stalks are easily broken and spoiled.

Spinach. When the plants have made strong growth the largest leaves are picked singly. In this way the plants will yield several times but care must be taken not to pick them too closely, especially in winter when growth is slow, or the plants will be ruined. During spring and summer many growers wait until the plants are well-grown and then cut them off close to the ground, so securing only one gathering from each sowing but saving much on the labour bill. The spinach should be clean and fresh, free from yellow or damaged leaves and coarse stalk or seed stems. Pack in lettuce crates or bushel boxes.

Sweet Corn. Each ear or cob should have at least 4 in. of its length covered with plump seeds, which should not be a deep yellow. The grain should be milky. The sheathing leaves should be left intact to give protection. Trim off the leafy tips. Pack in 12-lb. chip baskets.

Tomatoes. Gathering begins from the middle of July to the middle of August, according to the method of culture and the warmth of the season, and in a mild autumn generally continues until about the middle of October. The fruit is always of better quality when allowed to remain on the plants until ready for packing, but where blackbirds are troublesome the earliest should be gathered as soon as they show a slight change of colour, and finished under cover. The fruit should be gathered with the calyx and stalk attached, the fresh green calyx adding materially to its attractiveness. They are graded for quality and size. The fruit should be sound and free from blemishes like russetting and splitting; round in outline, not angular and ribbed; and it should be evenly coloured, being free from blotchy ripening. The sizes of the good-quality fruit are "Pink" with fruit weighing 5–8 per lb., "Pink and White" 8–12 fruit per lb., and "White" 11–16 fruit per lb. These terms "pink" and "white" refer to the colours of the paper which lines the packages and which are used by the trade as labels. Less shapely and very large fruit are sold as "Blues". Marketing is done in containers holding 12 lb.

Turnips. Early turnips, whether grown in frames or in the open, are made up into bunches containing about twelve roots, after which they are well washed and packed in bushel boxes. Later they have the tops and tap root removed, and after being washed are consigned to market in bushel boxes or bags. *Turnip Tops* are cut as soon as they begin to grow freely in spring, whilst they are still young and tender, and are usually consigned in bags, but sometimes in lettuce crates or boxes.

Vegetable Marrows. Marrows started early should begin to bear in the first or second week of July. The fruit should be cut before it has reached full size, as it is then of better flavour and the plants continue to bear longer. In gathering they should be handled carefully, so that the tender surface will not get bruised and disfigured. For a few weeks the earliest marrows are packed in crates or boxes bedded in soft hay. Later they are sent in bushel boxes without packing.

FOR FURTHER READING

Ministry of Agriculture and Fisheries, Marketing Guide 36: *National Recommended Grades and Standard Packs of Home-Grown Fresh Vegetables.*

PESTS AND DISEASES WHICH ATTACK VEGETABLES

BEING A DESCRIPTION OF THOSE MOST IMPORTANT, WITH PREVENTIVE MEASURES AND REMEDIES

THE difficulties to be overcome before a profitable crop of vegetables can be grown are many and great enough when the effects of bad weather and other unsuitable conditions alone are considered, but in practice these difficulties are greatly increased by the liability of so many crops to attack from insect, fungus, and virus enemies. Some knowledge of these enemies and of their life-history is of importance to the grower, to enable him to take steps to prevent their spreading and to minimise the damage to the crop. A brief account of the most important of these pests and diseases, and the treatment appropriate to each, will be found in the pages following, but for fuller details the reader is advised to consult the Advisory Leaflets and Bulletins of the Ministry of Agriculture.

Before dealing with remedies it will be worth while to consider general preventive measures which, though they cannot ensure immunity from attacks, will generally lessen their number and virulence, and prevent their becoming epidemic.

Each plant must be allowed sufficient space for development: an overcrowded crop is generally unhealthy and seldom profitable.

Proper drainage, good cultivation, and suitable manuring, by inducing sturdy and robust growth, increase the powers of the plant to resist disease, and make it less liable to attack. When nitrogenous manures are used in excess of the plants' requirements a soft unripened growth is made, which is very liable to attack from fungi; potassic fertilisers help to balance the growth.

Though an ideal rotation may be impossible in gardening it is always better, when practicable, to arrange the crops so that plants of the same families do not immediately succeed each other, and in no circumstances should a diseased crop be followed by another of the same family, as this would almost certainly be affected by the same disease, and probably to a more serious extent than its predecessor.

Acid soils—i.e. those deficient in lime—are favourable to the development of certain soil fungi, such as that causing Club Root in brassicas. All such soils should be dressed with slaked lime before cropping, and a moderate dressing at intervals of three or four years will do much to improve their general condition and keep this disease in check.

Crops which are especially subject to a particular disease, like potatoes or tomatoes to blight, should always receive one or more protective sprayings with a suitable fungicide, whether disease is visible or not. It is much easier to prevent serious infection than to treat the disease, when it is established in the tissues of the plant.

The method of disposal of diseased plants, or parts of plants, is of great importance. They should not be dug into the ground or left lying about in rotting heaps, because even a small piece of tissue in which the fungus is present may act as a centre of infection for a future crop, whilst a rotting heap would disseminate the spores in millions and so endanger future crops over a large area. All such diseased remains should be burnt. Diseased plants or roots should never be fed to pigs or other stock unless first boiled. When this precaution is not observed the germs of the disease frequently pass uninjured through the digestive tract of the animals. Unconsumed pieces also become mixed with the manure and are carried on to the land to infect future crops.

Many weeds are able to act as hosts for the pests and diseases of cultivated plants, and do so act in the absence of the usual host. Therefore, apart from other considerations, the suppression of weeds is of importance in regard to the health of crops, and not only should those on cultivated land receive attention, but also those on headlands, in hedgerows, and on waste places.

Some diseases are carried on the seed or other propagating material such as tubers or bulbs. These diseases should be eliminated in the parent crop or controlled by treatment of the seeds, tubers, etc., with a suitable fungicide or possibly by hot water as for Stem Canker of broccoli.

With some crops it is possible to grow varieties which are resistant, or even immune, to certain diseases.

Loam which is to be used for the preparation of seed compost should be sterilised to ensure its freedom from diseases which may cause damping-off or root rots. For this, steaming is the ideal treatment and the "John Innes" steriliser may be constructed by any handyman (see reference on p. 307).

The steaming of soil in permanent frames is sometimes worth while where it has become infected and a transfer of the frame ground to a new site is not possible. This operation also destroys all weed seeds in the surface soil. It is carried out by passing steam from a boiler through a grid buried in the soil. Where steaming is not possible and frames need to be sterilised use formaldehyde. Add 1 gallon of commercial formalin (40% formaldehyde) to 49 galls. water and apply the solution at the rate of 5 galls. per sq. yd. to the surface of the dug soil in the frames. Keep close for forty-eight hours, then after a few days fork over. Do not crop for at least four weeks and fork over two or three times on sunny days.

[*By courtesy of Messrs. E. Allman & Co. Ltd.*

FIG. 84. Allman "Pestmaster" duster

SPRAYING-MACHINES AND THEIR USE, WITH MATERIALS AND FORMULÆ

Spraying-Machines. For the smaller holdings knapsack sprayers, of which there are several good makes on the market, are probably the handiest machines. They are cheap and effective, need only one man to work them, and will, with care, last many years. There are three types of these machines; two are hand-operated throughout the time that the work is in progress and the other is pneumatic, having a cushion of air pumped over the liquid before work is started and holding the pressure until the tank is emptied. The manual types may be fitted with ball valves or diaphragm valves to maintain a steady flow of spray—the latter form gives very trouble-free service.

For a larger scale of working there are bigger machines to choose from. Some very effective work is done by hand-operated pumps fitted to portable tanks or barrels, the workers using spray-lances attached to 30–60-ft. lengths of hose to reach between rows of such crops as tomatoes. Small motor pumps may also be used for this work. Portable spraying equipment may at times be needed, but if pest control is necessary on a field scale it is often preferable to use dusts rather than liquid sprays unless "low-volume" spray equipment is available. For fungus troubles more than one application is likely to be needed.

Every spraying-machine should be emptied and washed out with clean water immediately after using, and it should never be allowed to stand with any unused wash in it.

Applying the Wash. When using an insecticide it is usual to give a thorough drenching to wet all parts of the plant and force is often needed. With some of the modern "low-volume" sprayers the spray is applied in minute droplets and a good cover may be obtained without drenching the crop. With a fungicide a complete cover is still necessary, but in this case a finer spray may often be used. A "spreader" is usually added to the spray to make the wash "run" more easily over the leaves. Spreaders may also be needed with insecticides in order thoroughly to wet the insects.

INSECTICIDES

Paris Green is an arsenical substance which is used as a poison mixed with such a bait as bran, against surface caterpillars (or cut worms) and leatherjackets. To 25 lb. of bran mix 1 lb. Paris Green and slightly moisten to make the Paris Green adhere to the bran. This quantity is sufficient for 1 acre.

Nicotine makes an excellent wash for soft-bodied insects, such as aphids, but it is only effective during periods of high temperatures. It forms the basis of many proprietary insecticides. Where an extract guaranteed to contain 98% of nicotine is purchased, use ¾ oz. of this and 1 lb. of soft soap to 10 galls. of water. The soft soap is dissolved in 1 gall. of warm water; allow to cool, then add the nicotine and make up to 10 galls. Dusts containing nicotine are also used. These and other forms of nicotine should be used according to the maker's directions.

Note: Nicotine is a dangerous poison and must be handled only by a responsible person. Keep under lock and key when not in use.

Hexa-ethyl tetraphosphate, **"HETP"**, and Tetra-ethyl pyrophosphate, **"TEPP"**, are insecticides derived from phosphorus and though highly poisonous as applied freshly mixed, yet, as a result of the addition of water, break down fairly rapidly after application and leave no dangerous residue. They control a similar range of pests to nicotine but are not dependent on high temperatures. Use according to the maker's instructions. In cool weather these may be more efficacious than nicotine. **Protective clothing must be worn.**

Derris, used as a dust or a wash is a good non-poisonous insecticide for use against aphids and caterpillars. It is variously prepared in proprietary forms and should be used as directed by the makers. Take care that the wash does not get into water containing fish, as derris is toxic to them.

DDT is a very persistent substance and the deposit left on foliage after spraying is toxic to many insects which walk on it. Caterpillars are particularly affected by it and so are many flies, beetles and weevils. It is toxic to fish.

Benzene Hexachloride, BHC, is somewhat similar in action to DDT and is very effective as a soil treatment for wireworms. Most forms have an odour which is very persistent and may taint root crops and potatoes even for two years after application. Its use is therefore rather limited in the vegetable garden except in the purer form known as Lindane. It is particularly useful on seed-beds of brassicas to control Flea Beetle.

White-oil Emulsions are prepared from highly refined petroleum oils and are used against Red Spider Mite.

Naphthalene in one of its cruder forms is a good soil fumigant for use against cockchafer larvæ, millipedes, etc. It is used on limited areas at 3–4 oz. per sq. yd.

Calomel. A 4% calomel dust is used around the stems of brassicas to control Cabbage Root Fly. The mercury vapour prevents the eggs from hatching. It is only an egg killer and of no use against the larvæ.

FUNGICIDES

Bordeaux Mixture. This is the most generally useful and effective fungicide. On some plants, and especially in continuously damp weather, it may injure the foliage, and it may also be objectionable on ripening fruit, as it leaves a visible stain. A really fine misty spray is necessary to get the best results from this mixture. It should be used on the day of mixing; when left longer than this it is difficult to keep the ingredients in suspension.

To make ordinary Bordeaux mixture take—

Copper sulphate (98%), 4 lb.
Hydrated lime, 5 lb.
Water, 40 gallons

The powdered form of copper sulphate is best, as it will then dissolve much more quickly than when in crystals. Tie it in a coarse bag and suspend in half the quantity of water in a wooden vessel (a vessel of iron or tin must not be used). It is slow to dissolve. The hydrated lime is then stirred into the remainder of the water until well mixed and finally, when the copper sulphate is all dissolved, that solution is poured into the milk of lime. It is wise to test for the presence of free copper and this is easily done by dipping the clean blade of a knife into the mixture for almost a minute. If on withdrawal it is tarnished and shows a copper deposit more hydrated lime must be added.

Alternatives to Bordeaux Mixture. Burgundy mixture is made as for Bordeaux, only washing soda is used instead of hydrated lime and at the same rate.

There are various proprietary copper washes, e.g. colloidal copper, and dispersible copper powders, which do not leave a conspicuous deposit as does Bordeaux mixture. They are therefore very useful on tomato fruit nearing maturity. They are very easy to prepare. There are also a number of copper dusts for use in a dry form.

Sulphur in various forms, for example, lime sulphur, flowers of sulphur, and green sulphur, is useful against some of the powdery mildews.

Corrosive Sublimate (mercuric chloride) is used when brassicas are to be planted on land known to affected with Club Root. 1 oz. of the corrosive sublimate is dissolved in 12½ galls. water in a wooden container. Half a pint of the solution is poured into each dibble hole and allowed to soak away before planting (pour ¼ pint and repeat with ¼ pint after the first has soaked away). This substance is very poisonous and must be used only by a responsible person.

Calomel (mercurous chloride) is a much safer material to use instead of the foregoing. It may be used as 4% dust sprinkled at 1 teaspoonful per dibble hole before planting (1 lb. of dust to 50 plants). Or the 4% dust may be made into a paste—1 lb. calomel dust to ⅓ pint water. The seedlings are dipped into this before planting so that the roots are coated. 1 lb. of dust will treat over 100 plants.

Seed Protectants. There are several proprietary substances for use on seeds before sowing which give a better stand of seedlings, particularly from early sowings when the slowly germinating seeds are liable to attack by various fungi. They include organo-mercury and various complex compounds.

Officially Approved Proprietary Insecticides and Fungicides. For most of the insecticides, etc., which may be used by the grower a wide range of makes is offered by the manufacturers. To help him select a reliable form of the material which he needs there is in operation a voluntary scheme which has been agreed between the Ministry of Agriculture and Fisheries, the Department of Agriculture for Scotland, and the Association of British Insecticide Manufacturers. Products which are approved by an Advisory Committee bear the brand name of the article and a diamond-shaped approval mark (Fig. 85).

The approved products fall into two main groups, (*a*) those which are guaranteed to comply with an official specification, and (*b*) those materials for which there is no official specification but for which the principal ingredients are declared by the maker. A list of the approved products may be obtained from the Ministry of Agriculture and Fisheries or from the Department of Agriculture for Scotland. This list makes no attempt to place the materials in order of merit.

There follow now notes on some of the troubles of vegetable crops. These are not intended to be fully comprehensive and when a grower is in doubt about the identity of a pest or disease, or the best control to suit his case, he should not hesitate to consult his local Advisory Officer.

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FIG. 85

The control measures which may be adopted are always liable to revision as more effective, safer, or cheaper materials become available. The Ministry of Agriculture issues a series of Advisory Leaflets which give up-to-date recommendations on the more important troubles and the grower should make full use of these leaflets. It is hoped that the following pages may be of use when read in conjunction with the text on crop cultivation and also for a quick check on the measures to take against a known trouble.

PESTS HARMFUL IN GENERAL

Aphids. Aphids are known under numerous names, of which that of "green fly" is perhaps the most common, although there are green, black and reddish forms. They are small soft-bodied insects, and may be winged or wingless according to the particular generation. Each has a sharp beak at the head, capable of piercing the foliage of plants. Aphids injure plants directly by sucking out the sap and so weakening their vitality, and also by interfering with the functions of the leaves by blocking up the stomata or pores with their excretions, known as "honey-dew", and indirectly by transmitting virus diseases. Some aphids cause the leaves to curl, so enclosing them and making it difficult to reach them with washes.

Aphids are almost inconceivably prolific. They may not only produce eggs which hatch out in due course, but for most of the summer produce young alive. The young aphis is able in a very short time to produce further living young. There is scarcely a cultivated crop which does not suffer more or less from aphid attacks, many plants having their own particular aphis, e.g. Cabbage Aphis of brassicas. When their extraordinary powers of reproduction are considered it will be seen that if allowed to multiply unchecked they would soon overrun and cripple a crop. Dry hot weather which is unfavourable to the growth of plants is very favourable to the increase of aphids, and if they are allowed to get a firm hold of a crop under such circumstances they may totally destroy it.

Treatment. Spray the plants with nicotine or HETP. In all cases it is important to deal with attacks in the early stages, before the plants have become badly infested, and this is particularly the case with leaf-curling aphids.

Chafer Beetles, or White Grubs. Chafer beetles may be recognised by their antennæ or "feelers", which are club shaped, with several flattened "leaves" or divisions at the end. The grubs are thick, fleshy, and of a whitish colour, with the tail curved downwards and swollen; the head is large and brown, the mouth being armed with strong mandibles. They belong to several genera, of which the Cockchafer, the Summer-chafer, the Garden-chafer, and the Green Rose-chafer are occasionally more or less troublesome to gardeners. In habits and general appearance the grubs are similar, but when full-grown there is a marked difference in size, those of the cockchafer and green rose-chafer being much the largest, attaining a total length of 1½ in. They are all voracious feeders, the damage they do in the larval or grub state being sometimes very serious, whilst the beetles feed on the leaves of various trees, occasionally quite stripping them of foliage. The larvæ are easily damaged during soil cultivation, as they are so soft-bodied. In the vegetable garden they are most likely to be serious on perennial crops.

Treatment: The grubs may be hand-picked when digging or infested land may be dressed with crude naphthalene at 2 cwt. per acre, which should be worked into the top-soil with a cultivator. Benzene hexachloride is effective against this pest (see p. 276).

Leatherjackets. These are the larvæ of the well-known fly, the Daddy Longlegs or Crane Fly (*Tipula paludosa*, and others). They are very destructive to many crops in the garden, especially on newly broken grassland, eating them at or just below the ground line. The larva is about an inch in length when mature, somewhat variable in colour, but generally of a greyish brown; it has a black head, furnished with strong jaws for biting, and although it has no legs it moves with comparative ease.

Treatment: Use the poison bait of Paris Green and bran (see p. 275). Broadcast it evenly over the soil in afternoon or evening. Take all reasonable steps to prevent domestic stock picking up any of this bait. Paris Green may be substituted by DDT or BHC. Use 1 lb. of 20% dispersible DDT or 1 lb. of 50% dispersible BHC to 25 lb. bran. These materials are slightly slower in action than Paris Green.

Millipedes (*Blanjulus* spp. and *Polydesmus* spp.). These are not insects, but belong to a group of the animal kingdom known as the *Myriapoda.* They may be usually found in dark and damp places, in decaying wood or under heaps of decaying vegetable matter. Millipedes are vegetable feeders, and often cause injury to the roots and other underground parts of plants. They should not be confused with centipedes which are carnivorous, feeding on insects, larvæ, worms, snails, and slugs, and are therefore useful to the gardener.

In millipedes the body is usually round—in the genus *Polydesmus* the body is angular—from half an inch to one inch long, blackish or pinkish in colour, with numerous segments, the front four of which have one pair of legs each, whilst the remainder have each two pairs of legs close together at the bases; the antennæ are short; they move slowly. The centipedes may be distinguished from the millipedes by generally having flattened bodies, brownish in colour, each segment having only one pair of legs, and their antennæ are longer; they move rapidly.

Treatment: On small areas traps of pieces of beet or potato buried an inch or two below the surface of the soil will attract them, when they may be caught and killed. Ground in which they are present should receive a dressing of crude naphthalene at 2–3 oz. per sq. yd. A 5% DDT dust may be sprinkled along the seed drills.

Red Spider Mites (*Tetranychus telarius*). These mites, variable in colour, are difficult to see with the naked eye. Their presence on plants is indicated by a yellowish scorched appearance of the leaves. They flourish most in a dry arid condition of the atmosphere, and are therefore most in evidence in greenhouses or frames which have been allowed to get too dry; cucumbers and melons are particularly susceptible to attack.

Treatment: The most obvious thing in dealing with greenhouses or frames or other confined spaces is to take measures to prevent an attack, by maintaining sufficient moisture at the roots and amongst the foliage. Frames are not easy to fumigate but where practicable Azobenzene smoke generators may be burnt. Spraying may be done with either a Derris extract or a petroleum emulsion wash.

Slugs (*Arion* spp., etc.) and **Snails** (*Helix* spp.). Of these there are a number of species. They are very destructive to green vegetation, particularly so to tender seedlings, large numbers of which they will completely destroy in a short time. These pests feed chiefly at night, but are active during the day in dull showery weather. They are protected by a mucous slime which they exude copiously, and this makes it very difficult to kill them with contact remedies.

Treatment: Decaying vegetable matter and other refuse lying at the foot of walls or hedges provides shelter for slugs and snails and should be cleared away.

Thrushes devour large numbers of snails and should be encouraged, as it is easier to guard against any injury they may do to fruit than to withstand the ravages of slugs and snails. Where it is possible to do so without injury to the crops, ducks may be run over infested gardens early in the morning, when they may be depended upon to discover and devour large numbers. A bait of bran and finely powdered metaldehyde is attractive to slugs and snails and effective in their destruction. The material may be obtained as a powder or in small quantities in blocks as a solid fuel, but in this latter case it must be finely crushed before use. To 28 lb. of bran add ½ lb. metaldehyde and mix thoroughly. Slightly moisten the bran to make the powder stick, but don't make a "bran mash". Scatter thinly over the ground during warm, damp, dull weather, but try to apply when it is likely to remain fine for several hours. On a small area the bait may be placed in little heaps about 12–18 in. apart, covered with a tile or piece of board—this gives protection from the weather and the bait will remain effective for several days.

Metaldehyde is not effective against any other soil pests.

Surface Caterpillars or Cutworms. The large caterpillars of several species of moths (particularly of the Heart and Dart, the Yellow Underwing, and the Common Dart or Turnip Moths) are very injurious to potatoes, turnips, cabbage, and many other crops. They attack the plants at or just below the ground line, often eating entirely through the stem. They hide under clods and stones and beneath the surface soil during the day, feeding at night. The mature caterpillars are about 1½ in. in length, brownish or greyish in colour, with spots and bands of darker colouring.

Treatment: Use the poison bait of bran and Paris Green (see p. 275), or bran and DDT (see Leatherjackets) or 5% DDT dust at ½ cwt. per acre.

Wireworms are the larvæ of the "click beetles" or "skip jacks", names given to the beetles from their habit of springing a few inches into the air when turned on their backs. The beetles lay their eggs near the roots of plants, grassland is preferred. The larvæ which hatch from these live in the soil for about five years. Wireworms are of a yellowish colour, with tough shiny skins; they are about ¾ in. in length when mature and have three pairs of legs—one pair to each of the first three segments of the body—a swelling or "foot" below the last segments, and a pair of very strong jaws well adapted for biting roots.

Treatment: Wireworms are always the most abundant in old pastures; the longer the soil of any field has lain undisturbed the more likely it is to be infested with wireworm. Newly broken grassland which may be badly infested, may by thorough cultivation have the wireworm population reduced by 30% per year, and in the course of three or four years be comparatively free. This clearance is not brought about by any measures taken for the destruction of the pest, though of course these have some effect, but because the beetle prefers to lay its eggs in a situation where the soil is undisturbed, and when the pupa hatch out of land under constant cultivation the emerging beetles leave for situations more to their liking.

Benzene hexachloride, BHC, gives a good control of wireworm when used as a dust containing 3% or 4% of BHC. This may be broadcast at 1½ cwt. per acre. The drawback to using BHC is that in the less pure form it gives a taint to root crops and potatoes grown on the land for up to two years after its use. The cruder form should therefore only be used on land where a cereal crop can be taken or a vegetable crop of which the edible portions are not taken from the soil. The purer form (gamma BHC) known as Lindane is always to be preferred on horticultural land. *Note:* peas and beans are somewhat resistant to attack by wireworm and may be grown with fair success on infested land.

In frames it may be practicable to use pieces of carrot, mangold, or potato as traps for wireworm; they should be buried an inch or so beneath the surface of the soil and frequently examined, when the wireworms they attract may be collected and killed. The beetles may be trapped during May and June by laying bunches of clover or grass about the ground. These serve to attract the beetles, which congregate underneath. The traps should be examined occasionally and the beetles destroyed. Many wireworms are collected by birds when exposed during cultivations.

Woodlice (*Oniscus asellus* and *Porcellio scaber*). Woodlice, known as "Sow-bugs" and "Slaters", are not often very troublesome to crops in the open air, but frequently do much mischief in frames to cucumbers or seedlings, or in places where seakale is being forced. They feed in the dark and during the daytime hide in crevices in walls, under heaps of dry litter, and in similar places. A favourite lurking place is the space between a bed and the wall or boards, where the soil or manure has shrunk through dryness.

Treatment: They can be destroyed by DDT. Give a light powdering of a 5% dust to edges of the frames and other possible haunts of the woodlice. The dust is effective following contact by the woodlice walking on it.

TROUBLES OF INDIVIDUAL CROPS

ASPARAGUS

Asparagus Beetle (*Crioceris asparagi*). The asparagus beetle is a well-known pest on asparagus plantations in the southern parts of England. It is slender and graceful in form, from one-fifth to one-quarter of an inch in length. Its body is shiny black, with a blue tinge; its head is black. It has red and yellowish markings, with a black cross on its back. It deposits eggs from June onwards, first on the asparagus shoots and later on the feathery foliage after it has developed. The eggs are spindle-shaped and oval, greenish brown in colour, and are fixed by their ends to the plants, occasionally placed singly but usually occurring in rows of from three to five, and occasionally up to eight in number. The eggs hatch in from five to seven days. The larva or grub is nearly half an inch long and is variable in colour, being generally greyish or slate-coloured but sometimes almost yellow. Both beetle and grub feed on the asparagus plant, at first disfiguring the shoots as they appear and later attacking the stems. In a bad attack the shoots become defiled and useless from masses of sticky eggs and from a dark-coloured sticky fluid emitted by the larvæ.

Treatment: As soon as infestation is observed a few shoots may be left uncut at intervals along the bed; these will serve as traps for the beetles, which will ascend them to pair and deposit their eggs. Once a week these should be cut down and burnt, others being left to fill their place. In this way the infestation may be kept in check until cutting is finished. Spraying with derris or DDT may be done whilst the beds are in crop.

Asparagus Fly (*Platyparea pœciloptera*). The larva of this fly is a yellowish glossy maggot, with a dark head and without legs. The fly lays its eggs from early in April to the middle of July, and the larvæ hatch out from two to three weeks later. They at once begin to bore into the tender young shoots, following a downward course. The affected shoots become dwarfed and yellowish, and rot at or below the ground line. This is an important pest in Europe and is now found in a few places in East Anglia.

Treatment: Cut out close to the root and burn all affected shoots. In the autumn burn all tops and remove and burn all dry stumps.

Asparagus Rust (*Puccinia asparagi*). This trouble does not appear until after midsummer. When a plantation is badly affected its general appearance is that of an unusually early maturing of the foliage. Instead of the glossy green appearance which healthy plants present, the foliage shows a yellowish brown colour, whilst the stems will be seen to have raised patches of blistered skin. This disease very rarely occurs nowadays and causes very little damage.

Treatment: Cut down and burn the stem and foliage from young beds early in the autumn before many of the autumn spores fall to the ground.

Violet Root Rot (*Helicobasidium purpureum*). Many cultivated plants—the grasses and cereals forming notable exceptions—are liable to the attack of this fungus. Generally the attack is confined to the roots and other underground parts, but in dull moist weather the disease may extend up the stem. It is easily recognised by the network of red or purplish mycelium which grows closely round the organ attacked.

The leaves of diseased plants become yellow and drooping. From the mycelium are produced hard roundish bodies—sclerotia—which are masses of closely interwoven mycelium, and which carry on the disease from year to year. Carrots, beet, potatoes, beans, and peas are also liable to be attacked, as well as many perennial weeds.

Treatment: All diseased roots, etc., should be carefully collected and burnt. After the bed is scrapped give the site a rest from asparagus or other susceptible crops for a few years.

As the disease spreads from plant to plant, a patch of diseased bed may be isolated by digging a deep trench and placing, on edge, in the trench, sheets of iron or asbestos, which prevent the passage of the disease to healthy plants.

BEANS, BROAD

Bean Aphis (*Aphis fabae*). This aphis is popularly known as the "Black Dolphin" or "Black Fly". Large clusters form at the tops of the broad-bean plants, and if allowed to remain, increase at such a rate that the shoots become covered by the insects and with a sticky excrement which, besides making the plants disagreeable to handle, interferes with the functions of the leaves and prevents any prospect of a profitable crop.

Many other garden crops and weeds are attacked by this pest. In the autumn it migrates to the spindle tree (*Euonymus*), where eggs are laid, and in that state the winter is passed. In spring the eggs hatch and in due course winged aphids migrate again to the annual host plants for the summer.

Treatment: Use a nicotine wash or dust, or spray with HETP (p. 275) when the aphids are first seen.

The first migrants to arrive on the beans concentrate on the young growing tips of the plants. If the plants are early and get three or four trusses of flowers set, the tips may be pinched out in small gardens or slashed with a hook, and such "topped" plants often escape attack.

Pea and Bean Weevils (*Sitona* spp.). These small beetles feed on peas and broad beans early in spring, eating out small semicircular notches from the edges of the leaves. During a cold period when growth is slow severe damage may be done.

Treatment: Dust or spray with DDT according to the maker's instructions, applying as soon as the damage is noted.

Chocolate Spot (*Botrytis fabae* and *B. cinerea*) is quite common in most years and may be present throughout the life of the plant, but is usually most serious from April to July. The leaves show chocolate-coloured spots about ¼ in. in diameter. In a bad attack the stem may be affected, the leaves drop, and the pods may be heavily marked.

Treatment: See that the soil is well supplied with potash and phosphates to help give resistance to attack. Provide good drainage and an open site. If severe attacks occur annually, spray with Bordeaux mixture.

BEANS, DWARF FRENCH

Foot Rot (*Fusarium solani*, var. *martii*). The base of the stem is somewhat shrunken and is rusty in colour; the leaves turn yellow prematurely, causing a reduction in crop.

Treatment: Practise a long rotation. Burn affected plants. Give a nitrogenous top-dressing and earth up the remaining plants.

Halo Blight (*Pseudomonas phaseolicola*). The pods develop "water-soaked" patches surrounded by a yellow ring. These are caused by a bacterial infection. The disease is spread by the splashing of rain-drops. The seeds become infested and carry the disease over to the next generation.

Treatment: Seed from an infected crop should not be used. Remove and burn unhealthy seedlings. The variety The Prince is resistant to stem and leaf infection. All English varieties seem susceptible to the pod infection. Burn diseased material at the end of the season. Practise a rotation.

Runner beans may also be affected by Halo Blight. Bean seed should never be soaked to assist germination, as the water will spread bacteria from infected to healthy seed and may completely destroy a batch of seedlings.

Mosaic. A virus disease which causes the leaves to be puckered and mottled, with a dwarfing of the plant and reduction of the crop. The appearance of the pods is often spoilt.

The disease is carried in the seed. Keep down green fly which may spread the trouble in the field.

Anthracnose (*Colletotrichum Lindemuthianum*). This fungus attacks the pods of French beans in the form of dark irregular-shaped spots and patches edged with a red line. These spread and often run into each other, becoming sunken, and are then more or less covered with a thin whitish crust. Sometimes the fungus passes through to the seed inside the pod, making yellowish or brownish pits or wrinkles upon them.

It is usually only serious in very wet seasons or wet districts. Burn infected refuse. Follow a rotation which allows a good rest between crops of dwarf beans.

BEETROOT

Surface Caterpillars can be very troublesome to this crop. For control see p. 281.

Seedling Troubles. Black Leg results from a fungal attack on the stem below the seed leaves. It is commonly a seed-borne disease; given good growing conditions the seedlings should get well away and recover. Stringy Root, where the stem and root of the seedlings are constricted at the affected point, is only serious on acid and impoverished soils. Prepare a good seed-bed and make sure that the land is in good heart with an adequate supply of lime. Poor seedling growth is likely to result from sowing under poor conditions for germination. Very early sowings are most liable to attack.

Violet Root Rot is sometimes serious; see under Asparagus. For control practise a rotation.

Beet Rust and Downy Mildew are sometimes seen but are rarely serious.

BRASSICAS

Cabbage, Cauliflower, Sprouts, Savoys, and Kales

Flea Beetles (*Phyllotreta* spp.). These beetles are often very destructive to young seedlings of cabbage and other brassicas, including turnips, especially in hot, dry weather on light soils. The seed leaves are eaten away directly they appear above ground, and on cloddy soil, even below ground. Unless the seedlings are assisted or the weather becomes more favourable it is often impossible to get a "plant". Under congenial conditions the beetles increase very rapidly, and clear off every particle of growth as fast as it appears, so that in such seasons successive sowings have been made three times and each has proved a failure. The beetles are very small, being only about one-tenth of an inch in length.

Treatment: Sow only on ground which has a good tilth. Avoid freshly worked land unless it is in very kindly condition, as when it is rough and cloddy it loses moisture rapidly and provides shelter for this pest. Roll or press the surface immediately after sowing to assist germination, and where it is reasonably possible water regularly in dry weather.

All cruciferous weeds, such as charlock and shepherd's purse, should be kept down, as they harbour the beetles.

Several insecticides may be applied as dusts and give very good control. They should be applied just as the first seedlings are seen to be breaking ground and again about 10 days later. In the case of transplanted seedlings a dressing may be needed after the plants are in their final quarters.

A 2% DDT dust may be applied at 40 lb. per acre or use the refined form of BHC known as Lindane (see p. 276).

Cabbage Root Fly Maggot (*Erioischia brassicae*). The Cabbage Root Fly somewhat resembles the common house fly but is rather smaller. It is a great pest to all members of the cabbage family and also attacks cruciferous weeds. The female fly begins laying its eggs during April and May, and there are two or possibly three generations during the summer. The eggs are deposited in cracks in the ground, as close to the plant as possible. Within four days the maggots hatch out and burrow first into the smaller roots, then into the larger roots, and finally into the stem. Plants attacked are stunted, with yellow and shrivelled leaves, and they rot off at the stem.

Treatment: In the seed-bed: Dust along the base of the stems with a 4% calomel dust, using 1 lb. to 60 yd. of row when the seedlings are showing the second true leaf.

To protect plants when transplanting: Prepare a paste by mixing one part of 4% calomel dust with an equal quantity of fine soil and make a thin paste by adding water. As the plants are lifted from the seed-bed take bundles of 30–40 and dip the roots in this paste. Make sure that the stem is coated to a height which will clear the ground when planted.

After planting: About half a teaspoonful of 4% calomel dust placed at the collar of the plant *within four days* of planting gives good protection. On a large scale dusters are used giving a small "puff" to each plant. Very good results can be obtained by using a "60" or "48" size pot with a small drainage hole. The pot is filled with the dust and may be held with one hand in such a way that when it is given a sharp tap with the other hand a small quantity of powder drops at the base of the plant.

Cabbage Aphis (*Brevicoryne brassicae*). This aphis is of a greenish-blue colour, and is common to all the members of the cabbage family, attacking them on the undersides and in the folds of the leaves. It is most prevalent in the latter part of a hot dry summer and in the autumn. It increases very rapidly, and being protected by a waxy covering which throws off spray, it is more difficult to eradicate than most aphids.

Treatment: This pest over-winters as an egg and sometimes in the adult form on old brassica plants which have come through the winter. Old stems of Brussels sprouts, etc., should be destroyed not later than the middle of May. Pay particular attention to plants being grown for seed, as not only may the seed crop be badly reduced by a heavy infestation of aphis but such plants form a centre from which the pests may spread to new crops. A seed crop may be sprayed with nicotine or HETP (see p. 275). This prevention of spread from over-wintered plants should be regarded as the main method of control, as, though spraying or dusting of a summer crop will give a kill on young plants, it is rarely practicable on a crop where the leaves are turning in.

Cabbage Butterflies and Cabbage Moth. The cabbage tribe is subject to attack by the caterpillars of three kinds of butterfly—the Large White (*Pieris brassicae*), the Small White (*Pieris rapae*), and the Green Veined (*Pieris napi*); also by the caterpillar of the Cabbage Moth (*Mamestra brassicae*). Both butterflies and moth deposit their eggs on the leaves, especially those of cabbages; these eggs hatch out in about fourteen days, and the caterpillars at once begin to attack the leaves. The Cabbage Moth, although chiefly a cabbage pest, by no means confines its attention to that family; there are very few plants in the garden which altogether escape its ravages.

Treatment: Spraying with derris wash is quite effective, preparing according to the maker's recommendations. Dusting with DDT, using a 3% dust at about 40 lb. per acre, is to be advised for the commercial grower. On a small scale, hand-picking of the egg clusters and caterpillars may prove very effective.

Diamond-back Moth (*Plutella maculipennis*). In some years the caterpillars of this moth do much damage to cabbage, turnips, and other cruciferous plants, by feeding on the green tissue on the underside of the leaves. The caterpillars are about half an inch in length, green in colour, and spindle-shaped—tapering to both ends.

Treatment: Dusting the leaves when they are wet, and especially the under-side, with DDT or derris dust will check the pest.

Cruciferous weeds harbour the caterpillars and should be destroyed.

Turnip Gall Weevil (*Ceutorrhynchus* spp.). These weevils lay their eggs in holes which they make in the root or at the base of the stems of cabbages and other brassicas. The irritation thus set up causes small lumps or swellings to form which are known as "galls". If these are cut open the grubs of the weevil will be found in the cavity they have eaten out.

Treatment: Try to avoid planting seedlings which are galled at planting time, though on good soil even such seedlings will make fair plants. When lifting the stumps of an old crop which is attacked, if it is not possible to burn them right away then leave them lying to dry, as in such condition the weevils cannot eat their way through the tough dry skin.

Snowy Fly (*Aleyrodes brassicae*). This tiny white fly is in some seasons very troublesome on cabbage, sprouts, and other members of the same family. They congregate beneath the leaves in myriads, and when disturbed rise above the plants like a thin white cloud. The larvæ is fixed beneath the leaves and protected by a waxy covering. Affected leaves turn yellow or brown from loss of sap, and the plants become dirty and disagreeable from the exudations of the pest.

Treatment: Spray plants with DDT emulsion or with HETP, getting well underneath the leaves.

The Cabbage Stem Weevil (*Ceutorrhynchus quadridens*) lays its eggs in the stem of young seedlings just above soil level. On hatching, the grubs feed inside the stem, making it hollow. The plant eventually dies. This weevil is often very troublesome on autumn-sown cauliflowers.

Treatment: Dust with a DDT preparation as the seedlings break ground.

Club-root (*Plasmodiophora brassicae*). This disease, also known as "Finger-and-Toe", causes malformation of the roots of cabbages, turnips, radishes, and other brassicas; it also attacks wallflowers and stocks and cruciferous weeds, such as charlock and shepherd's purse. It is caused by a minute organism in the soil which enters the plant through the fine root hairs, multiplying rapidly in the tissues and inducing distortion and decay. The disease is very widespread and destructive. It is readily spread by carrying soil from a diseased area on boots, tools, etc., or by feeding diseased roots to stock, from whence it is returned to the ground in the manure. It can remain in the soil for many years in a quiescent condition, immediately making its presence known when the ground is cropped again with brassicas. The disease is most prevalent on soils deficient in lime, and especially so when such soils are sour by reason of defective drainage.

Treatment: Never raise seedlings on infected land. Burn diseased roots. Before cropping with brassicas make sure that the land is adequately supplied with lime. Avoid cropping diseased ground with any kind of brassica for several years. Drain wet land. Keep down cruciferous weeds.

Should it be necessary to grow a crop of brassicas on land which is known to be infected a good start may be given to the young plants by the use of mercury compounds. The severity of the attack is lessened but the production of a disease-free crop by these methods cannot be expected. *Calomel:* Using a 4% calomel dust make a paste by mixing 1 lb. of dust with ⅓ pint of water in a wooden or earthenware vessel. Before planting dip the roots of the plants in the paste. One pound of dust should treat 100 plants. *Corrosive sublimate:* A solution of 1 pint in 2,000 parts of water (1 oz. in 12½ galls.) is prepared and applied as directed on p. 277.

Mosaic. The virus which causes mosaic disease may attack all kinds of brassica crops, causing the leaves to be mottled with light and dark green. The affected plants are stunted and give only a poor return. The winter cauliflowers are particularly susceptible to attack. The disease is spread by aphids migrating from infected crops, and crops which occupy the land for a long time are not only more liable to attack but also more likely to be spreading the trouble to other crops.

Treatment: Raise the seedlings in isolation, well away from old stocks of brassicas. It may pay to arrange for the young plants to be grown on contract in a district right away from market-gardens. On clearing the marketable produce from a plot dispose of the residue as quickly as possible; if it is infected then the longer it hangs about the more infection is likely to be spread. Whenever possible avoid planting a new crop immediately alongside an old crop. There are many times when this will not be possible, but at least with the winter cauliflowers an effort should be made to this end.

Canker (*Phoma lingam*). This trouble attacks many brassicas, particularly in the North of England. The fungus may attack all parts of the plant above ground, including the seed, but the most conspicuous attack is on the stem, where brown cankers appear which cause the plant to be stunted.

Treatment: Prepare the seed-bed on a fresh site each year, giving several years' rest before re-using a given site. Seed which is likely to be infected may be given warm-water treatment. It is placed in bags made of cheese-cloth and immersed for thirty minutes in water which is kept at a steady temperature of 112 deg. F. On removing from the warm water, dip into cold water; allow to drain for a few minutes, then spread out to dry.

Downy Mildew (*Peronospora parasitica*) is often seen in seed-beds and in frame-grown seedlings, especially if they have been too wet. Severely attacked seedlings may be stunted and killed.

For seedlings in frames give plenty of ventilation. Avoid overcrowding. For crops in the open choose a site well away from shelter. Keep a close watch on the seedlings and at the first sign of the disease dust with a copper dust.

Cabbage Black Rot (*Xanthomonas campestris*). This disease is caused by bacteria; it attacks cabbages, cauliflowers, sprouts, turnips, seakale, and all other members of the crucifer family. The bacteria work in the leaf-stalks and stems, causing blackening of the vascular bundles and rotting of the plants.

It is considered that the disease is usually introduced with the seed.

Treatment: All diseased plants should be carefully collected and burnt; they should never be given to stock or put on dung or rubbish heaps, or a further infection of the land will follow sooner or later. Destroy all cruciferous weeds. Infected soil should be kept clear of cruciferous plants for some years.

CARROT

Carrot Fly (*Psila rosae*). The Carrot Fly is shiny black or dark brown in colour, about one-third of an inch long, with a wing expanse of nearly half an inch. The flies lay eggs near the carrots just below the ground. The maggot is without legs, yellowish white in colour and nearly a quarter of an inch long. It has no distinct head, but its fore-end tapers to a point; the hind-end is blunt. As soon as the maggot is hatched out it goes down and bores holes in the lower part of the root, then tunnels upwards, with frequent holes to the outside. The effect upon the roots is to cause them to become brown or "rusty" and finally rotten. An attack is indicated by browning of the foliage; when this is observed the roots should be carefully forked up so that no part is left in the ground, and destroyed.

Carrots grown early for bunching are seldom injured by the fly, which does not, as a rule, attack them until late May.

There are two broods of flies in the course of the year and the first is rarely active before early May. Sowings made in late May or early June escape the first attack and often escape attack or are only lightly affected by the second brood. Keep early sown crops well away from the site of the main crop.

Treatment: The flies usually take advantage of shelter and if a strip of the crop about 4 yards wide around the headland (and possibly the ditch and hedge) is sprayed with an emulsion containing 0·5% DDT many flies are caught and egg-laying is lessened. Several applications will be needed to ensure a cover of the period during which flies may be present.

A BHC dust applied to the seedlings and the adjoining soil gives good protection against this pest. Where an oil spray is being used as a weed killer it may be possible to add BHC with good results. In all cases use the refined gamma BHC. Look out for up-to-date recommendations.

On a small scale choose an open site, well away from shelter. The flies may often be repelled by dressing the bed with some strong-smelling substance which masks the smell of carrots. Crude naphthalene, or 1 fluid ounce of creosote mixed with 2 lbs. dry soil, are good for this purpose if scattered thinly between the rows.

CELERY

Celery and Parsnip Fly (*Philophylla heraclei*). The Celery Fly makes its first appearance in April. It is a small fly, about one-fifth of an inch in length with a wing expanse of nearly half an inch; tawny brown body with a lighter colour underneath. The eyes are deep green and the legs dark yellow. The wings are transparent with dark brown markings. The eggs are laid singly on the celery and parsnip leaves; these hatch out in about six days and the larvæ or grubs immediately burrow between the upper and lower epidermis of the leaves, eating the green tissues and doing much damage by checking the growth of the plants. Celery subjected to a bad attack is stunted, whilst parsnips come small and of bad shape. The grubs change into pupæ in about fourteen days, sometimes remaining in the leaf and sometimes falling to the ground. From these, flies hatch out in about three or four weeks and another attack begins, and when the weather is mild the second brood continues until late in autumn.

The pupæ of the second generation spend the winter in the ground. It is wise to have the crop in the following season well away from the site used the previous year. The risk of attack from the first brood is thus lessened.

Treatment: Where practicable collect and burn the foliage which is trimmed from an infested crop, as in that way many pupæ will be destroyed.

DDT used as a 5% dust at frequent intervals from the time when flies are likely to be about lessens the attack. Such dressings will not affect the larvæ which may be in the leaves. A nicotine wash will penetrate the burrows and kill the larvæ (see p. 275).

Carrot Fly also attacks celery.

Celery Leaf-spot (*Septoria apii* and *S. apii-graveolentis*). This disease is carried with the seed from an infected crop and the young seedlings may be infected at a very early stage. From thence onwards there may be a succession of infections on the newer foliage. At first spots appear and in a severe attack the whole leaf blade dies. One of the fungi concerned may attack the stems. Infected plants being grown for seed carry the disease over the winter and eventually the new seed may be infected. In wet seasons the damage may be severe.

Treatment: Infected seed may be given warm-water treatment by immersing for twenty-five minutes in water which is held at 122 deg. F. At the end of this period cool in running water and dry.

By repeated sprayings with Bordeaux mixture (4 lb. copper sulphate, 5 lb. hydrated lime, 40 galls. water) (see p. 276) starting with the seedlings before pricking out, clean crops may be obtained. Intensive spraying should be adopted on any plants being grown for seed.

Soft Rot (*Bacterium carotovorum*). Rotting of the leaf-stalks may follow injuries, e.g. from slugs, and is encouraged by unbalanced nutrition caused by excessive applications of nitrogenous fertilisers.

Treatment: Destroy infected material; keep down soil pests, ensure a good balance of nitrogen and potash in the soil. Practise a rotation.

CUCUMBER AND MELON

Red Spider Mite. See p. 280. } but avoid using DDT products on
Woodlice. See p. 282. } these crops.

Mosaic. A troublesome virus disease, particularly on ridge cucumbers. Infection may arise from marrow or tomato as well as several ornamental plants. The whole plant is dwarfed, the leaves are mottled, and the fruits are malformed.

Save seed from healthy plants. Plant only perfectly sound seedlings. Remove and destroy infected plants.

Foot rot (*Corticium solani*) attacks the plant at or just below soil level and causes its rapid death. Carefully remove and burn infected plants and some of the surrounding soil should be taken out.

Blotch (*Cercospora melonis*) can be a most destructive disease. Small water-soaked spots develop on the upper sides of the leaves. As they spread the leaf soon dies.

The variety Butcher's Disease Resister should be grown in frames or houses which have carried infected crops. Destroy infected plants and after an outbreak thoroughly disinfect the frame or houses with formalin. The soil in permanent structures should be steam sterilised.

Gummosis (*Cladosporium cucumerinum*) causes small sunken spots on the fruit which later develop a "gumming". The trouble is encouraged by wet conditions.

Treatment: Remove and burn diseased fruit. Dusting or spraying with one of the sulphur preparations may be adopted in severe cases.

Cucumber and Melon Mildew (*Erysiphe cichoracearum*). This fungus produces a white network of mycelium on the leaves of ridge cucumbers, marrows, etc. It is very prevalent after the middle of the season, or earlier when the weather is very dry.

Treatment. As soon as the mildew is noted dust with sulphur.

Cucumber and Melon Rot. In damp sunless weather melons and cucumbers growing in frames are subject to attack from the fungus Botrytis which settles upon and causes rapid decay at the cut ends of the shoots, stubs of leaves, or abraded portions of the stem. If not checked the rot spreads to other parts and may destroy fruit or even the plant.

Treatment: Carefully cut out and burn all parts affected with the rot; handle the pieces gently so as not to scatter the spores, or the disease will be broadcast. Dress the fresh-cut ends with flowers of sulphur.

Keep the frames and plants as dry as possible consistent with healthy growth. Put a piece of tile or slate under each fruit to keep it from contact with the damp soil.

LEEK

Leek Moth (*Acrolepia assectella*). This pest has become established along a coastal strip in south-east England. The larvæ tunnel into the young leek plants, causing them to grow with a ragged appearance. There are three generations in a year.

Treatment: Dust with a 5% DDT dust at the first sign of damage and continue at fortnightly intervals until early autumn.

Leek Rust (*Puccinia porri*). Bright orange spots are seen on the leaves of the leek. The trouble is usually serious only where old plants or rubbish from the previous season enable a carry-over to the new crop. Keep new plantings well away from crops being grown for seed. Dust with a copper lime dust.

White Rot. See ONIONS, p. 297.

Smut. See ONIONS, p. 296.

LETTUCE

Aphis. There are several species of aphids which in addition to attacking lettuce may also live on other plants, including some weeds.

Treatment: A severely attacked crop, if nearing maturity, is not worth treating otherwise than by ploughing-in. New outbreaks in spring arise from over-wintering aphids giving rise to winged forms which migrate to new crops. Take care to keep clear of this pest any seedlings which are being wintered in frames. Keep all surrounding paths, etc., free from weeds which might serve as hosts for the aphids. If any aphids are noted on the seedlings in the frames before planting time the frames may be sprayed or dusted with nicotine or sprayed with HETP (see p. 276). The latter is likely to be more suitable than nicotine in cool weather.

Surface Caterpillars. See p. 281.

Leatherjackets. See p. 279.

Grey Mould (*Botrytis cinerea*). This disease is very troublesome both under glass and in the open, on plants which have stood the winter and on newly planted seedlings. Attacks are associated with poor growing conditions or with injured plant tissue. Under glass a shortage of water leading to wilting is often a predisposing condition. Slight wilting of the lettuce crop which is almost mature may lead to injury of the leaf margin, which develops into "tip-burn" or under wet conditions to "greasiness" and may pave the way for an attack by Grey Mould. The only really satisfactory controls are cultural ones —giving the plants growing conditions which are, as near as possible, ideal. Whenever planting lettuce reject any seedlings which show signs of reddening on the stem or the leaf stalks.

Downy Mildew (*Bremia lactucae*). The leaves first show yellow patches on the upper side where the fungus is spreading in the tissue. Then on the under sides these affected patches develop secondarily. The disease is most troublesome where the plants have received a check, usually following the onset of a cold, wet period which has been preceded by good growing conditions.

It is not practicable to treat plants in the open; in frames avoid draughts during a cold period. Remove damaged outer leaves. If the crop is near maturity it is probably better to get it off to market quickly if the heads are not too infected to be offered for sale. Destroy infected leaves. Spray when very young with Bordeaux mixture at the rate of 2 lb. copper sulphate, 10 lb. hydrated lime, 40 galls. water, before the disease appears.

Damping-off (*Corticium solani*) sometimes causes trouble amongst seedlings which are being raised in frames. Destroy infected seedlings. Frames which are known to be infected should be avoided for propagation or the soil sterilised with formaldehyde (see p. 274).

Mosaic. This is a virus disease which may be carried with the seed or more generally it may be transmitted from an infected crop by aphis carriers. The leaves are puckered and mottled. Groundsel may be a carrier.

Treatment: Destroy infected plants. Do not leave the remains of an old crop hanging about; get it ploughed in as speedily as possible.

Keep aphids in check.

MINT

Mint Rust (*Puccinia menthae*). Mint is frequently attacked by this fungus. It appears as orange-coloured raised patches on the leaves and stems, causing them to become distorted and spoiling the crop. The plants become brown and die down early in the season.

Treatment: Where it may be desired to retain for another season a bed which has shown infection, burning over on a dry day in early autumn often clears the trouble. Scatter a light layer of dry straw over the bed and set alight.

Roots which are to be lifted for forcing may be warm-water treated as they are being taken to the houses. Water should be heated in a bath to 112–115 deg. F., using a reliable thermometer. Roots which have been washed clear of earth are put in the bath and the temperature is adjusted to 110–112 deg. F. and held at that for ten minutes. Remove roots from the bath and cool by hosing with cold water.

The annual establishment of a new bed by taking young rooted shoots in spring helps to keep down this trouble, particularly if such propagation material is taken from a bed which has been burnt over in the previous autumn.

ONIONS

Onion Fly (*Delia antiqua*). The Onion Fly is a little over a quarter of an inch long, with a wing-spread of about half an inch, dark grey in colour. Egg-laying starts about the beginning of May, and there are three generations through the summer. The eggs are white and somewhat oval, and are laid in batches of six to eight upon the neck of the plant, just above the ground. The maggots hatch out in three days;

they are of a dirty white colour, without legs, and when full-grown are about one-third of an inch long. As soon as they are hatched they make their way to the base of the bulb and burrow into it. The first indications of infestation are shown by the plants flagging and the leaves becoming yellow.

Treatment: Destroy all infected plants. Dress with 4% calomel dust by mixing the seeds with an equal weight of calomel in a glass or wooden container, having first moistened the seed with flour paste (¾ teaspoonful of paste to each ounce of seed), or resin-alcohol as for White Rot.

To treat the growing crop, apply a 4% calomel dust along the rows of seedlings, at 1 lb. to 50 yd. of row (about 3½ cwt. per acre). Give two doses, one when the seedlings are an inch high and another ten days later.

Stem and Bulb Eelworm (*Anguillulina dipsaci*). This pest causes young plants to become twisted and swollen and finally die. Bulbs maturing from plants which are attacked late in the season rot in store. The flowerheads may be attacked, leading to the spread of the pest with the seed. This eelworm has many hosts, including some weeds. A rotation should be followed, *but keep down weeds*. Do not grow a crop for seed on infected land.

Seed which is known or suspected to be infected may be fumigated with methyl bromide, but any grower interested in having seed treated should consult an Advisory Officer.

Onion and Leek Smut (*Urocystis cepulae*) is sometimes a serious trouble with young seedlings soon after they come through the ground. The leaves show dark spots, become thickened and twisted, and later, black powdery spores are released. Some seedlings are killed outright and the soil is infected for many years to come.

Treatment: Destroy infected material. Keep onions and leeks off infected land. Treat the seed with Ferbam applied as for calomel (see Onion Fly). A "formalin drip" treatment to the soil enables a good establishment of seedlings on infected land. Add 1 pint of formalin (40%) to 16 galls. water. Place a few gallons in a small metal tank which can be wheeled along the land, allowing a trickle of water into the drill—16 galls. treat 800 yd. of drill.

Onion Downy Mildew (*Peronospora destructor*). This disease of the onion is very well-known and wide-spread. It appears first in the form of small yellowish patches on the leaves, which gradually increase in size until the whole of the leaves assume a yellowish, wilted appearance. The surface of the leaves becomes covered with a white powder, which soon changes to a dingy lilac colour.

The bulb itself is not attacked, but its growth is completely arrested, whilst at the same time the "neck" between the bulb and the base of the leaves rapidly increases in length, this elongation being a certain sign of the existence of the disease. The attack is usually made in the early stages of growth, and then unless remedial measures are at once taken the crop is completely destroyed.

Treatment: Avoid low-lying, badly drained sites for growing onions. Avoid sowing in spring near to a bed of autumn sown plants, and vice versa. Practise a rotation, as spores may linger for some time on an infected bed. Spraying or dusting is of doubtful value.

White Rot of Onions (*Sclerotium cepivorum*) is a serious disease of onions and leeks. Land which has carried an infected crop can remain infective for many years. Affected plants turn pale and collapse. At the base may be seen a white, cotton-wool-like mould.

Treatment: Practise a long rotation and destroy infected material, Apply 4% calomel dust at the rate of 1 lb. to 50 yd. of drill or treat the seed with pure calomel as for onion fly, using as a sticker a resin-alcohol (resin in four times its weight of industrial methylated spirits). Use 1 oz. sticker to 1 lb. seed; shake well; add the calomel; shake and spread out thinly to dry.

PARSNIP

Carrot Fly. See CARROT, p. 290.

Celery Fly. See CELERY, p. 291.

Stem and Bulb Eelworm (*Anguillulina dipsaci*). This is the same pest as that which attacks onions (see p. 296). The crown is attacked and may decay in a manner resembling Canker. It can be very destructive. Practise a rotation and keep down weeds.

Canker is very troublesome in some years, particularly following wet weather during late summer. Slight wounds, even growth cracks, open the way to an attack, and in severe cases the whole of the "shoulder" of the parsnip may be covered with an unsightly, dark-brown, corky canker. Plants grown on land in a high state of fertility may suffer more severely than those on a less rich soil.

Treatment: Give no fresh dung. On the richer soils it may be wise to grow the crop entirely on the residue left in the soil from the previous year's crop.

PEAS

Pea and Bean Thrips (*Kakothrips pisivorus*). Occasionally considerable damage is done to peas and beans by thrips, popularly known as the "Thunder Fly". They are tiny insects, about one-twelfth of an inch in length, blackish brown in colour, with a lighter-coloured head. The adult insects have four narrow wings, fringed with fine hairs. The females appear in spring and lay their eggs upon the unopened flowers of the pea and bean plants. The larvæ hatch out in eight or ten days; they are very active, similar to the adult in form but are orange-coloured and wingless.

The haulm, pods, and flowers are attacked and in a severe outbreak the green parts of the plant develop a silvery, scaly appearance.

Treatment: Spray with a DDT wash as recommended for Pea Moth. On a small scale up to half a gallon of wash may be used on about 10 yards of row.

Pea and Bean Weevils. See BROAD BEANS, p. 284.

Pea Moth (*Cydia nigricana*). This moth is greyish brown in colour and has a wing-span of half an inch. Winter is spent as a cocoon in the soil and the moths appear about mid-June and may be present until mid-August. Eggs are laid on the plants and the maggots eat their way into the young pods, where they feed on the developing seed. Early sowings and late sowings usually escape attack, as they do not have pods in a vulnerable condition for attack at the time when the eggs are being laid.

Treatment: On a field scale rotation gives some measure of control. A DDT emulsion containing ¼% DDT sprayed at the rate of about 120 galls. per acre gives a good control if applied about seven to ten days after the first flowers open.

Pre-emergence Damping Off. Several species of fungi are liable to attack the seeds whilst they are germinating, particularly when sown early whilst the soil is cold and possibly very wet. Losses from this cause may be checked by treating the seed with one of the dressings mentioned on p. 277.

Fusarium Foot Rot. Well-grown plants may wither and die, usually in patches. Wet conditions followed by hot weather seems to favour the disease, and it is worst where a poor rotation is followed.

Practise a long rotation. Give seed dressings (see p. 277). As the disease causes a poor development of nodules on the roots give plants on infected land generous supplies of nitrogenous fertiliser.

Pod and Leaf Spot (*Aschochyta pisi* and others) causes brown circular spots on the leaves and pods. The trouble is most serious in a wet season.

Treatment: Destroy infected haulm and follow a rotational cropping system.

Powdery Mildew (*Erysiphe polygoni*). Usually worst late in the season. Dust with a sulphur dust. Destroy haulm as soon as crop is picked to prevent spread to younger crops.

POTATO

Potato Root Eelworm (*Heterodera rostochiensis*). This pest is very minute, lives *in the roots* of the potato for about forty days, by the end of which period the females have become distended with eggs and burst out of the roots, As they die their skin hardens into a protective covering around the eggs and in this form are known as cysts. Each cyst may contain 200 or more eggs and may remain viable in the soil for as long as eight to ten years, many eggs being still capable of attacking a potato or tomato crop if such be planted during that period.

Crops grown on infested land usually show a patchy appearance, being dwarf and stunted and dying off prematurely. If the roots of plants from such an area are examined the cysts may be seen on them—yellowish whilst young, brown when older.

This eelworm is responsible for a greater number of failures than any other pest or disease of the potato. All over the country on small gardens and allotments where little or no rotation has been practised, it has built up until it is impossible to grow a decent crop. In bad cases it may be that the grower lifts a crop of tiny chats which total in weight less than the seed which was planted.

Treatment: There is no treatment for infested land in the open field or garden. Keep land clear of this pest by practising a rotation of at least four years. If trouble arises a much longer rotation should be followed.

Potato Blight (*Phytophthora infestans*). This is the commonest fungus disease to which potatoes are subject. Whilst other diseases are only occasional incidents, this is always present to a greater or less degree, ready to play havoc with any unprotected crop in a season favourable to its development, and must therefore always be taken into the reckoning. It is always most destructive in wet seasons, and especially so if the wet is accompanied by a "close" or "muggy" condition of the atmosphere.

The first sign of its activity is indicated by brown patches on the leaves. If left untreated these patches or spots rapidly increase in size and the leaves die. Spores from the leaves are washed into the soil, where they attack the tubers. The trouble is usually most serious with the late varieties.

Treatment: In districts where attacks early in the season may regularly be anticipated protective spraying with Bordeaux mixture or Burgundy mixture (see p. 276), or dusting with a proprietary copper dust, should be done at the first appearance of the trouble.

If the rows are well earthed up the tubers are given some protection against attack.

Where a crop has not been sprayed and the haulm is attacked late in the season it is a good plan to destroy the haulm to prevent the tubers becoming infected. This may be done on a small plot by cutting the haulm and removing it from the plot. On a large scale it is customary to "burn" the haulm chemically by spraying with a 10% solution of sulphuric acid, or other substance which will kill green leaves together with the spores. Do not lift the crop for about ten to fourteen days after this, or after the haulm has died down or been cut off, to make certain that any spores on the ground are dead.

Common Scab (*Streptomyces scabies* and related fungi). The tubers which are affected by this disease show brown scars. Care should be taken to obtain a correct diagnosis, as another trouble referred to in the next paragraph may be confused with this disease.

Treatment: Give plenty of organic matter in a fresh condition. On a small scale this may often be done by adding lawn mowings to the row at planting time. Spent hops and dead leaves may also be used. Do not put too thick a layer or the fermenting material may injure the sets. Only in exceptional cases and under guidance should lime be given to potatoes.

Powdery Scab (*Spongospora subterranea*). Tubers attacked by this fungus show more distortion of growth than do those attacked by the last-mentioned disease.

This trouble is usually most severe where too short a rotation has been practised.

Treatment: Increase the length of the rotation. Destroy infected tubers or if they are to be fed to pigs ensure that they are first well cooked. Do not plant infected tubers as "seed". Dormant tubers if only slightly infected may be disinfected by soaking in a solution of formaldehyde at the rate of 1 pint of formalin to 30 galls. of water.

Wart Disease (*Synchytrium endobioticum*) is not such a menace as it was in the early years of this century. Some varieties are immune to this disease and plant breeders have paid attention to this fact to such an extent that we now have a wide range of high-yielding good-quality immune varieties for use on infected land.

Infected plants show what may best be described as cauliflower-like growths on the tubers and sometimes at the base of the stems. When young these may be white, but they soon turn to a black decaying mass.

Treatment: On suspecting the presence of this disease the grower must inform the Ministry of Agriculture. This may be done through the local Advisory Officer. Infected material must be burnt and not sold. Carry out fully any instructions given by the Ministry.

Dry Rot (*Fusarium cæruleum*). Tubers in store develop sunken, wrinkled patches, and later the light-coloured pustules of the fungus appear. Badly attacked tubers should obviously not be planted, but late infection may not show easily and the tubers may sprout. Such tubers if planted may die, and this disease is a common cause of the gaps seen in a plot after the plants have started to grow in spring. The disease is most serious in early varieties.

Handle carefully when lifting to avoid bruising. Seed of early varieties is better set out in sprouting boxes than being clamped or placed in bins. Dipping the tubers, *immediately after digging*, for one minute in an organo-mercury dressing is a good protection for the sound tubers.

Skin Spot (*Oospora pustulans*). The skin of the potatoes affected with this disease shows many small pimples or spots. If heavily attacked around the eyes a seed tuber fails to sprout. Boxing and sprouting enables "blind" tubers to be rejected.

Black Scurf and Stem Canker (*Corticium solani*). Tubers affected by Black Scurf show very dark, hard encrustations attached to the skin which are easily removed and do not harm the tubers. These are sclerotia, the resting bodies of the fungus. If infected tubers are used for seed the sprouts may be infected and the plants fail to develop, a condition often found on cold, wet soils. With a light attack the plants may grow, but not strongly.

Use sprouted seed and reject anything which is unsound.

Virus Diseases. There are several diseases of potato which are caused by viruses, e.g. Leaf Roll and Mosaic. The names describe the general symptoms of the trouble, but the important point to remember is that the plants are not so vigorous and the yield of tubers is much reduced.

There is no treatment for an infected plant. Seed tubers should not be saved from stocks showing the presence of the disease. Healthy tubers may be obtained from districts specialising in the production of seed potatoes (see p. 211).

RHUBARB

Crown Rot (*Bacterium rhaponticum*) is well known in the important rhubarb-growing areas. The buds and the underlying root die and rot away. The stem eelworm (*Anguillulina dipsaci*) is often associated with the rot and may help to spread the trouble.

Treatment: There is no cure for infected plants. Diseased material should be burnt. When preparing for making a new planting it is worth while to mark outstandingly good plants and use them for propagation. Practise a long rotation.

SEAKALE

Black Rot. See under Brassicas, p. 290. This trouble is sometimes present in seakale. Badly affected plants are weak and may die. Lightly infected plants show the trouble in the roots when cut and a sharp look-out should be kept when trimming the "thongs" for propagation, making sure that no roots showing blackened marks in the flesh are used.

SHALLOT

Yellow Dwarf. Plants infected by this trouble are less vigorous than the healthy ones, have leaves which are somewhat twisted, and show yellow streaks. The disease is caused by a virus.

Treatment: Stocks which show only a small number of affected plants may be rogued. This should be done early and if done regularly for two or three years stocks may be cleaned up.

White Rot. See p. 297.

TOMATO

Blight or "Potato Disease" on Tomatoes (*Phytophthora infestans*). Tomatoes grown in the open air are liable, especially during wet, sunless periods in the latter part of the summer, to attacks of this disease, sometimes to a serious extent. The symptoms differ from those found when potatoes are affected, as the attack on the leaves is not so serious, but the fruit may be ruined if unprotected during a few days when blight is spreading badly.

Under conditions favourable to the spread of the disease practically the whole of the crop may be lost.

Treatment: As in the case of potatoes, the only safe course with this crop is to include preventive spraying with a fungicide as part of the routine of culture. In normal summers two applications of Bordeaux mixture at half strength, the first in the middle of July and the second a fortnight later, will generally be sufficient to ward off the disease, but in an unfavourable season the sprayings should be continued at fortnightly intervals. When the fruit is ripening a copper dust may be used instead of Bordeaux, as it stains the fruit less.

Keep any plantings of potatoes well away from the tomato plot.

Potato-root Eelworm. See Potato, p. 298.

TURNIPS AND SWEDES

Turnip Gall Weevil. See Brassicas, p. 288. This pest, whilst not so much affecting the yield, can seriously injure a crop of turnips or swedes by rendering them unsightly for market. Encourage rapid growth and market early for the early summer crop. On land where this pest is regularly serious it may be that these root crops have to be dropped, at any rate for the autumn crop.

Flea Beetles. See p. 286.

Club Root. See p. 289.

FOR FURTHER READING

Ogilvie, L. *Diseases of Vegetables.* Bulletin 123 of the Ministry of Agriculture and Fisheries. H.M.S.O.

Smith, K. M. *Virus Diseases of Farm and Garden Crops.* Littlebury & Co. Ltd., Worcester Press, 1946.

Green, D. E. *Diseases of Vegetables.* Macmillan & Co., 1943.

Jary, S. G. *Good Control of Insect Pests.* Hodder & Stoughton, Ltd.

MISCELLANEOUS INFORMATION

APPROXIMATE QUANTITY OF SEED REQUIRED TO SOW AN ACRE, OR TO PRODUCE A GIVEN QUANTITY OF GOOD PLANTS

Asparagus	3–5 lb.
Beans, Broad	1–1½ cwt.
,, Dwarf, or French	¾ cwt.
,, Runner (kept dwarf)	¾ cwt.
,, ,, (on poles)	½ cwt.
Beet	14–18 lb.
Brussels Sprouts	6 lb. for 1–acre seed-bed to plant 10 acres
Cabbages	6 lb. for 1–acre seed-bed to plant 10 acres
,,	2½ lb. per acre in 24-in. rows to cut out to stand
Carrots in field	3–5 lb.
,, in frames	1 oz. to 16–18 Dutch lights
Cauliflowers	6–8 lb. for 1-acre seed-bed to plant 8–9 acres
,,	1 oz. to 16–20 Dutch lights
Celery and Celeriac	1 oz. for each 5,000 plants
Chicory	4 lb.
Cucumbers, Ridge (sown in open)	1½ lb.
,, Frame (raised in heat)	1¼ oz. for 1,000 plants
Endive	3–4 lb.
Leeks	4 lb. for 1-acre seed-bed to plant 6–8 acres
Lettuce in open	1½–2 lb.
,, in frames to prick out	1 oz. to 4 Dutch lights will prick out to about 15 lights
,, ,, ,, not pricked out	1 oz. to 25 Dutch lights should give enough seedlings to plant over 600 lights
Melons	1¼ oz. for each 1,000 plants
Onions for bulbs	5–8 lb.
,, for pulling green, spring-sown	30 lb.
,, ,, ,, ,, autumn-sown	40 lb.

Parsley	6–8 lb.
Parsnips	6–8 lb.
Peas	1½–2 cwt.
Potatoes	16–20 cwt.
Radishes	½ cwt.
Savoys	as for cabbage
Spinach, autumn sowing	30 lb.
,, spring sowing	10–20 lb.
Sweet Corn	6–8 lb.
Tomatoes	1 oz. for each 5,000 plants
Turnips	3–6 lb.
Vegetable Marrows, Bush, sown in open	2 lb.
,, ,, Trailing, ,,	1–2 lb.
,, ,, raised in heat	6 oz. for each 1,000 plants

APPROXIMATE AVERAGES OF YIELD PER ACRE OF VARIOUS VEGETABLE CROPS

These average yields are calculated from crops grown with good ordinary cultivation, under suitable conditions, in a normal season.

Artichokes, Globe	10,000 to 15,000 heads
Asparagus	1,500 to 2,000 bundles
Beans, Broad	3 to 4 tons
,, Dwarf French	250 to 350 bushels
,, Runner	3 to 5 tons
Beet	14 to 16 tons
Broccoli	500 to 700 doz. heads
Brussels Sprouts	3 to 5 tons
Cabbages, spring	6 to 8 tons
,, summer and autumn	12 to 16 tons
Carrots, early	1,500 to 2,000 doz. bunches
,, maincrop	15 to 20 tons
Cauliflowers	500 to 800 doz.
Celery	10,000 to 15,000 heads
Doré in broad beds	40,000 to 50,000 heads
Cucumbers, Ridge	4,000 to 6,000 doz.
Kale	12 to 16 tons
Leeks	6,000 to 10,000 bundles
Lettuce, Cos	25,000 to 30,000 heads
,, Cabbage	25,000 to 35,000 heads
Onions, dry	10 to 15 tons
,, green, bunched	1,500 to 2,000 doz. bundles

Parsley	6 to 8 tons
Parsnips	14 to 16 tons
Peas, Green	100 to 200 bushels, 6 to 8 tons
Potatoes, early	4 to 6 tons
,, late	10 to 15 tons
Radishes	20,000 to 25,000 doz. bunches
Rhubarb, natural	15 to 20 tons
Seakale, natural	3,500 to 4,500 lb.
Savoys	6 to 10 tons
Shallots	4 to 6 tons
Spinach	500 to 800 bushels
Tomatoes	7 to 10 tons
Turnips, early	350 to 400 doz. bundles of 12
,, maincrop	15 to 20 tons
Vegetable Marrows	1,000 to 1,500 doz.

AVERAGE TIME REQUIRED FOR GARDEN SEEDS TO GERMINATE

	Days		*Days*
Asparagus	14 to 21	Melons (in heat)	3 to 6
Beans	7 to 14	Onions	10 to 16
Beet	10 to 18	Parsley	15 to 26
Brassicas (all sorts)	5 to 10	Parsnips	10 to 20
Carrots	12 to 18	Peas	7 to 14
Chicory	5 to 10	Radishes	3 to 6
Cucumbers (in the open)	7 to 14	Spinach	7 to 10
,, (in heat)	2 to 4	Tomatoes (in heat)	6 to 10
Endive	5 to 14	Turnips	4 to 10
Leeks	10 to 14	V. Marrows (in the open)	7 to 14
Lettuce	6 to 10	,, (in heat)	3 to 5

AVERAGE LONGEVITY OF GARDEN SEEDS

	Years		*Years*
Asparagus	3	Onions	2
Beans	3	Parsley	3
Beet	6	Parsnips	2
Brassicas	5	Peas	3
Carrots	4	Radishes	5
Chicory	8	Sage	3
Cress	5	Seakale	1
Cucumbers	6	Spinach (all varieties)	5
Endive	10	Thyme	3
Leeks	3	Tomatoes	4
Lettuce	5	Turnips	5
Melons	5	Vegetable Marrows	6

NUMBER OF PLANTS FOR AN ACRE, AT GIVEN DISTANCES APART

	Plants
2 in. × 6 in.	522,720
,, × 7 in.	448,045
,, × 8 in.	392,040
,, × 9 in.	348,480
,, × 10 in.	313,632
,, × 1 ft.	261,360
3 in. × 6 in.	348,480
,, × 7 in.	298,697
,, × 8 in.	261,360
,, × 9 in.	232,320
,, × 10 in.	209,088
,, × 1 ft.	174,240
4 in. × 6 in.	261,360
,, × 7 in.	224,022
,, × 8 in.	196,020
,, × 9 in.	174,240
,, × 10 in.	156,816
,, × 1 ft.	130,680
5 in. × 6 in.	209,088
,, × 7 in.	179,218
,, × 8 in.	156,816
,, × 9 in.	139,392
,, × 10 in.	125,452
,, × 1 ft.	104,544
6 in. × 6 in.	174,240
,, × 7 in.	149,248
,, × 8 in.	130,680
,, × 9 in.	116,160
,, × 10 in.	104,544
,, × 1 ft.	87,120
7 in. × 7 in.	128,013
,, × 8 in.	112,011
,, × 9 in.	99,562
,, × 10 in.	89,609
,, × 1 ft.	74,674
8 in. × 8 in.	98,010
,, × 9 in.	87,120
,, × 10 in.	78,408
,, × 1 ft.	65,340
9 in. × 9 in.	77,440
,, × 10 in.	69,696
,, × 1 ft.	58,080
10 in. × 10 in.	62,726
,, × 1 ft.	52,272
,, × 1 ft. 3 in.	41,817
,, × 1 ft. 6 in.	34,848
,, × 1 ft. 9 in.	29,869
,, × 2 ft.	26,132
,, × 2 ft. 6 in.	20,908
,, × 3 ft.	17,424
,, × 3 ft. 6 in.	14,935
,, × 4 ft.	13,068
1 ft. × 1 ft.	43,560
,, × 1 ft. 3 in.	34,848
,, × 1 ft. 6 in.	29,040

	Plants
1 ft. × 1 ft. 9 in.	24,891
,, × 2 ft.	21,780
,, × 2 ft. 6 in.	17,424
,, × 3 ft.	14,520
,, × 3 ft. 6 in.	12,446
,, × 4 ft.	10,890
,, × 4 ft. 6 in.	9,680
,, × 5 ft.	8,712
1 ft. 3 in. × 1 ft. 3 in.	27,878
,, × 1 ft. 6 in.	23,232
,, × 1 ft. 9 in.	19,913
,, × 2 ft.	17,424
,, × 2 ft. 6 in.	13,939
,, × 3 ft.	11,616
,, × 3 ft. 6 in.	9,953
,, × 4 ft.	8,712
,, × 4 ft. 6 in.	7,744
,, × 5 ft.	6,969
1 ft. 6 in. × 1 ft. 6 in.	19,360
,, × 1 ft. 9 in.	16,594
,, × 2 ft.	14,520
,, × 2 ft. 6 in.	11,616
,, × 3 ft.	9,680
,, × 3 ft. 6 in.	8,297
,, × 4 ft.	7,260
,, × 4 ft. 6 in.	6,453
,, × 5 ft.	5,808
1 ft. 9 in. × 1 ft. 9 in.	14,224
,, × 2 ft.	12,445
,, × 2 ft. 6 in.	9,956
,, × 3 ft.	8,297
,, × 3 ft. 6 in.	7,111
,, × 4 ft.	6,223
,, × 4 ft. 6 in.	5,531
,, × 5 ft.	4,978
2 ft. × 2 ft.	10,890
,, × 2 ft. 6 in.	8,712
,, × 3 ft.	7,260
,, × 3 ft. 6 in.	6,223
,, × 4 ft.	5,445
,, × 4 ft. 6 in.	4,840
,, × 5 ft.	4,356
,, × 6 ft.	3,630
3 ft. × 3 ft.	4,840
,, × 3 ft. 6 in.	4,148
,, × 4 ft.	3,630
,, × 4 ft. 6 in.	3,226
,, × 5 ft.	2,904
,, × 6 ft.	2,420
4 ft. × 4 ft.	2,722
,, × 5 ft.	2,178
,, × 6 ft.	1,185
5 ft. × 5 ft.	1,742
,, × 6 ft.	1,452
6 ft. × 6 ft.	1,210

GOOD COMPOSTS TO USE WHEN SOWING IN POTS OR BOXES IN GLASSHOUSES OR FRAMES

"John Innes" Seed Compost

Medium to Heavy Loam*	2 parts by bulk
Granular Peat . .	1 part ,, ,,
Very Coarse Sand . .	1 ,, ,, ,,

To each bushel of this mixture add:

Superphosphate . .	1½ oz.
Ground Chalk . .	¾ oz.

"John Innes" Potting Compost

Medium to Heavy Loam*	7 parts by bulk
Granular Peat . .	3 ,, ,, ,,
Very Coarse Sand . .	2 ,, ,, ,,

To each bushel of this mixture add:

"John Innes" Base .	¼ lb.
Ground Chalk . .	¾ oz.

"John Innes" Base can be bought ready mixed. It consists of:

Hoof and Horn, ⅛-in. grist (13% N) .	2 parts by weight
Superphosphate (18% P_2O_5) . .	2 ,, ,, ,,
Sulphate of Potash (48% K_2O) .	1 part ,, ,,

To use ¼ lb. of J.I. Base per bushel of potting compost gives a J.I.P_1 Compost.

To use ½ lb. of J.I. Base gives a J.I.P_2 Compost.

To use ¾ lb. of J.I. Base gives a J.I.P_3 Compost.

For autumn-sown cauliflowers sow in J.I. Seed Compost and pot to J.I.P_3.

For cucumbers sow in J.I.P_1 and pot in 60's in J.I.P_2, to 48's in J.I.P_3.

For raising lettuce in winter sow in J.I.S. and prick out to J.I.P_2.

For tomatoes for outdoor planting sow in J.I.P_1 and prick out to 60's in J.I.P_2.

FOR FURTHER READING

The Fruit, The Seed, and The Soil—the collected leaflets of the John Innes Horticultural Institution. Oliver & Boyd. These include instructions for the erection of a good soil steriliser.

* The loam should be sterilised by steaming.

FERTILISER CONVERSION TABLES, ETC.

To bring percentage to lb. per cwt. multiply by 112 and divide by 100, e.g. Nitrate of Soda—15·5% N:

$$\frac{15 \cdot 5 \times 112}{100} = 17 \cdot 36 \text{ lb. N per cwt.}$$

To find the percentage of plant food in a home-made mixture—take the weight in cwts. of each ingredient and multiply by the percentage of plant food in that material, then divide by the total weight of the mixture in cwts.

e.g. 2 cwt. Sulphate of Ammonia at 20·6% N; 3 cwt. Superphosphate at 18% P_2O_5; and 1 cwt. Muriate of Potash at 50% K_20 = 6 cwt.

$$\frac{2 \times 20 \cdot 6}{6} = 6 \cdot 8\% \text{ N}$$

$$\frac{3 \times 18}{6} = 9\% \ P_2O_5$$

$$\frac{1 \times 50}{6} = 8 \cdot 3\% \ K_2O$$

Rates of application: 1 cwt. per acre = 7 lb. per 300 sq. yd. (approx.)

tons per acre = stones per sq. rod.

per acre	per rood	per sq. rod	per sq. yd.
1 cwt.	28 lb.	12 oz.*	⅜ oz. approx.
2 cwt.	56 lb.	1 lb. 8 oz.*	¾ oz. ,,
3 cwt.	84 lb.	2 lb. 3 oz.*	1 oz. ,,
4 cwt.	1 cwt.	2 lb. 13 oz.*	1½ oz. ,,
5 cwt.	1¼ cwt.	3 lb. 8 oz.	1⅞ oz. ,,
6 cwt.	1½ cwt.	4 lb. 4 oz.*	2¼ oz. ,,
8 cwt.	2 cwt.	5 lb. 9 oz.*	3 oz. ,,
10 cwt.	2½ cwt.	7 lb.	3¾ oz. ,,
12 cwt.	3 cwt.	8 lb. 7 oz.*	4½ oz. ,,
15 cwt.	3¾ cwt.	10 lb. 8 oz.	5⅞ oz. ,,
20 cwt.	5 cwt.	14 lb.	7½ oz. ,,

* approx.

RECEPTACLES, WEIGHTS, MEASURES, AND TERMS USED IN MARKETING PRODUCE

NOTE.—*In packing produce for market the most important points to observe are that it is good, clean, and attractive, of equal quality throughout, of the full weight or measure described, and in parcels of convenient and equal size and shape. Granted these points, the particular kind of receptacle used is to some extent immaterial—in fact some of those described below are gradually being displaced by others, and so becoming obsolete. Still, it is not wise to disregard local or trade customs without a good reason, and before doing so the salesman who is to handle the produce should be consulted.*

Bag (39 in. × 27 in.). A sack holding from ½ to 1 cwt. according to nature of contents. Cabbage, Onions.

Half-bag (34 in. × 18 in.). A sack holding from 20 to 15 lb. according to contents. Jerusalem Artichokes, Beet. Carrots, Peas.

Net. Holds 28 lb. of Brussels Sprouts.

Bushel Box (19¾ in. × 13¾ in. × 10 in.). A very widely used container for many crops. Beans (all kinds), Beet, Celery, Cos Lettuce, Radishes, Spinach, etc.

Quarter-bushel Box (13 in. × 9½ in. × 6 in.). Chicory, high-quality early French Beans, Tomatoes.

28-lb. Box or Crate (20 in. × 13 in. × 7½ in.). Another widely used general container.

Cheshire Box (30 in. × 21 in. × 6 in.). A container much used on the Manchester market for many crops.

Wood Box (18 in. × 12 in. 5in.). Mint, Chicory, Seakale.

Artichoke Box (20⅝ in. × 14½ in. × 4½ in.). Used for Globe Artichokes.

Crate (22½ in. × 14½ in. × 14½ in.). A light container made of laths, sometimes collapsible when used as a returnable. Bunched Beet and Carrots, Cabbage Greens, Cauliflowers, etc.

Roscoff Broccoli Crate (22½ in. × 14 in. × 14 in.). Used for several green crops, but particularly important for Broccoli or Winter Cauliflowers.

Lettuce Crate (22¾ in. × 14½ in. × 9 in.). Lettuce, Endive, Carrots, Salad Onions, etc.

Large Lettuce Crate (22½ in. × 16½ in. × 9 in.). Lettuce, Endive, Carrots, Spinach, Salad Onions.

Small Lettuce Crate (20 in. × 13 in. × 14 in.). Radishes, Cabbage, Lettuce, Beans (Runner and Dwarf French), Mint.

Dutch Tray (20¾ in. × 15⅞ in. × 4 in.). Tomatoes.

Pot, Wicker (20 in. × 13 in. × 14 in.). A basket much used in the Midlands for a wide range of crops.

Bushel Sieve. A round wicker basket, diameter 17 in., depth at side 10½ in., depth in centre 9 in. Used for many vegetables.

Flat Wicker Basket (12 in. × 15 in. × 8 in.). Asparagus, Beans, Cucumbers, Herbs, Watercress.

Chip. A basket made of thin strips of wood interwoven. Of various sizes. The largest, No. 12, is used for choice Beans, Marrows, Herbs, Tomatoes, Watercress. No. 6 is used for Beans, Chicory, Tomatoes.

Empties. A term used to denote empty containers which are sent to the grower by the salesman to be filled with produce and consigned back to him.

Bunch. A quantity of vegetables or herbs tied together; the size and numbers may vary with season and market.

Bundle. Asparagus, Rhubarb, Seakale, and other stem crops were formerly always tied in bundles—the size varying with district. Rhubarb and Seakale are now mainly sold unbundled in boxes. Asparagus is sold in bundles and there is a trend towards the standardisation of bundle size.

Hand. A term used to describe a bunch of long Radishes tied up in such a way that the roots spread out fanwise.

Roll. A term sometimes used for a bundle of celery.

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The numerals in *italic type* indicate main entries

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