Outdoor salad crops.

Contributors

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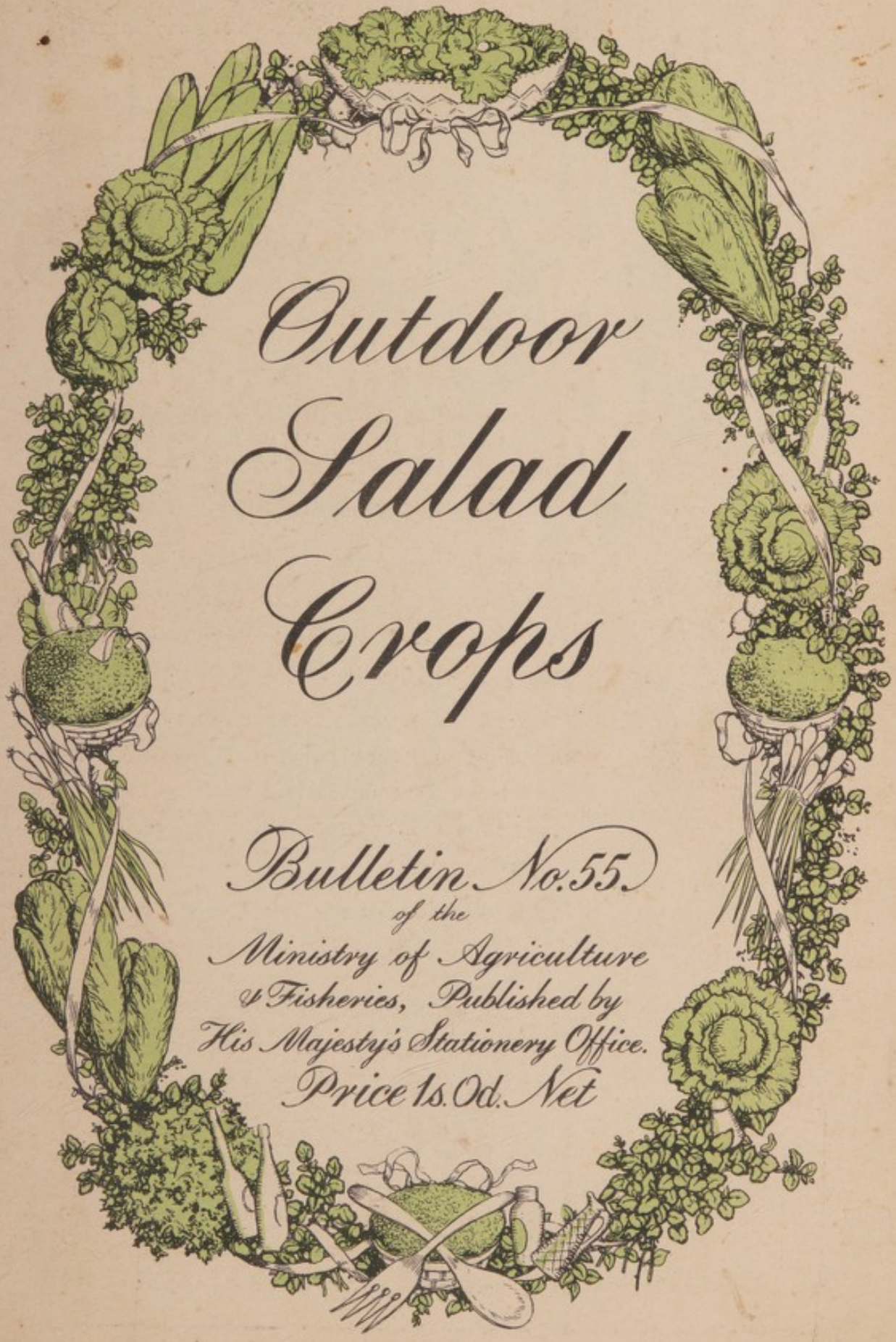

Outdoor Salad Crops

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MINISTRY OF AGRICULTURE AND FISHERIES

BULLETIN No. 55

OUTDOOR SALAD CROPS

LONDON: HIS MAJESTY'S STATIONERY OFFICE
1948

FOREWORD

WITH the setting up of the Ministry's National Agricultural Advisory Service, responsibility for the information on cultivation in the Ministry's horticultural publications now rests with the Advisory Specialists who are attached to the provincial headquarters of the Service.

The Vegetable Group, dealing with all bulletins and leaflets on vegetable crops, is under the Chairmanship of Mr. F. A. Secrett, C.B.E., F.L.S., V.M.H., Hon. Adviser on Vegetable Production to the Ministry. The members of the Group are Messrs. G. C. Johnson, C. H. Oldham, N.D.H., H. W. Abbiss, M.B.E., D.C.M., M.M., N.D.H., W. L. Steer, P. H. Brown, N.D.H., H. Fairbank, N.D.H., and A. D. Harrison, N.D.H. Material for the section on celery in this bulletin was provided by Mr. P. E. Cross, County Advisory Officer for the Isle of Ely.

Information on the diagnosis and treatment of pests and diseases is the responsibility of the Ministry's Plant Pathology Laboratory.

This bulletin deals with the salad crops grown in the open only, with the use of glass as necessary for providing plants early in the season. Salad crops grown in glasshouses and in frames and cloches are dealt with in other bulletins. Separate bulletins dealing with tomatoes and watercress are also available.

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CONTENTS

LETTUCE

The demand for lettuce increases year by year. This demand, however, seldom remains constant, since it is controlled largely by climatic conditions, and it is for this reason that continuity in production should be maintained. Also, since the demand for salads is less during the soft fruit season, large quantities are grown up to the middle of June, but from then until the end of the plum crop only small acreages are required (see p. 7).

While outdoor lettuce may be produced in the majority of the English and in some of the Scottish counties, the date of maturing is controlled largely by soil and climatic conditions, and for this reason the warmer districts, such as Cornwall and certain of the Home Counties, have grown large acreages of lettuce for supplying to the northern counties and Scotland. Markets at Manchester, Liverpool, Leeds, Bradford, Newcastle-on-Tyne and Glasgow receive large quantities of lettuce from the south between the first week in May and the first week in June, by which time local supplies become available in sufficient quantity.

Periods of Production

The lettuce crop can be divided into four sections:

1. Early outdoor lettuce grown from plants sown the previous autumn and wintered in frames.

2. Lettuce also maturing in early spring but sown outside in early autumn and planted out later to winter in the open.

3. Summer crop lettuce sown in the open and maturing from mid-June to August.

4. Autumn lettuce to mature between the end of the plum season and the arrival of winter frosts.

GENERAL CONSIDERATIONS

Soils

For early lettuce the lighter types are necessary, i.e., the alluvial silts, sandy loams or Lower Greensands, and the lighter Brick-earths, although the last mentioned are liable to crop a little later than the others. Gravelly soils containing a large proportion of small stones need not be ruled out, since this type of soil warms up quickly and drainage is good; moisture conditions may be maintained by the use of organic matter. Good drainage is essential, in fact the land should be of the type that can be worked to a fine tilth early in February, since it is essential that plants which have been in frames the whole winter should be planted in the open before they become drawn and leafy. It is seldom that plants which have become too lush in the frame will stand up to the frost and cold winds so often prevalent in March.

Soil naturally supplied with water, or having a capacity for holding it, is very desirable, since the plant must have a continuous supply of moisture on which to draw. The water-holding capacity of the soil can be improved by increasing the supply of organic matter, for example dung, compost, peat, or green manure such as lupins or mustard. When dung is used it should not be applied direct to the crop in question but to the previous crop. One of the best crops for lettuce to follow is leeks which have been fairly heavily

manured, since it has been found that the young lettuce plants grow well among the fibrous roots left by the leeks. For this reason efficient growers of lettuce usually grow large areas of leeks in addition. If fresh stable manure is applied to the lettuce crop, *Botrytis* will probably be prevalent. Peat, which has been used with successful results at the Cheshunt Research Station, can be applied in one dressing of 10-15 tons per acre. Before planting, it is important to ensure that no coarse organic debris, such as bits of straw, remains on the surface, as it increases the risk of *Botrytis*.

Irrigation

The use of irrigation is dealt with later in the bulletin (see p. 8). It is seldom needed for the spring planted crop, although it is generally required for summer and autumn lettuce.

CROP PRODUCTION

1. Autumn-Sown, Spring-Planted Lettuce

Varieties suitable for sowing in frames in autumn for planting out in early spring are: CABBAGE TYPE: *May Queen* (syn. *May King*), *White Boston* (syn. *Green Trocadero, Improved Trocadero, Borough Wonder*), *Feltham King*. COS TYPE: *Lobjoit's Dark Green Cos* is preferred to any other variety, but in some districts *Prince of Wales* is used.

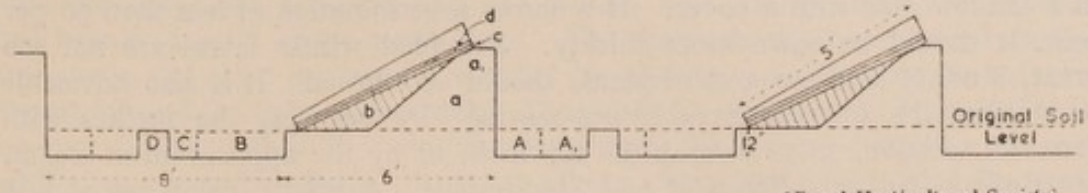
Methods of Plant Raising

There are two methods: (A) to sow thinly in frames and allow the plants to remain until planted out in the spring; (B) to sow in frames and prick out the seedlings 2 in. apart in frames as soon as they are large enough to handle.

The second method is recommended as much sturdier plants with good root systems are obtained. Also, by using this method the crop will be ready for market ten days earlier than by the first method, and losses through *Botrytis* and Downy Mildew will not occur so readily.

METHOD A:

PREPARATION OF SITE. A level site should be chosen, if possible with a slight fall to the south. The site should be well-drained, and provision should be made for the removal of surface water from the alleys into a ditch or underground drain. The land should be free from all weed growth and not too highly fertile, since an excess of nitrogen will cause soft growth at a time of year when sturdiness is essential. The same site should be used year after year, and in order to maintain the correct physical condition the soil should receive a dressing of well-turned stable manure (30 tons per acre) once every other year as soon as the frames are removed in the spring. To maintain the frame ground in satisfactory condition, three or four crops of radish may be grown during the summer months on light dressings of meat and bone meal, the land being ploughed or dug after each crop. The three or four ploughings necessary for these crops will keep the soil aerated and assist in reducing the weed population. Further, this crop does not exhaust the soil's fertility. When the beds are constructed a light dressing of bone meal (not more than 2 cwt. per acre) should be given. The site should not be cropped with radishes after the beginning of August, but given two ploughings during that month.



[*Royal Horticultural Society*]

FIG. 1. Showing arrangement of Lights and Alleys and Source of Soil for Filling Frames.

In September the frames are erected. French or Dutch lights used with boxes and boards respectively may be used. Erection should not be carried out during wet weather. The land should be marked out in alternate strips 6 ft. and 8 ft. wide, the 6-ft. areas being for the beds and the 8-ft. areas for the alleys. These alleys are required for supplying top spit soil for the frames and also to give the necessary space for removing the lights. The measurements are for Dutch lights and must be reduced proportionately for the shorter ones. A line is laid and trodden in at the back of the 6-ft. strip, and a spade cut is made down the whole length of the line. One spit of soil is taken from the alley adjoining (see Fig 1, A and *a*), and is used to form a bank along the whole length of the spade cut. This is trodden lightly, and the next top spit A1 is placed on top of it to bring the bank up to the correct level, i.e., to give the lights a pitch of about 25 degrees, so that full advantage can be taken of the light and the drainage improved. The bank will naturally slope a little towards the bed side, but its back must be neatly faced so that it can stand up to the weather. In dry weather it is sometimes necessary to water the site before banking to make the soil remain in position.

Boxes or boards of a suitable size are placed with the back on top of the bank and the front dropped 3 in. below the surface of the soil; a 6-in. space is allowed between the back of the frame and the back of the bank. The corners of the frame should be rested on 9-in. bricks. The remaining top soil in the other alley is used as follows: the boxes are filled up to within 9 in. of the top with the soil from the alley marked B in Fig 1, care being taken that no clods or small lumps are included, as unsuitable physical condition encourages fungus diseases. The portion marked C is sifted and used for the seedbed on top of the soil in the frame, two handfuls of bone phosphate being applied to each French light, and one to each Dutch light. Strip D in the alley is used to give a very light covering ($\frac{1}{8}$ in.) to the seed; a little peat or well-spent organic matter should be added to the surface siftings.

Erection of the frame should be completed by the beginning of October. The condition of the soil for sowing seed should be similar to that suitable for seed trays, i.e., moist but not soaked. To preserve this condition the lights should be put on if it rains during the period between the erection of the frames and sowing.

SOWING SEED. As an approximate guide, sowings should commence in the south on October 25, and successional sowings should be made every four days up to November 7; these dates should be adjusted for sowings in the north. The seed should be sown thinly so that it falls about $\frac{1}{2}$ in. apart. Before sowing, the seed should be tested by placing it on moist blotting paper

in a shallow dish with a cover. If it shows a germination of less than 90 per cent. it should be sown more thickly. Provided winter losses are not too great, 8 oz. of seed per acre of plants should be allowed. It is also advisable to sterilize the soil ten days before sowing* by watering the surface with formalin solution, so as to soak the top inch, or by the application of steam, see Bulletin No. 22—*Practical Soil Sterilisation*. A bright, calm day should be chosen for sowing; on no account should it be done when it is raining. The seed must be covered to a depth of ¼ in. with sifted soil from the alley (D. Fig. 1). The boxes or boards should be swept clear of soil and the lights shut down until the seed has germinated.

It is important that the lights should be removed entirely in fine weather as soon as the seedlings come through. In wet weather the frames must be given air at back and front. This can conveniently be done by placing 2 x 2 in. timber under the back of the lights and strips of ½-in. timber under the front of the lights. If the weather is wet or foggy when the seedlings are coming through, the lights cannot be removed, and the plants tend to become drawn and spindly. To counteract this, on the first fine day the stems should be carefully covered by sifting over them a mixture of dry soil (10 parts) and carbonate of lime (1 part), taking care not to cover or bury the seed leaves.

In windy weather the lights should be roped down. This is done by passing a rope through each galvanized iron handle on the lights and taking it round a nail driven into the back board mid-way between the handles. A peg 2 ft. long is driven obliquely into the ground in front of the frames, so that it keeps the light from slipping down and from lifting in gales. It is usually 1½ in. square in cross-section, and can be made from pieces of old wood or from branches of trees.

As soon as the seedlings break through the surface of the soil they should be protected from birds by stretching strands of black thread 12 in. apart across the boxes.

METHOD B:

PREPARATION OF THE SITE. Same as for method A (see p. 2).

SOWING SEED. For the pricking-out method seeds are sown fairly thickly about October 7; 4 oz. of seed per acre of plants being required. Suitable varieties for this method are *May Queen* and *Feltham King*. Successional sowings should be made every fourth day up to October 20. Sowings should be planned so that no more plants are available than can be dealt with at any one time.

PREPARATION OF BEDS FOR PRICKING OUT. As the seedlings are pricked out on slightly raised, but level, beds, about 3 in. above the original soil level, the land should be marked out in strips measuring the width of the frame used, plus an extra 6 in. front and back; 6-ft. alley should be left. After the frames have been filled, a dressing of 2 cwt. bone meal per acre is raked into the top inch of the beds, which should consist of finely sifted soil containing peat. When large enough to handle, the seedlings are carefully lifted from the nursery frames and pricked out 2 in. apart both ways on the specially prepared beds in the frames. After pricking

* For formula and method of application, see p. 22.

out, the lights are replaced and the frames kept closed until root growth has begun, usually about seven days. The lights should be removed during fine spells and aired during wet weather by placing 2 × 2 in. blocks between the frame and the light at the back. During frosty weather the frames should be kept closed; if frost is severe and continuous the frames should be covered with straw or mats. If the plants are affected by a night frost, and the early morning is sunny, they should be aired as soon as thawing starts by opening the frames with the 2-in. block at the back until the plants have recovered.

Preparation of the Land for Planting Out. Whichever method of plant raising is used, the land on which the seedlings are to be planted in their permanent quarters should be ploughed and subsoiled; it should have been manured for the previous crop. A top dressing of 4 parts finely ground hoof and 2 parts bone phosphate should be applied at the rate of 8 cwt. per acre, and worked into the surface before planting. As an alternative, 8 cwt. meat and bone meal (or tankage) may be used. This top dressing should be applied on a still day during January. As thorough cultivations are essential, in early February advantage should be taken of the first period of fine weather to cultivate, harrow and roll. The soil must be rolled in order to obtain that degree of firmness which is essential for a satisfactory crop. Rolling can be done only on fine days when the soil does not stick to the roller. This is often possible on light soils in early February, but on heavier soils the operation may have to be delayed. Every advantage should be taken of fine periods to carry out these surface cultivations, as the time factor is important at this stage.

Planting. Cabbage lettuce are planted 12 by 12 in. apart on light soils; on heavy soils this distance is increased to 14 in. Deep impressions made by a marker, or racer, must be avoided because cabbage lettuce grown in these depressions develop a base which is conical when trimmed for market and which is a disadvantage when they are packed. To avoid this either a marker which makes no depression should be used or the land lined out, two lines being used for the purpose. These lines are stretched from one end of the field to the other, a man being in charge of each end. After the lines have been shaken up and stretched exactly parallel, 12 or 14 in. apart according to the soil type, the men tread the line from one end of the field to the other; this leaves only a slight impression of the line. Cos lettuce however may be planted in rows marked out with a racer since this type has a conical base.

Cultivations after Planting. As soon as the lettuce has been planted, the dibber holes are filled in. This affords protection against the plants being lifted by frost. The first hoeing should be done by hand, so that the soil is moved round the stem of the plant. After the plants have become established a row-crop implement with tines attached is used; at the following row-crop cultivation " L " knives should be used to destroy weeds. In order that the crop can be kept thoroughly clean, a further hoeing by hand is necessary to weed the rows. Planting on the square will not remove the necessity of this second hoeing, since the moving of the soil around the plant is essential.

2. Autumn-Sown Winter Lettuce in the Open

Varieties. To-day, varieties of the cabbage type have superseded those of the cos. *Hick's Hardy Winter* and *Hardy Green Hammersmith* are no longer grown, since the British public will no longer buy lettuces with tough leaves.

Varieties of lettuce suitable for the winter are *Imperial*, *Wintercrop* and *Arctic King*. This last-named variety is possibly inferior to the other two.

Raising Plants. The seed should be sown on a well-firmed seedbed. The nitrogen of the soil should not be too high, but an adequate amount of potash and phosphate should be available. The drills should be spaced 12 in. apart, and the quantity of seed required is 4 lb. per acre, 1 acre of plants being sufficient for 6 acres of lettuces. The seed should be sown at the end of the first week in September, though northern growers are advised to sow a little earlier.

Preparation of the Land for Planting Out. The order of crop rotation is important; winter lettuce should not follow any brassica crop but may follow the legumes. The land should be ploughed and subsoiled, since good winter drainage is essential. In some wet districts the land is prepared in "stetches" 2 rods (11 yards) wide, since this has the advantage of keeping the soil better drained and warm. At the time of ploughing, hoof fertilizer (dust to $\frac{1}{4}$ in.) should be applied at the rate of 5 cwt. per acre. A top dressing of 3 cwt. superphosphate, 1 cwt. muriate or sulphate of potash and 1 cwt. of sulphate of ammonia should be applied during the final cultivations before planting out. If muriate of potash is used, it should be worked into the soil three weeks before planting.

Planting Out. Planting from the seedbed should be carried out during October and up to November 15, according to locality. Planting must not be done in wet weather or immediately after frosts. The plants are set out 12 in. apart both ways.

Cultivations after Planting. When the plants are established the land should be hoed; if possible this should be done twice before Christmas, but the operation should not be carried out during frosts. Hoeings should be done again during fine spells in early spring. It is often advantageous to apply a light dressing of finely-ground nitrate of soda, at the rate of $\frac{1}{2}$ cwt. per acre, since the winter rains wash out the nitrogen in the soil. This is sufficient to start the plants into growth. The winter crop is liable to suffer from attacks of aphis and may thus become a source of infection to the spring-planted crop. The small grower would, therefore, be wise to dispense with the winter crop, while the larger grower should isolate the winter lettuce from the spring crop and so avoid spring infestation. It should also be noted that lettuce which has wintered outside is inclined to be tough in texture, and may not find so ready a sale as the frame-grown lettuce. There is also little demand for it after the spring-planted frame-raised lettuce is ready for market. It must be borne in mind that crops of spring-planted lettuce grown from plants raised under glass, especially where they are pricked out, will invariably mature as early as the outside over-wintered crop, and their quality will be 50 per cent. better.

3. Outdoor-Sown Lettuce for Cropping June to August

Varieties. CABBAGE TYPE: *White Boston* (syn. *Green Trocadero, Improved Trocadero, Borough Wonder*), *Feltham King, Syston's Glory, Glory of Nantes;* for dry weather *Chavigny* should be used. COS TYPE: *Lobjoit's Dark Green* and (in some districts) *Prince of Wales* are used.

Preparation of the Land. For the first sowings in early spring the land should be prepared in late autumn, ploughed and subsoiled, and should have been

manured for the previous crop. Lettuce may be grown after the majority of crops except winter roots and brassica crops; for example, it forms an excellent successional crop to leeks, onions, radish, French or runner beans or potatoes.

The land should be left in its rough state until it can be worked easily. At the end of January, a top dressing of 10 cwt. meat and bone meal per acre should be applied. Giving this dressing a few weeks before spring cultivations ensures that the nitrogen and phosphate may readily be available to the young plants. Cultivations must be of a thorough nature, the land being cultivated crossways to the ploughing. It should then be harrowed and rolled to a definite degree of firmness, as well-hearted lettuce can be grown only on a well-firmed seedbed.

Sowing Seed. If the soil can be worked to a friable condition in early February the first sowing may be made at this time in the south; in the north, sowings are a little later. To obtain a continuous supply, successional sowings should be made every 14 days throughout March and April. Periodical sowings may be made throughout the summer, but it should be remembered that, except during periods of drought when lettuce is in short supply, the demand for salads is considerably reduced when soft fruit becomes available in quantity. For this reason it is not advisable to make large sowings during late May and June. The produce from small acreages will, however, find a market during the soft fruit season and will continue up to the end of the plum season, when salads are again in greater demand. For an acre of land 4 lb. of seed may be used. This quantity should be considered as the minimum with a brush drill; with the Planet type of drill less seed may be used. The seed is drilled in rows 12-14 in. apart, to a depth of $\frac{1}{8}$ in., and if the weather is dry the bed may be lightly rolled with a wooden roller, after harrowing. Small seed such as lettuce should be harrowed in with light seed harrows. The tines of these harrows should be close together, but not following one another; in this way no ridges are left by the tine marks. It is essential that every seed should be buried to the same depth, so that the seedlings will break through the soil surface at the same time.

Subsequent Cultivations. As soon as the rows can be seen from one end of the field to the other, row-crop cultivation should take place, using a horse hoe or a light row-crop mechanical tool. Before the plants become overcrowded they should be thinned out to 12-14 in. apart. Later hoeings will be necessary, the first being carried out with a 7-in. onion hoe, so that the soil may be moved around the collar of the plant. Subsequent hoeings should be done with row-crop tools or with long-handled hoes.

Pests. Special care must be taken to protect the crop from attacks from birds, since the seedlings emerge from the soil before mating and nesting time, and flights of birds are capable of destroying the whole crop in a few hours.

4. Summer Sowings for Autumn Maturity

It is common practice to grow a catch crop for marketing from the end of the plum season until the advent of the winter frosts. In some years this crop will show a good profit; in others climatic conditions may seriously affect it. Taking one season with another, however, the growing of this crop is justified by the cash return.

Varieties. These are the same as used in Method 3 (see p. 6).

Land Preparation. As the previous crop may have made heavy demands on the soil moisture, or, since there may be drought at this time of year, it is essential that the land should be worked to a very fine tilth. All weeds or debris from the previous crop must be removed. If conditions are dry, the land should then be disced to a depth of 3 in. and be left for five or six days. It should then be subsoiled and ploughed, and a roller should follow the plough so that the moisture is trapped. A harrow, which will create a dust tilth, should follow directly behind the roller. Further cultivations may be necessary, and these, together with the ploughing and drilling, should be carried out the same day, the drilling taking place towards the end of the day when conditions are cooler. At the time of ploughing, a top dressing of high grade meat and bone meal, at the rate of 10 cwt. per acre, should be given.

Sowing Seed. Sowings should commence after Midsummer day, but if the weather is dry it should be delayed until early July when dew appears again. Successional sowings should be made up to about August 10. The same amount of seed per acre (see p. 7) should be used. The seed should be harrowed in but the land should not be rolled. If the weather is extremely warm a dressing of 10 cwt. hydrated lime should be applied, since this will have the effect of keeping the land cool.

Cultivations After Sowing. The crop should be cleaned and thinned as recommended for the spring and summer sowings. Great care should be taken to keep the land free from weeds which compete with the crop plants for moisture. As the moisture content of the soil is of the greatest importance in the summer, the production of the crop with the aid of irrigation (artificial rain) should be considered.

USE OF IRRIGATION FOR LETTUCE CULTIVATION

The spring-planted crop and the very early sowings outside seldom require or even benefit from an additional supply of water. If manuring is adequate, and cultivations have been carried out efficiently, there are few seasons when an extra water supply is necessary. With the later spring and summer sowings, however, the position is quite different, especially when the crop grown before the lettuce has made heavy demands on the reserves of moisture in the soil. It may be claimed that if good quality lettuce is to be obtained in continuous supply, it must be watered during certain periods of growth. The subject of irrigation and the equipment required are dealt with fully in Bulletin No. 138*, but the following summarizes the information applicable to lettuce growing. It should, however, be stressed that irrigation is a subject requiring special care and treatment:

1. The initial watering must precede sowing and not follow it.

2. It is claimed by many that the initial watering should also precede ploughing and subsoiling.

3. The water should not be applied at a greater rate than it can be absorbed by the soil, or a flooded condition will result. Under normal conditions it should take 8 hours to apply the equivalent of 1 in. of rain.

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* Bulletin No. 138, *Irrigation of Horticultural Crops*—price 1*s*. 6*d*. (by post 1*s*. 8*d*.) Obtainable from the Sales Office of H.M. Stationery Office or through a bookseller.

4. The above quantity is generally sufficient to saturate the soil to a depth of 12 in., this depth being all that is necessary.

5. Ploughings can seldom take place the same day as watering. It is advisable to leave the ploughing until the moisture content of the soil is such that the land can be walked over without the soil sticking to the worker's boots. In dry weather this is generally achieved 24 hours after watering.

6. It is considered by some growers that, provided the equipment is available, the addition of a small quantity of nitrates to the irrigation water is a great benefit, as not only does the seed germinate quicker and better, but plant growth is more rapid. The addition of 1 part of potassium nitrate in from 10,000 to 20,000 parts water is sufficient to give these results.

7. It has been found in practice that aerated water is more satisfactory than non-aerated, and it is considered by some that the extra oxygen content of the aerated water may act as a stimulant to growth.

When the land is sufficiently moist (see under 5), the land is ploughed to a depth of 12 in. and subsoiled a further 6 in. If the cultivations outlined in the previous sections are carried out, this soil moisture will be conserved for the plants.

In times of very severe drought, additional water may be necessary during the period of growth. The best time to water a crop that is half mature is during the early morning hours when the aerial organs are cool; thus in summer, watering may start between three and four a.m. and continue until eight a.m. In that period an additional equivalent of $\frac{1}{2}$ in. of rain should be applied. While with aerated water it is possible to water over the plants without producing scorching when the sun rises, care should be taken that the temperature of the plant is not reduced too speedily by using cold well water or there will be a tendency to the development of Bacterial Rot under the capping leaves.

Lettuce can be helped to grow away from infestations of aphis by irrigating the crop with a very weak solution (1 part in 30,000 parts) of potassium nitrate. Either a staggered line or an oscillating line is best for this procedure, since a continuous soaking is necessary. In all cases flooding must be avoided, and for this reason overhead spray lines are recommended. The furrow method practised in America is unsuitable for our relatively shallow soils.

HARVESTING AND MARKETING

Cabbage Lettuce

It cannot be emphasized too strongly that the English housewife demands a well-hearted lettuce and will not purchase soft leafy heads. For this reason it is essential that only clean, well-hearted produce is packed. However good the cultivation and growing may have been, no lettuce crop will mature so that the field may be cleared in one operation; indeed, it will have to be cut over four or five times in order to obtain suitable produce. Gapping up is seldom worth while, since the plants used mature too late. Only well-developed specimens should be cut; in this operation it is usual to have two workers, each cutting three rows at a time, moving up the rows and putting their cut lettuce head downwards, in a row between the first worker's right hand row and the second worker's left hand row. A third worker follows and packs the cut lettuce. The box used for this is the standard lettuce crate, which holds two dozen heads. The lettuce are packed in two

layers of 12, the lower layer placed with the butts downwards and the upper layer with the butts upwards.

Immediately after cutting, the packed crates are taken into a shed, stood on end and lightly sprayed with water. The crates are then stacked ready for loading for dispatch. Care must be taken that no loose or discoloured leaves are left on the butt, which is trimmed so that a satisfactory pack is obtained. It is not usual in this country to line crates for outdoor-grown lettuce with paper, although it is essential for produce grown under glass. If paper is used the lettuce must be repacked in lined boxes in a shed to prevent the paper from blowing away, which would probably happen in the field.

Cos Lettuce

The same remarks as regards selection of heads apply to cos lettuce, but these are pulled and not cut. The soil is shaken from the roots and the lettuce are packed in an upright position in 1½- to 1-bushel boxes or collapsible cauliflower crates. The number of heads in the box will depend on their size, but they must be packed sufficiently tightly so that they cannot shift. If bushel boxes are used they are not loaded on top of one another but face to face and back to back. The collapsible crates, on the other hand, may be loaded on top of each other, since there is sufficient space between the bars for the heads not to be damaged by undue pressure. In hot weather it is advisable to give the loaded lorries a good soaking with a hose after loading.

PESTS AND DISEASES

This bulletin is not the place for a detailed account of pests and diseases, but the following short notes on the chief methods of prevention and control of the more common troubles affecting outdoor lettuce crops may be useful. More detailed information about many of them is available in the Ministry's Advisory Leaflets*, and references to these are given. It is essential that the cause of the trouble should be correctly diagnosed in the first place, and if in doubt growers are advised to consult an officer of the National Agricultural Advisory Service.

Aphides

At least three species of aphides (greenfly) live on lettuce, and they are the most troublesome pests of lettuce grown in the open. In addition to direct injury to the plants, they may act as carriers of Mosaic virus disease which causes stunting and a yellow mottling of the leaves. Plants growing well under good soil conditions, with adequate water supply and suitable fertilizers, suffer less from attack by aphis than poorly grown plants. Lettuce does not thrive in acid soils, and if necessary lime should be applied (see p. 8).

It is particularly important to prevent the development of infestations on winter lettuce in the spring, and treatment with a nicotine solution has proved effective. At the time of transplanting in the autumn, the plants are submerged for three minutes in a nicotine wash of the following composition:

Nicotine (95-98 per cent)	1 fluid oz.
Wetting agent	According to maker's instructions
Water	9 gal.

(Soap is not recommended as a wetting agent, for it may cause damage under some conditions).

* Obtainable free and post free from the Ministry, 1, St. Andrew's Place, Regent's Park, London, N.W.1.

This quantity of wash will dip about a thousand plants at a time and can be used six times over.

The young plants should be pressed under the surface of the solution and very gently moved about during the treatment, the greatest care being taken to avoid damage, since injured plants may fail to grow when set out. Plants treated carefully by this method are found to be commercially clean at the time of cutting in the following May.

Infestations on young plants during the summer can be controlled by application of a nicotine dust or spray, but if the attack has developed in " hearted " lettuce there is little that can be done.

Slugs

The control of slugs is important, not only because of the damage that they themselves cause to the lettuce, but also because slug-damaged leaves form an open door for the entry of *Botrytis*. On a small scale and in frames and glasshouses, slugs may be collected by hand, but the best method of controlling slugs is by metaldehyde bran bait (see Advisory Leaflet No. 115) applied before planting out the lettuce and among the young plants.

Swift Moth Caterpillars, Leatherjackets and Cutworms

SWIFT MOTH CATERPILLARS, LEATHERJACKETS and CUTWORMS (the caterpillars of the TURNIP MOTH, the YELLOW UNDERWING and related moths) are often the cause of loss of plants by feeding on the roots or biting into the stem just above the surface of the soil. All these pests are most likely to be troublesome in weedy undisturbed land; adequate manuring and periodic cultivations to keep the land clean greatly reduce the risk of losses. Where necessary, leatherjackets and cutworms can effectively be controlled by the use of a Paris green and bran bait and promising results in control of leatherjackets have also been obtained with DDT insecticides (see Advisory Leaflet Nos. 179 and 225). Swift Moth caterpillars (Advisory Leaflet No. 160) are difficult to deal with, but dressings of crude naphthalene at about 2 oz. per sq. yd. and worked into the soil have proved useful.

Grey Mould (*Botrytis cinerea* Fr.)

Young lettuce plants raised in frames are liable to attacks by Grey Mould and the seedlings are apt to damp off after planting out. Much can be done by cultural methods to prevent the disease. The soil should be worked to a fine tilth, and a smooth and even surface should be created before sowing the seed and pricking out. When pricking out, damage to the seed leaves should be avoided and it is necessary to see that the seed leaves are above the surface of the soil, for the *Botrytis* readily enters through wounds and decaying leaves. Good ventilation in the frames should be maintained and, after frost, the frames should be slightly opened before the sun shines on them, so that the plants are naturally thawed out by free circulation of air. Losses can be reduced considerably by dusting the seedlings from an early stage with a proprietary dust containing chloronitrobenzene. Three or four applications may be necessary, the early ones being light to avoid any check to the plants.

Downy Mildew (*Bremia lactucae* Regel)

Mildew can cause total destruction and is not easy to control. Attacks may however, be held in check to some extent by preventing excessive moisture at sowing time, by avoiding rapid thawing out as described for Grey Mould, and by spraying or dusting the seedlings with a copper fungicide or with salicylanilide soon after emergence and again just before transplanting.

Mosaic

This disease is usually worst in lettuces overwintered in the open. It is caused by a virus which may be carried in a small number of seeds and transmitted from infected plants to healthy ones by greenfly. Little infection takes place if the seedlings are raised under glass, and aphis infestation of the winter crop can be kept down by submerging the seedlings before transplanting in a nicotine wash (see p. 10).

ENDIVE—CURLED AND BATAVIAN

There are three main types of endive: (*a*) *Staghorn*, in which the leaves are branched like the horns of a stag, (*b*) *Batavian*, distinguished by its broad and undivided but slightly waved leaves, and (*c*) *Ruffec Curled*, in which the leaves are less finely curled.

This salad has been extensively grown as a market crop on the Continent, particularly in France, but only to a limited extent in this country, owing to the preference for lettuce. During recent years this salad has become more popular and is used extensively in hotels and canteens, mostly in the autumn and winter. As the climate in the south-west is suitable for the growing of endive in the winter months, it has become an important crop in this area.

STAGHORN AND CURLED TYPES

Varieties

The different varieties vary in the extent to which their leaves are divided and curled, in hardiness and in size of plant.

Ruffec Green Curled. This variety is grown extensively by market gardeners in the Home Counties. It is not hardy and requires light protection against frost. In the south-west no protection is usually required. It makes a large plant 18-21 in. in diameter; the leaves are deeply toothed, but rather finely divided and curled at the ends.

Staghorn (syn. *Rouen*). Perhaps the best selection of this is *Exhibition*. It makes a plant midway in size between *Ruffec Green Curled* and *Moss Curled*, and is grown extensively by the market gardeners around Paris. It requires protection either with cloches or frames during the winter months. During recent years this variety has supplanted *Ruffec* and it finds a much readier sale on the markets. The texture of the leaves is not so coarse as *Ruffec Green Curled* or as fine as *Moss Curled*.

Green Curled Winter Endive. This variety forms a plant 18-21 in. in diameter. The leaves are very finely cut at the base, but with a less divided lobe. It requires protection.

Green Curled. Varieties of this type have deeply cut leaves, curled and usually tinged with pink at the margin. This variety is not favoured on the English markets, and is now almost obsolete.

Moss Curled. This is a compact variety 12-15 in. in diameter, approximately equal in size to *Rouen,* and most suitable for forcing. The leaves are more finely divided and curled than any other variety. The quality of this variety is exceptional. In areas with a mild climate and heavy rainfall, Heart Rot may cause severe losses in this variety.

Louviers, Exquisite, Exhibition are all very similar and are the smallest types grown in this country, being not more than 6 in. to 9 in. in diameter. Quality of each variety is exceptional. Several market growers prefer this type because of its good habit, and also for the amount of the edible material contained in the centre of each head after blanching. *Exquisite* and *Exhibition* are rather higher in the crown when fully matured than *Louviers.*

Soils

Endive will grow on the majority of well-drained soils but heavy clays should be avoided.

Land Preparations

To obtain good endive a soil of high fertility is essential. Since the plants need to be grown fairly hard, they require a steady supply of nitrogen, which can best be provided by stable manure or another organic manure such as hoof. An excess of inorganic fertilizers, such as sulphate of ammonia, should be avoided since the resulting lush growth encourages Bacterial Rot in the hearts. Preparation of the land and manuring should be the same as for lettuce.

Sowing Seed

For early crops seedlings should be raised on a hot-bed of 60°F., since they are less liable to bolt. *Exhibition* should be used for this purpose, 1½ lb. of seed per acre of plants being required. When large enough to handle the plants are set out in moist soil in the permanent quarters in rows 14 in. apart and 12 in. between the plants in the row. Any check through drought must be avoided or the plants will bolt.

Successional sowings for continuous supplies are made from the middle of June, when *Exhibition* is used, and from early July in the case of the other varieties previously mentioned. Sowings should not be made after the end of July since the plants will not have time to develop before the winter months. This crop is sown direct into its permanent quarters and 4 lb. of seed per acre of plants is required. The rows are sown 14 in. apart, and are subsequently thinned to 12 in. between the plants, the thinning being carried out early in the plant's life. With either method of plant raising, the crop must be kept free from weeds by hoeing.

Harvesting and Marketing

As the time for cutting approaches, the heart of the endive must be blanched. In early autumn the hearts will become blanched in about 5-10 days; later, 20 days or longer is required, since the plants will be growing more slowly. The outer leaves are tied up over the centre about 4 in. from the top of the plant in the same way as a cos lettuce. It is important to do this when the plants are quite dry to avoid rot being set up on the heart. It is possible to blanch the plants by covering them with litter, placing a flower-pot or stone over the heart. Some growers use boards for covering hearts for blanching, but if the weather is damp the heart may get wet, and rot—endive is very susceptible to this trouble.

In Cornwall winter varieties of endive can be grown in the open throughout the autumn and winter. The *Ruffec* variety is the most popular, the seed usually being sown early in July in drills 15 in. apart. The seedlings are subsequently thinned to stand 14 in. apart in the rows. Treatment is similar to that for winter lettuce, since the crop matures in winter and early spring.

In other parts of England protection from frost is necessary. Probably the best method is to grow the plants in the usual way out-of-doors, lift before the onset of frosts and plant them in cold frames. Lifting should be carried out when the plants are quite dry and the outer leaves tied up as already described. Any damaged plants should be discarded, since they are likely to decay. The plants are lifted with a good ball of soil and placed close together in frames containing moist sand or soil. The ties are removed and the lights placed in position, being raised slightly to allow free passage of air. It is very important that the plants should not be allowed to get wet, and in frosty weather the frames should be covered with mats. The endive can be cut from November until the end of the year.

Endives should be cut at midday (when the plants are quite dry), graded and packed dry in lettuce crates, 24 heads in each.

BATAVIAN TYPE

Varieties

Sutton's Winter Lettuce-leaved. This variety originated in France about 1875, and is intermediate between the curled and Batavian types, the leaves being wavy and lightly lobed. It is vigorous and withstands all but the hardest winters.

Round-leaved Batavian Endive (*Green*). This is the variety most widely grown by French market gardeners. The plants have a diameter of about 18 in., the leaves are large and rounded, and very close hearted. This, and the majority of the Batavian types, are most suitable for autumn cutting in England.

Soils

Same as for curled endive.

Land Preparation

Same as for lettuce.

Sowing Seed

Same as for curled endive.

Harvesting and Marketing

The plants are blanched in the same way as for curled endive, care being taken that they do not rot through the leaves being wet. Batavian endive should be tied like cos lettuce and should be packed by being laid sideways in returnable 1-bushel or 2-bushel boxes.

CHICORY

Varieties and Types

The type of chicory in general use as a vegetable or salad is the *Witloof*, which is thought to be a selection from the *Magdebourg* type; it has wider leaves, smoother edges and thicker midribs.

This salad crop, although of a most agreeable flavour and possessing medicinal qualities, has never been cultivated in England to the extent prevailing on the Continent. Up to 1931 almost all supplies were imported, chiefly from Belgium, where chicory production is a large and important industry. Since that year the cultivation of this crop in England has steadily increased and growers, particularly in Cambridgeshire and Huntingdonshire, and also in the Home Counties, are now producing chicory. Supplies for the English markets normally arrive from December to April.

Soils

Any light, fertile soil is suitable.

Land Preparation

During the previous autumn the land is ploughed and subsoiled. Farmyard manure, supplemented with basic slag, superphosphate and potash, is applied, since it is important that the manure should be well decomposed before the seed is sown. The surface should be thoroughly cultivated so that a fine tilth is obtained before sowing.

Sowing Seed

A stock of plants for forcing is raised each year from seed sown outside. Seed should be sown in late May or June in rows 1 ft. apart and ½ in. deep; earlier sowings may be made, although there is a risk of the plants running to flower. The young plants are thinned out to a spacing of 9 in. and the crop must be kept clear of weeds by subsequent hoeing.

Lifting and Storing the Roots

The plants are lifted between the end of September and mid-November, spades, forks or the plough being used. For immediate forcing the leaves are cut off 1 in. above the crown. The roots are then allowed to dry by storing them for at least 6 or 7 days to check growth. When required for forcing later the roots are stored in trays protected from frost. In the United States the roots are kept in a cold store at 31° F. It should be noted that temperatures up to 45° F. are not injurious, but actual freezing of the roots causes damage: the freezing point of chicory roots is below 28° F.

Forcing in the Open

Either hot-water pipes or a manure hot-bed can be used as a source of warmth for forcing, but it should be remembered that comparatively low temperatures are required (see above). The beds should be about 5 ft. wide so that they can eventually be covered with Dutch lights. Roots of medium size, i.e., 1-1¾ in. in diameter, give the best results; larger roots are liable to yield split, compound heads, while small roots produce heads that are too small. The roots are trimmed to a uniform length of 8 in., side shoots being removed. Boards 9 in. wide are erected on the side of the bed, and the roots are placed in an upright position, 1 in. apart in the rows, and 2 in. clearance is left between the rows. The bed is then given a thorough watering and is filled with light soil, peat or sand to a depth of 6-7 in.; it is important that this filling material should be dry. Dutch lights or corrugated iron are now placed over the top, and in frosty weather these must be covered with litter.

Forcing under Cover

Chicory can be forced in glasshouses or sheds, and in such conditions an air temperature in the building of 65-68° F. is sufficient. The procedure of laying in the roots is the same as for outside, and the beds are covered with some fine dry material such as sand or peat. Also chicory can conveniently be forced under the staging in a propagating house.

Harvesting and Marketing

As soon as the points of the chicory are lifting the covering material and are within ½ in. of the surface, the crop is ready for cutting. An opening is made at one end of the bed and the chicory is cut at root level with a short-handled edging iron or strong knife. The heads must be cut sufficiently low to leave the crown intact, but there should be no portion of root. Any discoloured outer leaves are removed. The heads are graded and packed unwashed into boxes lined with paper holding 10-12 lb., which are similar to those used for tomatoes; 12 lb. chips have also been favoured. Whichever container is used, the heads are neatly laid with the bases towards the outside.

RADISH

The radish is grown to some extent in all the market-gardening districts, and is an important crop in Worcestershire, Bedfordshire, Lancashire and the Home Counties. It is one of the most important salad crops, there being a good demand for radishes in the industrial areas in England, although the demand in Scotland is extremely limited. They are also used extensively in hotels, especially in the early spring months, although only limited quantities are required during the soft fruit season, the demand again increasing after the plum crop has been taken. It is evident, therefore, that cropping must be carefully regulated to meet this fluctuating demand. Besides those grown outside, radishes are also raised in glasshouses and frames and cloches; their cultivation is dealt with in Bulletin No. 65*.

A salad specialist should have a supply of radish throughout the year, which should be heavy in spring and autumn and light in the summer. This crop during the late spring and summer takes only about three weeks to develop from the seed to a marketable size. Thus a quick turnover of capital is obtained, as well as additional advantage that radishes are a cleaning crop. Since six or seven crops can be taken off the same piece of land in one season, and the land is ploughed and cultivated six or seven times in a season, there is a total destruction of weeds.

Varieties

Turnip and Oval Shaped Types

French Breakfast, Glowing Ball, Turnip-shaped Red, Saxa, Scarlet Globe, Sparkler.

Long Type

Wood's Early Frame, Long Scarlet

A variety such as *Scarlet Globe* should be used for the first sowings outside, since a short top variety does not produce sufficient foliage at this time of

* Bulletin No. 65, *Crop Production in Frames and Cloches*, price 2*s.* 6*d.* (2*s.* 8*d.* by post).

year for satisfactory bunching. However, as the weather becomes warmer, and gives increased vegetative growth, the short top varieties are more suitable, since an excess of top is not favoured in the markets. Thus for later sowings *Saxa* and *Turnip-shaped Red* are recommended. *Sparkler,* which is half red and half white, has never found favour in the southern markets, but the variety is used in considerable quantities in Lancashire and other northern areas. It is in no way comparable, either in appearance or flavour, with *Scarlet Globe* or *Turnip-shaped Red. French Breakfast* has lost its popularity, owing chiefly to the fact that it tends to become pithy in the centre quicker than any other variety. Small quantities may, however, be grown since it is sold in limited quantities, and is chiefly used for garnishing. The long-rooted, brightly coloured variety, *Wood's Early Frame,* is popular in some markets and may be sown early, with *Long Scarlet* to follow.

EARLY RADISHES OUT-OF-DOORS

In favoured districts special radish beds are made in sheltered situations to provide the earliest crops. A warm soil, light but fertile and well drained, is essential. In most districts the production of early radishes is specialized work, involving a considerable amount of hand cultivation and protection with straw unless, as is commonly done by the Dutch growers, the beds are covered with lights until April.

In the Evesham Valley early radishes are grown on warm, sunny banks and in the alleys of plum orchards, preferably where there is some shelter from cold winds. Straw wind-screens are also used to afford additional protection. The beds are used for radishes year after year, and, owing to the shade thrown by the fruit trees, it is unusual for another crop to be planted when the radishes are finished.

The soil is dug over in November and some organic fertilizer, such as hoof-and-horn (10 cwt. per acre), is dug in. Fish manure is sometimes applied to the surface and the soil is thoroughly raked before the seed is sown.

Several successive sowings of seed are made, beginning at the end of December. The seed is sown broadcast fairly thickly, lightly raked in, and then rolled.

The earlier sowings are covered with straw—wheat straw for preference—which is left in position until the young plants begin to appear. It is then taken off whenever the weather is favourable and piled up at the sides of the beds. On frosty nights the straw is drawn over the plants and in very severe weather left on all day. This usually affords sufficient protection to the young plants, although in very hard winters the crop may be completely lost.

The radishes grow away very quickly if mild damp weather occurs at the end of February and in March. If the weather is dry and the crop is not growing well, a light dressing of nitrate of soda or Peruvian guano is useful in encouraging growth.

The time at which the crop is ready to be pulled varies considerably according to the weather. Radishes from the sowing made at the end of December may be ready at the end of February in a favourable season, but if a cold dry spell occurs, the crop may not mature until the end of March.

Wood's Early Frame was at one time used extensively for this early crop, but it has been superseded by the globe or round varieties. There are, however, certain localities where it is still in demand, but for quality it cannot compete with the round varieties.

MAINCROP RADISH IN THE FIELD

Soils

Light sandy soils are essential for this crop, which cannot be satisfactorily grown on heavy land. A friable soil which can be worked early in the year is essential and it also makes pulling easy; in fact on heavy soils, especially in time of drought, pulling is impossible.

For early crops a highly fertile soil rich in organic matter is essential, but as the season proceeds a lower standard of fertility is required. If a continuous supply of radishes is required then irrigation is essential. It is hardly ever necessary for early crops, but only for those later in the season; the equivalent of half an inch of rain is sufficient to maintain the crop in dry periods. This water should be applied, when necessary, before cultivations and never after sowing has taken place.

Land Preparations

Although the radish is a surface-growing crop, deep cultivations are necessary. For the first crop the land should be ploughed and subsoiled in late autumn. Ploughing is essential for succeeding crops but subsoiling again will not be necessary provided the land is ploughed deeply. During the first spell of dry weather in February the land should be well cultivated, harrowed and rolled; a fine tilth is essential. This cultivation should take place only when the soil is dry enough not to adhere to the boots. If the land is acid a dressing of lime should be given after the autumn ploughing, the soil chemist will take a sample of the soil, and advise the quantity of lime that should be applied. Land which has been well dunged for previous crops should receive a top dressing of 10 cwt. of tankage per acre, well worked in during surface cultivations. In land preparations for sowing during April, 5 cwt. per acre of tankage is required; for later sowing 5 cwt. bone flour per acre can be used instead.

As the crop is harvested at one time, the soil should be left as level as possible so that all the seeds may be covered to the same depth and germinate evenly.

Sowing Seed

The amount of seed required varies with the time of sowing as follows: February-March, 1½ bushels; April, 1¼ bushels; summer months onwards, one bushel.

It is usual for market-gardeners to take a risk with early sowings and sow as early in February as possible, although in some years the crop may be destroyed by frost. This risk is worth while, especially in sheltered districts. Sowings may be made during March and early April every ten days; this period is reduced to a week from mid-April onwards. It should be noted that owing to climatic conditions some of these sowings may overlap, and if the plants from one sowing are too large for market and a later sowing is ready, the over-matured one should be destroyed by ploughing it in. Towards the end of May large areas should not be sown since the demand for radishes decreases. Larger sowings may be made from the middle of August onwards, but all sowing should cease from about the third week in September since the crops are then liable to be damaged by frost. This does not apply to the warmer districts, such as Cornwall, where it is possible to continue sowing a little later. For the varieties suitable for growing at different times of the year (see p. 16 and 17).

The seed can either be drilled in the field or sown in beds, but the first method saves labour and is favoured in all large radish-growing areas. The type of drill used is the brush drill with 10-12 coulters spaced 3 in. apart. The seed should be sown not more than ½ in. deep, since deep sowing prevents the proper formation of the root.

After sowing, the seed is harrowed in, and, if the weather is dry, a wooden roll should be drawn over the ground. This operation ensures that the seed is buried to a uniform depth, the importance of which has already been emphasized.

MARKETING

Special care should be given to the pulling and bunching of the crop. If by proper cultivations and manuring uniformity in size has been obtained, this operation is quite simple. The bunching is generally done by women, the whole crop being pulled at one time. Any radishes which are split or those which have not developed a global root are discarded.

The size of the bunch may vary according to the season of the year, but under normal conditions it should contain 25-40 radishes. The bunches should be round with all the " roots " level on the surface, and tied with fillis string. This operation should be done neatly, since it assists in the sales. Bunching is done in the field and the radishes are then taken into the sheds for washing. If this is done by hand the bunches should be passed through cleaning and rinsing tanks.

Radishes are packed in standard lettuce crates which hold 2-dozen bunches. In the bottom layer the green tops are downwards; in the top layer they are upwards.

PESTS AND DISEASES

Flea Beetles are serious pests of radish, bad attacks often necessitating re-sowing. They are most injurious to seedlings at and just after germination, but they also attack older plants, feeding on the leaves. A fine seed-bed and soil in good heart, helping the plants to grow away rapidly, is very important, but, in addition, application of a good insecticide dust is frequently necessary to save the crop. Dusts containing derris or DDT are effective and should be applied as soon as germination begins; a second dusting after a few days may be required in heavy attacks (see Advisory Leaflet No. 109).

Slugs (Advisory Leaflet No. 115) are also often injurious.

Birds. Finches and other birds are very fond of young radish seedlings and sometimes attack this crop soon after it germinates. During nesting, little trouble is experienced. At one time boys were employed to rattle cans and clappers to keep off the flocks. The method used today is to place ropes hung with cartridges in metal cases on the field. The rope is lighted at one end, and as it burns the cord the cartridges are exploded intermittently. Three or four of these ropes are sufficient to protect one acre.

Canker (*Corticium solani*) is not common but may become troublesome where the same soil is cropped too frequently with radishes. The fungus causes dark lesions on the roots, and these spoil the appearance of the bunches.

CELERY

The cultivated forms of celery are of two main types: (*a*) the green or ridge type, which is grown in rows and earthed up in order to blanch the leaf-stalks, and (*b*) the self-blanching type which is grown very close together in beds on the flat. The French and Italians were the first to select forms suitable for cultivation, and the crop was introduced into this country towards the end of the seventeenth century. By breeding and selection celery has become improved in flavour and in the length and size of the hearted portion. It is today regarded as one of the most useful vegetables, providing a salad, a cooked vegetable, or flavouring herb for use in soups.

The chief celery-growing area in Britain lies in counties comprising the rich fenland area around the Wash, where 60 per cent of the commercial acreage is located. The crop is also well established on the peat and warp lands bordering the River Trent in the Isle of Axholme, Lincolnshire (Lindsey) and on the so-called " moss " lands in the south-west area of Lancashire

Soil and Water Requirements

The choice of soils on which celery can be grown profitably is very limited, and confined almost wholly to peat and warp land possessing an abundance of humus and a high water-table. The growth of celery should never be checked by lack of moisture or it will become stringy and poor in flavour.

Although the moist fen and warp lands have proved suitable for celery in a physiological sense, it is not generally realized that they also favour the crop in a mechanical sense. In earthing celery a deep friable soil of soft texture can be worked with comparative ease, since deep cultivations must precede earthing. This is a task which requires two and sometimes three horses drawing a " butterfly " ridger or hiller plough—followed, in the later stages, by men who pack the soil closely around the heads and strike off and consolidate the sides of the ridges. Soft-textured peaty soils never pan, nor do they form into lumpy clods which would damage the heads when banking up is in progress.

It is obvious that the public demand for celery will continue to grow, but whatever the increase in acreage it may be assumed that the fenlands will provide most of the additional land required. This assumption is based largely on the difficulty of providing a sufficient quantity of farmyard manure (upwards of 40 loads per acre) for lands not so suitable for celery. Although peaty soils can carry the crop in rotation without bulky organic manure, it is not known how long they will continue to do so.

Rotation

The usual farm rotation is: celery, potatoes, sugar beet, and corn. In the fens, carrots, parsnips or beetroot may replace whole or part of the root shift, while on small farms or market gardens celery alternates with a wide range of vegetables and salads. Intercropping is not practised in the fens, but in Lancashire, quickly maturing salads or root crops for bunching are taken from between the rows before earthing commences.

FIG. 2 (*opposite*). Outdoor Salad Crops at Walton-on-Thames

Photo: Messrs. F. A. Secrett, Ltd.

FIG. 3. Raising lettuce plants in frames, Middlesex

Photo: Mr. John R. Scott and Reginald A. Malby & Co.

FIG. 4. Cabbage Lettuce *May Queen*, with outer leaves removed

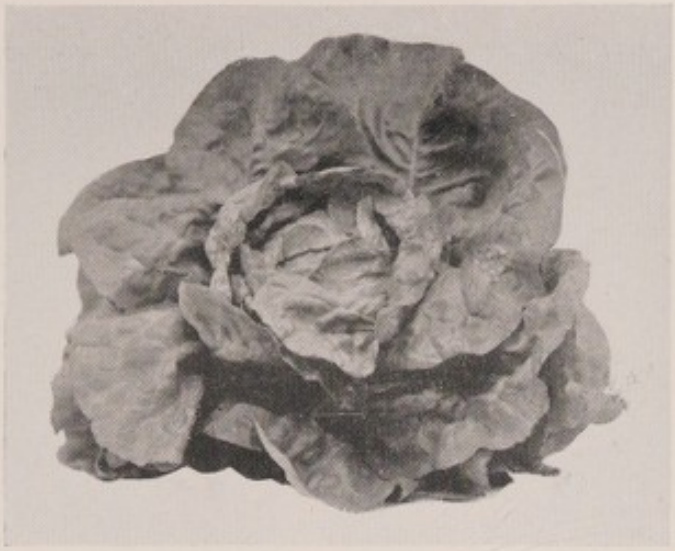

FIG. 5. *Market Favourite* lettuce

FIG. 6. *Lobjoit's Green* lettuce (Cos)

FIG. 7. *Feltham King* lettuce

(*Photo.: Reginald A. Malby & Co.*)

FIG. 8. Radishes—*Wood's Frame* and *Scarlet Globe*

FIG. 9. Watercress bed

Varieties

	The Fens	*Lancashire*	*Isle of Axholme*
White (early) ...	Wareing's Dwarf Early Market (Clucas)	Early Market (Clucas)	Bibby's Defiance Wareing's Dwarf Early Market (Clucas)
White (maincrop) ...	Wright's Giant White Monarch	Blundell's White Monarch	Blundell's White Brown's White
Pink	Clayworth Prize Moore's Pink Resistant Pink (Clucas) Winter Pink (Clucas)	Ball's Pink Late Pink (Clucas) Hybrid Perfection Pink Liverpool Pink (Woodward)	Clayworth Prize Resistant Pink

The early white varieties are susceptible to damage by frost, and, generally speaking, should be lifted and marketed within five or six weeks of earthing, otherwise they become very brittle and break in transit.

The pink varieties are more hardy than the white, and for this reason are grown more in Lancashire. Various strains of Clayworth Prize are particularly hardy, and, in addition, fairly resistant to Soft Rot (*Bacterium carotovorum* (L. R. Jones) Lehm.).

Raising Plants

The raising of plants is a specialist's job, and most celery growers in the Fens and north Lincolnshire obtain their plants from raisers who are equipped to carry out the task of supplying large quantities to growers in the neighbourhood. An important factor operating in favour of the specialist plant-raiser is a supply of trained labour of the highest calibre. Whittlesey, in the Isle of Ely, is the main plant-raising centre for the fens, where one of the larger growers of plants contracts to supply upwards of 20 million plants annually. The total yearly plant output from this area is in the region of 100 million plants.

As a crop is either made or marred before it leaves the plant raiser's premises, it is appropriate to mention the important points which must be considered before plants are raised for sale.

(1) It is necessary to have special equipment for seed sowing and pricking out, consisting of skeleton frames, covered by 6 × 3 ft. or 6 × 4 ft. English, or 5 × 2½ ft. Dutch lights, together with permanent or Dutch light glass-houses. The pricking- or bedding-out areas outside should be protected from ground winds. Irrigation equipment should be available, as once pricking-out has commenced, drought cannot be allowed to hold up operations; otherwise the whole time-table of a large number of contracting growers may be put seriously out of gear. As the plant raiser must not fail to produce the plants by the date specified in the contract, he should be fully equipped and adequately staffed.

(2) The plants must be raised on soil containing plenty of humus, with an admixture of clay, silt or sandy particles. Plants raised on such soils are stocky and firm in tissue, and are better able to withstand lifting, transport and transplanting shocks than plants raised on fenland soil, which is far too " fluffy " to grow a strong *young* plant.

(3) The plants must be raised from clean seed, i.e., seed free from contamination by the most feared of celery diseases—Leaf Spot caused by *septoria apii-graveolentis* Dorogin and *S. apii* Chester (see p. 26).

(4) The plant raiser must be alive to the possibility of seedbed infection by Leaf Spot occurring before the plants leave his charge, for however careful he may be in the purchase and sowing of clean seed, some infection is almost bound to occur. The observant plant raiser diligently rogues the seedbeds and plantbeds, and has equipment available for spraying the young plants with Bordeaux mixture or one of the copper compounds. Only by careful attention to detail is it possible to produce disease-free plants.

Sowing Seed

Since clean seed is the prerequisite of a clean crop, every effort should be made to ensure that the seed obtained is clean, or has been efficiently treated with formalin. Alternatively, it should be treated before sowing as a routine practice (see p. 27).

The seed is very small and from a quarter to half a million plants can be raised from a pound. By far the greater proportion of plants is now raised from seed sown in boxes and germinated on temporary staging in glasshouses. By this system the boxes of seedlings can quite easily be moved outside to harden off before bedding-out. The glasshouses are then used for a crop of tomatoes or cucumbers. The old system still largely practised in North Lincolnshire, is to make firmly consolidated hotbeds of fermenting stable manure about 1 ft. deep, on which is placed a framing with side boards 9 in. deep. The seedbed compost, consisting of screened fertile soil, is then placed 3 in. deep over the manure and levelled by raking and stamping until uniform consolidation has been obtained. The frames are covered by lights, and as soon as the hotbed and compost has attained a uniformly steady temperature of about 55° F., the seed can be sown.

When raising seedlings one of the biggest problems is the amount of weed growth which may arise after using composts containing a large number of weed seeds. Careful growers take steps to prevent weeds seeding upon land or compost which will be used later for seed sowing, but the trouble may be dealt with by sterilizing the compost with steam. Steam sterilization also kills the spores of the damping-off organism (*Pythium*), and Root Rot (*Phoma apii cola*), which may be particularly troublesome on nurseries where old celery soil is used over again for compost-making. (See Bulletin No. 22, *Practical Soil Sterilization*.)

If steam sterilization of contaminated compost is impracticable, raisers of plants under framelights may follow the advice given by H. H. Stirrup, in the Ministry's Bulletin No. 25 (*Investigations on Celery Diseases and their Control. H. H. Stirrup, M.Sc. and J. W. Ewan*—out of print), which may be summarized as follows:

A 2 per cent solution of formalin (38 per cent formaldehyde) is prepared by adding 1 pint of formalin to 6 gallons of water. This solution is watered over the compost with the aid of a fine-rosed watering can at the rate of $3\frac{1}{2}$-7 gallons per 6 × 3 ft. framelight; the frames should be closed for 2-3 days. If the frames do not fit tightly the soil should be covered for 48 hours with clean hessian or sacking wetted with the formalin solution. Alternatively,

the lights may be covered with straw to a depth of 9-1 in. The soil is not ready for seed sowing until the formalin fumes have dispersed. To effect this, the frames are opened and the soil stirred every day over a period of 10-14 days, using clean or sterilized rakes. Compost laid by for covering the seed after sowing should also be treated.

In heated glasshouses sowings are made in seed boxes measuring 16 × 20 in., containing steam sterilized compost. Graduated seed measures are used to sow just sufficient seed to raise 4,000 seedlings per box. Sowing begins about the middle of February and continues at weekly intervals into early March. The usual practice is to make a test sowing from the bulk of seed during the first week in January; from the result it can be seen how thickly the seed should be sown later. A suitable gauge can then be selected for measuring the correct quantity of seed to be sown per box. In order to provide a succession of plants for pricking- or bedding-out, the first sowing in frames usually takes place the second and third weeks of February, followed by sowings at regular intervals into March. About ½ oz. of seed per light is the average, although the tendency nowadays is to make thinner sowings in order to obtain sturdier seedlings. The seed is lightly raked in or lightly covered with screened compost sown by hand.

Of late years Dutch light glasshouses have been used for pricking off the earliest batches of seedlings. These structures are very useful to the plant raiser, for if bad weather stops the gangs from working outside they can be transferred to work under glass, and the progress of bedding-out is not impeded.

After sowing, care must be taken never to allow the surface of the soil to dry out, or germination may be seriously limited. During sunny weather a light spraying of limewash over the glass tends to offset the possibility of a quick dry out, and each day the surface soil should be lightly damped over by a rosed watering can. When germination is complete air can be admitted during the day and progressive airing given until a crack of ventilation is left on all night. Otherwise, the seedlings very quickly become drawn and leggy—a condition disliked by the bedders.

Bedding or Pricking Out

The seedlings are bedded out when between 1½ and 2 in. in height and possessing about four leaves by which they can be safely handled. The first batch is pricked out in beds 6 ft. wide in Dutch light houses, and later batches in 6 ft. beds outside. Bedding out commences towards the end of March and continues throughout April and sometimes into May.

Two women work a 6-ft. bed, kneeling on potato trays and working backwards. Training for this work begins early, and women over 25 years of age cannot be expected to attain the high speed of those who received their training in their late 'teens. A trained woman has been known to bed out 32,000 seedlings between six-thirty a.m. and eight p.m., with breaks for meals, but a good average for a skilled woman is 14,000 per day.

The pricking-out beds or gardens are manured each year with the manure and compost from the hotbeds and frames. In addition 2-3 cwt. of balanced compound is used as a base dressing before the seedlings are bedded out about 1½ to 2 in. square. Under glass, the seedlings should be watered as the work proceeds and should also be kept moist during the full period of

their growth under glass. Irrigation for outdoor beds is valuable during early summer droughts, which are quite likely to occur in eastern England during April and May.

Lifting and Planting Out

Towards the end of May the first batches of plants are ready for planting out in the field. The women bedders turn to the task of lifting the plants and packing them into potato chitting trays. In dry periods the beds should be watered 24 hours before lifting, but if an irrigation system is operated, they should be moist enough for lifting without further watering. The plants are split out from the rows with a sharp spade, the women following to shake excess soil from the roots and to stack the plants in round hundreds into trays. A standard-sized potato tray holds 4,000 plants of average size. The lifting process should synchronize with the work of planting in the field, with relays of motor lorries or tractors and trailers to transport the plants from the nursery to farms in the area.

After deep ploughing in early winter, the land remains untouched until April. Then several surface cultivations are given to eliminate weed growth, particularly chickweed—one of the most troublesome weeds on fen or peaty soils. Care should be taken, however, not to open up the soil too freely during periods of hot sun or when drying winds are blowing over the fens, otherwise it may begin to lift and " blow " with disastrous results.

A fortnight or three weeks before planting, fenland soils receive a base dressing of fertilizers in the proportion of 2 cwt. muriate of potash and 5 cwt. superphosphate. This is lightly harrowed in before marking out the rows.

The field is then marked out for planting. The rows are spaced 4½-5 ft. apart for dwarf early varieties, and 5½ ft. for the taller and later sorts. It is easy to rig up a marker by inverting the hoe stalks on a horse hoe, or a rubber-tyred tractor toolbar, binding the base of the stalks with strips of sacking tightly bound on with wire. This makes a pronounced mark which is not easily filled in by rain or wind.

One of the problems on black soil is the removal of the surface tilth of loose dry soil before planting. If not removed the planters make slow progress owing to the silting up of the hole as the dibber is withdrawn. Growers use a device resembling a wooden snow-plough, which, drawn by horse or tractor over the row mark, makes a shallow depression some 3-4 in. deep and guides the dry tilth away to the centre of the rows, where it does not trouble the planters. A pointed marker, fixed to the rear of the plough, re-marks the row position again. Needless to say, the task of crumb removal should be carried out only a little ahead of the planters, otherwise the surface would again dry out.

The plants are then dibbled out about 4½-5 in. apart; the number required ranges from 20,000 to 22,000 per acre in 5½-ft. rows, and from 28,000 to 32,000 (of the early varieties) in 4½-ft. rows. The trays of plants are spaced out by " carriers " along the rows and the plants are dropped a little ahead of the planters by " spacers." The latter lay the plants out at the required distance apart—all laying one way and in such a position that the " planters " can pick them up without trouble as they move along on their hands and knees, dibbling with great speed. Skilled men planters in the Fenland districts have planted upwards of 20,000 plants per day, although

12-15,000 is a fair average. About a week to ten days later, especially in dry seasons with hot sun, the rows are walked over and the " misses " are gapped-up.

Summer Cultivations

Summer cultivations begin as planting proceeds, for on rich black soil the weeds grow more quickly than the celery. Scuffling between the rows with Planet type cultivators is undertaken every week or ten days, whilst the plants in the rows are hand-hoed until they are large enough to suppress the growth of weeds around them.

On rich fenland soils it is not usual to give side or top dressings of nitrogenous fertilizers, as practised in other districts, but on some of the poorer soils a dressing of 1-2 cwt. sulphate of ammonia may be given to encourage growth. Excessive nitrogen, however, tends to produce " frothy " growth, a conditions in which the leaf stalks crack open and expose their inner tissues. Heads of this type are of low value, and are liable to become infected with Soft Rot.

Blanching

The first furrow is turned towards the plants in July, when they are about 9 in. high. Either an ordinary plough or a double-breasted or " tommy " plough with extended mould-boards which throws soil to two rows at once is used. The purpose of this early furrow is to deter the outer leafstalks from assuming an angular or semi-horizontal position away from the heart leaves. Delay in laying the first furrow to the rows allows soil to penetrate into the heart tissues with consequent reduction in quality, apart from the possibility of inducing Soft Rot at a later date.

The second furrow is laid about 14-21 days later when the plants are 15-18 in. high—first making plenty of soil between the rows by frequent and deep cultivation. Men follow the plough with padding boards or spades and nestle the soil around the stems to exclude light.

A third and final banking is undertaken some 21 days later. Plenty of mould must be built up between the rows, as the final banking is heavy work for two or three horses. Most growers possess hiller or banking ploughs specially constructed to suit the row width worked by them. This operation is followed by the final padding and banking by hand, making up or trimming down the ridges where necessary.

Lifting and Marketing

In soft fenland soil the rows are sliced down as closely as possible on one side, the operator using a spade only. On some farms the side slice is ploughed away. The operator is followed by a man who lifts, shakes, and lays the heads in tufts of three or four heads, a third operator following who groups the tufts into rolls or bundles, each of a dozen heads, and ties or thongs them top and bottom.

A good team can total upwards of 300 rolls per working day. Sometimes, however, a man will prefer to work alone, doing the slicing down, digging, trimming and bundling with rhythmic facility and totalling from 100 to 150 rolls per day.

A good average crop is 100 rolls per ton, although early varieties or disease-infected heads may fail to reach this figure. Allowing for poor heads and

misses, about 1,500 rolls per acre are produced, or a crop weight of some 15 tons per acre. Exceptional crops of 20 tons per acre and more are produced by good growers in favourable seasons from fenland soils.

Clean Crop Production

The first protective sprays should be applied by the plant raiser before the plants leave the nursery beds. It is, however, more usual to commence the spraying in June, just as the plants begin to grow away in their permanent quarters. At least four wet sprayings will be required during the season, and additional sprayings may have to be given if the season is favourable to the development and spread of infection. About 40 gallons of spray per acre is required when the plants are between 6-9 in. high, 85 gallons when they are 15-18 in. high, and 100 gallons per acre when approaching their maximum growth. Spraying should be continued into September, as Blight can spread through and devastate a crop during September and October.

In the fens, growers are able to hire high-wheel power-driven spraying machines, which straddle the rows and cover two to three rows of plants at a time. Some growers prefer to alternate their wet sprays with copper-lime dustings. However, dusting is not so effective as wet spraying, but is a means of affording *some* fungicidal cover to the foliage during periods of rapid growth.

Clean Seed Production

Seed-producing plants, raised from true stocks, are planted on the flat about 15 in. apart in rows 2½-3 feet apart. Wider working alleys should be allowed through the seed plot at intervals to facilitate the work of fungicidal spraying, which is carried out several times during the first season of growth, and six times at least during the following season when the plants flower and produce their seed crop for harvesting in September.

Small seed producing areas can be sprayed with a knapsack sprayer, but power-driven outfits reduce fatigue and encourage more efficient and regular spraying.

The first spraying should be applied when the plants are about 6 in. high and other sprayings carried out at intervals throughout the first year of growth. Between four and six sprayings may be needed, depending on the season and weather conditions conducive to the spread of the disease.

Spraying is commenced during May of the second year of growth and carried through without a break at about fortnightly intervals until the middle of September or thereabouts. Stirrup has shown that the most important sprays are those which are applied while the plant is actually in flower and producing its seed heads. He also showed that by discontinuing the spraying at flowering time, seed infection might be increased from 1 or 2 per cent to 50 per cent.

The standard Bordeaux mixture is 4/4/40 if hydrated lime is used. Proprietary fungicides have also given good results.

PESTS AND DISEASES

Leaf Spot (*Septoria apii-graveolentis* Dorogin and *S. apii* Chester) is the most widespread and serious disease with which the celery grower has to contend. The disease is carried on the seed and the first infections appear as discoloured spots on the leaves of seedlings in the seedbeds or boxes.

The numerous spores of the fungus causing the disease are soon formed in these spots, and are spread to surrounding plants during the watering. Infected seedlings are then planted out in the field and serve as centres from which the disease is further spread by rain. In wet seasons the disease can spread rapidly through a field and destroy almost the whole of the foliage, seriously reducing yield and blemishing the stalks.

Everything, therefore, points to the use of disease-free seed as the only real solution of the problem of Leaf Spot prevention. It has been shown conclusively by Stirrup and Ewan that clean seed can be produced by care and attention to detail. Seed growing, however, is now a specialist's job, and involves repeated spraying of the plants with Bordeaux mixture from the time they are 6 in. high during the first season, and from May to September, at about fortnightly intervals, during the second season. The most important sprayings are those which are applied while the plant is in flower and the seed is ripening. In addition, the flowering stalks of second-year plants should be tied up to wires to hold them upright.

Unfortunately, much of the seed in commerce today is infected with Leaf Spot and cannot be relied on to give a healthy crop. Growers who do not raise their own should demand healthy seed from their merchants; an additional or alternative safeguard is to obtain a report on the health of a sample from the National Institute of Agricultural Botany, Cambridge. Steeping the seed for three hours in a solution of formalin (1 part of 40 per cent strength in 300 parts of water), with subsequent drying, will reduce infection considerably, but not entirely eliminate it. Clean seed is the best safeguard.

A full description of the disease and of methods of control is given in Advisory Leaflet No. 241.

Root Rot (*Phoma apiicola* Kleb.) is a disease which can be very destructive in seedbeds. Although it may be seed-borne, it is probably most destructive when old celery soil is used in the preparation of the seedbeds. Seed infection should be eliminated by the precautions taken to ensure freedom of the seed from Leaf Spot, and soil infection should be destroyed by steam sterilization of seedbed soil before use, if it is known to have been previously used for celery. Steam sterilization of seedbed soil is also the best precaution to take against certain other seedling root diseases—DAMPING OFF (*Pythium* sp.) and BLACK ROOT ROT (*Thielaviopsis basicola* (Berk. and Br.) Ferraris).

Soft Rot (*Bacterium carotovorum*) is a slimy bacterial rot of the heart leaves, which may develop rapidly under certain conditions. It usually invades the stems through wounds made by insects or slugs, or through cracks such as may result from excessive nitrogenous manuring. It is best avoided by the encouragement of good balanced growth and keeping down pests such as slugs.

Cracked Stem, consisting of numerous small cracks with a corky appearance on the leaf stalks, has rarely been recorded in this country. It is due to deficiency of boron in the soil.

The Celery Fly (*Acidia leraclei* L.) is a troublesome pest. The grubs burrow within the leaves of celery, causing blisters, and the crop may be seriously damaged, particularly when seedlings are infested. Parsnips are also attacked by this insect. The pest is liable to build up high populations if

successive crops of celery (or parsnips) are grown in close proximity, and this should be avoided so far as possible. Where spraying is practicable, several applications of a nicotine wash during the early stages of growth will greatly reduce the risk of damage later. Full information will be found in Advisory Leaflet No. 87.

Slugs (Advisory Leaflet No. 115) are often the cause of much loss of celery crops.

DORÉ OR SELF-BLANCHING CELERY

In the traditional system of cropping in a "French Garden",* the old beds are cleared of the last crop (cauliflowers), and after digging over, levelling and watering, they are recropped with *Feltham King* lettuce interplanted with Doré celery. This celery is a quick-growing, self-blanching type, and although it is grown chiefly for culinary purposes, it is included in this bulletin, as it is often interplanted with lettuce.

The lettuce, sown in a separate seedbed some three weeks previously, is planted out on the re-made beds in rows 10 × 9 in. The most suitable variety of celery is *Célèri plain blanc doré*, the seed of which should be obtained from a reliable source, since there are many inferior strains. This seed is sown in frames on a hotbed of 70°F. in the first or second week in March. When large enough to handle, the seedlings are pricked out 2 in. apart on a cooler hotbed (about 60-65°F.) and are later gradually hardened off; or the seedlings may be pricked out into frames where the soil has been warmed by the lights being left on and the frame kept closed for one week before the pricking out. When hardened off the celery is planted out between the lettuce, and while both crops are growing together they must be kept free from weeds.

The lettuce is cut during July, and after it has been cleared the celery is given plentiful supplies of water, and a dusting of 1 part soot (at least 12 months old) and 3 parts lime is recommended. Two dressings of this material should be given with an interval of 10 days between them. It should be applied in the early morning when the celery is still damp with dew and remain on the plant 24 hours, after which it should be washed off with overhead irrigation. This dusting is not only a very good stimulant for the plant but it also acts as a deterrent to celery fly.

The first Doré celery is marketed at the end of August and the bulk in September. It must all be cleared before the autumn frosts, and marketing should be completed by the end of October. Doré celery may be grown as a single crop instead of in conjunction with lettuce. The cultivations are the same, except that it is planted out at a distance of 10 in. between the plants both ways.

SALAD OR SPRING ONIONS

Spring onions form an important crop in most market-garden districts of England, and home production satisfies the demand for this salad. Worcestershire and districts adjoining this county in the midlands grow very large acreages, mainly to supply South Wales and other industrial centres.

* For further details of this method of crop production see Bulletin No. 65—*Crop Production in Frames and Cloches.*

Varieties

White Lisbon is the best for this purpose, although other white varieties may be grown for summer crops.

Soil Preparation

Any good market-garden soil is suitable for growing these onions, but it must be well drained and fertile. As the weeding of this crop is extremely costly, it should be as free as possible from perennial and annual weeds. Spring onions are best grown after a crop that has been well manured. If this is not possible and the land is poor, 30 tons per acre of stable manure or compost should be ploughed in; alternatively, a dressing of hoof at the rate of 8 cwt. per acre should be worked well into the surface soil. Thorough cultivations are essential. The land should be worked into a fine tilth and well consolidated by rolling. On no account should the soil be worked, especially rolled, in wet weather, because the resultant packing down is very harmful to this crop.

Sowing Seed

The dates of sowing depend on whether a spring or early summer crop is required, but it should be remembered that the demand for spring onions falls off about the end of June. For the spring crop sowings should take place from the last week in July to the middle of August, according to district, the earlier sowings taking place in the north and later ones in the south. Spring sowings for the early summer crop should take place as early as possible in February, as soon as the ground is fit to work (see above). Sowings may continue throughout March to give a succession.

From 35-40 lb. per acre of seed are required for the autumn sowing and in spring 30 lb. per acre is sufficient. The seed is drilled in rows 12 in. apart and sown to a depth of ¾ in. The land should be harrowed and then lightly rolled.

Cultivation

Row-crop cultivation should commence as soon as the rows can be clearly seen. This is followed by the removal of the weeds from the actual rows with short-handled onion hoes. Top dressings of stimulating fertilizers are seldom given, but if growth is backward a light dressing (about 1 cwt. per acre) of nitrate of soda may be given after removal of weeds to stimulate the crop into more rapid growth. Subsequent hoeings, either by row-crop tools or by hand are necessary, as the crop must be kept free from weeds until ready for market. Weeds in onion beds may be controlled to a certain extent by spraying with sulphuric acid, which is dealt with in Advisory Leaflet No. 309*. The crop is sprayed before the seed emerges and again in the seedling stage just after the seed leaf (cotyledon) has straightened up from its bent position, and its tip is out of the seed. Experience has shown that it is not advisable to apply the second, or post-emergence, spray to salad onion crops. The pre-emergence spray is, however, quite safe and gives a satisfactory control of weeds. Before the seedlings emerge the following concentration of spray is used: Brown oil of vitriol (77 per cent acid) 13 gal.,

* *Weed Control in Onions and other Horticultural Crops by Sulphuric Acid sprays*, Advisory Leaflet No. 309, obtainable free and post free from the Ministry of Agriculture and Fisheries, 1, St. Andrew's Place, Regent's Park, London, N.W.1.

made up to a 100 gal. of spray with water, then 1 pint of wetting agent is added. For the seedling stage the strength of the spray depends on the species of weeds and therefore varies from 7-10 gal. of acid diluted to 100 gal. with water, plus 1 pint of wetting agent. When diluting, *the acid must be added to the water* or the operation is highly dangerous. The quantity of spray required depends on the type of sprayer used and the size of the weeds, but varies between 100-150 gal. per acre. The spray must be mixed in wooden containers and protective clothing should be worn.

Autumn-sown crops seldom require overhead irrigation. For spring-sown crops water should be used sparingly and be given only during the periods of severe drought, otherwise growth will become too lush and the onions will neither pack nor travel well.

Marketing

Before the last war, in the London districts, it was usual for onions to be bunched in fans, while in the Evesham district they were made into small bunches, which in turn were tied into larger ones. As during the war onions were sold by weight, this bunching was discontinued and they were packed loose in lettuce crates. They are washed clean before dispatch.

CORN SALAD

Corn salad or Lamb's Lettuce (*Valerianella olitoria* Moench) is a pleasantly flavoured salad used mainly by restaurants, especially those which specialize in Continental menus. Imported supplies normally come from France and Italy. It is useful in winter when lettuce is scarce, and is easily grown. Corn salad grows wild in cornfields in various parts of Great Britain (usually on lime-free formations), and also on the Continent, where it is often gathered in winter and early spring for the markets. Most of the improved cultivated types are derived from the wild form, but they produce larger and more succulent leaves. Another kind, also widely cultivated, is the Italian Corn Salad, which is derived from the wild species *V. eriocarpa* Desv., a native of southern Europe.

Varieties

Large-leaved English Corn Salad

This variety is distinguished by its size, vigour and large seeds. It gives a large amount of salad per plant, but the produce tends to deteriorate rapidly in transit. It is the type most widely grown in Holland and Germany.

Italian Corn Salad

This is less hardy but has the advantage of yielding leaves over a longer period and being slower to run to seed, so that a supply of salad can be obtained in the late spring. It is cultivated most widely in the south of France and in Italy, but at present the seed is not available in this country.

Cultivation

Any fertile, well-cultivated soil is suitable for corn salad, the best situation being one that is dry and open. Special cultivation of the soil is not necessary. Any suitable ground becoming vacant during July is prepared by ploughing, harrowing and rolling, as it is important that the land should be firm. Sowings are made at frequent intervals from the end of July until September.

Seed is sown in drills 6 in. apart, and the plants are subsequently thinned to 6 in. apart.

Marketing

The crop is gathered by cutting the whole plant just above root level and packing in trays, 12 lb. chips or quarter-bushel boxes.

RIDGE CUCUMBERS

The bulk of the country's supply of cucumbers is grown under glass, but during the war, when this cropping was curtailed, outdoor ridge cucumbers were in demand, especially as growth could be advanced by the use of cloches. The cultivation of cucumbers in frames is dealt with in Bulletin No. 65*.

Suitable varieties are: *Cheltenham Long Ridge, Bedfordshire Ridge, Perfection Ridge* and *Wither's Ten Weeks*. The following have shorter fruits (6-9 in. long), they are much more prolific, and the weight of crop per acre is much heavier than for the larger fruited types: *Japanese Climbing, Long Green* and *Stockwood Ridge*.

Cultivation

As moisture is important for the cultivation of this crop, well-drained loams are the most suitable, especially those of a silty nature, provided there is sufficient manure to give them an open texture. The very light types of soil should be avoided, owing to their poor water-holding capacity. A sheltered position is necessary.

It is preferable that ridge cucumbers should follow a well-cultivated and well-manured crop such as cabbage or potatoes. Moderate dressings of well-rotted manure should be given, and this should preferably be trenched in where the rows of plants will run in advance of planting.

The earliest crops are obtained from seed sown in glasshouses in early April, one seed being sown in a 3-in. pot, and the plants hardened off from the end of April. When planted out they must be protected by cloches in mid-April, but if no protection can be given they should not be planted out until late May or early June, when the danger of frosts has passed; plants from later sowings should be used. When no cloche protection is available, sowing should be delayed until the second half of May, or early June when the seed may also be sown in drills direct in the area to be cropped; 1½-2 lb. of seed per acre is required. Single rows may be 5 or 6 ft. apart. Double rows, 30 in. apart with 5 or 6 ft. between the pairs of rows, may also be used. If sown by hand the seed should be dropped 12-18 in. apart, sowing two seeds at each position; subsequently the plants are thinned by removing one of each pair. The seed may also be drilled and the plants thinned in the same way. When it is not sown direct the plants are set out in rows the same distance apart, and 18 in. should be allowed between the plants in the row. In some districts ridge sowing is favoured, the seed being sown on the south side of ridges formed by turning the soil over manure laid in trenches.

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* *Crop Production in Frames and Cloches*

The land should be kept well cultivated and clean. When the plants start to run, a complete fertilizer, rich in phosphate, should be given along the rows and hoed in. Some growers apply 4-5 cwt. superphosphate before sowing and give a top dressing of nitrate of soda when the plants begin to flower, but it should be remembered that sufficient time must be allowed between dressing with superphosphate and sowing the seed, as cucumber seed is sensitive to the chemical action of fertilizers. Others top-dress with a mixture composed of hoof and horn—5 parts (by weight), bone meal 4 parts, sulphate of potash 1 part, applied at the rate of 10 cwt. per acre when the plants are growing satisfactorily.

Marketing

Ridge cucumbers should be cut while still hard and green, when nearly full size, all yellow fruits being discarded. It will be necessary to go over the plants regularly about three times a week during the cropping period, for if the fruit is not closely cut cropping will cease. The fruit is packed in wooden boxes or crates and a little fresh grass or hay should be used as packing material.

TOMATOES

Tomatoes form a useful health-giving salad crop and may be cultivated in the open as well as under glass. The following is a summary of the cultivation of this crop in the open, fuller details being given in Bulletin No. 77.*

Tomatoes may be successfully grown on a wide range of soil types, but heavy clays should be avoided. Because of the risk of disease, land which has carried a recent crop of tomatoes or potatoes should be avoided. The site should be sheltered from the north and east by hop lewing or some other windbreak. It is inadvisable to attempt to grow tomatoes out-of-doors in Wales because of the heavy rainfall.

Varieties

Suitable varieties are: *Harbinger, Market King, Hundredfold, Plumpton King, Early Market* and *Potentate*. As these vary in behaviour in different districts and according to soil type, the grower is advised to try several in order to determine which is the most suitable for his conditions. A variety for outdoor cultivation should be selected for its earliness, i.e., the weight of ripe fruit which can be picked in late July and August, as well as the general characters of shape, size and quality required of a commercial crop.

Raising Plants

Plants for planting out should be sturdy and well rooted, with the first bloom truss visible and well developed. These plants are either raised in (1) glasshouses, or (2) frames.

(1) When the plants are raised under glass a variety of composts may be used (referred to in Bulletin No. 77), but the one selected should contain a good deal of gritty material in the form of sand, a fair proportion of organic residues or humus to hold the water, and adequate phosphates. The compost and boxes or pots should be sterilized before use. The most

* Bulletin No. 77. *Tomatoes, Cultivation, Diseases and Pests*—price 2s. (by post 2s. 2d.). Obtainable from the Sales Offices of H.M. Stationery Office or through a bookseller.

satisfactory method of plant raising is to sow 45 seeds in a box measuring 14 × 7 × 2 in. (inside measurements) and to transfer the seedlings to size 60 pots. Sowings made during the first week in April will be ready for planting out during the last week in May or first week in June according to district. The same compost as used for seed sowing is suitable for pricking out the plants in pots, but bone-flour or superphosphate should be added to it at the rate of one 48-size potful to a barrow load of compost, i.e., 1 lb. bone-flour or superphosphate to 100 lb. of compost.

(2) Plants may be raised in frames on hotbeds in which case seed is sown in trays measuring 14 × 9 in., during the last week in March. When large enough to handle, the seedlings are pricked out either into frames being set out 3 in. apart both ways, or they are transferred to seed trays, 2½ or 3 in. deep, with 24 per tray. After pricking out, the seedlings are kept in closed frames until established, after which ventilation is freely given whenever possible. During frosty weather the frames should be covered with mats or straw.

General Cultivation

As tomatoes require fertile land, the normal manurial treatment should be farmyard manure or compost, at the rate of 30 tons per acre, together with 2 cwt. sulphate or muriate of potash, 7 cwt. meat or bone meal and 3 cwt. superphosphate per acre. The land should be ploughed or dug over early in the year and the manures harrowed into the top 2 or 3 in. of soil about a fortnight before planting. If a crop of lettuce is taken off the land before the tomatoes are planted, the above manures should be worked into the land before the lettuce is planted.

Tomatoes should not be planted in the open until all risk of frost is over, i.e., in the last week of May or the first week in June, according to district. For large-scale production, planting is often done with mechanical planters. The rows should be either 3 ft. apart when cultivations are done by hand, or 5 ft. 6 in. or 6 ft. when small tractors are used for cultivations and mechanical dusting machines for pest and disease control. The distance between the plants in the rows is generally not less than 12 in. though it may be reduced to 9 in. with the wider row spacing.

The plants are supported either by individual staking or by stringing with 4-ply fillis twine to permanent or semi-permanent wires.

All side shoots are removed when quite small and the plants should be stopped not later than the second week in August in the south but possibly earlier in other parts of the country. Stopping should be done so that two leaves are left above the last truss which has at least the flowers set, otherwise the fruit will not be large enough when the green fruit is removed in early October. One or two side shoots should be allowed to grow out after stopping to prevent the splitting of fruit.

In general, leaf removal should be kept to a minimum. With most varieties, complete leaf removal close to the stem, up to the first truss, about the time the plant is stopped, is sufficient. Further thinning out of the leaves may be desirable with the heavy foliaged varieties; with these, whole leaves should be removed rather than a large number of portions of leaves. In no case should the leaves be almost entirely removed after the fruit has swollen, as this may damage the crop.

Excessive moisture, which causes coarse growth, should be avoided and the plants must not be allowed to get too dry, or bad setting and splitting of the fruit may result. Where it is possible to supply water, it should be done some days before the plants show signs of water shortage. Sufficient water should be given at one time to penetrate to a depth of 6-9 in. and watering should be done regularly. The most satisfactory method of watering is by overhead irrigation

Marketing

The fruit should be picked when it has begun to change colour, so that it is fully coloured when it reaches the consumer. It is removed from the plant at the joint near the calyx (green, leaf-like growths on top of the fruit), so that the latter remains on the fruit. Great care must be taken not to bruise the fruit when picking or packing. It should preferably be packed in the new "National" tomato boxes which have perforated "liners" to ensure good ventilation in the box and a current of air round the boxes when they are stacked. In very hot weather the fruit should be picked early in the day and should not be packed immediately; it should be left in special trays (like potato-sprouting trays) in a cool packing-shed over night.

Early in October or before the danger of severe frost all large, fully developed green fruit should be picked and ripened under cover in a shed, glasshouse or under whitened Dutch lights. A layer of fruit, not thicker than 6 in., is laid on, and covered with, straw. The temperature of the shed or glasshouse should be kept at 60-65° F. The fruit should be inspected frequently, those which have coloured being taken out for marketing.

PESTS AND DISEASES

Blight (*Phytophthora infestans* (Mont.) de Bary) is the worst disease of outdoor tomatoes and spraying with a copper fungicide should be done as a routine operation. Half strength Bordeaux mixture (4-4-100) can be used but it leaves a deposit and tends to harden the foliage, so that one of the proprietary copper sprays may be preferred. Spraying should be begun as soon as Potato Blight is seen in the neighbourhood or at the beginning of August, whichever is earlier, and it should be repeated at roughly fortnightly intervals.

Stem Rot (*Didymella lycopersici* Kleb.). No satisfactory preventive spray is known and this disease can be controlled only by strict hygiene and care in the seed used. Seed should only be used from a known healthy source. Seed taken from a crop grown outdoors should never be used unless absolutely necessary. If it is essential to use this seed, it should be taken only from unbroken healthy fruit, and plants for seeds should be isolated.

If possible, the outdoor crop should be grown on a fresh site each year. Sterilize all pots and boxes as well as soil used for plant production. Sterilize with formalin all stakes and use new fillis twine for training the plants each year. Train the plants carefully, avoiding bruising the stems, and remove the leaves close to the stem, leaving no snags. Pick off all diseased fruits from the plants and burn them, also keep the surface of the soil around the plants free from debris during the season, by picking up all dead and infected fruit, leaves, etc., which should be burnt. After the crop has been

picked all plants should be burnt; on no account should they be ploughed in. If they cannot be burnt, the plants should be collected into heaps and sprayed with formaldehyde or cresylic acid.

Grey Mould (*Botrytis cinerea* Fr.) may be troublesome in wet seasons and the only way to cope with it is by strict hygiene as outlined above.

The virus diseases MOSAIC and STREAK (Advisory Leaflet No. 38) are common out-of-doors, as also in some seasons is the form of FERN LEAF caused by Cucumber Mosaic virus, but SPOTTED WILT (Advisory Leaflet No. 238) is not often seen in the open.

Outdoor tomatoes as a rule suffer comparatively little from attacks by insect pests.

Wireworms (Advisory Leaflet No. 199). Occasionally serious losses are caused by wireworms burrowing into the lower part of the stems of young plants. Care should therefore be taken to avoid planting tomatoes in fields where there is a high population of wireworms, for there is no cure once the plants have been attacked in this way.

Slugs (Advisory Leaflet No. 115) and **Cutworms** (Advisory Leaflet No. 225) are sometimes troublesome.

WATERCRESS*

Watercress is one of the most useful salad crops. It is in season ten months of the year because the same beds can be cropped continuously. It usually sells best, and commands the highest prices, during February and March when other salad crops are scarce.

Site and Lay-out of Beds

Good sites for watercress beds are not easily found. It grows best in those parts of the country where chalk and limestone exist, usually in valleys, and where there are indications of natural springs, found usually at the source of a stream or along its course. Such springs give good, clean, pure water which is essential for watercress growing. Water rising from these formations register 50-52° F. throughout the year, the necessary temperature for cultivations during the winter and spring.

Besides natural springs, artesian wells may be used, which usually have a bore from 4 to 6 in. in diameter, and are from 40 to 300 ft. deep, according to the rock formation of the valley. A pointed perforated tube driven into the ground, generally to a depth not exceeding 20 ft., is another method of obtaining water under suitable conditions.

It is essential to have a constant supply of water, as 300,000-500,000 gal. per day per acre of beds are required. When choosing a site this must be borne in mind, as the amount of water varies considerably in individual valleys according to rainfall and local conditions. A good fall in the waterway is essential, especially if it is used directly as a " carrying stream " for the beds, though frequently a " carrying stream " has to be specially constructed to discharge into the waterway. The beds must be sufficiently high above the stream to prevent their being flooded when the water rises, since it is essential to control the water passing through the beds at all times.

* For further details see Bulletin No. 136, *Cultivation of Watercress*, price 1*s*. (1*s*. 2*d*. post free).

The size, plan and shape of the beds depend on the supply of water, the contour of the land, and also on the grower's knowledge and skill of management. The ideal lay-out is a group of beds, side by side, supplied with a natural spring or bore in each bed. It is a great asset if a supplementary supply can be arranged so that it is conveyed in a common stream, with controlled inlets at the top of each bed. It is important to lead the water directly into each separate bed, the individual beds being furnished with a separate outlet discharging into the common carrying stream. The water should not be lead from one bed to the other, or the crop in the second bed will not thrive satisfactorily. Alternatively, one large spring or bore can be made to supply a group of beds by means of a common carrying stream discharging into separate inlets to each bed.

The size of the bed is influenced by the volume of the water supply and the peculiarities of the site, the most practicable size being 120-200 ft. long and 20-40 ft. wide. Larger beds should be avoided, since they are more difficult to manage. The sides of the beds should be supported either with timber and turfs or concrete. Timber supports are easier and cheaper to construct, while concrete walls, though more expensive to erect, are easier to keep clean and thus control attacks of the mustard beetle. Common walls between beds should be constructed with concrete sides and a core of chalk or clay, so that in the event of a leak it can be stopped by ramming-down the core. The fall of the beds should be from 6-8 in. for every 120 ft. length of bed. There should be a small waterfall or " stank " at the outlet of the bed so that water leaving the bed may drop 4-6 in. into the common carrying stream.

The bottom or floor of the beds is generally formed from the natural subsoil, i.e., chalk, silt or gravel. Silt is very good but not so clean as chalk; it is also easily disturbed, making the floor uneven. Gravel is not so good, because in March and April, watercress growing in this material may be adversely affected by the sun.

Planting the Beds

There are two distinct types of watercress, i.e., the green and the brown. The green type tends to grow out of the water and can be cropped throughout the year, while the brown, which grows in the water and is more hardy, is essentially a winter and spring cress.

Planting is necessary for laying down new beds, or when old beds become foul with weeds, or the floor of the bed becomes uneven due to silting or rough usage during cultivations. Either cuttings (" tops " 9-15 in. long), or " pulled " plants, are used for planting material. Watercress may be planted at any time of the year when the material is available, but the usual time is from June to October. In June and July cuttings are used; after this it is advisable to used pulled plants since cuttings are difficult to establish later in the year. If the material is available it is an advantage to plant up a few beds in early March as they rapidly establish themselves and a crop can be taken in April.

In preparing the bed for planting it must be cleared of all weeds, rubbish and surplus mud and silt. If the floor of the bed is uneven the plants will root up the stem and be of poor quality in the shallow places, while in the parts which are too deep the crop will be thin and the stalks a bad colour.

The floor of the bed is therefore levelled, a special wooden rake being used for this and for weeding. A good depth of water should be used; working from the bottom end of the bed in an upstream direction, the weeds are loosened and raked up, using the teeth of the rake, and a rough levelling is given. For the final levelling the water supply is reduced so that there is enough just to cover the floor of the bed; all parts showing above the water are smoothed down. This is carried out working downstream, and the flat side of the rake is used.

The bottom end of the beds should be planted first and the work proceeds upstream. With large beds it is advisable to begin in the middle of the bed and plant the top half first. The plants are inserted in pinches of 4 or 5 heads, the first row being stuck into the floor of the bed, or if it is too hard the pinches may be held in position with a stone. After the first row has been put in the heads are thrown in, each pinch falling on the stalks of the row before it. Gradually the whole area is covered with plants. It is advisable to plant right across the width of the bed and not a strip at a time. The beds are planted right up to the banks except at the top end where a 12-in. strip is left to allow for the free circulation of the water from the spring or inlet. It is advisable for the planter to stand on a plank extended across the bed. One cwt. of cuttings should cover 12 sq. yd. of bed; pulled plants need not be planted so thickly.

After planting, the crop is left in shallow water until it starts to root, when the heads are trimmed off with a light bagging hook. This operation is started from the bottom end of the bed and the work proceeds upstream. The water is then increased to the normal level. The crop is now established; usually shoots breaking from this stubble are used for further plantings (pulled plants), or if it is not required for planting it may be marketed.

General Cultivation

General cultivations consist of manuring and cleaning the banks, carrying streams and beds. A dressing of 1-2 cwt. superphosphate per acre is beneficial after the crop has been taken, and also when the stubble begins to break. As a rule other fertilizers are not required. All banks must be kept trimmed or they will harbour pests, particularly the mustard beetle, and the carrying streams must be cleared of weeds. From April to June the stubble must be kept free from weeds. This is done with the wooden rake, and it is advisable to work from a wooden plank suspended across the bed. As much water as possible is allowed to enter into the bed to wash off the weeds. Starting from the top end of the bed the stubble is pushed down so that it will lie the same way as the flow of the water. The stubble is struck lightly to release the weeds, as far as can be reached comfortably by the worker, and then it is pushed under the water in an orderly manner. The plank is pushed along over the work just done, then the worker, facing upstream, scrapes the stubble already put down free from weeds with the flat side of the rake, using sharp light strokes. The rubbish is pulled up into a heap on the middle of the plank and is removed in baskets. Where weeds are growing in the crop the whole area is pulled out, including the cress, and replanted. In autumn when the final cleaning is done, the beds should be flooded overnight to float off the weeds. The stubble is then cleaned as already described and the water level reduced to normal.

A short sturdy crop is required to withstand the winter frosts. To obtain this the stubble should be kept short in August, if necessary discarding the heads cut if there is no market, and in October or November the crop is picked over or halved; i.e., pinches of 3 or 4 heads are cut at a time evenly over the bed, so that about half of the crop is left, which protects the stubble from frosts. This treatment is only suitable for the green type, as it is not advisable to cut the brown after September.

During the colder months of the year watercress grows in the water and the stubble thickens, while in the summer the shoots grow in the air. In October with the approach of frosts, after the final cleaning, the stubble is carefully put down under the water with wooden rakes or slatted wooden rollers, and this operation should be repeated after any open weather in October or November, since the cress will grow out of the water during warmer spells. In November the stubble is very brittle and special brooms are used for this purpose.

Marketing

There are two methods of harvesting watercress, varying according to the season. From March to October, when the cress is cut as it grows above the water; in the winter and early spring, when it is pulled as it grows in the water. With the former method the watercress is cut in "hands" weighing about 2½ lb., and in the latter 2 or 3 heads are taken evenly over the bed, so that two-thirds of the crop is left to thicken. The watercress is either packed in wicker baskets known as flats, holding 70-80 lb. (there are half- and quarter-flats), or in large chips which weigh 10-12 lb. when packed. The cress is packed loose in the flats, with the heads towards the centre, and it is marketed either in bunches (3 doz. to a chip) or loose in chips. When packed, the flats or chips are placed in a cool shed and frequently watered until ready for dispatch, when they are drained and labelled for their destination. As watercress must be marketed in a fresh condition it should be cut and dispatched the same day.

PESTS AND DISEASES

Mustard Beetle (*Phaedon cochleariae* F.). These bright blue beetles and their grubs are common pests of watercress. They feed voraciously on the foliage and damage may be severe. Cleanliness is the important thing, and if the beds are constructed of concrete and the bank and all water-courses kept cleaned and trimmed, the risk of serious attacks will be reduced to a minimum. In small outbreaks, areas of affected plants should be cleared out and destroyed before the pest spreads; where larger areas are attacked, the best means of control is to flood the beds for a few hours, sweeping off the beetles and grubs into the water with wooden rakes. The pests can also be killed by applying insecticide dusts containing pyrethrum or derris or DDT, but great care is necessary if these insecticides are used because of the danger of killing fish. Derris is extremely poisonous to fish and must not be used if there is any risk that even very small amounts will get into streams or ponds containing fish.

Fresh Water Shrimps and Caddis Worm. Attacks by the fresh water shrimp and caddis worms can be prevented by keeping the beds cleaned regularly.

Mosaic disease is not infrequently seen on this host, and the stems and roots are apt to be invaded by a species of the water mould fungus *Pythium*.

ROOT VEGETABLES.

Root vegetables are being used increasingly for salads. As their general cultivation is outlined in Bulletin 120* only a summary is given in this bulletin.

CARROTS

There are three types: long, intermediate, and stump-rooted, and these may further be divided into early carrots, which are bunched, and maincrop carrots, which are marketed loose and can be stored.

Suitable varieties are——Earlies: *Amsterdam Forcing* and *Ideal*, ready for market in late June; *Broadcast* and *Primo*, ready for market in early July; *New Bunching* and *Early Market*, ready for market from July onwards. Maincrop: *Chantenay, Blatchford's Early Model, James's Scarlet Intermediate. St. Valery* is suitable for the peaty lands.

A light friable soil, through which the roots can penetrate deeply, is required for carrots. There must be no fresh manure present or the roots will fork, and for this reason carrots are grown after a previously well manured crop. There must be sufficient lime present in the soil for successful cultivation; if growers are in doubt as to whether there is sufficient lime, they should consult the County Horticulture Advisory Officer of the National Agricultural Advisory Service.

The land for the seedbed should be as free as possible from weeds. Deep cultivations are essential for all types of carrots. For early carrots a stale furrow is necessary to obtain a regular germination. The land should be thoroughly cultivated with a cultivator or disc harrow until a fine tilth is obtained. When preparing the seedbed every care must be taken to conserve moisture, especially when summer sowings are to be made. The land is harrowed at intervals right up to the time of seed sowing to kill any weeds which germinate. During the pre-sowing cultivations the following fertilizers should be worked in:

For early carrots :	*cwt. per acre*
Meat meal or tankage	6
Sulphate of ammonia	1
Sulphate or muriate of potash	2
Superphosphate	5

For maincrop varieties the organic nitrogen, i.e., meat meal or tankage, should be omitted and the sulphate of ammonia may be increased to 2 cwt.

In the south and other early areas, seed sowing may start during the first fine days in February, provided the soil is friable, and may continue throughout March and April. In the north, sowings should be deferred a few weeks. Later sowings for bunching may be made as a catch crop in July and early August, after potatoes or some other summer crop. Successional sowings of maincrop carrots are made from April to June. For sowing in February, 8 lb. of seed per acre should be used, and for subsequent sowings 6 lb. per acre is sufficient; less seed may be used under good conditions. Seed should be sown thinly, as heavy thinnings encourage attacks by carrot fly. For bunching carrots the drills should be spaced 12 in. apart; for later sowings 18 in. is required. Sowing the seed to a depth of $\frac{1}{2}$ in. is usually sufficient, and in no case should it be deeper than $\frac{3}{4}$ in.

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* Bulletin No. 120. *Root Vegetables*, price 9*d*. (10*d*. post free).

Post-drilling cultivations consist of hoeing by hand, push hoe or mechanical row-crop tool as soon as the rows of carrots can be seen from one end of the field to the other. Provided care is taken in the amount of seed used, thinning should not be necessary. If it must be resorted to, the holes left by removing the plants should be filled with soil immediately. If overhead irrigation is available, it can be used with advantage, especially when pulling bunching carrots during spells of drought. The land should be well watered 24 hours before pulling. It should be noted that excessive irrigation causes split roots.

Early carrots are pulled by hand or lifted with a fork. If cultivations have been good all the carrots should be ready for pulling at the same time. The early varieties are marketed with their foliage, in bunches weighing 2 lb., at the beginning of the season. The roots are usually washed and packed in lettuce crates or bushel boxes. Maincrop varieties are either lifted with forks or ploughed out. The tops are removed by hand and the roots are usually packed in bags of 56 lb. The roots may be either washed or unwashed, according to the requirements of the market.

Maincrop carrots may be left in the ground and lifted as required until the frosts set in, when they should be lifted and stored in small clamps.

BEETROOT

Three types of beetroot are grown—the round or globe, the intermediate, and the long. Suitable varieties are: Round type (early): *Model Red Globe, Detroit Red Globe.* Intermediate type: *Cobham Early.* Long type: *Cheltenham Green Top.*

It is important to aim at producing tender, fibre-free and well-coloured roots, which are not too large. For this a deep, fertile soil is necessary, which has been manured for the previous crop. The best roots are grown on light land; if heavier land must be used the early varieties will give the most satisfactory results.

The land is prepared in the same way as for carrots, great care being taken to conserve the moisture, especially for maincrop sowings. The following dressing should be worked into the soil during the pre-planting cultivations:

	cwt. per acre
Sulphate of ammonia	1
Superphosphate	3–4
Sulphate or muriate of potash	1

If dung has not been used for the previous crop, the following alternative mixture should be used:

	cwt. per acre
Sulphate of ammonia	2
Superphosphate	5–6
Sulphate or muriate of potash	2

This may be supplemented at thinning time by a top dressing of 1 cwt. per acre of some inorganic nitrogenous fertilizer. In some districts a dressing of 3-4 cwt. per acre of agricultural salt is given before sowing which increases the moisture in the soil and thus assists germination.

Round beet and the intermediate variety, *Early Cobham,* should be sown from the second week in March until the end of June. Early sowings of beetroot are inclined to bolt and in some seasons considerable losses may occur.

Long beetroot should be sown from about May 10 to the end of June, since it requires a warmer soil than round beet; May 10 sowings are marketed during August and September, and the crop from later sowings is stored for the winter. The seed should be sown 1½-2 in. deep in drills 12 in. apart, the plants being subsequently singled to 3-4 in. apart for round varieties, and 6 in. apart for long varieties.

Surface cultivations and weeding are the same as for carrots. If available, overhead irrigation may be used with advantage for early round varieties, but except in times of severe drought, when the seed is germinating, it should not be used for the long types or coarse roots will result.

The lifting of round beetroot for bunching of early varieties begins in June or July. After a month or two, when the prices drop, bunching is no longer profitable, and the roots are marketed loose. The season for topped beetroot then commences and lasts until the following May. It is important to lift the roots with care, and not to bruise them during packing and marketing, since damaged roots will " bleed " and lose their colour. In a loose, light soil the beet can be pulled by hand, or a sugar-beet lifter may be used. Early round beet are marketed in bunches of 6, the foliage being tied round with fillis string. The bunches are packed in boxes or crates or sold in units of a dozen bunches. When round beetroot is marketed " topped," the leaves are twisted off by hand after the roots have been lifted, and they are marketed loose in lettuce crates. The most popular sized roots are those which require 4 doz. to fill a bushel box. Very large beet and " chumps " (forked roots) should be packed alone. Maincrop beet may be stored in clamps or sheds for winter use.

CELERIAC

Celeriac tastes very much like celery, but instead of the leaf stalks being eaten, the swollen, solid base of the plant is used in salads, being cooked and served cold or shredded raw.

Cultivation of this crop is similar to that of celery, except that the plants are set out on the surface instead of in trenches. The soil should be light, very fertile and well supplied with moisture, but need not be deep.

Seed is sown in gentle heat, under glass, early in March. The seedlings are pricked out into frames and gradually hardened off. In June they are planted out in their final quarters with a spacing of 12-18 in. apart each way; at the wider spacing an intercrop of lettuce or endive can be taken. It is important not to plant too deeply, and any lateral shoots formed should be removed so that only one solid base is formed. A further removal of laterals may be necessary during the summer.

The land should be kept clean and the soil drawn away from, rather than towards the " roots." Towards the end of the season the soil is drawn lightly over the " roots," and in October part of the crop is lifted, all leaves except a few in the centre being removed, and the roots stored in sand. Roots may also be left in the soil, earthed over to prevent frost damage, and drawn upon when required.

PESTS

The **Carrot Fly** (*Psila rosae* F.) is the most important pest of carrots; the maggots burrow into and feed on the roots, causing them to become " rusty."

Damage by the first brood can often be avoided by delaying sowing until the end of May or later. Early carrots should not be grown close to maincrop carrots or parsley or parsnips which are other host plants of the fly. The flies find shelter in vegetation round carrot beds and all hedges and ditches should be kept cleared and trimmed and weeds eliminated. It is bad practice to allow carrots to remain in the soil through the winter or to dig in badly damaged crops. Details of chemical control measures will be found in Advisory Leaflet No. 68.

The **Beet Eelworm** (*Heterodera schachtii* Schmidt) (Advisory Leaflet No. 233), an important pest of sugar beet, sometimes attacks Red Beet, causing stunting and poor growth, with an excessive development of lateral roots. Tiny lemon-shaped swellings (cysts) can be seen in these roots. If this pest is noticed, the County Horticulture Advisory Officer of the N.A.A.S. should be consulted.

Other pests that may attack beetroot are BLACKFLY (Advisory Leaflet No. 54), FLEA BEETLES (Advisory Leaflet No. 109) and MANGOLD FLY (Advisory Leaflet No. 91).

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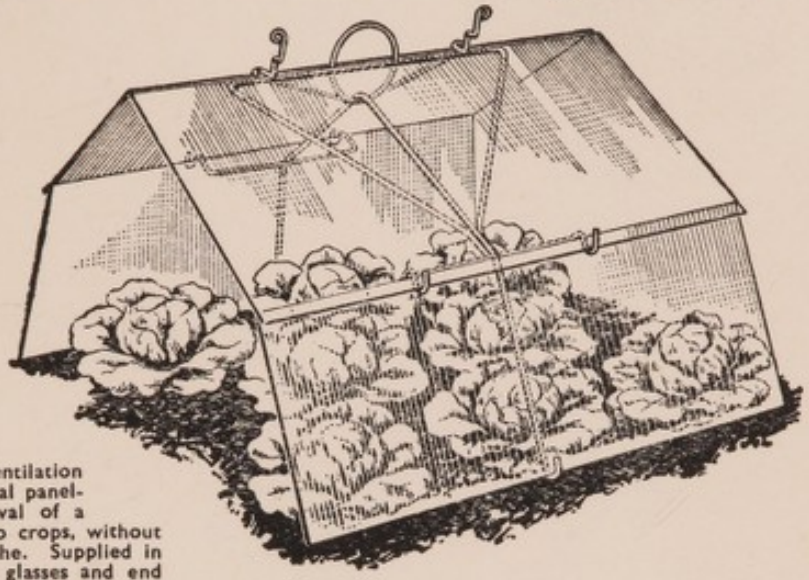
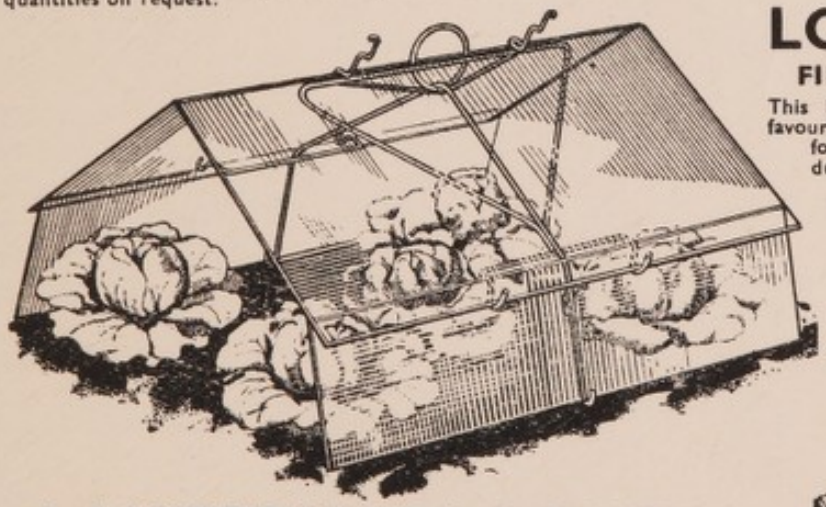
It is 24" long, 23" wide, 15½" high. The V-handle allows of instant adjustment of ventilation along the ridge and the special panel-fitting makes the entire removal of a top glass easy for full access to crops, without lifting or weakening the cloche. Supplied in 'Packs' and 'Cases' with end glasses and end wires. Quotations gladly sent for large or small quantities on request.





LOW BARN

FINE FOR LETTUCE

This Low Barn model is a great favourite with growers and amateurs for all-round vegetable production, especially for lettuce.

24" long, 22" wide, 12" high it easily covers up to five rows of seedlings and will take a double row of lettuce with room for an inter-crop of peas, onions or carrots. Supplied with ventilating handle and panel-fitting similar to the Growers' Barn. Sold in 'Packs' and 'Cases'; complete with end glasses and end wires.

LANTERN CLOCHE

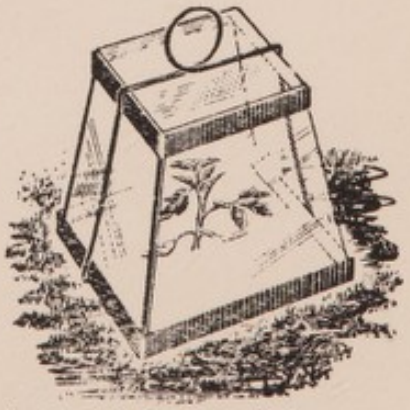
SAVES TRANSPLANTING AND CHECKS

Holding the Royal Horticultural Society's Award of Merit, these miniature handlights afford invaluable protection from wind, heavy rain and damp and are of great assistance in frost. They save all the trouble of transplanting and all danger of checks.

Vegetables and Flowers are sown under Lanterns on the sites where they are to mature. When the plants are sufficiently advanced the Lanterns are changed for full sized cloches and the crops allowed to grow on.

Ventilation is easily adjusted by the sliding roof glass of the Lantern.

Lanterns are made in two sizes, Medium, 6" square base, 6" in height.
Small, 4½" square base, 4½" in height.



Lantern Cloches are light to handle and when not in use nest inside each other and take up very little space.

FULLER DETAILS AND PRICES ON REQUEST

It is advisable to order EARLY to make reasonably sure of prompt dispatch

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