

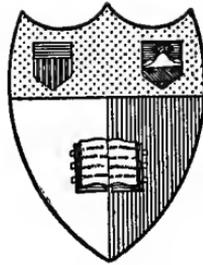
# LIPPINCOTT'S FARM MANUALS



## PRODUCTIVE VEGETABLE GROWING

JOHN WILLIAM LLOYD M.S.A.

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"The first farmer was the first man, and all historic nobility rests on possession and use of land."

—EMERSON.

# LIPPINCOTT'S FARM MANUALS

EDITED BY

KARY C. DAVIS, PH.D. (CORNELL)

PROFESSOR OF AGRICULTURE, SCHOOL OF COUNTRY LIFE  
GEORGE PEABODY COLLEGE FOR TEACHERS, NASHVILLE, TENNESSEE

---

## PRODUCTIVE VEGETABLE GROWING

By JOHN W. LLOYD, M.S.A. (CORNELL UNIVERSITY)

PROFESSOR OF OLERICULTURE IN THE UNIVERSITY OF ILLINOIS

# LIPPINCOTT'S FARM MANUALS

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By GEORGE E. DAY, B.S.A.

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**WHEEL HOE IN OPERATION**

THE INTRODUCTION OF THE WHEEL HOE AS A TILLAGE TOOL MARKS A DISTINCT EPOCH IN THE USE OF LABOR-SAVING METHODS IN HOME AND MARKET GARDENING

# LIPPINCOTT'S FARM MANUALS

EDITED BY K. C. DAVIS, PH.D. (CORNELL)

---

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PROFESSOR OF OLERICULTURE IN THE UNIVERSITY OF ILLINOIS

*194 ILLUSTRATIONS IN THE TEXT*

"If vain our toil,  
We ought to blame the culture, not the soil."  
POPE—*Essay on Man*

THIRD EDITION, REVISED



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## PREFACE TO THIRD EDITION

THE War has given a special impetus to vegetable production, and particularly to the planting of home gardens. The substitution of vegetables for some of the more concentrated foods in the diet of civilians will release for the use of the American army and the Allies large quantities of cereals and meats. So far as these vegetables are the products of home gardens, they will reduce the amount of transportation necessary to supply food to the American people, and thus assist in relieving the railroads in this time of congested traffic.

There was never a time when home gardens were more important; yet in the present effort to increase vegetable production, there is likely to be large waste of energy and seeds by those previously unfamiliar with vegetable gardening, unless they have proper guidance. The special literature being published to meet this emergency is good in many respects, but much of it is fragmentary and leaves the reader without a firm grasp of fundamental principles of gardening. It is hoped that the present edition of *Productive Vegetable Growing* will supply this need, and be of material assistance to planters of "war gardens."

JOHN W. LLOYD.

URBANA, ILLINOIS,  
January, 1918.



## PREFACE

Books on vegetable production have been written from the viewpoint of the East, West, North and South. The present volume is written from the viewpoint of conditions as they exist in the great central prairie region, known agriculturally as the corn belt. But the principles here laid down are applicable in all sections. The cultural requirements of the various crops have been analyzed in the light of many years' experience with vegetables, and an attempt has been made to present the underlying principles of vegetable production in a clear and logical manner, and place vegetable gardening on a rational basis. It is impossible for man to control the climate of a given locality. It is possible, however, for him to adapt his gardening operations to the conditions as he finds them. Knowing the temperature requirements of a given crop and the length of season demanded for its development, he can adjust the time of planting and method of handling to meet as fully as possible the needs of the particular crop. But in spite of all that can be done even by the well-informed gardener, vegetables demanding radically different climatic conditions may not thrive equally well in the same garden. A reasonable degree of success with a large number of different vegetables can be attained by a careful grower in almost any locality, but the commercial production of special crops should rarely be undertaken except in localities where the climatic and other conditions are especially favorable for the particular crop in question.

A thorough understanding of the temperature requirements of the different crops is considered of such vital importance to productive vegetable growing that this feature is made the basis of the classification of vegetables used in the present volume, and is given special prominence in the cultural directions for the various crops.

The aim throughout the book has been to emphasize principles rather than mere details of practice. The order of presentation has been carefully planned, and in using the book as a text, the various topics should be taken up in the order presented. The Suggestions for Laboratory Work, in Chapter XXXIII, however, should be read by the instructor before beginning the course.

In discussing the handling of the individual crops, it is assumed that the earlier chapters of the book have already been mastered, and details of numerous operations are not repeated.

While this book is intended primarily as a text for use in schools and colleges, it is the hope of the author that it may also prove helpful to the ever-increasing number of persons who desire to supply their tables with vegetables from their own gardens, and to persons who contemplate the commercial production of vegetables as a business.

The author wishes to acknowledge his indebtedness to the Illinois Agricultural Experiment Station for the use of many negatives in preparing the illustrations, and for permission to use certain material from the publications of this Station. He is also especially grateful to Mr. C. E. Durst for taking the photographs to make the following illustrations: Frontispiece, Figs. 4, 8, 17, 24, 26, 27, 28, 32, 45, 53, 60, 65, 68, 69, 73, 82, 89, 102, 125, 127, 131, 132, 133, 134, 136, 137, 158, 159, 160, 161, 162, 184 and 191. Thanks are also due to W. Atlee Burpee & Co., Philadelphia, Pa., for Figs. 9, 10, 56, 93 and 185; to the Bateman Mfg. Co., Grenloch, N. J., for Figs. 29, 39, 40, 44, 50, 107, 116, 117, 118, 122 and 164; to the Madison Plow Co., Madison, Wis., for Fig. 31; to Dr. S. A. Forbes, State Entomologist, Urbana, Ill., for Figs. 46, 47, 48, 129 and 130; to the John A. Salzer Seed Co., La Crosse, Wis., for Fig. 55; to the Henry Field Seed Co., Shenandoah, Iowa, for Figs. 67 and 120; to R. & J. Farquhar & Co., Boston, Mass., for Fig. 124; to Wm. Siebold, Peoria, Ill., for Fig. 179; to J. J. Gardner, for Figs. 186 and 188; to C. B. Sayre, for Figs. 97 and 189; to the Orange Judd Co., New York, for Fig. 49; to L. L. May & Co., St. Paul, Minn., for Figs. 62 and 119; to P. K. Blinn, Rocky Ford, Colo., for Fig. 19a; to Walter S. Schell, Harrisburg, Pa., for Fig. 138; and to Holmes-Letherman Seed Co., Canton O., for Fig. 143.

JOHN W. LLOYD.

URBANA, ILLINOIS,  
July, 1914.

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# PRODUCTIVE VEGETABLE GROWING

## CHAPTER I

### TYPES OF VEGETABLE GROWING

There are two distinct types of vegetable growing, amateur and commercial. In amateur or home vegetable gardening, the primary object is to supply the home table with vegetables of high quality. A large assortment and continuous supply are desirable. In commercial vegetable growing, the primary object is to supply the demands of the market in the way that will be most remunerative to the grower. The assortment may be either large or small and the supply either continuous or intermittent. There are really three types of commercial vegetable growing: (1) The growing of a general assortment of vegetables for local market, (2) the growing of one or a few special crops, mainly for shipment to distant markets, and (3) the growing of vegetables for canning or pickling factories.

#### MARKET GARDENING

The term "market gardening" is usually employed to designate the growing of a general assortment of vegetables for supplying a local market, the term "local market" meaning a market within driving distance from the point of production. If the local market is a comparatively small town, the market garden in that vicinity does not differ materially from a properly planned home garden, except that it is larger. A general assortment of vegetables is grown, so that vegetables of some kind may be marketed at almost all seasons of the year. Much of the land produces only one crop a year, and none of it more than two crops. Sometimes the land is manured once a year and sometimes less frequently.

Where the local market is a large city, the land available for gardening purposes within convenient driving distances from the market is likely to be exceedingly high priced, so that very intensive methods of culture must be practiced in order to secure

large returns per acre. The intensity of the methods practiced usually varies directly with the value of the land (Fig. 1), and depends upon the size and location of the city, the distance of the particular piece of land from the heart of the city, the density and character of the population in the immediate locality, the character of the roads leading to the market, and the adaptability of the land for gardening purposes. From two to four crops are grown on the same land each season. Very heavy and frequent manuring is practiced and artificial watering sometimes employed.



FIG. 1.—Market garden near Boston, on land worth ten thousand dollars per acre. This land will eventually be sold for building lots.

The growing of vegetables for local market has certain advantages over the culture of vegetables for shipment to distant markets. The grower who can market his product in his immediate locality avoids the expense of railroad transportation and a large part of the expense for packages. He is in closer touch with the market, and, except in the case of extremely perishable goods, can largely regulate the quantity of products which he will market upon a given day, and make the supply correspond quite closely with the demand at that particular time. There is, therefore, less fluctuation in prices, and more certainty of a fair profit. This is

especially true of marketing in the smaller and medium-sized cities.

The growing of one or a few special crops is usually practiced only where the conditions are especially adapted to the production of the crop or crops in question. The favorable conditions may be those of soil, climate, shipping facilities, availability of labor or accessibility of fertilizer, or a combination of two or more of these factors. Labor and manure can be secured most abundantly in close proximity to large cities. It is therefore not surprising to find special crops, requiring heavy manuring and demanding a large amount of cheap hand labor, grown on a large scale in the vicinity of large cities, where at certain seasons women and children are transported by the trainload from the city to the fields in the morning and back to the city at night. Onion sets constitute a crop of this character and are very extensively grown near Chicago and certain other large cities.

#### TRUCK-GROWING OR TRUCK FARMING\*

When vegetables are grown at so great a distance from market that railway or water transportation is required for reaching the market, the industry is commonly referred to as "truck-growing," "truck farming," or "trucking." It is usually carried on where land is low priced as compared with that on which vegetables are grown within driving distance of the large city markets. Less intensive methods of culture are practiced and a smaller assortment of vegetables is grown, but the acreage devoted to a single crop by an individual grower is usually larger in truck-growing than in market-gardening. Often only one or two truck crops are grown in a given locality, and these may constitute the "money crops" in a system of mixed farming, or in exceptional cases large areas may be devoted to a single crop by a person who gives his whole attention to that one crop. The latter condition obtains only in regions especially adapted to the particular crop in question.

The extension of vegetable growing to a distance from market has been brought about by the enormous increase in land values near cities, occasioned by the growth of the cities, and the demand for products earlier in the season than they could be produced under outdoor conditions in the immediate vicinity of the market.

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\* Extract from the author's article on "Truck-Growing" in *Cyclopedia of American Agriculture*, Vol. II, pp. 653-656. Printed by permission of the MacMillan Co., Publishers, New York.

The latter cause has resulted in the development of early vegetable growing at the South for shipment to northern markets while the former has resulted in the removal of the growing of staple, cool-season, late crops to locations more or less remote from the northern markets though perhaps in the same latitude.

**Considerations of soil and climate** largely determine the general location of truck-growing areas for given crops. Of these the climate is the more important except in the case of a few crops requiring special soil conditions for their proper development. However, by no means all localities adapted to the production of certain crops have become commercial centers for those crops. The exact location of truck-growing areas within a region adapted to the production of certain crops is determined by transportation facilities and the inclinations of the inhabitants. New shipping points are continually being developed by reason of the extension of railroad lines to new regions, and the enterprise of a few progressive men in each locality.

It is only at points where a sufficient number of men are growing the same crop or crops that are marketed at the same season to enable shipments to be made in car lots, that good shipping facilities and desirable freight rates can be secured. In the case of some crops, such as watermelons or late cabbage, the individual grower can ship in car lots; but with many crops, such as asparagus, green peas, muskmelons or tomatoes, an individual grower would usually be able to furnish only a small fraction of a car in any single shipment. In order, therefore, to develop a new shipping point, it is necessary that the men who wish to enter the trucking business induce a sufficient number of other men to grow the same crops to secure adequate shipping facilities.

**As an adjunct to general farming**, truck-growing is becoming an important factor in the agriculture of many localities; and it is on that basis that it is destined to hold a permanent place among the activities of rural people.

In general, truck crops demand heavy manuring and very thorough tillage. A system of rotation which includes a truck crop every three or four years will usually result in increasing rather than diminishing the productive capacity of the soil. In a sandy region where watermelons thrive and winter wheat is the staple grain crop, a rotation of wheat, clover and melons is highly satisfactory; or if corn also is grown, the rotation may be extended one year, and the corn planted on the clover sod. In case clover

does not thrive in the region, cow peas are sown immediately after the wheat is harvested, and will leave the land in ideal condition for melons. On a clay soil in regions where clover does not thrive and wheat is not grown, but where muskmelons constitute an important money crop, the following rotation has given exceptionally good results: Corn, cow peas, melons, timothy. The melons are heavily manured, and the thorough tillage required by this crop leaves the land in ideal condition for seeding to timothy immediately after the melon harvest (Fig. 2). Early tomatoes might be substituted for melons in the same rotation with almost as good results.



FIG. 2.—Field of muskmelons. An important truck crop in a system of mixed farming.

#### GROWING VEGETABLES FOR THE CANNERY

The growing of vegetables for canning and pickling factories is usually carried on in regions especially adapted to the production of the crops in question. Factories are commonly located only in such regions. It is not a mere coincidence that blanched asparagus is canned in eastern Long Island or peas in Delaware, Maryland and western New York. Other vegetables extensively grown especially for canning or pickling are sweet corn, tomatoes, string beans and cucumbers. The growing of these crops for this purpose does not differ from their culture for marketing in the fresh state, except that earliness is not sought, and the methods

of culture are usually less intensive. The main difference is in the method of marketing. The crops are usually grown under contract at a specified price per ton or bushel, agreed upon before the crop is planted. There are no fluctuations in price through the season, no packages to buy, no worry about delayed cars and no freight bills to pay; so that, although the factory price per bushel or ton may seem low as compared with city market prices early in the season, the net proceeds from the crop may be fully as great.

#### HOME VEGETABLE GROWING

As already suggested, a home vegetable garden is maintained not for the direct purpose of making money, but for supplying the owner's table with fresh vegetables. However, if properly planned and cared for, the home garden may be made exceedingly profitable by reason of the large amount of table supplies it furnishes. A home vegetable garden differs from a local market garden principally in size. It seldom consists of more than one acre, and may be of any size from this down to a single square rod or even less. Its size will depend to some extent upon the size of the family whose table it is to supply, but primarily upon the amount of land available for gardening purposes. Three types of home vegetable gardens may be distinguished: (1) The farmer's garden, (2) the village or suburban garden, and (3) the city garden.

The differences in the type of gardening practiced in these three sorts of gardens are due mainly to differences in the size of the gardens. On the farm, where any amount of land the owner desires can be reserved for a garden, there is no restriction on the assortment of vegetables or the space allotted to each sort. Plantings are made in long rows (Fig. 3), wide apart, and horse tillage employed as much as possible. The most distinctive feature of a farmer's garden should be the reduction of hand labor to a minimum, for time is more expensive to the farmer than space, and the main effort should be to produce maximum crops at a minimum expenditure of labor, regardless of the amount of space required.

The conditions to be met in the village or suburban home garden are often radically different from those on the farm. Space is likely to be limited so that the rows of vegetables are usually planted rather close together, and hand methods of tillage employed. It may be necessary to omit from the suburban garden certain vegetables that require a large amount of space.

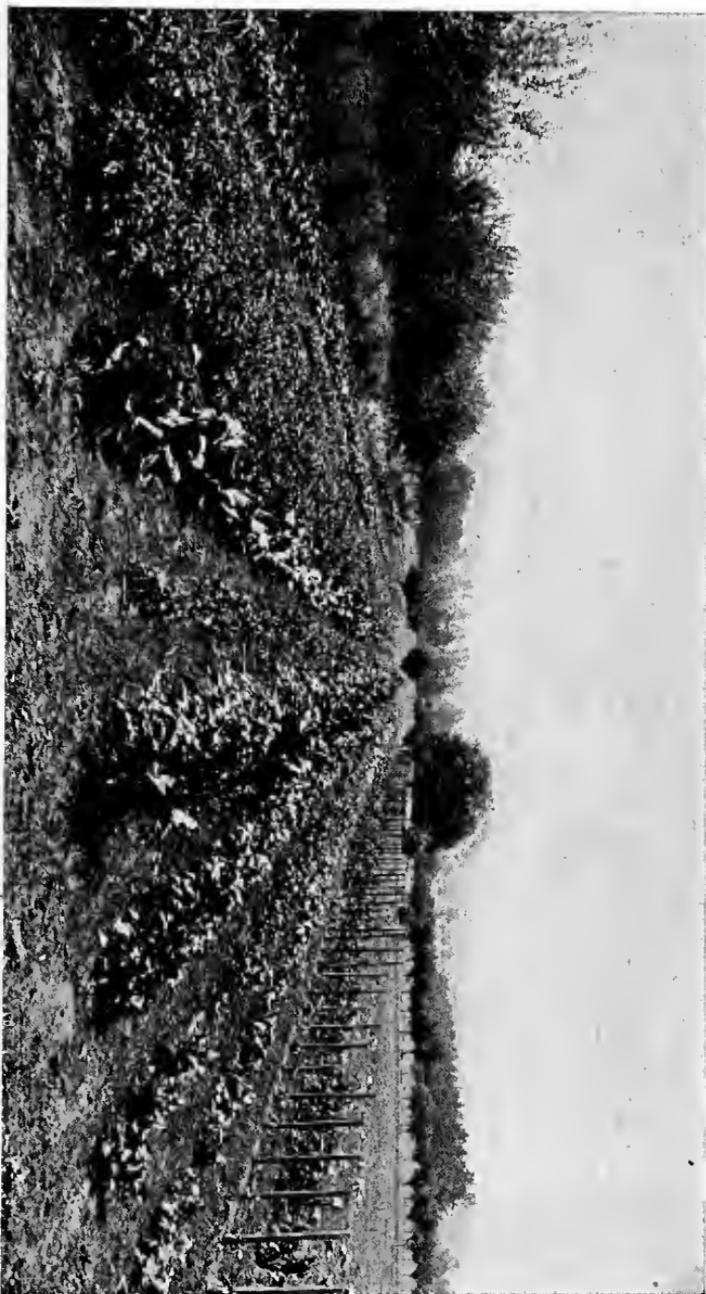


FIG. 3.—Farmer's home vegetable garden. Note the long rows with ample space between for tillage with a horse.

**Gardening in a city back yard** is even more intensive than suburban gardening, and is usually attended by greater difficulties. Space is likely to be very limited, and the soil often ill-adapted to gardening, on account of being "filling" composed principally of clay subsoil secured from the excavation for the basement of the residence. However, the limitations of space are at least partially offset by an abundance of water from the city supply, and the nature of the soil can be radically changed by the addition of sand and humus, so that extremely intensive methods of gardening may be practiced and the small area made to yield an abundant harvest.

### QUESTIONS

1. What is the primary object in home vegetable gardening?
2. What is the primary object in commercial vegetable growing?
3. Distinguish three types of commercial vegetable growing.
4. Define "market gardening." What distinct characteristics and advantages has this type of vegetable growing as compared with truck farming?
5. Define "truck farming." In what respects does it differ from market gardening?
6. What causes have led to the development of truck farming?
7. What factors determine the location of truck-growing areas?
8. Suggest three rotations adapted to general or mixed farming, with one truck crop in each.
9. Where are canning factories usually located?
10. What vegetables are commonly canned? Pickled?
11. What advantages has growing vegetables for the cannery over growing them for the general market?
12. Distinguish three types of home vegetable gardens, and characterize each.

## CHAPTER II

### SOIL AND LOCATION

A FEW special crops, like celery and watermelons, demand particular types of soil if they are to attain their highest development, and are grown extensively for general market purposes principally in localities where the type of soil they demand can be found in abundance. Thus, the great commercial watermelon-producing regions of the country are located where sandy ridges abound, and the most famous celery areas where there are reclaimed peat or muck swamps (Fig. 4). Most vegetable crops, however, can be successfully grown on many different types of



FIG. 4.—Michigan celery field. Celery is one of the few vegetable crops demanding special soil conditions.

soil. It is fortunate that this is the case, for it makes possible the growing of vegetables for home use and for local market in almost every locality where there is any soil whatever suitable for agricultural purposes.

**Sandy Soil.**—Although vegetables will grow on many kinds of soil, where there is chance for a choice it is an advantage to select a somewhat sandy soil for the production of early crops. This is because such a soil dries out earlier in the spring, and hence can be planted earlier than a heavier soil. It is also warmer, and therefore hastens the early development of the crops.

Other advantages of a sandy soil for general gardening purposes are that it is easily worked, responds readily to fertilizer treatment, reaches workable condition within a short time after a rain, and is not injured by tramping, as in the harvesting of crops, when in a wet condition.

On the other hand, a sandy soil has some drawbacks. Crops grown on such a soil are likely to suffer in time of drought, unless the surface soil is underlaid by a retentive subsoil.

**Soils of a heavier type** and more clayey nature are often preferred for the later crops in localities where the midseason rainfall is likely to be deficient. However, unless the soils with a large amount of clay in their composition are well supplied with organic matter they are likely to bake after a rain, and to be difficult to work. Much more care is required in working a clay soil than a sandy soil in vegetable crops, for the clay is likely to become puddled if worked or tramped upon when it is too wet. A clay soil reaches workable condition slowly after a rain and remains in ideal condition for working only a short time. Unless it is worked during the short interval when it is neither too wet nor too dry, extreme difficulties are likely to be encountered in managing a heavy clay soil.

**A clay soil may be improved** for gardening purposes by the incorporation of organic matter or humus. This may be accomplished by the application of manure or the plowing under of green crops. Such treatment makes the soil more friable.

Heavy soils can be brought into workable condition earlier in the spring if they are thoroughly drained. Tile drainage of a heavy soil for early gardening purposes involves the placing of the drains much closer together than would be necessary in ordinary farm drainage. Often they are placed as close as two rods apart. If, in addition to the drainage, the land is thrown up into ridges in the fall, by plowing in very narrow "lands," the soil will reach workable condition earlier in the spring than if this precaution is not taken. Thus, it is possible, by proper management, to plant a garden early, even on heavy soil.

**The best location** for an early garden is on a gentle southern slope. The slope should be sufficiently steep to afford natural surface drainage, yet not so steep as to permit serious washing of the soil. A southern slope affords the most direct exposure to sunshine. Such a slope also is protected more or less from cold northern winds. All these factors influence the earliness of the

crops. For some late crops, low, flat lands are especially desirable, since they are usually rich and moist.

As already mentioned, any soil suitable for general agricultural purposes can be made to grow vegetables if properly handled. Too much stress is often laid upon the type of soil necessary for the production of a given vegetable. With few exceptions, the common garden vegetables can be grown with at least a fair degree of success on almost any type of soil suited to the production of agricultural crops, provided the moisture supply is normal and the soil is properly handled in reference to time and method of working, the incorporation of humus, and addition of plant food.

## QUESTIONS

1. Name two vegetable crops that demand special soil conditions.
2. Do most vegetables demand particular types of soil?
3. What advantages has a sandy soil for general gardening purposes?
4. What are the chief points of weakness in a sandy soil?
5. What precautions must be taken in handling a clay soil?
6. How may a clay soil be improved for gardening purposes?
7. Describe an ideal location for an early vegetable garden.
8. What soils may be used for growing common vegetables for home use?
9. Give the proper conditions for their growth on the less favorable soils.

## CHAPTER III

### FACTORS INFLUENCING THE QUALITY OF VEGETABLES \*

A NUMBER of factors may influence the quality of vegetables as they appear upon the table. The efficiency and training of the cook who prepares and serves the vegetables are potent factors in determining their palatability and wholesomeness. Cabbage cooked by the ordinary hotel or boarding-house method is far inferior in appearance, texture, flavor and digestibility to the same vegetable cooked in a proper manner. There is also an art in the cooking of carrots, parsnips, cauliflower, turnips and egg-plant; and it is probable that these vegetables would rise in popular favor if they were properly cooked by a larger proportion of the people who try to serve them.

The freshness of vegetables has a direct bearing upon their quality, though this factor has a much more marked influence in the case of some vegetables than others. Certain vegetables lose moisture rapidly after gathering, and unless precautions are taken to keep them fresh, they soon become so badly wilted that their characteristic crispness is largely destroyed. Radishes and lettuce lose their distinctive value as salad materials if they become badly wilted. Summer cabbage, especially when used for slaw, and string beans are more acceptable if used before they wilt.

In the above-mentioned vegetables it is chiefly the texture which is affected by the staleness of the product. In sweet corn and green peas, however, there is a marked deterioration in flavor if these vegetables are allowed to stand even a few hours after gathering. To be of the finest possible flavor, sweet corn should be served within an hour after it leaves the stalk.

Strictly fresh vegetables of the most perishable kinds cannot readily be obtained on the ordinary market. This renders it imperative for the person who desires perishable vegetables of high quality to grow them upon his own grounds. One great advantage of the home garden over the grocer's stall as a source of the vegetable supply lies in the superior freshness of the product from the former source.

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\* Synopsis of an address given by the author at the Fifty-third Annual Meeting of the Illinois State Horticultural Society, December 18, 1908.

**Relation of Maturity to Quality.**—Another factor influencing the quality of vegetables is the stage of development or maturity at which the product is gathered. Nearly all vegetables are in their most edible stage before reaching full maturity, and remain in the most desirable condition for use a comparatively short time. Market growers have a tendency to allow certain crops to stand too long for the sake of increasing size, or to gather too large a proportion of the crop at one picking, so that specimens of several degrees of ripeness are marketed together, some of which are too old and tough and others too young and watery. Sweet corn and green peas become hard and undesirable if allowed to remain unpicked a few days too long. String beans become too “stringy.” radishes either too woody or too pithy, while in cucumbers and eggplants the seeds become hard and render the fruit undesirable. Gathering at the proper degree of ripeness has a marked influence upon the quality of vegetables; and here again the home gardener has a decided advantage over the person who tries to purchase palatable vegetables in the market.

**Influence of Temperature on Quality.**—Important as are the factors already mentioned, it is impossible to secure high quality in vegetables by proper cooking or serving of a freshly gathered product picked at the right degree of ripeness, unless the vegetables in question have been grown under conditions favorable to the development of a product of high quality.

Temperature has a marked influence upon the quality of certain vegetables. It is impossible to grow good radishes, lettuce, turnips, spinach, or cauliflower at excessively high temperatures. On the other hand, there are certain vegetables which require hot weather to develop their full quality, and which refuse to grow or develop at low temperature. Watermelons, muskmelons and tomatoes are examples.

**The moisture supply** is another factor which influences the quality of vegetables. Cool-season crops having a short period of growth, especially those in which the root, stem or leaves constitute the edible part, require an abundance of moisture throughout their entire period of growth; and an ample supply is especially important at the time they reach edible maturity. A drought setting in just before radishes or lettuce are ready to use will ruin their flavor. If deficiency in moisture is accompanied by high temperature, as it often is, the influence on the flavor of these crops is still more marked than when one factor is acting alone.

Some of the warm season crops, while requiring considerable moisture early in the season to promote a strong vegetative growth, develop a product of the highest flavor and most desirable texture if the soil is comparatively dry at the time the crop matures.

High quality in many vegetables is associated with rapidity of growth. This is especially true of the cool season, short season crops of which a vegetative part is the desired product. While a congenial temperature and adequate supply of moisture are favorable to a rapid growth, such growth is dependent primarily upon an abundant supply of available plant food. Plants used for their fruit and seed parts must also make a strong vegetative growth if they are to bear a full crop of high quality. Therefore they, too, must be well fed.

**Tillage** is the principal means of retaining moisture. It also assists in rendering conditions favorable for the plant to make use of the food which is supplied. A crop of high quality can be grown with thorough tillage better than without it, and tillage may therefore be considered as another factor influencing quality.

In certain crops the quality of the produce may be impaired by the attacks of insect enemies or fungous diseases. For example, the quality of muskmelons is almost sure to be ruined if the vines are seriously attacked by lice or rust. In other crops, the quantity and appearance of the product may be more greatly influenced than the quality, by reason of an attack of insects or disease, but in case of an attack sufficiently severe to seriously interfere with the proper nutrition of the plant, there will usually be also a diminution in quality. Protection of a crop from its enemies promotes the development of high quality in the product.

**The Variety Factor.**—While the conditions under which a crop is grown are of prime importance in determining its quality, there is another factor which, if disregarded, may thwart all efforts at the production of vegetables of high quality. This is the variety factor. Varieties differ as much in quality as they do in size, shape, season or color. The varieties of vegetables which are usually offered on the market, and of which seeds can be purchased at the grocery store, are, for the most part, the so-called "standard" varieties. Most of them have been "standards" for years, and are used as market sorts by reason of their market qualities rather than their table qualities. The characteristics of a variety most often selected for market are productiveness, earliness, good appearance, and good shipping qualities, rather

than fine flavor and desirable texture for the table. The varieties of radishes, peas, string beans, and corn most commonly grown for market are far inferior in quality to the best modern sorts. In selecting varieties for the home garden it is wise to discard some of the old "standard" market sorts, and choose in their stead varieties known to be capable of producing a product of high quality.

## QUESTIONS

1. Name four vegetables which deteriorate rapidly if not used when strictly fresh.
2. What is the most reliable source from which to procure strictly fresh vegetables?
3. What undesirable qualities do vegetables develop if allowed to become too mature before they are gathered?
4. How does high temperature affect the quality of radishes, lettuce, and turnips?
5. What effect has drought on the quality of radishes?
6. How does thorough tillage influence the quality of vegetables?
7. What effect have melon lice on the quality of muskmelons?
8. How extensively do varieties of vegetables differ in quality?
9. Try to find out how many different kinds of radishes, tomatoes, potatoes, and other vegetables are grown in your neighborhood.
10. Name the varieties of these which are grown.

## CHAPTER IV

### THE SEED SUPPLY

ONE of the primary requisites to success in vegetable growing is the use of good seed. There are several sources from which seed may be procured. The most usual source of the seed supply for planting the home garden is the corner grocery store. Many people neglect to purchase their garden seeds until the day they need them for planting. For such people the corner grocery is a great accommodation. There are many gardens which would never have been planted except for this ever-present source of seed supply. However, the corner grocery is by no means the



FIG. 5.—Result of planting unreliable seed: Four types of tomatoes from the same packet.

best place to buy seeds. Usually the assortment of varieties is small, and those which are offered are the more common sorts. A gardener with a discriminating taste for high quality varieties usually cannot secure the seeds he wants at a grocery store. A much surer way of securing the varieties desired is to order the seeds by mail from the catalogue of some reputable seedsman who makes a feature of furnishing seeds of high quality.

Commercial vegetable growers who desire large quantities of seed of some particular strain, often purchase their supplies directly from a seed grower who makes a specialty of producing that particular kind of seed. Such seed growers are usually located in regions especially adapted to the production of the seed in question.

**Home Production of Seed.**—Some people try to save their own seeds. This can be done without much trouble in the case of certain vegetables, provided only one variety of each vegetable is grown. Otherwise there is serious danger of crossing, resulting in seed that will produce a mixture of vegetables of uncertain quality (Fig. 5). Also, unless extreme care is taken in the selection of the seed plants, departure from the desired type and deterioration in productiveness and quality are likely to take place in succeeding generations. When only a small quantity of seed is needed it is cheaper to buy than to raise it. On the whole it is usually much more satisfactory for the home vegetable gardener to purchase his seeds from a reliable seed firm than to try to grow them himself.



FIG. 6.—Good and poor types of cabbage of the same variety.

On the other hand, commercial vegetable growers, especially those who make a feature of some particular crop, often find it desirable to produce their own seed. This is most likely to be true if the grower desires to use a special strain of seed that it is difficult or impossible to procure on the market. It is not unusual for a grower of some special crop to develop a strain of his own that is better adapted to his conditions and his market than any he can buy. Under such circumstances, a grower can ill afford not to produce his own seed.

**Factors Essential to the Production of Good Seed.**—However, no one should attempt the production of vegetable seed without a full realization of certain features involved in the producing of reliable seeds. To produce good seeds of any vegetable it is

essential that the grower be located where the conditions of soil and climate are especially favorable for the development of the particular crop in question. The grower must have intimate

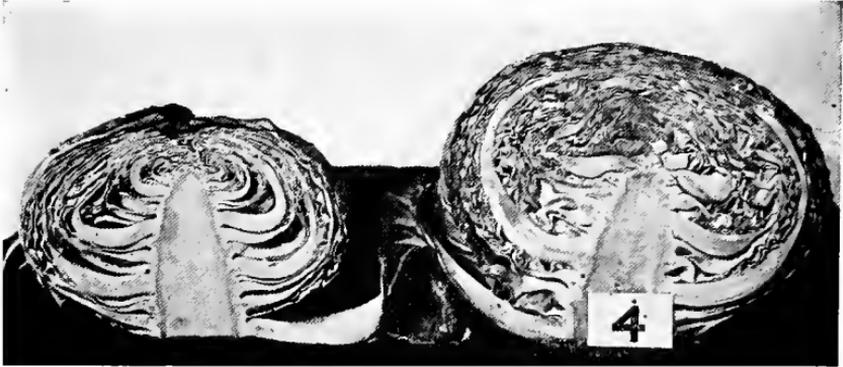


FIG. 7.—Sectional views of the cabbage heads shown in Fig. 6. Note the solidity of the head at the right: a good seed type.

knowledge of all the features that go to make up the most desirable type of the variety with which he has to deal. This is essential to the proper selection of seed plants at the start (Figs. 6 and 7), and the discarding of undesirable plants from the growing crop.

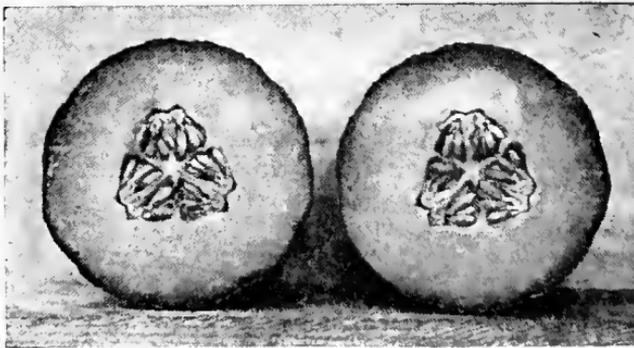


FIG. 8.—The result of five years' selection for thickness of flesh in muskmelons.

The pulling out of plants untrue to type in a growing seed crop is known as "roguing." All vegetable crops grown for seed should be very carefully "rogued." Almost any variety of vegetable can be improved by a careful selection of seed plants year after

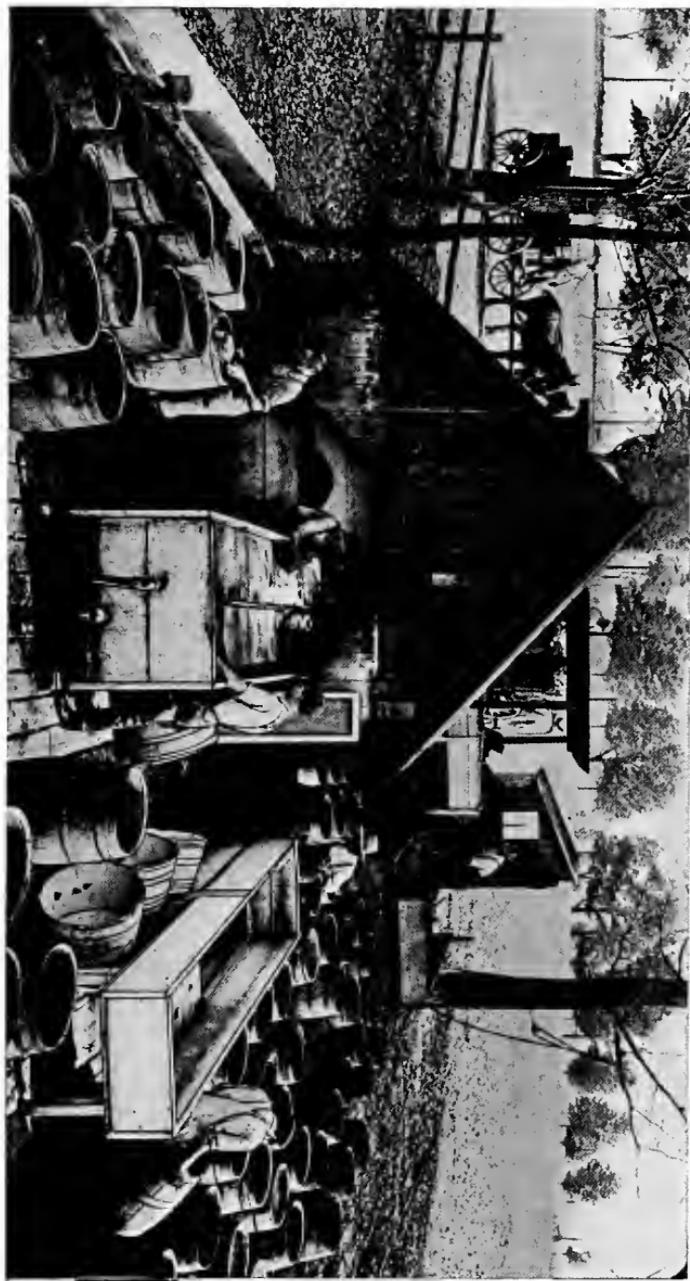


FIG. 9.—Washing tomato seed.

year (Fig. 8). This is the way special strains of the different varieties are developed.

**The reliability of seeds** for planting purposes depends upon a number of factors. In the first place, as above indicated, the seeds must have been produced from carefully selected seed plants, grown far enough away from other varieties or undesirable seed plants of the same variety to insure against cross pollination. These seed plants should be given careful attention and every effort made to promote their full development, for a stunted plant is likely to produce inferior seed.

**Cleaning and Curing Seeds.**—When the seed is ripe it should be carefully harvested, and threshed or otherwise separated from the plant. In the case of seeds borne in fleshy fruits, like tomatoes or melons, it is necessary to wash the seeds from the pulp. Whether threshed or washed out, all seeds should be spread out in thin layers and allowed to cure as soon as possible after gathering. After the seed is thoroughly cured it may be placed in sacks or other receptacles and stored in a dry place not accessible to mice.

Seed growers and seedsmen are equipped with special machinery for cleaning and handling the various kinds of seeds. A brief description of the method employed by an extensive grower of tomato seed may be of interest in this connection. The freshly picked fruits from which seed is to be saved are run through a grinder somewhat similar to a cider mill. The ground pulp passes into a revolving drum which takes out the coarsest parts (Fig. 9). The seeds, juice and fine pulp go through the drum and are caught in a barrel. This material is allowed to remain in the barrel to ferment for forty-eight hours. Except for the fermentation, it would be almost impossible to separate the seeds from the gelatinous pulp surrounding them. The fermenting mass is put on a sieve mounted in a water tank in such a way that it can be covered with water to a depth of a foot or more, and also be at least a foot from the bottom of the tank. After the mass of seeds and pulp is put on the sieve, water is turned into the tank and kept running, while the seeds and pulp are rubbed on the sieve with a hoe. The seeds go through the sieve while most of the pulp floats along the tank to a place where it flows out with the water. However, there is still some pulp with the seeds, so that further washing is necessary. The seeds are removed from the tank and placed in a half-barrel or vat. Here they are washed five times, the seeds being allowed to settle and the water being

poured off after each washing. The seeds are then put into a hand cider press and much surplus water squeezed out, after which they are spread out on sheets and allowed to dry in the sun for about three days. When thoroughly dry they are screened and gone over by hand for the removal of any remaining trash. The seeds are then put in sacks and hung up where the air can circulate through them.

**Seedsmen's Trial Grounds.**—The most progressive seedsmen maintain extensive trial grounds (Fig. 10) for the testing of new



FIG. 10.—View in seedsmen's trial grounds.

varieties, and also for determining the purity of different stocks of the standard varieties. Such tests are of material assistance to seedsmen in supplying their customers with reliable seeds, for only the purest stocks are used for the production of a new seed crop.

#### THE VITALITY OF SEEDS

**Germination Tests.**—If conditions are unfavorable while the seed crop is growing, or if the seeds are not properly cured, or if they are not stored under proper conditions, or if they are kept

too long before sowing, they may fail to grow when planted, or so large a percentage of them fail to grow that the stand will be poor. The only way to be absolutely certain that any given lot of seeds will grow is to make a germination test. In order to be sure of sending out reliable seeds, it is the practice of seedsmen nowadays to test each lot of seeds before putting them up for the trade.

One of the best ways of making a germination test is to count out 100 seeds and plant them in the soil of a greenhouse bench or a hotbed. By counting the seedlings that appear the percentage of germination can be determined. Other ways of making germination tests are to place the seeds in a plate of moist sand covered by another plate, or between two sheets of moist blotting paper. In all germination tests the medium surrounding the seeds must be kept moist and warm until the test is over. A person who grows his own seeds should test them before planting.

Some seeds normally show a much lower percentage of germination than others. The following standards of germination have been adopted by the United States Department of Agriculture, and any samples that equal or exceed these standards may be considered as satisfactory for planting, so far as germination is concerned.

TABLE I.—Standards of Germination for Vegetable Seeds

Asparagus.....	80-85	Okra.....	80-85
Bean.....	90-95	Onion.....	80-85
Beet.....	150*	Parsley.....	70-75
Cabbage.....	90-95	Parsnip.....	70-75
Carrot.....	80-85	Pea.....	93-98
Cauliflower.....	80-85	Pepper.....	80-85
Celery.....	60-65	Pumpkin.....	85-90
Corn, Sweet.....	85-90	Radish.....	90-95
Cress.....	85-90	Salsify.....	75-80
Cucumber.....	85-90	Spinach.....	80-85
Eggplant.....	75-80	Squash.....	85-90
Lettuce.....	85-90	Tomato.....	85-90
Melon.....	85-90	Turnip.....	90-95
Mustard.....	90-95		

**Longevity of Vegetable Seeds.**—Some kinds of seeds normally retain their vitality much longer than others, so that old seed of some sorts may be perfectly reliable, while seeds of the same age

\*The beet "seed" is really a fruit, and usually contains more than one seed.

of other kinds may have entirely lost their power to germinate. While the length of time a given kind of seed will retain its vitality varies considerably and depends largely upon the original strength of the seed and the conditions under which it has been kept, the approximate lengths of time that the various kinds of garden seeds may reasonably be expected to retain their germinative power are as indicated in Table II.

TABLE II.—*Length of Time Seeds May be Expected to Retain their Vitality*

	Years		Years
Asparagus.....	5	Mustard.....	4
Bean.....	3	Okra.....	5
Beet.....	6	Onion.....	2
Cabbage.....	5	Parsley.....	3
Carrot.....	4	Parsnip.....	2
Cauliflower.....	5	Pea.....	3
Celery.....	8	Pepper.....	4
Corn, Sweet.....	2	Pumpkin.....	5
Cress.....	5	Radish.....	5
Cucumber.....	10	Rhubarb.....	3
Eggplant.....	6	Salsify.....	2
Endive.....	10	Spinach.....	5
Kale.....	5	Squash.....	5
Kohlrabi.....	5	Tomato.....	4
Leek.....	3	Turnip.....	5
Lettuce.....	5	Watermelon.....	5
Muskmelon.....	5		

Old seed should always be tested a short time before the planting season, and if it does not show strong germinative power it should be discarded and a fresh lot procured. If only a small quantity of seed is needed, and a person does not wish to go to the trouble of testing the old seed he may have on hand, it is wiser to procure a fresh supply each year than to run the risk of crop failure due to the use of seed of low vitality; for seed may deteriorate much more rapidly than indicated in the preceding table if the conditions under which it is kept are unfavorable. The cost of a supply of fresh seed is insignificant as compared with the value of the crop, and the first essential in the production of any crop is good, reliable seed.

**In time of war**, it may be necessary to depart from the usual practices in reference to many things. This is true in regard to the saving of seed in home gardens. While under ordinary conditions, it is usually preferable for home gardeners to purchase all their seeds rather than attempt to save them from their own gardens, the situation in 1918 warrants the saving of many kinds of vegetable seed by home gardeners for their own planting the following year. Regarding the seed situation in America, the following statements were made in a circular issued by the United States Department of Agriculture in the summer of 1917:

“Under normal conditions of commerce, considerable quantities of vegetable seed are imported by American seedsmen from Europe. Since the beginning of the European war these importations have decreased, until at the present time, they are relatively small. Furthermore, America has been called upon to furnish certain vegetable seeds to Europe, and this has increased the tendency to deplete the stocks available for our own use. In view of these facts, it is believed that the supply of vegetable seed in this country should be conserved and augmented to the fullest extent possible.

“While the practice of saving seed in the home garden can not be generally recommended because of the difficulty in keeping stocks pure, it is quite feasible to save seed of many vegetables for one or two seasons. \* \* \* If this is done it will assist in the return of normal conditions, not only in the supply of vegetable seed, but also in the price to the gardener.”

### QUESTIONS

1. From what different sources may vegetable seeds be procured?
2. What difficulties is a gardener likely to encounter when he attempts to grow his own seeds?
3. Under what circumstances should a commercial vegetable grower produce his own seeds?
4. Give directions for the selection of seed plants.
5. What is “roguing”?
6. Describe the process of cleaning tomato seed.
7. Why do seedsmen maintain trial grounds?
8. What factors may affect the vitality of seeds?
9. Describe the process of making a germination test.
10. What percentage of germination can reasonably be expected in most vegetable seeds?
11. How long may vegetable seeds of different kinds be expected to retain their vitality?
12. Is it safe to plant old seeds without first making a germination test?
13. What is the seed supply for the chief market garden crops of your locality?

## CHAPTER V

### THE PLANT FOOD SUPPLY

IN ORDER that maximum crops of vegetables may be produced it is essential that the soil be abundantly supplied with plant food in a readily available form. Much heavier applications of fertilizing materials are needed for the production of vegetables than for the growing of the ordinary farm crops. Since, in many vegetables, the quality as well as the quantity of the product is greatly influenced by the amount of plant food available, it is especially important that the supply be ample.

**Elements of Plant Food.**—Although it is generally recognized that there are at least ten elements of plant food essential to the development of any crop, all but three can usually be secured by the plant from the soil, air, and water in sufficient amounts for the production of maximum crops. These three elements (which are present in all soils, but often in insufficient quantities in an available form) are nitrogen, phosphorus and potassium. If one or more of these elements are deficient the productive capacity of the land is thereby diminished. The aim of the vegetable grower in fertilizing land is to supply these elements in the right proportions for the development of maximum crops of the vegetables in question. Different soils and different crops need these elements in different proportions. (See Table VI, p. 328.)

**Sources of Plant Food.**—Plant food for the growing of vegetable crops may be secured from a number of different sources. Only a small part of the plant food present in an untreated soil is available to the plants at any given time. Judicious tillage and the incorporation of organic matter in the soil will render available part of the plant food that would otherwise remain in an insoluble form and hence of no immediate use to the plants.

However, in vegetable gardening, tillage alone is usually inadequate to render sufficient plant food available to the plants for the production of profitable crops. Therefore, direct applications of plant food must be made. The chief sources of plant food that can be employed in vegetable growing are animal manures, green manures and commercial fertilizers.

## ANIMAL MANURES

Animal manures are especially valuable in vegetable gardening, for in addition to the plant food they contain they supply a large amount of organic matter to the soil, which, as indicated above, assists in the liberation of plant food already present in the soil. This is accomplished by means of the solvent effect of the organic acids which are formed during the decomposition of the manure.

Animal manures differ considerably in the amount of plant food they contain. Their composition depends chiefly upon the kind of manure (whether produced by horses, cattle, sheep, swine or poultry), the amount of litter it contains, and the conditions under which it has been kept. Manure that has been allowed to leach or to become overheated has usually lost much of its plant food. However, for vegetable gardening purposes, the mechanical condition of manure may be of more importance than its plant food content. Part of the plant food may be sacrificed in order that the remainder may be rendered immediately available to the plants. "Well-rotted manure" is better adapted for use on many garden crops than is fresh manure; yet considerable plant food is usually lost during the process of rotting.

**Compost.**—Very fine, thoroughly-rotted manure or other organic matter is known as "compost." It is prepared by piling up the manure or other material in long, low piles six or eight feet wide and two to four feet high (Fig. 11). This is done from six months to a year before the compost will be needed for use. The sides of the pile are made as nearly perpendicular as possible and the top is flattened so that rains will soak in instead of running off. If the weather is dry, water may be applied. Sometimes the pile is made of alternate layers of earth, sod or muck, and manure. In this case there is less loss of fertility from the manure. A few weeks before the compost is to be used, the pile is cut down and the material repeatedly turned and mixed until the manure is thoroughly decomposed and the entire mass is of fine texture. Formerly this work was done by hand with a fork or spade and entailed a large amount of labor. Now some of the most progressive gardeners do all this turning of the compost with a disk and plow. The pile is worked over three or four times at intervals of one or two weeks. Compost is especially desirable for use in seed beds, melon hills, for top dressing a growing crop, or for any other purpose where very quick action of the plant food is desired.

Animal manures, whether composted or not, form a better balanced fertilizer for most vegetables than they do for general farm crops, especially the cereal grains. This is because of their relatively high content of nitrogen and potassium (especially the former) as compared with phosphorus. Vegetables, especially those of which a vegetative part (root, stem or leaf) constitutes



FIG. 11.—Compost pile being made in September for use the following May.

the edible product, demand nitrogen in enormous quantities, and are relatively light in their demands for phosphorus.

#### GREEN MANURES

Green, growing plants of any kind, that are plowed under instead of being harvested or removed from the soil, may be considered as "green manure." Upon their decomposition the plant food they contain becomes available for other plants, and also during the process of their decomposition organic acids are formed which help to dissolve plant food already present in the soil and make it available to the succeeding crop. The indirect

effect of green manures upon plant food already present in the soil is thus similar to that of animal manures.

Although a crop of weeds growing on idle land may be made to serve as green manure when plowed under, vegetable growers usually cannot afford to let land be idle and depend upon nature to furnish the plants for the green manure. Usually some crop is used for green manuring that will make sufficient growth for that purpose after the regular crop of vegetables has been harvested and before it is necessary to prepare the land for the next crop. Rye is a good crop for green manuring because it can be



FIG. 12.—Heavy growth of cow peas to be plowed under for green manure.

sown at any time land is cleared of vegetable crops from August 1 to October 15 in temperate climates, and will live through winter and make a strong growth in spring before time for planting any but the very earliest crops. If sown as early as August 15 it may be plowed under in the fall instead of spring, and thus not delay the planting of even the earliest crops.

**Plants for Green Manuring.**—Weeds and rye add no plant food to soils. They merely give back to the soil the food they have taken from it during their growth, and also in the process of their decomposition help liberate some of the mineral elements of the soil and make them available to other plants. There is, however,

a group of plants that not only perform these two functions, but are able, through the aid of bacteria working on their roots, to secure nitrogen from the air and add it to the soil. This group of plants, known as legumes, includes clover, alfalfa, cow peas (Fig. 12), soy beans, vetch, and others.

One of the best of these plants for green manuring in connection with vegetable growing is hairy vetch. It can be sown from July 15 to September 15, and will grow until the ground freezes in



FIG. 13.—Four-horse load of manure near Boston.

fall. It lives over winter and resumes growth in spring. As in the case of rye, early sowings may be plowed under in the fall or later sowings in the spring.

In the South, cow peas and soy beans may be grown as green manuring crops in the summer, to prepare the land for growing vegetables in the fall, winter or early spring. In some forms of truck-growing where the vegetable crop occupies the land only one season in a three- to six-year rotation, clover or alfalfa preceding the vegetables serves the purpose of a green manuring crop for the vegetables. If a heavy growth of clover can be plowed under, rather than merely the sod, it is usually a decided advantage.

**Conditions for Using Green Manure.**—Green manuring can be employed more advantageously under the less intensive methods of vegetable growing, such as truck farming, than in connection with market gardening proper. It is the cheapest method of manuring on low-priced land. At a distance from large cities, where stable manure is difficult to obtain, it furnishes the most available means for maintaining the soil in proper condition for vegetable production. However, near large cities, on high-priced land that is kept in vegetable crops from early spring till late fall, there is no time to grow green manuring crops. It is cheaper to employ the time of teams to haul stable manure from the city than to employ the time of the land in growing green manures (Fig. 13).

Green manures alone cannot be depended upon to produce as good results as animal manures, for they do not add to the actual supply of phosphorus and potassium in the soil, and unless they are legumes they do not add to the nitrogen supply. So far as the plant food supply is concerned, they merely help make available to the plants the plant food already present in the soil.

#### COMMERCIAL FERTILIZERS

Commercial fertilizers are concentrated forms of plant food that can be purchased in the market. They may be either complete or incomplete fertilizers. A complete fertilizer is one which contains all three of the essential elements of plant food: Nitrogen, phosphorus and potassium. An incomplete fertilizer is one which contains only one or two of these three elements.

Commercial fertilizers differ widely in the amount of plant food they contain. They are therefore usually sold on the basis of a guaranteed analysis specifying the percentage they contain of each element of plant food. Different fertilizers are manufactured to meet the demands of different crops and different soils. The separate ingredients from which complete commercial fertilizers are made are usually cheaper than the complete mixtures in relation to their plant food content. It is therefore more economical for a gardener to purchase the separate ingredients and mix his own fertilizer than to buy the ordinary commercial brands of ready-mixed fertilizers. He can also make a fertilizer to meet his own specific needs.

**Sources of Nitrogen.**—Some of the leading commercial forms in which nitrogen can be bought are nitrate of soda, sulfate of ammonia, dried blood, castor pomace, cotton seed meal.

**Phosphorus** may be bought in rock phosphate, or bone meal. Either may be bought in the raw or in the "treated" form. Rock phosphate or bone that has been treated with acid contains its phosphorus in a more quickly available form than the raw material, but its continued use is likely to have an undesirable effect upon the soil. Steamed bone meal is an especially desirable form in which to apply phosphorus for vegetable crops. It acts quickly and does not injure the land.

**Sources of Potassium.**—The principal commercial sources of potassium are muriate of potash, sulfate of potash and unleached hard-wood ashes. Where ashes can be procured, they constitute one of the best sources of potassium. They act quickly, and do not injure the plant or the soil. The percentage of potassium they



FIG. 14.—Manure spreader in operation.

contain is rather low, so that they may be used much more freely than either muriate or sulfate of potash. Sulfate of potash is considered more desirable than the muriate for certain crops. Potatoes, for example, are claimed to be of better quality when fertilized with the sulfate rather than the muriate of potash.

**Purchasing Fertilizers.**—Commercial fertilizers can be bought by the ton or the carload at any time of the year. They are concentrated, so that enough plant food for ten acres of ground can be stored in a small space. They are in condition to apply at any time, and modern machinery makes their application a simple matter. (For composition of fertilizing materials, see Table VII, p. 328.)

**Effects of Commercial Fertilizers.**—So far as plant food is concerned, they furnish the same elements as are contained in animal manures. Yet their continued use, to the exclusion of animal manures and green manures, will lead to disastrous results.

If commercial fertilizers are used exclusively the soil becomes deficient in organic matter, and therefore loses its friable texture and its ability to resist drought. Commercial fertilizers are often valuable to supplement, but never to supplant, animal and green manures. If one form of fertilizer alone must be depended upon in the growing of vegetables, that form should be stable or barnyard manure.

#### TIME AND METHOD OF APPLICATION

For early spring crops or when coarse manure is to be used, even for a late crop, it is advisable to apply the manure and plow



FIG. 15.—Applying manure to melon hills.

it under in the fall. This gives it a chance to decay and become incorporated with the soil by the time the plants are started in the spring. Fine, rotted manure may be applied just before plowing immediately preceding the planting of any crop, whether the season is spring, summer, or autumn. It may also be applied as a top dressing after plowing or even after planting, under certain conditions; but its application previous to plowing is usually the more satisfactory method (Fig. 14).

Commercial fertilizers are usually applied after plowing. They may be sown broadcast and then thoroughly mixed with the soil by repeated disking and harrowing, or they may be drilled in with a fertilizer attachment on the seed drill at the time the crop is

planted. Quick-acting fertilizers, like nitrate of soda and wood ashes, are more often applied as top dressings to the growing crop. They are either drilled in, or strewn on the surface of the ground and cultivated in.

In the case of crops planted in hills far apart, such as melons, squashes and Lima beans, it is often the practice to apply manure or fertilizer to the hills rather than broadcast, or even in addition to a broadcast application (Fig. 15). This is for the purpose of giving the plants a quick start; and only thoroughly rotted manure or readily available fertilizer should be used.



FIG. 16.—Making heavy application of manure for fall crop of spinach.

#### QUANTITIES OF MANURE AND FERTILIZER TO USE

Fertilizing materials are used in much larger quantities per acre in vegetable growing than in general farming. Forty tons of stable manure per acre per year is a very moderate application for the production of certain kinds of vegetables; and commercial fertilizers are sometimes used at the rate of 1000 to 1500 pounds per acre. The quantity that will be most profitable in a given case will depend upon the nature and condition of the soil and the particular crop in question (Fig. 16). Many vegetable crops yield a

product of very high value per acre, and any material increase in yield or quality that can be brought about by additional applications of plant food is usually attended with corresponding profit. Of course, there is a limit beyond which it is not profitable or expedient to go, but that limit is seldom reached if intelligence is used in the selection of the forms of plant food that are to be applied and the method and time of their application.

An additional reason for applying much larger quantities of fertilizing materials in the growing of vegetables than in the production of ordinary farm crops, is that, in the case of many vegetable crops, the plants occupy the land a much shorter time than do farm crops, and must be liberally supplied with available plant food in order to make the proper development in the limited amount of time. Furthermore, much of the growth of early spring crops must be made at a time when the soil is still cool and conditions are unfavorable for the action of the agencies which assist in making available to the plants the plant food already present in the soil.

#### QUESTIONS

1. What three elements of plant food is it usually necessary to apply to soils?
2. What are the three chief sources of plant food that can be employed in vegetable growing?
3. What valuable material, aside from plant food, do animal manures add to the soil?
4. Upon what factors does the plant food content of animal manures depend?
5. What is "compost"? How is it made? What are its special uses?
6. What are "green manures"?
7. Discuss the relative merits of different crops for green manuring under specified conditions.
8. Under what circumstances is green manuring preferable to the use of animal manures, and *vice versa*?
9. What is a "complete fertilizer"? An "incomplete fertilizer"?
10. What are the advantages of home mixing of commercial fertilizers?
11. What are some of the leading commercial sources of nitrogen? Of phosphorus? Of potassium?
12. What dangers attend the continued use of commercial fertilizers as the sole source of plant food?
13. What circumstances determine the time and method of application of manures and fertilizers?
14. How much manure per acre can profitably be used for the production of vegetable crops?
15. What forms of fertilizer are used in market gardening in your section?

## CHAPTER VI

### THE MOISTURE SUPPLY

THE mere presence of an abundance of plant food in the soil will not result in bountiful yields of vegetables. In order that plants may use the food it must be in solution; and in order that it may be in solution, moisture must be present in the soil. Furthermore, the plant food must be in very dilute solution; therefore, large quantities of moisture are necessary to properly nourish the plants.

In addition to its function as a carrier of plant food, soil moisture is essential to the welfare of plants in supplying the water they are continually transpiring from their leaf surfaces. If the water supply at the roots is cut off, the plants wilt, and if the shortage continues, they eventually die. Plants abundantly supplied with moisture make a more rapid and succulent growth than those less fully supplied. Rapidity of growth, in many kinds of vegetables, means earlier market condition, larger size and better prices. Succulence is closely associated with high quality in many vegetables. Rapid growth makes for a tender product in the root and foliage crops, while slow growth is likely to result in toughness of texture. Large crops of vegetables of good quality are therefore dependent to a considerable extent upon the moisture supply available to the plants. If no moisture whatever is available, there will be no plant growth. The difference between a desert and a prairie is a matter of moisture; so is the difference between a sage brush plain and an irrigated garden.

#### SOURCES OF WATER SUPPLY

In humid regions vegetable growers as well as general farmers depend almost exclusively upon the natural rainfall to supply moisture to their growing crops. Even where the annual rainfall is ample for the production of maximum crops, it often happens that on account of unfavorable distribution of the rainfall through the season, vegetable crops suffer severely from lack of moisture at critical times. Cauliflowers fail to head, lettuce runs to seed, turnips turn bitter, sweet corn "fires" clear to the tassel—all from the lack of a good rain at the right time. The planting of

late crops is also frequently delayed while the gardener is waiting for a rain to soften the soil so that a suitable seed-bed may be prepared and germination take place. Plants ready for transplanting may become worthless during the wait. If the delay is too long the crop, though finally planted, may not have time to mature.

Gardening is thus a somewhat precarious business where the clouds constitute the sole source of the moisture supply. For this

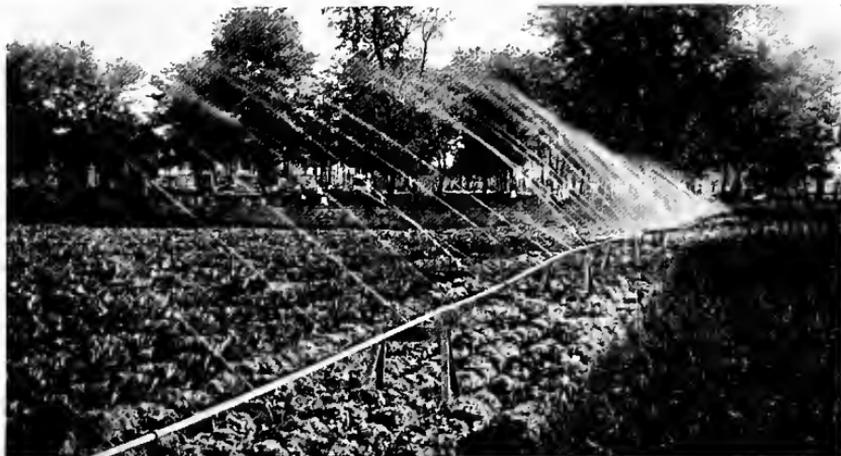


FIG. 17.—Skinner system of irrigation in operation near Danville, Illinois.

reason, even in humid climates, market gardeners operating on high-priced land, where it is imperative that no time be lost between succeeding crops, are more and more equipping their gardens with facilities for artificial watering. The old practice of carrying water in buckets or hauling it in tanks to keep plants from dying that were recently transplanted, is giving place in some of the more intensive gardens to facilities for applying sufficient water to make the plants thrive—and not merely live—in spite of a protracted drought. Such arrangements are feasible only where an abundant supply of water is available. Gardens located along the bank of a river or the shore of a lake may be supplied with water by means of a private pumping station operated by a gasoline or steam engine. An ordinary well is seldom adequate to supply water for a market garden of any considerable size. Gardens within the limits of large cities are often in reach of the city water supply. In such cases, that is the most feasible source of water.

**The Old Plan.**—Until within very recent years, the market gardens of the East which were equipped for artificial watering were supplied with water through underground pipes to which short vertical pipes terminating in hose bibs were attached at intervals of from one to two hundred feet. When the watering of a given area was desired, a hose was attached to the nearest bib and the distribution of water manipulated by an attendant.

**The most recent development** in the line of watering market gardens where there is a supply of water under pressure is known as the overhead, or Skinner system of irrigation. It consists essentially of a line of galvanized iron pipe, extending lengthways of the area to be watered, mounted usually on posts, and attached to the water supply pipe in such a way that it can be readily turned upon its longitudinal axis. A series of small holes



FIG. 18.—Irrigating onions near Greeley, Colorado. The water has broken out of the shallow furrows and is flooding the field on the left.

are drilled in the pipe at intervals of three to four feet, and small nozzles inserted in the holes. The nozzle and the machine for drilling the holes are covered by letters patent. Care is exercised in drilling the holes to have them exactly in line with one another. When the apparatus is connected up and the water turned on, a fine stream that breaks into a spray issues from each nozzle. By turning the pipe slightly from time to time, the direction of the spray is changed so that eventually the entire area along both sides of the pipe within range of the nozzles is thoroughly watered. By having a series of lines of pipe close enough together so that the spray from one will reach half-way to the next, it is possible to water an area of almost any size.

The higher the pressure, the more rapidly the water will be discharged from the nozzles. Thus, at a pressure of 20 pounds,

200 nozzles (the number used for an acre of ground, if the nozzles are four feet apart on the pipe, and the pipes are 54 feet apart) will deliver 27,152 gallons of water (the quantity required to equal one acre-inch or the equivalent of one inch of rainfall over one acre) in 13 hours and 18 minutes. If, however, the pressure is 40 pounds, the same amount of water will be discharged by the same nozzles in 9 hours and 23 minutes. The slow delivery of the water resembles a very fine, misty rain, rather than a dashing shower. In large installations, the turning of the pipes is automatically



FIG. 19.—Field of cabbage furrowed out ready for irrigating. Greeley, Colorado.

controlled from the pumping station. In small installations, the gardener who is attending to other work, occasionally gives the pipes a turn; so that, although it takes a long time for an acre to be watered, very little of an attendant's time is required.

Sometimes in small installations one line of pipe is made to water a large area by being moved from place to place across the field. In such cases, the pipe may be mounted on movable supports instead of permanent posts (Fig. 17).

#### IRRIGATION

Arrangements for watering such as those already described are used principally in humid regions for supplementing the natural rainfall where some special crop is likely to suffer from lack of moisture. Relatively few gardens in the East are fully equipped for the artificial watering of their entire areas. Chief dependence is placed upon the rainfall to supply the moisture for producing the crops. In eastern gardens rain is fundamental and irrigation

incidental. In the arid regions of the West, however, where rainfall is scarce during the growing season, irrigation is depended upon to produce the crops and any summer rains that may occur are purely incidental. In humid regions, irrigation is a problem for the individual grower; in arid regions it is a problem for the



FIG. 19a.—Furrow irrigation of melons (cantaloupes) immediately following planting. Rocky Ford, Colorado.

entire country, for in many places no crops whatever in field or garden can be produced without it.

**Sources of Irrigation Water.**—Some of the sources of water



FIG. 20.—Plantation of lettuce arranged for raised-bed irrigation. Sacramento, Cal.

supply in irrigated regions are rivers fed from melting snow through mountain streams, natural lakes at high elevation, artificial lakes or reservoirs for the storage of storm water, artesian wells. Usually the water is conducted for long distances through open ditches, flumes or conduits, before it reaches the land to be

irrigated. Whenever possible it is delivered by gravity, but sometimes pumping is necessary to raise the water to a point higher than the land to be irrigated.

Lateral ditches, connected with the main ditches by gates, conduct the water to each field or garden. The time at which a man may secure water from the main ditch that is supposed to supply his land is determined by law or agreement rather than by the needs of his crops. Lateral or sublateral ditches carry the water along the highest parts of each field. From the laterals it is distributed over the fields or gardens to be watered. To be irrigated readily the land should slope gradually and uniformly in at least one direction from a given lateral.

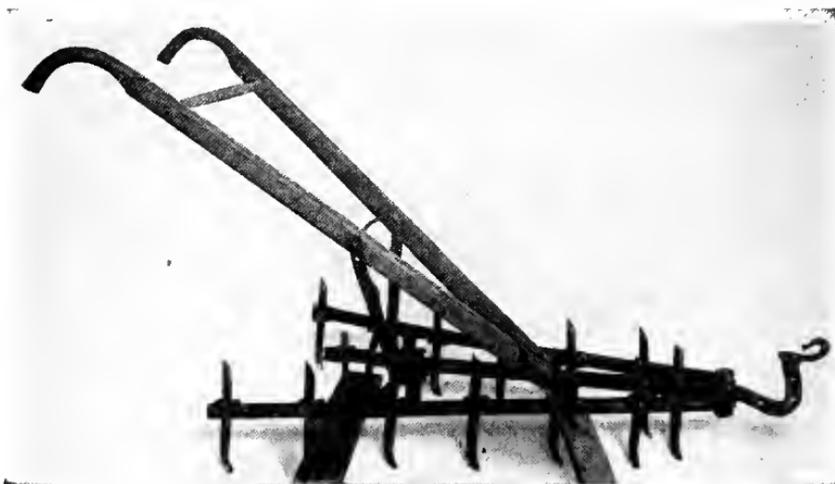


FIG. 21.—Narrow tooth cultivator—a good tool for conserving moisture.

**Methods of Irrigating.**—There are various methods of applying the irrigation water to the growing crop, but they are usually some form of either flood or furrow irrigation. Flood irrigation is extensively used for alfalfa and sowed grains, but much less frequently for vegetable crops planted in rows. Furrow irrigation of vegetables is much more common, though if very shallow furrows are made and a large amount of water turned in, it frequently breaks out of the furrows, so that in some parts of the field the effect is much the same as if flood irrigation had been employed (Fig. 18). Flooding is admissible with certain vegetable crops, but detrimental to others, such as celery.

A field of vegetables planted in rows is prepared for irrigation by making shallow furrows at the proper intervals by means of suitable attachments on tillage tools (Fig. 19). If the rows are very close together, as is common with onions and similar crops, one furrow for every two or three rows may be sufficient. In crops planted far apart, like melons, one furrow is usually made for each row but is close to the row rather than midway between two rows (Fig. 19a).

After the furrows are made and little ditches cut to connect them with the lateral, the water is turned from the lateral, by



FIG. 22.—Conserving moisture by thorough tillage.

means of a temporary dam, into a few of the furrows at a time. It is allowed to run the entire length of these furrows and continue running until the soil surrounding the plants becomes well soaked with water. The temporary dam in the lateral is then moved downstream a few feet, and dirt is quickly shoveled in to close the little ditches leading from the lateral to the furrows already irrigated. The process is repeated, irrigating a few rows at a time, until the whole field has been watered. The number of rows that can be irrigated at a time is determined mainly by the head of water available. For irrigating celery, the furrows are connected with the lateral by means of miniature water gates, which make it possible to regulate to a nicety the amount of water delivered into each furrow, and thus avoid flooding.

A modified form of furrow irrigation is raised-bed irrigation. The vegetables are planted in very narrow beds, each bed often

containing only two rows of vegetables, one planted along each edge. Furrows from four to eight inches deep, and often as wide as the beds themselves, separate the beds. In irrigating, the furrows are filled with water, which is prevented from escaping, by a dam at the lower end, and is soon absorbed by the soil (Fig. 20).

#### CONSERVATION OF MOISTURE

Whether water is supplied to the land by rainfall, sprinkling, or irrigation, it escapes rapidly by evaporation unless some means are employed to conserve it. The most feasible means of retarding evaporation of moisture from the soil is to break up the surface layer into fine particles so that it will serve as a mulch and prevent rapid evaporation from the undisturbed soil below. The breaking up of the surface can best be accomplished by means of tillage tools (Fig. 21). To be most effectual in conserving moisture, it should be done as soon after a rain or irrigation as the soil reaches workable condition (Fig. 22). The depth of tillage and the particular kind of tool to use will depend upon the crop, the type of soil, and the climate. Deeper tillage is usually necessary in arid than in humid regions.

Thorough preparation of the soil before planting, so that it is finely divided to a considerable depth, the presence of a large amount of organic matter in the soil, and careful surface tillage following each application of water, whether through rain or irrigation, will enable the growing crop to secure the maximum benefit from the moisture which reaches the soil. It is surprising how much drought some crops can endure if the moisture present in the soil earlier in the season has been intelligently conserved.

#### QUESTIONS

1. In what form can plants make use of plant food?
2. What is the relation of water to rapidity of growth?
3. Is irrigation of vegetable crops practicable in humid climates?
4. What is the most recently developed system of irrigation for garden crops? Describe this system.
5. Contrast the relation of irrigation to crop production in humid and in arid regions.
6. What are some of the chief sources of water for irrigation purposes?
7. How is the water conveyed from the source of supply to the field to be irrigated?
8. Describe the process of furrow irrigation.
9. Is the application or the conservation of moisture the more important?
10. Describe any irrigation system you have seen.

## CHAPTER VII

### THE TEMPERATURE FACTOR \*

THE vegetables grown in our gardens are native to many different countries, differing widely in climatic conditions. Each kind of vegetable has its own peculiarities and thrives best under certain climatic conditions. When an attempt is made to grow many sorts in the same garden under the same conditions, it is not surprising that some thrive better than others. However, many of the difficulties encountered can be overcome by adjusting the time of planting each crop to meet its temperature and moisture requirements as fully as possible. Failures in gardening often result from planting some crops too early and others too late. Each should be planted at the season most favorable to its development.

Vegetables are usually classified as "hardy" and "tender." This classification is based upon the fact that certain vegetables will endure the ordinary frosts of spring without injury, while others would be killed if subjected to the same temperatures. This classification implies that danger of frost injury is the chief distinction between the two classes of vegetables, and that while the "hardy" vegetables can safely be planted "before danger of frost is over," there would be no objection to planting them after that time. As a matter of fact many of the so-called hardy vegetables would be as utterly ruined by the heat and drought of summer as are the tender vegetables by the light frosts of spring. They demand cool weather, and without it will not produce an edible product. Furthermore, the danger of frost injury is not the only reason the so-called tender vegetables should not be planted early. The cool weather normal to that season of the year, though no killing frost occurred, would preclude the proper growth and development of the crops in question, for they thrive only in warm weather. A more satisfactory wording for this classification of crops would therefore be "cool season" and "warm season" crops, for these terms suggest the conditions

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\* This chapter is essentially the same as an article written by the author for the *Illinois Agriculturist*, February, 1911, and later published in Circular 154 of the Illinois Agricultural Experiment Station.

under which the crops must be grown to develop satisfactorily, rather than merely designating their susceptibility to, or immunity from, frost injury.

While vegetables in general may be classified as cool season and warm season crops, the different vegetables in each of these classes do not thrive equally well under the same conditions of temperature and moisture. Although all the cool season crops will germinate and grow at a relatively low temperature, and demand comparatively cool weather for their highest development, some will endure and even demand lower temperature than others. The converse also is true: Some will endure much higher temperature than others.

**Cool Season Crops.**—From a cultural standpoint, the cool season crops may be divided into three general groups: (1) The first group is composed of short season crops which cannot endure the heat of summer, but which can safely be planted in the open ground sufficiently early to attain full development before the normal season for hot weather. The following vegetables belong to this group: Garden cress, kohlrabi, leaf lettuce, mustard, peas, radishes, spinach, turnips. Of these crops, cress, lettuce, mustard, and spinach will stand slightly lower temperature in the seedling stage than the other crops mentioned. However, in practice they are usually all planted as soon as the ground can be worked in the spring. Additional plantings of lettuce, radishes and peas can be made somewhat later for the sake of securing a succession, since radishes and lettuce grow quickly, and peas can stand a slightly higher temperature than most of the other crops of the group. Any later plantings of cress, mustard, spinach, or early turnips are usually overtaken by such high temperature that the products are of little value, so that it is usually unwise to plant these crops in central latitudes any later than the very opening of spring.

Some of the crops in this group can also be grown in the autumn if there is sufficient moisture available. Turnips, radishes, lettuce, and spinach are the crops best adapted to this purpose. In the extreme South, this entire group of plants may be grown in the midst of winter.

(2) The second group of cool season crops consists of those which cannot endure excessive heat, and which at the same time have so long a period of growth that it is impossible for them to complete their development before the normal season of hot

weather, if the seed is planted in the open ground even as early as it is possible to work the soil. Such crops are early cabbage, early cauliflower and head lettuce. The only way that these crops can be grown with any assurance of success in central latitudes is to start the plants under glass and have them ready for transplanting as early as the weather will permit. This will be about the time the second planting of radishes and peas is made.

Another crop having temperature requirements similar to those of cabbage and cauliflower is celery; but this crop requires so long a season that it is impossible to grow it under field conditions as a spring planted crop except in northern localities, where the summers are relatively cool. Together with late cabbage and cauliflower, it can be grown as a summer planted crop designed to make its principal growth during the cool, moist weather of autumn. The success of these three vegetables as autumn crops in central latitudes depends primarily upon the temperature and the moisture supply during July, August, and September. Cool, wet seasons favor their development. In hot, dry years they may fail utterly. As commercial crops, they reach their highest development only in relatively cool climates.

(3) The third group of cool season crops consists of relatively long season crops, demanding cool, moist weather during the earlier stages of their development, but capable of enduring considerable heat and even drought after becoming fully established. This group includes beets, carrots, chard, kale, leeks, onions, parsley, parsnips, early potatoes, salsify, upland cress and New Zealand spinach. It also includes the perennial crops, asparagus and rhubarb. All of these crops should be planted relatively early, though extremely early planting is more important with some than others and is especially imperative in the case of onions. In actual practice, all the vegetables in this group, together with those of group 1, may be planted as soon as the ground can be worked in the spring. If, however, the early planting is followed by unusually cold, wet weather, replanting of the beets, carrots, chard, and parsnips may become necessary, for these crops do not germinate readily at as low temperatures as onions or kale, nor will the seedlings survive so severe a frost.

**Warm Season Crops.**—The warm season crops fall naturally into two groups: (1) The first group includes those with a sufficiently short period of growth to enable them to perfect their

product in temperate climates during the normal season of weather favorable to their development. Such crops can be planted in the open ground after the weather has become sufficiently warm in spring, and will complete their growth and mature their crop before the plants are killed by the frosts of autumn. This group includes string beans, Lima beans, sweet corn, cucumbers, gherkins, muskmelons, watermelons, okra, squashes and pumpkins. Of these crops, string beans and sweet corn will germinate at a lower temperature, and hence can be planted earlier, than the Lima beans and the vine crops. All the crops in this group demand warm weather, but some of them will suffer if the weather is excessively hot and dry. Those most resistant to drought are gherkins, watermelons and okra; and these crops are especially adapted to southern localities.

Some of the vegetables in this group will not mature in the extreme northern part of the United States unless transplanting is resorted to, as in the following group:

(2) The second group of warm season crops consists of those having so long a period of growth that they are unable to mature a full crop in temperate climates unless started under glass considerably in advance of the normal season for weather suited to their growth in the open. This group includes eggplants, peppers, sweet potatoes and tomatoes. Of these, eggplants and sweet potatoes demand a higher temperature than tomatoes and peppers, and under normal seasonal conditions should not be transplanted to the open ground until two or three weeks after the ideal time for setting tomatoes. Eggplants and sweet potatoes are especially suited to growing in localities subject to severe drought, for after these plants have once become well established, their demands for moisture are not great, and the more intense the heat, the better they grow.

**Importance of Season.**—The wide differences in the temperature and moisture requirements of the various vegetable crops, as above outlined, explain why some crops thrive much better some seasons than others, in the same locality, and also why certain crops are most extensively grown in certain localities. However, careful attention to the time of planting each crop in view of its particular temperature requirements, will enable the gardener to grow to perfection a much larger assortment of vegetables in the same garden than could possibly be done without consideration of the specific requirements of each particular crop.

The importance of planting vegetables at the right time is not appreciated by most home gardeners. In spite of all the advice of writers to the contrary, many people continue to plant peas and corn, spinach and cucumbers, lettuce and tomatoes at the same time, and then wonder why their gardening is not a success. The most important teachings in this book deal with the temperature requirements and time of planting of each of the different vegetables. A thorough mastery of this important subject would turn failure into success for many gardeners.

### QUESTIONS

1. Why do not all vegetables thrive equally well in the same garden?
2. What is meant by a "hardy" vegetable? A "tender" vegetable? Suggest more appropriate terms for designating these two groups of vegetables.
3. Into what three general groups may the cool season crops be divided?
4. Give several examples of vegetables belonging to each of these groups.
5. Into what two general groups may warm season crops be divided?
6. Give four examples of vegetables belonging to each of these groups.
7. What will increase the number of kinds of vegetables that can be grown successfully in a given locality?
8. What vegetables are commonly grown in your locality, for home or for market?
9. Do any gardeners succeed with other kinds not commonly grown?

## CHAPTER VIII

### TRANSPLANTING

**Reasons for Transplanting.**—As already mentioned in connection with the consideration of temperature requirements, there are certain crops that cannot be successfully grown in temperate climates unless the gardener resorts to transplanting. These crops have been enumerated in Chapter VII. Mention was also made of the fact that in extreme northern localities, certain other vegetables, normally planted in the open, might be started under glass and transplanted, in order to secure a crop outside the normal limits of their successful culture. It is also true that in localities where these crops could be successfully grown without transplanting, they are sometimes transplanted in order to secure a crop ahead of the normal season. The same is true of certain other crops in addition to all those to which reference has been made. Market growers sometimes transplant beets, onions, kohlrabi and parsley in order to secure an extra early crop.

Under intensive methods of culture, there is also another reason for transplanting. It saves the time of the land and makes it possible to grow an additional crop during the season. In this case, the crop may be started in the open and not mature ahead of its normal season. It is merely transplanted instead of being thinned, in order that space may be saved during the early stages of its growth. Rutabagas are sometimes handled in this way.

**Economic Questions Involved.**—Except in the case of vegetables which cannot be successfully grown in the given locality without resorting to transplanting the question as to whether or not transplanting is admissible must be decided partly from an economic standpoint, and partly from the standpoint of the behavior of the plant. In general, transplanting is most desirable in the case of crops in which the product of the individual plant is of considerable value or in which there is a substantial premium on earliness. The greater the value of the product, the more pains it is possible to take in order to make the plants thrive. When beets, onions and kohlrabi are transplanted, little time can be spent with each plant, for the value of the individual product is slight. On the other hand extreme care can be taken

with eggplants, because the product of a single plant may be worth as much as fifty beets.

**Behavior of Different Plants.**—In regard to the behavior of the plants, it may be said that some plants bear transplanting much more readily than others, and are almost certain to survive and develop a marketable crop even though no special precautions are taken in handling them. On the other hand, there are certain crops which suffer severely when transplanted unless special care is taken to have all conditions favorable. In general, plants with a large development of fibrous roots and a compact root system are likely to suffer less in transplanting than those in which the root system consists principally of a few long fibres or a single tap-root. Plants in which the long tap-root constitutes the edible product, as in the case of parsnips, would be especially difficult to transplant successfully. If the tap-root were broken during the operation, a misshapen product would likely result. Long beets would be almost as difficult to transplant. Turnip-shaped beets can be handled satisfactorily.

**The age of the plant** may have an important bearing upon the success attending its transplanting. In general, the root system of a very young plant will be much less seriously disturbed in transplanting than that of an older one of the same species, so that, under controlled moisture conditions, it may be feasible to transplant certain species while small that could not readily be handled when older. Furthermore, early transplanting favors the development of a fibrous root system, which in turn may have an important bearing upon the success of subsequent transplanting of the same specimen. However, if shifted from a greenhouse or hotbed to outdoor conditions, a very young and tender plant of a readily transplanted species has insufficient substance to withstand the vicissitudes of the weather, and is much less likely to thrive than a somewhat older plant of the same species.

**The one great principle** involved in all successful transplanting is that the plants must be in such condition and handled in such a way that they will not suffer from lack of moisture during, or shortly following, the operation of transplanting.

**Character of Plants Desired.**—For transplanting into the open ground, the plants should be strong and stocky as a result of having been grown under favorable conditions with sufficient space for good development of both root and top (Fig. 23). They should be of suitable age for transplanting. This varies from four to

twelve weeks, depending upon the kind of plant in question. Plants grown in hotbeds or greenhouses should be properly "hardened off" before transplanting into the open. This is accomplished by diminishing the amount of water applied and gradually accustoming the plants to lower temperature. Under this treatment the plants cease their rapid, sappy growth and become more hard and woody. In this condition they bear transplanting more readily.



FIG. 23.—Well-grown tomato plants ready for transplanting.

Plants are kept from suffering from lack of moisture while being transplanted (1) by very thorough watering a few hours before they are removed from the seed-bed, so that their tissues will be filled with water, and also in order that they may be removed without seriously damaging the roots; (2) by transplanting as quickly as possible after removing from the seed-bed; and (3) by protecting the plants from wilting while they are being carried about the field during the transplanting. This protection is

afforded (1) by carrying the supply of plants with their roots submerged in a bucket of water; (2) by sprinkling the tops as well as the roots; (3) by carrying the plants in a basket covered with a wet sack; or (4) by having the roots of the plants encased in a mass of moist soil.

**Means of Insuring Moisture following Transplanting.**—There are a number of different means of insuring that the plant shall have a sufficient supply of moisture immediately following transplanting. These naturally fall into three different groups: (1) Making sure that there is moist soil in close contact with the roots of the plant at the time of transplanting; (2) preventing the drying out of the soil close to the plant after transplanting; (3) reducing the rate of transpiration of water from the plant itself.

In order that there may be moist soil in close contact with the roots of the plants it is essential that the soil in the field where the transplanting is to be done shall have been thoroughly worked to render it fine and mellow. This working should have been done while the soil was in ideal condition as to moisture, and if transplanting was not to take place until some time later, the surface should have been stirred at frequent intervals in the meantime in order to conserve the moisture in the layer of soil immediately below. If this has been done, it is possible to transplant successfully even when the top soil is very dry, by scraping away the dry soil where each plant is to be set and placing the roots of the plant in the moist soil below. Of course, the operation of transplanting can be carried on more readily if the soil is moist clear to the top, for it is then unnecessary to hunt for moist soil.

**Firming the Soil about the Roots.**—In all transplanting the soil should be packed firmly about the roots of the plant. Moisture in the soil is of no benefit to the plant unless it is in close contact with the roots. Loose moist soil soon dries out. If the soil is packed tightly about the roots of the plant (Fig. 24), not only the moisture in the soil in immediate contact with the roots will be available to them, but moisture will also be drawn to them from adjacent soil by capillary action. The drier and looser the soil the tighter it should be packed.

Even when these precautions are taken, certain kinds of plants that it is sometimes desirable to transplant seem unable to establish themselves in their new location. They are likely to wilt and die before the roots have time to re-establish themselves. Melons, squashes and cucumbers are striking examples of such

plants. If to be transplanted, these plants must be handled in such a way that the roots will not be removed from the soil in which they grew in the seed-bed. They may be grown on inverted sods, in earthenware pots, paper pots, oyster buckets, strawberry boxes, or veneer dirt bands (Fig. 25). The dirt bands are extensively used by commercial growers for handling these plants. Other plants often handled in pots, especially if to be transplanted when quite large, are eggplants and tomatoes. Large tomato plants are frequently handled without pots, but with a block of soil six inches square enclosing the roots. Almost any kind of plant is



FIG. 24.—Transplanting lettuce seedlings from one flat into another. The soil is firmed about the roots of each plantlet with a pointed stick or pot label, used as a dibber.

somewhat surer to resume growth quickly after transplanting if it is moved with soil adhering to the roots (Fig. 26). There is then no uncertainty regarding the presence of moist soil in intimate contact with the roots. While this method increases the labor of transplanting, it also increases the probability of success in case soil or weather conditions are unfavorable.

**Tillage following Transplanting.**—The drying out of the soil close about the plant after transplanting may be largely prevented by planting deeply and covering the compact soil about the roots with a layer of loose soil which shall serve as a mulch to check evaporation from the moist soil below. Thorough tillage close

to the plants immediately after setting will serve the same purpose, and is sometimes the most convenient way of making the mulch.

**Watering.**—If transplanting must be done at a time when the soil is dry, water must be applied to each plant at the time it is set. It is usually best to apply the water at the root of the plant and to cover the mud with loose dry soil to prevent evaporation. If subsequent watering becomes necessary, as is likely to be the case in a dry time, the water should be applied close to each plant in sufficient quantity to reach

the roots. As soon after the watering as the soil begins to dry, the surface crust should be broken by tillage, so that further evaporation will be checked.

In this way the plant is enabled to secure the full benefit of the water applied.

**Reducing Transpiration.**—

If transpiration of water from the plant itself takes place more rapidly than it can be supplied from the soil through the roots, the plant will wilt; and then if unfavorable conditions continue too long it will eventually die. Therefore, in addition to insuring the presence of moisture in the soil immediately surrounding the roots, it is advisable to take such precautions as are feasible to reduce the rate of transpiration from the plant



FIG. 26.—A pot-grown tomato plant, showing ball of earth and development of roots.



FIG. 25.—Watermelon plants in veneer dirt band, ready for transplanting.

immediately following transplanting. The rate of transpiration depends considerably upon the temperature and humidity of the atmosphere. The more humid the atmosphere at the time of



FIG. 27.—Removing tops from beet seedlings preparatory to transplanting.

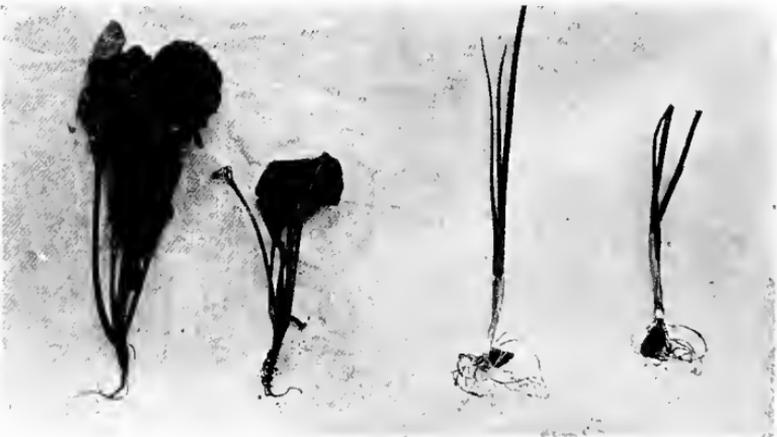


FIG. 28 —Beet and onion seedlings before and after removal of tops preparatory to transplanting.

transplanting, the less rapid will be the rate of transpiration from the plant. Therefore, transplanting immediately before or after a rain is advisable. Plants are likely to wilt on account of too rapid transpiration if they are exposed to intense sunlight immedi-

ately after transplanting. Therefore transplanting on a cloudy day or late in the afternoon is a decided advantage. However, such a precaution secures protection from the sun for only a few hours at best, and in intensely hot weather may be inadequate. Protection from direct sunshine for as long a time as may be desired can be secured by shading each plant with a broad shingle, flower pot, old basket, or even a rhubarb leaf.

Since, under the same conditions, the amount of water transpired by a plant bears a definite relation to the extent of its leaf surface, reducing the leaf surface by the removal of part of the foliage at the time of transplanting (Fig. 27) will reduce the amount of transpiration and therefore in many cases prevent the wilting of the leaves that remain. It is much better to sacrifice part of the foliage than to run the risk of losing the entire plant. It is a common practice to cut or twist off one-third to two-thirds of the foliage from late cabbage and celery plants that are transplanted in midsummer. This reduction of the foliage is unnecessary in the case of early cabbage, for at the time it is set the weather is much cooler and transpiration therefore much less rapid. When beets and onions are transplanted, even in early spring, it is customary to remove part of the foliage (Fig. 28).

#### METHODS OF TRANSPLANTING

Various methods of transplanting are employed. When the soil is moist clear to the surface and weather conditions are favorable, plants that can be transplanted without dirt on the roots can be very rapidly and readily set with a dibber (Fig. 29). This is essentially a sharpened stick with the upper end shaped to fit the hand, but may be shod with iron, or even made entirely of steel. In the latter case it is usually flat rather than round. In transplanting, the dibber is thrust into the ground to make a hole; the plant is inserted, and the soil pressed against its roots by another thrust of the dibber or by pressure upon the surface with the hands of the operator. Cabbage, celery, beets, and onions are usually set with dibbers.



FIG. 29.—  
Dibber.

For setting certain plants, such as sweet potatoes, a spade is often used instead of a dibber. One man operates the spade and another, or preferably a boy, places the plants. The spade is thrust into the soil and the handle moved slightly forward to make a wedge-shaped opening. The plant is thrust into the opening and held in

place until the spade is withdrawn. Another thrust of the spade and a step of the foot closes the hole and firms the soil about the plant. Experienced hands set sweet potatoes very rapidly by this method.



FIG. 30.—Trowel.

If small plants are to be transplanted with earth attached, a garden trowel (Fig. 30) is often a more convenient tool to use than a dibber. This is especially true if the plants are to be transplanted

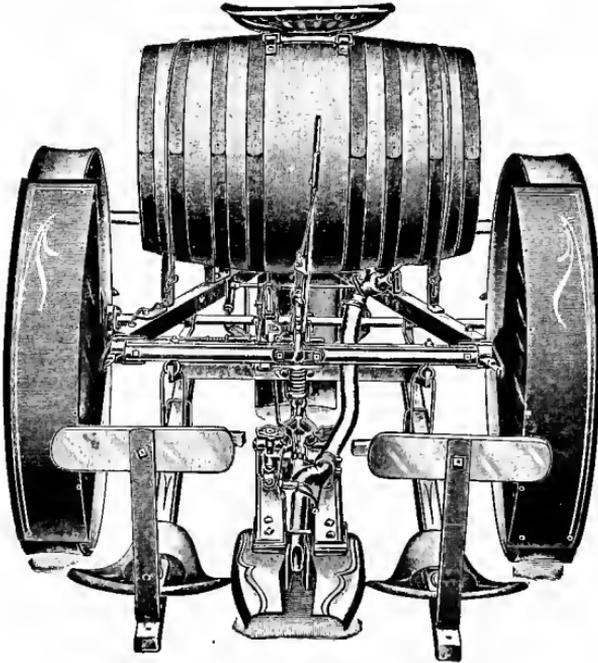


FIG. 31.—Transplanting machine.

from pots. A hole is dug with the trowel, the plant inserted, and with the hands moist earth is packed about the mass of soil containing the roots.

When large plants, such as eggplants, tomatoes and melons, are to be transplanted with a mass of earth surrounding the roots, a hole for each plant may be dug with a spade if the number of plants is

small. However, in commercial operations, the field to be planted is furrowed out both ways and the plants set at the intersections.

**Transplanting machines** drawn by horses are useful for the commercial planting of certain crops. Only plants that can be set without dirt attached can be transplanted by the use of these machines (Fig. 31). One person drives the team and two others seated at the rear of the machine with a supply of plants in their laps, place the plants in the furrow as it is opened. Shoes or rollers following close the furrows and compact the soil. There is an attachment for applying water to the plants as they are set. It is practicable to use a machine of this sort only when large numbers of plants of the same kind are to be set.

In nearly all transplanting of vegetable plants it is customary to set the plants slightly deeper than they grew previous to their transplanting. If they have grown too tall, they must be set still deeper, in order to make them stand erect and to avoid sun scalding of the stems.

## QUESTIONS

1. What are the principal reasons for transplanting vegetable crops?
2. What economic questions must be considered in connection with transplanting?
3. How do plants differ in the readiness with which they lend themselves to transplanting?
4. What relation has the structure of the root system of a plant to its adaptability to transplanting?
5. What is the relation of the age of a plant to the ease with which it may be transplanted?
6. State the great underlying principle involved in all successful transplanting.
7. Characterize plants that are in desirable condition for transplanting.
8. What is meant by "hardening-off"? How is it accomplished?
9. In what different ways may plants be kept from suffering from lack of moisture while being transplanted?
10. What are the various means of insuring that a plant shall have a sufficient supply of moisture immediately following transplanting?
11. What special precautions must be taken in transplanting melons, cucumbers, and similar crops?
12. Why is tillage important immediately following transplanting?
13. Under what circumstances is watering necessary at the time of transplanting?
14. How may the transpiration of water from a plant be reduced?
15. Describe the method of setting plants with a dibber. With a spade. With a trowel.
16. Describe the operation of a transplanting machine.
17. How deeply should plants be set when transplanted?
18. Are any machine planters used in your vicinity? If so, for what kinds of plants are they used?

## CHAPTER IX

### THE USE OF GLASS IN VEGETABLE GROWING

VEGETABLE plants for early transplanting are usually started under glass. Glass is also used for growing certain crops to maturity outside their normal season, and in certain sections for wintering over plants started in the autumn. There are three kinds of glass structures that may be used in vegetable growing: Coldframes, hotbeds and greenhouses.

A **coldframe** is the simplest form of glass structure and consists essentially of a wooden frame covered with glass sash. It depends solely upon the sun for its source of heat, and upon the protection of the glass and additional covering to prevent too rapid radiation of the heat at night. It is impossible to make a coldframe very warm in cold weather. Its usefulness is therefore limited to relatively mild climates, the growing of cool-season crops, the starting of plants for rather late transplanting, or the hardening-off of plants started in greenhouses and hotbeds. Its principal use in general vegetable growing at the North is for hardening-off plants preparatory to transplanting, and for this purpose it has no equal. Sometimes, for the sake of cheapness, cloth is substituted for glass as a cover for coldframes (Fig. 32), but this limits their use to still warmer weather than when glass is employed.

A **hotbed** is very much like a coldframe except that it is supplied with heat in addition to that furnished directly by the sun. The most common source of heat for hotbeds is fermenting horse manure placed under the soil of the bed. Other hotbeds are heated through flues by means of wood or coal fires. Occasionally a bed is heated by steam or hot water through pipes connected with the heating system of a greenhouse or residence.

Hotbeds are superior to coldframes for starting early plants because they can be operated in colder weather. At the North it is impossible to grow really early tomato, pepper, or egg plants by the use of coldframes alone, for these plants demand higher temperatures than can be maintained in a coldframe at the time they must be started. Fire hotbeds have an advantage over manure hotbeds, since they can be started in colder weather and the heat controlled much more completely.



FIG. 32.—A cloth-covered coldframe.



FIG. 33.—A modern greenhouse. The tall smoke stack insures a good draft for the fires.

**Greenhouses** furnish the most ideal conditions for starting early vegetable plants, for in a properly constructed house any desired temperature can be maintained to a nicety no matter how cold the weather (Fig. 33). Greenhouses can be used for growing certain crops to maturity in the dead of winter, as well as for starting early plants to be later transferred to coldframes and the open ground. In addition to the better control of temperature, another great advantage of a greenhouse over hotbeds and coldframes for starting early plants is that the gardener can give the plants better attention in bad weather. On stormy days, when it may be entirely impracticable to work at plants in hotbeds, the gardener can go into his greenhouse and give the plants the attention they need. It is a decided advantage to the gardener and to the plants if both can be under the same roof when the weather is bad.

The advantages of hotbeds and coldframes, as compared with greenhouses, are their cheapness of construction and cost of maintenance, and the facility with which they can be thoroughly ventilated (by removal of the sash) when the warm days of late spring arrive. A spring crop of lettuce is more certain to develop properly in a coldframe than in a greenhouse. On the whole it may be said that each type of glass structure has its place in vegetable gardening operations and none can be fully substituted for the others.

#### CONSTRUCTION OF MANURE HOTBEDS\*

A manure hotbed may be made very cheaply by placing a sash-covered frame on top of a flat pile of fermenting manure (Fig. 34). However, such a bed is badly exposed to winds, and is less satisfactory in cold weather than a bed made by placing the frame above a pit containing the manure. The pit may be merely an excavation in the ground or may be walled up with plank, or even brick if a permanent bed is desired. The bed must be in a well-drained location if the manure is placed in a pit; otherwise water would likely seep into the pit and interfere with the proper fermentation of the manure.

**The preparation of manure** for a hotbed should begin at least three weeks before the hotbed is to be used. Fresh horse manure from grain-fed animals should be placed in a compact pile. The

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\*Directions for the construction of both manure and fire hotbeds have been adapted from Illinois Bulletin No. 144.

manure should contain a fair amount of litter but should not be too strawy. If it is rather dry, it should be moistened with water as it is being piled. As soon as fermentation has become well started, the manure should be thoroughly forked over and re-piled. Care should be taken to break up all lumps and place the coolest manure from the outside of the original pile in the midst of the new pile, to insure uniform fermentation of the entire mass. As soon as the whole pile is steaming, the manure may be placed in the pit, or in a flat pile if the bed is to be constructed entirely



FIG. 34.—Simplest form of manure hotbed. The frame is placed on a pile of fermenting manure.

above ground. The manure should be thoroughly tramped as it is being piled, and care taken to have it uniformly compact throughout the bed, so that it will not settle unevenly and let the soil sink in spots after the bed is in operation. A good plan is to put the manure on in layers about six inches deep, and tramp each layer thoroughly before putting on the next. When the bed is completed, the manure should be about two feet deep. If a pit has been used, the manure should extend approximately to the level of the ground.

As soon as the manure has been placed in the bed, the frame

and sash should be put on to protect the bed from rain or snow and help retain the heat. The soil in which the plants are to be grown may be placed in the bed at this time or a few days later, but in no case should seeds be sown or plants set until after the violent heat following the moving of the manure has somewhat subsided. Sometimes this violent heating does not become evi-

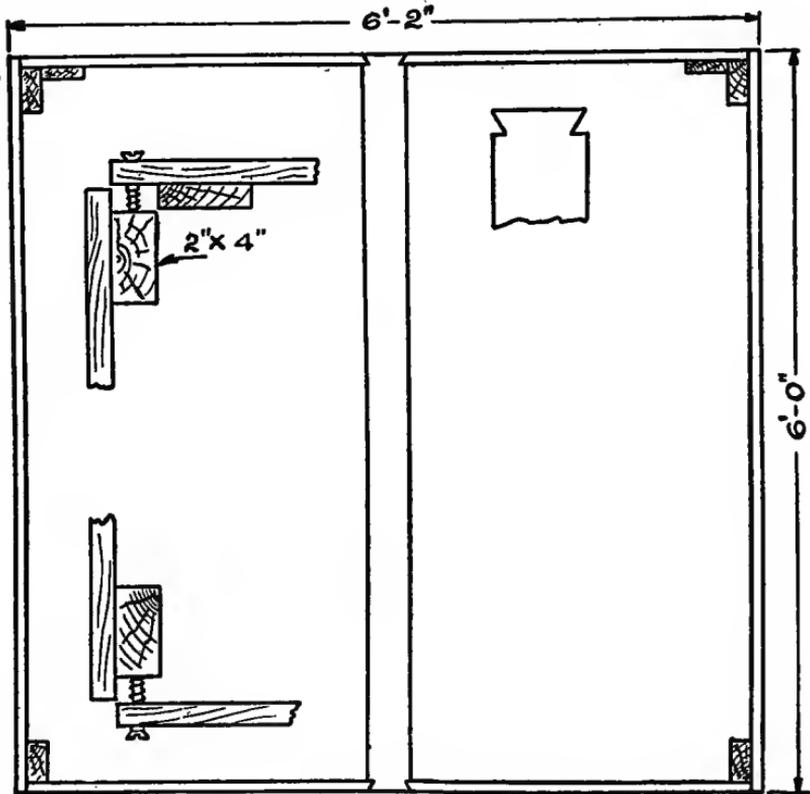


FIG. 35.—Diagram of frame for manure hotbed.

dent for three, four, or even more days after the bed is made, and a person is inclined to think the bed is not going to heat. It would be a serious mistake to plant the bed at this juncture, for if the manure is of good quality and has been properly handled, the violent heating is sure to occur and would kill any seeds or plants in the bed. Some persons favor putting in the soil when the bed is first made, for the sake of killing the weed seeds in the soil

by this violent heating. After the bed has heated up, and then cooled down to 85° F., the seeds may safely be sown.

The hotbed frame should be twelve inches high in front and sixteen or eighteen inches high at the rear, and should face the south to get the full benefit of the sun. Since most hotbed sash are six feet long, the frame should be six feet wide, outside measure, and long enough to accommodate the number of sash required; or if a large amount of hotbed space is required, it is a common practice to make a series of beds of four sash each. Since a 3' x 6' sash is often a little over three feet wide, the frame may need to be over twelve feet long to accommodate four sash. It is a good plan to measure the exact width of the four sash to be used and cut the lumber for the frame accordingly. In making the back of the frame avoid having a crack near the top of the bed. If only

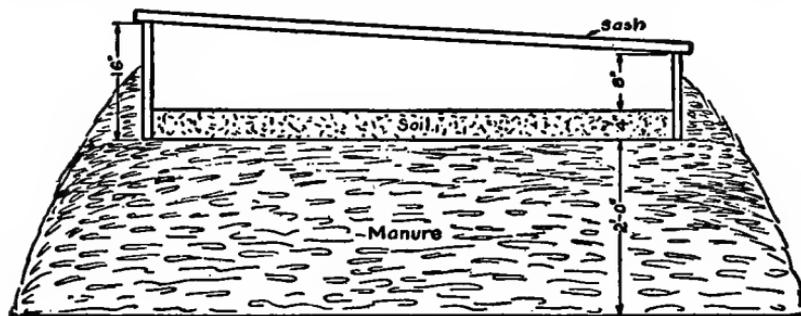


FIG. 36.—Cross-section of simplest form of manure hotbed.

a small amount of hotbed room is needed, a bed may be made with only two, or even one sash. Unless the hotbed is of the permanent type, it is advisable to have the frame put together with screws, so that it may be taken down at the close of the season without splitting the lumber. The frame can be stored in a small space until needed the next season. The accompanying diagram shows the arrangement of the different parts of such a frame made for two sash, together with enlarged views of the corners and joints (Fig. 35).

With a hotbed frame made as indicated there will be room for four inches of soil in which to grow the plants, and still leave eight inches of space between the soil and sash at the front of the bed. A cross-section of a hotbed of the simplest and cheapest type, showing the location of manure, soil, and sash, is shown in Fig. 36.

## CONSTRUCTION OF FIRE HOTBEDS

The essential features of a fire hotbed are a long sash-covered frame underlaid by two flues connected with a fire-pit at one end and chimney at the other. An ideal location for a fire hotbed is a gradual slope to the south or east. Such a location insures full exposure to sunlight, protection from cold winds, good draft for the flues and drainage for the fire-pit.

Fire hotbeds differ somewhat in details of construction. The method of construction here described is in common use by truck growers in southern Illinois. An area six feet wide and from 80 to 100 feet long is marked off in such a way that one end of the bed will be a few feet higher than the other. A row of posts is set along each side of this area, those on the north or west side extending eighteen inches above the level of the ground and those on the south or east side twelve inches. These posts must be set about two and one-half feet deep to prevent their being heaved out by frost. The distance between the posts will depend upon the length of lumber to be used in making the frame. For sixteen-foot lumber, the posts should be placed five feet four inches apart.

After the posts are set, boards are nailed onto the inside of these rows of posts to make the walls of the bed. It is well to allow the boards to extend two inches above the tops of the posts, so that the latter will not interfere with the sash.

The dirt should be dug out from between the walls to within three inches of the posts on either side. At the upper end of the bed it is dug out to the depth of six inches, the depth gradually increasing until the lower end of the bed is reached, where it is two and one-half feet. The excavation is extended several feet beyond the lower end of the bed. This extension is made one foot narrower and one and one-half feet deeper than the bed proper. Six feet of the upper part are to be used for the fire-pit, the lower part being dug out for convenience in firing. The sides of the pit are walled up with rock or brick to a height of two feet and covered with broad flat rocks well supported by iron bars, or the cover may be entirely of old boiler iron.

From each side of the back of the fire-pit, a trench twelve inches deep and nine inches wide is dug diagonally toward the side of the bed. When within four inches of the side of the excavation the direction is changed and the trench cut parallel with the side of the bed. These trenches are covered closely with flat stones to prevent dirt from filling them. The dirt which is first

filled in over these stones is well packed to prevent smoke from going through into the dirt of the bed. Thus, flues are made which conduct the heat and smoke under the bed to the chimneys at the upper end (Fig. 37).

In localities where rock is not easily obtained, sewer tiles, four to six inches in diameter, are sometimes used for flues in place of the rock-covered flues above described. In this case it is unnecessary to excavate the full width of the bed, since the tile can be placed in the bottom of trenches dug to the proper depth.

Chimneys for the upper ends of the flues are made by nailing together four ten-inch boards. The board on the side toward the flue should be a foot shorter than the other three so as to allow an opening into the chimney.

As the flues are finished, most of the dirt which was dug out is shoveled back into the bed, filling it to the original level or perhaps two inches higher. Boards are nailed across the ends of the bed. The fire-pit is covered about two feet deep and the remainder of the dirt is banked against the out-

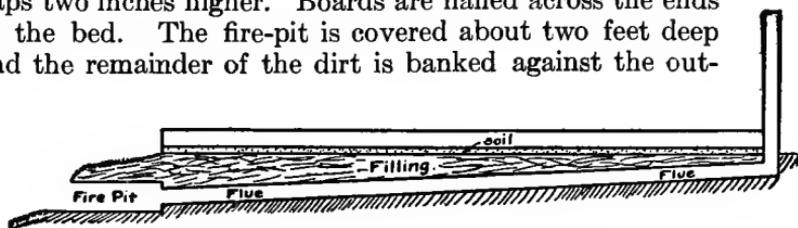


FIG. 37.—Longitudinal section of fire hotbed.

side of the walls of the bed. Additional dirt should be piled against the walls to bank them to the top, for the severe weather of February and March will make it necessary to protect the plants as much as possible.

To be in readiness for use in the spring the bed should be completed in the fall, and the soil put in for growing the plants. This should be about four inches deep. Soil rich in humus and relatively free from weed seeds is secured. This is usually enriched with well-rotted manure in the proportion of one load of manure to ten loads of soil. After the soil is put in, the bed is left open to the weather until late in December, when it is covered with sash to keep out rain and snow.

The sash are supported by cross-bars resting on the walls of the bed. Each cross-bar is made by nailing together two strips of wood, one of which is 1" x 3" and just long enough to fit loosely between the walls of the bed, and the other is 1" x 2" and

as long as the sash, so that the ends may rest upon the sides of the bed. These supporting strips afford a base on which to slide the sash in opening the bed, and also insure good connections between adjoining sash.

About a week before seeds are to be planted, a fire is started in the pit in order to warm the soil in the bed and put it in condition for working. A hot fire is required for several days to get the bed into good condition for early planting, but after the soil has once become warm much less fuel is needed to keep up sufficient heat.

#### CONSTRUCTION OF COLDFRAMES

The construction of a coldframe is similar to that of a manure hotbed, except that the frame is placed directly upon the ground



FIG. 38.—Cloth-covered coldframe eighty-four feet long.

instead of being upon a pile of manure or over a pit containing manure. For use early in the season, the sides of the coldframe are well banked with manure. For hardening-off plants late in the season, such banking is unnecessary. Temporary coldframes may be made by setting up two parallel lines of plank, six feet apart, held in place by stakes driven into the ground. One line should be of wider plank than the other to provide for slope. Boards are nailed across the ends and the top is covered with sash or cotton cloth. If sash is used, cross-bars may be omitted from a temporary frame of this sort.

A cloth cover is sometimes used. If so, it must be supported by cross-bars at intervals of about four feet. For making a cloth

cover, two widths of heavy unbleached muslin are sewed together. One edge of the cover is nailed to the top of the plank forming the upper side of the frame, while the other edge is fastened to a roller made by nailing together two 1" x 2" strips of wood in such a way that the strips break joints and form a continuous roller as long as the frame, except in the case of frames over sixty feet long (Fig. 38), when the cover may be made in sections for convenience in handling. The cover must be of such a width that when put over the frame the cloth will come a little beyond the top of the front plank. The weight of the roller will then hold the cover in place.

#### CARE OF PLANTS UNDER GLASS

The first essential in the care of hotbeds, coldframes and greenhouses is the maintenance of the proper temperature for the welfare of the plants. In the greenhouse the temperature is controlled mainly by turning on or cutting off heating pipes, though ventilation is also used as a means of controlling the temperature, especially late in the spring. Shading of the glass may also be resorted to when the weather becomes warm. In a fire hotbed, the temperature is regulated by the extent of firing and also by ventilation. In manure hotbeds and in coldframes the supply of heat cannot be changed at the will of the operator. However, the heat can be conserved or dissipated according to the needs of the plants and the condition of the weather. On cold nights heat is conserved by covering the sash with mats, shutters, straw or manure. During the day the sash may be raised to let out surplus heat.

**The object of ventilation**, by opening the ventilators of greenhouses or raising the sash of hotbeds and coldframes, is not merely to assist in the control of the temperature. It is even more important for changing the air in the house or bed. Fresh air should be admitted every day. If the weather will permit, the sash or ventilators should be left slightly open for several hours in the middle of the day. Hotbeds require even more attention to ventilation than greenhouses, because the volume of air is so much smaller. When the weather is so cold and windy that the hotbed cannot be left open for any great length of time, it may be opened slightly for a few minutes two or three times during the day, and thus a change of air secured. This assists in drying out the bed and preventing the damping-off of seedlings. Plants grown without sufficient ventilation are likely to be weak, spindling and sappy.

The watering of plants under glass should be carefully done. Water should be applied only as frequently as is necessary to keep the plants growing properly; but whenever water is applied it should be put on in sufficient quantity to soak well down to the roots of the plants. Infrequent, heavy waterings are better than frequent, light waterings. The frequency of watering required will depend greatly upon the amount of sunshine and the humidity of the atmosphere. In damp, dark weather, watering should be withheld as much as possible in order to avoid danger of damping-off and other fungous troubles. Care should be exercised to have the foliage of the plants dry at night. It is also considered better to apply water to plants under glass when the temperature is rising rather than when it is falling. Therefore watering in greenhouses and hotbeds should usually be done in the morning rather than the afternoon, especially in winter weather.

**Tillage of Plants under Glass.**—Plants growing under glass respond to tillage the same as plants outside. The repeated watering packs the soil, and it should be loosened up. Tillage with hand weeders and similar tools should be given at least once a week to all plants that are planted in such a way that tillage is feasible. Of course, seedlings growing thickly in flats, from broadcast seeding, could not very well be tilled.

**Shifting Young Plants.**—Young plants started under glass for later transplanting often require one or two shiftings before they are ready for the final transplanting to the field. If the seeds have been sown in flats, the young seedlings, as soon as they are large enough to handle, may be shifted to other flats or to small pots. This gives them space to develop into strong, stocky plants. Sometimes, instead of being placed in flats or pots, the young seedlings are set directly into the soil of a hotbed or coldframe. Under the controlled moisture conditions there is little danger of losing any of the plants.

#### QUESTIONS

1. What are the three kinds of glass structures used in vegetable growing?
2. What are the uses and limitations of coldframes?
3. What cheaper covering is sometimes substituted for glass on coldframes?
4. How does a hotbed differ from a coldframe?
5. What is the most common source of heat for hotbeds?
6. What other means of heating hotbeds are sometimes employed?

7. Compare coldframes, manure hotbeds and fire hotbeds in reference to their suitability for starting plants in cold weather.
8. What points of advantage have greenhouses over all other glass structures?
9. Compare the two types of manure hotbeds.
10. Describe the preparation of manure for hotbeds.
11. How soon after a manure hotbed is made, may seed safely be planted in it?
12. Describe the construction of the frame for a manure hotbed.
13. Describe the method of constructing a fire hotbed.
14. Describe the construction of a cloth-covered coldframe.
15. How may the temperature be controlled in various kinds of glass structures?
16. What are the objects of ventilation in greenhouse and hotbed management?
17. Give directions for the watering of plants under glass.
18. Can you describe the special structure of hotbeds, coldframes, or greenhouses in your vicinity?

## CHAPTER X

### THE PREPARATION OF SOIL FOR PLANTING

THE first step in the preparation of land for the planting of vegetables is a thorough breaking up of the soil to a depth of from four to ten inches, depending upon the nature of the soil and the crop to be planted. The principal means of breaking up the soil is plowing, though it is often a decided advantage to disk (Fig. 39) the land before plowing in order that there may be finely pulverized soil at the bottom of the furrow.

**Advantages of Fall Plowing.**—For the early spring plantings of vegetable crops it is advisable to have the ground plowed the preceding fall. This facilitates early planting, for plowed ground dries out earlier in spring than unplowed, and also no time is lost in plowing after the soil has reached workable condition. It often happens that early in the spring when the cool season crops should be planted, the soil remains in ideal condition for working only a brief period, and then becomes so thoroughly wet by copious rains that further garden work is precluded for two or three weeks. If the manuring and plowing have been done in the fall, it is often possible to plant the early vegetables in the brief period during which the soil is fit to work, while otherwise this entire period might be expended in making preparations, and the actual planting necessarily deferred until the next time the soil is dry. Since the success of many of the early crops depends upon early planting, the wisdom of fall preparation is apparent.

If the land has been manured and plowed in the fall, and is worked at the proper time in the spring, very little labor is necessary in the preparation of a seed-bed for the early planting. Soil containing sufficient humus to grow vegetable crops advantageously can be fitted for planting without the use of hand tools, if the precaution is taken to work it at the exact time it reaches the right degree of dryness. It will then crumble readily, and a seed bed can be prepared by the use of a disk, harrow and planker (Figs. 39, 40 and 41).

**How to Determine when the Soil is in Workable Condition.**—To determine when the land has reached the right stage of dryness

for working in the spring, a small portion of the soil should be taken in one hand and pressed into a ball. When the fingers are relaxed, the mass of soil should retain its shape and show the marks of the fingers, but should readily crumble when rubbed lightly between the thumb and finger, and should not stick to the hand.

**Treatment of Unplanted Land to Conserve Moisture.**—For later crops the land should be plowed fairly early in the spring while it is still well supplied with moisture, and should be harrowed the same day it is plowed, in order to break up the surface lumps

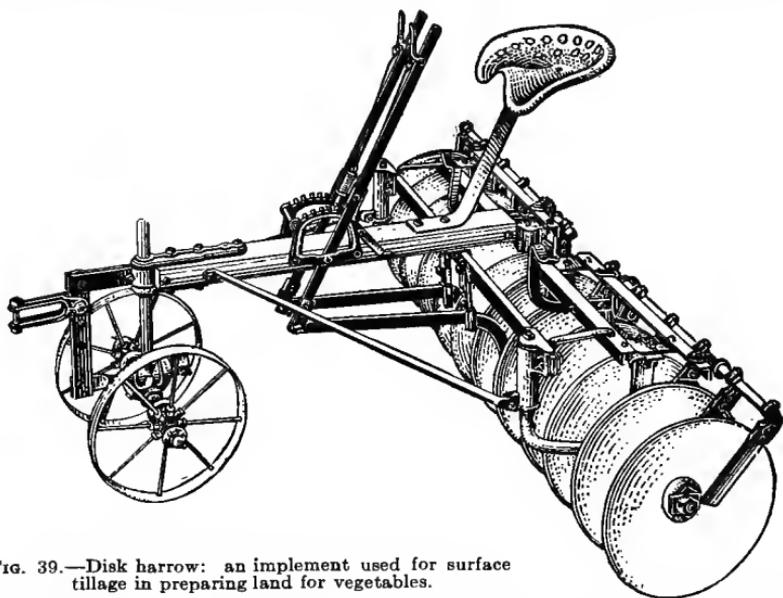


FIG. 39.—Disk harrow: an implement used for surface tillage in preparing land for vegetables.

before they become hard, and also to create a mulch that will conserve moisture in the lower layers of the soil. At frequent intervals and before a crust forms after each rain, the ground should be disked or harrowed, and thus kept in good tilth until the time it is needed for planting. It will then be an easy matter to finish the preparation of the seed-bed with harrow and plunger.

In a small home garden, where there may be insufficient space for working with horse tools, the same principles of preparation apply. To facilitate early planting it is an advantage to work up the ground roughly but deeply in the fall. Fall worked ground can be fitted for early planting by the use of a hoe and rake. Land for later planting should be spaded in early spring while it is in

good workable condition, and kept free from weeds and crust formation by hoeing and raking the surface at frequent intervals.

Whether prepared by horse or hand tools, the soil should be fine to a considerable depth and preferably moist clear to the

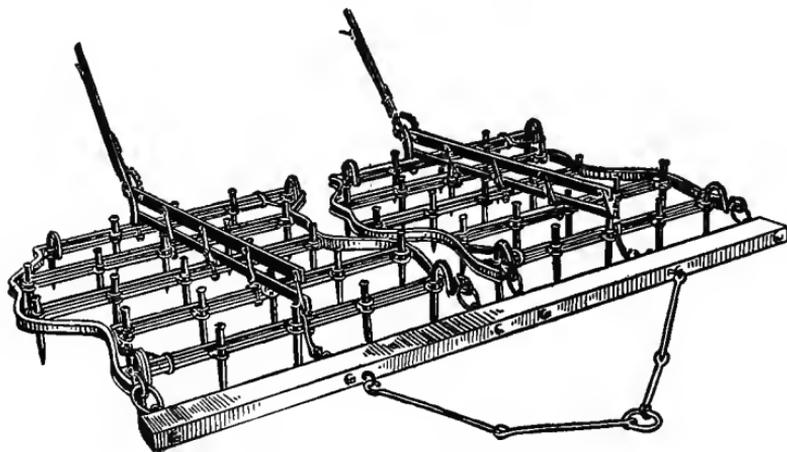


FIG. 40.—Spike tooth harrow.

surface at the time the seeds are planted. Thorough preparation of the soil before planting is a very important factor in the production of any crop.

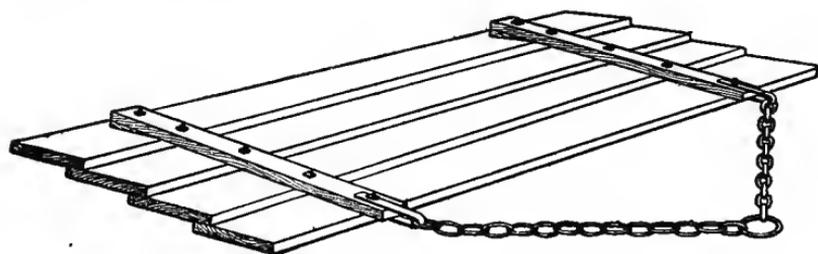


FIG. 41.—Planker.

In preparing soil for planting seeds in greenhouse flats, pots, or boxes, it is advisable to sift the soil through a screen to make it uniformly fine throughout. Unless the soil already contains a high percentage of sand, it is customary to add considerable sand in preparing it for seed boxes. This makes the soil less likely

to pack under repeated watering, affords better drainage and reduces the danger of damping-off. In order that the seedlings may make a vigorous growth, rotted manure also is often added in preparing soil for seed flats; though since the manure increases the danger from damping-off, some growers omit the manure from the seed flats, but use it in large amounts in the soil which is to receive the seedlings at the first shift. A very good formula for preparing a soil for planting seeds in greenhouse flats—unless damping-off is feared—and for growing young seedlings after the first shift, is four parts rich garden loam or rotted sod, two parts fine, thoroughly rotted manure and one part sand. All the ingredients should be sifted, and thoroughly mixed together by shoveling. If the soil is too dry, water may be sprinkled on repeatedly during the mixing, until it is of the right consistency. The fineness of the screen (Fig. 42) to be used

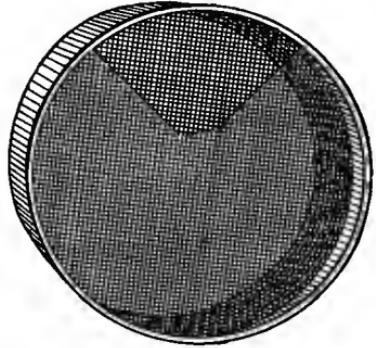


FIG. 42.—Soil sieve.

in sifting the soil will depend upon the condition of the soil and the kind of seed to be planted. For ordinary purposes a three-quarter-inch screen for the manure, a half-inch screen for the loam, and a quarter-inch screen for the sand, will be satisfactory; but for some fine seeds a quarter or even one-eighth-inch screen may be used for all ingredients. When a soil is thus carefully prepared the plant roots have no difficulty in reaching every part of it, and a small mass of soil is capable of supporting a large amount of plant life.

QUESTIONS

1. What is the first operation in the preparation of soil for planting?
2. When should the ground be plowed for early spring planting?
3. What advantages has fall over spring plowing for early garden planting?
4. How may a seed-bed for vegetables be prepared without the use of hand tools?
5. Describe a method of determining when the soil has reached workable condition in spring.
6. Describe the proper method of treating land to conserve moisture for late spring planting.
7. How may soil be prepared for planting small seeds in greenhouse flats or boxes?
8. Can you describe bad examples of soil preparation which you have witnessed?

## CHAPTER XI

### THE PLANTING OF SEEDS

IN order that seeds may germinate it is necessary that certain conditions be met. In the first place, the seed must be viable, that is, it must possess strong germinative power. No matter how carefully all other conditions are met, if the seed itself is weak or dead, satisfactory germination cannot take place. The precautions necessary to the producing of good viable seed have already been discussed in Chapter IV. Other conditions essential to germination are the presence of moisture and oxygen, and the proper temperature for the kind of seed in question.

**Moisture is necessary** because the absorption of water is the first stage in the process of germination. In the absence of moisture, seeds will remain dormant indefinitely regardless of the presence of all other factors essential to germination. It often happens that seed improperly planted in dry soil will remain inactive for weeks, and then sprout after a heavy rain. To insure prompt germination, an adequate supply of moisture must be maintained in direct contact with the seed. This is accomplished by planting the seed in fine, moist soil, and firming the soil sufficiently to bring the soil particles in close contact with the seed on all sides. Moisture is then carried to the seed by capillary action, and its needs thus supplied. Provision must be made for a continuation of the water supply until the seed has germinated and the plantlet become well established. In outdoor culture, in the case of seeds that can be planted deep, there is little danger of the soil becoming too dry before germination is completed if it was sufficiently moist at the time the planting was done. However, it is a wise precaution to scarify the surface of the soil over deep-planted seeds and thus provide a mulch for conserving the moisture in the layer of soil containing the seeds. This insures prompt germination and an abundance of moisture for the seedlings.

If the loose top layer of soil is dry at the time small seeds are to be planted, but there is plenty of moisture below, very thorough firming of the soil over the seeds may establish sufficient capillary action to bring the moisture to the seed and effect germination. However, the deeper the layer of dry soil and the shallower the

seeds must be planted, the more difficult and uncertain is this method of attempting to secure moisture for the germination of seeds. The much more certain way of securing germination is to plant only when the seeds can be planted in direct contact with moist soil.

In the carefully prepared soil used in a greenhouse or a hotbed and with the facilities for artificial watering, there is no difficulty in maintaining an abundant supply of moisture in contact with any seeds that may be sown under these conditions.

**Relation of Drainage to Germination.**—Since seeds will not germinate without the presence of oxygen, it is essential that provision be made for the rapid draining away of any surplus water that may fall as rain or be applied artificially; for if the soil becomes completely saturated with water and remains in that condition, there will be no room for air, and hence no oxygen available to the germinating seeds. Soils that are naturally well drained or artificially drained present conditions more favorable to the germination of seeds than do poorly drained soils. In the greenhouse, seed flats and flower pots have holes in the bottom to facilitate drainage.

**Different seeds germinate best at different temperatures,** but in general most seeds germinate well at a temperature closely corresponding to that at which the plants thrive after they have become established. Thus, seeds of the cool season crops will germinate at a much lower temperature than those of the warm season crops. Seeds of the warm season crops, if planted in moist soil when the temperature is low, are likely to rot instead of sprouting. Some of the cool season crops will germinate readily at a temperature of 50° to 60° F., while a temperature of 70° to 80° is required for rapid germination of the warm season crops.

In outdoor culture, the proper temperature for the germination of the seeds is secured by regulating the time of planting the various crops to meet their respective demands. Under glass, the temperature is regulated by the amount of piping in the greenhouse, the extent of firing in a flue-heated hotbed, and the amount and quality of manure used in making a manure hotbed.

#### DEPTH OF PLANTING

Seeds should be planted deep enough to be well supplied with moisture, yet shallow enough for the seedlings to be able to push their way to the surface. Three factors chiefly determine the

exact depth of planting in any given case: The seed, the soil, the season.

**Size and Structure of Seed.**—In general, the seedlings of vegetables having large seeds have greater power to push their way to the surface of the soil than seedlings of vegetables having small seeds. The structure of the seed and seedling, irrespective of size, also has some influence upon the ability of the seedling to reach the surface. However, in general, large seeds can safely be planted deeper than small seeds.

**The type and condition of the soil** also influence the depth of planting. It is necessary to plant seeds deeper in a sandy than in a clayey soil in order to insure sufficient moisture. The converse also is true: It is necessary to plant seeds shallower in a clayey than in a sandy soil, in order that the seedlings may reach the surface. A sandy soil is loose and open and the surface does not bake into a crust following a rain subsequent to planting, as is the case with a clayey soil. If a heavy rain falls soon after the planting of small seeds in a clayey soil, unless the seeds are close enough to the surface so that the seedlings can reach the surface before the crust forms, they are likely not to get through until another rain softens the crust. If that is too long delayed they may perish in the meantime. In general, the looser and the more friable the soil, whether this condition is due to the presence of sand or of humus, the deeper the seeds may be planted; and the deeper they are planted the surer they are of having plenty of moisture for germination.

The more thoroughly prepared the seed-bed, the shallower it is possible to plant seeds and yet have them supplied with sufficient moisture for germination. This is because capillary action is much more perfect in such a seed-bed. In a poorly prepared seed-bed on clayey ground, the soil is sometimes so lumpy that it is necessary to plant the seed so deep in order to secure moisture that, in the event of subsequent rains and crust formation, the seedlings are unable to penetrate to the surface. The seed-bed in clayey soil should be sufficiently well prepared to make shallow planting possible.

Under greenhouse conditions it is possible to plant seeds very shallow, since the soil of the seed-bed can be sifted and the moisture supply is under complete control. Water can be applied whenever necessary and evaporation prevented by covering the seed flat with a newspaper or a pane of glass. It is thus possible to grow

plants of species in which the seeds are very small and the seedlings delicate.

**Influence of Season on Depth of Planting.**—The same kinds of seeds may be planted at different depths in different seasons of the year. Early in the spring, when the soil is barely dry enough to work and is almost too cold for the germination of seeds, it is driest and warmest close to the surface. There is little danger of its drying out too much before the seeds germinate. Under these conditions shallow planting is advisable. On the other hand, in midsummer, when evaporation is rapid and the heat intense, the conditions of both moisture and temperature are likely to be more favorable for germination at a considerable depth below the surface. Under such conditions the seeds should be planted as deeply as the strength of the seedlings will permit.

Sometimes a general rule is given to the effect that the depth of planting should be four times the diameter of the seed. This is a satisfactory depth under greenhouse conditions; but out-of-doors it is difficult to maintain sufficient moisture for the seed so close to the surface of the soil. In general practice in a humid climate, in soils of medium rather than extremely light or extremely heavy texture, it is customary to plant small seeds, like lettuce, onions, carrots, parsnips, radishes and spinach, from one-half to three-quarters of an inch deep, at the normal time for planting these crops in spring. Large seeds, like beans and corn, are planted from one to three inches deep, depending upon the amount of moisture in the soil and the season of the year.

#### DISTANCE OF PLANTING

The distances at which seeds shall be planted are determined by two factors: The amount of space needed by each plant for normal development during the time it is expected to occupy the given location, and the amount of space needed to properly care for the plants. The former is determined chiefly by the size of the plants at maturity if they are not to be transplanted, or their size at the time of the first shift if they are to be transplanted. The latter is determined chiefly by the method of tillage to be employed, especially by the kind of tools to be used and the power by which they are to be operated.

**Space for Tillage.**—Plants growing on a narrow greenhouse bench, the center of which can be reached by a man standing at either side, can be tilled with hand weeders, or similar tools, and

it is not necessary that there be sufficient distance between the rows for the gardener to place his feet, as is necessary in outdoor gardening unless the vegetables are planted in very narrow beds.

If a wheel hoe is to be used in the tillage of a garden, the rows of vegetables must be far enough apart to permit the free passage of the tool as well as the operator's feet. Twelve inches between the rows is a satisfactory distance for planting such crops as onions, carrots, spinach, lettuce, early beets and other small vegetables of which the seed is sown in drills.

If horse tools are to be used in the tillage of these crops, more space is needed between the rows. It is seldom wise to plant any crops closer than two feet between the rows, if the tillage is to be done by horse power, though some gardeners who have small, well-trained horses or mules are able to cultivate between rows planted as close as twenty inches apart. Corn, melons and squashes require much more space, both for the proper development of the plants and for convenience in tillage and harvesting. Watermelons and winter squash require more space than any other vegetables and are often planted ten to twelve feet apart each way.

Plants that are to occupy a given location a very short time, under conditions where tillage is unnecessary for the maintenance of moisture and where the seed-bed has been very thoroughly prepared previous to planting, may need no tillage, and hence the seed may be sown broadcast. This is often done in the case of seeds sown in flats in the greenhouse, where artificial watering can be practiced, or in the case of radishes or leaf lettuce sown in moist ground in early spring, or spinach sown during the rainy season of autumn.

The size of the plants in the same species may differ widely with different varieties, and hence necessitates a variation in distance of planting. Summer varieties of radishes make much more foliage than early spring varieties and hence need more room. Dwarf peas may be planted much closer than tall peas, dwarf early sweet corn closer than tall growing late varieties. The size to which a plant of the same variety will grow also varies with the soil and season. Rich soils are favorable to a luxuriant growth of foliage, and hence may necessitate wider planting than is ample on poorer soils. Some plants started late in the season make a much smaller growth than those of the same variety planted early. This is true of peas, kale, lettuce and other cool season crops. The late plantings are likely to be overtaken by

hot, dry weather and checked in their growth. Even warm season crops, like muskmelons, make a much smaller vine growth in a dry than in a wet season. Since, however, it is impossible to forecast the season at planting time, it is wise to plant at distances that will allow sufficient space for the plants to develop even if the season should be wet and the growth rampant. There is usually little advantage to be gained by unduly crowding plants of any kind.

#### THICKNESS OF SEEDING

The thickness of sowing seeds in the row or the number of seeds planted per hill depends upon whether or not the plants are to be thinned. The advantage of thick seeding is that there is more certainty of securing a full stand in spite of failure of some of the seeds or unfavorable soil conditions. A mass of seedlings close together can break through a soil crust that could not be penetrated by a single seedling. It was formerly the practice to sow a large number of seeds in the hope that some might find conditions favorable for germination; and then, if the stand was too thick in places, to thin the seedlings. Thick seeding is still permissible where small areas are planted; but in commercial operations the labor of thinning becomes an important item, and it is more economical of seed and labor to use only viable seeds and so thoroughly prepare the seed-bed that, except under abnormal weather conditions, a good stand will be secured without the thick seeding and consequent necessity of a large amount of thinning.

Many commercial onion growers have dispensed with thinning altogether. They test each lot of seed for germinative power, and adjust their drills with such extreme precision that the amount of seed sown per acre can be regulated almost to the ounce. Corn growers formerly planted heavily and then thinned if necessary. Now the practice is to test and grade the seed and regulate the planter to drop the same number of kernels per hill as the number of stalks desired.

It is true that a more absolutely uniform stand can be secured by thick planting and subsequent thinning, and that greater uniformity in the size and shape of some products (such as onions) can be secured if each plant is allotted a definite amount of space, as is possible only when thinning is practiced. However, with proper care in the preparation of the seed-bed and in the seeding, it is possible to dispense with a large amount of

thinning, though it will probably always be necessary to practice thick seeding in the case of crops in danger of excessive insect ravages in the seedling stage, such as melons, cucumbers and squashes.

In the case of certain crops, if the seeding is fairly thin, whatever thinning is necessary may be deferred until the plants are large enough for use. This practice is permissible only when the original stand is fairly thin, for crowded seedlings do not reach edible size as soon as they would if not crowded; and the removal of part of the crowded plants when they are wanted for the table is likely to seriously disturb and impair the growth of those that

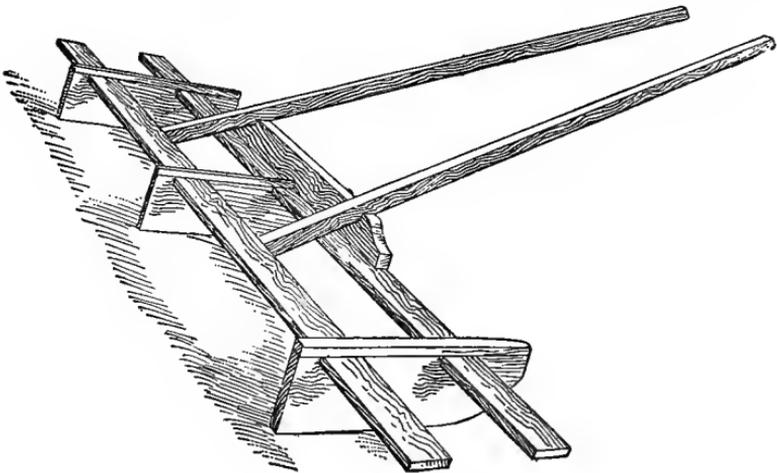


FIG. 43.—Sled marker.

remain. Where the seeding has been thick, a better plan is to make at least a preliminary thinning as early as possible, leaving the plants perhaps twice as thick as they are eventually to stand; and then to pull out every other plant after they reach edible size. This method of thinning is especially adapted to beets, carrots, lettuce and onions in the home garden.

#### METHODS OF SOWING SEEDS

Seeds sown in drills may be planted either by hand or with a garden seed drill. Where only a small amount of seed of each kind is to be sown, the hand method is usually employed. This method involves four distinct operations: (1) Making the drills,

(2) dropping the seed, (3) covering, and (4) firming. The drills may be made either with a marker (Fig. 43), which makes three or four drills at a time, or with the end of a rake or hoe handle drawn along a line stretched in the desired position. For peas or beans a deeper drill may be made with a hoe or the plow attachment of a wheel hoe. After the seed is dropped, usually by rolling



FIG. 44.—Garden seed drill in operation.

a pinch of seed at a time between the thumb and first two fingers, it is covered with a rake, or, in the case of deep planting, with a hoe or wheel hoe. The soil is firmed over the seed by the use of the feet, the back of a hoe or a garden roller. For seeds to be planted in hills it is customary to fine the soil and make a depression with a hoe where each hill is to stand, then to drop the seed, and cover and firm it with the same implement.

In commercial vegetable growing, seeds sown in drills out-of-doors are almost invariably sown by means of a garden seed drill (Fig. 44). This opens a furrow, drops, covers and firms the seed, and marks the next row all at one passage of the implement across the field. With a machine of this kind, one man can sow an acre a day in drills twelve inches apart, if the seed-bed has been carefully prepared; but unless the soil is fine and the surface fairly even the seed drill will not do satisfactory work. However, unless the seed-bed is in good enough condition for the seed drill to work properly, it is not in good enough condition for the welfare of the seeds, and more work should be put upon it before sowing is attempted.

Most garden seed drills plant only one row at a time. However, extensive growers of certain crops, such as onion sets, have rigged up machines that plant as high as five rows at a time. Some of these are operated by hand, others by a horse or a gasoline engine. When peas are grown in large areas for canning they are usually sown with a grain drill. Sweet corn and beans may be planted with a regular corn planter, and sometimes even cucumbers and muskmelons are planted on rich soil with this machine by using a special plate.

#### QUESTIONS

1. What conditions are essential to the germination of seed?
2. How may a supply of moisture be maintained in direct contact with the seed?
3. Why will seeds not germinate properly in a poorly drained soil?
4. At what temperatures do seeds germinate?
5. How may the proper temperature for germination be secured?
6. What factors determine the depth for planting seeds?
7. What two factors determine the distance for planting seeds?
8. Mention the proper distances for a number of common vegetables.
9. What advantages are claimed for thick seeding of vegetables sown in drills?
10. What difficulties arise as a result of thick seeding?
11. What is the present tendency among commercial vegetable growers in regard to thickness of seeding?
12. If thinning of the seedlings is necessary, when should it be done?
13. What are the two general methods of sowing vegetable seeds?
14. Describe the four distinct operations involved in the sowing of seeds by hand.
15. What advantages has sowing with a garden seed drill over the hand method of sowing seeds?
16. With what crops is thinning practiced in your locality?

## CHAPTER XII

### CONTROLLING INSECTS AND DISEASES THAT ATTACK VEGETABLE CROPS

THERE are a number of insects and diseases that attack vegetable crops. Some are very general in their distribution, and are likely to be more or less prevalent over a wide range of territory every year. Others are more restricted in their range, or appear to a serious extent only when conditions for their development are especially favorable. If these enemies are allowed undisputed possession of the garden, they will at times utterly destroy certain crops and reduce the yield or quality of others. On the other hand, if proper precautions are taken to control these enemies, serious loss of crops from this cause can usually be avoided.

**Rotation of crops** is a potent factor in the control of certain insects and diseases that pass the winter in the soil or in the refuse of crops in the soil. This applies especially to organisms that normally are not distributed in spring to any great distance from the place where they pass the winter.

Many insects and disease germs can be destroyed by burning the refuse from an infested or infected crop, instead of allowing it to remain in the field or throwing it upon the compost heap where it will later be returned to the land. Also, in the case of crops infected with certain diseases, it is unwise to feed the crop refuse to farm animals, for the disease germs may remain viable in the manure and serve as a source of re-infection when returned to the land.

Sometimes serious injury from a given insect may be avoided by varying the time of planting so that the crop will not be at the most easily injured stage when the insects are most abundant. Certain plantings of sweet corn may be seriously damaged by the ear-worm, otherwise known as the cotton boll-worm, while both earlier and later plantings may quite largely escape. Late plantings of cucumbers and squashes are much less likely to be severely attacked by striped beetles than are early plantings.

Late fall plowing can often be made a means of breaking up the winter quarters of certain insects and thus exposing them to the elements and to their enemies.

**Mechanical Means of Controlling Insects.**—All the above are very indirect, yet often quite efficient, means of avoiding trouble from insects and diseases. Unfortunately they are applicable only in the case of certain enemies, and other means of control must be sought. Certain mechanical means, somewhat less indirect than those mentioned above, can be employed to prevent injury to certain crops by their insect enemies. Protection of individual plants of cabbage or tomato from cutworms may be afforded by wrapping a piece of stiff paper about the stem of the plant when it is transplanted (Fig. 45). Individual hills of melons or cucumbers may be protected from striped beetles by means of a bottomless box or frame covered with mosquito bar or cheese

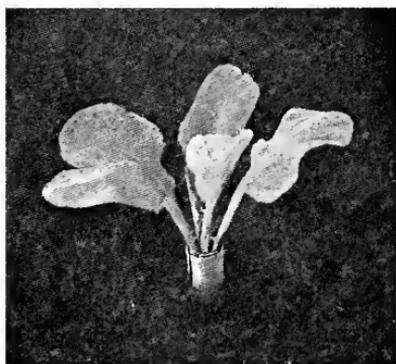


FIG. 45.—Cabbage plant wrapped with stiff paper as a protection against cutworms.

cloth. Plants growing in hotbeds or coldframes may be protected from this insect enemy by covering the entire frame with netting with sufficiently fine mesh to exclude the insects in question. A similar method may be employed to protect young cabbage plants from the maggot (Fig. 46). Another mechanical means of controlling insects is hand picking of the insects or their eggs. This method is applicable to the tomato worm and celery cater-

pillar, and on small areas to the squash bug and potato beetle.

**The use of trap crops, poisoned baits and repellents** are also indirect methods of controlling insects. A trap crop is planted in advance of the regular crop with a view to having the insects collect in large numbers on this crop, where they may be destroyed before the plants of the regular crop appear above the ground. Squashes are sometimes planted as a trap crop to aid in the protection of cucumbers or melons from the striped beetle.

*Poisoned baits* may be used to kill off cutworms immediately preceding the planting out of cabbage and tomatoes. The usual method of preparing poisoned bait is to dip freshly cut clover into a strong mixture of Paris green and water, or to make up a stiff bran mash to which Paris green and sugar or molasses are added. In either case, the bait is scattered around the area to be planted.

The best results are likely to accrue if the baiting is done a few days before the planting is started, but some degree of success may be attained by scattering the bait after the plants are set.

*Repellents* may be effectively used against the striped beetle. Any material possessing an odor offensive to the insect in question may be used. Among the common repellents are turpentine and crude carbolic acid. Either of these may be mixed with ashes, land plaster or other fine, dry powder, and dusted upon the plants by means of a coarsely woven sack or perforated tin can.



FIG. 46.—Cabbage seed-bed screened with cheese cloth to keep out the cabbage maggot.

Diseases which are transmitted on the seed may often be controlled by treatment of the seed before planting. This is especially true of the potato scab. The usual treatment is to soak the seed tubers for two hours in a solution of formalin made by mixing a pint of formaldehyde with thirty gallons of water, or for one and a half hours in a solution of corrosive sublimate containing one ounce of the chemical to eight gallons of water. Care must be taken to avoid re-infection of the tubers by contact with infected receptacles before they are planted.

Weevils in seed peas or beans can be killed by treatment with carbon bisulfide. The seeds are placed in an air-tight receptacle and a quantity of the liquid poured out into a shallow dish which is set on top of the mass of seeds. The liquid quickly evaporates,

forming a deadly gas that is heavier than air and permeates throughout the mass of seeds. The receptacle containing the seed should be left closed for several hours after the treatment is started in order to insure thorough action upon the insects within the seeds. The gas given off from the carbon bisulfide is very inflammable, and hence no fire of any kind should be in the vicinity while the treatment of the seed is in progress. The carbon bisulfide is used at the rate of one pint per 1000 cubic feet of space. For most effective results the treatment of beans and peas should take place as soon as possible after harvesting.

**In greenhouses, fumigation** is the most common means of controlling insects. Some form of tobacco or tobacco product is ordinarily used for the control of plant lice and similar insects. Formerly tobacco stems were burned to make a smudge in the house, but a more modern method is to apply a concentrated liquid tobacco product to the heating pipes, the heat from which causes the poisonous gases to be given off. Some greenhouse pests are harder to kill than plant lice, and necessitate the use of a more deadly material than tobacco compounds. For the white fly, hydrocyanic acid gas is sometimes used. This is generated by bringing potassium cyanide into contact with a mixture of sulfuric acid and water. It is a deadly poison, and extreme care must be exercised to avoid breathing any of the fumes.

Fumigation is also effective in controlling certain fungous diseases in greenhouses. The material most commonly used for controlling fungous diseases in greenhouses is sulfur. When the houses are empty in summer, they may be given a thorough fumigation by burning the sulfur in quite large quantities, as a precautionary measure. When plants growing in the houses become affected with mildew, a milder treatment must be employed, since the actual burning of sulfur would injure the plants. However, the slow evaporation of the sulfur by means of moderate heat will check the mildew without injuring the plants. A common practice is to sprinkle powdered sulfur on the heating pipes, or to paint the pipes with a paste made of sulfur, lime and water.

#### SPRAYING

While the various methods of controlling insects and fungous diseases mentioned above are applicable to particular cases, they do not constitute the chief means of warfare against crop pests under outdoor conditions of culture. Spraying is the great modern

means of controlling insects and diseases on vegetables as well as fruit crops; though vegetable growers have been somewhat backward in recognizing this fact, and for the most part have allowed the fruit growers to perfect spraying methods and appliances. The principles of spraying for the control of insects and fungous diseases are essentially the same whether the plant to be protected is classified as a fruit or a vegetable.

For effective spraying the first essential is a knowledge of the nature of the organism to be controlled. There are three classes of enemies that can be controlled by spraying. They are chewing



FIG. 47.—Potato beetle, a chewing insect: a, eggs; b, larvæ; c, pupa; d, adults; e, wing cover of adult.

insects, sucking insects and fungous diseases. These three classes of enemies are so different that different spraying materials are needed to control them.

**The chewing insects** bite off portions of the plant, chew them up and swallow them, the same as any of the higher animals take their food. Potato beetles, cabbage worms and the various forms of caterpillars belong to this class (Fig. 47). The simplest means of killing such insects is to poison their food. This is accomplished by applying a thin, uniform coating of poison over all parts of the plants to be protected. The poison must be sufficiently virulent to cause death of the insects when eaten in relatively small quantities, so that no large part of the plant need be

destroyed before the insects succumb. For the same reason, the application should be made at the beginning of the attack rather than after considerable destruction has taken place.

The spraying materials most commonly used at the present time for the control of chewing insects are Paris green and arsenate of lead. Both are compounds of arsenic. They can safely be used on vegetables if they do not come in contact with the edible part, or if considerable time is to elapse between the spraying and the gathering of the crop for use. For crops that are to be used soon after spraying, white hellebore is a safer material to employ, since it is a vegetable product and loses its poisonous properties

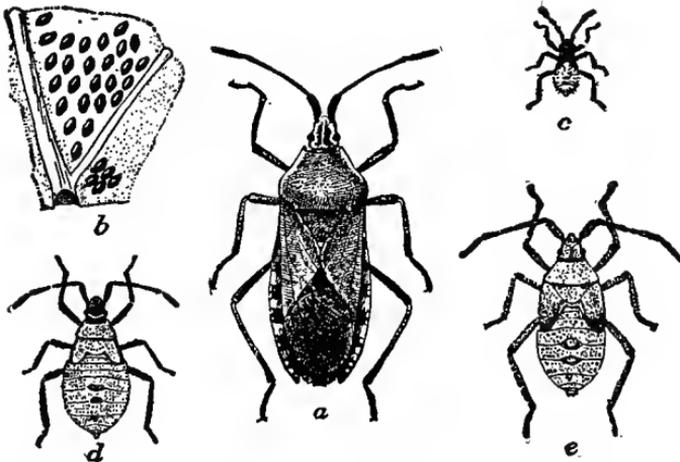


FIG. 48.—Squash bug, a sucking insect: a, adult; b, egg cluster; c, d, e, young bugs in different stages. Twice natural size.

after a few days' exposure to the air. It is especially useful for spraying cabbage attacked by worms after heading has commenced.

**Sucking insects** do not have distinctly developed jaws like the chewing insects, but are provided with tube-like, sucking mouth parts (Fig. 48). They cannot bite off portions of the plant, but must take their food in liquid form. Their method of obtaining food is to insert the beak into the tissue of stem or leaf and suck out the plant juices. When these insects attack a plant in large numbers, so much juice is abstracted that the plant is seriously weakened, and in extreme cases may be killed outright. It is impossible to poison the food of sucking insects, since they draw

their nourishment from within the tissues of the plant. Therefore, a spraying material must be used for these insects that will kill them by coming in contact with their bodies. Formerly kerosene emulsion and whale-oil soap were used for spraying vegetable crops attacked by plant lice and other sucking insects; but the most approved treatment for plant lice on outdoor vegetables at the present time is spraying with a solution of nicotine sulfate. This is purchased in concentrated form and diluted with water as needed for use.

**Fungous diseases** of plants are caused by the development of low forms of plant life, known as fungi, on or within the tissue of the higher plant. These fungi secure their sustenance from the

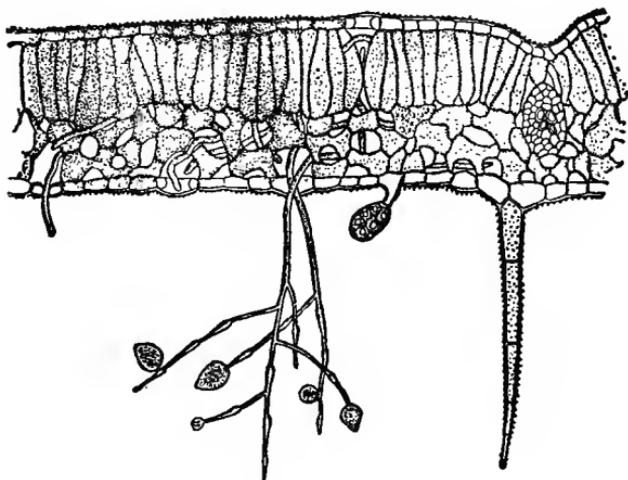


FIG. 49.—A fungus growing within the tissue of a leaf.

plant on which they grow, and their development may result in the partial or complete destruction of the host plant. Fungi are propagated by spores, which correspond to the seeds of higher plants. The spores are exceedingly small and in the case of many fungi are carried about by the wind. If they find lodgement on a susceptible host plant, and the conditions of temperature and moisture are favorable for their germination, they start growth and soon develop into plants that are securing their nourishment at the expense of their hosts (Fig. 49). Spraying for the control of fungous diseases involves the application of a material that will either prevent germination of the spores or kill the germ tube

before it enters the tissue of the host. To be effective, the spraying material must be applied to the host plant before the spores of the fungus germinate. Therefore, if the spraying is to be most effective, an attack of the fungi must be anticipated, and the spray applied *before* the disease appears. In localities where given diseases are prevalent, the usual time of attack must be known and precautionary measures taken accordingly. Some diseases are almost continuous in their attack through a large part of the growing season. Such diseases can be controlled only by repeated applications of spraying materials, so that the new foliage that develops between applications will not remain long without protection, and the coating will be renewed on older foliage from which it has been washed by rains, or more or less dislodged by reason of foliage expansion.

The spraying material best adapted to the control of fungous diseases on vegetable crops is known as Bordeaux mixture.

#### FORMULAS FOR SPRAY MIXTURES

**Bordeaux mixture** consists of lime, copper sulfate and water. The lime is slaked with water and the copper sulfate dissolved in water. The two ingredients are kept separate until immediately before the spraying is to be done; then they are each diluted to half the volume of the spray mixture desired, poured together and stirred thoroughly.

In slaking the lime only a small quantity of water should be applied at first, and additional amounts added from time to time as the slaking proceeds, only enough water being supplied each time to keep the mass from becoming overheated. After slaking is completed, the mass may be diluted to any desired volume. Before it is combined with the copper sulfate the lime must be strained to remove any coarse particles.

To dissolve the copper sulfate, it should be suspended in a sack or basket near the top of a barrel or other wooden receptacle filled with water. If thrown into the bottom of the barrel and covered with water, the copper sulfate crystals will soon become surrounded by a saturated solution of copper sulfate, which will prevent any further dissolving of the crystals. On the other hand, if the crystals are suspended as directed, the solution of copper sulfate, which is heavier than water, will sink towards the bottom of the barrel as fast as it is made, and leave the purest water in contact with the crystals to continue the dissolving process.

Bordeaux mixture may be made of different strengths for spraying different plants, but a common strength is four pounds of lime, four pounds of copper sulfate and fifty gallons of water. If large quantities are to be used, it is better to make stock solutions of copper sulfate and of lime than to prepare separate lots each time a barrel of spraying material is needed. If the stock solutions are made by using one pound of copper sulfate or of lime to each gallon of water, it is only necessary to measure out four gallons of each stock solution to get the required amounts to make fifty gallons of Bordeaux mixture. The stock solutions should be kept in wooden vessels, and should be stirred thoroughly just before any of the material is measured out, in order to insure getting material of uniform strength. The stock solutions will keep indefinitely, if covered to prevent evaporation; but the Bordeaux mixture should be used the day it is made.

**Paris green** is purchased in the form of a dry powder. It may be applied as a simple mixture with water, but since it is likely to contain soluble arsenic which is injurious to foliage, a safer plan is to add a small quantity of slaked lime to the mixture of Paris green and water. This combines with any arsenic that may dissolve in the water, and makes the mixture much safer to apply to the foliage. Equal quantities of Paris green and lime make a safe mixture, though more lime is often used. In mixing Paris green with water, it should first be made into a thin paste with a small quantity of water. This insures a smooth mixture free from lumps. When lime is to be used with the Paris green it is a good plan to dilute the slaked lime with water to almost the full volume of the spray mixture to be made; then stir in the Paris green, which has previously been made into a paste with a small quantity of water as already suggested. Paris green is used at different strengths, but four ounces to fifty gallons of water is a very common strength. Sometimes as much as eight ounces to fifty gallons is used for spraying potatoes for the control of the Colorado potato beetle.

**Arsenate of lead** is usually purchased in paste form, though there are now powdered forms offered on the market, and it is also possible to make this material at home by combining solutions of arsenate of soda and acetate of lead. If the paste form is used, it must be worked up with a small quantity of water until a smooth, homogeneous mixture is obtained. This is then gradually diluted to the desired volume. A common strength of

arsenate of lead for ordinary spraying is two pounds to fifty gallons of water, though as much as four pounds is sometimes used. Although it is usually assumed that arsenate of lead is perfectly safe to apply to foliage without the addition of lime, slaked lime is sometimes added in quantity equal to the arsenate of lead as a precautionary measure when tender foliage is to be sprayed.

White hellebore may be dusted on the plants in the dry form without dilution; or it may be mixed with water at the rate of one pound to fifty gallons, and applied as a spray.

Nicotine sulfate is offered on the market in various degrees of concentration and under various trade names. One of the most concentrated forms is known as "Black Leaf 40." This will kill plant lice even when used as dilute as one part in a thousand of water.

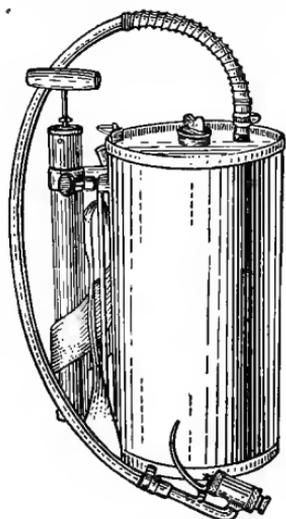


FIG. 50.—Compressed air knapsack sprayer.

#### GENERAL PRINCIPLES OF SPRAYING

##### Suit the Material to the Plants.—

In all spraying operations, the material used must be of such a nature and applied at such a strength and in such a manner that it will control the enemy without injuring the host plant. Since both enemy and host consist of organic tissue, and both enemies and hosts vary in their degree of resistance to spray materials, the margin of safety is sometimes small. For this reason a material which may be effective in controlling a certain enemy on a given plant may be unsafe to use in controlling a similar enemy on another kind of plant. The usual strength of Bordeaux mixture is perfectly safe for spraying potatoes, but is likely to injure melon foliage; hence half strength Bordeaux mixture is used in the spraying of melons.

**Methods of Applying Spray Materials.**—Spray materials should be applied as uniformly as possible to all parts of the plant to be protected. If plant lice are working on the under surfaces of the leaves, these parts must receive special attention. In order that the application may be uniform, the spray must be fine. The fineness of the spray is determined mainly by two factors, the character of the nozzle and the amount of pressure. A nozzle

of the cyclone type with a very small orifice is best adapted to general spraying of vegetable crops. As high pressure as is consistent with the type of spraying apparatus used is advisable. For small-area vegetable spraying, a compressed air sprayer of the knapsack type (Fig. 50) is very satisfactory, since it can be carried anywhere and used in thickly planted areas as well as where the rows are wide apart. However, for plantations of any considerable size, spraying with such an apparatus becomes very tedious, and a larger outfit should be employed. A regular barrel spray pump mounted on a two-wheeled cart is quite generally useful in spraying an assortment of vegetable crops (Fig. 51).



FIG. 51.—Spraying eggplants with small-sized barrel pump.

In order that such an outfit may be used to best advantage, it is advisable in planting the crops to space the rows for the accommodation of the spray cart, or if a close-planted crop is to be sprayed, to leave driveways at sufficiently close intervals so that the hose will reach half-way from one drive to the next. When large areas are planted to individual crops requiring spraying, spray machinery designed especially for the purpose is usually employed. Thus there are potato sprayers that spray three to six rows at a time, as fast as a team can walk. Melons may be sprayed with similar outfits by proper training of the vines (Fig. 52).

**Timeliness** in spraying is fully as important as thoroughness. Chewing insects must be killed before they have destroyed much of the foliage. It is of little use to spray potatoes after the beetles have reduced the plants to bare stalks, for the crop from such plants is likely to be less than the quantity of seed planted. If flea beetles are allowed to work unchecked on eggplants, they cause so much injury that the yield may amount to practically nothing. If there is delay in bringing cabbage worms under control, the development of the crop is seriously retarded and the size of the heads greatly reduced.



FIG. 52.—Spraying muskmelons with three-row, geared-power sprayer.

Sucking insects, also, must not be allowed to seriously weaken the plants before they are brought under control, for a weakened plant can not yield as large or as good a product as one in full vigor. A melon vine badly injured by plant lice never yields fruit of good quality.

Fungous diseases must be checked before they have gained serious headway, if satisfactory results from the spraying are to be secured; for spraying will not restore leaf tissue that has already become diseased, and the loss of leaf surface is weakening to the plant. The diseased spots can not be "cured"; but the spraying

will protect the foliage that has not yet been attacked. Hence the effectiveness of spraying the entire plant as soon as diseased spots appear on any part of it.

**Caution.**—Most spray materials are poisonous. Special care should be taken to avoid leaving any of them where there is any possibility of their being accessible to small children or to farm animals. All packages should be conspicuously labeled "POISON." When fumigating with carbon bisulfide or hydrocyanic acid gas, conspicuous signs should be posted warning everybody to keep out, and stating the reason why. The doors of the building where the fumigating is being done should also be locked, and no one allowed to enter until at least twelve hours after the fumigating has been started. Even then the building should be entered with caution.

### QUESTIONS

1. How may rotation of crops be made a means of avoiding loss from the attacks of insects and diseases?
2. What should be done with the refuse from a crop infected with a fungous disease?
3. What is the relation of time of planting to insect injury in certain cases?
4. How may individual plants be protected from insects by mechanical means?
5. What is meant by a "trap crop"?
6. What insects may be killed by poisoned baits? How is the poisoned bait prepared?
7. What insects are sometimes controlled by repellents? What materials may be used as repellents?
8. What materials may be used for treating seed potatoes for the control of scab? Give directions for treatment.
9. How may weevils in seed peas or beans be killed? What precautions must be taken in handling the material used?
10. What is the general method of controlling insects in greenhouses?
11. What three classes of enemies to vegetable crops can be controlled by spraying?
12. How may the chewing insects be killed? What poisons are used?
13. How does a sucking insect obtain its food? How may it be killed? What materials are used?
14. What is the nature of a fungus? How may fungous diseases of vegetables be controlled by spraying? What material is commonly used?
15. Give directions for the making of Bordeaux mixture.
16. Give directions for preparing Paris green for spraying.
17. How is arsenate of lead prepared for spraying?
18. In what two forms may white bellebore be used?
19. How much is "Black Leaf 40" diluted for spraying plant lice?
20. State the most important general principles of spraying.

## CHAPTER XIII

### CLASSIFICATION OF VEGETABLES

THE number of different kinds of vegetables is so large that, unless the kinds that are similar in certain particulars are grouped together, it is extremely difficult for the student to remember the details regarding the culture and uses of each crop. The matter is very much simplified if the crops are grouped according to their cultural requirements. Some suggestions regarding the grouping of crops, based upon their temperature requirements, were given in Chapter VII. A more complete classification, including subdivisions of the various groups, is given here. Only those vegetables are included in this classification which are to be treated in the present work.

#### I. COOL SEASON CROPS:—

##### 1. Cool season crops that quickly reach edible maturity:

###### (a) Spring salads—

Leaf lettuce, *Lactuca sativa*.

Garden cress, *Lepidium sativum*.

Corn salad, *Valerianella olitoria*.

###### (b) Spring greens—

Spinach, *Spinacea oleracea*.

Mustard, *Brassica nigra*, *B. alba*, *B. juncea*, and *B. Japonica*.

###### (c) Short season root crops—

Radishes, *Raphanus sativus*.

Turnips, *Brassica Rapa*.

Kohlrabi, *Brassica oleracea*, var. *caulo-rapa*.

Rutabagas, *Brassica campestris*.

###### (d) Peas, *Pisum sativum*.

##### 2. Cool season crops that usually are transplanted:

###### (a) Spring crops that mature before the heat of summer—

Head lettuce, *Lactuca sativa*, var. *capitata*.

Cos lettuce or romaine, *Lactuca sativa*, var. *Romana*.

Early cabbage, *Brassica oleracea*, var. *capitata*.

Early cauliflower, *Brassica oleracea*, var. *botrytis*.

###### (b) Crops that make their principal growth in the cool weather of autumn—

Late cabbage, *Brassica oleracea*, var. *capitata* and var. *bullata*.

Late cauliflower, *Brassica oleracea*, var. *botrytis*.

Broccoli, *Brassica oleracea*, var. *botrytis*.

Brussels sprouts, *Brassica oleracea*, var. *gemmifera*.

Celery, *Apium graveolens*.

Celeriac or turnip-rooted celery, *Apium graveolens*, var. *rapaceum*.

##### 3. Cool season crops that will endure summer heat:

###### (a) Root crops that endure summer heat but not winter freezing—

Beets, *Beta vulgaris*.

Carrots, *Daucus Carota*.

- (b) Root crops that withstand winter freezing as well as summer heat—

Parsnips, *Pastinaca sativa*.

Salsify, *Tragopogon porrifolius*.

Horse-radish, *Cochlearia Armoracia*.

- (c) Greens that endure heat—

Chard or Swiss chard, *Beta vulgaris*.

Kale or borecole, *Brassica oleracea*, var. *acephala*.

Collards, *Brassica oleracea*, var. *acephala*.

New Zealand spinach, *Tetragonia expansa*.

Dandelion, *Taraxacum officinale*.

- (d) Salad plants that endure heat—

Parsley, *Carum Petroselinum*.

Upland cress, *Barbarea vulgaris*.

Endive, *Cichorium Endivia*.

- (e) The onion group—

Onions, *Allium Cepa*.

Leeks, *Allium Porrum*.

Garlic, *Allium sativum*.

Shallots, *Allium Ascalonicum*.

Chives, *Allium Schænoprasum*.

- (f) Potatoes, *Solanum tuberosum*.

- (g) Perennial crops—

Asparagus, *Asparagus officinalis*.

Rhubarb, *Rheum Rhaponticum*.

Globe artichoke, *Cynara Scolymus*.

Sea-kale, *Crambe maritima*.

## II. WARM SEASON CROPS:—

1. Warm season crops usually not transplanted:

- (a) Beans—

String beans, *Phaseolus vulgaris*.

Green shell beans (including Limas, *Phaseolus lunatus*).

Dry shell beans, *Phaseolus vulgaris*.

- (b) Corn—

Sweet corn, *Zea saccharata*.

Pop corn, *Zea everta*.

- (c) Okra or gumbo, *Hibiscus esculentus*.

- (d) The vine crops—

Muskmelons, *Cucumis Melo*.

Watermelons, *Citrullus vulgaris*.

Citron or preserving melon, *Citrullus vulgaris*.

Cucumbers, *Cucumis sativus*.

Gherkins, *Cucumis Anguria*.

Squashes, *Cucurbita maxima*, *C. Pepo* and *C. moschata*.

Pumpkins, *Cucurbita Pepo* and *C. maxima*.

2. Warm season crops that require transplanting:

- (a) Tomatoes, *Lycopersicum esculentum*.

- (b) Eggplant, *Solanum Melongena*.

- (c) Peppers, *Capsicum annum*.

- (d) Sweet potatoes, *Ipomœa Batatas*.

## CHAPTER XIV

### COOL SEASON CROPS THAT QUICKLY REACH EDIBLE MATURITY

THE crops in this group are seldom transplanted. So short is their period of growth that they are usually able to reach edible maturity in central latitudes before the normal season for hot weather, if the seed is sown in the open ground as soon as the soil reaches workable condition in the spring. The group includes certain salad plants, "greens" and root crops, and also garden peas. The chief point which these crops have in common is their ability to thrive at low temperature and inability to endure heat.

#### SPRING SALADS

**Leaf Lettuce.**—The most widely grown salad plant in America is leaf lettuce. Almost every one who does any gardening at all includes leaf lettuce in his plantings. It is an easy plant to grow, but does not reach perfection unless the weather is cool and the soil rich and moist. Therefore, in central latitudes\* it should be planted at the earliest possible moment in spring in order that it may have time to complete its growth before hot weather arrives. Farther north, in localities where the nights are always cool, successive plantings may be made. In the South lettuce may be grown as a late fall or winter crop.

The seeds of leaf lettuce may be sown in the open ground in drills twelve inches apart, so that thorough tillage may be given. The plants are usually not thinned before reaching edible age, but are allowed to grow in dense tufts if the seeding has been thick. The leaves reach edible size sooner if the

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\* The terms "central," "northern" and "southern latitudes" as used in this and succeeding chapters are synonymous with central, northern and southern "localities" respectively. While no absolute boundaries for the localities indicated can be ascribed, since one merges into another, nevertheless, in a general way, the territory lying between the 37th and 42nd parallels of latitude may be considered as essentially "central" so far as climatic conditions are concerned, while the area north of the 42nd parallel may be considered "northern" and that south of the 37th parallel "southern." These boundaries refer to relatively low elevations. There is a difference of approximately one week in the earliness of the season for each hundred miles difference in latitude.

plants are somewhat crowded, for then they stretch for light. However, if large individual plants (Fig. 53) are desired for market, the seeding must be light or the plants thinned. In the home garden it is a good plan to begin thinning the lettuce as soon as it is large enough to use, and continue the process as the product is needed for the table. By the time the thinning is completed, the plants first thinned will have attained large size, and the harvesting of the lettuce may continue.

In gathering leaf lettuce, the usual practice is to pull the entire plant. However, there are some varieties of lettuce that will



FIG. 53.—A well-developed plant of leaf lettuce.

produce a new crop of leaves if the first crop is cut off just above ground. These are sometimes designated as "cutting" varieties. They are desirable for the home garden, since they make it possible to have lettuce for a long time from a single planting.

Sometimes, in the home garden, leaf lettuce is sown broadcast and not cultivated. However, this is usually a less satisfactory method than sowing in rows and giving thorough tillage.

Since lettuce requires an abundance of moisture if the growth is to be rapid, and since rapid growth is essential to good quality, facilities for artificial watering are highly desirable. Shading of the plants, if the weather becomes warm, is also beneficial. How-

ever, even these precautions will not make it possible to produce good lettuce in midsummer in a hot climate, for lettuce is essentially a cool weather plant. In hot, dry weather it becomes tough, bitter and undesirable.

Under favorable conditions of temperature and moisture lettuce grows rapidly and will usually be ready for the table in six to eight weeks after the planting of the seed. This makes it an attractive crop for the amateur gardener.

**Garden cress**, known also as "pepper grass" because of its pungent flavor, is another crop of easy culture and exceedingly rapid growth. It may be used for flavoring salads, for garnishing or for making sandwiches. The seed should be sown in the open ground very early in spring. It germinates quickly at a low temperature, and the plants grow rapidly if the weather is cool



FIG. 54.—Corn salad.

and the soil moist. Later plantings run quickly to seed without making much foliage if the weather turns warm. Its chief function in the home garden is to furnish garnishing material early in the season before parsley is available. For this purpose the cut-leaved and curled forms are most desirable.

The plants are small, so that the rows may be as close together as eight to twelve inches. The plants are usually not thinned, except as pulled or cut for use. Usually the entire plant is taken.

No special treatments are necessary in the growing of garden cress, the only precautions being to plant early, maintain moisture, and gather promptly. It is a short-lived crop and does not remain in edible condition very long. In six weeks from planting it should be ready for use.

Corn salad (Fig. 54) is not extensively grown in America. Its cultural requirements are much the same as those of garden cress.

It thrives only when the weather is cool. The edible part is the rosette of leaves formed at the crown before the seed stalk begins to develop. In hot weather the plants either run quickly to seed or perish outright. The planting should therefore be done exceedingly early in spring, so that the crop may develop before the weather becomes hot. In mild climates the seed may be sown in the fall, and the crop wintered over with slight protection for early spring use. Sometimes it is also sown earlier in the fall for use before winter sets in. For best results the plants should



FIG. 55.—Spinach. A typical plant.

be thinned to about six inches apart in the row. From six to eight weeks are required to produce the crop.

#### SPRING GREENS

**Spinach.**—In American gardens the most important plant grown exclusively for “greens” is spinach (Fig. 55). It is distinctively a cool season crop, and quickly runs to seed in warm weather. In central and northern latitudes the seed is sown as early in spring as the ground can be worked, and the crop is ready for cutting in six to eight weeks.

In the latitude of Cairo, Illinois, and Norfolk, Virginia, the seed is more often sown in September or October, and the plants allowed to winter over, usually without protection. As soon as growth

is resumed in spring, the crop is harvested and sent to market. Still farther South, spinach may be grown and harvested in mid-winter. Formerly it was quite an important crop for hotbed and coldframe culture at the North, but now the winter market is supplied with the shipped-in product from the South.

*Spring and Fall-sown Crops Contrasted.*—When grown as a spring-sown crop, spinach is usually planted in drills about a foot apart, and given thorough tillage until the crop is nearly ready to harvest. It is not customary to thin the seedlings. The fall-sown crop is often seeded broadcast on rich, carefully prepared land, and given no tillage whatever after the seed is planted. Sometimes the seed is sown along with timothy when a new meadow is being started. The spinach is cut so early in spring that it does not interfere with the growth of the grass.

Spinach demands rich soil, and especially an abundance of nitrogen. For this reason, on some soils it responds remarkably to top dressings of sodium nitrate.

Spinach does not grow well unless it has an abundance of moisture. It should therefore be planted in moist soil at a time when rainfall is abundant or where artificial watering can be given. In wet seasons and cool weather it makes a luxuriant growth of almost perfect foliage; but when the weather is hot and dry, it is not only stunted by the unfavorable weather conditions, but also seems much more subject to insect attacks. It is thus almost impossible to produce good spinach when the weather is hot and dry.

*Method of Harvesting.*—As soon as the spinach plant has formed a nice rosette of big succulent leaves it is ready to harvest. Usually the entire plant is taken. It may be pulled, but the more usual method is to cut the tap-root about one-half inch below the surface of the ground. In the home garden, the plants are cut with a knife, the largest being taken first, and the smaller ones being left to grow. In gathering a commercial crop of spinach grown in drills, the plants are sometimes cut by means of a wheel hoe. In this case all the plants in the row are harvested at the same time, regardless of variation in size of individual plants.

There are two distinct types of spinach, the round seeded and prickly seeded. Hand sowing of the latter is a painful operation, for the prickles are very sharp. However, the prickly seeded type is preferred for fall sowing because it is hardier. For spring sowing in the home garden, the round seeded type is the more satisfactory.

**Mustard** is sometimes used for greens in place of spinach. It is of easy culture and thrives on almost any soil, provided it is rich and moist. Cool weather is essential to a large development of foliage before seed stalk formation begins. Seed should be sown very early in spring, either in drills or broadcast, and the crop gathered as soon as the leaves are large enough to use. The entire plant may be pulled or individual leaves plucked off. The crop is one of quick development but also of short duration, for the plants soon run to seed.

Mustard may be used for salad as well as for greens, though the latter is its principal use. There are improved, large-leaved types which produce an enormous amount of foliage in a very short time. Mustard is not as fully appreciated in American gardens or American markets as its merits warrant. In many markets it is unknown, and attempts to introduce it have often been futile.

#### SHORT SEASON ROOT CROPS

**Radishes** are of three distinct types: Spring, summer and winter. All are cool season crops, but some will endure more heat than others. The summer radish will complete its development under moderately high temperature provided it has made a good start in cool weather, while the winter radish must have cool weather at the finish though it starts its growth in the hot weather of July or August.

In this country, the spring type of radish is very much more extensively grown than either of the other types. The earliest varieties will furnish an edible product in from four to six weeks from the planting of the seed, the exact length of time depending primarily upon the temperature. Fairly cool weather is required, but too low a temperature retards the growth. The roots of the earliest varieties remain in edible condition only a few days; then they become pithy. Later varieties of spring radishes remain in edible condition a somewhat longer time, but even these must be gathered promptly or they will suffer in point of quality.

*Spring radishes* (Fig. 56) should be planted at the very opening of spring and successive plantings made at intervals of ten days or two weeks. This may be continued till about the middle of May in latitudes where spring gardening begins about April 1. If planted later than this, the spring radishes are usually unsatis-

factory, for they become tough and extremely pungent before reaching edible size when grown in hot weather. Still, if rains are abundant in September, or artificial watering can be given, plantings of the spring type of radishes made about the tenth of that month sometimes produce crops of very good quality.

*Summer radishes* may be sown in the month of May and will furnish an edible product after the weather has become too hot for spring radishes (Fig. 57). They are considerably larger than the spring radishes, and the most pungent part is close to the skin. By peeling, this is removed and a much more agreeable relish secured. Most summer radishes are white in color, while



FIG. 56.—An extra early variety of spring radish.

spring radishes are usually red, white, or red tipped with white.

*Winter radishes* are sown the same time as late turnips; *i.e.*, late July in northern latitudes and August 1 to 20 in central locations. They seldom produce an edible product if sown at the proper time for sowing spring or summer radishes. The roots either remain unusually small or develop a pungency comparable only with horse-radish. The same varieties are crisp, tender and mild-flavored when grown at their proper season. A winter radish (Fig. 58) is very much larger than a spring or summer radish

and has to be cut in pieces when served. One root is sufficient for an entire family. Winter radishes are harvested before the ground freezes in fall, and, if properly stored, will remain in edible condition for three or four months.

Radishes are usually sown in drills from eight to twelve inches apart, though the spring type is sometimes sown broadcast, and for the winter type at least eighteen inches should be allowed between the rows. Spring and summer radishes are not thinned except as the early maturing specimens are harvested. In order that the specimens may develop to normal size, thinning of the winter type is essential, and should be done relatively early. The

plants should stand at least six inches apart in the row if large specimens are desired.

To avoid trouble from the root maggot it is wise to practice rotation in the growing of radishes.



FIG. 57.—Strasburg, a popular summer radish.

**Turnips** may be grown either as a spring or a fall crop (Fig. 59). The fall crop is of much the greater importance. The spring crop is consumed immediately, while the fall crop is stored for winter

use. The spring crop is sold by the bunch, the fall crop by the bushel. The spring crop is often sown in drills and cultivated; the fall crop is usually sown broadcast and not cultivated.

In order to grow a satisfactory crop of spring turnips it is essential that the seed be sown extremely early. Unless this is done the crop is likely to be overtaken by hot weather and become tough and bitter. The development of the roots is hastened by an abundance of moisture. Therefore tillage is advisable. The soil should also be rich to promote rapid growth. If the soil is rich enough to grow the roots rapidly, the foliage is likely to be rank. Therefore the rows should be at least eighteen inches apart. For the spring crop the plants are usually thinned. Sometimes the thinnings are used for greens. Root maggots are likely to be bad in the spring crop if radishes or turnips have previously been grown upon the same ground. In extreme cases they may ruin the crop. Therefore rotation should be practiced.



FIG. 58.—A winter radish.

*The fall crop* is more easily grown than the spring crop if the temperature is sufficiently mild. It thrives better in northern than in southern localities. The usual practice is to plow and thoroughly prepare a piece of land from which an earlier crop has been removed, sow the seed broadcast and harrow it in. This is done from July 20 to August 20, depending upon the latitude. No further attention is given the crop until time for the harvest. Fall turnips thus constitute an incidental crop requiring very little labor in its production. The chief item of expense is the harvesting, for the roots must be pulled and topped by hand. This is done just before the ground freezes in autumn.

**Kohlrabi.**—Although not strictly a root crop, kohlrabi corresponds so closely to the spring crop of turnips in its cultural requirements that it is treated in this connection. The seed should be sown in drills about a foot apart as early as the ground can be

worked in spring; or if an extra early crop is desired, the plants may be started in a hotbed and transplanted at the same time as early cabbage. After thinning, the plants should stand four to six inches apart in the row. Sufficient tillage should be given to retain moisture. The edible portion is the swollen part of the stem immediately above the ground (Fig. 60). It is of much



FIG. 59.—The globe type of turnip: now more popular than the flat type.

the same consistency as a turnip. Kohlrabi should be gathered for use before it has attained full size; otherwise it will be tough. It is of the best quality when about two inches in diameter.

Sometimes a late crop of kohlrabi is grown, though the early spring crop is the more important. The late crop is sown in drills at the time late turnips are sown. Tillage is given and the plants thinned. The crops may be stored for winter use.

**Rutabagas** are known also as Swedish turnips or "Swedes." They require from four to six weeks longer to complete their growth than do the common or flat turnips. This makes it impossible to grow them as a spring crop in latitudes where the summers are warm. Their chief importance is as a fall crop for winter storage. They do not thrive except in northern latitudes, for their period of growth is too long to enable them to adapt themselves to regions where the summers are hot. Although they will stand somewhat higher temperature than will flat turnips, they need the cool nights of the North to develop their characteristic sweetness and flavor. When grown in central localities they are likely to be both small and bitter.



FIG. 60.—Well-grown plant of kohlrabi. The swollen central portion is the edible part.

The seed is usually sown in drills and the plants thinned. Sometimes they are transplanted if the original stand is uneven or a larger plantation desired. Usually the rows are far enough apart to permit of tillage with a horse. The plants should stand about a foot apart in the row. The crop is thoroughly cultivated and even some hand hoeing practiced.

Rutabagas constitute an important crop in certain northern localities, where the climate is cool and the soil is moist. They

are sold on the winter market in the Central States much more extensively than flat turnips. The flesh is dense, yellow and sweet.

## PEAS

**Common garden peas** are of two general types, smooth-seeded and wrinkled. The smooth-seed varieties are the hardier; their



FIG. 61.—A wrinkled pea of high quality.

seeds will germinate when the soil is so cold and wet that the seeds of wrinkled varieties would rot. They are therefore the more reliable for extremely early planting. On the other hand the

wrinkled varieties (Fig. 61) are of much better quality than the smooth (Fig. 62), being sweeter and more tender. They are therefore preferred for the home garden and for the later plantings in market gardens.

Peas demand cool weather and must be planted sufficiently early to perfect their crop before the hot weather of summer arrives. In some localities the season of favorable weather is not sufficiently long to make it feasible to grow the later varieties. These succeed best in the North where even the summers are cool. The early varieties, in both smooth and wrinkled types, can be grown in almost any locality if planted at the proper time.

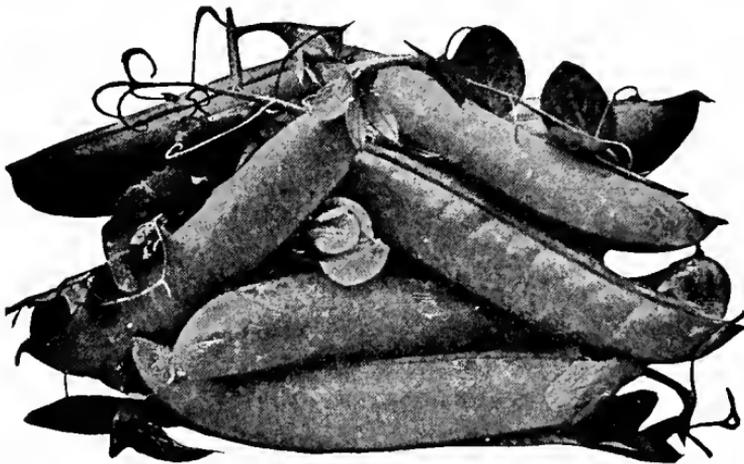


FIG. 62.—A smooth-seeded pea of the hardy type.

The smooth-seeded sorts should be included in the earliest planting of spring, along with spinach and lettuce. Small plantings of early wrinkled varieties may be made at the same time if desired, but if the weather turns cold and wet the seed is likely to be lost, and planting two weeks later is considered much safer. The later wrinkled varieties also may be planted at this time. In localities where outdoor gardening normally begins April 1, and the summers are hot, it is usually unwise to plant garden peas of any kind after about April 20, for later plantings are almost certain to suffer from heat before perfecting their crop. If hot weather occurs before the pods are formed they will be scarce, short and poorly filled; if excessive heat occurs when the pods are nearly grown, they are likely to dry up without finishing their

growth. Peas are thus an uncertain crop when the weather is hot, and their culture should be confined to the part of the year that is likely to be cool. In the South they may be grown in the fall and winter, and a fall crop is occasionally grown in central latitudes, but the yield is usually light, for the crop must be started while the weather is still warm and the plants thus become stunted. The early spring crop is the most satisfactory one in central and even northern latitudes.

*Size of Plants.*—Different varieties of peas produce different sized plants. Those under two feet in height are usually designated as dwarf; those between two and four feet, medium or half-dwarf, and those over four feet, tall. The dwarf varieties may be grown without support and hence are usually preferred for commercial plantations. The medium and tall varieties are supported by means of brush, wire netting, or strands of wire stretched on either side of the row. The medium and tall varieties, by reason of their size and their supports, must be planted in rows farther apart than the dwarf varieties. This is to allow space for tillage and for pickers. Sometimes the seed is planted in double rows, the two rows of a pair being six to eight inches apart, and the pairs being three to four feet apart. In that case one line of supports is sufficient for the double row. The space between the two rows of a pair can be tilled with hand tools early in the season before the supports are put in place. Later tillage can take place only in the wide spaces. This arrangement of rows was formerly more popular than at present. The usual plan now is to plant both tall and dwarf varieties in single rows. For the very dwarfiest varieties, which do not grow much over a foot in height, the rows may be made from eighteen inches to two feet apart. Two and a half to three feet is a better distance between the rows for varieties that make vines two feet long. As the crop approaches maturity the vines fall over, and the distance between the rows should be slightly greater than the length of the vines in order to avoid serious tangling and consequent trouble in picking. Varieties requiring support should be in rows three to four feet apart, preferably four. This allows room for horse tillage after the supports are set.

Peas are sown so that the seeds are one to two inches apart in the row. The plants are never thinned, except occasionally by cutworms. The depth of planting varies somewhat, but is usually two to three inches.

*Peas grown for canning factories* are sometimes sown with a grain drill and given no cultivation whatever after planting. When the crop is ready to harvest the vines are cut with a mowing machine and hauled to the factory where the peas are hulled out by special machinery. For factories not equipped with modern machinery it is necessary to pick the pods by hand the same as if they were to be marketed in the fresh state. Some varieties mature much more uniformly than others, and are preferred for the cannery and for market because the entire crop is ready to harvest at one time. On the other hand, varieties which mature their crop gradually and have a long picking season are preferable for the home garden.

**Sugar Peas.**—In addition to the common garden pea, the immature seeds of which are the edible product, there is a type of pea known as the sugar or edible-podded pea. The pods are tender and juicy and are gathered for eating at the same stage of development as string beans. Their chief function is to furnish a substitute for string beans earlier in the season than the latter can be secured. They are planted at the same time and handled in the same way as other garden peas. Most varieties are tall and require support. This type of pea is seldom seen on the markets or in home gardens. It deserves more attention than it is receiving at the present time.

#### QUESTIONS

1. Name nine crops that quickly reach edible maturity and thrive only in cool weather.
2. What is the most widely grown salad crop in America?
3. How may leaf lettuce of large size be grown?
4. What is meant by a "cutting" variety of leaf lettuce?
5. How does hot, dry weather affect the quality of lettuce?
6. How long does it take to grow a crop of leaf lettuce?
7. What are the uses of garden cress?
8. What are the essential features in growing garden cress?
9. How may corn salad be grown?
10. What is the most important plant grown exclusively for greens, in America?
11. Contrast northern and southern methods of growing spinach.
12. What are the moisture demands of spinach? How may they be met?
13. Describe the method of harvesting spinach.
14. What are the characteristics of mustard as a garden crop?
15. Name and describe the three types of radishes.
16. At what time should each type of radish be planted? When is each harvested? How long will each remain in edible condition?
17. Contrast the spring and fall crops of turnips.

18. Describe the kohlrabi plant. What crop does kohlrabi most resemble in cultural requirements?
19. By what other names are rutabagas known?
20. How do rutabagas differ from turnips?
21. In what part of the country are rutabagas an important crop?
22. What are the two types of garden peas? How do they differ in hardiness and quality?
23. How does hot weather affect peas?
24. Classify peas according to size of plant.
25. How far apart should peas be planted?
26. How are peas harvested for a canning factory?
27. What are "sugar" peas?

## CHAPTER XV

### TRANSPLANTED CROPS THAT MATURE BEFORE THE HEAT OF SUMMER

#### HEAD LETTUCE

IN head lettuce the leaves fold over one another, forming a more or less compact head somewhat resembling a cabbage in structure (Fig. 63). The interior leaves are perfectly blanched and the flavor is much more delicate than that of leaf lettuce.

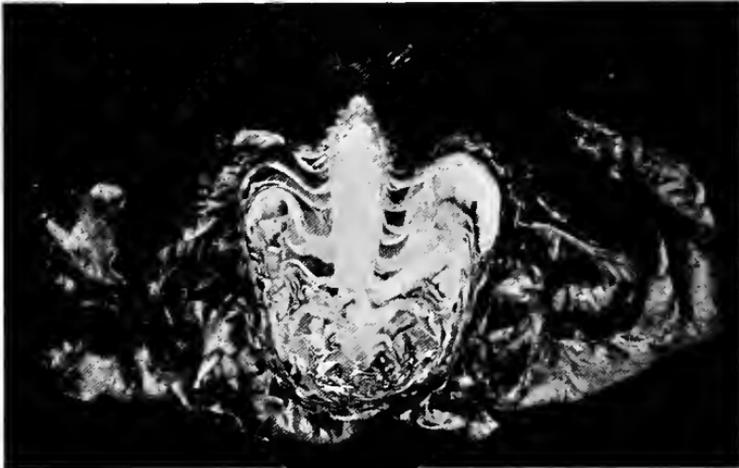


FIG. 63.—Head lettuce in longitudinal section, showing structure.

Although head lettuce can be successfully grown in cool climates from seed sown in the open ground, the cool season in central latitudes is usually so short that the lettuce is likely to be unable to complete its growth before the advent of hot weather. If overtaken by hot weather rather early in its development the lettuce may fail to form any heads whatever. If the hot weather arrives after the heads have started to form the injury may consist in a browning of the edges of the leaves that compose the head (sometimes called "tip-burn") and the development of a bitter taste. In either case the product is of little value. It is only when the season remains cool and wet unusually late that a satis-

factory crop of head lettuce can be produced from open ground seeding in central latitudes.

**To insure a crop of head lettuce**, except in cool regions, it is necessary to start the plants under glass at least six weeks before time for setting them in the open. Where open-air gardening starts before April 1, lettuce plants usually may be transplanted about April 15. Therefore the seed should be sown by the first of March. It may be sown in flats in greenhouses or in the soil of a hotbed. In either case the plants should be shifted in about three weeks, or as soon as they are large enough to handle. They may be planted in flats, about two inches apart each way (Fig. 64), or may be set in two and one-half inch pots. The latter

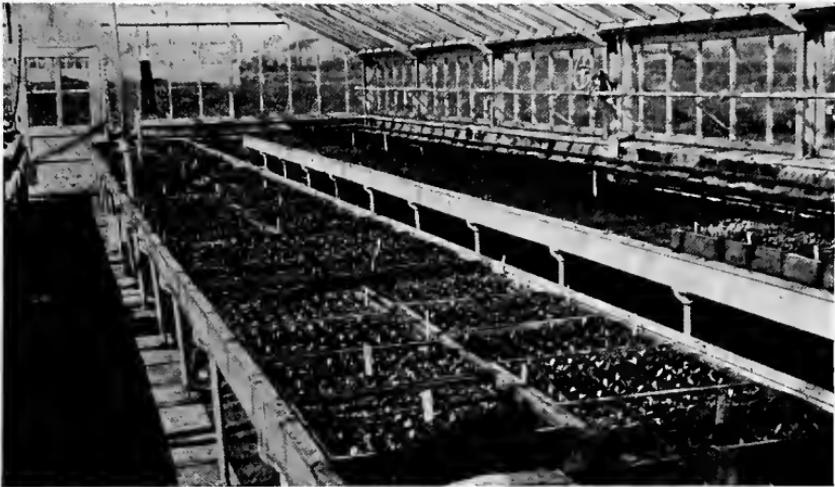


FIG. 64.—Flats of shifted lettuce seedlings on greenhouse bench.

method is preferable, for plants so handled are less sappy at the time of the final transplanting, and their root systems are not disturbed in the operation. However, good results can be secured with plants from flats if all soil and weather conditions are favorable at the time of transplanting and care is taken to have plenty of soil attached to the roots when the plants are taken from the flats.

Whether in flats or pots, the plants should be transferred in the containers to a coldframe for hardening-off, at least ten days before it is expected that they will be transplanted into the open ground. Whether in the greenhouse, hotbed or coldframe, pots containing lettuce plants should be plunged to the rim in soil or

sand. This is to prevent the soil in the pots from drying out too rapidly.

When set in the open ground the lettuce plants should be planted twelve inches apart in the row in order to allow them sufficient room in which to develop (Fig. 65). The rows may be either twelve or eighteen inches apart. The latter distance makes tillage more convenient.

**Thorough cultivation** should be given the lettuce from the time it is set in the field, in order that moisture may be conserved. If the weather is dry, artificial watering is an advantage. Shading with screens of tobacco cloth or similar fabric is also beneficial to lettuce in case the weather should be slightly too warm and dry.



FIG. 65.—A well-developed head of Hanson lettuce. The plant is over a foot across.

**Constructing Screens for Shading Lettuce.**—If lettuce is to be grown under screens, there are two ways of making these screens. The more usual method is to set posts in the ground and construct a framework about seven feet high, over as large an area as it is desired to shade. The tobacco cloth is stretched over the sides and ends as well as the top of this frame, making a complete enclosure that will subdue the intensity of the

sunlight and retard evaporation of moisture from the soil (Fig. 66). The object of having the framework so high is to enable a man to stand erect while working under it in tending the lettuce. Another method is to make a movable screen by stretching the cloth over an inverted V-shaped frame with sides two to three feet wide and ten to twelve feet long. If the frame is made of one by two-inch wooden strips it will be sufficiently light to be easily handled, and can be placed over a row or two of lettuce at any time desired.

Some varieties of head lettuce will stand more heat than others and these sorts should be selected where the weather is likely to be getting warm when the lettuce is heading.

In localities where head lettuce can be grown from outdoor

planting of seed, the method of culture is essentially the same as for leaf lettuce (see p. 99) except that the individual plants require more space. They should be thinned to a foot apart in the row. This should be done early, while the plants are still very small, and before they have a chance to become stunted by reason of crowding.

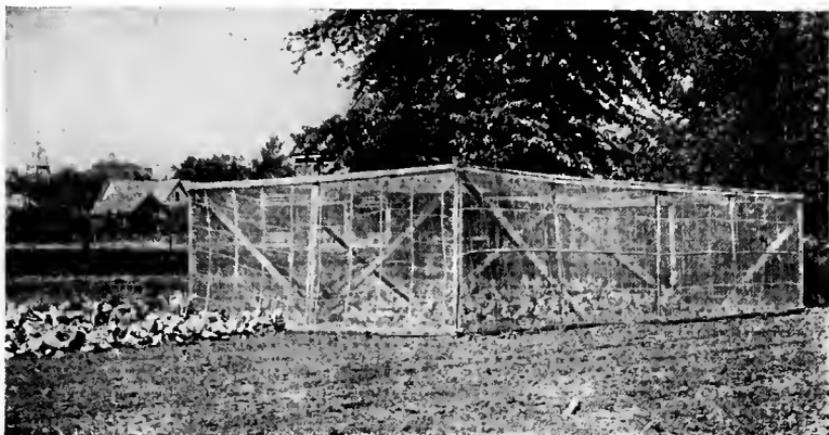


FIG. 66.—Frame-work covered with "tobacco cloth" to afford partial shade for head lettuce and similar crops.

#### COS LETTUCE

There is another type of lettuce somewhat midway in structure between leaf and head lettuce. This is known as cos lettuce or romaine (Fig. 67). The leaves grow erect and are tied together at the top, to induce blanching of the inner parts. In some varieties the outer leaves close over the top, so that tying is unnecessary. The cultural requirements of the crop are essentially the same as those of head lettuce.

#### EARLY CABBAGE

Early cabbage is of two general types, the conical-headed and the round-headed (Figs. 68 and 69). Until recently, the very earliest varieties were of the former type, but now there are also round-headed sorts that are extremely early. Both types demand the same kind of culture.

Since cabbage thrives best when the weather is comparatively cool, though it will stand somewhat more heat than will head

lettuce, the early crop should be started in time to complete its growth before the normal season for excessively hot weather (Fig. 70). In order that this may be done, it is necessary to start the plants under glass before outdoor gardening can begin. If the seeds are sown in hotbeds from February 20 to March 1, the plants will be of the right size for transplanting about April 15. Usually the plants grown from seed sown in hotbeds are not shifted before the final transplanting to the field, but are simply



FIG. 67.—Cos lettuce or romaine.

hardened-off in the hotbed, which by that time will be virtually the same as a coldframe, since the heat of the manure will have been spent or the fire can be withheld. In some parts of the South early cabbage seed is sown in September and the plants wintered over in coldframes for early spring planting, but the method just described is the one usually employed in the corn belt and northward.

Early cabbage bears transplanting very readily. It is not necessary that the plants be taken up with earth adhering to the

roots. They are simply pulled from the seed-bed after thorough watering, and set with a dibber or transplanting machine in well-prepared soil. The rows should be far enough apart to permit of tillage with a horse, and the plants from fifteen to twenty-four

FIG. 68.

FIG. 69.

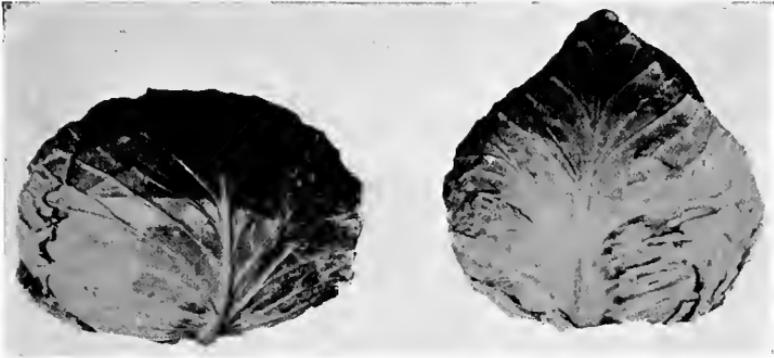


FIG. 68.—Early cabbage of the round-headed type: Copenhagen Market.  
 FIG. 69.—Early cabbage of the conical-headed type: Jersey Wakefield.

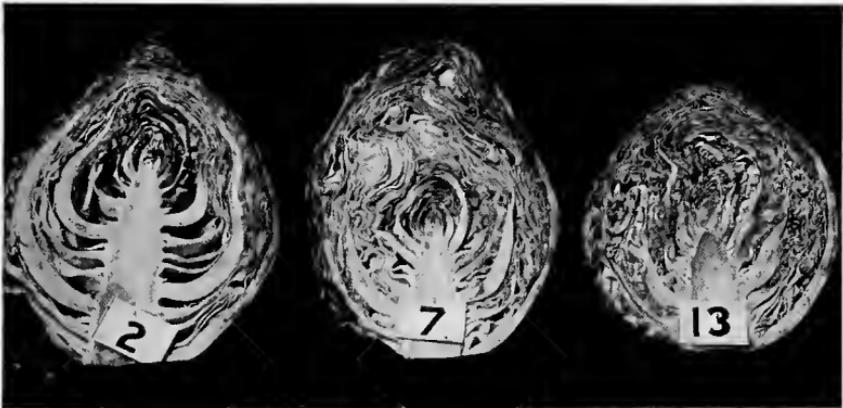


FIG. 70.—Longitudinal section of three heads of conical cabbage. The head at the right is the most solid and hence most desirable.

inches apart in the row. The latter distance is preferable unless space is limited.

Cabbage requires an enormous amount of tillage. This should include both cultivation between the rows and hoeing about the plants. Tillage should be continued as late as possible even

though some of the outer leaves may be broken off during the operation.

With early planting, thorough tillage, an abundance of moisture and rich soil, there is usually no difficulty in growing a good crop of early cabbage for June cutting in the corn belt. In the South it may be grown as a winter crop, and in the far North it may be grown any time in the summer. Occasionally cabbage worms attack the crop after the plants have begun to head. They may be held in check by sprinkling with almost any kind of dry dust while the plants are wet with dew. Air-slaked lime, white hellebore or dry road dust may be used.

FIG. 71.

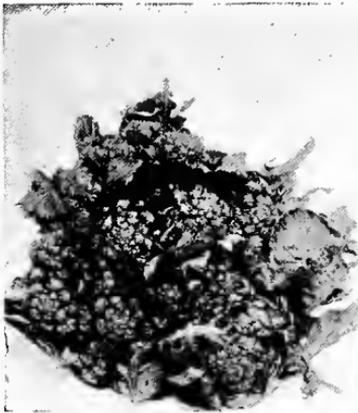


FIG. 72.

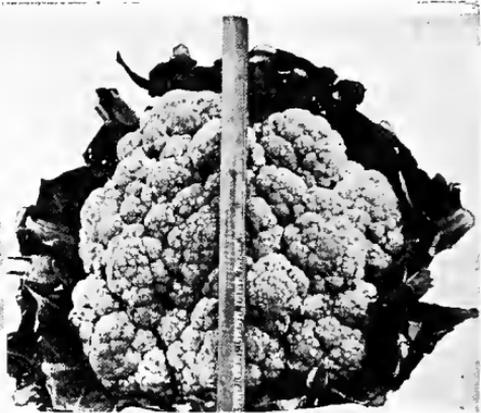


FIG. 71.—A cauliflower head as it is likely to develop when the weather is too hot and dry.  
FIG. 72.—A typical head of early cauliflower as grown in a favorable season in the corn belt.

#### EARLY CAULIFLOWER

Early cauliflower demands much the same conditions as early cabbage, but is unable to endure as cool or as warm temperatures, and is much more seriously affected by unfavorable conditions. It is very sensitive to drought and to sudden changes in temperature. If the plants are stunted by too cold weather or insufficient moisture, or excessive heat, the heads may either fail to form, or form prematurely while the plants are small and weak and unable to produce heads of marketable size, or break into irregular growths with circlets of leaves scattered through the head (Fig. 71). On the whole, early cauliflower is a much more uncertain crop than early cabbage unless all conditions of soil and tempera-

ture are right. It belongs in regions where the atmosphere is humid and the nights are cool, and succeeds especially well near large bodies of water. In the South it thrives as a winter crop and in some parts of the North may be grown in summer. In the interior regions of the central states it is even harder to grow than head lettuce, since it requires a longer period to complete its development and is fully as sensitive to heat and drought. However, with proper care, it is possible to produce early cauliflower most seasons even in the corn belt (Fig. 72).

The plants are grown the same as the early cabbage plants (Fig. 73), but the seed should be planted a week earlier, since the



FIG. 73.—A flat of well-grown cauliflower plants ready for transplanting.

growth is slower, and large, vigorous plants are wanted. Special care should be taken to have the plants thoroughly hardened-off before they are transplanted into the open. Otherwise they are likely to become stunted, and never produce satisfactory heads. The plants should be set in the field the same time as early cabbage. Plenty of space should be allowed between the plants in order that each may be able to secure moisture from a considerable area. Two by three feet is as close as the plants should usually be set. Thorough and frequent tillage should also be given to assist in retaining moisture in the soil. Watering with liquid manure when the plants begin to head is sometimes advised.

**Blanching the Heads.**—Cauliflower heads must not be allowed to become sun-burned, for that would injure their appearance and flavor. As soon as the heads begin to form, the outer leaves of the plant are drawn up together and secured by tying at the tips (Fig. 74). The head thus develops in comparative darkness



FIG. 74 —Cauliflower tied up for blanching.

and remains white and attractive. Care should be taken to allow plenty of space above the head when it is tied; otherwise it may rot. The proper time for cutting the head is just as soon as it reaches full size, and before it begins to break. This stage can be readily determined by slightly parting the leaves at the north side of the plant and examining the head. The heads develop

very rapidly, and, unless care is taken, there is danger of letting them stand too late.

## QUESTIONS

1. How does head lettuce differ from leaf lettuce?
2. Under what conditions can head lettuce be grown as an outdoor crop from seed sown in the open?
3. What happens to head lettuce if the weather becomes too hot?
4. Describe the process of growing head lettuce by the transplanting method.
5. Describe two methods of making screens for protecting head lettuce from the sun.
6. Describe the structure and cultural requirements of cos lettuce or romaine.
7. What are the two types of early cabbage?
8. How and when are cabbage plants started for the early crop?
9. How is early cabbage transplanted?
10. What are the essential points in the culture of early cabbage?
11. How does early cauliflower compare with early cabbage as to behavior under unfavorable conditions of temperature and moisture?
12. How are the heads of cauliflower protected from the sun?
13. What plants mentioned in this chapter are commercially grown in your locality?
14. If none of them are grown, give reasons.

## CHAPTER XVI

### LATE CABBAGE AND SIMILAR CROPS

#### LATE CABBAGE

LATE cabbage is of three general types: Common or white cabbage, savoy cabbage and red cabbage. The first named is by far the most important. It is handled by the carload and is a staple product on the markets from late fall till early spring. Savoy cabbage differs from the ordinary cabbage in that the leaves are darker green, and very much more wrinkled and curled (Fig. 75). Sometimes it is referred to on the market as "curly cabbage." It is more delicate in flavor than common cabbage, but as yet is very little grown. Red cabbage is used chiefly for pickling and its demand for that purpose is quite limited. The culture of all three types of late cabbage is essentially the same.

**Climatic Requirements.**—Late cabbage makes its principal growth during the cool weather of autumn, but since its period of growth is much longer than the normal period of cool autumn weather in warm climates, it is not reliable as a commercial crop except in locations so far north that the summers as well as the autumns are comparatively cool. Under favorable conditions it produces enormous crops, but as its culture is extended southward smaller heads are produced and the crop becomes more uncertain. In the corn belt it is much less reliable than early cabbage because the plants have to make much of their growth during hot weather, and do not outgrow their stunted condition when favorable weather finally arrives. It is only in seasons that are abnormally cool and wet, or on rich bottom lands, that late cabbage makes good crops in central latitudes. However, market gardeners usually plant small areas, and sometimes have a crop to sell. Farther north, immense areas are planted and large yields regularly harvested.

**Growing the Plants.**—The seed for late cabbage should be sown in a carefully prepared seed-bed in the open ground four or five weeks before time for setting the plants in the field. Since the days are longer than when early cabbage plants are grown, the plants reach transplanting size in a shorter time. Transplanting may take place from June 15 to July 15. When large areas

are to be planted, several sowings of seed may be made in order to distribute the transplanting over a considerable period and have all plants of the right size when transplanted. The latest plantings are made of varieties capable of developing in a shorter time than the earlier plantings.

**Precautions for Successful Transplanting.**—Since the weather is likely to be rather hot and dry when late cabbage is transplanted, precaution should be taken that the plants do not suffer from



FIG. 75.—Savoy cabbage. Delicate in flavor but little grown.

lack of moisture. The best results are likely to be secured if the cabbage is transplanted on land that was plowed early when it contained an abundance of moisture and that has been harrowed frequently until the time for transplanting. To prevent too rapid loss of moisture from the plants themselves, the tops of the leaves should be twisted off. (See chapter on transplanting.) Sometimes, in order to avoid the risks attending transplanting in dry weather, the seed of late cabbage is sown where the crop is to mature.

Late cabbage should be planted on rich, moist soil, and every care taken to conserve moisture and promote rapid growth (Fig. 76). Thorough and frequent tillage should be given. The plants should be far enough apart to allow full development. Two and one-half by three and one-half feet are good distances for large growing varieties. In regions especially well adapted to late cabbage, planting may be somewhat closer in order that the heads may not grow too large; but in other localities the difficulty is rather to make them grow large enough, and wide planting favors



FIG. 76.—Field of cabbage grown under irrigation, near Greeley, Colorado.

larger development, since it makes later tillage possible and allows each plant a larger foraging area, and hence more moisture and more plant food.

**Cabbage worms** are likely to be a serious enemy to the late cabbage crop. Early in the season, the plants may be sprayed with a mineral poison, such as Paris green or arsenate of lead; but after they have commenced to head, applications of white hellebore are considered preferable. This material may be applied as the dry powder, or mixed with water at the rate of one pound to fifty gallons and applied as a spray.

**Diseases of Cabbage.**—There are several diseases of cabbage which may become serious where the crop is grown extensively. One of the most prevalent of these is known as the club root, so named on account of the peculiar malformation of the roots of the infected plant. In severe cases this disease so weakens the plant that it does not produce a good head. Spores form in vast numbers in the infected roots and remain in the soil ready to transmit the disease to the succeeding crop. The same disease attacks cauliflower, kale, kohlrabi, turnips and several other members of the mustard family, including weeds, notably the shepherd's purse and hedge mustard. Experiments show that the germs of the disease may remain in the soil for as many as four years following the production of a badly diseased crop, even when no crops subject to the disease are grown upon the land during that time.

To avoid serious injury from this disease, it is best to prevent the land from ever becoming badly infected with its germs. This can usually be done by practicing a systematic rotation of crops, so that cabbage or any other crop subject to this disease is grown only once in three or four years upon the same land. A slight infection does not seriously damage the crop, and if another crop of the same kind is not grown for three or four years, the disease does not gain much headway. This method of avoiding injury is applicable only to fields which have not become badly infected.

If it becomes necessary to plant cabbage on a piece of land that has previously produced a badly diseased crop, the stumps, roots and all other refuse from the diseased crop should be removed immediately after the harvest, and destroyed by burning or burial. Refuse from a diseased crop should not be thrown upon the compost heap or fed to animals, for it has been found that manure from animals fed upon diseased cabbage or turnips will transmit the disease to otherwise uninfected soil.

In addition to the removal of the refuse from the preceding crop, a badly infected field should be treated with lime used at the rate of 75 to 150 bushels per acre. The lime is more effective if applied considerably in advance of the setting of the plants. It is usually applied broadcast and allowed to become air-slaked before being plowed under. Then if the land can be replowed before setting the plants, it is an advantage.

Cabbage plants may become infected in the seed-bed; in fact, they seem more subject to infection while young than after they

become older. It is therefore extremely important in preparing the seed-bed to use only soil in which plants subject to the disease has never been grown. As an additional precaution it would be well to mix a small amount of air-slaked lime with the soil when preparing the seed-bed.

When setting plants in the field, if any with diseased roots are noticed, they should be discarded; and if very many diseased plants are found, it might be the wiser course to discard the whole bed and procure plants from some other source, or even stay out of the cabbage business that season. Without plants free from disease at the time of setting, it is almost impossible to produce a good crop of cabbage. On the other hand, experiments show that by using plants grown in an uninfected seed-bed it is sometimes possible to produce a fair crop of cabbage in a badly infected field, without liming. If, however, diseased plants are set, the crop will be a failure even if the field has been limed. The best plan is to grow the plants in uninfected soil, and set them in an uninfected field or one that has been limed.

Other diseases of cabbage are the black rot and the wilt. Both of these can best be controlled by careful rotation and by care in avoiding infected soil in the seed-bed. Germs of the black rot may also be carried on the seed. If there is reason to fear this disease, the seed should be soaked for fifteen minutes in a solution of corrosive sublimate or formalin before planting. If corrosive sublimate is used, one ounce of the poison is sufficient to make eight gallons of the solution; and one fluid ounce of formalin is enough to make two gallons of solution of that material. In making small quantities of these solutions care should be taken to avoid having them too strong. If diseased cabbage plants appear in the seed-bed they should be discarded when transplanting.

The black rot and wilt are likely to be especially troublesome to control on bottom lands subject to inundation, for infected soil is readily carried great distances in the flood waters:

#### LATE CAULIFLOWER

As compared with late cabbage, late cauliflower is even more imperative in its demands for coolness and moisture. It is harder to grow in warm climates than early cauliflower, for the young plants are unable to survive the normal heat and drought of July and August, and it is only occasionally that a crop can be produced

where the summers are warm. It delights in the cool, moist air of the ocean breeze, and reaches its highest development in locations like eastern Long Island. It may also be grown in northern interior regions like Wisconsin and Minnesota, but even here succeeds best near large areas of water. Under irrigation it thrives in the high altitudes of Colorado. In central Illinois, Indiana and Missouri the summers are usually so hot and dry that late cauliflower is a failure, and few gardeners in these regions attempt its culture.

Wherever late cabbage does exceptionally well, late cauliflower may usually be grown with at least a fair degree of success. The method of starting the plants is essentially the same as for cabbage, except that even more care is taken in the preparation of the seed-bed, and the plants are started slightly more in advance of the transplanting season owing to their slower growth at the beginning. The reason for greater care in the preparation of the seed-bed is that the seed is very expensive, and it does not pay to run the risk of getting a poor stand through negligence in the preparation of the seed-bed or in the matter of watering.

When transplanted to the field late cauliflower needs even more room than late cabbage, owing to its greater demand for moisture. The failure of late cauliflower to produce satisfactory heads is sometimes caused by too close planting. Large, late varieties should be planted at least three by four feet, and sometimes even four by four feet is advised.

#### BROCCOLI

Broccoli resembles late cauliflower in cultural requirements and form of head (Fig. 77). However, it demands a longer season of cool weather in which to develop, and it is little grown in this country. In France and England it is more prominent than cauliflower and is used as a substitute for it at certain seasons of the year. In some parts of southern Europe it is planted in the fall, grows all winter, and then heads the following spring. Farther north, it may be planted in early summer and grow all the fall without heading; then with slight protection survive the winter and produce heads in the spring. In America the winters are too cold where the summers are not too warm to practice this method of handling the crop. On the whole, broccoli gives little promise of ever becoming a prominent vegetable in this country.

## BRUSSELS SPROUTS

Brussels sprouts differ from cabbage in that the central stem of the plant is elongated, so that the leaves remain separate instead of forming a compact head, and that miniature heads are formed in the axils of the leaves. These little heads or "sprouts" are about an inch in diameter, and may be so numerous as to completely hide the stem (Fig. 78). A good yield is one quart of the "sprouts" to the plant.



77.—A typical plant of broccoli as grown in Illinois. In Europe, larger and more compact heads are produced.

**Climatic Requirements.**—A long, cool season and plenty of moisture are essential to the proper development of Brussels sprouts. The plants will stand considerable heat, but the "sprouts" remain little tufts of loose leaves instead of becoming compact heads, unless the weather is cool and moist. The culture of Brussels sprouts is practicable only in locations where late

cabbage is a certain crop. The time required for full development is somewhat longer than that for most varieties of late cabbage, so that the planting should be done no later than for the first of the late cabbage.

The plants are started in seed-beds and transplanted the same as late cabbage. They also require essentially the same kind and amount of tillage, and need an abundance of plant food and moist-

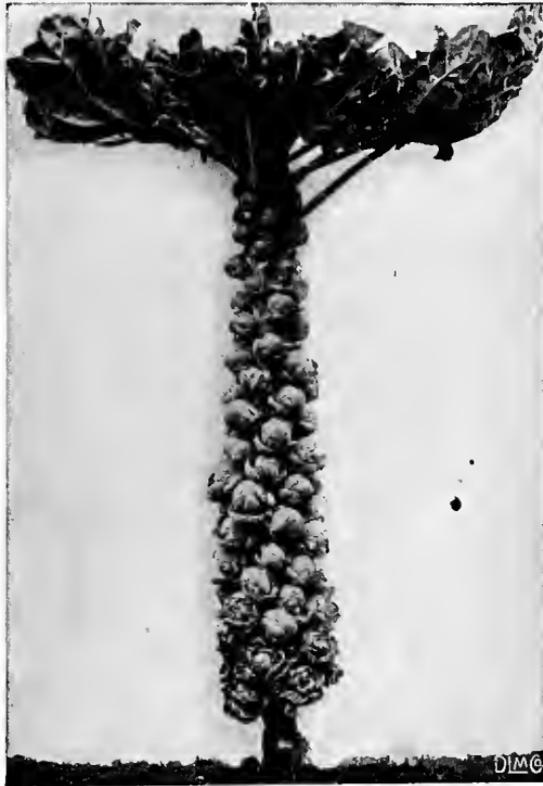


FIG. 78.—Plant of Brussels sprouts after removal of side leaves.

ure. After the sprouts have formed they seem to develop better if the leaves are cut from the sides of the stalk. The tuft of leaves at the top, however, should be left intact. The sprouts complete their development late in autumn, and the quality is thought to be improved by slight freezing. The sprouts may be cut from the stalk in the field or the entire plant may be taken up and stored.

Brussels sprouts are considered to be the most delicately flavored vegetable of the cabbage family, and where they can be successfully grown they form a valuable addition to the list of vegetables for the home garden, as well as being a profitable crop commercially. They are not commercially grown in the corn belt; and only in occasional seasons, when the weather is abnormally cool, will they yield a satisfactory crop there. The large city markets of the Middle West are supplied principally with the product from California. Eastern markets are supplied largely from Long Island. The crop also thrives well in Ontario.

#### QUESTIONS

1. Name the three general types of late cabbage and state the relative importance and particular uses of each.
2. Under what climatic conditions can late cabbage be most successfully grown?
3. How are the plants grown for the late crop of cabbage? At what time are they transplanted?
4. What precautions are necessary in transplanting late cabbage?
5. How may a sufficient moisture supply be maintained for growing late cabbage?
6. How may cabbage worms be controlled?
7. Describe the disease known as "club-root" of cabbage. How may trouble from this disease be avoided?
8. How may trouble from the black rot and the wilt of cabbage be avoided?
9. How does late cauliflower compare with early cauliflower in ability to make a crop in warm climates?
10. Mention some localities where late cauliflower can be grown successfully. What sort of climate have these localities?
11. How are plants grown for the late crop of cauliflower?
12. Why must late cauliflower plants be set far apart?
13. Describe the broccoli plant, and discuss the importance of the crop in different parts of the world.
14. Describe the structure of a plant of Brussels sprouts and compare it with the cabbage plant.
15. Under what climatic conditions can Brussels sprouts be successfully grown?
16. What particular attention do Brussels sprouts need after the miniature heads have formed?

## CHAPTER XVII

### CELERY

WITHIN recent years celery has increased greatly in importance among vegetable crops. Formerly it was found only on the tables of the rich, or used upon special occasions like Thanksgiving and Christmas. Now it is common in any but the smallest markets a large part of the year, and is considered more in the nature of a staple vegetable than a luxury, as was formerly the case. However, it has not become common in home gardens, and its commercial culture is confined principally to particular areas where conditions are especially favorable to its growth.

**Celery demands cool weather, a soil rich in humus, and an enormous quantity of water.** Its period of growth extends over a longer season than the cool spring or autumn weather of central latitudes. It is therefore grown principally as a summer and fall crop in the North or a winter crop in the extreme South. It may also be grown as a summer crop in the high altitudes of the mountain regions, and to some extent as a fall crop in the central prairie regions. Celery culture has reached its highest development on reclaimed muck swamps in cool climates, where the soil is composed principally of organic matter and the water table is within a foot or two of the surface. These soils are so loose and "springy" that horses working on them must be equipped with broad blocks of wood on their feet to prevent their miring down. One of the most famous celery regions of this character is located at Kalamazoo, Michigan. The great celery fields of California are also located on similar soil.

**The chief difficulties in growing celery** in ordinary localities are excess of heat and deficiency of moisture. The latter may be overcome by furrow irrigation in the arid mountainous regions of the West or by overhead sprinkling in the intensive market gardens of the East. On upland soil that cannot be artificially watered, celery is an uncertain crop except in unusually wet seasons. In central localities, when the summer is so wet and cold that corn almost refuses to grow, celery flourishes luxuriantly; in ordinary years it will make a fair crop on rich soil, if given

careful attention and occasional watering. For market purposes, however, it should be grown only where conditions are most favorable. It is a crop requiring a large amount of hand labor, and its culture should not be undertaken, except in a small way, by persons unfamiliar with the crop.

**The Early and the Late Crop.**—Market growers in Michigan and similar latitudes recognize two distinct crops of celery—early and late—though at the harvest one merges into the other, for successive plantings result in a continuous supply after the marketing season opens. The early crop is put in the field as soon as conditions will permit, usually by May 1, and makes its growth during the summer months. It is usually harvested in August. It is not feasible to grow celery maturing at this time except where the summers are relatively cool and the soil well supplied with moisture. The late crop is usually set in the field from June 20 to July 15. Outside the regular commercial celery regions, the late crop alone should be attempted. Celery is such a slow-growing crop that in central localities there is not time for it to complete its development before hot weather, even if started very early in the spring; and the product is likely to be small in quantity and poor in quality if its principal growth is made during a period of high temperature and deficient rainfall. However, the late crop makes its principal growth and develops its edible portions chiefly during September and October, after the fall rains have usually become abundant and the weather is cool.

**Growing Celery Plants.**—Plants for both the early and the late crops are grown from seed planted in carefully prepared soil from three to four months before the plants are wanted for setting in the field. This means that seed for the early crop should be sown in January and for the late crop in March or early April. Greenhouse facilities are almost necessary for growing the early plants, while a hotbed or coldframe would answer the purpose for the late plants. In fact, plants for a late crop are sometimes grown in an open seed-bed, but this method is less reliable than starting the plants under more completely controlled conditions. Since the seeds are very small and germinate slowly, it is best to sow them in a flat or box of carefully prepared soil. The seed should be covered very lightly, and the soil kept moist. As an aid in preserving the moisture, a pane of glass or a newspaper should be laid over the box. As soon as the plants appear above the ground the covering may be removed.

As soon as the plants are large enough to handle (Fig. 79) they should be pricked out into other flats, being placed about two inches apart each way (Fig. 80). These flats may be placed in a coldframe as soon as the weather is sufficiently warm, and the sash should be kept off as much as possible (Fig. 81). The plants should receive careful attention and frequent watering. Here they are allowed to grow until needed for transplanting. If the



FIG. 79.—A flat of celery seedlings ready for pricking out.

FIG. 80.—A flat of celery seedlings immediately after being pricked out from the flat in which the seeds were sown.

tops grow too tall in the meantime they may be clipped with sheep shears or a sickle.

**Transplanting Celery Plants.**—At the time of transplanting the soil should be well supplied with moisture, either as a result of recent rainfall or of thorough tillage following early preparation. If the spot where the celery is to be planted can be partially shaded, it will be an advantage, both in retaining moisture before the

celery is planted and in protecting the plants from the glaring sun. For this reason the home supply of celery is sometimes grown between the rows of grapes in a vineyard, or between rows of sweet corn planted wide apart. If the space between the rows has been thoroughly cultivated the soil will usually be quite moist even though much moisture has been used in growing the corn or grapes.

*The usual distance* for planting celery is six inches between the plants in the row. The distance between the rows depends upon the method of blanching to be employed, but is usually



FIG. 81.—Celery plants in coldframe, ready for transplanting to the field.

from two and one-half to five feet. The plants are ordinarily set with a dibber, without much earth adhering to the roots. If the weather is warm, a large portion of the top of each plant is cut or twisted off. (See chapter on transplanting.)

Celery may be planted either in trenches or on the level.

*Planting in trenches* has the advantage of placing the plants in contact with moister soil and securing partial shade, especially if the trench is deep. A further advantage is that less banking is required to blanch the crop. The chief disadvantages of the trench method are that a heavy rain is likely to bury the newly

set plants in the earth and necessitate much hand labor in digging them out, and that some difficulty is experienced in properly cultivating the plants in the bottom of the trench. However, this latter difficulty is not serious if the trench is not over six inches deep, for in that case a double wheel hoe, equipped with two narrow cultivator teeth, can be run astride the row. As the plants grow, the trench is gradually filled with earth during the process of cultivating.

*In irrigated regions* of the West, celery is sometimes planted in double rows, with one row on each edge of the irrigation furrow. Following an irrigation, the soil in the furrow is broken up by means of an especially constructed cultivator drawn by one horse walking midway between two double rows. Two men are re-



FIG. 82.—A Michigan celery field. Blanching the early crop with boards.

quired to guide the cultivator since there are two sets of shovels and handles for cultivating two double rows at a time.

**Blanching Celery.**—Whether grown in trenches or on the level, the celery must be blanched. This is accomplished by excluding the light from the growing celery. The early crops are usually blanched by setting up boards on either side of the row, but the late crop is ordinarily banked up with earth. The reason for blanching the early crop with boards rather than earth is that banking with earth in warm weather is likely to cause the celery to rot. Only varieties that blanch with comparative ease, known as self-blanching varieties, are used for the early crop, since these sorts alone can be satisfactorily blanched with boards. Boards twelve inches wide and twelve or fourteen feet long are used.

They are laid flat on the ground on either side of a row of celery, with one edge close to the base of the celery plants; then raised up and the top edges drawn as close together as the presence of the foliage will permit (Fig. 82). The boards on either side of the row are held together at the top by a clasp of wire or a block of wood tacked to the edges of the two boards. Ordinarily the boards are not put in place until the celery is twelve or fourteen inches high. Rows of celery to be blanched with boards may be planted as close together as two and one-half feet.

The late crop is almost invariably banked with earth if it is to be blanched in the field. In the case of the trench-grown celery



FIG. 83.—Late celery banked with earth for blanching.

the earthing-up process really begins with the filling of the trench by cultivation. Subsequently the earth is banked up about the plants the same as if they were planted on the level, the main difference being that less earth is required to complete the process. In either case, care must be taken to avoid getting dirt into the "hearts" of the plants. For this reason the plants are usually "handled" before being banked. The "handling" consists in gathering the leaf stalks together in one hand, and drawing up the earth and packing it about the plant with the other hand until there is sufficient earth to hold the stalks in place. Earth is then drawn up with a hoe until only the tops of the leaves are

left exposed. This first handling and banking is usually done when the plants are about a foot high. In the case of trench-grown plants, some handling may be necessary before the trench is filled. As the plants grow, additional earth must be placed upon the bank and drawn up close to the plants in order that they may be blanched nearly to the tips (Figs. 83 and 84). A cultivator or a one-horse plow may be used to loosen up the dirt to be used in



FIG. 84.—Earth-blanching celery as dug from the field.

banking. There are also special celery hillers in use which greatly facilitate the operation of banking. Banking can be much more readily done in a soil containing an abundance of sand in a moist condition than in an ordinary silt or clay loam, for a bank of moist, sandy soil can be made to retain its position much like a founder's moulding sand.

Sometimes, instead of being blanched in the field, late celery intended for winter storage is allowed to remain green until the



FIG. 85.—Bed of "new celery culture" celery, showing board in place to blanch the outer row. The other rows are blanched by their own shade.



FIG. 86.—"New celery culture" celery ready to harvest.

harvest, then dug and stored in a dark place where it continues a slow growth and becomes blanched.

**The “New Celery Culture.”**—There is a method of growing celery in which the plants are set so close together that the stalks are blanched by the shade of their own foliage. This method of



FIG. 87.—Celeriac or turnip-rooted celery.

growing celery is sometimes called “the new celery culture.” It is practicable only where the soil can be made exceedingly rich and a constant supply of water is available; for enormous quantities of both plant food and moisture are needed to support the great numbers of plants that are set on a limited area.

In preparing soil for this method of growing celery it is custom-

ary to apply about one ton of rotted manure to each square rod of ground. The plants are set six inches apart in rows only eight to ten inches from one another. Usually the plants are arranged in beds about twelve feet wide for convenience in working among them with hand tools. When they have grown so much that tillage can no longer be given, boards are placed edgewise around each bed in order to blanch the outside rows (Fig. 85). Under thorough watering, the plants eventually make so dense a mass of foliage that no sunlight is able to penetrate to the stalks below. Under these conditions, the early or self-blanching varieties become as fully blanched as if boards were used for every row (Fig. 86).

This method of celery culture is especially adapted to furnish a home supply if the celery bed can be placed within range of a hose connected with a water supply under pressure.

#### CELERIAC OR TURNIP-ROOTED CELERY

This plant is also known among gardeners as "root celery" and "German celery." It greatly resembles celery in general appearance, and in their early stages of development it is difficult to distinguish between the two. However, in celeriac, it is the enlarged root, rather than the leaf stalk, which constitutes the edible product (Fig. 87). In a well-grown specimen the root is three to four inches in diameter. Celeriac is used chiefly in flavoring soups and making salads, but may also be creamed and served as a side dish.

The culture of celeriac is like that of late celery except that no blanching is required. The seed is sown in flats or carefully prepared seed-beds, the plants shifted once before their final transplanting to the field, and the crop given good tillage and plenty of water during its growth. Celeriac is considered a less exacting crop than celery, but does not produce full-sized roots unless the weather is cool and the soil rich. The crop is harvested late in fall and is sometimes, though not usually, stored for winter use.

#### QUESTIONS

1. Compare the present importance of celery with its status thirty or forty years ago.
2. What soil and climatic conditions are essential to successful commercial celery culture?
3. Why is not celery more generally grown in home gardens?

4. Compare the early and the late crop of celery as to the time of setting the plants in the field, time of harvesting, and behavior in localities where the summers are warm.
5. Describe the method of growing celery plants.
6. How far apart should celery plants be set in the field?
7. Discuss the relative merits of planting celery in trenches and on the level.
8. In what different ways may celery be blanched? What circumstances determine which method to employ?
9. Describe the "new celery culture." Under what conditions is this method practicable?
10. What is celeriac?
11. Describe the method of growing celeriac.
12. What are the chief uses of celeriac?

## CHAPTER XVIII

### ROOT CROPS THAT ENDURE SUMMER HEAT

#### BEETS AND CARROTS

BEETS and carrots thrive under practically the same conditions and may therefore be treated together. They are fairly hardy and can therefore be planted quite early in the spring, though they will not stand such cold weather following planting as will lettuce, spinach and turnips. In seasons when the opportunity for outdoor gardening arrives exceptionally early, the sowing of beets and carrots should be deferred until the second, rather than included in the first planting. The seeds are sown in drills from twelve to eighteen inches apart if hand methods of tillage are to be employed, or two and one-half to three feet if horse tools are to be used. In market gardens close planting and hand tillage are the rule.

The seeds of carrots are much smaller than those of beets and the seedlings are weaker; hence the planting should be shallower, and special precautions should be taken to avoid letting a crust form on the soil before the seedlings appear. For this reason sandy soil is preferred to clay for carrots, for there is less danger of crust formation. In both beets and carrots, the sowing of a few radish seeds in the same drill is considered an advantage, for the radishes come up quickly and mark the rows so that tillage can begin before the beets and carrots are visible. The radishes are removed before the other plants need the room.

Thorough tillage with hand or wheel hoes should be given from the very start. Some hand weeding and also thinning of the seedlings will be necessary, and should be attended to promptly. The thinnings of the beets may be used for greens, but thinnings of the carrots are of no value except that occasionally the foliage is used for garnishing. The distance between the plants in the row will depend primarily upon the stage of development at which the crop is to be harvested. If the roots are to be pulled for early use when only partially grown (Fig. 88), they will not need so much space as if allowed to grow through the season for winter use. There is also some difference in the amount of space required

by different varieties. In general, however, the plants should stand from two to four inches apart in the row, the latter distance being preferable if the plants are not intended primarily for early use. Sometimes even greater distances are allowed if large specimens are desired. Medium-sized roots are considered better for table use than those that are overgrown (Fig. 89), and hence thinning to greater distances than above specified is seldom neces-

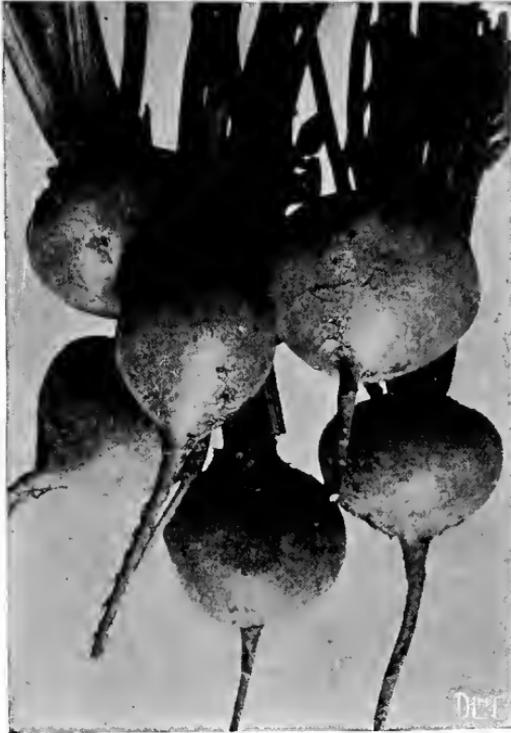


FIG. 88.—Young beets pulled for early use.

sary. In fact, the desire for small, tender roots for late use has led some gardeners to adopt the practice of making successive plantings of these crops. It is difficult, however, to secure a stand of beets or carrots in hot, dry weather, and unless artificial watering can be employed it is safer to depend upon early plantings to furnish the winter as well as the summer supply of these two crops. Sometimes, the long type of beet is grown for winter use.

ROOT CROPS THAT WITHSTAND WINTER FREEZING AS WELL  
AS SUMMER HEAT

Beets and carrots must be harvested before the ground freezes in the fall. Parsnips, salsify and horse-radish constitute a group of root crops that are not injured by freezing during the winter following the season in which they have made their growth. In fact, freezing is thought to improve rather than to impair their quality. At any rate they are surer to be crisp if freshly dug than if stored under unfavorable conditions. Therefore it is a common



FIG. 89.—Carrots of three types. The short type is usually grown for early use, and the larger types for winter.

practice to allow them to remain in the ground all winter and dig them very early the following spring. However, part of the crop is often dug in the fall to afford a winter's supply.

**Parsnips.**—Parsnip seed quickly loses its germinative power. Therefore, none but fresh seed should be planted. It should be sown in drills about eighteen inches apart, at the time early beets and carrots are sown. Parsnips require the entire season in which

to make their growth. They must be planted early in order to enable them to get a good start during the cool, moist weather of spring. They are deep-rooted plants and are able to withstand long periods of drought after once becoming well established. The roots do not increase much in diameter during the hot, dry weather of summer, and may seem disappointingly small in early September; but under the influence of autumn rains and agreeable temperature, they swell rapidly during that and the following month, and may be full-sized when dug in November.

*Soil for Parsnips.*—In order that parsnip roots may be symmetrical, the soil in which they are produced should be deep and friable. Shallow or dense clay soil is likely to produce roots of undesirable shape. The long, smooth tap-root devoid of side branches does not form so readily in such a soil; and the market value of a parsnip is determined largely by its shape (Fig. 90).



FIG. 90.—Well-grown specimens of parsnip.

*Tillage, weeding and thinning* should be given to parsnips the same as beets and carrots. However, since parsnips are never used in the early immature stages, thinning to the required distance for full development should be done in all cases as early as the size of the plants and the condition of the soil will permit. The roots soon become so long that the plants are hard to pull except when the ground is soft. Therefore, they should be thinned at the earliest opportunity after they have reached sufficient size to be readily handled.

*The digging of parsnips* demands special attention. If the roots are cut or broken their value for market is largely destroyed. The entire root to a point one-fourth inch in diameter should be secured. Attempts to dig the roots out with a spade or to plow them out are sure to result disastrously. A trench should be dug

or plowed close to each side of the row, and then the roots pulled out by hand. This is about the only practicable way of securing them without injury.

**Salsify.**—This plant is also known as “vegetable oyster” and “oyster plant.” Its cultural requirements are very much the same as those of the parsnip. It requires the whole season in which to develop, and can endure much dry weather after gaining a foothold. The seeds are large and of very awkward shape for sowing with a seed drill. The plants are even more difficult than parsnips to thin, on account of the presence of numerous side roots. Therefore, since the seed usually germinates well, it is often advisable to sow it by hand, taking sufficient time and care to place the seeds individually where the plants are wanted, and thus dispense with the necessity of thinning.

The care of the growing crop is the same as that of any other root crop grown in drills. There are no serious enemies, and no particular skill is required in growing the crop. All that is necessary is to plant on deep, rich soil in early spring and give good tillage throughout the season. The crop is harvested the same as parsnips (Fig. 91).

*Scolymus* and *Scorzonera*, known respectively as Spanish salsify and black salsify, are sometimes grown as substitutes for common salsify. They thrive under the same conditions and demand the same kind of culture as salsify. As yet they are little known in America. The Spanish salsify is less promising than the black, on account of the thistle-like character of the foliage (Fig. 92).

**Horse-radish** is extensively used as a condiment to serve with cold meats. It is in great demand at the present time and the price is high. Comparatively few gardeners seem inclined to grow the crop. Perhaps this is because of the difficulty of eradicating it from a piece of land on which it has once been grown.

Although horse-radish makes its most rapid growth in the cool weather of autumn, it is usually planted early in the spring, and is able to withstand almost any extreme of heat. The roots are uninjured by freezing and may be dug late in the fall or left in the ground until spring.

**Propagation.**—Horse-radish seldom produces seed; hence root cuttings or “sets” are used for planting. These are made from the small side roots removed from the main roots in trimming for market. As ordinarily used they are five to six inches long and from one-fourth to one-half inch in diameter. The top is

usually cut off square and the lower end slanting, so that no mistake will be made in planting, since a cutting planted wrong end up will produce a crooked or branching root. If the crop is trimmed for market in the fall, the cuttings may be tied into bunches and stored over winter for planting the following spring.



FIG. 91.—Bunch of salsify roots ready for market.



FIG. 92.—Scolymus or Spanish salsify. Note the thistle-like foliage.

*The soil on which horse-radish is grown should be very deep, rich and moist, and should contain a good supply of humus. If grown in such a soil and given proper cultivation the roots will*

be large, shapely and of good market quality. If the soil is too dry or too wet the roots are likely to be small and badly branched. A shallow soil underlaid by a hard sub-soil will likewise produce branching roots of little commercial value. Shallow plowing or hasty and incomplete preparation of a naturally good soil may cause the production of similar roots. The ground should therefore be deeply plowed and thoroughly pulverized by means of a disk, harrow, and plunger before the sets are planted.

*Planting.*—Furrows are laid out three feet apart and deep enough to accommodate the sets, which may be planted either vertical or slanting and with the top either level with the surface of the soil or three inches below it. Deep planting is more often practiced when the horse-radish is to be started between the rows of early cabbage or peas. In this case the horse-radish sets are planted twelve to eighteen inches apart in rows midway between the rows of the early maturing crop, either at the time that crop is planted or from two to four weeks later. If planted after the other crop is already in the ground it is customary to place the sets in holes made with a crow-bar or dibber rather than to plow out a furrow for them. When grown in this manner the horse-radish receives no attention until the other crop is harvested; the early crop is cultivated the same as if the horse-radish were not there. Being planted deeply, the horse-radish does not start into growth for some time, and it is not materially injured if the tops are cut off by the cultivator two or three times early in the season. After the early crop is off, the horse-radish is cultivated repeatedly until the leaves shade the ground.

When grown by itself, horse-radish can be cultivated the same as any other crop requiring good tillage. It should be cultivated at least five or six times. If the sets are planted rather deep, it will be a decided advantage to harrow the field once or twice before the plants appear, and it may also be found economical to use the harrow in cultivating the first time after the plants are up.

*Harvesting.*—Since horse-radish makes its principal growth late in the season, it should be left in the ground as late as possible; but for the sake of convenience and economy in harvesting, the crop should be plowed out before the cold and wet weather of winter sets in. The roots should be trimmed before being sold or stored, and the side roots should be saved for sets for the next season's planting. If desired, a part of the crop may be left in

the ground till spring, but it is likely to be difficult to dig it out of the mud at that season of the year.

## QUESTIONS

1. What two root crops will endure summer heat but not withstand the freezing of winter?
2. Should beets and carrots be included in the earliest planting of spring?
3. What special precautions should be taken in order to insure a good stand of carrots?
4. How far apart should beets and carrots stand in the row after thinning?
5. What root crops will endure both summer heat and winter freezing?
6. How long a time is required for parsnips to become fully grown?
7. When is parsnip seed sown and when is the crop harvested?
8. What kind of soil favors the development of marketable parsnips?
9. How early should parsnips be thinned?
10. Describe the proper method of digging parsnips.
11. By what other names is salsify known?
12. How may the difficult task of thinning salsify be avoided?
13. Describe the general care of the salsify crop.
14. What forms of salsify, besides the common sort, are sometimes grown?
15. What reason may be assigned for the limited extent to which horse-radish is grown at the present time?
16. How is horse-radish propagated?
17. What kind of soil is best adapted to the growing of horse-radish, and why?
18. Describe the planting of horse-radish.
19. How much tillage does horse-radish need?
20. How and when is horse-radish harvested?
21. What root crops mentioned in this chapter are grown commercially in your vicinity?

## CHAPTER XIX

### GREENS AND SALAD PLANTS THAT ENDURE HEAT

#### GREENS THAT ENDURE HEAT

ALTHOUGH greens are in greatest demand in the spring, so that the necessity of heat-enduring sorts is not as imperative as might otherwise be the case, nevertheless it is fortunate for those who desire greens during the summer that there are certain sorts which withstand the heat in central and even southern regions, and are available for use at any time from early summer till late autumn, since they continue to produce new and tender foliage through the entire season. Chard, kale, collards and New Zealand spinach are the principal crops that furnish summer greens.

**Chard or Swiss Chard.**—This is a form of beet in which the foliage develops much more prominently than the root (Fig. 93). The leaves are large, light green in color, and considerably wrinkled. The midribs and leaf stalks are exceedingly broad and nearly white. Chard is also known as “silver beet,” from the color of the leaf stalk, and “spinach beet” from the fact that it is used as greens in place of spinach. The root is white in color, and much branched and is not used as food. While the leaves of chard are used chiefly as greens, the leaf stalks also may be creamed and served like asparagus.

The seed of chard is usually sown in early spring at about the time for planting other beets. On account of the large tops which the plants form, the rows should be at least eighteen inches apart. The seedlings are thinned to six or eight inches apart, as soon as large enough for greens. The greens secured by this means are purely an incidental crop; the main crop is produced by the plants that remain. As soon as the oldest leaves have attained full size they are pulled off and used as greens, or the entire top may be cut off. In either case, care must be taken not to injure the crown. The plants continue to produce new foliage, so that material for greens may be gathered repeatedly. A good plan is to have a sufficient number of plants so that leaves are harvested from only a small part of them at a time, and a continuous supply thus maintained.

If an extra early crop of chard is desired, the plants may be started under glass and transplanted the same as is sometimes done with ordinary beets.

Swiss chard is seldom seen on the market, but is very popular with home gardeners who have given it a fair trial. It is worthy of much more extensive culture, for it is a sure crop producer even under unfavorable weather conditions, and remains edible through an indefinite period. This makes it an exceedingly handy crop to have in any garden.



FIG. 93.—Swiss chard.

**Kale or Borecole.**—Kale belongs to the cabbage group, but produces no head. The leaves are from one to two feet long and rather narrow in proportion to their length. They are kinked and curled somewhat like savoy cabbage, and considerably frilled at the edges (Fig. 94). The plant will stand extreme heat and drought and may be grown from seed sown almost any time from early spring till late summer or early autumn. It continues growth late in fall and is killed only by severe and repeated freezing. In fact, it survives mild winters even in central localities, and is regularly grown as a fall-sown crop for early spring market in the

latitude of Norfolk, Virginia. Sometimes the hardiest sorts are used for greens in midwinter. Thus it is a plant that can be made to furnish greens through a large part of the year. If only a few leaves are picked at a time, the same plant continues to produce new foliage indefinitely. The leaves are more tender if picked before they have attained full size, since the midribs of the mature leaves are likely to be stringy. In the fall-sown crop grown for early spring market, the entire plant is usually taken at one



FIG. 94.—Kale.

picking. The quality is thought by some to be improved by freezing; therefore kale is more popular in late fall and early spring than in summer, but if the more tender leaves are selected, it is an excellent vegetable at that season also. Its great merit is its ability to produce a crop regardless of unfavorable weather conditions.

The seeds should be sown in rows from two to three feet apart where the plants are to remain. After thinning, the plants should stand a foot apart in the row. Ordinary care in the way of tillage

is all that is required. The plant does not seem to be subject to attacks from cabbage worms.

**Collards.**—Young collards look so much like cabbage plants that the two cannot be readily distinguished. However, collards continue to grow all summer without producing heads. The stem elongates so that the plants may become three feet in height before the season is over. New leaves are continually formed. Collards are not sensitive to the heat of summer, and are often grown in the South to be used as a substitute for cabbage where the weather is too hot for the latter. They are little grown at the North. The young leaves from near the top of the plant form the edible part, or early in the season the entire plant may be used (Fig. 95).

The seeds may be sown in early spring where the plants are to stand and the seedlings thinned to about a foot apart in the row. Tillage should be given as required.

**New Zealand Spinach.**—This plant is entirely distinct from ordinary spinach. Instead of producing a dense rosette of leaves early in the season, and quickly running to seed and passing out of the edible stage, as is the case with common spinach, the New

Zealand spinach forms a large branching plant that continues growing through the summer and may eventually attain a spread of three to four feet. The main branches spread over the ground, but short upright and oblique laterals arise in large numbers from these, and new growths are continually being formed. The tender tips of the growing laterals, covered with succulent leaves, constitute the edible portions, and make an excellent substitute for spinach in hot weather (Fig. 96).



Fig. 95.—Collard plant at stage of development when the entire plant (except the root) might be used.

New Zealand spinach may be planted at almost any time in early spring, and will continue growth until the severe frosts of autumn. It will endure a large amount of summer heat. The seed should be sown in rows three to four feet apart, and the plants thinned to a foot apart in the row. No special care, other than good tillage, is required. Gathering of the crop should not begin until the plants have attained considerable size, but, from early summer until late fall, repeated pickings can be made from the same plants.



FIG. 96.—The edible tips of New Zealand spinach.

**Dandelion.**—Dandelions growing wild are often dug for greens in early spring. These wild plants are usually small and with but few leaves, and the time required to prepare them for cooking is enormous. If given room in which to grow on rich soil, and cultivated like other crops, the dandelion develops an immense mass of large, succulent leaves, and a much smaller number of plants is required to make a "mess of greens." Dandelions are

cultivated in some private gardens and by some commercial growers, particularly in the East. The seed is sown in early spring in rows one to two feet apart, and the plants are thinned to six inches to a foot apart in the row. Sometimes the tops are mowed off with a scythe in June and sent to market if other greens are scarce. This is thought to improve rather than to injure the plants, as well as increasing the cash receipts. The dandelions are then usually allowed to grow all summer without any further harvesting of the crop that season. They will endure a large amount of heat and drought, and develop large roots with strong crowns before winter sets in. Sometimes a crop of greens is cut late in the fall, but this is rather unusual. The ordinary method is to allow the plants to remain in the ground over winter. Very



FIG. 97.—Parsley plants in six-inch pots: One method of producing the home supply for winter use.

early in the spring the strong roots, with their abundant store of food material secured the season before, send up a great mass of foliage which is available for greens long before any spring-planted garden crop is large enough for use. The extreme hardiness of the dandelion, enabling the roots to pass severe winters without injury, makes it a desirable plant for early spring greens in northern localities, where fall-planted spinach and kale will not survive. As soon as the crop is harvested, the land should be plowed to kill out the roots and prevent any stray plants from going to seed.

#### SALAD PLANTS THAT ENDURE HEAT

**Parsley** is used primarily for garnishing, and surpasses all other plants for that purpose. It is also used for flavoring salads and sometimes for flavoring soups. It will endure extreme heat

and drought in summer, and continues growing in the fall until the ground freezes. The same plants that have been furnishing foliage all summer may be dug up late in the fall and placed in coldframes or in boxes or pots of earth in the kitchen or cellar window and will continue to supply garnishing material all winter (Fig. 97).

The seed is small and germinates slowly. Hence the seedbed must be thoroughly prepared and contain plenty of moisture. Sometimes to insure a stand the plants are started under glass where the seeds can be sown very shallow and water applied



FIG. 98.—Well-grown parsley under field conditions.

whenever necessary. If the seed is sown in the open, radishes should be sown to mark the rows. Since the plants are hardy, outdoor sowing may take place at the time of the earliest garden planting in the spring. If the plants are started under glass they should be ready for transplanting at the same time as early cabbage. The rows should be twelve to eighteen inches apart and the plants, after thinning or transplanting, should stand from four to eight inches apart in the row (Fig. 98). Tillage and weeding should be given as necessary.

Under favorable conditions parsley will produce foliage suffi-

ently large for use about three months after planting. Only a few leaves are picked from each plant at a time, and the same plants furnish a continuous supply of foliage throughout the season.

**Upland cress** somewhat resembles water cress in both appearance and flavor, and may be used on the home table as a substitute for the latter. It is seldom grown commercially. If planted early in spring it continues to thrive through the hot weather of summer and is uninjured by the frosts of autumn. It does not run to seed the first year, and, in central and northern localities at least, kills out during the winter. The plant forms a dense tuft of leaves five or six inches high and ten to twelve inches across.



FIG. 99.—Endive ready for market. After blanching is completed, in preparing endive for market, each plant is opened up to show the white interior.

The crop is ready for use in eight to ten weeks after the sowing of the seed; and if care is taken in gathering the leaves, the same plants will continue producing new foliage until the end of the season, so that a constant supply will be available.

The seed should be sown in drills twelve to eighteen inches apart early in the spring if the crop is desired for summer use. Sometimes later sowings are made for a fall crop and occasionally in mild climates a fall-sown crop is grown for early spring use.

**Endive** is grown principally for use as a salad in the fall. The plant makes its most rapid growth and develops its best quality

in cool weather; but in order that it may have time to complete its growth before winter sets in, it must be started in early or midsummer. Fortunately it is able to endure the heat of that season. The seed may be sown in June or July where the plants are to stand, or may be sown in a seed-bed and the plants later transplanted. In either case the plants should eventually stand a foot apart in rows twelve to eighteen inches apart. Good tillage should be given and water supplied if the weather is dry, especially following transplanting.

Endive makes a dense, wide-spreading mass of cut and curled leaves (Fig. 99), the flavor of which is likely to be bitter and the texture tough unless they are blanched. Blanching is accomplished by drawing the leaves of a plant together and tying them at the top with raffia or soft twine. From two to three weeks are required for the blanching, and the plants should be used as soon as the blanching is completed, for the inner leaves soon begin to rot. For this reason, only a few plants should be tied up at a time; otherwise, the crop would be of short duration. Care should be taken to be sure that the plants are dry at the time they are tied, or they may rot before blanching is completed.

### QUESTIONS

1. At what season of the year is there the greatest demand for greens?
2. What plants grown for greens will stand the heat of summer?
3. By what other names is chard sometimes known?
4. Describe the culture and harvesting of chard.
5. Through how long a season will chard continue to produce, if properly handled?
6. How may an extra early crop of chard be secured?
7. What is the present status of chard from a market standpoint?
8. Describe the kale plant.
9. Discuss the ability of kale to withstand extremes of temperature.
10. Describe the collard plant.
11. In what part of the country are collards most popular? Why are they grown in that region?
12. At what stages of development may collards be used?
13. Describe the character of growth of New Zealand spinach as compared with ordinary spinach.
14. What are the edible parts of New Zealand spinach?
15. Through how long a season will New Zealand spinach continue to furnish an edible product?
16. How does a cultivated dandelion plant compare with one growing wild?
17. Describe the culture of dandelions.

18. How long after planting is the crop of dandelions usually harvested?
19. What particular advantage has the dandelion over other greens?
20. What is the best plant for garnishing purposes?
21. How long may the same parsley plant be made to furnish foliage for garnishing?
22. Describe the culture of parsley.
23. What well-known market form of cress does upland cress resemble?
24. What advantage has upland cress over both water and common garden cress?
25. Describe the culture of upland cress.
26. Describe the culture of endive.
27. How is endive blanched?
28. What greens and salad plants are grown in your neighborhood?
29. Give some idea of the extent to which each is grown.

## CHAPTER XX

### THE ONION GROUP

#### ONIONS \*

THE onion is one of the most important vegetable crops grown in the United States. It is used in both the immature and mature stages, and can be found in all large markets in one or both forms throughout the entire year. Its adaptability to storage in the mature state enhances its value as a staple product. Its relatively imperishable nature also adapts it to long distance shipment, rough handling, and keeping for a considerable time even under unfavorable conditions (Fig. 100). It is thus an important article of food in mining, construction and lumber camps, and other places remote from sources of food supply. It is also used extensively on the tables of all classes of people, and its use is rapidly increasing. The former aversion to onions on account of their offensive odor is being overcome as the knowledge of their healthfulness and palatability increases. Whether raw or cooked, alone or in combination, onions are appetizing and healthful. They form the basis of many important dishes, and give flavor and character to a number of others into which they enter only in small quantities.

**Temperature and Moisture Requirements.**—Onions grow best in relatively cool weather and require an abundance of moisture during their early stages of growth. After they have made a good start, they will stand considerable heat and ripen better if the weather is relatively dry at the time they mature. This makes them an important crop in central and northern latitudes, where the weather of spring is cool and moist, and a dry period normally occurs in August or early September. However, the season must be sufficiently long for the onions to mature before the autumn rains set in, or they are likely never to ripen properly. Unless properly ripened, onions will not keep. For northern localities it is sometimes necessary to use only the earlier maturing varieties.

The above statements refer to the growing of ripe onions. Green onions reach edible size in a comparatively short time and can be grown during the normally cool and moist weather of early

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\* See also Circular 173 of the Illinois Agricultural Experiment Station.

spring in central and northern latitudes, or of fall and winter in southern localities. As a commercial crop they are of minor importance as compared with ripe onions.

Ripe onions may be produced in three different ways: (1) by sowing the seed in the open field where the crop is to mature; (2) by transplanting seedlings that have been started under glass or in a seed-bed, and (3) by planting sets. The bulk of the onion crop of the United States is produced from seed sown directly in the field.



FIG. 100.—A well-cured sample of dry or ripe onions. The picture was taken in the spring after the onions had been kept all winter.

#### GROWING RIPE ONIONS FROM SEED

**Land** for the production of ripe onions should be exceedingly rich. It is preferable to use land that has been heavily manured for other crops two or three years preceding its use for onions, rather than to start with a piece of ordinary land and attempt to make it rich enough for onions in one season. Ordinary land is also likely to contain too many weed seeds to make onion growing profitable until after two or three years of preparatory cropping

with other plants demanding very thorough tillage. During the preparatory cropping very heavy applications of manure should be made every year, and the land kept free from weeds. In the fall preceding the spring in which the onions are to be planted, from forty to sixty tons of manure should be applied to each acre of ground, and the land deeply plowed. If onions are grown on the same land in succeeding years, as is often the case, similar quantities of manure should be applied for each onion crop. The land will thus be continually getting in better condition for the production of onions with each succeeding crop, unless it becomes infested with insects or infected by diseases. Onions are one of the few crops that give better results if grown successively upon the same land than if new ground is used each year. This is because it takes a few years to get a piece of land in ideal condition for the production of onions, and land once in that condition can be

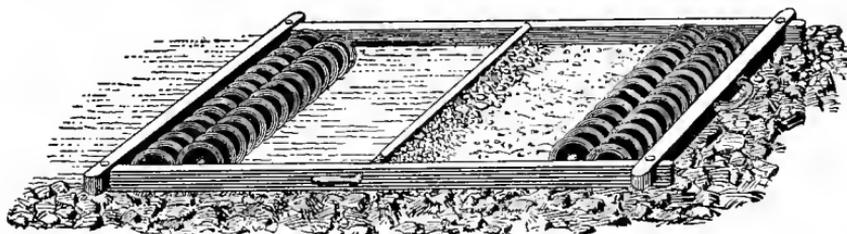


FIG. 101.—Meeker harrow.

kept so, much more readily than a new piece of land can be brought up to the same condition. The "condition" referred to in this connection involves three things: (1) Richness in available plant food, (2) friability due to the presence of large quantities of humus and extremely thorough tillage, and (3) relative freedom from weed seeds. These three factors of soil condition are essential to profitable onion culture.

**Sowing the Seed.**—In order that onions may get a good start before hot weather, it is essential that the seed be planted early. This is one reason that the land should be plowed in the fall. At the very earliest date that the fall-plowed land can be worked in the spring, preparations for planting the onions should begin. Soil that is sufficiently friable for the production of onions usually will not need replowing in the spring, so that the first operation in the spring preparatory to planting will be a thorough disking.

The disk should be followed by a spike-tooth harrow. Many successful onion growers complete the preparation of the seed-bed by the use of a Meeker harrow (Fig. 101), while others use a planker (Fig. 41). These various tools should be used repeatedly, if necessary, so that an exceedingly fine seed-bed may be prepared. Land for only one day's planting should be prepared at a time, and the seed drill should follow immediately after the last preparation tool. This prevents the top soil from drying out before the seed is planted, and insures the presence of moist soil in direct contact with the seeds.



FIG. 102.—Tools used in onion culture: Seed drill at right; double and single wheel hoes with various attachments.

Seed is usually sown by means of a garden seed drill (Fig. 102) in rows twelve inches apart, and this is the standard distance whether a few rows or several acres are grown. If the plants are to be thinned, from four to five pounds of seed are sown to the acre. If thinning is not to be practiced, a smaller quantity of carefully tested seed is preferable. Some of the most successful growers sow from three and one-eighth to three and one-fourth pounds per acre, and do not thin. This method results in smaller and less uniform bulbs, but is a great saving in labor.

**Tillage.**—As soon as the plants are up, tillage with wheel hoes (Fig. 102) should begin, and should be repeated at frequent intervals until the plants are so large that it can no longer be done. Care should be taken to cultivate the onions as soon as the ground

is sufficiently dry after each rain and at other times if necessary. On the average they should be cultivated at least once in ten days for a period of about three months. Early in the season the double-wheel hoe is usually employed. This cultivates both sides of one row at a time. The blades should be set to cut as close as possible to the row, and thus kill all incipient weeds except those directly between the plants in the row. Later, a single-wheel hoe, that goes between the rows, may be more advantageously employed. One with a large wheel (Fig. 103) is preferable to the small-wheeled type for late tillage, since there is less danger of injuring the plants with the axle and framework. Under average conditions a man should be able to cultivate an acre of onions a day.



FIG. 103.—Single-wheel hoe, with twenty-eight-inch wheel, for late tillage between the rows.

**Weeding.**—Although every precaution may have been taken to keep weed seeds out of the onion land, and to kill young weeds by tillage before they are fairly started, some hand weeding will be necessary to eliminate the weeds that are directly in the rows. These should be pulled before they become large, so that they will not rob the onions of moisture, plant food and sunlight. Also, if the weeds are numerous and are allowed to

become large, their ultimate removal is likely to seriously disturb the roots of the onions, and cause them to ripen prematurely without developing to normal size. On the whole, the weeding of onions is exceedingly important and must be attended to promptly, or disastrous results are likely to follow. Usually the onions will need weeding about three times, but if more frequent weeding is needed to keep the plantation clean, it should by all means be given.

**Thinning.**—If the onions are to be thinned, this may be done at the time of the first or second weeding. It should preferably be done before the onions are as large as lead pencils; for if the plants are very thick, they soon begin to interfere with one another, and the surplus plants have the same effect as weeds upon those that are to remain. The thinning should be done when the soil



FIG. 104.—Results of thinning onions. The onions in the box at the left were thinned so that the plants stood three inches apart in the row; those in the box at the right were not thinned.



FIG. 105.—Good and poor onions shortly before the harvest. The tops of the good onions have fallen over due to the shriveling of the necks; the poor onions, with thick necks, still stand erect.

is moist, and care taken to disturb as little as possible the roots of the plants that are to make the crop. Care should be taken to leave the most vigorous plants. If large, uniform bulbs are wanted, the plants should stand at least three inches apart in the row after thinning (Fig. 104).



FIG. 106.—Properly and improperly ripened onions. The onion at the left has ripened from the top downward, and is unsuitable for storage; the bulb at the right has ripened properly.

**Harvesting.**—When onions ripen properly, the necks shrivel first and the tops fall over while they are yet green (Fig. 105). Gradual drying of the leaves from the tips downward, while the necks remain rigid and erect, indicates abnormal ripening and usually poor keeping quality. Therefore such onions should be used soon after the harvest and no attempt made to store them

for winter (Fig. 106). Following the shriveling of the necks in normal ripening, the leaves gradually turn yellow, and finally the tops become dry and brown if the onions are not pulled before they reach that stage. However, it is usually best to begin the harvest as soon as the tops have fallen over and begun to turn yellow. This insures getting the onions harvested while they are in good condition, and avoids the risk of their starting a second growth in case of heavy rains following their ripening. If onions start into a second growth after once ripening, their keeping quality is forever ruined, and they are fit only for immediate use.

If the soil is dry and hard when the onions are harvested, it is sometimes an advantage to loosen the bulbs by running along the row with an "onion harvester" attachment on a wheel hoe (Fig. 107). This is a U-shaped piece of steel that passes under the bulbs and loosens the soil about them so that they can be much more easily pulled. If the soil is loose at harvest time, the use of this machine is unnecessary. The bulbs are simply grasped by the tops and pulled out, or any deep-seated or tenacious specimens may be caught by the edge of the bulb itself and pulled sideways.



FIG. 107.—Onion harvesting attachment for wheel hoe.

**Curing.**—The old method of handling the onions at harvest time was to place them in windrows in the field as they were pulled (four rows of onions usually making one windrow) and allow them to cure in the sun for one or two weeks. In case of rain while curing, the onions were occasionally turned with a wooden rake to insure their drying out on all sides and to prevent their taking root in the moist soil. This method of handling results in more or less discoloration of the bulbs in case of rain, and even considerable loss due to rotting and sprouting if the rains are abundant (Fig. 108). In the absence of rain, there is sometimes serious loss due to sun-scald of the curing bulbs in excessively hot weather. White onions are especially difficult to cure in the field, and for this reason their curing under cover has been often advocated and sometimes employed, even when other sorts were cured in the field.

**Topping.**—In the old method topping was usually deferred until after the curing was completed. When onions were taken up from the windrows, or sometimes later, the tops were pulled off by hand or cut off with shears or a knife. The top was sup-

posed to be severed at a point about three-fourths of an inch from the bulb to avoid injury to the latter. Machines have also been invented for removing the tops.

**The modern method of harvesting onions** now employed by practically all commercial growers in the vicinity of Chicago, where onion growing is an important industry, dispenses with field curing for all varieties, and completes the pulling and topping at one operation. The onions remain bright in color, there is no loss due to injury by excessive heat or moisture, and no ex-



FIG. 108.—Onion starting into growth soon after the harvest, because of unfavorable curing conditions in the field.

pense for repeated handling. The onions are pulled at the stage already indicated—before the tops are dry. When a handful of onions is pulled, the tops are grasped in the other hand and twisted off. The onions are dropped into a crate or into a basket to be emptied into a crate. The crates in common use about Chicago are really trays. They are four feet long, three feet wide and four inches deep. The bottoms are made of lath with half-inch cracks between for ventilation; the ends are of five-inch boards, and the

sides of four-inch strips. The crates are filled barely level with the tops of the sides, so that when they are stacked one above another there is at least an inch of air space between the onions in one crate and the bottom of the crate above. This provides for a free circulation of air and aids greatly in the curing of the onions. Within a few hours after the crates are filled in the field they are hauled to the curing shed. This is simply an open shed with the gables boarded down only as far as the eaves, if at all (Fig. 109). Here the crates of onions are stacked in tiers nearly to the top of the shed. A space thirteen inches wide is left between every two tiers. This provides for ventilation between the tiers, and also allows space for temporary staging of twelve-



FIG. 109.—Onion curing shed at left, filled with empty crates; onion storage house at right.

inch boards, which enables the workmen to stack the crates to any desired height. The onions may remain in the curing shed until there is danger of freezing. Then they must be either marketed or placed in winter storage.

In the absence of a curing shed and onion crates, a considerable quantity of onions could be cured in a corn crib, if one were available. The onions should be spread over the floor of the crib in a layer not over three or four inches deep. If there are more onions than enough to cover the floor, false floors about one foot apart could be put in, and thus the capacity of the crib greatly increased. On a small scale onions may be spread out in a thin layer in almost any dry place where the air will circulate freely through them. Unless thoroughly cured, onions will not keep.

## TYPES OF ONIONS

There are two general types of onions grown in America for use in the ripe state. They are usually spoken of as the "American" and the "foreign" or "European" types. As a class the American onions produce bulbs of smaller size, denser texture, sharper flavor and better keeping quality. They also ripen earlier and are much surer to mature properly in the North. Three distinct colors of American onions are recognized in the markets: Red, yellow and white. Each of the large markets has its preferences, but, in general, white onions are in greatest demand in the East, yellow in the central West, and red in some parts of the North. There are other intermediate colors, but these three are the standards in the market. Onions vary in shape from flat to globular. The globe-shaped sorts are usually preferred on the market, and also are likely to produce greater yields, for their greater depth enables them to attain larger size without crowding.

There are several types of the foreign onions. The type most likely to succeed in open ground culture in the North is best represented by the Prizetaker variety. American grown seed of this foreign sort produces bulbs that mature almost, if not quite, as early as the leading American sorts. It is larger in size and milder in flavor than most American onions, and keeps better than most foreign sorts. The Gigantic Gibraltar is also a foreign variety that promises to be of value in the North. Both these varieties are grown to some extent as winter crops in the South, by using the transplanting method.

**Bermuda onions** constitute another foreign type. They are the mildest flavored, most tender fleshed, and poorest keeping onions in the entire list. In this country they are grown almost exclusively in restricted areas in the South, principally in Texas, where the soil and climate seem especially adapted to their culture. They are grown under irrigation, as a winter crop to be harvested early in spring, and are always transplanted. Seed is imported directly from Teneriffe, the largest of the Canary Islands, located in the Atlantic Ocean off the west coast of Africa.

## THE TRANSPLANTING METHOD

The transplanting method of growing onions, also called the "new onion culture," involves sowing the seed in an especially prepared seed-bed (which in the South may be in the open, but

in the North is either in a hotbed or greenhouse) and transplanting the seedlings to the field where they are to complete their growth, when they are from three-sixteenths to three-eighths of an inch in diameter. This method is considered especially adapted to growing the large and foreign types of onions, and as already noted is used in the production of "Texas Bermudas." It is also sometimes used on a limited scale by market gardeners in the North for the production of the Prizetaker and other large onions.

The chief advantages claimed for this method of growing onions are earlier maturity and larger size of bulbs, greater uniformity in stand and in size of specimens, larger yields, higher prices, and saving in the cost of weeding.

The chief disadvantages are that the expected advantages do not always materialize, that it takes considerable time, trouble and equipment to grow the plants, and that the transplanting is an enormous task. If the plants are placed three inches apart in the row it takes nearly 175,000 to set an acre. Although the individual plants can be set quite rapidly, and there is no particular difficulty in making them live, the setting of even one acre involves a very large amount of tedious labor. No one should ever undertake to grow a large area of transplanted onions until after giving the method a thorough trial on a conservative scale.

**Growing the Plants.**—One difficulty likely to be encountered in trying to grow onions by the transplanting method is that the plants often fail to reach transplanting size at the time they should be transplanted. To get the full benefit of this method in earliness, it is necessary to set out the plants very soon after it would be possible to plant seeds in the open. Although it is sometimes claimed that plants can be grown to transplanting size in six weeks, it is more likely to take double that time during the short, dark days of February and March. In localities where outdoor gardening usually begins about April 1, onions should be transplanted not later than April 15, and the seeds for growing these plants should be sown in a greenhouse or fire hotbed not later than January 15. Otherwise the size of the plants is likely to be disappointing. The seed should be sown in rows three to four inches apart in the hotbed or on the greenhouse bench. The soil of the seed-bed should be thoroughly mixed and well prepared. The watering should be very carefully done in the dark winter weather. A fairly low temperature should be maintained, and

plenty of ventilation given; otherwise the seedlings are likely to damp-off.

**Transplanting.**—When the time for transplanting arrives, the field should be prepared the same as for sowing onion seed. Rows should then be marked out one foot apart and the seedlings set in the freshly worked soil. Usually both the roots and the tops of the plants are trimmed to a considerable extent. A whole bunch of plants is trimmed at two strokes of the knife, so that very little time is required for this operation. The reason for trimming the roots is to facilitate planting and to avoid having any long roots curl upward. The tops are trimmed to reduce transpiration (in the chapter on transplanting) and make the growth of the plant more certain. The transplanting is usually done with dibbers, though in loose soil the workmen's fingers are sometimes substituted for the dibbers.

After transplanting, the crop is immediately tilled, and thereafter the treatment is essentially the same as for a crop grown from seed sown directly in the field, except that no thinning is ever required and the necessity of early weeding is eliminated. The success of this method depends primarily upon good plants and extra early planting. In the hands of beginners this method of onion culture is likely to be a failure.

#### GROWING RIPE ONIONS FROM SETS

The surest way for a beginner to grow a good crop of ripe onions is to plant sets. These are miniature onions grown from seed the preceding year (Fig. 110). Their method of production will be described later. They can be procured from almost any seedsman, and are technically known as "bottom sets." These are offered in the three colors, red, yellow and white, but no variety names are usually mentioned. If a person wishes to grow onions of a given variety from sets, he can purchase seed and grow the sets one year, and then store them over winter for the next spring's planting.

**The Three Methods Compared.**—The essential factors in growing a large crop of ripe onions from sets are practically the same as for growing a large crop of onions by either of the other methods, *viz.*, very rich soil, extremely early planting, thorough tillage, plenty of moisture. The distinct advantages of using sets as compared with the transplanting method are that the sets can safely be planted considerably earlier, that it is never necessary

to delay planting while waiting for the plants to attain the proper size, that the planting can be done much more rapidly, that the expense and trouble of growing the seedlings are obviated, and that the bulbs are surer to attain large size. As compared with growing onions from seed sown directly in the field, the set method is more expensive on account of the high cost of sets and the labor of planting, but is much surer to produce a profitable crop, especially under unfavorable weather conditions. The sets may sometimes be planted even earlier than it is safe to plant onion seeds. The stored-up food material in the sets gives the plants a strong start and they are able to make a much larger proportion

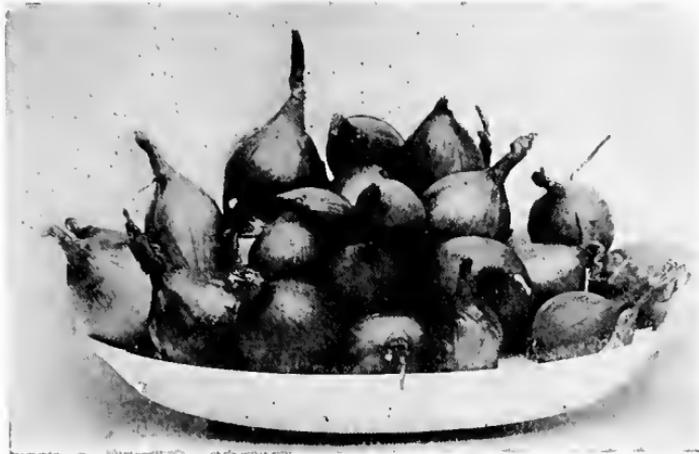


FIG. 110.—Onion sets.

of their growth than are plants started from seed, during the period in which the weather is certain to be cool and the soil moist. This makes the onions from sets a much surer crop than onions from seed. The bulbs are usually larger and the crop matures nearly a month earlier than when grown directly from seed (Fig. 111).

**The Size of Sets to Use.**—When large, ripe onions of the preceding year's growth are planted out in the spring they send up seed stalks and the bulbs become inedible. If large, overgrown sets are planted, many of them behave like large onions and send up seed stalks. The bulbs produced by these sets that run to seed are worthless as ripe onions. They are tough, exceedingly strong, and will not keep. Small sets, on the other hand, do not

form seed stalks, but produce normal, well-matured bulbs that cannot be distinguished from those grown directly from seed. Very small sets do not make as vigorous a start as larger ones. It is therefore advisable to plant as large sets as can be depended upon not to run to seed. Experience has shown that sets from one-half to three-fourths inch in diameter are a satisfactory size to use for the production of ripe onions. This size is secured by screening the sets first through a three-quarter-inch sieve, then passing them over a half-inch screen. Only a small percentage of sets of this size will send up seed stalks, and they are large enough to make a quick start and produce large bulbs before the weather is very hot.



FIG. 111.—Onions from sets, harvested and curing, at the left; onions from seed, still growing vigorously, at the right.

**Planting the Sets.**—For growing a crop of ripe onions from sets, the land should be prepared the same as for sowing onion seed, then marked out in rows twelve inches apart, and the sets planted by hand. The only precaution necessary in planting sets is to place them right side up and push them far enough into the ground so that the base from which the roots are to start will be in close contact with moist soil. For the production of large onions the sets are planted about three inches apart in the row. After the sets are placed, soil is drawn lightly against them with a rake.

**Care and Disposition of the Crop.**—The tillage and general care of a crop of onions grown from sets are essentially the same as for a crop grown from seed, except that comparatively little weeding is required. The crop may be harvested and cured in the same way, but usually should be sold soon after the harvest, before onions grown from seed are available, for prices are likely to be good at that time, and the onions grown from sets are not considered as good keepers for winter use as those grown directly from seed.

#### GROWING ONION SETS

When an onion seed is planted the normal thing for it to do is to produce a bulb. The size of the bulb produced will depend upon circumstances. If the plant has undisputed access to an abundance of food, moisture and sunlight, and the temperature is congenial, the bulb is likely to attain normal size for the variety, —perhaps two, three, or even four inches in diameter. If the soil is poor, or the season dry, or the plants crowded, the bulbs will be smaller; and the more pronounced any or all of these unfavorable conditions, the more strikingly small will be the bulbs. Onion sets are merely miniature onions that have remained small because of the conditions under which they were grown.

**Thickness of Seeding.**—In growing onion sets it was formerly the practice to sow the seed late in the season on poor soil. About thirty pounds of seed were used to the acre. The lack of plant food, lack of moisture, and hot weather during which the plants had to make their principal growth, combined with the fairly thick seeding, were depended upon to keep the bulbs small. The practice now among many commercial growers of onion sets is to sow the seed on rich soil at the usual time for sowing onion seed, and to depend primarily upon the thickness of seeding to keep the bulbs from growing too large. From eighty to one hundred pounds of seed are used per acre. This is at the rate of about two hundred seeds per foot of drill. Under these conditions it is impossible for the bulbs to become too large for sets except in seasons particularly favorable to their growth. Then the largest bulbs can be screened out and used for pickling, in the case of white and even yellow varieties.

In sowing seeds for onion sets, the rows are usually made twelve inches apart and the seed is sown with a regular drill the same as for large onions. Sometimes a special attachment is

used to spread the seed out in a wide row, so that the individual seedlings will have a little more space at the start.

Onion sets are cultivated with wheel hoes the same as large onions, and require as careful weeding. If sown at the same time as other onions, they ripen earlier, and can thus be harvested and out of the way before the large onions are ready to harvest.

**Harvesting and Curing.**—Under modern methods of handling onion sets, they are harvested as soon as the necks begin to lose their sap and while the tops are still green and erect. If the soil



FIG. 112.—Harvesting onion sets, near Chicago.

is compact, an onion harvester may be run under the rows or each workman may be furnished an iron hook with which to loosen the soil on each side of the row. The sets are pulled by the handful, the tops immediately twisted off, and the bulbs dropped into a half-bushel basket or measure (Fig. 112). When filled, the measures are emptied into crates similar to those used in curing large onions except that the slats forming the bottom are closer together. The crates of onion sets are left in the field exposed to the sun for a few hours; then hauled to a curing shed or more often stacked up in tiers in the field, each tier being covered with a

temporary roof of boards (Fig. 113). Here the sets are allowed to cure until time to put them into winter storage. If the soil contains considerable moisture at the time the sets are pulled, they are sometimes run over a screen before being placed in the crates, and the surplus dirt thus shaken off.

The growing of onion sets is an important industry, and is especially well developed in the vicinity of Chicago, Illinois, and Louisville, Kentucky. From these points onion sets are shipped



FIG. 113.—Onion sets curing in field. Note temporary roof over tier of crates.

by the carload to all parts of the country. Before being shipped out, the sets are cleaned by being run through a machine similar to a fanning mill.

#### GREEN BUNCH ONIONS

While ripe onions constitute the more important crop, green onions are included in the majority of home gardens and are also quite extensively produced by market gardeners. They are called "bunch onions" because they are tied in bunches when placed on the market. The simplest way to grow green onions, and the method employed by most home gardeners, is to plant ordinary

onion sets early in the spring, and pull the green onions when they have attained the desired size. The larger the sets, the quicker they will produce green onions of edible size; but unless green onions grown from large sets are pulled promptly they usually start to send up seed stalks, and soon become strong and tough. Large sets will produce green onions ready for eating in about four weeks from the time of planting; small sets require from six to eight weeks.

The earliest green onions in spring are obtained by the fall planting of multiplier, perennial or potato onions. In all cases, small bulbs are planted. These produce green onions early in the spring, and if allowed to continue growth, the multiplier and potato onions will develop large ripe bulbs. If these large bulbs are planted, they break up into clusters of small bulbs, which in turn may be planted for the production of green onions or large bulbs. In the case of the perennial or "tree" onions, as they are sometimes called, a cluster of little bulbs is produced at the top of the stalk, where seed is produced in an ordinary onion. The little bulbs are known as top sets. The bottom also divides as in the case of the multiplier and potato onions, but no large bulbs are ever produced. Both the top sets and the divided bottoms may be planted for the production of green onions. The divided bottoms produce larger and earlier green onions than the top sets.

In central latitudes, the perennial or tree onions should be planted about September 1. Furrows about four inches deep should be made in rich, thoroughly prepared soil, and the bulbs planted in the bottom of the furrows, which should then be filled with loose soil or very fine compost. If compost is not used at the time of planting it is a common practice to mulch the bed with this material late in fall. In either case only sufficient tillage is given to keep down weeds. The onions grow nearly to edible size in the fall, and the deep planting insures long white "stems." As soon as the frost leaves the ground in spring and the tops of the onions start to grow, those produced from the divided bottoms will be ready to use, and those from the top sets will follow shortly after. Any of the onions not used while green may be allowed to remain for the production of top sets and divided bottoms for planting the next fall. They usually mature by the first of August and should be cured before being planted.

These perennial or tree onions, also the multiplier and potato onions, may be planted later in the fall than September 1, if

desired, but in that case they produce a later crop, since their principal growth is made in the spring instead of the fall. The method of growing green onions from sets of multiplier and potato onions is essentially the same as from perennial or tree onions.

The variety of perennial onion most extensively grown is known as the Egyptian or perennial tree onion. It is also referred to by gardeners as the "winter onion," because it will survive the winter without protection.

**Green onions for late use** may be grown from seed sown the same as for the production of ripe onions; but usually the demand for green onions is not so great at that season of the year, and seed is seldom sown especially for the production of green onions. It is customary in the home garden, however, to pull green onions from the growing crop at any time they are desired for the table. Also market gardeners sometimes harvest part of their onion crop at this stage if the demand is good. If the plants stand rather thick, this pulling of some of the green onions amounts only to a thinning of the crop that remains.

#### OTHER ONION-LIKE PLANTS

**Leeks.**—Although essentially a cool season crop, the leek will stand extremes of heat as well as cold. The seed is usually sown in early spring where the plants are to remain and the crop is not harvested until shortly before the ground freezes in the fall. Sometimes the plants are transplanted about the first of July, being placed in trenches which are gradually filled as the season advances, so that the plants will be blanched to a considerable height. If not transplanted, the plants are banked with earth in order to effect the blanching.

Rich soil, an abundance of moisture and good tillage are required for the production of large leeks. A leek resembles a green onion in shape, but is much larger when properly grown. The larger and longer the blanched portion, the better the leek (Fig. 114). Leeks are used principally for flavoring soups and stews in place of onions. They are milder in flavor but coarser and tougher in texture. They are used principally during the late fall and winter months.

**Garlic.**—Anything which leeks may lack in intensity of flavor is fully made up in the garlic. This vegetable is used principally for flavoring stews and salads, and also in hotels for removing the tainted taste from "ripe" meats. The garlic is so strong that all

that is necessary to flavor a salad is to rub a little piece of a raw bulb over the inside of the dish in which the salad is to be made. In some parts of Europe and by certain foreign peoples in America, garlic is cooked and served as a side dish as other vegetables.

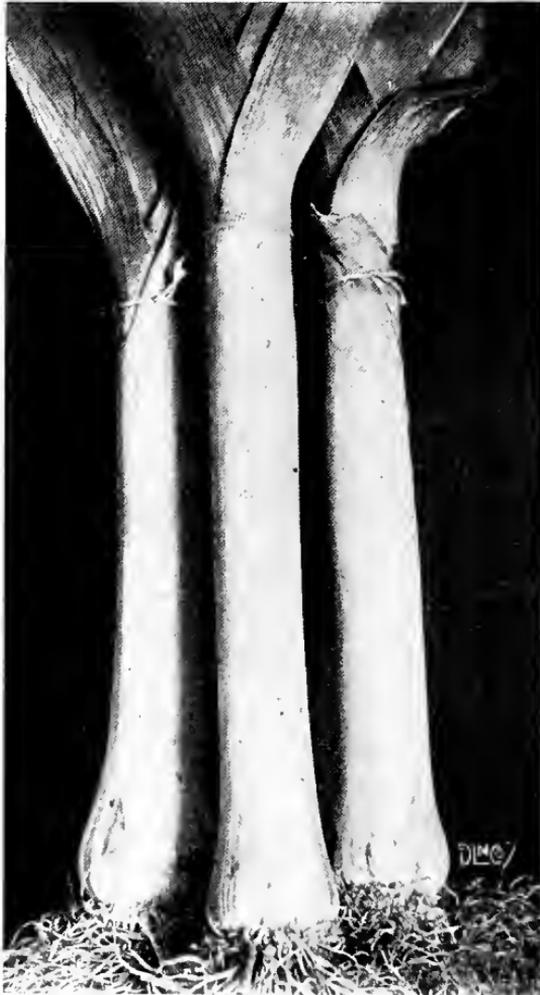


FIG. 114.—A good sample of leeks—long and well blanched.

A garlic bulb is made up of a number of small divisions, known as "cloves" (Fig. 115). Each clove is surrounded by a thin membrane like the outside skin of an onion, and the entire bulb

is also encased in a similar membrane. To plant a crop of garlic, all that is necessary is to pull the bulbs to pieces and plant the separate cloves like onion sets. Planting should be done in early spring. The care of the crop is similar to that of onions. The plants continue growth through hot, dry weather. The crop is usually harvested in early fall and cured for winter use by hanging up the bulbs in long "strings" held together by braiding the tops.

**Shallots.**—The shallot differs in structure from the garlic in that the separate cloves are not enclosed by a common sheath, so that the mature plant consists of a cluster of elongated bulbs

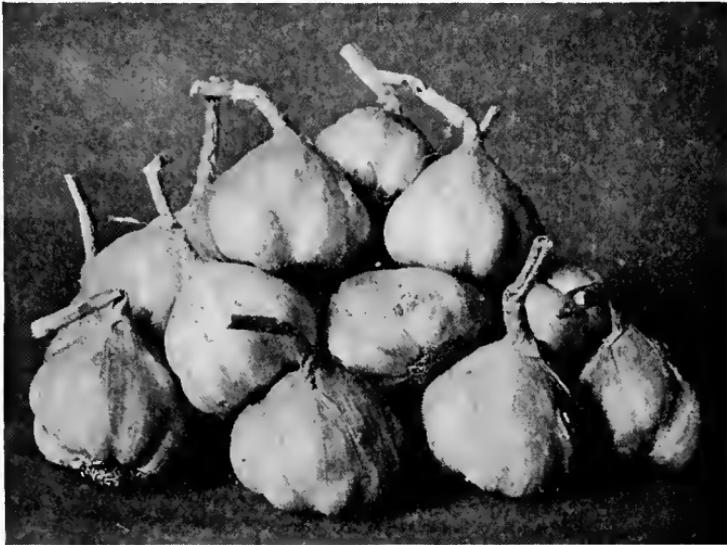


FIG. 115.—Garlic bulbs.

joined to a common base. The bulbs are separated for planting, and each one produces a cluster of bulbs like the original.

Shallots should be planted in early spring about four inches apart in the row, and cared for like onions. The crop will ripen about the same time as onions, and may be cured in the same way. The bulbs keep well and may be stored for winter use. They are used principally for flavoring, and are milder than most onions.

Sometimes shallots are planted late in the fall in the South and are pulled and marketed like green bunch onions during the winter. They are shipped to the North at a time when local bunch onions cannot be produced.

**Chives** are perennial onion-like plants that grow in dense tufts, their interlacing roots forming a sod. The leaves are about the size of straws and are the parts used for flavoring. They may be sheared from the plant at any time desired, and new foliage will quickly form. The plant is propagated by dividing the masses of roots. This is usually done in early spring. The clumps may be placed in checks about twelve inches apart each way, and cultivated both ways with a wheel hoe. If desired for use after the growing season is over, the clumps may be dug late in fall and placed in flats in a coldframe or greenhouse.

### QUESTIONS

1. What is the relative importance of onions as compared with other vegetable crops in the United States?
2. What climatic conditions are best suited to the growing of onions?
3. In what two distinct forms, or stages of development, may onions be marketed? Which is the more important crop?
4. In what three different ways may dry or ripe onions be produced? In which of these ways are most of the onions in the United States produced?
5. What preparatory cropping and treatment are advisable in fitting a piece of land for the growing of onions?
6. What soil conditions are essential to the profitable culture of onions?
7. Describe the preparation of the soil for sowing onion seeds.
8. When should onion seeds be sown? How many pounds of seed are required for sowing an acre?
9. Describe the tillage of onions.
10. Discuss the importance of hand weeding of onions.
11. What relation has the thinning of onions to the size of the bulbs?
12. Describe the normal process of ripening in onions.
13. At what stage of maturity should onions be harvested?
14. Describe the process of harvesting onions.
15. Describe the old methods of curing and topping onions.
16. Describe the modern method of harvesting onions as practiced by commercial growers near Chicago.
17. Describe the modern method of curing onions under cover.
18. What two general types of onions are grown in America for use in the ripe state?
19. Compare the two types as to size, texture, flavor and keeping qualities.
20. What three colors of onions are recognized on the markets?
21. What foreign onions succeed in open-air culture at the North?
22. What are the outstanding characteristics of the Bermuda onion?
23. In what part of America and under what conditions are Bermuda onions grown?
24. Where is seed of Bermuda onions procured?
25. What is meant by the "new onion culture"?

26. What advantages are claimed for the transplanting method of growing onions at the North? What disadvantages may become evident?
27. Describe the method of growing onion plants for transplanting.
28. Give details of the operation of transplanting onions.
29. On what does the success of the transplanting method of onion culture primarily depend?
30. Would you advise an inexperienced gardener to undertake the transplanting method of onion culture? Why?
31. What are onion sets?
32. What advantages are there in growing a crop of ripe onions from sets as compared with the transplanting method?
33. Compare the merits of growing ripe onions from sets and from seeds.
34. What size of sets should be used for growing ripe onions?
35. Give directions for the planting of onion sets.
36. What is usually the best time to sell onions grown from sets?
37. What three conditions may cause onion sets to be small?
38. Which two of these conditions were formerly depended upon to keep the bulbs from growing too large for sets?
39. What is the present practice among commercial growers of onion sets in reference to time and thickness of seeding?
40. When do onion sets ripen, as compared with large onions?
41. At what stage of maturity are onion sets harvested?
42. Describe the method of harvesting onion sets.
43. How are onion sets usually cured?
44. What is the commonest method of growing green onions in home gardens?
45. What size of sets will produce green onions the quickest?
46. What kinds of onions will produce green onions earlier in the spring than the ordinary bottom sets? When are these onions planted?
47. How may a late crop of green onions be obtained?
48. How much time is required to grow a crop of leeks?
49. Describe the shape, texture and flavor of leeks as compared with onions.
50. How is provision made for the blanching of leeks?
51. What are the principal uses of garlic? How strong is its flavor?
52. Describe the structure of a garlic bulb.
53. How is garlic propagated?
54. How is garlic cured for winter use?
55. How do shallots differ in structure from garlic?
56. How does the flavor of shallots compare with that of onions?
57. In what two stages of development are shallots used?
58. Describe the perennial onion-like plant known as "chives."
59. How are chives propagated?
60. How are chives planted and cultivated?
61. How may chives be handled for winter use?

## CHAPTER XXI

### POTATOES

POTATOES are by far the most important of all vegetable crops. They are grown in every State in the Union and are found daily on the tables of all classes of people. They are always "in season" twelve months in the year, and constitute the great staple vegetable in all markets. Potatoes are marketed in both the immature and mature stages. At the former stage they are quickly perishable, and are known as "new potatoes;" in the latter stage they will keep for months under proper conditions of storage. The principal markets are supplied with new potatoes from the South early in the season and with mature potatoes from the North during the fall and winter.

The potato is essentially a cool season crop. The early crop grown at the South makes its principal growth during the normally cool weather of the spring months, and is nearly ready for market by the time the weather becomes hot, but is capable of continuing its growth into the hot weather if a mature product is desired. The late crop at the North finishes its growth in the cool weather of September and early October. Attempts to grow mid-season crops in southern localities are likely to be disappointing. Sometimes a late or second crop is planted in the South on rich, moist bottom land after the time of harvesting the early crop. If the season is cool, this crop is often satisfactory. However, large yields and large tubers are produced principally in the cool climates of the northern states, such as Maine, New York, Michigan, Wisconsin, Minnesota, and Colorado. The last-named State is somewhat to the South, but high altitudes counterbalance the lower latitude.

The early potatoes produced at the South for northern markets are grown mostly from northern seed planted on fall-plowed ground at the earliest possible date in spring, or even in early or mid-winter at the extreme South. They are planted on sandy land if possible, and heavily fertilized to promote rapid development. As soon as the tubers are large enough to satisfy the demands of the market they are harvested, even though they may be only two-thirds grown. "New potatoes" from Bermuda and

Florida command high prices in February and March. As the season progresses, localities farther north take their turn in supplying the markets, until finally in June or July the northern cities are supplied with new potatoes by their own local gardeners. Local gardeners also usually supply the markets with mature tubers during the early fall months, before the main crop ripens in the distinctively potato regions of the North.

For the early crop, early varieties are grown, such as Triumph, Early Ohio, and Irish Cobbler. The Triumph is especially valuable where the soil is somewhat heavy. This is a red-skinned variety, valued chiefly on account of its extreme earliness, and is of little merit for table use except in the immature stage. For the main crop later varieties are grown, which produce larger tubers and larger yields.

**Soil.**—In general, potatoes thrive best on rich, sandy loam containing plenty of humus. The tubers are able to develop better in such a soil than in a silt or clay loam and are also likely to be of better quality.

For an early crop of potatoes in central latitudes, the ground should be plowed in the fall. Since a good supply of humus is needed in the soil, it is advisable to apply a heavy dressing of manure previous to the plowing, or to plow under a clover sod or a catch crop of vetch or cowpeas. As soon as the soil reaches workable condition in the spring, it should be disked or re-plowed, depending upon its type and condition, and the potatoes planted immediately. Often commercial fertilizers rich in potassium are applied while fitting the land for planting or during the planting process.

**Planting.**—Potatoes should be planted about four inches deep, so that the tubers will have room to develop without being exposed to the sun or necessitating the hilling up of the soil against the row. Hilling potatoes is a common practice, but results in injury to the roots and unnecessary loss of moisture from the soil at a time when the crop is most in need of moisture. Except in shallow or poorly drained soils it is best to plant the potatoes deep and give them level culture.

Small areas of potatoes are planted by hand, while large areas are often planted by special machinery. For hand planting, the land is furrowed out by means of a single-shovel or turning plow, and the seed pieces dropped by hand in a straight line along the bottom of the furrow. The furrows are then filled in with the

plow or with a corn cultivator. It is a good plan to throw the soil up in a ridge over each furrow in which the potatoes are planted, and then work the field down level by means of a harrow two or three weeks later, thus killing all the little weeds directly in the potato row and leaving the surface soil thoroughly stirred close about the plants just as they are coming up.

Potato-planting machines open the furrow, drop and cover the potatoes, and distribute fertilizer, if desired, all at one operation (Fig. 116). They are used extensively by commercial potato



FIG. 116.—Potato planter in operation.

growers at the North, but are seldom seen at the South, where hand labor is cheaper and more abundant.

The distance of planting potatoes varies somewhat with the variety, but more with the individual notions of the growers. A common distance between the rows is thirty to thirty-six inches. The distance between the plants in the row varies from ten to eighteen inches, with fourteen inches as a very common and satisfactory distance. Sometimes potatoes are planted in checks twenty-eight to thirty inches apart, and cultivated both ways, but the more usual practice is to plant in drills and cultivate only one way after the plants are up.

In planting potatoes, a tuber or piece of a tuber is used for the "seed." There has been considerable difference of opinion as to the proper size of the seed piece, but it is now quite generally conceded that a piece weighing about two ounces and containing at least two good eyes is a very satisfactory size for planting. The objection to extremely small pieces is that they do not contain sufficient food material to give the plant a strong start, especially if the weather should be unfavorable. The chief objections to extremely large pieces are that their use may result in the production of a large number of stalks and many small tubers, and also that their use is extravagant in case the price of seed is high.

**Tillage.**—After potatoes have been given the first early tillage with a harrow as suggested above, they should be cultivated at intervals of a week or ten days until the tops have grown so large that they seriously interfere with the tillage. If beating rains threaten to cause crust formation, more frequent tillage may at times be necessary. The aim should be to preserve a surface mulch that will prevent excessive evaporation of moisture from the soil.

**"Straw Potatoes."**—In some parts of the country it is the practice to grow potatoes without any tillage after planting. A heavy mulch of straw is substituted for tillage, to conserve the moisture. The potatoes are planted as early as possible in the spring, and the straw is spread to a depth of about four inches over the entire field as soon as the sprouts appear at the surface of the ground, or even before. If a hard rain should pack the soil before the straw is applied, one cultivation is given; otherwise it is not. The straw not only conserves the moisture, but it also keeps down weeds and protects the potatoes from the sun. "Straw potatoes" are allowed to mature, rather than being harvested green. They are considered of superior table quality, and sell at higher prices than other potatoes in some markets.

**Insect and Fungous Enemies.**—Potatoes are almost invariably attacked by the Colorado potato beetle, and frequently also by the flea beetle. In many localities they are likewise subject to attacks by two fungus diseases, known as the early and the late blight. The former causes a premature ripening of the crop and lack of size in the tubers; the latter often causes the tubers to rot either in the field or in the storage house. Both can be controlled by proper spraying with Bordeaux mixture. The spraying should

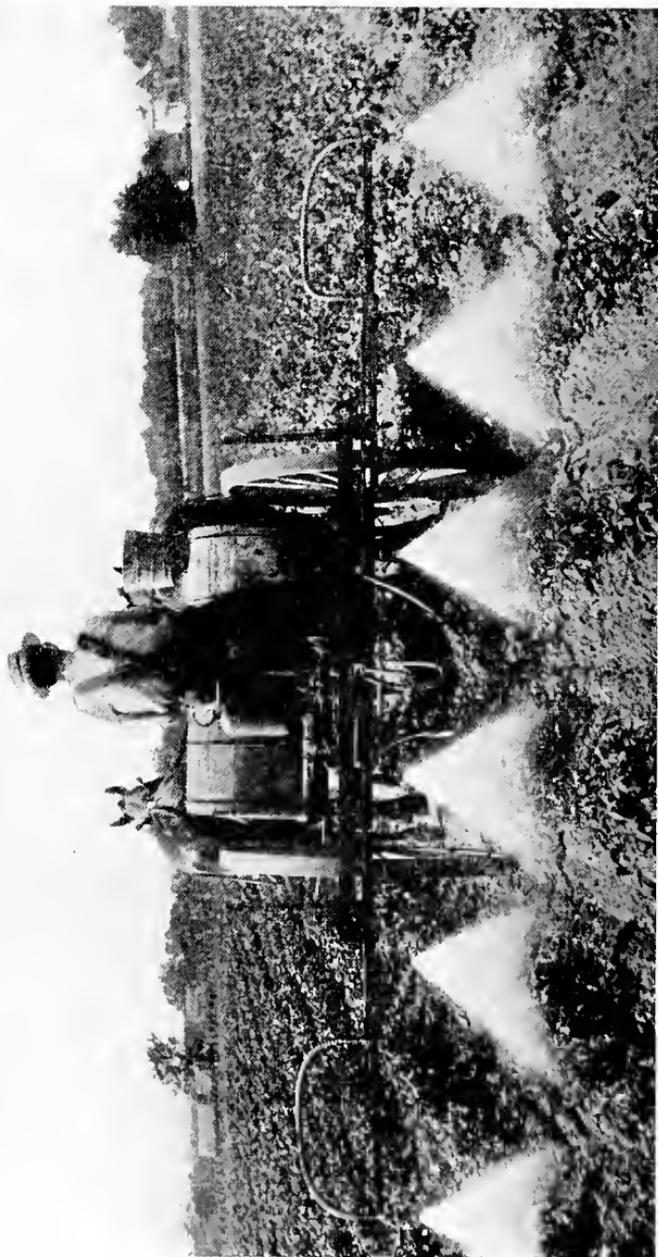


FIG. 117.—Six-row potato sprayer in operation.

begin when the plants are six or eight inches high and should be repeated at intervals of about two weeks until the crop is nearly ripe. In badly infected regions, from five to seven applications are made. This treatment also holds the flea beetle in check, for Bordeaux mixture acts as a repellent to this insect. If Paris green or arsenate of lead is added to the mixture, it will dispose of the Colorado potato beetle. Thus, one line of treatment will hold the four enemies in check. The spray should be applied to the



FIG. 118.—Potato digger in operation.

under as well as to the upper surface of the leaves in order to be most effective. Special spraying outfits are equipped for this purpose, and are capable of spraying from three to six rows at a time (Fig. 117).

**Potato Scab.**—Another common disease of potatoes is the scab. This affects the tubers themselves, and in the case of a severe attack, renders them of little commercial value. Since the germs of the disease live over winter in the soil as well as on the diseased tubers, two precautions must be taken in order to avoid infection

of the succeeding crop: Land which has once produced scabby potatoes should not again be planted to potatoes for three or four years; and the seed potatoes should be treated with formalin or corrosive sublimate before they are planted (see p. 85). The treatment of seed potatoes for scab is a wise precaution even if no scabby spots are visible on the tubers that are to be planted. Apparently sound tubers may carry the infection if they have been in contact with diseased tubers or with crates or other receptacles that have been used in handling diseased potatoes.

**Harvesting.**—Potatoes are harvested by digging with spading forks or potato hooks, or by means of a digger drawn by two, three, or four horses. Sometimes an ordinary plow is used, but it cuts many of the potatoes and bruises others, and is withal unsatisfactory as a potato harvester. A modern type of potato digger lifts the tubers, separates them from the adhering soil, and deposits them on the surface of the ground ready for the pickers (Fig. 118). The tubers must be picked up immediately after digging and not allowed to remain exposed to the sun.

#### QUESTIONS

1. How do potatoes rank in importance as compared with other vegetables?
2. In what two stages of maturity are potatoes marketed?
3. What parts of the country supply the markets with potatoes at the different seasons of the year?
4. What weather conditions are most favorable to the growth of potatoes?
5. Name six states of importance in the production of late or "main crop" potatoes.
6. When are early potatoes planted? When are they harvested?
7. Name three varieties of early potatoes.
8. What kind of soil is considered best for potatoes?
9. Describe the preparation of land for the growing of potatoes.
10. Discuss the "hilling" of potatoes. How can it be avoided?
11. Describe the planting of potatoes by hand. By machinery.
12. At what distances may potatoes be planted?
13. Of what does the potato "seed" consist?
14. What size of seed piece do you prefer? Why?
15. Describe the proper tillage of potatoes.
16. Describe the straw-mulch method of growing potatoes without tillage.
17. What are the principal enemies of the potato crop and how may they be controlled?
18. Contrast hand and machine methods of harvesting potatoes.

## CHAPTER XXII

### PERENNIAL CROPS

#### ASPARAGUS \*

ASPARAGUS is the most important of the perennial crops. After a plantation is once established, it produces a crop every year without the necessity of replanting. This feature makes asparagus a desirable vegetable to grow, for it is certain to produce a crop even if the weather of spring is unfavorable for the early planting of annual crops. The nature of the edible product also, consisting, as it does, of the early vegetative shoots (Fig. 119), renders crop failures impossible, for if the plant grows at all it produces an edible product. The crop is not subject to destruction by frost, for in the advent of frost only those shoots that were above ground and not yet of edible size would be affected, and no single frost could destroy any large proportion of the crop. The roots are extremely hardy and survive even the severest winters. While the edible product is produced principally during cool weather, the plants do not suffer from the heat of summer, and are able to endure even excessive drought.

**Starting the Plantation.**—An asparagus plantation is started by the planting of roots. These may be either one or two years old. The one-year roots are preferable. They may be either grown from seed by the prospective planter or purchased from a seedsman. If a person decides to grow his own roots, the seed should be sown in drills about one and one-half feet apart, early in the spring. Since the seed germinates very slowly, it is wise to sow a few radish seeds with it to mark the rows so that cultivation may be started before the asparagus plants appear. Otherwise it may be difficult to find the asparagus on account of weeds. An additional precaution is to hasten germination by soaking the seed in warm water for twenty-four hours before planting.

The care of the asparagus seedlings consists in cultivating, weeding and thinning, the same as onions or any similar crop

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\* Adapted from a paper presented by the author at the Thirty-Sixth Annual Meeting of the Southern Illinois Horticultural Society, November 24, 1909.



FIG. 119.—Bunch of Palmetto asparagus ready for market.

grown in drills. The plants should stand about three inches apart in the row.

Whether grown from seed or purchased from a seedsman, the plants should be set in their permanent location in the spring. Planting should take place as early as the ground can be worked to advantage, since this gives the plants a longer season in which to grow and insures a better stand than if planting is delayed until the best part of the growing season of spring has passed. If possible, the plants should be set before the normal season for asparagus to start growth in established plantations.

If the plants are grown on the premises they should be dug as needed for planting; if they have been shipped in from a distance, they should be heeled-in upon arrival, to prevent their drying out, and taken out as needed. This is a wise precaution, even though asparagus roots will stand considerable hard usage.

**The soil for asparagus** should be rich. Land that has been manured the preceding year is preferred. If this cannot be secured, the land selected should be manured and plowed in the fall, if possible, preparatory to spring planting. In case this cannot be done, and the soil needs enriching, an application of well-rotted manure may be made immediately before the spring plowing.

**Planting.**—Whether the land is plowed in the fall or not, deep plowing immediately before planting is essential. As soon as plowed, the land should be thoroughly disked and harrowed to make it fine to as great a depth as possible. The field should then be laid out for planting by making furrows either four or five feet apart and from eight to ten inches deep. The roots (Fig. 120) are set two feet apart in the bottom of the furrow at such a depth that the crown will be five or six inches below the level of the ground after the furrows are filled. However, at the time of planting the furrows are not completely filled, only enough dirt being put in to cover the crowns about two inches. If covered more deeply at this time, the plants may fail to grow.

**Tillage the First Season.**—As soon as the plants start growth, cultivation should begin. A cultivator is used on the ridge between the furrows, and a hoe is employed in stirring the soil close to the plants and shaving off any weeds that appear in the furrow. At each cultivation and hoeing, soil is worked toward the plants. Thus the furrows are gradually filled, so that by the end of the growing season there will be no furrows, but the field will present a level appearance.

**Dressing with Manure.**—When the season's growth is over, the tops are mowed and removed from the field. A dressing of manure may be applied broadcast at this time or early in the spring. In either case, the spring treatment of the field consists in disking the manure thoroughly into the soil before the asparagus starts to grow. This work should usually be done at the earliest date the soil is in workable condition. Since the roots are planted deeply there is no danger of injuring them with the disk, and also no danger of injuring any shoots if the work is done sufficiently early. The field is disked lengthwise and crosswise, just as if no crop were there.

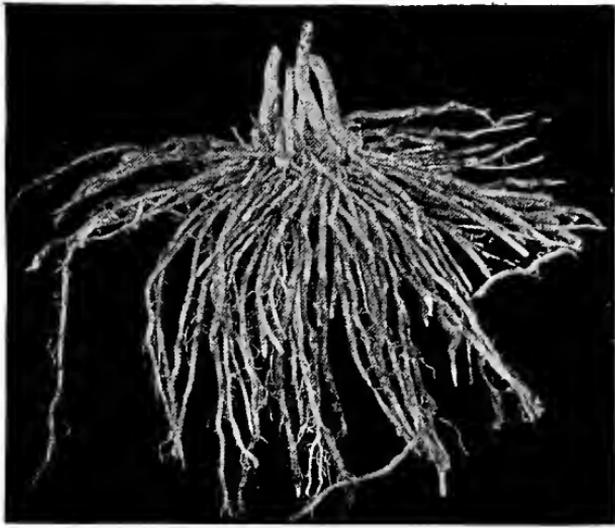


FIG. 120.—Asparagus root.

Following this early spring treatment, cultivation between the rows is begun as soon as the shoots appear above ground. This cultivation is continued until the tops have grown so large that they make it inconvenient to get between the rows with a horse (Fig. 121). Late in the fall the tops are removed and a dressing of manure applied either at that time or in the spring, the same as in the preceding year.

In the spring of the third year—that is, two full years after the asparagus is planted—a light crop of shoots may be cut, but under no consideration should the cutting continue for more than

three weeks, for excessive cutting from a plantation of this age would seriously weaken the plants and might result in the permanent injury of the plantation.

**Tillage of an Established Plantation.**—The principal cultivation of an asparagus field the third year and each succeeding year consists of a thorough disking before growth starts in the spring and another equally thorough disking at the close of the cutting season. It is true that this latter disking cuts off many shoots that might be saved to the plant if a more laborious method of tillage were employed; but since no cultivation is given during



FIG. 121.—A thrifty asparagus plantation as it appears in midsummer.

the cutting season, the weeds are usually very abundant and well established at this time, and no other method of treatment can compare with the disking for rapidity and efficiency. As soon as the shoots start, after the disking, the cultivator is run between the rows. Usually the plantation can be cultivated two to three times before the tops become so large as to prevent further tillage. Any stray weeds that appear in the rows during the first two or three weeks after the disking are hoed out or pulled by hand. Some growers sow cowpeas between the rows at the time of the

last cultivation. Late in the fall the asparagus tops are mowed and burned, in order to clear the field of trash, destroy the asparagus seeds, and assist in the control of rust.

**Annual Dressings of Manure.**—To maintain an asparagus plantation in full productiveness through a series of years, it is essential that it receive a top dressing of manure every year. The manure may be applied at any one of three different times, but in all cases is applied at such a time that it can be worked into the soil with a disk before growth starts following its application. If applied in the fall, it is disked into the ground the following spring. It may be applied in the spring immediately before the early disking or immediately before the disking at the close of the cutting season.

**Cutting the Crop.**—As already intimated, an asparagus plantation may be seriously injured by continuing cutting too late in the season. This applies to an old plantation as well as a young one, although the cutting in a well-established plantation in full vigor may continue for six weeks without seriously impairing the



FIG. 122.—One form of knife used in cutting asparagus.

vigor of the plants. If cutting is continued for eight weeks, as is the practice with some growers, the shoots in the last cuttings are likely to be small, indicating the impaired vigor of the plants; and if cutting is continued after the small shoots become numerous, the bad effect of this late cutting is likely to be evident in the small size of the shoots during the entire cutting season the next year. The plants must be given time after the last cutting to make vigorous growth and store up food in their roots for the next year's crop. A serious mistake made by commercial asparagus growers is in cutting their plantations too late. For cutting asparagus a special knife is ordinarily used (Fig. 122).

**Blanched Asparagus.**—The method of culture outlined above has reference primarily to green asparagus, which constitutes the bulk of the crop in the United States. Green asparagus is cut an inch or two below the surface of the ground after the shoots have attained a height of six to eight inches. The production of blanched or "white" asparagus differs from that of the green mainly in

that before the beginning of the cutting season a ridge of soil is thrown up over each row, and the shoots are cut or broken off several inches below the surface as soon as their tips appear at the top of the ridge. Being produced in the dark the shoots are free from green coloring matter, and are much in demand in certain markets. After the close of the cutting season, the ridges are plowed down, and the field kept level till the following spring.

## RHUBARB

Rhubarb, or pie plant, is another important perennial vegetable. It produces enormous leaves, and the fleshy leaf stalks are the edible parts. New leaves appear from early spring till midsummer, but the stalks produced early in the season are most in demand, and the harvest usually does not last more than six or eight weeks. The later leaves are allowed to grow and supply the root with food materials for producing the next season's crop. The roots are perfectly hardy, requiring no winter protection, and the plant is capable of surviving the extreme heat of summer in central latitudes.

**Propagation.**—Rhubarb is usually propagated by the division of old roots. In dividing the roots care must be taken to see that each piece of root to be planted contains a portion of the crown bearing a bud. New plantations may also be started by the use of one-year-old roots grown from seed. The latter method requires a year longer, but is very much cheaper unless the grower has an old plantation from which he can procure the old roots for dividing, for when rhubarb roots are purchased they are very expensive. Were it not for the high cost of the roots, it is probable that many more home gardeners would plant rhubarb. This difficulty can be overcome by growing the roots from seed, and even though many of the seedlings are untrue to type, selections may be made and a very satisfactory rhubarb plantation established at small expense (Fig. 123).

For growing rhubarb plants from seed, the seed is sown in rich, moist soil, early in the spring, in drills about eighteen inches apart. The plants are thinned to six or eight inches apart in the row, and given good tillage throughout the season.

**Planting.**—Whether yearling roots or divisions of old roots are used for starting a rhubarb plantation, the plants are usually set early in the spring, though fall planting is sometimes practiced. The rows should be at least four feet apart and the plants three

to four feet apart in the row. Usually rhubarb is planted in checks so that it can be cultivated both ways. The roots should be set so that the crowns are level with, or slightly below, the surface of the ground. The soil in which the rhubarb is planted should be rich, deep and well supplied with humus, for the crop requires an enormous amount of plant food and moisture to develop a maximum product.

**Tillage and Fertilizing.**—The plantation should be given thorough tillage, and heavy applications of manure should be made every fall or spring. Fall applications are usually placed immedi-



FIG. 123.—Rhubarb plantation in Union County, Illinois.

ately over the crown of the plant, and raked slightly away in early spring so as not to interfere with the growth of the leaf stalks. If spring applications are to be made, it is sometimes the practice to plow out a furrow on one side of the row late in fall, throwing the earth away from the plants. Very early in the spring this furrow is filled with coarse manure and the earth that was thrown out in the fall is plowed back over the manure.

**Harvesting.**—No crop should be gathered from a rhubarb plantation until the third year after planting, for that amount of time is required for the roots to gain sufficient strength to maintain

themselves unimpaired in spite of the loss of a large amount of their foliage produced in early spring. In gathering rhubarb, only the larger stalks are pulled, the small ones being left to assist in maintaining the plant; and at no time is the plant bereft of anywhere near all the foliage. In pulling, the stalk is grasped close to its base and pulled straight in the direction of its growth. In this way there is little danger of breaking the stalk.

Some of the rhubarb plants, and sometimes most of them, will start to send up seed stalks. These should be promptly removed with a knife as soon as they appear; for the production of seed is exhaustive to the plant, and uses up food materials that should go to the support of the root.

When rhubarb roots become old they are likely to produce smaller leaf stalks than when in their prime. When indications of this condition occur, the roots may be dug up and divided for starting a new plantation, or they may be pruned where they stand, by cutting off the lateral portions with a spade or plow. This seems like harsh treatment, but is said to be fully as effective in promoting the production of large stalks as is starting a new plantation.

#### GLOBE ARTICHOKE

Globe or burr artichokes are little grown in this country outside of California. The large city markets are supplied chiefly from that state and from Bermuda. However, with proper care it is possible to grow the crop on the rich black soil of the corn belt. The easiest way to secure a start with artichokes is to purchase a supply of seed and sow it under glass in February or early March. The young seedlings should be shifted to pots when three or four weeks old, so that they can later be transplanted to the open ground without disturbing the roots. Late in April the plants may be placed in the field, about four feet apart each way. Previous to planting, the soil should have been made very rich by heavy manuring. Good cultivation should be given throughout the season. If an early start is secured, the plants may produce a crop the first year. The edible part consists of the fleshy portions of the unopened flower buds (Fig. 124). The buds are from three to four inches in diameter.

**Winter Protection.**—Whether or not the plants flower the first season, they must be given protection to enable them to survive northern winters. The usual method is to cover the crowns with

a foot of earth late in the fall, and, if the weather becomes severe, to supplement this covering with a layer of leaves or coarse manure.

**Propagation by Suckers.**—Early in the spring the covering is removed. Unless the plants have been winter killed, growth soon starts, including numerous suckers or side shoots. Most of these should be removed. They may be used in starting a new plantation; in fact, this is the usual method of propagating globe artichokes after a start has been secured, for the varieties are not sure to come true from seed. Suckers for planting are taken only from plants of the most desirable type. In removing the suckers from the parent plant, care must be taken to secure a small portion of the crown with each sucker. Otherwise the suckers will not

readily strike root. After removal, the suckers may be planted temporarily in a nursery row, or permanently in the garden or field. An abundant supply of moisture must be afforded them at the start; otherwise they will die.

Although the globe artichoke is a perennial, the same plant does not produce good crops for more than three or four years. Hence, new plantings should be made at frequent intervals. Winter protection should be provided every year.



FIG. 124.—Flower bud of globe artichoke.

**The Jerusalem artichoke** is an entirely different plant, forming tubers somewhat resembling the potato. These are sometimes used as food, but more often as feed for swine. When once planted Jerusalem artichokes persist indefinitely. They are exceedingly difficult to eradicate, and may become worse than weeds.

#### SEA-KALE

Sea-kale is a hardy perennial vegetable, quite popular in England, but little grown in other countries. It is offered by American seedsmen, and is occasionally found in American gardens. The parts used are the large succulent leaf stalks. These arise from the crowns very early in the spring, and are ready for the

table before asparagus starts into growth. Since this crop is cooked and served much like asparagus, it offers an agreeable substitute before the asparagus is ready for use. The development of the sea-kale may be further hastened by banking fermenting manure about the crowns.

**Propagation.**—Sea-kale may be propagated either from seeds or root cuttings. If seed is used, it should be sown in early spring either in a carefully prepared seed-bed out-of-doors, or in a mild hotbed. If out-of-doors, the rows should be from one to one and one-half feet apart, and the seedlings thinned to six inches apart in the row. If started in a hotbed, the seedlings are transplanted to similar distances in the open as soon as they are large enough to be readily handled. Here they are given good tillage through the season, and mulched in the fall. Early the following spring the plants are set in their permanent location. Here they should be placed in rows from three to four feet apart, with the plants two to three feet apart in the row. Two years later a crop can be cut.

If root cuttings are used, they may be procured from an old plantation that needs renewing, or from the trimmings of roots that are dug for winter forcing. The main root has numerous side branches, from which the cuttings are made, much the same as in the case of horse-radish. The cuttings may be from four to nine inches long. If taken in the fall they are tied in bunches and buried in sand until spring. If taken in the spring they may be planted directly after making. They are planted with dibbers, and the top is placed about an inch below the surface of the ground. A crop may be harvested two years after the planting of the cuttings.

Sea-kale should never be allowed to produce seed, unless seed is needed for planting, for this reduces the strength of the plant, and strong plants are needed to produce good crops. The flower stalks should be cut off as soon as they appear. It is also a common practice to remove the weaker leaf stalks if these appear in large numbers. A strong growth is also encouraged by annual dressings of manure or compost, usually applied in the fall.

**Blanching.**—The leaf stalks of sea-kale are always blanched if they are to be gathered for the table. Blanched stalks are nearly white and do not have the bitter flavor characteristic of this plant when allowed to develop in sunlight. Since it is the earliest growth of spring that is desired for the table, the blanching can be very

readily accomplished by covering the crowns with coarse litter, sand or loose soil, or by inverting a deep flower pot over each plant, care being taken to close the drainage hole to exclude all light. Under these conditions, the leaf stalks grow from six to ten inches long, including the midrib, which is also used.

### QUESTIONS

1. Which is the most important of the perennial crops?
2. What are some of the attractive features of asparagus culture?
3. How does asparagus behave under extremes of temperature?
4. How is an asparagus plantation started?
5. At what age should asparagus roots be planted?
6. Describe the method of growing asparagus roots from seed.
7. At what time of the year should asparagus roots be planted?
8. Describe the fitting of land for planting asparagus roots.
9. How deep should asparagus roots be planted?
10. Describe the tillage of an asparagus plantation the first season.
11. Describe the late fall and early spring treatment of a young asparagus plantation.
12. How soon after planting can a crop of asparagus safely be cut? What restrictions must be placed upon cutting from a young plantation?
13. Describe the regular tillage for one season in an established asparagus plantation.
14. How often should manure be applied to an asparagus plantation?
15. How long each season is it safe to cut an asparagus plantation?
16. What are the indications that an asparagus plantation is being cut too late?
17. Describe the production of blanched asparagus.
18. What part of the rhubarb plant is edible?
19. When is the rhubarb crop harvested? How long does the harvest continue.
20. What extremes of temperature will rhubarb endure?
21. How is rhubarb propagated?
22. Describe the planting of rhubarb roots.
23. Describe the tillage and fertilizing of a rhubarb plantation.
24. Contrast the harvesting of rhubarb and asparagus.
25. Why and when should the seed stalks be removed from rhubarb?
26. What treatment is advised for an old rhubarb plantation?
27. What is the easiest way to get started in the culture of globe artichokes?
28. What part of the globe artichoke plant is the edible product?
29. What winter protection must be given globe artichokes?
30. After a person has an artichoke plantation, how may it be extended or renewed?
31. How long will a globe artichoke plantation continue to produce good crops?
32. How do Jerusalem artichokes differ from globe artichokes?
33. What part of sea-kale is the edible portion?
34. What advantage has sea-kale over the perennial crops already considered?
35. In what ways may sea-kale be propagated?
36. How may sea-kale be blanched?

## CHAPTER XXIII

### BEANS

BEANS thrive only in relatively warm weather, but their period of growth is sufficiently short so that they are usually able to develop their crop between the last frosts of spring and the first frosts of fall in most localities where gardening is done in the United States. Some types of beans require a longer time for their development than do others. The length of time required depends partly upon the species and partly upon the stage of development at which the product is desired for food. In general, beans are used at three different stages of maturity: (1) The immature pods, in which the fleshy pulp surrounding the developing beans constitutes an important part; (2) the beans themselves at the time they have reached their greatest size and before they begin to shrink and harden; (3) the mature seed. The immature pods, when in edible condition, are known as "string" or "snap" beans; the large, immature seeds when used as food are called "green shell" beans, and the mature seeds are called dry beans, or dry shell beans. Different types of beans are grown especially for use at the different stages, though some types are desirable for use at more than one stage of development.

#### STRING BEANS

Only those varieties of beans which produce pods that are practically free from woody tissue when at the stage of development desired for eating are of value for the production of string beans. Since string beans are used at an earlier stage of development than any other type, they constitute a crop that can be brought to edible maturity in a shorter time than any other class of beans. Under favorable conditions the crop is ready for use within two months from the time of planting, and string beans can be grown even where the summers are very short.

There are two classes of string beans recognized on the market and on the table: Those that produce green pods and those that produce yellow pods. The latter are usually called wax beans or wax-podded beans, while the former are referred to as green string beans. Both the green and the wax-podded sorts are represented

by dwarf and running varieties. The dwarf kinds are also called bush or bunch beans because of the compact form and low stature of the plant (Fig. 125). These require no artificial support. The running varieties are also called pole beans, because they require artificial support and poles are commonly used for this purpose. The dwarf or bush varieties of string beans are much more extensively grown than the pole sorts, because they are less bother and usually produce an earlier crop. However, the pole sorts are more productive and continue in bearing for a longer period.

**Planting.**—String beans are usually planted as soon as danger of frost is over, and later plantings may be made at intervals of two to four weeks for the sake of securing a succession. Plantings



FIG. 125.—The bush type of string beans.

may be made until July 15, in central latitudes, and the crop will normally be harvested before danger of autumn frosts. Farther south, even later plantings may be made. The seeds are planted either in drills or hills. If the former method is employed the seeds are dropped at intervals of three or four inches. When planted in hills, three to five seeds are placed in each hill, and the hills are from one to two feet apart in the row. In either case, the rows are from twenty to thirty inches apart, the latter distance being preferable if horse tillage is to be employed.

Dwarf string beans are among the easiest crops to grow, and do not require any special treatment other than good tillage. The pole varieties, of course, require support. They are usually planted

in hills about four feet apart each way, to allow sufficient space for tillage. Four or five seeds are usually planted in each hill. Except for the provision of support and the difference in distance of planting, the culture of pole string beans is the same as for the dwarf type.

#### GREEN SHELL BEANS

Almost any variety of bean may be used when the seeds have attained full size but are still immature. However, there are certain types that are often grown especially for use at this stage of development. The most important of these are the Lima beans. These are of three distinct types, the classification being based primarily upon the size and shape of the seed. In the true large Lima the beans are extremely large when at the right stage of development for use as green shell beans, and this type is the one most in demand on the market. This large type of Lima is more difficult to grow and is a more uncertain crop than the small-seeded Sieva or Carolina Lima. The latter type will stand greater extremes of temperature. If the ground should become cold and wet immediately following planting, seeds of the Sieva type are much less likely to rot than those of the large Lima; and in hot weather the Sieva Limas will continue to set pods and produce a crop, while under the same conditions the blossoms of the large Limas may all become blasted. The large Limas also demand a richer soil than the Sieva type. In short, the Sieva Limas are a vegetable that almost any one can grow successfully, while the large Limas demand special care and even then sometimes fail.

A type of Lima beans that produces seeds somewhat intermediate in size between the large- and the small-seeded sorts, is known as the potato Lima, from the shape of the seeds, which are short and thick.

Until less than thirty years ago Lima beans were known only in the pole or running form. Now, all three types are represented in bush form also. The pole varieties are usually more productive than the bush sorts, and are still extensively grown in spite of the inconvenience and expense of providing them with supports.

**Temperature Requirements.**—In general, Lima beans require higher temperature and richer soil than string beans. Under normal seasonal conditions it is unwise to plant Limas until nearly two weeks after it is perfectly safe to make the earliest planting of the string beans. For the sake of securing an earlier crop, Lima

beans are sometimes transplanted. In this case the seeds must be planted on inverted sods or in dirt bands (see chapter on transplanting), to avoid disturbing the roots when the plants are moved. The plants are allowed to grow in the hotbeds for only about three weeks, for they quickly reach transplanting size. The transplanting method is seldom employed except for the large-seeded pole varieties. This type is also sometimes manured in the hills, in order to stimulate rapid growth and increase the yield.

Pole Limas are normally planted in hills about four feet apart



FIG. 126 —Plantation of pole beans with laths for supports.

each way, and a pole placed at each hill to support the vines. In regions where native timber is abundant, the poles are usually slender hickory or oak saplings from seven to nine feet long, with the bark left on. These are sharpened at the base, where they are usually about one and one-half inches in diameter, and are either placed where the hills are to stand, before the seeds are planted, or inserted after the plants are up but before they begin to run. The latter method makes early tillage more convenient, and also saves time during the busy planting season. In either case the poles may be inserted in holes made with a crow-

bar, or may be forcibly pushed into the ground when the soil is soft following a heavy rain. If it is expected that each pole will stand erect, independent of others, the former method of inserting the poles should be employed. It is a common practice, however, to lean the poles of four adjacent hills together in the form of a wigwam, and tie them where they cross near the top. Thus they help support each other, and there is no danger of any poles being blown down when heavily laden with the crop. In localities where bean poles can not readily be secured, two pieces of ordinary



FIG. 127.—Bush form of the small-seeded Lima.

plastering lath may be nailed together and made to serve as a substitute for a pole. Such "poles" are not sufficiently rigid to stand alone, and must always be tied in groups as above suggested (Fig. 126).

**Dwarf Lima beans** may be planted at the same time as the pole sorts. They are usually placed in rows about three feet apart, and may be either in hills or continuous drills. In the latter case, the plants should stand from eight to twelve inches apart, depending upon the variety. The care of the crop is essentially the same as for other bush beans. The dwarf Limas of the small-seeded type are especially desirable for the home garden, for they require little space and no special care, and are sure croppers (Fig. 127).

**Other Types of Green Shell Beans.**—Types of beans other

than Limas grown primarily for use as green shell beans are of relatively minor importance. There are, however, a few varieties particularly adapted to this purpose. They have relatively large seeds, especially in the immature stage. One type sometimes used for this purpose is known as the "Horticultural Lima," because it is used the same as the Limas, though it is an entirely different type. There are both pole and bush forms. The culture of these green shell beans is the same as for string beans. This type of beans, and also the various Limas, may be used in the mature state as dry beans if desired, though their principal use is in the immature state as above indicated.

#### DRY SHELL BEANS

Dry beans are a staple food product that will keep indefinitely like wheat or corn. They are considered more in the nature of a field rather than a garden product. Although any variety of bean that has become ripe may be used as a dry shell bean, there are certain varieties especially adapted to this purpose. They are for the most part white-seeded sorts that yield heavily and mature their entire crop at one time. The pods are usually woody and ill-adapted for use as string beans, and the seeds so small that shelling by hand in the immature stage would be a very tedious task. When ripe, the pods are brittle, and the beans are readily threshed out by suitable machinery.

Beans as a field crop for use in the dry state are usually planted with a grain drill or corn planter, by making proper adjustments. They are also cultivated with field tools, either those used regularly for cultivating corn or potatoes, or special tools adapted to cultivating narrow rows and taking more than one row at a time.

When the beans are ripe, they are either pulled by hand or harvested with special machinery made for the purpose. They are allowed to cure in the field in windrows or small bunches for several days; then they are either threshed immediately or stacked up in a barn or shed where they may be threshed during the winter.

Small quantities of beans may be threshed out on the barn floor with a flail; but this is a slow and tedious process. For larger quantities, an ordinary grain thresher is sometimes used; but this requires special adjustments, and even then is likely to split many of the beans. In regions where dry beans are an important commercial crop, special bean threshers are used.

After threshing, the beans need cleaning to separate out any pieces of dirt, stems, broken pods, etc. Where beans are handled commercially, the receiving warehouses are equipped with special machinery for this purpose. If part of the beans have become discolored on account of wet weather at harvest time, the damaged specimens must be separated out by hand picking.

The threshing and cleaning of beans require special equipment if the work is to be done economically. Such equipment is usually not accessible to the home gardener; and the production of dry shell beans in the home-garden under hand methods of culture, harvesting, threshing, and cleaning is likely to consume a large amount of time and yield a product of relatively small value. While of high food value per bushel, and an important staple crop for growing under field conditions in certain regions, dry beans do not constitute a crop that lends itself well to garden culture on small areas. The results are not commensurate with the labor involved.

#### QUESTIONS

1. What kind of weather is necessary for the growth of beans?
2. At what three stages of maturity are beans used as food?
3. What is the most important characteristic of varieties of beans that are suitable for use as "string" beans?
4. How do string beans compare with other beans as to length of time required to produce the crop?
5. What are the two distinct types of string beans recognized on the market?
6. What other classification of string beans is important from the cultural standpoint?
7. How and when are string beans planted?
8. What kind of beans are grown most extensively for use as "green shell" beans?
9. Name and characterize the three types of Lima beans.
10. In what two forms of plant is each type of Limas represented?
11. State the advantages in favor of the bush and of the pole Limas?
12. How do Limas compare with string beans in temperature requirements?
13. How may an extra early crop of Limas be secured?
14. Describe the methods of providing support for the pole or running varieties of Limas.
15. What type of dwarf Limas is the surest cropper under average conditions in the home garden?
16. What are the leading characteristics of varieties of beans well adapted for use as dry shell beans?
17. Are dry shell beans primarily a field or a garden crop?
18. Outline the planting, care and harvesting of a crop of beans for use in the dry state.
19. What kinds of beans are mostly grown for home use in your neighborhood?  
For market?

## CHAPTER XXIV

### SWEET CORN AND OTHER CROPS WITH SIMILAR CULTURAL REQUIREMENTS

#### SWEET CORN

SWEET or sugar corn, so named because of its distinctly saccharine qualities as compared with field corn, is an exceedingly important table vegetable. It is grown in most home gardens that have sufficient space for the larger vegetables, is one of the standard crops among market gardeners, and is extensively grown as a field crop for canning factories. It is available in the fresh state on the large markets from early summer until frost, and may be purchased in tin cans twelve months in the year. Canned corn is a staple vegetable for winter use. It may also be dried for winter if desired. In central localities fresh, home-grown corn may be had for the table from about July 15 until frost, if successive plantings are made on land that has been plowed early and kept in friable condition by repeated working until needed for planting. Ordinarily, however, only one or two plantings are made and the product is available principally during late July and early August. However, some home growers and also some market gardeners extend the season as above suggested.

**Planting.**—Sweet corn may be planted at the same time as string beans. It is tender to frost and the main crop should not be planted before the soil is fairly warm. Some varieties will germinate better than others in soil that is slightly too cool and wet, and these should be selected for the earliest plantings. Ordinarily, sweet corn is planted about May 1 in central latitudes, and successive plantings made as desired. The latest plantings should usually be made about July 1.

Varieties of sweet corn differ considerably in reference to the amount of time required to reach edible maturity. In general, the early varieties are smaller in every respect than the later sorts; the stalks are much shorter, the ears smaller, and the kernels shallower. The earliest sorts will produce edible corn in about seventy days from planting, if the planting is done as early in the spring as the weather is sufficiently warm for corn. Later

plantings of the same varieties, that make their principal growth in warm weather, will develop faster. In northern locations, where the nights are cool, a correspondingly longer time is required. Late varieties require ninety to one hundred days to produce edible corn, under the same conditions that early corn develops in seventy days. There are also intermediate varieties. In planting for a succession, therefore, due consideration should be given to the selection of varieties. For canning, the late varieties are chiefly grown, because of their generally larger yield and sweeter flavor, though there are now some early varieties of exceptionally high quality.

**Culture.**—The general culture of sweet corn does not differ from that of field corn, though early varieties are usually planted closer. In small areas the earliest varieties may be planted in hills as close as two by two and one-half feet; late varieties should have three to three and one-half feet of space between the hills each way. Two to three stalks should be allowed to the hill. If desired, the corn may be planted in drills instead of hills, the individual stalks being allowed from twelve to eighteen inches in the row.

Sweet corn is cultivated the same as field corn, and in addition hand hoeing close to the plants is sometimes employed in small areas. To produce a good crop of sweet corn the soil should be quite rich. Sandy soil will produce an earlier crop than clay or silt loam, but corn on such soil is more likely to suffer from lack of moisture.

#### POP CORN\*

It is unusual to mention pop corn in any treatise on vegetable growing. However, the demand for information regarding the method of handling this crop seems to warrant at least a brief discussion of some of the principal points involved in the culture and curing of this important crop.

There are three standard varieties of pop corn recognized on the market: Rice, the rough-kerneled corn, which is probably the best general-purpose variety, since it keeps better than any other; Pearl, the smooth, small-kerneled corn; and Eight-Rowed or Yankee, a smooth variety with very large kernels, which is in special demand for sugar-coating and stringing. Colored and

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\* This account of pop corn is essentially the same as an article contributed by the author to the *Orange Judd Farmer*, in 1902. Printed by permission of the Orange Judd Company, Publishers, New York.

variegated corns are salable, but at a discount. They are grown to some extent for home use.

The requirements for the production of a good crop of pop corn are essentially the same as for field or sweet corn, and the crop is grown more or less throughout the entire corn belt. Some growers make a specialty of it and plant as much as a hundred acres each year. The average yield per acre is about one ton (fifty bushels), though yields of two tons per acre are occasionally obtained. Under the same conditions of soil, weather and cultivation, pop corn will usually yield as many bushels per acre as field corn and sometimes slightly more.

**Planting.**—In planting pop corn care should be taken to avoid getting it too thick. The kernels are so small that if they are planted with a check rower carrying the plate ordinarily used for field corn, too many will be dropped in a place. A special plate should be procured if necessary, so that the pop corn may be properly planted. It does best when about three stalks are grown per hill.

**Harvesting.**—It is tiresome work gathering a crop of pop corn, because the ears are so small as compared with field corn, and they must be husked clean. Two men will gather only forty-five or fifty bushels in a day, so that the expense of harvesting the crop is considerably greater than for field corn. However, the pop corn is ready to husk earlier than field corn, so that it may be gotten out of the way before the latter crop demands attention. It is therefore a crop which the general farmer can grow without hiring extra hands at husking time.

**Curing.**—Considerable care is necessary in the curing and storage of a crop of pop corn. It must be kept under cover, in a place neither too damp nor too dry. Until it has reached a certain degree of dryness it will not pop. If allowed to become too dry, it loses forever its popping qualities, and is practically worthless. It is not considered good feed for farm animals, with the exception of turkeys.

To cure the pop corn some growers arrange a series of floors in their corn cribs, one above the other, and place the ears only a foot deep on each floor. This arrangement is particularly desirable if the corn is husked a little green, since it will prevent heating and will insure thorough curing. After the corn is well cured, there is sometimes danger of its becoming too dry if left spread out in thin layers, though it has been known to keep

perfectly for two years in this condition. So much depends upon atmospheric and other conditions that no definite statement can be made as to how long pop corn will keep. The time varies all the way from one to four years. After the crop has become sufficiently dry to pop well, it will usually keep better in bulk than spread out in thin layers. A crop in storage should be tested from time to time to see how it is keeping.

Pop corn is always bought and sold by sample. Upon receipt of a sample, the dealer shells off and carefully measures a given quantity of the corn, usually one pint; then pops it and measures

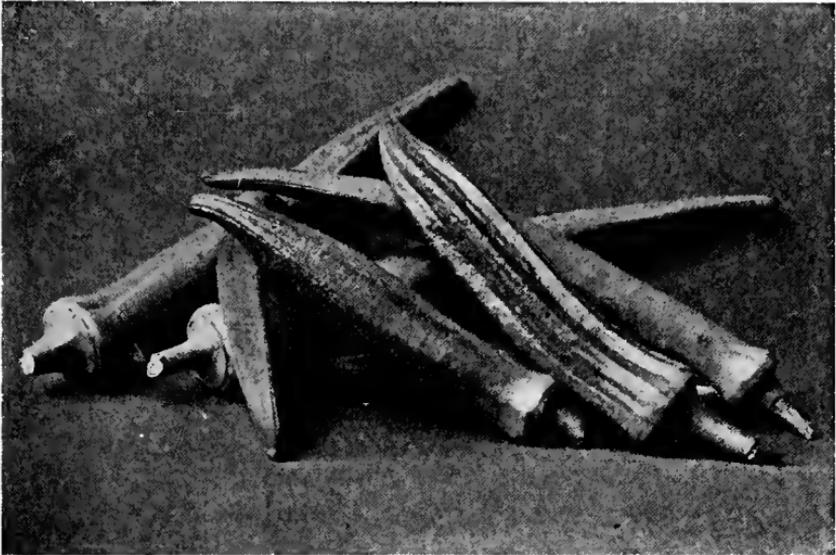


FIG. 128.—Okra. A favorite southern vegetable.

the popped corn. The price paid for the corn is based upon the amount of increase in popping. A good sample of corn will increase about twenty times.

#### OKRA

**Okra or gumbo** is a warm season crop grown quite generally in the South, where it is a favorite dish, cooked either alone or with tomatoes. It is canned with tomatoes for winter use and the resulting mixture furnishes the foundation for the soup known as "tomato and gumbo." The immature seed pods are the edible product (Fig. 128). When cooked, these exude a large amount

of mucilaginous substance, which makes the cooked vegetable one of peculiar texture.

While primarily a southern product, okra will develop in a sufficiently short time to make its culture possible in central and even somewhat northern latitudes. There is no difficulty whatever in growing it in the corn belt. The seeds are planted in the open ground at about the same time as corn and beans. The rows are made about three feet apart and the plants thinned to about one foot apart in the row, and cultivated the same as beans or corn. The pods must be picked promptly when they have reached the desired size, for if allowed to continue their growth they soon become woody and unfit for use. The plant continues to grow and produce new pods through a long season.

#### QUESTIONS

1. Discuss the importance of sweet corn as a table vegetable.
2. How may the season for fresh sweet corn be extended from about July 15 till frost?
3. When can the earliest planting of sweet corn be made?
4. Compare early and late varieties of sweet corn as to size of stalk and ear, depth of kernel, and time required to reach edible maturity.
5. What kind of soil is considered best for sweet corn?
6. What three kinds of pop corn are recognized on the market?
7. What is considered an average yield of pop corn?
8. How is pop corn planted?
9. What two factors make the harvesting of pop corn tedious?
10. Describe the curing of pop corn.
11. How is the value of a given sample of pop corn determined?
12. Is pop corn grown commercially in your locality? If not, why not?
13. What is the other name for okra? In what part of the country is it most popular?
14. What constitutes the edible product of the okra plant?
15. Can okra be readily grown in central or northern latitudes?
16. Give the salient points in the culture of okra.

## CHAPTER XXV

### THE VINE CROPS

**MELONS**, cucumbers, squashes, and pumpkins form a natural group of crops that are much alike in manner of growth and in general cultural requirements. All are warm season crops easily injured by frost, yet with a sufficiently short period of growth so that, even though the seeds are not planted until after the frosts of spring are over, the plants are usually able to mature their product before the frosts of autumn in all except northern localities. Owing to this fact and also the difficulty with which the plants are transplanted, these crops are usually grown from seed planted in the open ground. However, for the sake of growing an early crop or in northern localities where the season is short, they are sometimes transplanted. In the transplanting, extreme care must be taken to avoid disturbing the roots. (See chapter on transplanting.)

The vine crops are usually planted in hills, and, unless the soil is very rich, it is customary to apply manure or fertilizer to the individual hills. Nearly all these crops grow slowly at the start and need special attention to stimulate their growth and protect them from insect attacks. The object of manuring in the hill is to encourage rapid growth. Hand tillage close to the plants is an aid to the same end, as is also protection from the striped beetle, which attacks all these crops indiscriminately, though it is perhaps the worst on cucumbers and is therefore called the striped cucumber beetle (Fig. 129).

**Striped Beetles.**\*—These small yellow and black beetles may be expected every year, though the severity of the attack varies greatly in different seasons and different places. Usually the plants are attacked as soon as they appear above the ground, and, unless prompt treatment is given, the plants will be severely injured; if the attack is severe, the entire plantation may be destroyed. Since the insects feed mainly upon the under side of the seed leaves and on the stems, the application of a material

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\* This account of striped beetles and most of the material on muskmelons in the present chapter were published by the author in Circular 139 of the Illinois Agricultural Experiment Station.

offensive to their sense of smell is usually more effective than a poison. Various materials have been recommended, and, in the case of a severe attack, two or three different materials are often used consecutively. A very satisfactory treatment consists in spraying the plants repeatedly with dilute Bordeaux mixture. Usually four ounces of Paris green are added to each fifty gallons of the Bordeaux, for the purpose of poisoning any beetles that refuse to leave the plants. The first application should be made as

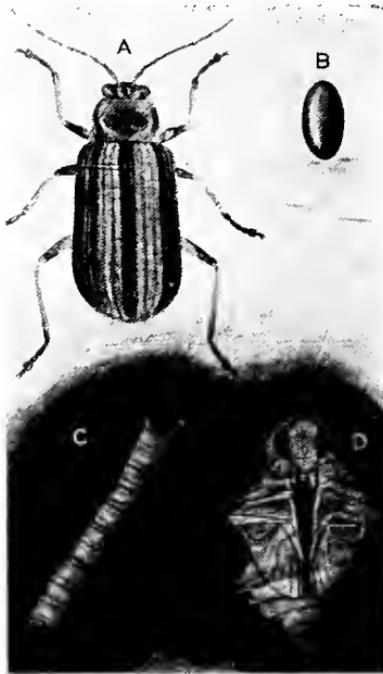


FIG. 129.—Striped cucumber beetle: a, adult beetle; b, egg; c, larva; d, pupa.

soon as the plants appear above ground, whether any beetles are present or not. It is far easier to keep the beetles off the plants than to drive them away after they have once become established. To effectively protect the plants it may be necessary to spray them every three or four days for a period of three or four weeks.

Another method of controlling the beetles is to dust the plants with land plaster, sifted ashes or other fine powder, to which a small quantity of turpentine or crude carbolic acid has been added. Three or four tablespoonfuls of the liquid are thoroughly mixed with a half-peck of the powder in a pail. The bottom of an old tin can is punched full of holes with a shingle nail, and the can tacked to a piece of lath about three feet long. This can is filled

with the prepared powder, and a person walking across the field dusts two rows at a time by shaking the can slightly over each hill. It is unnecessary and unwise to place a large quantity of the powder on the plants, for excessive quantities, especially if air-slaked lime is used, may cause serious injury. Light applications, repeated at frequent intervals, are preferable.

When the plants are grown in a hotbed, the beetles often do not find them; but in case of a threatened attack, the bed can be

covered with netting, or the plants very quickly sprayed or dusted, since they are all in a limited area. It may also be necessary to treat the transplanted plants once or twice after they are in the field.

**Melon Lice.**—Another insect likely to attack muskmelons, cucumbers and watermelons is the melon louse or aphid (Fig. 130). This insect is likely to be especially bad in hot, dry weather. It commonly appears about the time the plants begin to run. Usually the first attack is confined to a few hills, which may be in various parts of the field. Unless prompt treatment is given, the insects spread rapidly to adjoining hills, and may be distributed throughout the field by the time the first fruits have set. These insects feed upon the under side of the leaves, causing them to curl. They suck the juice from the plant and render the vine so weak that the quality of the fruit is seriously impaired, and in case of a severe attack, especially in dry weather, the vine may be completely killed.

Under normal conditions, the natural enemies of the aphid, notably the lady beetle, will do much to keep this insect in check. In fact, many growers depend almost entirely upon the work of this predaceous insect to control the lice. If a melon or cucumber

hill is discovered to be only slightly infested with lice, and the lady beetles are abundant, it is safe to leave the two species to fight out their battle together. If, however, the lice are abundant on the hills attacked, or the lady beetles are scarce, a common way of preventing the spread of the lice and the possible loss of a large area from the field is to bury the affected hills with dirt where they stand. To be effective this method must be put into operation as soon as the insects appear.

However, the most efficient method of controlling the lice is spraying the vines with a commercial preparation of nicotine sulfate, known in the trade as "Black Leaf 40." This is an exceedingly concentrated tobacco product and is diluted with 1000 times its volume of water for the spraying of melon lice. Since the lice are sucking insects, they must be killed by contact, and it is necessary that the spray be so directed as to hit the insects

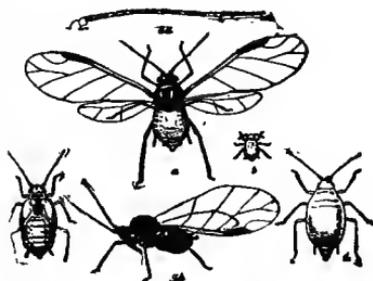


FIG. 130.—Melon aphid.

themselves. The under sides of the leaves must therefore be sprayed. This is accomplished by using a nozzle that is set at an angle on a short spray rod. High pressure should be used so that an exceedingly fine, mist-like spray will be produced. The spraying should be done when the lice first appear, and before the leaves become badly curled. The modern method of training muskmelon and cucumber vines in "windrows" makes it possible to do the spraying much more readily than if the vines are allowed to spread promiscuously over the ground. The spraying of watermelon vines is more difficult, especially if spraying becomes necessary late in the season after the vines are large.

#### MUSKMELONS

Two types of muskmelons are widely grown under field conditions in America: The large fruited and the small fruited. The large-fruited sorts are grown chiefly by market gardeners for local trade and in private gardens, while the small-fruited sorts are grown much more extensively in trucking regions for shipment to distant markets. There are green-fleshed and salmon-fleshed varieties in both types. The green-fleshed sorts are usually more delicately flavored than the salmon-fleshed, the latter having a more pronounced "musky" flavor.

**The soil for muskmelons** must be well drained and contain an abundance of humus and readily available plant food. If these conditions are met, it matters little what the particular type of soil may be. The crop may be successfully grown (Fig. 131) on the light sandy soils of watermelon regions, on thin gray and yellow silt loams, and on the deep prairie soil of the corn belt.

A knoll or ridge sloping gently to the south and protected by timber on the north and west furnishes an ideal site for melons. Such a location will usually produce earlier melons than a north or west slope and is better than a level area because the soil dries out more quickly after a rain, thus permitting more timely tillage in a wet season, and resulting in the production of melons of better flavor. It is only in dry seasons that low, flat lands, unless thoroughly tile-drained, produce good melons.

The condition of the soil in reference to its supply of humus has a marked influence upon the welfare of the melon crop. Because of its abundance of humus, newly-cleared timber land is well adapted to melon culture, but is difficult to work on account

of the stumps and roots. Land slightly deficient in humus can be put into condition for growing melons by plowing under a clover sod, or a crop of cowpeas or rye, or a coat of manure applied broadcast. If melons are to be grown as one of the crops in a regular rotation, they should constitute the crop immediately following the leguminous crop designed to add humus and nitrogen to the soil.

Even with careful attention to rotation and the incorporation of humus by plowing under catch crops or manure, ordinary farm



FIG. 131.—A good hill of muskmelons.

land—including good corn land—is not sufficiently rich to produce a satisfactory crop of melons without the use of fertilizing material in the hills. It is only on garden soil that has been made exceedingly rich by repeated applications of manure that it is wise to attempt to grow melons without special treatment of the hills. Various fertilizers have been suggested, but the material most extensively used and most certain of producing satisfactory results is well-rotted stable manure or compost.

**Time of Planting.**—The muskmelon is a warm season crop, and unless the soil is warm and the weather favorable the seeds will not germinate nor the plants grow. It is therefore usually

unwise to plant in advance of the normal season in the hope of securing an early crop. Occasionally, such plantings do well, but usually the stand is poor, necessitating much replanting, and the early plants which do survive are likely to be so badly stunted by reason of the cool weather that they do not mature their crop much in advance of the later plantings which have had the benefit of warm weather from the start. Under normal seasonal conditions, planting can safely begin in central latitudes from the tenth to the twentieth of May.

**Preparations for Planting.**—Melon ground should be plowed early in the spring, or replowed if it was broken in the fall. After plowing, it should be thoroughly pulverized by the use of a disk harrow or smoothing harrow, or both, and then kept in good, friable condition by occasional working until planting time arrives. Shortly before planting is to begin, the field should be furrowed out both ways with a single-shovel plow or a one-horse turning plow. The furrows should be about six inches deep and as far apart as the hills are to be placed. On some soils melon vines make only a moderate growth and the hills may be planted as close as four feet apart each way, but on rich soil, where they make a stronger growth, they should be at least five by five, and in some cases six by six.

After the land is furrowed out as indicated, the rotted manure is applied at the intersections of the furrows (Fig. 15). Three or five rows are usually manured at a time, the wagon straddling the middle row. From a quart to a half-peck of manure is used for each hill, depending upon the quality of the manure and also the quantity available. The manure is dropped into the bottom of the furrow, and either mixed thoroughly with the soil there, and covered with a layer of pure soil in which to plant the seed, or is merely covered with the soil without any mixing. The latter method seems to give fully as good results as the former, especially when a small quantity of manure is used, and is a great saving of labor. In either case, especial care should be taken to compact the soil over the manure so that when the seed is planted it will not suffer from lack of moisture by reason of any vacant air space in or about the mass of manure. Sometimes the manure is covered with soil by merely plowing a furrow on each side of the furrow containing the manure, but unless the soil is in exceedingly fine condition, this method is not as satisfactory as using a hoe and giving each hill individual attention. In making the hill, some

planters compact the soil with the hoe, while others use the feet. The extent of compacting advisable will depend upon the type of soil and the amount of moisture it contains. When ready for planting, the hill should be practically level with the general surface of the field. If too low, the hill will become water-soaked in case of rain and the seeds or plants injured; if too high, there is likely to be insufficient moisture to insure proper germination and growth.

**Planting the Seed.**—If the hills have been made more than a few minutes before the seed is dropped, the top layer of dry soil should be scraped aside with a hoe so that the seed may be placed in immediate contact with moist soil. The area thus prepared for planting the seed should be at least six inches across, and should be smooth and level. From ten to fifteen seeds should be scattered uniformly over this area and covered with about half an inch of fine, moist soil. This should be firmed with the back of the hoe and then covered with a sprinkle of loose dirt to serve as a mulch. If a heavy rain packs the top soil and a crust is formed before the plants appear, it is wise to go over the field and carefully break the crust over each hill by means of a garden rake.

The method of preparing the hills and planting the seed described above applies to field rather than garden conditions and to soils of medium rather than excessive fertility. In a market garden, where the soil is exceedingly rich as a result of repeated manuring for onions or cabbage and is in fine tilth, it is a common practice to sow the melon seed in drills six to eight feet apart by means of a garden seed drill. This is done without any special preparation of the soil where the plants are to stand, or application of fertilizing material other than manure applied broadcast before plowing.

**Poisoning Field Mice.**—The night after the seed is planted, a large part of it may be dug up and destroyed by field mice. If the seeds in each hill have been planted close together, the hills that are attacked are usually destroyed completely, but if they have been scattered as previously advised, some seeds may escape. However, in regions where mice are at all abundant, some additional precaution is necessary in order to insure a stand of plants. The simplest method is to scatter poisoned melon seed about the field the day the crop is planted. For poisoning the seed, one-eighth of an ounce of strychnine is dissolved in a quart of water. Hot water should be used, since several hours are required to effect

solution. Sometimes a small quantity of sugar is added. After the strychnine crystals are completely dissolved, a quantity of melon seed is placed in the solution and allowed to soak for twenty-four hours. The seed is then removed from the solution and scattered about the field where the mice can readily find it. Usually ten or fifteen seeds at a time are dipped from the mass by means of an old teaspoon, and dropped close to a melon hill. These little piles of poisoned seed are placed at intervals of three or four hills in a row entirely around the portion of the melon field planted that day, and also in several rows extending lengthwise and crosswise of the area. If replanting becomes necessary from any cause, a fresh lot of poisoned seed is applied.

The solution of strychnine from which the seed has been removed can be used for soaking additional lots of seed until it all has been absorbed. If the last lot of seed to be used does not take up all the solution, corn meal is added and the mass of corn meal, melon seed and strychnine applied, so that no unused poison is left about the premises.

Instead of the melon seed soaked in strychnine, a mixture of corn meal and Paris green is sometimes used. This is prepared by mixing an ounce of Paris green in a quart of water and stirring in enough corn meal to form a thick mash.

When there is danger of birds or poultry getting the poison, the poisoned seed or meal is placed on shingles, bits of board or chips, at nightfall, and removed in the early morning. This is repeated until the planted seeds germinate.

**Thinning the Plants.**—While ten to fifteen muskmelon seeds are planted per hill for the sake of insuring a full stand, only two, or at most three, plants are left to make the crop. Thinning is usually deferred until the plants have become fully established, and the struggle against the striped beetle is nearly over. However, the plants must be thinned before they begin to crowd badly, or those which are to remain will be stunted in growth. Usually the thinning is completed by the time the plants have four rough leaves. If the seed has been well scattered in planting, so that each plant stands apart by itself, the superfluous plants may be pulled with the fingers, but extreme care must be taken to avoid disturbing the roots of the remaining plants. Sometimes the plants are cut off with a knife or shears instead of being pulled, and thus all danger of disturbing the roots is avoided.

If the seeds have been sown with a drill as in market garden

practice, the plants are usually thinned to one in a place at distances of two to two and one-half feet in the row.

**The Transplanting Method.**—Since it is impossible to increase the earliness of the crop to any great extent by early planting in the field, some growers have adopted the transplanting method. This makes it possible to plant the seed three or four weeks earlier than would otherwise be feasible, and to grow the plants under controlled conditions of temperature and moisture during their most critical period. It also simplifies the matter of protection from striped beetles. The main objections to this method are the expense for sash, and the difficulties attending transplanting.

A melon plant will not survive transplanting if the root system is disturbed. For this reason the seed is sown on inverted sods, in pots or in dirt bands. The dirt bands are used almost exclusively by commercial growers. These are thin strips of wood veneer, three inches wide and eighteen inches long, scored at intervals of four inches so that they can be bent without breaking (Fig. 132). When folded ready for use, each band resembles a small strawberry box without the bottom. These bands are placed close together in a hotbed and filled level full with fine, rich soil. With a block of wood shaped for the purpose, the soil within each band is pressed until it is one-half to three-fourth inch below the top of the band. If only part of the dirt is put in at first, and is pressed down firmly, then the rest of the dirt put on and pressed, the soil in the band will be more compact throughout and will hold together better in the transplanting than if the dirt were pressed only once. Unless the soil used was very moist, the bed is then thoroughly watered. Next, three seeds are placed in each band. These are covered with fine, loose soil deep enough to fill the band. This soil is not firmed.

The hotbed for melon plants should have full exposure to light and be maintained at a high temperature—about 85° F. during the day and 65° to 70° at night. As much ventilation should be given as the weather will permit, and care exercised to avoid over-watering.

As soon as the plants are well started, they are usually thinned to two in a band by cutting off the extra plant with a sharp knife. The thinning is done when the plants are about the size of those represented in Fig. 133.

When the plants are about four weeks old from the planting of seed they will be in the right condition for transplanting to the



FIG. 132.—Placing dirt bands in a hotbed.

FIG. 133.—Muskmelon seedlings growing in dirt bands in a hotbed.

FIG. 134.—Lifting melon plants from the hotbed.

field. They are then compact, stocky plants with about four rough leaves. If allowed to remain longer in the bed they begin to stretch for light and are of little value for planting, for the long, naked stems, unable to support themselves and unaccustomed to direct sunlight, would easily be sunburned, and the plants seriously checked if not killed outright.

When the plants are ready for the field, the bed is thoroughly watered, and the bands, enclosing their masses of earth and plant roots, are lifted by means of a spade (Fig. 134) and placed close together on the platform of a low wagon. The wagon is then driven to the field where the hills have previously been prepared by mixing rotted manure with the soil as already described, except that the mixture of soil and manure usually extends to the surface. The hills are opened with hoes or a plow just ahead of the planters. When a plow is used it may be necessary to follow with hoes to remove the lumps from the bottom of the furrow at the point where each plant is to be set. Five rows across the field are set at a time, the team straddling the middle row. The plants are lifted from the wagon either by hand or with the aid of a flat trowel made for the purpose, and carefully placed in the hills, band and all. Care is taken to be sure that the bottom of the mass of earth within the band is in close contact with the soil of the hill. Then the band is carefully removed, and fine, moist soil is drawn in about the mass of earth containing the plants.

**Cultivation.**—Whether the melons are transplanted from a hotbed or grown from seed planted in the field, the tillage of the crop should begin as soon as the plants can be seen. In case of transplanted plants, this will be the same day that they are set in the field. The early tillage should be deep, and as close to the plants as it is feasible to run the cultivator. The object of this deep tillage is to establish a deep root system so that the plants will not suffer so severely from dry weather later in the season. In the case of a field-planted crop it is not feasible to cultivate so close to the plants early in the season because of the danger of tearing out the little plants. For this deep tillage a one-horse five-shovel cultivator, often weighted with a rock, is the tool most commonly used. It is customary to follow this with a "boat" (Fig. 135) or a 14-tooth cultivator to more fully pulverize the soil. Tillage is usually given after each rain or at least once each week so that the soil is maintained in a loose, friable condition. In addition to the cultivation with the horse, much hand hoeing

is required close about the plants. Any crust forming after a rain is broken, and fresh, moist soil drawn up about the plant. Grass and weeds appearing in the hill are removed by hand.

Most growers cease tillage and lay-by the crop as soon as the vines have run enough to interfere with the cultivator. The experience of a few growers, who have turned the vines and kept them in windrows so the tillage could be continued until the picking season opened, indicates that a departure from the old method is likely to insure better development of the melons and a longer picking season, though the first fruits may not ripen so early. There is another distinct advantage in this turning of the vines, in that the gathering of the crop is greatly facilitated and there is no injury to the vines from tramping.



FIG. 135.—"Boat," a home-made device used in the tillage of melons.

**Extremes of Moisture.**—The muskmelon suffers severely from extremes in the moisture supply. An excess of moisture can be largely avoided by planting on well-drained land, as already suggested; but if the rain falls in torrents, as it often does in the melon regions, the soil is washed along the hillsides, and many vines and melons are partially buried in mud. Sometimes entire hills are destroyed, but usually most of them can be saved by sys-

tematically digging them out. If a melon fruit is allowed to remain partially buried, the part that is under ground does not develop properly and will be of poor flavor. In fact, if melons are being grown for a select trade and the season is wet, it may be necessary to go over the field repeatedly and move each melon out of the pocket of mud which has been made about it by the rain; for the smaller the point of contact of the melon with the earth, the more nearly will the lower side equal the upper in reference to flavor. The old gardeners' practice of inserting a shingle or piece of slate under each melon for the sake of improving its flavor is not without foundation.

While excessive rainfall is unfavorable to the proper growth and development of muskmelons, and comparatively dry weather at the time of maturity is considered essential to the production of melons of the highest quality, yet muskmelons will not withstand as much drought as watermelons. Extremely dry weather associated with excessively high temperatures, especially if these conditions obtain before the melons are netted and continue for a considerable time, will sometimes cause the melons to ripen prematurely without properly netting and to be of little commercial value. In an unirrigated region, little can be done to help the crop under such conditions, though the influence of an ordinary drought can be largely overcome by continuing tillage until late in the season, as already suggested.

**Melon Rust.**—After the muskmelon crop has escaped the ravages of the mice, beetles and lice, and the melons are almost ready to harvest, a fungous disease known as the “rust” is likely to cause the foliage to collapse and the melons to ripen prematurely without a proper development of netting or flavor. This disease appears first as small, circular, brown spots on the leaves. The spots gradually increase in size and number until finally they run together and the entire leaf becomes brown and dead. The oldest leaves, at the center of the hill, are the first to be attacked, and the infection gradually spreads outward until all the foliage is involved (Fig. 136). If the leaves die before the melons ripen, the fruits do not develop normally and are decidedly deficient in both netting and flavor.

Repeated tests show that the rust can be controlled to some extent by thorough and persistent spraying with Bordeaux mixture. A dilute mixture is used, consisting of two pounds of copper sulfate and four pounds of lime to fifty gallons of water. Spraying should begin soon after the vines have set their earliest fruits, and should be repeated at intervals of one week until the harvest is well under way. This treatment will not prevent the appearance of the rust, and in many cases will not prevent even the ultimate destruction of the foliage, but it retards the development of the disease and keeps the leaves green for a longer time than would otherwise be the case (Fig. 137). This enables the melons to develop normally and acquire the requisite netting and flavor.

The cheapest way to do the spraying is to train the vines lengthwise of the row, as already suggested for facilitating late

tillage, and to use a three-row sprayer. For large areas, a geared-power row-sprayer may be employed (Fig. 52). On stumpy ground, or where the vines have not been turned, a few rows may be turned to make driveways every sixty feet, and by the use of a long hose a strip thirty feet wide can be sprayed on each side of each driveway.



FIG. 136.—A muskmelon vine killed by rust.

FIG. 137.—A muskmelon vine protected from rust by spraying.

The introduction of rust-resistant varieties of muskmelons within the last few years has made it possible to avoid severe injury from the rust without resorting to spraying, and where these varieties are grown, spraying for the rust may be unnecessary.

## WATERMELONS

Watermelons constitute one of the most important truck crops. They are grown almost exclusively on low-priced land at a distance from market and are seldom found in market gardens near cities. There are various reasons for this. The value of the crop from an acre is not sufficient to warrant its production on high-priced land, and watermelons will not stay on the vines until they reach maturity in a densely-populated district. Furthermore, the soil and climate in many localities are not adapted to the production of watermelons. Profitable watermelon culture is confined almost exclusively to sandy soil and hot climates. The farther north they are grown, the earlier the varieties that must be selected and the more imperative the demand that the soil be sandy.

**Soil.**—Watermelons are usually grown on yellow sand ridges or knolls, where the drainage is good, rather than on the rich, darker, level, sandy bottom lands between the knolls or close to river beds. Often the watermelon lands are in the vicinity of rivers but are usually at a considerable distance above the level of the water.

Often watermelons are the only truck crop grown in a given locality. When grown for shipment they are usually planted in large fields and grown in rotation with grain and other farm crops rather than with garden or truck crops. Experienced growers like to plant watermelons following a crop of grass, clover or cow-peas, or following the plowing under of fall-sown rye when it is from one to two feet in height. Sometimes land is allowed to lie fallow and grow up to weeds for a year or two before planting to melons. Land newly cleared of scrub pine or oak is also considered desirable for watermelons. In general it is considered undesirable to plant watermelons very frequently on the same piece of land, though this is often done in distinctively watermelon localities, where a large percentage of the tillable land is devoted to this crop.

**Preparations for Planting.**—Comparatively little labor is required to prepare sandy land for the planting of watermelons. Sometimes it is plowed in the fall and planted in the spring without replowing. At other times, merely a strip two or three furrows wide is plowed at planting time, where each row is to be placed, and the intervening space plowed later, a furrow at a time, as the

vines grow. Sometimes this is done even when the field is occupied by fall-sown rye. The standing rye between the rows is thought to be a protection to the young melon vines from cold winds. Some growers, however, plow the whole area of the field in the spring the same as for planting any other crop. In any case, very little or no harrowing is given the land previous to planting. Of course this applies only to typical sandy watermelon land; other types of soil would remain too lumpy following plowing. It must also be remembered in this connection that the watermelons will withstand extreme drought, and hence will thrive even though precautions for the conservation of moisture are largely neglected. Such a course could hardly be followed in the case of any other cultivated crop.

Preparatory to planting the watermelons, whether the field has previously been plowed or not, it is customary to plow a double furrow where each row is to stand, throwing the dirt out on both sides, or to make a deep furrow with a lister. Usually single shallow furrows are also plowed crossways of the field to mark the rows so that the watermelons can be planted in checks. The distance of planting varies in different localities from eight by eight to ten by twelve feet. Ten by ten is a common distance.

After the land is furrowed out, a quantity of rotted manure, varying from a spadeful to a scoop-shovelful, is placed where each hill of melons is to stand. After the manure is placed, it is covered by plowing in one or two furrows on each side of the furrow previously made. Sometimes the ridge thus formed is smoothed down by drawing a log or planker over it, or a small block of wood drawn by one horse and guided by handles may be passed crossways over the ridges to level them down merely at the points where the melon hills are to be placed. The seeds are then planted. Usually ten or twelve seeds are planted to the hill, though the vines are thinned down to one, or at most two in a place, before they commence to run.

**Cultivation.**—Watermelons are usually cultivated astride the row with a regular two-horse corn cultivator. If the entire field has been plowed previous to planting, the space between the rows also is cultivated with the same tool, and tillage is given in both directions. If only a narrow strip has been plowed for each row, the tillage between the rows consists principally in completing the plowing of the field. For the last tillage close to the rows the vines have to be turned. In some localities, the practice is to

wad up the vines of each hill into a little bunch about the size of a half-bushel basket and cultivate astride the row the same as when the plants were small. It is necessary to straighten out the vines the same day, or they will grow into a hopeless tangle. Another common method is to turn the vines lengthwise the row and cultivate as close as possible on each side. In this case, care is taken to keep the vines and leaves right side up when they are turned, and they are not turned back following the tillage, but allowed to branch out sidewise as growth continues. It is considered unwise to turn watermelon vines or otherwise disturb them after the fruits have set. Therefore the last cultivation close to the plants is usually given just before the melons begin to form.



FIG. 138.—Kleckley Sweets watermelon. A favorite variety for home use.

In addition to the cultivation with horse tools, considerable hand hoeing is necessary in the production of a good crop of watermelons. Different growers hoe them about the hill from three to six times, and it is considered that there is a fairly close relation between the amount of hoeing and the size of the melons produced.

**Size of Melons.**—The size of the melon also depends to some extent upon whether one or two vines are grown per hill, and whether or not deformed and defective melons are cut off while young, so that the strength of the vine will be concentrated on

those that remain. Since small melons are not wanted in most markets and buyers are likely to reject specimens under eighteen pounds in weight, it is wise for watermelon growers to use every effort to produce large-sized melons.

**Watermelons for Home Use.**—The above discussion refers primarily to the growing of watermelons on a commercial basis. For home use they may be grown on almost any good soil where the season is sufficiently long and hot for the melons to ripen. Except under favorable conditions of soil, climate and cultural methods, the melons are likely to be small. This does not, however, impair their quality for home consumption, and the fact that a person is not located upon a distinctively watermelon soil should not deter him from growing a supply for home use (Fig. 138).



FIG. 139.—Citron or preserving melon.

#### CITRON OR PRESERVING MELON

The citron closely resembles the watermelon in general appearance of vine and fruit; and the cultural methods are essentially the same for both, except that the citron is somewhat less particular as to soil than the watermelon. The flesh as well as the rind of the citron is of much the same consistency as the rind of a watermelon, and is used for making sweet pickles and preserves. It is not edible in the raw state.

The citron melon contains an unusually large percentage of pectin—the substance which must be present in fruits to make their juice “jell.” It has been discovered that the addition of equal parts of the pulp and juice of the citron melon to fruits such as peaches, cherries, blue berries and others, which will not

“jell” by themselves, causes them to make perfect jelly. This makes a much wider range of flavors possible to the house-wife who takes particular pride in her store of jelly for winter use in her own family, or for the countrywoman who makes jellies for city markets as a means of earning spending money.

## CUCUMBERS

Cucumbers are used almost entirely in an immature state. This makes it possible for the crop to develop in considerably less time than is required for muskmelons or watermelons, and therefore extends the northern limit of cucumber culture considerably beyond that of the melons. In central latitudes it is possible to produce a crop of cucumbers from outdoor plantings made as late as July 1.



FIG. 140.—A slicing cucumber.

Cucumbers are grown for two distinct purposes: For slicing in the fresh state (Fig. 140), and for making pickles. For slicing, they are gathered after they have attained full length and have filled out considerably, but before the seeds begin to harden. For pickling they are gathered at various stages of earlier development, but are especially desired when under four inches in length. The pickling of cucumbers is an important industry, and in certain localities hundreds of acres are devoted to growing this crop for the factories.

For the production of pickle cucumbers earliness is no particular object, and planting is usually deferred until at least the fifteenth or twentieth of June in order to escape the severest attacks of the striped beetles. In the case of slicing cucumbers, however, earliness is a prime factor, since the crop is most in demand early in the season. Therefore the seeds are planted as early as the weather

will permit, and may even be started under glass by the use of dirt bands, as described under " muskmelons " (see p. 225).

**Soil.**—Cucumbers demand more moisture than any of the other vine crops. They also require a soil rich in humus. Therefore they are usually planted on low spots near creek beds or in depressions between knolls, where the soil is black and deep. For the best results with cucumbers the soil should be sufficiently rich to produce the crop without the addition of manure in the hills, though heavy manuring in the hill is often practiced for the early crop.

For the planting of cucumbers, hills may be prepared the same as for muskmelons, and the crop planted at the same distances and tilled in the same way. In rich market gardening soil, for a crop of pickles the seed may be sown with a drill, in rows six to



FIG. 141.—Gherkin vine and fruit.

seven feet apart, and the plants thinned to a foot apart in the row. If the vines are trained lengthways of the row as suggested for muskmelons, the gathering of the pickles will be greatly facilitated and the vines remain untramped.

#### GHERKINS

Sometimes extremely small pickle cucumbers are called gherkins. However, this name is applied also to a distinct species of cucumber-like plant which produces small, oval, prickly fruits about an inch long (Fig. 141). They make exceedingly fine pickles

and are very high priced, and hard to obtain in the market. They are the most easily grown of any of the vine crops thus far discussed and are much surer of making a crop than are cucumbers, especially in a dry season. The chief objection to growing them is the large amount of time required to gather the crop. The fruits are so small and produced so continuously that the task of pickling them becomes very tedious before the season is over. For home use, a few hills will furnish all that an ordinary family will care to pick.

## SQUASHES

**Types.**—There are two distinct types of squashes, summer and winter. The summer squashes are used in an immature stage,



FIG. 142.—Bush form of summer squash.

before the shell or seeds harden. In some varieties the flesh becomes coarse and bitter at maturity. The winter squashes are allowed to reach full maturity unless overtaken by frost, and under proper storage conditions may be kept until late in the winter. The summer varieties commonly grown are of bush form (Fig. 142), while the winter varieties make long trailing vines. The summer varieties are less exacting as to soil and climate than the winter sorts and are the more reliable crop producers under unfavorable conditions. They will make a crop in the shade of a corn field

and will also endure the intense heat of southern summers. Winter varieties, on the other hand, do not thrive in competition against corn, and suffer severely from extreme heat or drought. The summer varieties have hard, dense stems and vines, while those of the typical winter varieties are more fleshy and succulent (Fig. 143). The summer varieties are small fruited and the winter varieties large fruited.

In addition to the two common types already mentioned, there



FIG. 143.—Hubbard squash, showing fleshy stem typical of the large winter varieties.

are also two others that are grown to some extent. One is a small-fruited type resembling the summer varieties in size of fruit, texture of stem, and ability to withstand heat and drought. They are, for the most part, running rather than bush varieties. The fruit may be used at an immature stage, like summer squash, and they are also of good quality when mature. They may be kept for winter use the same as the large winter varieties. A typical representative of this class of squash is the Perfect Gem (Fig. 144). Another type of squash grown to a limited extent in this country is the Winter Crookneck or Cushaw. It forms long, often curved, fruits of large size, in which the seed cavity is confined to one end, while the rest of the squash is a neck, three to five inches in diameter, which consists of solid flesh (Fig. 145).

In England the vegetable marrow is used the same as summer squash is in America. It forms a running vine, and is handled



FIG. 144.—Perfect Gem squash, showing small, hard stem.



FIG. 145.—Section of winter crookneck squash, showing the solid flesh of the "neck."

the same as other squashes. It is grown to a very limited extent in this country (Fig. 146).

Squashes in general are grown much less in America than their importance as a food would seem to warrant. Markets that handle hundreds of carloads of watermelons during a season are easily overstocked with a few carloads of winter squashes.

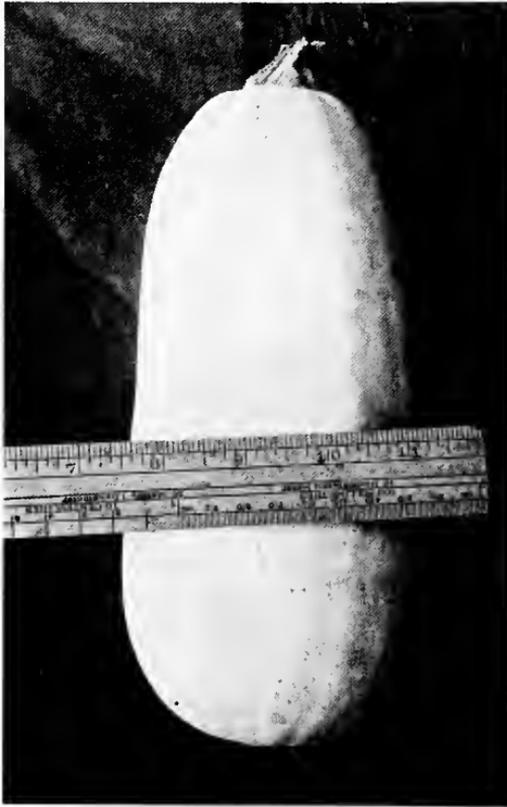


FIG. 146.—Vegetable marrow; a favorite in England.

**Culture.**—Squashes thrive best in soil containing considerable humus. Manure applied broadcast and also in the hill contributes greatly to the production of a good crop. The method of preparing a field for planting is much the same as for other vine crops. The entire area should be plowed and pulverized before the hills are made. For bush varieties the hills may be four by four feet; for

running sorts they should be from eight by eight to ten by twelve, depending upon the vigor of the particular variety and the type of soil. Usually the seed is planted in the open ground, but occasionally the summer varieties are started in hotbeds and transplanted to secure an early crop. The same precautions must be taken as in transplanting muskmelons and cucumbers. Two to three plants should be allowed in each hill. The tillage and general care of the crop are the same as for the other vine crops. The



FIG. 147.—One type of "pie" pumpkin: of small size, but high quality.

running varieties make a rampant growth and no amount of training will keep them within prescribed limits. For this reason they should never be planted close to small vegetables that occupy the land late in the season.

#### PUMPKINS

Pumpkins are of three principal types: "Mammoth," grown mainly for exhibition purposes; "field," grown especially for stock feeding; and "pie," produced principally for the making of

pumpkin pies. Almost any variety of pumpkin may be used for making pies, but some sorts are especially adapted to this purpose (Fig. 147). They are finer grained and sweeter than the other sorts. They may be stored for the winter supply of pies, or the flesh may be canned for the making of pies at any time of the year.

Field pumpkins are often grown as an incidental crop in corn fields. They are like the summer squash in being able to endure the shade and also the competition against the corn. However, pumpkins are much more likely to produce large crops if they are relieved of such competition and given a piece of land to themselves. In this case they are planted and cared for much the same as winter squashes. However, on rich land it is not necessary to apply manure in the hills unless extra large specimens are desired.

### QUESTIONS

1. What plants belong to the group known as vine crops?
2. What common characteristics have the vine crops?
3. What insect enemy is common to all the vine crops?
4. Discuss means of controlling the striped cucumber beetle.
5. How does the melon aphid affect the melon crop?
6. What different ways have been suggested for the control of the melon aphid, or louse? Which way is the most effective?
7. What different types of muskmelons are recognized on the market?
8. Describe an ideal site for growing muskmelons.
9. Discuss the fertilizing of muskmelons.
10. When should muskmelons be planted.
11. Describe the preparation of a field for planting melons, including the making of the hills.
12. Describe the actual process of planting the melon seed.
13. Describe the method of poisoning field mice to protect newly-planted melon seed.
14. How many muskmelon vines should there be in a hill? How and when are the surplus vines removed?
15. What are the advantages of transplanting muskmelons?
16. Describe the method of growing melon plants for transplanting.
17. At what age are melon plants transplanted?
18. Describe the process of transplanting the melon plants from the hotbed to the field.
19. Describe the tillage of a commercial plantation of muskmelons.
20. How does excessive moisture affect muskmelons?
21. Will muskmelons withstand extreme drought?
22. What is the effect of melon "rust" on the quality of muskmelons?
23. How may melon rust be controlled?
24. What sort of a spraying outfit can be used in a melon field?
25. What is meant by a "rust-resistant variety" of muskmelon?
26. Under what conditions of soil and climate do watermelons thrive?
27. Describe the preparation of land for the planting of watermelons.

28. Describe the tillage of watermelons, especially the last tillage of the season.
29. What size of watermelon is most in demand on the market?
30. Can watermelons for home use be satisfactorily grown on other than sandy soil?
31. How may the citron or preserving melon be grown?
32. Why can cucumbers be grown in a shorter time than melons?
33. For what two uses are cucumbers grown?
34. At what stage of development are cucumbers gathered for slicing? For pickling?
35. When should cucumbers be planted?
36. Describe two ways of planting cucumbers.
37. What are gherkins and how are they grown?
38. What are the two common types or classes of squashes?
39. In what respects do these two classes of squashes differ?
40. What other types of squashes are grown to a limited extent?
41. How far apart should squashes be planted?
42. What are the three principal types of pumpkins?
43. How do "pie" pumpkins differ from the other types?
44. Under what conditions may pumpkins be made to produce a maximum crop?
45. What vine crops are grown for market near you? Which ones seem to pay best? Why?

## CHAPTER XXVI

### WARM SEASON CROPS THAT REQUIRE TRANSPLANTING

THE plants in this group include two of the most important vegetable crops (tomatoes and sweet potatoes) and two others of considerable importance (peppers and eggplants). All demand high temperature for their best development and have too long a period of growth to produce a full crop before frost unless the plants are started under glass before the weather is warm enough for their outdoor planting in central and northern latitudes.

#### TOMATOES \*

Tomatoes are extensively grown throughout the United States. No home garden or market garden is complete without them. They constitute one of the most important truck crops of the South for shipment to northern markets, and are extensively grown for canning factories. While primarily a long season crop adapted to southern climates and normally continuing growth until killed by frost, it is possible, by the selection of early varieties and by starting the plants early under glass, to grow tomatoes even in the extreme northern states, though the crops may be cut short by early frosts.

**Growing the Plants.**—Whether grown for home use, local market, or shipment to distant markets, it is desirable that tomatoes commence ripening their fruit early in the season and that the crop be large. The first essential in the production of an early crop and large yield is the securing of large, well-grown plants at the proper time for transplanting. To this end, the seeds are sown in flats in a greenhouse or in a hotbed, eight to twelve weeks before the plants are needed. As soon as the seedlings have made their first pair of rough leaves and before they become spindling, they should be transplanted to other flats or hotbeds, being placed about three inches apart each way; or they may be placed in two-and-one-half-inch pots. After growing here for two or three weeks, they should be shifted to a coldframe, in which they are placed six inches apart; or if previously placed in small pots they may be

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\* Adapted from a paper presented by the author at the Fiftieth Annual Meeting of the Illinois State Horticultural Society, December 14, 1905.

shifted to four-inch pots, which are then plunged to the rim in the soil of the coldframe. Here they develop large root systems, and strong, stocky tops that will stand erect when the plants are placed in the field (Fig. 23).

As the time for transplanting approaches, the plants should be gradually hardened-off, so that they will be making a slow, hard growth rather than a rampant, sappy growth, at the time they are placed in the open. If handled in this way, the plants start growth more quickly in the field, and very few are lost by reason of the changed conditions.

**Transplanting.**—In removing the plants from the coldframe, if pots have not been used, it is customary to cut the soil in squares, with a plant in the center of each square, and then carefully lift the blocks of soil by means of a spade, and place them on a low wagon for transporting to the field. Here they are again lifted with the spade (Fig. 148), and placed in holes previously prepared, as described below. The earth is filled in about the plants by means of a hoe.

The preparation of a field for tomatoes does not differ materially from its preparation for corn or other field crops, except that after being plowed and pulverized it is furrowed out for the reception of the plants. The furrows are usually from four to five feet apart each way, the latter distance being preferable except for dwarf varieties. Except in the case of rich soils, it is also customary to apply fertilizer or manure to the hills. After the land has been furrowed out both ways, the loose soil is scooped from the intersections by means of a hoe, making for each plant a hole about one foot across. In this, a handful of fertilizer is scattered just before the setting of the plant. A mixture of steamed bone, dried blood and potassium sulfate, used at the rate of one-fourth pound per plant, is a good fertilizer for tomatoes. Sometimes manure is used in the hills, but more often it is applied broadcast when used at all. Sometimes tomato fields are manured broadcast and fertilized in the hill. However, on rich soils it is not necessary to fertilize in the hills, and good crops can often be grown without manuring or fertilizing of any kind.

The time of transplanting varies somewhat with the season, but in general it may be said to follow closely upon the time of planting early corn. The earlier it can be done without running serious risk of losing the plants by frost, the earlier the crop is likely to be.

**Cultivation** should begin as soon as the plants are set. The early tillage should be deep and close to the plants, but the later tillage should be more shallow in order to avoid injury to the roots. The later the cultivation can be continued, the longer the picking season is likely to last, except in seasons of abundant and well-distributed rainfall. Some hand work close about the plants early in the season will aid in giving them a good start, but if the plants are set so as to be cultivated both ways, little hand work is really necessary.

**Staking.**—In some localities it is customary to support the plants by means of stakes. A stout oak stake five feet long is



FIG. 148.—Transplanting tomatoes, Union County, Illinois.

driven beside each plant. When the plant has reached a height of fifteen or eighteen inches, it is tied to the stake by means of soft, stout twine. The twine is first tied tightly about the stake so that it will not slip; then it is tied loosely about the plant so as not to bind and injure the stems as the plant increases in size. When the plant has grown a foot or so more, it is again tied; and a third tying is usually necessary when the plant has reached nearly to the top of the stake. Sometimes a fourth tying is made in the case of strong-growing varieties.

Many other methods of supporting tomato vines have been employed from time to time, but tying to a single stake, as above

outlined, is the method employed by extensive commercial growers in certain localities where tomato culture is an important industry. It is the simplest and most satisfactory method yet devised that is applicable to large area operations.

The advantages of staking and tying tomatoes instead of allowing them to spread over the ground are that in a cool season the fruits ripen more readily; in a wet season they are less subject to rot; and in a dry season the plants can be kept thrifty and productive by continuous cultivation, long after untrained plants have ceased to bear (Fig. 149). In any season fruits which lie in contact



FIG. 149.—A row of staked tomatoes.

with the ground, as is the case with many fruits on untrained plants, are more or less blemished by rough places on the skin. However, the staking and tying involve considerable expense, and many growers prefer the other method, even though the crop is less certain in an unfavorable season.

The pruning of tomatoes to single stems (Fig. 150) is claimed to hasten maturity, but it greatly reduces the yield.

When tomatoes are grown for canning purposes, earliness is not essential; and since the crop is usually contracted at a low price, cheap methods of culture must be practiced. The plants

are started rather late in a hotbed or a coldframe, from which they are transplanted directly to the field while still quite small, usually being set with a dibber or a spade. They are cultivated entirely by machinery, and are never staked or tied.

**Picking.**—The method of picking and handling a crop of tomatoes depends upon the purpose for which it is grown. If intended

for home use, local market or canning, the fruits are allowed to fully mature upon the vines; if for distant shipment, they are picked as soon as they begin to color.

Care should be taken in the picking and handling of tomatoes to avoid bruising or otherwise injuring the fruits. If the stems are not removed at the time of picking they are likely to puncture the riper specimens.

**Adaptation of Varieties.**—There are many varieties of tomatoes, and the purpose for which the crop is to be grown will be an important factor in determining which variety it is best to plant. Personal preference serves as the chief guide in the selection of a variety for home use. It matters not whether the variety is large or small, wrinkled or smooth, red, purple or yellow, so long as it satisfies the personal tastes of the grower. In the local markets there is usually not



FIG. 150.—Tomato plant pruned to a single stem, and supported by a stake.

much discrimination in favor of particular varieties. However, in a large city market, certain kinds sell much better than others, and the kind should be grown which sells best in the particular market that is to be supplied. For canning purposes, any large, smooth, heavy-meated tomato is usually acceptable, though some factories specify particular varieties in their contracts.

**Diseases of Tomatoes. Leaf Spot.**—One of the most prevalent and widely distributed diseases of the tomato is the leaf spot, sometimes called the "rust." The presence of this disease is indicated by the appearance of small, circular, brown spots on the lower leaves. The infection gradually progresses upward on the plant, the leaves dying in the order of their infection as the season advances (Fig. 151). In the case of a severe attack the vines are



FIG. 151.—Unsprayed tomato plant, badly affected by leaf spot. Lower leaves dead.



FIG. 152.—Sprayed tomato plant. The leaf spot has been effectively controlled.

so weakened that their later fruits fail to develop properly. On untrained vines, the death of the lower leaves so exposes the fruits that they are likely to sunscald. This disease can be readily controlled by spraying with Bordeaux mixture (Fig. 152). Applications should be made at intervals of two weeks, beginning as soon as the plants are set in the field and continuing until the close of the picking season.

**Wilt.**—Another disease of the tomato is the fusarium wilt. This cannot be controlled by spraying, for it lives over winter in the soil and infects the plants through the roots. The first evidence of its presence is the sudden wilting and dying of the entire plant or of one or more of its branches. Cross-sections of the wilted stems show a discolored, brownish appearance of the woody portion, and microscopic examination of the discolored tissue reveals the presence of a fungus. The plants may die before any fruit has matured, or at any time during the normal fruiting season (Fig. 153).



FIG. 153.—Tomato plantation completely ruined by fusarium wilt.

The first season that the wilt appears in a given field, usually only a few plants are infected; but if the same field is used for tomatoes the next year, the attack is likely to be very severe. The best way to avoid serious damage from the disease is to practice rotation of crops so that the soil will not become badly infected. Care should also be taken in securing soil for the hotbeds and cold-frames in which the plants are grown. Fresh soil should be put in the beds each year, and it should be secured from a field which has never grown tomatoes nor received the wash from tomato

fields. It is also important to avoid inoculating a new field by means of soil carried from an infected field on tools or the feet of workmen or farm animals.

#### EGGPLANT

The eggplant is an exacting crop, demanding careful attention to all details if satisfactory results are to be secured. The plants must be kept healthy and growing vigorously all the time. A check in growth at any time during their life is seldom fully overcome, and may result in the complete failure of the crop. The essential requirements of eggplant culture are high temperature, rich soil, thorough tillage, and protection from insects (Figs. 154 and 155).

Since the outdoor conditions in central latitudes are too cold for eggplants until about the first of June, the plants must be started under glass; and since the plants must be well grown at the time of transplanting, the seed should be sown about the middle of March.

**Growing the Plants.**—If a greenhouse is available, that is the best place in which to grow the plants; otherwise, a hotbed will do. In either case, the temperature should be about 80° to 85° F. during the day and 65° to 70° at night. As soon as the plants are large enough to handle, which will be from three to four weeks after the seed is sown, they should be removed from the seed-bed and potted off into two-and-one-half-inch pots, and replaced in the hotbed or greenhouse. Very rich soil should be used in the pots. As soon as the roots fill these pots, the plants should be shifted to four-inch pots. If the roots fill these pots before the weather is warm enough to warrant transplanting into the field, the plants should be shifted again, this time to six-inch pots. The plants must be afforded the protection of the hotbed or greenhouse until the weather becomes warm and settled, even if it be until the middle of June; and during this time they must not be allowed to become pot-bound, for that would check their growth.

**Transplanting.**—When conditions are favorable for transplanting to the field, the plants should be slipped from the pots without disturbing the roots, and carefully planted in rich, thoroughly prepared soil that has been kept moist by repeated harrowing following early plowing. The rows should be placed four feet apart and the plants two to three feet apart in the row.

**Cultural Requirements.**—Eggplants thrive best in hot weather, and although they need considerable moisture immediately following transplanting, after they have once become well established

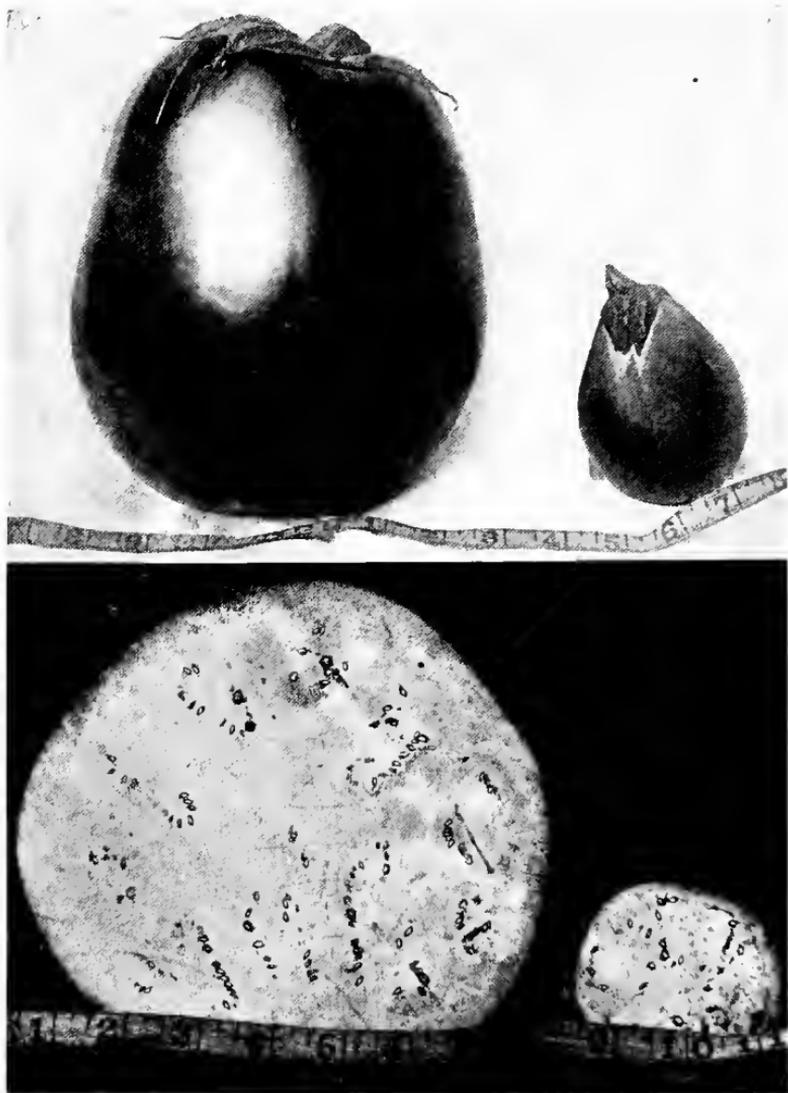


FIG. 154.—Fruit of the eggplant: Large type at left; small, extra early type at right.  
FIG. 155.—Cross-sections of fruits shown in Fig. 154, showing distribution of seeds and character of interior.

they will endure more drought than almost any other garden crop, provided they are growing in rich soil well supplied with humus and are given frequent and thorough tillage.

**Protection from Insects.**—From the time the plants are placed in the field until they are killed by the frosts of autumn they are subject to repeated attacks by small black flea beetles which eat little round holes through the leaves. They are also attacked by Colorado potato beetles, especially the adult form. Sometimes these beetles simply cut the midrib of the leaf as if bent on wanton destruction, and thus do much more damage than would be indicated by the amount of foliage they devour. The attacks of either of these insects result in a weakening of the plant, which may lead to a partial or complete failure of the crop. It is therefore essential that particular care be taken to prevent a serious attack. For this purpose repeated applications of Bordeaux mixture and Paris green should be made. Sometimes from seven to ten applications are necessary during the season.

#### PEPPERS

Peppers demand about the same temperature and care as tomatoes, though the plants grow more slowly, and must be started under glass a week or ten days earlier than tomatoes in order to reach transplanting size at the same time. For an early crop the seeds are sown in flats in a greenhouse, and the seedlings shifted to two-and-one-half-inch, and later to four-inch pots. Following the last shift the pots are plunged to the rim in the soil of a coldframe, where the plants are hardened-off preparatory to transplanting to the field. For a late crop, the seed may be sown directly in the soil of a hotbed and the plants transplanted to the field without any preliminary shifting or the use of pots. However, except in southern localities, a crop started at all late is likely to be cut short by autumn frosts.

In transplanting peppers to the field the rows should be placed far enough apart to admit of tillage with a horse—say three feet—and the plants should be from one to two feet apart in the row. Ordinary good tillage is all that is required. The pepper is not usually subject to attack by any insects or diseases; protection from enemies is therefore seldom necessary. The crop is an easy one to grow, provided the plants are started sufficiently early.

There are two general types of peppers, large and small fruited. The former (Fig. 156) are normally much milder in flavor than

the latter, and are used for salads, "stuffed peppers," and mixed pickles. The small-fruited sorts are for the most part exceedingly pungent, and are most in demand for flavoring pickles or making pepper sauce. Both types may be used in either the green or ripe state, though the large type is more often used green, and the small type in the mature condition. In the South, ripe peppers are dried for winter use; in the North they are sometimes canned.

#### SWEET POTATOES

Sweet potatoes belong naturally to warm climates. They constitute a very important crop in the South and are grown to a considerable extent in certain localities in central latitudes,

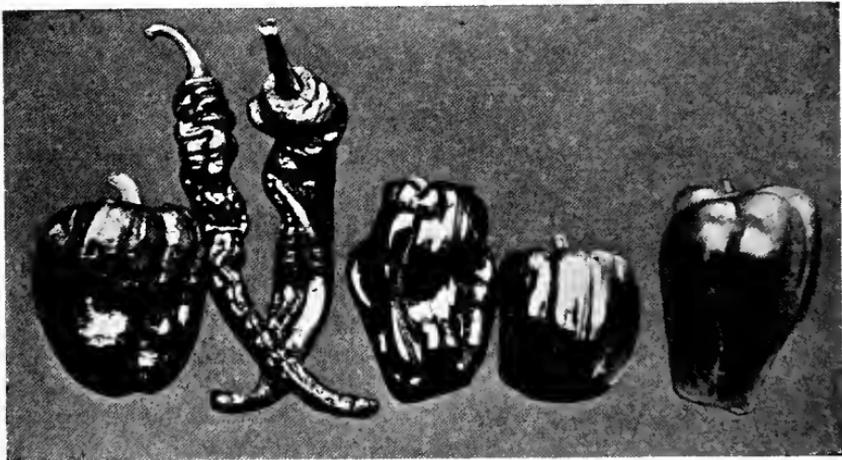


FIG. 156.—Several varieties of large peppers.

especially where the soil is sandy. The farther north they are grown the greater the precautions necessary to insure sufficient warmth and dryness of soil to promote their proper development. Warm, well-drained soil and a southern exposure are selected. The land is thrown up in ridges to further facilitate surface drainage and insure greater warmth (Fig. 157). Planting in the field is deferred until the weather is warm, even if that is after the first of June. The sweet potato delights in hot, dry weather, and after the plants are once fully established, very little rainfall is necessary to produce a good crop. In wet seasons or in poorly-drained soil, the tubers are likely to be long and stringy instead of short and plump, as is desired.

**Propagation.**—The usual way of propagating sweet potatoes is to place a single layer of medium-sized tubers in a hotbed, and cover them with four or five inches of soil or sand. The tubers are placed about half an inch apart, so that if rot starts it cannot readily spread from one tuber to another. This bedding of the seed tubers is done from four to six weeks before the plants are wanted for setting in the field. From three to five bushels of seed tubers are bedded for each acre to be planted. The hotbed is cared for in the usual manner as to watering and ventilating.

A large number of sweet potato plants, called “slips” or “draws,” develop from each tuber. When these have attained a height of from four to eight inches above the surface of the bed, and the season for planting has arrived, they are carefully pulled



FIG. 157.—A few rows of sweet potatoes grown for home use. Each row is on a ridge.

in such a manner as to avoid disturbing the tubers; for if left undisturbed the tubers will continue to produce plants, which may be used for replanting if necessary or for planting additional fields.

**Planting.**—The land for planting sweet potatoes should be plowed early and worked repeatedly so as to have it in good friable condition when the planting is to be done. Just before planting, the ground should be compacted by rolling, then thrown up into narrow ridges about three feet apart, by means of a plow or a “sweep” (Fig. 158). These ridges are then smoothed and somewhat compacted by means of a home-made tool designed especially for the purpose (Fig. 159). The plants are usually

set with a spade and are placed about sixteen inches apart in the row. A man thrusts the spade into the soft earth of the ridge and moves the handle slightly forward, so that a wedge-shaped opening is made. Into this opening a boy thrusts a plant, and holds it in place until the spade is withdrawn and the soil rolls back against the plant. As the man steps forward to make the next hole he places his foot close to the plant already set, and thus firms the soil against the roots. In this way the work progresses very rapidly.

**Cultivation.**—Special tools are used in cultivating sweet potatoes, so that the ridges are retained intact through the season. The principal tools are the “sweep” and “bull tongue,” in addition to the one-horse turning plow, which is used at times to



FIG. 158.—“Sweep” used in making sweet potato ridges.



FIG. 159.—Home-made device for smoothing sweet potato ridges.

“bar-off” both sides of the ridge if crab grass threatens to gain a foothold. In addition to the horse tillage, considerable hand hoeing close to the plants is necessary, for the ridges are scraped clean of all grass and weeds at frequent intervals. Cultivation is continued until the vines nearly cover the ground between, as well as on, the ridges. The crop is then laid-by and allowed to remain undisturbed until time for digging.

**Harvesting.**—Sweet potatoes should be dug before the vines are injured by frost. Special diggers are often used for the purpose where large areas are to be dug. These are equipped with two rolling coulters to cut the vines, two plowshares to cut away both sides of the ridge, and a U-shaped piece of steel that runs under the ridge and loosens up the tubers (Fig. 160). After this machine has passed along the row, the tubers are pulled out by grasping

the stem of each plant in the hand. All the tubers cling to the stem so that an entire hill can be pulled at one time (Fig. 161). The tubers are allowed to lie upon the ground and dry for a few



FIG. 160.—Sweet potato digger. When equipped ready for use the digger carries two rolling coulters to cut the vines.



FIG. 161.—Sweet potato tubers cling to the stem.

hours before they are hauled from the field. When sufficiently dry they are removed from the stems and placed carefully in slatted boxes. Usually the tubers are sorted as they are placed in the

boxes, the largest size being designed for market or table use, the next size for seed, and the "strings" for stock feed. In all handling of sweet potatoes, extreme care must be taken to avoid bruising the tubers.

In the absence of special digging machinery, the sweet potatoes can be loosened up with a plow from which the mould-board has been removed (Fig. 162), then pulled out by hand as already indicated. Small areas in the garden may be dug with a fork.

**Types.**—There are three general types of sweet potatoes:

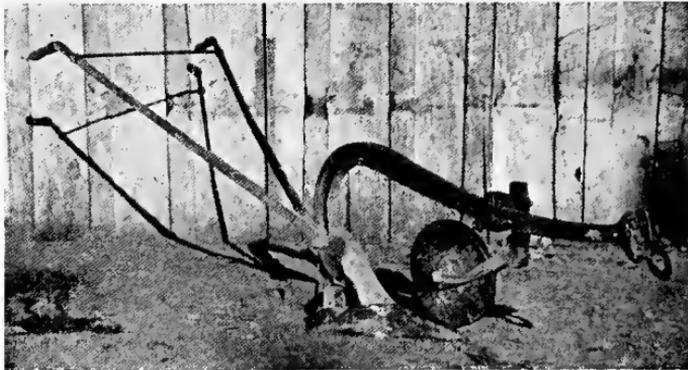


FIG. 162.—Plow rigged for digging sweet potatoes.

Yellow, red, and white. The yellow sorts with dry flesh are preferred on the northern markets. Some of the white sorts with moister flesh are great favorites for table use in the South. The red varieties are coarser and usually less desirable than either the yellow or the white, but are grown in some places because they are less particular as to soil than the other sorts, and are usually very productive.

#### QUESTIONS

1. Name four warm season crops that are usually transplanted.
2. Which is the most generally grown of these four crops? Which in your neighborhood?
3. How much time is required to grow well-developed tomato plants ready for transplanting?
4. Describe the most approved method of growing tomato plants for an early crop.
5. Describe the preparation of a field for the planting of tomatoes, and the process of transplanting.
6. When should tomatoes be transplanted to the field?
7. How are tomatoes cultivated?

8. Describe the most practicable method of supporting tomato vines.
9. What are the advantages of staking tomatoes as compared with allowing them to spread over the ground?
10. What precautions must be taken when picking ripe tomatoes?
11. Discuss the adaptation of varieties of tomatoes to particular purposes.
12. What is the most common disease attacking the foliage of the tomato? How may it be controlled?
13. Describe the appearance of a tomato plant affected with the "wilt."
14. What indirect methods of avoiding trouble from "wilt" of tomatoes may be employed?
15. What are the essential requirements in the growing of eggplants?
16. When are the seeds of eggplants sown, and when are the plants set in the field?
17. Describe the method of growing eggplants up to the time of placing in the field.
18. Describe the transplanting of eggplants.
19. What insects attack eggplants? How may they be controlled?
20. Describe the growing of pepper plants, and the growing of the crop after the plants are set in the field.
21. What are the two general types of peppers? What are the chief uses of each?
22. What soil and climatic conditions are best adapted to the culture of sweet potatoes?
23. How are sweet potatoes propagated?
24. Why are sweet potatoes usually planted on ridges?
25. Describe the process of planting sweet potato "slips."
26. What special tools are used in the tillage of sweet potatoes?
27. Describe the harvesting of sweet potatoes.
28. What are the three general types of sweet potatoes? What are the leading characteristics of each?

## CHAPTER XXVII

### SYSTEMS OF INTENSIVE CROPPING

IN market gardens located on high-priced land and in home gardens where the available area is limited, it is usually desirable to grow more than one crop on the same land the same season. Even where land is cheap and abundant, it may be more desirable to produce an extra crop of vegetables late in the season than to allow the land to become infested with weeds, as would likely be the case if it were allowed to be idle the rest of the season, following the harvesting of a crop of early vegetables.

The growing of more than one crop on the same land the same season is usually referred to as *double cropping*. When two or more crops occupy the land at the same time, they are referred to as companion crops and the system is called *companion cropping*. When one crop is removed before the other is planted the system is called *succession cropping*.

**In companion cropping** both crops are usually planted at or near the same time, but one is harvested much earlier than the other, thus allowing the later crop the entire space in which to develop. In this case the early crop is usually incidental, and considered of much less importance than the later crop. For example, radishes may be sown in the same row with parsnips. They serve the double purpose of marking the row so that the parsnips may receive early tillage, and of giving some revenue from the parsnip ground early in the season. However, parsnips are the main crop, and the radishes merely incidental. In some cases, the early or incidental crop is planted between the rows of the later maturing crop instead of being planted in the same row. For example, a row of radishes may be sown between every two rows of string beans. The radishes are pulled long before the bean harvest begins. In some cases, both methods may be used at the same time, as when head lettuce is planted between the rows of early cabbage and also between the plants in the row. The lettuce is ready to cut just before the cabbage needs all the room.

Sometimes two companion crops may occupy the land nearly the same length of time, but are so different in habit of growth that they do not materially interfere with each other. This is

true of early sweet corn and summer squash, though in some cases the squash, which is really the incidental crop, may continue to grow and produce for a long time after the corn has been harvested. Another combination in which the later crop is the incidental one is onions and leeks. In this case the leek seed is mixed thoroughly with the onion seed at the rate of about one ounce to a pound, and the two are sown together. The onions are harvested when they are ripe in August or early September, but the leeks continue growing until almost time for the ground to freeze.

**In succession cropping**, each crop in the series is harvested and the land usually cleared, plowed, and thoroughly fitted before the next crop is planted. In this kind of cropping, each crop in the series must be able to complete its growth in less than the full season and must leave the land in good condition for the succeeding crop. For this reason, crops subject to attack by the same insects or diseases should not be grown following one another. In order that the land may be occupied the full season it is necessary to begin with a cool season crop that can be planted early. If this early-planted crop is one that matures in a short time, it may be followed by a main season crop requiring warm weather. If, however, the first crop occupies the land until midsummer, it may be too late to plant a warm season crop, so that a crop that thrives during the cool fall months may be the only kind adapted to the combination.

Any of the early spring crops, such as radishes, leaf lettuce, spinach, green onions from sets, mustard or cress, may be used as the first crop in a system of succession cropping. These can be harvested and the ground cleared in time to plant a late crop of tomatoes, peppers, eggplant, sweet potatoes, squash, cucumbers, beans, or sweet corn. In case the early-planted crop were cabbage, cauliflower, peas, beets, carrots, or early potatoes, the land would be occupied too late for planting most of the warm season crops mentioned above, with the exception of dwarf string beans and early varieties of sweet corn. Early peas, beets, and potatoes could, however, be cleared from the land in time to plant late cabbage or cauliflower, rutabagas, turnips, kohlrabi, or winter radishes.

In some cases, three crops in succession may be grown on the same land the same season, and the ground completely cleared and plowed before the planting of each of the crops. In order

that this may be done, all three crops must have relatively short periods of growth, and the first and last must be capable of withstanding frost. One such combination would be: Leaf lettuce, string beans, fall turnips. Another would be: Spinach, early sweet corn, fall radishes. A third combination would be: Green onions from sets, pickle cucumbers, fall spinach.

**Combination of the Two Systems.**—Sometimes a system of intensive cropping is practiced which is essentially a combination of companion and succession cropping. In this case the second crop is planted considerably later than the first, but before the first has been harvested. For example, dwarf peas may be planted early in the spring in rows wide enough apart to be cultivated with a horse. About the time the tillage of the peas would normally cease, sweet corn is planted between the rows of peas, and cultivated close to the rows with a wheel hoe if necessary before the peas are harvested. Upon the removal of the peas, the tillage of the corn is continued with a horse cultivator. After the tillage of the corn ceases, turnips may be sown broadcast between the rows.

Another example of this method of cropping would be to plant winter squashes in a patch of early potatoes where a few hills (properly spaced) have been dug in advance of the regular harvest. In a field of onions grown from seed, every fourth or fifth row may be pulled out early in July and sold as bunch onions, and a row of celery planted to fill the space. After the regular crop of onions has been harvested in August or early September, the banking of the celery can begin.

The above combinations of vegetables for intensive systems of cropping are mentioned merely to illustrate the principles involved. A large number of other combinations might be employed. The particular set of crops to be selected would depend to considerable extent upon the demands of the market to be supplied, the length of the growing season, and the amount of rainfall or artificial water supply that could be depended upon at the time the later crops would necessarily be planted. The above combinations are based upon the assumption that planting could proceed at any time desired, without waiting for belated rainfall. With facilities for artificial watering this would be true; in gardens entirely dependent upon rainfall for the moisture supply, it might not be.

**Relative Merits of the Different Systems.**—Companion crop-

ping pure and simple, where both crops are planted at the same time, and preferably in the same row, is the most easily managed kind of double cropping under ordinary conditions of soil and moisture. Care is taken to use crops that do well under the same conditions and with the same kind and amount of cultivation. The planting is done in the normal season, when the soil is properly supplied with moisture, and both crops get a good start. The only danger is in planting too thickly or allowing the secondary or incidental crop to remain too long and thus encroach upon the forage space and sunshine area needed by the main crop. The gardener must know to a nicety the length of season and extent of foliage and root development normal to the particular varieties he proposes to plant. Early Scarlet Turnip radish could be used in places where Strasburg would not be permissible.

Succession cropping is very satisfactory where only two crops are attempted and where there is plenty of rainfall immediately preceding and following the planting of the second crop. In central, unirrigated localities, the season is likely to be too short to allow the full development of three crops and time enough between the successive crops to wait for rain and prepare the soil for planting.

The chief objections to the combination of companion and succession cropping, in which the second crop is planted shortly before the harvesting of the first, are that the seed-bed for planting the second crop cannot be very thoroughly prepared, and the young plants are likely to be encroached upon by the first crop and subjected to tramping during its harvest. The tramping is especially likely to take place if the second crop is planted between the rows of the first, and the over-shadowing by the first crop is likely to be most severe if the second crop is in the same row with the first.

In general it may be said that if double cropping is to be applied to any considerable number of crops and carried on with any pronounced degree of success, the soil must be exceedingly rich and abundantly supplied with moisture; and the gardener must be master of his art.

#### QUESTIONS

1. Under what circumstances is it advisable to grow more than one crop on the same land in one season?
2. What are the two kinds of double cropping?
3. Define "companion cropping," and give examples of suitable combinations.
4. What factors must be considered in selecting crops for a system of companion cropping?

5. Describe the system of double cropping known as "succession cropping."
6. What principles must be observed in selecting a series of crops for succession cropping?
7. Give examples of suitable crops for succession cropping.
8. How may companion and succession cropping be combined into one system? Give examples of suitable combinations.
9. Discuss the relative merits of the different systems of double cropping.
10. On what general factors does the success of double cropping depend?
11. Give examples of intensive cropping used in your section.

## CHAPTER XXVIII

### THE HOME VEGETABLE GARDEN \*

As suggested in Chapter I, a home vegetable garden is maintained for the purpose of supplying the home table with fresh vegetables, and should furnish as large an assortment and as continuous a supply as circumstances will permit. In the ideal garden, the supply is continuous throughout the season. Many gardens would be much better than they are, and much time and annoyance would be saved during their planting, if the gardener made a definite plan of his garden several weeks before time for the planting to begin. Suggestive plans for the three types of home gardens mentioned in Chapter I will be presented in the present chapter, together with relative dates of planting for the different crops and other suggestions regarding matters especially pertinent to the proper management of home gardens of different types.

#### THE FARMER'S GARDEN

**Plan of the Garden.**—It has already been suggested (see Chapter I) that the garden on the farm be planted in long rows and cultivated with a horse, and that every means possible be employed to reduce the hand labor to a minimum. Time and confusion in both planting and tending the garden will be saved if the vegetables are grouped according to their cultural requirements, and the number of plantings made as small as is consistent with the demands of the various crops. Each group of crops may then be planted and tended as one crop, and the garden operations thus greatly simplified. When more than one planting of a given crop is desired for the sake of securing a succession, the second planting may be put in at the same time that other crops are being planted, so that even in this case the number of plantings need not be multiplied. The use of two or more varieties of the same vegetable, differing in their times of maturity, will also aid in keeping down the number of different plantings.

The exact plan of the garden will depend upon the personal tastes of the owner, and will be different for each individual.

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\* Much of the material in this chapter has been adapted from Circular 154 of the Illinois Agricultural Experiment Station.

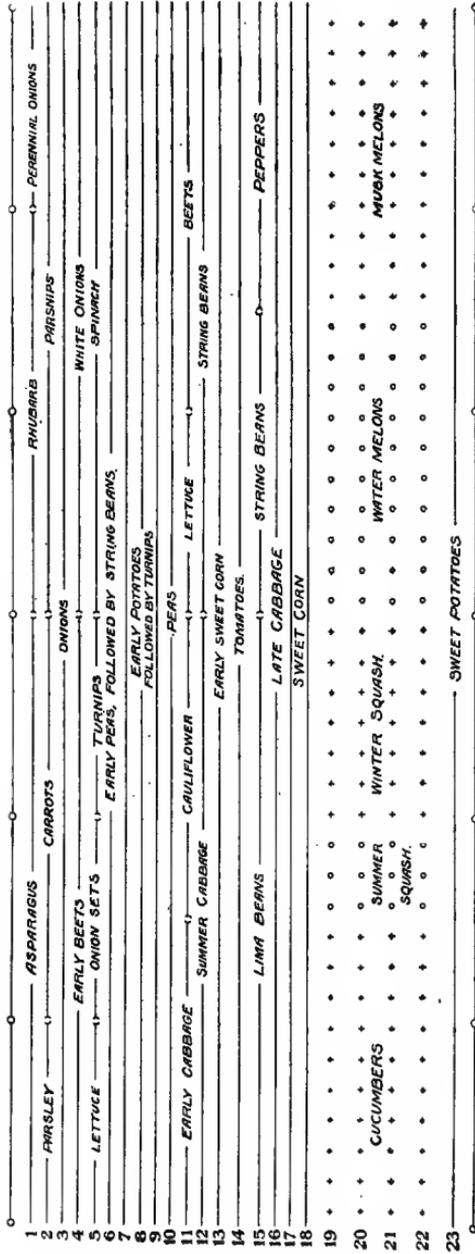


Fig. 163.—Diagram of a farmer's vegetable garden 90 by 240 feet.

The accompanying plan (Fig. 163) is presented merely as a suggestion, and illustrates one possible arrangement of a farmer's garden planned with a view to securing a large assortment and continuous supply of vegetables, and at the same time simplifying the planting and minimizing the labor of tillage. The area designated comprises nearly half an acre, but smaller or larger gardens could be arranged in much the same way. Except where noted, the rows are three feet apart.

**Time of Planting.**—In central latitudes the planting of the garden here illustrated would be as follows:

*First planting, about April 1:*

- Row 1. Perennials:  $\frac{1}{2}$  row asparagus;  $\frac{1}{2}$  row rhubarb;  $\frac{1}{3}$  row perennial onions.
- Row 2.  $\frac{1}{4}$  row parsley;  $\frac{1}{4}$  row carrots;  $\frac{1}{2}$  row parsnips. (Marked with turnip radishes.)
- Row 3. Onions (yellow).
- Row 4.  $\frac{1}{2}$  row early beets;  $\frac{1}{2}$  row onions (white). (Marked with long radishes.)
- Row 5.  $\frac{1}{8}$  row lettuce;  $\frac{1}{4}$  row onion sets;  $\frac{1}{4}$  row turnips;  $\frac{1}{2}$  row spinach. (Followed by celery planted July 1.)
- Row 6. Peas:  $\frac{1}{2}$  row extra early smooth;  $\frac{1}{2}$  row early dwarf wrinkled. (Followed by string beans planted July 1.)
- Rows 7, 8 and 9. Early potatoes. (Followed by turnips sown August 1.)

*Second planting, about April 20:*

- Row 10. Peas:  $\frac{1}{2}$  row early dwarf wrinkled;  $\frac{1}{2}$  row late wrinkled.
- Row 11.  $\frac{1}{4}$  row early cabbage (30 plants, 2 feet apart);  $\frac{1}{4}$  row cauliflower;  $\frac{1}{2}$  row lettuce;  $\frac{1}{2}$  row beets (marked with long radishes).

*Third planting, about May 1:*

- Row 12.  $\frac{1}{4}$  row summer cabbage (transplanted);  $\frac{1}{4}$  row of same (seed sown);  $\frac{1}{2}$  row string beans.
- Row 13. Sweet corn:  $\frac{1}{2}$  row extra early;  $\frac{1}{2}$  row second early.

*Fourth planting, about May 15:*

- Row 14. Tomatoes (60 plants, 4 feet apart). (4 feet from row 13.)
- Row 15.  $\frac{1}{2}$  row Lima beans;  $\frac{1}{4}$  row string beans;  $\frac{1}{4}$  row peppers (30 plants). (4 feet from row 14.)
- Row 16. Late cabbage (seed sown).
- Row 17. Sweet corn:  $\frac{1}{2}$  row extra early;  $\frac{1}{2}$  row second early.
- Row 18. Sweet corn: two late varieties.
- Rows 19, 20, 21 and 22. Vine crops in hills 6 x 6 feet, in blocks crosswise the four rows, as follows: 40 hills cucumbers; 12 hills summer squash; 28 hills winter squash; 40 hills watermelons; 40 hills muskmelons.

*Fifth planting, about June 1:*

- Row 23. Sweet potatoes (6 feet from row 22).

**Arrangement.**—It will be observed that the vegetables are arranged strictly in the order of their planting, so that planting may begin at one side of the garden and proceed across the area

as the season advances. This makes it possible to easily fit a piece of land for planting or to harrow the unplanted portion at any time desired and thus keep it free from weeds and in a moist, friable condition. Another feature of this plan is that while two or three kinds of vegetables may be planted in the same row, all the crops in a given row require essentially the same kind and amount of tillage and other care. It is also true that the crops occupying the land about the same length of time are planted together. After the early-maturing crops are harvested, it is therefore possible to clear quite a wide strip of land for the planting of turnips and other late crops, if desired.

While this plan specifies five different times of planting, besides the celery, late beans and turnips, it is possible in some seasons to combine the second and third plantings so that, if celery and sweet potatoes are omitted, there will be only three plantings besides the turnips or other incidental late crops. This simplifies the planting and better adapts the garden to the tastes of the average farmer.

**Labor-saving Methods.**—The arrangement of the garden as to length of rows and time of planting is not the only labor-saving feature that should characterize the typical farmer's garden. Field methods should be practiced in preparing the land for planting, and as much preliminary work done in the fall as is possible, for two purposes: (1) securing an early garden, and (2) reducing the amount of labor in spring. After the land is cleared of refuse from preceding crops, it should be heavily manured and plowed in the fall. If this is done and the land worked at the proper time in spring, a seed-bed can be prepared by the use of a disk, harrow, and planker. The use of these tools saves an enormous amount of labor and is a vast improvement over the old method of using a hoe and rake.

The actual planting of the garden is a simple matter, provided a definite plan has previously been made, so that no time is lost in deciding which vegetable to plant first, where to plant it, or how much to plant. In the home garden, only a small amount of seed of each kind is planted, so that a seed drill cannot be used to advantage, and the planting is therefore almost invariably done by hand.

Labor-saving methods can be employed in the care of the growing crop as well as the preparation of the seed-bed. Mention has already been made of the desirability of planting the garden in

long rows so that horse tillage may be introduced. By the use of a narrow-tooth cultivator (Fig. 164) it is possible, with a steady horse, to work fairly close to the rows of even small vegetables. However, for the early tillage close to the rows of beets, onions, carrots, and similar crops, there is nothing equal to a wheel hoe; and throughout the season this tool can be very largely substituted for the hand hoe. Its use will result in a great saving of labor. Labor will also be saved by cultivating the garden frequently, and keeping the soil in good, friable condition, rather than tilling

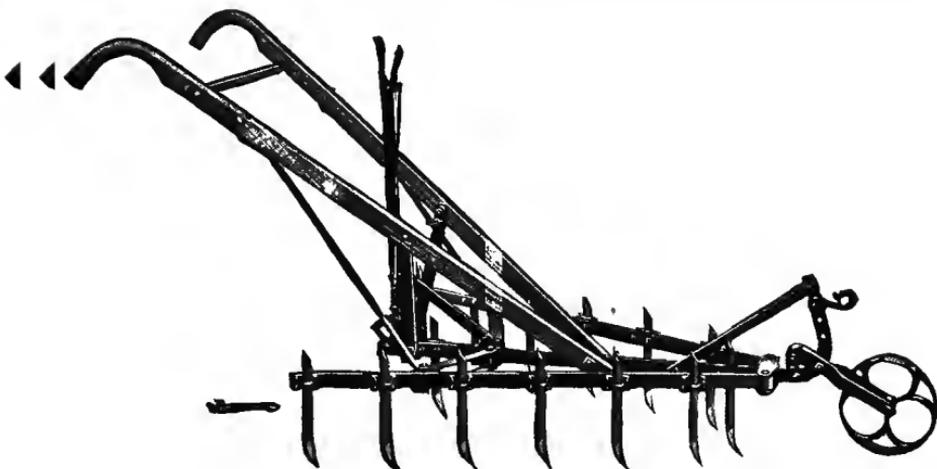


FIG. 164.—Narrow-tooth cultivator—an excellent tillage tool for the farmer's home garden.

it at less frequent intervals and allowing the ground to become baked before it is tilled after a rain.

#### THE VILLAGE OR SUBURBAN GARDEN

In striking contrast to gardening on the farm, hand tillage in a suburban garden is not looked upon as irksome or a waste of time that might be better employed in the field; for suburban gardening is often done fully as much for the pleasure of working among the plants and seeing them grow as for the edible products they yield. Instead of concentrating the garden work into as small a number of items as possible, as is desirable on the farm, the suburban gardener often prefers to take a little exercise in his garden each morning or evening and thus distribute a given piece of work over several days.

**Plan of the Garden.**—As intimated above, the personality of the gardener is likely to have fuller scope in the village or suburban garden than on the farm. This means that each garden is likely to be radically different from any other, both in the kind of vegetables grown and in their arrangement in the garden. The gardens also will vary greatly in size and shape, depending upon the land available for gardening purposes. It is therefore difficult to suggest an arrangement of vegetables for such a garden. However, the accompanying plan (Fig. 165) is inserted, showing one possible arrangement of vegetables in a garden thirty by sixty feet. Doubtless an entirely different selection of vegetables would be made by some gardeners, and rightly so, for the personal element should

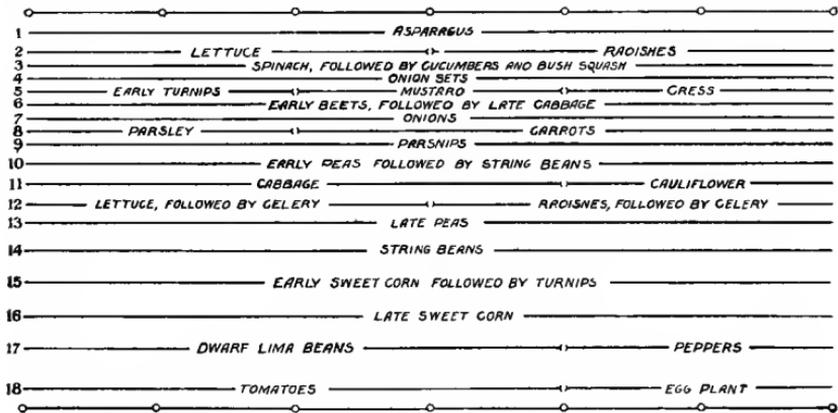


FIG. 165.—Diagram of suburban garden 30 by 60 feet.

pervade the garden if the greatest amount of pleasure is to be realized.

The planting of the garden here illustrated would be about as follows:

<i>Early planting, beginning about April 1</i>	Distance from preceding row <i>Feet</i>
Row 1. Permanent row of asparagus. (1.5 feet from edge) . . .	1.5
Row 2. 30 feet lettuce; 30 feet radishes. . . . .	1.5
Row 3. Spinach (followed by cucumbers and bush squash, planted May 20). . . . .	1
Row 4. Onion sets. . . . .	1
Row 5. 20 feet early turnips; 20 feet mustard; 20 feet cress. . .	1
Row 6. Early beets (followed by late cabbage set July 1). . . .	1
Row 7. Onions from seed. . . . .	1
Row 8. 20 feet parsley; 40 feet carrots. . . . .	1

Row 9. Parsnips.....	1
Row 10. Early dwarf peas (followed by string beans planted July 1).....	1.5
<i>Second planting, about April 20:</i>	
Row 11. 2 dozen cabbage; 1 dozen cauliflower.....	1.5
Row 12. 30 feet lettuce; 30 feet radishes (followed by celery set July 1).....	1.5
Row 13. Late wrinkled peas (with support).....	1.5
<i>Third planting, about May 1:</i>	
Row 14. String beans (green and wax).....	2
Row 15. Early sweet corn (followed by 2 rows turnips sown August 1).....	2.5
<i>Fourth planting, about May 15:</i>	
Row 16. Late sweet corn.....	2.5
Row 17. 40 feet dwarf Lima beans; 20 feet peppers.....	2.5
Row 18. 1 dozen tomatoes; ½ dozen eggplants.....	3
Margin.....	1.5
Total width of garden.....	30.0

The rows of vegetables, as indicated in the diagram, are about as close together as the growth of the respective crops will permit. It is assumed that the tomatoes are to be trained to stakes and thus confined to a smaller area than if allowed to spread naturally over the ground.

It will be noted that, with the exception of the permanent row of asparagus, the vegetables are arranged in the order of their planting, though such an arrangement is not so essential as in a farmer's garden, since hand methods are to be employed in fitting the soil for planting, and a small area can be fitted in almost any part of the garden whenever needed. However, a simple, orderly arrangement, like that suggested, is often a matter of convenience.

**Soil Preparation.**—If the garden has been plowed in the fall, there need be no delay in planting after the soil has reached workable condition in the spring. The ground can be fitted for planting by the use of a hoe and rake, and planting may begin as soon as a strip wide enough for one or two rows has been prepared. If each strip of ground is planted the same day as it is prepared, quick germination will be insured, and the early contest with weeds forestalled.

**Tillage.**—In a small garden much of the tillage can be done with a steel rake. This is an ideal tool for maintaining a dust mulch, and can be operated more rapidly than a hoe. If the soil is stirred with the rake as soon as sufficiently dry after a rain, it

can be kept in a loose, friable condition, the moisture retained and the weeds given no chance to start.

The efficiency of a rake as a tillage tool depends upon the frequency of its use. If a crust is allowed to form, or the weeds to start, the rake is rendered useless, and the only resort is the hoe. This is a more effective tillage tool than it is sometimes credited with being. Much of the dissatisfaction in the use of the hoe is due to the misconception that a hoe is necessarily dull. As a matter of fact, to do effective work, a hoe must be kept sharp by the occasional use of a file.

While the rake and hand hoe are well adapted to the tillage of a small garden, the real pleasures of gardening remain unknown to the person who has never used a wheel hoe. This modern invention stimulates good gardening. Like the rake, however, it is useless in badly crusted or weedy ground. The experienced gardener will use it often, and thus keep the soil of his garden in ideal condition.

#### THE CITY GARDEN

In the city garden, in order that maximum crops may be produced from a minimum space, it is essential that the ground be kept fully occupied all the time. This means not only that the rows of vegetables will be planted close together, but that short-season crops will be planted between the rows and even the plants of longer-season crops, and that as soon as one crop is harvested another will be planted in its place. Also, transplanting may be practiced to a considerable extent to save space during the early growth of the plants. The full amount of space required by a given plant at maturity is allotted to that plant the shortest possible time. Extremely rapid growth is made possible by making the soil very rich and applying water copiously. The land is kept at work from early spring till late in autumn, and two or even three crops may be harvested from the same area.

**Kinds of Vegetables.**—Since planting must be close, and a large amount of edible product secured from each square foot of ground, it will be necessary to omit from a garden of this kind some of the larger-growing vegetables which yield a relatively small edible product for the amount of space occupied. Predominance should be given to the vegetables which produce the largest amount of edible material in proportion to the space occupied by the plant, and the length of time this space is occupied. Sweet

corn, melons and squashes will therefore be omitted, and the garden devoted chiefly to such crops as lettuce, radishes, parsley, cress, mustard, beets, chard, carrots, onions from sets, string beans, and turnips; though cabbage, spinach, peas, peppers, tomatoes, and even cucumbers may sometimes be included. If tomatoes are grown they are trained in an upright position, so that comparatively little ground space is occupied.

**Plan of the Garden.**—The dimensions of a city back yard garden will vary with the amount of land available for the purpose;

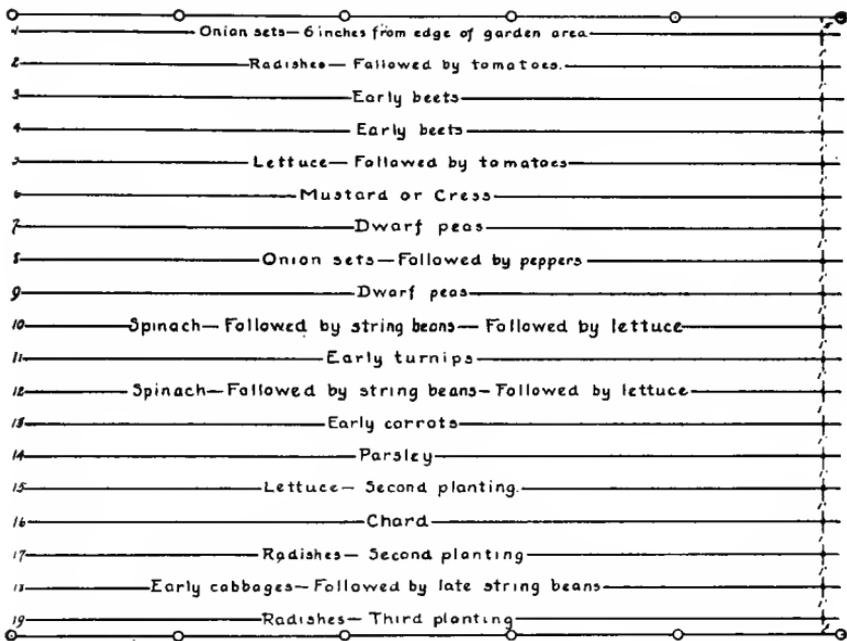


FIG. 166.—Suggested plan for a back yard garden where space is limited.

and the selection of vegetables will be determined partly by the taste of the gardener and partly by the limitations of space. A selection of vegetables and their arrangement for a garden twenty by twenty-five feet are suggested in the accompanying plan (Fig. 166). The rows are to run lengthwise the area. The original planting of rows 1 to 14 inclusive is to be made as soon as the ground can be worked in the spring; that is, about April 1, in central latitudes. Rows 15 to 18 are to be planted from two to three weeks later, and row 19 is to be planted about

May 1. It will be noted that in the original plantings the rows are to be only one foot apart. When the harvesting of the radishes, lettuce, green onions, and spinach begins, if care is taken to remove plants first from definite spots spaced at proper intervals, the tomatoes, peppers, and string beans can be planted in the same rows considerably before the harvesting of these early crops is completed. The early beets, mustard, and peas in the intervening rows can be harvested before the tomatoes and peppers need all the space. Likewise the turnips, carrots, and second plantings of lettuce and radishes will be removed by the time the string beans, parsley, chard, and cabbage begin to crowd for room.

**Tillage.**—The close planting advised calls for an abundance of tillage, as well as plant food and water. Since the rows of the original planting are almost too close together for the convenient use of a rake, a narrow-bladed hoe and a three-fingered weeder attached to a long handle are the most useful tools for working among the plants. The general principles of tillage and other care of the growing crops are the same as in any garden, but the details of the work must be adjusted to meet the conditions of the intensive gardening.

#### VARIETIES OF VEGETABLES FOR THE HOME GARDEN

For the home garden particular care should be taken to select varieties that are capable of yielding a product of high quality. Such varieties are numerous, though some are better for one region than another. The following list gives a few of the sorts which have a wide range of adaptation and are quite generally recognized as reliable sorts for planting in home gardens:

*Asparagus.*—Palmetto, Barr's Mammoth.

*Beans.*—Stringless Green Pod, Saddleback Wax, Henderson's Bush Lima, King of Garden Lima.

*Beets.*—Crosby's Egyptian, Dark Stinson, Early Model.

*Cabbage.*—Jersey Wakefield, Copenhagen Market, Market Gardener's No. 2, Autumn King, St. Louis Late Market.

*Carrot.*—Early Scarlet Horn, Chantenay.

*Cauliflower.*—Burpee's Dry Weather.

*Celery.*—Golden Self-blanching, Giant Pascal.

*Chard.*—Lucullus.

*Sweet Corn.*—Golden Bantam, White Cory, Chicago Market, Stowell's Evergreen, Country Gentleman.

*Cress.*—Fine Curled.

*Cucumber.*—Emerald, Cumberland, White Spine, Chicago Pickle.

- Eggplant*.—Black Beauty, New York Improved Purple.  
*Kale*.—Dwarf German, Tall Green Curled Scotch.  
*Kohlrabi*.—Early White Vienna.  
*Lettuce*.—Black-seeded Simpson, Morse, Mignonette, May King, Hanson.  
*Mustard*.—Giant Southern Curled.  
*Muskmelon*.—Netted Gem, Hoodoo, Rust-resistant Rocky Ford, Tip Top, Osage.  
*Watermelon*.—Cole's Early, Fordhook Early, Kleckley Sweets, Tom Watson.  
*Okra*.—Perfected Perkin's Long Pod.  
*Onion*.—Southport Yellow Globe, Southport White Globe, Australian Brown, Prize-taker.  
*Parsley*.—Extra Dark Moss Curled.  
*Parsnip*.—Improved Guernsey.  
*Peas*.—Maud S., Nott's Excelsior, Carter's Daisy, Vick's Charmer.  
*Pepper*.—Ruby King, Chinese Giant.  
*Radish*.—Earliest White, Scarlet Button, Cincinnati Market, Lady Finger, White Strasburg, White Chinese (winter).  
*Rhubarb*.—Victoria.  
*Salsify*.—Sandwich Island Mammoth.  
*Spinach*.—Long Standing, Victoria.  
*Squash*.—Giant Summer Crookneck, Fordhook, Hubbard.  
*Tomato*.—Langdon's Earliana, Chalks' Early Jewel, Livingston's Globe, Matchless, Stone.  
*Turnip*.—Purple Top Globe, White Egg.

## QUANTITIES OF SEED TO BUY

It is always a safe plan to have a little more seed on hand than is actually needed to plant the area desired. Sometimes the first planting of a given crop is destroyed by frost or insects, making replanting necessary. In such a case, delay in replanting could be avoided by having the seeds on hand. The additional expense is slight compared with the value of the crop. In the case of many seeds, an ounce costs but little more than a packet; and in such cases it is the part of wisdom to purchase an ounce, even though a packet might contain sufficient seed to barely plant the desired area. The more expensive seeds may be purchased in smaller quantities, with less margin between the actual amount required and the quantity purchased.

For the benefit of beginners, who may be unfamiliar with the quantities of seed needed to plant a garden of a given size, the following tabular statement is inserted. It represents the quantities of seeds which should be purchased for planting the gardens described on pages 267, 270, and 273, respectively, with due allowance for a normal amount of replanting.

TABLE III.—Quantities of Seed for Different Sized Gardens.

	Farmer's garden	Suburban garden	City garden
Asparagus.....	100 roots	50 roots	.....
Beans, green podded.....	1 pt.	½ pt.	½ pt.
Beans, wax.....	1 pt.	½ pt.	.....
Beans, Lima.....	1 pt.	½ pt.	.....
Beets.....	2 oz.	1 oz.	1 oz.
Cabbage, early.....	1 pkt.	1 pkt.	1½ doz. plants
Cabbage, second early.....	1 pkt.	.....	.....
Cabbage, late.....	1 pkt.	1 pkt.	.....
Carrot.....	1 oz.	1 pkt.	1 pkt.
Cauliflower.....	1 pkt.	1 pkt.	.....
Celery.....	1 oz.	1 pkt.	.....
Chard.....	.....	.....	1 pkt.
Sweet corn, extra early.....	1 pt.	½ pt.	.....
Sweet corn, second early.....	1 pt.	.....	.....
Sweet corn, late.....	1 pt.	½ pt.	.....
Cress.....	.....	1 pkt.	1 pkt.
Cucumber.....	1 oz.	1 oz.	.....
Eggplant.....	.....	½ doz. plants	.....
Lettuce, leaf.....	1 oz.	1 pkt.	1 pkt.
Lettuce, head.....	.....	1 pkt.	1 pkt.
Muskmelon.....	1 oz.	.....	.....
Mustard.....	.....	1 pkt.	1 pkt.
Onion seed.....	2 oz.	1 oz.	.....
Onion sets, bottom.....	1 qt.	1 qt.	1 qt.
Onion sets, top (perennial).....	1 qt.	.....	.....
Parsley.....	1 pkt.	1 pkt.	1 pkt.
Parsnip.....	1 oz.	1 pkt.	.....
Peas, extra early smooth.....	1 pt.	.....	.....
Peas, early dwarf wrinkled.....	1 qt.	½ pt.	½ pt.
Peas, late wrinkled.....	1 pt.	½ pt.	.....
Pepper.....	1 pkt.	1 pkt.	1½ doz. plants
Potatoes.....	3 pks.	.....	.....
Radish.....	3 oz.	1 oz.	1 oz.
Rhubarb.....	1 oz.	.....	.....
Spinach.....	1 oz.	1 oz.	1 oz.
Squash, summer.....	1 oz.	1 pkt.	.....
Squash, winter.....	1 oz.	.....	.....
Sweet potatoes.....	200 plants	.....	.....
Tomato.....	2 pkts.	1 pkt.	1½ doz. plants
Turnip.....	1 oz.	1 pkt.	1 pkt.
Watermelon.....	1 oz.	.....	.....

## QUESTIONS

1. What are the advantages of planning a garden before starting to plant it?
2. How should vegetables be grouped in a farmer's home garden to save time and confusion in planting and tending the various crops?
3. What is a convenient size and shape for a farmer's home garden?
4. How many different plantings are likely to be required in a farmer's vegetable garden in order to insure a full assortment and continuous supply of vegetables throughout the season?
5. Give approximate dates for planting each of the common vegetables in central latitudes.
6. Enumerate the desirable features of the arrangement of vegetables suggested in the plan of a farmer's vegetable garden on page 266.
7. What labor-saving methods of soil preparation should be employed in a farmer's vegetable garden?
8. What labor-saving methods of cultivating the growing crops should be employed in the farmer's garden?
9. Contrast the village or suburban garden with the farmer's garden.
10. Give the minimum distances for planting each of the common vegetables when hand methods of tillage are to be employed. How much more space is required when a horse cultivator is to be used?
11. How can the soil in a suburban garden best be fitted for planting?
12. Discuss the efficiency of the rake as a tillage tool.
13. What are the characteristics of a city back yard garden?
14. Discuss the arrangement of vegetables under an intensive system of cropping in a city garden when space is limited.
15. What should be the predominating characteristic of a variety of vegetables selected for the home garden?
16. Name from one to three high quality varieties of each of the common vegetables adapted to the home garden.
17. Why is it an advantage to have more seed on hand than is actually needed for planting the area contemplated?
18. Should seeds for a farmer's home garden usually be purchased by the packet or the ounce?

## CHAPTER XXIX

### HARVESTING AND MARKETING

WHETHER intended for home use or for market it is important that vegetables be harvested at the right stage of maturity. In many vegetables the quality or yield is deficient until a certain stage of development is reached; and after passing that stage the product may soon become objectionable or even inedible by reason of the development of undesirable texture or incipient decay. In the case of some vegetables, the period during which they are in ideal edible condition is extremely short (from one to four days) while in others this period is very much longer (from one to four weeks or even more). Promptness in picking is therefore much more imperative with some vegetables than with others. Examples of vegetables in which given specimens remain in edible condition only a short time are radishes (except winter varieties), green peas, string beans, sweet corn, cucumbers, okra, summer squash, tomato, muskmelon. The foliage crops, like leaf lettuce, spinach, and mustard, in which the entire plant is gathered at the harvest, are edible at earlier stages, but are deficient in yield unless allowed to attain full development. Unless harvested promptly when fully developed, they quickly run to seed. Examples of vegetables in which the same specimen remains in edible condition over a long period are beets, carrots, rutabagas, onions, leeks, parsnips, winter squash.

**The Harvesting Period.**—In some vegetables the entire crop can be gathered at one time, as in the case of late cabbage, celery, potatoes, sweet potatoes, ripe onions, winter squash, and the late root crops intended for winter use. The time of the harvest is governed partly by the maturity of the crop, but in many cases fully as much by the advancement of the season and danger of unfavorable temperatures. In certain other crops the harvesting season may extend over a long period, but prompt picking of individual specimens be essential. This is particularly true of tomatoes, eggplants, cucumbers, summer squash, melons, and okra.

In the case of green peas, string beans, and sweet corn, the harvesting season is shorter, but several pickings are often necessary in order to gather the entire product at the right degree of

maturity. Several pullings are also necessary to harvest a crop of early radishes, beets or carrots in the best stage for market or table use. Plantations of early cabbage, cauliflower, and head lettuce must likewise be cut over a number of times in order to harvest these crops in ideal condition, since not all the plants will develop to the same stage at the same time. The important point is that the gardener must know when a given product has reached its optimum condition, and how long it will remain in that condition, in order that the harvesting may be done at the proper time. It is true that market conditions sometimes warrant a departure from the normal time of harvesting a given product; as, for example, when prices are high early in the season, it may pay to sacrifice somewhat in yield, and harvest rhubarb, leaf lettuce, spinach, and even early cabbage before full development has been attained. Under such circumstances, the judgment of the gardener must determine the time at which the harvesting will be done. In the home garden, it is often customary to sacrifice in yield, in order to secure products for the table a few days ahead of their normal season and also to lengthen the season during which a given product may be used.

**Care of Vegetables between Harvesting and Marketing.**—

After vegetables are severed from the plant or removed from the soil, it is essential in the case of quickly perishable products that they be kept as cool and moist as circumstances permit. This means that they must not be exposed to direct sunshine or drying winds any longer than is absolutely necessary between the time they are gathered and the time they reach the consumer's table; and, other things being equal, the shorter this time the more desirable the quality of the product. Since most vegetables contain a high percentage of water, and their quality bears a close relation to their succulence, evaporation of water from their tissues is likely to greatly impair their quality. Some vegetables also owe their characteristic flavors to the presence of essential oils, which rapidly volatilize after the vegetables are harvested. Such vegetables must be handled very promptly from garden to consumer's table if the highest quality is to be realized.

PACKING SHEDS

The keeping of vegetables in a fresh and unwilted condition between harvesting and marketing is facilitated by the use of a packing house or shed to which the products are taken as soon as

they are gathered. Such a building not only affords protection from sunshine and showers to the vegetables, the supply of packages and the workmen, but also greatly facilitates the handling of the crop during the process of preparing it for market. While

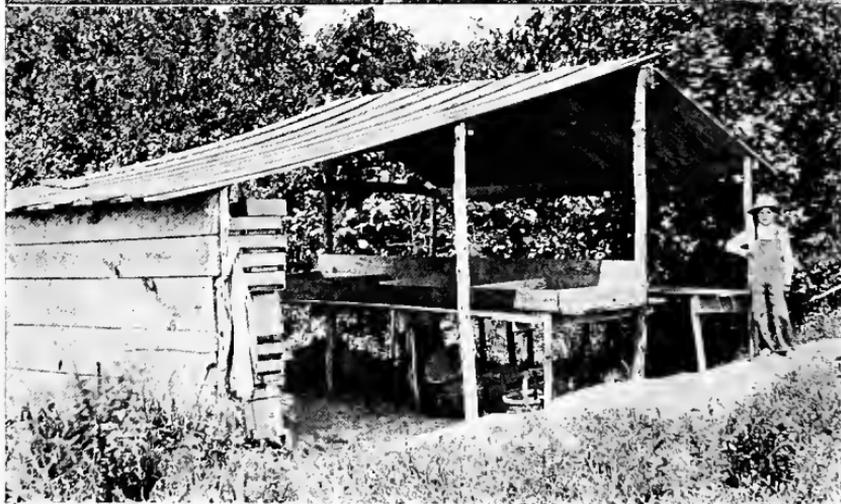


FIG. 167.—Simple packing shed, with curtain.

FIG. 168.—A convenient, though temporary, packing shed for melons and tomatoes.

some crops may be advantageously packed or loaded for market directly from the field, in the case of most crops which require any considerable preparation for market, the work can be handled much more expeditiously in a building arranged for the purpose.

The permanence of the structure and the elaborateness of the equipment will depend upon its location and the kind and volume of products that are to be handled. For the handling of certain crops, a temporary shed located at the edge of the field is all that is required. Muskmelons and tomatoes grown as truck crops in fields at considerable distance from the farm buildings are usually packed in a temporary structure built for the purpose just before the harvest begins. The essential features of such a structure are a packing bench or table, ample light and a roof that does not leak. It may or may not be boarded up at the back and sides. If not boarded up, it is usually provided with a curtain which may be shifted from one side to another as the day progresses. Often a canvas wagon cover is used for this purpose. One of the simplest forms of packing shed is shown in Fig. 167. A more complete shed, though of a temporary nature, is shown in Fig. 168. A sectional view and plan of the latter shed are presented in Fig. 169. Such a shed may be built of any length desired, depending upon the size of the crop to be handled. The one here illustrated is twelve by sixteen feet, and will accommodate three packers in handling a crop of melons or tomatoes. There is also sufficient space for stacking two wagonloads of the packed product.

For the sake of economy in the construction of a shed of this kind, the posts are usually cut from the timber, if in a timber country, so that a comparatively small amount of sawed lumber is used in the frame. The posts are set deeply in the ground so that they will retain their position without much bracing.

For the construction of the shed here illustrated, besides nine long posts for supporting the roof and twelve short ones for the table and bench, the following bill of lumber would be needed:

- 4 ps. 2" x 4", 12 ft., for supporting roof.
- 4 ps. 2" x 4", 4' 8", for supporting packing table.
- 4 ps. 2" x 4", 2' 4", for supporting receiving bench.
- 24 boards 1" x 12", 12 ft., for roof, laid with 3-inch lap.
- 6 boards 1" x 12", 12 ft., for packing table and receiving bench.
- 6 boards 1" x 12", 12 ft., for boarding up south side.
- 1 board 1" x 12", 12 ft., for partitions in packing table.
- 2 boards 1" x 6", 12 ft., for sorting and packing shelves.
- 1 board 1" x 6", 12 ft., for front wall of table.
- 2 boards 1" x 6", 6 ft., for bracing ridgepole.

The short two-by-four's for supporting the packing table and receiving bench could be sawed from two pieces each fourteen

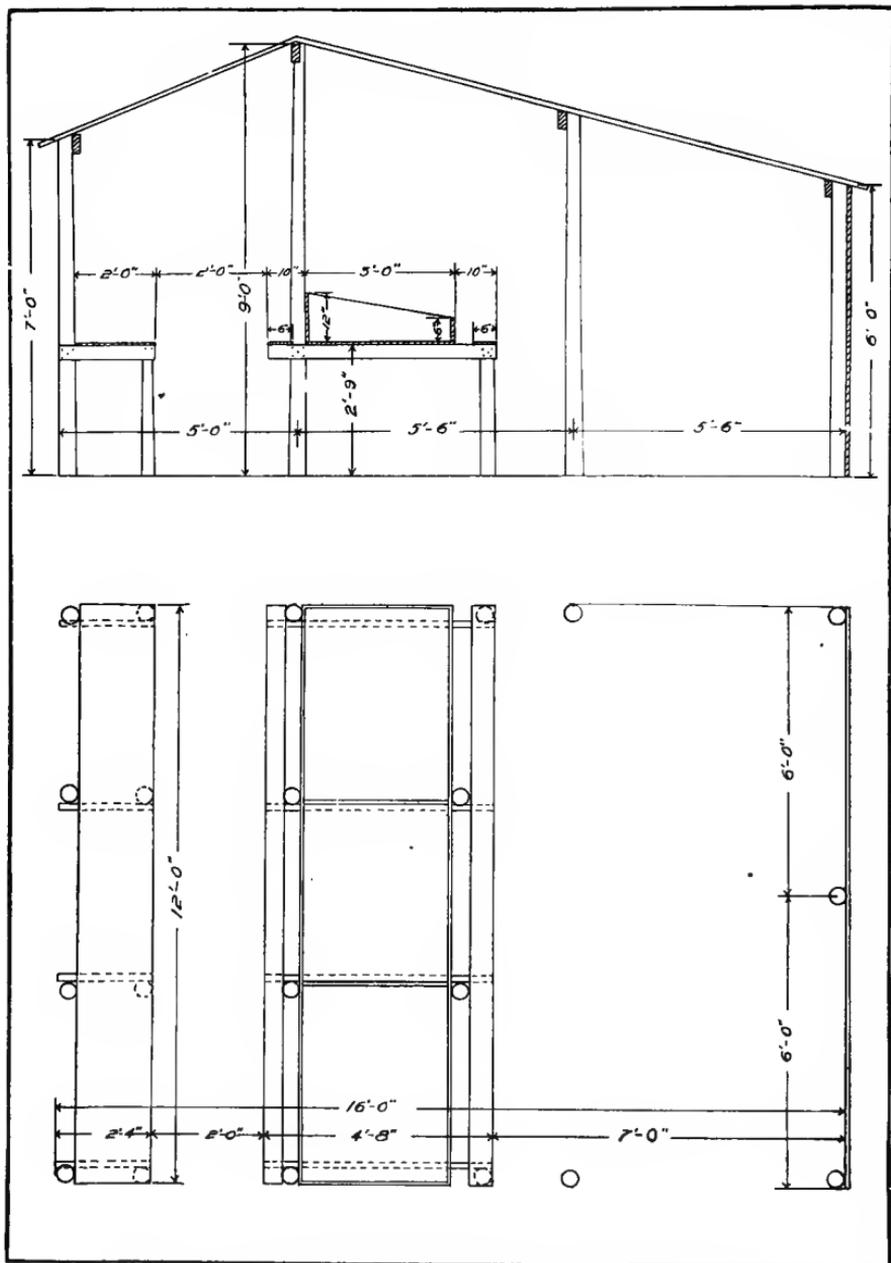


FIG. 169.—Sectional view and plan of packing shed shown in Fig. 168.

feet long. A summary of the bill of lumber would therefore be as follows:

4 ps. 2" x 4", 12 ft.....	32 board feet
2 ps. 2" x 4", 14 ft.....	19 board feet
37 ps. 1" x 12", 12 ft.....	444 board feet
4 ps. 1" x 6", 12 ft.....	24 board feet
Total.....	519 board feet

At \$30.00 per M. this lumber would cost \$15.57. This is a larger amount than is usually expended for material in the construction of a temporary shed; and if other sides were boarded up, the amount would be still greater. This type of shed is better suited to a location at the intersection of the boundaries of three or four fields which are to be used successively for the growing of melons or tomatoes, than to an isolated field where they are to be grown only one season. For the last-named situation it is probable that a shed like the one shown in Fig. 167 would be preferable. The lumber used in the construction of that particular shed was as follows:

3 ps. 2" x 4", 12 ft., for supporting roof.
3 ps. 2" x 4", 5 ft., for supporting table.
16 boards 1" x 12", 12 ft., for roof.
3 boards 1" x 12", 12 ft., for table.
1 board 1" x 10", 12 ft., for back wall of table.
4 boards 1" x 6", 12 ft., for shelves, front wall and partitions of table.

This lumber amounts to a total of 296 feet. At \$30.00 per M. it would cost \$8.88.\*

For handling vegetables which need washing during their preparation for market, an ample water supply at the packing shed is essential. For this reason, a shed intended for the handling of a general assortment of vegetables is usually located near the other farm buildings rather than near the field, and is provided with tanks, tubs, and washing tables, as well as being connected with a supply of water, preferably under pressure. Provision must also be made for rapid and complete disposal of the waste water. Such arrangements demand that the packing shed or house be of a more permanent nature than the field packing sheds already mentioned. Also, for the handling of vegetables in winter, such as celery and the root crops, it is important that

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\* The specifications and diagrams of packing sheds presented here, as well as certain other portions of the present chapter, have been taken from Bulletin 124 of the Illinois Agricultural Experiment Station.

the structure be warmly built and provision made for artificial heating if desired, so that the workmen may be comfortable even on cold days. Some convenient vehicle should be used to haul vegetables from the field to the packing shed (Fig. 170).

#### PREPARATION OF VEGETABLES FOR MARKET

Few vegetables are ready for market without some special preparation after they are gathered from the field. It is true that certain of the coarser vegetables are sometimes loaded into a wagon in bulk to be hauled to the local market or transferred to



FIG. 170.—Type of cart used by Boston gardeners for transporting vegetables from field to packing shed.

cars where they are likewise loaded in bulk. This applies to watermelons, winter squash, late cabbage, and sometimes also to potatoes, rutabagas, and even onions. However, most vegetables are usually placed in some sort of receptacle for hauling or shipping to market.

**Packages.**—The receptacles or packages used for vegetables are of many different kinds, the particular kind to be used in a given case depending partly upon the nature of the product to

be transported, but often fully as much upon the custom of the locality or recognized standards of the market. Usually a package for hauling vegetables to a local market is heavier and more durable than one used for distant shipments, since transportation charges are not involved, and it is the expectation that the same package will be used repeatedly; for in such a market the package is usually not included in the sale of the contents. In local markets the same kind of package is used for a great variety of products. In some local markets the bushel basket is the usual package for a large variety of products, in others a "bushel" box of certain



FIG. 171.—Boston market gardener's load of vegetable boxes.

dimensions, and in still others the two-and-a-half or the three-bushel barrel. In all cases the wagons of the progressive gardeners are built of such dimensions, or equipped with such staging, as to facilitate the building up of large loads of the type of package in common use in the locality (Fig. 171). One of the principal reasons for using the same kind of package for so many products is that it enables the general market gardener to transport a mixed load to advantage.

In trucking regions where vegetables are grown for shipment

to distant markets, a much smaller number of different crops is likely to be handled in the same load. In fact, each shipment is likely to consist of only one kind of vegetable, and there is usually a recognized standard package in a given market for each kind of vegetable shipped from a given locality.

In shipping vegetables to the large city markets it is essential that standard packages be used, for the products do not sell as well in packages other than those to which the market is accustomed. Barrels, baskets, hampers and crates of various sizes and shapes are employed for different products and different markets. For the most part packages are well adapted to transporting and displaying the products for which they are used.



FIG. 172.—The slatted covers of melon baskets insure thorough ventilation, and also display the contents of the package to good advantage.

They are neat in appearance and as light as the nature of the product will permit. The more delicate and easily injured the product, the smaller, and especially shallower, should be the package. Thus, a suitable package for ripe tomatoes is so shallow that the specimens can be placed only two layers deep. On the other hand, onions or potatoes can be shipped in barrels or sacks.

Packages used for shipping green vegetables in hot weather must be provided with plenty of ventilation. They are usually

constructed quite largely of veneer strips, with ample spaces between, which serve the double purpose of ventilation and means for displaying the contents without the removal of the cover (Fig. 172). The methods of packing employed take this factor into account, and involve careful placing of the specimens with reference to the openings in the packages, so that a neat and attractive appearance will be secured. This applies with particular force to tomatoes, string beans, muskmelons, okra, and other vegetables that are normally shipped in packages with quite wide openings at certain places.

**Washing and Bunching.**—Whether intended for local or distant

market, most vegetables must be free from dirt or other stains at the time they are packed. In the case of vegetables that have been pulled or dug from the soil, like root crops and celery, or cut from close to the surface of the ground, like spinach, lettuce and asparagus, washing with water is usually a necessary step in the preparation of the products for market. In muddy weather, tomatoes, melons, cucumbers, and eggplants may sometimes be washed, though the usual custom is to merely wipe them off with a moist cloth. Root crops and celery grown in sandy



FIG. 173.—Bunch of kohlrabi, as marketed.

soil are much more easily washed than those grown in the heavier types of soil.

Certain vegetables are usually tied in bunches when sent to market. This is true of all root crops early in the season, radishes (except the winter type) at all seasons, green onions, asparagus, rhubarb, kohlrabi, parsley, leeks, celery, and sometimes leaf lettuce and various other products (Fig. 173). Root crops may be washed either before or after bunching, but can usually be more expeditiously handled if bunched before the washing. Materials used in

bunching are string, raffia, tape, and rubber bands. The rubber bands are especially useful in the bunching of asparagus.

**Grading.**—The different specimens in a crop, and even in a single picking or pulling, are likely to differ widely in size, shape and degree of perfection. If these widely differing specimens are placed indiscriminately into the same bunch or package, the smallest, most misshapen and altogether most undesirable specimens appear most prominently when subjected to the scrutiny of the prospective buyer. In fact, one or two markedly inferior specimens will sometimes ruin the sale of the entire lot. Fairly good specimens appear decidedly common when in company with others that are superior; they sell better in separate packages. Therefore, grading is essential in the case of nearly all vegetables in which there are conspicuous differences in the size, shape, color, or degree of perfection of the various specimens. The greater the differences, the larger the number of grades which should be made. Usually it will be found advisable to make at least two grades for market, besides the culls that are discarded. When the market is high or vegetables are scarce, a much larger number may sometimes be made, as in the case of greenhouse cucumbers, of which as many as six distinct grades are sometimes made.

The grading of tomatoes will serve to illustrate the principles involved in the grading of vegetables in general and indicate the kinds of differences that may determine the grade of different specimens.

Tomatoes should be graded before they are sent to market. Much of the dissatisfaction with tomatoes on the market, and much loss in the hands of the retailers, are due to the fact that many tomatoes are sent to market which should never have left the premises of the grower. This applies particularly to specimens which are so badly cracked that the juice oozes from them before they reach the market. One leaking tomato in a crate is likely to ruin the sale of the entire package, for if it leaks enough to be detected, the crate is designated as a "leaker" and is sold at a decided discount. Rough or over-ripe specimens or those of very small size are almost as objectionable, for they spoil the sale of good specimens if placed in the same package, and if packed alone they often fail to bring enough on the market to pay for the expenses of marketing.

In grading tomatoes, then, all badly cracked, rough, over-ripe, or under-sized specimens should be discarded as culls. The

salable tomatoes are usually put in one grade, but for discriminating markets better results would be secured if two grades were made. There is a distinct demand for sound, smooth tomatoes, regular in shape, free from cracks, and of such a size that twelve specimens fill one basket of a "flat" or four-basket crate. Tomatoes of this character should be marketed in a grade by themselves, and may be designated No. 1 or fancy. Sound specimens, slightly inferior to the above in size or smoothness, or with slight cracks about the stem, which have healed over so that there is no danger of their leaking, may be graded as No. 2. Tomatoes which are so small that over twenty specimens would be required to pack a basket are not in demand on the market.

If the tomatoes are not uniform in ripeness, each grade should be further sorted, on the basis of color, and only tomatoes uniform in maturity packed in the same crate.

The grading of tomatoes, as well as the wiping (when necessary), is usually done as the fruits are being transferred from the picking baskets or field boxes to the packing table.\*

The importance of grading is even more forcibly illustrated in the case of muskmelons, for there are marked differences in quality and flavor as well as in size and appearance. Extremely high quality and uniformity in size and condition are essential in making of a fancy grade. The size must also be normal and the packing perfect. The No. 1 grade should be of nearly as high quality as the fancy grade, but may include odd sizes, though the different specimens in a given package should be fairly uniform in size. This grade may include melons too large or too small for the fancy grade. The No. 2 grade should consist of the balance of the salable melons.

In varieties of melons which are normally well netted, there is a close relation between the amount and character of netting and the quality of the melon, so that, after a little experience, it is possible to grade melons with extreme accuracy as to quality, on the basis of netting. As a rule, the denser and more fully developed the netting, the better the quality of the melon. The netting should stand out like whip-cords on melons graded as fancy stock. Well-netted melons, in which the netting is not quite so prominent, together with off sizes of the best netted melons, may be graded as No. 1. Specimens with still less netting, but in which the netting is fairly well developed, may be graded as No. 2.

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\* See also Bulletin 144 of the Illinois Agricultural Experiment Station.



FIG. 174.—Fancy melon above; No. 1 melon below.



FIG. 175.—No. 2 melon above; cull melon below

The extent to which the netting is developed is more important than the absolute amount of netting in determining whether a given specimen shall be graded as a No. 2 or a cull. Melons in which the netting is very poorly developed, as well as those without any netting, should be classed as culls. Cracked or over-ripe specimens must be graded as culls even though of fine quality, for they would be likely to spoil before reaching the consumer. Gem melons having the characteristic netting of the four grades above mentioned are illustrated in Figs. 174 and 175.

**Packing.**—The subject of packages has already been discussed. From a market standpoint, the proper placing of the specimens in the package is fully as important as the use of the right kind



FIG. 176.—Flats of fancy tomatoes, properly packed.

of package, for, unless properly packed, vegetables shipped to distant markets are likely to arrive in deplorable condition. In the first place, the vegetables must be cool when placed in the packages, so that the danger of heating in transit will be reduced as much as possible. As already mentioned, the packages used in hot weather should be provided with ample ventilation. In the case of products in which the individual specimens are large and easily subject to injury, each specimen should be so placed in the package that it will remain in its exact position until the package reaches the market. This state of affairs can be secured only by placing each specimen by hand and packing firmly, yet not so tightly that any of the specimens will be bruised. In the case of products in which the individual specimens are smaller

and less subject to injury and for which a package of considerable depth is used, it may suffice if only the specimens forming the surface layer of the package are placed by hand. This is true of string beans and okra packed in climax baskets or bushel boxes.

Firmness is not the only essential in good packing. The arrangement of the specimens in the package must be such that the package and its contents will present an attractive appearance when displayed on the market. This means that the specimens must be arranged in a systematic and orderly manner, with the same part of each specimen in the same relative position in reference to the side or top of the package; and the custom of the market usually dictates what particular part of the vegetable



FIG. 177.—Crates of melons, with the specimens properly arranged for their respective sizes.

shall appear uppermost. For example, No. 1 or fancy tomatoes packed in the standard four-basket flat are invariably placed with the blossom end uppermost (Fig. 176), and muskmelons packed in crates or baskets are so placed that the ribs of the melon extend lengthwise of the package (Fig. 177). String beans in climax baskets have the top layer of pods laid straight across the package, so that they appear in regular order as seen through the crack between the slats of the cover. There is a definite, recognized standard way of packing nearly every kind of vegetable that is shipped to market, and failure to conform to this method of packing usually results in unfavorable discrimination on the market. However, the methods of packing are different for different markets, so that the custom of the given market that is

to be supplied must be known by the shipper if he is to obtain full value of his products.

The differences in customs of individual markets extend to even smaller details than the kind of package and arrangement of specimens in the package. In some markets, radishes in bunches are sold with the roots on; in other markets, the tap-roots of turnip radishes are cut off. In some markets green onions are sold with the roots on, in others with the roots off. The amount of top left on green onions also differs greatly in different markets, in some the entire top being left on. Rhubarb likewise is sold in different markets with different amounts of the leaf remaining on the stalk, but always the same amount in the same market. For some markets, bunch beets are always washed, for others they are not. In all these details, the grower must conform to the custom of the given market if he wishes to sell his products to the best advantage.

#### SELLING THE CROP

As mentioned in Chapter I, there are two distinct kinds of market, local and distant. The local market may be a street or stall market to which the various growers haul their wagons laden with produce and sell at wholesale to retail dealers or at retail to individual consumers. Such markets are organized and operated in most American cities of any considerable size.

**Local Produce Markets.**—A good example of a thoroughly organized street market is that on West Randolph Street, Chicago. For a distance of four blocks the street is about double the width of an ordinary street, and is set apart for the use of the market gardeners in selling their products. The gardeners' wagons are pulled up as close as possible to the street car tracks which occupy the center of the street, and the teams and tongues are removed. There is a solid bank of wagons on each side of the tracks. Sales are made and produce unloaded from the rear of the wagons. Produce is hauled to this market from a distance of ten to eighteen miles. Some gardeners start from home early in the afternoon and get their wagons placed by five o'clock; others drive in during the night. Nobody holds the same place for the season. Each one gets the best position he can find each day. Business begins about 3:00 A.M. and all wagons must be off the market by 1:00 P.M., so that the city can clean the street of all refuse. This market is both wholesale and retail; any grower will sell in any quantity to suit the purchaser. Wholesale dealers, grocers, peddlers, and

ultimate consumers are all purchasers on this market. Packages are not furnished with the purchases. The price for his products is named by the grower, and varies greatly from day to day. It is influenced by the amount of the particular product on that market, and also the amount on South Water Street, shipped in from other points. The grower holds to his price if conditions warrant, but when the market is over-supplied will accept lower offers if necessary to effect sales, rather than be obliged to haul home part of his load.

Conditions are much the same in the Buffalo produce market, except that an entire block, instead of a street, is reserved for the market, and that a definite space in the block is rented by each



FIG. 178.—Partial view of "Eastern Market," Detroit, Michigan, where enormous quantities of produce are sold by growers. Good example of a local market.

gardener at the height of the season. The entire block is paved, and raised flag-stone walks are placed at certain intervals. The wagons are backed up along both sides of these walks, so that the prospective purchasers can easily examine the products. This is essentially a wholesale market, though retailing is done on one "row."

A view of a Detroit, Michigan, market is shown in Fig. 178.

In greater New York there are at least four open street markets, to which the growers bring their produce and sell it from their wagons. These markets are open blocks, paved, with raised stone walks, as in Buffalo.

In Philadelphia, Baltimore, and Washington, stall markets

predominate. They are usually in buildings owned by some company which rents the stalls to growers or dealers. A good example of this type of market is the Ridge Avenue Market in Philadelphia. Here a stall about twelve feet wide rents for \$80 a year. The growers haul in their produce twice a week (Tuesdays and Fridays), at noon, and remain until noon of the next day. Produce is sold at both wholesale and retail from the same stall. In Baltimore there are about ten retail stall markets, with "market days," Tuesday, Friday, and especially Saturday, lasting until late Saturday night. The upper class of customers do their marketing in the morning, the middle class in the afternoon, and the



FIG. 179.—Four loads of vegetables for a single day's marketing from one garden near Peoria, Illinois.

lower class Saturday night. Hucksters buy everything that remains after the retail trade for the evening is over, so that nothing has to be hauled home by the growers.

Sometimes a street and stall market is combined under one supervision. This is true of the market in Peoria, Illinois (Fig. 179). The building is owned by an organization composed of six growers. Stalls are rented to the owners and to others for the season. The organization also collects ten cents per day from every grower who sells from a wagon on the street near by without renting a stall. A "market manager," with police power, preserves order and collects the dimes.

In smaller towns or where there is no organized market, the

grower may drive around to the various retail stores and offer his products, or he may offer his goods from house to house in the residence districts. In either case, a regular trade can be established by furnishing choice products, and making deliveries at stated intervals, either every day or three times a week. Usually, at each delivery, orders may be taken for the next delivery. Often a very satisfactory business in fresh vegetables can be established in even a small town by an enterprising gardener located near its borders.

A vegetable grower who is located within driving distance from his market, so that he hauls his products directly to the market in his own wagons and pays a personal visit to the market every time he has goods to offer, has a distinct advantage over a grower located a distance from his market, in that he can learn at first hand the demands of the particular market in reference to types of products and styles of packing, as well as keeping in daily touch with changes in market conditions, and demands for particular products.

On the other hand, the early market must be supplied almost exclusively with vegetables shipped from a distance by growers who seldom or never visit the market. Such growers must keep themselves advised by other means regarding market demands and conditions.

**Shipping to Distant Markets.**—Under existing conditions there are three general methods of marketing vegetables open to the grower who is located at a distance from his market: Shipping by express to commission men or retail dealers in the small cities; shipping by freight to commission men in large cities, and selling f.o.b. shipping point either to local buyers or to representatives of city firms.

**Express Shipments to Small Cities.**—Each of these methods has certain advantages, and any one may be superior to the others for a given grower, depending upon circumstances. If the grower is located where vegetables are not extensively grown for shipment, he must, perforce, ship by express or parcel post, since there will be no facilities for the handling of perishable goods by freight. In that case he will usually ship to the smaller cities, and try to deal directly with a retailer. Usually vegetables consigned to commission men in the smaller cities do not sell for as high prices early in the season as those consigned to the large markets, but there is usually less fluctuation in price through the season, so

that the average price received for the crop will be fully as great in a small market as in a large one. This is assuming that the small market would be able to handle the entire product, which is often not the case. The greatest objection to the small market is the ease with which it is overstocked. The prices may not drop as low as in a large market, but the goods simply cannot be moved. When the product from slightly southern points becomes abundant, the smaller cities to the north, which may have been taking the earlier shipments at satisfactory prices, begin to be supplied with home-grown stock, and when this becomes plentiful the stock shipped in from other points is usually not wanted at any price. The grower who has been depending upon this kind of a market then suddenly finds himself confronted with the problem of seeking another outlet for his goods.

Another serious defect in the wholesale markets handling goods on consignment in the smaller cities is that no premium is placed upon superior goods, No. 2 and ungraded stock usually bringing the same price as a strictly fancy article. There is no incentive to proper grading and packing for such a market.

The most satisfactory way of supplying vegetables to the markets of the smaller cities is to arrange with one high-class retailer in each city to handle a certain number of packages of a given product each day through the shipping season. In this case each shipment is usually billed out at a price set by the grower rather than the dealer. In this way it is often possible to build up a very satisfactory trade in high-grade products. The most serious drawback to this method of marketing is the impossibility of determining the number of packages that can be furnished per day, and hence the necessity of limiting orders to the supply that can normally be furnished. This makes it necessary to find some other way of marketing part of the crop when the yields are heavy. The surplus is usually consigned to some commission man located in a small city other than those in which a retail dealer is being supplied.

**Consigning to Large Cities.**—Since transportation by express is always expensive, most growers located at points where vegetables are shipped in quantity send their goods by freight to a large city market rather than express them to smaller markets. At each shipping point there is usually an organization of the growers, which makes possible the securing of better railway rates and accommodations than would be the case where the growers

are working independently, and provides for the loading of the cars and other matters connected with the shipping of the goods (Fig. 180). These are the chief functions of the organization as operated at many shipping points, for the interests of the various growers are not pooled. Each grower consigns his products to any commission house he may select in the city to which cars are being shipped. Each lot of vegetables retains its identity upon the market, and returns are made directly to each grower



FIG. 180.—Muskmelon growers at Alma, Illinois, waiting their turns to load their melons for shipment.

for his own goods. The grower is thus directly dependent upon his own commission man for the prices he will receive.

The prices secured by different commission men on the same market the same day differ widely. Some growers change commission men frequently in the hope of securing higher prices; but such results seldom follow, especially when the market is well supplied, for at such a time any good commission man will first take care of the produce from his regular shippers, and sacrifice, if necessary, that received from spasmodic shippers.

Other growers divide each day's shipment among two or three

firms in the hope of getting high prices for part of the goods each day. The proportion shipped to each man on a given day is usually determined by his latest returns, and the man who secured the best prices one day may secure the lowest three days later, so that on the entire season's business little or nothing is gained by dividing shipments, and often much is lost. The safest plan to follow in shipping to a large city market is for the grower to make arrangements with some trustworthy commission firm to handle his entire product. This should be done before the shipping season begins. If the grower can visit the market and talk per-



FIG. 181.—Packing shed for cantaloupes at railway siding near Rocky Ford, Colorado. The product of 200 acres was packed under the supervision of one man in this shed.

sonally with his commission man, much will be gained. There should be a specific understanding between the grower and the commission man regarding the grading and packing of the products and the meaning of the different brands to be used on the packages, so that the salesman may know with absolute certainty the exact character of the goods contained in a given package. This will enable him to place the different grades with the different classes of trade, and thus realize for the grower the largest possible proceeds from the entire product.

If this method is followed, and the same grades of each product are shipped under the same brands to the same firm, year after year, the reputation of the goods will soon be established, and there will be a distinct demand for them at prices considerably in advance of those received for the same kind of goods shipped indiscriminately to various dealers.

The method of marketing just described, that of each individual grower consigning his products to a commission man of his own selection, but shipping in the same car with other growers (the car being loaded under the supervision of a shipping association),



FIG. 182.—Loading platform of Rocky Ford Cantaloupe Growers Association, where every crate of cantaloupes brought in by the growers is inspected before being loaded for shipment.

is in operation principally at points within one or two days' run from the market and where a number of different products rather than some one specialty is grown. In regions where the production of some one important crop has been highly developed, the shipping association usually has full charge of the marketing, as well as the loading of the cars. In some cases, and with certain products, the grading and packing are done at a central packing house under the supervision of the association (Fig. 181). In other cases, the grading and packing are done by the grower according

to a definite set of rules adopted by the association, and the goods are subject to inspection before they are shipped (Fig. 182). In either case, the goods are shipped in the name of the association, and not that of the individual grower. In this way it is possible to ship straight car lots of a uniform product and command the attention of wholesale buyers or general distributors. This method of marketing places great responsibility upon the manager of the association, for upon his judgment largely depends the successful marketing of the entire output of the association. He must establish connections in the leading markets long before the shipping season begins, and keep in daily touch with market conditions all over the country during the shipping season. Basing his judgment upon the information at hand, he must decide what to do with each car by the time it is loaded. Sometimes the crop is quite largely sold f.o.b. at a definite figure, but very often a large part is sold on consignment through general distributors.

No matter how each car is disposed of, nor in what market it is eventually sold, nor how much it sells for, each and every grower who delivered produce to the association's loading shed the same day receives the same price per crate or package for the same grade of goods. That is, the net proceeds for the entire output of the association for a given day are pro rated among the growers according to the number of packages of a given grade shipped by each. In this way the individual grower is relieved entirely from the responsibility of marketing his products. This is a decided advantage over attempts at independent marketing, especially where the producing point is located a great distance from the market. The farther from market a grower is located, the more dependent he is upon organized methods of marketing, and the less he can afford to try to assert his independence.

#### QUESTIONS

1. Mention six vegetables that remain in edible condition only a short time, and six others that remain in edible condition a long time.
2. Mention six vegetables in which the entire product may be gathered at one time.
3. Mention six vegetables in which the harvest extends over a considerable period, but in which the individual specimens must be harvested promptly at a given stage of maturity.
4. How may market conditions cause a departure from the normal period of harvesting a given product?

5. Describe the deterioration in quality that may take place in vegetables between harvesting and marketing, and suggest means of preventing such deterioration.
6. Discuss the advantages of using a packing shed for vegetables as compared with packing in the field.
7. Describe the construction of a simple packing shed.
8. What additional facilities in a packing shed must be available if products demanding washing are to be prepared for market?
9. What factors determine the kind of package to use for marketing vegetables?
10. Contrast packages used for local market and for shipping.
11. What are the advantages of using the same kind of package for a number of products?
12. What is meant by a "standard" package?
13. Why must packages be provided with ventilation in hot weather?
14. What vegetables are usually washed before marketing?
15. What vegetables are usually marketed in bunches?
16. Why is grading of the product essential to successful marketing?
17. How many grades of vegetables are usually made?
18. Give full directions for the grading of tomatoes.
19. Describe the different grades of Gem melons as made by critical packers.
20. Discuss the importance of the proper placing of specimens in the package.
21. Why must the specimens be placed tightly in the package?
22. Describe the proper arrangement of tomatoes and of muskmelons in their respective packages.
23. Mention some details in which the demands of different markets are decidedly at variance.
24. Discuss the importance of knowing the particular customs of the market that is to be supplied.
25. Describe the methods of operating local street and stall markets when the vegetable grower is his own salesman.
26. What are the advantages of a local market over a distant market?
27. What three methods of marketing vegetables are open to a grower located at a distance from market?
28. Describe the conditions under which each of these methods would be preferable to the others. Also point out the defects or weaknesses of each method.
29. How can a reputation for high-class products be established?
30. What advantages has an association of growers over an individual grower in matters pertaining to marketing?
31. When an association has full charge of marketing the products of its members, how are the proceeds due each member determined?

## CHAPTER XXX

### THE STORAGE OF VEGETABLES FOR WINTER USE\*

ALTHOUGH the northern cities and large towns may be supplied during the winter with fresh vegetables shipped in from the South or in certain cases grown in greenhouses in the North, the smaller towns and country places are likely to be without an adequate supply of vegetables in winter unless some one in the locality has sufficient foresight to store them and put them on the market as needed. Local market gardeners in many places find the marketing of fall-stored root crops during the winter a very remunerative way of employing their time between one growing season and the next. Large quantities of cabbage, onions, potatoes, and other crops with good keeping qualities are likewise stored every winter at producing points for supplying the wholesale trade with these commodities in carload lots. A person who grows vegetables for home use should include in his garden a large assortment of vegetables intended primarily for winter, and give proper attention to their storage.

**Time of Planting.**—Vegetables to be stored for winter use should be planted at such a time that they will reach the right stage of development at the proper season for storing. This means that in the case of some of the crops they will be planted considerably later than if designed for summer use, since the product is of better quality if not allowed to continue growth after reaching the desired stage of development, and this stage should not be reached before the arrival of the storage season. Since most vegetables usually keep best if put into storage comparatively late, it should be the aim of the gardener to mature the vegetables for winter use as late in the season as he can, and yet have them harvested before they are injured by the cold. If planted too early the root crops are likely to become tough and woody or pithy before the season for storage arrives. If cabbages are planted too early they are likely to burst open before the weather is cool enough for them to be stored.

The proper time for planting the various vegetables for winter

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\* Portions of the present chapter were first published by the author in Circular 154 of the Illinois Agricultural Experiment Station.

use will depend upon the variety and the length of the season. The earlier maturing the variety, the later it can be planted; and the farther north the locality, the earlier the planting may and must be done. The cool nights of the northern summers are especially favorable to the growth of root crops, cabbage, celery, etc., so that it is feasible to grow a larger assortment of vegetables for storage in the North than in the South. It is fortunate that such is the case, for in the South, vegetables can be grown in the winter, while in the North, storage is a much more important factor in the winter supply.

In central and northern localities, the dates for planting the vegetables designed for winter use would be about as follows:

1. Onions (for either summer or winter use), as early as the ground can be worked in spring. Onions differ from all the other vegetables stored for winter in that they must be ripened and cured while the weather is still warm. The earlier they are planted, the surer the crop.

2. Parsnips, salsify, horse-radish, and leeks would be planted about the same time as onions, for, although an extremely early start is not so imperative in the case of these vegetables, they demand a long season to complete their growth, and the earlier they are started, the longer the time they will have to grow.

3. Beets and carrots, late varieties, May 1 to May 15; early varieties, June 1 to June 15. Plantings made in May are surer to make a crop than those made in June; hence the late varieties are the more reliable.

4. Rutabagas are not adapted to hot climates, and hence are seldom grown in central and southern localities. In the North they should be planted from June 15 to July 1.

5. Cabbage, Brussels sprouts, and celery (transplanted), July 1 to July 15.

6. Turnips, winter radishes, and kohlrabi, July 20 to August 10.

The other crops suitable for storage would be planted at the same time, whether intended for immediate use at maturity or designed to be stored for winter.

**Conditions Essential to Successful Storage.**—Of the vegetables stored for winter, some require entirely different conditions in storage than do others, so that attempts to store all vegetables under the same conditions would result only in failure. In order that root crops may be stored without wilting, rotting or starting into growth, they must be kept cool, fairly moist, and away from

contact with circulating air. Cabbage may be successfully stored under the same conditions. Onions must be kept at a low temperature, but differ from the root crops in that they must be in a dry atmosphere and have free circulation of air. In a moist atmosphere, under high temperature, they would either rot or sprout. Vegetables that are expected to continue growth while in storage, such as celery, leeks, Brussels sprouts, and parsley, must be planted in dirt and the roots kept moist. Air should circulate freely about the tops, and the temperature must be low. On the other hand, sweet potatoes, pumpkins, and squashes demand a high temperature and dry atmosphere, with free circulation of air.

The conditions of storage favorable to the different crops are secured in various ways. Market gardeners use outdoor pits or specially constructed cellars for their root crops, cabbage and celery. Onions are commercially stored in slatted crates piled in tiers in frost-proof houses provided with means for ventilation so that the temperature can be maintained at slightly above freezing. Sweet potatoes and squashes are also stored in specially constructed houses, in which the temperature can be controlled; but since a high temperature is demanded for these crops, artificial heat is usually employed. Circulation of air about these products in storage is facilitated by the use of slatted bins, and allowing ample space between the bins and the side walls of the building.

#### VEGETABLE STORAGE HOUSES

In the construction of vegetable cellars and storage houses, protection against frost is provided in various ways. Outdoor cellars used for the storage of potatoes, celery, cabbage or root crops in cold climates are usually made partly under ground, and the roof is supported by heavy timbers and covered deeply with earth (Fig. 183). Usually this is sodded to prevent washing by heavy rains. Storage houses for onions, sweet potatoes (Fig. 184) and squashes are usually built entirely above ground, and the walls insulated to prevent fluctuations in temperature. The air in a storage house above ground can be kept drier than that in one below; hence the use of above-ground houses for these products. The insulation may consist of a series of dead-air spaces in the wall, made by using layer after layer of building paper, separated by wooden strips from one to four inches wide, until a wall twelve

to fourteen inches thick is built up; or a double wall may be built with the two parts twelve inches apart, and the intervening space filled with sawdust or other material that is a poor conductor of



FIG. 183.—Outdoor cellar for storage of potatoes, near Greeley, Colorado.



FIG. 184.—Storage house for sweet potatoes, Union County, Illinois.

heat. In this case, also, the wall is lined with paper to make the insulation perfect. In both cases it is customary to use matched lumber in the construction of the walls.

## STORAGE IN SMALL QUANTITIES FOR HOME USE

**Root Crops and Cabbage.**—For home use the root crops and cabbage can best be stored in outdoor pits for late winter use, and in the cellar for use early in the season. The chief objection usually urged against storing root crops in the cellar is that they are likely to wilt. This difficulty can be obviated by packing the roots in boxes with alternate layers of earth or sand, and placing the boxes in the coolest part of the cellar. The earth will absorb any odors in case the vegetable should start to decay, and thus



FIG. 185.—Arrangement of cabbage for winter storage.

avoid endangering the health of the family. Cabbage can be stored in the same way if the roots and outer leaves are removed and merely the heads are packed in boxes or barrels of earth.

Cabbage intended for late winter use, however, will keep better in an outdoor pit than in a cellar. The same is true of parsnips, salsify, horse-radish, and some of the other root crops. Except where the ground is especially well drained, the pits are usually made entirely above ground. For storing cabbage in this manner, the plants are pulled with the roots and leaves on, and placed upside-down in regular order on a level piece of ground. Usually three plants are placed side by side, with two above, and this arrangement repeated so that the final result is a long, low pile of cabbage showing five plants in a cross-section (Fig. 185). Earth is piled against and over this array of cabbage until the plants, including the roots, are entirely covered. In a severe climate, a layer of manure may be added when cold weather arrives.

For storing parsnips, salsify, and horse-radish; which are uninjured by freezing, the roots may be placed in a pile on the ground and covered with about six inches of earth. The advantage of storing in this manner, instead of allowing the roots to remain where they grew, is the saving in time of digging, when a few roots are wanted during the winter. It is much easier to open the pit when the ground is frozen than to dig the roots from the garden with a pick. In fact, the difficulty of digging almost precludes the use of these crops in midwinter unless they are more accessible than in the place where they grew.

Beets, carrots, turnips, rutabagas, kohlrabi and Irish potatoes can also be stored in outdoor pits, but they must be covered sufficiently to prevent freezing. One of the best ways of handling these crops is to place them in a conical pile and cover first with six or eight inches of hay or straw, then with earth to a similar depth (Fig. 186). If extremely cold weather is expected, a layer of manure should be placed outside of the earth. In getting vegetables from pits of this kind in midwinter, the manure is



FIG. 186.—Outdoor pit of beets opened up in March.

removed slightly from one side of the pit near the bottom and a hole about a foot square chopped through the frozen earth with an old ax. Sufficient hay is then pulled out, by means of an iron hook, to enable a person to thrust his arm into the opening and reach the vegetables. Enough are taken out to last a few days and the hole through the dirt then stuffed with hay, the manure being replaced if necessary.

**Celery** may be stored in various ways, but one of the most satisfactory methods for home use is to dig the plants with the roots on and plant them in moist earth placed on the cellar floor,

or in boxes to be placed in the cellar (Fig. 187). In either case the cellar must be cool, the ventilation good, and the earth surrounding the roots kept moist by repeated applications of water. In applying the water, care must be taken to wet only the roots and not the tops of the plants. If the cellar is kept dark, all new growth made during the winter will be thoroughly blanched.

**Leeks and Brussels Sprouts** stand considerable freezing, and can often be carried through the winter in good condition by digging with the roots on and planting close together in coldframes

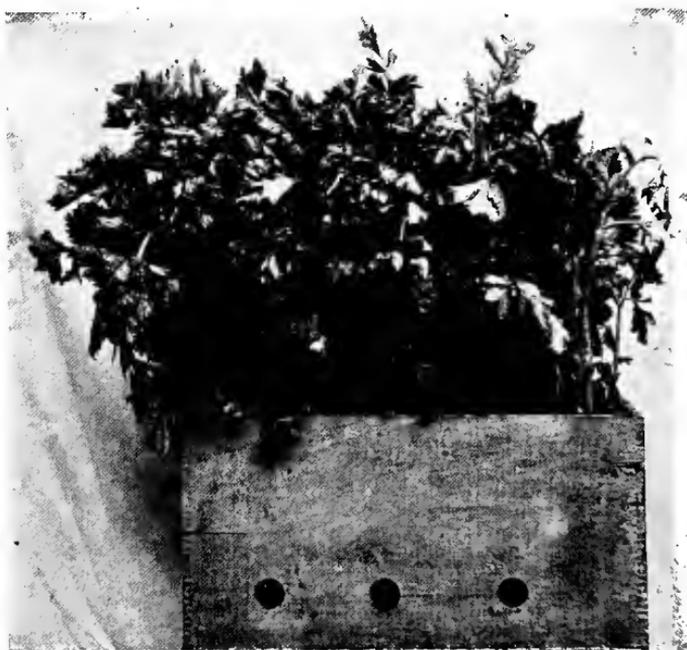


FIG. 187.—Celery packed in box for winter storage in cellar. The holes in side of box are to facilitate watering without wetting tops of plants.

late in the fall. In extreme weather, straw or other protection should be provided in addition to the sash.

**Parsley** can be wintered in a coldframe along with leeks and Brussels sprouts, or a few roots may be planted in boxes of earth and placed near the cellar window, or the plants can be placed in pots and grown in the window of a living room like geraniums or other house plants. The last-named method is as satisfactory as any, and when garnishing material is needed, it is extremely accessible.

**Onions** intended for winter use should be thoroughly cured, as soon as possible after harvesting, by being kept in a dry place where the air can circulate freely about them. After the onions are cured, they keep best at a low temperature. If the cellar is cool, as it should be for the storage of most crops, onions will keep fairly well if placed in market baskets hung on the joists at the top of the cellar. Frequent ventilation of the cellar, especially when the outside air is dry, will improve the conditions for the onions. If milk and butter are to be kept in the cellar, the onions had better be somewhere else. They can frequently be kept in the attic all winter if placed close enough to the chimney to prevent freezing, yet far enough away to prevent over-heating or sprouting. The dry atmosphere of a good attic is unfavorable to the sprouting, even though at times the temperature may become somewhat high.

**Sweet Potatoes, Squashes, and Pumpkins.**—All the vegetables considered thus far keep best at a relatively low temperature. In marked contrast to these vegetables are sweet potatoes, squashes, and pumpkins. These demand high temperature, a dry atmosphere and free circulation of air. There is no better place to keep sweet potatoes for home use than in a slatted crate close to the chimney in an upstairs room that is kept warm at night as well as during the day. Another good place is in baskets hung from the ceiling of the furnace room in a basement. Squashes and pumpkins also keep much better in the furnace room than in the “vegetable cellar” or cool part of the basement.

## QUESTIONS

1. Discuss the importance of storing vegetables, from the standpoint of the market gardener and the home grower.
2. What should govern the time of planting vegetables that are to be stored for winter use?
3. What three factors must be considered in the storage of all vegetables?
4. State the conditions essential to the successful storage of four different groups of vegetables.
5. Describe the essential features in the construction of a storage house for vegetables.
6. How may the root crops and cabbage be stored for home use?
7. Describe the storing of celery for home use.
8. Where can the home supply of onions be kept for winter?
9. Where is the best place to keep the winter supply of sweet potatoes and squashes for home use?

## CHAPTER XXXI

### FORCING VEGETABLES

As mentioned in the preceding chapter, one of the ways of securing fresh vegetables at the North during the winter is to grow them under glass. The growing of vegetables to edible maturity under glass at a time of the year when it would be impossible to grow them out-of-doors in the given locality on account of unfavorably low temperatures, is known as "forcing." This term is used whether the crops are grown in greenhouses, hotbeds or coldframes, but is most often employed to designate the growing of these crops in artificially-heated glass structures tall enough to protect the gardener as well as his crops from the cold of winter. Certain crops, such as lettuce and radishes, may be grown in low structures like hotbeds (Fig. 188) and coldframes, especially in late winter and early spring; and other crops, like cauliflower, celery, eggplants, cucumbers and certain varieties of muskmelons, may be planted in hotbeds early in the spring and permitted to remain there until reaching maturity, even though at the time they mature the weather is warm enough for the outdoor culture of these crops and the glass is left off at night as well as during the day. In this case, the crops are started under forcing conditions, but complete their growth essentially in the open. In the strictest sense, forcing implies the maturing of the crop at a time when the plant could not live in the open, though often the last crop of the forcing season continues bearing until after the weather is sufficiently warm for starting a similar crop out-of-doors.

**Marketing Hothouse Vegetables.**—Forced vegetables in winter do not compete in the market against stored products. They are, for the most part, sorts that do not lend themselves readily to storage, such as lettuce, cucumbers, and tomatoes.

Furthermore, there is not much competition between forced products grown close to market and outdoor vegetables of the same kind shipped in from a distance, for the greenhouse products can be marketed in a much fresher condition, and are likely to be more perfectly developed on account of being grown under controlled conditions of temperature and moisture. Hothouse products ordinarily sell much higher than outdoor products at the same

season. This fact, together with the saving in transportation, makes it possible to grow greenhouse crops at a profit, even though the cost of glass houses, fuel, and hand labor is great.

In nearly every large city of the North and in many smaller towns there are extensive greenhouse plants devoted to the growing of vegetables, some individual growers having as much as ten acres under glass. Lettuce is grown in this manner more extensively than any other crop (Fig. 189), though it is quite a common practice to grow spring crops of cucumbers or tomatoes in houses devoted to lettuce during the coldest months.



FIG. 188.—Hotbed of head lettuce approaching maturity.

Hothouse vegetables are not marketed exclusively in the cities where they are grown. Considerable shipping trade has been developed. In this case there is some competition with southern products, but the superior quality of the forced product quite largely eliminates this factor.

**Regulation of Temperature.**—The temperature and moisture requirements of a given vegetable are essentially the same whether it is grown under glass or in the open; but in growing a crop under glass, especially in a modern greenhouse where plenty of heating pipes have been installed and the arrangement of valves makes it

possible to turn the heat into any number of pipes as desired, it is possible to more fully meet the temperature requirements of a given crop in midwinter than in the case of the same crop grown out-of-doors in the summer. During the season when artificial heat is required, the heat is regulated primarily by manipulation of the valves which connect the pipes with the source of heat, cutting off or turning on whatever pipes may be necessary. Incidentally, opening or closing the ventilators will assist in maintaining the proper temperature in case of sudden changes from cloudiness to sunshine or *vice versa*. However, ventilation of a greenhouse in midwinter is primarily for the purpose of changing



FIG. 189.—Interior view of large range of lettuce houses near Chicago.

the air rather than lowering the temperature. In late spring, on warm days, when no artificial heat is required, ventilation may aid materially in keeping the houses from becoming too warm. In still warmer weather, shading of the glass by whitewashing may further aid in keeping the houses cool. Thus the temperature in a glass house can be controlled to a nicety, if the house is properly equipped and the operator is skilful. This makes plant growing easy, so far as temperature is concerned.

**Greenhouse Troubles.**—However, other difficulties are encountered. The damp atmosphere of the greenhouse makes conditions especially favorable for the development of fungous diseases on the growing crops; and unless extreme care is exercised in the watering, especially during a siege of cloudy weather.

serious outbreaks of disease are likely to occur. The damp atmosphere and dark weather are not only favorable to the development of the fungi causing disease, but also encourage a sappy growth in the plants which is more susceptible to disease than a harder, more normal growth. In cloudy weather it is necessary to water sparingly and hold the temperature rather low if trouble is to be avoided.

Certain insects also thrive better in the greenhouse than out-of-doors, and an almost continual warfare must be waged against them if the crops are to be fully protected. In fact, some growers practice fumigation of their houses regularly, at intervals of about a week, rather than ever give the plant lice and other insects a chance to become seriously abundant.

Thus, in greenhouse vegetable growing, constant attention must be given to the regulation of heat, ventilating, watering, and the control of insects and diseases. Yet, when properly managed, the crop in a greenhouse is under much more complete control than an outdoor crop.

**Selection of Crops for Forcing.**—Greenhouse vegetable growing is the most intensive type of vegetable production, and only those crops which yield a product of high value per square foot of space occupied can be profitably grown under glass. It is also true that certain crops adapt themselves more readily to greenhouse conditions than others. There are also special forcing strains of nearly all the vegetables commonly grown under glass. These have, in many instances, been developed under greenhouse conditions, and are better adapted to such conditions than are the varieties and strains commonly grown out-of-doors. Furthermore, some of the best forcing strains are of little value for outdoor culture, owing to the difference in conditions, though some sorts are well adapted to both uses. The point that must be kept in mind is that, in order to succeed in growing vegetables under glass, it is necessary to select varieties and strains that are adapted to the purpose. Such varieties are usually designated distinctly in seed catalogues.

**Lettuce and Radishes.**—The leading forcing-house crops are lettuce, radishes, cucumbers, and tomatoes. Of these, lettuce is by far the most important. Both radishes and lettuce make a very rapid growth, so that, in spite of the short days of winter, several crops can be grown in succession in the same house in one season. In order to economize space, the lettuce is usually started

in seed-beds or flats and later transplanted to the bench or bed where it is to complete its growth (Fig. 190). Often it is shifted once from the seed flat before the final transplanting. When handled in this way, leaf lettuce occupies for only a few weeks the final amount of space allotted to it; and as soon as one crop is harvested another set of plants is ready to take its place. Radish seeds are sown directly where the crop is to complete its growth. Both these crops are comparatively easy to grow, for a vegetative



FIG. 190.—Grand Rapids lettuce ready for cutting.

part constitutes the edible product; they endure relatively low temperatures without a serious check in growth and are not subject to serious attack of insects or disease if proper care is taken in the management of the houses in which they are grown. Head lettuce is much more difficult to grow than leaf lettuce, since it is likely to fail to head, or to tip-burn or rot or become bitter, if conditions are not exactly to its liking.

**Cucumbers and tomatoes** require a much longer time to develop than lettuce or radishes, and are more uncertain as midwinter

crops. They require pollination, and pollen is likely to be scarce in dark winter weather. The artificial support and the careful training required make their culture more laborious than that of lettuce or radishes (Fig. 191). They are also susceptible to certain diseases that may utterly ruin the crop. They are more satis-



FIG. 191.—Bench of hothouse tomatoes, showing method of training. Each plant is pruned to a single stem, and tied with raffia to upright cord.

factory as fall and spring than as midwinter crops. As already mentioned, a favorite practice among some growers is to plant a spring crop of cucumbers or tomatoes in the houses following the last crop of lettuce. Such a crop may begin ripening only a month or six weeks in advance of the outdoor product, but usually meets with ready sale at good prices in the local markets.

## QUESTIONS

1. What is meant by the forcing of vegetables?
2. What different kinds of glass structures may be used for the forcing of vegetables?
3. What are the leading hothouse vegetable crops?
4. Why is there little competition on the market between hothouse vegetables and outdoor products shipped in from the South?
5. How can the temperature of a greenhouse be controlled at different seasons of the year, and in sudden changes of weather conditions?
6. Can the temperature requirements of a given crop be more fully met in a greenhouse or out-of-doors? Why and how?
7. Are plants more or less subject to disease in a greenhouse as compared with out-of-doors? Why?
8. What precautions should be taken in the care of greenhouse crops in cloudy weather?
9. What is the chief means of controlling insects in greenhouses?
10. What considerations should govern the selection of crops for forcing?
11. How is lettuce handled as a greenhouse crop?
12. Why are radishes and leaf lettuce comparatively easy crops to grow in a forcing house?
13. What difficulties are encountered in growing head lettuce in a greenhouse?
14. Why are cucumbers and tomatoes more difficult to grow in a greenhouse than radishes and lettuce?
15. How are greenhouse tomatoes trained?
16. What combination of greenhouse crops is suitable for fall, winter, and spring, to get the longest use of the houses in profitable crops?

## CHAPTER XXXII

### EXTENT OF VEGETABLE GROWING IN THE UNITED STATES

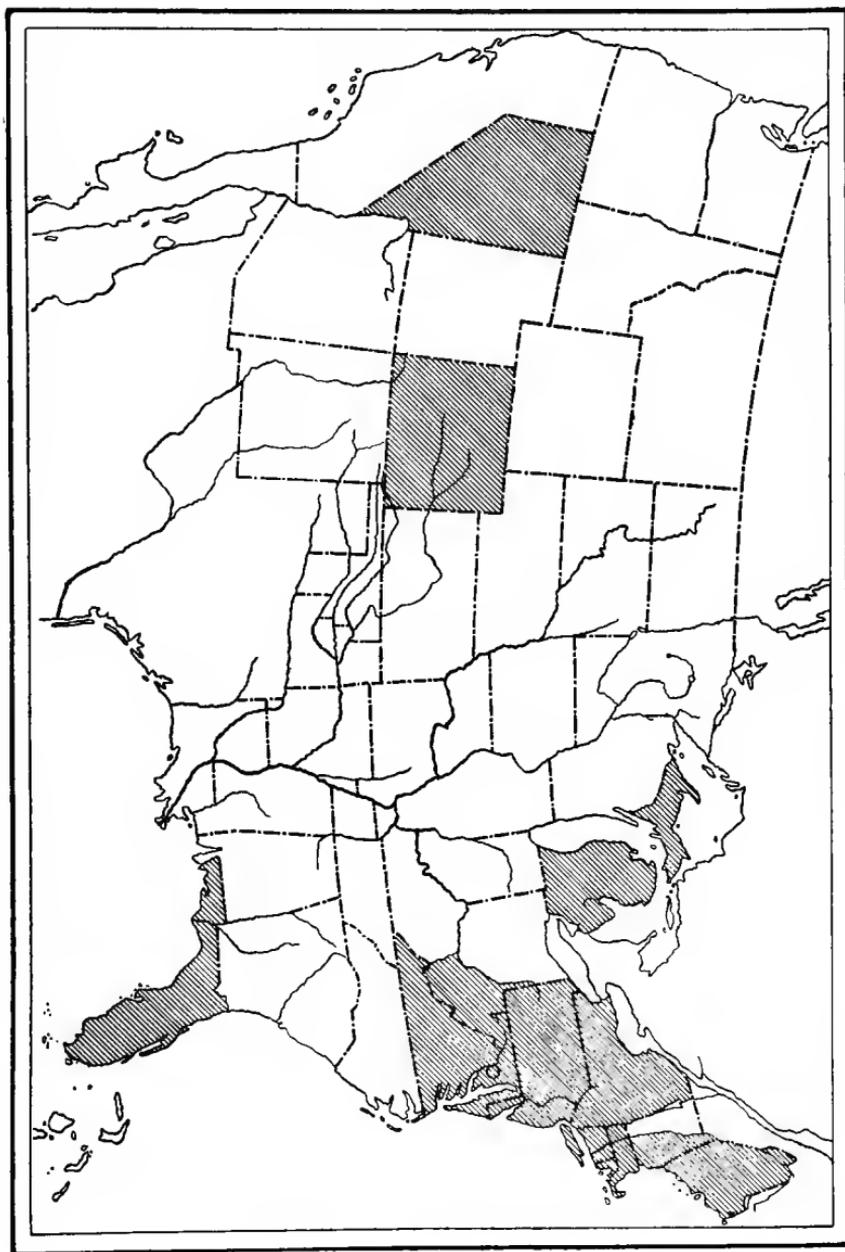
VEGETABLES are grown quite generally throughout all parts of the United States, and their production constitutes an industry of large aggregate proportions. The Thirteenth Census Report, which gives the figures for 1909, shows that the value of all vegetables reported for that year was \$418,110,154. The same year, the value of all fruits and nuts, including small fruits, orchard fruits of the temperate zone, citrus and tropical fruits, and edible nuts, was only \$222,024,216, or only slightly over half the value of the vegetable crop. About two-fifths of the value of the vegetable crop was represented by potatoes. The value of the vegetables other than potatoes was more than equal to the value of all the fruits. The total value of the vegetable crop was slightly greater than that of the oats crop and nearly two-thirds that of the wheat crop of the nation.

The above statements refer to the value of the nation's crop as a whole. In some states the vegetable crop is of much more importance as compared with other crops than in other states. However, in every state except California the value of the vegetable crop exceeded that of the fruits and nuts. In each of seven states the value of the vegetable crop exceeded that of all cereal grains combined. These states were Maine, New Hampshire, Massachusetts, Rhode Island, Connecticut, New Jersey, and Florida. In thirteen other states the value of the vegetables exceeded that of the corn crop. These states were Vermont, New York, North Dakota, Montana, Idaho, Wyoming, Colorado, Arizona, Utah, Nevada, Washington, Oregon, and California. The vegetable crop exceeded in value the wheat crop in twenty-one different states in addition to the seven states where it exceeded in value all cereal grains. These states were Vermont, New York, Wisconsin, Iowa, Delaware, Virginia, West Virginia, North Carolina, South Carolina, Georgia, Kentucky, Alabama, Mississippi, Arkansas, Louisiana, Texas, Wyoming, New Mexico, Arizona, Nevada, and California.

The acreage and value of the potato crop and of other vege-

tables (except sweet potatoes) in each state for the year 1909, as recorded in the Thirteenth Census Report, are given in Table IV. The acreage and value of the sweet potato crop is also given for states in which the acreage exceeded 1000. The totals for the United States in the case of sweet potatoes include the record for the states not indicated in detail. The last two columns of this table indicate the percentage of improved farm land which was occupied by vegetable crops in each state in 1909, and the value of the vegetable crop for each state expressed in percentage of the total value of all crops produced in the state. It will be seen that the value of vegetable crops is high considering the amount of land occupied. On the accompanying chart (Fig. 192) shading is used to indicate the states in which the value of the vegetable crops amounted to over 10 per cent. of the total value of all crops.

FIG. 192.—Shading indicates the states in which vegetable crops exceed 10 per cent. of the total value of all crops.



## EXTENT OF VEGETABLE GROWING

TABLE IV.—Acreage and Value of Vegetable Crops in the United States, 1909

	Potatoes		Sweet potatoes		Other vegetables		Per cent. of improved farm land planted to vegetables	Per cent. of total value of all crops
	Acreage	Value	Acreage	Value	Acreage	Value		
<b>New England:</b>								
Maine.....	135799	\$10224714	.....	.....	25288	\$2153003	6.8	31.5
New Hampshire.....	17370	1204626	.....	.....	8855	1071551	2.8	14.2
Vermont.....	26859	1743049	.....	.....	8548	872183	2.2	9.5
Massachusetts.....	24459	1993923	.....	.....	37220	6189857	5.3	25.6
Rhode Island.....	4649	408429	.....	.....	5275	636656	5.6	26.5
Connecticut.....	23959	1882197	.....	.....	16250	1965635	4.1	17.1
<b>Middle Atlantic:</b>								
New York.....	394319	20338766	.....	.....	175402	15963384	3.8	17.4
New Jersey.....	72991	4979900	22504	\$1527074	86227	7566493	10.1	34.9
Pennsylvania.....	262013	11973843	1306	104434	94111	10013920	2.8	13.3
<b>E. N. Central:</b>								
Ohio.....	212808	9377955	1143	104181	123461	11393791	1.8	9.1
Indiana.....	99504	3816126	1561	139886	114267	7498024	1.3	5.6
Illinois.....	138052	6401598	10568	506760	120291	9392296	1.0	4.4
Michigan.....	365483	9913778	.....	.....	90861	6280645	3.6	10.0
Wisconsin.....	290185	7917754	.....	.....	70123	4593865	3.0	8.4
<b>W. N. Central:</b>								
Minnesota.....	223692	7685259	.....	.....	46021	3359052	1.4	5.7
Iowa.....	169567	6629234	2274	125763	80402	5266411	0.9	3.8
Missouri.....	96259	4470135	7938	567413	129570	8268281	1.0	6.0
N. Dakota.....	54067	2079125	.....	.....	13383	1069125	0.3	1.7
S. Dakota.....	50052	1967550	.....	.....	15150	1033163	0.4	2.4
Nebraska.....	111151	3785224	.....	.....	36164	2118393	0.6	3.0
Kansas.....	79025	3471488	4883	373432	48757	2963733	0.4	3.2



## CHAPTER XXXIII

### SUGGESTIONS FOR LABORATORY WORK

WHEREVER possible, text-book work in vegetable gardening should be supplemented by practical exercises. No matter how lucid the text may be, the student will gain a much more accurate conception of the various garden operations and the cultural requirements of the different crops if he does some actual gardening. If the school is provided with land and equipment for this purpose, the laboratory work may be made a part of the regular class exercises. In the absence of provision for gardening exercises at the school, in the case of high school students living at home it is usually feasible for each student to carry on the laboratory work in his own back yard. In this case he can plant and maintain a regular home garden designed to fit the available space and meet the requirements of the particular family. It is expected that the instructor will inspect the gardens of the various pupils as often as circumstances will permit.

Whether the gardens are maintained at the school or at the homes, the seeds should be purchased in bulk and distributed to the various students. If the school funds do not provide for material of this kind, a small laboratory fee may be charged or the actual expense for the seeds shared *pro rata* by the students.

Even though land for the outdoor work may not be available at the school, it is often feasible to grow the plants there that require starting under glass. Some of the plants may be started in boxes, or flats, in the schoolroom. However, the students should have practice in the making and management of hotbeds, and this can be carried on more satisfactorily at the school than at the homes of the individual students. Therefore it is strongly advised that schools undertaking to give instruction in vegetable gardening be provided with equipment in hotbeds and coldframes, even though there be insufficient land available for outdoor gardening.

When the conditions are such that all the garden work can be carried on at the school as a part of the regular class exercises, it is suggested that there be one practical exercise (Fig. 193) per week, besides incidental items in the care of the plants from day

to day, such as opening and closing the hotbeds and watering the plants. After the hotbeds are started it is a good plan to assign their care to certain students for a definite period, usually for one week at a time.

The following list of practical exercises\* is suggested for schools equipped with land and tools, as well as hotbeds, for the garden work. In localities where outdoor gardening normally commences about April 1, the preliminary work in the subject should begin very shortly after the middle of February. The



FIG. 193.—Class in vegetable gardening, University of Illinois, 1915.

dates given below are of course only approximate, since the date for a given exercise will have to be varied from year to year to meet local conditions. The notations in parentheses indicate team work or other special labor that must be done in preparation for the class exercise following.

1. February 18.—Draw plans for gardens.
2. February 25.—Mix soil for flats. Plant seeds of head lettuce, cabbage, celery, and tomato in flats.  
(Have manure hauled for hotbeds.)

---

\* Adapted from report of sub-committee on courses in vegetable gardening, presented by the author at the annual meeting of the Society for Horticultural Science, Washington, D. C., November 19, 1913.

3. March 4.—Place manure for hotbeds. Set up hotbed frames.
4. March 11.—Clean, repair, and place hotbed sash.  
(Have soil hauled for hotbeds.)
5. March 18.—Prepare soil in hotbeds. Plant part of hotbeds with radishes.
6. March 25.—Shift seedlings of lettuce, cabbage, and tomatoes to other flats; and place flats of lettuce and cabbage in hotbeds.  
(Have land plowed and fitted, and gardens staked out.)
7. April 1.—Prepare soil and plant cool season crops in the open, as follows: Potatoes, peas, radishes, spinach, lettuce seed, onion seed, onion sets.
8. April 8.—Finish planting early crops: Beets, carrots, parsnips. Shift celery seedlings to flats.  
(Have coldframes prepared.)
9. April 15.—Transplant cabbage and head lettuce into the garden. Shift tomatoes to other flats and place in coldframes.
10. April 22.—Hoe all crops and study seedlings.  
(Have unplanted land harrowed.)
11. April 29.—Plant string beans and sweet corn. Hoe everything.
12. May 6.—Hoe and weed everything. Study seedlings.  
(Have unplanted land harrowed.)
13. May 13.—Plant tomatoes, Lima beans, and cucumbers.
14. May 20.—Thin and weed beets, carrots, parsnips, and onions.
15. May 27.—Till the entire garden and make observations on the various crops.

## APPENDIX

### COMPOSITION OF VEGETABLES

THE chemical composition of a number of vegetables is given in the following table. It will be seen that, in general, vegetables are high in water content, and, with few exceptions, rather low in total nutrients. However, their food value is not determined entirely by the percentages of protein, fat and carbohydrates they contain. They furnish needed bulk to the diet, and stimulate the appetite by reason of their pleasant flavors. The mineral salts contained in them are also beneficial to the system.

TABLE V.—*Chemical Composition of Vegetables* \*

	Water	Protein	Fat	Car- hohy- drates	Ash	Fuel value per lb.
	<i>P. ct.</i>	<i>P. ct.</i>	<i>P. ct.</i>	<i>P. ct.</i>	<i>P. ct.</i>	<i>Calories</i>
Asparagus, as purchased.....	94.0	1.8	0.2	3.3	0.7	105
Beans, dried, as purchased.....	12.6	22.5	1.8	59.6	3.5	1605
Beans, Lima, fresh, edible portion.	68.5	7.1	0.7	22.0	1.7	570
Beans, string, edible portion.....	89.2	2.3	0.3	7.4	0.8	195
Beets, fresh, edible portion.....	87.5	1.6	0.1	9.7	1.1	215
Cabbage, edible portion.....	91.5	1.6	0.3	5.6	1.0	145
Carrots, fresh, edible portion.....	88.2	1.1	0.4	9.3	1.0	210
Cauliflower, as purchased.....	92.3	1.8	0.5	4.7	0.7	140
Celery, edible portion.....	94.5	1.1	0.1	3.3	1.0	85
Collards, edible portion.....	87.1	4.5	0.6	6.3	1.5	225
Corn, green, edible portion.....	75.4	3.1	1.1	19.7	0.7	470
Cucumbers, edible portion.....	95.4	0.8	0.2	3.1	0.5	80
Dandelion greens, as purchased....	81.4	2.4	1.0	10.6	4.6	285
Eggplant, edible portion.....	92.9	1.2	0.3	5.1	0.5	130
Kohlrabi, edible portion.....	91.1	2.0	0.1	5.5	1.3	145
Leeks, edible portion.....	91.8	1.2	0.5	5.8	0.7	150
Lettuce, edible portion.....	94.7	1.2	0.3	2.9	0.9	90
Okra, edible portion.....	90.2	1.6	0.2	7.4	0.6	175
Onions, fresh, edible portion.....	87.6	1.6	0.3	9.9	0.6	225
Parsnips, edible portion.....	83.0	1.6	0.5	13.5	1.4	300
Peas, green, edible portion.....	74.6	7.0	0.5	16.9	1.0	465
Potatoes, Irish, edible portion....	78.3	2.2	0.1	18.4	1.0	385
Potatoes, sweet, edible portion....	69.0	1.8	0.7	27.4	1.1	570
Pumpkin, edible portion.....	93.1	1.0	0.1	5.2	0.6	120
Radishes, edible portion.....	91.8	1.3	0.1	5.8	1.0	135
Rhubarb, edible portion.....	94.4	0.6	0.7	3.6	0.7	105
Rutabagas, edible portion.....	88.9	1.3	0.2	8.5	1.1	190
Spinach, fresh, as purchased.....	92.3	2.1	0.3	3.2	2.1	110
Squash, edible portion.....	88.3	1.4	0.5	9.0	0.8	215
Tomatoes, fresh, as purchased....	94.3	0.9	0.4	3.9	0.5	105
Turnips, edible portion.....	89.6	1.3	0.2	8.1	0.8	185

\* Adapted from Bulletin 28, Office of Experiment Stations, U. S. Department of Agriculture.

TABLE VI.—Quantities of Plant Food Elements Contained in Different Vegetables\*

Vegetable	Nitrogen	Phosphorus	Potassium	Vegetable	Nitrogen	Phosphorus	Potassium
	<i>P. ct.</i>	<i>P. ct.</i>	<i>P. ct.</i>		<i>P. ct.</i>	<i>P. ct.</i>	<i>P. ct.</i>
Asparagus.....	0.29	0.035	0.240	Onion.....	0.14	0.017	0.083
Beans, dry.....	4.08	0.528	1.070	Parsnip.....	0.22	0.083	0.514
Beets.....	0.24	0.039	0.365	Peas, dry....	3.58	0.366	0.838
Cabbage.....	0.38	0.048	0.356	Potato, Irish.	0.21	0.030	0.240
Carrots.....	0.16	0.039	0.423	Potato, sweet	0.24	0.035	0.307
Cauliflower.....	0.13	0.070	0.298	Pumpkin....	0.11	0.070	0.074
Celery.....	0.24	0.096	0.630	Radish.....	0.19	0.022	0.133
Corn, sweet, kernels	0.46	0.030	0.199	Rhubarb....	0.13	0.009	0.299
Cucumber.....	0.16	0.052	0.199	Rutabaga....	0.19	0.052	0.406
Horse-radish....	0.36	0.030	0.963	Spinach....	0.49	0.070	0.224
Kohlrabi.....	0.48	0.118	0.356	Tomato.....	0.16	0.022	0.224
Lettuce.....	0.23	0.030	0.307	Turnip.....	0.18	0.044	0.323

\* Adapted principally from Yearbook of the United States Department of Agriculture, 1894.

TABLE VII.—Composition and Value of Fertilizing Materials \*

Material	Composition			Value of the plant food elements in a ton of the material			
	Nitrogen	Phosphorus	Potassium	Nitrogen	Phosphorus	Potassium	Total
	<i>P. ct.</i>	<i>P. ct.</i>	<i>P. ct.</i>				
Fresh farm manure.....	0.5	0.1	0.4	\$1.50	\$0.24	\$0.48	\$2.22
Nitrate of soda.....	15.5	.....	.....	46.50	.....	.....	46.50
Sulfate of ammonia.....	20.0	.....	.....	60.00	.....	.....	60.00
Dried blood.....	14.0	.....	.....	42.00	.....	.....	42.00
Castor pomace.....	5.5	0.75	0.9	16.50	1.80	1.08	19.38
Cotton seed meal.....	7.1	1.35	1.5	21.30	3.24	1.80	26.34
Raw bone meal.....	4.0	9.0	.....	12.00	18.00	.....	30.00
Steamed bone meal.....	1.0	12.5	.....	3.00	25.00	.....	28.00
Acidulated bone meal.....	2.0	7.0	.....	6.00	16.80	.....	22.80
Raw rock phosphate.....	.....	12.5	.....	.....	7.50	.....	7.50
Acid phosphate.....	.....	6.25	.....	.....	15.00	.....	15.00
Muriate of potash.....	.....	.....	42.5	.....	.....	51.00	51.00
Sulfate of potash.....	.....	.....	42.5	.....	.....	51.00	51.00
Unbleached hardwood ashes	.....	0.5	5.0	.....	1.20	6.00	7.20

\* Adapted principally from Hopkins' "Soil Fertility and Permanent Agriculture," published by Ginn & Company, Boston. The values are based upon the following prices: Nitrogen, 15 cents; potassium, 6 cents; phosphorus in raw rock phosphate, 3 cents, in bone meal, 10 cents, and in acid phosphate, 12 cents, per pound.

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