

The Agricultural Experiment Station

OF THE

Colorado Agricultural College

Vegetable Growing In Colorado

Hot Beds and Cold Frames

BY

R. A. McGINTY

Common Insects of the Garden

BY

C. P. GILLETTE

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FORT COLLINS, COLORADO

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Vegetable Growing In Colorado

By R. A. McGINTY

In the days of the early settlers, it was thought that many vegetables which grew to perfection in other parts of the country would not grow well in Colorado, on account of the high altitude. But we have gradually learned by experience that the larger number of our cultivated vegetables can be produced in as high a state of perfection in Colorado as elsewhere. Many vegetables, as cabbage, celery, onions, peas, and tomatoes, to say nothing of potatoes, are now grown commercially in this state. On account of the short season, it is often advisable and sometimes necessary to start plants having a long growing season in hotbeds or greenhouses, but the majority can be planted outside, in the ordinary way.

Some vegetables, as tomatoes and egg plants, which cannot be grown profitably in some sections for market, may well be grown in the home garden for the family table. They may require extra care, but the satisfaction of having fresh homegrown products rather than other kinds, together with their economic value, makes the home garden worth while.

The Experiment Station is constantly receiving inquiries as to the method of culture for different vegetables, indicating a general demand for more information on the subject. It is with the idea of giving this information that this publication is issued.

Soil.—The soil for general vegetable growing should be a rich, friable, well drained loam. One containing some sand is desirable, since such soils warm up earlier in the spring. However, much heavier soils may often be modified by the addition of stable manure and the turning under of green crops so that they will serve. A southern or eastern slope is preferable.

Preparation of the Soil.—The ground should be plowed to a depth of ten or twelve inches in the fall and left in a rough state during the winter. Cross-plow again early in the spring and harrow smooth.

Fertilizers.—Many of the Colorado soils are deficient in organic matter, so that the best fertilizer is well rotted stable manure. This should be applied before plowing in the fall at the rate of 20 to 30 tons per acre. The turning under of green crops is also advisable.

Irrigation.—While the various vegetables require different amounts of water, it is thought advisable to treat the matter in a general way at this point to avoid useless repetition. Vegetables contain from 85 to 90 per cent of water, so it is very necessary that they have plenty of moisture. The soil in which the plants are growing should be moist at all times and the plants should never become wilted or checked for lack of water. This condition is best maintained by thorough but not too frequent irrigation. The soil should be wet to a good depth and then not irrigated again until needed. This causes the plants to send their roots deep into the soil and economizes water. Frequent, light irrigations induce a shallow root system, so that plants are much more easily affected by dry weather.

The furrow method of irrigation is preferable. It is more economical of water than the flooding method and is one factor in controlling plant diseases. Where a garden is irrigated with a lawn sprinkler, the tendency is always to give too little water. The soil appears to be wet when in reality it is not. If this method is used, the garden should be thoroughly soaked and not sprinkled again for a week. Sprinkling every day or two will cause the plants to be shallow rooted.

ASPARAGUS.

Soil.—Asparagus will grow well on a variety of soils, the one condition to be avoided being that of too much moisture. If earliness is desired, a rich sandy loam with a southern or eastern exposure is best. Such a soil will warm up earlier in the spring than a heavier one.

Preparation.—In the fall preceding the planting, the land should be well plowed to a depth of ten or fourteen inches and left to the action of the weather during the winter. In the spring twenty or more tons of well rotted stable manure per acre is applied and plowed under. This is followed by a thorough harrowing which puts the soil in the best condition for planting. This thorough preparation is very necessary to the success of the crop. New land should not be used for asparagus culture.

Plants and Planting.—If the plants used are purchased from a seedsman, good one-year-old plants should be procured. One may grow very satisfactory plants from seed. The seed are gathered when ripe and put in water in order to soften the pulp which surrounds them. They are mashed up and the hard seed worked out, washed and dried. They are stored during the winter and planted in the spring. The rows should be two and a half or three feet apart to permit horse cultivation and the seed planted one to two

inches apart in the row and about one inch deep. Seed may also be purchased from reputable seed houses. These plants will be ready for transplanting the following spring.

Asparagus plants are either pistillate or staminate, the former producing the seed. It has been shown by experiment that the staminate plants produce the larger crop and these should be used when possible. It is hard to distinguish between the male and female plants before the end of the second year, when the seed are produced for the first time. Therefore if plants are left in the seedbed until two years old, they may be separated and the male plants, only, used for planting.

When ready to set out the plants, trenches or furrows four and one-half or five feet apart and six to seven inches deep are made in the field and plants set in the bottom of the furrows about two feet apart. When set, the plants are covered with two or three inches of soil. The furrow is not entirely filled at the time of planting, but this is done gradually during cultivation.

To grow blanched asparagus, the plants are usually set a few inches deeper. Clean cultivation is given during the summer, and before winter comes, the tops should be cut off and burned, after which a mulch of well rotted manure three or four inches deep should be put over the bed. This prevents rapid freezing and thawing during the winter, which is detrimental to the plants. Manure which is free from weed seeds is best, and it may be worked into the soil in the spring.

In the spring, the soil is loosened up by plowing to the depth of a few inches and cultivation is kept up throughout the summer. None of the young shoots should be cut the second spring, as the plants will be much stronger if left undisturbed until the third spring. The crop is given practically the same culture each year. Shallow cultivation is the rule during the summer and the old stalks are cut and burned after the berries have turned red. This is followed by the mulch of manure late in the fall. When the first shoots appear the third spring the soil is thrown toward the plants, hilling them up slightly. This is particularly desirable if bleached asparagus is to be grown. Soon after this, cutting of the young shoots begins and they are kept cut clean for six or seven weeks. After this, the shoots are allowed to grow in order to provide for next year's crop.

The shoots are cut with a knife, or they may be broken off just below the surface of the soil, after they have attained a length of six or eight inches.

In growing bleached "grass," the rows are hilled up, and when the tips of the shoots appear above the surface of the ridge, they

are cut off several inches below the top of the ground.

In local markets, asparagus is often sold loose, by weight, bringing a good price, but in the city markets, bunched asparagus is desired. It is of first importance that the bunches be of uniform length and size, containing stalks of the best quality only, and neatly tied. There are several styles of bunchers on the market, in which the stalks may be placed, the uneven ends cut off and the bunches easily tied. These simple devices greatly facilitate the bunching of asparagus, secure uniformity, and are a necessity to the grower who sells any considerable amount of his crop.

Forcing Asparagus.—Asparagus may be forced by putting three or four-year-old roots in soil under the benches in the greenhouse or by placing them in hotbeds where the temperature is about 65° or 70°. The roots must undergo hard freezing for about three weeks before this is done, so that ordinarily they cannot be taken in before the latter part of December.

The plants will begin to grow in about a week. Shoots may be cut for a month or more, after which the plants are thrown away.

Varieties.—Some of the best varieties of asparagus are Conover's Colossal, Palmetto, and Columbian (Mammoth White).

BEANS.

Types of Beans.—There are several types of beans, but the two of most importance to the average vegetable grower are the kidney and Lima beans. From the former come our ordinary string or snap beans, while the large, flat-seeded kinds belong to the Lima type. Kidney beans are divided into green-podded and wax-podded types, while both kidney and Lima beans are divided into dwarf and pole varieties. The dwarf varieties are ordinarily planted for the early crop, while the later crops come from the pole varieties.

Soil for Beans.—While beans will produce well on a wide range of soils, a rich clay loam is probably best adapted to the plant. A soil rich in potash and phosphoric acid is desirable. The nitrogen content of the soil is relatively unimportant, as beans are capable of taking nitrogen from the air and appropriating it to their needs.

Planting and Cultivation of Snap Beans.—Beans are tender plants and cannot be planted until danger of frost is past. Plow the soil from six to eight inches deep in the spring and immediately smooth and harrow it to prevent evaporation of moisture. When ready to plant, make the rows two and a half feet apart and plant the seed three or four inches apart in the row. Six inches would probably be the best distance if a perfect stand could be obtained.

Beans planted this way will produce larger yields than when planted in hills eighteen inches or more apart. Plant the seed not more than two inches deep, and one and a half inches is better.

Shallow cultivation should be given frequently during the growing period of the crop.

Planting and Cultivation of Lima Beans.—Lima beans require a longer season for maturing than snap beans, and, since they are more tender, should be planted a few days later. The usual method is to plant four or five seed in hills, eighteen to thirty-six inches apart, with the rows about three and a half feet apart. After danger from cold and insect enemies is past, they are thinned to three plants in a hill. Shallow cultivation is given and a trellis of some kind is usually provided for the pole varieties. Beans should not be cultivated when the plants are wet from dew or rain, as this may cause the plants to become diseased.

As with most all vegetables, the soil for beans should be well fertilized, but a fertilizer containing high percentages of potash and phosphoric acid and a low percentage of nitrogen may be used to advantage, since beans are nitrogen gatherers.

BEETS.

There are four distinct types of beets: (1) The ordinary garden beet; (2) Swiss chard, the so-called leaf beet; (3) the sugar beet; (4) the mangel, or stock beet. Vegetable growers are concerned only with the first two.

The Soil and Its Preparation.—A rich sandy loamy soil is best adapted to beets. If a very early crop is desired, the land should be deeply and thoroughly plowed in the fall. The ground should be broken eight to twelve inches deep, so that the root system will not be restricted.

Planting.—Because of the roughness and irregularity of beet seed, they are handled with difficulty by the various seed drills, but on a large scale they must be handled by machines. Some modifications of the ordinary seed drill enable this to be done. The seed should be sown three-fourths to one inch deep, and where the crop can best be harvested all at one time, the plants should be thinned to stand from three to six inches apart in the rows, which are made eighteen to twenty-four inches apart. For the home or local market garden it may not be necessary to thin the plants, but allow the largest ones to reach marketable size, say one and a half to two inches in diameter, when they are removed to make room for the others. Since the beet is a relatively hardy plant, the seed may be planted about the same time as radishes or lettuce.

Cultivation.—Beets should never be allowed to become

checked in their growth so that frequent cultivation, particularly in the early stages of the crop, should be given to conserve moisture and keep down weeds, which might hinder the growth of the beets.

Swiss Chard.—This type of beet does not produce a thickened root, as do the others, but is grown for the leaves and the thickened leaf stalks, which attain the size of rhubarb leaves. The young leaves are often boiled the same as spinach, while the leaf stalks may be cooked and served in the same manner as asparagus. In cultivation it requires about the same conditions as the beet, but more room should be allowed between rows and between the plants in the row.

Swiss Chard is a vegetable which deserves to be more extensively cultivated than it is at present.

BRUSSELS SPROUTS.

Brussels Sprouts is the name given to one of the variations of cabbage. While the stem and leaves resemble those of the cabbage, it does not form one large head, but a number of small heads in the axils of the leaves.

Cultivation.—Brussels Sprouts require about the same soil and climatic conditions as cabbage. The natural season of the vegetable is late fall and this is the time when it reaches its best development. The plants should be started in April and transplanted to their permanent locations about the middle of June. In severe climates the plants may be lifted at the approach of winter and set in moist sandy loam in cool cellars and used as needed. Set the plants in the field at about the same distance as cabbage and give the same culture. Brussels Sprouts are usually sold by the quart and bring about the same price as strawberries.

CABBAGE.

Soil.—While cabbage will thrive on most any soil used for growing ordinary farm crops, it prefers one that is cool, moist and deep. The soil should be rich and the plants never allowed to become stunted. Cabbage is often used as one of the factors in a rotation of farm crops following clover or alfalfa.

The soil should be well fertilized with stable manure, and in locations where the soil is somewhat sandy and has been under cultivation for a long period, commercial fertilizer may be used to advantage. It should be applied at the rate of about 1200 to 1500 pounds per acre and the mixture should contain a high per cent of nitrogen and potash.

How Plants Are Obtained.—The seed may be sown in the field where the crop is to mature, but this is not the best plan. For

the early crop, the seed should be sown in the hotbed in February or March and if possible transplanted once before they are finally put in the field. They are put out in the open as soon as the weather will permit. In milder climates where the temperature does not go below zero, the seed may be planted in cold frames in the fall. They spend the winter in the frames in a dormant state and are ready for planting out early in the spring.

The seed for the late crop may be planted in beds outside when winter is over and the plants are transplanted to their permanent positions when they have attained sufficient size.

The best time for transplanting plants of any kind is just before a rain and one of the worst times is right after a rain. Transplanting may be done to advantage in cloudy weather or late in the afternoon, and if the soil is dry, it is necessary to apply a small quantity of water around the roots of the plants when they are put out.

The leaf area of cabbage plants should be reduced one-third or one-half when transplanted so that transpiration, or evaporation of water through the leaves, will not be so great. This is accomplished by gathering the leaves of the plants together and shearing off the upper portion, being careful not to cut the stems.

Planting.—For the early crop, plants are set in the field in rows two and a half to three feet apart and fifteen to twenty-four inches apart in the row. For the late varieties the plants should be set three feet apart each way, as they require more room for development. This also permits cultivation in both directions.

Cultivation.—Frequent cultivation is necessary for the best development of cabbage. There is an old saying that "cabbage should be cultivated every day." It seems to be benefited by shallow cultivation, even in very dry weather when there is already a dust mulch over the area. Such culture retains moisture and keeps down weeds. Cultivation should be continued as long as the leaves will allow passage between the rows.

Storing.—In storing cabbage for home use they may be kept in a cool, well ventilated cellar, or they may be stored in the ground as follows: Dig a trench or plow out a deep furrow eighteen inches wide and ten to twelve inches deep on a slight ridge or some well drained location. The cabbage heads are pulled up, roots and all, and placed heads down in this trench. The first layer will consist of two rows of heads and a second layer of one row of heads may be put on top of the first, placing the heads between the roots of the first layer. Straw may be placed next to the cabbage and the whole covered with a light layer of soil which is gradually

added to as the weather becomes colder so as to prevent alternate freezing and thawing.

The cabbage should be in good condition when put into storage. Any water contained between the leaves ought to be drained out and diseased leaves removed. When stored in a cellar or other storage house, the temperature should be kept as near 34 degrees F. as possible.

CARROTS.

The carrot is usually considered a vegetable of secondary importance, but is grown to some extent in almost every garden and is becoming more popular all the time. In addition to its use as a vegetable, it is a valuable stock feed, and the large quantities produced per acre are responsible for its extensive culture as a farm crop.

Cultivation.—Carrots are given much the same culture as beets. The seed is sown thinly, about one-half inch deep, in drills eighteen to twenty-four inches apart. The plants are thinned, if necessary, and all weeds are kept down, especially while the plants are very young, as they are easily smothered at that stage.

When the crop is harvested, the tops are removed and the roots may be stored in a cellar the same as potatoes, or they may be put outside in conical heaps, containing twenty to thirty bushels, and covered with straw and earth.

CAULIFLOWER.

This is another variation of the cabbage and is grown for the thickened flower stems or curd which forms a white compact head.

Soil.—The soil for cauliflower should be practically the same as for cabbage. A rich, sandy loam which can be cultivated in the cooler part of the year is preferable. The plant is a gross feeder and the soil must be well fertilized with stable manure of commercial fertilizers.

Cultivation.—Cauliflower does not thrive in hot, dry weather, so it should be grown either as an early or late crop. For the early crop, start the plants in the greenhouse or hotbed in March and when they have four or five leaves, transplant, giving more room. Set the plants in the field when cold weather is past. The distance between plants should be about eighteen inches in the row, and about two and a half to three feet between the rows.

For the late crop, the plants are started later and finally transplanted to the field about July 1st.

Frequent shallow cultivation is given throughout the growing season. One of the essentials to successful cauliflower growing is to never allow the plants to become checked in their growth.

When the head or curd begins to form, care must be taken to prevent it being discolored or injured by insects. This is accomplished by folding the outer leaves over the head and tying them in place.

If the vegetable is to be sold, the outer leaves are trimmed off so as to project about one inch beyond the head, and the heads are usually wrapped in paper and packed in ventilated barrels or crates. Cauliflower may be forced profitably in the greenhouse. It requires about the same temperature as lettuce, with a high degree of humidity.

The seed is always expensive, but it pays to secure the best obtainable.

CELERY.

Soil.—A moist loamy soil containing an abundance of vegetable matter is best suited to celery growing. It is better if the water table is only three or four feet below the surface, and, for this reason, the river bottoms of Colorado are best adapted to the crop. But celery may be grown profitably on higher land where the necessary moisture can be supplied by irrigation. The climate of this state is well suited to the growing of celery. It delights in our cool nights and bright days.

Fertilizers.—The soil on which celery is grown must be rich in vegetable matter. This is best supplied by stable manure, applied at the rate of 30 to 40 two-horse loads per acre. Commercial fertilizer may sometimes be used to advantage. When used, it is usually applied at the rate of 1000 to 1500 pounds per acre.

Seed Bed.—The growing of plants in the seed bed is one of the most exacting operations connected with celery culture. The seed are small and slow to germinate and great care in watering and shading is necessary for good results. The soil in the seed bed should be fine and rich. The seed may be planted rather thickly in drills or broadcasted. For the early crop the seed should be planted in hotbeds the first or second week in March, while the seed for the late or main crop may be planted during the early part of April. The seed should be covered very lightly, say about a quarter of an inch and sometimes sand is used for this. Between the time of planting and the appearance of the young plants is a critical period. The surface of the soil should not be allowed to become dry, but large quantities of water cannot be applied. The beds should be watered with a fine spray. When the plants are very young, shading on warm sunshiny days may be desirable. Cloth or lath screens will serve for this. When the plants are large enough to handle, they should be transplanted, if it is possible to

do so. They may be planted in beds with two inches between plants each way. This method gives much more stocky plants and a much better developed root system. Sometimes the cost of transplanting is prohibitive and a different method is substituted. One method is to shear off the tops of the plants once or twice in the bed, while in other cases, a knife, mounted on wheels, is run under the plants so as to cut the roots, especially the tap root, causing the development of a better root system.

Setting the Plants in the Field.—For the early crop, the plants will be ready to set in the field in May, and for the late crop the latter part of June. The bed should be given a thorough sprinkling before removing the plants, and if they have made a vigorous growth, it will be advisable to cut the tops back slightly in order to reduce transpiration. Usually, a dibble is used to make the holes in which the plants are set and for pressing the soil around the roots. Sometimes in dry weather it may be necessary to apply a small amount of water around the roots of the plants as they are set out.

Distances to Plant.—The distances at which the plants are set depends entirely on the method of blanching. There are three methods of blanching employed. The most common method is that where the plants are banked up with earth. In this case the rows are made five or six feet apart and the plants set six inches apart in the row. Sometimes double rows six inches apart, with six feet between the double rows are planted. This method gives a greater number of plants per acre than the single row method where there is a distance of five feet between the rows. Another method used quite extensively with the early crop is to blanch the celery with boards about twelve inches wide and sixteen to twenty feet in length. When this plan is followed, the rows are made three feet apart and the plants set six inches apart in the row. A heavy paper is now being manufactured which can be used instead of boards. With proper care this will last two or three seasons and is more easily handled than boards.

“The New Celery Culture” is a term applied to the growing of celery so close together as to cause self-balancing to a greater or less extent. By this method the plants are set eight by eight inches over the entire area. This crowding together causes them to grow tall and the shading keeps the stems from growing green. Its disadvantage lies in the fact that the plants are more subject to disease and more hand labor is required in cultivation.

In addition to the above methods, celery may be blanched by wrapping the individual plants in old newspapers or by setting

pieces of tile around them. In fact, anything which keeps out the light will serve the purpose.

Cultivation.—Frequent surface cultivation should be the rule with celery. The plant needs abundant moisture and everything possible should be done to retain moisture in the soil. In irrigating, a thorough wetting should be given and then withhold water until it is needed again. The grower must always keep in mind, however, that the plant requires a large amount of water.

Celery plants must never be allowed to become checked if possible to prevent it, as checking injures the quality and is apt to cause the plants to run to seed.

Blanching.—The methods of blanching celery have already been outlined. When the crop is blanched by means of boards, 20,000 to 30,000 feet of lumber are required for blanching an acre. If all the celery is not needed at one time, the same boards can be used for blanching two or three lots, so that less than the above will be required per acre. The time for blanching is from ten to thirty days. The early crop usually requires less time than the late crop. The plants should not be allowed to stay in the field after blanching, as the quality is injured thereby.

When the crop is blanched with earth it is almost always of better flavor than when other methods are employed. The banking up of the soil around the plants may be done by hand or a celery "hiller" may be used. This is a plow having large moldboards which bank the soil against the plants. Before it is used, a small amount of soil must be placed around the base of the plants to hold them in an upright and compact position. When celery is to be kept in storage for some time it is not necessary to blanch it in the field. If stored in a dark cellar blanching will take place there. Sometimes the blanching is begun in the field by banking the soil partly up around the plants and the process is completed in storage.

Harvesting, Storing and Marketing.—If the plants have been blanched with earth, they are taken up by means of a digger, having a U-shaped blade which runs under the plants and cuts the roots, slightly lifting them at the same time. The plants can then be easily lifted.

If blanched with boards, the plants can be cut slightly below the surface with a large knife.

When the plants are to be shipped long distances, they are not trimmed, but packed in crates or put into cars in bulk. If the celery is to be sold in a near market, the plants are trimmed and washed and tied in bunches of one dozen plants each, after which they are packed in crates and sold.

Celery can be stored in an ordinary cellar by placing the roots

in moist sand, giving proper ventilation and maintaining a temperature of from 33 to 35 degrees.

Another way is to select a well-drained spot in the field and make an excavation about two and a half feet deep, four or five feet wide and as long as necessary. A permanent hotbed can be cleaned out and used for the purpose. Have three or four inches of loose soil in the bottom, in which to place the roots of the plants. The celery is put close together in the pit and then well watered. When the leaves are dry, boards are put over the pit, leaving openings for ventilation. As freezing weather comes on, straw is thrown on the boards and later, a layer of earth over the straw. The holes left for ventilation should be closed tightly in very cold weather. The plants must not be allowed to wilt between the time of digging and removal to the place of storage. All diseased plants or parts of plants must be thrown out. Provide against the eating of celery by mice and rabbits, but do not poison mice, as celery absorbs odors very easily and the whole lot may be ruined.

Celery can be kept in storage for two to three months. If it dries out during storage, apply water to the roots of the plants, keeping the tops as near dry as possible.

SWEET CORN.

Sweet corn is less adapted to Colorado conditions than many other vegetables, but is a profitable crop in some sections, especially at the lower altitudes of the southern part of the state. The nights at the higher altitudes are ordinarily too cool for its best growth. However, a small amount of the early maturing sort may be satisfactorily grown for home use.

Soil and Fertilizers.—A warm, well drained loamy soil is best suited for corn growing. It is a rapid growing plant and therefore requires a liberal quantity of available plant food. It is impossible to make the soil too rich and large quantities of manure may be used to advantage.

Planting.—The soil should be more thoroughly prepared than for field corn because the seed require better conditions for successful germination and the young plants, when they appear, are less vigorous than field corn.

Rows are laid off from two to three feet apart and the seed planted so as to have the plants eight to ten inches apart in the row. Another method is to plant in hills three feet apart each way, leaving about three plants in a hill. The seed are planted one to one and one-half inches deep. Growers often take a chance with early corn and plant earlier than the normal season. Then, if the crop escapes frosts, it matures earlier and is correspondingly valuable. If it is killed or fails to come up on account of the seed rotting, it

may be planted again. In the home garden, it is well to have a succession of plantings in order to supply the table for a considerable period.

Sweet corn is in the proper stage for gathering when the grains are plump, well developed and just entering the dough stage. It should not be gathered for the table more than two or three hours before it is to be cooked, as its quality is injured by keeping longer than this. The ideal stage of sweet corn on the stalk is of short duration and it should be pulled at the proper time.

CUCUMBER.

Soil and Climate.—The best soil for cucumbers is a sandy, gravelly, or clayey loam. For early crops the sandy soils are best, while the clayey loam is better suited for the main crop. The cucumber, being a semi-tropical plant, will not grow to its greatest perfection in Colorado on account of the cool nights, but by starting the plants early good yields can be obtained. The plants are less susceptible to disease in this climate than in the east and this compensates to a large extent for the smaller yield.

Planting.—Since the cucumber is a tender vegetable, the seed cannot be planted until after danger of frost is past. The soil should previously be well prepared and fertilized with stable manure. Rows are laid off about six feet apart and the seed planted in hills three feet apart in the row. Six or eight seed should be planted in a hill and when the plants are well established all but two or three are thinned out.

In order to secure plants early, thus allowing for a longer growing period, the seed may be planted in strawberry boxes in the greenhouse or hotbed about the middle of March and transplanted to the field when there is no longer danger from frost. Cucumber plants do not transplant readily by the ordinary method, but when put in strawberry boxes a mass of soil adheres to the roots and they can be transplanted without any difficulty. The boxes, which will have become more or less rotten can be easily broken away from the enclosed soil.

Cultivation.—Clean surface cultivation should be given cucumbers. If planted in check rows, the crop may be cultivated both ways, thus saving much hard work. All weeds must be kept down and the soil stirred after each rain or irrigation.

Picking.—In order to keep the vines growing and bearing, the cucumbers must not be allowed to ripen. For slicing, they are picked when six to eight inches long, while for pickling, they are removed when they have attained the desired size. Usually, the smaller the fruit, the more desirable it is for pickling.

EGG PLANT.

The egg plant requires a warm, loamy soil and a long, warm season to grow to the best advantage. In Northern Colorado, the season is too short to allow the crop to mature if the seed are planted in the field, so that every advantage must be taken to prolong the growing period. The seed may be planted about March 15th in the greenhouse or hotbed in strawberry boxes or pots and treated much like cucumbers started by this method. They may be planted in flats and transplanted to pots when two true leaves have developed. By doing this, the plants are of good size when the time comes for setting them in the field. Before finally planting them in the field, they should be hardened off in the cold frame.

The seed and young plants require careful attention as to moisture and temperature for best results. They must not receive too much water, especially while the seed are germinating, and the temperature must not be allowed to fall too low.

When set in the field the plants are put in rows three feet apart and eighteen to twenty-four inches apart in the row. They are given about the same cultivation as potatoes or tomatoes during the growing period.

KOHL-RABI.

Kohl-rabi is a vegetable with which the average American is not very familiar. It will grow well under the same conditions necessary for the production of good radishes and deserves to be cultivated wherever possible.

Kohl-rabi is closely related to the turnip and produces a thickened stem or bulb above the surface of the ground. It has excellent quality and is sometimes called the "Lazy Man's Cauliflower," being cooked and served in a similar manner.

The plant is hardy and can be grown in sections where the cauliflower cannot. The seed should be planted as early in the spring as possible in rows eighteen inches apart. The plants should later be thinned to stand six to eight inches apart in the row. Successive plantings at intervals of two weeks will insure a supply for a longer period. The vegetable should be gathered as soon as ready, which is about the time the swollen stems are one and a half to two inches in diameter. It remains in prime condition only a short time, so for best results must be used when just right.

LETTUCE.

Lettuce is the most important salad plant under cultivation and can be grown under a variety of conditions. The two types of lettuce most commonly cultivated are head lettuce and curly-leaved

or cutting lettuce. The latter will probably give more general satisfaction in this climate.

Soil and Climate.—Lettuce is a comparatively hardy plant and grows best in the cooler parts of the growing season. A rich, well drained, sandy soil is best, but the crop can be grown on heavier soils.

Planting.—For the early crop the seed can be planted in the greenhouse or hotbed in March and transplanted to cold frames when large enough, or the seed may be planted directly in cold frames the latter part of March and when the plants are up they are thinned to the proper distance apart. In cold frames, the plants should stand about eight inches apart each way. Plants may be set in the field the latter part of April, and in this case the rows should be eighteen inches apart and the plants six to eight inches apart in the row. Lettuce transplants readily and if properly handled the plants will be only slightly checked.

Cultivation.—Lettuce which grows rapidly without being checked possesses the best texture and flavor, so the aim of the grower should be to cultivate the crop in a way to obtain this result. Transplanting should be carefully done and the plants given surface culture frequently during the growing period. The surface of the soil should be kept as dry as possible at all times, though the roots of the plants must not be deprived of the proper moisture. Lettuce is very susceptible to disease and particularly so when the surface of the soil and the foliage of the plants are kept moist. In applying water, precautions should be taken to keep the leaves from getting wet and this is especially important when the crop is grown in greenhouses, hotbeds, or cold frames.

Forcing Lettuce.—Lettuce is the most uniformly profitable vegetable that is grown under glass. It can be found on the market of large cities at all seasons of the year. When grown in greenhouses the plants are commonly set in solid beds slightly raised above the general level of the floor of the greenhouse. The plants are started in flats and when large enough to handle, are transplanted to other flats or small pots in order to give them more room. They are later transplanted into the permanent beds, being set about eight to ten inches apart each way. Great care must be used in watering to keep the leaves dry and not allow the surface of the soil to become too wet. By using a deep soil containing a large per cent of sand and organic matter, trouble is avoided in growing lettuce under glass. A soil properly prepared will sometimes produce a crop of lettuce in the greenhouse with one good watering. Sub-irrigation, by which water is applied beneath the surface, is often used to advantage in greenhouses. This method

greatly lessens the danger from disease which may destroy the whole crop within two or three days.

In addition to being forced in greenhouses, lettuce can be grown to maturity in hotbeds. Both hotbeds and cold frames can be used to advantage for bringing lettuce to maturity in the fall or early winter and for starting them early in the spring.

MUSKMELON.

Under the term "muskmelon" is included a number of types of melons. The most common of these are the ordinary muskmelon, characterized by a large seed cavity, distinct ribs, and a surface more or less free from netting, and the cantaloupe, an ideal specimen of which has a small seed cavity and a heavily netted surface, showing no ribs at all. Much effort has been expended toward perfecting the latter type at Rocky Ford in this state. The Rocky Ford section and the type of melon grown there are well known throughout the country.

Climate and Soil.—The muskmelon is naturally a tropical plant and requires a long, warm season for its best development. For this reason we cannot expect to produce as profitable a crop in the northern part of the state as at Rocky Ford, but some should be grown for home use. A warm, sandy loam is the best soil for growing cantaloupes. Such land on which alfalfa has grown for one or two years is probably the ideal in this climate. The soil should be in the best of tilth and should be well, but not too heavily fertilized with stable manure.

Planting.—Rows are laid off six feet apart each way and eight to ten seeds planted at each intersection. The seed are covered to a depth of about one inch. They may be planted either by hand or with one of the many types of planters. After planting it may be necessary to irrigate in order to cause the seed to germinate. If this is the case, the water should be run in furrows parallel to the rows and four to six inches from it. By this method, the water soaks through to the seed, but leaves the surface above the seed dry. If the soil over the hills should become dry and crusted before the seed germinate, it should be raked with a garden rake in order to allow the young plants to come through more easily.

Cultivation.—Thorough and frequent cultivation should be given. During the early stages of the crop the ground is stirred rather deeply and close to the plants, but as the vines spread, the cultivation should be more shallow and further away from the plant. Light, frequent irrigations have proven to be of more advantage than heavy soakings given at considerable intervals.

Picking.—Muskmelons are said to have three stages in three

days—green, ripe and rotten. While this is exaggerating the actual facts to some extent, the time when the melons are in the best of condition for picking is very short. If harvested too early or too late, the quality will not be up to the standard. It is hard to describe just the proper stage at which the melons should be picked. There is a slight change of color in the interstices of the netting which can be recognized by an experienced picker. The proper stage can be more clearly determined by cutting a melon occasionally.

ONION.

The growing of onions is an important industry in several sections of the state. They can be grown in practically all parts of the state for home use and for local markets and in some districts they may be grown with profit for distant markets.

Soil.—The soil is one of the most important factors affecting the growing of onions. It is necessary that the soil be in workable condition early in the spring, so that heavy clay land is not suitable. The light sandy or gravelly soils do not hold moisture well, and are not the best for onion growing. The best soil is one between these, a retentive sandy loam. On account of the heavy yields per acre, a large amount of available plant food should be present. This may be supplied by heavy dressings of stable manure which should be plowed in in the fall. If the land was planted to some hoed crop like potatoes or beets, it will be in much better condition for onions.

Preparation.—For best results the land should be plowed in the fall to a depth of eight inches and in the spring the surface soil thoroughly pulverized. If preparation is delayed until spring, six inches will probably be the best depth. The soil for onions should not be too loose and when spring plowing is done, it should be compacted by using a roller or clod crusher. When planting time arrives, the ground should be in the best of tilth. Young onions are small and delicate and the work is largely done with hand power implements, so the soil must be free from lumps and easy to work.

Planting.—There are two methods of planting. By the first method the seed are planted in early April in rows twelve to fifteen inches apart. The seed are sown thickly and covered about one-half inch deep. When the plants are well up they are thinned. More plants than are needed are left the first time and some of these are taken out later, finally leaving them three to six inches apart in the row.

The other method, which has many advantages and which should be employed more extensively, is what is known as the "new

onion culture." The seed are sown in flats in the greenhouse or in hotbeds six weeks to two months before time to put the plants in the field. When ready to put the plants outside, they are taken up, the roots cut back to one-half inch in length and part of the top removed, after which they are transplanted in the usual way, being set three to six inches apart in the row. By this method the grower is able to lengthen the growing period by starting his onions early, and is thus enabled to grow to perfection the milder flavored onions which require a longer season than we normally have here. He also eliminates the tedious process of thinning and is sure of a perfect stand of good plants properly spaced. The ground can be cultivated before the onions are transplanted to it, and the first crop of weeds killed.

To offset these advantages are the disadvantages of transplanting and of supplying hotbed space. However, transplanting an acre of onions requires but little more labor than thinning the crop which has been planted the old way. About 150,000 plants per acre are required. One man can set 8,000 or 10,000 plants per day. The cost of hotbed sash is the most important item. It requires twenty 3x6 sash to grow enough plants to set an acre.

Seed.—The gardener should use good judgment in the selection of seed. Poor seed will produce a large number of small bulbs and scullions or "thick necks." Buy the best seed, even though the price is high.

Cultivation.—Frequent shallow cultivation should be given. The hand wheel hoe is best for this. Care must be exercised in irrigating. The tendency is to give too much water, causing a large per cent of scullions. In the early part of the season water should be given sparingly to promote strong root development. An irrigation every ten days is all that is necessary during the growing period. No more water should be applied after August 15th, but withheld in order to allow the crop to mature.

Breaking the tops of the onions down by rolling a light roller of some kind over them may sometimes be advisable when the crop is tardy about maturing. However, if the plants can be induced to mature naturally, a much more satisfactory product will result.

Harvesting.—The roots should first be cut by running a U-shaped blade under the bulbs. Such a blade may be attached to a double wheeled hand hoe, or a longer blade, cutting two rows at a time can be attached to a horse hoe. The tops are then cut off about a half inch above the bulb, and the onions are raked into windrows, preferably with wooden rakes, and allowed to dry for

six or eight days. They are then put in sacks and sold, or they may be placed in storage.

Storing.—In storage, they are either put in crates or placed on racks in layers eight or ten inches deep. A dry frost-proof storage house is necessary. The temperature is kept just above the freezing point, or if the bulbs can be frozen at the beginning of winter and not allowed to thaw out again until spring, and then very gradually, they will keep very well. When stored, onions should be very carefully handled or they will not keep well. They must not be handled while frozen and even the jarring of the building should be guarded against.

Seed Production.—Some growers in Colorado have found it to their advantage to produce their own seed. The method followed is this: At harvest time, the best bulbs of the desired variety are selected in the field and put in storage. The following spring these bulbs are set six inches apart and four or five inches deep in rows two and a half feet apart. They are given clean cultivation and in July send up flower stalks two and a half to three feet high. As the seed mature, the stalks are cut and placed on canvas to dry, after which they may be separated by using a flail and then running through a fanning mill to remove the chaff and light worthless seed.

PARSNIPS.

The soil for parsnips should be rich and deeply prepared. Before planting, the surface should be thoroughly fined, as the seed are rather slow to germinate, and the young seedlings very delicate. The seed are planted as early in the season as possible, in rows 18 to 24 inches apart. Plant about ten seeds to the foot and cover not more than one inch deep. The plants should be thinned to stand three or four inches apart in the row when well up. Cultivate frequently during the growing season, keeping down weeds and maintaining a surface mulch.

The roots will be ready for use by September, but they have not the quality then that they have later in the season. Parsnips are considered to have a better flavor if subjected to frost and they may be allowed to remain in the ground over winter, in which case they should be protected with a light mulch of some kind.

PEAS.

The growing of peas for canning purposes is of considerable importance in Colorado. They are adapted to most all sections of the state and are grown extensively in the northern part of the state

to supply the canning factories at Greeley, Loveland and Longmont.

Soil.—Peas do well on a variety of soils. For the early crop a sandy loam is best, while a clayey loam is perhaps more suitable for the main crop. The soil should be deeply prepared and liberal quantities of stable manure applied.

Planting.—For the home garden, peas are often planted in double rows six inches apart with two to two and a half feet between the double rows. The tall growing kinds require a trellis of some kind to support them and this may be supplied by using brush stuck between the rows, or chicken wire may be used. The seed are planted as early in the season as the ground can be gotten in shape. It has been found that the vines will produce better and for a longer period if the seed are planted four or five inches deep. For the home garden, successive plantings should be made in order to have them in edible condition for a longer period.

For canning purposes, the seed may be sown with an ordinary grain drill. The crop is allowed to mature with no special attention or cultivation other than thorough preparation of the soil. The vines grow at will and are not provided with trellises or supports. When the greatest percentage of the pods are in the proper condition, the vines are cut with a mowing machine and run through specially prepared threshing machines which separate the peas from the pods. They are then washed and graded, after which they are ready to be canned.

Types of Peas.—There are three types of peas under cultivation: (1) The smooth round-seeded kinds; (2) the wrinkled-seeded kinds; and (3) those with edible pods. Only the first two are of importance. The different kinds are further divided into tall, medium and dwarf growing varieties. Generally speaking, the dwarf round-seeded varieties are the earliest and most hardy. On the other hand, the tall growing, wrinkled-seeded varieties are of better quality and have a longer fruiting period.

PEPPER.

Pepper requires about the same conditions as the egg plant and tomato. The seed are slow to germinate and should be started in the greenhouse or hotbed in March in order to have good sized plants for setting out when danger of frost is past. The young plants should be transplanted once before they are finally moved into the field. The distances for setting the plants outside are 15 to 18 inches apart in rows which are two to two and a half feet apart. The subsequent cultivation of the crop consists in keeping down weeds and stirring the soil from time to time.

POTATOES.

For many years, Colorado has ranked among the leading states of the Union in growing potatoes, and though the growers in some sections, at the present time, are confronted with serious problems as regards diseases and soil conditions, yet the state will doubtless continue to maintain her position in the production of this valuable crop.

Soil.—In general, the best soil for potatoes is a deep sandy loam underlaid by a porous subsoil. The character of the subsoil is important. Even the heavier soils are often productive when the subsoil below is gravel or porous clay. Heavy clay soils which easily become puddled are not suitable for potatoes. The soils in the immediate vicinity of Fort Collins are largely of this character, and growers have not been successful in producing a profitable crop. It is possible that the addition of large quantities of stable manure will so lighten up the soil as to give better results.

Preparation of the Soil.—The preparation of the soil for potato growing is of great importance, as the tubers must have a congenial medium in which to develop. Potatoes should always be grown as a factor in some system of crop rotation. Very often they are planted to follow alfalfa. In turn they are followed by peas for canning, sugar beets, small grain or alfalfa. Wherever possible they should not be grown on the same soil more than once in four or five years, and, especially where diseases are prevalent. Where stable manure can be obtained, a liberal dressing should be applied in the fall and turned under. Cross-plow the land again in the spring, a short time before planting, and follow with a thorough harrowing. Do not plow or harrow the land while wet, as it will destroy the texture and leave the soil lumpy.

Planting.—Planting may be done by hand on a small scale, but when large areas are devoted to potatoes, a mechanical planter is necessary. These are of two types—the “picker” and “non-picker” planters. The former requires one man who thoroughly understands his business to operate, while the non-picker type requires two men to operate. Both have been satisfactory in Colorado.

The rows are made three to three and one-half feet apart and the seed pieces dropped eight to fifteen inches apart in the row. The closer distances are used with the early varieties. The seed is covered to a depth of four or five inches.

Some growers prefer to use whole seed rather than cut seed, and this is advisable where there is much disease. In this case the smaller potatoes should, of course, be used, as it would not pay to

use the larger sizes. Where cut seed is used, as is most commonly the case, the pieces should contain one or two good eyes each, and should be large enough to nourish the young plant until it takes hold of the soil. The growth of the young plant from germination until a root system is formed is dependent entirely on the stored food contained in the seed piece.

Cultivation.—Cultivation should begin soon after the crop is planted—sometimes before the plants are up. The soil becomes packed during planting, and immediate cultivation is advisable in order to conserve moisture and aerate the soil.

Before the crop is up the ground should be well harrowed with a spike-tooth harrow. This may be profitably repeated after the plants are well up, and without any injury to the growing crop. The next two cultivations should be deep, and close to the rows. This leaves a loose medium for the potatoes to grow in. After this, surface cultivation which keeps down weeds and maintains a soil mulch, should be the rule.

Irrigation.—It is usually unnecessary to irrigate during the early stages of the crop, as there is enough rainfall, ordinarily, to cause the seed to germinate and bring the plants to the stage where the tubers begin to form. From then until about the time the crop matures, irrigation is necessary. The number of irrigations needed will, of course, vary with the weather conditions. The general tendency seems to be to give too much, rather than too little water. The water may be allowed to run down every other furrow the first irrigation and down alternate furrows the next time.

In dry seasons, however, it will be necessary to apply water to get the plants up. When this is the case, the water should be run in a furrow a few inches from the row and allowed to soak through to the soil around the seed. After that, it will probably not be necessary to irrigate again until the potatoes commence to form. As soon as the surface soil is dry enough, after each irrigation, it should be cultivated in order to check evaporation.

It is sometimes necessary with varieties which set their tubers shallow, to employ protective ditching, by which soil is thrown over the hills, in order to protect the potatoes from frost. This is accomplished by running through the middles some implement which makes a narrow, straight-sided ditch, throwing the soil from the ditch over the hills. Of course, none of the tubers must be disturbed by this operation.

Harvesting.—The dates after which it is dangerous to leave potatoes in the ground vary with the altitude, from October 1st to

October 20th, the latter date corresponding to the lower altitudes. Therefore the crop should be harvested by this time.

On large areas, potatoes are harvested by means of elevator diggers, which are very satisfactory. However, these are too expensive for the small grower, and he usually digs his crop with a "shaker digger," costing about \$12.00, or with a turning plow. Regardless of the method used, the potatoes should be cut or bruised as little as possible, as this injures their market value and keeping quality. They should be moved to market or into the storage cellar immediately to avoid possible frost injury. It is advisable to let the potatoes become thoroughly dry before they are placed in storage or before being sacked and shipped to market.

Storing.—A good storage cellar is essential where potatoes are grown for market. The grower does not always find it profitable to sell directly from the field, and in order to hold the crop, some kind of storage is necessary. The most common type of cellar in Colorado is one where an excavation is made and this roofed over with straw, earth, etc.

The storage cellar should be located on a slight knoll, if possible, or on level ground. The nearer the house it can be placed the better, as attention can be given much more easily than when situated farther away. If the walls and ends can be constructed of concrete, the cellar will be more permanent. Provision should be made for light and ventilation. This can be done by having from four to six shafts running through the roof. Light is necessary for sorting over the potatoes and desirable for greening seed potatoes in the spring before planting. Ventilation is necessary in maintaining the proper temperature. If the cellar is divided into two compartments, one can be kept dark for table potatoes and the other light when necessary for seed potatoes. A driveway with doors at each end of the cellar, so that a wagon may be driven through, will greatly facilitate loading and unloading. Tight double doors should be provided to keep out cold and heat. Two or three thermometers should be hung in the cellar to indicate the temperature, which should be kept as near 33 or 34 degrees F. as possible. To do this, careful attention is necessary, particularly in the fall and spring, when the cellar must be kept closed during the warm hours of the day and opened in the cooler hours of evening. By doing this the temperature can be kept about right in the cellar.

In addition to potatoes, other vegetables, such as turnips, cabbage, celery, etc., may also be stored in the cellar and kept for use during the winter.

Potato Diseases.—There are three fungous diseases which are of considerable importance in Colorado. These are *Fusarium*,

Rhizoctonia and *Scab*. Other diseases, as early blight, which is a leaf trouble, sometimes attack potatoes over the state, but it is rarely necessary to employ preventative measures against these.

Fusarium gains entrance to the plant from the soil, and, by growing in the stem, shuts off the water supply, causing the vine to wilt. If a section of the stem is cut, the sap wood will show a darkened appearance not found in healthy plants. Areas where the trouble occurs should not be planted to potatoes again for four or five years, thus starving out the fungus. In addition to damaging the growing crop, this disease also causes dry rot of potatoes in storage.

Rhizoctonia also attacks the plant from the soil, and works on the lower portion of the stem. It restricts the downward flow of food material which has been prepared in the leaves, thus preventing the development of the tubers. Rotation, together with the use of clean seed is the only remedy.

Scab is another fungus trouble and causes unsightly, rough spots on the tubers, reducing their value on the market. One of the most common preventatives against scab is seed treatment. The uncut tubers may be soaked for two hours in a solution of four ounces of corrosive sublimate in thirty gallons of water. This solution is very poisonous and care must be used so that animals will not gain access to either the solution or the tubers which have been soaked therein. Crop rotation should also be practiced. Greening of the seed for a time, before planting, has also been recommended.

Seed Potatoes.—The question of pure seed is of vital importance to the potato growers of the state. Not only should the seed be true to type but they should be free from diseases. It is also important that in choosing the variety for a given section of the state attention must be paid to the question of maturity, as some of the standard varieties will not mature in some districts of the state and it would be useless to plant them. Then due attention should be paid to one or two standard varieties. In order to secure a favorable market, enough should be grown of each variety to insure car-load shipments. The question of importing the seed from year to year is of especial importance to the older potato growing districts. These sections are now more or less infested with diseases that preclude the using of their own crop for seed the following year and seed must be obtained from other portions of the state or outside of the state where the disease is not known. There should be a correlation to mutual advantage between the potato growers in the mountain section and the potato growers in the valleys or on the plains, so that the latter can obtain their seed from the former.

There are a number of locations in the state where high-grade seed potatoes can be grown and these localities should take advantage of their location and furnish high-grade seed for the other districts not so favorably located.

Potatoes grown on a field known or found to be infested with *Fusarium* or *Rhizoctonia* diseases should under no circumstances be used for seed, nor should land so infested be planted to potatoes for at least four years, but be planted to alfalfa.

There is considerable controversy and difference of opinion as to the relative value of seed grown in the state or seed grown in Wisconsin and Minnesota. Experience has shown that seed grown in the last named states do not yield as heavily the first year as the second; in other words, it appears that the potato requires one year to become adapted to the conditions of Colorado. This adaptation does not seem to be necessary in the case of seed obtained from the mountain valleys and from higher altitudes in Colorado, but yield a maximum crop the first year. We would recommend the use of Colorado grown seed, for the cost of transportation, under most conditions, is much lower than the freight rate from Minnesota or Wisconsin.

In order that the potato seed growing industry in the state may prosper, it will be necessary that the growers pay particular attention to the varieties and types; in other words, the selection of typical plants and best yielding hills should be practiced, for experience has shown that by the hill selection system, we can greatly increase the yield of our present varieties and at the same time obtain a market.

PUMPKIN.

Pumpkins are very often grown as a companion crop with corn in the northern and New England States. They are also grown as a separate crop, being handled the same as winter squashes. The seeds are planted in hills eight feet apart each way, five to ten seeds in a hill when there is no longer any danger from frost. The pumpkins should be harvested with a portion of the stem adhering before frost kills the vines in the fall. They can be kept for some time in warm, dry storage.

RADISHES.

The radish is one of the most popular spring vegetables on account of its hardiness, quick return and agreeable crispness and flavor.

Soil.—For early radishes, the soil should be "quick," that is,

it should be a sandy loam containing plenty of humus. The soil should be deeply cultivated late in the fall and left in slight ridges which allow it to warm up earlier and dry out sooner in the spring.

Planting.—The surface is harrowed and smoothed early in the spring and the seed planted in rows fifteen to eighteen inches apart. About 30 or 40 seed are planted to a foot of drill and these are covered three-fourths of an inch deep and the soil compacted over them. It has been found that it pays to use only the largest seed. A much better and earlier crop results when large sized seed are planted than when smaller ones are used.

In addition to being planted in the above manner, radishes are very often grown as a companion crop with lettuce or as a catch crop between cabbage, beans and potatoes. Radishes require only a short time for maturity and when planted between the rows of these crops they reach maturity and are out of the way before the ground is needed by the other crop.

Forcing Radishes.—This vegetable is often forced in hotbeds, cold frames, muslin frames, and sometimes in greenhouses. Seed are usually planted in the hotbed or cold frame very early in the spring in rows about six inches apart with 30 or 40 seed to the foot. Grown in this manner the crop will reach maturity in three to five weeks. In a good hotbed a crop of radishes may be grown in the middle of winter. In the greenhouse, they may, of course, be grown at any season of the year, but spring conditions must be imitated as far as possible. Radishes are comparatively hardy plants and naturally grow in the cool parts of the year. Therefore when grown in greenhouses or hotbeds, low temperatures should be the rule. A temperature of 60° to 65° Fahrenheit during the day and 45° to 55° Fahrenheit at night is about right.

Winter Radishes.—The winter varieties are comparatively little grown in this country. The seed may be planted in July or early September and cultivated until the approach of severe weather. Then they are taken up and placed in sandy soil in the cellar or put in pits in the field the same as turnips. In this way, they will keep in as good condition as turnips.

RHUBARB.

Rhubarb, or pieplant, is found in almost every garden. It is grown for its thick leaf stalks which are used in making pies. The stalks are also cut in cubes and canned for use as occasion requires. Rhubarb does best in northern climates.

Soil.—The soil should be deeply plowed and given a heavy dressing of decomposed stable manure. It is difficult to make the soil too rich.

Planting.—Good strong one-year-old roots are the kind usually used for planting out permanent plantations. Such roots may be obtained from seedsmen or they may be grown by planting the seed. The latter method is cheaper, but requires one year longer.

When ready to plant, rows are laid out four or five feet apart and the plants set rather deeply, two or three feet apart in the row. The crowns of the plants are covered two or three inches deep with soil. The plants should be set deep enough so after covering there is a slight depression over the crowns. The roots are set out early in the spring.

Cultivation.—The crop should be carefully cultivated and liberally fertilized until it reaches bearing age. This is one or two years after the plants are set. It is better to wait until the plantation is two years old, as the roots will be stronger and better able to withstand the removal of the leaves.

After the plants reach bearing size, cultivation is usually delayed until after the harvest period in the spring. Then a heavy dressing of stable manure should be given and cultivation given throughout the remainder of the growing period. Seed stalks must not be allowed to mature, as they are a heavy drain on the vitality of the plants.

Forcing Rhubarb.—Rhubarb may be forced in greenhouses, cellars or hotbeds with very little trouble. One thing, however, is necessary before this can be done. The roots must have a rest period and it is better if they can be thoroughly frozen for three weeks or more. Regardless of the method of forcing, strong, vigorous roots should be used.

When forced in greenhouses the roots are placed as close together as possible on the ground and covered with soil. In a short time the leaf stalks appear and are soon ready for harvesting. Light is not necessary for the growth of rhubarb under such conditions, but when grown in the dark, the stems are inclined to be long and slender. For this reason excellent rhubarb can be grown under the benches in a greenhouse where the benches are used for other plants, or in a cellar.

When grown in a cellar, the roots are simply placed in sand or soil and moisture applied in proper quantity. A temperature of from 45° to 60° Fahrenheit is best for forcing this vegetable.

When a hotbed is used, one that is comparatively cool is desirable.

SALSIFY.

This vegetable which is popularly known as "Oyster plant," is grown for the fleshy roots which are sent to the table boiled. It

is quite hardy and the roots may be left in the ground during the winter for use early in the spring.

The seed are sown in the spring at the same time as early radishes in a deep rich soil. They are planted in drills fifteen or eighteen inches apart and the plants later thinned to stand two or three inches apart in the row.

Salsify may be harvested at any time during the winter when frost will permit, but if a supply is wanted for the winter, a part of the crop should be harvested late in the fall and the roots stored in sand in the cellar.

SPINACH.

This is a plant grown in early spring and late fall for "greens." While grown extensively in some sections its cultivation in the home garden should be more general. It is superior to any other salad plant grown for boiling.

The soil best suited for spinach is a rich sandy loam. Being a hardy vegetable, it is planted very early in the spring for the early crop. The seed may be sown thickly in rows 12 to 18 inches apart and the plants thinned out when well up.

For fall use, the seed are sown in July or August, and the crop is ready to harvest before severe weather sets in.

SQUASH.

There are two general types of squashes, known as summer and winter squashes. The former includes the summer crookneck, the scallop squash, and the cymling of the south, while the latter includes the "late keeping" varieties like the Hubbard. The summer squashes require a much shorter period for maturing and are better adapted to northern Colorado, but the winter kinds can be grown.

Soil.—For early squashes, a quick sandy loam is best, while the late varieties grow best on rather retentive clayey soils. The soil should be well fertilized with stable manure and thoroughly plowed and harrowed before planting time.

Planting.—Squashes are planted about the same time as corn. Rows are laid off in checks, four to eight feet apart each way, depending on variety, and 6 to 10 seeds planted at each intersection of the check marks. The seed are covered about one inch deep and when the plants are well up and danger from insects is past they are thinned to two or three plants in a hill. Subsequent cultivation consists in keeping down weeds with an occasional stirring of the soil.

For early planting the seed may be sown in berry boxes in the greenhouse or hotbed, as suggested for cucumbers, and transplanted to the open after danger of frost is past.

Harvesting and Storing.—The summer squashes are edible only before the shell begins to harden. As long as it is possible to cut through the skin with a slight pressure of the thumbnail, the squash is in edible condition, but after it becomes more resistant, it is not fit to be put on the market.

With the late-keeping kinds, however, the harder and more resistant the shell, the better. This type is not used until mature, and their hard shells enable them to be kept for some time in storage. In harvesting them, a small portion of the stem should be left attached to the squash and care observed so as not to bruise the fruits. They should be left in the field as long as possible in the fall, but must not be subjected to freezing weather. They will keep fairly well in dry, comparatively dark, cellars where the temperature ranges from 38° to 45° F.

SWEET POTATOES.

Sweet potatoes, while not adapted to all parts of the state, can be successfully grown at the lower altitudes in the southern part of the state.

Soil.—A rich sandy loam is desirable for growing sweet potatoes. The soil should be well prepared and fertilized with stable manure. In the south, low ridges are usually thrown up and the sets planted on this, but the ground may be left flat.

Planting.—Sweet potatoes are propagated by means of sets, which are grown in large numbers from the smaller-sized potatoes placed in a hotbed a few weeks before planting time. A manure hotbed should be prepared in the usual way and the manure covered with about three inches of sandy soil. The potatoes are placed on this just far enough apart not to touch and covered with three inches of good sandy soil. This hotbed should be made about April 1st to 15th and the plants set in the field as soon as danger of frost is past.

The slips are ready to pull when about six inches high, and, after the first crop of sets is removed, a second crop will come up to take its place. They are removed by holding down the mother root with one hand and pulling the sets off with the other.

The plants are set about fifteen inches apart in rows three and a half or four feet apart.

Thorough cultivation to prevent weed growth should be given until the vines begin to run, after which horse-drawn implements cannot be used.

Harvesting and Storing.—The crop is harvested at about the same time as Irish potatoes, and in much the same manner. Sometimes a turning plow equipped with two rolling colters which cut

the vines on either side of the row, is used. The potatoes are handled as carefully as possible to avoid bruising.

According to a recent bulletin issued by the Georgia Experiment Station, sweet potatoes can be kept over winter by the following method: As soon as the tubers are harvested, they are brought into the storage house and put in bins. The temperature is then raised to 90 or 100 degrees F. and held there for seven to ten days, in order to dry out the excess moisture. The temperature is then gradually lowered to 50 or 60 degrees and maintained at that point. This is the only satisfactory method, so far developed, by which sweet potatoes can be successfully kept during the winter.

TOMATO.

The tomato has come to be one of our most important vegetables and is now universally cultivated in the gardens of this country. There are three types of tomatoes grown. They are the current type, the cherry type, and the commercial type. The first two are rather weak-growing, small-leaved, small-fruited plants, while the commercial type is the one commonly found on the markets. This type makes a sturdy growth and has large leaves and fruits.

Soil.—While the tomato will grow well on a variety of soils, a warm sandy loam is preferable.

Securing Plants.—The tomato being a tropical plant, requires a long growing period, and any method by which the growing period can be lengthened in this climate will prove an advantage. This can best be accomplished at the beginning rather than at the end of the season. Seed may be sown in flats in the greenhouse or in the hotbed from March 1st to March 15th. As soon as the plants are large enough to handle, they are transplanted to other flats or small pots, giving them more room. As soon as the roots have filled the small pots or the plants have begun to crowd in the flats, they are transplanted again. They may be put into six-inch pots or into the hotbed, or if danger of severe freezing is past, into the cold frame, where they will have room for more growth before their final removal to the field the latter part of May. When treated in this manner the plants will often be in bloom at the final transplanting. If handled properly, however, they will not be checked in their growth.

Setting the Plants.—The plants should be set about four feet apart each way in the field. Care should be observed to check their growth as little as possible. Leave as much soil as possible adhering to the roots when the plants are being moved.

Cultivation.—When the plants are set four feet apart each

way, they can be cultivated almost entirely with horse-drawn implements. The objects of cultivation are to keep down weeds and maintain a surface mulch in order to preserve moisture.

When tomatoes are grown on a large scale for canning they are usually allowed to grow at will and are not provided with supports. On a small scale, however, the plants are trained to stakes two to three feet high. In this case the plants may be grown to a single stem or two or three stalks may be allowed to develop, and these are tied to the stakes in order to keep the fruits and foliage off the ground and expose them to the sunlight.

Forcing Tomatoes.—Tomatoes are forced quite extensively in greenhouses. When so grown, they must have a day temperature of from 70° to 80° F. and a night temperature of 60° to 65° F. Tomato forcing houses are usually constructed with solid benches with no provision for bottom heat.

The plants for forcing are secured in about the same way as suggested for early field planting, except the seed are sown in August instead of March. The plants are transplanted two or three times, being put into 4 to 6-inch pots the last time. When they have filled these pots and flower buds are beginning to appear, they are ready to place in their permanent positions in the bench about eighteen inches apart each way.

In the greenhouse tomatoes are commonly grown to a single stem which is supported by twine stretched between two wires.

Hand pollination is necessary when this crop is grown under glass. This is accomplished by brushing the stamens with a small camel's hair brush and then brushing the end of the pistil. Or the pollen may be shaken on a watch glass and the stigma of the flower dipped into the pollen. Another method is to use a small sharp-pointed stick. This is run between the stamens and a few grains of pollen will adhere. These are applied to the stigma. By using one of these methods a large per cent of the flowers can be made to set fruit.

TURNIP.

The turnip is grown either for early spring use or for use in the late fall and winter. The term "turnip" includes both the common turnip and the rutabaga. The former is grown as an early spring crop to be followed by some other crop, or it may be grown after early potatoes, peas, or beans, while the rutabaga requires the soil for a longer period, the seed being sown in May and the crop harvested in the fall.

A rich sandy or clayey loam is best for turnips. The crop grows rapidly and must have a good supply of available plant food.

The seed for the early crop are sown in March or April in

rows fifteen to eighteen inches apart. The seed are covered to a depth of three-fourths of an inch. When the plants are well up, they are thinned to stand four to six inches apart in the row. After they have attained edible size, they are bunched and sold the same as beets.

For the late crop, the seed are sown in July or August, following the harvesting of some other crop. They may be planted broadcast or in rows. When mature, the crop is harvested and the tops cut off. The turnips may then be sold or stored in pits or cellars much as potatoes.

Rutabagas are treated in the same manner as the late crop except they must be planted in May instead of July or August.

WATERMELONS.

Watermelons are much less widely cultivated in Colorado than the muskmelon, but with proper care they can be grown in most any part of the state.

Soil.—Watermelons thrive best on a warm sandy soil, while the cool nights and short season of northern Colorado are not conducive to the best development of the crop. The abundance of sunlight during the summer offsets this to some extent. The soil should be thoroughly prepared and well fertilized with stable manure.

Planting.—The watermelon is a tender plant, so that planting must be delayed until danger from frost is past. The seed are planted in hills about eight feet apart each way and covered one inch deep. It is best to use a dozen or more seed to each hill in order to be sure of having a perfect stand. After the plants have become well established they should be thinned, leaving two or three to a hill.

In the northern part of the state a better plan to follow is to sow the seed in pots, strawberry boxes, or on pieces of sod placed in the hotbed or greenhouse. By this method the seed may be planted in March or April and the plants removed to the field after cold weather is over. The plants can be moved without checking them at all, and the advantage gained by lengthening the growing period is considerable. Moreover the growing plants can be protected at the most critical stage from insects and other troubles when in the greenhouse or hotbed, much more easily than if they were scattered over a field.

Cultivation.—The best culture possible should be given the crop early in the season so that the least amount possible will be required later when the vines begin to cover the ground.

Hot Beds and Cold Frames

By R. A. McCINTY

Everyone who plants a garden should have a cold frame or hotbed in order to have early plants for the field. These are either temporary or permanent structures used for starting plants early in the season, carrying half hardy plants over the winter, and for growing quick maturing crops out of their ordinary season. In the hotbed, heat is supplied by fermenting manure or other means, while there is no artificial heat in the cold frame. Plants like radishes and lettuce may be grown to maturity in hotbeds, even in mid-winter, while others, like cucumbers, tomatoes, and cabbage, may be started in the hotbed early in the season and transplanted to the open after danger of frost is past.

Cold frames are used for hardening off tender plants such as tomatoes and cucumbers: that is, they are transplanted from the greenhouse or hotbed into the cold frame in order to allow them to become more gradually accustomed to outside conditions. Cabbage, pansies and other semi-hardy plants may be started in cold frames late in the fall and carried over the winter so as to be ready for transplanting to the open very early in the spring. Tender perennial plants like geraniums and some of the roses can be successfully wintered in cold frames.

Location.—The hotbed or cold frame should be located on a well drained spot with a southern aspect. If protected from the prevailing winds by a hedge, board fence or building, so much the better. The hotbed, particularly, is best located on a walk between the house and barn or other outbuilding to insure that it will not be neglected in the matter of ventilation, protection, etc.

HOTBEDS.

Permanent Hotbeds.—In preparing a permanent hotbed, an excavation about two and one-half feet in depth, six feet wide, and any length desired, extending east and west, is made. This may be walled up from the bottom with brick or cement. In this case the walls are made to extend about twelve to fifteen inches above the surface of the ground on the north side of the bed and five or six inches lower than this on the south side, thus giving a slope to the south. If it is preferred not to use brick or cement, a frame made from planks two inches thick will serve. However, the plank does not extend to the bottom of the excavation, but just a few inches be-

low the surface of the soil. Wooden or iron stakes are used to hold the boards in place.

Manure for Hotbeds.—The heating material most commonly used is fresh manure from grain-fed animals—horses or mules. It is better to secure it from a livery stable, as larger quantities can be gotten within a short time. As much as one-third or more of the manure may consist of straw or litter used in the bedding. If the manure has less straw or litter than this, it will be too dense and will not heat well and if it contains too much, the period of heating will be shortened. The manure is taken from the stable and placed in a flat-topped pile four or five feet high and as long and wide as necessary. If the manure is dry, it should be moistened by sprinkling, but must not be made too wet. Under normal conditions, it will start heating in four or five days. If the weather is cold, it may be necessary to sprinkle a part of the pile with hot water in order to start fermentation, or a small quantity of hen manure placed in one part of the pile will sometimes cause it to begin heating.

When fermentation has progressed for a short time the pile is turned in order to make the heat uniform throughout. It may be necessary to turn the pile two or three times. When it is steaming uniformly throughout, the manure is ready to be put in the hotbed. The period between the piling of the manure and the time when it is ready to put into the bed is ordinarily about two weeks.

In putting the heating material into the hotbed, the amount used depends on the outside temperature. If zero or colder weather is expected, manure to the depth of 18 to 30 inches should be put in the bed. For milder temperatures less can be used, and where there is only three or four degrees of frost, six or eight inches will be sufficient. The material is best put in by layers, each layer a few inches deep, and well tramped down with the feet before the next layer is put in.

When the necessary amount of heating material has been put in and well packed down the bed is then ready for the soil. Soil made of one-fourth sand, one-fourth well rotted manure, and one-half good garden soil will answer very well. It is spread over the heating material to a depth of five to seven inches, the greater depth being desirable for radishes and other root crops. If plants in pots or boxes are to be put in the hotbed, sawdust or sand may be used instead of soil. Plants in pots are plunged to the rim in the sawdust, while boxes are simply set on it, the sawdust or soil, either of which can be used, being only three inches deep in this case.

Temporary Hotbeds.—A temporary hotbed may be made as follows: Construct the walls of the hotbed of one-inch instead of

two-inch plank, but make them of the same dimensions otherwise. An excavation is often made somewhat wider and longer than the ordinary dimensions of the bed and the heating material put in. The boards forming the walls are then set on top of the manure. By this plan the heating material extends somewhat beyond the edges of the bed and there is less danger of the temperature falling too low. Glass sash or muslin may be used for covering. The board walls of the hotbed are easily removed after they have served their purpose and the ground may be cultivated as desired.

Another plan that is often followed in making a temporary hotbed is to place the heating material on top of the ground instead of in an excavation. The pile of manure is made somewhat wider and longer than the frame which is set directly on top. Manure may also be banked up around the boards in order to further protect the bed from cold; a layer of soil is put over the heating material and the hotbed is ready for planting. The frames may be removed after they have served their purpose and the rotted manure removed scattered or plowed into the soil.

Sowing the Seeds.—The manure will ordinarily heat very vigorously for a few days after being put into the bed and the temperature may go up to 130° to 140° F. Soil thermometers should be thrust through the earth to the manure and the frame kept tightly closed with sash. After a few days the temperature will begin to decline. When it has declined to 90° the seed may be planted. The soil should be loosened before planting and the rows made four to six inches apart, usually crosswise the bed.

Covering for Hot Beds.—The most common covering for hotbeds in the ordinary glass sash 3x6 feet. The sash cost, glazed, about \$1.75 to \$2.00 each. In addition to the glass sash, straw mats or some such covering is necessary during very cold weather. These can be bought for 50 cents to \$1.00 per sash, or straw, or home-made covers can be used instead. A very good cover can be made by stuffing old sacks (not too full) with straw. In addition to mats it is well to bank manure or soil up around the walls of the bed to help keep out the cold.

A covering which is used on hotbeds considerably instead of glass after the middle of March is made by dipping muslin in linseed oil and letting it dry. The muslin is then tacked to light frames and makes a very serviceable covering in weather that is not too cold. The linseed oil makes it more impervious to moisture and semi-transparent.

Care of the hotbed.—In the management of the hotbed there are two things which must be given especial care. They are water-

ing and ventilation.

It is better to water the bed with a watering pot than with a hose because there is less tendency to pack or puddle the soil. The bed should not be watered toward night, as this tends to lower the temperature when the outside temperature is falling. Too much water checks the heating of the manure and must be avoided. Wet the soil thoroughly (but not too wet) and then do not apply any more water until the plants show that they need it.

Ventilation is particularly important. On warm days, the combined heat of the sun and fermenting manure will be enough to destroy the plants unless the hotbed is properly ventilated. Ventilation can be given by sliding down the sash or by propping it up a few inches. When the time approaches for setting the plants in the open, the sash should be removed entirely when the weather permits. In this way the plants become accustomed gradually to a lower temperature and the normal conditions of the atmosphere. Whenever the air in the hotbed is so moist that drops of water collect on the panes, ventilation should be given if the temperature will permit. Plants which are kept in a close moist atmosphere tend to grow too tall and soft.

In very cold weather or during snowstorms it may be necessary to keep the sash and mats over the hotbeds for several days at a time. In this case, the plants are in the dark and tend to become soft and tender, so that care must be used in admitting light after this period, as they are likely to be scalded by the sunlight.

The hotbed should not be started too soon. If it is to be used for starting plants which are to be transplanted to the field early in the spring, it should be made from five to eight weeks before time to set out the plants. If they have to be held back on account of the cold weather and not transplanted, they will become stunted. The average life of a hotbed is about two months. A good size for the ordinary garden is 6x12 feet, requiring four 3x6 sash. It is a good idea to fill the pits with litter of some kind in the fall. When the time for making the hotbed arrives, this litter may be pitched out, leaving an unfrozen area for the making of the hotbed.

COLD FRAMES.

Cold frames may be either temporary or permanent structures. If temporary, they are boarded up with the same material as the temporary hotbed, that is, one-inch plank. Cold frames are made the same size as hotbeds and have a slope to the south. Glass sash and mats are used for covering them, or the muslin cover described under hotbeds may be used after about the 20th of April.

When the cold frame is to be used for growing lettuce or for

hardening off plants such as tomatoes or cabbage, it is not necessary to make an excavation unless to make room for a few inches of good soil. The soil in a cold frame may be the same as that for a hotbed, or a good sandy, loamy garden soil will be sufficient.

If the cold frame is to be a permanent structure, the sides should be made of heavy plank two inches thick or of brick or cement. If it is desired to use it for carrying half hardy flowers in pots over the winter an excavation three feet deep may be made and the walls and bottom cemented. Sawdust is then put in to a depth of a few inches and the pots are plunged in this to the rim.

Hardy plants like cabbage, kale, and cauliflower can be carried through the winter in cold frames in order to have them for early transplanting in the spring. The seed are sown in the open in the fall in time to develop three or four true leaves before freezing weather comes on. When the plants are transplanted into the cold frames they should be as stocky as possible. All weak or poorly developed plants should be discarded, as they will hardly survive the winter. When freezing weather comes on, the frames are covered, but they should be left open as late as possible in order to make the plants more hardy. The sash is first put on and later the covers are used. The plants do not grow during the winter. They gradually freeze, but if proper care is exercised that the sun does not strike the frozen plants and thaw them out too quickly, they will come through unharmed. They may stand for several days under a cover of snow on the sash without injury with the ground frozen, but if the ground should thaw out, they should not be kept in the dark for more than a day or two at a time. When warm weather comes, the plants are thawed out as gradually as possible and the sash is removed on bright warm days.

The proper age and condition at which plants should go into the cold frame can be determined only by experience. If the plant is too old when put into the cold frame, it is apt to run to seed when planted out in the spring, and if it is too young it will not be likely to survive the winter.

Such plants as pansies, carnations and daisies may be kept over winter in the ordinary cold frame without any trouble.

The best use to which cold frames can be put in this climate is that of hardening off plants in the spring. If tomatoes, cucumbers and other tender plants are started in the hotbed or greenhouse, it is better to transplant them into a cold frame for a short time before they are finally put in the field. By this means they are gradually accustomed to a lower temperature and yet may be protected on cold nights.

MODIFIED HOTBEDS AND COLD FRAMES.

Hotbeds, instead of being heated by fermenting manure, may have smoke flues, steam or hot-water pipes running through them to furnish the necessary heat. In such cases the pipes, flues, etc., are run beneath the soil in the beds.

A device which serves the purpose of a miniature cold frame is the forcing box which is used in small gardens to place over a plant or a hill of plants in order to protect it in the early spring. The forcing box is made about 10 inches wide, 12 inches long, and 6 inches deep, without top or bottom. Provision is made whereby a pane of glass may be slid into the top. The box is so made that this pane of glass slopes toward the south when it is placed in the field. The boxes are placed over the plants in the early spring and protect them during cool weather, particularly at night.

Common Insects of the Garden

By C. P. GILLETTE

CORN.

Striped Corn Rootworm (Diabrotica virgifera).

This insect is becoming very abundant in some of the market gardens and home gardens in Eastern Colorado. The female, in the adult stage, is a small striped beetle, easily mistaken for the striped cucumber beetle. The male beetle is almost wholly black. This is a comparatively new pest, having been first recorded as injurious to corn by the writer in *Journal of Economic Entomology*, Vol. 5, page 364, 1912.

The beetles lay their eggs about the roots of the cornstalks during late summer and in the fall. The eggs remain over winter and hatch the following spring, and if corn is planted upon the same ground the following year, it is sure to be attacked. The little grubs, upon hatching, burrow into the roots and crowns of the corn, causing the stalks to become stunted, and they often fall over of their own weight, and are specially prone to do so at a time of wind and rain.

Remedy.—There is one very efficient means of preventing the injuries of this insect, and that is to avoid planting corn upon the same ground several years in succession.

Corn Ear-worm (Heliothis armigera).

This insect is very destructive, especially to sweet corn, in Colorado, by eating into the ears and feeding upon the kernels at any time during the summer months. It is known as the cotton boll-worm in the Southern States and is a rather general feeder.

often eating into tomatoes and string beans when it is present in large numbers.

The eggs are laid upon the tassels, silk and leaves of the corn and the little worms burrow their way into the ears of corn and are most commonly found near the tips of the ears.

There are several broods a year in the Southern States, and in Colorado the worms are found throughout the summer.

Remedies.—There is no satisfactory remedy for the control of this insect. Probably the best one for the garden is to destroy the worms by hand as they eat into the ears of corn. Poisonous sprays are of very little effect and are dangerous, as they render the corn fodder unfit for stock food.

CABBAGE AND CAULIFLOWER.

Green Cabbage Worm (Pieris rapae).

Cabbage, cauliflower and allied plants are nearly always seriously attacked in Colorado by the common green cabbage worm, which feeds upon the cabbage leaves, and, when abundant, often eats deeply into the cabbage heads, ruining them for market.

The adult insect is a white butterfly, which deposits its eggs, one in a place, upon the leaves of the plants attacked. If one will watch these butterflies over a cabbage patch, it will be no trouble to notice the butterflies occasionally descending and touching the tip of the abdomen to a leaf. In doing this an egg is deposited. The eggs hatch in a few days and the little worms begin at once to feed upon the leaves near where they hatch.

Remedies.—One of the most efficient remedies for this insect is the use of arsenical poisons. Perhaps the most satisfactory one to use is Paris green, though arsenate of lead may be used with satisfactory results. One of the best methods of applying the Paris green is to mix a teaspoonful of the poison in about one pint of common wheat flour and then dust the mixture over the infested plants through a cheese cloth sack. The application is best made early in the morning when there is no wind and when a little dew is still upon the leaves. A very light dusting is all that is necessary for good results. If arsenate of lead is used, dilute one pound of the lead paste, or one-half pound of powdered lead, in twenty gallons of water and thoroughly spray the leaves. The application should be begun as soon as the butterflies begin to deposit their eggs, and should be repeated once every week or ten days until the cabbages are nearly grown.

Insect powder, or Pyrethrum, may be used either in the form of a spray, one ounce to three gallons of water, or may be lightly dusted over the infested plants for the destruction of the worms.

This insecticide is not poisonous to man or higher animals, but is very destructive to most insect life. This powder is best applied with a small bellows that will drive it deeply into the cabbage head, as the powder must come in contact with the insect's body in order to kill it.

If the poisons above mentioned are used, the leaves will not be fit for stock food, but there will be no danger of poisoning people who eat the cabbage heads, as all of the outside leaves that catch the poison are removed when the cabbages are cooked. These arsenical poisons must not be used on cauliflowers after the heads have begun to form, and should not be used on cabbage nearer than two weeks to the time when the heads are to be gathered.

Cabbage Louse (Aphis brassicae).

The green cabbage aphid is often very abundant upon the leaves of cabbage, cauliflower and closely allied plants. The surface of the body of this louse is covered with a fine powder which will shed water and ordinary insecticide poisons, unless the application is made with a good deal of force so as to cause the liquid to wet through the powder. It is better still to wash the lice off the leaves. Strong soapy mixtures (a pound of whale oil or fish oil soap to each eight gallons of water), nicotine preparations such as Black-leaf 40, or oil emulsions, will be found efficient in the destruction of this louse if used as a forceful spray.

BEANS.

Spotted Bean Beetle (Epilachna corrupta).

This insect is very destructive to garden and field beans in the area adjacent to the eastern foothills of the Rocky Mountains, from Wyoming to Southern Colorado and far into New Mexico. The insect belongs with the lady beetles, but has acquired the habit of feeding upon plant tissues instead of plant lice and insect eggs. Its occurrence is not known in the states farther east. The adult insect is of a rusty yellow color with a number of small black spots upon its wing covers. The eggs are yellow in color and are laid in patches, usually of twenty or more, on the under side of the bean leaves and can hardly be distinguished from egg patches of the Colorado potato beetle.

The grubs or larvae that hatch from these eggs are light yellow in color and are covered with stout branched hairs or spines. There is only one brood of the insect during the year, but it continues upon the bean foliage throughout the season.

Remedies.—The use of insecticides for the control of this insect have not been very satisfactory. After much experimentation we have come to the conclusion that the best methods of control

are picking the adult beetles and their eggs from the plants early in the summer, and brushing the insect in all stages of development from the leaves upon the hot ground later in the season. To do this work successfully the day must be hot with the sun shining brightly, and only two or three hours of the warmest part of the day can be used.

Arsenical poisons applied to the leaves will usually do more injury to the plants than to the bean beetles.

SQUASH AND PUMPKIN.

The Squash Bug (Anasa tristis).

This large dark colored squash bug, often designated as "stink bug" because of its very disagreeable odor, has been credited with a great deal of injury to winter squashes in Colorado. I have been noticing its presence upon squash vines in Colorado for many years but have never yet seen a plant that I thought was seriously injured by it. When abundant enough to do serious harm, the bugs, in all sizes, accumulate upon individual leaves in sufficient numbers to cause them to wilt and die.

Remedies.—The application of insecticides for the control of this insect, is not satisfactory. The best remedies are hand picking and destruction of the adult insects and their eggs early in the season, and collecting the bugs later in the summer in a pan of water with a spoonful of kerosene on top. The latter method is most successful early in the morning when the bugs are inactive.

The destruction of squash vines by the squash root maggot mentioned below is commonly attributed to the squash bug.

The Squash Root Maggot.

During the middle of the summer, almost any time after the winter squash vines have begun to run, they will sometimes wilt and die within a day or two. If these vines are examined, it will usually be found that the plants are being attacked at the crown, or root, by maggots, causing them to decay. As soon as the maggots are fully grown they leave the plants and burrow into the ground about the roots, where they undergo their transformation and later emerge as two-winged flies, very similar to our common house fly, but somewhat larger.

Remedies.—When the plants die, the dirt immediately around the crown should be removed and the maggots or their pupae destroyed, which can easily be done by stamping the earth under foot. The flies may be prevented from depositing their eggs about the plants by placing a collar of tar-paper close about the crown. This should be done just before the vines begin to run. Part of the plants that can be spared should be left without the collar to catch the eggs and so serve as traps.

It is quite often that the vines of winter squash or pumpkins wilt down quickly as mentioned above, when the crown and roots of the plants are apparently sound. In such cases the plant will nearly always be found to be attacked by a bacterial organism which causes the interior of the stem to change to a yellowish color, and usually there is considerable exudation of an amber-colored fluid from portions of the vine, and especially near the root. If insects are abundant on the squashes, they are liable to carry the disease organisms upon their mouth parts from vine to vine until the entire patch is destroyed. To prevent the spread of this disease, pull and burn all dying plants as soon as they are noticed and reduce the insects that are attacking the squashes to the smallest possible number.

MELONS AND CANTALOUPE.

The Melon Louse (Aphis gossypii).

The little green melon louse which attacks the foliage of melon, cantaloupe and cucumber vines, is perhaps the most destructive pest that these plants have in Colorado. The melon aphid usually attacks, at first, but very few plants scattered through the patch. Upon these plants the lice increase rapidly in numbers, some of them acquiring wings, and then the insect spreads rapidly over the field, and may become so numerous as to almost destroy the crop.

Remedies.—It is sometimes the case that the lady beetles and other natural enemies of these lice are abundant enough to keep them in check, but it is not safe to depend upon the insect enemies to do this work, as a rule. Probably the best artificial remedies are either burning or burying the first infested vines of the year. In order to be successful in this work, the melon raiser must keep very close watch of his plants and as soon as any of them are found infested, the treatment should be made promptly. The burning is done by throwing a small forkful of straw or hay upon the infested vines and burning it. The plants are buried by throwing a few shovels of dirt upon them, which, however, must be sufficient to prevent the escape of any of the lice. All of the infested leaves should be buried under, at least, one or two inches of earth, and then it is well to tramp down the dirt. The lice cannot burrow out.

The ordinary insecticides for the destruction of other plant lice will kill the melon louse also, so far as they can be thoroughly applied to them. These insecticides are seldom effectual, however, because of the difficulty of making an application that will thoroughly reach the lice on the under side of the curled leaves. Fumigation of the plants under wash tubs may be carried on successfully, but I believe this is too expensive a method for practical purposes in the field.

Striped Cucumber Beetle (Diabrotica vittata).

This is one of the oldest and best known enemies of melon and cucumber vines. The adult insect is a small yellow beetle with three narrow black lines upon the back, or wing covers. It is very similar in appearance to the corn rootworm mentioned above, but shows the stripping much more plainly than that insect. The beetles usually appear about as soon as the second leaves start upon the cucumber plants. They often come in a single day in sufficient numbers to destroy the plants. The beetles have the habit of going in swarms, so that they often destroy certain hills completely without attacking others. While this insect is not generally distributed in Colorado, it has become rather abundant in the melon growing sections of the southeastern portion of the state.

Remedies.—Insecticides are often of little avail for the control of this insect. Pyrethrum powder, when thoroughly dusted over the plants early in the morning, while the insects are still dormant, will usually give good results. The plants should be disturbed enough to cause the insects to drop to the ground, so the powder can be thoroughly applied to them. Any very fine powder, such as fine road dust, ashes, slaked lime and the like, when thoroughly applied to the plants, will help some to reduce the injuries of this beetle. The application of arsenical poisons will do some good, but is seldom very efficient. The beetles may be kept away from the plants by putting mosquito netting over the vines and holding it down by means of dirt, stones, or wooden pegs.

Wherever this insect is abundant, it is advisable to plant plenty of seed, so that many of the plants may be sacrificed and still enough remain to produce a crop.

ONIONS.

The Onion Thrips.

The onion thrips, sometimes spoken of as a louse, is a very minute, active insect that commonly attacks onion tops in Colorado, causing them to turn white, and often to wilt and fall to the ground. This insect is so small that it is often overlooked by the gardener, even when it is present in large numbers. When fully grown these minute insects have wings and will readily fly from the plants when disturbed, which makes it somewhat difficult to apply insecticides effectively.

Remedies.—The onions should be closely watched and when grayish or whitish places begin to appear upon the tops, it is quite certain that this insect is present and beginning its injuries. If the tops seem to be bleaching rapidly, it is advisable to apply some insecticide for the destruction of this insect. The best remedies are either some strong tobacco extract, such as Black-leaf 40, in the

proportion of one part to 700 or 800 parts of water; or one of the oil emulsions, or miscible oils, in the form of a spray. The application is best made early in the morning while the air is quite cool and before the insects have become active. If the application is made by means of a pump and spray nozzle and with sufficient force the thrips can be washed from the onion tops and thoroughly drenched, which will destroy a very large proportion of them.

RADISHES.

Flea-beetles.

Little black beetles of more than one species, which jump readily when disturbed, often are very severe pests to radishes early in the season. Sometimes the first leaves are almost entirely eaten as soon as they break through the ground. The injury is always done by the adult insects. The characteristic manner of feeding is to eat small holes, hardly larger than a pin hole, through the leaves and when these are very abundant, the entire surface of the leaf will often die and turn brown. The same flea-beetle also attacks tomatoes, potatoes and other garden crops.

Remedies.—Any fine dust, such as road dust, ashes, slaked lime, and land plaster may be freely used upon the plants with some good results, but none of these are very effective if the insects are present in large numbers. The arsenical sprays, such as Paris green and arsenate of lead will also destroy some of the beetles, but are not considered satisfactory. Bordeaux mixture such as is commonly used for the control of fungus, diseases, if thoroughly applied to the plants, is often very effectual and prevents serious injury. I have had the best results, however, from the free use of insect powder, or Pyrethrum, applied freely by dusting it through a cheese cloth sack very early in the morning. The beetles should be brushed from the leaves so that they may be well covered with the powder.

Cut Worms.

Perhaps the cut worms, of which there are several species in Colorado, are the most destructive pests to the average garden. These worms burrow just beneath the surface of the ground, where they remain in quiet during the daytime, but during the night or upon cloudy days it is their habit to come to the surface of the ground and feed upon a great variety of plants, having the peculiar habit of eating just at the surface of the ground, where they often cut the stem of the plants completely off; hence the name, cut-worm.

The adult insects are dark-colored moths, expanding about one and a half inches when their wings are fully spread. These moths

are often troublesome about the lamps in the evening on account of their habit of flying to the light in the night time. The moths are more or less common through the summer, but are usually most abundant in Colorado during the latter part of May and June. When the worms become fully grown, they burrow into the earth, change to the pupal or resting stage, and later emerge in the moth stage mentioned above.

Remedies.—In large fields, the method of control is to plow the ground during the summer and keep it cultivated and free from all vegetable growth until winter. This will prevent the moths laying eggs and will nearly always result in freedom from cutworm injuries the following spring.

If it is impossible to keep the garden tract free from vegetation late in the season, it is necessary to depend upon other means of control. One of the best of these remedies is to watch for the appearance of the plants that have been cut off during the night, and dig out and destroy the worms that are doing this work. Individual plants, or hills, of any plants in the garden that are liable to be attacked by the worms, may be protected by surrounding each plant or hill by a collar made of stiff paper, or tin. Tin cans may be cut in suitable sizes by means of tin shears and be used from year to year. A good size for the protection of a single plant is a strip of tin or paper three inches wide by five inches in length. The strip is curled in the form of a cylinder and placed about the plant and then pressed into the ground so that the top of the cylinder will project one and a half or two inches upon the surface of the ground. The worms will almost never climb over one of these cylinders to attack the plants. Care should be taken not to enclose the worms within the cylinder when it is placed about the plant.

Small weeds between the rows of plants in the garden are also a great protection from cut-worm injuries. When the cultivated plants are small, the worms feed as freely upon most of the garden weeds as upon the cultivated plants. If the weeds are all hoed out, the worms are compelled to feed upon the few cultivated plants that remain. It is bad advice, without doubt, to recommend allowing weeds to grow in the garden, but this can often be done judiciously for a week or two early in the season when the plants are tender and easily destroyed by the worms. As soon as the plants become woody and resistant to the worms the garden, of course, should be freed from all weeds and kept in as good condition as possible for the growth of the cultivated crops.

POTATOES.

The Colorado Potato Beetle (Leptinotara 10-lineata).

The striped Colorado potato beetle is too well known to need description. The remedies are also quite generally known and are as follows: Early in the season collect as many of the adult beetles and their eggs as is possible and destroy them to prevent injury from the brood of young that would otherwise destroy the potato tops. If the eggs have been allowed to hatch and the young beetles are numerous upon the potatoes, the best remedy is the application of one of the arsenical poisons. Paris green may be used in the form of a spray in the proportion of one pound of the powder to each fifty gallons of water. If arsenate of lead is employed, dilute two pounds of the powdered form or four pounds of the paste to each fifty gallons of water. If a second brood appears, repeat the treatment for them.

The Potato Tuber Moth (Phthorimaea operculella).

This very destructive insect has been introduced into Colorado from infested districts in Southern California and Texas, but so far as I am able to determine, it has not as yet become established in any portion of the state.

This insect is an importation from China and bids to be one of the most serious enemies to potato growing in the the southern potato growing sections of the United States. Attention is called to this insect here chiefly for the purpose of warning growers of the possibility of introducing it in their communities and to ask for prompt information from anyone who suspects this insect to be attacking his crop.

The adult insect is a small, dark colored, narrow winged moth, which measures about one-half of an inch from tip to tip of its wings when they are spread. The eggs are laid upon the tubers, or upon the leaves or stems of the potato plant. The light colored worm, upon emerging from the egg, burrows into tuber, stem, or leaf, as the case may be, and feeds until it is fully grown, when it is about one-third of an inch in length. There are several broods during the year. The greatest injury is usually done to potatoes in storage, and especially if the temperature is high enough to be favorable for the development of this pest.

Remedies.—About the only remedies to be suggested are the burning of the potato tops when the insect is found to be burrowing into them, the careful gathering of all of the cull potatoes from the field at digging time, and the fumigation of cellar and storage rooms where the tubers are being kept.