The Montana Farm Garden

By

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Planning the garden. Ordinarily we do not think about gardening when the snow lies deepest, but that is when we have the most leisure for deciding the kind and amount of each vegetable to be grown and for ordering seed. Buying seed early is important. Such a practice will usually insure a better selection of varieties, if not a better grade of seed, and late buying may mean a delay in planting. If a well arranged, systematic plan is worked out before hand, time, space and labor will be saved when seeding time arrives. A systematic planting plan involves the grouping of vegetables according to season of planting, and also grouping together those crops which require about the same length of time to mature.

There are many different kinds of vegetables which can be grown in Montana, thus affording a wide range of healthful, nutritious foods. In addition to supplying fresh vegetables in season, many crops can be canned, dried, pickled, or stored and kept in fresh condition, thus providing an ample supply through the winter months. The necessity of an abundance of fruit and vegetables in the diet for the maintenance of good health is widely recognized. With a well selected variety of fruits and vegetables produced on the farm, the family will use more than if they have to be purchased, and better balanced meals are possible. Investigations show that such vegetables as spinach, cabbage, carrots, lettuce, tomatoes, asparagus, and chard are especially high in the vitamins which it is believed are essential for growth and well being. Vegetables are also a good source of such minerals as calcium, phosphorus and iron which are essential elements in the human body.

A certain quantity of bulk food is necessary for good health, and vegetables are the main source of “roughage.” Because of their succulence and relatively large bulk the leafy vegetables and most of the root crops probably aid in the digestion of the more concentrated foods. The slogan “eat vegetables for vitamins” is a sound one. The name “vitamin” has been given to a group of food substances that have been found necessary for growth and health. These vitamins have been classified as A, B, C, D, and E. The farm garden can supply all of these except vitamin D. Table 1 gives the relative distribution of vitamins A, B, and C in many vegetables, as reported by Smith in U. S. Department of Agriculture circular 11 (1929). In this table “x” indicates that the food contains a small amount of the vitamin; “xx” indicates that the vegetable is a good source; “xxx” indicates the vegetable an excellent source; “-” indicates that the vegetables contains no appreciable quantity; “*” indicates lacking in vitamins, or appearing insufficient.
TABLE 1

<table>
<thead>
<tr>
<th>VEGETABLE</th>
<th>Vitamin</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>A</td>
</tr>
<tr>
<td>Asparagus</td>
<td>xx</td>
</tr>
<tr>
<td>Beans, string (cooked)</td>
<td>*</td>
</tr>
<tr>
<td>Beets, leaves</td>
<td>xx</td>
</tr>
<tr>
<td>Beets, roots</td>
<td>- to x</td>
</tr>
<tr>
<td>Cabbage (cooked)</td>
<td>x</td>
</tr>
<tr>
<td>Cabbage (raw)</td>
<td>x</td>
</tr>
<tr>
<td>Carrot (raw) young</td>
<td>xxx</td>
</tr>
<tr>
<td>Carrot (cooked) young</td>
<td>*</td>
</tr>
<tr>
<td>Celery</td>
<td>- to x</td>
</tr>
<tr>
<td>Chard</td>
<td>xx</td>
</tr>
<tr>
<td>Lettuce, head</td>
<td>x to xx</td>
</tr>
<tr>
<td>Lettuce, leaves, green</td>
<td>xxx</td>
</tr>
<tr>
<td>Onion (cooked)</td>
<td>- to x</td>
</tr>
<tr>
<td>Onion (raw)</td>
<td>- to x</td>
</tr>
<tr>
<td>Peas</td>
<td>xx</td>
</tr>
<tr>
<td>Potato, baked</td>
<td>x</td>
</tr>
<tr>
<td>Potato, boiled</td>
<td>x</td>
</tr>
<tr>
<td>Spinach</td>
<td>xxx</td>
</tr>
<tr>
<td>Tomato</td>
<td>xx</td>
</tr>
<tr>
<td>Turnip</td>
<td>- to x</td>
</tr>
</tbody>
</table>

Location of the garden. Any piece of land having soil suitable to raise good grain crops may be selected for the production of vegetables. The garden, however, should have a permanent location in order to permit building up the soil to the point where maximum production can be secured. To be of greatest value to the housewife, it must be near the house. The nearer the dwelling the greater the convenience in cultivating and harvesting. A level piece of land or one having a very slight slope to the north or northeast is most desirable. Steep grades are subject to washing. A slight slope to the northeast is not as likely to be affected to as great an extent by drying hot winds as is a southwest slope. Protection from high winds, especially from the south and west, is desirable. A few rows of trees on the south and west will check the drying winds of summer (See pages 4 and 5, Mont. Exp. Bul. 109), while a garden located with a shelterbelt on the north will be likely to be covered deeply by drifting snows which upon melting will be stored in the subsoil and serve as a reserve supply of moisture throughout the growing season.

Size of the garden. On most farms the possibilities of the home garden are not fully realized. A garden of sufficient size is omitted in many cases for fear that too much labor will be involved. The way to reduce labor in a farm garden is to increase its size and introduce field methods
of tillage. Man labor is scarce, so horse labor and machinery should be used as much as possible. One acre is ample in size for an average family of five, providing that the main potato crop is not included in the garden. The size of the garden, of course, will be determined by the needs of the family and the method of cultivation.

Seeds and plants for a garden of this size can be provided for approximately $15.00 to $20.00, and returns will average close to tenfold in normal seasons. The financial value of a farm vegetable garden is quite generally underestimated because the bulk of the produce goes to the family table instead of being sold and converted into actual dollars and cents. If accurate records were kept of a well planted and cared for garden, they would show that the farm area devoted to the raising of vegetables produces a larger gross return with less investment of time and money than any other part of the farm. Where hand work is to be the chief method of cultivation, vegetables can be spaced closer between rows than with horse cultivation and greater yields produced from a given area.

The long row system has its advantages for horse cultivation, as fewer rows and less turning are involved. A long, narrow strip of land is better adapted for horse cultivation than a square piece. Drifting snows will be more evenly distributed over a long, narrow strip of land when protected by a shelterbelt than will be the case of a square piece. The advantage of having snow evenly distributed applies to dry land gardens and would be of little value where irrigation is practiced. Providing for double the space needed for a garden under dry land conditions is not a bad idea in some localities. Half of the garden area can then be summerfallowed each year. Summerfallowing is a good means of destroying weeds and reducing hand labor. Heavy applications of manure can be made to the area that is to be summerfallowed. This method of building up the fertility of garden soils on dry situations is preferable to applying manure to a piece of land the same spring it is to be planted to crops.

Estimating family needs. The home garden should be planned for the particular home it is to serve. Family needs and preferences should guide its making. Every family has varying tastes, as well as individual members of a family. With the wide range of vegetables from which to choose it is possible to supply the wants and needs of every individual. A carefully planned garden will include a list of varieties so that there will be a succession of crops maturing, beginning with the very earliest kinds and extending throughout the entire growing season. A study of Table 1 will help in selecting the varieties that provide the necessary vitamins throughout the season. Should the members of the family be especially fond of some particular vegetable, a larger amount of that crop should be planted. From the following table can be determined the length of row required to produce the amount required of each crop and the amount of seed necessary for planting. Yields in this table are based on normal production. Allowance should be made for probable drought with such crops as are used for preservation and storage.
<table>
<thead>
<tr>
<th>Vegetable</th>
<th>Number of seed per plants or 100-ft. row</th>
<th>Distance between rows</th>
<th>Distance apart in the row</th>
<th>Probable yield per 100-ft. row</th>
</tr>
</thead>
<tbody>
<tr>
<td>Asparagus</td>
<td>65 plants</td>
<td>4 feet</td>
<td>18 inches</td>
<td>75 lbs. (after 3rd season)</td>
</tr>
<tr>
<td>Beans, green</td>
<td>1/2 pint</td>
<td>2 feet</td>
<td>4 inches</td>
<td>1 1/2 bushels</td>
</tr>
<tr>
<td>Beans, dry</td>
<td>1/2 pint</td>
<td>2 feet</td>
<td>4 inches</td>
<td>5-8 pounds</td>
</tr>
<tr>
<td>Beets</td>
<td>2 ounces</td>
<td>18 inches</td>
<td>1-3 inches</td>
<td>1 1/2 bushels</td>
</tr>
<tr>
<td>Cabbage</td>
<td>2 packets</td>
<td>2 1/2 feet</td>
<td>2 feet</td>
<td>200 pounds</td>
</tr>
<tr>
<td>Carrots</td>
<td>1 ounce</td>
<td>18 inches</td>
<td>1-2 inches</td>
<td>1 bushel</td>
</tr>
<tr>
<td>Cauliflower</td>
<td>2 packets</td>
<td>2 1/2 feet</td>
<td>2 feet</td>
<td>Uncertain crop on dry land</td>
</tr>
<tr>
<td>Celery</td>
<td>1 packet</td>
<td>2 1/2-5 feet</td>
<td>6-9 inches</td>
<td>150 bunches</td>
</tr>
<tr>
<td>Chard, Swiss</td>
<td>1 ounce</td>
<td>2 feet</td>
<td>12 inches</td>
<td>100-200 pounds</td>
</tr>
<tr>
<td>Corn, sweet</td>
<td>1/4 pound</td>
<td>3 feet</td>
<td>2 feet</td>
<td>100 ears</td>
</tr>
<tr>
<td>Corn, pop</td>
<td>1/4 pound</td>
<td>3 feet</td>
<td>18 inches</td>
<td>1/2 bushel</td>
</tr>
<tr>
<td>Cucumber</td>
<td>1/2 ounce</td>
<td>5 feet</td>
<td>4 feet</td>
<td>200-400 fruits</td>
</tr>
<tr>
<td>egg plant</td>
<td>2 packets</td>
<td>2 feet</td>
<td>18 inches</td>
<td>50-100 fruits</td>
</tr>
<tr>
<td>Kohlrabi</td>
<td>1 ounce</td>
<td>18 inches</td>
<td>4 inches</td>
<td>Uncertain crop on dry land</td>
</tr>
<tr>
<td>Lettuce, leaf</td>
<td>1/2 ounce</td>
<td>1 1/2 feet</td>
<td>3-8 inches</td>
<td>2 bushels</td>
</tr>
<tr>
<td>Lettuce, head</td>
<td>2 packets</td>
<td>1 1/2 feet</td>
<td>12 inches</td>
<td>25-foot row sufficient</td>
</tr>
<tr>
<td>Muskmelon</td>
<td>1/2 ounce</td>
<td>4 feet</td>
<td>3 feet</td>
<td>25-40 heads</td>
</tr>
<tr>
<td>Onion</td>
<td>1 ounce</td>
<td>1 1/2 feet</td>
<td>3 inches</td>
<td>Uncertain crop on dry land</td>
</tr>
<tr>
<td>Parsnip</td>
<td>1/2 ounce</td>
<td>18 inches</td>
<td>4 inches</td>
<td>50-100 fruits</td>
</tr>
<tr>
<td>Peas</td>
<td>1/2 pound</td>
<td>2 feet</td>
<td>1-2 inches</td>
<td>1 bushel</td>
</tr>
<tr>
<td>Pepper</td>
<td>2 packets</td>
<td>2 1/2 feet</td>
<td>18 inches</td>
<td>1 1/2 bushels</td>
</tr>
<tr>
<td>Pumpkin</td>
<td>1 ounce</td>
<td>8 feet</td>
<td>8 feet</td>
<td>200 fruits</td>
</tr>
<tr>
<td>Radish</td>
<td>1 ounce</td>
<td>1 1/2 feet</td>
<td>7/8-1 inch</td>
<td>225 pounds</td>
</tr>
<tr>
<td>Rhubarb</td>
<td>25 plants</td>
<td>4 feet</td>
<td>4 feet</td>
<td>120 bunches</td>
</tr>
<tr>
<td>Rutabaga</td>
<td>1/2 ounce</td>
<td>2 feet</td>
<td>8-12 inches</td>
<td>150 pounds</td>
</tr>
<tr>
<td>Salsify</td>
<td>2 ounces</td>
<td>18 inches</td>
<td>3 inches</td>
<td>1 bushel</td>
</tr>
<tr>
<td>Spinach</td>
<td>1 ounce</td>
<td>1 1/2 feet</td>
<td>2 inches</td>
<td>1 1/2 bushels</td>
</tr>
<tr>
<td>Squash</td>
<td>1 ounce</td>
<td>8 feet</td>
<td>8 feet</td>
<td>250 pounds</td>
</tr>
<tr>
<td>Tomato</td>
<td>1 packet</td>
<td>4 feet</td>
<td>4 feet</td>
<td>3 bushels</td>
</tr>
<tr>
<td>Turnip</td>
<td>1/2 ounce</td>
<td>1 1/2 feet</td>
<td>6 feet</td>
<td>3 bushels</td>
</tr>
<tr>
<td>Watermelons</td>
<td>1 ounce</td>
<td>6 feet</td>
<td>6 feet</td>
<td>30-50 fruits</td>
</tr>
</tbody>
</table>
Space 3 feet between rows for horse cultivation.

Draw a plan of your garden on paper, showing where each vegetable is to be planted. Group early maturing kinds together.

Plant perennials on one side so that they will not interfere with plowing.

If a single row full length of the garden is too long for one kind of vegetable, continue that row with some other kind.

Estimate what you will need, and then plant enough to allow for drought.

Table 3 will be found helpful in determining the amount to plant of the crops listed for canning purposes.

### TABLE 3—APPROXIMATE YIELD IN CANNING

<table>
<thead>
<tr>
<th>Vegetable</th>
<th>Approximate Yield</th>
</tr>
</thead>
<tbody>
<tr>
<td>Asparagus</td>
<td>12 pounds</td>
</tr>
<tr>
<td>Asparagus</td>
<td>makes 6 pints with stalk</td>
</tr>
<tr>
<td>Asparagus</td>
<td>12 pounds</td>
</tr>
<tr>
<td>Asparagus</td>
<td>2 pints with tips only</td>
</tr>
<tr>
<td>Beans, string</td>
<td>1 1/2 pounds</td>
</tr>
<tr>
<td>Beets</td>
<td>12-15 baby beets</td>
</tr>
<tr>
<td>Corn, sweet</td>
<td>1 dozen small ears</td>
</tr>
<tr>
<td>Peas</td>
<td>1 bushel</td>
</tr>
<tr>
<td>Tomato</td>
<td>1 bushel</td>
</tr>
<tr>
<td>Spinach and greens</td>
<td>1 bushel</td>
</tr>
<tr>
<td>Tomato</td>
<td>6 pints with stalk</td>
</tr>
<tr>
<td>Tomato</td>
<td>2 pints with tips only</td>
</tr>
<tr>
<td>Corn, sweet</td>
<td>1 quart</td>
</tr>
<tr>
<td>Peas</td>
<td>1 pint</td>
</tr>
<tr>
<td>Tomato</td>
<td>3 pints</td>
</tr>
<tr>
<td>Spinach and greens</td>
<td>7 quarts</td>
</tr>
<tr>
<td>Tomato</td>
<td>7 pints</td>
</tr>
<tr>
<td>Spinach and greens</td>
<td>13 quarts</td>
</tr>
</tbody>
</table>

*Data provided by the Home Economics Division of the Montana Extension Service.

Study Tables 2 and 3. They will help you in determining the amount of each vegetable to plant.

You should serve at least one vegetable each day, in addition to potatoes.

Plant enough of each kind that you like so that it will be possible to can, dry, or store a sufficient quantity to last until the next crop season.

Varieties. There are many good varieties of each class of vegetables, some of which will do better in some locations than others. A given variety will not always perform the same under all given conditions. The following is merely a list of vegetables that may be grown. Only the more important classes are given.

- Asparagus
- Beans, snap
- Beans, dry shell

<table>
<thead>
<tr>
<th>Vegetable</th>
<th>Variety</th>
</tr>
</thead>
<tbody>
<tr>
<td>Asparagus</td>
<td>Mary Washington</td>
</tr>
<tr>
<td></td>
<td>Reading Giant</td>
</tr>
<tr>
<td>Beans, snap</td>
<td>Stringless Greenpod</td>
</tr>
<tr>
<td></td>
<td>Bountiful</td>
</tr>
<tr>
<td></td>
<td>Refugee</td>
</tr>
<tr>
<td></td>
<td>Roundpod</td>
</tr>
<tr>
<td></td>
<td>Kidney Wax</td>
</tr>
<tr>
<td>Beans, dry shell</td>
<td>Pilot</td>
</tr>
<tr>
<td></td>
<td>Great Northern</td>
</tr>
<tr>
<td>Category</td>
<td>Varieties</td>
</tr>
<tr>
<td>-------------------</td>
<td>---------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Beets</td>
<td>Eclipse (for early bunching)</td>
</tr>
<tr>
<td></td>
<td>Detroit Dark Red (late)</td>
</tr>
<tr>
<td></td>
<td>Long Season (for trail, a good storage beet)</td>
</tr>
<tr>
<td>Cabbage</td>
<td>Copenhagen Market (early and mid-season)</td>
</tr>
<tr>
<td></td>
<td>Danish Roundhead (late, storage and kraut)</td>
</tr>
<tr>
<td>Carrot</td>
<td>Chantenay</td>
</tr>
<tr>
<td></td>
<td>Coreless</td>
</tr>
<tr>
<td></td>
<td>Danvers Half Long</td>
</tr>
<tr>
<td>Cauliflower</td>
<td>Burpee's Best Early</td>
</tr>
<tr>
<td></td>
<td>Dry Weather</td>
</tr>
<tr>
<td>Celery</td>
<td>Golden Plume</td>
</tr>
<tr>
<td>Corn, sweet</td>
<td>Golden Gem (for trail)</td>
</tr>
<tr>
<td></td>
<td>Sunshine</td>
</tr>
<tr>
<td></td>
<td>Golden Bantam</td>
</tr>
<tr>
<td>Corn, pop</td>
<td>Tom Thumb</td>
</tr>
<tr>
<td></td>
<td>Japanese Hulless</td>
</tr>
<tr>
<td>Cucumber</td>
<td>Early Fortune (for slicing)</td>
</tr>
<tr>
<td></td>
<td>Boston Pickling (for pickles)</td>
</tr>
<tr>
<td>Chard, Swiss</td>
<td>Lucullus</td>
</tr>
<tr>
<td>Kohlrabi</td>
<td>Early White Vienna</td>
</tr>
<tr>
<td></td>
<td>Early Purple Vienna</td>
</tr>
<tr>
<td>Lettuce, leaf</td>
<td>Grand Rapids (green leaf type)</td>
</tr>
<tr>
<td></td>
<td>Tom Hannock (red leaf type)</td>
</tr>
<tr>
<td>Lettuce, head</td>
<td>New York Wonderful</td>
</tr>
<tr>
<td></td>
<td>Salamander</td>
</tr>
<tr>
<td>Muskmelon</td>
<td>Emerald Gem</td>
</tr>
<tr>
<td></td>
<td>Burrell's Superfecto (for trail)</td>
</tr>
<tr>
<td></td>
<td>Golden Champlain</td>
</tr>
<tr>
<td>Onion, transplants</td>
<td>Riverside Sweet Spanish</td>
</tr>
<tr>
<td>Onion, sets</td>
<td>Southport Yellow Globe</td>
</tr>
<tr>
<td></td>
<td>Ebenezer</td>
</tr>
<tr>
<td>Onion, seed</td>
<td>Australian Brown</td>
</tr>
<tr>
<td></td>
<td>Ebenezer</td>
</tr>
<tr>
<td>Onion, picking</td>
<td>White Portugal or Silverskin</td>
</tr>
<tr>
<td>Parsnip</td>
<td>Improved Guerensey</td>
</tr>
<tr>
<td></td>
<td>Hollow Crown</td>
</tr>
<tr>
<td>Vegetable</td>
<td>Early Alaska</td>
</tr>
<tr>
<td>-----------</td>
<td>--------------</td>
</tr>
<tr>
<td>Peas</td>
<td></td>
</tr>
<tr>
<td>Pepper, sweet</td>
<td>California Wonder (thick flesh)</td>
</tr>
<tr>
<td>Pepper, pimento type</td>
<td>Long Canenne</td>
</tr>
<tr>
<td>Pumpkin</td>
<td>Small Sugar</td>
</tr>
<tr>
<td>Radish</td>
<td>French Breakfast</td>
</tr>
<tr>
<td>Rutabaga</td>
<td>Purple Top Yellow</td>
</tr>
<tr>
<td>Salsify</td>
<td>Mammoth Sandwich Island</td>
</tr>
<tr>
<td>Spinach</td>
<td>Long Season</td>
</tr>
<tr>
<td>Squash, summer</td>
<td>Cocozelle</td>
</tr>
<tr>
<td>Squash, winter</td>
<td>Green Hubbard</td>
</tr>
<tr>
<td>Tomato</td>
<td>Sunnybrook Earliana</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Turnip</td>
<td>White Milan (early flat)</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Watermelon</td>
<td>Cole's Early</td>
</tr>
</tbody>
</table>

**TOPICS FOR DISCUSSION**

1. What is the primary object in home vegetable gardening?
2. Why should the garden be planned during the winter months?
3. What are the advantages of having a well thought-out garden plan in advance of planting?
4. Discuss the location of the garden in reference to slope and proximity to the house.

5. How does a shelter belt affect a garden?

6. What are the advantages of a long, narrow strip of land over a square piece for a garden?

7. How large should the garden area be for a family of five?

8. What are the advantages of having a plot of ground large enough so that one-half can be summerfallowed each year?

9. Should manure be applied to the land that is to be summerfallowed or to that part to be planted to vegetables?

10. What vegetables supply vitamin A, B and C?

11. How long a row of beans must be planted to produce sufficient to can 40 quarts? (Study Tables 2 and 3).

12. How long a row of spinach will it take to produce enough to can 20 pints?

13. How many pints of sweet corn is it possible to can from a 100-foot row?

14. How many quarts of tomatoes is it possible to can from a 100-foot row? Will that be sufficient to last your family throughout the season, assuming that canned tomatoes will be used to replace oranges if necessary?

15. What do you think of this argument advanced by some: It is cheaper to buy vegetables than to fool with a garden? Do the children in a family where such a stand is taken get all the nourishing vegetables they should have?

MANURE HOTBEDS

Uses of hotbeds. The principal use of hotbeds is for starting plants to be grown in the garden or field, although they may be used to grow short-season crops to maturity out of the normal growing season. The growing season can be lengthened by starting plants under glass, which makes it possible to grow some crops that are not profitable when seeded in the field.

Location. The main points to consider in locating hotbeds are: (1), nearness to the farm buildings so that they can be cared for with least trouble; (2), convenience to a good water supply; (3), protection from cold winds, particularly from the north; the southern side of a building, board fence, or hedge is generally suitable; (4), good drainage is necessary; avoid locations where water will collect in the pit, as water-soaked manure will not heat.

The hotbed pit. The depth of the pit will vary with the length of time heat will be required. Pits 2½ feet deep will generally supply sufficient heat for six to eight week’s growth. The width and length of the pit depend upon the size and number of sash used. Where only one or two sash are
used, it is well to have the pit extend a foot from each side of the frame, especially if hotbeds are started early.

Hotbed sash. The sash can be secured through dealers, or they may be made by a carpenter. Only the most durable wood should be used. Cypress and cedar are popular for this purpose. The most common size sash is 3x6 feet. A larger sash is too heavy to handle and is more subject to breakage. A good sash does not need more than one bar crosswise in the center for reinforcement. More would tend to shut out sunlight. A good grade of glass is always desirable. Some gardeners are using glass substitutes and are satisfied with results; others do not like the substitutes. Most gardeners are using glass sash. Glass cloth and other substitute forms of glass either do not admit enough light or lack durability. They may be suitable for temporary protection, but not for continuous use. Sash should be constructed to guard against leakage from snow and rain.

Framework. The framework for the hotbed may be either of the permanent or take-down type. The general make-up and construction of a hotbed is illustrated on a following page. If plants requiring different temperatures are to be grown the hotbed should be partitioned off so different temperatures can be maintained in different sections. The hotbed can be partitioned off by placing boards underneath the sash support. For tall growing plants, such as tomatoes, the front of the frame should be 10 inches high, and the near 16, instead of 6 and 12 as indicated in the diagram.

![Diagram of a hotbed](image)

Fig. 1—In preparing a hotbed the pit should extend beyond the frame if it is to be used early. For later use and for large hotbeds the pit may be made same size as frame as shown by dotted lines.

Fig. 1 illustrates a cross section of a hotbed with pit 30 inches deep, manure 2 feet deep, with 6 inches of soil on top. The lower end of the sash is 6 inches high, the upper end is 12 inches high. A large pit, indicated by the outside solid lines should be dug for small hotbeds started early.
Figs. 2 and 3 illustrate ways of fastening the corners of a take-down hotbed frame. In Fig. 2, the end of one board is cut to fit into a hole made in the other board. The boards can be held in place with spikes or wooden pins inserted at either of the places indicated by the small circles.

Fig. 4 indicates the method of fitting center sash supports into the side frame of a take-down type of hotbed.

Preparation of manure. The preparation of the manure should begin two or three weeks before time for the seed to be planted. Fresh horse manure should be secured and piled at some convenient place near the hotbed. When the pile begins to heat, particularly if the heating is confined to one place, it should be turned and the fermenting manure thoroughly mixed all through the pile. The frequency and number of turnings will depend on the manure. Sometimes several turnings are necessary before fermentation is uniform throughout the pile, but ordinarily one or two should be sufficient. Violent heating may be checked by spreading out the manure a little, by mixing in straw, or by the addition of water. Too much water should not be applied, however, or the heating value of the manure will be impaired. The turning process also will retard fire fanning. If the manure
is very pure, the addition of one part straw to two parts manure is advisable as this will prolong the heating period. Good manure should not be soggy; it should have some spring.

As soon as the pile has started to heat uniformly it should be placed in the pit which should be filled to within 6 inches of the top. Place several inches at a time and tramp well. If hot water is poured over the manure heating will be hastened. Six inches of dirt should then be placed over the top. If flats or boxes are used in the hotbed, 2 or 3 inches of soil instead of 6 inches should be placed on top the manure. The hotbed should be banked to keep the cold away from the frame and to shed water. Horse manure makes very good material for banking.

Plant bed soil. A good plant bed soil is one that is of good physical character, friable, retentive of moisture, free from disease organisms, and carries an abundance of plant food. The base soil should be sandy loam well supplied with humus. A good soil can be made by mixing two parts loam, one part sand, and one part well rotted manure. If the original soil is of a good sandy loam type the one part sandy may be omitted or reduced to one-half part. Before the manure is added it is well to put it through a coarse screen, or in some way break it up, so that it can be easily and thoroughly mixed with the soil.

Some gardeners make a compost heap a year in advance for plant bed use. A compost heap can be made by using one part manure to two or three parts of good loam soil. The manure and soil are spread in alternate layers about 6 inches thick, building the heap about 4 feet high and from 6 to 10 feet in width. A compost heap needs to be kept moist to bring about decay and should be thoroughly mixed before using. Poorly mixed soils produce uneven plants. The work of planting the seed and caring for the young plants is much easier if the upper inch or two of the soil is sifted through a screen with 8 meshes to the inch.

Time of seeding hotbeds. Conditions vary so much over the state that no definite date can be set for starting hotbeds that will be suitable for all sections. Hotbeds are prepared the last of March and are ready for seeding the first of April at Bozeman. They can usually be started earlier in the lower altitudes.

The length of time required for seedlings to reach a size for transplanting to the field will range from 4 to 12 weeks for the various vegetables.

Tomatoes, peppers, and egg plant require from 4 to 8 weeks, depending on the size of plant desired. These do not succeed well when seeded in the field. Cabbage, cauliflower, green sprouting broccoli require from 4 to 6 weeks in the hotbed. These crops can ordinarily be seeded in the field soon after the soil dries and becomes workable in the spring. Hotbed grown plants, however, provide for earlier harvest.

Head lettuce requires about 4 weeks in the hotbed. Field seeding can be made as early as the ground can be prepared.
Onions from seed require about 8 weeks to reach the transplanting size.

Celery requires from 10 to 12 weeks. It is rather difficult to maintain uniform temperature under hotbed conditions as is required for the production of celery plants. A temperature of 65 to 70 degrees seems to be most favorable for celery plants. Temperatures very much lower than 65 degrees seem to induce premature seeding, which makes the plant worthless for food.

Sowing seed. Firm the soil well right after placing it in the hotbed, put on the sash, and let it stand for a few days before planting as the temperature may run high enough to injure the seed. After the violent heating stage has passed and the temperature has receded to 80 or 85 degrees, the seed can be planted with safety. Loosening the surface soil with a garden rake just before planting will improve the seed bed. Be sure that the soil is level, or difficulty will be encountered in watering.

The seed can either be broadcast or planted in rows 2 to 4 inches apart. Spacing between rows will depend on whether the young seedlings are to be pricked out or left in their original place until transplanted to the field. Most vegetable seeds are sown in rows. A convenient method of measuring and marking the rows is to use a stick 2 inches wide, ¼ inch thick, and of a length to fit the seed bed. Press the edge of the stick into the soil to the depth desired. After all the rows are made, sow the seed thinly in the depressions and cover by sifting fine soil over the rows. Firm lightly. Small seeds, like celery, should be barely covered with dirt, or just pressed into the soil. Seeds like cabbage and tomatoes may be covered to a depth of ¼ inch.

Some gardeners like to use a light covering of clean, sharp sand for covering seeds. A sand covering tends to check the development of the disease known as "damping off." Sand also acts as a mulch and checks loss of moisture. It is a good plan to shade the seed bed until the seedlings appear.

Instead of planting the seed directly in the hotbed it may be planted in boxes which are 3 to 4 inches deep and of some convenient size to handle easily (12x20 inches inside measurement). Boxes are desirable for they can be planted without chilling the hotbed and without causing fatigue to the operator from bending over. Transplanting can also be done when the weather is unfavorable for outdoor work. The boxes can easily be taken to the garden when it is time to set the plants in the fields.

As soon as the seedlings have developed the first true leaves they should either be pricked out or thinned to the desired spacing. Most vegetables will require about a 2x2 inch spacing in order to develop good stocky plants; plants grow spindly when spaced too close. Tomatoes, however, if good sized plants are desired, should be spaced 4x4 inches. A general practice is to sow seeds rather thickly in small flats and then prick out the seedlings into other flats or directly into the hotbed soil, allowing the space they will need until transplanted to the field. Plants like tomatoes will stand the
shock of moving to the field better if they have been grown in 3 or 4-inch pots. Various single plant containers are adapted to this purpose.

CARE OF THE HOTBED

Ventilation. Ventilation needs careful attention. It is a means of drying the air and controlling the temperature. Day temperatures of 65 to 75 degrees are best for warm season plants like tomatoes, peppers, etc., while 50 to 60 degrees is about right for cabbage and cauliflower. To ventilate, raise the sash on warm sunny days before the hotbed gets too warm, and in the afternoon do not leave them open too late so as to chill the hotbed. Avoid extremes and sudden changes of temperature as much as possible. In ventilating in cold weather the wind should not be allowed to strike the plants. This can be prevented by raising the end of the sash on the side of the frame opposite to the direction of the wind.

Watering. Caution must be exercised in watering the seed bed. Before the seedlings come through the surface there is danger of washing out the seed and puddling the soil. To avoid washing, use a fine spray. A cloth or piece of burlap spread over the seed bed while watering will prevent washing. Care should be taken to keep the surface soil moist while the seeds are germinating. The seed bed should never be allowed to dry out; neither should it be kept soaked. When watering, apply sufficient to wet all of the soil.

Plants should be watered preferably in the morning and bright sunny days. This gives the foliage and the surface of the ground opportunity to dry off rapidly and allows the soil to warm up again during the day. It is not advisable to apply water when it is too hot as the leaves are apt to be burned. Sometimes it is advisable to omit watering on cloudy, damp days. Be guided by the condition of the soil and the weather. Over-watering is dangerous as a soil that is continually wet at the surface favors development of the damping off disease.

Before plants are to be taken up and set in the field the plant bed should be thoroughly soaked so as to have as much of the soil as possible adhere to the roots.

The hotbed should be covered on cold nights and on very cold days. It may be necessary to leave the covering on during the daytime. For this purpose sacks sewed together, blankets of any kind, or straw can be used. In windy sections these things should be fastened or weighted down in some way. Specially made mats can be procured from seedsmen. Such coverings should not be left on late in the morning on bright sunny days as the plants need all the light they can get to make them stocky.

Things to avoid in the care of the hotbed are: (1), chilling of plants; (2), overheating and lack of ventilation which makes the plants soft; (3), overwatering, which makes the plants soft and susceptible to damping off; and (4), wilting of plants due to too much heat or too little water.

Containers for plant growing. There are various kinds of containers
for growing plants, one plant to a container: clay pots, paper pots, peat pots, paper bands, and good veneer bands are the most common. Clay pots are considered best, but are most expensive to start with. However, they can be used for a number of years, whereas the others mentioned are good for only one season.

Better plants can be grown by using individual containers for vegetables such as tomatoes, peppers, etc., but they can also be produced by growing them directly in the hotbed soil. Corn and vine crops are difficult to transplant and about the only way they can be transplanted is to grow them in individual containers and then only with a fair degree of success. Transplanting corn and vine crops cannot be advocated as a general practice. They do best seeded in the field.

Blocking plants. When plants like tomatoes are grown in a seed bed instead of in individual containers, it is a good idea to block them about a week or ten days before they are to be set in the field. Blocking consists of cutting the soil about each plant in as large a square as the spacing permits and to the full depth of the soil. The cutting severs the large lateral roots, checks growth, and results in the development of more feeder roots.

Hardening plants. The term "hardening" is applied to treatments that result in a firming of the plant tissue, thus enabling them better to withstand the more unfavorable conditions they will be subjected to when transplanted to the field.

Plants can be hardened by gradually exposing them to lower temperatures for a week prior to setting in the field. This is accomplished through ventilation. Withholding water until the plants are kept on the dry side also helps in hardening off plants. Hardening should be gradual in order to prevent a severe check to growth, or possibly killing the plants. A severe check in growth will reduce yield.

Damping off. This is a disease that attacks the young seedlings just at the surface of the soil. It produces a soft rot of the stem which results in death of the plant. It is brought on by lack of ventilation, overwatering, and too close spacing. To check the disease (1), transplant healthy plants; (2), provide careful ventilation; (3), keep the plants on the dry side for a couple of days and thereafter see that the surface soil is not wet continuously. The surface of the soil should be dry soon after each watering. If a light covering of sand has been used on the seed bed, damping off is not as likely to develop.

TOPICS FOR DISCUSSION

1. Why are hotbeds necessary?
2. Discuss the location of the hotbed.
3. Discuss dimensions of the hotbed pit.
4. Describe method of preparing manure and placing it in the pit.
5. What kind of manure should be used in the hotbed pit?
6. What is a compost soil and how is it made?
7. If a compost soil is not available, how can a good plant bed soil be prepared?
8. What are the requirements of a good plant bed soil?
9. How deep should the soil be in a hotbed when seeds are sown direct in the soil? How deep should it be if shallow boxes or flats are used?
10. Discuss methods of sowing seed.
11. What are the advantages of a light covering of sand over the seed bed?
12. What are some of the advantages of shallow boxes for growing plants in connection with hotbeds?
14. Give instructions for watering.
15. Discuss methods of protecting hotbeds for cold nights.
16. What are some of the principal things to avoid in the care of a hotbed?
17. What crops are difficult to transplant?
18. What is meant by blocking off plants?
19. How are plants hardened off? Why should plants be hardened off?
20. What is damping off, and how can it be checked?

THE SEED BED

Soil type. A deep sandy loam soil that contains plenty of humus is best suited for general garden purposes. Sandy loam soils are not available on every farm. Fortunately, however, either a heavy, medium, or light soil will make a good garden spot if plenty of well rotted manure is worked.
Vegetables to be of best quality should make quick growth, and to secure quick growth the soil must be built up to a high state of fertility.

Drainage essential. Good drainage is especially important for early vegetables because earliness is not possible in a wet soil. Good drainage is a factor to be considered in selecting the garden spot on farms under irrigation. This applies especially to locations where there is likely to be heavy sub-irrigation. Where heavy sub-irrigation takes place it may be worth while to drain a piece of land for a garden for the sake of convenience. Alkali spots should be avoided in locating the garden. Good drainage is a means of removing alkali.

Plowing. Soils for vegetables should be fairly deep. Plowing to a depth of 8 to 10 inches is satisfactory for practically all vegetables. In case of shallow, surface soils or soils that have never been plowed deep it is advisable to deepen them gradually. Turning up too much subsoil at one time is injurious to crops.

Time of plowing. Fall plowing is desirable on all soils where it can be practiced, more especially so on the heavier soils where water is not available for irrigation. Land turned over in the fall and left rough will be in better physical condition the following spring. Advantages of fall plowing are: (1), improves the physical condition of heavy soils by exposing them to frost action; (2), aids in control of certain insect pests by exposing them to the weather; (3), makes possible the earlier preparation of the soil for planting; (4), hastens decay of coarse vegetable matter turned under. Too much coarse material turned under may be actually injurious to plant
growth. Raking and burning the remains of vegetable plants before plowing may be helpful in the control of garden pests.

Very heavy soils may pack too much after fall plowing, but in such cases turning in the fall and again in the spring is better than spring preparation alone.

**Summerfallow.** Since moisture is a limiting factor in plant growth it is advisable to summerfallow for dry land gardens. Moisture conditions will be better on summerfallow than on land that has been cropped. It also is a means of controlling weeds. The extra labor involved will to a large extent be offset by saving of hand work the following year. To summerfallow, plow as early as possible in the spring and then work shallow the balance of the season as often as necessary to control weeds. Such a piece of land need not be plowed again in the fall unless it is a very heavy soil and has packed too hard to make a good seed bed.

Fig. 7—A crop of cantalopes produced in Fallon county, season of 1931. No irrigation water available. The crop was protected by a shelterbelt.

**A firm seed bed.** After spring plowing the ground should be harrowed before the surface has had time to dry so as to pulverize all clods. Plants do not root and grow well in a loose soil, hence a firm seed bed is required. Three implements that are almost indispensable in preparing a seed bed are: a disc harrow, spike-tooth harrow, and a smoothing plank. The disc harrow is valuable for pulverizing the soil to a considerable depth. The spike-tooth harrow will aid in pulverizing and leveling, and the smoothing plank is used for smoothing the surface.

The thoroughness with which the soil is prepared before planting de-
terminates to a large extent the ease and efficiency of cultivation, but no amount of cultivation will overcome poor preparation. Pulverizing and smoothing the seed bed immediately after spring plowing will prevent surface baking and reduce loss of moisture by evaporation.

**MANURES**

Value of manure. Manure carries plant food elements such as nitrogen, phosphate, and potash. It is also a valuable source of humus. In the decomposition of manure, materials are set free which act on the mineral compounds of the soil and make them more readily available for the growing plants.

Humus is decomposed manure or vegetation. In addition to supplying plant food to the soil, humus increases the moisture-holding capacity of light soils and makes heavy soils more friable and workable. Soils that contain plenty of humus can be worked up into a mellow seed bed, while soils that are devoid of humus are more likely to pack and bake. Keeping a good supply of humus in the soil is an essential feature to successful gardens.

The time to apply manure. The time of application depends on the kind and stage of decomposition. Well rotted manure may be applied just before plowing in the fall. A satisfactory method of application is to spread it evenly and work it into the soil by discing before plowing. The rate of application may be as heavy as 30 to 40 tons per acre on irrigated land if decomposition is well advanced. On dry land gardens 10 to 15 tons per acre is about as heavy as is desirable when applied in the fall prior to the cropping season. A better way to handle the fertility problem on dry land gardens is to provide double the area needed for a garden and summer-fallow one-half each year. The manure can then be applied to the half that is to be summerfallowed just before early spring plowing.

Fresh manure and manure containing considerable straw or coarse material should not be applied to the garden as it is likely to have a depressing effect on plant growth.

Decomposing manure requires considerable water, and unless in a well advanced stage the decaying processes will make too heavy a demand on the soil moisture for best interest of plant growth. That is one of the reasons why the application of fresh manure or coarse material to garden soils is not advisable. Such applications may be made with excellent results to irrigated gardens a year in advance of cropping. In the case of dry land gardens it is advisable to use partly decayed manure even though the application is made a year in advance of cropping. Manure that is well rotted is not likely to carry weed seeds, while fresh manure generally does. Hen manure should be applied very lightly as it contains a high percentage of nitrogen and will burn plants if applied too heavy.
SOIL IMPROVING CROPS

Growing crops of such legumes as red clover, sweet clover, and field peas may be plowed under as substitutes for barnyard manure. They decompose quickly when plowed under green and are satisfactory in maintaining the humus content of the soil. Rye is similarly used, but wherever possible one of the legumes should be used instead of rye as they add nitrogen to the soil in addition to humus. For this method of soil improvement a garden of sufficient size will be required to provide ample space for vegetables in addition to the part seeded to a green manuring crop.

PLANTING VEGETABLE CROPS IN THE OPEN

Time of planting. A definite planting date cannot be set that is applicable to all parts of the state. One should be guided by soil and weather conditions, and the kind of vegetables to be planted. Keeping records of the latest killing frosts in the spring will be helpful in planning seeding dates. There are some vegetables that may be seeded as soon as the ground can be prepared in the spring; others require a warm soil for germination. Vegetable crops may be divided into three classes in respect to hardiness or resistance to cold.

Group 1 includes those that will stand the hard frosts of late spring and are classed as hardy.

Fig. 8—The long row garden lends itself well to horse cultivation. A long narrow strip of ground is more thoroughly protected by trees than a wide strip would be.
Group 2, or the half-hardy crops, are those which will withstand light frosts and the seeds of which will germinate at low temperatures.

Group 3 includes the tender plants that are unable to withstand even light frosts and must have a warm soil for the seeds to germinate.

The hardy group includes lettuce, peas, onions, radishes, kale, rutabagas, spinach, turnips, Kohlrabi, cabbage, and cauliflower. Seeds of these may be sown as early as the ground can be prepared in normal seasons. Cabbage and cauliflower plants that have been well hardened may be transplanted to the field about a week to ten days later.

Seeds of the half-hardy group, such as beets, carrots, parsnips, salsify, and Swiss chard, may be sown from one to two weeks later than Group 1.

Beans, cucumbers, squash, pumpkins, muskmelons, watermelons, tomatoes, peppers, egg plant, and corn should not be seeded or transplanted to the open field until danger of frost is past.

Depth of planting seed. The depth of planting is determined by: (1), kind of seed; (2), type of soil; and (3), season. Large seeds, like peas and corn, may be planted from 2 to 3 inches deep, while other large seeds, like beans, squash, and pumpkins that push the two halves of the seed up through the soil, should not be planted deeper than 1 to 2 inches. Small seeds, like lettuce, carrots, and onions, may be covered to a depth of $\frac{1}{2}$ to 1 inch.

Seeds may be planted somewhat deeper in sandy soils than in heavy soils. Seeds planted early in the season need not be covered as deep as is required by later planting. The more moisture there is in the soil, the less need there is for deep planting.

Seeding by hand is practical on a small scale, but in large gardens a seed drill is a great convenience and time-saver. Whichever method is used, it should be seen to that the soil is firmed about the seed. Poor stands usually occur when the seed is dropped in loose soil.

Rate of seeding. In small gardens it is wise to seed rather thickly and then thin the seedlings so as to insure a good stand. With large gardens it may be more profitable to seed rather sparingly and thus avoid much of the labor of thinning. It is a good practice to sow a strong growing seed along with those that are slower to germinate. Radishes are often planted with carrots, beets, and parsnips. The radish seedlings break the crust for the others. Thick seeding is advisable on heavy soils, especially with small seeds, so that the seedlings will be able to break the soil crust. Scattered seedlings often fail.

For most small seeds, like radishes, turnips, carrots, and lettuce, it is advisable to seed at the rate of 3 to 4 seeds to the inch. Beans, peas, and corn should be seeded so that thinning will be unnecessary (See Table 2 for recommended spacing). Vine crops may be planted in hills. Plant 8 to 10 seeds in a hill and cover about 1 inch deep. After they have made a good start, thin to 2 or 3 plants to the hill.

Transplanting. Transplanting is a means used to secure earlier harvests
with crops like cabbage and cauliflower, and also to increase the length of the growing season for some of the warm season crops. Tomatoes, peppers, and eggplant are warm season crops.

Plants with fibrous root systems can usually be transplanted easily. Cabbage, tomatoes, peppers and celery are good examples. All of the vine crops and corn have rather coarse root systems and cannot be transplanted very successfully unless they are grown in individual pots. Even then the shock of moving them to the field retards growth so that yields are reduced.

Success in transplanting plants depends on doing the work carefully, good condition of the soil, and good stocky plants that have been well hardened. It is better to do the transplanting on cloudy days or in the evening if possible. Plants that are to be transplanted to the field should be thoroughly watered a few hours before they are moved. When lifting them from the seed bed, handle carefully so that as much soil as possible will cling to the roots.

![Image of trees and snow]

**Fig. 9**—Trees make excellent snow catchers. They pile it up for gardens and keep it away from buildings. Here is an ideal spot for a garden.

Firm the soil well but not too hard about the roots in the process of transplanting. Leave a small depression at the surface of the soil for water. Give each plant about a cupful of water, and after that has soaked away, level off with dry dirt. Watering tends to settle the soil and makes it easier for the roots to establish contact.

**Shading plants.** There are times when it is advisable to shade plants to prevent rapid loss of moisture. One of the best methods of shading is to stick a broad shingle up on the southwest of each plant, inclining the shingle at an angle so that the top extends well over the plant.

**Topics for discussion.**

1. What soil type is best for general garden purposes?
2. What are the advantages of fall plowing?
3. What is summerfallow, and what are its advantages? How should plowing be done for summerfallowing?
4. What three implements may be used in preparing a firm seed bed? Give the chief purpose of each.
5. What do manures add to a soil?
6. When should manure be applied to an irrigated garden? To a dry land garden?
7. At how heavy a rate may manure be applied to irrigated gardens? Why not the same rate in each case?
8. Are fresh manures and coarse materials desirable for applying to a garden? Why?
9. What substitutes may be used for manure in building up soils?
10. Is rye as good to plow under as clover? Why?
11. Into what three groups may we divide garden crops? Name some plants that belong to each group.
12. How early may plants belonging to Group 1 be planted? Group 2? Group 3?
13. Why shouldn't beans, pumpkins, and squash seeds be planted as deep as corn and peas?
14. What are the factors that determine depth of planting?
15. How thick should seeds of carrots, lettuce, onions, and radishes be sown? Beans and peas?
16. What are the recommended spacings for vine crops, asparagus, cabbage, and tomatoes? (See Table 2, Lesson 1.
17. What are the reasons for transplanting plants?
18. What plants are difficult to transplant? What kind of root system do they have as compared with those that are easy to transplant?
19. Upon what does success in transplanting depend?
20. Give instructions for transplanting plants from the hotbed to the field. How may plants be shaded?

COMMON GARDEN CROPS AND CULTURAL REQUIREMENTS

PERENNIAL CROPS

Perennial plants are those that live for a period of years and do not require renewing each season. Asparagus and rhubarb belong to this classification. In the home garden these crops should be planted to one side or at one end so that they will not be disturbed in plowing the remainder of the garden.
Asparagus. This crop is well worth growing in every home garden. Its early appearance in the spring, together with the fact that a bed once-established will produce for several years, makes it of special importance. It is a good source of vitamin A. As a canned product asparagus is one of the best because it retains its flavor better than most vegetables.

Starting the bed. One-year old crowns are usually preferred by growers. These may be purchased from nurseries, or one can grow his own crowns by sowing seed one year in advance of starting the bed. When starting with seed it is advisable to sow in a nursery row in the garden where the plants can be given special care. The young plants should be given a light covering of coarse straw in the fall after the ground has frozen if they are to be left in the ground until planting season next spring. They may, however, be dug in the fall after growth stops and stored in clean dry sand in a good storage cellar.

The permanent bed should be started as early in the spring as it is possible to work the soil. To set the plants, plow out a furrow 6 to 8 inches deep and space the crowns about 18 inches apart in the furrow. Cover to a depth of 3 inches to begin with, and gradually level the furrow as the plants grow. Planting the crowns to a depth of 6 to 8 inches puts them down where they are not likely to be injured by a knife when cutting the spears. If more than one row is planted, space the rows 4 feet apart.

Harvesting. No cutting should be done until the third season as the plants need the first two years to develop good strong crowns. The length of the harvesting season will vary from year to year, but cutting must stop when new spears are making slender growth. When cutting is carried on too late in the season it robs the crowns of strength and reserve food for the following year's crop.

Cultivation and Care. It is better to leave the old tops standing until spring when they may be disked into the soil. At the end of the cutting season weeds in the row may be destroyed by a light surface cultivation without destroying much of the new growth, or by hand hoeing and weeding. The bed must be kept free from weeds if good crops are expected.

Varieties. The Mary Washington, a rust resistant variety, is preferred by most commercial growers. The Martha Washington is a good variety and rust resisting. The Palmetto is an old favorite, but is subject to attack by rust.

Rhubarb. This hardy perennial does well on a wide range of soils but prefers a rich loam. Applications of partly decayed barnyard manure early in the spring improve growth. An abundance of moisture is needed for best growth but this crop succeeds well in good dry land gardens.

Planting. Although plants may be started from seed the easiest method of propagation is by division of old plants. The pieces of roots are usually planted 3 to 4 inches deep in rows 4 feet apart, and 2 to 3 feet apart in the row.

Harvesting. No harvesting should be attempted the first season and
only for a short period the second year. The first, and to some extent, the second season, is needed to develop strong crowns.

**Forcing Rhubarb.** Large well developed crowns may be used for winter forcing. The crowns should be dug or plowed out just before the ground freezes and left out until after they have frozen, when they may be brought in for forcing. Rhubarb may be forced in cellars where a temperature around 60° Fahr. can be maintained. Pack the crowns as closely together as possible and cover with about 2 inches of soil. The soil should be forced down and packed firmly between the crowns. Some growers cover the surface with a thin layer of sand to guard against damping off. The soil should be kept moist, but not wet. Light is not necessary or desirable in forcing rhubarb.

**GREENS OR POTHERBS**

Greens are crops grown for their foliage. They must therefore make rapid growth in order to be crisp and of good quality. These crops, when added to the diet, supply essential salts found in green plants and are of especial value because they are rich in vitamins.

**Spinach, Leaf Type.** Leaf spinach grows best in the cold weather of spring or fall. It is a quick maturing plant and provides our earliest source of greens. Where seed bed conditions are favorable late fall planting may be practiced for an extra early spring crop. However, early spring planting is generally best. The seed is planted in drill rows and covered 1/4 to 1/2 inch deep. The plants may be thinned to 4 or 5 inches apart in the row, but this is not necessary in the home garden unless it is partly planned for local market. For the home garden a 2-inch spacing is satisfactory.

**Harvesting.** Spinach may be harvested from the time the plants have have five or six leaves until just before the seed stems develop. Using the larger plants first serves as a means of thinning and extends harvesting over a longer period.

**New Zealand Spinach, or Branch Type.** This is not a true spinach but is used the same as the leaf type. The leaves resemble spinach to some extent but the plants are much branched.

New Zealand spinach grows and develops during the warm part of the growing season and provides a source of greens in between the spring and fall crops of the leaf type.

**Culture.** For best results the seed should be started in hotbeds and the young plants transplanted to the garden. Seeding, however, may be done in the garden in the lower altitudes of the state. The plants should stand about 1 foot apart in the row.

**Harvesting.** When grown for home use the tips of the branches 3 to 4 inches long are sniped off. This is continued throughout the season.

**Winter Supply of Greens.** Either type of spinach may be grown for canning or drying to supply greens for winter. The leaf type is the most reliable, especially in the higher altitudes. The New Zealand grows too
slowly in the higher altitudes to mature and should be started in hotbeds so that good sized plants are available for transplanting to the garden early in the season.

**Swiss Chard.** Swiss Chard is a foliage beet that has been developed for its large fleshy leaf stalks and broad crisp leaves. It is one of the best summer greens and stands the heat of summer better than most plants grown for greens. It can be prepared for the table in the same way as spinach, or the large fleshy stalks may be cooked and served like asparagus. It is a good crop to grow for canning for winter use. Chard is not as rich in iron as spinach but it is a good addition to the list of greens. Table beet tops also make excellent greens when prepared like chard or spinach.

**Culture.** Chard is easily grown. Seed may be planted in drill rows or in hills. Plants should be spaced 10 to 12 inches apart in the row. When thinning the plants removed may be prepared for table use. Seeding time is the same as for table beets.

**Harvesting.** The usual method of harvesting for home use is to cut the outer leaves an inch above the ground while they are still tender and crisp. Avoid injuring the central bud when harvesting the outer stalks.

**Kale.** This crop belongs to the same family of plants as the cabbage. It is hardy to cold but does not thrive in hot weather; hence it is better adapted for early spring seeding or late July for a fall crop. Seed is sown in drill rows and thinned to about 6 inches apart. Plants removed in thinning may be used for food.

**Culture.** General care is about the same of for spinach. Kale is attacked by the same insects as cabbage. The spray treatments that control insects on cabbage will control them on kale.

**Harvesting.** Leaves are often picked from the plant for home use, or the entire plant may be cut off near the ground.

**SALAD CROPS**

Salad crops are considered of especial value in the diet for their ash and vitamin content, as well as for supplying bulk. They are generally prepared for the table without cooking. The home garden should include a sufficient range of varieties to supply the table in season.

**Celery.** It requires about sixty days to grow celery plants large enough to set in the garden. Hence a hotbed or greenhouse is needed for starting the plants. One of the problems in celery production is premature seeding. It has been found that plants grown the first sixty days from seed under controlled temperatures ranging from 65° to 75° Fahr. are not as likely to form seed stalks as those grown at lower temperatures during the seedling stage. The temperature of mature hotbeds cannot be controlled sufficiently always to guard against this difficulty. The usual method of starting celery is to seed in drill rows in shallow flats or boxes and when the plants are large enough to handle they are transplanted to other flats,
allowing about 1¼ inches between plants. They should not be set in the
garden until danger of spring frost is over.

When transplanting to the garden it is well to guard against dirt lodging
in the hearts of young plants. The plants are set 6 to 9 inches apart in
rows spaced 2½ feet apart when blanching is to be done with boards, and
5 feet apart when blanching is to be done with earth.

Celery needs a rich soil with plenty of moisture. It is not adapted to
dry land gardens unless moisture conditions are exceptionally good. The
fertility of the soil can be improved by liberal applications of well rotted
manure.

Blanching. About three weeks before celery is to be used the stalks
should be made to stand erect by pressing dirt about the base of the plant.
The crop can then be blanched by standing 12-inch boards on edge on both
sides of the row close against the plants so that only the tops are projecting
above the boards. Another method of blanching is to bank the plants high
with earth. The earth method is not desirable in warm weather as it has
a tendency to cause rotting of plants.

Endive. This salad plant requires about the same culture as lettuce.
Seed may be sown in early spring after danger of hard freezes is past.
Blanching is practiced to make the leaves more tender and to reduce bit­
terness. This is accomplished by drawing up the outer leaves and tying
them at the top about two weeks before using. Green Curled Winter and
White Curled are suitable varieties.

Lettuce. Lettuce grows best during cool
weather. Head lettuce in
particular does not thrive well during the warmest part of the season.
Leaf lettuce is better adapted for the dry land garden. Several seedings
may be made at intervals of ten days to extend the harvest season. Leaf
lettuce may be seeded rather thickly and then thinned as the crop is needed
for the table, but if large plants are desired they should be spaced about
6 inches in the row.

Head lettuce plants started early in a hotbed have a better chance to
mature before hot weather sets in than plants grown from seeding in the
garden. A 10-to-12 inch spacing in the row is required for head lettuce. If
the seed has been sown in the garden it is necessary to thin to single plants
soon after the young seedlings become well established and before they
start crowding. Double plants produce poor heads.

Overhead irrigation has a tendency to cause tip burn. Soil moisture
should be kept fairly uniform until the heads are about one-half to two­
thirds developed. Irrigating after they have reached that stage is likely
to damage the crop seriously.

Parsley. Plants may be started in hotbeds and later transplanted to the
garden. Seed is commonly sown in the garden in early spring and at inter­
vals during the growing season. A 4- to 8-inch spacing is required.

In harvesting parsley for home use only a few leaves are picked from
one plant at a time. By this method the plant continues to produce for
several weeks. Leaves are picked from one plant at a time. By this method the plant continues to produce for several weeks. The leaves are used for flavoring, garnishing, and to some extent for salads.

**COLE CROPS**

The most important vegetables of this group are cabbage, cauliflower, kohlrabi, Brussels sprouts, Chinese cabbage, and green sprouting broccoli. All of these can be grown successfully in Montana.

Cabbage. This crop thrives best in a rich, moist soil and if irrigation water is not available the ground must be cultivated thoroughly to conserve moisture. The seed should be sown in a hotbed or indoors, especially for an early crop, six to eight weeks before the plants are to be set in the garden. Late cabbage may be seeded in the open in the lower altitudes.

The season for fresh cabbage may be lengthened by planting early, second early, and late sorts, or by making successive plantings of a variety such as Copenhagen Market. Danish Roundhead is a good late variety for winter storage.

Unless the soil dries out rapidly, late cabbage should not be irrigated after the heads are half grown. Irrigation or a heavy rain after the heads are well formed and solid will often cause them to burst. Bursting of heads can be checked by pulling on plants until the roots pop and then letting them settle back in place.

Cauliflower. This crop requires about the same cultural methods as cabbage. Being a cool season crop the seed should be started indoors or in a hotbed six to eight weeks before transplanting to the field. The first crop may be set in the field when danger of hard freezes is past. A second planting should be made four to six weeks later than the first if a fall crop is desired. When the heads start to develop the leaves should be tied together over them so that they will be blanched when ready for use. Cauliflower requires good moisture conditions and usually does not thrive satisfactorily without some irrigation. The heads should be harvested before they start to push up their flower stalks.

Brussels Sprouts. This crop is generally grown for late fall use and it may be canned for winter use. The plants are grown and handled the same as cabbage. The edible portion of Brussels sprouts is the buds, or small heads, that grow in the axils of the leaves. The first picking should not be delayed after the lower leaves begin to turn yellow or the buds will become tough and lose their flavor. In picking a bud the leaf immediately below is broken off. As the lower leaves and buds are removed new leaves and buds are formed at the top of the plant. A light freeze does not injure the plant.

Kohl-rabi. This plant is grown for the turnip-like enlargement of the stem above ground. Seeding may be done as early as the soil can be prepared. Additional planting at intervals of two to three weeks will insure a continuous supply. Seeding may be as late as the last of July for a fall crop. The enlarged stems should be harvested when 2 to 3 inches in diameter
and before they became tough and woody. The fall crop will keep for a short time under the same storage conditions as are recommended for turnips.

**Chinese Cabbage.** This plant is generally grown as a salad crop. It requires a cool temperature for best growth. When grown for a spring crop the seed should be started about four weeks before transplanting to the field. For the fall crop the seed may be sown where the crop is to mature. The plants should be thinned to stand about 12 inches apart in the row. Cultural requirements are the same as for cauliflower but the time required to grow a crop is less than that required for cauliflower.

**Green Sprouting Broccoli.** Cultural requirements are about the same as for the early crop of cauliflower. The head with its cluster of stems should be harvested before the flower buds open. It may be prepared for the table like asparagus.

**ROOT CROPS**

Root crops thrive best in the cool part of the season. The cultural requirements are similar for the different kinds. A deep, rich, mellow soil is needed for good growth. These crops provide an excellent source of fresh vegetables for winter use.

**Beets.** For an early crop, seed as soon as the land can be prepared. Successive plantings made two weeks apart will insure a continuous supply of small beets. Seeds are planted ½ to 1 inch deep, and ½ inch apart in the row. When the plants are a few inches high they should be thinned to stand 1 to 3 inches apart. For winter storage harvest as late as possible but before the ground freezes. Beets 2½ to 3 inches in size will keep better in storage than smaller ones. Long Season is a good storage variety, but is rough in appearance.

**Carrots.** The time of seeding is the same as for beets. Where moisture conditions are good the last seeding may be as late as early July. Three or four seeds should be planted to each inch of row and covered not more than ½ inch deep. A light seeding of radishes is often made with carrots to help break the crust that forms on heavy soils. After the carrots are through the ground the radishes are weeded out. When the seedlings are 2 to 3 inches high they should be thinned to stand 1 to 3 inches apart in the row. Carrots about an inch in diameter are of best quality for immediate table use, but those 1½ to 2 inches in diameter are better for winter storage.

**Parsnips.** Seeding should be delayed until the soil has warmed up. Plant 3 or 4 seeds to the inch and cover with about ½ inch of soil. The seedlings should be thinned to about 4 inches apart in the row. It is better to delay harvesting as late as possible. Severe freezing improves the quality. They may be left in the ground until spring but if wanted for winter use a portion of the crop can be harvested and placed in storage. The larger roots keep best in storage.

**Salsify.** This crop is also known as “vegetable oyster” because of its
flavor. Cultural requirements are practically the same as given for parsnips except spacing. The plants are generally spaced 2 inches apart in the row. A portion of the crop may be harvested in late fall and placed in storage for winter use.

Turnips. The first seeding can be made as early as the land can be prepared. Successive plantings made two weeks apart will insure a continuous supply of best quality roots. Seeding for fall crop and winter storage may be made the last of July. Two to four seeds are planted to the inch of row and covered with about ½ inch of soil. They keep best in storage when placed in clean dry sand.

Rutabaga. This crop requires a longer season for development than turnips. Seeds may be planted as late as the first of July. Two seeds are dropped to the inch and covered with ½ inch of soil. The plants are later thinned to about an 8-inch spacing. Harvesting should be delayed until just before the ground freezes. This makes an excellent root crop for winter storage.

Radishes. A quick maturing crop that requires cool temperatures for best growth. The first planting may be made as soon as the ground can be prepared. Successive plantings made at intervals of ten to fourteen days will supply the table throughout a long period. Two to three seeds are dropped to the inch and covered about ½ inch deep.

Horseradish. A few plants will produce sufficient for the average family. Propagation is by means of root cutting. When harvesting in late fall the side roots that are about the size of a lead pencil and 8 to 10 inches long are saved for the next spring’s plantings. Plants are spaced 10 to 15 inches apart. The roots are hardy and may be left in the ground all winter, but it is better to dig them in the fall and store them so they will be available when wanted.

**BULB CROPS**

The onion is the most important member of the bulb crops. It is hardy and may be started either from seed or sets as early as the ground can be prepared. Sets are commonly planted for early green onions although they may be planted for the main crop. Sets that are less than 3/4 inch in diameter are preferable to the larger ones as they are less likely to develop seed stalks. The bulb usually does not grow very much after the seed stalk starts to develop. Pinching out the bud of the seed stalk when it first starts helps to correct this evil to some extent. Sets are normally spaced 3 inches apart in the row.

Onion seed is sown thickly in drill rows and covered about ½ inch deep. When the seedlings are a few inches high they should be thinned to stand 2 to 3 inches apart.

Frequently onion seed is sown early in the hotbed so that the seedlings are 5 to 6 inches high by the time the garden soil can be prepared. Clipping-
off half of the tops of the green transplants just before they are transplanted to the field is advisable.

It is better not to irrigate or cultivate after the middle of August in order to hasten maturity. Early maturing may be hastened by closer spacing but will reduce the size of bulbs. After the tops have fallen down and dried a little the crop may be pulled and piled in windrows in such a manner that the tops give partial shade to the bulbs. In two or three days they should be topped and spread out in thin layers in a well ventilated shed to cure. White skinned varieties should not be exposed to direct sunlight after pulling or they are likely to sunburn, which reduces their market value. They must not be exposed to freezing weather after harvest. Three or four weeks are required for thorough curing. They are then ready for market or storage. Before placing in storage it is well to sort out the immature, soft, and thick-neck bulbs as they will not keep in storage. The essentials for successful storage are thorough ventilation, uniform low temperature, dry atmosphere, and protection against actual freezing. A temperature of 32° to 36° Fahr. is satisfactory. Attics that can be kept just above freezing are better than basement or cellar storage. The average root cellar is too damp for onions.

BEANS AND PEAS

Beans and peas belong to the same family but their cultural requirements vary quite widely. They are rich in vitamins and are excellent for canning.

Beans. This is a warm season crop easily injured by frost. Seeding should be delayed until danger of light frosts is past. Plant seeds of the bush type about 1½ inches deep and 2 to 3 inches apart. Beans are subject to diseases called blight and for that reason it is advisable not to cultivate them when there is moisture on the leaves.

Pole beans are suitable for sections having a growing season of 125 days or more. They are generally planted in hills 3 by 4 feet. Five or 6 seeds may be planted about the base of a 6-foot pole.

Dry shell beans require a growing season of about 125 days. Seeding requirements are the same as for the bush string beans. When the beans are well matured but before they shatter, they should be pulled and placed in small piles to cure. Small quantities may be piled under a shed until dry enough to thresh.

Peas. Peas require a cool temperature for best growth. The early smooth varieties may be planted as early as the ground can be prepared. The wrinkled varieties are not quite so hardy and planting should be delayed until the soil has warmed a little. By using both kinds a succession of crops is provided for. The normal rate of seeding is 6 to 12 seeds per 1 foot of row. Planting to a depth of 1½ inches in heavy soils and 1½ to 2 inches in sandy loam soils is generally satisfactory. Deeper planting may result in slow germination and poor stands.
SOLANACEOUS CROPS

This is a warm season group and includes tomatoes, peppers, eggplant, and ground cherries.

**Tomato.** Seeding is done indoors or in the hotbed from the middle of March to the middle of April. To secure good strong plants the seedlings should be transplanted to shallow boxes or flats when the third leaf is showing, giving them about a 2-inch spacing, or they may be planted into the hotbed soil. If planted in hotbed soil they can be spaced 4 inches apart and left until time to transplant to the field. Those transplanted to flats should be shifted to 4-inch pots or transplanted to the hotbed soil when they are beginning to crowd.

Spacing in the field will depend upon the method of training. Where pruned to a single stem and staked they may be spaced 18 by 18 inches, but when allowed to grow without pruning they should be spaced 4 by 4 feet. When kept well cultivated tomatoes will produce quite well without irrigation but a little water at the right time will improve the yield.

Pruning of the plants is accomplished by pinching out the branches that start in the axil of the leaves when they are about 1 to 2 inches in length. Earlier maturity is favored by pruning, which is an advantage in those sections with less than a 125-day growing season.

Nearly mature sound fruits may be picked just before frost, packed in single layer crates and stored in a cellar where they will continue to ripen until late fall.

**Peppers.** The young plants are handled in the same way as tomato plants. When transplanting to the field they should be spaced 18 inches apart in the row.

**Eggplant.** Plants are started and handled the same as tomato plants until transplanted to the field. Spacing is the same as for peppers.

VINE CROPS

These are warm season crops that are injured by light frosts. Seeding should be delayed until danger of frost is past. Seeds do not germinate well in a cold soil. While irrigation is an advantage these crops may be grown on good fertile soil without watering if kept free from weeds and pests.

**Cucumber.** Cucumbers require a growing season of about three months. The use of plant protectors in the seedling stage has given an increase in yield at the experimental grounds at Bozeman. The protectors guard against light, late spring frosts, warm the soil, and hasten early growth. It is not known whether a sufficient increase in yield can be obtained at lower altitudes to pay for the added expense of the protectors.

**Muskmelon and Watermelon.** These can be grown at the lower altitudes of the state. A sandy loam soil is considered best. Clean cultivation is essential and in years of normal rainfall they succeed in dry land gardens.
Planting is usually done in hills. Several seeds are propped in a hill and covered about 1 inch deep. Later on the hill is thinned to about 3 plants.

**Pumpkin and Squash.** These are handled in much the same way as the other vine crops from a cultural standpoint. Well matured specimens are suitable to place in storage for fall use. Stems should not be broken off when picked for storage. A dry, moderately cool temperature apparently is favored for storage of these crops.

**SWEET CORN**

This is a warm season plant and is easily injured by frost. It thrives best in the lower altitudes of the state but will succeed in the higher altitudes where there are 90 days or more of frost-free period. Planting should be delayed until danger of killing frost is past. The crop may be planted in hills or in drill rows. When planted in hills 3 to 4 seeds are dropped in hills spaced 2 feet apart in the row, and rows 3 feet apart. The seed is normally covered about 2 inches deep. When planted in drill rows the seed is dropped 8 inches apart and covered the same as in hills.

Clean, shallow cultivation is essential. The crop is adapted both to dry land and irrigated gardens. Irrigation will increase the yield.

A continuous supply of roasting ears can be provided for the table from the time the earliest variety is ready for harvest until frost by planting early, midseason, and late varieties. Some prefer to make three or four successive plantings of one variety, such as Sunshine, planting at intervals of 5 to 10 days. Golden Gem, Sunshine, and Golden Bantam make a good combination for a continuous supply. Country Gentleman and Stowell’s Evergreen mature too late to be satisfactory for most of the state.

Topics for discussion.

1. Discuss starting a celery bed.
2. How old should an asparagus patch be before cutting is started? How long may cutting continue?
3. Discuss cultivation and care of asparagus.
4. How is rhubarb started and how soon is it safe to start harvesting?
5. Discuss forcing of rhubarb for winter use.
6. Discuss growing of spinach, both types.
7. What is Swiss chard and how is it produced and harvested?
8. Discuss starting of celery plants. How is premature seeding controlled?
9. How is celery blanched and when should blanching start?
10. Discuss growing of head lettuce.
11. Discuss growing of cabbage, early and late crops.
12. What is kohlrabi and how is it grown?
15. Give cultural directions for horseradish.
16. Discuss onion production.
17. Give cultural directions for production of beans.
18. Give instructions for starting and handling tomato plants.
19. Discuss pruning of tomato plants.
20. Discuss production of vine crops.

CULTIVATION

Cultivation is one of the essential operations in gardening to secure maximum yield. Hence we can say that cultivation increases the yields of crop plants. This is due mainly to weed control and the formation and maintenance of a soil mulch. Perhaps the value of a soil mulch as a means of conserving moisture has been over-phased by some writers, but nevertheless, plants will do better in a good soil mulch than in a soil that is allowed to form a deep, hard crust. The real conservation of moisture for the growing crop is dependent upon thorough destruction of weeds.

When to cultivate. Since weed control is the most important function of cultivation, it follows that the work should be done at the most favorable time for killing weeds. Weeds are most easily destroyed just as they are breaking through the soil. Their roots are small at that stage of growth and they do not have much of a hold on the soil. Shallow working of the soil is effective while the weeds are small, but if they are allowed to grow large, deep cultivation becomes necessary. It is well to remember that weeds rob the growing crop of both moisture and plant food. Early cultivation checks this loss.

Cultivation should be given as often as is necessary to keep down weed growth. There is no justification, however, in working the ground when there are no weeds and when there is a good soil mulch established. Cultivating dry land gardens when unnecessary may do more harm than good by cutting roots and bringing moist soil to the surface. Under irrigation, and especially with heavy soils, it is necessary to cultivate frequently to maintain a soil mulch.

Cultivation immediately after a rain that soaks down only a few inches is likely to do more harm than good, due to hastening the drying of the surface soil. The destruction of roots in the wetted soil would also prevent the plants from getting the full benefit of such light rains. In such cases one should determine whether to cultivate or not by the condition of weed growth.

Depth to cultivate. Shallow cultivation is preferable to deep cultivation for all vegetable crops. Deep cultivation will destroy many of the roots of the crop plants, especially after the plants have reached considerable size. Vegetables prefer a deep, mellow soil, but deep working of the soil should be done at the time of preparing the seed bed.
Hoeing and weeding. These operations are expensive but no matter how carefully the cultivating is done some hoeing between plants is necessary. Removal of weeds between plants in the row is just as essential as the removal of weeds between rows.

**PAPER MULCH**

Interest in the use of paper mulch has been greatly stimulated the last few years, due no doubt to results secured under most favorable conditions by research workers and gardeners in other states. Reports show that results are favorable for some crops, such as tomatoes, while with beets a decrease in yield resulted at one experiment station.

Paper mulch has been tried out the past two years at the state experiment station at Bozeman. An increase in yield was secured with some crops, while with others no increase resulted.

Paper mulch unquestionably conserves soil moisture and reduces labor in cultivating and hoeing. Under some conditions maturity is hastened, which is a point in its favor for crops that require a long season to mature. Surface soil temperature is increased, which is beneficial to early growth of some crops. Several investigators have reported an increase of available nitrates in soils, due to paper mulch.

**Laying the paper.** When seeding is done drill rows a strip of paper may be laid down and a row planted close to the paper edge, then the next strip of paper laid. For plants that are spaced a considerable distance apart, such as tomatoes, cabbages, cucumbers, and melons, the paper may be placed first and the seeding or transplanting done through holes cut in the paper.

**Holding the paper in place.** This is a serious drawback to its use in sections where there is considerable wind. One of the common methods is to use wire staples made from No. 9 or No. 10 wire bent into the shape of croquet wickets, with legs 6 to 8 inches long. These wire staples are placed along the edges of the paper 15 to 18 inches apart and forced into the soil to the full length of the legs so that the edges of the paper are held close to the surface. Soil is usually thrown over the edges to prevent the wind from getting under. Every precaution possible should be taken to fasten the paper down, and even then disastrous results may occur in sections where there is considerable wind.

Another drawback to the use of mulch paper is the cost. Some reports indicate that the increase in yield resulting from its use does not pay for the increase in cost of production.

**Grade of paper.** There are several grades of paper on the market made especially for this purpose. If mulching with paper is attempted, paper that is made for the purpose should be used. The light colored paper apparently has not been as satisfactory as the dark colored. The reason for this is probably due to the fact that light colored paper tends to deflect sunlight, while the darker color will absorb more of the heat rays. Absorption of heat is associated with more rapid development and earlier maturity.
IRRIGATION

An ample supply of moisture in the soil not only increases the yield but improves the quality of most garden crops. This statement is not made with the intention of discouraging the strictly dry land farmer from trying to raise a garden, but rather to encourage him to put forth greater effort to develop such potential water resources as he may have.

Fig. 10—This farmer has provided for years of deficient rain fall. He has sufficient water to irrigate a good sized garden and to raise feed for his livestock. A few rows of trees planted about his reservoir and garden will help him conserve his water supply and add to the beauty and comfort of his home.

The potential resources of water may be classed as follows: 1, watering from a well; 2, building small reservoirs to catch and hold spring run-off so that there may be a supply for at least part of the season; 3, dyking coulees to catch and hold spring run-off and thereby storing a good supply of moisture in the subsoil before spring preparation of the seed bed; 4, utilizing spring flood water from small streams to store moisture in the soil; 5, to a lesser extent a good shelter belt adds to the moisture supply by catching and holding drifting snow; and 6, a snow fence may be used as a substitute to catch drifting snow until the shelter belt grows up.

A shelter belt with any system of irrigation is worth while. Trees break the force of the wind and prevent whipping of plants. Plants that are protected will not pump water out of the soil as rapidly as those subjected to the full force of winds and also the loss of moisture by direct evaporation from the soil is less in protected than in unprotected areas.

Watering from a well. Not all well water is suitable for irrigation. If the water is not of good quality it might be well to arrange with the State Board of Health, at Helena, to have it analyzed before going to any expense of preparing to use it for irrigation. If the well is located close
Fig. 11—Well water used for irrigating a garden. The only equipment needed was a windmill and a large tank. When the tank is filled a 3-inch plug is removed and the water distributed over the garden where needed.

to the garden investment in a large tank is about the only expense that needs be incurred. By pumping water into the tank it warms up somewhat before being applied to the soil. If water is pumped directly into an open ditch there is usually considerable loss before it reaches the garden.

Time of application. No hard and fast rule can be given as to the time of irrigating, or how often irrigating should be done. Some soils require more water than others and the same type of soil will require more water some seasons than others. The best rule to follow is to watch the condition of the soil and of the plants. Keep the soil in a good workable condition at all times.

Method of application. The best method is the furrow or drill system for all plants. Some plants will stand flooding, but others are injured by flooding. Some plants, like head lettuce and tomatoes, are injured at certain stages of growth by the overhead sprinkling system. The overhead sprinkling system with tomatoes has a tendency to reduce fruit set, while with head lettuce it aggravates tipburn or internal browning.
When applying water, leave it on long enough to soak well down into the subsoil. A light surface cultivation is in order as soon as the ground is dry enough after each irrigation, so as to form a mulch and prevent baking.

Fig. 12—Shallow rills are plowed out between rows to conduct the water. Avoid flooding garden crops.

On strictly dry land farms where water is limited and only a few plants, such as tomatoes and cucumbers, are to be watered, it can be accomplished to good advantage by sinking tin cans in the soil close to the plant. The bottom of the cans should be perforated with a few small holes so that the water will soak away gradually.

Sub-irrigation system. Where there is a limited amount of well water available for irrigation purposes a more economical use can be made of the available supply by installing a sub-irrigation system. Such a system may be constructed of either lath tile or concrete tile.

Lath tile construction. Cypress lath is recommended because of its durability. Fir lath may be used as a substitute, but will not last as long.

The ends of the lath must be squared in order to make them dirt tight when nailed together. Cut one lath one foot long, one 2 feet long, and one 3 feet long. Use a whole lath for the fourth side, and also for continuation of the section. This provides a joint every 12 inches on one of the sides for water to pass through. Use 3-penny nails for nailing the lath together. It is a good plan to soak the lath overnight to prevent splitting when nailing together. It is practical to build a continuous tile and then saw into sections of desired length. These sections are used for both mains
and laterals. The ends of the sections should be closed except where attached to a main. Short sections are cut and used for vertical feed pipes. They are attached to the main and should be long enough to extend a few inches above ground.

When laying the laterals, see that (1) they are placed below the plow line, which usually is about 12 inches; (2), the laterals are spaced about 4 feet apart, depending upon soil types; and (3), the laterals are level throughout their entire length and case the ground is sloping, run the tile line across the slope in order to have it approximately the same depth and at the same time level its entire length.

Too many laterals should not be connected with the same main. Where the ground has considerable slope it may be advisable to omit the mains and have a separate vertical feed pipe for each lateral.

Fig. 13—A garden in Phillips county, season of 1931. This garden was irrigated from a well and protected by a shelterbelt.

Cost. A bundle of lath will make about 50 running feet of tile. Fir and pine lath will cost about 50 cents per bundle; cypress lath is more expensive but also more durable. Material for tiling a quarter of an acre will perhaps cost from $35 to $50. Such a system once installed will save water and labor.

Topics for discussion.
1. What is the primary object of cultivation? How does cultivation affect yields?
2. When is the best time to kill weeds? Why?
3. Discuss deep cultivation versus shallow cultivation for garden crops.
4. What effect does immediate cultivation after light showers have on soil and plants?
5. How do weeds injure crop plants?
6. What benefits result from the use of mulch paper?
7. Discuss methods of laying mulch paper. How is planting accomplished with each?
8. What are the drawbacks to the use of mulch paper?
9. Discuss the value of color of paper.
10. Name the potential resources of water on dry land farms.
11. How may each of these sources be developed?
12. Discuss time of application of water.
13. Discuss methods of application.
14. How long should water be left on? Why is it necessary to cultivate after each irrigation?
15. Give instructions for watering a few individual plants.
16. How is cypress lath tile made?
17. What are some of the points to observe in laying tile?
18. Why are joints provided every 12 inches in the construction of the tile?
19. What would happen if the tile were placed too shallow?
20. Give the advantages of a sub-irrigation system.

INSECT PESTS

Loss sustained from various pests is one of the limiting factors in successful gardening. So many different pests can be found in a garden that it would require too much space to attempt to give a description of each. From a practical standpoint the important thing is to know the feeding habits of the pests and what general methods can be applied for their control.

Two types of insects. Considered from the control standpoint there are two types of insects: (1), insects with biting and chewing mouth-parts, and (2), those with piercing and sucking mouth-parts.

The biting insects, such as the cabbage worms and Colorado potato beetle, usually feed on the foliage of the plants. They may be controlled by the application of poison sprays or dusts such as arsenate of lead, Paris green, calcium arsenate, etc. These may be defined as stomach poison insecticides.

Sucking insects, such as the aphids or plant lice, feed by sucking the sap from within the plant tissues and may be controlled by proper application of nicotine sulphate (Blackleaf 40 is one form), nicotine dust, and oil emulsion. These are called contact insecticides and kill the insects by coming in contact with the body.
It is well to practice clean cultivation, crop rotation, and the burning of plant refuse left on the garden after the harvest season is over. Some insects winter over among leaves and trash. Other insects burrow into the soil for their winter quarters. Fall plowing where it can be practiced will destroy many of them.

Only the more important garden pests will be discussed. The crops involved are arranged alphabetically.

**Beans.** Garden beans are generally quite free from insect pests. Slugs sometimes appear in wet places. Probably the best remedy in the use of poison bran bait.

**Beets.** Tops of beets, Swiss chard, or any other plant used for greens should NOT be sprayed with poison owing to the danger to human life. However, beet tops may be sprayed when they are not to be used for greens. Beets generally are not troubled by insects. Occasionally the blister beetle will damage the crop.

**Blister beetles** range in size from one-half to one inch in length and may be black, gray, or greenish purple according to the species. Spray with Paris green for control.

**Cabbage**

**Cabbage worms.** Before the heads are well formed, arsenate of lead dust may be used. Sometimes satisfactory results can be secured by dusting with hydrated lime or helibore dust can be safely used after the heads are formed. When using a poison dust, care should be exercised to see that it does not blow over on such plants as lettuce, spinach, Swiss chard, or beet tops if the latter are to be used for greens.

**Cabbage lice.** Spray with nicotine sulphate. It is necessary to hit each insect with the spray in order to kill them.

**Cutworms.** They can be controlled with poison bran bait. Scatter about the garden in the evening. Two or three applications may be required. Stiff paper collars 3 to 4 inches high placed around the stem of the plant and pushed ½ inch into the soil are generally successful in keeping the worms away from the plants. This is a practical way to handle a small number of plants.

**Cabbage maggots.** They feed on the roots of cabbage and cauliflower, frequently causing severe injury. The insects spend the winter in the soil in the pupa stage. In the spring a small fly, about half the size of a house fly, emerges and lays eggs on the stem of the plant or in the soil close to the plant. In gardens where this insect has become numerous it will pay to treat with corrosive sublimate. (Make up a solution of corrosive sublimate 1 to 1000 by dissolving ½ ounce of the crystals in a small quantity of hot water. Then add enough cold water to make 4 gallons. Soon after the plants are set in the garden, pour about one-half cupful of solution around each plant. Make a second application in ten days, and if the spring is
abnormally cold, make a third application ten days after the second. Avoid wetting the leaves of the plant with this poison as much as possible.

**Carrots and parsnips.** These crops are not likely to be seriously injured by insects. Should any trouble occur, report it to your county agent at once.

**Corn, sweet.** The insects that are most likely to injure sweet corn in this state are cutworms and the corn ear-worm.

**Cutworms.** Scatter poison bran bait about the patch in the evening. Two or three applications may be necessary. The bait must be broken up very fine or birds and poultry are likely to be poisoned.

**Corn ear-worm.** Dust the silk just as it is forced out of the ear with equal parts of arsenate of lead and lime.

**Cucumber, Cantaloupe, Watermelon.**

**Cucumber beetle.** This is a small striped insect about 1-6 inch in length. It feeds on the young seedlings, often completely destroying them. To control it dust with the following mixture: calcium arsenate, 1 ounce, gypsum, 6 pounds. Dust through a coarse cloth from time to time as the beetles appear.

**Plant lice.** This is a sucking insect that feeds largely on the underside of the leaves. Turn the vines over and spray with sulphate of nicotine. It is necessary to hit each insect. Nicotine dust is quite effective and may be used instead of the wet spray.

**Lettuce.** When it is necessary to spray lettuce for control of insects, use a non-poisonous spray such as pyrethrum.

**Onion.** The insects that are likely to attack onions are onion maggots, thrips, and cutworms.

**Onion maggot.** This insect is similar in appearance and habits to the cabbage maggot. The same treatment applies.

**Onion thrips.** This is a tiny insect that scrapes the surface of the leaves and causes them to wilt and collapse. Spray with sulphate of nicotine when they appear. Two or three applications on alternate days will generally control them.

**Peas, garden and Sweet peas.** Plant lice sometimes attack peas. Control them by spraying with sulphate of nicotine.

**Potatoes.**

**Colorado potato beetle.** This insect is familiar to everyone and a description of the pest and its habits is not necessary. It can be easily controlled by spraying or dusting with either arsenate of lead or Paris green. Use the arsenate of lead at the rate of 2 pounds to 50 gallons of water, and Paris green at the rate of 1 pound to 50 gallons of water.

When applying a liquid spray use 180 to 200 pounds pressure so as to throw the spray out in a fine mist or fog. High pressure is essential to
secure a good covering of all foliage. A coarse spray runs off and does not cover the leaves well. A poor application will result in poor control.

When using a dust spray apply heavily enough to form a thin coating on all leaves. The spray should be applied soon after the eggs start hatching.

**Potato flea-beetle.** This is a small rounded black insect about 1-16 inch in length. It is provided with well developed hind legs for jumping. The insects feed on the foliage of potatoes, as well as some other garden crops such as tomatoes and ground cherries, by eating small round holes in the leaves.

Spraying with Bordeaux mixture, to which has been added 2 pounds of arsenate of lead to every 50 gallons, is recommended. The Bordeaux acts as a repellent. Generally the infestation is not heavy enough to warrant the expense of spraying for control in this state.

**Radish.** About the only insect that attacks the radish is the cabbage maggot. It can be controlled by applications of corrosive sublimate solution, the same strength as recommended for cabbage. Two applications will in most cases control the pest. The first application is made when the first true leaf is showing, and the second about ten days later. Apply sufficient amount of the solution to wet the soil to a depth of 3-4 inch.

**Tomato.**

**Tomato worm.** This is a large green worm having a curved horn projecting backwards at the tail. The pest usually makes its appearance after mid-season. Hand picking is the best method of control under garden conditions.

**Cutworms.** Same treatment as for cabbage.

**Turnips and Rutabagas.** For control of leaf-eating insects, spray with arsenate of lead.

**Cabbage maggots.** Control measures same as for cabbage.

**Turnip lice.** Nicotine dust applied with a good dusting machine is effective when the temperature is above 70 degrees Fahrenheit but not very effective when the temperature is below 70 degrees. The dust should be applied on a quiet day when the plants are dry.

Nicotine sulphate may be applied as a wet spray. Be sure to spray the under-surface of the infested leaves or it will not be effective.

**MISCELLANEOUS INSECTS**

**Ants.** Ants apparently do not attack green vegetation but visit plants mainly in search of nectar. These insects are most commonly seen on plants infested by plant lice. Here they gather the sweet liquid excreted by the aphids. They are often seen on peony plants gathering the syrup-like sap that exudes from the buds and other parts of the plant.
Control. Any of the cyanide compounds are quite effective in destroying ants when applied directly over their hills or nests. To apply cyanide, sprinkle about a tablespoon over the ant hill and cover with a sheet or canvas to confine the fumes. Cyanide compounds are very deadly to animals and plants and all necessary precautions must be observed in using them. The following poison baits will give a fair degree of control:

No. 1. 1 part tartar emetic; 20 parts strained honey. Mix well and place in shallow covered containers which have holes in the top large enough for the ants to enter. Set these containers in places visited by ants, but be sure they are inaccessible to children.

No. 2. 1 ounce of Paris green; 1 pound of brown sugar. Mix thoroughly, being sure there are no lumps, and scatter where the ants are working. Any reserve supply should be kept in tightly closed containers well labeled and inaccessible to children.

Red Spider. The red spider at times becomes a serious pest on raspberries, evergreens, and some of the ornamentals. A mixture of 1 pound of glue dissolved in 10 gallons of water sprayed on with considerable force is quite effective.

INSECTICIDES

Arsenate of lead. A violent poison; may be used as a liquid spray or as a dust.

**Liquid formula**

| Arsenate of lead | 1½ to 2 pounds |
| Water           | 50 gallons    |

**Dust formula**

| Arsenate of lead | 1 pound |
| Hydrated lime    | 3 to 5 pounds |

Paris green. This is also a violent poison and should be handled with care.

**Liquid formula**

| Paris green | 1 pound |
| Hydrated lime | 1 pound |
| Water       | 50 gallons |

**Dust formula**

| Paris green | 1 pound |
| Hydrated lime | 6 pounds |

Pyrethrum. This is non-poisonous to man or animals and should be used where it is dangerous to use the arsenical sprays. Instructions for mixing are supplied by the manufacturer with each container.

Helibore. The ground root of a plant which contains poisonous alkaloids. It is safer to use on edible portions of plants than the arsenicals.

Sulphate of nicotine. A violent poison used as a contact insecticide. The product known as Blackleaf 40 is a trade name for sulphate of nicotine.
MONTANA EXTENSION SERVICE

Liquid formula

Blackleaf 40                  1 fluid ounce
Laundry soap                  ½ ounce
Water                        6 gallons

For larger quantities 1 pint of Blackleaf 40 is sufficient for 100 gallons of water.

Dust formula

Blackleaf 40                  1 pound
Hydrated lime                20 pounds

This formula makes a 2 per cent nicotine dust. An outfit such as is used for treating wheat with copper carbonate can be used for mixing nicotine dust.

Poison bran, garden quantity

Bran                          1 quart
Molasses                      1 tablespoonful
Paris green                   1 teaspoonful
Water                         Sufficient to moisten

Topics for discussion.

1. What are the two types of insects? Give general control measures for each type.
2. What different treatments may be used for control of cabbage worms?
3. What part of the plant does the cabbage maggot attack, and how may the maggots be controlled.
4. Give different methods for control of cutworms.
5. Give instructions for spraying for control of Colorado potato beetle.
6. How are blister beetles controlled? (They attack potatoes and garden crops such as beets and Swiss chard).
7. Discuss ants and methods of control.
8. Give control measures for red suiders.
9. How are lice controlled on the various garden crops?
10. What strength of arsenate of lead, Paris green, and Blackleaf 40 should be used? Give formulas for liquid sprays and for dust sprays.

HOME STORAGE OF VEGETABLES

Production of vegetables in sufficient quantity to supply the family needs during the winter months is an economical means of reducing the living expenses. With a plentiful supply of vegetables on hand, better balanced meals may be planned. Beets, late cabbage, carrots, celery, onions, parsnips, potatoes rutabagas, salsify, and turnips may be stored in their natural condition and should be grown in sufficient quantity to supply the needs for winter use.

To care for the surplus vegetables in many cases requires nothing more than the use of existing facilities on the farm. Potatoes, late root crops,
and cabbage can be stored and kept in good condition in outdoor pits. The pit type of storage generally requires very little cash outlay other than for labor. The main disadvantages of the pit type of storage are that temperature and moisture cannot be controlled and the stored crops are hard to remove when the ground is frozen.

The conical pit can be listed as the cheapest storage method. Potatoes, root crops, and cabbage may be stored in a conical pit. This type of storage is constructed as follows. Select a well-drained place and make a shallow excavation which may be lined with straw and the vegetables placed on the straw in a concile pile. A flue should be inserted in the center of the pile for ventilation. A flue can be constructed by nailing two 1 x 6 inch boards together with cleats spaced close enough together to prevent vegetables from passing through. One such flue will be sufficient for a conical pile. If the pile is made longer than wide, additional flues must be provided. The flues should extend from the bottom of the pile to above the covering. A layer of coarse straw two to three feet in thickness may be used for covering, over which should be placed ten to twelve inches of dirt. Market gardeners who use this type of storage to some extent generally add a heavy covering of manure from the horse barn as severe cold weather approaches. Root crops and cabbage keep well in this type of storage as they are not easily injured by frost, but it must be remembered that potatoes require a frost-proof covering.

Another cheap type of storage can be provided by excavating a pit to a depth of four or five feet, making the pit four to six feet in width and as long as desired. The dirt removed in excavating should be piled so that it can be used for covering. A covering can be provided by placing heavy poles crosswise and covering with brush or woven wire, straw, and dirt. The covering should extend well beyond the edges of the pit to guard against frost entering from the sides. By piling the straw deeper in the center a rounded top can be constructed with a minimum amount of weight for the poles to support. An entry way can be provided at one end so that the vegetables will be accessible at all times. Flues for ventilation should be put in place before the straw and dirt coverings are added. An opening for intake of air can be provided through the entry way to the pit. It will be necessary to close the intake during cold weather for protection of such products as are injured by freezing. Frost can be prevented from entering through the flues by filling them with straw or burlap sacking. This type of pit should last several seasons if located in a well-drained place.

The cellar under the dwelling is used to a considerable extent for storage of vegetables for house use. If the cellar contains a furnace the air is apt to be too warm and too dry for the storage of root crops. It is often possible however to partition off a room where the temperature may be controlled by means of outside windows. Such a room must be well insulated to keep out the warm dry air from the furnace room. When the air becomes too dry, root crops will start shriveling and deteriorate in quality. Humidity of the air can be controlled to some extent by placing pans of water on the
floor or by occasionally sprinkling the floor. The condition of the storage room must be observed from time to time to see that the humidity of the air is not increased to the point where moisture collects on the ceiling, or molding and rotting of stored products will result.

Although the cellar under the dwelling can be made to serve for storage purposes, it usually is not as satisfactory as an outdoor cellar from the standpoint of ventilation, moisture, and temperature control. A good outdoor cellar can be made by excavating to a depth of 3½ to 4 feet and using poles, woven wire, straw, and dirt for a roof. The walls may be of natural earth, concrete tile, or stone. If the walls are of natural earth it is better to make them sloping to guard against caving in. A cellar 10x12 feet will provide ample space for storage of fruits and vegetables for the average farm family. It will be necessary to construct a larger cellar where space is needed for storage of potatoes for market and root crops for livestock. The same principles of construction will apply. In estimating storage needed for potatoes, allow one square foot of floor space for each forty pounds of potatoes, piled one foot deep. Potatoes may be piled five to six feet deep when stored in narrow bins on raised, slanted floors. One square foot of floor space will hold 240 pounds, or four bushels of potatoes, when piled six feet deep.

The location chosen for the cellar should be one that is well-drained and if possible convenient to the house. A low knoll or side hill offers better possibilities from the standpoint of construction than level ground but there is no objection to level ground if the drainage is good.

Heavy timbers, either round or sawed, may be used for posts, purlins, and rafters. Use only good sound timbers. For construction of small cellars, the timbers for posts and purlins should be at least eight inches in diameter and the poles for rafters four inches in diameter at the small end. Set the posts from six to eight feet apart on a line just inside the excavation for the support of purlins and rafters. The post should be of sufficient length to allow for a six-foot clearance next to the side walls and eight feet in the center. It is not advisable to space the rafters farther apart than fifteen-inch centers. Unless the roof extends well beyond the excavation there is danger of frost entering through the side walls. Extension of the roof can be made by placing short rafters from the plate to a sill three feet beyond the line of posts. The ends of the cellar may be constructed in the same manner but it is better to make substantial walls of concrete or rock. Woven wire is placed over the rafters to hold the straw. Three feet of straw covered with twelve inches of dirt is generally considered sufficient to keep out frost from overhead. Dirt and straw are recommended for the roof because they make good insulating material. When the placing of rafters is such as to leave the roof fairly flat, more straw should be placed over the center so that after the dirt covering has been added the roof will have a well rounded finish. Before putting the straw and dirt over the rafters, ventilator flues should be put in place. It is necessary that the outlet flues extend at least a foot above the dirt covering. For small cellars it is well
to allow at the rate of 60 to 80 square inches of flue area per each 1000 cubic feet capacity of the cellar. Intake ventilators should be approximately the same area as the outlet flues. The inside ends of the intake ventilators should be located so as to open at the surface of the floor. The outlet flues are generally constructed of lumber and tile is used for the intake flues. Provision must be made for closing both the intake and outlet in severe weather. Screen placed over the ends of the intake will keep out rodents and guard against the tile becoming filled with leaves and rubbish.

Entrance. A well constructed vestibule over the entrance is the best means of keeping out rain and snow. Too much emphasis cannot be placed on construction of doors. If doors are not properly made or do not fit tightly, freezing is quite likely to occur. Doors should be constructed of double thickness with a good grade of building paper between.

**STORAGE REQUIREMENTS OF INDIVIDUAL VEGETABLES**

**Beans and peas.** The usual procedure is to pull the plants and cure them like hay when the maximum number of pods are ripe. After thorough drying the beans are threshed and stored in bags hung in a dry, well ventilated place. The attic of the dwelling or the granary may be utilized for storage of beans and peas.

**Beets.** Beets for storage should be harvested as late as possible but before there is danger of the ground freezing. The tops should be removed soon after lifting the roots. A good storage beet is one that has made a rapid growth and has reached a size of 2½ to 3 inches or even larger so long as it has not become woody. When beets are stored in the basement of a dwelling or outdoor storage cellar they may be placed in boxes and barrels or in small piles along the wall. Storage in large piles should be avoided as it is likely to cause heating and decay. Some folks recommend storing in clean sharp sand. Beets will keep best at a temperature just above freezing. Good ventilation and humid air are required. When the air becomes too dry shrivelling of the roots results. Beets keep well in the outdoor pit such as has been described but they must be sufficiently protected to prevent freezing.

**Cabbage.** A good storage variety of cabbage is one with compact, hard heads. Danish Ballhead and Danish Roundhead are good storage varieties. Heads selected for storage should be compact and free from disease and injury of any kind. Rough handling from field to storage is responsible for some of the losses that occur in storage. A temperature of 32° F. is favorable for storage of cabbage. Where different kinds of fruit and vegetables are stored in the same room it may be necessary to maintain a temperature of 35° to 38° F. While this is slightly higher than is favorable for cabbage there is no serious objection, provided good ventilation and humidity of the air is maintained. Moderate humidity is required. A very moist atmosphere is favorable for development of storage rots and rots and wilting occur under very dry conditions.
Cabbage may be stored in narrow bins with raised slatted floors but it is generally considered best to place the heads on shelves in single layers.

The pit method for storage of cabbage is used by some market gardeners. This method is satisfactory when properly handled inasmuch as cabbage is not seriously injured by light freezing, providing it is not handled when in a frozen condition.

Hotbeds that have been cleaned out, or pits may be utilized for storage of cabbage. One method that is used by some gardeners is to pull up the plants and set them in the pit, roots down, and pack dirt around the roots and stalks almost up to the heads. Another method is to pull the plants and turn them upside down in the pit. The pit is then covered with poles, woven wire, straw, and dirt. When the weather becomes severe a covering of manure from the horse barn is added to prevent hard freezing. Provision can be made at one end of the pit for removal of the product during the winter months.

Carrot. This crop is prepared and handled in the same manner in storage as beets. The medium sized carrot, 1¾ to 1½ inches in size, is less likely to shrink in storage than the smaller sizes. A good plan is to sort out the larger sizes and store them for later use.

Celery. Celery may be stored in pits such as have been described or the unused pit of a permanent hotbed may be utilized in the same manner as described for cabbage. The plants should be removed from the field before freezing with a considerable amount of soil adhering to the roots. Set the plants in rows three to four inches apart and firm the soil well about the roots. It is a good plan to soak the soil thoroughly as the celery is placed in the pit. Exercise care in applying the water so as not to wet the tops. Wetting the tops is likely to start decay. Provide covering as discussed under cabbage for protection against frost.

Celery may also be stored in narrow beds in a root cellar. Pack the plants close together and use boards to hold up the plants at the sides of the beds. Small quantities of plants may be packed in boxes. Make provision for keeping the soil moist without wetting the tops.

When celery is stored in the same room with other crops, like cabbage and rutabagas, it has a tendency to absorb the odors of other vegetables, which injures its flavor.

A temperature of 32° F. is favorable for celery. Higher temperatures hasten maturity and shorten the storage period.

Onions. To keep well, onions must be mature and thoroughly dry. They require a dry atmosphere and a temperature of about 35° to 38° F. The ordinary root cellar is too damp for onions. An attic in the dwelling that can be kept from freezing makes a suitable place for onions if the temperature is held low.

Parsnip. Freezing does not injure parsnips. Hence the crop can be left in the ground if desired. It is a good plan, however, to harvest a portion of the crop before the ground freezes up and store like carrots.
Irish potato. The outdoor cellar is the most suitable place for farm storage of potatoes. A temperature of 38° F. seems to be about ideal although they will stand 32° without injury. At the lower temperatures the tubers develop a sweet flavor that is objectionable to some. Tubers stored for seed show a lower vitality when held in storage for a considerable period of time at a temperature much below 38° F. Effort should be made to hold temperature as uniform as possible. A moderately moist atmosphere and good ventilation together with the temperature recommended are essential to good storage. When the air becomes too dry the tubers lose moisture and become soft. Too humid an atmosphere on the other hand encourages development of molds and rots.

Potatoes stored in narrow bins and with raised slatted floors are less likely to start heating and sweating than when stored in large piles on the ground floor. Mechanical injury, such as bruises, skin breaks, cuts, and broken knobs, is detrimental to keeping quality.

Pumpkin and squash. When harvesting they should be cut or carefully broken from the vine, leaving the stem attached to the fruit. After the fruits are harvested it is a good plan to cure them in a dry, warm, well-ventilated room to harden the shell. When cured they can be stored in a temperature of 40° to 50° but they require a dry atmosphere. The outdoor root cellar is not a satisfactory place to store pumpkins and squash. An attic in the dwelling that can be kept from freezing, or a warm dry room in the basement provide about the best possible storage for these crops on the farm.

Turnips and rutabagas. Handle the same as beets and carrots. Outdoor storage cellar or pit are preferable to placing them in the basement of the dwelling as they give off odors that penetrate throughout the house.

Tomatoes. Well developed green fruits picked just before frost can be ripened in the root cellar or basement of the house. It is a good plan to spread them out in single layers on shelves. They will not all ripen at the same time so by storing a sufficient quantity it is possible to have fresh tomatoes for three or four weeks after the vines have been cut down by frost.

**TOPICS FOR DISCUSSION**

1. Discuss construction of pits for storage.
2. Give directions for building an outdoor storage cellar.
3. Give directions for insulating a room in the basement of the dwelling.
4. Discussion: My experiences in storage of root crops.
5. Discussion: My experiences in ripening tomatoes in storage.
6. Discussion: My experiences with celery.
7. Discuss harvesting and storage of potatoes.
8. Discuss harvesting, curing and storage of onions.
9. Describe various methods of storing cabbage.
10. Give directions for control of humidity and temperatures of air in storage cellars.