Extension Circular 321
Revision of Circular 251

February,
1939



# GROWING EARLY VEGETABLE PLANTS UNDER CLASS

by

A. G. B. Bouquet
Vegetable Crops



**Federal Cooperative Extension Service**
**Oregon State College**
**Corvallis**

Cooperative Extension Work in Agriculture and Home Economics
Wm. A. Schoenfeld, Director
Oregon State College and United States Department of Agriculture, Cooperating
Printed and distributed in furtherance of the Acts of Congress of May 8 and June 30, 1914

# GROWING EARLY VEGETABLE PLANTS UNDER GLASS

by
A. G. B. Bouquet
Vegetable Crops

Several important vegetable crops are started under glass in the early spring in order to mature at a desirable date for harvesting. In the case of cabbage, lettuce, celery and onions, and sometimes melons and cucumbers, plants are started in the early spring in order to bring the crop to an early date of maturity. It is not necessary to start these crops under glass in order that they may have long enough time in which to mature a crop but the object in the case of these six vegetables is to develop a crop as early as possible. Cauliflower plants are sometimes started in the early spring, but if the plants are set outside in the garden too early there is danger of the plants making small heads before they have started a normal leaf growth.

In the case of tomatoes, peppers and eggplants, it is necessary that the plants be started under glass in order that they may mature a satisfactory crop of fruit over as long a season as possible. There are, therefore, two classes of crops which require some kind of a forcing structure in which the early plants are grown.

A vegetable grower has the option of growing his own plants or purchasing them from some reliable grower. Whether he shall do one thing or another will be dependent very largely upon the equipment which he may have for plant growing and the extent of his operations. In some cases a tomato grower may be able to buy his plants more cheaply from some extensive grower of plants than he could produce them himself. On the other hand, if he has a plant growing structure, such as a greenhouse or a hotbed, the necessary plants may be grown therein. In any case it should be realized by growers of early vegetables that a vigorous and healthy plant with a good, stout top growth, together with a well developed root system, is fundamental in producing an early crop and satisfactory yields. The price of plants is of secondary consideration in contrast with quality. Plants that are strong and stocky will give far more satisfaction than those plants bought at a cheaper price which have been crowded in the plant boxes or flats.

## Forcing Structures

The manure heated hotbed. Due to the scarcity of manure, particularly horse manure, the growing of plants in manure heated beds is being displaced by other means of plant growing except in rural areas where considerable horse manure is available from the stables of the farm. There are some disadvantages in this method of heating beds, including the necessity of excavation for putting in the manure, the necessity of removing the manure after the heat is diminished, and the possibility of inconsistency in the heating material to furnish a uniform temperature for the young plants. A special circular on the manure heated hotbed is obtainable from the office of the local county agent.

The electric hotbed. Growing plants in soil heated by electricity is now a common form of plant propagation. While the initial cost of this bed is higher than for other types of hotbeds, the equipment is useful for a number of years and the larger initial expense is offset to a great extent by the uniformity of the heat produced and the readiness with which seeds germinate and the

rapidity with which plants grow in a uniformly heated bed. Complete information regarding this type of hotbed is contained in Oregon Experiment Station Bulletin 307.

The flue heated hotbed. A very satisfactory way of growing young vegetable plants is to grow them under glass sashes covering a frame which is heated by hot air passing through tile which is placed under the soil, the hot air being provided by fire from a firebox, much on the same principle as a residence is heated by hot air. The value of this form of heat for growing young plants lies largely in the fact that there is no excavation necessary once the tile and firebox have been put in place. Also, the heat is consistent and can be regulated by varying the amount of fire in the firebox. In order to start the plant growing beds in the spring, one can start the fire in the firebox and dry out the soil in the frame. For particular details regarding this type of hotbed, those interested should obtain a copy of a circular on the flue heated hotbed, obtainable from the office of the local county agent.

Plant greenhouses. There are various forms of greenhouse structures that are used for plant growing. These vary from a small building up to one of standard construction and moderate size. Some of the smaller, more inexpensive greenhouses are made of hotbed sash, in which the standard 3 x 6 sash is used lengthwise of the greenhouse for the sides and the same style of sash used for the roof.

Most greenhouses used for plant growing, however, are of the standard, even span type of construction. Such houses may vary in width from 18 to 30 feet or so, with eaves of 6 to 6 1/2 feet and an interior arrangement of benches for plant growing. The particular value of the greenhouse in growing young plants is that the operator can proceed with his work at any time regardless of the weather despite unfavorable conditions which may prevent work being done in hotbeds where no protection is provided for the operator, except where a cage is used over the frame to permit handling of plants.

Extension Circular No. 295 discusses in detail the specifications of small greenhouses useful in the growing of young plants.

## Plant Growing

### Soils

It is desirable to prepare soil for plant growing some months ahead of the time that it is to be used, for it should be well composted and rotted before seeding or transplanting. A good mixture of soil for this purpose would consist of one-third clay or fairly heavy silt loam, one-third sandy loam, and one-third manure, preferably rotted manure. In some cases leaf mold is available, making an excellent ingredient for the addition of organic matter. These materials can be composted out of doors, preferably under cover, so as to prevent leaching of plant foods, or they can be put in the greenhouse benches so as to be ready for operations in the spring. A satisfactory soil for plant growing cannot be obtained out of doors in the winter or very early spring because of it being too wet and cold; consequently the soil should be put into the greenhouses preferably in the fall and turned over from time to time so that the soil is well mixed and the organic matter becomes thoroughly rotted as the moist soil is in the benches.

A good soil for sowing seed is one that is friable and will not form a crust on the surface. The soil should be screened before it is put into the flats for seeding, using a screen of from four to eight meshes to the inch, depending upon the type of seed to be sown.

## Methods of Seeding

Seeds of cabbage, lettuce, tomato, eggplant, pepper, and cauliflower are sown at the rate of eight to ten to the linear inch if the plants are to be grown in rows. If this is done a shallow furrow should be marked with a straight edge about three-quarters of an inch in width. It is preferable to distribute the seed in a wide furrow made with such a straight edge rather than in a narrow, pointed furrow. Plants in a broad row have a better chance to spread and develop into good, stocky plants for transplanting than those plants of which the seed is sown in a pointed furrow.

Another method of seeding is to sow the seed broadcast in the flat or bench. If this is done the seeding should be made carefully and uniformly so as to obviate too much crowding of the plants.

Cucumber and melon plants are often started in individual containers by sowing a few seeds in each container which will usually hold 2 to 3 plants to form an individual hill in the field.

Temperatures in a hotbed or greenhouse for germinating such seed as mentioned above should range between 65 and 75. Tomato, eggplant and pepper require warmer temperatures than cabbage, lettuce, cauliflower and onions.

In many cases it is desirable to treat the soil or the seed for disease control previous to seeding, and directions for such operations are discussed in future paragraphs of this circular under the heading of the control of insect pests and diseases attacking young vegetable plants.

## Transplanting Young Plants

The same type of soil in which the seed is grown will be useful for transplanting plants. With most kind of vegetable plants the first transplanting is made when the third or true leaf is well formed. If the seedlings are allowed to stand for a considerable time after this stage, they will become spindling and more difficult to transplant. Likewise they should not be first shifted until there is a good leaf growth as suggested and a good root development. The accompanying table indicates the approximate dates of seeding, transplanting and setting of plants in the field.

In order to facilitate and speed the work of the first transplanting of seedlings, especially a large number, the soil into which they are to be set may be "spotted" by means of a "spotting board" that will indicate the hole wherein each plant is to be set. This will also assure the plants of an even distribution and equal distance between each other.

## MANNER OF GROWING EARLY VEGETABLE PLANTS UNDER GLASS

| Vegetable | Date of Seeding | Time of Transplanting | Distance Between Plants Inches | Date of Transplanting to field | Distances of Field Planting | |
|---|---|---|---|---|---|---|
| | | | | | Rows Inches | Plants Inches |
| Cabbage | 1/15-3/1 | After 12-14 days | 1 1/2-2 | 3/10-4/15 | 30 | 18-20 |
| Lettuce | 1/15-3/1 | After 12-14 days | 2 | 3/10-4/15 | 18-24 | 12 |
| Cauliflower | 2/15-3/1 | After 12-14 days | 2 | 4/10-4/20 | 30-36 | 24-28 |
| Tomato | 2/15-3/15 | After 18-21 days | 2 1/2-4 | 4/25 After frost | 54-72 | 48-72 |
| Pepper | 2/15-3/15 | After 18-21 days | 2 1/2-4 | 5/1 - 20 After frost | 30 | 18 |
| Eggplant | 2/15-3/15 | After 21-30 days | 4" bands or hallocks | After frost | 30 | 18-24 |
| Onion | 2/1 - | None | | 4/10-25 | 18 | 4 |
| Celery | 2/20*- | After 30 days | 1 1/2-2 | 4/25 | 32-36 | 6 |
| Melons | 4/1 - | None | Grow plants in 4" hallocks | 5/10 After frost | 72 | 60-72 |
| Cucumbers | 4/1 - | None | Grow plants in 4" hallocks | 5/10 After frost | 72 | 60-72 |

* Successional seedings made for this crop.

Dates are variable according to localities in the state of Oregon, also according to the variations in individual earliness or lateness of season. Tender plants, such as tomato, pepper, eggplant, melon, cucumber, etc., should not be set in the field until all indications of frost have passed, unless the plants can be covered with some kind of protectors. Other plants, such as cabbage, lettuce and onions, can stand a few light frosts without injury, but cauliflower plants should never be set out until the weather is frost-free, otherwise the plants will produce premature small heads.

### Individual Containers for Plants

In the case of the tomato, eggplant, pepper, melon, and cucumber, it is often desirable to grow the plants in individual containers such as made of veneer. Such containers come in sizes from 2" x 2" x 3" to 4" x 4" x 4". In 4" x 4" containers one can grow a sufficient number of melon plants to make a hill as previously indicated. If individual containers are used for tomatoes, peppers and eggplants, the plants can be set directly from the seedbed in flat or bench into the container.

### Maintenance and Care of Young Vegetable Plants

There are three things of prime importance in the care of young vegetable plants: first, providing suitable temperature both day and night; second, careful

watering; third, adequate ventilation. Young plants of tomato, eggplant, pepper, melon and cucumber require a slightly higher temperature than such plants as lettuce, cabbage, celery, cauliflower, and onions. For the warmer plants, temperatures of 70 to 75 degrees F. and a night temperature of 55 degress F. are suitable. For the cooler plants a day temperature of 60 to 65 degrees and a night temperature of 50 to 55 degrees is best. As plants increase in age and size the temperatures can be reduced.

Young vegetable plants should not be watered excessively, otherwise there is a tendency for the damping-off fungus to attack the plants and spread over the plant bed or flat. It is advisable to water early in the day or in the morning of bright, sunshiny days rather than toward the latter part of the day.

The greenhouses or hotbeds in which the young plants are growing should be given as much fresh air as possible by ventilation for maintaining the desired temperatures. They should not be allowed to become chilled or be in direct drafts; on the other hand there should not be such little ventilation as to allow moisture to condense on the under sides of the hotbed sash or the inside of the greenhouse. High temperatures, excessive watering and scant ventilation tend to make plants succulent, spindling, weak, and susceptible to disease.

## The Use of Cold-frames

Cold-frames are used for hardening plants before they go into the field. It is not wise to take plants from a warm greenhouse or hotbed directly into the garden, exposing them suddenly to lower temperatures, which may sometimes give the plants a considerable check in growth.

Hardening can be accomplished in two ways, first, by decreasing the water given to the plants; secondly, by increasing the ventilation of the greenhouse or frame and giving the plants more air so that they will become gradually accustomed to lower temperatures. The hardening process should be gradual and not severe. This period wherein the plants are grown at a cooler temperature usually covers a period of about 10 to 14 days. During this time the plants may have enough water to keep them from wilting but not as much as formerly given in the early stages of growth. Toward the end of the hardening period the sashes covering the cold frames can be entirely lifted in the day time and later on left off entirely at night, provided weather conditions warrant the lack of covering of the plants.

A special circular on the construction and operation of the cold frame is available from the office of the local county agent.

## Insect Pests and Diseases Attacking Young Vegetable Plants

Snails and slugs oftentimes do much damage in plant beds by eating the leaves of the young, tender plants. The slugs can be found in many cases in the daytime by lifting up boards or trash in the vicinity of the beds. Grass and weeds should be removed from around the edge of the cold-frame area so that these insects are not harbored. One should consult Extension Bulletion 523 for suggested methods in the control of these insects.

Cutworms can be controlled by the standard poison bait suggested in the bulletin mentioned.

The damping-off disease is the worst enemy of young vegetable plants. The small plants turn black at the surface of the ground, fall over and die. Almost any soil used in the growing of seedlings is liable to be contaminated with damping-off, and this disease may do serious damage to seedlings of vegetables when the plants are in the seedbed before they have been first transplanted, or in some cases losses of plants may occur after the plants have been pricked out from the seed rows and put into soil of greenhouse benches, hotbeds or cold-frames.

The damping-off disease usually, though not always, appears as soon as the seedlings are above ground, but in some cases it may attack the embryo plant as soon as it has germinated from the seed and before it has appeared above the soil. Small plants that are but a few days old may appear to be healthy one day but may collapse very shortly thereafter. The tissue of the stem near the soil surface becomes water-soaked or blackened and appears constricted. Wilting takes place and later the plant falls over and dies.

To avoid the danger of needlessly losing plants in the early stages it is particularly important that the soil for seedbeds and also the soil into which the plants are transplanted shall be free from the damping-off fungus. The grower should have a clean soil in which to carry on his operations.

There are two types of treatment to prevent losses of plants due to seedling diseases: (1) soil treatment, and (2) treatment of seed.

It is usually easier to prevent damping-off than to control it after it has once started.

Soil treatments include the application of formaldehyde (40%), using this material at the rate of one gallon to 50 gallons of water, applied preferably 10 to 14 days before the soil is to be used. Extension Circular 291, on applying formaldehyde to vegetable greenhouse soils, is available from the office of the local county agent.

Formalin dust is useful in that seeds can be sown or plants transplanted a day or so after the dust is mixed with the soil. This method, however, is more expensive than the liquid formaldehyde.

Boiling water soil drench is useful on a small scale. The soil may also be heated in the oven provided the temperature of the soil is raised to 145 to 150 degrees F.

The soil may also be pasteurized by being heated in an electric pasteurizer, details of which can be obtained from the writer. Where a greenhouse is heated by steam, the soil in the bench or a number of flats can be steamed, bringing the soil to the temperatures named above.

Seed Treatment

Losses occasioned by the damping off disease of seedlings can be reduced in part by treating the seed with various materials. Seed treatment will not

prevent the plants from damping off after they have come through the soil, but the treatment may be effective in providing a better germination of seed in the seed rows.

The seed of the plants mentioned in this circular can be treated by dusting them with Semesan or red copper oxide. Directions regarding the amount of material to be used for a certain amount of seed are contained on the packages of individual dusts. Very little dust is necessary for the average packet of seed. For example, the ordinary five or ten cent packet of seed requires only four to six times as much Semesan or red copper oxide as can be lifted on the inverted head of an ordinary pin.

## Miscellaneous Methods

The Cheshunt mixture is composed of the following materials: copper sulfate, 2 ounces; ammonium carbonate, 11 ounces. These two materials should be in finely powdered form, added together in a glass jar and mixed by thoroughly shaking together. The mixture should be set aside for 24 hours or so to allow chemical action to take place, keeping the cover of the jar on tightly to prevent escape of ammonia. When ready to treat the soil after seeding or after the plants are up, instead of using plain water, one ounce of this mixture may be dissolved in two or three gallons of water and applied to the soil. This solution should not be made up in tin or zinc because of chemical reaction, but in glass or earthenware, which do not corrode.

## Zinc Oxide

Zinc oxide is useful in its galvanizing effect to prevent the spread of damping-off when the seedlings are above ground. A sufficient amount of this fine, white, powdered chemical should be applied to the surface of the soil to give a smooth white layer. This requires about one-half to one ounce per square foot in a soil flat of ordinary depth. Most growers prefer to apply it through a cheesecloth bag or large salt shaker. This layer of chemical should not be disturbed until danger of damping-off is past. The box of seeds can be watered as usual after the application of the zinc oxide.

## Red Copper Oxide

A solution of this material can be made in the proportion of one ounce of red copper oxide to three gallons of water and applied to the soil after seeding or at the first signs of any lot of plants showing damping-off, using the solution instead of plain water.

Additional details concerning treating the soil for damping-off disease are contained in Circular 280, available from the office of the local county agent.