

GROWING VEGETABLE PLANTS IN THE MANURE-HEATED HOTBED
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Early vegetable plants of cabbage, lettuce, cauliflower, onion, celery, tomato, pepper and eggplant, and sometimes melon and cucumber are grown in some form of hotbed during the early spring months in order that plants may be of suitable size for transplanting to the field or home gardens when weather conditions are favorable.

One of the oldest forms of heating a hotbed is through the use of fermenting stable manure, which is placed under the soil, covered with a frame and sash of glass or a glass substitute. Manure hotbeds are now not so commonly found in commercial gardens nor home gardens as formerly due largely to various causes among which are first, scarcity of manure, thereby necessitating the use of the available supply to be applied as fertilizer to the soil; secondly, other means of providing heat such as by hot air, hot water or electricity, etc., which in general are capable of providing more uniform heat than the manure.

One of the disadvantages of the manure hotbed lies in the possible failure of the manure to properly ferment, thereby not heating the bed as desired. There is no definite control of the heat which can be maintained as is true in the case of beds heated by hot air, hot water or electricity. Another disadvantage of the manure hotbed is the necessity for excavating the soil in order to make the pit in which to place the manure. Again, after the manure has given up its heat and the bed is no longer used for plant growing, the manure must be removed from the pit, thereby further increasing the amount of labor in connection with the use of the manure as heating material.

In the case of many individual gardens, however, particularly farm gardens, manure is more or less abundant and a supply of fresh horse manure can, therefore, be readily obtained for the heating of the soil in the frame. On many farms, therefore, the manure-heated hotbed is the source of supply of various kinds of young plants, both vegetable and flower, grown for transplanting later to the garden.

Location of the bed. Any hotbed should be reasonably handy to one's daily operations so as to be looked after during certain parts of the day. Weather conditions vary considerably during the spring months, with the result that the sash covering the bed may need attention at times to regulate the temperature in the bed. A southeast exposure on a well-drained piece of ground is best. If there is a windbreak which does not throw shade, so much the better. Cold winds and rains in the spring will cause hotbeds to cool off rapidly so that the bed should be protected if possible. Advantage should be taken of a warm, sunny, southeast slope. If the ground is well-drained, the soil can be more readily worked in the early spring and also plants such as lettuce can be grown in the frames for a longer period during the fall and early winter.

Materials needed. The manure used for heating the soil for plant growing is fresh, fermenting horse manure. This manure should be comparatively fresh from the stable and should contain about one-third its bulk of straw as litter. Manure with shavings used for bedding is not desirable; neither is strawy manure that has been allowed to stand for a time and partially fire-fangle and rot. Manure for a hotbed is usually taken from the stable and made into a pile four feet high or so and as long as

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necessary to fill the space desired for the bed. For a single sash of 3 x 6 feet, sufficient manure must be obtained for a space of those dimensions and about 18 inches deep. The manure, however, should be placed in a pile not less than 4 feet high during the period when it is being composted before placing in the pit. This handling is discussed in a later paragraph.

The frame which is used over the manure and soil to hold the sash should preferably be of 2-inch material. It should be about 5' 10" in depth, that is, from the back board to the front, and 3 feet or any multiple of three feet in length in order to accommodate the sash which is three feet wide. If the frame is to be set up permanently, 4 x 4 inch posts can be put in at the corners of the bed to which the sides and ends of the frame are nailed. If 4 x 4 inch posts are not used, 2 x 4 inch pieces will be satisfactory. If the frame is not to be set up permanently, the ends and sides can be hooked together and thus be removable. The back board of the frame should be from 12 to 18 inches high, depending upon the type of plants which are to be grown in it, and the front board should be from 8 to 12 inches high. For a five foot ten inch frame, therefore, there will be a difference of six inches between the height of the back and the front board. Where young plants of tomatoes are grown, it is advisable to have the boards at least 18 inches and 12 inches respectively, in order that the covering material may not press down on the tops of the plants when they are in the frames.

The reason for the frame being made 5 feet 10 inches in depth is to allow at front and back for the raising or lowering of the sash, which is 6 feet in length and which, therefore, will extend over the edge of the front and back boards by one inch.

If more than one sash is to be used so that the frame is six feet or longer, it is desirable to have a 2 x 4 inch piece extending from the back board to the front with a center strip which is $1/2$ inch wide. The 2 x 4 will act as a cross bar, holding the sashes in place as they are slid up or down the frame in ventilation. They will also help in strengthening the frame and make it more convenient to handle the sash.

Glass sashes are 3 feet wide by 6 feet long. They can be bought glazed or unglazed. These sash will usually contain three rows of 10 by 12 inch glass. Sash of cedar which are tightly morticed, well glazed, and receiving at least two coats of paint should last for many years. If the vegetable grower is doing his own glazing of the sash, care should be taken to see that the glass does not overlap more than $1/4$ inch, otherwise considerable dirt collects under the lappings, thereby eliminating light for the plants.

Sashes of material other than glass are sometimes used in covering sash, such as glass cloth, which is treated cloth, and celoglass, which is a screen base material with a celluloid filling. The value of these materials is discussed in Circular 258 regarding the construction and operation of the cold frame in vegetable growing.

Soil for the hotbed should consist of a mixture of good garden loam to which may be added one-third sandy loam and one-third rotted manure. This will make a fine, friable soil of good fertility. Any soil for plant growing is liable to be affected by disease, particularly the damping-off fungus. This disease may do serious damage to young plants when they are growing in the hotbed. It is desirable, therefore, to sterilize the hotbed soil, which can be done readily and inexpensively by applying a solution of formaldehyde, using a formula of 1 gallon of

formaldehyde to 50 gallons of water and applying this to the soil through a watering can sprinkler at the rate of 1/2 of a gallon to the cubic foot of soil.

There is available on the market also for treating the soil formaldehyde dust, which will make it possible to use the soil for seed sowing or transplanting immediately after the dust has been applied to the soil. In the case of the formaldehyde treatment mentioned above, it is necessary to wait several days until the soil has aired and dried out sufficiently before seed sowing or transplanting can be done. Soil treated with boiling water will usually be free from the damping-off organism.

The soil for the hotbeds should preferably have been made up during the fall and early winter of the spring during which it is to be used. It is difficult to obtain good soil in the spring that is not water soaked and cold; hence if the hotbed soil has been under cover during the winter it will be in a much better condition to be placed in the hotbed in the spring. Previous to being placed in the bed it may be treated for the damping-off fungus as has been suggested.

Treatment of manure. The horse manure as it comes from the stable will be heating rapidly and care must be taken to prevent it from burning or fire-fangling. The temperature of the manure will be up to 130 to 150 degrees F. at the beginning of the fermentation, and to prevent burning it must be turned over so as to have the fermentation or heating spreading well throughout the pile. Care should be taken to get the outside of the pile well mixed with the inside. The manure should be moist throughout the pile during the process of first heating, and if it is not moist, water should be added to it. Also, if the manure is heating too rapidly and is beginning to fire-fangle, cold water should be put on the manure so as to reduce the rapidity of the fermentation. In view of the fact that this first treatment of the manure is taking place during the early months of the spring, it is desirable, if possible, to have this manure under cover in a shed where it can be protected from heavy rains, which will have a tendency to cause the pile to become too wet and possibly interfere with the heating. A thermometer is useful in determining the temperature of manure for hotbeds, especially at the time when seeding takes place in the beds.

Filling the pit. It is customary to use from 12 to 18 inches of manure for heating a hotbed; consequently the pit for the manure should be excavated to the depth of the amount of manure to be used. The pit should be as wide (deep) as the frame is to be and as long as necessary to accommodate the number of sash to be used.

In putting the manure into the pit, it should be placed in layers of about six inches at a time, each layer being pretty well tramped, especially along the sides and in the corners, so as to prevent too many air spaces in the bed. The manure will also settle to some extent after it is in the hotbed and consequently enough manure should be used to allow for the settling. The manure should be moist when put in the pit but not wet enough so that one can wring water from the straw.

After placing the manure in the pit, the soil mixture already mentioned should be put on top of the manure. It is customary to use about 6 inches of soil in the hotbed and the top of the soil should be slightly higher than the ground line of the hotbed. There will then be ample room for growth of plants from the surface soil up to the covering material of glass sash or its substitute.

In areas where the spring weather is quite cold, it is customary to use straw or manure banked on the outside of the frame in order to keep the bed as warm as

possible. Some growers of plants also give additional covering to the bed at night by straw, sacking, old carpeting, etc.

It is especially important that the sash covering the frame be water-proof in order that the soil in the hotbed be of the proper degree of moisture. If the soil inside the bed becomes excessively moist, there is greater danger of damping-off of the seedlings.

Plant growing in the hotbed. The temperature of the hotbed must decrease to about 85 degrees or so before it will be desirable to sow the seed of early vegetables. A thermometer put into the soil will indicate this temperature.

Before sowing fine seeds such as of lettuce, tomato, cabbage, cauliflower, etc., it is desirable to screen the top inch of soil, using a screen not larger than a quarter-inch mesh. The number of plants of each vegetable should be estimated before sowing the seed. Seed is usually sown in a hotbed at the rate of 6 to 10 to the lineal inch, covering the seed at the rate of 1/4 to 1/2 inch deep, depending upon the size of the seed. In some cases seed are sown broadcast, as in the case of celery. The furrows in which the seed is sown may be made with a straight edge which is thrust into the soil to the depth of about a quarter of an inch. It is especially desirable for the amateur gardener not to sow the seed too thickly in the furrow. The limit of thickness should be 10 to 12 to the inch. The straight edge making the furrows should be 3/4 or an inch or so wide in order to allow for a wide distribution of the seed in the furrow. In this way, each little plant will have a greater amount of room in which to develop. Seed should be lightly covered and the soil firmed, afterwards being watered with tepid or warm water from a sprinkling can. It is customary to make the rows of the seed about 2 inches apart. It is always desirable to use small wooden labels in order that the variety and date of seeding may be properly recorded. Use a pencil with which to record this on the label. Ink on a label will soon be obliterated by the watering.

Maintenance of the beds. It is important to maintain a desirable temperature of 60 to 70 degrees in the beds for the growth of the young plants. Ventilation can be accomplished by the use of a notched stick, which will raise the sash to the desired point in order to regulate the temperature. A common mistake of plant growers is to keep the beds too warm with the humidity too high, and as a result plants succumb to the damping-off fungus. If the soil has been treated as suggested in earlier paragraphs, it is improbable that this disease will affect the seedlings, especially if the bed is given proper daily attention. Ventilate the bed so as to prevent a direct draught of cold air.

A common error in growing young vegetable plants is to allow them to grow too large before the first transplanting is done. The best time to do this "pricking off" is when the plant has three or not more than four leaves. The transplanting of the plants can be made into the same bed in which the seed was sown. The customary distance for setting the plants apart in the bed is 2 inches for such plants as lettuce, cabbage, cauliflower, and celery, and 3 or 4 inches for plants of tomato, pepper and eggplant. Plants set 2 x 2 inches beneath a standard 3 x 6 sash will total 648, or set at a distance of 4 x 4 inches, 162 plants can be grown. Cabbage, cauliflower and lettuce plants are usually ready for the first transplanting in 14-18 days, tomato in 21-24 days. Pepper, eggplant and celery plants grow more slowly.

In some cases, plants are transplanted directly from the seedbed into individual containers which are placed in the hotbed directly on the soil. These containers are especially useful for plants of tomato, eggplant and pepper and in some

cases cucumber, melon and summer squash. A single plant is set in the middle of the container in growing tomato, pepper and eggplant. Melon, cucumber and squash plants are transplanted but once; namely, directly to the field.

As the plants continue to develop in size, the temperature in the bed should be slightly reduced so that the plants are growing at a temperature approximating 60 to 65 degrees Fahrenheit. This cooler temperature in the bed may be obtained by giving the plants more air during the daytime and later on a slight amount of air at night. Later on, the young plants will be hardened before being set out in the field. For suggestions concerning this work in connection with plant growing, the reader is referred to Extension Circular 258, regarding the construction and operation of the cold frame in vegetable growing. A copy of this circular will be sent free on request. In a word, the hardening of the young plants can be accomplished by giving an ample supply of air during the daytime and there should also be reduction of the amount of water given. A severe hardening of the plants is unnecessary and undesirable. Some plant growers feel, for example, that tomato plants are not brought to a desirable hardening stage unless they are yellow or purple. Such a treatment can only result in harm to the plants, which can be properly hardened without such severe treatment. It is important to bear in mind that some of the plants which are raised in the hotbed are subject to injury by frost, such as those of tomato, eggplant, pepper, sweet potato, melon, cucumber, and summer squash, but plants which are hardy to frost include those of cabbage, cauliflower, lettuce and onions.

In the matter of watering the young plants in the bed, it is undesirable to sprinkle any seedlings except during the time that the young plants are first beginning to grow after the seed germination. After the plants are once above the ground, the watering should be with a watering can or hose without any sprinkling, preferably running the water between the rows of the seedlings.

The reader is referred also to Circular 251 regarding the growing of early vegetable plants under glass, Circular 274, regarding the flue-heated hotbed, also to Circular 258 on the use of the cold frame in the growing of early vegetable plants.
