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TREATING SOIL FOR CONTROL OF THE DAMPING-OFF DISEASE IN
THE GROWING OF EARLY VEGETABLE PLANTS

by

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During the plant growing seasons (extending usually from January to May inclusive, and sometimes during other months of the year) large numbers of young vegetable plants, such as cabbage, lettuce, cauliflower, onion, celery, tomato, pepper, eggplant, melon and cucumber, are grown in greenhouses, hotbeds, or cold frames. It is particularly important that in the growing of these young plants no factor hinder their proper development so that they may be ready for the field at the desired time and without serious losses in numbers. However, it frequently happens that a certain percentage of the plants, often a large proportion, succumb to the attacks of soil-borne diseases, principally the damping-off disease. In some cases losses due to this trouble may be heavy and involve a considerable number of the young plants.

Almost any soil used in the growing of seedlings is liable to be contaminated with disease-producing parasites, including those that cause damping-off. These may do serious damage to seedlings of the above mentioned 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 young plants have been pricked out from the seed rows into soil of greenhouse benches, hotbeds or plant boxes.

The damping-off disease usually, though not always, appears as soon as the seedlings are above ground since the young plants are then particularly susceptible. Plants that appear to be healthy one day may collapse by the next morning. 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.

Of the vegetables previously mentioned, plants of cabbage, cauliflower, cucumber, melon and tomato are particularly susceptible to damping-off, while plants of lettuce, eggplant and pepper are susceptible in a lesser degree.

To avoid the danger of needlessly losing plants in the early stages, it is particularly important that the soil for seedbeds, and also soil into which the plants are transplanted, shall be free from the damping-off fungi. 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: first, soil treatment or sterilization; second, treatment of seed.

CHEMICAL SOIL TREATMENTS

The several ways by which soil for plant growing may be treated are herewith discussed. The usefulness of one treatment over another may be estimated on a basis of the relative cost of the treatment, the readiness with which the materials can be obtained and applied, and the efficiency of the application in sterilizing the soil.

Formaldehyde Solution. A concentrated formaldehyde solution contains about 40 per cent of formaldehyde gas and is often sold under the name "formalin." It is mixed with water at the rate of 1 gallon of this solution to 50 gallons of water, applying this dilution to the soil at the rate of 1/2 gallon per cubic foot of soil. In some cases a formula of 1 gallon of formaldehyde to 100 gallons of water is used, 1 gallon of the dilution being applied to each square or cubic foot of soil.

The formaldehyde in this dilution can be applied to the soil by putting it on with a watering can having a coarse sprinkler. The soil should be spaded up and loosely raked before applying the liquid in order that it will spread uniformly through the soil area. The soil should be damp but not too wet. If the formaldehyde is poured on hard, dry ground it will not penetrate enough to be of any value. On the other hand, if it is mixed with soil which is saturated with moisture, the fungicide will be diluted to such an extent that it will not be of very great benefit.

Following the application of this material, the soil should be covered with burlap sacks, old carpeting, or some such material to prevent the fumes from escaping. This covering can be removed after a few days and when the soil is dry enough to spade, it should be stirred up occasionally so as to assist in dissipating the formaldehyde fumes.

The disadvantage of using formaldehyde is that this method of soil treatment must be done at least two weeks before it is desired to sow the seed in the soil or transplant the plants; otherwise germination and growth of seedlings may be seriously impaired.

The cost of the formaldehyde treatment (at 1933 prices) is approximately $1\frac{1}{2}$ to $1\frac{5}{4}$ cents per square foot of soil treated. The current price for formalin in relatively small quantities is about \$1.50 to \$1.75 per gallon.

The Cheshunt Mixture. This is composed of the following materials: copper sulfate, 2 ounces; ammonium carbonate, 11 ounces. These two materials, which should be crushed into a finely powdered form, added together in a glass jar and mixed by thoroughly shaking together. The mixture must 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, one ounce of this mixture is dissolved in two gallons of water and applied to the soil, thoroughly drenching it. The copper sulfate unites chemically with the ammonium carbonate, forming a new chemical combination of copper carbonate -- an effective soil fungicide, and ammonium sulfate -- a useful fertilizer. The soil solution should not be made up in tin or zinc because of chemical reaction but in glass or earthenware, which do not corrode.

One of the particular values of the Cheshunt mixture is that it can be used instead of plain water to water boxes of seed recently planted or in watering young plants which have been transplanted. On the basis of average cost of the chemical materials the Cheshunt mixture costs about one and a third cents per square foot of soil when applied at the rate of one gallon per square foot or about two-thirds of a cent per square foot if applied at half that rate.

Commercial Formaldehyde Dust. (Six per cent in powdered charcoal) This material is used at the rate of $1\frac{1}{2}$ ounces per square foot of soil for the depth of the average plant box or flat. However, where the soil in the flat is 3 to 4 inches deep, two or three ounces of dust per square foot must be used. If the soil is 10 to 12 inches deep and a foot square, 6 to 9 ounces of dust per square foot must be used. The dust is mixed uniformly with the soil and then the seed planted and the soil thoroughly watered. Previous to transplanting plants, the soil should be treated as above but allowed to stand 24 hours before setting the plants in the soil. At 1933 prices, the cost of the formaldehyde dust treatment varies from $2\frac{1}{2}$ to 15 cents per square foot, depending upon the amount of the dust purchased. In small quantities the commercial 6 per cent formaldehyde dust costs 30 cents per pound, but only 10 to 12 cents a pound in lots of 50 to 100 pounds.

Homemade Formaldehyde Dust. Homemade 6 per cent formaldehyde dust can be made from pulverized dried peat or muck to which commercial formaldehyde solution has been added at the rate of 1 pint to $5\frac{1}{2}$ pounds (or 1 ounce to 6 ounces). It should be mixed with the soil of the seedbed in the same manner and in the same proportion as the commercial dust.

Organic Mercury Compounds. The soil may also be treated with organic mercury compounds such as Semesan, in which case it is recommended that 2 ounces of Semesan be used mixed with 3 gallons of water. However, while the mercury compounds are not expensive when used for treating seed in dry or liquid form, the use of them for a liquid treatment of the soil is somewhat expensive. If half a gallon of the solution is used per square foot the cost would be about five to six cents, based on 1933 prices of these materials. Some ten days or two weeks should intervene between the period of soil treatment and planting.

When damping-off develops in patches in a seedbed, the spread of the disease may sometimes be arrested by watering the areas with Semesan made up at the rate of 1 ounce to 3 gallons of water. If this is done with care to prevent the chemical being sprayed on the leaves of healthy plants, this treatment may prove quite beneficial.

HEAT TREATMENT

Boiling Water. Small quantities of soil for plant growing can be treated against noxious parasites by saturating or drenching the nearly dry soil thoroughly with boiling water previous to seed sowing or transplanting. The heat should be retained as long as possible by covering the soil with canvas, burlap, old blankets, etc. The heat does the work but it requires some time to dry the bed out before planting.

SEED TREATMENT

Losses occasioned by the damping-off disease of seedlings can in part be reduced by treating the seed with various materials.

The organic mercury compounds, such as Semesan, are often used for this purpose, the seeds being treated by either dusting them dry at the rate 1/2 to 1 ounce of the dust to 15 pounds of seed; or if the seeds are treated with the liquid organic mercury compound, they are given a soak in a normal solution of 1 ounce to 3 gallons of water. The length of the soak varies with the kind of seed to be treated. Semesan is one of the safest and directions for its use are stated on the label of the material. The amount of the mercury compound material required is dissolved in a little warm water and then enough cold water is added to make up the required dilution.

For small quantities of seed a glass jar is satisfactory. Place the seeds in the jar and after adding the dry organic mercury compounds the seed should be shaken thoroughly for five minutes or so. The ordinary 5 or 10 cent package of seed requires about four to six times as much Semesan as can be lifted on the inverted head of an ordinary pin by holding the pointed end as a handle. Amounts of the dusting material recommended for various kinds of seed are stated in the leaflet accompanying the purchase of the materials.

GROWING CONDITIONS

General Maintenance of Greenhouses and Frames. Conditions maintained by some growers of young vegetable plants may encourage the development of the damping-off disease and aggravate its development and spread in the greenhouse. Such conditions as a close, humid atmosphere, high temperature, tightly shut sashes on frames or greenhouse ventilators, together with possible frequent waterings of the soil about the plants tend to cause ideal conditions for the attack of young plants by the disease. On the other hand, if the conditions prevailing include a normal air circulation, a moderate temperature of 60 to 68 degrees Fahrenheit, and only a sufficient amount of water applied at intervals to keep the plants growing steadily, such a condition will tend to reduce the possible development and spread of the fungus.

The maintenance of a forcing place in which young plants are growing requires particular watchfulness and care during period of dull or rainy weather. During such time water should be withheld unless absolutely necessary, and there should be an abundance of fresh air, providing a proper air circulation throughout the greenhouse or frame. The seedlings are much less liable to suffer from the damping-off disease when growing under bright, moderately warm, sunny conditions. Even then, however, at times there are serious developments of the disease so that in general it is wise for the grower to adopt methods of prevention rather than cure in attacking this problem.

It is also desirable to avoid crowding of plants in seed rows and heavy watering in soil that dries slowly. The soil mixture should contain approximately one-quarter to one-third sand or sandy loam so that the top soil of the plant boxes or beds will dry off readily. High humidity in greenhouses and frames is likewise undesirable and may be controlled largely by careful manipulation of ventilators and heat.