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Wm. A. Schoenfeld, Director
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SUGGESTIONS FOR THE CONTROL OF THE LEAF-MOLD DISEASE OF TOMATOES

by

A. G. B. Bouquet, Horticulturist, Vegetable Crops
F. P. McWhorter, Plant Pathologist

Tomato plants in Oregon greenhouses are frequently seriously injured by the leaf-mold fungus, Cladosporium fulvum, which causes the blighting, curling and molding of leaves usually referred to as the tomato "leaf-mold" disease. This fungus has no other economic host, but nevertheless when it once becomes established in a greenhouse it continues to be a menace regardless of what rotation sequence may be followed. This is because it can over-summer or over-winter either as a restive mold intermixed with dust and dirt or as an active mold vegetating in soil and debris. It is very difficult to eradicate this fungus in a greenhouse by means of chemical or heat sterilization methods; therefore in attempting control one must employ methods which tend to protect the plants from its attack. This circular discusses certain practical methods which are now in use.

Type of injury. All above ground parts of the plant are subject to attack. An outbreak of the disease is usually heralded by the development of unsightly spots on the lower leaves. These spots are pale green or yellowish above and olivaceous or purplish below. The lower discolored areas appear raised and fluffy since they consist of erect fruit bodies of the fungus bearing myriads of spores. Affected leaves soon blight and die. Meanwhile the fungus rapidly spreads to the upper leaves and also to the stems and blossoms, preventing the normal pollination and development of the latter. If the disease is unchecked, the whole plant later presents a brown, parched appearance, with hardly a green leaf remaining. Even mild attacks tend to devitalize the plants and reduce the size and setting of fruit.

Plants which have been weakened by virus diseases such as mosaic and winter blight, are extremely susceptible to injury by leaf-mold. Control of these virus troubles and avoidance of the losses which they produce is discussed in another circular of information.

Conditions favorable to the disease. An undesirable greenhouse atmosphere, namely, high air humidity and high temperatures, is especially favorable to the development of leaf-mold. Even under moderate temperatures when the humidity is high, the fungus often develops and spreads. The leaf-mold spores will not germinate if the humidity is less than 90%; hence the regulation of the moisture content of the air is an important factor in preventing the distribution of the fungus. Cloudy days are favorable for the disease, as the humidity is then high and the temperature usually somewhat lower. When the plants are actively growing and are giving off large quantities of moisture, high humidities in the greenhouse

are likely to occur, making it easy for the fungus to infect the plants. When the temperature decreases at night, the humidity increases as the moisture from the greenhouse soil condenses and forms a moist layer on the under side of the leaves, thereby providing a suitable medium for the infection of the leaf by the fungus. For this reason greenhouses having little or no heat at night are particularly liable to have considerable leaf-mold on the plants. The lower price of tomatoes during the fall and early part of the winter may prohibit the use of sufficient fuel to maintain the greenhouses to a desired temperature and a resultant lower humidity.

Greenhouse tomato plants usually have the greatest amount of infection during the fall and early winter crop when there is comparatively little sunshine and the humidity is high. The spring and early summer plants also are often affected, especially if the spring weather is unusually moist and cool.

Suggestions for the Control of Leaf-Mold

Time of watering. It is inadvisable, except in warm, bright weather, to apply water to beds or benches of tomato plants during the afternoon. It is best to water in the morning or during a period of rising rather than falling temperatures, thus giving the surface soil an opportunity to dry out before the temperature lowers. Especially is this important during the cloudy short days of fall, winter and early spring. So far as possible the leaves should be kept dry when watering. One can also reduce the danger of moisture of condensation during dark weather by applying the water in furrows near the plants instead of watering the entire bed. The furrows may then be closed up with dry soil.

Ventilation and air circulation. This is especially important in helping to regulate humidity and temperature. Ordinary ventilation by means of the ventilators fully or partially opened may not necessarily induce the circulation of air sufficient to reduce the humidity to a desirable degree. In some greenhouses there has been installed a system of forced ventilation sufficient to keep the air in constant circulation so that the humidity is lowered and the spores of the leaf-mold disease, if present, do not alight on a place favorable for their development. Ventilation and air circulation are particularly important when the plants are giving off large quantities of moisture during a period of rapid growth. Ventilation should be so arranged that cold drafts of air will not directly strike the plants. Some ventilators in the side of the greenhouse may serve to bring in fresh air for circulation throughout the house.

An automatic ventilating control is now available which will raise and lower the ventilators of the greenhouse according to thermostatically controlled temperatures. This automatic temperature control, however, does not necessarily control the humidity nor influence a desirable circulation of air throughout the house.

Night temperatures. If reasonably cheap fuel is obtainable the maintenance of higher night temperatures are helpful in controlling leaf-mold. Temperatures up to 62 and 65 degrees Fahrenheit help reduce the relative humidity and keep the air dryer. At 50 to 55 degrees there is a tendency to increase the relative humidity. There should, of course, be some ventilation at night when heat is provided.

Use of fungicides. Leaf-mold is not readily controlled by spraying or dusting. Copper sulfate mixtures are injurious to leaves and blossoms and are not satisfactory as a general control measure. Copper lime dusts show evidence

of only partial, if any, control. Lime sulfur has given partial control but has also been injurious to plants and left an undesirable residue on the fruit. In general the use of sprays or dusting materials is ineffective due to injury to foliage, difficulty of covering the parts of the plant affected by the disease, and the lack of actual killing of the spores by the materials used.

Vaporization of sulfur. Recent investigations in the use of vaporized sulfur indicate that this method may be capable of reducing the injury by the disease. The principle of the control is that the sulfur when vaporized into a dense fog will be deposited in very fine particles on the leaves, thereby preventing the germination of the spores.

The equipment for the use of sulfur in a vaporized form is as follows:

Electricity to heat the hot plate.
Electric hot plates. (Number varies according to area fumigated.)
Porcelain evaporating dishes, preferably seven to eight inches in diameter and about two and one-half to three inches deep. These dishes should hold at least one quart of sulfur and one-half gallon would even be better.
Asbestos pads, quarter inch thick by 8 x 8 inches, sufficient to cover the electric plate and having a hole 4 1/2 inches in diameter in the center.
Asbestos, four pieces, one inch square.
Flowers of sulfur.

In the matter of the number of plates required, it is customary to have one hot plate to each six to eight thousand cubic feet of glass, but the more hot plates used, the less time required to vaporize and the more thorough the application. Under most circumstances, however, one plate is used for 6,000 cubic feet.

In view of the fact that no two hot plates will supply the same amount of heat, it may be necessary to modify the use of asbestos lying between the porcelain dish and the hot plate. One should set up the heating apparatus by placing the four asbestos one inch sqares on the hot plate. Then on these squares put the asbestos pad with the hole already cut out to accommodate the porcelain dish, which should be full of sulfur when the fumigation begins. It is advisable to keep the surface of the melted sulfur in a porcelain dish within one-quarter to three-quarters of an inch of the rim of the dish. If the volume of sulfur is decreased much below this point there is danger of the sulfur taking fire and producing fumes, which would quickly injure the crop. There should be a periodical inspection of the dishes every twenty minutes or so to see that there is plenty of sulfur in them.

Some hot plates may require a complete covering with asbestos board without the holes, depending upon the amount of heat generated. The volume of the dish would also have some influence, for a dish of large volume on a hot plate generating a large amount of heat would be much safer than a dish of small volume on the same type of stove; vice-versa, a dish of large volume on a plate supplying but very little heat might not volatilize much sulfur and consequently would be rather unsatisfactory.

The period of vaporization may extend from two to four hours, a period which usually suffices to make the vapors in the air quite dense. There is no danger of using excess sulfur. The main precaution is to have enough sulfur in the dish and to have the plates set up properly to avoid danger of ignition of the sulfur itself.

It is desirable to make a vaporization just as soon as any symptoms of the disease are observed and to repeat the treatment two or three times at weekly intervals in order that the disease may be entirely checked in its development.

It is customary to vaporize the sulfur in the evening and have the ventilators closed for the night in order to confine the vapors and permit them to settle naturally on the plants.