

Disease Control in Greenhouses by Manipulation of Environment*

Robert E. Partyka

Department of Plant Pathology
Cornell University

Controlling the environment is often considered an ideal way to grow a crop. However, as most greenhouse operators can testify, this is often easier said than done. Some manipulation can be done in the greenhouse to grow the crop under the most desirable conditions. In some cases there must be a compromise, because other cultural factors enter the picture that result in serious losses when considering the overall operation.

Temperature and moisture are two important factors that must be considered. Most diseases in a greenhouse operation are influenced by moisture. Temperature affects the amount of moisture that the air can hold; as the air temperature is raised, the more water it can hold, consequently a drop in relative humidity.

Most fungi, causing problems in the greenhouse, will grow over a wide variation of temperature, growing best at optimum greenhouse temperature ranges. Therefore, primary control or restricted fungal growth must be obtained by controlling moisture conditions. In general, if relative humidity can be kept below 85 percent, diseases, such as botrytis stem and fruit rot, leaf mold (Clado-

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sporium), *Rhizopus* fruit rot, and *Trichothecium* fruit rot, seldom become a problem.

Some factors to consider in controlling the greenhouse environment are listed. All of them may not apply to a particular situation. Oftentimes only one or two factors should be considered to help give better disease control.

1) Accurate thermometers should be placed in strategic locations in the greenhouse to record cold spots and warm areas. Thermocouples and recording instruments will facilitate better records. A recording device will aid in knowing what occurs in the greenhouse when no one is there, especially at night.

2) Humidistats or portable sling psychrometers should be used to determine relative humidity readings in the area near the plant foliage. These can be used as warning devices to reduce relative humidity or to apply protective fungicides if it is apparent that relative humidity cannot be lowered due to weather conditions at a particular time of the year. Location of the sensing device is important. Measurement should be close to the plant, as readings in a walkway are meaningless from the standpoint of favorable disease conditions on plant tissue.

3) Distribution and location of heat lines is important in establishing proper thermal convection currents in the greenhouse. Air currents sweep the plants free of excessive moisture. Lines should be placed as close to the ground as possible. In the case of tomatoes, a heat line between every other row is necessary. Low areas in a greenhouse will need more heat lines to avoid a cold pocket.

4) Fans often can be used to eliminate stagnant air pockets in the greenhouse when heat lines will not do the job. The newer fan and perforated plastic tube system will help give better air distribution and eliminate cold air and stagnant air pockets.

5) Mulches serve a definite purpose in the greenhouse operation. However, they must also be considered from the standpoint of aggravating disease-causing situations or introducing disease-causing organisms into the greenhouse.

Mulches on cold soil tend to keep the soil cold because of their insulating properties. If placed too close to the plant, they act as barriers and restrict movement of air near the base of the plant, thus favoring a disease problem.

Some mulches can introduce disease-causing organisms into the greenhouse. Soil-borne diseases in the soil attached to roots or surface of mulches can be carried into the greenhouse. Weed hosts, such as lamb's-quarters for *Verticillium*, and red-root pigweed for *Rhizoctonia*, can often be found in mulches.

6) Drain tiles should be kept open at all times. High soil moisture can add to atmospheric moisture as well as causing root damage. Gutters should be kept in repair to avoid wet spots. Bacterial soft rot often develops in areas where gutters leak excessively.

7) Recognizing critical conditions that favor disease

build-up is essential in maintaining a disease-free condition in the greenhouse. If outside weather conditions are such that it becomes impossible to maintain desirable conditions inside, then knowing the next step is important.

8) Protective fungicides are useful in preventing a disease problem and in supplementing other practices to control diseases. Fungicides should be used when other practices fail to maintain the desired climatic conditions in the greenhouse.

9) When fungicides are used, they must be applied properly to achieve good protection. Drenches should cover the lower stem and soak into the soil. Foliage applications must be directed to the plant where protection is needed. A dust applied over the tops of tomato plants will settle on the top leaves and will not reach the lower leaves where protection is needed. When lower leaves are removed during wet weather, apply a fungicide immediately to protect the wounded petiole scar from botrytis invasion. Follow directions carefully when using pesticides in the greenhouse. Do not use excessive amounts, as injury and residues may occur; do not use less than prescribed amounts, as the degree of control may be poor.