The Effect of Greenhouse Cooling Systems on the Development of Plant Diseases

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In the past few years there has been widespread interest in various methods of greenhouse cooling. Because of this it has become increasingly important to determine what effect, if any, these cooling systems will have on the development and severity of plant diseases.

In the summer of 1957 experiments were set up at Ithaca and the Ornamentals Laboratory at Farmingdale to study the effects of various greenhouse cooling systems on several common plant diseases. Greenhouse cooling systems studied at both locations were low pressure mist, and pad and fan, and in addition to these, a high pressure fog system was used at Ithaca.

The plant diseases studied were divided into three main groups, the vascular wilts, bacterial blights and foliage diseases. Representative plant diseases from each group were studied under the various cooling systems and under no cooling.

VASCULAR WILTS

The diseases studied in this group are listed below.

Bacterial Wilt of Carnation—*Pseudomonas caryophylli*

Fusarium Wilt of Carnation—*Fusarium oxysporum* f. *dianthi*

Verticillium Wilt of Snapdragon—*Verticillium albo-atrum*

Verticillium Wilt of Chrysanthemum—*Verticillium albo-atrum*

If the cooling effect is great enough there are two effects that might occur with diseases in this group. One effect may be a delay in symptom expression and the other may be a decrease in the severity of symptom expression.

We were able to observe a delay of symptom expression in our experiments. This was particularly true with Verticillium wilt of chrysanthemum and snapdragon where the first and most severe symptoms were seen in the greenhouse with no cooling. Our experiments did not show any examples of a decrease in severity of symptom expression but it is possible that this might occur with diseases such as bacterial and Fusarium wilt of carnation if the cooling effect is great enough.

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The important thing shown by this experiment was that these differences were only of short duration and that after two months, when the experiment was terminated, these differences had disappeared. Under the conditions of our experiments there were no significant differences in disease development or symptom expression of the vascular wilts studied in plants grown in cooled greenhouses and those grown in an uncooled greenhouse.

BACTERIAL BLIGHTS

Bacterial blight of geranium (*Xanthomonas pelargonii*) was used in studying this group.

Symptom expression was most severe in the greenhouse cooled with low pressure mist. Such severe symptom expression under low pressure mist may be due to one or the other of two effects or a combination of both. First, the low pressure mist system may provide ideal environmental conditions for the development of this disease. Second, the low pressure mist system may provide ideal environmental conditions for secondary organisms such as *Alternaria* and *Botrytis* which invade plant parts only after they are first injured by the bacterial blight organism. Once established in the plant these secondary organisms further aggravate and increase the severity of the disease.

Under the conditions of our experiments the severity of symptom expression was probably due to a combination of these two effects. The plants under low pressure mist were the first to show symptoms. There was ample evidence of secondary organisms growing on injured plant parts during the experiment and the plants were killed back to the crown under low pressure mist. Inoculated plants in the pad and fan and uncooled greenhouses showed killing of individual branches or leaves but in no case was the entire plant killed.

FOLIAGE DISEASES

The following foliage diseases were used in this study.

Carnation Rust—*Uromyces caryophyllinus*

Snapdragon Rust—*Puccinia antirrhini*

Carnation Leafspot and Branch Rot — *Alternaria dianthi*

Chrysanthemum Leafspot—*Septoria obesa*

Rose Powdery Mildew—*Sphaerotheca pannosa*

Carnation rust and snapdragon rust developed most seriously in the pad and fan cooled greenhouse. Secondary spread occurred under these conditions in air currents from the fans. Rust development was less serious and secondary spread did not occur to any appreciable extent in the low pressure mist and the uncooled greenhouses.

Symptoms of carnation leafspot and branch rot were more severe under low pressure mist than under the other systems. Inoculated plants under mist had abundant lesion formation on leaves with some entire leaves killed by the fungus. Plants in the pad and fan and uncooled greenhouse exhibited only limited lesion development. After two months, when the experiment was terminated, entire branches on some plants were killed under low pressure mist while plants in the pad and fan and uncooled house showed limited lesion development and mild symptoms.

Chrysanthemum leafspot developed abundantly on all

inoculated leaves regardless of type of cooling.

Powdery mildew did not develop on roses in the mist house. In the other houses mildew developed seriously on plants near the door and at the opposite end of the houses but only to a limited extent at the center.

Summary

Under the conditions of this experiment symptom expression of the vascular wilts, such as Verticillium wilt of chrysanthemum and snapdragon, Fusarium wilt of carnation and bacterial wilt of carnation, was not affected by the greenhouse cooling systems used. No evident differences were apparent in any of the treatments after two months. Rust on both snapdragon and carnation developed more rapidly and more abundantly in the pad and fan house. Rust development was poorest in the uncooled house. Secondary spread of the rusts occurred in the pad and fan house. Carnation plants inoculated with *Alternaria dianthi* exhibited more severe symptoms under mist than in either the pad and fan or uncooled house. Geranium plants inoculated with *Xanthomonas pelargonii* were more severely injured when grown under mist than in the pad and fan or uncooled houses. Rose mildew was almost lacking in the mist house, and varied a great deal in the others, depending on position of the plants within the house.

Greenhouse cooling systems will not create diseases. Here, as in any other greenhouse operation, it is of the utmost importance to begin the crop with disease-free planting stock. If the planting stock is disease-free and proper measures are taken to keep it that way diseases will not be any more of a problem under cooling than they are in the usual growing operation. However, if the crop is started with diseased planting stock and put under cooling the disease problem may in some cases be more serious.