Colorado Flower Growers Association, Inc.

IN COOPERATION WITH COLORADO STATE UNIVERSITY

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Current Considerations

For Insuring That "Clean Stock" Is Absolutely Pathogen-Free

by Ralph Baker

The development of the shoot tip technique (3) for producing clean propagative stock was a significant advance toward the ultimate objective of obtaining absolutely pathogen-free material for commercial growers. Use of cultured cuttings had controlled only the vascular diseases. Now, using heat treated shoot tips, carnations may be freed of all the known viruses (4). In addition, and probably most important, pathogens carried over on the surface of the cutting (e.g., Fusarium roseum f. cerealis) are eliminated.

The final and perhaps most difficult problem remaining is that of preventing reinfection and reinfestation by pathogens. Protection against virulent strains of virus may be accomplished by infecting all mother plants with related attenuated strains. Much basic research will be required before this is accomplished.

For the past five years, attempts have been made at Colorado State University to prevent or inhibit reinvasion of pathogenic fungi, especially F. roseum, into steamed soil. Several approaches have been investigated. Treated soil has been reinfested with likely antagonistic but nonpathogenic microflora. Fungicides have been applied. Practically, these could be water soluble and could be applied at intervals along with nutrient solutions using proportioners now installed in most greenhouses. Nonsoluble fungicides usually have longer residual action and thus might be placed in the soil immediately after steaming persisting for some months. All of these possibilities have been and are being studied, but at present only sporadic success has been obtained.

Another approach has been studied. Systemic uptake of fungitoxins by mother plants could make the cuttings more resistant. These fungitoxins may be antibiotics, demonstrated to be systemic, or they may be a combination of a nonfungitoxic systemic with a fungicide. Ten of the most promising antibiotics have been screened for this purpose with no consistent success. Systemic chemicals combined with fungicides are now being studied and initial tests have been promising.

Steam-Air Mixtures

Perhaps the method now in development that holds most promise for "buffering" soils against reinvasion by F. roseum is the aerated steam treatment (1). This method has been developed in outstanding work by Dr. Kenneth F. Baker and co-workers at the University of California at Los Angeles and Berkeley.

In general, recommendations for steam treatment have urged that the temperature be raised to at least 180° F for one-half hour. Actually most plant pathogenic microorganisms, insects, viruses, and weed seeds in soil may be destroyed at considerably lower temperatures:

140° F for 30 minutes should be sufficient (Fig. 1). Treating soils by this means should insure a heat resistant "residue" population of nonpathogenic organisms able to resist reinvasion attempts by pathogens.

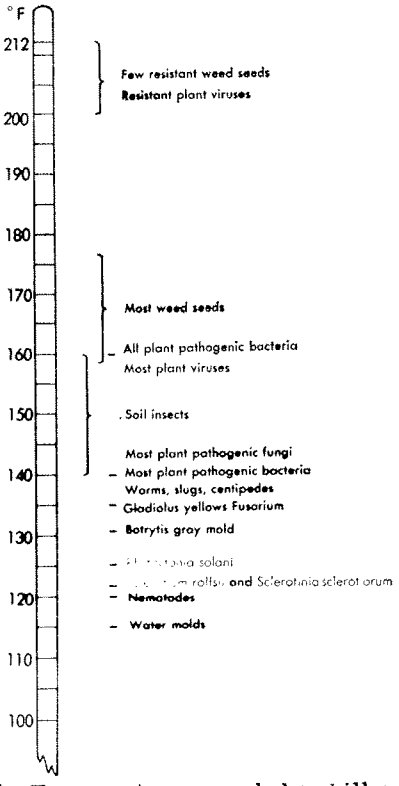

Fig. 1. Temperatures needed to kill organisms harmful to higher plants. These temperatures should be held for 30 minutes duration. (Source-UC Manual 23, Univ. of Calif., edited by K. F. Baker)

The validity of this reasoning has been amply demonstrated with certain organisms, like Rhizoctonia solani, that attack seeds and seedlings. In these cases the spread of the pathogen is suppressed in soil treated with aerated steam allowing the plants to mature and thus become resistant. Thus, aerated steam has proved its worth for application to bedding plant operations. For these operations growers would be well-advised to incorporate this method into their disease control program.

Whether this same control is possible with other types of pathogens is problematical. For instance, F. roseum usually attacks through wounds so that young plants are only susceptible during propagation and for a short period after transplanting (2). Treatment of benches with aerated steam might be advantageous in control in this case. Since the fungus is such a good competitive saprophyte, however, it is doubtful whether the residual microorganisms left in the soil after aerated steaming would be able to check the activity of the pathogen over long periods of time. Thus the later invasion of F. roseum through branch stubs probably would not be prevented using this treatment. Studies testing the desirability of using aerated steam for control of Fusarium stem rot will be initiated this fall.

Mixing Steam and Air

There is no system currently on the market for introducing aerated steam into benches. Interested growers will have to manufacture their own systems. Essentially, air and steam must be introduced into a common channel. Air can be introduced by means of a large volume, low velocity commercial blower (blade impeller or squirrel cage). A steam trap should be inserted immediately before the mixture enters the bench to insure that no free water is introduced into the soil. A vent with manual control in the air stream can be regulated to bring the mixed steam to the desired temperature. This temperature should be regulated by noting thermometer readings at a considerable distance from the discharge. An aluminum down spout about 3 inches in diameter with large holes at suitable intervals can be used to carry the steam down the bench. Runs should probably not be over 100 feet; at least no longer than necessary to bring the soil up to the desired temperature in one-half hour. In practice, a tarp is placed over the bench (Thomas method) and raw steam is introduced to billow it up. This insures that much of the air is driven from beneath the tarp. After this is accomplished, air can be introduced bringing the steam to the desired temperature.

While the value of this method has yet to be tested in all applications, growers should be aware of its possibilities. Research now in progress should give a more concrete basis for specific recommendations.

(The author wishes to express his appreciation to Dr. K. F. Baker for his helpful personal communications relating to the portion of this paper dealing with aerated steam.)

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