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Biology of *Pythium* Root Rot

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BACKGROUND

Pythium root rot is one of the most common causes of crop losses in floriculture. *Pythium*, a fungus-like organism is found in water, soil, sand, sediment, and peat as well as in plants infected at a propagator's facility. It can be spread by moving infested soil on tools or in water. It can also be moved by fungus gnat and shorefly activity. In order to effectively manage *Pythium*, we need to fully understand its biology , including what cultural practices render plants more susceptible to attack. To that end, several related lines of research were initiated. Research was done to examine the effects of soluble salt levels on geranium, poinsettia and begonia susceptibility. Work was done to determine whether soluble salt levels in plants affected peroxidase, an enzyme that may be involved in the plant's resistance reaction to pathogens. Finally, non-chemical disease management of *Pythium* was examined.

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Soluble salts threshold above which geraniums are more susceptible:
Experiments were conducted to clearly define the threshold level of fertilization at which geraniums become more susceptible to *Pythium*. Fertilizer levels were established in steps of 50 ppm N using 15-16-17 (N-P-K) fertilizer from 100 ppm N to 450 ppm N and also by using 15-16-17 at a base level of 50 ppm N and supplementing that with NH_4NO_3 to obtain the steps.
Results: A distinct soluble salts threshold level, below which plants were resistant and above which they were susceptible, was not identified. As the salt level increased, so did disease incidence and severity. This indicates that the interaction among the plant root, the fertilizer and *Pythium* is very complex and does not hinge on a simple mechanism.

Effects of soluble salts on *Pythium* susceptibility of poinsettias known to differ in nitrogen uptake:
It was determined that the root environment can have different effects on the host-*Pythium* interaction depending on the cultivar of its host plant. The influence of fertilization rates (100, 200, 300, 600 ppm N) on *Pythium* root rot was examined.
Results: Poinsettia cultivars Hegg Red, Angelica, and Subjibi were significantly more susceptible at high fertilization rates. Red Sails, known to be efficient in taking up nutrients, was more susceptible to root rot only at the very high rate (600 ppm N). Low and moderate rates did not differ in their influence on disease development.

Effects of soluble salts on *Pythium* susceptibility of begonias:
Various species of plants respond differently in *Pythium* susceptibility as influenced by soluble salts. This may also be the case at the cultivar level.
Results: The begonia cultivar Olympic White was slightly more susceptible at high fertilization rates (400 ppm N using 15% N-16% P-17% K)

than at the low rates (100 and 200 ppm N). Olympic Red was very susceptible at all three fertilizer levels.

Influence of soluble salt levels on plant resistance enzyme activity:
The peroxidase and polyphenol oxidase enzyme activity (indications of response to pathogen attack in some types of plants) in root extracts taken from healthy and *Pythium*-inoculated seedling geraniums up to 4 days after inoculation were measured.
Results: The activity of these enzymes was low and was not suppressed in geraniums grown at high fertilizer levels as compared to geraniums grown at moderate or low fertilizer levels. Geraniums grown at high fertilizer rates are much more susceptible to *Pythium* root rot than plants grown at low rates (100-200 ppm N). The generally low levels of these enzymes in the roots indicates that they do not play a significant role in root susceptibility to *Pythium*.

Non-chemical management of *Pythium*:
Studies were carried out to determine whether *Pythium* root rot, initiated by zoospores or mycelium, could be managed either by supplementing liquid fertilizer with elevated levels of calcium or a surfactant or by the application of a biological control agent. The seed-type geranium cultivar, Showgirl, was grown in a soilless potting mix and fertilized with a water soluble fertilizer (15% N-0%P-15%K). While some plants received no other treatments, others were treated with metalaxyl (Subdue 2E) or *Trichoderma* (RootShield). Some plants received fertilizer supplemented with the surfactant AquaGro 2000L at 20, 30, or 100 ppm. Reduced nitrogen-elevated calcium treatments were established by supplementing the 15-15-15 fertilizer mixed at 50 ppm N with calcium nitrate at 20 or 30 ppm N. Plants in each treatment were inoculated with *Pythium ultimum*, *P. irregulare*, or *P. aphanidermatum* by initially growing them on sterile rice grain and then sprinkling colonized grain into partially filled pots prior to transplanting. Other plants in each treatment were inoculated with *P. aphanidermatum* or *P. irregulare* by pouring water containing 1000 zoospores on the surface of the potting mix in each pot.
Results: Metalaxyl consistently protected plants against all three species of *Pythium* regardless of whether zoospores or colonized rice were used as inoculum. The reduced nitrogen-elevated calcium, surfactant, and *Trichoderma* treatments tended to suppress disease when zoospores were used as inoculum but not when colonized rice was used.

CONCLUSIONS

The research revealed that although high levels of soluble salts often render plants more susceptible to *Pythium*, no threshold point above which growers should not venture was identified. While some plants become very susceptible to *Pythium* at high salt levels, other plants and cultivars are made only slightly more susceptible. Therefore, the only generality that can be made is that, in general, high salts render most plants more susceptible to *Pythium*. The mechanism of increased susceptibility is not known and is probably very complex. Finally, although supplements to fertilizer, including surfactants and calcium, can disrupt the activity of the zoospore stage of *Pythium* the vegetative mycelium can also cause infection and is not sensitive to these supplements. On the other hand, fungicide can control both stages.

IMPACT TO THE INDUSTRY

1.) In order to avoid increasing plant susceptibility to Pythium root rot growers must monitor soluble salts levels in their crops regularly and try to maintain moderate levels of fertilizer in the potting mix at all times. 2.) Calcium or surfactant supplements can disrupt *Pythium* zoospore activity and assist in control but cannot be relied on to completely control this organism.