Pythium only successful in stressed plants

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Pythium is probably the most wide-spread root disease; it occurs in nearly all greenhouse crops. Different Pythium species prevail in different crops and under different conditions. Some Pythiums can be devastating, while many others are not fatal but they just retard the growth. It is very typical for Pythium that it only successfully attacks plants in poor growing conditions. The best way to prevent Pythium is by avoiding plant stress.

Pythium infection
Spores of Pythium can be found everywhere: in nature, in horticultural soils, in potting mix, sometimes in rivers and water stores, in soil dust and on plant roots. However, even when Pythium is present it does not necessarily harm the plants. Sometimes the spores do not germinate, or if they germinate they are not strong enough to penetrate healthy plant tissue. Sometimes Pythium accomplishes a small infection, causing some root death which is compensated by the formation of new roots. A healthy plant outgrows a Pythium infection, and the grower won't even notice that Pythium is present. In other cases Pythium retards the plant growth, and the plants get uneven. Occasionally Pythium causes massive crop loss by severe root rot in many plants or even plant death.
The severity of the damage depends on the Pythium species and on the conditions. Successful infection is due to a combination of factors:

1) stress on the plants (non-optimal growing conditions)
2) the presence of a Pythium species that thrives under the prevailing conditions.

Cold stress and water logging
The conditions are often miserable for plants in the winter, especially in poorly heated greenhouses. Low temperatures and dull conditions slow the plants down and reduce the transpiration and water uptake. This may cause water logging in the soil as well as in soilless systems (for instance in low places in the gullies). Water logging is notorious for promoting Pythium infection. Plants on cold and/or wet places are the first to be conquered by Pythium. The Pythium species involved are adjusted to low temperatures.
The root rot caused by Pythium can be reduced by removing the stress factor. Any method of increasing the temperature and reducing water logging will benefit the plants. Obviously the best method of avoiding cold-stress is by heating the greenhouse, especially near the root-zone. Another option is to put polystyrene under the bags or plastic gullies. This improves the temperature and supports the plastic gullies (thus avoiding waterlogging pits). It is important not to over-water the plants in dull periods, and to create adequate drain.

Heat stress
Other Pythium species are specialised for warm conditions for instance 30 °C and higher. A so-called 'tropical Pythium' can play havoc with hydroponic lettuce plants in warm summer periods. At 30 °C, the plant are under (heat) stress. Infection occurs only at high root-zone temperatures and in the presence of a high-temperature Pythium species.
In an experiment we introduced 'tropical Pythium' spores to hydroponic lettuce plants. Some gullies were heated to 32 °C. We observed that the inoculated plants in heated gullies got readily infected by Pythium root rot. In contrast, the inoculated plants under normal temperatures withstood the Pythium attack without a glitch because they were not under stress. This type of Pythium disease can be avoided by avoided too high root-zone temperature, for instance by covering the gutters with white plastic, and keeping the irrigation tubes shaded too.

Chemical stress

A grower of hydroponic lettuce experienced serious root rots and considerable yield loss. Diagnosis of some sick plants revealed that Pythium was involved. New crops became infected all the time, and so the root rot existed year-round with ups and downs. The grower started adding hydrogen peroxide to the nutrient solution for root rot control. But the situation aggravated. Thus he dosed more hydrogen peroxide into the mixing tank, up to 60 ppm every day. Also this could not cure the problem: many roots were completely rotten. Samples were diagnosed repeatedly and Pythium was found all the time.
Then a few of the most severely rotten plants were transplanted into another hydroponic system. In fact this was because we wanted to introduce Pythium into a Pythium experiment. To our surprise we saw that the test plants stayed healthy and that the rotten plants quickly recovered (see photo 2). The grower then decided to do away with hydrogen peroxide, and from then onwards the crop improved considerably. The grower had thought that Pythium was the cause of the root rot, whereas in fact hydrogen peroxide caused the damage, and Pythium was the secondary problem.
Also other chemicals in the nutrient solution may pose chemical stress on the plants. We did some other experiments, similar to the one with heat stress (see above, and photo 1). We found that both low-pH stress and high-CF stress were able to weaken the plants so that Pythium could infect the plants. The remedy of course is removing or reducing the chemical stress factor.

Heavy plant load

Tomato, capsicum or cucumber plants with a heavy fruit load are susceptible for Pythium. Loaded plants tend to put nearly all their energy in the growing fruits, and a little bit into the growing point, while the roots often miss out completely. This means that no new roots are being formed to replace dying roots (it is normal that some roots break down continuously). Heavy fruit load mostly occurs in summer, thus we are dealing with high-temperature Pythium species. Three factors are involved in this situation: plants with high fruit load, high temperature and the presence of a high-temperature Pythium species. If they all happen at the same time, there is a fair change that Pythium root rot will take its toll.
A remedy is to properly control plant load and ‘internal balance’ between generative and vegetative growth, so that the roots still get sufficient sugars and keep growing.

Stress by pest and diseases

A major stress factor is a pest or disease. Plants that suffer from an insect pest or a pathogen (fungus, nematodes, virus, etc.) grow slower than normal. Pythium takes advantage of the weakness of the plants, especially weaker roots. Quite often Pythium is found on the roots together another root disease. Mostly the other root disease conquered and weakened the plant first, and Pythium entered the plant secondly. Generally the pests and diseases themselves are harmful enough, so the grower will be urged to control them. Pythium will get reduced at the same time.

In conclusion, Pythium disease is at least a nuisance and sometimes a real disaster for a crop. It can be reduced to a great deal by avoiding stress conditions that weaken the plants.

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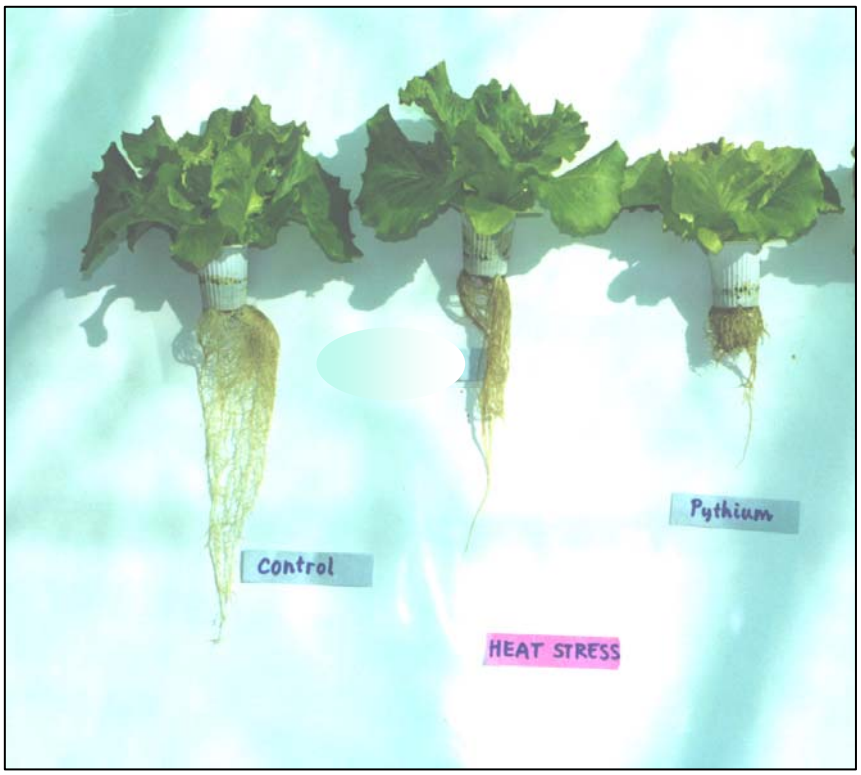

Photo 1: plants exposed to heat stress (32 °C root temperature).
Left: control plant.
Right: plant inoculated with Pythium.
But Pythium had no effect on plants at normal temperature.

Photo 2. A hydroponic lettuce plant recovers from chemical stress. This was on the second day after trans- planting from a chemically stressed nutrient solution, to a stress-free nutrient solution. In a new fresh environment, the new white roots were able to completely outgrow the Pythium. Pythium was found on the old rotten roots, but was not the cause of the rot.