Sanitation and hygienic husbandry to prevent root rots

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Published in the Commercial Grower 55(2), 2000, p. 27-28

A soilless system at the start of a new growing cycle can be clean from diseases and virtually sterile. But this normally won't last very long, especially in a pure hydroponic system (water culture). Pathogens are eagerly waiting to enter the system. Different growers have different attitudes towards disease control. Grower X, for example, lets the pathogens come in freely and when the first disease symptoms appear, he frantically starts using chemicals. Grower Y, in contrast, tries to make it very difficult for the pathogens to access the system. And if a disease shows up later, this grower applies mild control methods and his plants will suffer minimal damage. Grower Y understands the biological balance in the root environment, and he knows that hygienic husbandry and sanitation are the key factors for reducing root disease problems.

Where does infection come from?
There are very few micro-organisms (microbials) present in a new growing system, whereas in an older culture there is abundant microlife. They enter the growing system from various sources, such as:

- seedlings, sometimes even the seeds
- potting medium used for propagation
- irrigation water
- dirt on hands, tools, shoes, boxes
- dirt splashing up from the ground under the gutters
- dust blown in from surrounding areas
- via insects and birds

Once in the growing system, the microbials settle in easily when the conditions are suitable for them. Amongst the different microbial species, it is likely there are some that can cause root diseases: these are the pathogens. Pathogens include viruses, bacteria, funguses and nematodes. Although there is a real risk for root diseases, there are different approaches as how to deal with this threat.

The 'sterile' / chemical approach
After a clean start, the young crop may gradually show the first signs of root disease. Grower X believes that the best growing system is a 'sterile' growing system, so he immediately starts adding a control agent to the nutrient solution in an attempt to kill the pathogens. The control agent can be an agrichemical (pesticide), of which there is a range in use, or an oxidant such as chlorine, bromide, iodine, or hydrogen peroxide. Or an ozone treatment can be applied. These compounds may kill the disease-causing organisms in the nutrient solution, but unfortunately they cannot reach any pathogens inside the plant or ‘hiding somewhere in a corner’. And thus the pathogens are not completely eradicated and they can re-appear at any time.
When grower X finds the root rot symptoms again later, he will increase the dose of the chemical. But too high a dose of oxidant damages the roots, often seen as brown or grey roots. The grower can incorrectly interpret this as root rot caused by pathogens. He will then add even more chemical or try another one, thus aggravating the condition of the roots. Some pathogens such as Pythium are just waiting for this opportunity: as the roots get weaker, the pathogen strikes harder. The roots are then severely damaged by both the oxidant and the disease.

Systemic agents
Systemic pesticides may be more effective because they act from within the plant. But they leave residues in the plants and require a longer withholding period between application and harvest, to avoid that customers get the pesticides on their plate. Generally with pesticides there is a risk that the pathogens develop resistance, so that the pesticides loose their effectiveness in the long term. In a desperate attempt, the grower can empty the system and clean everything using oxidants such as chlorine. However, sooner or later the infection will reoccur from water or soil. Thus to keep a system 'sterile' is a hard battle.

Non-chemical approach
Grower Y knows that mother nature has her own ways of protecting plants from pathogens. A range of micro-organisms (microbials) such as bacteria and fungi live on the roots. Some of these microbials are harmful (the pathogens) but many are harmless, or even beneficial to the plants. The harmless and beneficial types don't feed on the roots but on products discharged by the roots. They occur naturally in each system! All microbials, the harmful and harmless, compete with one another for space and nutrients. In some conditions the 'good guys' thrive, and in other conditions the 'bad guys' do better. When the conditions are right for the good ones, they can keep the pathogens at bay. But they do not eradicate the pathogens. As long as there is a healthy balance (more good than bad ones!) the plants won't get affected by root diseases as much.
In this balanced situation, it is critical not to use any chemicals (pesticides or oxidants), as these would kill all the microbials including the naturally occurring beneficials, and it would take a long time before the natural balance is re-established. It is also important to avoid extreme conditions in temperature, CF and pH. A change in conditions can shift the balance in favour of the pathogens and can also damage the roots.

Biological control
A step further in the non-chemical approach is to use biological control. This means that the grower helps mother nature by adding the friendly micro-organisms, instead of waiting for them to establish naturally in the system. There are various promising products being developed, but at present there are not many products with a 'guarantee for success'. This means growers will need to find out how these products perform best in their system, and sometimes a product may not be effective. Biological control is very promising, but more research and development is needed.

Hygienic husbandry and sanitation
Let's go back to the start again, when there were very few disease causing organisms in the growing system. Grower Y tries to keep the pathogens out of the system as much as possible and thus minimises root diseases. The main components of his 'hygienic husbandry' are:

Sanitising. To make a clean start, the propagation place and the production area are sanitised before the plants arrive. All parts of the system are treated and rinsed thoroughly, and the growing medium is renewed or sterilised. However, in a biological operation one can choose not to treat the old growing medium and thus to maintain the beneficial micro-organisms.

Sterile seeds and growing medium. The seeds and the growing medium used for propagation must be absolutely free of pathogens. When buying organic material such as bark or potting mix ask for guarantee from the supplier that the medium has been sterilised. Keep asking, because different batches may be of different quality. The seedlings should not be in contact with infectious or suspicious material (anything with soil!). It should not be necessary to use chemicals on the young seedlings.

Clean irrigation water. Checked regularly if the water, whether from a bore, pond or stream contains pathogens. A possible cause is that dust (soil particles) with pathogens can land on the greenhouse and end up in the water storage. Pathogen-containing water should be sterilised. The various water treatment methods (heating, UV, special filtration, ozone etc.) are topics of discussion in a previous and in several forthcoming articles in this series.

Optimal growing conditions. Plants growing vigorously are much more capable of resisting an attack by pathogens. Every attempt should be made to create ideal growing conditions throughout the plants' life. Stress on the plants (too hot, cold, dry) must be avoided. The CF and pH of the nutrient solution should not vary too much, as that may weaken the roots and may affect the beneficial microbials living on the roots.

Avoid contact with soil. Natural soils host a range of pathogens, for instance Pythium is very common in most soils. Soil particles can end-up in the growing system by sticking to boxes, tools, hands, shoes; splashed up with water; or blown in as dust. Boxes, tools etc. can be sanitised before they get in contact with the plants: rinse them with water or (if there is a real risk of disease transfer) with chlorine. The ground under the soilless system should be isolated as much as possible for instance by covering with (white) plastic foil.

Removing sick plants. A plant with root rot is a source of infection, as it is full with disease material. A fungus living in a plant produces spores and mycelium. Some organisms produce survival structures that are very hardy. In hydroponics (water cultures), rotten roots break off and root particles move freely through the nutrient solution. In bag cultures, the disease will be present in the drain water (run-off). Recirculating this drain without treatment spreads the pathogens. Therefore all sick plants should be removed (or isolated) and to reduce the infection pressure on the healthy plants.

Insects. Insects, nematodes, birds and other creatures can transfer disease-causing organisms from one plant to another. Removing sick plants removes the source, but still the diseases can be brought in from elsewhere. Controlling the vector (insects) is the other way.

In summary, proper hygiene and sanitation help to minimise contamination and reduce plant infection by root pathogens. They are part of integrated and biological control, and are also extremely beneficial in traditional soilless growing operations.