Ozonation in soilless cultures. Part III: growers' experiences

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The previous two articles in this series dealt with ozonation: one was about the principles and techniques, and the other about the recommended dose and contact time, or rather the lack of recommendations. In this article we describe the experiences of some growers who are actually using ozone for their soilless systems.

Ozone against Pythium in bore water (1)
A cucumber grower since ten years in North Auckland has problems with the quality of the source water, which comes from a dam. The water is filthy and full of pathogens. Cucumbers are sensitive to Pythium and hence there used to be root rot all the time. Already six weeks after planting the first symptoms appeared, and often 20-30% of the plants were affected. The grower had to apply a lot of chemical drenches, and the results were never satisfactorily.
Four years ago he decided to treat the source water, and installed an ozone generator. The water is pumped from the dam into a 20 m^3 holding tank, and from here onto a large sand filter. After coming out of the filter the water is ozonated and then goes back into the holding tank. The ozonation continuous 24 hours a day, at a rate of 1 gram per hour. Water is pumped out to the mixing tank when necessary, and the holding tank is topped up automatically to keep a constant water level.
Since the ozone generator was installed, the root problems disappeared. Fungicide drenches have not been used since, saving a lot of costs. The water is crystal clear. The micro-tubes used to be blocked by dirt and are now clean. The roots are a lot better and the whole plants have improved.

Ozone against Pythium in bore water (2)
A hydroponic lettuce grower in Christchurch had tremendous problems with Pythium in his crop, with two-third of the plants going down. The water comes from a shallow bore in a swamp area and proved to be heavily contaminated. He looked at the options, and installed an ozone generator with an air dryer. A tank of 25 m^3 bore water is ozonated continuously with 1 gram per hour, 24 hours per day. Water is pumped out of the tank when needed, and new water comes in, while ozonation takes place. He used an ORP meter in the beginning and saw that the readings were high, showing that the system worked. He does not measure ORP anymore.
Since the ozonation started, the hydroponic lettuces have been free from Pythium. The grower says he would have been bankrupt without ozone, whereas now he is one of the top producers. Ozone saved his business.

Ozone against algae in source water
A grower in Tauranga grows roses in pumice bags in a run-to-waste system. The water is collected from the greenhouse roof. The grower is not aware of any diseases, but he found algae a problem, as they blocked the drippers. He installed an ozone generator with a capacity of 1 gram per hour. First the water passes a filter. Then it is pumped from a catchment tank to a 25 m^3 tank clean water tank. In between the catchment tank and the clean water tank ozone is added via a venturi. From the clean water tank the water goes to the nutrient tank when needed. This treatment produces perfectly clean water, which is used for making up the nutrient solution as well as for drinking water. Since the ozone generator was installed there are no problems with algae anymore. The plants are doing well. He has no diseases in the roses, and he believes that the extra oxygen in the water is good. He commented how difficult it is to get guidelines or recommendations for ozonation.

Ozone against iron in bore water

A hydroponic herb grower South of Auckland uses bore water with a high iron and sodium content. This is mixed with rainwater from the roof that may contain disease spores. A few years back she had Pythium problems. She looked at UV, but that was not an option due to high turbidity. So the choice was ozonation. The source water is treated in batches. It flows from the main storage tank into two treatment tanks of 5 m^3 each. In the evening the ozone generator starts putting ozone in, and early in the morning the generator is switched off to let the ozone disappear from the water. The treated water from these tanks is used for making up the nutrient solution during the day.

At first the grower used one ozone generator. The results were excellent: the roots became whiter and healthier. However, some time later a serious Pythium infection caused havoc in lettuce plants. The property had expanded and it was thought that the capacity of the ozone generator had become too low, which led to the root rot problems. So a second generator was installed. This made a big difference, as the roots became healthy and white again. This grower has got an ORP meter, but does not use it.

At present there are minor root disease problems, perhaps due to the fact that the recirculating nutrient solution is not treated. The grower believes that treatment is not necessary, because the nutrient solution is dumped every week due to sodium accumulation. She is content with the ozonation, as it solves the iron problem in the bore water and improves the quality of the roots.

Ozonation and flocculation

A hydroponics tomato grower in Auckland has long-term troubles with various root diseases. He uses rainwater collected in an unlined pond. The water is muddy and contains pathogens. The grower decided to use ozone. However, the water contains also a lot of silt and algae, which would hamper the ozonation process. Therefore the water must first be clarified by a flocculation process. This means that a flocking product is added to the source water in a flocculation tank. This binds the debris and forms a sediment in the tank, which has to be removed regularly. From the flocculation tank the water is pumped to the ozone generator, and ozone is dispersed in two ozone towers.

Flocculation is normal practice for municipal water but is not often applied for horticultural purposes because of the costs and the fact that it has to be monitored daily to avoid over or under flocculation. The grower has experienced some problems, for instance that the flocks came in the hydroponic system. Subsequently the amount of flocking material was reduced, but perhaps was set too low. Recently the flocculation was fine-tuned again, and the grower expects that ozone will be effective from now on.

Ozone in the nutrient solution

Not many growers use ozonation for the nutrient solution, as ozone is considered to affect the nutrient solution. A grower in Christchurch, growing tomatoes in a recirculating bag culture, had a bit of root rot problems, especially Pythium. At that time he saw excellent results of ozone against root diseases in a hydroponic lettuce crop. So he decided to try ozone treatment of the nutrient solution. He got an ozone installation to treat the water of two greenhouses of around 1000 m^2 each, and later he bought a second installation for a third greenhouse. The run-off is treated in a continuous flow. A T-piece in the line with a venturi sucks the ozone in. The nutrient solution with ozone flows into the line and through a diffuser (a pipe with very small holes) into a 3 m^3 nutrient tank. Here the ozone is supposedly absorbed by the nutrient solution. The treatment takes place in a continuous flow of nutrient solution.

Initially he treated each tank for 12 hours per day, at a supply rate of 0.5 gram per hour. After 12 hours treatment there was yellow foam floating on the nutrient solution, which may have been iron. He also saw that some materials, which were not made out of the right material, were damaged by ozone. These two observations made him decide to reduce the duration of the ozone treatment. At the moment he uses the ozonation only three hours every other day, still at the same rate of 0.5 gram per hour in the 3 m^3 tank with flowing nutrient solution. The ORP meter did not work for this grower: he finds that the ORP readings don't make sense.

Directly after starting the ozonation the roots got very white and the root mat thickened. To test the effect on the nutrient solution, the grower took samples before and after the ozone treatment, and had them analysed. He did not see any significant differences, at the ozone concentration that he used.
Apart from treating the solution, this grower also found that ozone was very good for cleaning the system after the crop was finished. He fills the tank with water, puts the ozone generator on for 48 hours, and lets it pump around for two days. This really cleans up all the pipes, pumps and drippers. This grower is very positive about ozonation.

Conclusion
Most growers interviewed were very satisfied about ozonation as a water treatment. It is mostly used for source water to remove iron, manganese, algae and pathogens. Also pesticides and bacteria (including iron bacteria) can be removed effectively, and micro-tubes are cleaned. An extra benefit is that ozone increases the amount of oxygen in the water. Most growers and suppliers indicate that the dose and contact time are not very clearly defined, and some suppliers said that such information is confidential. It seems to be a matter of experience, or trial and error, to establish a method that works for the particular situation. The risk of oversupply is minimal because ozone is broken down so quickly in water. Hence root damage due to ozone is unknown in normal situations. Growers found that ORP measurements were not consistent and therefore not helpful. Some growers commented that ozone is cheap, or at least cheaper than other options. The costs are mainly the power costs for running the pump. In conclusion, most people in the know agree that ozone is not a good option for treatment of a recirculating nutrient solution, but that it is excellent to fix the problems in source water.

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