Water Quality in Propagation

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INTRODUCTION

Over 70% of the world's surface is covered by water, but 97% of this water is salty. Of the remaining 3% of fresh water, 2/3 is tied up in glacial ice. Only about 7/8 of 1% of the world's freshwater is liquid, and 95% of that is underground. In most countries 90% of people depend on ground water as drinking water. Looking at these figures it is clear why our ground water resources are so precious.

To many of us water is taken for granted. Most of us have water on tap in our homes to use for drinking and washing, and watering our gardens. When we take a glass of water to drink, and we look into it and through it, how many of us realise the effort that has gone into making that water safe for us to drink. It has been taken from a storage facility, many kilometres away, and after many treatments and tests, it is delivered to our home. We take for granted that all has been done to it that is necessary, to make it safe for our use.

I am sure that our thoughts of safety in water supplies carry over in many cases to the water we use on our nursery crops. We look at water as essential to plant growth, which of course it is. What many do not consider is that it can also be the carrier of a deadly brew of bacteria and fungal spores just ready to explode into growth when applied to propagation and growing areas and to the media in which plants grow.

This paper is designed to make you think about what you are doing. All the best hygiene in the world will break down, if you do not get this essential area right.

In propagation of plant material, whether by seed or cutting, all of us realise that water, in its basic form, is one of the most critical elements for success. I would suggest that all of us think long and hard about the media type we use, about the fertilisers we incorporate, and about the types of cuttings or seed material we use, but I am sure very few give much thought to the unwanted microorganisms in the water we apply. Through its physical properties water can dissolve, hold in suspension, and spread many things that are harmful to our crops.

Over the years, many ways have been introduced to maintain moisture in the seed or cutting until it germinated or rooted. Only once the seed or cutting has established itself does this reliance on moisture become less critical. At this stage of its development we wean the young plantlet to normal cultural practices.

PLANT PATHOGENS IN PROPAGATION WATER

In applying water to hold transpiration to a minimum we use several methods. All of these methods result in water from an outside source being applied in lesser or larger quantities to our propagation benches.

Plant pathogens can be transferred in surface water. They are commonly called water moulds, and include *Phytophthora*, *Pythium,* and *Rhizoctonia*.

On cutting benches and in seedling trays, *Phythium* and *Rhizoctonia* are devastating. *Phytophthora* fungi are generally slower-working, but always results in the eventual death of the plant. It is critical, at all stages of the nursery program,

that we use water from a clean source, or that we treat the raw water to ensure that it is completely free of pathogens.

In most cases water coming from deep wells is clean. However, tests for pathogens would need to be carried out over a long period to ensure that the source is clean. One must not take it for granted that because one is using well or bore water, one will have no problems. These tests for problem pathogens must be carried out throughout the year, including very wet and very dry periods of the weather cycle, and should continue for at least two full cycles of the seasons.

DESTROYING UNWANTED PATHOGENS

There are several ways of treating water to kill these unwanted microorganisms.

Filtering—The First Step. In using any method, water has to be filtered beforehand to remove suspended silt and solids. Sand filters are commonly used for this purpose. Impurities in the water tie up chemicals being applied and result in a situation that is impossible to monitor. Sand filters are back-washable, and can either be hand-operated or automatically operated, depending on the amount of sediment to be filtered from the raw water.

Chemical Water Treatments. Available water treatments to eliminate pathogens are of two types. These are by chemical treatment or physically by micron filters or ultraviolet light. Chemical treatments in use include the following:

Chlorination.

- Chlorination by injection of chlorine gas.
- Chlorination by injection of liquid sodium hypochloride.
- Chlorination by batching water and adding calcium hypochloride powder.

Bromination. The systems I have seen in use in nurseries were using sodium bromide in a solid form. These blocks were immersed in the storage tanks. Water was used for irrigation after predetermined times from the storage filling.

Ozone. One reads of this treatment in the literature. I have not seen it used in our industry, but did hear a paper on it at a conference which told us that ozone is extremely corrosive and also highly toxic. I doubt that it is of use in our industry.

NON-CHEMICAL TREATMENTS.

Fine Membranes. Fine membrane filters could be used but in practice, the sheer volumes of water often needed, will mean that the installation will have to be so large as to be uneconomical.

Ultraviolet Light Irridation. This system works well if water going into the treatment area is clear. Silt particles, and even minor impurities in the water, will result in some escape areas for pathogens. Silt particles can shield some of the water passing through from the light, just as a door will either let light shine through or be dark, depending on whether it is shut or open. Impurities can discolour the tubes the lights are in, so maintenance of this area is on-going.

WATER TREATMENT AT REDLANDS GREENHOUSES

It is not up to me to recommend one treatment above any other. Each has its place and it depends on each operator to choose the one best suited to the operation.

In our situation, where we reuse water from holding ponds, we catch our excess through a system of drains and paths that run through the growing areas of the nursery sites. This water is relatively clean, and so we manually backwash our filter on a two-day rotational basis. After heavy rain, when our creeks run and dams fill, we switch to daily washing until the excess sediment in this run-off water settles.

These filters are relatively trouble free. We clean them on a regular basis, and recharge the sand whenever necessary.

Water is pumped from the dam, through the filter, into holding tanks, where we add liquid sodium hypochlorite. We endeavour to make sure that the treatment has at least 30 min to work in the tank before we use the water. The cleanliness of water for propagation purposes is more critical than general irrigation water for growing fields. In all cases pathogens must be eliminated.

We aim for 4 ppm of residual chlorine at discharge. We test for this residual with a pool chlorine test kit, and use our eye for colour comparison with the chart enclosed with the kit. We have found this successful.

Water which has dissolved quantities of fertiliser salts even in small amounts, is not always suitable for propagation purposes. I can recall one instance, several years ago, when we used our usual irrigation water for our mist benches. We lost many of our native plant cuttings through the small amounts of dissolved fertiliser salts in the water. It was a disaster. We changed back to town water supply, and immediately the problem went away.

Therefore, if one has to use recycled water for propagation benches, I would strongly suggest blending with a better source of water, if at all possible. In this way you can dilute the residual fertiliser salts to a more tolerable level. This can be monitored simply with a small EC meter.

WATER APPLICATION AND HYGIENE IN APPLYING WATER

Water application to propagation beds and to crops is an area of variability. Each employee has a slightly different appreciation of what is enough, and what is too much. It is very hard, if not impossible, to teach the art of watering to most employees. There is a relatively fine line between a flood and a drought. The water needs of plants vary tremendously and nowhere is this more apparent than in the propagation department. When one has a mixture of unrooted cuttings, just-rooting cuttings, and rooted plants at many stages of development awaiting potting up, we have created a nightmare in so far as watering is concerned.

Quality can so easily be sacrificed at this stage. If you opt to use overhead automatic watering, you will find that some plants get too much water and others too little. With this situation, hand-watering for at least part of the week is needed. Otherwise edges of benches and trays get too dry while centres get too wet. In cooler months of the year, watering by hand is essential for best quality.

Mist and fog nozzles are also an area where quality of watering can be sacrificed. Cleanliness of the system should result in few blockages, but vigilance and a cleaning of the nozzles is necessary on a regular basis.

Some things are so obvious but simply overlooked. It is common to visit nurseries and see hoses lying on the ground with the nozzles lying on the ground, either on

the bed or the track. A simple wire hook at the tap is all that one needs to keep the nozzle off the ground and out of the way. A sure way of picking up water-borne pathogens from the ground is thus eliminated.

We have done all we can to treat our water. The system is only as good as the operators. All will fall down unless the propagation area is kept "kitchen clean." Hygiene is one of the tools of the propagator that is sometimes neglected. A lot of problems can be eliminated with just a little more attention to detail in our work area and surrounds.

I don't know the explanation, but I am told that algal bloom in rivers and water storages results in a lowering of oxygen in the water and in severe cases this causes dead water. Whilst visiting the Southern Region I.P.P.S. meetings last year in Maryland and Virginia, we saw nurseries that were doing things to correct this problem with reused water.

The water in the holding dams, where the run-off was caught, had large fountains playing in them. This resulted in any floating debris being pushed to the side of the dam where it was skimmed off. The water was collecting oxygen from the air as it was lifted and sprayed through the fountain. The dams were very clean. In speaking with the propagators at these nurseries we were told that they were having much better results in their propagation houses since this water treatment was started. They put this down to extra oxygen in the water being applied. I wonder what would result if we super-charged water with as much oxygen as it would absorb? Here, no doubt, is an area for research.

In 1972, the U.S. Congress amended the Federal Water Pollution Control Act, so that the EPA delegated to Regional Boards the responsibility of setting water standards in their areas.

One of the guidelines sets a limit of 45 ppm nitrate (10 ppm N) for discharge water. This is the current drinking water standard. Most nurseries using ammonium nitrate in constant liquid feed, use 200 ppm N, so would have 20 times the allowable figure. Other residual limits per liter are:

- 75 mg suspended solids
- 15 mg oil and grease
- 750 mg total dissolved solids
- 175 mg chloride
- 500 mg sulphate

There is no way anyone can meet these standards unless discharged water is treated. In addition, one cannot discharge without a permit, and this requires inspection. Some states have tight controls in place; most others have a deadline of 1993 for compliance. Nurseries in Texas have to collect all run-off for reuse, and also they have to collect the first 1/2 in. of rainfall each time rain falls. Fines for infringements are **$10,000 per day** until fixed.

I would leave you with the thought that we should put a lot more thought into the way we use water in our propagation and growing systems. It is a precious resource, and is one that is becoming limited on a global scale. We have to find ways to use less water, and to re-use the water that we usually let run away.

We will have to come to terms with reusing this run-off. If we don't do it voluntarily, we will be forced by legislation. How much better it is to be prepared, and get our nurseries in order before this happens.