Water Recycling in Container Plant Production

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INTRODUCTION

Irrigation is no longer a matter of simply applying enough water to the crop. Modern nursery-stock growers have to be aware of the increasing amount of legislation and restrictions enacted to avoid pollution of the environment and to protect natural resources, such as soil and water. Nevertheless, to remain competitive in the market, growers have to produce plants of a high quality and at the lowest possible costs. Irrigation of container-grown plants now means the management of several interacting factors which range from the selection of water of the right quality for growing plants, to the safe and appropriate disposal or use of surplus water.

IRRIGATION REQUIREMENTS

There are three factors which now need to be taken into account when choosing and managing irrigation systems.

- **Irrigation requirements for environmentally sound plant production.** This includes, for example, collection of the right amount of rain water, recirculation of runoff water, closed irrigation cycles instead of more-or-less water recycling, water-saving irrigation techniques, and minimised production of waste material.
- **Irrigation requirements for good quality.** This includes factors such as mineral content, contamination with disease organisms, availability of the right quantity of water at the appropriate times and locations, and bed construction.
- **Irrigation requirements for low cost.** Here the grower needs to consider procedures which will result in savings on items such as technical devices, labour, water, fertiliser, energy, side-effects, follow-up care of plants, etc.

Since some of these requirements are contradictory, no irrigation system can fulfil them all completely. However, the progressive nurseryman will see that the traditional system of well or borehole water only, overhead sprinklers, and vast quantities of surplus water running off site, will meet none of these requirements and is not beneficial in the long run.

WATER RECYCLING

The best combination of characteristics, which will meet most of the criteria discussed above, is provided by an optimised recirculating system. Such a system consists of four components.

1) **Sealed but Perfectly Drained Beds.** These beds collect rain water and all surplus irrigation water and deliver it completely to collection ditches. This requires a durable compacted bed base covering an appropriate area. It needs to be well tailored to the kind of water supply and to the amount of rain water that is required for

irrigation. Rain water is eminently suitable for irrigation in terms of quality and economy of placement. It is very difficult, for example, to tailor a fixed point overhead sprinkler system for nursery stock. One reason is the difficulty of determining the appropriate size of sprinkler. Erratic wind drift and severe water losses by evaporation have also to be taken into consideration, as well as the enormous water output required to make up for losses and missed areas. Use of a gantry system to deliver overhead irrigation makes it much easier to determine the area the system will cover and hence tailor the delivery system to suit. Drip irrigation or some kind of subirrigation is even better because the potential for losses and missed areas is even further reduced. It is important to realise that if individual beds are too large they will collect more rain water than can be used for irrigation, and this water then has to be used differently or disposed of in a way which will not contaminate the ground or natural water courses with possible fertiliser or pesticide runoff residue.

2) **Sealed Collection Channels.** These intercept the water running off the beds and divert it to a containment pond, using gravity wherever possible to avoid the expense of installing and running pumps. The channels must be designed to cope with maximum expected volumes of water in order to avoid floods and prevent compost, leaves, silt, etc. from flowing into the pond. A settlement pit or pond before the main containment pond is a good idea to prevent the main pond silting up.
3) **Containment Ponds.** Such a reservoir, in form of a pond or tank, collects the runoff water and keeps it for recirculation. It must, therefore, be on an appropriate site, and of an appropriate construction type and capacity. These factors depend on the local situation, the amount of rainwater to be used as a substitute for well or mains water, and the local possibilities of surplus water disposal. It is necessary to monitor the actual volume of water stored in the pond, which may vary depending on seasonal variations in natural precipitation. It might be necessary to collect a large volume of rainwater during the winter, and there should always be sufficient room to store the runoff water after a heavy rainfall. It is desirable to install a means of controlling the flow of pure rain water into the pond. Integration of the reservoir with a disinfection device would also be wise. It is possible to install a slow filtration tank just before the water intake of the irrigation pump, for example in a pit at the bottom of the containment pool.
4) **Modern Irrigation Techniques.** Sprinklers are hard to control automatically, and often their operation time is limited to only a few hours in the evening. This means the whole system has to be "over-designed" so that it can supply unnecessarily vast quantities of water during a short period of time. More modern systems are designed both to save water and keep the amount of circulating

water low. It is important to use techniques which diminish wind drift and evaporation water losses, and which distribute the water uniformly and at the right time. This can be achieved by drip irrigation for large- or medium-sized containers, and with subirrigation such as a capillary matting system or ebb and flood tables for medium or small containers. Automatic controls, e.g., by tensiometers or a similar device, also improve the system. For some crops a gantry system is a good solution. The somewhat greater costs for constructing an optimised recirculating system are offset by stronger plant growth, more uniform crops, labour savings, and saved costs for water, fertiliser, energy, smaller pumps and pipes, etc.

WATER QUALITY

Water recycling brings with it a risk of plant damage resulting from the quality of the recirculating water, which may contain spores of disease organisms, salts, residues of chemical treatments, organic matter, and so on. However, this problem can be minimised by some simple measures as part of the overall management programme.

Disease. Avoid the risk of spreading diseases throughout the crop by:

- Permanent hygiene throughout the production process.
- Stop using overhead irrigation.
- Dilution of spores by large water circuits and big ponds, natural biological control of disease organisms by their antagonists within biologically active ditches and ponds.
- Use of slow filtration technique, if susceptible crops are grown.

Chemical Contamination. Diminish the risk of the accumulation of fertilisers and plant protection chemicals by:

- Use of adequate fertilising programs and fertilisers, control by EC meter.
- Avoid treatments with persistent herbicides, use integrated pest management approach.
- Dilution of residues by large water circuits and big ponds.

Blockages. Reduce the risk of algae, silt and/or salts, etc. blocking irrigation lines by:

- Storage of cleaner water, minimised leaching of fertilisers, and planted collection ditches.
- Correctly placed water intake, if installed through a slow-sand or rockwool filter.
- Use of filters with a self-controlled back flush.
- Use of appropriate distribution equipment, such as bigger emitters.
- Regular inspection and cleaning of drippers, emitters, and valves.

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