The Nursery Papers

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Reed beds clean up nursery run-off water

Government legislation in many parts of Australia now restricts the discharge of nutrient-laden run-off water from any premises, including nurseries. Restrictions also exist in many areas on water usage, regardless of the source. Reed beds efficiently remove nutrients and organic matter from nursery run-off. This *Nursery Paper* describes how they work and their potential in a nursery run-off recycling system.

The nursery run-off problem

Significant levels of nutrients can leach from potting media during irrigation of containerised plants. A survey of nurseries found that overwatering of plants was widespread. In some cases, concentrations of nitrogen (N), phosphorus (P), iron and manganese in the leachate, particularly in the first few weeks after potting up, regularly exceeded water quality guidelines. Nutrient losses were around 60% higher in summer, due to more frequent and longer irrigations.

The experimental reed beds at the Alstonville Centre for Tropical Horticulture in New South Wales.

Nursery run-off typically contained around 10 milligrams a litre of total nitrogen (TN), predominantly as nitrate and 0.5mg/litre of total phosphorus (TP), predominantly as phosphate. This represents a significant nutrient pollution source for natural waterways. Furthermore, dams used to collect and store nursery run-off water for recycling often accumulate an excess of plant growth nutrients, which means that it is eutrophic, resulting in algal blooms and extreme changes in dissolved oxygen levels. This water then needs to be acidified and filtered before being reused.

The answer

It has been shown in experimental reed beds at the Alstonville Centre for Tropical Horticulture that established reed beds are very effective in removing 90% of the N and 96% of the P from nursery run-off. Furthermore, reed beds eliminated the root disease *Phytophthora*, even though the inlet water was 'seeded' with the disease spores.

What is a reed bed?

A reed bed is a sub-surface flow wetland. It is a sealed bed filled with a porous medium of sand or gravel about 0.5 metres deep supporting aquatic wetland plants known as macrophytes. Water moves horizontally through the pore spaces between the media and plant roots and remains below the surface.

Constructed reed beds are accepted worldwide as a cost-effective option in remediating polluted water, sewage effluent and nutrient-laden agricultural run-off. In the nursery industry they can be used to effectively treat run-off water.

How does a reed bed work?

Treatment of water in a reed bed occurs through a combination of physical, chemical and biological processes via interactions between the water, substrate, macrophytes and micro-organisms. The Alstonville study showed that N and P removal was greatly enhanced by the presence of reeds.

The nutrient removal processes in a reed bed are time dependent. The level of treatment achieved and the concentration of nutrients in the effluent are affected by the hydraulic residence time.

What reeds to plant

Macrophytes play an important role in the treatment of water within a reed bed. They directly take-up nutrients, pump oxygen into the substrate and provide a food source for the micro-organisms responsible for breaking down pollutants.

There is a range of macrophytes that are suitable for planting in a reed bed. Locally occurring native species that exhibit rapid and luxurious growth should be used. The common reed, *Phragmites australis*, was used in the Alstonville study.

Nutrient removal

Nitrogen removal in reed beds generally occurs through the processes of plant uptake, microbial activity and chemical reactions.

Phosphorus removal occurs through fixation onto the substrate, around 30% in year two, microbiota and detritus accounted for 40% usage, the remainder being used for plant uptake for above and below-ground growth.

In order to maximise the amount of P removed by plants it is recommended that the above-ground biomass be harvested at the end of summer to prevent P from being redistributed to rhizomes.

Reed beds are capable of achieving outlet concentrations of less than 0.5mg/litre total nitrogen and less than 0.1mg/litre of total P.

Plant pathogen control

Many plant pathogens are water borne and infect the roots of host plants causing significant decline in the health and vigour of the plant and increased mortality. Experience from the hydroponics industry indicates that recycling irrigation water increases the risk of spreading a number of major root pathogens such as *Phytophthora* spp and *Pythium* spp. A recent survey indicated that these pathogens were present in water from nurseries.

The Alstonville study was the first recorded investigation of *Phytophthora* control by reed beds. It demonstrated that despite being continuously loaded with *Phytophthora*, over nine months, the reedbeds consistently eliminated all traces of the pathogen.

Interested in building a reed bed?

For information on how to design and build a reed bed, refer to *Nursery Paper* 'Designing a nursery reed bed', issue number 2003/07.

The bottom line

Passing nursery run-off through a reed bed treatment significantly reduces the nutrient load, minimises the problem of algal growth in stored dam water and controls the root disease, *Phytophthora*.

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