



Nursery & Garden Industry
Queensland

MANAGING WATER QUALITY IN NURSERY IRRIGATION STORAGEES - A CASE STUDY



Managing water quality in nursery irrigation storages

Managing a farm dam and the water quality required for irrigation within intensive horticulture is always challenging. Growers need to be flexible and able to react quickly to the many changing factors that can influence water quality. Aeration and circulation of the water body can have the effect of maintaining a stable pH and preventing stratification or temperature layering of the water. This can assist in providing a healthy and biologically active water storage, delivering water suitable for irrigation with minimum management interventions.

Despite the best of intentions, water storages can become 'out of balance', causing algal blooms and surface weed infestations to develop that require an injection of labour and finance to restore back to their natural balance. Filtration and intake foot-valves become troublesome and require extra backwashing or cleaning, irrigation application componentry such as solenoids and emitters become clogged or behave erratically, all with the potential to effect production and yield. These 'out of balance' storages require resources, labour and finance to overhaul.

*“Aeration and the
addition of a clarifier
to our water storage
provided amazing
results in just weeks”*

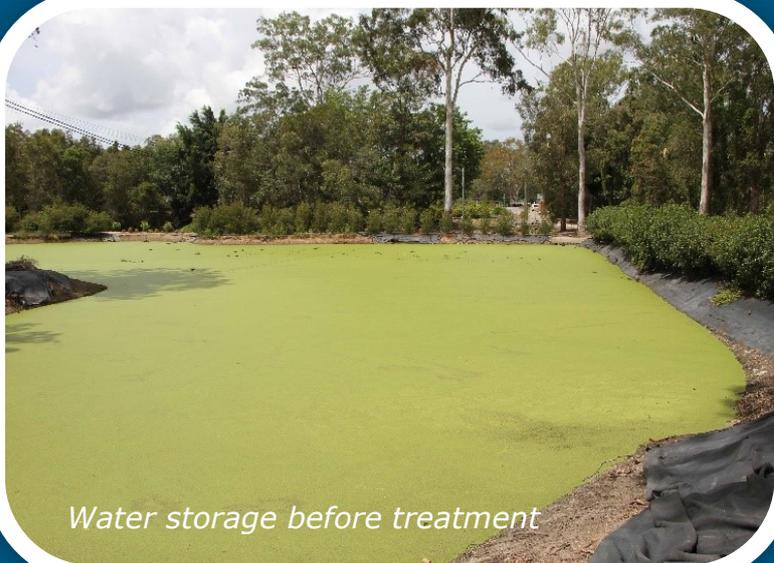
*Beau Tomlinson
Tara Valley Nursery
May 2016*



Improving irrigation management
for a profitable and sustainable future



Managing water quality in nursery irrigation storages



Water storage before treatment

Date	Volume	Date	Volume
11/02/16	80%	07/04/16	60%
25/02/16	75%	21/04/16	75%
10/03/16	80%	05/05/16	45%
24/03/16	85%	19/05/16	30%

Table 1. approximate water volumes in storage



Water storage after treatment

In early March 2016, the water storage facility at Tara Valley Nursery on the Southside of Brisbane required intervention to improve the level of water quality used for nursery production. The storage facility collects nursery wastewater and rainfall runoff, and is the primary source of irrigation water for the business. Algae, plankton and duckweed were developing to alarming levels, causing increased levels of irrigation infrastructure maintenance and cleaning. Staff and site visitors also became aware of an unpleasant odour emanating from the water storage facility.

The management at Tara Valley Nursery made the decision to introduce a biological clarifier to the storage in an attempt to improve the water quality. The concentrated microbial product contained bacterial *Bacillus* strains developed to;

- ◇ improve water clarity and quality
- ◇ reduce ammonia, nitrate and phosphorus levels
- ◇ control methane and sulphide odours
- ◇ reduce sludge and organic sediment.

The label guidelines for product use recommend maintaining water temperatures above 10°C and pH levels between 6 and 8, as microbial activity is much slower outside these ranges. Maximising dissolved oxygen levels to encourage microbial activity is recommended, including the use of mechanical aeration where necessary.

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In March, Tara Valley Nursery introduced 'LakePak', a biological lake clarifier to their water storage facility, their principal water source for irrigation. The storage facility contained increasing levels of algae, plankton and surface floating weeds, leading to costly management and maintenance activities, crop production issues and an unpleasant odour. By the middle of May, ten weeks into the treatment, the water turbidity had significantly improved, algal blooms had disappeared, and the previous unpleasant odour was no longer evident.

Added to the 5.9 megalitre (ML) storage was approximately six and a half kilograms of the concentrated microbial product containing billions of CFU's (Colony Forming Units) of blended bacterial Bacillus strains. The strains of bacteria contained within the product are blended and designed to manage Ammonia (NH₃), Nitrate (NO₃), Phosphorus, Hydrocarbons and Lignon/cellulose within a water body not only reducing nutrient levels but also reducing sludge in the bottom of the dam. A follow-up application was applied after three weeks, when a further six and a half kilograms was applied, and again at week five a further four kilograms was added to the storage.

The dissolved oxygen levels in the water storage at this point were tested and found to be approximately 13%, and to support the biological activity in the water, some level of mechanical aeration was introduced.

Two maintenance applications of the biological water clarifier were applied at week seven and week nine to the irrigation storage facility which was then at 45% of its full capacity.

<i>Initial application</i>	<i>7th March</i>	<i>applied 6.8kg</i>	<i>biological water clarifier</i>
<i>Week 3</i>	<i>28th March</i>	<i>applied 6.8kg</i>	<i>biological water clarifier</i>
<i>Week 5</i>	<i>11th April</i>	<i>applied 4.0kg</i>	<i>biological water clarifier</i>
<i>Week 6</i>	<i>19th April</i>	<i>introduced mechanical aeration (13% DO)</i>	
<i>Week 7</i>	<i>25th April</i>	<i>applied 1.3kg</i>	<i>biological water clarifier</i>
<i>Week 9</i>	<i>9th May</i>	<i>applied 1.3kg</i>	<i>biological water clarifier</i>

General Manager of Tara Valley Nursery, Scott Hickman, remarked how happy he was with the water quality after treatment with the biological water clarifier. The clarity of water in storage is greatly improved, irrigation maintenance issues have halved, the volume of oxidising agents used for irrigation water disinfection has returned to normal. Side benefits of the treatment were the disappearance of the duckweed, and the unpleasant odour was no longer apparent.

Approximately fifteen hundred dollars was invested in returning the irrigation water storage facility at Tara Valley Nursery back to a healthy, biologically active state. The process took approximately ten weeks to achieve, but future maintenance applications may be required depending on nutrient loading and wastewater inflows. Aeration has continued post treatment and a rainfall event has returned the facility to 50% capacity.

Managing water quality in nursery irrigation storages

“The clarity of the water in storage is greatly improved, irrigation maintenance issues have halved, the volume of oxidising agents used for irrigation water disinfection has returned to normal, and the unpleasant odour has vanished.”

Scott Hickman
Tara Valley
May 2016

Tara Valley Nursery operates under the Nursery Production Farm Management System (FMS) and the industry Best Management Practice (BMP) programs of NIASA (BMP in nursery production) and EcoHort (BMP in environmental management).

The EcoHort program encourages production nurseries to collect and recycle wastewater from irrigation and rain events. The program recommends the responsible use and calibrated application of fertilisers, and the responsible storage and use of pesticides, to protect and maintain water quality. The program also recommends the use of premium quality growing media to optimise water use efficiency.

Under the FMS, maintaining water quality in nursery irrigation storages is achieved through an integrated approach, including the following:

- * Installing and operating irrigation systems to industry BMP
- * Regular testing and maintenance of irrigation systems
- * Scheduling irrigation systems to meet crop requirements
- * Using premium quality growing media
- * Using controlled release fertilisers
- * Utilising fertilisers at the recommended rates
- * Incorporating fertilisers into the growing media
- * Responsible storage and use of pesticides
- * Collecting and recycling of nursery wastewater
- * Installing suitable drains and directing wastewater to storage
- * Installing sediment and trash traps in drainage systems
- * Regular testing of water quality
- * Managing the water quality in the storage facility.

Wastewater entering a storage facility from nursery production may be contaminated with organic matter, nutrients, and sediments. Organic matter can be dissolved in the water or be solid particles such as growing media, both of which consume oxygen. Nutrients provide food for the various forms of algae and therefore initiate biological growth, which on decomposition, also consumes oxygen. Sediments can settle on the bottom of storages, acting as a store for nutrients, leading to low levels of dissolved oxygen. Early intervention has always been found to be the best management technique.

Managing water quality in nursery irrigation storages

Aeration and circulation is a great first step in improving the overall condition of any water storage facility in almost every case, and when combined with beneficial bacteria, produces a healthy, biologically active water storage suitable for nursery irrigation.

Storages are subject to seasonal influences that may affect the water quality. Algae are free floating, often microscopic plants, that are normal and essential inhabitants of sunlit surface waters, but can affect water quality, and become a significant management issue if their growth becomes excessive.

Algae in nursery irrigation storages are classified into three forms, planktonic, filamentous and macro algae.

Planktonic algae are microscopic plants, floating in suspension in the upper 60 - 90 cm of the water column where the sunlight penetrates. These algal forms are an essential part of the food chain in a healthy dam. Temperature, light, wind and nutrient levels can influence excessive growth of planktonic algae, causing algal blooms that colour the water varying shades of green, blue-green, red or brown. The natural degradation of the algal blooms during cooler weather conditions results in a depletion in oxygen levels. Some forms of planktonic algae can be toxic to animals and humans and produce unpleasant odours.

Filamentous algae, sometimes known as pond moss or pond scum, are made of single celled organisms, joined end to end to form threadlike chains or filaments. This type of algae grows along the bottom of the storage in relatively shallow areas, then floats to the surface due to oxygen production, to form floating mats on the water surface. Filamentous algae are harmless and non-toxic and have a texture that may seem cottony and slimy.

Macroalgae are branch type algae that are visible to the human eye, known as Stoneworts. This form of algae grows attached to the bottom of the storage in depths of one to six metres, and can often crowd out other aquatic plant species. Mats of Stoneworts, *Nitella* spp. and *Chara* spp. have a wiry, coarse texture along with a fishy odour.

Duckweed, *Lemna* spp. and *Azolla* spp. are common free floating aquatic weeds, and are usually a sign of high nutrient loads, and can lead to organic sedimentation and build-up on the bottom of the storage. Duckweed outbreaks are traditionally an issue in mid summer.

Lemna appears as a green cover on the water surface, growing rapidly in nutrient rich, stationary water bodies and can double in numbers in five to seven days.

Azolla appears as a green or reddish cover, and has a fern like leaf appearance with roots trailing below the water surface. *Azolla* can double in numbers in seven days.



Managing water quality in nursery irrigation storages

Managing the water quality in nursery irrigation storages is best achieved by preventing water quality issues from becoming extreme. Stay ahead of the problem by regular monitoring of water quality, reducing nutrient levels, limiting organic material in wastewater, and providing some level of mechanical aeration.

Historically, physical removal and chemical treatment of water weeds and algae were the only control methods available, however this only treated the symptoms and not the cause, often presenting a new set of problems from dying and decaying vegetative material further depleting the water storage of oxygen. Physical removal of surface floating duckweed, filamentous and macro algae, partnered with chemical treatments to remove duckweed and algae, can support the addition of biologicals in storages containing extreme algae and surface weed growths. Ensure all label directions are followed on all chemical and biological materials introduced into the storage.

Further information on water storage management can be found in the publication 'Managing water in plant nurseries' a guide to irrigation, drainage, and water recycling in containerised plant nurseries.

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Queensland Government The RWUE-IF initiative helps irrigators make better use of their on-farm water supplies, through efficient irrigation system design and management. It also helps irrigators to reduce energy consumption associated with their pumping applications. RWUE-IF is a partnership between the Queensland Government and major rural industries, where the government provides financial support to assist industry groups in providing services to irrigators.