CENTRAL QUEENSLAND PINEAPPLE STUDY GROUP 7 MARCH 2023

Valley Syndicate farm, Ingrey Rd, Bungundarra

TAKE HOME MESSAGES

The current 'Pineapple Integrated Crop Protection Program' project ends on the 30th of April 2023. The project team is working on updating the 'Pineapple Best Practice Manual', monitoring and evaluation of the project and the final report.

Trial briefs have been completed for the demonstration trials. The Briefs and the Fact sheets were handed out at the study group – please contact Bridie Carr (0436 675 740) if you would like a copy of any of these, they are also available on the website for download.

It's crucial for growers to identify areas on their farms at risk of nutrient, sediment and pesticide loss and take proactive steps to manage it. Even if best practices are implemented like targeted nutrient application and contours, there can still be losses of nutrients, sediments or pesticides through leaching to shallow groundwater or surface run-off. The use of bioreactors or vegetated buffers and wetlands can help filter and remove pollutants helping to protect water quality in downstream waterways. The use of sediment traps and mixed treatment systems on the farm complements crop production best management practices and builds a necessary dual approach towards improving water quality leaving farms. It also demonstrates a proactive approach towards meeting an environmentally sustainable benchmark associated with obtaining Hort360 Reef Certification.

Nitrate test strips are an affordable means by which to measure and monitor N in water on your farm. They can be used to verify where and how much nitrate is being lost in drainage waters on the farm (note that nitrate is the dominant form of nitrogen that makes up Dissolved Inorganic Nitrogen (DIN) which is a priority for Reef water quality). The cost is approximately $100.00 for 100 strip tests, comes with a reference card and can be purchased online (Merck nitrate strip test) or from some rural supply stores. The Merck strip tests can be read using an App and results recorded for later use. The App is called MQuant StripScan and is downloadable for free on your phone for future reference. It only takes a few minutes to take a measurement and therefore it is recommended you do this regularly when there is water flow to get a picture of changes in your farm water quality at known locations over time.

All growers are strongly encouraged to register for access to the new grower website to access all the project content (www.australianpineapples.com.au). If you have any issues with access, please contact Natalie Brady from Growcom 0406 387 381.

Bioreactor information and additional reading can be accessed here or here is a link 'Using denitrifying bioreactors to improve water quality on Queensland farms'

The question of possible assistance in Central Queensland with implementation of on-farm mitigation practices to manage sediment and farm run off (E.g. installing a bioreactor) has been referred to the Department of Environment and Science.

CQ pineapple growers during the study group watching the procedure for a nitrogen strip test.

Present (15 + 13 = 28)

Growers (15)

Steven, Beau, Fletcher & Nelson Black, Jake Brooks, Eric Burrowes, Doug Christiansen, Ben Clifton, John Cranny, Robert Pace, Neil Parami, Peter Sherriff, John Steemson, Nathan Stevens, Chris Williams

Non-growers (13)

Olive Hood (Hort Innovation), Doug Jones and James Tattersall (Golden Circle Ltd), Paul Wortley and Peter (Elders), Lee Dendle (Nutrien), Bridie Carr, Paul Humphries, Renata Grunennvaldt, Stuart Irvine-Brown, Simon Newett, Carla Wegscheidl (DAF), Tim Wolens (Agri Supply Global)

Agenda

10:00am - 10:15am – *Australian pineapple introduction/welcome – Jake Brooks (CQ representative)/Bridie Carr*

10:15am – 11:15am - *Bioreactor - farm walk with Stuart Irvine-Brown and Carla Wegscheidl (DAF) to discuss bioreactors, potential benefits, siting etc*

11:15am – 11:45am - *Outcomes from demonstration trials (during farm walk)*

11:45am – 12:30pm - *Lunch*

12:30pm – 1:00pm - *Evaluation of the current pineapple extension project which ends soon – Bridie Carr*

1:00pm – 2:00pm - *Grower input into design of next extension project via a co-design process – Olive Hood, Hort Innovation*

2:00pm – 2:20pm - *Collect production data and discuss estimates of losses from the big natural flowering event*

2:20pm – 2:30pm - *Brief mention of the program for the annual Pineapple Field Day which will be held in Yeppoon this year.*

3:00pm - *Meeting ends*

OVERVIEW OF PI17001 ACTIVITIES

The current '[Pineapple Integrated Crop Protection Program'] ends on the 30th of April 2023. The project team is currently working through the final tasks of the project which include:

- General review and update to the 'Pineapple Best Practice Manual' with some chapter updates provided to the industry. This also includes a literature review of nutrition.
- Monitoring and evaluation of the project
- And the final report!
- ***If you have any feedback on or questions the project activities, please contact Bridie Carr – 0436675740***

AUSTRALIAN PINEAPPLE UPDATES – JAKE BROOKS (CQ REPRESENTATIVE)

- Jake Brooks emphasized the challenges in the industry related to the natural flowering event.
- Olive Hood from Hort Innovation will be leading a Co-design session for the next extension project during each of this last round of study group meetings and all growers are encouraged to participate and have their say.
- Australian Pineapples Central Queensland representative Jake Brookes and Tim Wolens are working with the local growers and a number of resellers to set up demo trials as well as Neil Parami from Valley Syndicate for the Annual Pineapple Field Day in July 2023.
- Today is Simon's final CQ study group meeting, and the industry is thankful for his 30 years of service.

BIOREACTOR - FARM WALK WITH STUART IRVINE-BROWN AND CARLA WEGSCHEIDL (DAF)

Declining water quality in Queensland's coastal and marine ecosystems has driven efforts to develop and promote fertiliser and crop best management practices to reduce the potential for off-farm nitrogen transport. Best management practices such as matching fertilisers to crop requirements, timing of application and application techniques to minimise loss to the environment can significantly reduce the risk of nitrogen loss.

Given that some level of loss is unavoidable in any growing system, there are several options available to treat shallow groundwater or surface run-off to retain soil and treat nutrients within the farm. These include managed/vegetated drains, grass buffers, vegetated treatment zones/wetlands, implementing bioreactors, and building sediment retention basins.

Bioreactors use a carbon source (like woodchips) that naturally remove nitrate from water through denitrification. They are a relatively affordable, simple, and passive option for treating groundwater, or run-off, to remove nitrate.

Two key conditions for the denitrification process are the presence of carbon and a slow water flow. Slow water flow is essential as it provides sufficient oxygen conditions (zones of oxygen and low-oxygen close together) for the microbes to carry out the denitrification process. Water that is stagnant typically lacks enough oxygen, while rapid water flow can provide too much oxygen for the process to occur effectively.

Bioreactors trialled on sugarcane farms in the Burdekin were monitored to identify any reduction in pesticides in the irrigation tailwater flowing into and out of the bioreactor beds. The bioreactors did reduce the concentration of 10 pesticides, including diuron or its byproduct, although the exact process is not yet fully understood. Given that diuron is a crucial herbicide for the pineapple industry, it's important to implement management practices that minimize its impact on waterways. Even foliar fertilizers can be lost from the crop. Therefore, bioreactors and other treatment systems that promote denitrification can help to minimise the loss of nutrients from farms.

It's crucial for growers to identify areas on their farms where nutrients and pesticides are being lost and take proactive steps to manage it. This can involve the use of bioreactors or vegetated buffers and wetlands to reduce the risk of nutrients impacting downstream waterways or the Reef.

Question: Is there any assistance to install those systems?

Answer: Pineapple growers in the South East Queensland (SEQ) region have access to a pilot program that offers financial assistance for pineapple growers to adopt environmentally beneficial practices. The program is aimed at supporting growers who want to make changes to their farming practices that have a positive impact on the environment. The PET group provides a platform for discussing these aspects, and it would be beneficial to expand the program to cover the entire industry.

John Cranny of Valley Syndicate recently reached out to Stuart Irvine-Brown and Carla Wegscheidl from DAF because most of the bioreactor trials have been conducted on farms located in the SEQ region. Given that Central Queensland has a different landscape and climate, he was seeking advice and a benchmark for this specific region.

A range of measures can be taken on-farm to reduce nutrient, pesticide and soil loss include:

- Reduce the use from pre-plant and side-dress fertiliser, apply only the necessary amount of fertiliser
  - Sediment/retention basins
  - Well-designed and vegetated drains
  - Vegetated buffer zones
  - Grass swales (spoon drains)
  - Bioreactors
- Wetlands

FARM WALK AND NITRATE STRIP TEST

A nitrate strip test was conducted in a natural spring adjacent to the pineapple growing site. The test determines if the concentration of nitrogen is above 10 mg/L (below this shows up as white although there could still be nitrate present). To conduct the test, the strip is immersed in the water for a few seconds, and then after waiting for 60 seconds, the colour of the strip is compared with the colour chart included in the package. Additionally, the test result can be measured in an app that is downloadable on your phone. The app records monitoring results and monitoring locations for future reference. The cost of the strips is $100 for 99 tests. For more information about the tests see **appendix 1** of the minutes.

The first reading from the natural spring showed a nitrogen concentration of 250 mg/L. However, once the water had flowed through a natural vegetation buffer, the nitrogen concentration in the water had dropped to below 10 mg/L further downstream. This could be a sign that denitrification is occurring in the soils in the vegetated area and there could also be some vegetation uptake, resulting in a lower concentration of nitrate in the water flowing to the streams. As the strips only test nitrate, we don't know if the nitrate was removed or just converted to another form of nitrogen (e.g. taken up in microalgae but still potentially lost as nitrogen during a rain event).

The natural vegetation buffer and wetlands on the farm might be helping to naturally treat nitrate, and another option to ensure elevated nitrogen concentrations are reduced on the farm is to use bioreactors. Bioreactors use wood chips to denitrify the water, but the age of the wood chips can affect their ability to remove agrichemicals, such as pesticides. Fresh or old wood chips can be used in bioreactors to denitrify nitrogen. However, when it comes to removing pesticides, older wood chips are more effective in adhering to the compounds of the pesticides. For more information on what a bioreactor is check out **Appendix 2** of the minutes.

Salinity issues were also discussed during the farm walk and what species could be planted that were tolerant of salt.

Refer to **Appendix 3** in these minutes.


Carla Wegscheidl and Stuart Irvine-Brown (DAF) demonstrating the nitrogen strip test and discussing effective strategies for minimising nutrient runoff from farms with growers.

Vegetation buffer in action! This area adjacent to the pineapple growing site acts as a natural filter, reducing the amount of nutrients and sediment that may leave the farm with water runoff.


A natural spring adjacent to the pineapple site with elevated nitrate concentrations (left) and a retention pond also with a high concentration of nitrate – note the green colour and algal scum can indicate elevated nitrogen (right)


The colour of the strip is compared with the colour chart included in the package (left). The test result can be measured in an app that is downloadable on your phone (right).

DEMONSTRATION TRIALS

- As part of the extension project, 17 demonstration trials have been conducted. The outcomes of these trials have been shared through study groups, and the content has been uploaded to the industry website as trial briefs and fact sheets. If you would like to obtain a copy, please contact Bridie or visit the industry website at https://australianpineapples.com.au/members/
- The demonstration trials were not only focused on environmental aspects and best management practices but also on reducing cost of production and addressing agronomic issues. Below are some of the trials that presented interesting outcomes to be adopted by the industry:
    - Erosion control, these trials evaluated different techniques and products to mitigate soil erosion and capture and manage soil and water in the retention ponds prior to leaving the farm.
    - The development of the precision boom sprayer involves spraying nutrients and pesticides in a more effective manner directed to the crop and other target areas. This approach can help substantially reduce the cost of inputs, as well as minimize the loss of nutrients and pesticides. For example, fertiliser can be applied directly to the plants, while herbicides can be applied in the inter-row areas. By targeting the application of these inputs, growers can optimize their use while minimizing negative impacts on the environment.
    - The development of precision pre-plant injection involved accurately applying pre-plant inputs necessary for plants to take off quickly, more evenly and develop roots faster.
    - The Agrisilica trial showed that it can help control nematodes populations and may offer a residual control solution for growers to help reduce nematode populations and improve plant health.
    - Fumigation trials showed that Telone C35 applied broadcast was the most effective option. Growers were advised to conduct small trials on their own farms and choose the fumigation option that best suits their farms and / or different areas of their farms.
    - Herbicide trials: Herbicides that are used in other industries have been shown to be effective in controlling weeds in pineapples as a pre-plant application. Despite the good results, those herbicides are not currently registered for the pineapple industry but will be elevated to the relevant organisations.

Tim Wolens presenting the best outcome of the demonstration trials

EXTENSION PROJECT CO-DESIGN

Olive Hood from Hort Innovation facilitated the first of four co-design workshops with the growers. This workshop aimed to discuss the industry's needs and aspirations to help develop the finer details of the next 5-year extension project. The growers had the opportunity to share their ideas and express what they believe is essential for the development of the pineapple industry moving forward. After the four workshops have been held, Hort Innovation will be working with DAF to develop the details of the new project before it commences later this year.

PRODUCTION DATA AND NATURAL FLOWERING LOSSES

Growers completed their production data forms and shared information about the production losses caused by a natural flowering event for the CQ region. On average, growers reported a 10% loss in production for the 2022/2023 financial year and anticipate a further 10% loss in the 2023/2024 financial year.

THANK YOU, SIMON!

It was Simon Newett's final Central Queensland pineapple study group. Thank you, Simon, for your hard work and dedication to the pineapple industry over the past 30+ years. Throughout this period, you have attended and organised 225 study groups and 29 field days, played a pivotal role in developing industry's leadership, and directed the creation of the Pineapple Problem Solver and Best Practice Manual. Simon will be greatly missed by his colleagues and the industries he has tirelessly worked alongside during his long successful career. Your contributions have been invaluable and greatly appreciated.

Simon Newett has been providing support and leadership to the industry for over 30 years.

Renata Grunennvaldt, Simon Newett, Bridie Carr and Tim Wolens

These workshops are part of the project "Pineapple Integrated Crop Protection" (PI17001) which is a strategic levy investment under the Hort Innovation Pineapple Fund. The project is delivered by the Department of Agriculture and Fisheries, Agri Supply Global and Growcom and funded by Hort Innovation using the pineapple industry research and development levy, with co-investment from the Queensland Department of Agriculture and Fisheries, and contributions from the Australian Government.

A guide to using rapid Nitrate – N strip tests for on-farm water quality assessment

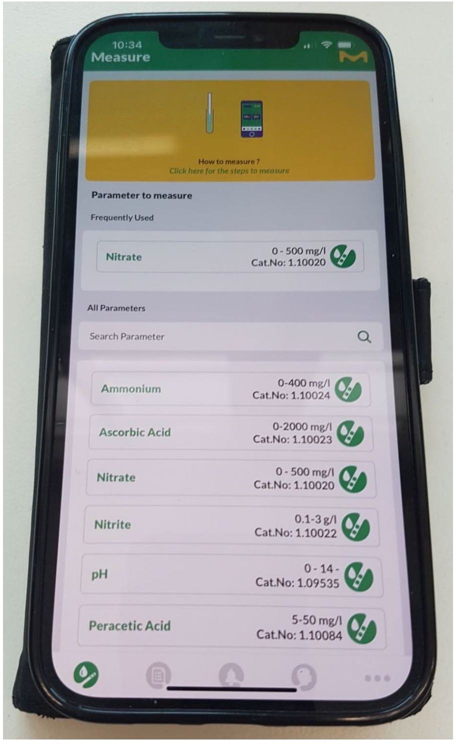
- Rapid Nitrate - nitrogen (N) strip tests can be used for quick water quality assessment.
- Target leaky / wet areas to help identify where you may have on-farm water quality issues.
- N strip tests are cost-effective to inform decision making on bioreactor placement.
- Tests strips need to be kept cool (2-8°C) in an esky otherwise they may give misleading results.
- Remove any sediment / organic matter from water samples by filtering before testing.

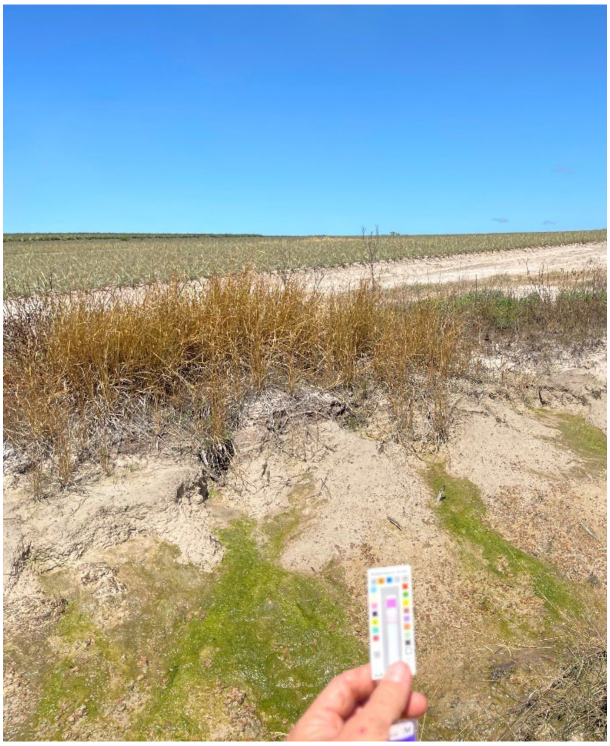
Step 1 - Location. Use a farm map to identify where to take water samples which can be tested for nitrate. Good locations are surface drains, edge of farm sediment traps, from below ground ag-pipe drainage systems, creeks or water bodies.	

<table>
<tr><td>Step 2 - Collection. Collect a water sample using a clean syringe, bottle or jar. Avoid dirt in the water sample. Label where and when each sample has come from for location specific results at different times.</td><td></td></tr>
<tr><td>Step 3 - Filter. It is best to filter the sample so that sediment / organic matter does not contaminate the nitrate test strip. Insert a filter on your syringe and filter the sample. Or leave the sample standing for time to settle before testing the water sample with a nitrate strip.</td><td></td></tr>
<tr><td>Step 4 - 1-minute test. Check the time for 1 minute test. Fully immerse both reaction panels of a ‘MERCK’ Nitrate test strip into the water for 1 second. After 59 seconds compare with the colour chart for nitrate level. Make sure to shake excess water from the test strip after removing it from the sample.</td><td></td></tr>
<tr><td colspan="2">Step 5 - Record results of the predicted nitrate strip result specific to that location.
Measuring range / colour = 10 - 25 - 50 - 100 - 250 - 500 mg/l NO_3
or = 2.3 - 5.6 - 11 - 23 - 56 - 113 mg/l NO_3-Nitrogen</td></tr>
<tr><td colspan="2">The MERCK MQuant StripScan App available free on iPhone or Android improves accuracy but requires a strip scan reference card. The App can be used to store results for later reference.</td></tr>
<tr><td colspan="2">REMEMBER!!!
• Be consistent with your sample location and build records of nitrate levels over time.
• Ongoing testing provides insight on high-risk times for nitrate transfer to off-farm locations.
• To ensure accuracy keep the strips in the fridge (2-8°C) not the glove box or dash of the ute.</td></tr>
</table>

Units required =	units given x	conversion factor
mg/l NO_3-N	mg/l NO_3-	0.226
mg/l NO_3	mg/l NO_3-N	4.43



Appendix 2 – What is a bioreactor?

Bioreactors

What is a bioreactor?

A bioreactor is a woodchip filled trench placed on a farm to intercept and treat groundwater or surface water from crops.

Bioreactors are relatively inexpensive to construct and are efficient at removing nitrate (a form of nitrogen), provided the site conditions are suitable.

What does a bioreactor do?

Bioreactors convert nitrate in groundwater, or surface water, to nitrogen gas using microbes and a carbon source (typically woodchip) under low oxygen conditions. The potential for woodchip bioreactors to remove other nutrients, chemicals and pesticides is less studied.

Bioreactors are currently being trialled in different parts of Queensland to determine their treatment performance and design criteria in different production systems and climatic conditions.

Are all bioreactors the same?

No, there are two main types of bioreactor—a wall bioreactor and a bed bioreactor.

What is a wall bioreactor?

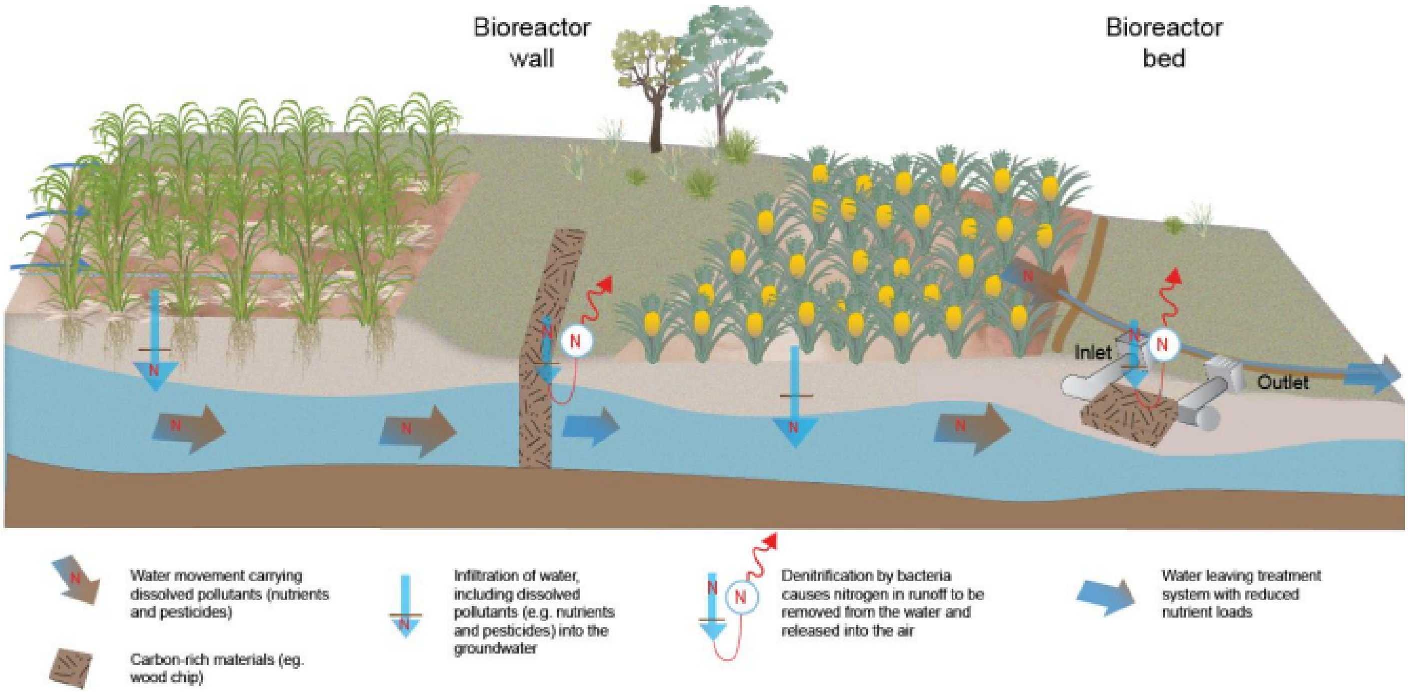
Bioreactor walls consist of a trench filled with woodchips or another carbon source, located perpendicular to the groundwater flow.

Denitrification (the conversion of nitrates to nitrogen gas) is enhanced in the presence of carbon and anoxic conditions and occurs as the groundwater passes through the wall.

What is a bed bioreactor?

Bioreactor beds consist of a bed of woodchips or other carbon source through which water from subsurface pipes (e.g. tile drains) or an open drain is passed. They are either in-line (within a drain) or off-line (water is diverted into the bioreactor via an offtake). An inlet and outlet structure is required in either instance. Excess flow is bypassed.

A sediment trap is generally required upstream of the woodchip to prevent clogging of the bioreactor bed.





What are the steps involved?

Site selection

The most important and time-consuming part of installing a bioreactor is choosing the right site and design. There are variables to consider such as the location in the landscape, hydrology, catchment area, pollutant of concern and production system management. It is recommended that you seek professional advice.

Approvals

Approvals may be required for the construction of a bioreactor. Please contact your local government and the Queensland Government to check what approvals are required. Prior to construction, check for any existing infrastructure by contacting electricity, water and telecommunication providers.

Engineering advice should be sought prior to construction to ensure the bioreactor is sized and sited appropriately, taking into account soil suitability, groundwater and local hydrology.

Construction

Bioreactors require earthworks to excavate a trench. For beds, an inlet and outlet into a farm drain or subsurface drain will need to be constructed and can be an open drain or pipe.

If you anticipate large amounts of surface water flowing across the site, you may consider installing an embankment to prevent damage to the bioreactor through scouring and/or topsoil loss or deposition.

Install geofabric or plastic on top of the woodchip, to prevent sedimentation and clogging of the woodchip over time. This will also allow the woodchip to be exposed later, if desired.

Time for establishment

A bioreactor can be constructed and operational within one to two days (depending on the size of the structure and any associated pipe work or other structures). Denitrification will commence almost immediately. The denitrifying microbes are naturally present in the environment. No 'seeding' is required.

Operation and maintenance

Operational requirements are minimal. Bioreactors operate passively. Typical maintenance of a bioreactor bed will involve occasional excavation of the sediment trap to remove sediment build up.

Monitoring

Check sediment traps. Check inlet and outlet structures for blockages. Measure flows and nitrate removal for ongoing design purposes.

Lifespan/replacement time

The expected life span of a bioreactor in Queensland is 10-12 years. This will depend on the location and the type of carbon source. After this time the carbon source will need to be added to or replaced.

Where can I find more information?

https://wetlandinfo.des.qld.gov.au/wetlands/management/treatment-systems/for-agriculture/treatment-sys-nav-page/

*Content sourced from Department of Environment and Science Wetland*Info *website.*

2021

Queensland Government

Appendix 3 – Plant species suitable for saline areas

Extracted from Appendixes—Salinity management handbook - Salinity management handbook - Publications | Queensland Government

Pasture species for saline soils

The following table (Table 48) lists plants considered suitable for planting on saline soils in Queensland (I. Christiansen, pers. comm.; Townson & Roberts 1992). Information is included on growth habit, propagation, tolerance to waterlogging and salinity, and pasture characteristics. The species are divided into four groups:

- grasses for severely saline soils
- grasses for highly saline soils
- grasses for less saline soils (such as the periphery of saline areas)
- other plants for saline soils.

Grazing management is particularly important in saline areas. Natural regeneration after stock have been excluded or stocking rates decreased is often significant. When salt-tolerant pastures are planted, stock should ideally be excluded for an initial period—generally one to two years depending on conditions—to allow pasture species to establish and achieve satisfactory growth.

Notes on saltbush and samphire species

Atriplex (saltbush) shrubs enhance nutrient cycling, increasing fertility in the mounds under individual bushes and creating favourable microniches for other species. Pasture production beneath the shrubs is greater than in the surrounding area (Mott & McComb 1974). Growth of ephemerals is also promoted under *Atriplex* shrubs (Wilcox 1979). When sown, saltbush plants should be spaced to allow other pasture species to establish in the intervening area.

Saltbush is best regarded as a protein supplement to dry grasses or cereal stubbles. For instance, sheep fed on saltbush alone are likely to lose weight (Warren et al. 1990). Provided a plentiful supply of fresh water is available, cattle productivity on (supplemented) saltbush pasture is similar to that of sheep (Wilson & Graetz 1980).

Because samphires are high in soluble salts, these species are more suitable for grazing by sheep than by cattle or other stock. Samphire grazing should be diluted with alternative fodder such as crop stubble, grass or hay, and a plentiful supply of fresh water should be available. Samphire stands do not tolerate heavy grazing (Malcolm & Cooper 1974). Grazing on samphires is best restricted to late summer and autumn so that the plants can maintain normal summer growth and set seed.

Table 48. Plants considered suitable for saline conditions in Queensland (I. Christiansen, pers. comm.; Townson & Roberts 1992).

Grasses for severely saline soils

Species	Growth habit	Waterlogging and salinity tolerance	Pasture features	Propagation
Brown beetle grass *Diplachne fusca*	Tufted, semiaquatic grass up to 1.5 m high. Leaves are soft and succulent. Forms a dense mat. Generally found growing only in patches.	Often found in flooded depressions or in areas where the watertable is close to the surface. Very high salt tolerance. Tolerates drought and fire.	Highly palatable and nutritious. (Regarded as a weed of rice crops and waterways.)	Does not set viable seed; best established from rooted slips. Active growth in summer.
Salt-water couch *Paspalum distichum* (formerly *P. vaginatum*)	Slow growing, mat forming.	Very resistant to high salt concentrations. Suitable for drainage lines or areas where continuous salty seepage keeps the ground moist most of the time. Fairly resistant to frost and high temperatures	Palatable, readily grazed. Tolerates strategic grazing once established.	Seed viability very low and not available commercially; all plantings to date have used rooted clumps, runners and cuttings. Has been observed to spread and stabilise a salt-affected waterway near Monto and Kingaroy, and to spread slowly downstream.
Marine couch *Sporobolus virginicus*	Fine-leaved, mat forming grass, 5–40 cm high.	Establishes and spreads well on highly saline soils with high watertables. Tolerates extremely high salt levels. Found naturally in areas where the watertable is high or which are subject to periodic flooding or marine inundation. Responds well to controlled burning.	Considered a valuable pasture for fattening cattle. Palatable and nutritious. Tolerates strategic grazing once established.	Establishes well from rooted clumps. Needs plentiful moisture for good growth but is able to survive dry periods. Seeds do not germinate readily
Buffalo grass *Stenotaphrum secundatum*	Hardy perennial grass. Spreads vigorously by runners; roots readily at stem joints.	Tolerates high salinity in moist, swampy soils. Tolerates frost, short dry periods, flooding and shade.	Palatable when young; can be made into useful silage. Best grazed every second week to 6 cm; recovery is slow if grazed shorter than this.	Plant from rooted runners, dig or disc harrow then roll into the soil. Does not set seed.

Grasses for highly saline soils

Species	Growth habit	Waterlogging and salinity tolerance	Pasture features	Propagation
Rhodes grass *Chloris gayana*	Perennial, tufted grass up to 1 m high. Tough, wiry, leafy runners root and shoot readily at the nodes	Most salt-tolerant pasture species available commercially. Suggested for erosion and watertable salting areas on a wide range of soils. Tolerates frost and drought. Can extract water to 4.25 m.	Highly valued as a pasture species. Cultivar Pioneer is the most salt tolerant but the least palatable when mature; produces abundant seed. Some Katamboora cultivars are salt tolerant and palatable.	By seed.
Common or green couch *Cynodon dactylon*	Perennial grass which forms a tough mat.	Tolerates moderate to high levels of soil salinity, particularly in subtropical conditions. Can be highly productive on very saline soils. Tolerates drought. Recovers from frost.	Very palatable and nutritious if fertilised and growth kept short. Good soil binder to prevent erosion. Resistant to heavy grazing.	Can be included in the seed mixture under most conditions except in low rainfall and very salty areas. Once established, spreads quickly by rhizomes and stolons.
Curly windmill grass *Enteropogon acicularis*	Tufted perennial grass up to 1 m high, but usually less. Grows in clumps up to 30 cm wide with a strong, fibrous root system.	Tolerates extreme soil salinity. Tolerates drought.	Varieties found on heavy soils are valuable fodder; taller, coarser variety found on sandy soils is only moderately palatable, but is useful when other feeds become scarce. Does not tolerate heavy grazing.	Readily establishes (naturally) on bare ground and in waterways.

Grasses for less saline soils (such as the periphery of saline areas)

Species	Growth habit	Waterlogging and salinity tolerance	Pasture features	Propagation
Pangola *Digitaria decumbens*	Stoloniferous; summer growing.	Does not tolerate extreme salinity but is useful for less saline margins. Tolerates temporary flooding only. Susceptible to frost but recovers well when weather warms. Will survive drought once established.	Highly palatable and nutritious when young. Makes good silage if cut before it becomes stemmy.	By sprigs or roots from which it spreads rapidly. Does not set viable seed.
Tall fescue grass *Festuca arundinacea*	Winter growing grass. Will gradually colonise surrounding area.	Good for margins of saline areas and wet toeslopes.	Good pasture species.	Vegetative or seed. Sets viable seed.
Para grass *Brachiaria mutica*	Perennial grass up to 2 m tall with long, hairy leaf blades.	Commonly found in swampy areas. Grows well in areas that are flooded occasionally or in seepage areas. Often found on deep loams over saline clays and on marine floodplains. Can be used in high rainfall areas (more than 800 mm/year).	Sensitive to frost. Young grass is very palatable. Valuable as feed in the dry season.	Set seed not generally viable, so vegetative planting is usually necessary. Planting material should be reduced to 20–30 cm lengths, spread over the area and disced into the soil. Irrigation after planting, if available, is most beneficial.

Other plants for saline soils

Species	Growth habit	Waterlogging and salinity tolerance	Pasture features	Propagation
River saltbush *Atriplex amnicola*	Bushy, perennial shrub.	Grows vigorously in extremely saline areas provided sufficient moisture is available. Tolerates waterlogging.	Good forage, recovers well from grazing. High protein, low carbohydrate.	Best established from seedlings or cuttings.
Wavy leaf saltbush *Atriplex undulata*	Bushy, low-growing shrub.	Grows well on drier sites. Not recommended for waterlogged areas.	Generally not as productive as *A.-amnicola*. Recovers well from grazing. Readily grazed by sheep. High protein.	Establishes well from seed. Susceptible to dieback disease.
Old man saltbush *Atriplex nummularia*	Upright growth habit. Leafy.	Tolerates very high salinity. Not tolerant of prolonged waterlogging. Tolerates drought.	Less palatable than *A.-amnicola* and *A.-undulata*. High protein.	Grows rapidly from seedlings even in low rainfall conditions. Seeds should be washed with running water for 2 to 4 hours before sowing to leach out germination inhibitors. Susceptible to Phytopthera (root rot).
Grey saltbush *Atriplex cinerea*	Both prostrate and upright forms.	Tolerates moderate waterlogging.	Variable palatability. High protein.	Spreads rapidly.
Queensland bluebush *Chenopodium auricomum*	Upright, open shrub.	No information available.	Useful as a drought-resistant fodder.	Volunteers readily in areas spelled from stock.
Ruby saltbush *Enchylaena tomentosa*	Dense, rounded bushy shrub with short, succulent leaves, up to 1.5 m high. Flowers and fruits during most of the year.	Grows well on highly saline soils. Tolerates moderate waterlogging.	Readily grazed with very high digestibility. Does not withstand continuous, heavy grazing. Sweet berries are edible.	Volunteers readily after grazing pressures have been removed. Fresh seed (encased in pink berry) germinates well.
Coastal pigface *Sesuvium portulacastrum*	Succulent, prostrate, perennial herb. Spreads by long stems flat on the ground.	Good coloniser of severely saline, bare ground, creating more favourable niches in which other plants can establish. Tolerates waterlogging.	A good pioneer of severely saline areas, paving the way for other species to become established.	Establishes by plant pieces. Once established, spreads well by runners. Does not compete well with other species, but will re-establish if competing species fail.
Samphire *Halosarcia* spp.	Low-growing, leafless shrub. May cover considerable ground area.	Colonises severely affected areas well, and can improve soil conditions for other species to establish. Tolerates extreme waterlogging.	High protein content. Readily grazed provided sufficient other, less saline feeds are also available.	Establishes well from surface-sown seed; plant pieces that hold seed can be spread.
Swamp rat-tail grass *Sporobolus mitchelli*	Spreads rapidly over bare ground by means of long runners.	Grows well in saline seepages.	Good early coloniser but takes some time to produce good ground cover. Tolerates strategic grazing once established.	Plant as rooted clumps or runners.

Note: Refer to notes on saltbush and samphire species at the beginning of this section.

Tree species for salinity management

The information in Table 49 has been collated from the results of research trials conducted in Queensland and other States, supported by information based on the experience of Forestry officers and researchers in establishing and observing tree planting projects around Queensland (Hinchley 1994). (Further information on selecting, establishing and maintaining trees is provided in Tree planting page 104.)

This information, along with more detailed information on tree species, is now available on the Internet. The Queensland Tree Selector ‹www.dpi.qld.gov.au› is a computer program that selects the most suitable trees and shrubs for the site conditions entered by the user.

Notes for Table 49

1. Salinity, waterlogging and sodicity tolerance:
   - VH very high tolerance
   - H high tolerance
   - M moderate tolerance
   - L low tolerance
   - ? tolerance unknown
2. Frost tolerance:
   - H tolerates heavy frost
   - L tolerates light frost
   - N intolerant of frost
   - ? frost tolerance unknown
3. Suitability for saline discharge sites.
4. Rainfall zone:
   - VH very high (› 1250 mm/yr)
   - H high (1000–1250 mm/yr)
   - M medium (750–1000 mm/yr)
   - L low (500–750 mm/yr)
   - VL very low (‹ 500 mm/yr)
5. Potential uses:
   - s/s shade/shelter
   - fge forage
   - wbk windbreaks
   - frm farm timber
   - cbt cabinet or craft timber
   - pol poles/sawlogs
   - oil oil/tannin/chemicals
   - hny honey
6. Approximate maximum mature height (m).
7. Origin:
   - Q natural range includes Queensland
   - A Australian native, not from Queensland
   - NQ Australian native, suitable for North Queensland only
   - WA Western Australian species
   - E exotic species
8. Origin of information for this table:
   - F field trialled in Queensland
   - G glasshouse or interstate trials
   - E expert information, Queensland source
9. Potential weed.
10. Potential weed on floodplain.

Table 49. Trees suitable for growing in saline and waterlogged conditions and for use in salinity management (Hinchley 1994).

Scientific name	Tolerance						Potential uses[5]	Height[6] (m)	Origin[7]	Info origin[8]
	Salinity[1]	Water-logging[1]	Sodicity[1]	Frost[2]	Suit SDS[3]	Rainfall zone[4]				
Acacia aulacocarpa	M	L	L	L		M	frm, cbt, pol, hny	28	Q	F,G,E
Acacia auriculiformis	H	L	H	N	✓	H	fge, frm, cbt, pol, oil	20	Q	F,G,E
Acacia crassicarpa	L	L	M	L	✗	H	frm, cbt, pol	12	Q	F,E
Acacia leptocarpa	L	L	?	N	✗	M	fge, frm, cbt	7	Q	F,G,E
Acacia mangium	L	L	L	L	✗	H	s/s, wbk, cbt, pol	25	Q	G,E
Acacia melanoxylon	M	M	L	H		H	s/s, wbk, cbt, pol	25	Q	F,G,E
Acacia pendula	L	M	M	H		L	s/s, fge, cbt	6	Q	G,E
Acacia salicina	H	L	H	H	✓	L	fge, wbk, cbt, pol	12	Q	G,E
Acacia saligna	M	L	L	H		L	fge, wbk	4	A	G,E
Acacia stenophylla	H	M	H	H	✓	L	s/s, fge, frm, cbt	8	Q	G,E
Atriplex spp.	H	L	M	H	✓	L	fge	2	Q	E
Callistemon linearis	H	M	L	H	✓	H	wbk	4	A	E
Callistemon montanus	H	M	L	L	✓	M	wbk	2	Q	E
Callistemon phoenicius	H	M	L	H	✓	H	wbk	3	A	E
Callistemon rigidus	H	M	L	H	✓	H	wbk	3	Q	E
Cassia brewsteri	M	L	M	H		M	s/s	8	Q	G,E
Casuarina cristata	H	M	M	H	✓	L	s/s, wbk	20	Q	E
Casuarina cunninghamiana	H	H	L	H	✓✓	H	s/s, fge, wbk, cbt	30	Q	F,G,E
Casuarina equisetifolia	M	M	H	L	✓	H	s/s, fge	15	Q	G,E
Casuarina glauca	VH	H	M	H	✓✓	M	s/s, wbk	20	Q	F,G,E
Eucalytpus argophloia	H	M	M	H	✓	L	s/s, frm, pol	25	Q	G,E
Eucalyptus brassiana	H	L	H	M	✓	H	s/s	20	Q	F,E
Eucalyptus brockwayii	M	M	?	H		VL	s/s, frm	15	WA	G,E
Eucalyptus camaldulensis	H	H	H	H	✓✓	VL	s/s, fge, wbk, frm, pol, hny	30	Q	F,G,E
Eucalyptus citriodora	M	L	L	L		M	s/s, frm, pol	30	Q	F,G,E
Eucalyptus cloeziana	L	L	L	L	✗	H	s/s, frm, pol	35	Q	G,E
Eucalyptus curtisii	H	L	H	H	✓	L	s/s, pol	6	Q	E

Scientific name	Tolerance						Potential uses[5]	Height[6] (m)	Origin[7]	Info origin[8]
	Salinity[1]	Water-logging[1]	Sodicity[1]	Frost[2]	Suit SDS[3]	Rainfall zone[4]				
Eucalyptus grandis	M	L	L	H	✗	H	s/s, pol	35	Q	F,G,E
Eucalyptus intermedia	L	L	L	L	✗	H	s/s, frm, hny	30		F,E
Eucalyptus largiflorens	M	H	?	H		L	s/s, hny	20	Q	G,E
Eucalyptus leucoxylon	M	L	L	H		L	hny	20	A	G,E
Eucalyptus longicornis	H	M	M	H	✓	L	s/s, hny	20	A	E
Eucalyptus maculata	H	L	M	L		H	pol, hny	30	Q	G,E
Eucalyptus melliodora	M	M	M	H	✓	L	s/s, wbk, frm, pol, hny	25	Q	F,E
Eucalyptus microtheca	H	L	H	H	✓	VL	s/s, frm, pol, hny	25	Q	F,G,E
Eucalyptus moluccana	H	M	M	H	✓✓	H	s/s, wbk, pol, hny	20	Q	F,G,E
Eucalyptus paniculata	L	L	?	L	✗	H	wbk, frm, hny	30	NQ	E
Eucalyptus pellita	M	M	L	L		H	s/s, pol, hny	30	NQ	G,E
Eucalyptus pilularis	L	L	L	L	✗	H	s/s, wbk, frm, cbt, pol	35	Q	G,E
Eucalyptus platypus var.	M	M	?	H		L	hny	6	WA	G,E
Eucalyptus raveretiana	H	M	?	H	✓	L	s/s, frm	20	Q	F,G
Eucalyptus robusta	H	H	L	L	✓	VH	s/s, wbk, frm, cbt, pol, hny	25	Q	F,G,E
Eucalyptus saligna	L	L	L	L	✗	VH	s/s, wbk, pol, hny	30	Q	G,E
Eucalyptus sideroxylon	H	L	M	H	✓	L	s/s, frm, pol, oil, hny	30	Q	F,E
Eucalyptus spathulata	M	M	?	H		L	s/s, wbk, oil	6	A	G,E
Eucalyptus tereticornis	H	H	H	H	✓✓	M	frm, pol, hny	30	Q	F,G,E
Eucalyptus tessellaris	H	L	H	H		M	frm	25	Q	E
Grevillea robusta	M	L	L	L	✗	M	s/s, cbt, pol	25	Q	G,E
Leptospermum petersonii	L	L	L	L	✗	M	wbk	3		G,E
Leptospermum polygalifolium	H	H	L	H	✓✓	L	wbk	2	Q	E
Leucaena leucocephala	M	L	L	L		M	fge	6	E	F,E
Lophostemon confertus	L	L	L	L	✗	H	s/s, wbk, frm, cbt, pol, hny	30	Q	G,E

Scientific name	Tolerance						Potential uses[5]	Height[6] (m)	Origin[7]	Info origin[8]
	Salinity[1]	Water-logging[1]	Sodicity[1]	Frost[2]	Suit SDS[3]	Rainfall zone[4]				
Melaleuca alternifolia	M	H	L	L	✓	H	s/s, wbk, oil	7	Q	G,E
Melaleuca arcana	H	?	?	N		M	s/s, wbk, hny	8		F
Melaleuca argentea	M	M	?	N		M	s/s, wbk, hny	8	Q	G,E
Melaleuca armillaris	M	L	M	L		M	s/s, wbk, hny	6	Q	G,E
Melaleuca bracteata	H	VH	M	H	✓✓	M	s/s, wbk, oil, hny	8	Q	F,G,E
Melaleuca cajeputi	H	?	?	N		M	s/s, wbk, oil	8	Q	F,G
Melaleuca dealbata	L	M	?	?	✗	H	s/s, wbk	8	A	F,G,E
Melaleuca decussata	H	H	L	L	✓✓	M	wbk	2	A	E
Melaleuca lanceolata	L	M	?	H		M	s/s, wbk, hny	4	Q	G,E
Melaleuca lateritia	H	L	L	L		H		2	A	G,E
Melaleuca leucadendra	H	H	M	L	✓✓	H	s/s, wbk, frm, pol, oil, hny	20	Q	F,G,E
Melaleuca linariifolia	M	H	M	H	✓	H	s/s, wbk, oil, hny	10	Q	G,E
Melaleuca nodosa	M	VH	M	H	✓✓	M	hny	3	Q	F,E
Melaleuca quinquenervia	M	H	M	L	✓✓	M	s/s, wbk, oil, hny	20	Q	F,G,E
Melaleuca thymifolia	H	H	L	H	✓✓	H	hny	1	Q	G,E
Melaleuca viridiflora	L	H	L	L		H	hny	15	Q	E
Melia azedarach	M	L	M	H	✓	M	s/s, pol, hny	25	Q	E
Metrosideros queenslandica	M	L	?	L		VH	pol	20	Q	G,E
Pinus caribaea var. *hondure* [9]	L	L	M	L	✗	H	s/s, wbk, pol	30	E	G,E
Pittosporum phylliraeoides	M	L	M	H		M	s/s, fge	6	Q	E
Syzygium forte spp. *forte*	M	M	?	N	✓	VH	s/s	20	Q	E
Tamarix aphylla [10]	H	L	?	?	✗	L	s/s, wbk	20	E	G
Tipuana tipu [9]	L	L	L	H	✗	M	s/s, fge	15	E	F,E