

MANAGEMENT CONSIDERATIONS FOR WATERLOGGED SOILS

Fact sheet

Regenerating waterlogged soils can be a slow process, especially for heavy soils or areas that have been inundated for a long time. As conditions begin to dry out, it's important to take initial steps to assess the soil before planting seedlings.

Being aware of the physical and chemical state of the soil (including pH), and what available nutrients are present will help implement a management strategy that will give the plants the best chance of survival. This strategy may include how the soil is cultivated, such as how deep or how many passes must be undertaken, the incorporation of organic matter, or adjusting the fertiliser schedule to apply smaller amounts more frequently (especially if another waterlogging event is likely during the growing season) which can help minimise nutrient losses.

It is also important to look at current soil management practices and make improvements when viable to reduce the likelihood of waterlogging in the future.

At a glance

Soil is classified as waterlogged when it becomes saturated with water, meaning there is no space for air in the soil pores and the root zones becomes anaerobic.

Plants are negatively affected due to reduced oxygen intake at the roots and nutrient deficiencies, which can lead to plant death.

Waterlogging can result from excessive rainfall, poor drainage, high groundwater levels, or over-irrigation.

Consulting your agronomist and analysing a soil test should always be the first steps. A soil test will tell you what crucial elements have been depleted in the soil, and will determine the best way to rehabilitate the area.

EFFECTS OF WATERLOGGING ON SOIL AND PLANTS

Soil Structure Deterioration:

Prolonged water saturation can cause soil particles, especially in dispersive or sodic soils, to disperse and collapse, leading to reduced aeration and drainage capabilities.¹

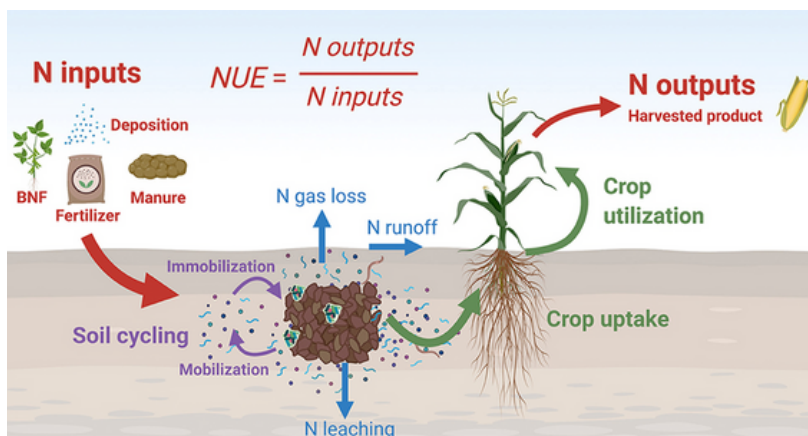
Nutrient Dynamics:

Waterlogged conditions often lead to oxygen depletion, resulting in anaerobic processes that can cause nutrient imbalances. For instance, nitrogen may be lost through denitrification, and phosphorus availability can fluctuate, affecting plant uptake.

Root and Plant Health

Oxygen deficiency impairs root respiration, leading to reduced nutrient and water uptake, stunted growth, and increased susceptibility to diseases.²

WATERLOGGING AND THE NITROGEN CYCLE



(Image: Udvardi M, et al, 2021)

When soil is waterlogged, it changes the following processes in the nitrogen cycle³:

- Increased denitrification: High losses of nitrogen to gas form occur when the soil becomes anaerobic. Microbes in the soil use nitrates (NO_3^-) as a source of oxygen, converting $\text{NO}_3^- \rightarrow \text{N}_2$ (gas) and O_2 .
- Increased nitrogen loss: Nitrogen in its plant available form (nitrate) is mobile in water. Therefore, it is readily lost in waterlogged conditions.
- High organic matter soil: Peats, swamps and low-lying areas that are waterlogged usually have high organic carbon. This increases the ability to immobilise nitrogen.

MANAGING WATERLOGGED SOILS

Working with your agronomist to get relevant soil tests will inform how to proceed after waterlogging. The following strategies may be suitable factors in the management of your waterlogged soils:

5

Nutrient Management:

1

- Monitor soil nutrient levels post-waterlogging and apply fertilisers judiciously to replenish lost nutrients, ensuring not to overapply, which can harm recovering root systems. A soil test will determine what nutrients have been depleted in the soil, as well as the pH level.⁵
- The application of trace elements through foliar or irrigation water to crops already planted during the waterlogging event can assist in reducing plant stress and re-establishing normal plant process and repair damaged root systems.

2

Soil Amendments:

- Gypsum Application: Apply gypsum to sodic soils to improve soil structure and reduce dispersion.⁶
- Organic Matter Addition: Incorporate compost or other organic materials to enhance soil aeration and structure.

3

Soil Aeration:

- Use aeration techniques to introduce air into the soil profile, promoting root respiration and microbial activity. Your agronomist can advise which cultivation technique is most suitable for your paddock, keeping in mind that excess passes should be avoided to reduce the risk of compaction.

4

Crop Selection and Rotation:

- Implement crop rotations to break disease cycles and improve soil structure. A cover crop may be the best course of action to restore soil structure before planting seedlings.

Paddock Management:

- Ensure the paddock drainage is set up correctly so water can drain away. Laser levelling and sub surface drainage, albeit expensive, is a long-term beneficial investment.
- Raised beds should be considered if that paddock is at continual risk of water logging or heavy rain fall events.
- If strategic tillage is being used to alleviate compaction and/or improve paddock damage, it is important not to do so while the soil is too wet as it will cause further compaction in sections and smear the soil.

The Soil Science

Waterlogging is often linked to poor soil structure, which typically worsens further down the soil profile. This makes it essential to understand subsurface conditions when selecting the appropriate remediation approach. A 20cm soil sample is often insufficient for this purpose. In particularly problematic paddocks, deeper assessments using subsurface samples, soil cores, or a soil pit are recommended. However, it is important that an experienced person both interprets the results and knows how to conduct the investigation correctly.

Duplex soils often feature an acidic surface layer overlying an alkaline, poorly draining sodic clay, highlighting the importance of understanding soil profiles at depth. In such cases, a targeted combination of lime and gypsum is an effective strategy to help boost productivity while also improving drainage capacity.

Short to mid-term solutions for waterlogged areas could include changing row direction to limit water collection in one area, improving soil drainage, or using raised beds for plants. However, if waterlogging is a common occurrence in a particular area of your farm, considering these 5 steps may provide a long-term solution to maximise soil health and productivity into the future.

Websites and resources:

- 1) <https://www.agric.wa.gov.au/waterlogging/waterlogging-%E2%80%93-science>
- 2) <https://www.sciencedirect.com/science/article/pii/S0098847224001825>
- 3) Graham, J, Waterlogged Soils, Farmacist News, October 2022, <https://www.farmacist.com.au/resources>
- 4) Udvardi M, et al, 2021, A Research Road Map for Responsible Use of Agriculture Nitrogen, Frontiers in Sustainable Food Systems. <https://www.frontiersin.org/journals/sustainable-food-systems/articles/10.3389/fsufs.2021.660155/full>
- 5) <https://www.business.qld.gov.au/industries/farms-fishing-forestry/agriculture/disaster/flood/recovery/crops/recovery>
- 6) <https://www.agric.wa.gov.au/dispersive-and-sodic-soils/managing-waterlogged-dispersive-sodic-soils>

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