MANAGEMENT OF POTATOES UNDER WET CONDITIONS

Many parts of Australia have seen Dorothea Mackellar's famous poem writ large across the landscape over the past few years. Three successive La Niña seasons have left prime potato growing areas waterlogged. Farmers more used to managing drought now find themselves with a suite of new challenges.
By Paulette Baumgartl

KEY POINTS

- Plant cover crops/green manure to improve soil physical properties that can better cope with wet conditions
- Ensure hills are stable and water can drain away in furrows. Reassess furrows following heavy rain
- Closely monitor nutrient levels, particularly in sandy soils, or if sub-soils are waterlogged
- Check moisture content of soil at different levels. A shovel is your best friend!
- If soil moisture below 25cm is at field capacity, the root system will be severely impacted
- Make sure hills are staying in place
- Avoid harvesting when soil conditions are wet; this will save soil structure and machinery

While flooding rains provide much needed relief to parched catchments and water tables, too much rainfall has consequences that are numerous and complex for potato growing. Challenges for growers are evident at every stage, from managing seed, planting, crop management and storage.

PRE-PLANTING

COVER CROPS AND PREPARING THE SOIL

Waterlogged soils are bad news for potato plants. Although we cannot control the weather, with some preparation we can create conditions that are better adapted to extreme wet conditions.

When soil is saturated, it cannot drain properly. The excess water inhibits the movement of oxygen into the soil, and thus the soil ecosystem quickly becomes anaerobic (Figure 1).

With a relatively shallow root system, potatoes have a very low tolerance to waterlogging and anaerobic conditions. Obviously, waterlogging cannot always be prevented, but improving drainage of water away from the crop and improving the soil's physical structure will help when the rains set in.

The many benefits of cover crops and green manures to soil health are widely known. These extend to helping soils prepare for a deluge by promoting a good physical structure through the addition of organic matter

Waterlogging in Ballarat, Feb 2023 - J Ekman to the soil. The extra organic matter improves drainage and optimises the amount of oxygen in the soil pores. Organic matter also increases the field capacity of soil, which is the amount of water the soil can hold before the air pockets fill with water and become waterlogged.

Organic matter from cover crops helps improve the physical properties, and thus the soil's ability to cope with excess water in a number of ways by:

- 'Gluing' particles together to form soil aggregates, creating a more porous soil structure.
- Acting as a sponge to absorb water and making it available to plants, slows down saturation, reducing the risk of waterlogging.
- Improving aeration by creating channels for air and water exchange. This is important for soil microorganisms, which are critical for soil health.
- Creating voids following decay: larger organic debris, for example roots and stems from green manure decay, leave an empty space, improving soil structure.

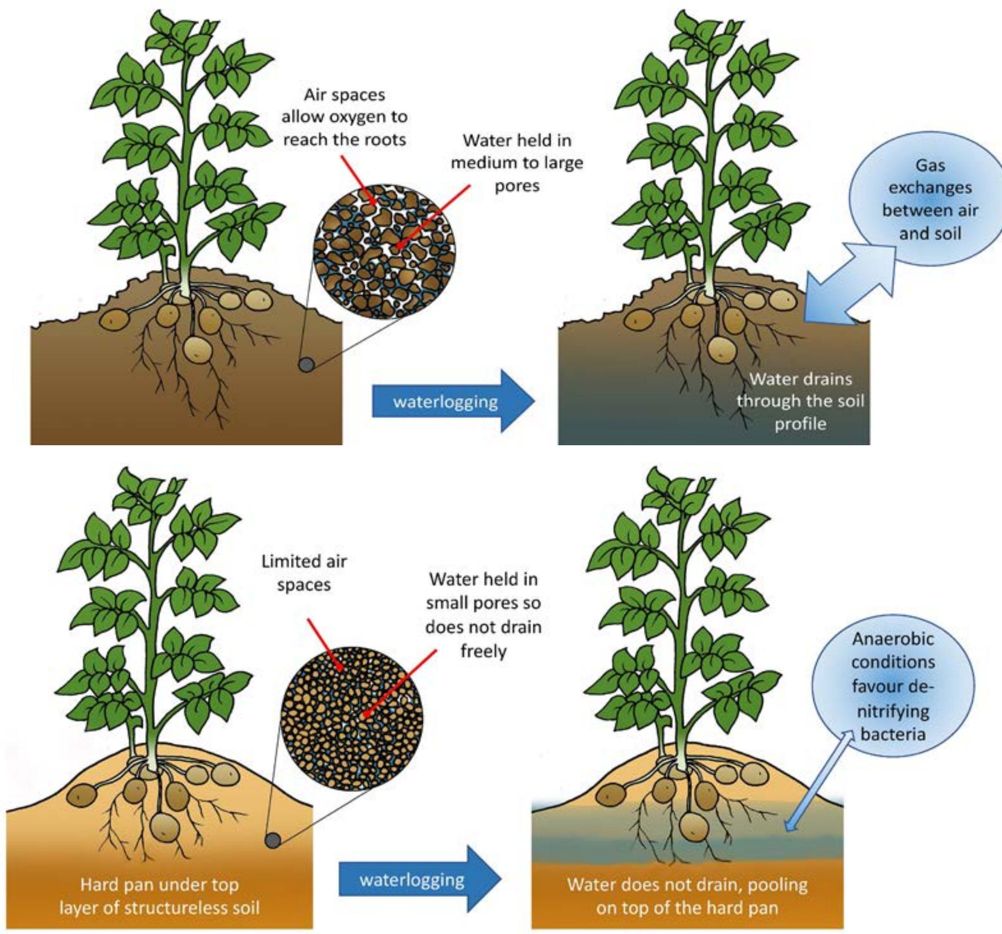


Figure 1. Top - good, healthy soils have a higher resistance to excess water and can maintain healthy conditions for longer. Bottom - poor soils can quickly become waterlogged, leading to unfavorable, anaerobic conditions.

Most soils, especially those with a high clay content, become compacted and slump after heavy rainfall and local flooding. This can form a crust, preventing oxygen and water penetrating the soil. Driving on the cropping area while the soil is very wet will result in further compaction and potential damage to expensive machinery.

However, once the paddock has dried, a light cultivation can be used to break up the crust to allow water and oxygen to penetrate. Care should be taken during cultivation not to cause further damage the soil structure.

Waterlogged ares are more prone to disease - T. Walker

SEEDBED PREPARATION

When a wet season is forecast, particular care needs to be taken when hilling potatoes. Potato seed pieces should be grown in hills of moist, weed free, stone free, friable soil, usually about 25-30cm high.

For soils that are prone to waterlogging, a bed former can be used before planting. This eases the planting operation by creating stable furrows and raised beds. These assist water flow and aeration through the hills. If a deluge occurs after hill formation, it is worthwhile checking the hills for damage and reconstructing if necessary. It is equally important to ensure that existing hills are not capturing water and preventing effective drainage.

Drainage can be either natural or artificial. Many areas have some natural drainage; this means that excess water flows from the farmers' fields to swamps or to lakes and rivers. Natural drainage, however, is often inadequate and artificial or man-made drainage is required.

There are two types of artificial drainage: surface drainage and subsurface drainage.

Surface drainage is the removal of excess water from the surface of the land. This is normally accomplished by shallow ditches, also called open drains. The shallow ditches discharge into larger and deeper collector drains. In order to facilitate the flow of excess water toward the drains, the field is given an artificial slope by means of land grading.

Subsurface drainage is the removal of water from the rootzone. It is accomplished by deep open drains or buried pipe drains.

i. Deep open drains

The excess water from the rootzone flows into the open drains. The disadvantage of this type of subsurface drainage is that it makes the use of machinery difficult.

ii. Pipe drains

Pipe drains are buried pipes with openings through which the soil water can enter. The pipes convey the water to a collector drain.

Buried pipes cause no loss of cultivable land and maintenance requirements are very limited. The installation costs, however, of pipe drains are likely to be higher due to the materials, equipment and skilled manpower involved.

Waterlogging can lead to nutrient deficiencies - Daniel Geisseler, UC Davis

DURING CROP GROWTH

MANAGING NUTRITION

Heavy rainfall and flooding can lead to nutritional deficiencies, especially in sandy soils.

If significant rain events occur after the crop has been planted, nutrient levels need to be closely monitored through regular soil and tissue testing.

Elements such as nitrogen and potassium are readily leached from the soil. Fertiliser applications should be adjusted to make up for shortfalls. Rates should be increased with caution though, as over application adds unnecessary cost and pollutes the environment.

Soils containing clay have a higher CEC so leaching is less of a problem. However there are other risks, including denitrification. The anaerobic conditions in wet soils favour denitrifying soil bacteria; these microbes convert nitrates into nitrogen gas, reducing available soil nitrogen.

MANAGING WEEDS

Pre-emergent herbicides are an important tool. If a dry window of 48 hours can be relied upon, these products can be highly effective.

Post-emergent herbicides need to be used with caution and are not generally recommended when wet conditions have reduced the growing season. Herbicides easily burn new potato leaves, damaging the ancillary parts of the leaves where important hormones for root growth are formed. While the potato leaves can recover, below the ground the root growth has been stunted. Recovery can take a week or more. If wet conditions have already shortened the growing season, even one lost week will have a significant impact on yield and quality.

In general, applying chemicals in the right conditions can be hard in wet years. If possible look out for a dry window to apply pre-emergent herbicide.

MANAGING PESTS AND DISEASE

Very wet weather clearly increases the risk of fungal disease, including late blight, pink rot, and powdery scab.

Mild growing conditions also create a heavy but soft potato canopy, increasing the risk of foliar disease. Observe your crop carefully (potentially using a drone) and remove infected plants to reduce the spread of disease. Powdery scab, for example, will make itself known at around day 20 after planting.

Although it is difficult to keep fungicide applications on schedule during wet conditions, they are vital to prevent spread and entry of disease. To ensure the best outcomes, consider the following:

- Adhere to correct rates and concentrations to reduce risk of resistance.
- Speak to your local agronomist to ensure timely application.
- Prevention and not cure is the key. Where late blight was last year, it will most likely be present this year. Be swift, take early action.
- Inform yourself on the latest, approved products.
- Ensure hills and furrows are well managed.
- Check spray nozzles are calibrated and oriented correctly.

OTHER PROBLEMS

Lenticels are the pores in the skin of a potato tuber that allow gas exchange between the internal tissues and external atmosphere.

Under waterlogged conditions tubers struggle to get enough oxygen to support normal respiration. In response, the lenticels swell into puffy, corky white growths. This is not only unsightly, but makes infection easier for a range of fungal and bacterial pathogens.

If the soil remains waterlogged for an extended period, plant health will suffer. The roots are restricted and may die, crops become stressed and nutrient uptake is reduced. The air between soil particles is displaced by water, eventually leading to plant death due to lack of oxygen. It may seem counter-intuitive, but waterlogging can lead to wilting, as the oxygen starvation kills the roots and vascular system blocks.

Even after the sun comes out, problems may persist, as damaged root systems struggle to keep up with demand from an oversize leaf canopy.

Puffed lenticels on waterlogged potatoes - R. Hall

HARVESTING AND POST-HARVEST CONSIDERATIONS

When harvesting the crop following the challenges of a wet season, the best advice is to understand the variability in your crop and identify problematic areas.

Some important considerations when harvesting in wet conditions:

- If you know an area has disease present, avoid placing the potatoes in a storage facility.
- Keep everyone informed. Buyers and processors need to know about issues. Talk to customers and discuss issues with your local agronomist.
- If the potatoes are stored by the processing company, it is vital they know about and can anticipate potential problems.
- If soft rot is suspected, delay crop harvest and let soft rot run its course, which should take approximately two weeks.
- Potato tubers normally contain air spaces, which allow gas to diffuse for respiration but also provide some 'cushioning' of impacts during harvest. These are reduced when potatoes are fully turgid (i.e. the plant cells are full with water), increasing the risk of bruising during harvesting.
- Waterlogged soils are heavy and can break expensive machinery.
- Waterlogged but otherwise 'valuable' soils can be sticky and leave the farm via machinery.

EXPLORE FURTHER

Watch more in these PotatoLink webinars:

Pink rot with Dr Robert Tegg.
http://bitly.ws/BFB7

Late blight with Professor Steven Johnson and Dr Rudolf de Boer
http://bitly.ws/BFBa

Common scab with Dr Tonya Wiechel.
http://bitly.ws/BFBj

Panel discussion on managing potatoes in wet conditions with Peter O'Brien, Peter Philp, and Tim Walker.
http://bitly.ws/BFCh

Read more about soil test reports in this PotatoLink factsheet:

http://bitly.ws/BUKX

SOURCES

https://www.fao.org/3/r4082e/r4082e07.htm

Panel discussion: Managing potatoes in wet conditions Peter O'Brien, Peter Philp, and Tim Walker

SLUGS IN POTATO CROPS

The recent wet spring and summer has provided ideal conditions for slugs to build their populations. As soils start to dry out during Autumn, slugs will seek moisture in soils and crop residue. Potato crops become targets for slug attacks, with the potato tuber providing an ideal harbour for this serious pest.

In recent years, slugs have emerged as a significant pest group in Australian agriculture. Potato tubers, rich in starch and with high water content, are attractive to slugs. The rasping mouth parts of slugs can penetrate the tuber. Feeding creates a cavity that increases risk of disease.

For both processing and fresh crops, the presence of slugs in tubers can result in load rejection and significant financial loss.

While these slug species differ in appearance, they can coexist in the same area. Accurate identification is essential for effective control. Incorrect identification can mean that controls miss peak activity, or are applied to non-pest species, allowing the real problem to persist.

THE UNUSUAL LIFECYCLE OF SLUGS

Slugs are hermaphrodites. That is, they have both male and female sexual parts.

Unlimited by a biological gender, any two individuals can mate and both then lay eggs. The breeding period occurs when moisture and temperature conditions are suitable, which is generally over winter and spring.

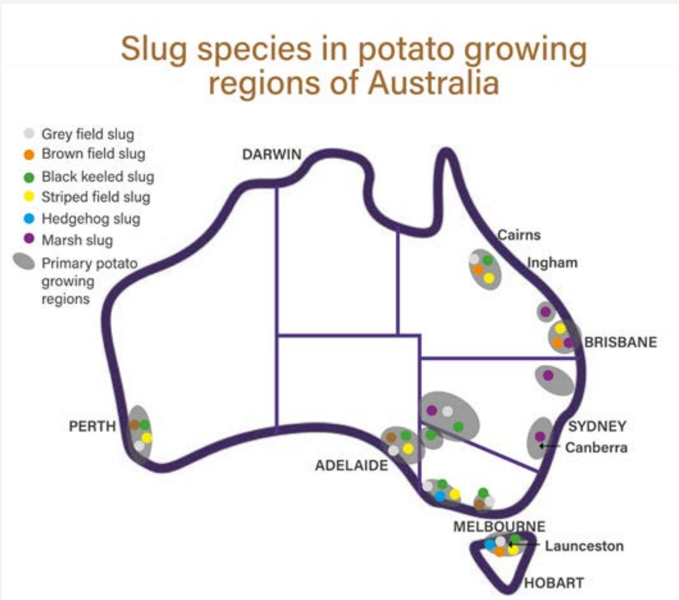
Slugs will lay eggs in clutches into moist soil over one to two month periods. The ideal soil temperature for egg development is between 10°C and 16°C for grey field slugs. Neonates hatch from the eggs within three to six weeks. These initially grow slowly, but accelerate as they develop into juveniles, especially given damp conditions and plenty of food. Temperatures ranging between 4°C to 21°C are suitable to many species.

The juveniles can become as large as adults, reaching sexual maturity after 10 to 40 weeks, depending on the species and conditions.

One intriguing aspect of slug development is that development times vary between individuals hatched from the same clutch. Within a population, there are both slow and quick breeders. This staggered breeding is believed to be an adaptation to survive difficult conditions.

Adult slugs can survive dry conditions by hiding under the top layer of soil and lowering their metabolism. They re-emerge once the subsurface wets up, which generally occurs after 75 to 100 millimetres of rain. However, emergence is often staggered, another adaptation to variable conditions.

Perforations and holes caused by slugs - potato-tuber-blemishes.com



Distribution of common slugs in Australia's potato growing regions

Along with plant damage, slugs leave a silvery, slime trail in their wake, caused by a secretion of mucus. Slugs a ravenous feeders, and can kill seedlings.

Factors which may cause a slug infestation include:

- A nearby crop, or weedy and grassy areas nearby
- Long grass in drains
- Wet areas from leaking irrigation
- Following a pasture crop
- Minimum tillage
- Wet, moist weather

The control of slugs is best achieved by adopting effective Integrated Pest Management (IPM) strategies (Table 1). Sampling, for example using slug mats, should the first step in any control program to determine the location, population and species present.

Cultural practices	Biological control	Chemical control	Physical barriers
Reduce soil moisture (if practical and suitable); remove weeds that provide favourable habitats; use trap crops to keep slugs and snails away; cultivate weed free strips between crop and headland to prevent migration; keep gully lines clean.	Birds, rats, frogs, and lizards feed on slugs and snails. Carabid beetles and native earwigs also feed on slugs.	Chemical baits are effective when used with cultural practices at those times when the populations have not reached damaging levels. Bait choice is important. Small, even sized pellets/granules will give a better coverage, increasing the likelihood of slugs and snails finding the baits	A protective border can be used to prevent the movement to crops. Lines of sawdust, ash, lime, and copper sulphate are effective barriers but efficacy is often reduced on wetting.

Table 1: IPM for the control of slugs (adapted from https://ausveg.com.au/biosecurity-agrichemical/crop-protection/overview-pests-diseases-disorders/slugs-and-snails/)

COMMON SLUGS FOUND IN AUSTRALIA (IMAGE CREDITS, WIKIMEDIA)

Grey field slug (*Deroceras reticulatum*); 50mm long. PEST: Yes (all crop types)

Brown field slug (*Deroceras invadens*); 30mm long. PEST: Yes (all crop types)

Black keeled slug (*Milax gagates*); 50mm long. PEST: Yes (all crop types)

Striped field slug (*D. nyctelius, Ambigolimax valentianus*); 70mm long. PEST: No

Hedgehog slug (*Aron intermedius*); 20mm long. PEST: Yes (wheat and pasture)

Marsh slug (*Deroceras laeve*); 25mm long. PEST: Yes (all crop types)

SOURCES

Nash, M. 2022. Slugs in crops: The back pocket guide. GDRC

https://ausveg.com.au/biosecurity-agrichemical/crop-protection/overview-pests-diseases-disorders/slugs-and-snails/

https://www.potato-tuber-blemishes.com/Symptoms/Pitted-or-raised-symptoms/Slug-holes

https://ahdb.org.uk/knowledge-library/how-do-slugs-damage-crops