

Managing waterlogging in crops Northern NSW

Key points:

- North Coast soils have excessive levels of magnesium and low calcium, which leads to higher compaction, low porosity and poor soil water infiltration.
- Waterlogging can lead to loss of nutrients, soil structure decline and crop loss.
- Water does not have to appear on the surface for waterlogging to be a potential problem
- Waterlogging occurs when roots cannot respire due to excess water in the soil profile.
- Raised beds are the most effective way of improving drainage.
- Foliar applied nutrition is an effective way to help plants overcome nutrient deficiencies due to waterlogging.

Waterlogging damage to crops:

North coast soils are generally highly weathered with low porosity, low Calcium magnesium ratios and excessive magnesium levels leading to compaction and poor soil water infiltration. And in periods of high rainfall can lead to excess moisture buildup.

Damage to crops by waterlogging after a significant rain event can frequently occur on the north coast during the late summer-early autumn months. Waterlogging occurs when the soil is so wet that there is insufficient oxygen in the plant's root zone to be able to respire (take up oxygen). Plants need for oxygen will change depending on their stage of growth and maturity. This lack of oxygen in the root zone causes the plant root tissues to decompose. Plant growth is stalled or inhibited. If waterlogged continues, the plant will usually die or will not recover sufficiently to yield a profitable crop.

Waterlogged plants are also starved of nutrition, especially Nitrogen, as nitrate is leached out of the root zone or legumes nodule formation is halted, and nitrogen fixation is also stopped. Plants are also starved of most other nutrients and will be noticeable as yellowing or discolouration of the leaves.

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Assessing water damage to waterlogged or submerged soybeans:

Several factors are involved when determining the level of yield loss in a soybean crop such as:

- Duration of waterlogged conditions.
- Growth stage of the crop.
- Solar radiation and temperature.
- Level of disease resistance of the soybean variety.

Crop injury from waterlogging is challenging to assess. If soybean plants are waterlogged for two days or less, yield losses are generally minimal however, if waterlogged conditions continue for more than four days, this can cause significant yield reductions, especially if the plant is in the reproductive stage and yield losses can be anywhere up to 50%.

Survival and yield decline depend on air temperature, humidity, cloud cover, soil moisture conditions before flooding, and soil drainage rate.

Soybeans will survive longer when flooded under cool and cloudy conditions. Higher temperatures and sunshine will speed up plant respiration which depletes oxygen and increases carbon dioxide levels. Suppose the soil was already saturated before flooding. In that case, soybean death will occur more quickly as slow soil drainage after flooding prevents gas exchange between the rhizosphere and the air above the soil surface. Soybeans often do not fully recover from flooding injury.

Assessing water damage to waterlogged or submerged maize crops:

Assessing waterlogging damage and yield loss for maize is the same as above for soybeans, although there are a few differences.

- Maize is quite tolerant to waterlogging from growth stages v6 through until v10
- Maize that is younger than the growth stage v6, is much more susceptible to waterlogging and flooding.
- Maize uses a lot of Nitrogen and does not fixate its own Nitrogen as soybeans do so waterlogging, and flooding can affect the crop if flooded at critical growth stages.

Growth stages from emergence through to V5 are critical for root development and establishment of maize. Therefore waterlogging can have detrimental impacts on yield and or establishment. Excessive water during this growth period can result in poor nutrient uptake (yellow plants from lack of Nitrogen or many symptoms such as purpling due to lack of Phosphorous) and can lead to root diseases such as pythium crown rot. The combination of lack of nutrient uptake due to poor root development and disease results in stand loss and can severely impact yield potential. In general, plants cannot tolerate more than 4 to 5 days of excessive water at this stage.



Soil borne diseases such as phytophthora, Pythium, rhizoctonia and fusarium may increase with warm and waterlogged conditions and affect plants' yield potential and will affect younger plants more so over older, more mature plants so be on the look out for wilted plants that are struggling to grow or total death of plants before deciding on to keep the crop or not.

Another thing to look out for in soybeans after waterlogging or flooding is signs of new growth from the main growing point and any branches.

It is also advisable to pull out plants and inspect root to look for healthy nodules, and this is done by cutting open nodules looking for a pink colour. Brown or mushy nodules or lack of nodules will fail to provide the plant with Nitrogen, so applying Nitrogen via a side dressing or foliar application will benefit the crop.

After looking at all these factors, it is then up to you to decide if your desired plant population will persist and whether the potential yield will be enough to warrant keeping the crop. A conversation in the paddock with your agronomist or consultant might be the best option.

Waterlogging in growth stages V6-V10 is not as damaging for maize crops as the roots are better developed and can recover more effectively from the soil's lack of oxygen. And at this stage, plants can generally withstand waterlogged conditions for up to 10 days or more.

From growth stage V10 through until V16, maize uses most nutrition so waterlogging through this period can significantly affect yield if plants are waterlogged early in this period it may be beneficial to side dress plants with extra nutrition when possible to do so or apply foliar application of nutrition to pull plants through.

If crop loss or yield looks to be too great to keep the crop through until harvest, seek advice from your local agronomist.

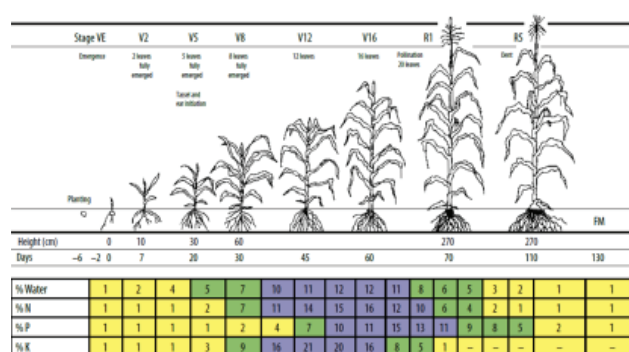


Figure 4. Growth stages, basic parts of the maize plant and water and nutrient requirements. Source: Gillies (1992)

Assessing water damage to waterlogged or submerged forage sorghum crops:

If there is a possible upside to the timing of this flood, it is that on the north coast, autumn is an ideal time for sowing temperate forages so follow normal autumn sowing guidelines in terms of species and seeding rates.

Sorghum is more tolerant of waterlogging and stress than other crops such as maize or soybeans. Waterlogging in sorghum can suppress growth and tillering, but good recovery can occur after by applying Nitrogen and sulphur as a top dress to promote growth and tillering.

Forage sorghum, when stressed, can produce hydrocyanic acid, which can lead to prussic acid poisoning in cattle. This can be produced by sorghum when the plants are under stress or are under periods of rapid growth, and this can happen under waterlogged conditions, especially if applying Nitrogen-based fertilizers after a waterlogging event. For more information on prussic acid poisoning, please see the following link **Grazing sorghum and millet - Website - Local Land Services** (nsw.gov.au).

Assessing your forage sorghum crop after a waterlogging event can be easier than grain crops if the crop looks well established with good plant populations and minimal plant death it may be worth keeping although look out for signs of nutrient stress and apply fertilizer where needed. Before any grazing event, the plants must be palatable for stock with minimal soil residues. After a submerged period, it may be best to graze after a small period of rainfall to allow washing off any flood sediment.

What to do with flooded crops:

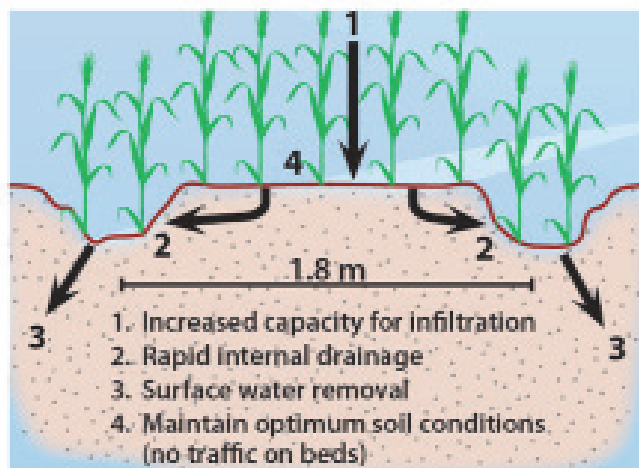
If a crop is not salvageable for its purpose as grain, consider cutting for hay or grazing if the crop still has some bulk to it and is not too dirty or covered in silt or whether further rain in the season 20-30mm will be enough to wash away most silt and mud.

Consider also using the crop as a cover crop to mulch in later in the season. This will provide ground cover and prevent erosion and increase carbon levels by mulching back in with further growth.

Minimizing Waterlogging damage:

Damage caused by waterlogging can be minimized in a few ways before deciding to plant a crop into a paddock that has the potential to be waterlogged.

Raised beds are an option for removing excess water from the root zone of susceptible crops and are designed to create and maintain a deepened seedbed that is not dense or constrains root growth and has furrows on either side that can drain water out of the root zone and off of the paddock.



Raised beds are constructed using an implement called a bed former and are generally quite an inexpensive piece of equipment. Another strategy to negate yield loss of waterlogged crops is to adjust your seeding by planting crops earlier

in the season as crop damage in waterlogged paddocks is higher when plants are in the seedling stage or increase sowing rates to negate the yield loss.

Manage weeds in paddocks as weeds will compete for the remaining Nitrogen left in a waterlogged crop. Weeds can be controlled in the crop before a rain event using a post-emergent selective herbicide.

Waterlogging effects can also be lessened by applying foliar nutrition that contains all of the major nutrients such as Nitrogen (N) and potassium (K) as these are nutrients required in large amounts by plants. Foliar sprays of nutrition help pull a plant out of stress and supply the crop with enough nutrition to overcome waterlogging.

Improving drainage of your soils can also be done by applying gypsum to hard-set, compacted and heavy clays by enhancing the soil's soil structure and porosity. Before doing so, this must be confirmed with a soil test. Well Structured soils generally have twice the amount of exchangeable calcium to exchangeable magnesium. If the calcium to magnesium ratio is less than 2:1, then this may indicate reduced soil stability.

Need more information?

Contact North Coast Local Land Services
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