■ FACT SHEET

# HOW DROUGHT AFFECTS SOIL

## Impacts and short-term management options

*Wind erosion - Eyre Peninsula 2018*

**During drought moisture stress leads to various changes in how the soil behaves. This fact sheet outlines these effects and short term measures to reduce the impact of drought and manage the soil back to recovery.**

### Increased soil wetting up requirement

Following a drought, clayey soils will require a significant amount of water to wet the soil profile beyond its crop lower limit (wilting point) and provide moisture for seed germination and plant growth. This is because clays hold water more tightly than sands, and a reasonable amount of water in clay is normally unavailable for crops to use. For example, a crop may wilt at 5 – 10% moisture in sands, but at 15 - 20% moisture in clays.

Drought removes this tightly-held water too. When it does rain, water needs to replenish the micro pores as well as the larger pores that hold water crops can use.

### Increased water repellence

Water repellence, where water ponds on the soil surface instead of infiltrating (or infiltrates very slowly), causes patchy crop establishment and exacerbates erosion risk. Drought makes water repellence worse. Sandy soils are more susceptible to water repellence.

### Decreased soil microbiology

Microbial activity in the soil is influenced by the type and amount of food available, temperature, oxygen and moisture content. During drought, the food source and the ability of microbes to move around the soil in solution is also affected. Lack of water can eventually lead to dehydration of the microbes and they break down.

Different types of microbes respond differently to moisture stress. For example, fungi are generally more adapted to hot dry conditions than bacteria. However, soil microbes are quick to re-colonise following dry conditions and populations can bounce back provided soil organic carbon, the food source for soil biota, has not been lost through erosion.

### Nitrogen may accumulate

During drought, crops take up less nitrogen but organic matter continues to slowly mineralise, increasing the pool of plant-available nitrogen. After drought breaks there is often a strong increase in mineralisation causing a flush of nitrogen. Un-used fertiliser can also contribute to increased soil nitrogen stocks.

### Phosphorus may not decline

The type and rate of transformation from fertiliser phosphorus to soil phosphorus and fixation can vary widely because of the number of factors involved.

*Figure 1. Emergency Tillage – Pinery 2015. Photo: D Woodard*

*Figure 2. Clay added to eroding sand- 2015. Photo: D Woodard*

Poor crop growth or a failed crop during drought will limit phosphorus uptake. When applied in a drought year, calcareous and other high phosphorus fixing soils will continue to fix phosphorus and available phosphorus will become less available while in other soils significant carryover of un-used phosphorus will occur. The new DGT phosphorus test is a good indicator of plant available phosphorus.

## Chemical constraints

Less water in the soil increases the concentration of ions in soil solution so that chemical constraints such as salinity, alkalinity, sodicity and boron toxicity generally increase.

Areas of saline topsoils (magnesia patches) can expand in dry years—evaporation of soil moisture concentrates salts in the surface layers and there is insufficient rain to flush them down the soil profile. These areas typically contract in size in wetter years or where surface cover reduces evaporation.

## Increased physical constraints

Compaction and soil strength increase as soils dry out making it harder for roots to penetrate and restricting overall plant growth.

## Increased erosion risk

The greatest effect drought has on soils in dryland cropping areas is increased soil erosion. Drought leads to a decline in plant growth and vegetative cover over the soil surface. Diminished plant growth means fewer roots and less organic matter to bind soil particles. As soils dry out, they lose coherence and weight, and readily break down into smaller, lighter, more erodible particles.

Sandy soils are more prone to wind erosion. Barriers placed in the wind's path will deflect it upwards away from the soil surface. The greater the height of the barrier, the greater the deflection. On cropping soils, barriers can be clay clods but are most commonly plants or plant residues such as crop stubble.

Wind erosion damages paddocks and surrounding areas. Soil blown off-site causes a range of environmental, economic and social problems. Soil erosion removes nutrients and carbon from the paddock and reduces the volume of soil available to plant roots, ultimately reducing the soil's productive capacity.

Water erosion commonly occurs after the drought breaks, particularly when heavy rain falls on bare ground. The main agents of water erosion are raindrop impact and flowing water and can damage land downstream, watercourses, roads and other infrastructure. Again anchored plant cover is best at reducing raindrop action and stopping damage from water flows.

*Table 1. Minimum and desirable cover levels to prevent water and wind erosion.*

| | Minimum Cover | | Desirable Cover | |
|---|---|---|---|---|
| | % | ha | % | ha |
| **Wind erosion** | | | | |
| - loam | 15 | 0.5 | 35 | 1.0 |
| - sandy loam | 20 | 0.6 | 50 | 1.5 |
| - sandy | 50 | 1.5 | 70 | 2.5 |
| **Water erosion** | | | | |
| - level land | 60 | 2.0 | 75 | 3.0 |
| - sloping land | 75 | 3.0 | 85 | 4.0 |

# SHORT-TERM MANAGEMENT DURING AND AFTER DROUGHT


*Stock containment area- temporary feedlot.*

## Maintain soil cover

- Vital to protect soil from erosion and for soil biological activity. Soil cover has a major influence on the ability of crops and pastures to rebound following drought.
- Remove livestock before critical soil cover levels are breached.
- Do not till or rip, retain stubble and direct drill seed.
- On eroding areas emergency tillage can be used but only on soils able to maintain fist-sized clods following tillage. If sands are drifting, consider applying clay if suitable clay is available (does not have chemical issues such as elevated boron or sodium). Avoid disturbing sands unless clay delving.

## Fine-tune fertiliser management

- Soil test to assess nutrient levels.
- Reduced phosphorus rates may be possible after the drought breaks. Zero phosphorus inputs come with a risk of reduced seedling growth. Highly calcareous soils continue to fix phosphorus during dry weather; these soils may need normal rates.
- Provided there has not been major erosion, soil nitrogen may have increased through continued mineralisation. However, if erosion has depleted soil carbon, mineralisation may be slow and different forms of nitrogen fertiliser, such as manures to add organic nitrogen back into the soil, may be necessary. Use nitrogen cautiously. Apply low levels up front, monitor plant nitrogen status and provide in-crop additions if needed.
- Vary fertiliser rates across paddocks and zones as needed.

## Crop management

- While it is tempting to quickly sow cereal as a cover crop, consider the rotation. Some soil borne diseases (e.g. crown rot) can become more severe after drought while for many others inoculum levels are lower. If in doubt, test for soil diseases. Use proven crops and varieties rather than experimenting to get cover.
- On sandy soils, consider overcoming water repellence with wetting agents. Sowing strategies include on-row and edge-row sowing, using winged points instead of knife points, and delaying seeding if the soil is still dry. Disturbing non-wetting soils when they are dry can make repellence worse.
- In many cases weed seed banks have been reduced, however management options may be reduced due to plant back periods on previously applied herbicides. Read labels or guidelines where relevant.

## Further Information

Contact the PIRSA-SARDI soils and land management team on 0429 691 468.


**References**

Hughes, B, Young, M, Davenport, D, Phogat, V, Wilhelm, N, Petrie, P, Mitchell, R and Cann, M (2022) *Managing soils during and after drought in cropping systems*. CRC High Performance Soils Fact Sheet



It is acknowledged that much of this fact sheet is taken from the CRC fact sheet. This fact sheet has been compiled by Brian Hughes SARDI.