SoilWealth NURTURING CROPS

Integrated Crop Protection PROTECTING CROPS

DECEMBER 2018

SOIL HEALTH AND WATER USE EFFICIENCY

KEY MESSAGES

- ✔ **Soil organic matter can improve soil water holding capacity**
- ✔ **Tillage, fallowing and crop removal all cause losses of soil organic matter**
- ✔ **Cover cropping and soil amendments can improve soil organic matter**
- ✔ **Irrigation scheduling and soil moisture monitoring are tools for improving water use efficiency**

WATER USE EFFICIENCY

Using water efficiently means applying enough water to meet the needs of the crop - not more, not less. Water use efficiency calculations (**water use index**) can be used to monitor the performance of irrigation practices. Examples are:

$$\textbf{Irrigation water use index (IWUI) for crop} = \frac{\textbf{Yield} \text{ (tonnes [t] per hectare [ha])}}{\textbf{Irrigation water applied} \text{ (Megalitre [ML] per [ha]) or [mm]}}$$

$$\textbf{Irrigation water use index (FWUI) for farm} = \frac{\textbf{Total crop water requirements} \text{ [ML/ha] or [mm]}}{\textbf{Total water supplied} \text{ (incl. rainfall) [ML/ha] or [mm]}}$$

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Ways to improve water use efficiency

- Determine a water budget for each crop. This is best by crop stage, to measure actual water applied including rainfall and irrigation.
- Confirm soil texture and conditions and the variability of soil across a paddock to determine whether irrigation should be varied for different zones, if possible.
- Plant available water that can be easily taken up by crops is called Readily Available Water (RAW). Calculate RAW in the rootzone to determine how much plants can easily extract. RAW gives information about the maximum amount of irrigation which can be applied at any one time.
- Check the wetting pattern of the soil after irrigation to ensure that the entire root zone gets wet and determine how much water is needed to achieve this, without run-off or puddling.

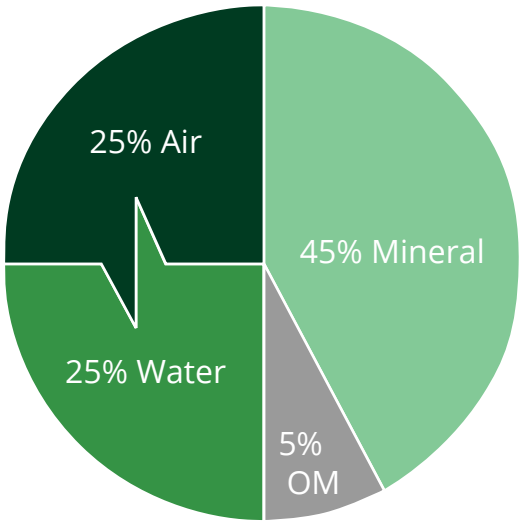

Figure 1: Ideal composition of soils

Readily available water (RAW) and soil texture

When comparing soils in good condition, loam, silt loam and clay loam soils have the highest volume of RAW. The higher the sand content, the lower the RAW. Clay soils have RAW similar to sandy loams (about 6-8%).

- Monitor soil moisture in the rootzone visually/ by feel and using technology to manage irrigation scheduling. Ensure the sensors you are using are suitable for your soil type(s) and outputs are calibrated according to soil texture if the readout is % water.
- Maintain healthy soil conditions to maximise the amount of water a soil can hold, and plants can access.

Healthy Soil Conditions

A soil in good condition consists of around 50% solid matter; this includes organic matter. The remaining space should be half filled with air and half with water (Figure 1). A compacted soil with poor structure holds less air and water than a soil in good condition. Organic matter provides the food for soil life and helps build good soil structure required for air flow, water storage and healthy root growth. The greater the intensity of cultivation and paddock traffic, and the more often long fallow periods occur, the greater the loss in soil organic matter and negative effect on soil structure (compaction). Maintaining soil cover and returning crop residues, or importing organic soil amendments such as compost, can reduce or prevent the loss of organic matter.

A healthy soil promotes good root growth which in turn means that plants have more access to water and nutrients held by the soil. One great benefit of improving soil health lies in the relationship between

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Organic matter is the main driver of soil health

The amount of organic matter a soil can accumulate and maintain greatly depends on its texture (composition of sand, silt and clay) and the climate, if the pH is not too low or high. The hotter or colder the climate, the less organic matter a soil will typically have. The higher the sand content, the less organic matter a soil can accumulate. The amount of organic matter in soils not used for agriculture is a good indication of the level a soil of a certain texture can hold.

Fallowing, tillage and erosion are the main ways organic matter is lost when cropping.

soil organic matter and a soil's capacity to hold plant-available water.

According to many studies, every 1% increase in organic matter (0.58% organic carbon) to a depth of 15 cm can lead to an increase in water holding capacity of 3000 L/ha to 185,000 L/ha; the latter is assuming organic matter holds about ten times it's weight. The actual increase depends on the type of organic matter, soil texture and climate.

Macropores created by organic matter have important effects in increasing water infiltration and gas (e.g. oxygen) transport. In addition, adding organic matter can create a mulching effect that reduces soil moisture evaporation losses, thus maintaining soil water content. Organic matter binds soil particles together, provides overall better stability, resilience against compaction and evens out temperature fluctuations.

It will also greatly assist in drainage, preventing plant death/disease from waterlogging.

Apart from the structural (physical) benefits, organic matter has positive effects on soil chemistry and biology. It is a nutrient reservoir, increases nutrient holding capacity, nutrient cycling, buffers soil pH and provides food for soil life, which can help to suppress soilborne diseases.

Increasing soil organic matter can significantly enhance resilience of soils and cropping systems, to both dry and wet conditions and other adverse influences.

Soil condition can be measured via regular conventional soil tests that include organic carbon (OC% x 1.7 = OM%) or organic matter (OM%/2 = OC%) test. Penetrometer or water infiltration tests and assessing surface crusting / cloddiness can be helpful, if done at the same soil moisture level. Tight clods and surface crusting are signs of poor structure and thus poor water holding capacity and soil health.

Further reading

AHR (2008) Managing Water for Yield and Profit: A training guide for Irrigators in the Australian Vegetable Industry (link here)

SoilWealth (2018) Organic Soil Amendments - global scan and review (link here)

VegNET (2018) The 'breakdown' on composts (link here)

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