WATER AVAILABILITY

Key points
- Available water is the difference between field capacity which is the maximum amount of water the soil can hold and wilting point where the plant can no longer extract water from the soil.
- Water holding capacity is the total amount of water a soil can hold at field capacity.
- Sandy soils tend to have low water storage capacity.
- Sub-soil constraints (acidity, hardpans etc.) can prevent crops accessing water in the subsoil.
- Structure and depth of crop roots affects access to available water.

Background
Of the water entering a soil profile, some will be stored within the rooting zone for plant use, some will evaporate and some will drain away from the plant root zone. Plant available water is the difference between field capacity (the maximum amount of water the soil can hold) and the wilting point (where the plant can no longer extract water from the soil) measured over 100 cm or maximum rooting depth (Hunt and Gilkes, 1992). Beyond the wilting point there is still water in the soil profile, however it is contained in pores that are too small for plant roots to access. Soil texture, soil structure and plant rooting depth are the crucial factors in determining the amount of water available for plants to access.

Soil texture
Increasing clay content in the soil profile is associated with greater water holding capacity. However, this does not mean more water is available for plants to use, as the clay helps create a complex soil matrix of smaller pores which hold water at greater suction pressures (figure 1).

In a uniform, coarse-textured soil (e.g. deep sand, sandy earth) low amounts of clay or silt result in poor soil aggregation and a free draining profile. This results in low storage capacity for either water or nutrients in the root zone. These soil types can also be water repellent due to the build up of waxes on the surface of sand particles, restricting the rate of water infiltration into soil and resulting in greater surface water losses.

In soils where there is a sharp change in soil texture in the subsoil (e.g. sand over clay duplex soils) the amount of water available for plants, depends on the texture of the surface soil, depth to subsoil and the nature/texture of the subsoil and its interface with the surface soil (figure 2). In soils with dense clay subsoil, for example, perched water stored above this less penetrable layer can result in too much available water, i.e. waterlogging (see Waterlogging fact sheet).

Cracking clays store water very differently to the previously mentioned soil types. Typically these clays are characterised by a light clay texture throughout the soil profile, with coarser material on the surface. As the soil shrinks and swells, seasonal cracking occurs. Water infiltration is affected as water flows preferentially into the cracks, whilst areas between cracks remain dry due to the massive soil structure and rapid movement of water. Due to its clay content, this soil type can store a lot of water but the availability of this water will be determined by infiltration patterns and rooting depth.

Soil structure
Soil aggregates create pores which store water for plants to access. A poor or non-existent soil structure with high clay content will have a reduced volume of soil pores. The
Pores that are present are smaller so water is held at higher suction pressures, making the plant exert more energy to extract the water, rather than using that energy for yield. Coarser textured soils will generally have larger pore sizes and little soil structure, resulting in rapid water drainage. A lack of soil structure can also mean poor infiltration and sometimes a compacted subsurface which can result in waterlogging in the root zone.

Increasing soil organic matter content helps create and stabilise soil structure. Organic matter is considered integral in the capacity of a soil to maximise water storage through its effect on creating and stabilising soil pores and its absorption capacity. Large volumes of crop residues on the soil surface can also aid water infiltration and reduce evaporation.

**Rooting depth**

The large variation in the maximum rooting depth of different crops and the tolerance of plant species to different soil conditions, in addition to depth of soil, determines the capacity of a plant to access available water on many soils (Van Gool et al., 2005).

In many agricultural soils there are subsoil barriers which prohibit plant roots from accessing available water:

- **Physical barrier**—subsurface compaction which may allow the movement of water and nutrients, but restrict root growth.
- **Chemical barrier**—subsoil acidity and salinity prevents the plant roots from accessing the whole soil profile.

**Management options**

Apart from claying sandy soils, there are few options to influence soil texture to improve water holding capacity. However, improving soil structure and removing barriers to plant growth can improve both the storage capacity of the soil itself and increase the area/depth of soil which plant roots may utilise for exploration.

Potential management options:

- Deep ripping compacted subsoils (see Subsurface Compaction fact sheet).
- Liming to ameliorate soil acidity (see Soil Acidity fact sheet).
- Increase organic matter to improve water infiltration.

**Further reading and references**

Hunt N and Gilkes B (1992) ‘Farm Monitoring Handbook’. The University of Western Australia, Crawley, Western Australia.


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Figure 2: An example of restricted subsoil water infiltration in a soil with a sharp textural change. The blue dye indicates the flow of water through the sandier surface and restricted infiltration at the clay layer (photo by David Hall, DAFWA).