Soil water holding capacity and infiltration

Water Use Efficiency – factsheet

How does soil hold water?

Soil holds water through a combination of texture, structure, and organic content. Fine particles like clay retain water well due to small pore spaces, while sand drains quickly with minimal retention. Water is drawn into soil pores by capillary action, with well-aggregated soil balancing water retention and drainage.

The soil's ability to supply water to plants depends on its field capacity and wilting point. Organic matter enhances this water retention by acting like a sponge and supporting soil structure. Compaction on the other hand, can reduce pore space, limiting water infiltration and availability.

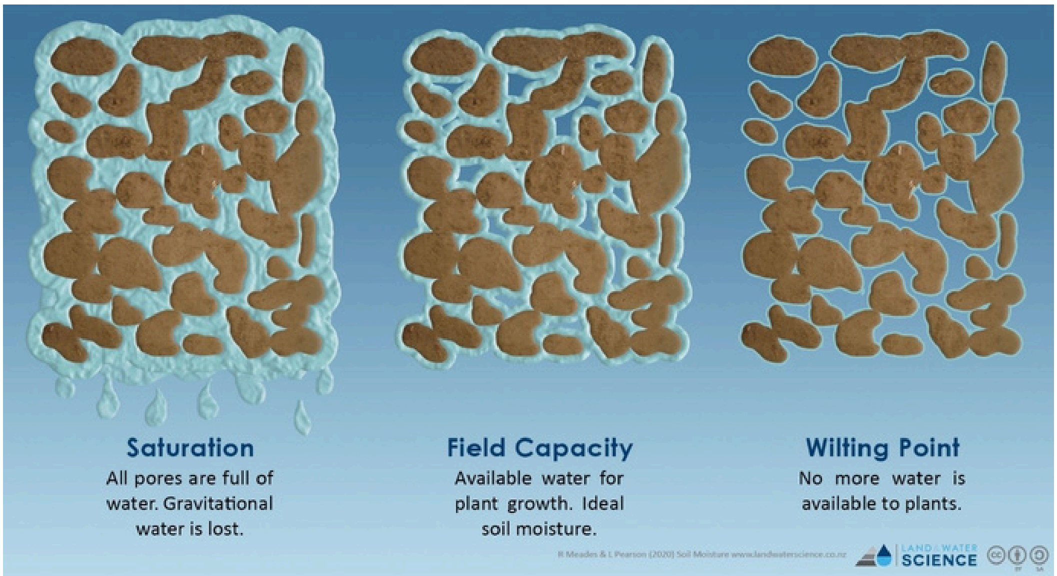

Figure 1 : How water is held within the soil particles at saturation, field capacity and wilting points (Image source: Meades & Pearson, 2020).

Soil texture determines water holding capacity

Soil texture refers to the relative proportions of sand, silt, and clay particles in soil, which determine its classification (e.g. loam, clay, sandy loam) and influences key properties like water retention, drainage, and nutrient availability.

Water holding capacity (WHC) is the soil's ability to retain water for plant use, primarily measured as the difference between field water capacity and permanent wilting point. Sandy soils drain quickly and have low WHC, clay soils retain more water but much of it is unavailable to plants, while loamy soils have properties of both.

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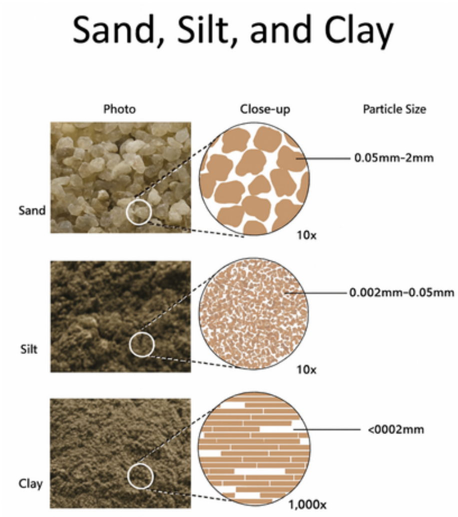

Figure 2: Particle size and description of different soil textures (Image source: Jurupa Community Services District).

Tip

There is often more than one soil type within a profile, usually associated with depth. Soils with a distinct change between the topsoil and subsoil are called 'duplex soils'.

Data to determine water holding capacity

Hands-on soil characterisation

Hand characterisation of soil moisture is a simple, low-cost field method used to estimate soil moisture by feeling and observing the soil. A sample is collected from the root zone (typically 10–30 cm deep), then assessed by rubbing it between the fingers to evaluate its texture, stickiness, and ability to form shapes. If the soil forms a firm ball or ribbon, it indicates higher moisture; if it crumbles or feels powdery, it's likely dry. Moist soils feel cool and cohesive, while wet soils are sticky and may glisten or ooze water. This method helps quickly gauge irrigation needs or monitor field conditions without specialised equipment.

To estimate the WHC and readily available water (RAW) of your soil; dig a hole, record the approximate depths of each distinct soil layer, and hand texture a sample from each layer. Once you have determined the texture and meters depth of layer, you can multiply this information using Table 1. The soil's WHC will be the summation of all layers.

Texture group	Water holding capacity (mm water/metre soil)	
	Readily available	Total available
Medium to coarser sand	30 – 50	40 – 80
Fine sand	40 – 60	60 – 100
Loamy sand	50 – 70	80 – 120
Sandy loam	40 – 70	100 – 140
Light sandy clay loam	60 – 90	110 – 170
Loam	80 – 100	140 – 200
Sandy clay loam	70 – 90	150 – 180
Clay loam	60 – 90	150 – 220
Clay	50 – 70	140 – 220

Table 1: The guide to amount of readily available water held in different soil types (Source: Weatherby, 1992).

Tip

When looking at your soil within a paddock, it is always a good idea to dig numerous holes to understand the variability.

Dig more holes and dig deeper holes.

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Infiltration

When it comes to irrigation, what goes on isn't always what goes in. It is important to get as much of the irrigation we apply to the root zone of the plant and not lost due to poor infiltration or deep drainage past the root zone.

Soil crusting and infiltration

Soil crusting refers to the formation of a compacted, often hardened layer on the soil surface, typically caused by the impact of raindrops or irrigation water breaking down soil aggregates. When the dispersed fine particles settle and dry, they form a dense crust that is less porous than the underlying soil. This crust acts as a physical barrier to water infiltration, reducing the rate at which water can enter the soil profile. As a result, more water runs off the surface rather than soaking in, leading to lower soil moisture availability, increased erosion risk, and reduced germination and emergence of seedlings. Soil crusting is particularly problematic in fine-textured soils and can be exacerbated by tillage and lack of vegetative cover.

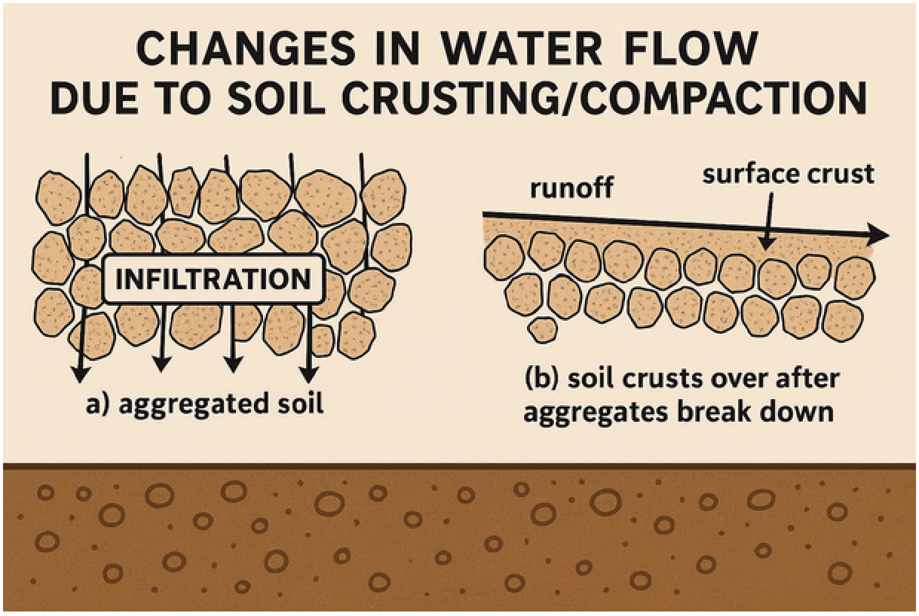

Figure 3: The impact of surface crusting on surface infiltration of water into the soil profile (Image source: OpenAI, generated by Ag Logic).

Organic matter and hydrophobicity

Soil hydrophobicity refers to a condition in which soil particles repel water instead of absorbing it, often leading to reduced water infiltration, uneven wetting, and increased runoff. This phenomenon is primarily caused by organic compounds, such as waxes, lipids, or microbial by-products which coat the soil particles, making them water-repellent.

Hydrophobicity is commonly observed in sandy soils, particularly following long dry periods, or in areas with high organic matter decomposition. The severity can vary from slight to extreme, influencing irrigation efficiency, and erosion risk.

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Assessing poor infiltration

Assessing your irrigation efficiency and making sure the water ends up where it is needed — the root zone — is often overlooked and can have a significant impact on crop yield. When irrigating, target the drier parts of your paddock that will be impacted more by surface crusting or hydrophobicity and scrape away the soil to see how far the water has infiltrated. This is more important in crops that have had significant soil preparation such as bed forming or moulding for potatoes.

Figure 4: An example of how hydrophobicity can impact surface infiltration. Water does not infiltrate the mound but runs into the furrow where it pools and slowly penetrates the soil profile (Image source; M Matuszek, Ag Logic).

For more resources to assist with optimising water use efficiency visit:

https://www.tasfarmhub.com.au/water-use-efficiency-project/

References

Weatherby K.G. (1992), *Soil Description Handbook*, Loxton: Irrigated Crop Management Services (ICMS).

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