Soil & Irrigation Fact Sheet

Soil Water

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Understanding a soil's water holding capacity is critical for effectively managing irrigation. With this knowledge, you can determine the plant-available water, how long this water will be available to your crop, and how much irrigation or rainfall is needed to replenish its supply.

During and after heavy rain or irrigation, soil pore space is filled with water and the soil is referred to as being **saturated**. While short-term saturation near the surface is normal, prolonged saturation impedes crop growth and can lead to nutrient loss. These impacts increase with duration and can be worsened by higher temperatures.

When a soil is wetted, excess water is redistributed through a combination of gravity and capillary action. Once the movement of water has substantially slowed, the soil is said to have reached its **field capacity (FC)**. FC is described as 'moist', representing the upper limit of water that a soil can hold against gravity. When a soil is near FC, water is readily available to plant roots. FC is not a precise value as the movement of water never stops completely. After saturation, sandy soils may reach FC in a day or two. Finer textured soils can take several days to reach FC.

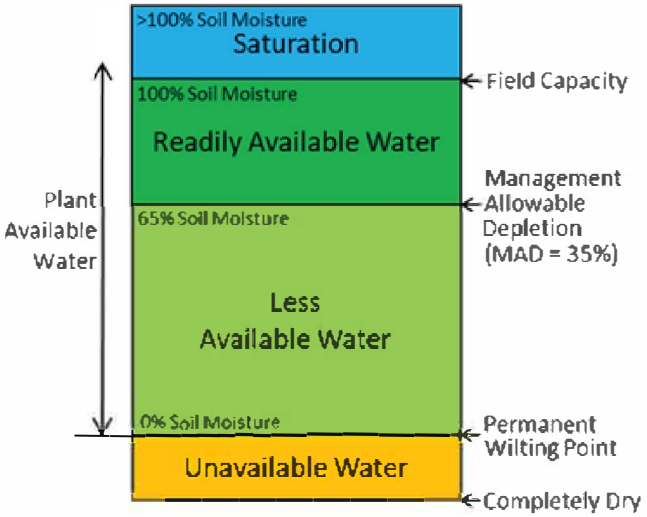

Figure 1: Soil Water Characteristics

As the soil dries, the remaining water becomes more tightly held to the particles, restricting what is available to crops. The **permanent wilting point (PWP)** is the lower limit of plant-available water. Although a crop will become stressed well before PWP has been reached. The concepts of FC and PWP correspond to the "tightness" by which the water is held in the soil.

The **plant available water (PAW)** is the difference between the FC and PWP. The PAW in the root zone represents the quantity of water that a crop can theoretically extract. PAW is often expressed as the percentage by volume, where the PWP is 0% and the FC is 100%. It can also be expressed as the depth of available water (millimeters or inches) within the estimated rooting depth of the crop.

The **management allowable depletion (MAD)**, sometimes called the availability coefficient is the maximum recommended soil water that should be permitted to become depleted between irrigations or rainfall. Soil water content between the MAD and FC ensures that water is readily available to the crop. MAD is usually expressed as a percentage of PAW in the rooting zone.

Small grains, corn, and soybean can withstand significant drying of the soil. These crops have MAD values as low as 50 to 70%. Potatoes are more sensitive to water stress and do best when soil moisture is higher. Potatoes generally require a MAD of 35%, meaning that soil moisture should be maintained between 65% and 100% of PAW. During tuber initiation and early tuber development, a MAD of 30% is recommended.

Soil Texture

Irrigators should know how long their soil can maintain a stress-free crop between irrigations. Estimates of water-holding capacities of the main soil textural classes are shown below.

Textural Class	Available Water by Volume (Percent)	Available Water per metre of soil	Available water in Root zone (0.6 m)	Readily Available Water in Root Zone (MAD of 35%)
Clay Loam	20%	200 mm	122 mm	43 mm
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Silt Loam	21%	208 mm	127 mm	44 mm
Loam	18%	175 mm	107 mm	37 mm
Fine Sandy Loam	14%	142 mm	87 mm	30 mm
Sandy Loam	13%	125 mm	76 mm	27 mm
Loamy Sand	10%	100 mm	61 mm	21 mm
Sand	8%	83 mm	51 mm	18 mm

As an example, a loam soil at field capacity can hold an estimated 175mm of available water within one meter of soil. Given that the effective rooting zone of potatoes is around 60cm (0.6m), the PAW is 107mm (175mm x 0.60m/1.0m). However, given an optimal MAD of 35% for potatoes the actual readily available water is only 37mm (107mm x 0.35). With a daily evapotranspiration rate of 4.5 mm, the readily available water would be depleted from a loam soil in eight days - or in four to five days from a sand or loamy sand.

It is important to recognize that soil water characteristics are likely to be different within a single soil profile and across a field. Therefore, these numbers are not precise and should be used as a general guide.

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