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How to use soil moisture readings for irrigation

(with examples for pasture)

Soil acts much like a sponge. When you immerse a sponge in water and repeatedly squeeze it, it becomes saturated. If you remove it from the water it will drain rapidly then drip for a while. Gravitational forces act against capillary forces until equilibrium is reached and the sponge stops dripping. This equilibrium state is called **Field Capacity**.

When soil is at Field Capacity and slightly below, conditions are excellent for plants. The addition of water above field capacity wastes water, causes leeching, and depletes the soil of valuable nutrients while also contaminating the groundwater with pesticides and fertilizers. It can also drive oxygen out of the soil and suffocate the roots.

As soil dries out from field capacity, a point is reached where plants have difficulty drawing water out of the soil and begin to experience stress. This lower limit is called the **Refill Point** or the **Stress Point**. This is the percentage of the available water in the soil that can be removed by plants before irrigation is required. This is also the point where irrigation water must be applied to keep the plants from experiencing stress. If water is not applied the soil will eventually dry to the **Permanent Wilting Point**. This is the point at which the plant will eventually die.

The proper moisture zone for healthy plants is between Field Capacity and the Stress Point. **The Stress Point is typically set at 75% of Field Capacity** in absolute volumetric water content terms. The Acclima sensors measure absolute volumetric water content without calibration if they have been correctly installed. See the short Harvest training video in order to carry out correct installation at harvest.com/acclimavideo.htm

The general rule of thumb is that the Stress Point is 75% of Field Capacity and the Permanent Wilting Point is 50% of Field Capacity. If you know the soil type then you can use the table below to more accurately determine the Permanent Wilting Point and the Stress Point.

Texture	FC (v%)	PWP (v%)
Sand	10	5
Loamy sand	12	5
Sandy loam	18	8
Sandy clay loam	27	17
Loam	28	14
Sandy clay	36	25
Silt loam	31	11
Silt	30	6
Clay loam	36	22
Silty clay loam	38	22
Silty clay	41	27
Clay	42	30

- Saxton and Rawls (2006)

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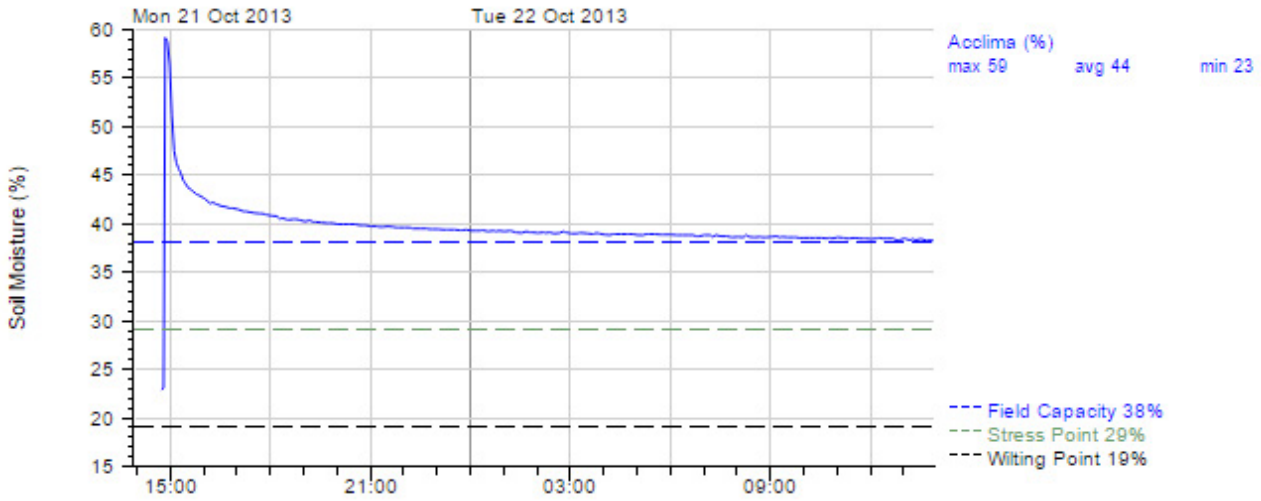
Determining Field Capacity

Field Capacity can easily be determined by flooding the sensor installation area then waiting for the sensor readings to stabilize. The stabilized reading is Field Capacity. For heavier soils it may be best to flood the sensor in the evening, then take a moisture reading the next morning before transpiration starts (before the sun gets too high) and assuming there is no rain during the night. In the morning the soil will be at Field Capacity. When you determine the Field Capacity, Harvest can plot a dotted line on your graphs to show the Field Capacity, Refill Point and Wilting Point, as shown in the graph below.



Probe Depth

For pasture the recommended depth for probes is 100mm for the main probe and 300mm for the secondary probe. The main probe is used to measure soil temperature and to calculate Field Capacity. The secondary 300mm deep probe is used to check that the soil is not being over-watered. The 300mm probe is also useful to forecast how badly the soil is drying out in the absence of rain or irrigation.

Grass can have quite deep roots but the plants draw most of their moisture from the soil zone going from the surface down to about 200mm, so it is best to place the probe halfway down that zone i.e. at 100mm depth.

If you think of the probe as being in the middle of a soil zone with half the soil above the probe and half below, then it is easy to calculate the irrigation that can be applied to bring the average moisture level in the zone up to Field Capacity.

Calculating Required Irrigation

Irrigation required to reach Field Capacity can be calculated using this formula:

(Field Capacity % – Current soil moisture %) x depth of probe in mm ÷ 100

e.g. if Field Capacity is 30% and current moisture level is 25%, the difference is 5% so you can apply 5mm for every 100mm of depth in the zone being measured. So if the probe depth is 100mm (recommended for pasture) then this is in the center of a 200mm deep zone, so you can apply 10mm of water to achieve Field Capacity at a depth of 100mm. This is called the Soil Moisture Deficit. This assumes a uniform soil type from the surface down to 200mm. After irrigation it can take 2-8 hours or more for the reading to stabilise at 100mm depth depending on the soil type.