2b - Available Water Capacity

The available water capacity (AWC) of a soil is a measure of its ability to make water available for plant growth within the rooting zone. The AWC of a soil is primarily related to the soil texture, organic matter content, and bulk density. A simple analogy would be that of a sponge, where it adsorbs water and then releases it when squeezed. For irrigation, the AWC is defined as the amount of water held between field capacity (FC) and the permanent wilting point (WP) as shown in Figure NC2-1. AWC is a simple and useful concept for irrigation, but it must be stressed that soils vary spatially and with depth over most fields, as do the AWC, FC and WP. It is recognized that plants can withdraw water from a soil that is above FC or is below WP. Also, FC and WP are hard to measure and define for a field and generally involves some lab work. For simplicity, AWC is commonly expressed as the water retained between 0.33 bar (FC) and 15 bar tension (WP) for fine to medium textured soils and between 0.10 bar and 15 bar for moderately coarse to very coarse textured soils. A formula for the computation of available water capacity is

Available water capacity in inches = $AWC = \frac{(d_b * T * P_w)}{(d_w * 100)}$

Where:

d_b = Bulk density = (Weight of ovendry soil sample in grams) / (Field volume of sample in cm^3)

T = Thickness of soil horizon under consideration in inches

P_w = Moisture content between field capacity and wilting point in percentage by weight

d_w = Density of water taken as 1 gm/cm^3

There are two methods to consider in the determination of AWC and when to irrigate. One method is based on the percentage of AWC within the root zone and the other is based on soil moisture tension. This difference in concept is shown in Figure NC2-2 which shows moisture release curves for three soils. In this figure moisture content is expressed as a percentage of AWC rather than a percentage by weight. FC is 100 percent of AWC and the WP is 0 percent of AWC (15 bars). Tension at any moisture level is different for the three soils. At the 50 percent level, for example, moisture tension for the clay is 4.3 bars; for the loam, 2 bars; and for the sand, 0.60 bars. Often, soil moisture gauges report their reading in tension (bars) and AWC must then be calculated from a moisture release curve.

Moisture is more readily available to plants at low soil moisture tension (near field capacity). Since tension values are so different in the three soils shown in Figure NC2-2, it is possible that crop response would be different if the soils were irrigated when available moisture depletes to the 50 percent level. However, for most soils, irrigation should be started when the soil moisture content is no lower than the 50 percent level.

The NRCS Soil Data Mart can be used to generate reports on physical soil properties for North Carolina soils, including AWC. For example, water holding capacity for 24 inches of rooting depth on an Norfolk (NrB) soil in Pitt County is:

0”-9”, 0.125 in./in. × 9 in. = 1.125 in.
9”-15”, 0.085 in./in. × 6 in. = 0.51 in.
15”-19”, 0.120 in./in. × 4 in. = 0.48 in.
19”-24”, 0.125 in./in. × 5 in. = 0.625 in.

Total AWC for 24 in. depth = 2.74 in.

The weighted AWC for the rooting depth is obtained by dividing the total AWC by the rooting depth. For the above example, the weighted AWC is:

2.74 in./24 in. = 0.114 in./in.

Note that the median Soil Survey AWC was used for each soil layer in the above example. For example, in the 0”-9” layer, the range for AWC was 0.10 $^{in}/_{in}$ to 0.15 $^{in}/_{in}$. This is a difference of about 50 percent and illustrates the need for on-site testing to determine the actual soil characteristics.

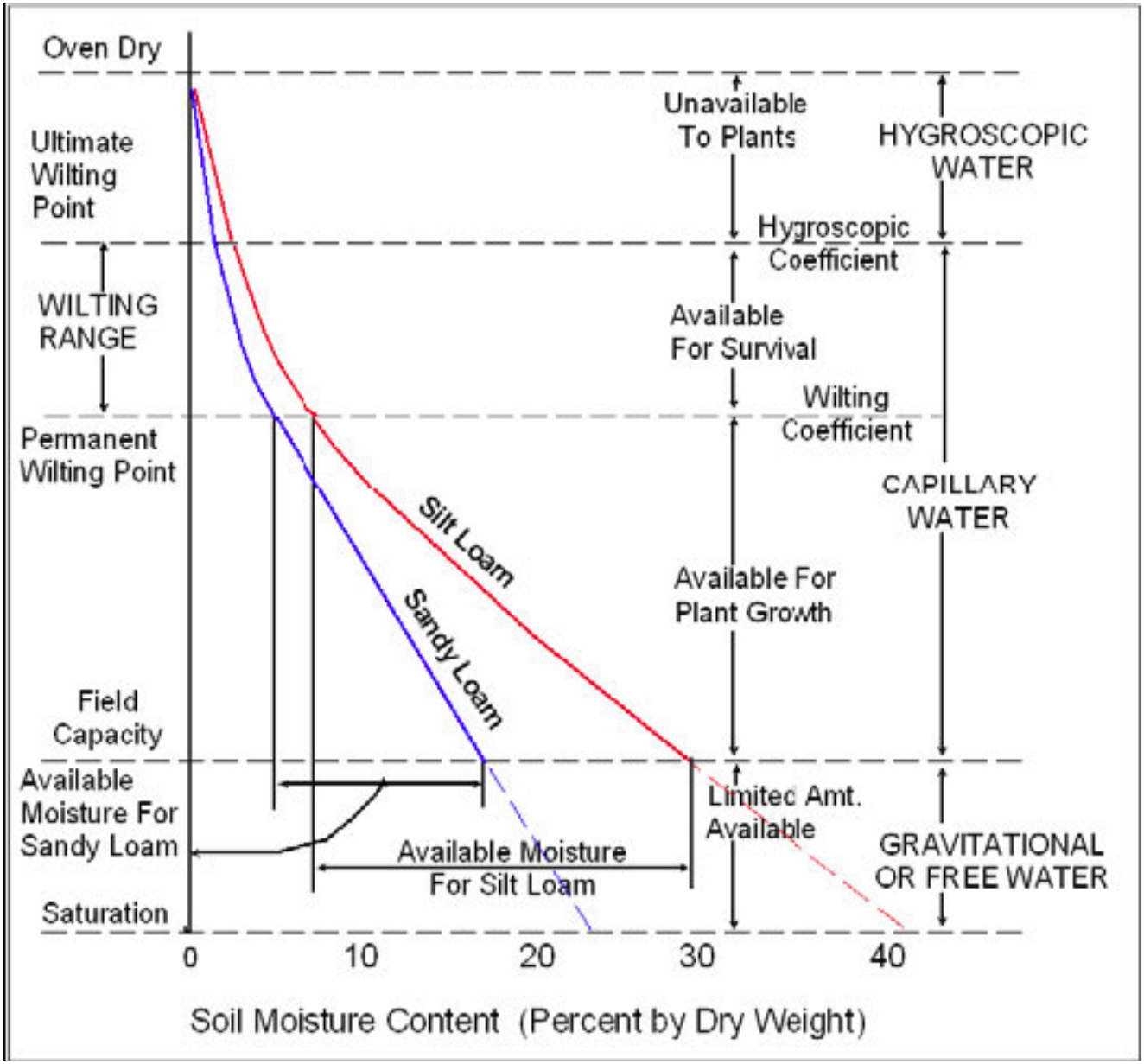

Figure NC2-1 Representative Soil moisture release curves for two soil groups