K-STATE Research and Extension | Wildcat District

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How Much Water the Soil Holds

In years like this one, the saying “two weeks away from flood or drought” is said pretty often. It refers to how in the Midwest we are always seemingly in a drought or flood. In Southeast Kansas, and much of the Ozark Plateau (the four-state area), this might actually be true. A lot of this comes down to our shallow, heavy-clay soils. Because our soils are 18” to 24” inches of silty clay above an impermeable rock layer, we do not have much water storage in our soils, our water holding capacity.

The water holding capacity is a calculation of how much water a soil can hold within a certain depth that is usable by plants. It is the difference between the field capacity and wilting point. The field capacity is the total amount of water the soil can hold and not drain due to gravity’s pull. The wilting point is the lowest amount of water soil can hold that is still accessible by plants. The accessible by plants component is important because even the driest soil will still have water that is tightly bound to soil particles, therefore does not count in the calculation. The water holding capacity is directly relatable to the texture of the soil.

Sandy soils have little water-holding capacity because of the very low field capacity. Pure clay soils have low water-holding capacity because of the high wilting point (can hold a lot of water but most of it is not accessible by plants). The sweet spot is right in the middle of soil textures of silty loams, edging towards silty clay loams. Our soils in this area range from silty clay loam to clay loams but with higher percentages of clay deeper in the profile. This means our soils have good water-holding capacity in the top foot but perhaps too much clay in the subsoil. The water holding capacity in the top foot is around 2.2 inches and around 1.8 inches in the 12” to 24” soil depth.

Water holding capacity is also increased by higher organic matter percentages as well, but the research behind how much more seems to be confounding. Some early research had shown huge increases in water-holding capacity with increases in organic matter, but more current research has shown that the increases are much more modest. The common saying that, “1% increase in O.M per acre can hold 20,000 gal of water”, is very likely highly overestimated. Still, we know increases in organic matter can increase water holding by noticeable amounts.

Our soils in this area are often somewhere between 12” to 30” inches deep. However, the plant-rooting zone can also stay shallow due to other factors like high water tables, claypan layers, and acidic subsoils. Fields with heavy plowpans might not have roots much below the top 8 inches. If given the opportunity to do so, crop roots are capable of reaching much deeper depths. Corn is not one of the more deeply rooting crop and can still get up to 5 feet deep, with 3 to 4 feet being common. Sunflowers frequently reach depths of 6 feet. It is entirely likely that crop roots in this area are likely staying much shallower than other parts of Kansas and the Midwest.

The result of our thin soils, shallower rooting zones, and heavy clays means that our total crop available water is unlikely more than 3 to 5 inches. In plowpan soils, this could be less than 2 inches. Most soils lose about 0.20 to 0.33 inches of water a day from crop use and soil evaporation, depending on the temperature and growth stage. This means that when crops are using a high rate of water, we really do only have about 2 to 3 weeks of water in the soil, and that is under the best conditions. It also means that every time a heavy rain erodes the fields, the storage capacity and days of available water get less and less.

I’ve heard many times how people not from here wonder why we don’t have the best yields, considering we have the most (on average) rain. It comes down to this; our soils do not hold it. Our infiltration rates can suffer greatly too. We might have the most rain, but we also have high amounts of runoff. Last year was a great example when we had huge rainfalls early in the growing season, and then nothing during the summer heat that resulted in near complete crop loss. This also shows that we need to do what we can to keep what soil we have because we really do not have any to spare.

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