Drought Proofing Soils by Managing Soil Water

CERTIFIED CROP ADVISER

By Dale Cowan, *CCA-ON*

The 2007 growing season, at the risk of understatement, has been dry. Spotty rains have provided relief to some areas. What we have witnessed, are areas in fields and fields within neighborhoods that are faring better than others with similar rainfall. Which begs the question, why? This observation leads to a more fundamental question of how do we drought proof our soils?

There are three main factors to consider in drought proofing soils:

- Increase infiltration rates
- Increase water holding capacity
- Increase plants' recovery of stored water

There are several important soil attributes that affect soil water management including: soil texture, aggregation, organic matter content and surface ground cover.

Soil texture refers to the relative proportions of sand, silt and clay particles a particular soil may have. A sandy loam will have more sand relative to clay loam which will have more clay particles. A loam is an even mixture of all three particle sizes. Texture is a property of a soil that cannot be changed by management, but knowing the texture will influence management decisions on maximizing soil water management. Soil texture influences the amount of total and available water. Available water is defined as the amount of water between permanent wilting point (no moisture available to plants) and field capacity (the amount of soil moisture or water content held in soil after excess water has drained away). A sandy loam will hold 1.9 inches per foot of soil with 1.3 inches available. Contrast this with a clay loam that holds 3.8 inches and has 2.0 inches available per foot of soil. This is easily observable in the fields this year as sandier soils dry out more quickly than clays or loams. One of the first management opportunities is to put crops which are more susceptible to drought stress in the finer textured clay type soils. Another consideration is to adjust planting dates to avoid flowering during the driest part of the season.

Aggregation refers to how the individual particles of sand, silt, and clay come together to form large soil granules. A well aggregated soil is evident in a crumbly appearance of the soil. Aggregation promotes greater infiltration rates, more water holding capacity. This allows for more root volume and penetration to access greater amounts of water in the larger soil profile. Contrast this with a poorly aggregated soil that forms surface crusts, increases runoff and erosion and likely has tillage pans that reduce root massing and greatly reduces the amount of stored water.

Aggregation can be impacted by management

Choice of tillage practice and timing can enhance or destroy soil structure and factors that promote aggregation. Working and smearing soils when too wet will destroy soil structure and aggregates.

Soil organic matter is closely associated with the desired trait of aggregation. Crop rotation with sod type crops or additions of green manures and livestock manures contribute greatly to soil organic matter. The benefits that added organic matter provide to soil biological diversity are extremely valuable. Soil flora and fauna, acting upon organic matter, provide the "glue" to allow aggregation to take place, and help stick together and stabilize soil particles that are vital to achieving well structured and aerated soils.

Organic matter increases soil water by as much as 16,000 gallons per foot of soil per 1% point of organic matter, largely due to the aggregation it promotes. A 2% organic matter soil can contain 25% water by volume. A 6% organic matter soil can contain as much as 40% water by volume.

Ground cover greatly increases the ability to manage soil water content as well. Surface cover increases infiltration and reduces evaporation and transpiration. Additions of manure can also have an impact. A Kentucky study showed 16 ton manure application with an infiltration rate of 2.7 inches per hour versus no cover at 1.2 inches per hour.

Ground cover and tillage interactions had similar effect on evaporation and transpiration. No-till had an evaporation of 41 mm of water and transpiration by plants of 307 mm versus conventional till at 191 mm of evaporation and 242 of transpiration. Less evaporation means more water for the crops to use.

Similarly, ground cover and tillage impacted on water infiltration rates. No-till with 48% ground cover allowed 2.7 mm per minute into the soil and conventional till with 12% ground cover allowed only 0.8 mm per min. Potentially higher infiltration rates allows more water to be retained for crop use.

A combination of reduced tillage, crop rotation, residue and surface cover can reduce surface run off. This, in combination with managing soil organic matter contributions, building soil aggregation and careful tillage practices increases water holding capacity. Well structured soils will allow plant roots to have access to larger volumes of water for extended periods of time.

These factors are part of the performance objectives that Certified Crop Advisers must be familiar with in order to gain certification. Seek out your local CCA and have a discussion on soil quality, it is worth the effort.

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