Notes from the field
July 5, 2016

Organic grain farming in drought conditions

The Canadian Prairies can dish out a wide range of moisture conditions. This 2016 season is turning out to be a bit like this. Some parts of the prairies are parched while others are soaked, making field work difficult. The next few "notes from the field" will focus on organic grain farming under drought conditions.

Water sources

In dryland farming, water comes from snow that was trapped over winter and rainfall during the growing season. Snow trapped water can contribute 20% or more to the crop's total water supply. The rest of the water must come from rainfall during the season. Snow trapping techniques such as grass strips, stubble, shelterbelts and cover crops are important (more on those later).

Getting water into the plant

Water enters plants through their root systems. This means we need to focus our attention on growing healthy roots. The best way to ensure healthy roots is to use a good crop rotation, and to minimize competition from weeds. Root studies in Canada have shown that corn and sunflower are our deepest rooting annuals (up to 6 feet); followed by cereals (wheat, oats, barley) and canola, which root to about 4 feet; then pulses, which tend to have shallower roots.

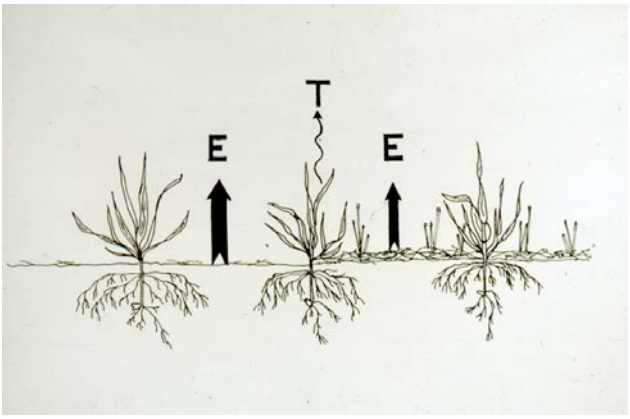
Here is a quote from Dr. Angadi's (and colleagues) work at Ag Canada, Swift Current: *We compared the root systems and water withdrawal patterns for three pulse crops (leguminous grain crops) [chickpea (Cicer arietinum L.), pea (Pisum sativum L.) and lentil (Lens culinaris Medik. L.)] and three oilseed crops [canola (Brassica napus L. and Brassica rapa L.) and mustard (Brassica juncea L.)] with one cereal crop [wheat (Triticum aestivum L.)] under well-watered, rain-fed, imposed drought water regimes during 1996–1998. Wheat withdrew the most water, whereas pulses withdrew the least amount of water from the soil profile. Pulses withdrew substantially less water than oilseeds and wheat below about the 80-cm depth, whereas oilseeds withdrew less water than wheat from the upper regions of the soil profile, thus increasing soil water available to the following crops. Therefore, producers can increase the overall efficiency of a crop rotation by growing deeper rooting crops, such as wheat and canola, following pulses, and by growing crops, such as wheat, that will use the increased soil water reserves following canola.* From Canadian Journal of Soil Science 2013, 93: 147-160.

One of my graduate students (Pamela de Rocquigny) looked at water use of crops varieties and found that oats used 1" more water than wheat – this makes oats well-suited to wetter conditions. She found that semi-dwarf oats used same amount of water as tall oats. This makes sense since semi-dwarf genes in crops like wheat and oats shorten the stem, but NOT the roots (roots have no nodes).

Evaporative water losses

Thirty percent or more water can be lost by soil evaporation – that is, water evaporating from a wet soil surface to the air. This evaporated water contributes nothing to crop yield. Covering the soil with crop residue or even a living cover crop will reduce this water loss and increase crop yield potential. The image below shows the effect of no-till on soil evaporation. Mulches, such as those described in

previous “notes from the field articles” are of interest partly because they suppress soil water evaporation.



Bushels per inch – a measure of water use efficiency

Wheat will produce from 6 to 10 kg/ha of grain per mm of evapotranspiration. Evapotranspiration is the water that is lost during the growing season by both soil evaporation and plant transpiration.

Let me rephrase this in terms that are more familiar to Canadian farmers. Wheat will produce from 5 to 8 bushels per inch of evapotranspiration water. But, it takes 4 to 5 inches of water to actually get a crop. After the first 5 inches of water, wheat will produce from 5 to 8 bushels for each additional inch of evapotranspiration. Nutrient deficient crops have a lower water use efficiency than those with sufficient nutrients, especially nitrogen.

Temperature - the wild card

The higher the air temperature, the less efficient water is used by the plant for growth. As air temperatures go above 30C, the plant uses water to cool itself without adding much growth. It is kind of like tractor tire slippage – lots of activity, but little progress.

Research in Saskatchewan in the 1980’s showed that winter cereals like wheat and rye have greater water use efficiency than their spring-type cousins. The reason for higher water use efficiency and yield of winter crops is that they go through their critical development period (heading, flowering) when air temperatures are typically lower.

In southern Alberta, researchers have tested winter peas – and they often survive. Winter legumes are very water use efficient and deserve attention in areas where they can be grown.

Focus on farming under drought

In the next few weeks, we will discuss additional ideas on improving water use efficiency of organic cereal and pulse crops. The topics will include: intercropping; seed rates; seed size; weed management; stubble management and tillage systems; and others.