SOIL HEALTH & LAND MANAGEMENT

NDSU EXTENSION SERVICE

SOYBEAN RESPONSE TO SOIL SALINITY

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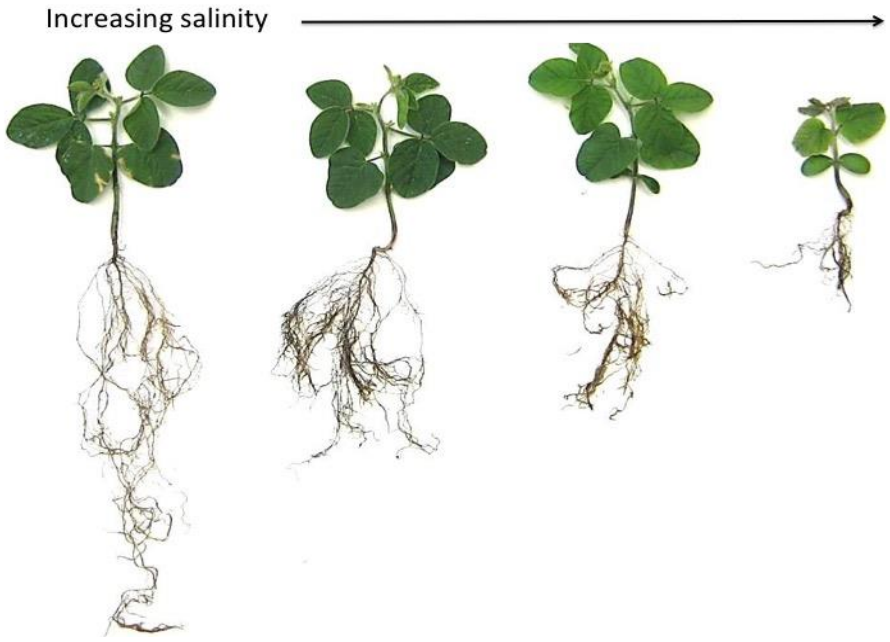
Approximately 1.2 million acres in the Red River Valley (RRV) are classified as slightly saline. Soybeans are salt sensitive, so even low levels of salts can significantly hurt yields. For soybean, this results in crop losses of $57 million annually. Much of the existing information on soybean response to salinity does not apply directly to North Dakota soils or the types of soluble salts we have here. From 2013-2016, a series of greenhouse and field studies were conducted at NDSU to look at soybean response to low levels of salinity in conditions specific to North Dakota.

In the greenhouse, we saw a 27% decrease in leaf area and 21% in root mass, indicating a crop response at low salt levels (figure below). What does this mean for salinity? As leaf area decreases, there is less surface shading resulting in more evaporative demand. As root mass decreases, there is potentially less water uptake. Both of which can lead to additional salts moving towards the soil surface with repeated stunted crops or failure to establish a crop. This is why saline areas "grow" in size.



Soybean yields were also evaluated in field-conditions on three quarters dominated by sandy loam soils and three quarters dominated by silty clay loam soil textures in Richland County. Veris salinity maps were completed for each field and samples were collected along identified gradients with relatively low levels of salinity where the plant is still growing, but may be showing signs of stress.

North Dakota Soybean Council
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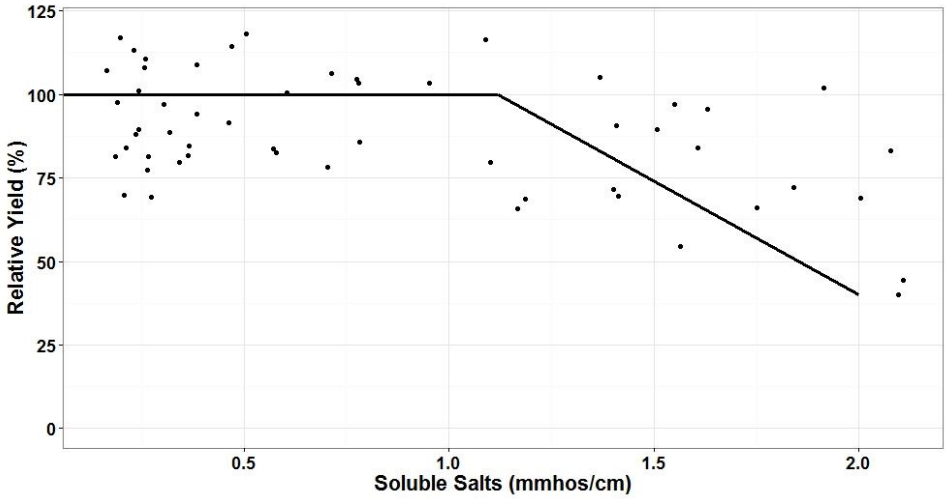
Soil Texture Matters

Soybean yield on silty clay loam soils did not appear to be reduced until a level of 3.0 mmhos/cm (versus 1.1 mmhos/cm in sandy loam soils).

Finer-textured soils may help alleviate some of the soluble salt stress on soybean because they have increased water storage. We believe that the extra water in these soils is diluting the soluble salts present in the soil.

To help visualize what is happening - consider two cups with the same amount of salt in them. One cup is only filled halfway with water (this is representative of a sandy loam soil), whereas the other cup is full of water (representative of a silty clay loam soil). Which glass of water would you rather drink? Likely, the cup with more water diluting the salts – it would be less potent. Crops do better in a diluted salt scenario, just like the cup that has more water. Consequently, we think the excess water in the finer-textured soil is reducing the stress from soluble salts experienced by the plant.

Soybean grown in sandy loams soils were found to be considerably more sensitive to soluble salts than previous studies suggest. We found soybean yields began to decline at a soluble salt level of 1.1 mmhos/cm, instead of 1.9 mmhos/cm originally identified in other studies not conducted in North Dakota. Fifty percent yield reductions occurred at soluble salt contents of 2.2 mmhos/cm (figure below).



These results are extremely important for soybean growers in North Dakota experiencing yield reductions as a result of salinity. Crop selection is key when managing saline areas in a field. However, even the more salt-tolerant crops (like wheat, barley and sugar beet) can become affected by salinity if soluble salts are not effectively managed. In this case, preventative management is key!

Looking for ideas on preventative management?

Salinity is a water management issue, so management practices that reduce evaporation and promote water movement thru soils are ideal for salinity management. Dilution of salts can also be important, so using residue to keep moisture in the soil can help dilute salts and provide an opportunity for crops to germinate. As soon as a yield reduction as a result of salinity is noticed, use tools like **crop selection** (use barley or wheat versus soybean in higher salt areas), **cover crops** (decreased surface evaporation thru cover and residue building, improve drainage with root channels), **reduced tillage** (decreased surface evaporation, improve water movement), **mulching** (decreased surface evaporation), and **drainage** (surface drainage to move water off the field and subsurface drainage to lower the water table).