Langdon Research Extension Center – Soil Health Update

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SOIL SALINITY AND SODICITY

Soil salinity and sodicity are on the rise and are major soil health-related challenges facing North Dakota farmers. There are about 5.8 million acres affected by soil salinity alone in North Dakota (Brennan, J., and M. Ulmer. 2010. Salinity in the northern Great Plains. Natural Resources Conservation Service, Bismarck, N.D.). That makes it a high priority issue to first understand and then manage these problems in order to sustain the health and productivity of our soils.

Commonly described as saline spots, alkali-ground, sour-ground or salt-land, these actually are two slightly different problems: soil salinity and soil sodicity.

Saline soils have excessive water-soluble salts, which don’t allow the plant roots to absorb soil water even under wet conditions and the end result is drought-stressed plants. That process is called osmosis. Soil salinity is determined by analyzing soil electrical conductivity (EC). Generally a soil will be considered saline if it has an EC value of 4.00 or more decSiemens/meter.

Sodic soils are the other hand have excessive sodium adsorbed (attached) to the cation exchange sites or the negative charges provided by the clay and humus fractions, to prevent the positively charged plant nutrients like ammonium (NH4+), calcium (Ca2+), magnesium (Mg2+) and potassium (K+) from leaching. Contrary to the general belief, this is an excessive sodium problem, not an excessive salt problem. Since this excessive sodium is adsorbed to the cation exchange sites and does not come readily into the soil water, it is also difficult to leach. Excessive sodium damages soil structure by disintegrating soil aggregates and by forming a hard crust or sealing of soil layers, which then leads to other problems like poor soil drainage, soils which are difficult to till, poor seed germination as well as root growth and potential for wind and water erosion. This process is called soil dispersion. Soil sodicity is determined by analyzing either soil exchangeable sodium percentage (Ex. Na%) or sodium adsorption ratio (SAR). A soil will be considered sodic, if it has an exchangeable sodium percentage of 15 or more or sodium adsorption ratio of 13 or more.

There are several indirect causes for both soil salinity and soil sodicity in North Dakota however the main source for excessive salts and sodium is the parent material of the soils including the underlying sodium-rich shale. The reason for that are: (1) The periodic intrusions of sea water which deposited marine sediments in the western part of the state (Williston Basin) before the influence of glaciation. Once exposed at the surface as parent material these sediments cause soil salinity/sodicity. (2) Glaciation then mixed and moved these sediments from the bedrock and Canadian Shield rocks together in the central and eastern parts of the state resulting in many poorly drained landscapes and closed basins with shallow saline water-table levels (Natural Conditions for Salt Accumulations in North Dakota by Alex Maiani). The main carrier for bringing these excess salts or sodium to the soil surface is the groundwater. Not to be confused with the term aquifer, in this article the term groundwater is used only in reference to the zone of soil or sediments saturated with water closest to the soil surface and preventive practices to remediate as well as to stop the future spread. Mitigation of these problems starts by managing the shallow water-table levels and improvement of soil drainage, as excessive salts/sodium will not leach below the shallow water-table level. First step is to intercept any surrounding subsurface water seeps (by planting high water-use efficient crops like alfalfa in 30 feet wide strips along sloughs or ditches) which may be contributing to a high water-table problem. Moderately high water-table levels may be controlled effectively through continuous cropping with late-maturing and deep-rooted crops. In case of a very high water-table level, installation of perforated pipes or subsurface drainage systems like tile drainage may become necessary.

Second preventative technique is to minimize the capillary rise of the groundwater towards the soil surface. For clay soils it can rise as high as 8 to 9 feet whereas in case of sandy soils it may be between 1 to 2 feet, due to the differences in the size of the soil pores. This can be achieved by preserving the moisture around the soil surface as capillary rise of groundwater happens from a wet area to dry area. Common ways to do that is by leaving the plant residues as is on the soil surface, by not exposing the soil surface directly to sunshine, by planting cover crops after fall harvest, using minimum or no-till practices and by adding soil organic matter.

Once established these problems can affect soil productivity a lot, however are manageable. For more information please use the following link: http://www.ag.ndsu.edu/langdonre/sotlo Heath

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This table is showing different criteria for saline, sodic or saline soils.

<table>
<thead>
<tr>
<th>Soil Type</th>
<th>pH</th>
<th>EC (decSiemens/meter)</th>
<th>Sodium Adsorption Ratio</th>
<th>Exchangeable Sodium %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Saline Soils</td>
<td>No Effect</td>
<td>4.00 or more</td>
<td>Less than 13</td>
<td>Less than 15</td>
</tr>
<tr>
<td>Sodic Soils</td>
<td>8.5 or more</td>
<td>Less than 4.00</td>
<td>13 or more</td>
<td>15 or more</td>
</tr>
<tr>
<td>Sulpho-Sodic Soil</td>
<td>8.5 or more</td>
<td>4.00 or more</td>
<td>15 or more</td>
<td>15 or more</td>
</tr>
</tbody>
</table>

Groundwater can move upwards to the soil surface either in shape of shallow water-table level or as capillary rise, especially under drier weather conditions.

Management of these problems should involve a mix of mitigation and preventative practices to remediate as well as to stop the future spread. Mitigation of these problems starts by managing the shallow water-table levels and improvement of soil drainage, as excessive salts/sodium will not leach below the shallow water-table level. First step is to intercept any surrounding subsurface water seeps (by planting high water-use efficient crops like alfalfa in 30 feet wide strips along sloughs or ditches) which may be contributing to a high water-table problem. Moderately high water-table levels may be controlled effectively through continuous cropping with late-maturing and deep-rooted crops. In case of a very high water-table level, installation of perforated pipes or subsurface drainage systems like tile drainage may become necessary.

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WIFE meets in Washington, D.C.

Dressed in red, members of Women Involved in Farm Economies of America. Members of the group were