

Langdon Research Extension Center – Soil Health Update

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EVALUATING THE SUITABILITY OF OUR SOILS FOR TILING

Considering the continuous wet cycle since 1993, shallow water-table levels are a common occurrence. Additionally the parent material of North Dakota soils is high in soluble salts including the under lying sodium rich shale. When groundwater comes too close to the soil surface, apart from raising the water-table level, it will also bring excessive salts and sodium with it. Water eventually evaporates leaving behind the salts. The pre-requisite for leaching excessive salts/sodium out of the plant root zone is to first lower down the soil water-table level. One of the ways is to install a subsurface drainage system like tile drainage which can be an excellent source to achieve this objective under suitable soil conditions.

In order to get the maximum output for our investment, it is essential to evaluate the suitability of our soils before installing tiles. The purpose of this article is to not to undermine the importance of tiling, but to ensure the successful remediation of our soils as there are some soils types which may not be suitable for tiling.

Need Assessment

Before considering tiling as the only solution, producers might also want to look into other options like

reducing the summer-fallow rotations, planting late-maturing, deep rooted and high water-use efficient crops like alfalfa, sunflower, safflower and in some cases sugar-beet to reduce the recharging of the groundwater reservoirs. However if none of these options would work well for a site having very shallow water-table issue, then installation of tiles may prove very useful. Once the decision is made one should start with the evaluating process.

Function

Contrary to the general belief, "tiling will solve all of the problems", the basic function of the tiling along with any other surface or subsurface drainage system is "to lower down the shallow soil water-table to a desired/planned level by draining the excessive soil water". Generally, after a medium to moderately heavy rainfall, most of the soil pores are filled with water. This water is called gravitational water. Gravitational water is excessive soil water and is not available to the plants as it only moves downward into the soils with the help of gravitational forces. Once this excessive soil water is drained out of the plant root zone it also leaches the soluble salts or sodium with it along with letting the oxygen back into the soil pores. Tiling however will not affect or control the movement of capillary water or capillary rise of the soil water that can happen in any direction. Capillary water moves from wet to dry areas against the force of gravity and with the help of adhesion and cohesion forces.

Evaluating Soil Chemical Properties

In terms of tiling, the most important soil chemical property is the concentration of sodium in the parcel of land meant for tiling. Excessive sodium attached to the negative sites of the clay particles causes the dispersion of the clay particles and could cause sealing of the soil layers above or around the tiles. This may result in reduced or inefficient drainage performance even after installing the tiles. Soil pH, (above 8.5) is also a good indicator of excessive sodium. Excessive soluble salts on the other hand don't create any negative effects in regards to the efficiency of the tiles, as they tend to cause dehydration of the plant cells by not letting the plant roots uptake the soil water even under wet conditions.

This sodium however, is measured in relation to the concentration of calcium and magnesium present in the sample. So, if a soil is high in excessive sodium but also high for soluble salts, then high amounts of calcium and magnesium coming out of the soluble salts will counter-balance the negative effects of sodium (Salinity and Sodicity in North Dakota. B. D. Seelig, 2000). This is true as calcium has 43 times greater and magnesium has 27 times more ability to promote soil particle aggregation (flocculation) versus sodium.

Soil chemical properties can either be evaluated through the internet by using "Soil Data Explorer" in Web Soil Survey (NRCS website) or by taking the soil samples. Even though Soil Data Explorer is a very good resource and can give a good

general idea about a particular soil series located on a piece of land. However, it only gives a range for important information such as Sodium Adsorption Ratio. Whereas we might be interested in knowing the exact values.

So, it is very important to start off the evaluation process by taking the site specific soil samples and getting them analyzed for their sodium (Sodium Adsorption Ratio) and soluble salts (Electrical Conductivity) levels along with pH. If there are some red flags a more thorough chemical analyses should be done before tiling. A Sodium Adsorption Ratio of 6 generally raises a red flag and requires more thorough soil chemical analysis (Evaluation of Soils for Suitability for Tile Drainage Performance by Cihacek et al., 2012). Another concern is that with tiles in place soil drainage will be faster initially causing rapid leaching of soluble salts as unlike sodium, salts are already in the soil water. Lower soluble salt levels will give rise to soil sodicity, making the sodium problem even worse.

Soil Sampling Strategy and Depth

Before sampling, based on the history of the area a rough map should be made in order to differentiate the differing areas. Generally one should be sampling the most problematic (saline or sodic) spots, in order to assess any future problems in regards to the efficiency of tiles. If there are differences among the problematic areas then separate samples should be taken from each area. If an area is uniform then one sample may be enough.

The guideline for the soil sam-

pling depth for tiling purposes is to sample at least 5 feet deep or 2 feet below the deepest depth of the drain line in 1-foot increments (Evaluation of Soils for Suitability for Tile Drainage Performance by Cihacek et al., 2012). This is unlike the regular soil sampling, in which the sampling depth is generally 2 feet; 0-6" and 6-24". For each sample one should take at least 2 to 3 cores or may be more depending upon the total area for that sample in order for the sample to be a good representative of that area. Each depth (for example 0-12", 12-24", 24-36", 36-48" and 48-60") should be separately sent to the lab for analysis. So if there are 2 samples from an area with 5 depths, there will be 10 soil samples; 2 samples X 5 depths. Also instead of discarding the extra soil from each sample and depth one should mark and save it for any further future analyses.

Another important aspect is to instruct the analyzing lab to use the "Saturation Extract Method" (a method which permits the interpretation of the data for all soil textures) instead of Soil/Water Extract of 1:1 Ratio (a method which permits a rapid determination of soil salinity for practical use) as Saturation Extract Method is considered more accurate.

For detailed information on this topic please read NDSU publication SF-1617: Evaluation of Soils for Suitability for Tile Drainage Performance by Cihacek et al., 2012. Copies of this publication can either be obtained through main NDSU website under publication or from the Langdon Research Extension Center.