Crop Solutions that Work

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Fertilizer Salt Index

Fertilizer salt index is a measure of salt concentration induced in a soil solution. Salt index is a numerical value expressed as a ratio in which the selected fertilizer product is compared to the same weight of sodium nitrate ($NaNO_3$), where sodium nitrate is assigned a value of 100. Sodium nitrate is used for comparison because it was widely available when the salt index was developed, and because it is 100 per cent soluble in water.

Photo provided by University of Nebraska-Lincoln

Salt injury to plant tissue is caused when the salt is in close proximity to germinating seed or to growing plant tissue. The presence of the salt creates an osmotic imbalance in which water flows from regions of higher relative water concentration in the plant tissue to regions of lower relative water concentration, where the fertilizer salt is located. This loss of water from the plant tissue causes desiccation, often referred to as fertilizer burn. Salt injury can occur with soil applied fertilizer or with foliar fertilizer applications.

Salt index of a fertilizer product and crop injury are generally of relatively little concern, except under these conditions:

- High salt index fertilizers are applied to foliage or in the seed furrow, or high amounts or concentrations of fertilizer products are applied.
- For foliar applications, leaf tissue is young and tender or plants have been growing under cloudy, moist, cool conditions.
- Susceptible crops are being grown (vegetables, sweet corn, etc.)
- For planter applications, soils are dry, preventing normal dilution of product through the soil and allowing high concentrations to remain near seed and seedling tissue.
- Weather conditions are hot and dry.

In general, nitrogen and nitrogen-plus-sulfur products should be watched for salt index concerns. Ammonium thiosulfate has among the highest salt indexes and foliar or in-furrow applications should be managed to avoid problems. Potassium chloride products also have high salt indexes. The old rule of thumb is that you should not apply a total of more than 10 lb./acre of N + K2O products alone or in combination as a seed furrow application. Also, for these seed furrow applications, products with salt indexes greater than 20 should not be used. Consider 2x2 planter applications or soil broadcast applications.

Salt injury from foliar applications can be reduced by avoiding application of products having a high salt index, avoiding application of high rates of fertilizers, diluting the fertilizer with water (increasing the total application volume), and avoiding fertilizer applications during periods with high daily temperatures and/or high relative humidity.

Some of the information in this article came from a 2001 article by Dr. John J. Mortvedt. The article features tables with salt index values, and offers instruction on how to calculate salt index for fertilizer combinations. This article is reproduced on the Spectrum Analytic website and can be found at this link: www.spectrumanalytic.com/support/library/ff/salt_index_calculation.htm

Evaluating survival of Winter Wheat

The winter wheat crop has generally avoided many of the potential winter survival issues, and the crop appears to be in pretty good shape right now.

In most years, late planting, extended warm weather or warm spells, alternating with bitter cold, wet soils, heavy snow, ice sheeting, and possible frost heaving all can take a toll on wheat stands. Generally mild winter conditions and little ice sheeting have allowed the wheat crop to come through the winter in generally good shape. Spring green-up of wheat is starting in some areas. For your area, as soon as temperatures start to consistently warm up, we should begin to evaluate stands of winter wheat for survival.

There are two things we will need to look for this year. One is overall survival. Make sure that the wheat is actively growing before making decisions. Split representative plant stems from the crown, upward, using a sharp knife or razor blade. Healthy wheat has a firm, yellow to green growing point, not mushy, brown, or water-soaked in appearance. The growing point is near the soil early in the spring but will later be above the top joint.

The second thing we need to look for is possible frost heaving. In most years, frost heaving is uncommon in wheat because of the fibrous root system. In years where we have late planting, the wheat root system does not offer as much of an anchor and plants will sometimes have the crown lifted above the soil surface as soils freeze and thaw. A general rule of thumb is that wheat should have three well established tillers as it enters winter dormancy. Plants that have heaved will often survive, but not be as productive.

Frost heaving tends to be worst in heavy textured soils or soils that have high clay content. These soils tend to hold water, and alternate freezing and thawing causes significant expansion and contraction. During soil expansion, the plants can be lifted. When the soil contracts, it sometimes leaves the wheat crowns elevated above the normal growing position. Uneven seeding depth is also often noted as a source of winter plant loss and frost heaving.

A full stand of wheat is generally regarded as having an average of 25 to 30 plants per square foot, but stands having as few as 15 plants per square foot should be kept. The wheat population can be counted by using any rigid frame, such as a hula-hoop. Toss the hoop or frame randomly at several places in the field. Count the number of wheat plants within the frame and divide by the number of square feet defined within the frame to arrive at the number of plants per square foot.

Nitrogen utilization and loss

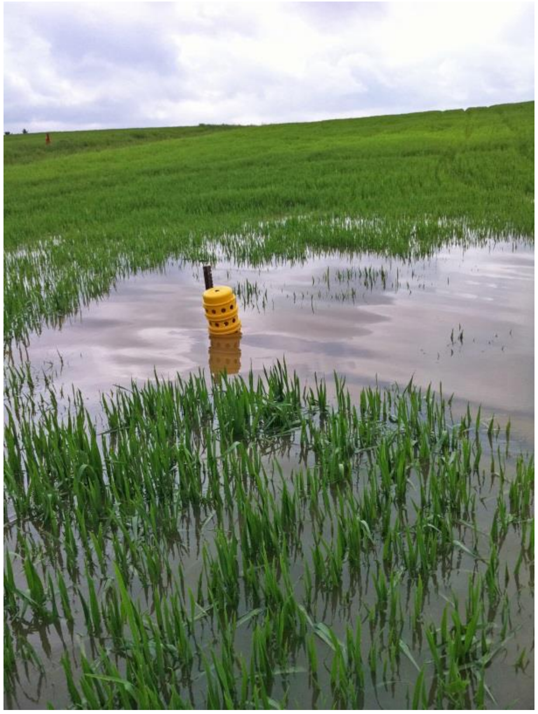

Photo provided by USDA-ARS.

There are three primary fates for soil applied nitrogen fertilizer and plant uptake and utilization is the best of these three fates. With sound management practices, plant uptake is the primary fate for soil applied nitrogen. Physical loss from the soil with water, or gaseous loss to the atmosphere are the other two potential fates for soil applied nitrogen.

Data indicates that we lose substantial amounts of nitrogen from annual fertilizer applications. This is nitrogen that the crop does not get to use. It ends up as a potential pollutant of air (greenhouse gases) or water pollutant (as a direct pollutant or feeding algae). The two primary ways in which nitrogen is lost from the soil root zone include physical loss through leaching, runoff and soil erosion, or through denitrification and loss to the atmosphere. Nitrogen in the soil can also be bound organically and gradually released for plant utilization through mineralization.

How much N can be found in the soil? – If an Acre Furrow Slice (AFS – 6 2/3 inches deep) weighs 2,000,000 pounds and has 3 per cent Organic Matter (OM), there would be approximately 3,000 pounds of N per acre (60,000 pounds OM x 5% N).

Why apply N for corn with the abundance of N found in the soil? – Over 95 per cent of the N found in soil is bound organically. Although an organic form of N is stable, it is also not available for plant uptake. The N captured within organic crop residue/organic matter must first be released through mineralization to an inorganic form that the plant can utilize (nitrate or ammonium-N), this process is sometimes called ammonification. Mineralization is driven by microbial activity, or the soil's biology. Factors that influence the speed of mineralization include soil organic matter, temperature, moisture, aeration, and pH.

Is the form of N important in the soil? – There are two forms of N available to a plant, nitrate-N and ammonium-N, both having different properties in the soil. Ammonium-N is reduced (without oxygen) and has a positive charge when in soil solution. Since it has no oxygen attached, it cannot be lost through denitrification (turning into a gas). Because of the positive charge, movement of ammonium-N is limited in the soil due to its attraction to the soil's negatively charged sites; this relationship is foundational to the Cation Exchange Capacity or CEC. Nitrate-N is an oxidized form of plant-available N in the soil, and can be lost under anaerobic soil conditions (without air) caused by flooding or saturation over time. Furthermore nitrate-N has a negative charge in soil solution and has the freedom to move wherever soil water moves since it is not attracted to the soil's Cation Exchange Capacity, (soil is also negative, two negative charges repel).

4R nitrogen management practices are being widely promoted. The 4Rs include: Right Product, Right Rate, Right Time, and Right Place. With our knowledge of the potential fates of nitrogen fertilizer in the soil, we can prescribe management practices that ***Maximize yield, Optimize nitrogen utilization, and Minimize environmental impact (MOM).*** Some of these practices may include applying nitrogen fertilizer closer to the time the crop will utilize the nutrient, splitting N applications for greater use efficiency, using nitrification inhibitors to help keep the nitrogen in the ammonium form, avoiding applications on wet soils, etc. Also, using N-Watch practices to inventory available soil nitrogen helps give a starting point for determining what the crop will need for the season.

Soil compaction is more easily avoided than corrected

Soil compaction takes four primary forms and has different causes. All forms of soil compaction are negative to the crop and most can be avoided with sound management.

There are different types of soil compaction, however, they have this in common… Ironically, the worst compaction does not occur with heavily saturated soils, but with soils that are at field capacity, the point at which the soil will hold water against the force of gravity although the excess has drained out. At this point, some of the pore spaces are filled with air instead of water but there is still enough water that it can serve as a lubricant between soil particles, allowing them to slide and collapse against each other. As this happens, natural pore spaces also collapse, eliminating oxygen. Crop roots will not grow or function normally in oxygen-deprived soil.

"Platy" soil structure common with soil compaction

With compacted soils, we're really dealing with two major issues. First: Compaction alters the natural soil structure, and increases the physical strength of the soil, preventing crop root systems from fully exploring to take up nutrients and water. Soils that are compacted in layers often will hold surface ponds of water early in the season, but can become dry and impenetrable to water later in the season. Second: Compaction eliminates air (oxygen) from the soil, so crop roots cannot take up nutrients or water, even when they're surrounded by it.

Soil compaction can take several forms in cropland. The form of compaction that we are probably most familiar with is the "plow layer." This develops with equipment traffic and use of certain implements, such as the large disk. A well-defined layer develops just below the depth of tillage. Look for a distinctive platy or blocky structure of the soil layer between six and eight inches deep.

Surface compaction develops when repeated tillage destroys soil structure in the top inches of the soil profile and/or heavy rainfall causes soil particles to settle together into a dense layer. Surface compaction also readily develops with no-till cropping when field traffic occurs before soils dry adequately. Surface compaction may or may not include soil crusting, and it need not be as dense as the plow layer to cause crop problems. Look for soil that appears to be lacking in pore spaces, will not easily crumble in the hands and has a blocky or platy structure.

Sidewall compaction is another familiar form of compaction. In wet soil, one type of sidewall compaction develops when the opener disk of the planter smears the side walls of the seed slit or furrow which roots have difficulty penetrating. In many cases, shrinkage of the drying soil causes the seed slit to pull open. Look for the distinctive seed slit with smeared walls, and roots that grow in a fan shape as they grow the only direction that they can.

Sidewall compaction also develops with anhydrous ammonia toolbars or similar implements. When sidewall compaction develops from use of anhydrous ammonia toolbars, the resulting fracture in the soil may also serve as a means for anhydrous ammonia to escape following application. Side-dress application may also interfere with lateral root growth. Initial diagnosis is as simple as occasionally walking over applied acres immediately following application to see if you can detect an ammonia odor. Using a spade to cut perpendicular sections across the application track will further reveal whether sidewall compaction is occurring.

Deep compaction is the general compaction that develops below the eight to ten inch depth in the soil. This compaction is usually caused by heavy equipment loads on wet soils or soils at field capacity. Effects can sometimes be detected twenty inches deep in the soil or more. Correction of deep compaction can take many years and often includes deep ripping under dry soil conditions, as well as planting and maintaining alfalfa or other deep-rooted forage or cover crops for several years.

For more information or discussion on any of the topics in this newsletter, please contact your local County Farm Centre FS crop specialist.

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