Mid-Atlantic Regional Agronomist Quarterly Newsletter

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Comments, suggestions, and articles will be much appreciated and should be submitted at your earliest convenience or at least two weeks before the following dates: February 28, May 30, August 30, and November 30. The editor would like to acknowledge the kindness of Mr. Todd White who has granted us permission to use his scenic photographs seen on the front cover page. Please go to www.scenicbuckscounty.com to view more photographs.
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Nitrogen Management for Soybean

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Soybean is second most widely produced crops in DE, ranking just behind corn for grain. In 2012, approximately 168,000 acres of soybeans were produced in Delaware with an average yield of 42.5 bu/ac. Producers seeking to improve yields of soybean and overall profitability may be considering application of supplemental N fertilizers or manures. However, growers should consider both economics and the environment when deciding to apply supplement N to soybean. The purpose of this publication is to help guide decisions about application of supplemental N to soybean.

Nitrogen Sources Available to Soybean

The N needs of soybean are quite high due to the higher protein content (≈40%) in soybean grain. Soybean N removal in grain is estimated at 138 lb/ac for soybean yielding 40 bu/ac, respectively; this is roughly equivalent to the amount of N removed by 200 bu/ac grain corn. An irrigated soybean crop yielding 70 bu/ac would remove about 242 lb N/ac in the grain. The main sources of N that are available to meet the N needs of soybeans are the atmosphere and the soil. In some cases, commercial fertilizers and/or manure may also be used to meet N needs of soybean.

Soybeans are a legume and are able to obtain N from the atmosphere because they form a symbiotic relationship with N fixing bacteria called Bradyrhizobium japonicum. These N fixing bacteria colonize the roots of the soybean plant forming nodules. Within these nodules, the bacteria are able to convert (or fix) N₂ gas from the atmosphere to ammonium (NH₄⁺), which is a plant available form. The relationship is considered to be symbiotic because the soybean plant provides a food source (carbon) for the bacteria and the bacteria provide N to the soybean plant. Maximum N₂ fixation potential by soybean is estimated to be 300 lb/ac under ideal environmental conditions (e.g., adequate soil, soil moisture, fertility, and sunlight; no compaction in root zone; etc.).

Soybean can also obtain inorganic N from the soil in the plant available forms of NH₄⁺ or nitrate (NO₃⁻). Some plant available N may be residual in the soil, meaning it was left over from fertilization of previous crops or breakdown of crop residues and residual manure applications.
Soil organic matter is also a source of plant available N. When organic matter or are broken down by soil microbes, the organic N is converted to NH$_4^+$ via a process called mineralization. Maximum soil N mineralization is estimated at 100 lb/ac, with less mineralization expected in the lower organic matter soils that are typical of Delaware.

Historically, application of commercial fertilizers and/or manures to soybean was not recommended because N$_2$ fixation and soil N should be adequate to meet the N needs of soybean crops. However, due to genetics, expansion of irrigation, and other factors, soybean yields in Delaware are increasing. There is some evidence that high-yielding soybeans (>60 to 80 bu/ac) may benefit from supplemental N applications because N$_2$ fixation and soil N may not be adequate to meet crop needs at high yields (Figure 1).

![Figure 1. Conceptualized N budget for soybean is based on grain N uptake (grain removal + stover removal), maximum soil N mineralization of 100 lb/ac and maximum N fixation of 300 lb/ac. Note that soil N + fixed N should meet crop N needs for grain yields <70 bu/ac.](image)
Potential Consequences of Supplemental N Application to Soybean

There is no cut and dry recommendation about whether or not to apply N fertilizers or manure to a soybean crop. However, there are situations when application of supplemental N to soybean is NOT recommended because it can limit yield, waste money, or have a negative impact on the environment.

Early season applications of manure and/or commercial fertilizer to soybean should be avoided because they can delay nodulation, reduce overall nodulation, or reduce the activity of the nodules. When supplemental N is applied to soybean, the plants essentially “get lazy” because it is easier to take up the supplemental N than it is to establish a symbiotic relationship with soil microbes. For example, nodulation of soybean planted at the Carvel Research and Education Center in Georgetown, DE in 2014 was greatly reduced when fertilized at planting with N (as urea fertilizer) at 100 lb/ac compared to plants receiving no supplemental N (Figure 2).

Figure 2. Comparison of soybean nodule development on unfertilized plants (upper) and plants fertilized with urea at an N rate of 100 lb/ac. Photo credit: Shawn Tingle, University of Delaware.
Nitrogen fixation by soybean decreases exponentially as N application rate increases, such that application of 45 lb/ac N can lead to a 40% or greater reduction in N fixation over the maximum achievable N fixation when no supplemental N is applied. Applications of N at higher rates can further reduce N fixation. If nodules do develop in the presence of supplemental N, it is possible that those nodules will be inactive and will not fix N (Figure 3). If supplemental N and soil N pools are not sufficient to supply the entire amount of N needed for optimum yield, nodulation or reactivation of existing nodules may be delayed and the plant will be unable to fix enough N to support maximum growth when the demand for N peaks during pod development. If plants are N deficient at the time of pod set/seed fill, a significant loss of yield may occur.

While application of supplemental N might not reduce yield in all situations, it will often result in wasted money. In addition, some forms of N are easily lost to the environment in runoff or leachate. Application of supplemental N to soybean may increase the risk for N losses, which may have negative impacts on water quality. Application of supplemental N should be avoided under the following situations because the economic and environmental risks are increased:

- Non-irrigated soybeans – Water will likely be more limiting than N (or any other nutrient).
- Expected yield is <60-70 bu/ac – There is probably enough N available in the soil and via fixation.
- Soybeans have matured past R6 (full seed stage) – The N requirement of soybean is greatly reduced and supplemental N applications past this point are wasteful.
• Fields with a history of soybean cyst nematode – Yield will be more limited by the impact of nematode feeding than N.
• Fields that have not had soybean for a long time (or ever) – Skip the commercial or manure N and apply a good inoculant.

**Suggestions for Getting Maximum Benefit from Supplemental N Application to Soybean**

Application of supplemental N *might* provide a yield benefit for irrigated high-yield soybean, but only in cases where expected yields are 60-70 bu/ac or higher. If yields are consistently lower than 60 bu/ac, skip the N and apply a good inoculant instead. Growers consistently exceeding 70 bu/ac yield on irrigated soybean should consider the following when considering applications of supplemental N:

• Keep rates low. Research suggests yield bumps were greatest (when yield increases were noted) when N applications were <30 lb/ac. If applying N pre-plant or early season, consider methods of application that won’t interfere with nodulation (e.g., deep placement of slow- or controlled-release fertilizers).
• Apply N in season between growth stages R2 and R4 to provide N just before pod set, when N uptake is most rapid. However, applications of N at R2 to R4 must be done to minimize damage to the soybean plant since any injury impacts nodule efficiency. Application of N through the irrigation system can prevent equipment damage to the standing crop.
• Consider application of B at a rate of 0.5 lb/ac in addition to N since some researchers showed a yield benefit of B application.
• If possible, save manure for corn. The soybean crop should still benefit from residual manure N/soil organic matter benefits of the manure. If you must apply manure, keep the rates very low. On average in Delaware, pre-plant application of 2 tons/ac of poultry litter will supply 114 lb/ac of total N (approximately 68 lb plant available N), which exceeds the rate at which N fixation can be impacted. Trials at UD showed beans receiving manure sometimes ran out of mineralizable N at the beginning of flowering; the delay before nodulation and N fixation can occur can lead to significant yield reductions.

**Inoculation of Soybean to Improve Yields**

In many cases, growers will see more yield benefit from applying one of the new improved strains of *Bradyrhizobia* inoculant than they would from applying supplemental N. Growers should consider applying one of the new high efficiency strains of *Bradyrhizobia* to the seed every second or third time soybeans are planted. Many soybean yield trial winners report that they apply fresh inoculum to every soybean crop planted. With the new liquid inoculants, the time and expense of applying soybean inoculant is much less than that experienced in the past. Many of the soybean fields in Delaware were found to contain strains of *Bradyrhizobia* that were either very inefficient at fixing N or actually produced toxins that could reduce soybean yield according to a Delaware Soybean Board project many years ago.
Summary

Soybeans are leguminous plants that are able to fix atmospheric N. In general, fixed N and soil N should be adequate to meet the N requirements of soybean. Growers are unlikely to see yield increases when applying supplemental fertilizer or manure N to soybean, except in the case of high-yielding, irrigated soybeans. In fact, application of supplemental N to soybeans is more likely to result in wasted money and increased risk to the environment. Under some circumstances, application of supplemental N could also reduce yields leading to an economic loss to the farmer. In most cases, application of a good inoculant will be more beneficial than applications of commercial N fertilizer or manure. Growers should consider applications of supplemental N only when yield of irrigated soybean consistently exceed 60 bu/ac.

References


Delaware/Publications/Annual_Statistical_Bulletin/2012/Deleware%20Annual%20Bulletin%202013.pdf


2014 Ohio Corn Performance Test: Regional Overviews

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In 2014, 209 corn hybrids representing 28 commercial brands were evaluated in the Ohio Corn Performance Test (OCPT). Four tests were established in the Southwestern/West Central/Central (SW/WC/C) region and three tests were established in the Northwestern (NW) and North Central/Northeastern (NC/NE) regions (for a total of ten test sites statewide). Hybrid entries in the regional tests were planted in either an early or a full season maturity trial. These test sites provided a range of growing conditions and production environments.

The 2014 growing season was generally characterized by favorable conditions for corn growth and development although temperatures and rainfall were variable across test sites. Wet soil conditions delayed planting until May 20. Temperatures were slightly above normal in May and June and below normal to near normal in July through September at most sites. Lower than normal temperatures combined with late planting reduced growing degree day (heat unit) accumulation at several test sites. Rainfall was above average during the early-mid vegetative stages in May and June and below average in July to September. Timely rains in July and August and moderate temperatures limited stress and contributed to high yields at most sites. Slow crop maturation and dry down, combined with persistent rains and saturated soils delayed harvest and resulted in higher than normal grain moisture and lower test weights. Stalk lodging was not a problem for most of the hybrids evaluated. It was most pronounced at Bucyrus but averaged less than 10%. Disease and insect pests were not a significant factor at most test sites. Symptoms of northern corn leaf blight and gray leaf spot were severe but usually
appeared late in the season. At Greenville, gray leaf spot may have reduced yields of some hybrids. Low levels of moldy grain were observed for some hybrids at Hebron.

Despite later than normal planting dates, high yields were achieved at most test locations due to ample and timely rainfall and moderate temperatures which created near stress-free growing conditions. Averaged across hybrid entries in the early and full season tests, grain yields were 244 bu/A in the Southwest and West Central region, 243 bu/A in North Central and Northeast region, and 201 bu/A yields in the Northwest region. Performance data for Upper Sandusky in the NW region are not presented because excessive rainfall shortly after planting combined with a dry July and August resulted in uneven crop growth and inconsistent yields. The Hoytville location in NW Ohio was the only test site that averaged less than 200 bu/A. Lower yields were due in part to soil crusting (caused by hard rains after planting which reduced plant population) and a very dry August (0.75 inches of rainfall).

Tables 1 and 2 provide an overview of 2014 hybrid performance in the early maturity and full season hybrid trials by region. Averages for grain yield and other measures of agronomic performance are indicated for each region. In addition, the range in regional test site averages is shown in parentheses. Complete results are available online at: http://oardc.osu.edu/corntrials/

As you review 2014 test results, it’s important to keep the following in mind. Confidence in test results increases with the number of years and the number of locations in which the hybrid was tested. Avoid selecting a hybrid based on data from a single test site, especially if the site was characterized by abnormal growing conditions (like drought stress and record high temperatures). Look for consistency in a hybrid's performance across a range of environmental conditions. Differences in grain moisture percentages among hybrids at harvest can provide a basis for comparing hybrid maturity. Yield, % stalk lodging, grain moisture, and other comparisons should be made between hybrids of similar maturity to determine those best adapted to your farm. Results of the crop performance trials for previous years are also available online at: http://www.ag.ohio-state.edu/~perf/archive.htm

Table 1. A regional overview of the early maturity 2014 Ohio Corn Performance Test.

<table>
<thead>
<tr>
<th>Region</th>
<th>Entries</th>
<th>Grain Yield (Bu/A)</th>
<th>Moisture (%)</th>
<th>Lodging (%)</th>
<th>Emergence (%)</th>
<th>Final Stand (plants/A)</th>
<th>Test Wt. (lbs/bu)</th>
</tr>
</thead>
<tbody>
<tr>
<td>SW/WC/C</td>
<td>71</td>
<td>242 (218-272)</td>
<td>22.3 (19.2-25.6)</td>
<td>3 (0-20)</td>
<td>96 (90-99)</td>
<td>35300 (29900-39100)</td>
<td>54.0 (50.4-56.1)</td>
</tr>
<tr>
<td>NW</td>
<td>61</td>
<td>201 (176-222)</td>
<td>19.6 (16.6-23.2)</td>
<td>2 (0-10)</td>
<td>89 (80-94)</td>
<td>32100 (24900-36300)</td>
<td>55.1 (51.1-57.8)</td>
</tr>
<tr>
<td>NE/NC</td>
<td>47</td>
<td>241 (218-263)</td>
<td>21.2 (17.9-25.0)</td>
<td>3 (0-18)</td>
<td>96 (87-99)</td>
<td>35000 (30800-39000)</td>
<td>53.8 (50.3-56.4)</td>
</tr>
</tbody>
</table>
Table 2. A regional overview of the full season 2014 Ohio Corn Performance Test.

<table>
<thead>
<tr>
<th>Region</th>
<th>Entries</th>
<th>Grain Yield (Bu/A)</th>
<th>Moisture (%)</th>
<th>Lodging (%)</th>
<th>Emergence (%)</th>
<th>Final Stand (plants/A)</th>
<th>Test Wt. (lbs/bu)</th>
</tr>
</thead>
<tbody>
<tr>
<td>SW/WC/C</td>
<td>56</td>
<td>246 (218-273)</td>
<td>24.6 (21.4-28.2)</td>
<td>0 (0-5)</td>
<td>97 (88-99)</td>
<td>35500 (30700-38000)</td>
<td>52.8 (50.0-55.6)</td>
</tr>
<tr>
<td>NW</td>
<td>91</td>
<td>202 (178-222)</td>
<td>22.6 (18.8-27.4)</td>
<td>2 (0-8)</td>
<td>88 (78-94)</td>
<td>31600 (27500-36000)</td>
<td>53.2 (49.1-56.5)</td>
</tr>
<tr>
<td>NE/NC</td>
<td>44</td>
<td>245 (229-264)</td>
<td>24.2 (21.1-28.3)</td>
<td>3 (0-25)</td>
<td>97 (94-99)</td>
<td>35500 (29700-40100)</td>
<td>52.5 (48.9-55.7)</td>
</tr>
</tbody>
</table>

Drought-Tolerant Corn Hybrids: What is the Fit for Ohio?

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Drought events are predicted to increase with rising global temperatures and altered rainfall patterns. It is important that agronomists investigate ways to maximize water use to help reduce grain yield losses from drought events. If Ohio corn yields had been reduced 10% in 2013 due to drought, then the economic loss for growers would have exceeded $250 million. Ohio producers have begun using drought-tolerant corn hybrids that were developed for use in the Western Corn
Belt to manage for drought events, but limited research has been conducted on these hybrids in the Eastern Corn Belt.

Drought tolerance can be thought of as the ability of a plant to produce greater yields under water stress conditions when compared to other plants under the same conditions. Since growing conditions are very different in Ohio than in the Western Corn Belt, the management practices that maximize grain yield and minimize environmental effects need to be determined for these corn hybrids. Drought-tolerant hybrids may respond to planting delays and higher plant populations (the number of plants per unit area) differently than susceptible hybrids. Under non-water stressed conditions, these corn hybrids may produce less grain yield that their susceptible counterparts (resulting in a yield penalty). Because water use efficiency and nitrogen use efficiency are related, these drought-tolerant hybrids may require a different amount of nitrogen (N) to maximize yield, which could influence environmental losses of N.

There has been little research on the modern drought-tolerant corn hybrid physiology, and measuring physiological characteristics such as net photosynthesis, stomatal conductance and chlorophyll fluorescence ratios may help identify the drought-tolerance mechanism(s) in these hybrids. Two field experiments were developed to investigate these problems. The first examined N use efficiency and minimum N required to maximize grain yield for four hybrids (two drought-tolerant hybrids and two non-tolerant hybrids) at two Ohio locations over two years. The second investigated how the same hybrids responded physiologically to increasing plant density, or plants per unit area (five different levels), and planting date (early versus late) at three Ohio locations over three years. The research was supported in part by an OSU-Ohio Agricultural Research and Development Center SEEDS Grant and a Pioneer Crop Management Research Award and the experiments were conducted at OSU research farms near S. Charleston, Hoytville, and Apple Creek, Ohio.

The drought-tolerant hybrids had similar ear-leaf N uptake and yield response to N application as compared to the susceptible hybrids. At most planting dates and locations, there was no yield difference between the drought-tolerant and susceptible hybrids. In three of the 12 environments (for 2012-2013), a 5-10% yield advantage occurred with the drought-tolerant hybrids. In one of the environments a 2% grain yield penalty was observed in the drought-tolerant hybrids compared to the susceptible hybrids. At some of the locations, the photosynthetic rates in the drought-tolerant hybrid were similar to the susceptible hybrid, but the same plants had reduced stomatal conductance indicating water use efficiency may have been increased. In the vegetative stages, chlorophyll fluorescence ratios tended to be greater in the drought-tolerant hybrids, which could indicate less plant stress in the vegetative stages. All hybrids exhibited a similar grain yield response to population density, and planting date, which indicates the drought-tolerant corn hybrids can be managed in Ohio environments using current production recommendations.

These results help to identify improved water use efficiency and less plant stress during vegetative growth as two possible mechanisms for greater drought tolerance. Additionally, they provide Ohio producers with recommendations based on research conducted in multiple locations and years on how to utilize these tools to manage for climate change and remain competitive in a global economy. Future research should investigate if the physiological
characteristics observed are similar in other corn hybrids. Additionally, the effect on grain quality is currently under investigation to see if the differences observed physiologically altered protein, oil, and starch content in the grain.

Management of Winter Feeding Systems to Meet Your Livestock's Needs and Conservation Goals

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During November, most livestock producers in West Virginia decide the number and type of livestock they plan to keep during the winter. The availability of fall pasture, the amount of stored feed, and the quality of the feed will help the farmer determine the number of livestock to retain. A winter feeding system then needs to be designed to meet the livestock's needs and to protect natural resources.

This feeding system should accomplish several objectives:
1. minimize livestock feeding in concentrated areas near water bodies during late fall, winter, and early spring when frequent snow and rain runoff occurs;
2. improve the use of pastureland;
3. reduce soil erosion;
4. maintain water quality; and
5. Improve the health of the livestock.

Reducing the amount of time cattle spend close to surface waters is important to protect water quality. Operations that discharged pollutants (sediment and bacteria) into surface waters potentially will be fined or even designated as Animal Feeding Operations and required to apply for a NPDES permit. Many options are available to farmers to improve management of riparian areas, including CREP, NRCS EQIP livestock exclusion practice. The use of temporary electric fence systems are also a good method of keeping cattle away from surface streams if flood events are frequent and fencing systems are likely lost or damaged during high water events. Single strand high tensile electric fencing is an economical and effective way to protect stream corridors. It is unlikely to trap debris during flooding. These fences should be
located a minimum of 35 feet from surface streams and sinkhole areas to allow the riparian or sod buffers to capture the sediment, nutrients, and pathogens that escape the feeding areas during runoff.

The sod buffers that are located down slope of a feeding area should have cattle excluded during the fall to allow the grass to grow to a 6-inch height.

This thickened stand of grass will reduce sediment transport during storm runoff. The critical feeding areas that are left with no vegetation should be reseeded at recommended rates as soon as cattle are moved in the spring. Seed can be incorporated into the disturbed area by letting livestock walk it in or seeding followed by dragging a chain harrow through the feeding area.

Table 1. Forage Species and Seeding Rates (lbs/ac alone/in mix, total 20-30 lbs/ac)

<table>
<thead>
<tr>
<th>Permanent winter feeding areas</th>
<th>Rotated winter feeding areas</th>
</tr>
</thead>
<tbody>
<tr>
<td>Annual ryegrass (25/12)</td>
<td>Orchardgrass (12/8) or Endophyte free tall fescue (14/12)</td>
</tr>
<tr>
<td>Kentucky bluegrass (6/2)</td>
<td>Kentucky bluegrass (6/2)</td>
</tr>
<tr>
<td>Crabgrass (5/3)</td>
<td>Red clover (8/4)</td>
</tr>
<tr>
<td>Optional additional species: choose one</td>
<td>Ladino clover (3/1)</td>
</tr>
<tr>
<td>[Timothy (10), smooth bromegrass (14),</td>
<td></td>
</tr>
<tr>
<td>reed canarygrass (14)]</td>
<td></td>
</tr>
</tbody>
</table>

**Rotated Winter Feeding Areas**

A permanent feeding areas needs a system to collect, store, and then apply the accumulated animal waste. A properly designed permanent feeding area will have a method (a diversion ditch or earthen berm) to restrict water flowing into the area. Using sawdust or straw or waste hay on concrete pads is recommended to absorb liquids and improve footing for the livestock. A feeding area that is roofed needs a gutter and drainage system to keep water from accumulating with the animal waste. For permanent feeding areas that store manure, a nutrient management plan needs to be developed and followed to best utilize the nutrients for crop production while protecting water quality.

Winter feeding strategies that move the herd every 30 or 40 days during the winter needs to be considered even if a farm has a roofed winter feeding area with manure storage. Most roofed winter feeding facilities cannot store all the manure generated during the winter period. Temporary feeding areas, managed correctly, maintain some vegetation and tend to recover quickly. Locate feeding areas so livestock have a protected area away from winter winds. Areas with more than 50% loss of vegetative cover need to be reseeded in the spring.

Extending the grazing season as long as possible is the best way to reduce the time that cattle spend in the feedlot. Stockpiling tall fescue during the fall and then grazing off this accumulated forage during December and January keeps the cattle on the pasture and out of the feedlot. Deferred grazing is a good addition to a winter feeding program and can be accomplished with an August application of nitrogen on tall fescue.
Waterborne bacteria can affect herd health when streams and ponds are used for livestock watering. Herds can pick up bovine leptospirosis and mastitis from this type of water source. Use streams and ponds only if no alternative watering source is available. To reduce stream and pond bank erosion, design a single access point for the cattle that is stabilized with stone.

Designing a winter feeding system that ensures the health of the livestock, returns a profit to the farm, and protects the environment is an increasing challenge to the producer. For help in putting all the parts together visit your USDA NRCS district conservationist, for a conservation planning and County Extension agent for a feed management evaluation.

**Growing Season Changes in Soil Test Potassium Levels in Irrigated Corn and their Potential Impact on Soil Test K Recommendations**

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*Introduction*

Recent discussions with nutrient consultants have highlighted a possible deficiency in potassium (K) fertilization recommendations for irrigated corn production. The agronomist brought in the Director of the UD Soil Testing Program to attend the meeting where a consultant showed graphs of the soil test K levels in several irrigated corn production the recommended rates of K either with or without poultry litter had been applied over the past 5 years. The data presented by the consultant indicated that Mehlich III soil test levels were dropping between 5 and 10 FIVs (fertility index values) per year even where the recommended rate of K was applied. Note that FIV’s of Mehlich III K equate to mg K/kg soil or parts per million and can be converted to pounds of K per acre by multiplying by two. Since many farmers have struggled with the rising cost of K fertilizer and therefore restricted their fertilization rates, this information raised a significant concern about current K recommendations. In response to this issue, we decided to conduct an in-season soil survey of a number of irrigated corn fields to validate consultant observations.
**Procedures**

At the beginning of the 2014 corn growing season, growers of irrigated corn were contacted by the county Agricultural Extension agents for permission to sample for soil K levels throughout the growing season in at least one of their production fields. Twenty-one field sites were sampled beginning shortly after or shortly before the initial sidedress nitrogen (N) application occurred and weekly thereafter until early August. From early August through black layer (crop maturity), fields were sampled every other week. At the beginning of the sample period and at black layer, soils were sampled at intervals of 6 inches down to a total depth of 18 inches unless soil compaction issues prevented sampling to that depth. Samples were dried and placed in soil test bags and sent to the University of Delaware Soil Testing Laboratory where they were analyzed using a Mehlich III extraction solution for K, phosphorus, calcium, magnesium, sulfur, manganese, copper, iron, boron, zinc, aluminum, and the phosphorus saturation ratio. The changes in soil test levels of each nutrient across the growing season were examined to determine if there were obvious trends. The trend in K levels was used to evaluate consultant observations that current regional K recommendations for irrigated corn are not adequate to replace that removed by the crop and irrigation/rainfall movement through the soil profile.

**Results and Discussion**

Initial soil test values for a 0-6 inch depth level indicated an average K Fertility Index Value (FIV) of 122.91 at sidedress N time and an ending value when corn reached black layer (physiological maturity of corn) of 71.33 FIVs (Table 1). At the initial sampling, only one site had a K FIV less than 50 (50 and above indicates an optimum range for a FIV value) and two sites below 75 FIVs (above which no K is recommended). By black layer, six sites were below 50 FIVs and 12 sites were below 75 FIVs. All 21 sites went down sometime during the growing season (a range of 22 to 75% reduction and an average 53.7% decline) and 20 of the 21 sites had declined in soil test K content at black layer stage (one site increased by 5% and the remaining decreased by 44.1% with a range of 11 to 75%).

Data from Table 2 characterizes changes in cation exchange capacity (CEC), soil organic matter (SOM), and soil test K values at three soil sample depths; 0 to 6 inches, 6 to 12 inches, and 12 to 18 inches. Samples were taken at the beginning and end of the survey. Compaction issues sometimes limited the maximum depth of sampling. For CEC, fifteen of the 21 sites showed the expected trend of lower CEC with increasing depth since for many soils in Delaware the percentage of sand increases with depth and the percentage soil organic matter (SOM) decreases rapidly with depth. At only one site (a silt loam soil) did CEC increase with increasing depth. At one site (site 5), the middle sampling depth (6-12 inches) increased slightly but the deeper sample was 1 meq/100g soil lower than the surface soil, a 23% reduction. At four sites (12, 13, 15, and 16), the lower sample depth was above the middle sample depth but the surface sample (0-6 inch) was higher than the other sample depths for CEC. At all sites the SOM decreased rapidly with increasing sample depth as expected.
Table 1. Potassium Fertility Index Values (equal to parts per million Mehlich K or mg K/kg soil) at the beginning and end of the 2014 study on 21 irrigated corn sites in Delaware.

<table>
<thead>
<tr>
<th>Site #</th>
<th>K FIV level at sidedress N time</th>
<th>K FIV level at black layer (BL)</th>
<th>% K FIV reduction at BL</th>
<th>Max % K FIV reduction observed</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>110.1</td>
<td>27.82</td>
<td>75</td>
<td>75</td>
</tr>
<tr>
<td>2</td>
<td>40.46</td>
<td>18.79</td>
<td>54</td>
<td>54</td>
</tr>
<tr>
<td>3</td>
<td>92.84</td>
<td>82.85</td>
<td>11</td>
<td>22</td>
</tr>
<tr>
<td>4</td>
<td>104.25</td>
<td>109.55</td>
<td>5↑ (increase)</td>
<td>40</td>
</tr>
<tr>
<td>5</td>
<td>80.24</td>
<td>56.38</td>
<td>30</td>
<td>50</td>
</tr>
<tr>
<td>6</td>
<td>158.55</td>
<td>62.27</td>
<td>61</td>
<td>69</td>
</tr>
<tr>
<td>7</td>
<td>72.27</td>
<td>49.08</td>
<td>32</td>
<td>43</td>
</tr>
<tr>
<td>8</td>
<td>78.6</td>
<td>65.48</td>
<td>17</td>
<td>46</td>
</tr>
<tr>
<td>9</td>
<td>95.35</td>
<td>35.95</td>
<td>62</td>
<td>62</td>
</tr>
<tr>
<td>10</td>
<td>133.01</td>
<td>78.44</td>
<td>41</td>
<td>52</td>
</tr>
<tr>
<td>11</td>
<td>175.19</td>
<td>115.28</td>
<td>34</td>
<td>67</td>
</tr>
<tr>
<td>12</td>
<td>193.03</td>
<td>84.36</td>
<td>56</td>
<td>58</td>
</tr>
<tr>
<td>13</td>
<td>209.16</td>
<td>114.27</td>
<td>45</td>
<td>48</td>
</tr>
<tr>
<td>14</td>
<td>89.69</td>
<td>54.95</td>
<td>39</td>
<td>50</td>
</tr>
<tr>
<td>15</td>
<td>116.49</td>
<td>97.16</td>
<td>42</td>
<td>42</td>
</tr>
<tr>
<td>16</td>
<td>155.93</td>
<td>98.39</td>
<td>37</td>
<td>48</td>
</tr>
<tr>
<td>17</td>
<td>192.16</td>
<td>143.82</td>
<td>25</td>
<td>45</td>
</tr>
<tr>
<td>18</td>
<td>110.62</td>
<td>50.30</td>
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<td>69</td>
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<td>19</td>
<td>84.91</td>
<td>38.67</td>
<td>54</td>
<td>60</td>
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<tr>
<td>20</td>
<td>125.19</td>
<td>67.61</td>
<td>46</td>
<td>55</td>
</tr>
<tr>
<td>21</td>
<td>135.98</td>
<td>46.56</td>
<td>66</td>
<td>73</td>
</tr>
<tr>
<td>Avg.</td>
<td>122.91</td>
<td>71.33</td>
<td>42</td>
<td>54</td>
</tr>
</tbody>
</table>

For soil test K at the 6 to 12 inch depth, seventeen sites declined an average of 32.6% (range 7-60%) and three sites increased an average of 24% (range 4 to 43%) (Table 2). At the 12-18 inch depth, ten sites decreased in soil test K an average of 24.4% (range 3 to 47%) and six sites increased an average of 43.2% (range of 2 to 81%). This indicated that there was at least some potential leaching of K deeper into the soil. Depending on rooting restrictions, this possibly represents a potential for some soil test K to be lost and could impact corn production potential.

Although corn yield was not evaluated at these sites or a paired comparison of with and without additional K fertilizer, the findings validate nutrient consultant observations and concerns. Even on sites with a high, for Delaware, cation exchange capacity (CEC), significant reductions in soil test K were observed. At 29% of the sites, K FIV fell below the minimum optimum range and 57% fell below the K FIV where additional K fertilization would be recommended.
Table 2. Cation Exchange Capacity (CEC), percent soil organic matter, and percentage change in K FIV from sidedress N application time to physiological maturity (corn black layer) at 21 irrigated corn sites in Delaware at three soil sampling depths (2014).

<table>
<thead>
<tr>
<th>Site #</th>
<th>Soil Sample Depth (Inches)</th>
<th>CEC meq/100 g soil</th>
<th>% Soil Organic Matter</th>
<th>% Change in K Initial vs. Ending K FIV</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0-6&quot;</td>
<td>6-12&quot;</td>
<td>12-18&quot;</td>
<td>0-6&quot;</td>
</tr>
<tr>
<td>1</td>
<td>4.7</td>
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<td>2</td>
<td>3.3</td>
<td>2.5</td>
<td>1.6</td>
<td>0.4</td>
</tr>
<tr>
<td>3</td>
<td>5.8</td>
<td>4.1</td>
<td>2.8</td>
<td>1.1</td>
</tr>
<tr>
<td>4</td>
<td>5.8</td>
<td>4.3</td>
<td>2.9</td>
<td>1.5</td>
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<td>5</td>
<td>4.3</td>
<td>4.7</td>
<td>3.3</td>
<td>0.9</td>
</tr>
<tr>
<td>6</td>
<td>6.1</td>
<td>4.7</td>
<td>ns</td>
<td>1.8</td>
</tr>
<tr>
<td>7</td>
<td>6.3</td>
<td>ns</td>
<td>ns</td>
<td>1.8</td>
</tr>
<tr>
<td>8</td>
<td>6.4</td>
<td>4.9</td>
<td>ns</td>
<td>1.1</td>
</tr>
<tr>
<td>9</td>
<td>6.1</td>
<td>3.5</td>
<td>2.6</td>
<td>1.2</td>
</tr>
<tr>
<td>10</td>
<td>8.1</td>
<td>6.2</td>
<td>ns</td>
<td>1.4</td>
</tr>
<tr>
<td>11</td>
<td>8.9</td>
<td>9.0</td>
<td>9.9</td>
<td>1.5</td>
</tr>
<tr>
<td>12</td>
<td>6.3</td>
<td>5.3</td>
<td>5.8</td>
<td>1.2</td>
</tr>
<tr>
<td>13</td>
<td>8.1</td>
<td>6.5</td>
<td>7.7</td>
<td>2.1</td>
</tr>
<tr>
<td>14</td>
<td>6.4</td>
<td>6.1</td>
<td>3.5</td>
<td>1.5</td>
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<td>15</td>
<td>5.9</td>
<td>3.8</td>
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<td>16</td>
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<td>4.8</td>
<td>3.2</td>
<td>1.9</td>
</tr>
<tr>
<td>21</td>
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<td>0.9</td>
</tr>
<tr>
<td>Mean</td>
<td>6.30</td>
<td>4.81</td>
<td>4.11</td>
<td>1.30</td>
</tr>
</tbody>
</table>

*, ns = not sampled at this depth due to compaction issues at that site and depth.

Future Work

These findings need to be correlated with irrigated corn yield potential and supplemental K fertilization to estimate the economic impact of the in-season reduction in soil test K values. In 2015, the plan is to have paired site rows with and without supplemental K fertilizer added immediately after the first samples are obtained. Corn population will be estimated near the end of the growing season (only plants with ears will be included in the stand count). At or shortly after black layer, ears from the paired rows with and without supplemental K will be pulled from a minimum of ten plants, dried, shelled, and used to estimate yield based on field plant population. It is hoped that the results will indicate if the significant decline in in-season soil test K values correlates with yield potential.
Fungicide Resistance in Fusarium graminearum: Why You Shouldn’t Worry.

Dr. Nathan Klczewski
Extension Plant Pathologist
University of Delaware
Email: nkleczew@udel.edu

Many are aware of a paper published earlier this season on an NY-based isolate of *F. graminearum* that was resistant to tebuconazole. This result generated a fair amount of concern in many wheat growing areas; however, the point of this article today is to allay your concerns. The sky isn’t falling.

Fungicide resistance is part of the game we play when we use fungicides and is a major reason solid IPM practices should be utilized when managing fungal diseases. There is always some level of fungicide resistance in a fungal population and mechanisms of resistance differ between different fungicide modes of action. The triazoles (e.g. tebuconazole, cyproconazole, prothioconazole, metaconazole, propiconazole) are not “yes or no” fungicides in terms of resistance. With triazoles, such as those we recommend for FHB, resistance is measured in shades of gray. Therefore you may see a general reduction in efficacy of triazoles in a pathogen population over time not a sudden failure of fungicide. This efficacy may is restored to a degree by increasing the rate of the fungicide. I discuss other aspects of fungicide resistance development below. The take home message: *Prosaro and Caramba are still the recommended fungicides for management of Fusarium Head Blight.*

Before I discuss the aforementioned research, I believe it is important to provide you a very brief overview of some of the high points of fungicide resistance in plant pathogens. When fungicides of the same mode of action are applied repeatedly to fields, the fungal population can develop resistance or insensitivity to that particular fungicide mode of action. For example, if a fungus develops resistance to azoxystrobin, it will also likely be resistant to other fungicides in the strobilurin class (group 11) of fungicides. This is because the fungicide kills most of the pathogen population, but a small subset of the fungal population has mutations that allow them to survive and cause disease in the presence of the fungicide. Therefore, if multiple sprays of fungicides with the same mode of action are used, these resistant individuals will continue to grow, reproduce, and cause disease. Over time, the population may contain a large proportion of resistant individuals, resulting in fungicide failure (Figure 1). This is basically what has been occurring with antibiotics and human pathogenic bacteria- the more people use and abuse antibiotics (ex-take them when not needed) the more the populations of bacteria will have the chance to develop resistance to the antibiotic. The result, as you may be aware, is that we are now dealing with high frequencies of antibiotic resistance. Some people even predict that current antibiotics will not work in the near future.

The potential for fungicide failure is one reason growers should rotate between fungicide modes of action if making multiple fungicide sprays during the growing season. In vegetables, growers often tank mix or alternate with multi-site, protective fungicides (ex-chlorothalonil), but this is not common in field crops. Growers may also tank mix fungicides of different modes of
action. Unfortunately for field crops, we have a very limited spectrum of fungicide modes of action that we use. This makes rotating fungicides difficult. There are several premix fungicides available, which often contain fungicides of different modes of action (typically a group 11-Headline type active with a group 3-Tilt type active ingredient).

![Diagram of fungicide resistance development](image)

**Figure 1. An example of the development of fungicide resistance in a fungal pathogen population.** A) The fungicide containing a particular mode of action (X) is applied to a field containing a population of fungal pathogens. Most of the fungi sensitive to the active ingredient, but a small number are not. B) The insensitive or resistant individuals survive, grow, reproduce, and continue to cause disease. C) The field is continually sprayed with the same fungicide or fungicides of the same mode of action (X). D) Because the pathogen population was resistant to fungicides in the X mode of action, they continue to grow, develop, and cause disease.

Several pathogens have developed fungicide resistance in recent years. For example, the pathogen that causes Frogeye leafspot of soybean has developed resistance to strobilurin fungicides (ex-Quadris, Headline, and premixes) in the Midwest and portions of the South. In Indiana the pathogen causing Gummy Stem Blight of cucurbits has developed resistance to bosalid (group 7), azoxystrobin, and pyraclostrobin (group 11). Many are familiar with fungicide resistance to mefamoxam in the late blight pathogen, and resistance to the triazoles (group 3) has been reported in several plant pathogenic fungi.

**So what’s the deal with Fusarium head blight?**

Fungicide use is recommended as part of an IPM program to manage Fusarium head blight. Tebuconazole has been used in many states to suppress this disease since the 1990’s. Currently, the most effective fungicides use metaconazole or a prothioconazole, or a combination of prothioconazole and tebuconazole. All of these fungicides belong to the DMI (group 3) class of fungicides. Products containing these active ingredients can suppress bleaching and production
of mycotoxins when applied around flowering. Mycotoxins are harmful to humans and some animals and can be a cause for rejection or downgrading of grain at mills. The Fusarium head blight pathogen produces mycotoxins after infecting the head. Some triazole fungicides (group 3) appear to be the best at penetrating tissues, stopping fungal growth, and reducing mycotoxin production.

**So if all the recommended fungicides contain group 3 active ingredients, why are they not equally effective?**

Some researchers speculate that variability in performance may be due to differences in populations of the Fusarium head blight pathogen to specific active ingredients. Others believe that the variability is due to differences in how the active ingredients target the fungus, as the triazoles in general differ greatly in spectrum of use. Our friends to the North at Cornell conducted a survey of Fusarium head blight pathogens in New York that was recently published online at Plant Disease (link below). Fifty pathogenic fungal isolates were tested for sensitivity to tebuconazole and metaconazole. Sure enough, the group identified one isolate that was resistant to tebuconazole.

The interesting part of this story is that the area where the isolate was collected was not an area where tebuconazole use is prevalent and therefore it is unlikely that the isolate evolved resistance as I explained previously. It’s possible that the isolate originated from another region where there is more frequent use of tebuconazole. The authors suggest that a more likely source of the resistant isolate is simply due to the high level of genetic diversity in the pathogen. Thus, if you look at Figure 1, there may be more of the black dots in part A. This isn’t the first time this pathogen has developed resistance to tebuconazole, but it is the first time we’ve seen it in the United States. Past reports of the Fusarium head blight pathogen resistant to tebuconazole have come from Europe, Asia, and South America.

The study showed that isolates were more sensitive to metaconazole than tebuconazole, and the resistant isolate remained sensitive to metaconazole. This led the researchers to conclude that in the case of the triazoles, using different active ingredients within the triazole group may be used as a fungicide resistance management strategy for Fusarium head blight. Thus, tank mixes or pre mixes containing multiple triazole fungicides may help slow the risk of fungicide resistance development in the Fusarium head blight pathogen. More extensive surveys are needed to better describe fungicide resistance in the Fusarium head blight pathogen throughout the region.


Organic no-till corn production is increasing in popularity amongst producers due in part to known environmental benefits and also because it can reduce dependency on cultivation as the primary weed control mechanism. High residue cover crop stands can be killed with a roller-crimper (roll-killed), creating a weed suppressing mulch. This production practice has been particularly successful in North Carolina for organic soybean production when rye is used as a high biomass cover crop and is roll-killed prior to planting. To achieve maximum corn yields additional fertility, beyond that provided by the cover crop, is likely needed.

We conducted studies to evaluate different starter fertilizer sources and their impacts on yield and weed competition in organic no-till corn production, using a cover crop mulch for weed suppression. Research was conducted at Kinston, NC and Salisbury, NC in the 2013 and 2014 corn growing seasons.

A cover crop mixture of Purple Bounty hairy vetch (12 lbs/acre) and Wrens Abruzzi cereal rye (90 lbs/acre) was planted from mid-September to mid-October, depending on study site. Cover crops were drilled into a clean-tilled seedbed, and were roll-killed one week prior to corn planting at three of the four study sites. Rolling occurred again at planting. At the fourth study site, roll-kill occurred at planting and then again one week later. The picture on the right illustrates cover crop termination of the rye/vetch mixture utilizing the roller-crimper.
Table 1: Average Cover Crop Biomass across Study Sites

<table>
<thead>
<tr>
<th>Location</th>
<th>Year</th>
<th>Cover Crop Biomass (lbs/acre)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kinston</td>
<td>2013</td>
<td>5,700</td>
</tr>
<tr>
<td>Salisbury</td>
<td>2013</td>
<td>8,700</td>
</tr>
<tr>
<td>Kinston</td>
<td>2014</td>
<td>8,600</td>
</tr>
<tr>
<td>Salisbury</td>
<td>2014</td>
<td>9,000</td>
</tr>
</tbody>
</table>

Table 2. Starter Fertility Treatments

<table>
<thead>
<tr>
<th>Fertility Treatment</th>
<th>Rate</th>
<th>N Applied (lbs/acre)</th>
<th>Cost ($/acre)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Topdress Poultry Litter</td>
<td>4 T/A</td>
<td>240</td>
<td>120</td>
</tr>
<tr>
<td>Topdress Poultry Litter</td>
<td>2 T/A</td>
<td>120</td>
<td>60</td>
</tr>
<tr>
<td>Subsurface Feather Meal</td>
<td>575-625 lbs/acre</td>
<td>75-82</td>
<td>280-305</td>
</tr>
<tr>
<td>Subsurface Pelleted Poultry Litter</td>
<td>575-625 lbs/acre</td>
<td>17-19</td>
<td>57-63</td>
</tr>
<tr>
<td>No Added Fertility</td>
<td>--</td>
<td>--</td>
<td>--</td>
</tr>
</tbody>
</table>

*For subsurface treatments, starter fertilizer boxes on the John Deere 7200 planter were used to deliver a subsurface banded fertility application. Pelleted material was used for each treatment, with fertilizer hoppers set to wide open, delivering between 575-625 lbs fertilizer/acre.

**Feather meal source was NatureSafe Blending Base (13-0-0).

***Subsurface banded poultry litter application was done using pelleted poultry litter. Loose litter has been known to clog fertilizer hoppers. Despite using the pelleted litter, tractor speed was still required to be very slow to prevent clogging.

****The same cover crop mixture was planted across all fertility treatments.

Dr. Chris Reberg-Horton, Crop Science Professor at NC State University, has been continuously modifying a no-till planter in order to create a planter which will reliably and efficiently plant into high cover crop biomass stands. Current planter modifications include both Yetter row cleaners and residue slicers mounted to an added front toolbar (Pictured on the right). We targeted populations of 28,400 plants/acre in Kinston and 31,800 plants/acre in Salisbury. While perfect stands were not achieved in these studies, stands were good, with minimal gapping. Some issues still need to be addressed with the current planter setup, but stands achieved in this study were impressive compared to research done in this system to date.

Overall, very good weed suppression was observed at three of the four study sites (Kinston 2014, Salisbury 2013, Salisbury 2014). There was less than 10% weed coverage across all treatments at these study sites. The Kinston 2013 site had lower cover crop biomass (Table 1)
and much higher weed pressure; therefore, fertility source had more of an impact on weed pressure and yield. The topdress fertilizer treatment had the highest yield and lowest weed pressure at this location because there was sufficient nitrogen for the corn crop to be competitive with weeds early in the season.

Yield results are presented below from three of the study sites. Field plots at Kinston 2014, Salisbury 2013, and Salisbury 2014 all had excellent weed suppression from the cover crop mulch, with cover crop biomass reaching over 8,000 lbs/acre at all three study sites (Table 1).
Our Kinston 2013 site had the lowest cover crop biomass, with only 5,700 lbs/acre biomass (Table 1). The yield data from this site shows the importance of providing plenty of nitrogen early in the season to give the corn crop a competitive advantage against weeds. In our subsurface and no added fertility treatments in Kinston 2013, there was high weed pressure and this had a large impact on yields.

**Yield: Kinston 2013**

Conclusions

1. The rye/vetch cover crop mixture provided excellent weed suppression at three of the four study sites.
2. Cover crop biomass over 8,000 lbs/acre is necessary to ensure good weed suppression by the cover crop mulch.
3. Rolling the cover crop one week prior to corn planting, and then again at corn planting seemed to be the most effective method for ensuring cover crop termination and effective corn planting.
4. The topdress fertility treatment achieved the highest yields across environments, and had the lowest weed pressure among treatments in the Kinston 2013 site where weed pressure was high.
5. Unless producers are restricted by how much P can be applied, the feather meal treatment does not seem to provide enough benefit to outweigh its high cost.
6. Additional study years and sites are needed in North Carolina to investigate this system further before recommendations are available to organic producers in North Carolina.
Is Soil Testing Pasture and Hay Fields Really That Important?

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University of Delaware  
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With the emphasis on reducing the impact of nutrient loading into the Chesapeake Bay, Delaware Bay, and the Inland Bays in Delaware, a great deal of effort has been expended on nutrient management planning, soil testing, and improving fertilizer technologies. In Delaware, anyone with 8 or more animal units [an animal unit (AU) is the equivalent of 1,000 pounds of live weight] or who applies fertilizer to more than a total of 10 acres of land (or water) is required to have a nutrient management plan and attend nutrient certification classes, obtain a specific level of certification, and maintain their certification by attending continuing education courses. Delaware nutrient management plans require that soil be tested at least every three years and that fertilization be based on test results.

The question often on a producer’s mind is whether it is really that important to test pastures and hay fields for fertility status. Further, producers often enquire about the importance of keeping old soil test reports. So, just what can we learn from both a current soil test and a historical record of soil test results.

There are a number of impacts from low pH or highly acidic soils. These include the following:

- Phosphorus availability falls rapidly as the pH declines below 6.0.
- The potential for potassium (K) leaching increases since low pH indicates that more hydrogen cations (H+) are present and these cations will out compete K cations (K+) for occupation sites on the cation exchange system in soil (clay and organic matter with available negative charges).
- Molybdenum becomes less available on acid soils reducing legume nodulation and nitrogen fixation effectiveness.
- Soil bacteria become less active slowing mineralization, nitrification, and many other processes in the soil and this slowdown results in less nutrients available for plant growth.
- Plant roots are sensitive to the toxic effect of aluminum ions. Aluminum ions become increasingly available as the pH declines.
- Reduced root growth results in less nutrient uptake, less water absorption, less stress tolerance, slower recovery from grazing, and less total forage production.
- At very low soil pH or high acidity levels, some micronutrients accumulate in plants and become toxic to plants.
Estimating Mineralization Rate and Plant Available Nitrogen from Spent Mushroom Soil in Irrigated Corn Production Systems

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Introduction

Farmers in northern Delaware have been offered an inexpensive composted spent mushroom soil (SMS) for use as a soil organic amendment for crop fields. Nutrient consultants have contacted the Extension agronomist at the University of Delaware since information about the mineralization rate of nitrogen from SMS is sparse with inconsistent mineralization rates assigned. There is concern that at an application rate of slightly more than 20 tons/acre that some growers use, the risk of crop lodging or nitrate leaching will be unacceptably high. Assistance of the agronomist was requested to determine the appropriate mineralization rate for SMS. In reviewing available literature, a range of mineralization rates ranging from about 20% to that used in the mid-Atlantic region for poultry litter (50 to 60%) were found.

The benefits of adding SMS (organic matter) to a soil are well known and range from improving the soil’s water holding capacity, boosting the cation exchange capacity (nutrient holding ability) in the soil, adding macro- and micro-nutrients to the soil and reducing the need for supplemental fertilization, and improving micronutrient availability by adding organic chelates to the soil. A local grower has contracted with an SMS producer to obtain enough SMS to apply about 22 tons/acre of the SMS to an irrigated corn production field. The grower expects to apply the SMS for two growing seasons and then move to another field. Without an accurate assessment of the mineralization rate from SMS, the risks of crop lodging and economic loss to growers and the environmental and economic risks if the N contribution from SMS is ignored are great. Since mushroom producers across the country use a wide-range of substrates in their production process, a literature review determined that there is too wide a range of mineralization rates reported to be of value in writing an accurate nutrient management plan.

Procedures

The Extension Agronomist joined forces with the Director of the University of Delaware’s Soil Testing Program to determine the actual mineralization rate of the offered SMS. A testing procedure for SMS was identified and a sample of the actual SMS provided to the grower was obtained. A four application rate study (0, 10, 20, and 30 tons SMS/acre equivalent) was
established using leaching tubes. A leached mineralization protocol was selected to estimate the maximum or “worst case scenario” of N release by the SMS. A twelve week mineralization study was established with weekly leachate sampling and analysis. When completed just prior to corn sidedress nitrogen (N) time for the grower, a report on the mineralization potential for SMS was provided to the nutrient consultant so that he could more accurately determine the appropriate sidedress N rate on the amended field.

**Results**

The SMS was analyzed for total N and total C (carbon) so that a carbon to nitrogen (C:N) ratio could be calculated. On an as is or as received basis, the material had 0.879% N and 10.47% carbon for a 11.9 C:N ratio. In general when the C:N ratio is less than 20:1 (this number varies from state-to-state and researcher-to-researcher but is always somewhere between 20:1 and 30:1), there is net mineralization (release) of N during the growing season if moisture and temperatures are favorable for organic matter mineralization.

The laboratory results also indicated an estimated total N on an as received basis of 176 lbs/ac if applied at a 10 ton SMS/ac rate; 352 lbs N/ac if applied at a 20 ton SMS/ac rate; and 527 lbs N/ac if applied at a 30 ton rate. These numbers represent the total amount of N that would be added to the soil at the corresponding application rate. It does not indicate how much of the N will be plant available N in the first growing season after application. For that answer, one needs to know how quickly the SMS will break down or mineralize under favorable weather and soil conditions. To determine the mineralization characteristics of this SMS, an 80-day laboratory study was conducted.

At the end of an 80 day mineralization incubation study, the soil alone had mineralized about 30.7 lb N/acre which is approximately what would be expected from this particular soil at just over 1 percent soil organic matter (Figure 1). Figure 1 shows the cumulative release of N for soil and soil plus three application rates of SMS over the 80 day incubation study to determine mineralization. The y-axis is in parts per million so to get to lbs/acre you should just multiply the number by 2 and that will give you the lbs N/ac. The soil plus a 10 ton/ac rate of SMS mineralized an additional 8.9 lb N/ac while the 20 ton/ac rate of SMS mineralized 22 lb N/ac more than the soil alone. This equates to about 1.1 lbs of N/ac/ton of SMS so that the grower could have expected from his 22 ton SMS/ac rate a total of a 24.2 lbs N/ac if conditions for mineralization were favorable during the growing season. At the 30 ton/ac rate, the SMS mineralized an additional 49.5 lbs N/ac which was slightly more than expected. The rate of release appeared to be rather flat early in the incubation but accelerated later in the incubation.
Conclusions

The grower and his nutrient consultant were able to more accurately pinpoint the appropriate sidedress N application rate that prevented severe lodging in the field and still provided adequate N for maximum corn yield. Estimated yield potential from the field was about 240 bu/ac. If the consultant had recommended N based on the UD Soil Test Laboratory analysis of the SMS (C:N ratio of 11.9 and an estimated total N content of 352 lbs N/20 ton/ac application rate) and an estimated mineralization rate similar to poultry manure (50%), the 22 ton/ac of SMS applied by the grower should have provided about 194 lbs N/acre for the corn crop. Instead of this rate, our study indicated that the SMS after 80 days would contribute about 22 lbs N/ac above the normal soil mineralization rate. Although this result indicated that the farmer should spend money on commercial fertilizer N, it meant that the consultant could recommend a rate with some confidence in not causing severe lodging and would meet the crop’s needs for N to optimize yield potential.

If the grower had depended on the SMS for the estimated 194 lbs N/ac based on a 50% mineralization rate of the total N content of the SMS rather than our estimate of 22 lbs N/ac, corn yields could have been severely limited by the lack of available N. This could easily have resulted in a reduction of 100 bu/ac or more. At a $4/bu corn price, this translates to a $400/ac loss. The additional 172 lbs N/ac required as commercial fertilizer would have cost about $86/ac resulting in an estimated economic value of $314/ac to the farmer.

From an avoidance point of view, the consultant was able to make a more accurate N recommendation with a lower risk of significant lodging. Purdue University estimates that lodging losses average 4-8% loss although this doesn’t take into account total economic loss since severely lodged corn often necessitates the farmer to deadhead (harvest only in one
direction) to improve the ability of the combine to pick up lodged plants. This loss estimate also
does not account for whole ear loss often experience in severely lodged corn since leaving whole
ears on the ground increases mechanical harvest loss much faster than the usual shelling losses of
combine harvesting.

Notices and Upcoming Events

January 7, 2015
Lower Shore Farm Bill Workshop, 9:30 am – 3:00 pm, Wor-Wic Community College, Fulton
Owen Hall, Room 308, Salisbury, MD. For more information, please contact Sudeep Mathew,
University of Maryland Eastern Shore, Dorchester County, 501 Court Lane, Room 208,
Cambridge, Maryland 21613 (410) 228-2880

January 12-15, 2015
Delaware Ag Week, Delaware State Fairgrounds, Harrington, DE. Contact either Dr. Cory
Whaley at whaley@udel.edu or Dr. Richard Taylor at rtaylor@udel.edu.

January 13, 2015
Delmarva Hay and Pasture Conference, Agricultural Commodities and Education (ACE)
Building, Delaware State Fairgrounds, Harrington, DE. Contact either Dr. Cory Whaley at
whaley@udel.edu or Dr. Richard Taylor at rtaylor@udel.edu.

January 13, 2015
Equine Pasture Management Evening Session, Exhibit Hall, Delaware State Fairgrounds,
Harrington, DE. Contact either Dr. Cory Whaley at whaley@udel.edu, Dr. Richard Taylor at
rtaylor@udel.edu, or Sydney Riggi at Sydney@udel.edu.

January 14, 2015
Southern Maryland Hay and Pasture Conference, Baden Volunteer Fire Department,
Waldorf, MD. Contact Mr. Ben Beale at bbeale@umd.edu.

January 14, 2015
An Evening Discussing Soybean Production with Dr. David Holushouser, Exhibit Hall,
Delaware State Fairgrounds, Harrington, DE. Contact either Dr. Cory Whaley at
whaley@udel.edu or Dr. Richard Taylor at rtaylor@udel.edu.

January 15, 2015
Agronomy/Soybean Day Session, Exhibit Hall, Delaware State Fairgrounds, Harrington, DE.
Contact either Dr. Cory Whaley at whaley@udel.edu or Dr. Richard Taylor at rtaylor@udel.edu.

January 15, 2015
Tri-State Hay and Pasture Conference, Garrett College, McHenry, MD. Contact Willie Lantz
at lantz@umd.edu.
January 22, 2015
Dorchester Agronomy Meeting, 8:30 am – 3:30 pm, English Hall – Eastern Shore Hospital Center, 5262 Woods Road, Cambridge, MD. For more information, please contact Sudeep Mathew, University of Maryland Eastern Shore, Dorchester County, 501 Court Lane, Room 208, Cambridge, Maryland 21613 (410) 228-8800

January 30, 2015
The State of the Science on Phosphorus, Chesapeake College, Wye Mills, MD. For more information and registration ($20 with lunch prior to Jan 20, $30 thereafter) visit the website www.PhosphorusSymposium.com

February 4, 2015
Kent County Crop Master Series on Soil Fertility, 6 to 9 p.m. Kent County Office, 69 Transportation Circle, Dover, DE. For more information, call the Kent County Extension office at 302-730-4000 or contact Mr. Phillip Sylvester via email at phillip@udel.edu

February 4, 2015 (Training)
Dorchester/Talbot/Caroline - Private Pesticide Applicators Exam Preparation/Training, 6:00 pm – 8:00 pm, English Hall – Eastern Shore Hospital Center, 5262 Woods Road, Cambridge, MD. For more information, please contact Sudeep Mathew, University of Maryland Eastern Shore, Dorchester County, 501 Court Lane, Room 208, Cambridge, Maryland 21613 (410) 228-8800

February 10-11, 2015
Eastern Shore Agricultural Conference and Trade Show, Eastern Shore Community College Workforce Development Center, 29300 Lankford Highway, Melfa, VA. For more information contact: Ursula Deitch, Northampton County VCE at 757-607-6133 or by email at utankard@vt.edu or Theresa Long, Accomack County VCE at 757-709-2342 or by email at tmjlong@vt.edu

February 11, 2015 (Exam)
Dorchester/Talbot/Caroline - Private Pesticide Applicators Exam Preparation/Exam, 6:00 pm – 8:00 pm, English Hall – Eastern Shore Hospital Center, 5262 Woods Road, Cambridge, MD. For more information, please contact Sudeep Mathew, University of Maryland Eastern Shore, Dorchester County, 501 Court Lane, Room 208, Cambridge, Maryland 21613 (410) 228-8800

February 26, 2015
Eastern Shore Vegetable Meeting, 8:30 am – 3:30 pm, Denton 4-H Park – 8230 Detour Rd, Denton, MD 21629. For more information, please contact Sudeep Mathew, University of Maryland Eastern Shore, Dorchester County, 501 Court Lane, Room 208, Cambridge, Maryland 21613 (410) 228-8800

March 6-7, 2015
Maryland Cattle Industry Annual Convention and Annual Maryland Hay and Pasture Conference, Clarion Hotel and Hager Hall Conference and Event Center, Hagerstown, MD. For
more information, visit their website at www.marylandcattle.org or contact Dr. Scott Barao at 410-795-5309 or by email at sbarao@marylandcattle.org

March 7, 2015
COOPTASTIC, Delaware State University, Dover, Delaware. For more information, contact Dr. Brigid McCrea at bmccrea@desu.edu

March 11-12, 2015
Northeast Pasture Consortium, Waterfront Place Hotel and the Greater Morgantown Conference & Convention Center, Morgantown, WV. Contact James Cropper at jbcropper@yahoo.com for more information.

March 13-14, 2015
2015 Appalachian Grazing Conference, Waterfront Place Hotel and the Greater Morgantown Conference & Convention Center in Morgantown, WV. Contact West Virginia University Cooperative Extension for more information.

December 13-16, 2015
6th National Conference on Grazing Lands, Grapevine, TX. For more information, please contact: John W. Peterson, 6NCGL Conference Manager at (703) 455-4387 (w), (703) 505-1782 (c) 703-455-6888 (f) or jwpeterson@cox.net

Newsletter Web Address

The Regional Agronomist Newsletter is posted on several web sites. Among these are the following locations:

http://www.grains.cses.vt.edu/ Look for Mid-Atlantic Regional Agronomy Newsletter

or

www.mdcrops.umd.edu Click on Newsletter

Photographs for Newsletter Cover

To view more of Todd White’s Bucks County photographs, please visit the following web site:

www.scenicbuckscounty.com