NUTRIENT BREAKDOWN

7
N
NITROGEN
14.007

Nitrogen (N-) is also known as the 'essential nutrient'. Nitrogen is needed for plant growth, plant health, and yield gain.

ANALYZING YOUR NITROGEN INDICATOR REPORT

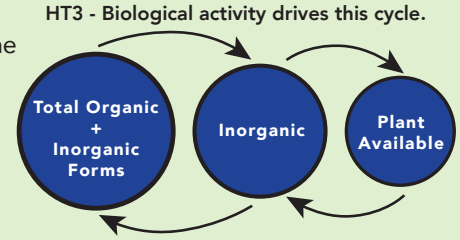
ORGANIC N LEVELS

- High organic N levels are KEY if the water extractable organic carbon (WEOC) is there to support it.

HT3

- Having a high HT3 level is important as this will increase the amount of organic N that is released and utilized by the plant.

HT3 - Biological activity drives this cycle.



**This is a continuous cycle that never stops. Chemistry reacts with chemistry. Carbon and biological activity controls the speed.*

SUFFICIENCY LEVEL OF AVAILABLE NUTRIENTS (SLAN)

- Check your SLAN levels during the second half of the growing season as this is a great indicator of late season nitrogen that has been released from the soil. When you have a high SLAN level, it is less important to get the late season pass of N on the ground if an adequate amount of N was applied at the beginning of the growing season.

CARBON TO NITROGEN RATIO

- Microbes need a good carbon to nitrogen ratio to stay active in the soil. Ideal microbial C:N ratios are 5:1 for bacteria and 27:1 for fungi. In order to stimulate both simultaneously along with the crop, 12:1 is the perfect C:N ratio. Microbes become dormant when the ratio dips too low, and plants become nitrogen deficient when the ratio is too high. The amount of humus in the soil determines how high the C:N ratio can be, because greater amounts of humus can hold more anions.
  - ***High Ratio:*** Anytime the carbon levels are greater than 12:1 in the soil, nitrogen becomes held-up and is not released as well from the soil to the plant. When this occurs, it is best to band N and apply more during the beginning of the season to ensure N availability.
  - ***Average Ratio:*** As C:N increases, it tells us if the soil's carbon levels can support and hold onto N for later season needs.
  - ***Narrow Ratio:*** If the C:N ratio is narrow, it tells us the amount of N applied should be available to the crop soon after application. The warning signs of a low C:N ratio, other than harder, more compacted ground, is that we need to stick closer to the rule of 10 lbs of nitrogen applied to every 1 CEC that was measured in the soil test, as we do not have carbon available to help hold onto nitrogen.

AMMONIUM VERSUS NITRATE

- We prefer to see more ammonium in the plant rather than nitrate. Nitrate is shown to elongate and thin cells, resulting in a plant more susceptible to disease.

IN THE FIELD - NITROGEN NUTRIENT MUST-KNOWS

1. There are three forms of nitrogen taken up by the plant: nitrate, ammonium, and amine forms of nitrogen.

2. When plants uptake nitrate (NO3-), HCO3 bicarbonate is released into the soil which increases the soil pH around the root zone.

3. When plants uptake ammonium (NH4+), H+ is released into the soil and decreases the soil pH around the rhizosphere, enabling microbiological biomass to increase as well. NH4+ also takes less energy from the plant to convert to a protein.

4. If ammonium is more readily available in contrast to nitrate, the plant will improve uptake of phosphorus.

5. The amine form of nitrogen (NH2) will sponsor the most reproductive growth in the plant - even more so than the ammonium form of N. This is very important for soybeans and potatoes. It takes very little of the plant's energy to convert NH2 into a protein as compared to the energy it takes for nitrate.

6. A great way to get this amine form of nitrogen into your plant is by liquefying urea. During hydrolysis, the urea will turn into the amine form. If you have an abundant amount of carbon in your soil, or if you add carbon to the liquid urea while applying, you will retain this amine form of N longer in the soil solution.

7. If there is an abundance of nitrogen in the soil, carbon will eventually be burnt out of the system.

AGRONOMY 365 TIPS

1. If the plant does not show enough nitrogen available in the tissue test, but the soil test is showing adequate nitrate and/or ammonium levels, look at the sulfur (S), molybdenum (Mo), and copper (Cu) levels, as these play an important role in converting nitrate to protein in the plant.

2. When the soil has equal or more ammonium to parts per million of nitrate, plant protein levels will rise. It is best to keep the soil range at a minimum of 25% of the total amount of nitrogen in the soil to be ammonium.

NUTRIENT BREAKDOWN

15
P
PHOSPHORUS
30.974

Phosphorous (P-) is the engine of energy. Phosphorous is the most important nutrient for the process of photosynthesis.

AGRONOMY 365 TIPS

1. It is best to have around 40 lbs of available phosphorus in the soil. You can decipher this by reading your soil sample report. In the cropping season, you will see the available phosphorus dip into the 25 lb range, but still see enough phosphorus on the plant to support optimal yields. If you do not see enough phosphorus, consider these tips:

Scenario #1: If the soil pH is 6.5 or less, it is best to utilize Next Level Ag's P-SAT score. When the P-SAT score is greater than 10, it is unlikely phosphorus is limiting in this scenario. If the P-SAT score is less than 6.5, we need to understand that the tie up potential is high and will see a value in either:

a) Overloading the soil with more P *(typically not economical)*

b) Band the P close to the seed. This allows the P to overcome the tie-ups at a lower rate of P applied.

Scenario #2: If the soil pH is 7.0 or greater, the calcium is our dominant tie up mechanism for our phosphorus. Look at your P/Ca ratio. If this is greater than 3, there is enough P available if we meet our goals of having 40+ lbs of available P in the soil.

2. If Scenario #1 is the issue, you will need to add a lime source depending on what is best for your soil *(dolomitic lime or high Ca lime)*. If we raise our pH, iron and aluminum tend to give us less of an issue. This, in conjunction with applying some P in a band, works excellent in improving your P uptake.

3. If Scenario #2 is the issue, place your P in a band. Also consider adding ammonium sulfate with phosphorus to increase availability. As the plant takes up more ammonium, it will release H+ into the soil. This lowers the pH of the soil and helps phosphorus be absorbed by the plant.

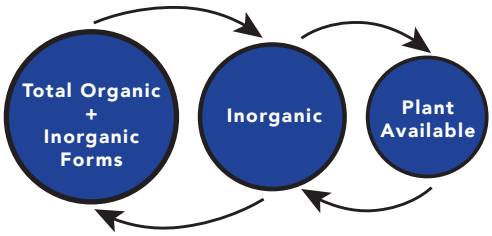
4.With an increase in biological activity you will find more efficient phosphorus uptake.

ANALYZING YOUR PHOSPHOROUS INDICATOR REPORT

HT3

- Respiration controls a majority of what happens when phosphorus is released. If there is more fungal activity present, we see an increased uptake of phosphorus in the plant.

HT3 - Biological activity drives this cycle.



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PH

- When soil pH is neutral to basic (low pH), iron and aluminum availability increases. This ties up phosphorus as iron/aluminum phosphate and is unidentified by the plant as a food source. To determine if this is the case, look at the Phosphorus Saturation Score on your Indicator Report.

IN THE FIELD - PHOSPHORUS NUTRIENT MUST-KNOWS

1. In the soil, it is important that phosphorus and calcium have a relationship.

2. When banding nutrients, increased depth is not always better. Keep in mind your soil's pH range. If you strip band nutrients, please take into consideration that the soil's pH range changes with depth in most scenarios.

a) It is recommended to test at 0-3", 3-6" and 6-9" depths as this is an inexpensive way to fully utilize your banding equipment.

3. Soil nitrate N can slow down phosphorus uptake. In contrast, soil NH4 can increase phosphorus uptake.

NUTRIENT BREAKDOWN

19
K
POTASSIUM
39.098

Potassium (K+) is the drought protector, sugar transporter, and stomata control nutrient.

Potassium needs are often overlooked based on traditional soil tests that can overestimate potassium release. This happens routinely on heavier soils that are dried with a lot of heat when arrived at the lab. The extractions of the Mehlich method and/or ammonium acetate can remove more potassium from your clay soils than what your root can extract, by releasing weaker acids into the soil in efforts to break free and take up the nutrients needed to fully develop.

IN THE FIELD - POTASSIUM NUTRIENT MUST-KNOWS

If potassium is an issue in your fields, take into consideration these management tips:

1. General Rule: If applications are being made to raise the soil test levels, and the application rates need to exceed 125 lbs of 0-0-60, use sulfate/potash for your potassium needs. Too much chloride from the 0-0-60 can be detrimental to your soil's structure and biological activity levels. If you raise the K levels too high, there is a risk of not allowing our plants enough boron, manganese and calcium.

2. In heavier soils, raising the base saturation of your soil's potassium levels is unlikely to be economical. In lighter soils (less CEC), consider changing the base saturations. You may not be able to justify the cost.

a) In this scenario, work around the low base saturation K numbers by adding gypsum to amend the high Mg, and balance the Ca:Mg ratio. This will open and flocculate the soil, and potentially leach out some of the magnesium in the soil.

3. Add an ammonium-based fertilizer to reduce the plant's uptake of magnesium. This will allow for the plant to better uptake potassium.

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ANALYZING YOUR POTASSIUM INDICATOR REPORT

PARTS PER MILLION (PPM)

- Begin the season with a minimum of 60 ppm from the H3A extraction. Throughout the growing season, hold on to a minimum of 40 ppm from the same extraction process.

VAST SCORE

- Evaluate Next Level Ag's VAST Score that can be found on your Indicator Report. As the VAST score increases greater than 25, the soil aggregates improve, which allows the roots of the plant to explore more of the soil profile.

BASE SATURATION LEVELS

- Aim for base saturation levels of 3.0 - 5.0%. With acidic soils, do not try to build your potassium soil levels. It is best to apply potassium in-season at or before rapid growth stages in your crop.

AGRONOMY 365 TIPS

1. Watch the soil sodium and potassium levels. Keep the potassium soil levels higher than the sodium soil levels because sodium out-competes potassium and will limit K uptake into the plant.

2. Keep the K:Mg ratio in mind. If it is less than 1:1 in the soil, magnesium may be the main reason why the plant is not seeing enough potassium.

NUTRIENT BREAKDOWN

5
B
BORON
10.811

If calcium is the truck, then boron (B-) is the steering wheel. Boron guides nutrients within the plant, and is a cell wall strengthener.

ANALYZING YOUR BORON INDICATOR REPORT

SOIL SAMPLING

- If you are short on boron, take a look at your soil sample results. Soil sample results should be between 1.25-2ppm if the soil was extracted with a DTPA solution. Though this may seem a low number to reach, this is not an easy task to accomplish.

TISSUE SAMPLING

- Ensure your corn plant tissue samples range between 18-30 ppm, and soybeans range between 45-70 ppm.

pH

- Optimal soil pH range for boron is between 5.75 - 6.5 pH.

PLANT REPRODUCTION

- Be sure that your crops have enough boron at the beginning reproduction stages. The biggest hit to yield correlates to a window of 3-5 weeks ahead of and after R2. In corn, ensure there is plenty of boron available at tassel, and in soybeans ensure there is plenty of boron available at R2 stage.

- Boron is still a very important nutrient during the vegetative stages of the crop as it helps build the cell wall with calcium and silica.

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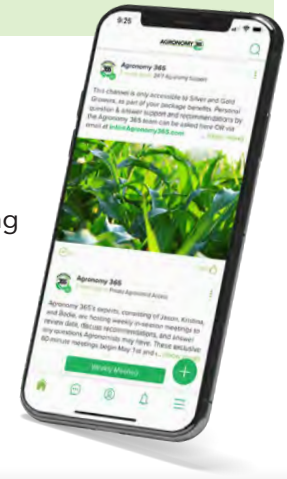

IN THE FIELD - BORON NUTRIENT MUST-KNOWS

1. If you have recently applied lime to amend a pH or calcium availability issue, this can slow down the boron uptake from the plant.

2. For excessive existing boron levels, raise calcium levels to an optimal level first, then elevate potassium. High calcium levels can block uptake of boron but will prevent toxic effects of excessive boron.

3. Fields with too much potassium, phosphorus, and calcium can tie up boron from the plant.

4. Add no more than 10lbs of Solubor boron per acre once a year to raise boron levels by .2-.4 ppm. If you are applying boron to help mitigate fungal disease issues, it is best to keep boron levels above 1.5 ppm.

AGRONOMY 365 TIPS

1. Increase yield gains in both soybeans and alfalfa with high levels of boron in your soil. Do consider that Boron leaches out of coarse-textured soil easily.

2. Crops can be toxic to boron if they are overlapped from the previous year, or if the soil calcium levels are low.

3. Boron can be applied in a multitude of ways, but we recommend keeping it out of your in-furrow starters. In 2x2 application you can apply a low rate of boron with little concern. Broadcast applications (Solubor or borax) at planting have had a great impact on crop performance.

4. The most economical way, according to Agronomy 365 research, is to apply boron up front in your 2x2 and follow up with more boron with your Y drops, or in-season side dress application. We have seen great results through the leaf as well; however, it may take two applications in-season, as well as an upfront application to maintain optimal boron levels.

NUTRIENT BREAKDOWN

16
S
SULFUR
32.065

Sulfur (S-), nitrogen's little brother, triggers enzymes and is involved with converting nitrate into protein

IN THE FIELD - SULFUR NUTRIENT MUST-KNOWS

The form of sulfur utilized makes a difference…

1. Though elemental sulfur is the least expensive, it is the toughest to judge when it will be broken down, and become available for the plant.

2. Ammonium Sulfate is a great product for delivering sulfur to the soil but can leach away from the rooting zone. In the liquid form, we typically see ATS, ammonium thiosulfate, and liquid AMS.

a) ATS is used most often, as it is a great source of sulfur. Only half of the sulfur in the product is available in the near term, the other half can take up to 3-5 weeks to be released.

b) Liquid AMS provides excellent sulfate availability as well as the ammonium form of nitrogen. The downfall of liquid AMS is the volume needed. This is our preferred choice of sulfur for late season needs.

Elemental sulfur and AMS are best if you are struggling with your sulfur levels. This is dependent on your soil type, crop grown, and time of the year. Keep in mind, if you are using excess sulfur, the sulfate can leach out sodium, calcium and magnesium. Some of us use sulfur for that exact reason. If that is your goal with sulfur, remember to keep your calcium base saturation number around 68-70 before trying to leach out sodium or magnesium.

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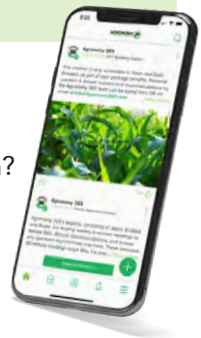

ANALYZING YOUR SULFUR INDICATOR REPORT

The sulfur soil test doesn't do a great job determining if sulfur is needed when the soil test shows high nutrient levels in the soil. Consider these suggestions:

NUTRIENT LEVELS

- Aim to keep your sulfur levels at 20-30 ppm.

HT3

- If you are seeing high HT3 levels, congratulations! This means the biology in the soil is working hard. A big part of sulfur release comes back to the soil's capacity to mineralize within the soil.

NITROGEN TO SULFUR RATIO

- Optimal tissue sample results of 10:1 between nitrogen and sulfur is key.

NUTRIENT RELEASE

- Sulfur is treated much like nitrogen, if the soil releases nitrogen well, it will typically release sulfur well.

AGRONOMY 365 TIPS

Are you actively applying sulfur, but your plant is not uptaking S? Consider these tips…

1. In high yielding crops, sulfur should be applied multiple times throughout the growing season. Sulfur can leach just like nitrogen, so the balance between N and S is vital to protein production within the plant.

2. If the soil has high nitrate levels, the crop tends to take up less sulfur. In our opinion, we feel it is a story about competing anions. Nitrate can slow down chloride and sulfate uptake in the plant, whereas NH4 can increase uptake of both sulfate and chloride nutrients.

3. Sulfur products typically have a negative effect on your soil pH. The more sulfur used will result in a lower pH, and you will need to apply more lime.

NUTRIENT BREAKDOWN

20
Ca
CALCIUM
40.078

Calcium (Ca++) is the trucker of seven key nutrients. Calcium also activates enzymes and is the key to cell wall strength.

ANALYZING YOUR CALCIUM INDICATOR REPORT

H3A EXTRACTION CALCIUM LEVELS

- Optimal extraction calcium levels range between 500-700 ppm.

BASE SATURATION

- The optimal range of ammonium acetate base saturation extraction is between 68-73% for most soils.

EXTRACTION CALCIUM TO MANGANESE RATIO

- If this ratio becomes too close (ex: 2.5:1 base sat of 50% Ca and 20% Mn) the plant's rooting depth will be restricted unless the soil is very coarse.

pH

- Optimal soil pH range is 5.9-6.8. If the subsurface soil pH is higher than the surface soil pH, the plants will be able to access some of the available calcium. If this is the case, cut back on your anticipated lime rate.

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IN THE FIELD - CALCIUM NUTRIENT MUST-KNOWS

The plant food calcium is overlooked and underappreciated to most growers and agronomists, but it is essential to efficiency and great yields. Too much calcium can tie up all other nutrients, especially magnesium, potassium, boron, zinc, and copper. Calcium is tied up when Mg and K are in excess.

AGRONOMY 365 TIPS

1. Calcium is viewed in two ways.
   1. Soil Structure + Chemistry Makeup
   2. Plant Availability

2. The basic soil test extracts calcium with Mehlich 3 or ammonium acetate.

3. Our basic soil test does a great job in showing the cation exchange relationship, and helps growers understand flocculation, porosity of the soil, and why your pH is reading what it does. However, the basic test does not relate well to calcium uptake. H3A extraction adds great value in showing you your plant food available Ca. We want to see the H3A numbers in the 500-700 ppm range depending on soil type.

NUTRIENT BREAKDOWN

25
Mn
MANGANESE
54.938

Manganese (Mn+) determines leaf width and is also an essential cofactor OEC of photosynthetic machinery. Manganese catalyzes water and splits reaction in the photosystem.

ANALYZING YOUR MANGANESE INDICATOR REPORT

BROADCAST APPLICATIONS

- Broadcast large amounts of lime to fix your current soil pH or calcium issues, and do not incorporate manganese to the application? Due to the temporary spike in pH, you may see manganese deficiencies.

pH

- The optimal pH range for Mg is between 5.5 - 6.5 pH. It is not recommended to build manganese levels within the soil.

SOIL TESTING LEVELS

- Optimal soil test levels are around 25ppm from a DTPA extraction. From plant analysis on corn, it is recommended to have around 55-65ppm in your soil test levels throughout the entire growing season. In soybeans, the optimal soil test levels range between 90-120 ppm. Keep manganese levels around 80% of iron levels in the soil. Please note that if there is more manganese in the soil than iron, there will be a tie up of iron within the soil.

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IN THE FIELD - MANGANESE NUTRIENT MUST-KNOWS

1. Manganese is often an overlooked micronutrient, but is beneficial for both corn and soybean production.

2. As the iron levels in the soil increase, manganese tends to become less available.

AGRONOMY 365 TIPS

1. Manganese applications should be kept in-season if iron and phosphorus, and sometimes potassium levels are high.

2. Consider applying manganese multiple times throughout the growing season in forms of foliar, sulfate-based, or chelated forms (both work as a foliar treatment). In sulfate form, manganese can be applied via broadcast, but may leach out of the rooting zone in lighter soils.

3. If you are side dressing soybeans or corn with high rates of potassium, watch your late season Mn levels.

4. Through the Agronomy 365 Dashboard, we've found that high rates of potassium require an additional foliar pass of manganese to bring the manganese back into range.

NUTRIENT BREAKDOWN

30
Zn
ZINC
65.38

Zinc (Zn+) creates the size of the solar panel in leaf length. Zinc is also an enzyme activator and aids in providing energy for the plant.

ANALYZING YOUR ZINC INDICATOR REPORT

STARTER-APPLIED ZINC

- This is great for early nutrient availability, but most of the time does not offer enough zinc to the plant for late season plant needs.

SOIL EXTRACTION

- An optimal range of 1.5 ppm on a soil extraction completed by DTPA extraction is needed to ensure a successful soil sample. Be sure to adjust this based on your phosphorus levels.

PHOSPHORUS TO ZINC RATIO

- It is best to have an optimal ratio of 10:1 phosphorous to zinc available in your soil. P limits Zn uptake into the plant if the ratio exceeds this.

ZINC TO COPPER RATIO

- Zinc limits the uptake of copper. It is best to have a 1.5:1 zinc to copper ratio available in your soil. Copper is a key nutrient which activates enzymes in plants which are involved in lignin photosynthesis, and is also essential in several other enzyme systems. It is also needed in photosynthesis, plant respiration, and other key functions in the plant.

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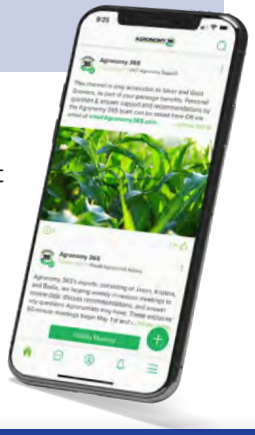

IN THE FIELD - ZINC MUST-KNOWS

1. Zinc is the solar panel nutrient for the plant. It determines the leaf size and is important in photosynthesis to attract sunlight.

2. Being much like sulfur, when deficiencies are present in zinc, they are visible early on in the growing season.

3. If high phosphorus and copper numbers are present in fields, the higher the zinc levels need to be.

4. Through plant analysis, it is recommended to hold 25 ppm of zinc through R2 in corn.

5. On soybeans, plant analysis recommends mid-50's ppm range throughout the entire growing season.

AGRONOMY 365 TIPS

1. Plant performance is built off of zinc availability later in the growing season.

2. When addressing zinc deficiencies, broadcasting zinc sulfate will do the trick, but will take a few years of spreading 8-12 lbs before any advantage is shown.

3. Y-dropping ammoniated zinc is the most economical solution, and does a great job on V12 corn.

4. Foliar Zn products have shown success at raising the zinc levels in the plant. Some products raise zinc levels but do not have a prolonged hold on zinc levels.