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PIONEER PREMIUM SEED & TREAT-MENTS, CROP INSURANCE, AGRONOMY SERVICES, FIELD DAYS, SEED WHEAT, SEED DELIVERY, & PERSONAL SERVICE

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NITROGEN APPLICATION TIMING IN CORN PRODUCTION

From Crop Insights by Steve Butzen

- Corn takes up half its N supply between V8 and VT, a period that may comprise only 30 days. Providing adequate N for this period is a key goal of N management.
- Spreading N applications is a good way to spread risks and reduce costs, but the extent to which this is practical depends largely on prevailing weather conditions.
- Fall-applied N is at highest risk of loss. In all instances of fall application, only ammonium sources of N should be used, as well as a nitrification inhibitor such as N-Serve®.
- Preplant N application may be considered in areas where growers are able to complete this practice without delaying planting beyond the optimum window.
- Planter N applications are sure to occur, unlike preplant or sidedress applications that may be disrupted by weather.
- In-season (sidedress) N applications allow for adjustments to planned N supply based on weather variations.
- If weather interferes with the originally planned inseason application, a quickly implemented backup plan can help avert significant N deficiency and yield loss.

The goal of timing nitrogen (N) applications to corn is to supply adequate N when the crop needs it, without supplying excess that can potentially be lost. Because N reactions in the soil are closely linked to both temperature and moisture conditions, this goal is often hard to achieve. Its importance, however, cannot be overstated. If corn is deficient in N during its rapid vegetative growth phase, yield losses are inevitable. On the other hand, oversupply of this expensive crop input reduces profits and harms the environment. Applying N at multiple times, including the time of maximum crop uptake, can spread the risk of N loss and crop deficiency, improve profitability by reducing N rates, and benefit the environment.

Corn Needs for Nitrogen

Because N is a constituent of all protein within the corn plant, it is needed in high quantities. When deficient, normal growth and development is thwarted. In fact, N stress

Corn yield

(bu/acre)

150

200

250

N removed

102

136

170

in stover

----- pounds of actual N -----

51

68

85

in grain

at any time during a corn plant's life will subtract from yield, much like drought, insect feeding, disease pressure or other stresses. The chart shows the approximate amount of N removed in corn grain and stover (i.e., the minimum amount of N required to grow the crop.)

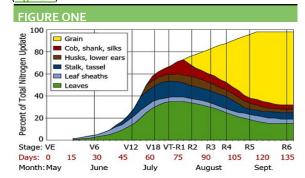
Importance of Adequate N During Ear Fill
In addition to its function in green tissue formation
gen plays a crucial role in ear and kernel develop
recent study of nitrogen translocation within the
indicates that N moves to the ear from other plan
even prior to silking, apparently for the nitrogen-
process of kernel embryo formation (Ciampitti an
2010). This study also reported that continued ea

with N content in the above-N removed Total N

> Perhaps most importantly, the can minimize the remobilization of N from vegetative to reproductive tissues. This

Corn requires only a fraction of this nitrogen during the seedling stage, but its needs escalate rapidly once corn reaches the V8 growth stage (8 leaf collar stage). This knee -high corn can grow to shoulder height (approximately V12 to V14) in about two weeks, and reach the tassel/ silking stage (VT/R1) in about two more weeks if conditions are favorable. Such rapid growth is equaled by few other crops, and requires a large supply of nitrogen to

fulfill the demands of prolific green tissue development



As the figure shows, corn generally requires over half its total N supply between V8 and tasseling (VT), a period that may comprise only 30 days, depending on temperature and moisture conditions. Recommendations to sidedress N by V4 to V6 are to provide some margin of safety in case weather and soil conditions delay N application or N movement to the roots. The figure also shows that the plant's needs for nitrogen do not end at tasseling – about one-third of plant N requirements must still be met by uptake during the reproductive (ear-fill) period.

removed*

204

255

ion, nitroment. A plant nt tissues -intense nd Vyn, ar growth and yield accumulation from R1 to R6 is closely associated

ground plant tissues.

study showed that continued N uptake during the ear-fill period means that

SOIL TEMPERATURE AND CORN EMERGENCE

Successful corn emergence is a combination of three key factors—environment, genetics, and seed quality:

- Environment: Temperature, residue, compaction and water
- Genetics: Stress tolerance and vigor
- Seed Quality: Harvest moisture, drying and conditioning

Hybrid genetics provide the basis for tolerance to cold stress. High seed quality helps ensure that the seed will perform up to its genetic ability. Environmental factors may dictate stand establishment.

Soil temperatures at planting are a key environmental component of stand establishment. It is generally recommended to plant corn when soil temperatures are at or above 50 degrees F. However, conditions after planting are also critical-low soil temperatures after planting are also critical—low soil temperatures after planting can greatly reduce stands at emergence.

OPTIMAL TEMPERATURE FOR EARLY CORN GROWTH

Corn is a warm season crop and does best under warm conditions. In North America, early-season planting typically puts stress on the corn seedlings. In germination tests using temps ranging from 59-95 degrees growth rates of both roots and shoots were measures. All three hybrids were averaged to determine the optimal temperature for corn growth. Both exhibited the fastest growth rate at 86 degrees suggesting optimal germination and emergence occur at much higher soil temps than is common most corn producing areas.

Planting date remains a critical management factor to help minimize the risks associated with sub-optimal conditions for germination. Planting into cold, wet soils, inflicts stress on corn seed emergence, as does planting just ahead of a cold spell. In some years, corn maybe planted prior to a cold rain or snow. This imposes very high stress on corn emergence due to seeds imbibing chilled water or prolonged exposure to cold, saturated soils.

TIMING OF COLD STRESS IMPACTS GERMINATION

Data suggests that planting just before a stress event such as a cold rain or snow can cause significant stand loss. The chances of establishing a good stand are greatly improved if hybrids are allowed to germinate at least one day in warmer, moist conditions before a cold-stress event. Choosing a hybrid with a higher stress emergence score can help moderate stand losses due to cold stress.

One reason why temperature doing imbibition is critical to corn emergence is the fact that seed imbibes most of the water needed for germination very rapidly.

Data show that seed imbibes the most water within the first 30 minutes after exposure to saturated conditions. If this early imbibition occurs at cold temperatures, it could kill the seed or result in abnormal seedlings.

You should consider the soil temperature at planting but also the expected temperatures when seed begins rapidly soaking up water. Seed planted in warmer, dry soils can still be injured if the dry period is followed by a cold, wet event.

SOIL TEMPERATURE FLUCTUATIONS AND EMERGENCE

Often you are able to plant fields with sandier soils earlier in the spring because they dry out faster than heavier soils. However, reduced stands after early planting have often been noted in sandier soils. Sandy soils are more porous and have lower water-holding capacity than heavier soils and will experience wider temperature fluctuations.

Data has shown that day-night temperature fluctuations after planting can pose an added stress on germinating corn. You should be aware of expected nighttime temperatures when choosing a planting date.

High amounts of residue can alter soil temperatures. Residue tends to hold excess water and significantly lower soil temperature in the spring, depriving seed of critical heat units needed for rapid emergence. These conditions can also promote seedling disease, particularly in fields that are not well drained or have a history of seeing

IMPACT OF COLD STRESS ON STAND ESTABLISHMENT

The optimal temperature for corn emergence is in the range of 80-90 degrees F. Emergence is greatly reduced at lower temperatures and is effectively halted around 50-55 F or below. Emerging seed may experience a degree of stress and potential damage from this as emerging temperatures are almost never optimal.

For success full emergence to occur, all parts of the shoot must working a coordinated way to push the coleoptile above the soil surface and allow the first leave to unfurl. Damage to any one of these structures will likely result in loss of the seedling and its yield potential.

When the dry seed bed imbibes cold water (50F or below) imbibitional chilling injury may result. The degree of damage ranges from seed death to abnormalities such as corkscrews or fused coleoptiles. The potential for cold-water damage generally decreases as the seedlings emerge. This may explain why early planted corn that was followed by favorable weather emerged better than corn planted later followed by a cold spell or snow cover.

Damage to the emerging root usually has less severe consequences on seedling survival. The primary root plays a relatively minor role in seedling establishment compared to the lateral and nodal roots. Seedling establishment an usually progress normally if the later and nodal roots are intact. Any damage to the roots will likely reduce vigor and increase the potential for disease and insect injury. Cold damage to emergence is generally irreversible. It can be difficult to diagnose since it usually occurs below the soil surface, long before the crop emerges. Above-ground

PLOTS & SIDE BY SIDES

Several of you do plots and side by side comparisons each year. If you have not done this in the past and would like to try some products for potential future use, please let us know. We are happy to help you and provide the seed for trying new varieties.

Pioneer has always encouraged farmers to test new hybrids and varieties. It has been our policy to provide seed for these trials. Our only request is that we be allowed to harvest and weigh these hybrids. Bushel weight and moisture can have a large effect on final yield.

Accurate measurements with a weigh wagon moisture testing equipment will provide reliable yield results. If you would like to test a particular hybrid or hybrids please let us know and we will be happy to

We may not say it enough but thank you to those who do participate in these plots and trials. The information we gather from doing these weighs is very valuable.

provide the seed.



NITROGEN APPLICATION TIMING IN CORN PRODUCTION PART 2

Continued on page 3

the plant does not have to cannibalize the leaves to provide N for kernel development when it can take up N from the soil during this period. This allows the plant to retain more green leaf area in late summer and early fall, which increases the duration of photosynthesis, carbohydrate production and grain yield.

Meeting Corn Needs for N

In order to meet corn needs for adequate nitrogen at V8, growers must often contend with aberrant weather patterns that impact N management goals. Excessive rainfall can threaten soil nitrogen reserves as well as hinder resupply by ground equipment. Excessively dry conditions can prevent applied N from moving from the point of application to the root zone of plants. Temperature and moisture conditions also impact the amount of N mineralized from the organic matter fraction of soils.

To help avoid weather-related pitfalls to corn N supply, **growers can spread their risk by applying N at multiple times**, or using products that help protect specific N fertilizers from rainfall-related losses. This is especially important on soils subject to N loss, such as sandy soils that are prone to N leaching, or heavier soils in high rainfall areas that may become saturated and subject to denitrification losses. This approach to N management can also increase the bottom line by decreasing the total amount of N applied.

Nitrogen may be applied by growers at several times during the year: in the fall, early spring (preplant), at planting, and in-season.

Fall-application: Fall application of N is practiced in areas where soil temperatures usually remain below 50°F from late fall to spring. These cool soil temperatures reduce the activity of nitrifying soil bacteria that convert ammonium to nitrate forms of N. However, if soil temperatures rise above 50°F, this N is at risk of loss through leaching or denitrification. Because of the extended period of time that this N is at risk of loss, fall application, if practiced, should be carefully managed. In all instances of fall application, only ammonium sources of N should be used (Murrell and Snyder, 2006). A nitrification inhibitor such as N-Serve® should also be considered to help keep N in the stable NH₄+ form.

Early spring (preplant) application: Preplant N application is commonly used in areas where growers are able to complete this practice without delaying planting beyond the optimum window. Because this N is applied well ahead of major crop uptake, it too is at risk of loss if warm soil temperatures and excessive rainfall occur. Application of ammonium forms of N can reduce loss potential. Depending on the time of application relative to planting, as well as expected weather conditions (determined by climate history) a nitrification inhibitor may also be advantageous.

At planting application: Though many planters are not equipped to apply fertilizer at planting, this method of application has certain advantages. When the field is fit to plant, planter N applications are sure to occur, unlike preplant or sidedress applications that may be disrupted by weather. However, there are limits on how much N can be applied at planting, due



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to concerns over effects on seed germination, as well as how much material can be reasonably carried on the planter. In addition, applying fertilizer at planting slows the planting process to some degree.

Liquid forms of N, such as UAN solution, are preferred for planter application. UAN solution can be combined with liquid starter or other liquid fertilizers to supply multiple nutrients to the crop.

In-season (sidedress) application: In-season N applications allow for adjustments to planned N supply based on weather variations. If wet spring conditions result in N losses, sidedress rates can be increased. If warm temperatures and moderate rainfall result in high N mineralization and an N-sufficient crop, sidedress rates can be reduced. This process of determining crop sufficiency or need can be aided by various methods of soil testing or plant sensing.

In-season N applications can supply N to the crop near the time of maximum plant uptake. However, if wet conditions develop, sidedress applications may be delayed beyond the optimum application date. Extremely dry conditions can result in a delay in availability of sidedressed N to the plant.

Because of the risks associated with in-season N application, this practice must be carefully managed to reap its potential rewards. Soil fertility specialists often recommend that only one-third of total crop supply should be targeted for sidedress application. In addition, growers should be well-prepared to apply sidedress N as quickly as possible when the window of opportunity arises. **Finally, a backup plan should be in place for in-season application.** If weather interferes with the originally planned application, a quickly implemented backup plan can help avert significant N deficiency and yield loss.

Ammonium Forms of N More Stable

The most common nitrogen fertilizers are anhydrous ammonia, urea-ammonium nitrate (UAN) solutions, and granular urea. Other forms include ammonium nitrate and ammonium sulfate. Ammonium (NH₄+) forms of N bind to negatively charged soil particles and are not subject to leaching or denitrification losses. Applying N fertilizers that include more ammonium and less nitrate forms of N reduces their potential for loss in the short term. However, over time, soil bacteria convert ammonium to nitrate (NO₃-), a form which is readily lost when excessive rainfall leaches or saturates soils. Nitrifying bacteria have minimal activity when soil temperatures are below 50° F, so cool or cold temperatures naturally help protect ammonium forms of N from losses.

Urea-containing fertilizers have yet another mechanism of loss: they are subject to volatilization when surface applied. However, once urea is taken into the soil by rainfall, irrigation, or tillage, volatilization potential ceases.

Nitrogen Stabilizers

To help reduce N losses, nitrogen "stabilizers" or "additives" can be applied along with N fertilizers. These products must be matched with specific N fertilizers in order to be effective. Several common products include Instinct®, N-Serve®, Agrotain®, Agrotain Plus® and ESN®.



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This is something that we suggest should be done on a planter at least every other year. Contact Mike, Tye, or Korey for details and to schedule your test. We would really like to do these this winter instead during the spring rush.

Pricing is and \$30/row after March 1st.

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