In This Issue

2023 Crop Management Workshops, Registration Now Open!

(John Obermeyer)

Purdue's 2023 Crop Management Workshop

In-Person & Virtual

The last day for IN-PERSON registration is Friday, January 20th or until venue capacities are met.

When: January 24, 25, and 26, 2023

How/Where:

In-Person –

Tuesday, January 24: In-Person only, Madison County Community Center, Alexandria, IN
Wednesday, January 25: In-Person only, Westgate Conference Center, Odon, IN
Thursday, January 26: In-Person, Beck Ag Center, W. Lafayette, IN

Virtual –

Thursday, January 26: Livestream, Beck Ag Center, W. Lafayette, IN

Time: All times listed are Eastern Time

In-Person – 8:30 am to 4:00 pm
Virtual – 8:45 am to 4:00 pm

Registration, click the following link:
http://www.purdue.edu/conferences/Crop

In-Person – $80.00 (includes handouts, refreshments, and lunch)
Virtual – $50.00 (unique/active email address required)

Schedule and Topics:

8:30 In-Person Check-in
8:45 Virtual Log-in
9:00 Meeting Begins

(State Chemist Highlights, Corn Responses to Sulfur, Effective Disease Management, Weed and Herbicide Updates, Insect Corn Traits, Input-Intensive Corn Management, Soybean Canopy and Nutrition, Safely Crossing Railroad Crossings)

4:00 In-Person and Virtual Meeting Concludes

Credits Awarded:

- Indiana commercial pesticide applicators (CCHs)

In-Person and Virtual*: (Cat 1 = 6, Cat 11 = 2, Cat 14 = 2, and RT = 4)

- Certified Crop Advisors (CEUs)

In-Person and Virtual*: 5.5 (PM 2.5, CM 2.0, NM 1.0)

- PARP (private applicator) available for in-person attendance only

*Livestream (i.e., Virtual) meeting may be watched individually, or together in groups. However, if credits (CCHs and/or CEUs) are desired, then each person must register with an individual (unique) email address, attend the entire meeting, and complete an online survey after the meeting. Understand, this is a whole day commitment, your attendance and attention are expected.

Additional Questions:

Purdue Conferences, 866-515-0023, confreg@purdue.edu

Plan the Pasture Management System For Most Success – Register For The "Heart Of America Grazing Conference"

(Keith Johnson)

Many conversations I have about pastures with forage-livestock producers start with the question “What should I seed in my pasture?” Before that question should be addressed, the producer should first:

- define their objectives
- determine what types of livestock and classes within a livestock species will be grazing the pasture
- review soil data of the pasture on the “Web Soil Survey”
- sample soil and receive up-to-date soil test results
- develop a liming and fertilization plan if recommended by soil test
- inventory what currently is in a perennial pasture
- control problematic weeds, especially perennial weeds
- review crop rotation intervals of herbicides used the past two years
- consider source and quality of water
- evaluate whether the water source will reliably deliver water during dry weather
- determine what perimeter and interior fencing is needed to keep livestock in the pasture and paddocks
- think about whether hay storage or a corral will be in the defined land area and where best locations would be
- review the above information while in development, if needed, with someone knowledgeable pasture planning
- find seed company locations that have access to quality seed and knowledgeable personnel.

Once the above is considered, then is the time to consider what forage seed types will meet the needs of yield, quality and persistence for livestock grazing the feed resource.

An opportunity to learn more about developing a pasture plan and other considerations regarding being an excellent livestock-pasture manager will be discussed at the upcoming “Heart of America Grazing Conference”. The conference will be held on February 20 and 21 at the Ferdinand, Indiana Community Center. Ferdinand is located in southern Dubois County. Details can be found at the Indiana Forage Council’s website (www.indianaforage.org). Please share the opportunity!

Corn Response To Starter Fertilizer In Indiana

(Jim Camberato) & *(Bob Nielsen)*

This summary is based on 55 field scale research trials conducted at Purdue Ag. Centers and with on–farm collaborators around the state of Indiana from 2014 – 2022. Many of the trials served as research projects for our former graduate students Cody Hornaday, Jason Lee, and Daniela Orjuela–Diaz.

Research Summary

- Starter fertilizer in 2×2 placement usually speeds up the plant development rate and dry matter accumulation of corn during vegetative growth stages. In-furrow fertilizer (pop-up) effects on early growth are not as large as higher nitrogen rates applied in 2×2 placement
- Faster crop development results in earlier silking, earlier grain maturity, and dryer grain at harvest. Starter fertilizer, depending on placement and rate, reduced grain moisture at harvest between 0.6 and 1.4 percentage points compared to no starter fertilizer in 80% of the trials (43 of 54). Grain moisture was drier with starter, than without starter, by an average of 1 percentage point whether or not a grain yield incase occurred.
- Grain yield responses to 2×2 starter fertilizer occurred less frequently in our trials than did grain moisture responses.

    1. In 24 of 25 trials, yield response to 2×2 starter fertilizer (23-50 lbs. N) averaged 7 bushels per acre (bu/ac> compared to no starter fertilizer and ranged as high as 18 bu/ac. No yield response to this range of starter fertilizer was detected in the other 31 trials.
    2. In 4 or 20 trials that compared normal (25-35 lbs. N) to higher than normal (46-50 lbs. N) rates of 2×2 starter fertilizer, yields woth the higher starter rate averaged 5.2 bu/ac greater than those with the normal rate. No yield differences between the two starter rates wre detected in the other 16 trials.

- In-furrow (pop-up) starter fertilizer (3-5 lbs. N) outyielded the [No Starter] control in only 1 of 21 trials (6.1 bu/ac) and decreased yield in 2 other trials by 3.3 and 5.4 bu/ac. No yield response to in-furrow fertilizer was detected in the other 18 trials.
- A combination of in-furrow plus 2×2 starter fertilizer (total of 25 lbs. N) was evaluated in 19 trials, but only outyielded a standard (25 lbs. N) 2×2 starter fertilizer treatment in one of those trials by 6.8 bu/ac.
- In 5 trials that evaluated N, N+P, and N+P+K starter 2×2 fertilizer sources, the nitrogen component of the 2×2 starter fertilizer was found to be the primary component that resulted in starter fertilizer benefits.

Figure 1. Taller plants, more biomass, and more advanced growth stage are common results of starter fertilizer use.

Introduction

Starter fertilizer is the practice of applying a band of fertilizer with or near the seed at the time of planting. The most common applications are in-furrow with the seed (aka pop-up) or 2×2 (a band placed 2 inches below and 2 inches to the side of the seed). Other distances from the seed including on the soil surface are sometimes utilized. Research in Indiana over the years, including our field trials, suggests that corn response to starter fertilizer is based primarily on the nitrogen component of the fertilizer, although farmers often include phosphorus and sometimes potassium. For soils prone to zinc deficiency, including zinc in starter fertilizers is a convenient and economical method to provide that nutrient to the crop.

Precautions when using starter fertilizer

Application of starter fertilizer at planting is not without risk, especially when placed in-furrow with the seed. Seed germination and seedling establishment can be damaged by too much of certain nutrients. Damage to seed or plant tissues can arise from salt, ammonia, and other components plus breakdown products. Direct contact of fertilizer with the seed is the riskiest placement. Urea, ammonium thiosulfate, and boron should never be placed with the seed.

For other fertilizers containing nitrogen and potassium we recommend no more than 5 pounds of nitrogen (N) plus potassium (as K_2O) per acre on sandy soils and no more than 8 lbs. N plus K_2O per acre for silt loam and heavier-textured soils. The more soil between the fertilizer and the seed the better, although problems can still occur especially in sandy soils and low soil moisture. We recommend applying no more than 20 lbs. N plus K_2O per acre within 1 inch of the seed and no more than 100 lbs. N plus K_2O per acre in a standard 2×2 placement. Rates approaching 100 lbs. N plus K_2O per acre in a 2×2 placement are not likely agronomically beneficial and often adds additional re-fill time to the planting operation.

Our field scale trials

We began evaluating corn responses to starter fertilizer in field scale trials beginning in 2014. Since then, we have conducted 55 trials around the state at Purdue Ag. Centers and with on-farm collaborators. The nature of the starter fertilizer treatments varied over the years. Nineteen trials evaluated in-furrow (3 gal/ac of 10-34-0 or 5 gal/ac of 6-24-6), traditional 2×2 (28-0-0 or 19-17-0) and in-furrow plus 2×2 placements compared to no starter fertilizer. Twenty trials included 2 rates of 2×2 starter fertilizer (25 and 50 lbs. N per acre). The remainder of the trials focused on comparing single rates of 2×2 starter fertilizer (either 28-0-0 or 19-17-0) ranging from 25 to 40 lbs. N per acre with no starter fertilizer.

Sidedress nitrogen rates were adjusted plot by plot in every trial to ensure that every plot received the same total amount of nitrogen fertilizer for the season. These totals were selected based on previous research we had conducted that established optimum N rates for different areas of Indiana. The corn hybrids used in these replicated field trials varied location to location and year to year, but all were widely grown hybrids well-adapted to Indiana. Seeding rates varied slightly among the trials from about 30,000 to 34,000 seeds per acre, except at the Southwest Purdue Ag. Center where 27,000 seeds per acre was planted because of its drought-prone sandier soils.

All the trials were field scale in size with individual plot widths ranging from 12 – 16 rows wide (30 – 40 ft) by length of field (300 – 2000 ft). Commercial farming equipment was used for every field operation. Plots were harvested with commercial combines equipped with GPS-enabled yield monitors that were calibrated to each field's conditions the day of harvest. Spatial as-applied planting, fertilizing, and yield data were processed and cleaned using a combination of commercially available mapping and GIS software. The resulting data sets were analyzed using statistical software available to us at Purdue.

Starter fertilizer increases early plant development rate

Starter fertilizer almost always results in faster early development of the crop. This is evident when an applicator nozzle plugs during planting and later that row is noticeably smaller than the other rows. Plants with no starter fertilizer are shorter, have less biomass, and are often lighter green
than those receiving the intended rate of starter. This apparent enhanced early growth due to starter fertilizer is mostly because the plants are literally at an advanced growth stage compared to plants grown without starter fertilizer.

Figure 2. No tassels without starter in the center of photo compared to tasseled plants on left and right with starter.

Earlier silking and drier grain at harvest

The consequence of faster leaf development is that pollination occurs earlier, which translates to earlier grain maturity. The earlier maturation allows the grain to dry down during a relatively warmer and longer time period and so grain moisture is less at harvest. Starter fertilizer in general reduced grain moisture at harvest by 0.6 to 1.4 percentage points in 80% of our trials. Drier grain at harvest with starter fertilizer, generally occurs even when grain yield does not respond to starter fertilizer. In 21 of 28 trials where yield was NOT affected by starter fertilizer, grain moisture was still lower than the [No Starter] Control by an average of 1 percentage point. In continuous corn a 2×2 starter rate of 25 lbs. N/ac averaged 1.1
points drier grain at harvest than no starter fertilizer, while twice this N rate lowered moisture 1.4 points on average. When 3 gallons per acre of 10–34–0 was used as pop–up, grain moisture averaged 0.6 point drier compared to no starter. In corn following soybean, grain moisture from a 2×2 starter rate of 25 lbs. N/ac was about 0.8 point lower than no starter. We did not examine higher rates of nitrogen or pop–up in rotation corn.

Yield response to starter fertilizer

In continuous corn, starter fertilizer at 20 – 50 lbs. N/ac increased yield in 15 of 36 trials compared to no starter fertilizer. The yield increases due to starter fertilizer at the responsive locations ranged from 2.4 to 18.4 bu/ac and averaged 8.3 bu/ac. Most of the responses we saw were at 3 locations that were farmed no–till.

Fifty pounds of nitrogen per acre as 2×2 starter was compared with 25 lbs. N/ac in 19 trials in long-term continuous corn to determine whether the higher starter fertilizer rate would be more beneficial in that cropping system. Yield responded to starter fertilizer in only 7 of the 19 trials and of those, yield increases were greater for the high starter rate in 4 trials by an average of 5.2 bu/ac.

Figure 3. Faster development and earlier senescence with starter fertilizer results in drier grain or earlier harvest even when no yield increase occurs.

Pop–up fertilizer (3 gal 10–34–0/ac or 5 gal 6–24–6/ac) increased grain yield in only 1 of 20 trials. At that site the yield increase was 6 bu/ac. However, pop–up fertilizer decreased yield at 2 of 20 trials by 3.3 and 5.4 bu/ac, respectively.

A combination of in–furrow plus 2×2 starter fertilizer (total of 25 lbs. N) was evaluated in 19 trials, but only outyielded a standard (25 lbs. N) 2×2 starter fertilizer treatment in one of those trials by 6.8 bu/ac.

Of 18 trials with rotation corn, starter fertilizer rates ranging from 20 to 45 lbs. N/ac increased yield in 8 trials by an average of 6.5 bu/ac and ranged from 2.7 to 11.7 bu/ac. Responses occurred in 3 of 5 no–till fields, 2 of 5 strip till fields, and 3 of 8 chisel–plowed fields.

Costs of starter fertilizer use

In our trials, the extra cost of fertilizer applied as starter was minimal. If P is included in the starter, the difference between the cost of P from granular fertilizer (usually MAP – monoammonium phosphate or DAP – diammonium phosphate) and the cost of P in 10-34-0 is only a few dollars per acre with common fertilizer costs. If only N is included in the starter fertilizer, which was the nutrient most responsible for the responses in our field trials, there is no additional cost to the starter fertilizer because the rate of sidedressed liquid N can be reduced by the amount of N applied at planting. Therefore, considering planting and sidedressing, the same amount of liquid N was used to apply the same amount of total N. If anhydrous is the primary N source than the N provided by liquid N would cost a few dollars per acre more than the N provided by anhydrous ammonia. Naturally, if one uses a higher priced specialty starter fertilizer blend, the cost per acre for starter fertilizer may be more substantial.

If one already has a 2×2 starter system on the planter the occasional increases in yield and the consistent reduction in harvest moisture or earlier harvest come with no additional cost, other than the time it might take to re-fill the fertilizer tank during planting. If buying a new planter, the cost of starter fertilizer attachments should be compared to the potential benefits of greater yield and reduced drying costs or earlier harvest to determine the profitability of purchasing the system. Even if only the benefits of lower grain moisture at harvest are considered, an average point drier grain for, say, a 225 bu/ac grain yield, at 2 cents drying cost per point per bushel, would translate to $4.50/ac savings in grain drying expense. Over 1,000 acres of corn, that would equal $4500 in cost savings per year.

Figure 4. Harvest of field-scale fertilizer trial at SEPAC in 2019.

Pop-up starter did not decrease grain moisture as much as 2×2 starter did and provided essentially no yield benefit. Our research suggests little incentive to utilize pop-up (at least with 3 gal/ac of 10-34-0). Higher rates of 10-34-0 or fertilizers of different composition would need to be tested to determine their effectiveness, but at this point we do not believe pop-up starter fertilizer provides significant yield or grain moisture benefits.

Take-aways from our research

Starter 2×2 fertilizer in corn does not consistently increase grain yield but frequently reduces grain moisture at harvest by as much as 1.5 percentage points. Across our 55 field scale trials, there were no clear relationships between the likelihood of yield response to starter fertilizer and factors like previous crop, soil type, soil drainage, tillage system, planting date, or region of the state. However, while yield increases due to starter 2×2 fertilizer
occurred less than half of the time in our trials, the potential for increased yield due to starter 2×2 fertilizer as high as 10 – 15 bu/ac makes its use attractive to consider. If you already have starter 2×2 fertilizer attachments on your planter and if you focus on traditional starter fertilizer sources (e.g., 28-0-0, 10-34-0), we believe that the use of starter 2×2 fertilizer, at 25 to 40 lbs N/ac, is a low-cost form of "crop insurance" against unpredictable soil and weather conditions at and after planting during the important stand establishment period. As indicated earlier, the higher frequency of drier grain at harvest due to starter fertilizer, and the annual cost savings that represents, adds to the attractiveness of making starter 2×2 fertilizer part of your corn production strategies.

Acknowledgements: Indiana Corn Marketing Council, Pioneer Hybrid Intl., Beck's Hybrids, Purdue Agricultural Centers, and farmer cooperators. This work was supported by the USDA National Institute of Food and Agriculture, Hatch Project 1010713.

Corn Response To Sulfur Fertilizer In Indiana – Research Update

(Jim Camberato), (Bob Nielsen), (Diana Salguero) & (Dan Quinn)

Summary

Sulfur (S) deficiency in Indiana crops is more common today than years ago because, in part, S deposition from coal–fired power plants has been reduced. Large plot strip trials were conducted at several locations from 2017–2022 to examine corn yield response to S applied as

ammonium thiosulfate (ATS) in starter and/or sidedressed nitrogen (N) fertilizers. Grain yield was increased by sidedress S in 26 of 55 trials. In the responsive trials, the average yield benefit to S fertilization ranged from 3 to 34 bu/acre, averaging 11 bu/acre. Sulfur in starter fertilizer as the only source of applied S and at rates of 5 lb S/acre or less, was only beneficial in 1 of 9 trials. Higher starter fertilizer rates of S may be effective, but further research is needed to evaluate this approach. Applying S in starter and sidedress was no better than applying S only in sidedress. A limited number of trials indicated sufficient S carryover from S applied to the previous soybean crop can satisfy S needs in the subsequent corn crop, but further research is needed to determine the consistency and magnitude of S from previous year applications. A summary of our sulfur research can be viewed on YouTube at https://youtu.be/XFV6vUpgphI.

Sulfur Deficiency

Sulfur (S) deficiency has become more common in Indiana crops because S emissions from coal–fired power plants have decreased over the past few decades (Camberato et al., 2022). Consequently, atmospheric S deposition to soils has also decreased.

Sulfur deficient corn plants exhibit a general yellow–green color from top to bottom of the plant, often also with visible leaf striping (Fig. 1). Other nutrient deficiencies can cause striping and can sometimes be confused with S deficiency (Camberato, 2013). Nitrogen deficiency on the other hand, will usually have green leaves emerging from the whorl while the lower leaves turn yellow from the tip through the mid-rib, then turn brown, and quickly wither away. Tissue S levels less than 0.15 – 0.18% and tissue sample N:S ratios greater than 15:1 – 20:1 are considered reasonably good indicators of S deficiency in corn.

Figure 1. Sulfur deficiency symptoms in corn.

Sulfur Response Trials

Starter fertilizer S

We conducted 9 field–scale trials exploring the impact of starter and/or sidedress S on corn yield in 2017 and 2018. To provide S we mixed ammonium thiosulfate (ATS) with urea ammonium nitrate (UAN–32% or 28%) or a mixture of UAN and ammonium polyphosphate (10–34–0) as a starter fertilizer in 2×2 placement and/or as ATS with UAN as a sidedress application. Rates of S ranged from 3–5 lb S/acre as starter and 12–25 lb S/acre as sidedress. Sidedress fertilizer was injected in the row middle to a depth of 2–4 inches at corn growth stages between V5 and V7.

Starter fertilizer alone, compared to no S, had no effect on yield in 8 of 9 trials. Interestingly, three of those trials were actually S deficient and responded to higher rates of S at sidedress with yield increases from 15 to 20 bu/acre. Sidedress alone at 15–25 lbs S was as good or better than splitting S between starter (5 lbs S) and sidedress (remainder of S). In the one trial in which starter S increased yield, compared to no S applied, sidedressing an additional 10 or 20 lb S/acre did not increase yield any more than starter alone.

In 2022 we compared 9 lb S/acre applied as 2×2 starter to the same rate at sidedress in a single on–farm trial in SE Indiana. Yield responses to S were similar. Both S application timings increased yield about 6 bu/acre over the no fertilizer S treatment.

Grain yield response to S supplied in sidedress applications

To determine the effect of sidedress S on corn grain yield, 55 field–scale trials (including the 10 with starter S treatments) were conducted at a number of sites from 2017-2022 (Fig. 2). Multiple rates of sidedress S were utilized in 23 of the 55 trials, ranging from 5 to 30 lb S/acre and always including a 0 lb S/acre treatment. Thirty-two trials only had 2 S rates, usually 0 and 15 lb S/acre (mostly in 2021 and 2022). Sidedress S was applied as described in the previous section.

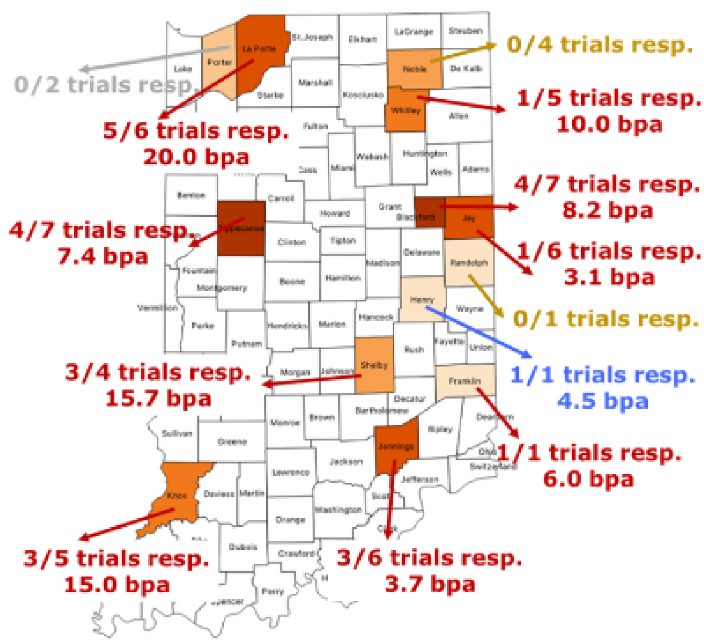

Figure 2. Effect of sidedress S on corn grain yield, 55 field trials, 2017-2022.

Sidedress S increased yield in 26 of 55 trials (Fig. 2), ranging from 3 to 34 bu/acre averaged over the entire experimental area. In 23 trials where corn responded to multiple rates of sidedress S, the lowest 3 sidedress rate examined (ranging from 5 to 30 lb S/acre) was enough to maximize the yield response.

Even at sites that had large yield increases with S fertilization in most years, no response occurred in other years (LaPorte and Knox counties for example). Several sites were mostly unresponsive to S fertilization over several years of testing – Purdue research farms in Whitley and Jay counties for example. Season to season and field to field differences in corn response to S fertilization may be explained by seasonal differences in S mineralization from soil organic matter and crop residues, and carryover of incidental application of S in phosphorus fertilizers and from S applied to the previous crop (Camberato et al., 2022).

Carryover of S from the previous crop in some soils

To determine if carryover of S applied to the previous soybean crop could provide S to the next corn crop, we applied S in 2021 to soybeans at 0 and 20 lb S/acre in 60– or 80–ft wide replicated strips. In the following 2022 corn crop, each half of the 2021 treatments received either 0 or 15 lb S/acre at sidedressing. Corn yield increased in response to previous year S and sidedress S at 3 of 4 sites with silt loam/silty clay loam soils (Table 1). In 2 of the 3 responsive fields (Blackford and Jennings counties) apparent carryover of S from the previous year's application was sufficient to maximize yield. At the Whitley County site, further yield increases occurred in response to the current year sidedress S application. Further research is warranted to more clearly document the potential for carryover S on a succeeding crop.

Table 1. Corn response to S fertilization in the previous (to soybean in 2021) and/or current year (to corn in 2022) on silt loam and silty clay loam soils.

Year S Applied		**County Where Trial Conducted**			
2021	**2022**	**Blackford**	**Jennings**	**Whitley**	**Jay**
Rate of S Applied, lb S/Acre		**——Corn Grain Yield, Bushels/Acre——**			
0	0	197	234	217	225
0	15	213	237	225	226
20	0	213	236	222	227
20	15	214	237	229	226
Treatment Comparisons		**——Statistically Significant Comparison at P≤0.10——**			
0/0 vs all other treatments		Yes	Yes	Yes	No
0/15 vs 20/0		No	No	No	No
20/0 vs 20/15		No	No	Yes	No

Soil and tissue testing for predicting S deficiency

No soil properties (including extractable sulfate–S, organic matter, and texture) or pre–sidedress plant tissue %S or N:S ratio consistently predicted responsive versus non–responsive sites, although some sites affirmed previous research which suggested S deficiency would be more likely and more severe on sandy low organic matter (OM) soils. For example, the LaPorte site is composed of loamy sand and sandy loam soils and averaged 2% OM. At this site S fertilization increased corn yield in 5 of 6 years, averaging 20.0 bu/acre. Similarly, in another site with substantial soil variability, S increased yield 10 bu/acre on a Whitaker silt loam (2.1% OM), while there was no response to applied S on a Bono silty clay (3.9% OM). However, the opposite occurred in a trial in Shelby County where the yield response to S was 35 bu/acre on soil mapped as Brookston silty clay loam (2.6% OM), while there was no response to S on soil mapped to the lighter-textured lower OM Crosby silt loam (1.9% OM). Other sites with clayey soils and high % OM have also had substantial responses to applied S (for example, a Chalmers silty clay loam soil with 3.9% OM in Tippecanoe County). Research continues to identify soil, plant, and environmental measurements that improve our ability to predict corn yield response to S fertilization.

Confirming S deficiency with earleaf sampling

Although tissue sampling prior to sidedress did not identify sites requiring S fertilization, measuring earleaf tissue %S or the tissue N:S ratio in the earleaf at silking was useful in confirming S deficiency. Current guidelines for adequate S in the earleaf at silking suggest greater than 0.15% S is sufficient. Our research suggests the critical level for sufficiency may be greater than 0.18% (Fig. 3). The N:S ratio of plant tissue concentrations is also often used to assess S deficiency in corn. Sulfur and N are primary components of plant protein and typically occur in a ratio of about 15 parts N to 1 part S (15:1 N:S). Greater N:S values suggest S is deficient. Our results are consistent with this assessment, with most of the responsive locations having a N:S ratio of 16:1 or greater (Fig. 4).

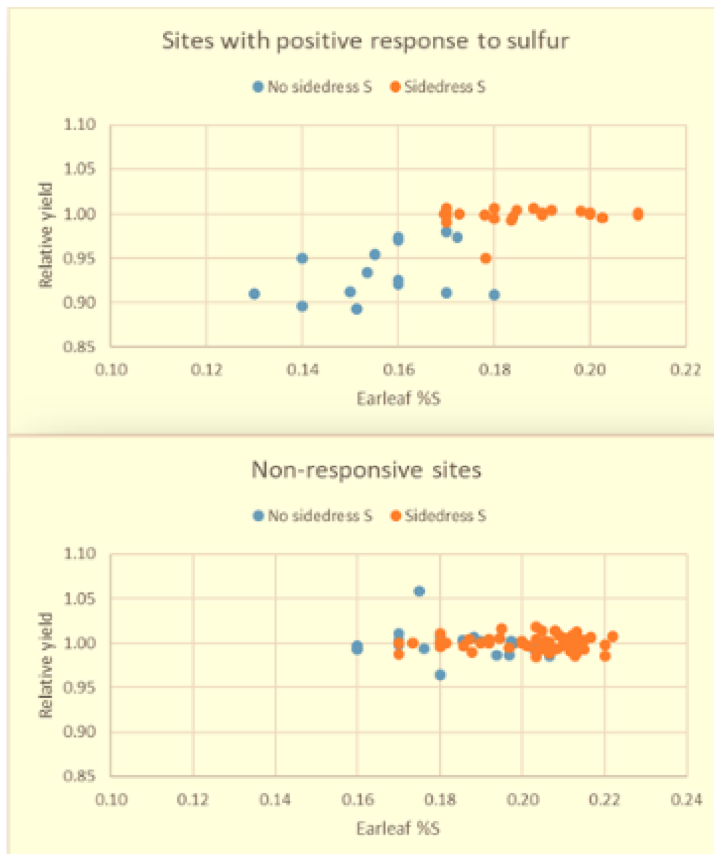

Figure 3. Earleaf tissue S concentrations at sites with positive responses (top) and non-responsive to S fertilization (bottom). Blue symbols indicate treatments not receiving S fertilizer. Relative yield is yield of the no S treatment divided by yield obtained with S. Data are from 13 responsive and 21 non-responsive sites.

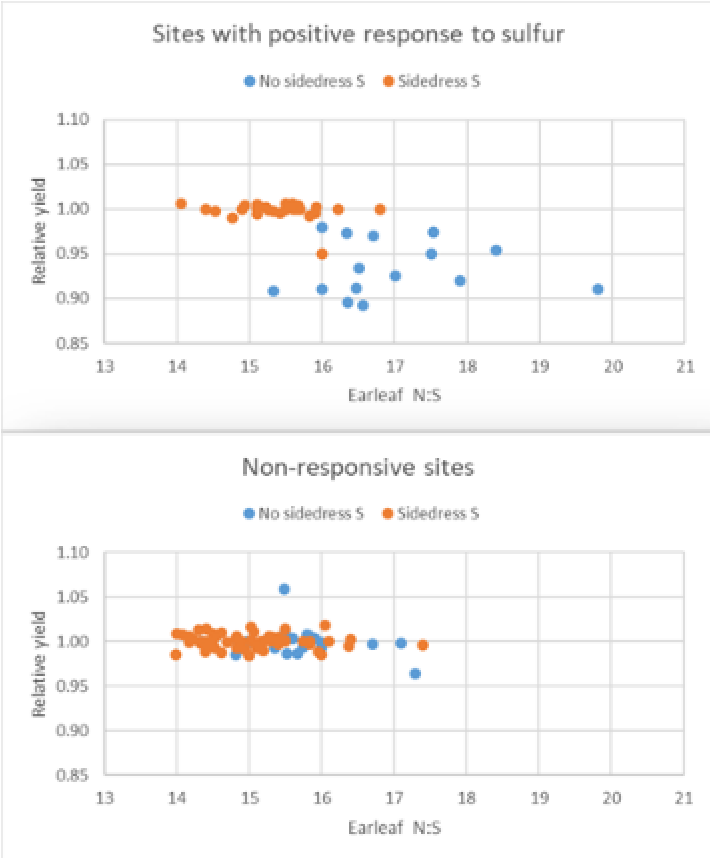

Figure 4. Earleaf tissue concentration N:S ratios at sits with positive responses (top) and non-responsive to S fertilization (bottom). Blue symbols indicate treatments not receiving S fertilizer. Relative yield is yield of the no S treatment divided by yield obtained with S. Data are from 13 responsive and 21 non-responsive sites.

Sulfur fertilization decisions

Not every field of corn is deficient for sulfur and so we do not recommend that everyone routinely apply S fertilizer to every single field they farm. Unfortunately, based on the results of on–going research, there is yet no consistent soil or plant predictor that accurately tells us where and when S fertilization of corn will be needed.

Sulfate–S analysis from fall soil samples is not helpful and we have found that even soil samples taken between planting and sidedress time are not helpful in determining whether a field needs S fertilization. The reason for this is that soil sulfate–S is subject to leaching from excessive rainfall, like soil nitrate–N, and soil–test S does not adequately reflect the organic–S that may come available during the growing season.

Our research also suggests that tissue analyses of plant samples taken just before sidedressing are also not reliably predictive of S needs by the corn plant – WITH THIS CAVEAT – If plants are (1) showing S deficiency symptoms prior to sidedressing and (2) plant tissue analyses show that %S is very low (approaching 0.12%) and (3) the N:S ratio of the plant tissue concentrations is very large (>24:1), then S fertilization is likely needed. We typically don't see these levels of %S and N:S at sidedress time in our research trials, but we encounter them occasionally when troubleshooting problem fields. Although it is possible the crop will grow out of such early season deficiency as soils warm, organic matter mineralization increases, and roots explore more soil, it is more likely that an application of 10–15 lb S/acre will be needed to provide non–limiting conditions. Furthermore, since our research indicates that sidedress alone is just as good or better at relieving S deficiency than starter plus sidedress, delaying the decision to apply S based on symptoms and tissue analysis between planting and sidedress is a reasonable strategy.

Neither earleaf tissue %S or tissue N:S ratios are perfect at separating responsive and non– responsive sites, so if tissue levels are near or below these critical levels, or if S deficiency symptoms were noticed, you should consider conducting simple S response trials on your farm next year. A simple protocol for conducting these trials can be downloaded at https://www.agry.purdue.edu/ext/corn/ofr/protocols.html. We would be eager and willing to
partner with you in conducting these trials.

Low rates of S as starter alone (<5 lb S/acre) have not increased corn yields in our trials. Higher starter rates might be beneficial but, unfortunately, we have only conducted 1 trial to address that question. We caution against applying more than 10–15 lbs of S in the form of ATS in 2×2 or closer starter placements without on–farm testing of your own because ATS can result in seed or plant toxicity.

The risk of soil sulfate–S loss increases the earlier that S fertilizer applications are made prior to planting, particularly on sandy soils. Counting on plant available S from elemental S is risky since availability is reliant on warm soil temperatures. Plant availability of S applied as elemental S in fall and winter is no different than a spring application because conversion to sulfate will not occur till soils warm substantially. Even fertilizers claiming accelerated
elemental S conversion to sulfate because of very small particle sizes include a sulfate component to provide plant available S soon after application. Additional discussion of different S fertilizer sources can be found in Camberato et al. (2022).

What is the minimum effective rate of S to apply? Our research suggests that 10-15 lbs S/acre, applied just before planting but no later than sidedressing, will be adequate in most S- deficient situations. Broadcast applications of sulfate-S at/or shortly after early season plant sampling should be similarly effective as knife/coulter sidedress S applications.

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