CORN RESPONSES TO SULFUR FERTILIZER IN INDIANA

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ABSTRACT

Corn yield increases in response to sulfur (S) applied as ammonium thiosulfate in liquid N (in sidedress and/or starter fertilizer applications) occurred in ~40% of 40 trials conducted between 2017 and 2021 and ranged from 4 to 24 bushels per acre on responsive sites. Increased grain yield with S fertilization occurred on soils ranging in texture from sandy loam to silty clay loam and soil organic matter concentrations from ~1 to 3%. Yield increases with S fertilization were not predicted by Mehlich-3 extractable sulfate-S in soil samples taken sometime between planting and sidedressing. The S concentration of plant samples taken just before sidedressing also did not correlate with responsive and non-responsive fields. Later in the season, earleaf S concentrations and nitrogen to S ratios (N:S) associated with sufficiency were >0.18% S and <16:1 N:S, respectively. Application of phosphorus fertilizers with incidental S content and potential carryover of S applied to the previous crop when grown on silt loam or heavier soils may need to be considered when attempting to predict S fertilization needs of the current crop.

MATERIALS AND METHODS

Corn response to S fertilization field trials were conducted on Purdue agricultural research farms and farmers' fields from 2017-2021. Sulfur treatments were applied with ammonium thiosulfate in liquid N (in sidedress and/or starter fertilizer) and the number of treatments and rates of S applied varied among trials – 1 to 5 rates (in addition to a zero S rate) and rates from 3 to 30 lb S/acre. Treatments were replicated from 3 to 18 times.

Whole plant and soil samples (0-8, 8-16, and 16-24" depth) shortly before sidedress treatments were applied and earleaves at silking were obtained from several trials. Plant samples were analyzed for N and S and soil samples for Mehlich3-extractable SO_4-S. Grain yield and moisture were obtained from calibrated yield monitors on commercial combines. Analysis of variance and single-degree of freedom contrasts (alpha=0.10) were used to compare treatments.

RESULTS AND DISCUSSION

Grain yield response to starter fertilizer containing S

The impact of starter and/or sidedress S on corn yield was evaluated in 9 trials. Sulfur rates ranged from 3-5 lb S/acre as starter and 12-25 lb S/acre as sidedress. Starter fertilizer did not increase grain yield in 8 of 9 trials (data not shown), compared to no S fertilizer, even though in 4 of the 8 trials supplying S at sidedressing increased

yield 15-20 bu/acre. Applying S in both starter and sidedress had no greater effect on yield than applying S in sidedress alone.

Grain yield response to sidedress fertilizer containing S

The effect of sidedress S on corn grain yield was evaluated in 40 trials (including the 9 with starter S treatments). Multiple rates of sidedress S were utilized in 26 of the 40 trials, ranging from 5 to 30 lb S/acre and including a 0 lb S/acre treatment. Fourteen trials only had 2 S rates, 0 and 15 lb S/acre (mostly those conducted in 2021).

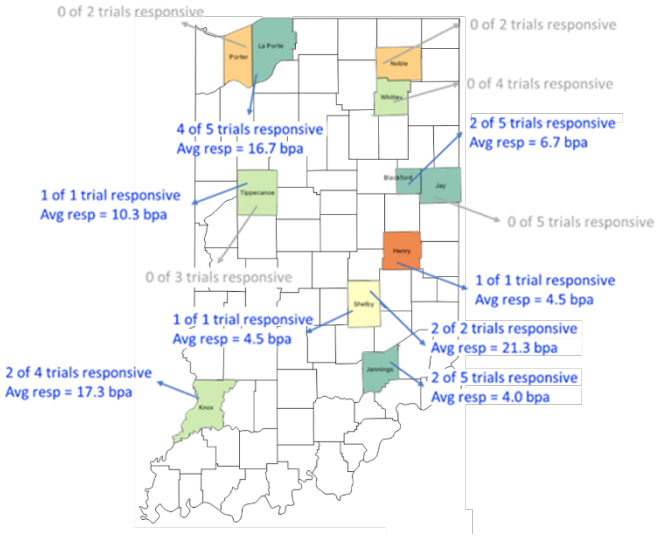

Figure 1. County of location for 40 corn response to sulfur fertilization trials conducted in Indiana from 2017-2021. The number of responsive trials and the average yield increase in responsive trials is shown.

Sidedress S increased yield in 15 of 40 trials (Fig. 1), ranging from 4 to 24 bu/acre averaged over the entire experimental area. In 7 trials where corn responded to multiple rates of sidedress S the lowest sidedress rate examined (ranging from 5 to 20 lb S/acre) was enough to maximize the yield response. Even at sites that had large yield increases with S fertilization in some years, no response occurred in other years (e.g. LaPorte and Knox Counties). Several sites were consistently unresponsive to S fertilization over several years of testing (e.g. Jay and Whitley County).

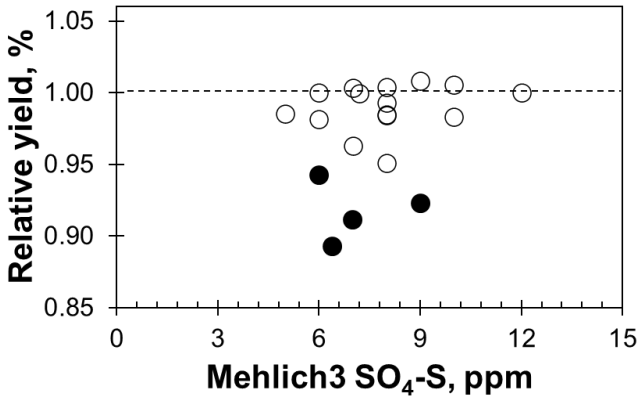

Figure 2. Relationship between Mehlich3-extractable SO_4-S in the upper 8 inches of soil sampled prior to sidedressing and relative yield (yield without S/yield with S). Solid circles denote sites where yield without S was lower than yield with S (P≤0.10) and open circles indicate non-significant effects of added S.

Mehlich3-extractable SO_4-S of the upper 8 inches of soil did not differentiate 4 sites where S fertilization increased yield from 14 non-responsive sites (Fig. 2). Including extractable SO_4-S from deeper depths, 8-16 and 16 to 24 inches, did not improve the relationship between soil SO_4-S and relative grain yield (data not shown).

Whole plant S concentration (Fig. 3) and N:S ratio (data not shown) at the V3-V7 growth stages prior to sidedressing did not separate 2 responsive sites from 11 non-responsive sites.

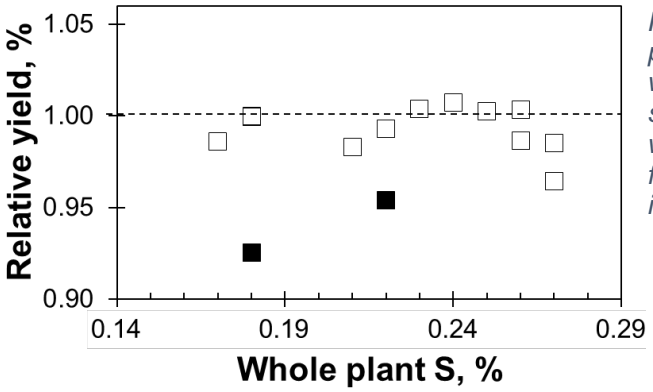

Figure 3. Relationship between whole plant S prior to sidedressing and relative yield (yield without S/yield with S). Solid squares denote sites where yield without S was lower than yield with S as determined by a single-degree-of-freedom contrast (P≤0.10) and open squares indicate non-significant effects of added S.

The earleaf S concentration and nitrogen to S ratio (N:S) at silking was reasonably well associated with sufficiency, separating responsive sites from non-responsive sites. Most sites where grain yield was lower without S fertilization had earleaf S ≤0.18% and N:S ratio ≥16:1.

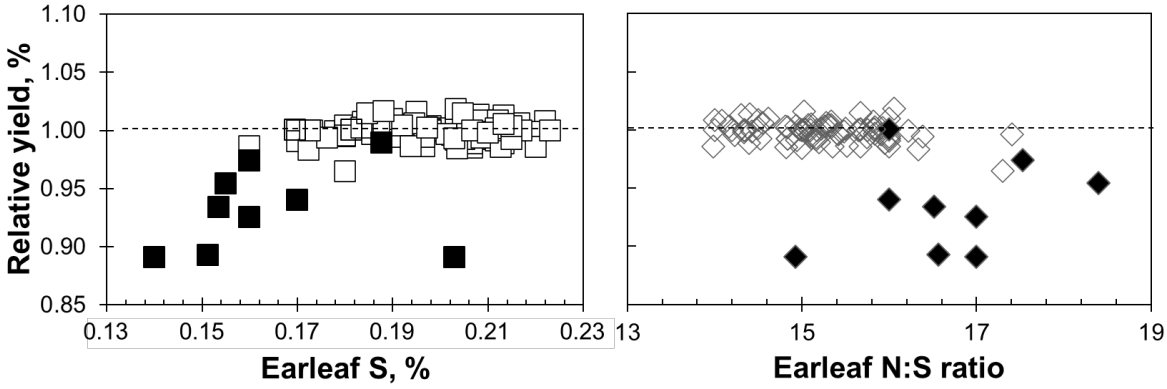

Figure 4. Relationship between earleaf S concentration and N:S ratio with relative grain yield. Relative yield was calculated as the mean of each treatment divided by the mean of all treatments receiving S. Solid symbols denote sites where yield with S was lower than yield with S as determined by a single-degree-of-freedom contrast (P≤0.10) and open symbols denote non-significant effects of added S. Data from 24 sites in 2018-2020.

Corn response to S occurred in ~40% of 40 trials conducted in Indiana from 2017-2021. Yield responses ranged from 4 to 24 bu/acre. Not surprisingly soil SO_4-S prior to sidedressing did not distinguish S responsive sites from non-responsive sites – nor did the %S or N:S ratio of plant tissue sampled at the same time. Earleaf %S and N:S ratio at silking was reasonably good at differentiating 7 of 9 responsive sites from 15 non-responsive sites, but of course this is not helpful for improving the yield of the current crop. Other factors that may impact corn response to S and should be investigated in future research are carryover of S applied to the previous crop, incidental S applied in phosphorus fertilizers, and the impact of drainage on mineralization of organic S.