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MISSISSIPPI SOYBEAN PROMOTION BOARD
PROJECT NO. 22-2017 (YEAR 1)
2017 ANNUAL REPORT

Title: Development of Fertilization Practices for Sustaining Mississippi Soybean Production

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BACKGROUND AND OBJECTIVES

Limited recent research exists in Mississippi regarding correlation of soil test indices to plant nutrient concentration and/or yield. Mississippi currently employs the Lancaster method to determine soil nutrient availability. Limited research investigating Lancaster extracted P and K correlation to soybean tissue concentration and yield suggests that differences may exist between Lancaster and Mehlich-3 extractable soil test P and K and soybean yield. Current data suggests that establishment of differing soil test critical levels between the two extraction procedures may be warranted, especially for P. Future research will maintain the current database and add new data points to allow for a more robust model to identify what soil test level soybean will respond positively to fertilization.

As Mississippi producers have shifted to a more grain-based system, Sulfur (S)-deficient soybean fields have routinely been observed in Mississippi over the last several years. Currently, most producers apply sulfur to corn and rice, but very few apply sulfur to soybean. Research is needed to determine the appropriate sulfur source and application rate and timing for fields that require S fertilization in Mississippi to produce maximal yield. Currently very little information exists on crop response to soil test-based sulfur recommendations. Mississippi State University currently employs a differing soil test S index than most private and public laboratories in the Midsouth region of the U.S. Therefore, correlation and calibration attempts for sulfur are required, and research will take a similar path as with recent and continuing work with P and K.

In Recent years, producer concern has risen over differences in soil test results when crop rotation has changed. In Mississippi we are blessed to have soils that support many cropping systems; however, the blessing also allows us to alter the crop mix as commodity price changes. Soybean is the backbone of most rotational cropping systems in Mississippi. Little recent research has described differences in soil test variability when soybeans rotation partners shift. Numerous research has described the positive benefit of rotating soybean with corn on both crops' potential in Mississippi, but limited data are available that describe the impact of rotating soybean and rice on soil test properties.

OBJECTIVE(S)

Objective 1. Evaluate crop response to P and K fertilization and continue to build the Miss. soil test responsiveness database used to update soil test recommendations for both Lancaster and Mehlich-3 extractants.

Objective 2. Determine the appropriate S source and application rate and time for Mississippi soybean production. Initiate database to generate soil test recommendations for S responsiveness used to develop Mehlich-3 recommendations and update current Modified combustion recommendations.

Objective 3. Evaluate the soil test variability among different soybean rotational partners and determine if soil test recommendations need to be altered based on rotational cropping history.

REPORT OF PROGRESS/ACTIVITY

2017

During 2017, research was established on numerous sites. We concluded the season with two harvestable sites for P and three harvestable sites for K research. For the P research, we observed no yield response at any of the harvestable testing locations. Soil test P was greatest (50 mg/kg) at the Quitman County site and lowest (33 mg/kg) at the Washington County site. At the Washington County site, no yield response was observed.

Across the range of P_2O_5 application rates, soybean yields ranged from 74 to 78 bu/acre (Fig 1). Although yield did not show a positive response to P_2O_5 application, tissue P concentration at R2 was increased (Fig 2). In general, at the Washington County site, tissue P increased with increasing P_2O_5 rate before reaching a plateau when 90 lbs P_2O_5/acre was applied. At the Quitman County site, a similar trend was observed. No response to P_2O_5 application rate was detected at the Quitman County site, with the numerically greatest yield (92 bu/acre) achieved with the 0 lb P_2O_5/acre application rate. However, tissue P was increased with application of P fertilizer. The lowest tissue P at the Quitman County site occurred when 0 lb P_2O_5/acre was applied, and the greatest Tissue P concentrations (0.33 %) were observed with the first application rate (30 lb P_2O_5/acre).

For the K research trials, we observed a positive yield response at two of the three testing locations. Mean soil test K was 163 at the Washington County site, 149 at the Quitman County site, and 106 mg/kg at the Sharkey County site. At the Washington County site, no yield response was observed. Across the range of K_2O application rates, soybean yields ranged from 75 to 78 bu/acre (Fig 3).

Similar to yield, Tissue K did not respond at the Washington County site (Fig 4). Soybean yield positively responded to K at both the Quitman and Sharkey County sites. At the Quitman County site, soybean yield was increased by approximately 5 bu/acre with application of K fertilizer. Similar to soybean yield, tissue K was also increased at the Quitman County site. Mean soybean tissue K increased with the first application rate of K_2O before reaching a plateau.
Although soybean yield and tissue concentrations were increased at the Quitman County site, tissue K levels at R2 were still below the established critical value.

The greatest yield increase observed to date has been at the Sharkey County site. Soybean yields were increased by 13 bu/ac when K fertilizer was applied compared to the untreated control. In general, soybean yield increased with the first application rate, but failed to increase with increasing K_2O rate. Unfortunately, no tissue data are available for this site because a leak in the greenhouse destroyed the samples via moisture and mold.

Three trials were established to evaluate soybean response to sulfur rate and/or sulfur product and application time. Of the three trials, only two trials were harvestable in 2017. One trial was lost due to overtreatment with sulfur. On the harvestable rate trial, no response to sulfur fertilizer was detected.

Soybean yield was 81 bu/acre from the untreated control and numerically increased to 82 bu/acre when 20 lb S/acre was applied. No sulfur tissue response will be presented for the rate trial as these samples were in the same greenhouse that leaked on one site of the P samples. Soil test S at the non-responsive rate trial site was estimated at 45 by LOI.

In the trial evaluating S sources and application times for soybean, a positive response was observed. All S sources (AMS, Sul4plus, and Kmag) and application times (V4 and R2) produced greater soybean yield when compared to the untreated control (Fig 5.) However, there was no increase in soybean yield between any S source and S application time combination. The numerically greatest yielding treatment was Sul4plus (85 bu/acre; pelletized Gypsum) applied at the V4 growth stage. The untreated control produced an average soybean yield of 78 bu/acre (soil test S = 24). In general, the yield increase from sulfur addition at this site, although statistically significant, was 7 bu/acre or less (LSD 1.18, P-value 0.0064), and may not provide enough benefit to warrant the cost associated with application. However, this is only the preliminary year of the research and future research will greatly refine recommendations for when S should be applied. Tissue S was not increased by the application of any S product or at any S application time. Thus a corresponding tissue concentration increase was not observed with the associated yield response at the R5 stage. Future research will aim at identifying the appropriate time to collect tissue samples with regard to S.

Initial rotations were established for objective three during 2017.

IMPACTS AND BENEFITS TO MISSISSIPPI SOYBEAN PRODUCERS

USDA-NASS estimates that approximately 17 and 19% of soybean acres in Mississippi receive P and K fertilization annually. The most recent MSPB surveys reported approximately 61% of respondents soil sample every 3 years, with nearly 70 % of respondents suggesting they apply nutrients based on soil test results.

The results reported here would immediately affect those producers who annually apply P and K and perhaps bring heightened awareness to those who do not, or provide economic balance for those producers who are over-applying nutrients. If successfully correlated, the data could provide a university-based prescription equation for variable rate nutrient application based on grid sampling. No data are available describing sulfur use trends in Miss.

END PRODUCTS–COMPLETED OR FORTHCOMING

Falconer, L., J.T. Irby, J. Orlowski, T.W. Allen, J.A. Bond, N.W. Buehring, A.L. Catchot, D. Cook, B.R. Golden, J. Gore, L.J. Krutz, and H.C. Pringle. 2017. Soybeans 2018 Planning Budgets. Mississippi State University Extension Service Publication P-3166.

Hydrick, H. T., J. A. Bond, B. R. Golden, B. H. Lawrence, H. M. Edwards, J. D. Peeples, and T. L. Phillips. 2017. Influence of foliar fertilizer on postemergence herbicide efficacy in soybean. Pages 42-43 in Mississippi State University Delta Research and Extension Center 2016 Annual Report. Stoneville, MS: Delta Research and Extension Center.

McCoy, J. M., B. R. Golden, J. A. Bond, D. Cook, and M. S. Cox. 2017. Soybean yield and biomass response to supplemental nitrogen fertilizer. Pages 14-15 in Mississippi State University Delta Research and Extension Center 2016 Annual Report. Stoneville, MS: Delta Research and Extension Center.

Pieralisi, B., J. M. McCoy, B. R. Golden, J. A. Bond, M. S. Cox, and D. Cook. 2017. Soybean nodule inhibition and root growth as influenced by nitrogen source and nitrogen rate. Pages 12-13 in Mississippi State University Delta Research and Extension Center 2016 Annual Report. Stoneville, MS: Delta Research and Extension Center.

RFDTV Radio Spot October 18, 2017 soybean fertility programs

RFDTV Radio Spot January 19,2017 Soil testing

Mississippi State University Extension Mid-season Update – Soil Fertility in Mississippi in 2017; Baldwyn, MS (July 20, 2017)

Grenada County Grower Meeting – Know your soil tests; Grenada, MS (March 7, 2017)

Benton County Grower Meeting – soil test interpretation for soybean and corn; Holly Springs, MS (February 23, 2017)

Lee County Grower Meeting – soil test interpretation for soybean and corn; Baldwyn, MS (February 23, 2017)

Tallahatchie County Grower Meeting – soil test interpretation for soybean and corn; Charleston, MS (February 22, 2017)

Yazoo County Grower Meeting – soil test interpretation for soybean and corn; Yazoo City, MS (January 17, 2017)

Noxubee County Grower Meeting – soil test interpretation for soybean and corn; Macon, MS (January 12, 2017)

Monroe County Grower Meeting – soil test interpretation for soybean and corn; Aberdeen, MS (January 12, 2017)

CPS Showcase – Soil fertility primer for 2018, Jackson, MS (Oct 18, 2017)

MACA Fall Update – where to go with corn and beans, Stoneville, MS (Oct 5, 2017)

Mississippi Agriculture Industries Council Certified Crop Advisor Training – Fertility issues in Mississippi row crops; Orange Beach, AL (July 28, 2017)

Mississippi State University Extension Service Scout School –Know your fertilizers; Verona, MS (June 1, 2017)

Mississippi State University Extension Service Scout School –know your fertilizers; Raymond, MS (May 30, 2017)

Mississippi State University Extension Service Scout School –know your fertilizers; Clarksdale, MS (May 25, 2017)

Mississippi State University Extension Service Scout School –know your fertilizers; Stoneville, MS (May 23, 2017)

Kunia information Exchange – Pyroxysulfone uses in the US, Stoneville, MS (May 23, 2017)
Jimmy Sanders Meeting – how fertilizer can improve your bottom line, Tunica, MS (March, 16 2017)

LA Consultants conference – Micronutrients for soybeans; Marksville, LA (February 16, 2017)
Jimmy Sanders Associate Training Meeting – Managing soil nutrient status in down budget; Rayville, LA (February 9, 2017)

Jimmy Sanders Associate Training Meeting – Managing soil nutrient status; Stoneville, MS (February 6, 2017)

Crop Production Services Associate Training Meeting –Managing soil nutrient status in 2017; Stoneville, MS (February 2, 2017)

Greenpoint Ag Associate Training Meeting –managing soil status in 2017; Stoneville, MS (January 30, 2017)

Graphics/Tables

Figure 1. Soybean yield increase as a function of phosphorus fertilizer rate at all sites managed for correlation calibration trials during 2017.

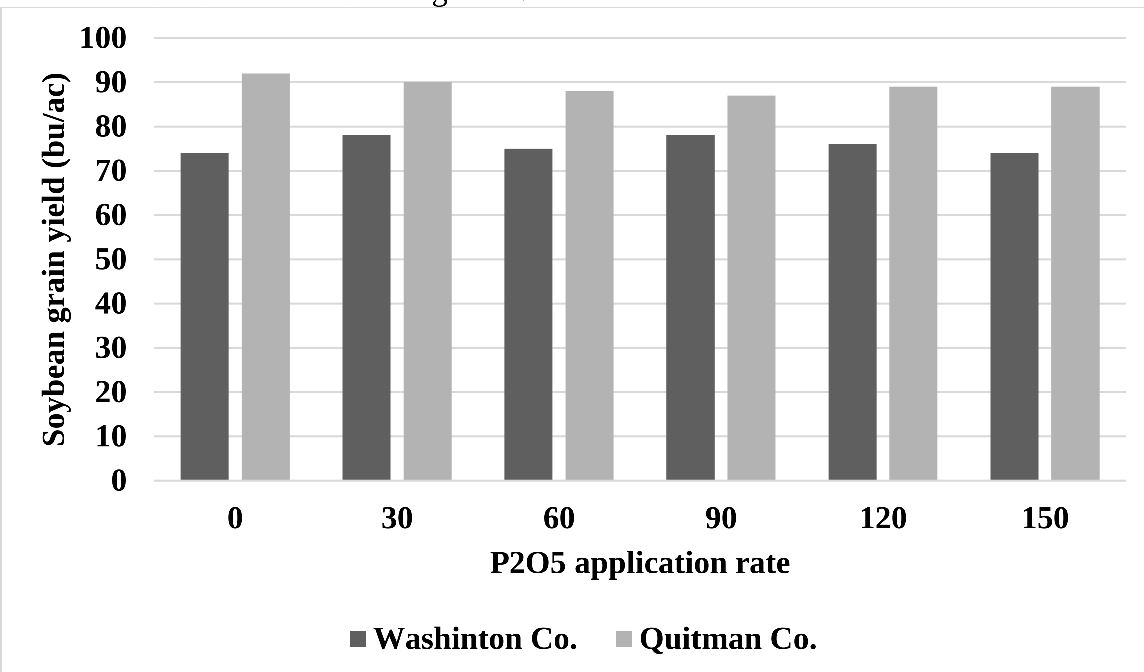

Figure 2. Soybean tissue P concentration as a function of phosphorus fertilizer rate at two responsive sites managed for correlation calibration trials during 2017.

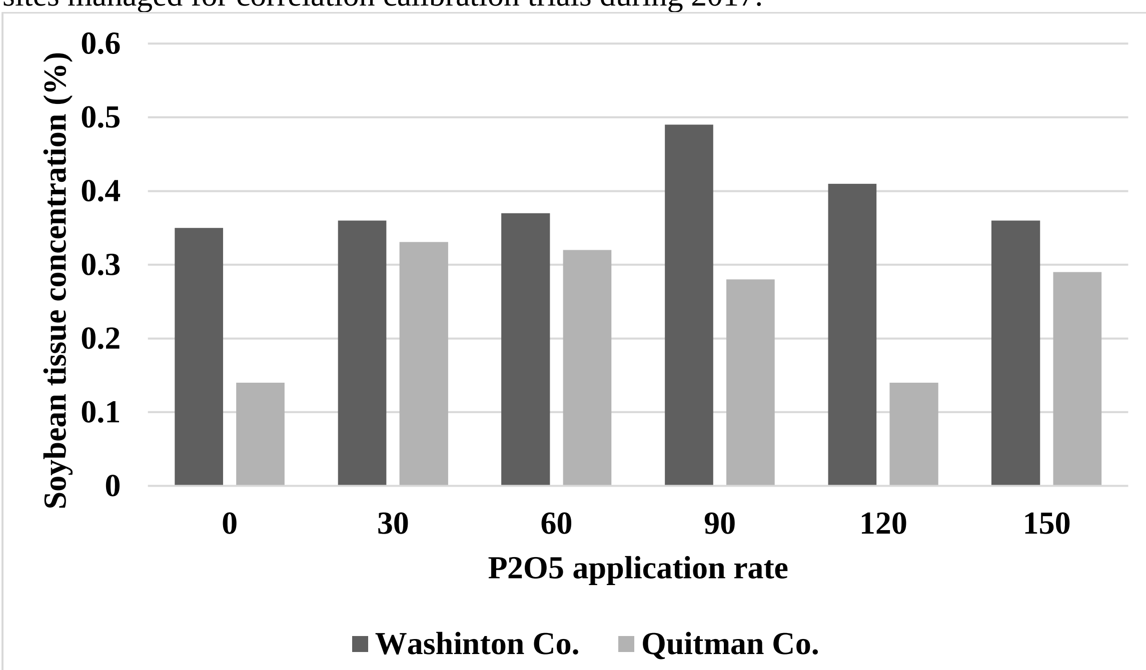

Figure 3. Soybean yield increase as a function of potassium fertilizer rate at all sites managed for correlation calibration trials during 2017.

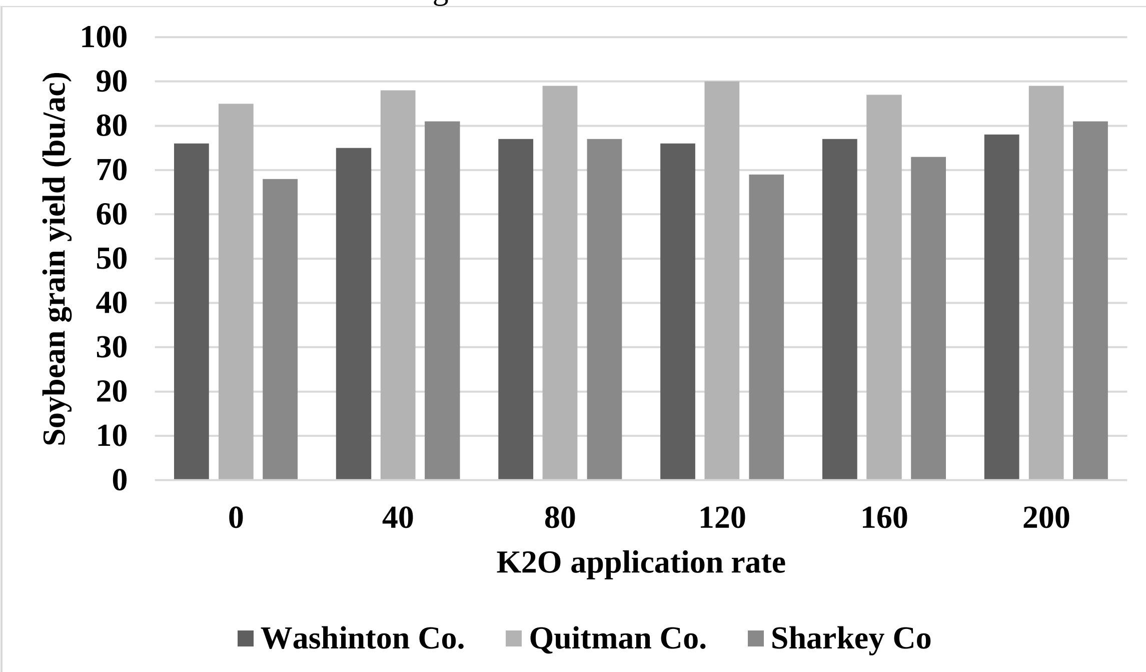

Figure 4. Soybean tissue K concentration as a function of potassium fertilizer rate at two responsive sites managed for correlation calibration trials during 2017.

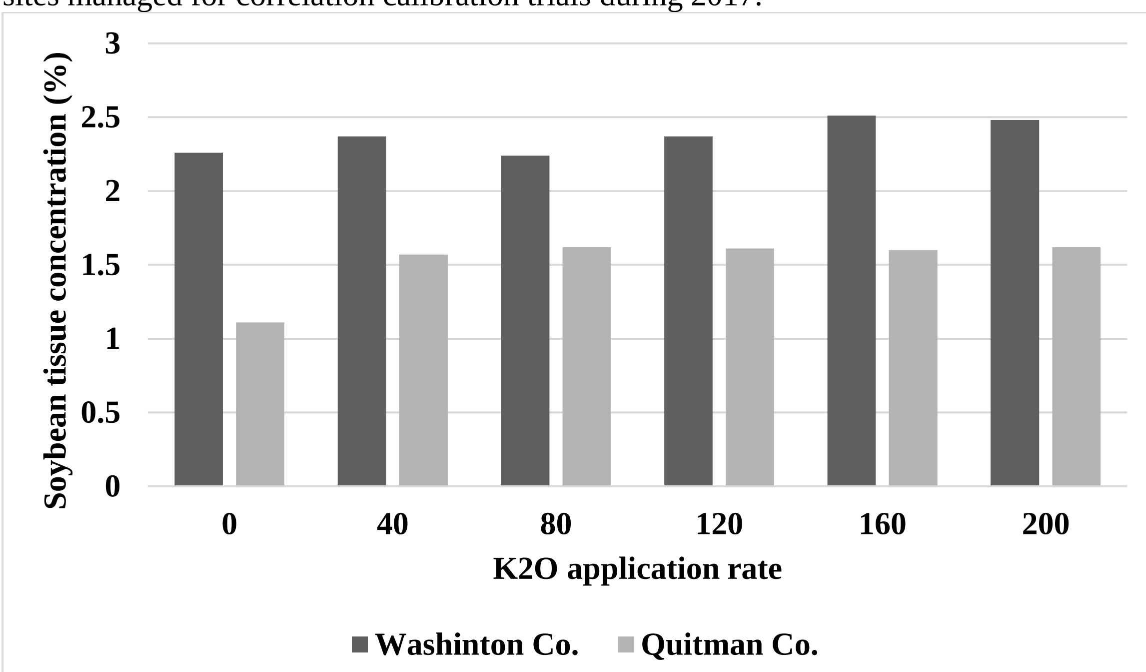

Figure 5. Soybean yield increase as a function of S fertilizer rate at all sites managed for correlation calibration trials during 2017.

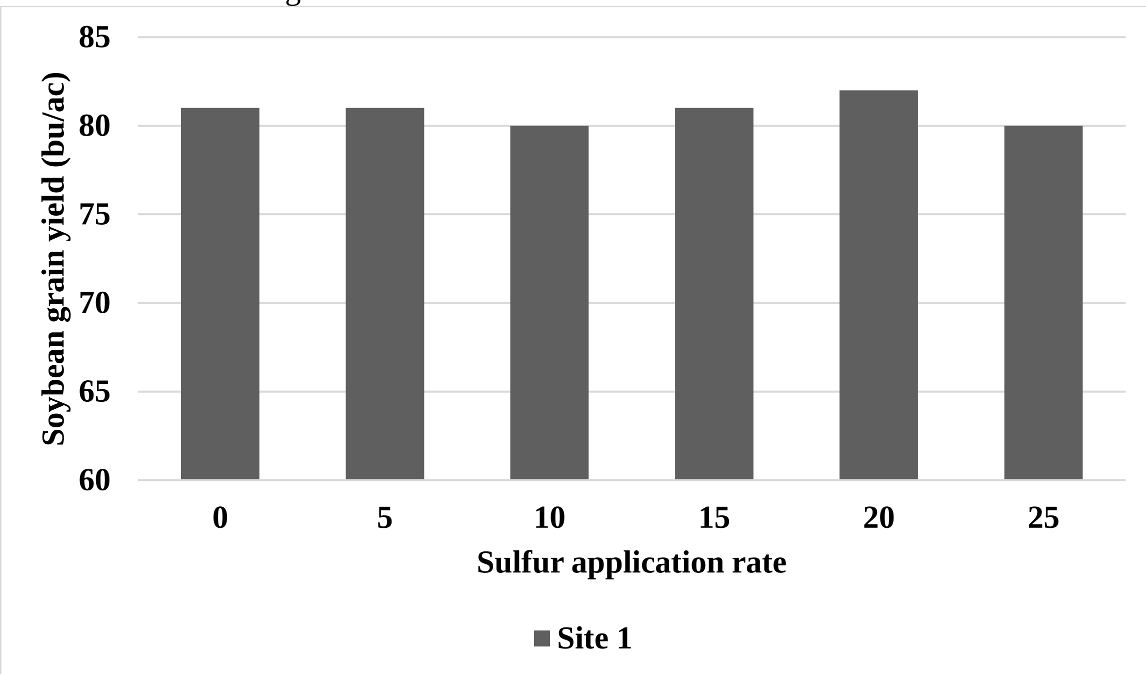

Figure 6. Soybean yield as influenced S fertilizer source and application time at all sites managed for correlation calibration trials during 2017.

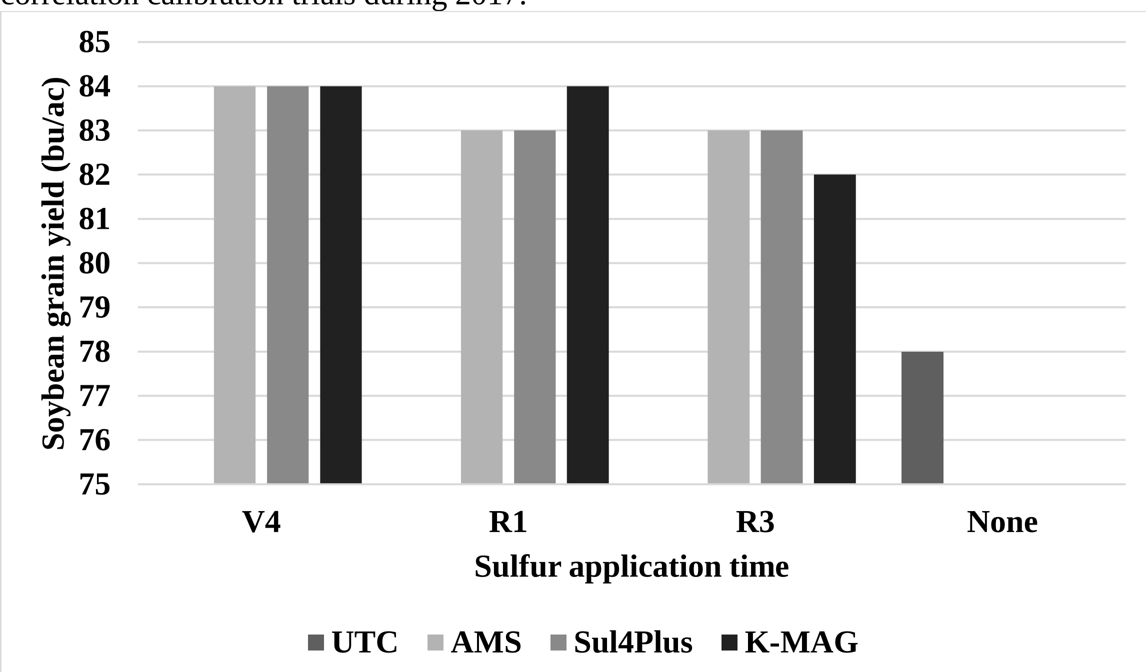

Figure 7. Soybean tissue concentration as affected by S fertilizer source and application time at all sites managed for correlation calibration trials during 2017.