SC Soybean Board Final Report

General Information

Principal Investigator(s) Name(s): C. Nathan Hancock (USCA) and Kendall Kirk (Clemson)
Organization: University of South Carolina Aiken
Date: 17 Jan 2022
Quarter: Final

Proposal Information

Title: Strategies for rescue of nitrogen deficient soybeans
Amount Expended to Date: $2,232.97

Project Summary

Briefly summarize this project and your final results. Summaries should be brief (limit to one page) and should be written in a way that is easy for our farmer audience to interpret and apply.

Six total research plots were set up with four nitrogen treatments (0, low = 40-50, med = 80-100, and high 120-150 pounds per acre) arranged in 4 complete randomized replicates (Table 1). We identified a range of conditions, including four chlorotic patches consistent with the target of this proposal. One plot was a healthy control, to assess the effect in properly nodulated soybeans. Plot 1000 contained severely stunted plants in a very sandy region that likely had more problems than just nitrogen deficiency. Plot set up included average soil sample, leaf tissue analysis, plot heights, handheld Greenseeker NDVI, and aerial images. Analysis of initial leaf nitrogen and height of these plots (Table 1) indicated that there is a direct correlation between initial leaf nitrogen levels and plant height.

A month after nitrogen application, we analyzed the health of the research plots. This included leaf tissue analysis, height, NDVI, and aerial images. As shown in prior years, we find that rescue nitrogen application to plots with low levels of leaf nitrogen (>3.5) increased the leaf nitrogen to normal amounts [>4%] (Figure 1). In contrast, the control plot with adequate starting nitrogen showed little response (data not shown). In addition, we observed a visible difference in canopy color for some plots (data not shown). The severely stunted 1000 plot showed a small response, but our observations of stand count suggest that they were beyond rescue and were not included in our final analysis.

At harvest, we measured plant heights, stand counts, and yield at the four informative research plots. Analysis of these results was performed by comparing the results for each treatment to the no treatment control. We observed a small increase in final height, though it was not significantly different (Figure 2). There also no significant difference in stand count indicating that the treatments did not affect plant survival (Figure 3). Yield analysis showed that all rescue nitrogen applications produced an over 6 bushel per acre increase in yield compared to the no

application control (Figure 4). This significant increase in yield can have a major impact for a grower, as it indicates that nitrogen deficient soybeans can be rescued as long as action is taken by the time the plants flower.

Economic analysis of our results is shown in Figure 5. The calculations assumed historically normal process of $10 per bushel soybean and $0.40 per pound for nitrogen. With these assumptions, the return after nitrogen costs were at least $25 per acre for all treatments. These results suggest that side dressing nitrogen deficient soybeans with moderate levels of nitrogen at R1 stage or earlier can be economically feasible depending on leaf nitrogen levels, nitrogen costs, and price of soybeans. Because of the danger of harming the plants with high levels of nitrogen application, our experiments suggest that application low levels of rescue nitrogen (40-50 lb/ac) would be the safest option. Thus, our general recommendation to soybean growers with chlorotic patches with leaf nitrogen levels below 3%, would be to apply 40-50 lb of nitrogen to the affected area.

As it is only advisable to apply rescue applications to areas that show clear signs of nitrogen deficiency, we are continuing to pursue methods for growers to use accurately prescribe variable rate application. In conjunction with out test plots at the Tampa Creek location, we were able to perform a simplified variable rate nitrogen application to the remainder of the field as needed (100 lb/ac in regions predicted to have low nitrogen levels). This basic test application produced very favorable results with striking differences in canopy color when comparing before and after images (Figure 6). Based on our results we predict that this nitrogen application produced an economically favorable increase in yield. Additional experiments will allow us to continue to develop mechanisms for confidently identifying low nitrogen areas and prescribing rescue applications.

Key Performance Indicators

What KPI(s) were used to measure project success? How were KPI(s) measured? Were KPI(s) not met? Were KPI(s) exceeded? Explain the key circumstances that impacted achieving or not achieving KPI(s).

We completed the aims of the 2021 project.

Next Steps

Explain the next steps of this project (if any) and the implementation of the findings from the project.

We plan to apply for 2022 funding to continue our experiments and move towards a digital platform to help growers. Our preliminary results are quite promising, but additional replicates will ensure that our recommendations will work for SC growers.

Additional Information

Provide any additional supporting information, facts or figures here.

Table I Research Plots

Plot Number	Name	Initial % N	Initial Height (cm)	Rescue Nitrogen	Used in final analysis	Notes
1000	Grady Odoms 1	2.68	10.4	Urea	No	Severely Stunted,
2000	Mount Calvary	3.89	27.9	Urea	Yes	
3000	Grady Odoms 2	3.08	17.5	Urea	Yes	
4000	Grady Odoms 3	4.23	25.1	Urea	Yes	
5000	Grady Odoms 4	4.91	38.9	Urea	No	Healthy Control
6000	Tampa Creek	2.04	-	Amidas*	Yes	

*applied at 50, 100, and 150 lb/ac

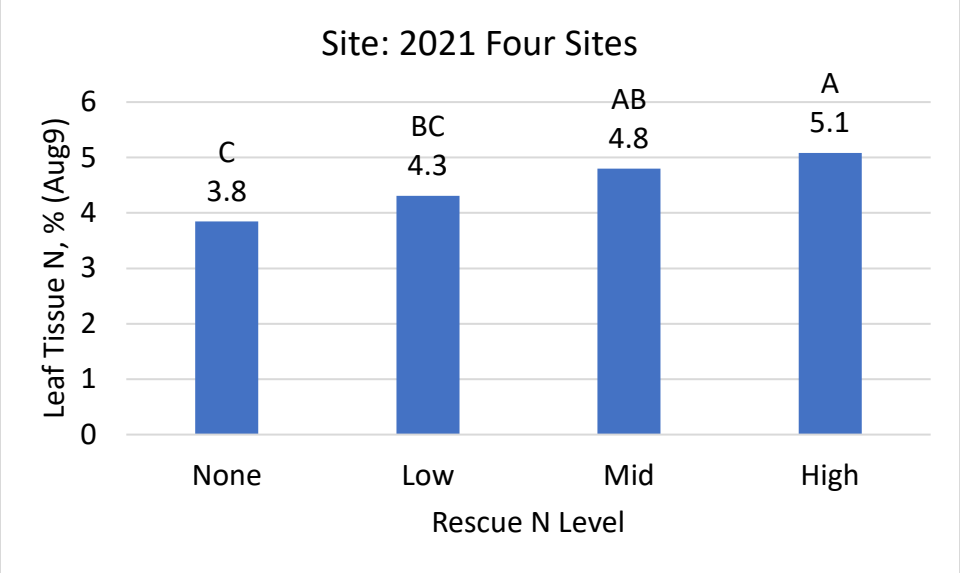

Figure 1 Leaf Nitrogen Response

Response in leaf tissue % nitrogen observed one month after rescue nitrogen application. Applications were Low = 40 – 50 lb/ac, Med = 80-100 lb/ac, High = 120-150 lb/ac. All three levels of application raised the lea nitrogen levels up to normal levels (4-5 %). Unique letters indicate samples that were significantly different.

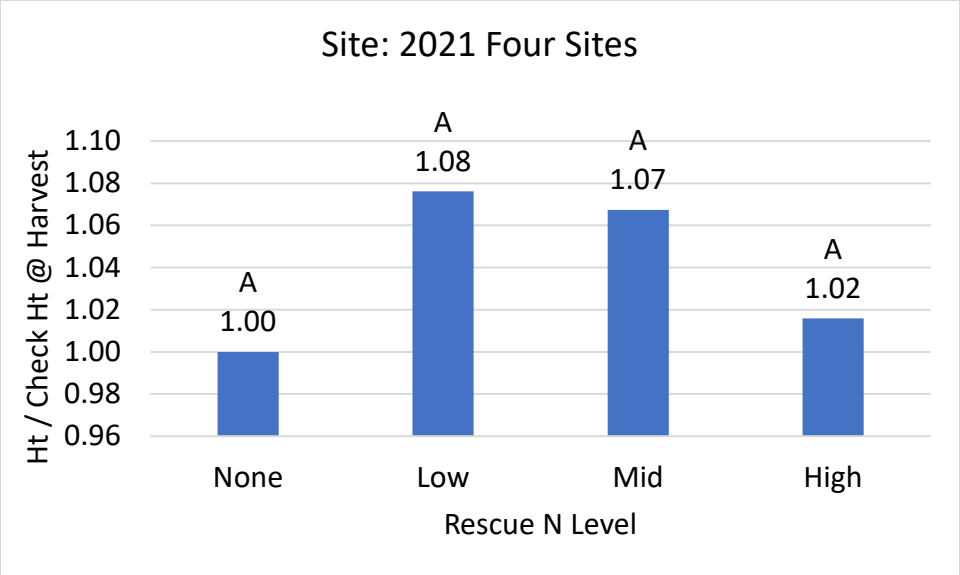

Figure 2 Final Plant Height

Final average height compared to the no nitrogen check sample. Rescue nitrogen application levels were Low = 40 – 50 ls/ac, Med = 80-100 lb/ac, High = 120-150 lb/ac. Although we observed increases (2-8%) in height for the nitrogen treatment, these were not statistically significant.

Figure 3 Final Stand Counts

Final stand counts for each treatment compared to the no nitrogen check sample. No statistically significant differences were detected, indicating that the treatments didn't affect plant survival.

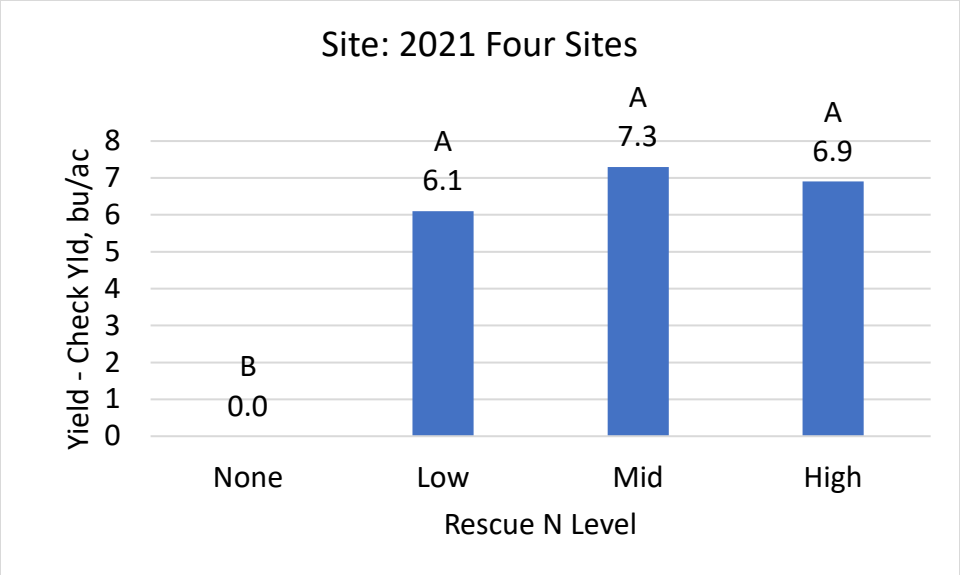

Figure 4 Yield Analysis

Increased yield in bushel/ac for each treatment (yield minus the check). Rescue nitrogen application levels were Low = 40 – 50 lb/ac, Med = 80-100 lb/ac, High = 120-150 lb/ac. Unique letters indicate samples that were significantly different. All nitrogen treatments resulted in significant increase in yield of more than 6 bushels per acre.

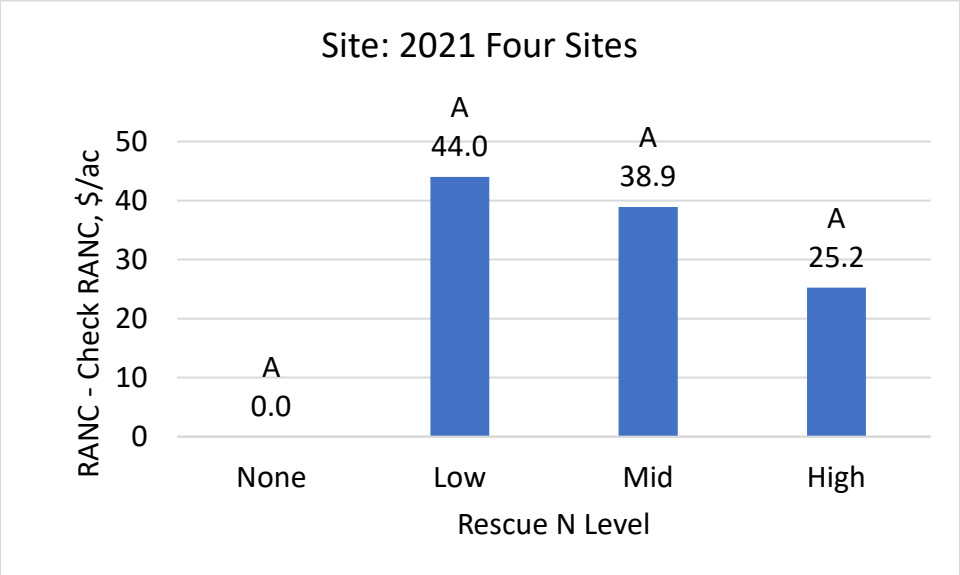

Figure 5 Economic Analysis

Return after nitrogen costs (RANC) were calculated using $10 per bushel revenue and $0.40 per lb nitrogen cost. The rescue treatments produced a $25 to $44 increase in revenue per acre, indicating an important impact on revenue.

Figure 6 Application Example

Before (left) and after(right) aerial photograph of a portion of the Tampa Creek field that was treated with a rescue nitrogen application. The chlorotic patches visible in the before image were completely eliminated by the rescue nitrogen treatment.