Nutrient Uptake and Foliar Fertilizer Effectivity in Modern Soybean Varieties

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INTRODUCTION

Modern soybeans, *Glycine max* (L.), are commonly grown throughout North Carolina. According to 2018 NCDA Ag Statistics, Union County produced over 63,000 acres of soybeans with an average reported yield of 44 bushel per acre, ranking third in overall soybean production for North Carolina. With increasing genetic technology, the influx of foliar fertilizer products, and increased production costs, producers need more research focusing on the ability of soybean plants to uptake nutrients through foliar methods. Producers need to know if foliar fertilizers can provide soybeans adequate nutrients at specific growth stages to maximize yield. The absence of recent data regarding the nutritional needs of modern soybean [*Glycine max* (L.) Merr.] production systems necessitates a greater comprehensive understanding of nutrient uptake and remobilization (Bender et al., 2015). **This study aims to monitor plant and soil nutrient levels over the growing season, assess the limitations of nutrient uptake on yield production, and identify the best growth stage to apply foliar fertilizers according to the nutrient uptake and accumulation of nutrients from the soil.**

MATERIALS & METHODS

Location:

- *Year 1* - Replicated trials are part of the 2019 NC Soybean Variety Evaluation Program at NCSU. Plant and soil data were collected from Cabarrus and Union Counties.
- *Year 2* – Small plot, replicated trial established at the soybean extension research field in Union County in 2020. Plant and soil data collected in Union County.

Varieties:

- *Year 1* - Cabarrus County Site – Asgrow 52X9, Croplan RX 50165, Dyna-Gro S52XT08, Pioneer P51A61X. Union County Site – Asgrow 38X8, Croplan RX 3750, Pioneer 37A78X, Pioneer P38T42R.
- *Year 2* – Pioneer 44TO4SE.

Treatments:

- *Year 1* – N/A.
- *Year 2* - Three products – Ag BioLogic's Over The Top Soybeans, Winfield's Gainer Wif K, and Brandt's Smart-KB. Five application timings – single applications at V3, R1 and R3; combination applications at V3/R1 and V3/R3.

Sampling Methods:

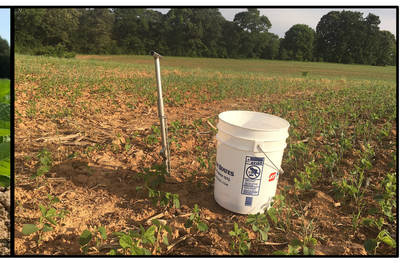
- *Year 1* - Soil samples were taken at the following timings: at plant, V2, V6, R2, R4, R8. Whole plant samples were taken at the following timings: V2, V6, R2, R4, R8. Plant and soil samples were taken from each replication per variety in a random pattern. Plant samples were cut at the soil surface and immediately placed into a paper bag and shipped for analysis.
- *Year 2* - Soil samples were taken at plant and after harvest. Whole plant samples were taken at the following timings: first trifoliate, V3 pre- and 2 weeks post-application, R1 pre- and 2 weeks post-application, and R3 pre- and 2 weeks post-application. Plant samples were cut at the soil surface and immediately placed into a paper bag and shipped for analysis.

Management:

- *Year 1* - All locations were planted at a seeding rate of 140,000 seed per acre. No fertilizer or fungicide were applied to either site. Glyphosate was applied to both sites at plant and at 3rd trifoliate.
- *Year 2* - Planted at a seeding rate of 140,000 seed per acre. No fertilizer or fungicide were applied to the site. Glyphosate and Paraquat was applied at plant. Enlist One mixed with Glyphosate was applied at the site at the 3rd trifoliate.

Harvest:

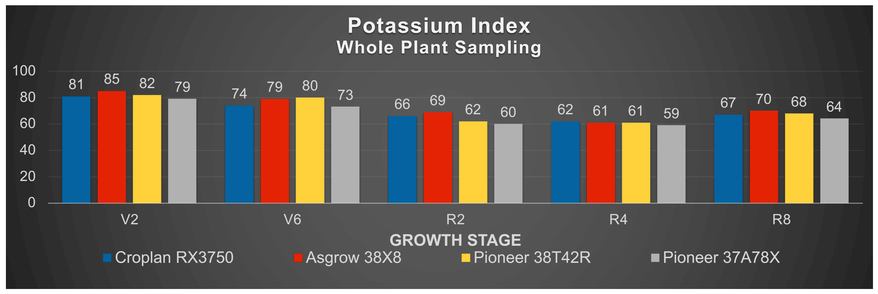
- *Year 1* - Replications were harvested individually and dumped into a weigh wagon for total weight. A Dickey John mini GAC Plus was used to record test weight and moisture.
- *Year 2* - The NC State Soybean Extension team used a small research combine to harvest the plots and record test weight and moisture.

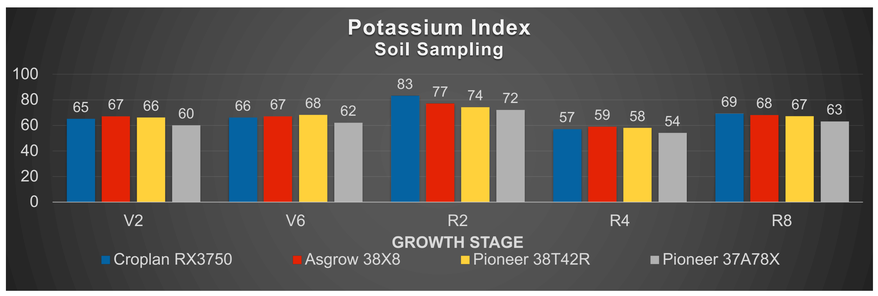


OBJECTIVES

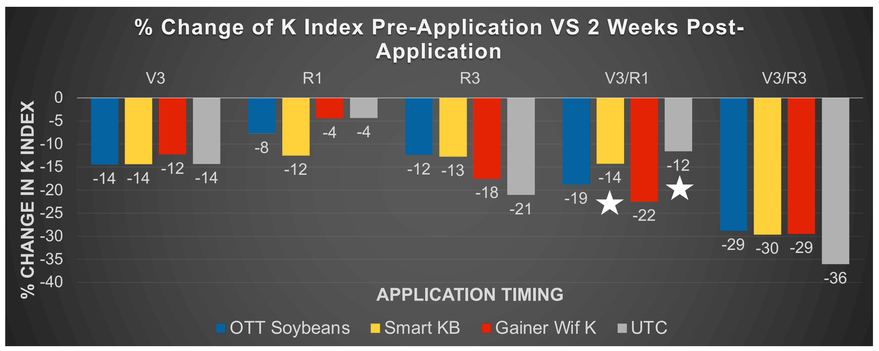
- Determine the uptake of nutrients on soybean growth and development throughout the growing season.
- Identify amount of nutrients in the soil and tissue of plants to assist in fertilizer application strategies based on plant growth stages.
- Conduct field trials to assess nutrient availability in the soil and in plant tissue at determined growth stages.
- Evaluate soybean production methods following the monitoring of nutrient availability for impacts and compare against different varieties within the same maturity group.
- Identify the optimum timing(s) for foliar fertilizer application to enhance plant health and yield production.
- Evaluate the ability of three different foliar fertility products to increase yield production of a single variety of soybeans.

RESULTS

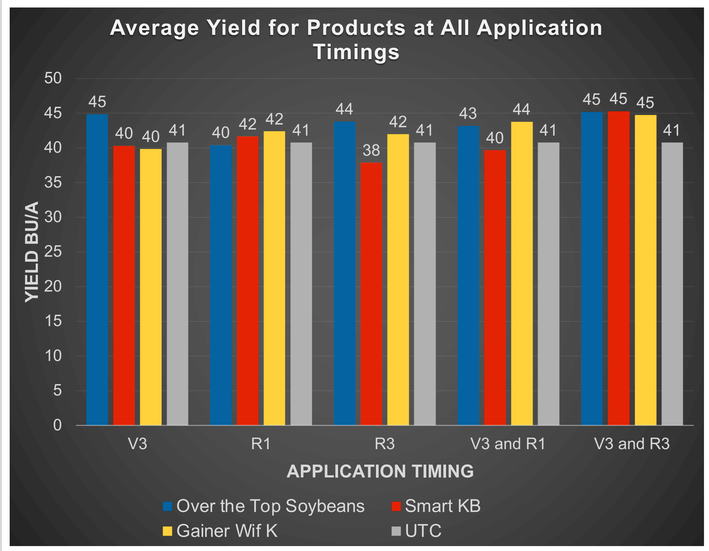




- Asgrow 38X8 had the highest potassium plant index across growth stages while Pioneer 37A78X had the lowest potassium index in the plant within all growth stages.
- Potassium indexes in the soil were highest at R2 growth stage with Croplan RX3750 having the highest index among varieties.
- Potassium index in the plant decreased significantly between V2 and V6, V6 and R2, and R4 and R8.



- In the V3/R1 combination application timing, the untreated check and SmartKB had significantly lower reduction in % change of K index.
- No other application timings saw significant differences between products



- There was no significant impact of timing on yield at $p<0.10$.
- Combining all application timings, there was no significant impact of product on yield at $p<10$

CONCLUSION

Year 1

- Whole plant nutrient indexes and soil sample nutrient indexes did not correlate with each other in this study.
- There does not seem to be varietal differences for nutrient content indexes for both whole plant and soil sampling at varying growth stages.
- Not all nutrients had the highest index in the plant or the soil at the same growth stage.
- Potassium levels in indicated that there may be opportunity to utilize potassium based foliar fertilizers at growth stages R1 and R3.

Year 2

- Foliar fertilizers did not show a significant impact on yield when applied at the V3, R1, R3, V3/R1, and V3/R3 growth stages.
- Foliar fertilizers did not show a significant impact on K index in most cases, with the exception of Smart KB applied at the V3/R1 growth stage.
- No specific application timing of foliar fertilizers had a significant impact on yield.

FUTURE RESEARCH

- Identify timings of maximum nutrient uptake of micronutrient foliar fertilizers throughout growth stages of the soybean plant.
- Assess nutrient uptake in plant tissue and amounts of nutrients at determined growth stages that will provide information on managing nutrient uptake and its relation to yield in soybean plants.
- Evaluate yield response of soybean to micronutrient foliar fertilizer applications at targeted growth stages.

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