Mississippi Corn Promotion Board
2013 Progress Report

Project Title:: Development of Cost-Effective Scouting Tools to Assess Early Leaf Nitrogen Status in Corn

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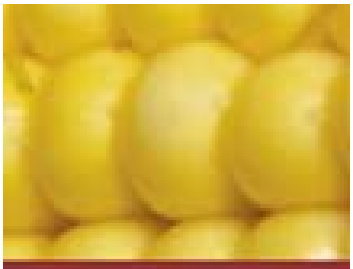
Department: Plant and Soil Sciences



Project Summary (Issue/Response)

Nitrogen (N) in various forms is key to agriculture production systems. Nitrogen is required in the greatest quantity of all fertilizer supplied nutrients for non-legumes and it constitutes one of the largest production input expenses. Inadequate N is a limiting factor in crop production and its deficiency, coupled with numerous other environmental and biophysical variables, reduces yields. Due to the transient nature of available soil N and its high mobility and potential for gaseous loss, managing it to optimize crop growth, while minimizing excessive costs and environmental losses is challenging. It is imperative to develop techniques which can easily help growers assessing in-season crop N status be developed and tested. Corn leaf N monitoring and variable rate applications have been successfully demonstrated using in-season remote sensing technologies, but these tools are often cost prohibitive for smaller producers. A one-year study was conducted at the W. B. Andrews Agricultural Systems Farm, Mississippi State, MS, to assess a hand-held spectral scouting tool (SE PSP 1100) and an inexpensive Nitrogen Status Assessment Tool (NSAT) for predicting corn leaf N status at V4 -V8 or prior to side dress fertilization. A urea-ammonium nitrate solution (32% N) was applied at 0, 80, 160, and 240 lb N ac^{-1}, with 50% of the total rate applied at emergence and the remainder at V4. The most recently matured, fully collared leaves were sampled for spectral reflectance, leaf N percent, NSAT score, SPAD chlorophyll, and other parameters at V4, V8, and VT growth stages.

Project Results/Outcomes

Corn grain yield in 2013 was directly related to fertilizer N application rate (r^2 = 0.93). The 0, 80, 160, and 240 lb N ac^{-1} rates yielded 16.8, 78.8, 170.5, and 191.3 bu ac^{-1} respectively. We determined that the NSAT did not result in a strong prediction of corn leaf N status at V4, although it may aid the observer in understanding the relative corn N status ranging from deficient to excessive fertilization (r^2 = 0.56). The strength of the relationship improved at V8. The NSAT data did closely relate to the SPAD chlorophyll meter data (r^2 = 0.92) suggesting the colors chosen related to the range in chlorophyll observed due to fertilizer N treatments. The NSAT may be useful for producers and scouts wishing to communicate relative corn N status when seeking advisement. Furthermore, we determined that the hand-held PSP-1100 spectro-radiometer did provide data that predicted leaf N status in early corn using the Green Normalized Difference Vegetation Index [(GNDVI) r^2 = 0.86]. Finally, we determined that multi-spectral aerial imagery flown of early corn does provide a moderate estimation of leaf N status related to N fertilization rate (GNDVI r^2 = 0.69) at the V4 stage. Further studies are needed to determine to what extent low-altitude, high-resolution aerial imagery might predict N status and aid in making N fertilizer recommendations.

Project Results

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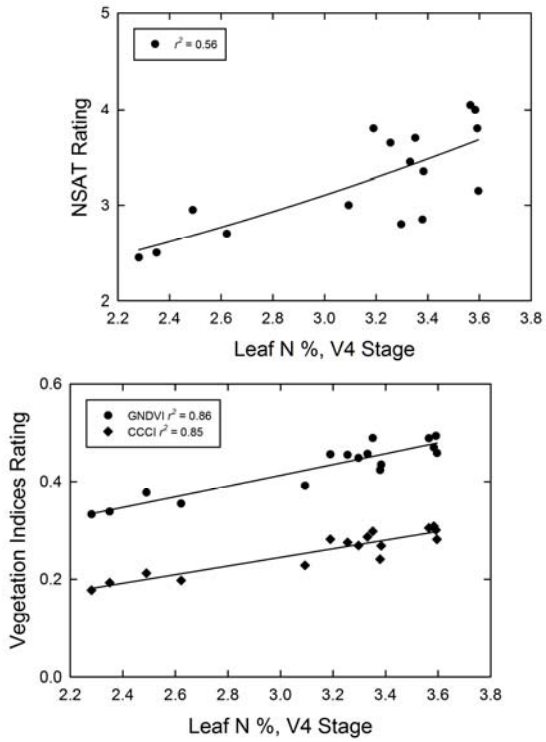

Fig. 1. Relationship between corn leaf N % at V4 and NSAT rating and GNDVI and CCCI vegetative indices.

Project Impacts/Benefits

With fertilizer N being the largest variable cost besides diesel fuel in the production of corn, quick and accurate scouting tools can assist the grower in dialing in the most accurate rate for fields which are uniform as well as variable. Tissue sampling is somewhat time consuming and costly on a large basis, whereas scouting tools could easily predict leaf N % with acceptable accuracy and provide growers with valuable information to adjust accordingly their fertilizer N application rates across fields. Optimizing fertilizer N application rates across fields can improve fertilizer N use efficiency while reducing losses to the environment. Reducing both under and over application of fertilizer N will improve profitability of the corn grain system.

Project Deliverables

Varco, J.J., A.A. Fox, T.B. Raper, and K.J. Hubbard. 2013. Development of sensor based detection of crop nitrogen status for utilization in variable rate nitrogen fertilization. p. 145-150. *In* John V. Stafford (ed.) Proc. of 9th European Conf. on Precision Agriculture, Lleida, Catalonia, Spain, 7-11 July 2013. Wageningen Academic Publishers, The Netherlands.

NSAT tool developed from available Munsell color sheets.

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