SOYBEAN YIELD AND BIOMASS RESPONSE TO SUPPLEMENTAL NITROGEN FERTILIZATION

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"ALTHOUGH YIELD RESPONSES TO NITROGEN FERTILIZATION IN HIGH YIELDING SOYBEAN WERE OBSERVED, ECONOMICALLY SUFFICIENT YIELD GAINS WERE NOT ACHIEVED TO WARRANT THE ADOPTION OF SUPPLEMENTAL APPLICATION IN THE MID-SOUTH PRODUCTION SYSTEM AT THIS TIME."

Bobby Golden

Field studies were conducted in 2014 and 2015 in Stoneville, MS, to evaluate soybean aboveground biomass and grain yield response to supplemental nitrogen (N) fertilization. Studies were carried out on two commonly cropped Mississippi soils, soil with Cation exchange capacity (CEC) <20 (Dubbs Silt Loam and Commerce Very Fine Sandy Loam) and soil with CEC >20 (Tunica Clay). The primary objective of this research was to evaluate the influence of supplemental N applications to soybean and observe any differences among N rate, source, and application timings. Soybean aboveground biomass was observed to be influenced by the main effects of application timing, N source, and N rate on soil with CEC <20. Soil with CEC >20 exhibited no response across all factors with respect to aboveground biomass, plausibly due to the greater organic matter content. Nitrogen application at V4 produced greater aboveground biomass at R5 on soil with CEC <20. However, increases in aboveground biomass due to application timing showed no influence on grain yield in our research, possibly due to the amount of available N during pod fill being greater for R1 application timing compared to that of V4 application timing on soil with CEC <20. Urea+NBPT was observed to produce the greatest aboveground biomass on soil with CEC <20. However, no association from biomass to grain yield was observed as PCU (polymer coated urea) produced the greatest grain yield on soil with CEC <20, suggesting PCU was able to supply available N at critical times of N uptake. The slow release characteristics of PCU could have resulted in the least antagonism between NO_3^--N concentration within the soil solution and the N2 fixation process, possibly limiting nodule inhibition on soil with CEC <20. However, with respect to overall soybean grain yield, N rate appears to be the most critical factor. Across soils, N fertilizer additions were able to supply available N at critical stages of soybean development (R3-R5) and grain yield increases were observed due to N fertilization. Yield component analysis exhibited a similar trend to that of overall soybean grain yield as N rate appeared to be the most critical factor. Soybean receiving N fertilization (> 0 lb N a^{-1}) were observed to produce a greater number of seeds $plant^{-1}$ than soybean receiving no N fertilization.

N fertilizer additions positively impacted soybean grain yields across soils, suggesting that soil-N concentrations were insufficient to meet soybean N requirement in a high yielding (> 55 bu a^{-1}) environment. Remobilization of tissue N within the plant may have accounted for some percentage of the excess N requirement during pod fill. However, yield increases were observed across soils due to N fertilization suggesting that available soil-N was able to fulfill the N requirement during critical stages of soybean grain development. Although yield increases were observed to be less than the levels suggested by others (Salvagiotti, 2008; Wesley et al.,1998), N fertilizer additions were able to fulfill the N requirement and increase the overall grain yields of the soybean plant in high yielding environments on two common Mississippi soils in the mid-south production system. Although yield responses to N fertilization in high yielding soybean were observed, economically sufficient yield gains were not achieved to warrant the adoption of this practice in the Mid-South production system at this time.

Table 1.1 *The main effect of N source pooled across application timing and N rate as it influenced soybean grain yield for research established on soil with CEC <20 during 2014 and 2015 at DREC.*

N Source¥	Grain yield†
	bu a⁻¹
AMS	88.2 ab
PCU	88.9 a
Urea+NBPT	86.7 b

¥(PCU-polymer coated urea, AMS-ammonium sulfate)

Table 1.2 *The main effect of N rate pooled across application timing and N source as it influenced soybean grain yield for research established on soil with CEC <20 during 2014 and 2015 at DREC.*

N rate	Grain yield†
lb N a^{-1}	*bu a^{-1}*
0	85.7 b
40	88.3 a
80	87.7 ab
120	88.8 a
160	89.4 a

Table 1.3 *The main effect of N rate pooled across application timing and N source as it influenced soybean grain yield for research established on soil with CEC >20 during 2014 and 2015 at DREC.*

N rate	Grain yield†
lb N a^{-1}	*bu a^{-1}*
0	68.8 b
40	71.6 ab
80	74.7 a
120	71.8 ab
160	73.8 a

Table 1.4 *The main effect of N rate pooled across application timing and N source as it influenced mean total seeds plant^{-1} for research established on soil with CEC <20 during 2014 and 2015 at DREC.*

N rate	Mean Total Seeds†
lb N a^{-1}	*# seeds plant^{-1}*
0	111 b
40	120 a
80	122 a
120	121 a
160	124 a

Table 1.5 *The main effect of N rate pooled across application timing and N source as it influenced mean total seeds plant^{-1} for research established on soil with CEC >20 during 2014 and 2015 at DREC.*

N rate	Mean Total Seeds†
lb N a^{-1}	*# seeds plant^{-1}*
0	127 b
40	142 a
80	147 a
120	143 a
160	145 a

†(Means within a column followed by the same letter are not significantly different at $P \leq 0.05$.)