HIGH YIELD SOYBEAN RESEARCH

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Introduction

High yield contest winners have achieved yields over 150 bu/ac, thereby demonstrating the yield potential of modern soybean cultivars. Major determinates of seed yield in soybean that may be manipulated by production practices are the number of plants/ac, the number of pods/plant, the number of seeds/pod and seed weight. The number of pods/plant is determined by number of nodes, number of branches and amount of sunlight reaching the pod positions. The planting density, row-spacing and crowding-out effect determines the final harvest population. A narrow row-spacing can accommodate a greater planting density with less crowding-out which may result in greater final harvest population. In Mississippi, a narrow row spacing of 15-inches was important to optimize yield with indeterminate early maturity group varieties (Bowers et.al, 2000). Skip or twin-row soybean is a compromise between narrow row and wide row systems, that supports a higher population density and encourages more branching and sunlight to reach lower leaves, thereby potentially increasing pod-set with cultivars that are bushy or medium-bushy growth types (McClure and Verbree 2013-2015, unpublished data). Bell (2005) reported that twin-row seeded soybeans produced greater yields than single-row soybeans due to more pods per plant. Nitrogen (N) supplied through N2 fixation may not be sufficient for high soybean yields. Ray et.al, (2005) concluded that high rates of N at planting could increase seed number and yield in irrigated or dryland environments. Other researchers have reported mixed findings with respect to consistency of response to N for soybean yield enhancement.

Subsequently, our objective was to evaluate effect of planting density, row configuration, post nodulation high nitrogen application, and apical dominance inhibition on factors that might influence yield such as stand, pod production and seed weight of two soybean cultivars grown under irrigation.

Methods

Irrigated field trials were conducted 2014-2016 at the Milan Research and Education Center (MREC) with 4 replications of the following treatments in a split-plot design:

- Two cultivars: Asgrow 4632 and Pioneer 47T36
- Two planting densities (Pop): 100,000 seeds/ac and 140,000 seeds/ac
- Three row configurations: 15-inch (40 cm), 30-inch (76 cm) and 15″ 2:1 twin-row systems.
- Two N rates (none, 150 lbs N/ac) post nodulation
- Apical dominance treatment (Cobra 12 oz/ac) applied V3 soybean on subset of plots

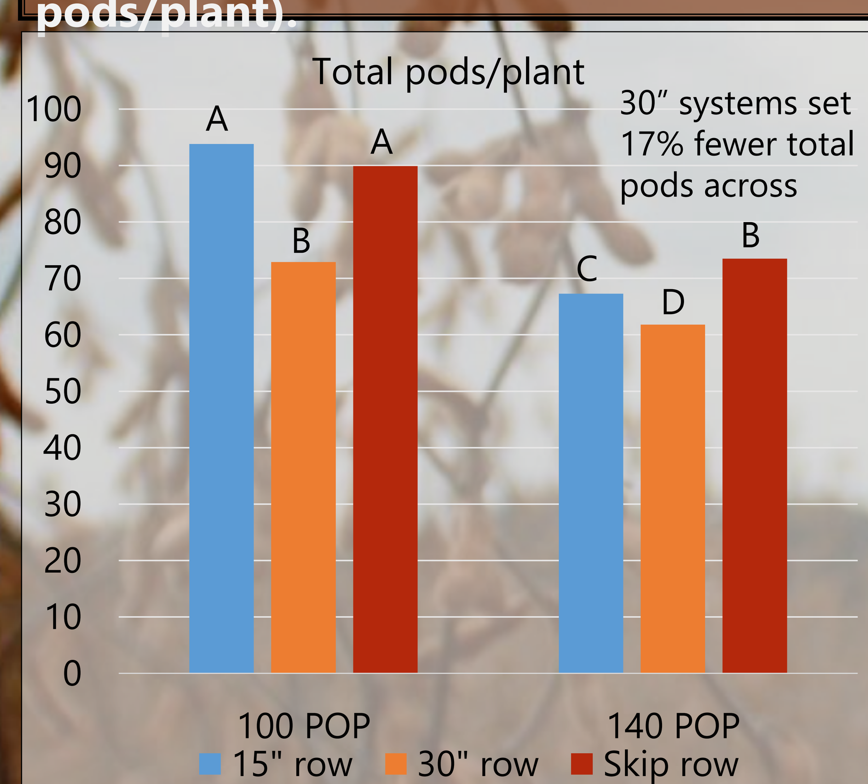
All plots were planted with a 15-inch modified John Deere MaxEmerge no-till planter outfitted with a Rawson Accu-Rate (Rawson Control Systems, Inc., Oelwein, IA 50662) controller. Twin-rows were obtained by turning off every third planter unit and 30-inch rows were obtained by shutting off every other unit. Plots were planted by May 10 all three years. Plots were irrigated using a center pivot system applying irrigation during each according to the University of Tennessee MOIST irrigation scheduler. 2014 and 2015 were high rainfall years with moderate temperatures, while 2016 was a low rainfall year with hotter temperatures during mid growing season. Ammonium nitrate (34-0-0) at 0 or 150 lbs N/ac was split-applied to R1 and R3 soybean. Stand counts were made at V-3 and harvest by counting plants in 10 row ft and converting to plants/ac. Leaf area (LAI) was measured at R1 (LAI-2000, Li-Cor Biosciences, Lincoln, NE). Plant height and node number were measured at R1 and harvest, and pod measurements made at harvest are expressed as total pod (average main + branch)/plant and average branch pod/plant. Plots were harvested with a Kincaid plot combine and harvest weights were converted to 13% standard moisture and expressed as yield in bu/ac. Hundred seed weights (g/100 seed) were determined from a sub sample of seed collected during harvest.

Data were combined across years and analyzed using Proc Mixed (SAS 9.4) where block and year were random factors, and cultivar, row configuration, N treatment and Cobra treatment were fixed factors. Type III statistics were used to determine main effects and interactions. Least square means were calculated based on α= 0.05.

Figure 1. Cultivar, Row Configuration, Planting rate, N Application effect on early and late season soybean growth and yield

Main Effect	Stand (V3)	Nodes (R1)	Height (R1)	LAI (R1)	Final Stand	Final Height	Final Nodes	Total Pod/plt	Branch Pod/plt	100 sd WT	Yield
Cultivar	ns	<.0001	<.0001	<.0001	0.0083	ns	<.0001	0.0159	ns	ns	0.0004
Row Configuration	<.0001	ns	<.0001	0.0002	<.0001	0.0098	<.0001	<.0001	<.0001	ns	<.0001
Planting Rate (Pop)	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001	ns	ns
N Treatment	ns	ns	ns	0.0453	ns	ns	<.0001	0.0059	ns	<.0001	<.0001
Cultivar*Row Config	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns
Cultivar*Pop	ns	ns	ns	ns	ns	0.0061	ns	ns	ns	ns	ns
Row Config*Pop	<.0001	ns	ns	ns	0.0008	ns	ns	0.0004	0.0002	ns	ns
Cultivar*Row config*Pop	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns
N Trt*Cultivar	ns	ns	ns	ns	ns	0.0031	ns	ns	ns	ns	ns
N Trt*Row Config	ns	ns	ns	0.0325	ns	ns	ns	ns	ns	ns	ns
N Trt*Cultivar*Row Config	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns
N Trt*Pop	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns
N Trt*Cultivar*Pop	ns	ns	0.0232	ns	ns	ns	ns	ns	ns	ns	ns
N Trt * Row Config*Pop	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns
N Trt*Cultivar*Row config*Pop	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns

Figure 2. Effect of Row Configuration and Planting rate on Total Pod (average main stem + branch pod/plant) and Branch pod production (average branch pods/plant)



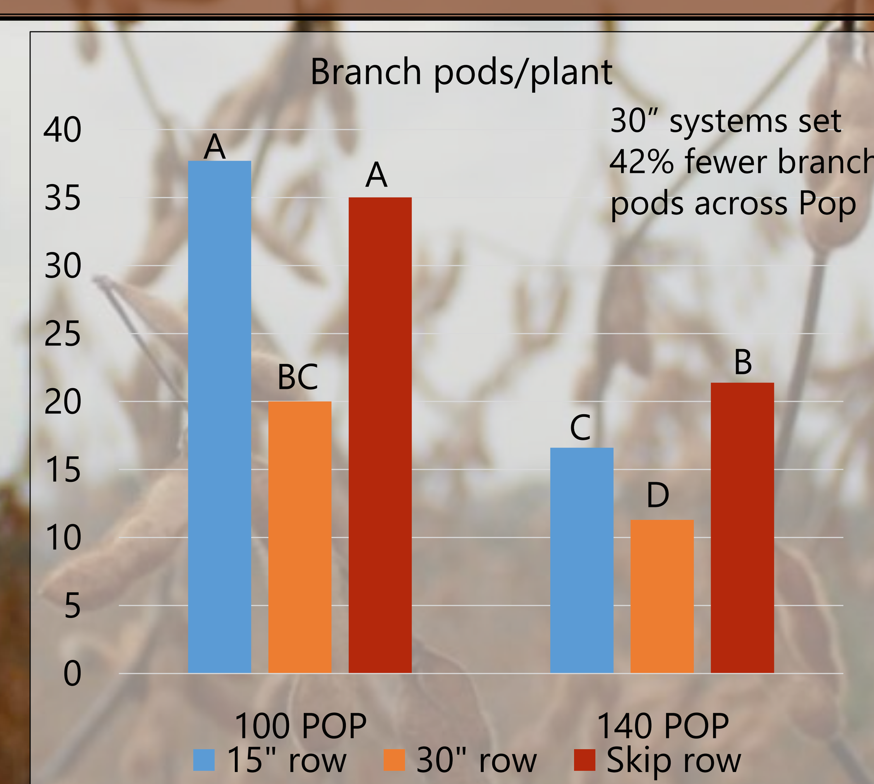


Fig. 3. Post nodulation N on 100 seed weight (g)

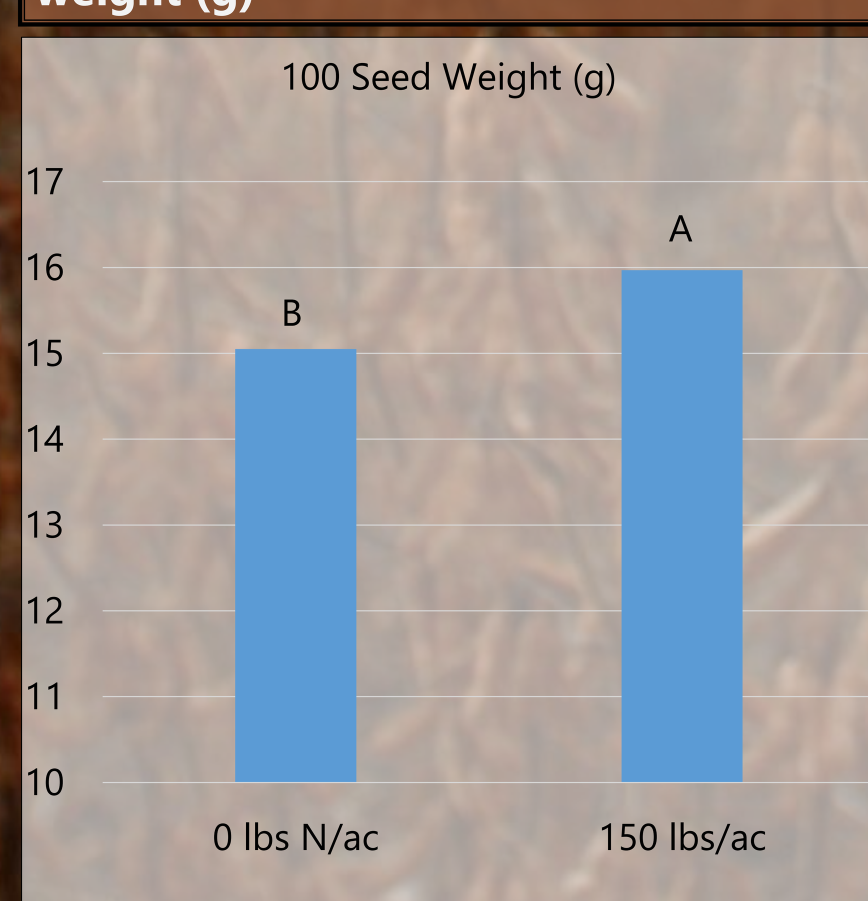


Figure 4. Yield across year by cultural practice (2014-2016).

Evaluated Cultural Practice	Yield (bu/ac)	Letter Group
Row Configuration		
15″	83.0	A
30″	76.7	B
Skip Row	82.9	A
Planting Rate (POP)		
100,000 sds/ac	87.3	A
140,000 sds/ac	89.7	A
Post Nodulation N		
0 lbs N/ac	77.9	B
150 lbs N/ac	83.8	A
Cobra at V-3		
0 oz/ac	81.3	A
12 oz/ac	78.9	A

Results and Conclusions (Fig 1-4)

- Highest numerical yield for Asgrow 4632 was with 140K Pop in a 15″ row with supplemental nitrogen.
- Highest numerical yield for Pioneer 47T36 was with 140K Pop in a skip row configuration with supplemental nitrogen.
- Row configuration was significant for most early and late season growth measurements except 100 seed weight (Fig 1).
- Row config*Pop was significant for final stand, total and branch pod (Fig 1,2,3):
  - 15″ row plots had more plants at harvest>skip row>30″ row
  - Skip row configuration set more total and branch pods at higher Pop
  - All row configurations produced more total and branch pods at the lower planting rate.
  - Across varieties, plants in 30″ rows filled 17 and 42% fewer total and branch pods, respectively, per plant compared to the 15″ and skip row configuration
- Planting rate (POP) affected all growth/development measurements except 100 seed weight (Fig1) and did not increase yield significantly (Fig 4), indicating that a lower but uniform Pop may yield similar to a higher Pop when cultivars have the ability to increase main stem and branch pods.
- Nitrogen application increased final node number, total pod production (data not shown), 100 seed weight (Fig 3) and yield (Fig 4) although amount of yield return would not be cost effective at rate applied.
- Cobra treatment was not significant for most growth/development measurements (data not shown) or yield (Fig 4).

References Cited

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Ray, J.D., L.G. Heatherly and F.B. Fritschi. 2005. Influence of large amounts of nitrogen on nonirrigated and irrigated soybean. Crop Science. 46; 1, 52-60.