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PROJECT TITLE: Maximizing Soybean Yield in Mississippi: Influence of Plant Populations, Seed Treatments, and Stand Loss on Overall Profitability

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IMPACT OF EARLY SEASON MANAGEMENT DECISIONS ON SOYBEAN YIELD

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Abstract

Neonicotinoid insecticide seed treatments are currently used in all row crops throughout the Midsouthern United States because of their high degree of efficacy on early-season pests that occur at the early growth stages. Seed treatments are one of several management tools adopted by soybean producers to achieve maximum yields across the Mid-South. Recent studies have shown that use of neonicotinoid insecticide seed treatments (IST) results in yield increases as well as positive net returns when utilized in soybeans.

A study was conducted to show the effect of stand loss on soybean yield at different plant populations and timings of plant loss. The treatments in this study included six soybean plant populations of 185,250, 247,000, 308,750, 370,000, 432,250, and 494,000 plants ha^{-1}, and timings of plant loss at V2 and V4. Another study was conducted to maximize soybean yields using plant populations, seed treatments, and planting dates. The treatments in this study included the six soybean plant populations shown above, three seed treatments of untreated, base fungicide only (ApronMaxx), and insecticide + base fungicide (CruiserMaxx), and planting dates of Mid-May and Mid-June. Plots were scouted weekly and insecticide applications were made when insect thresholds were reached. Our findings determined that increasing seeding rates could compensate for stand loss in these plantings; however, there is a potential risk incurred because higher seeding rates are not as profitable when no stand loss occurs.

These results will not necessarily extrapolate to plantings made significantly earlier than those used in this study when these factors (plant population, seed treatment, and stand loss) are applied to those earlier plantings.

Introduction

Neonicotinoid insecticide seed treatments are currently used on 90% of soybean acres in Mississippi. They are used for their high degree of efficacy on early-season pests that occur at the early growth stages. Recent studies have shown they can increase yields as well as net returns when utilized (North et al. 2016). Seed treatments are one of several recent management tools adopted by soybean producers to achieve maximum yields across the Mid-South. Different plant populations and planting dates, plus precision planting to achieve uniform stands early in the growing season, are several recent adoptions used along with seed treatments to maximize yields. The objectives of this research were to determine the effect of stand loss in different plant populations and timings of that plant loss on soybean yield, and to determine the effect of plant populations, seed treatments, and planting date on maximum seed yield of soybean.

Materials and Methods

Multiple experiments were conducted in 2016 and 2017 to quantify the effect of stand loss and timing of that stand loss on yield of soybean that was grown in different plant populations.

Objective 1. Asgrow AG4835 was planted at six locations in Mississippi over the years 2016 and 2017. Two trials were conducted at Mississippi State University, MS located on the R.R. Foil North Farm. Four trials were conducted at the Delta Research and Extension Center located in Stoneville, MS. Trials consisted of 12.2-m-long plots with 4 replications. The trials were grown in a randomized complete block (RCB) design with a factorial arrangement of treatments. Factor A was seeding rate, which included 185,250, 247,000, 308,750, 370,000, 432,250, and 494,000 plants ha^{-1}. Factor B was percent stand loss of 0%, 20%, and 40%. Factor C was stand loss timing at the V1 and V3 stages. Percent loss was achieved by mixing Asgrow AG4835RR (Roundup Ready) and HBKLL 4953 (Liberty Link) at the given percentages based on seeding rate. Roundup was applied to each assigned plot at V2 and V4 to remove plants with Liberty Link herbicide seed trait (LL) to achieve the desired percent stand loss in each plot.

Objective 2. Asgrow AG4835 was planted at six locations in Mississippi. Two trials were conducted at Mississippi State University, MS located on the R.R. Foil North Farm. Four trials were conducted at the Delta Research and Extension Center located in Stoneville, MS. Trials consisted of 12.2-m-long plots with 4 replications. The trials were in a RCB with a factorial arrangement of treatments. Factor A was the above seeding rates, Factor B was seed treatment of untreated seed, base fungicide alone (ApronMaxx), and insecticide + fungicide (CruiserMaxx), and Factor C was planting date of Mid-May and Mid-June.

Results

Stand Loss Trial. There were no significant differences between locations; therefore, all experiments were combined for data analyses. There were significant relationships between seeding rate and yield at 0% and 40% stand loss. There was a decrease of 1.1 kg ha^{-1} for every 1,000 seed planted at the 0% stand loss (Figure 1). There was no significant relationship between seeding rate and yield at the 20% stand loss (Figure 2); however, there was an increase of 1.7 kg ha^{-1} for every 1,000 seed planted at the 40% stand loss (Figure 3).

There were significant relationships between seeding rate and net returns to treatments at 0%, 20%, and 40%. Net returns to treatments decreased as seeding rate increased; however, when stand loss occurred, higher plant populations compensated for yield and offered higher net returns to the applied treatments (Figure 4).

Plant Population Trial. At the Mid-May planting date, untreated and fungicide-only treated seed yielded higher than the seed treated with insecticide + fungicide at the lower seeding rate (Figure 5). However, untreated and fungicide-only treated seed yield decreased as seeding rate increased, but the neonicotinoid insecticide seed treatment stabilized yield across all six plant populations. At the late planting date (Mid-June), untreated and fungicide-only treated seed resulted in increased yield as plant population increased, and the neonicotinoid seed treatment yielded higher and stabilized yield across all six plant populations. Overall, regardless of planting date, IST stabilized yield across all six plant populations in 2016 and 2017.

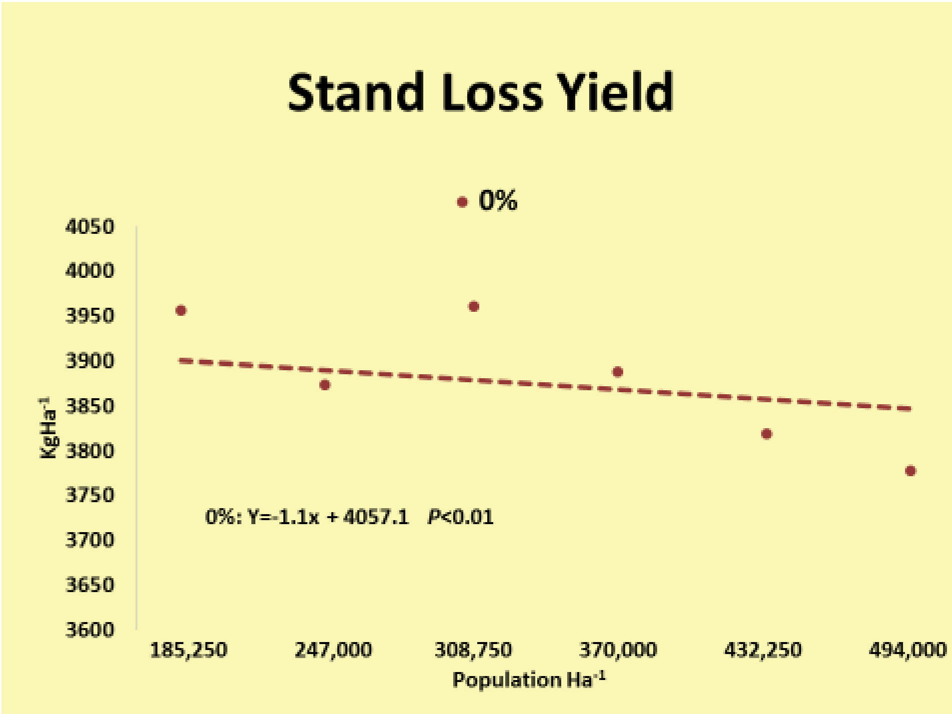

Figure 1. Relationship of stand loss and yield at 0% stand loss across all locations in 2016 and 2017.

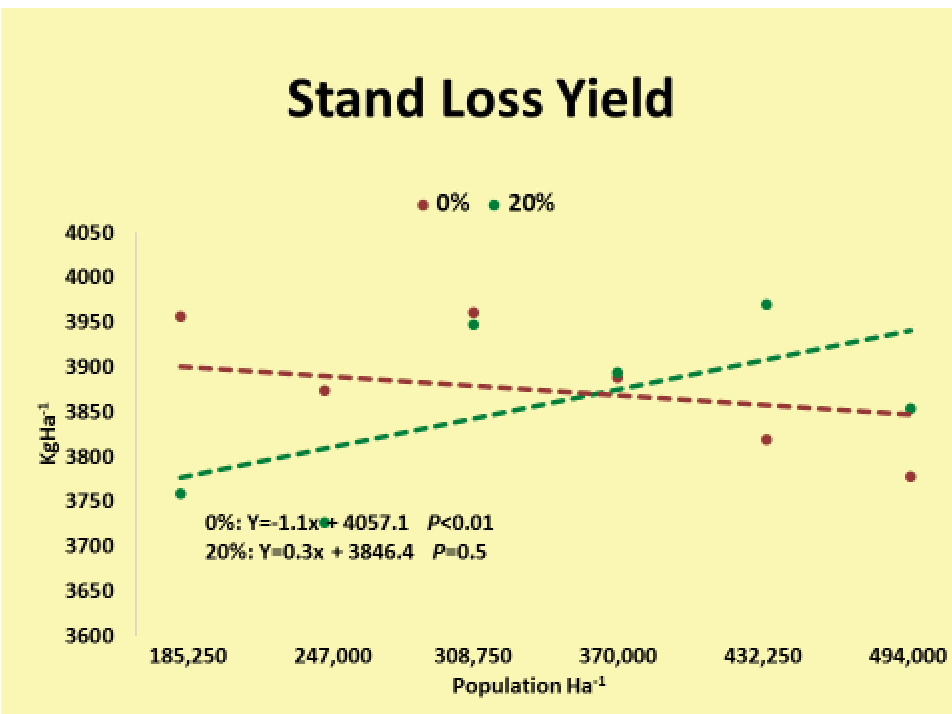

Figure 2. Relationship of stand loss and yield at 20% stand loss at all locations in 2016 and 2017.

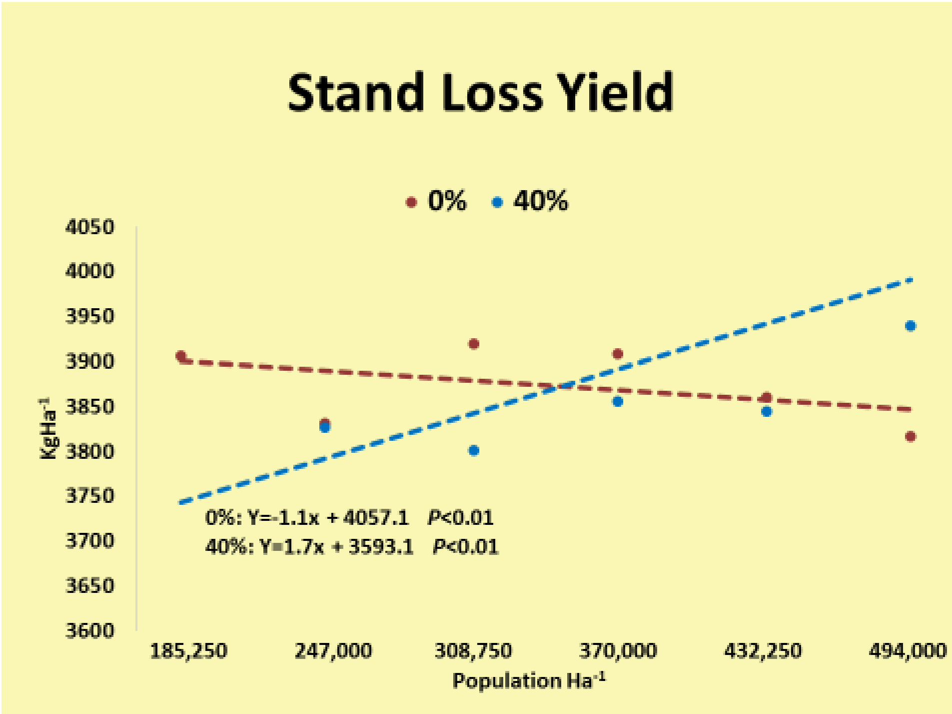

Figure 3. Relationship of stand loss and yield at 40% stand loss at all locations in 2016 and 2017.

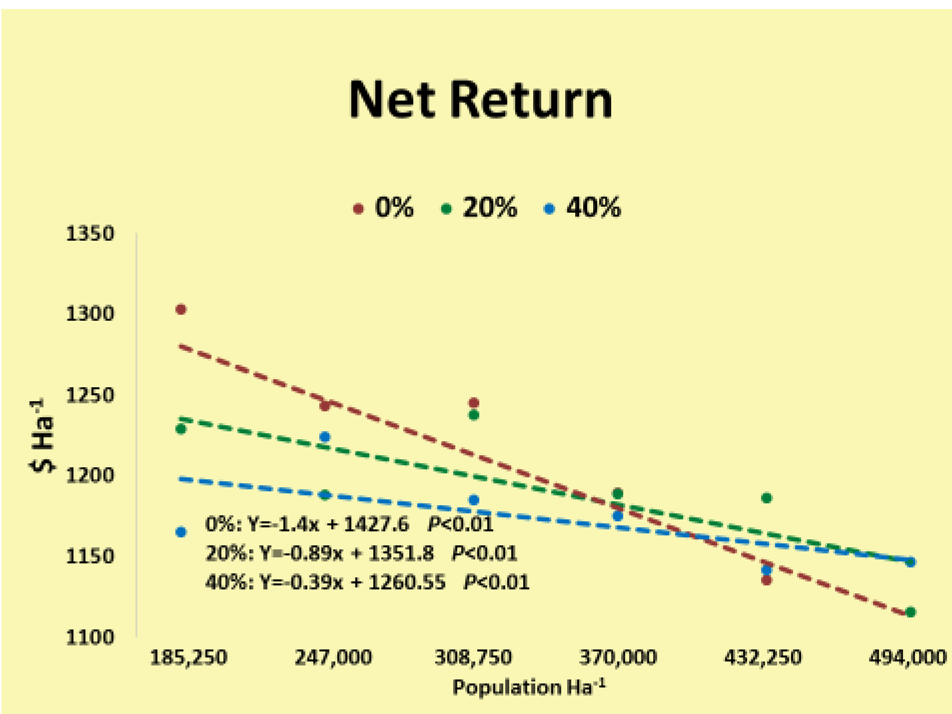

Figure 4. Net returns to seed and seed treatment costs for stand loss trials across all locations in 2016 and 2017.

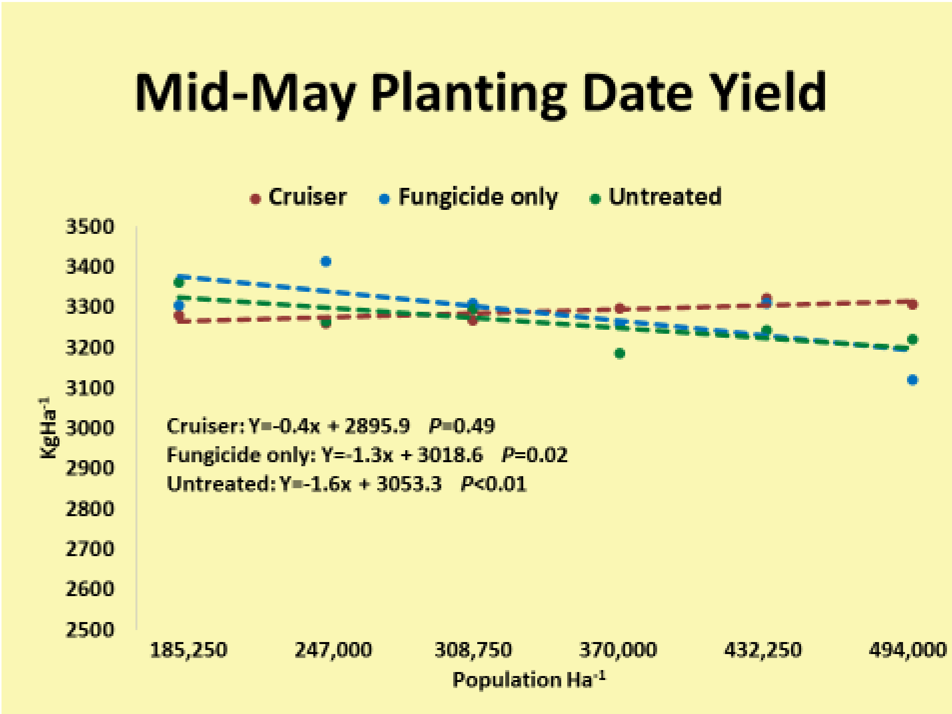

Figure 5. Plant population yields at mid-May planting date across all locations in 2016 and 2017. Cruiser is CruiserMaxx (insecticide + fungicide) and fungicide only is ApronMaxx.

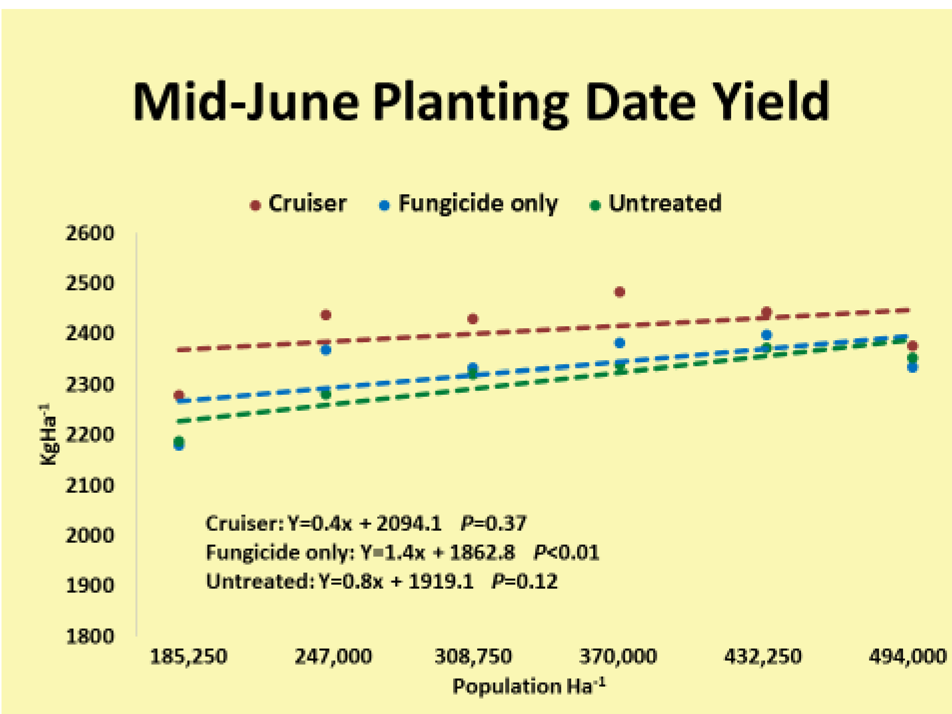

Figure 6. Plant population yields at late planting date across all locations in 2016 and 2017. Cruiser is CruiserMaxx (insecticide + fungicide) and fungicide only is ApronMaxx.

Summary

Across trials in 2016 and 2017, soybean yields were maximized at lower plant populations when no stand loss occurred. When stand loss occurred, soybean yields benefited from higher plant populations and compensated for the stand loss at 20% and 40%. The neonicotinoid IST stabilized yield across planting dates of mid-May and mid-June. Yield was penalized by increased plant populations without an IST in the mid-May planting. At the late planting date, IST stabilized yield across all plant populations and the fungicide-only and untreated seed benefited from increased plant populations. Overall, it is possible to compensate for stand loss by increasing seeding rate in mid-May and mid-June soybean plantings; however, there is a risk associated with increasing seeding rates and losing profit when a stand loss does not occur due to the higher cost of the seed needed for higher plant populations.

References Cited

North, J.H., J. Gore, A.L. Catchot, S.D. Stewart, G.M. Lorenz, F.R. Musser, D.R. Cook, D.L. Kerns, D.M. Dodds. 2016. Value of Neonicotinoid Insecticide Seed Treatments in Mid-South Soybean (*Glycine max* L.) Production Systems. Journal of Economic Entomology 2016.

Conversions	
Plants per hectare ÷ 2.47 = Plants per acre	
185,250	75,000
247,000	100,000
308,750	125,000
370,000	150,000
432,250	175,000
494,000	200,000
Kg per hectare ÷ 67.19 = Bushels per acre	
2,250	33.5
2,500	37.2
2,750	40.9
3,000	44.6
3,250	48.4
3,500	52.1
3,750	55.8
4,000	59.5
$ per hectare x 0.405 = $ per acre	
1,100	445.50
1,150	465.75
1,200	486.00
1,250	506.25
1,300	526.50