

2015 Soybean Production in Southeast Kansas

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Summary

Crop performance and yield varies as a function of the growing environment and soil properties within the field. Optimal soybean planting in southeast Kansas usually occurs from mid-May to mid-June for full-season or late-June to early-July for double-cropped soybean. Planting is timed to capture fall rains and cooler temperatures during critical periods of bean development and yield formation and avoid mid-summer heat and drought. Changing planting configuration (row spacing and plant population), timing of planting, and cultivar selection are methods of optimizing soybean production for different growing environments.

Introduction

Soybean yield potential is modified by the productive capacity of the soil and the growing environment. The difference between the yield potential of a cultivar and the actual harvested on-farm yield (the so-called “yield gap”) represents a loss of return on investment and inefficiency in crop production. Many factors contribute to this loss of yield potential, including environment (temperature, sunlight, and rainfall), soil quality, pests, and inefficiencies in selection of the best management practices. This research is designed to identify critical components that determine yield through on-farm measurements of crop performance, soil quality, and climate, coupled with research tests of soybean performance.

Advances in soybean breeding programs have developed cultivars for improved productivity. The optimal planting times and configurations for these cultivars under the varying soils and environmental conditions across the state of Kansas is not known. This study is part of a larger study examining optimal planting dates for modern soybean varieties from various maturity groups. Additional research is exploring changes in row spacing and plant populations to determine optimal configurations for planting and return on investment.

Conventional production practices in southeast Kansas time soybean planting to ensure that the high-water demanding reproductive period occurs during the fall rains, avoiding dry periods common during the summer. This later spring planting works best for longer maturity groups; however, these longer maturing varieties have later harvests. Harvest can be even further delayed by cooler temperatures and wet soils in the fall. Researchers in other parts of the United States have shown an earlier planting system for soybean can improve yields, more importantly under high-yielding conditions, by

increasing the vegetative growth period and forming more nodes where soybean pods can develop (Heatherly et al., 1998). This study explores the impact of planting date on yield for modern soybean cultivars at varying maturity groups in southeast Kansas.

Previous results from on-farm studies identify the number of plants per acre as the major factor contributing to soybean yield. Previous work by Ken Kelley at the Southeast Agricultural Research Center showed soybean yields were optimal at 15-in. row spacing in conventional tillage, and 7.5-in. spacing for no-till production. Here, additional studies were undertaken to determine optimal planting configuration and plant population for modern soybean cultivars.

Experimental Procedures

Soybean cultivars from maturity groups 3.9, 4.8, and 5.6 were planted at three times during the 2014 and 2015 growing seasons. The cultivars 'AG3934,' 'AG4831,' and 'AG5632' were planted on May 2, June 3, and June 26 in 2014; and May 5, June 2, and July 1 in 2015 on a Parsons silt loam soil at the Southeast Research and Extension Center in Parsons (KS, U.S.). All treatments were replicated 4 times. Conventional agronomic practices were followed to ensure optimal production. Total yield from each cultivar and planting date was determined by harvesting the center rows of each plot at maturity using a plot combine (200 sq ft).

A separate study was performed to explore the change in soybean productivity with row spacing and plant population. Soybean (48T80RR) were drilled into 7.5-in., 15-in., and 30-in.-wide rows in 2014 and 2015 with a Great Plains no-till drill to four different plant populations (100,000; 137,500; 175,000; and 212,500 seeds/a) at the Southeast Research and Extension Center research station near Columbus, KS. Plant stands were measured after germination to determine final plant population. Plots were 10 ft × 50 ft and replicated six times. Standard agronomic practices were followed for optimal crop production. Center rows of each plot were harvested at maturity with a plot combine (250 sq ft). Additional measurements were conducted on-farm by harvesting total plants within a 3 ft × 3 ft square at several locations in production fields. Plant stand and yield components were determined within plant stands for different planting configurations (7.5" drilled to 30" rows) on-farm. Yield and plant population were measured by dissecting and determining grain components (seed/ac; pods/ac; plants/ac; etc.).

Results and Discussion

Planting Date × Maturity Group

During 2014, the earlier maturity group (MG) (3.9) yielded highest at the earliest planting date (May 2), 49 bu/a (Figure 1). This earlier maturing variety planted relatively early likely benefited from a wetter and cooler than normal June in 2014, with most yield being determined prior to periods of heat and drought during August. Yield declined for this MG at later planting because flowering and pod set occurred later in the season during a period of heat and drought (26 bu/a planted on June 3 and 37 bu/a planted on June 26, 2014) (Figure 1).

The longer-maturing cultivars (both 4.8 and 5.6 MG) yielded better at the later planting dates (yields above 45 bu/a) in 2014. Improved yields with later plantings are likely due to a shift in flowering and pod set to the cooler and wetter conditions of September. Similar yields were observed for both later maturing varieties for the June 2014 plantings (both approximately 51 bu/a). The early May 2014 planting of the 4.8 and 5.6 MG soybean varieties shifted timing of flowering and pod set during the hot and dry periods of the summer, and yields were reduced (38 and 41 bu/a, respectively) (Figure 1). Although there was a trend in the data that supported timing of planting to capture fall rains to enhance yield, the results were not statistically significant between the later maturity groups (with both 4.8 and 5.6 MG yielding comparably).

Yields with planting date and maturity group in 2015 were not consistent with those observed in 2014 (Figure 2). The 2015 season was much wetter than average, especially for the early-planted soybeans (Figure 3). It was also a cooler year throughout the growing season, with fewer than 5 days of temperatures exceeding 95°F, the temperature above which soybean yields are reduced (Sassenrath et al., 2014).

This environment resulted in increased yields for all planting dates and cultivars (Figure 2). The lowest yield reported in this study in 2015, 53 bu/ac for the earlier MG (AG3934) planted early (May 5, 2015), exceeded all yields reported in 2014. The AG4831 had the highest yield of all cultivars at 75 bu/ac for the earliest planting date (May 5, 2015). No differences in yield were observed between MGs planted at the later dates. While there was a trend for lower yields at the later planting date (58 bu/ac planted on July 1 vs. 64 bu/ac planted on June 2 across all cultivars), the difference was not significant.

Row Spacing × Plant Population

Planting higher populations of soybeans tends to slightly increase yield when data are combined across all row spacings (Figure 4). These higher populations are more difficult to obtain at wider row spacings. Also, poor plant stands, particularly at the wider row spacing (30"), can significantly lower yield.

While yield increased at narrower row spacing and higher plant population, the increased seeding costs for higher populations limited the increase in net return (Figure 5). Note that only differences in seed costs were taken into account in determining the net return. The optimal plant population was approximately between 100,000 and 125,000 plants per acre. It is clear that the optimum economical seeding rate (approximately 110,000 plants/ac) is lower than the agronomically optimum seeding rate of more than 130,000 plants/ac. An estimated seed cost of \$50/bag with 140,000 seed/bag was used for the calculation reported here. The economically optimal population will change with seed costs.

Yield and net return are not significantly increased at higher populations; conversely, lower populations show a linear decrease in yield and net return. Some compensation of yield occurs in soybeans, as the number of pods per plant increase as plant population decreases below 100,000 plants per acre (Sassenrath et al., 2014). While it is imperative to have an adequate stand (above 60,000 plants/ac) to optimize yield of soybean, planting very high populations may not be cost effective.

Reference

- Heatherly, L.G., Bowers, G. ed. 1998. Early Soybean Production System Handbook. USB 6009-091998-11000. Agricultural Communications, Mississippi State University. http://unitedsoybean.org/wp-content/uploads/ESPS_Handbook_19984.pdf
- Sassenrath, G.F., Liu, X., Shoup, D. 2014. Crop Yield Trends in Kansas. Agricultural Research 2014, Southeast Agricultural Research Center, Kansas State University, SRP 1105. Kansas State University Agricultural Experiment Station and Cooperative Extension Service. p. 66 – 70.

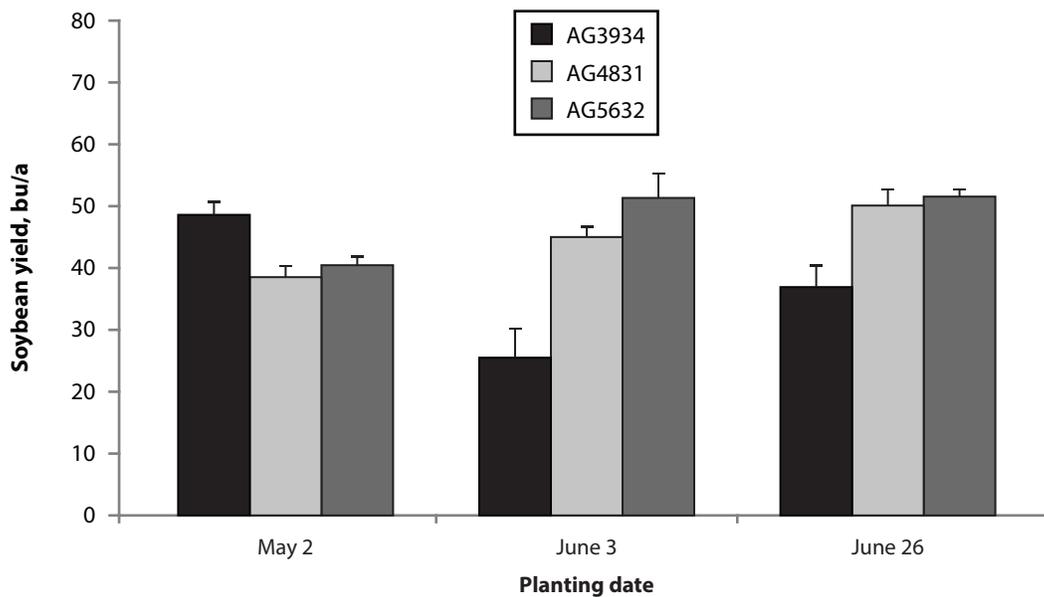


Figure 1. Soybean yield (bu/a) in 2014 for different planting dates (early = May 2, mid = June 3, and late = June 26) and maturity groups (3.9, 4.8, and 5.6 maturity group) for southeast Kansas.

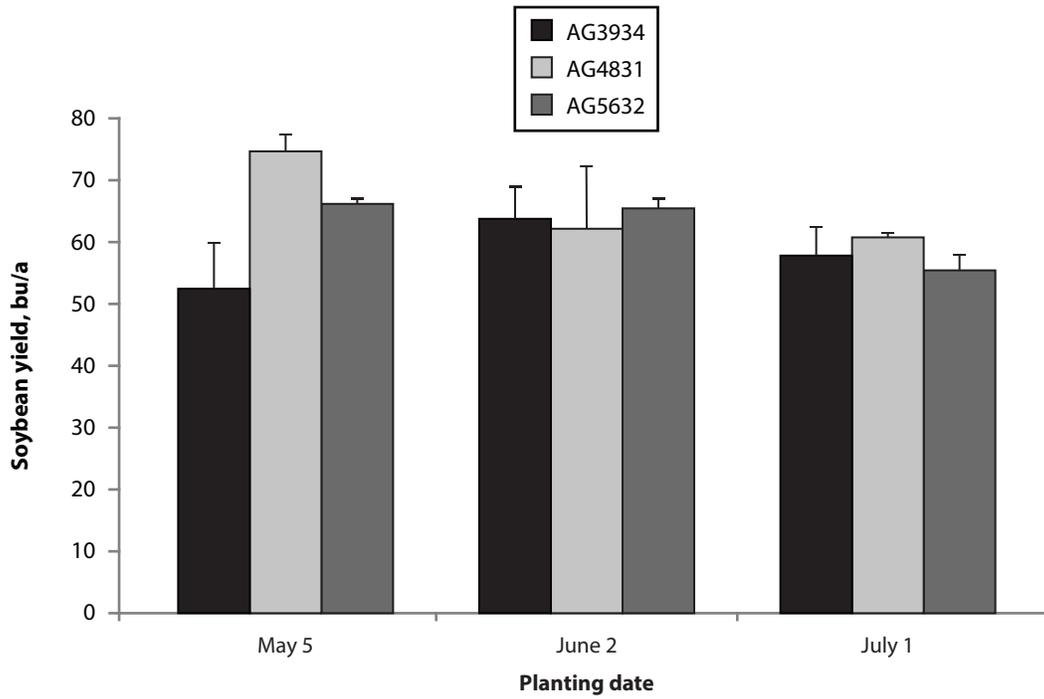


Figure 2. Soybean yield (bu/a) in 2015 for different planting dates (early = May 5, mid = June 2, and late = July 1) and maturity groups (3.9, 4.8, and 5.6 maturity group) for southeast Kansas.

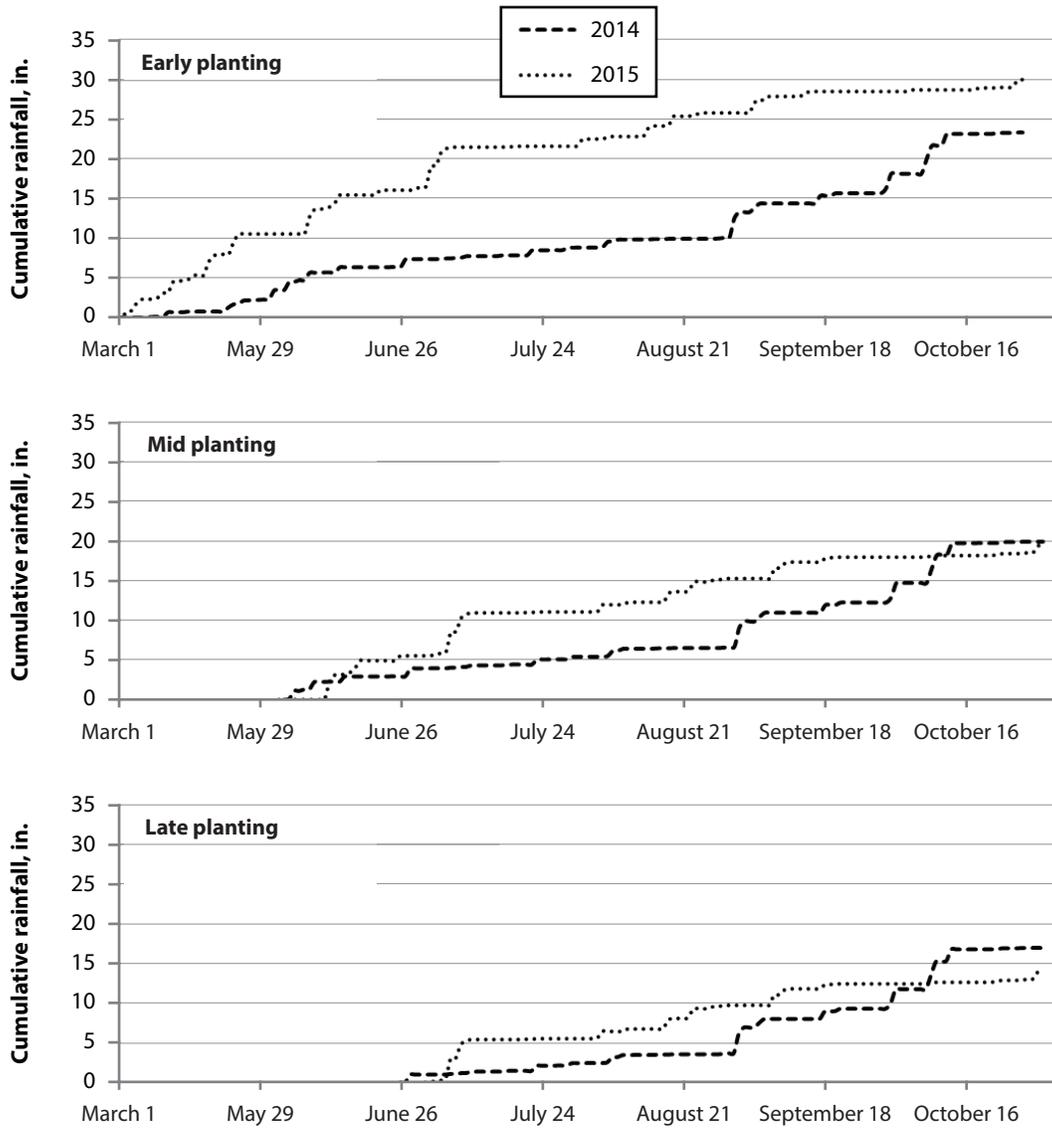


Figure 3. Comparison between growing environments. Cumulative rainfall totals during growing season for Early, Mid and Late soybean planting study in 2014 and 2015.

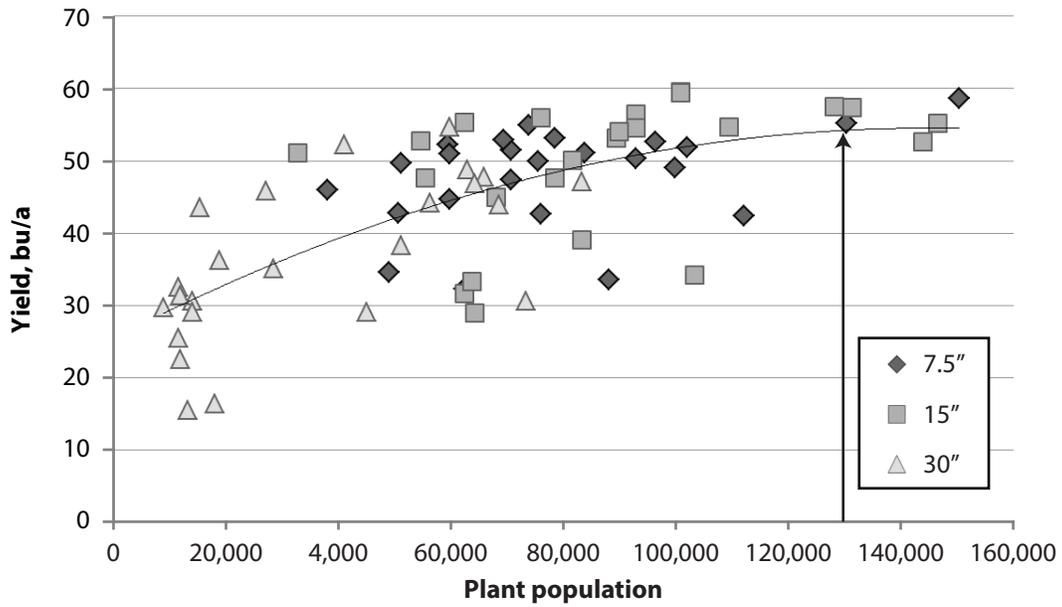


Figure 4. Change in soybean yield with plant population and row spacing. Approximate optimal agronomic population indicated by the arrow.

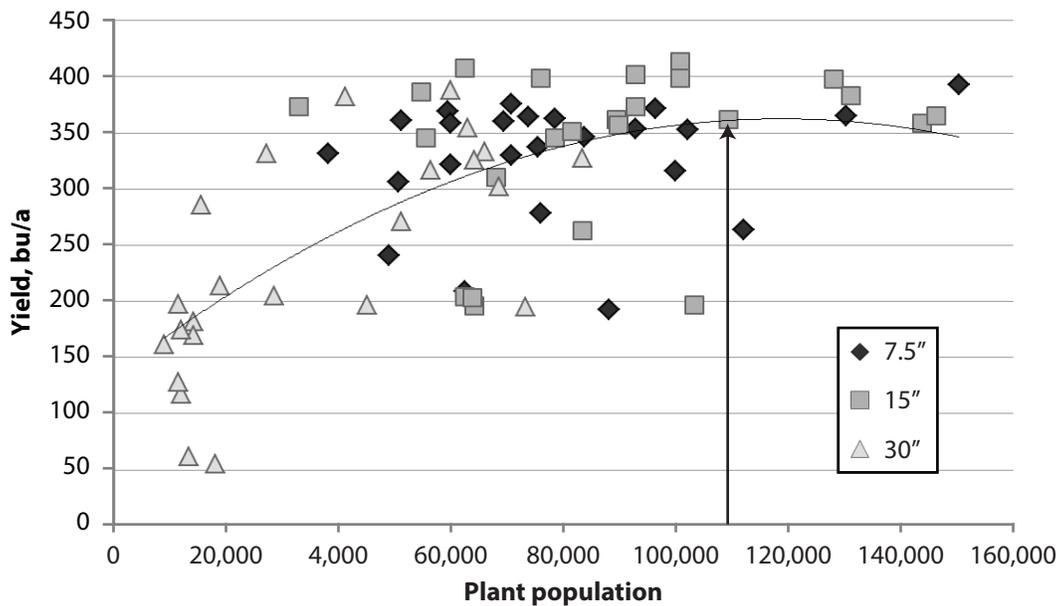


Figure 5. Optimal return on investment for soybean plant population at different row spacings. Approximate optimal economic population indicated by the arrow.