SOYBEAN YIELD RESPONSE:

PLANTING DATE AND MATURITY GROUPS IN ARKANSAS

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Farmers growing soybeans in the Mid-South region often face similar issues as their counterparts across state lines. For this reason, the Mid-South Soybean Board (MSSB) funds research projects that address soybean-production questions and challenges to benefit farmers across the region. The volunteer farmer-leaders who serve on MSSB invest checkoff dollars in ongoing research and extension programs designed to address soybean-production challenges and provide information to increase farmer profitability. Use the information in this publication to help you achieve success during the 2016 planting season and beyond.

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PLANTING DATE AND MATURITY GROUP REGIONAL PROJECT

The data presented in this article is a result of a large, three-year regional project funded jointly by the United Soybean Board (USB) and the Mid-South Soybean Board (MSSB). The aim of this project was to study the effect of planting date, latitude and environmental factors on the choice of soybean maturity group (MG) in the Mid-South when grown under fully irrigated conditions. Experiments were conducted from 2012 to 2014 at a total of 10 locations (Figure 1), with four planting dates and four cultivars in each of the MGs from 3 to 6. Yield results from two locations in Arkansas (Rohwer and Keiser, AR) are summarized in this report.

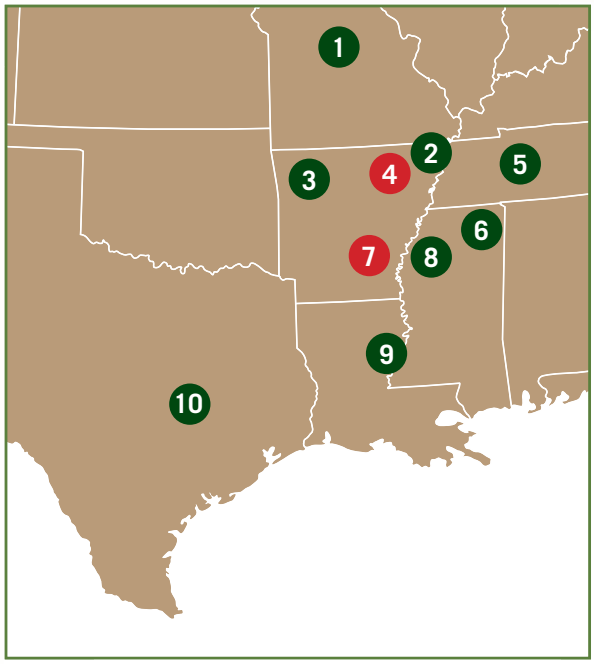

Figure 1: Locations where field experiments were located in the planting date and maturity group regional project: (1) Columbia, MO; (2) Portageville, MO; (3) Fayetteville, AR; (4) Keiser, AR; (5) Milan, TN; (6) Verona, MS; (7) Rohwer, AR; (8) Stoneville, MS; (9) St. Joseph, LA; and (10) College Station, TX. Results from Keiser and Rohwer, AR (highlighted in red) are summarized in this report.

BACKGROUND

Planting date is one of the main factors affecting soybean (*Glycine max* [L.] Merr.) yield. Delayed planting often reduces yield. Some of the main factors that explain this yield reduction are a shortened growing cycle and/or seed-filling phase, less light interception and higher temperatures during the seed-set period. In a review of planting-date studies under rainfed conditions, yields started to decrease with planting dates after June 7 in the upper Mid-South (Arkansas, Kentucky, Missouri and Tennessee) and after May 27 for the deep Mid-South (Alabama, Florida, Georgia, Louisiana, Mississippi, South Carolina).

Under the irrigated conditions common for soybean production in Arkansas, planting date recommendations may be different from those obtained under rainfed conditions. Irrigation and Arkansas' climate allow for a wide planting window. Some studies indicate that the highest yields are achieved with planting dates in April and early May. Nevertheless, planting dates after the optimum dates are common when double-cropping and in years when excessive rainfall delays the start of field preparation and planting in spring. Under these conditions, the choice of MG can be critical to minimize the yield reduction associated with the later planting date. Similarly, for very early planting dates, the choice of MG can be important, since relatively early MG 3 and MG 4 cultivars could have a shortened growing season, reduced light interception and a lower yield potential compared with cultivars in later MGs. Selecting the best MG choices for a given planting date and location can help farmers maximize yield potential under each set of environmental conditions.

SPECIFIC RECOMMENDATIONS FOR ARKANSAS

APPROACH: EXPERIMENTS AND ANALYSIS

At Rohwer (33.76° N, 91.27° W) and Keiser (35.67° N, 90.10° W), during the 2012, 2013 and 2014 growing seasons, treatments consisted of four different planting dates and cultivars within MGs 3, 4, 5, and 6. Planting dates ranged from March 30 to July 7 at Keiser, and from March 29 to June 28 at Rohwer. Seeding rate was 142,000 seeds per acre. At Keiser, plots were planted using an 8-inch, twin-row planter on 37-inch-wide beds. At Rohwer, plots were planted using a planter with 19-inch spacings in 2012 and 8-inch spacings with a twin-row planter on 37-inch-wide beds in 2013 and 2014. The experiments were furrow-irrigated according to the Arkansas Irrigation Scheduling Program.

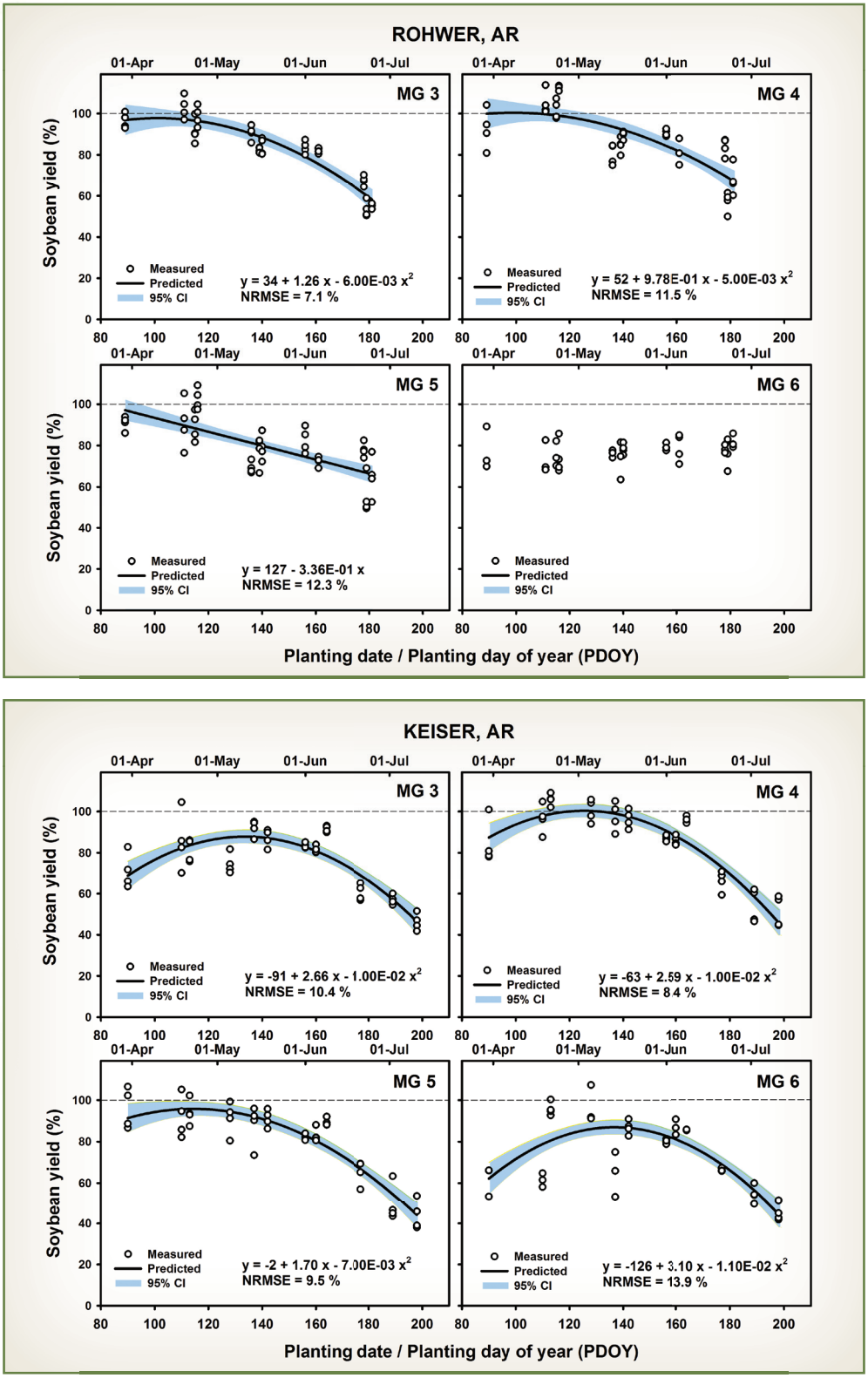

Figure 2: Soybean relative yield versus planting date by MG from a three-year study at Rohwer, Arkansas (top panel) and Keiser, Arkansas (bottom panel). The open symbols indicate observed data, the solid line shows the estimated relative yield for each MG (equation provided in the figure), and the blue shaded area represents the 95 percent confidence interval in the prediction of the relative yield model. The normalized root mean square error (NRMSE) is provided as a measure of the goodness of the model fit with lower values indicating a better fit.

Yields were converted to a relative-yield basis to remove year and location effects so that results from the three-year study could be compared across years (Figure 2). Therefore, a relative yield of 100 percent indicates the highest possible yield at that location, and yields lower than 100 percent represent yields proportionally less than the highest yield at that location. Figure 2 shows the models obtained describing the relationship between relative yields and planting date for each MG within a location. Detailed information about the experiment design and statistical analysis can be found in publications by Salmerón et al. that are listed in the reference section[3].

BEST MG CHOICES TO MAXIMIZE YIELD AT DIFFERENT PLANTING DATES

Across all planting dates, MG 4 cultivars had the greatest yields at both locations (maximum relative yield of 100 percent), followed by MG 3 and 5 cultivars at Rohwer (98 and 97 percent), and by MG 5 cultivars at Keiser (96 percent; Table 1). The best MG choice for a specific planting date was estimated for different planting dates in two-week intervals according to the relationships obtained in Figure 2 and is summarized in Table 1.

- **ROHWER**

  For early planting dates on April 1, MG 3, 4, and 5 cultivars had similar relative yields (96 to 100 percent). With planting dates from April 15 to June 1 at Rohwer, MG 3 cultivars had relative yields similar to the highest-yielding MG 4 cultivars, whereas MG 5 cultivars had relative yields 8 to 12 percent lower. For late planting dates on or after June 15, MG 4 had the highest relative yields. But, when planting was delayed until June 15 yields were only 78 percent of the yield of MG 4 cultivars planted in early April. Yields of MG 3 and 5 cultivars were similar to those for MG 4 cultivars for the June 15 planting date (72 and 71 percent). MG 6 cultivars did not respond to planting date and had a relative yield of 76 percent when averaged across all planting dates.

- **KEISER**

  Maturity group 4 and 5 cultivars had similar relative yields for planting dates from April 1 to May 1 (ranging from 88 to 100 percent), whereas MG 3 and 6 cultivars had significantly lower relative yields compared with the highest-yielding MG 4 cultivars. When planting date was delayed to May 15 and later, MG 4 cultivars had the highest relative yields (ranging from 99 to 83 percent at the latest planting date). MG 5 cultivars were the second-best choice for planting dates on May 15, but for planting dates in June, there were no differences among MG 3, 5, and 6 cultivars.

At both locations, MG 4 cultivars had the greatest yield at any planting date, or had similar yields to the highest yielding cultivars from other MGs. Decisions to use cultivars other than MG 4 would depend upon seed costs and availability, spreading equipment and labor needs over a greater portion of the season, price incentives for different harvest dates, and irrigation costs among other considerations.

Location	MG	Max rel. yield	Yield decline (% day^{-1})	Estimated relative yield for different PD†					
				Apr 1	Apr 15	May 1	May 15	Jun 1	Jun 15
Rohwer	3	98	0.55	97 a	98 a	95 a	91 a	82 a	72 b
	4	100	0.54	100 a	100 a	98 a	94 a	87 a	78 a
	5	97	0.40	96 a	92 b	86 b	82 b	76 b	71 b
	6	-		74	75	76	77	77	78
Keiser	3	88	0.32	70 b	80 b	86 b	88 c	84 b	77 b
	4	100	0.34	88 a	96 a	100 a	99 a	93 a	83 a
	5	96	0.37	92 a	95 a	95 a	93 b	85 b	76 b
	6	87	0.11	63 b	76 b	84 b	87 c	84 b	77 b

†Same letters within a location and planting date column indicate similar yields at the 0.10 probability level.

Table 1: Maximum relative yield, rate of yield decline with delay in planting date (from May 17 to June 2), and estimated relative yield on different planting dates for each soybean maturity group (MG) and location. Data from a 3-yr planting date study at Rohwer and Keiser, Arkansas. The highlighted area in the table indicates the MG choice(s) that would give the highest yield within a planting date.

OPTIMUM PLANTING DATES BY MG

The optimum planting date is the date when a MG would reach its greatest yield. A range of optimum planting dates or 'optimum planting window' was determined using data from Figure 2 that was within 95 to 100 percent of the maximum relative yield for each location and MG (Figure 3). In Figure 3, the lengths of the different colored bars indicate the optimum planting window for the respective MGs. The position of the bars on the vertical axis indicates the relative yield of the different MGs when planted during the optimum planting window relative to the highest yielding MGs.

- **ROHWER**

  Maturity group 4 cultivars had an optimum planting window from late March to early May and achieved the highest yields with a relative yield of 100 percent. The yields of the MG 3 and 5 cultivars were 98 percent and 97 percent of MG 4 yield, respectively. However, the optimum planting window for MG 3 cultivars was much wider (from late March to early May) compared with MG 5, which had a narrower planting window early in the season (late March to mid April). In the case of MG 6 cultivars, there was no response to planting date, and relative yields were on average 76 percent of those of MG 4 cultivars.

- **KEISER**

  At Keiser, MG 4 cultivars were again the highest yielding (relative yield of 100 percent), with an optimum planting window from early April to late May. MG 5 cultivars had an earlier planting window (from late March to mid May) and yields were 96 percent of those of MG 4 cultivars. In the cases of MG 3 and 6 at Keiser, maximum yields were only 88 percent and 87 percent of those of MG 4 cultivars, respectively, with an optimum planting window from late April to early June.

Overall, MG 4 cultivars were the highest yielding and with a relatively wide optimum planting window. The optimum planting window of MG 3 cultivars was similar (at Rohwer) or delayed (at Keiser), compared with MG 4 cultivars. On the other hand, MG 5 cultivars had optimum planting windows that occurred as early (Rohwer) or earlier (Keiser) than MG 4 cultivars.

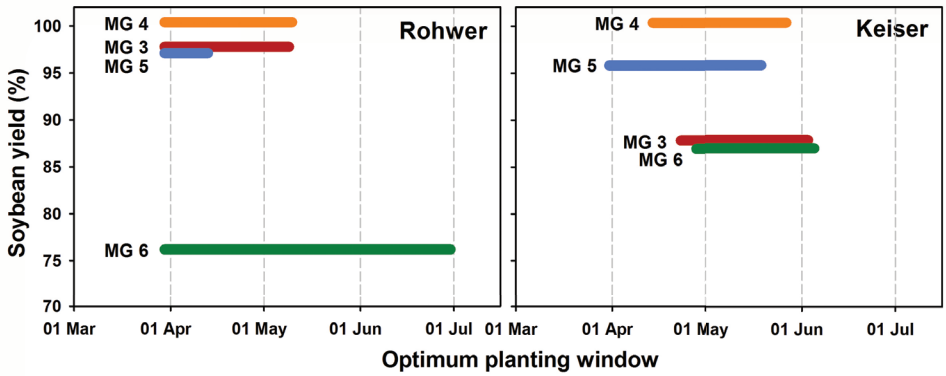

Figure 3: Optimum planting window by maturity group (MG) at Keiser and Rohwer, Arkansas. For both locations, MG 4 cultivars had the highest relative yield at the optimum planting window and other MGs had relative yields less than those of MG 4 cultivars.

RATE OF YIELD DECLINE WITH DELAY IN PLANTING DATES

When planting occurs after the optimum planting window, farmers should expect a yield reduction due to a shorter growing season, reduced sunlight interception and less-than-optimum environmental conditions. The rate of yield decline was calculated for each MG when delaying planting date from May 17 to June 2 and according to the relationships obtained in Figure 2. The rate of yield decline was expressed as a percent reduction from maximum relative yield per day of delay in planting (Table 1). The rates of yield decline were similar for cultivars from MGs 3 to 5 within each location, and on average were greater at Rohwer (0.49 percent per day, or 0.32 bu./ac. per day in absolute yield values) compared with Keiser (0.34% per day or 0.20 bu./ac. per day). A tendency for greater yield reductions with a delay in planting date at the most southern latitudes was also observed across locations in our regional study. MG 6 cultivars, on the other hand, did not respond to day of planting at Rohwer, and had a reduced rate of yield decline at Keiser. However, yields of MG 6 cultivars were lower in general compared with the other MG.

CONCLUSIONS

Relative yields were highest for MG 4 cultivars at both locations, not different from those of MG 3 and 5 cultivars at Rohwer, and similar to MG 5 cultivars at Keiser. MG 6 cultivars had the lowest relative yields in general, and did not have a significant response to planting date at Rohwer.

- The optimum planting dates to attain maximum yields (Figure 3) ranged from late March to early May at Rohwer, and from late March to early June at Keiser and was dependent on the MG cultivar. Results indicate a tendency for earlier or narrower planting windows for MG 5 cultivars compared with MG 3 ones.
- Rate of yield decline when planting after May 17 in MG 3 to 5 cultivars averaged 0.32 bu./ac. per day at Rohwer and 0.20 bu./ac. per day at Keiser (Table 1).
- Yields of MG 4 cultivars were the highest or not different from the highest-yielding MG cultivars at both locations at any planting date.
- Under scenarios of similar relative yields among MG cultivars, shorter-season cultivars could offer an incentive by reducing irrigation costs, avoiding late-season stress (insect and disease pressure), and benefiting from earlier harvest dates and higher market prices.

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