SOYBEAN YIELD RESPONSE:

PLANTING DATE AND MATURITY GROUPS IN TEXAS AND LOUISIANA

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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. Data from College Station, Texas, and St. Joseph, Louisiana, are the focus of this report.

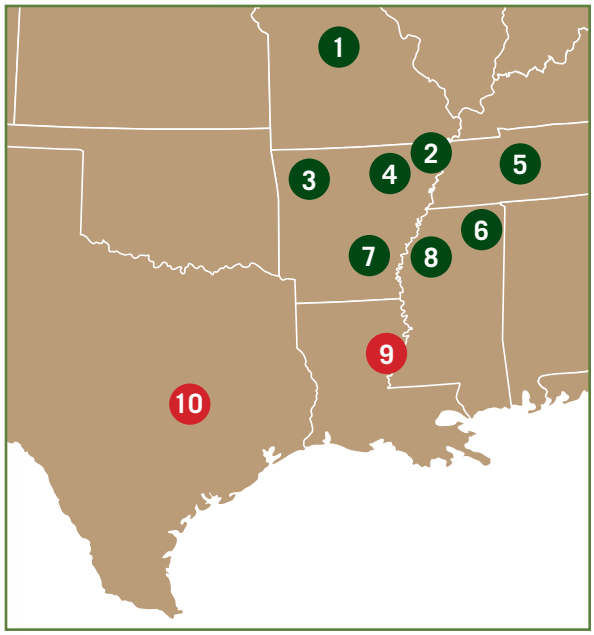

Figure 1: Locations where field experiments were located in the planting date and maturity group regional project: (1) Columbia, MO; (2) Portageville, MO; (3) Fayetteville, AR; (4) Keiser, AR; (5) Milan, TN; (6) Verona, MS; (7) Rohwer, AR; (8) Stoneville, MS; (9) St. Joseph, LA; and (10) College Station,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

BACKGROUND

Planting date is one of the main factors affecting soybean 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).[1] Under the irrigated conditions for soybean production in Texas and Louisiana, planting date recommendations may be different than those obtained under rainfed conditions. While irrigation allows for a wider planting window, some studies indicate that the highest yields are achieved with planting dates in April and early May. For very early planting dates, the choice of MG can be important since relatively early soybean MG 3 and 4 cultivars could have a shortened growing season, reduced light interception and a lower yield potential compared with longer soybean MGs.[2] Planting dates after the optimum are common when double-cropping and in years when excessive rainfall delays the start of planting in spring. Under these conditions, irrigation can mitigate the impact of drought on soybean yield; however, an optimum choice of MG can be critical to minimize the yield reduction associated with delayed planting.

SPECIFIC RECOMMENDATIONS FOR EAST TEXAS AND LOUISIANA

APPROACH: EXPERIMENTS AND ANALYSIS

At College Station, Texas, and St. Joseph, Louisiana during 2012, 2013 and 2014, treatments consisted of four different planting dates and four cultivars within MGs 3, 4, 5 and 6.

College Station:

- Planting dates ranged from March 26 to June 2.
- Seeding rate was 142,000 seeds per acre.
- Plots were planted on a 14-inch row spacing using a single-cone five-foot-wide plot planter.
- The experiments were irrigated as needed using overhead sprinklers.

St. Joseph:

- Planting dates ranged from April 6 to June 19.
- Seeding rate was 142,000 seeds per acre.
- Plots were planted using a 20-inch row spacing.
- The experiments were irrigated as needed using furrow irrigation.

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 that. Figure 2 shows the models describing the relationship between relative yields and planting date for each MG within a location.[3]

[1]Egli and Cornelius, 2009

[2]Salmeron et al, 2015

[3]More detailed information about the experimental design and statistical analysis can be found in publications by Salmeron et al, that are listed in the reference section.

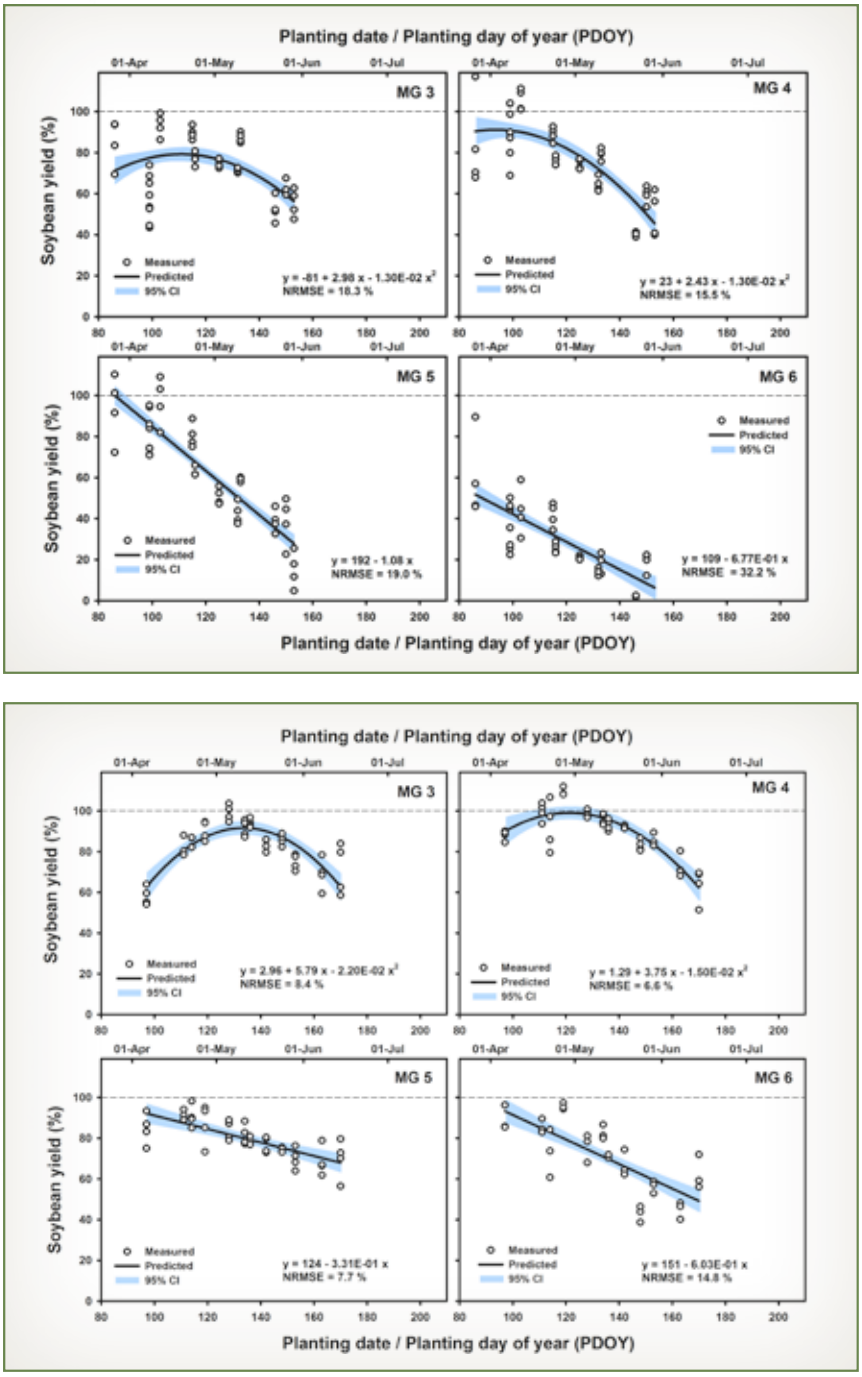

Figure 2: Soybean relative yield versus planting date by MG from a three-year study at College Station, TX (upper graph) and at St. Joseph, LA (bottom graph). The open symbols indicate observed data, the solid line shows the estimated relative yield over a wide range of planting dates for each MG (equation provided in the figure), and the blue shaded area represents the 95% 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 less dispersion of the observed data from the estimated model fit.

BEST MG CHOICES TO MAXIMIZE YIELD AT DIFFERENT PLANTING DATES

Across all planting dates, MG 4 cultivars had the greatest yields at both locations. When planting by early- to mid-April, MG 5 cultivars did as well as or better than MG 4 cultivars at both locations, while MG 3 cultivars performed as well as or better than MG 4 cultivars after May 15. The maximum relative yield (100 percent) was achieved by MG 5 cultivars at College Station and by MG 4 cultivars at St. Joseph.

The relative yield of MG 5 cultivars was followed by that of MG 4 (91 percent), MG 3 (79 percent), and MG 6 (52 percent)

cultivars at College Station. At St Joseph, the maximum yield attained by MG 4 cultivars was followed by that of MG 6, MG 5 and MG 3 (maximum relative yields of 93, 92 and 92 percent, respectively).

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.

COLLEGE STATION

When planted by April 1, MG 4 and 5 cultivars performed the best with similar relative yields of 91 and 95 percent, respectively. Yield for MG 5 cultivars dropped off quickly after April 1, while MG 4 cultivars maintained higher yields than MG 5 or MG 6 cultivars for all subsequent planting dates through June 1. MG 3 cultivars did not yield as well as MG 4 cultivars early in the planting season (April 1 and 15); however, once planting was delayed past May 1, MG 3 cultivars yielded similarly (78 percent) and even outperformed MG 4 cultivars (47 percent) by June 1 (57 percent for MG 3). MG 6 cultivars performed poorly under all planting dates and yield declined from 48 percent on April 1 to 7 percent relative yield with the latest planting date in June.

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Across all planting dates, MG 4 cultivars had the greatest yields. Prior to May, MG 5 and MG 6 cultivars did equally well as those from MG 4. Cultivars in MG 4 continued to do well with May planting dates, while yields for MG 5 and MG 6 declined. Later in the growing season, yields were maximized by using either MG 3 or MG 4 cultivars starting in mid-May and continuing through mid-June. Yields of MG 5 cultivars were once again in the top-yielding group by June 15. At both locations, MG 4 cultivars had the greatest yield from April 1 through May 15, or had similar yields to the highest-yielding cultivars from other MGs.

Decisions to use cultivars other than those of 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.

OPTIMUM PLANTING DATES BY MG

The optimum planting date is the date that allows a MG to reach its greatest yield. A range of optimum planting dates, or an optimum planting window, was determined using data from Figure 2. The window includes the dates that offer between 95 and 100 percent of the maximum relative yield for each MG (Figure 3) for each planting date. In Figure 3, the length of the different colored bars indicates 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 MG.

Location	MG	Max relative yield††	Yield decline (% per day)	Estimated percent relative yield for different PD†					
				Apr 1	Apr 15	May1	May 15	Jun 1	Jun 15
College	3	79	1.11	74 b	79 b	78 a	72 a	57 a	-
Station	4	91	1.48	91 a	89 a	81 a	69 a	47 b	-
	5	100	1.09	95 a	80 b	62 b	47 b	29 c	-
	6	52	1.33	48 c	39 c	28 b	19 b	7 b	-
St. Joseph	3	92	0.69	-	74 b	88 b	92 a	84 a	69 a
	4	100	0.57	-	95 a	99 a	96 a	84 a	68 a
	5	92	0.36	-	89 a	84 b	80 b	74 b	69 a
	6	93	0.65	-	88 a	79 c	70 c	60 c	52 b

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

The highlighted areas in the table indicate the MG choice(s) that would give the highest yield within a planting date. 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 three-year planting date study at College Station, TX and St. Joseph, LA.

COLLEGE STATION

MG 5 cultivars had a very short optimum planting window – from late March through April 1 – but achieved the highest relative yield (95 to 100 percent) across all cultivars at that time. Optimum planting for MG 4 cultivars occurred from late March through late April and had 92 percent of maximum relative yield. MG 3 cultivars had the widest optimum planting window from early April through mid-May, but with a maximum relative yield of only 79 percent. MG 6 cultivars had a similar optimum planting window as MG 5 cultivars, with best yields obtained in late March (52 percent relative yield).

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MG 4 cultivars were the highest-yielding (100 percent relative yield) and with the widest optimum planting window across MGs, starting in early- to mid-April and through mid-May (Figure 3). Compared with MG 4 cultivars, the optimum planting window of MG 3 cultivars was delayed, beginning in late April and lasting through late May (92 percent of relative yield). On the other hand, MG 5 and MG 6 cultivars had relatively narrow optimum planting windows that occurred early in the planting season (early- to mid-April), and achieved similar maximum relative yields at this time (92 to 93 percent).

RATE OF YIELD DECLINE WITH DELAY IN PLANTING DATES

When planting occurs after the optimum planting date, farmers typically expect some yield reduction from a shortened growing season, reduced overall sunlight interception and less-than-optimum temperature conditions. The rate of yield decline with delay in planting date was calculated for each MG and expressed as a percent reduction from maximum relative yield per day of delay in planting (Table 1).

Across MG cultivars, the average rate of yield decline of 1.25 percent per day in College Station (0.65 bu./ac. per day of delay in absolute yield values) was more than double the decline of 0.57 percent per day observed in St. Joseph (0.39 bu./ac. per day). Cultivars from MG 5 had the lowest rate of decline at 1.09 percent per day in College Station and 0.36 percent per day in St. Joseph, while MG 4 and MG 3 had the highest rate of decline at 1.48 percent per day in College Station and 0.69 percent per day in St. Joseph.

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 had the second-highest yield-decline rate at both locations, which is not unexpected since they

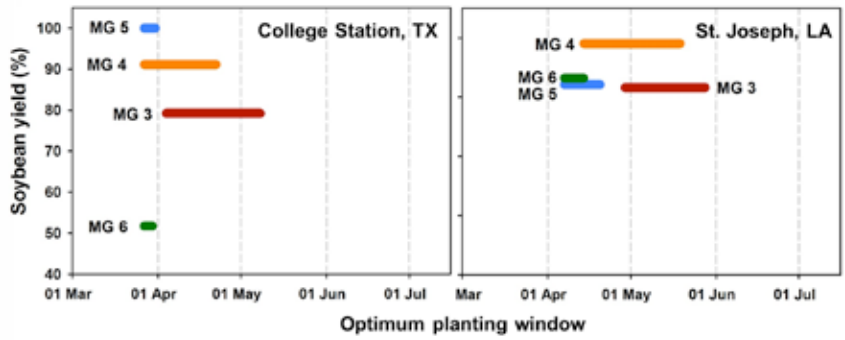

Figure 3: Optimum planting window by maturity group (MG) at College Station, TX and St. Joseph, LA. MG 5 had the highest relative yield at the optimum planting date in College Station, while MG 4 had the maximum relative yield over the majority of the planting season at St. Joseph.

had the lowest recorded yields at the final planting date for both College Station and St. Joseph.

CONCLUSIONS

Relative yields were highest for MG 4 cultivars on average in nearly every case at both locations, except for College Station after June 1. Cultivars for MG 3 performed best in May and June and had yields similar to MG 4 during that planting window. MG 5 and 6 cultivars performed best early in the planting season and declined as the season progressed. MG 6 cultivars did poorly overall at College Station, but compared favorably with MG 4 and MG 5 cultivars at St. Joseph when planted early.

- The optimum planting dates to attain maximum yields (Figure 3) ranged from late March to early May at College Station and from early April to late May at St. Joseph. Results indicate a tendency for earlier and narrower planting windows for MG 5 and MG 6 cultivars compared to those from MG 3 and MG 4.
- The rate of yield decline when planting date was delayed past May 17 averaged 1.25 percent per day (0.65 bu./ac. per day) at College Station and 0.57 percent per day (0.39 bu./ac. per day) at St. Joseph. Cultivars of MG 5 had the lowest rate of decline at both locations (1.09 and 0.36 percent per day at College Station and St. Joseph, respectively) while MG 4 (1.48 percent per day) and MG 3 (0.69 percent per day) had the highest rate of decline at College Station and St. Joseph, respectively (Table 1).
- Yields of MG 4 cultivars were the highest or not different from the highest-yielding MG cultivars at both locations for all but the latest planting date at College Station.
- Where yields are similar, shorter-season cultivars could offer specific benefits, such as shortening the irrigation window and reducing costs, avoiding late-season stress and benefiting from earlier harvest dates and higher market prices for early delivery.

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