SOYBEAN YIELD RESPONSE:

PLANTING DATE AND MATURITY GROUPS IN MISSISSIPPI

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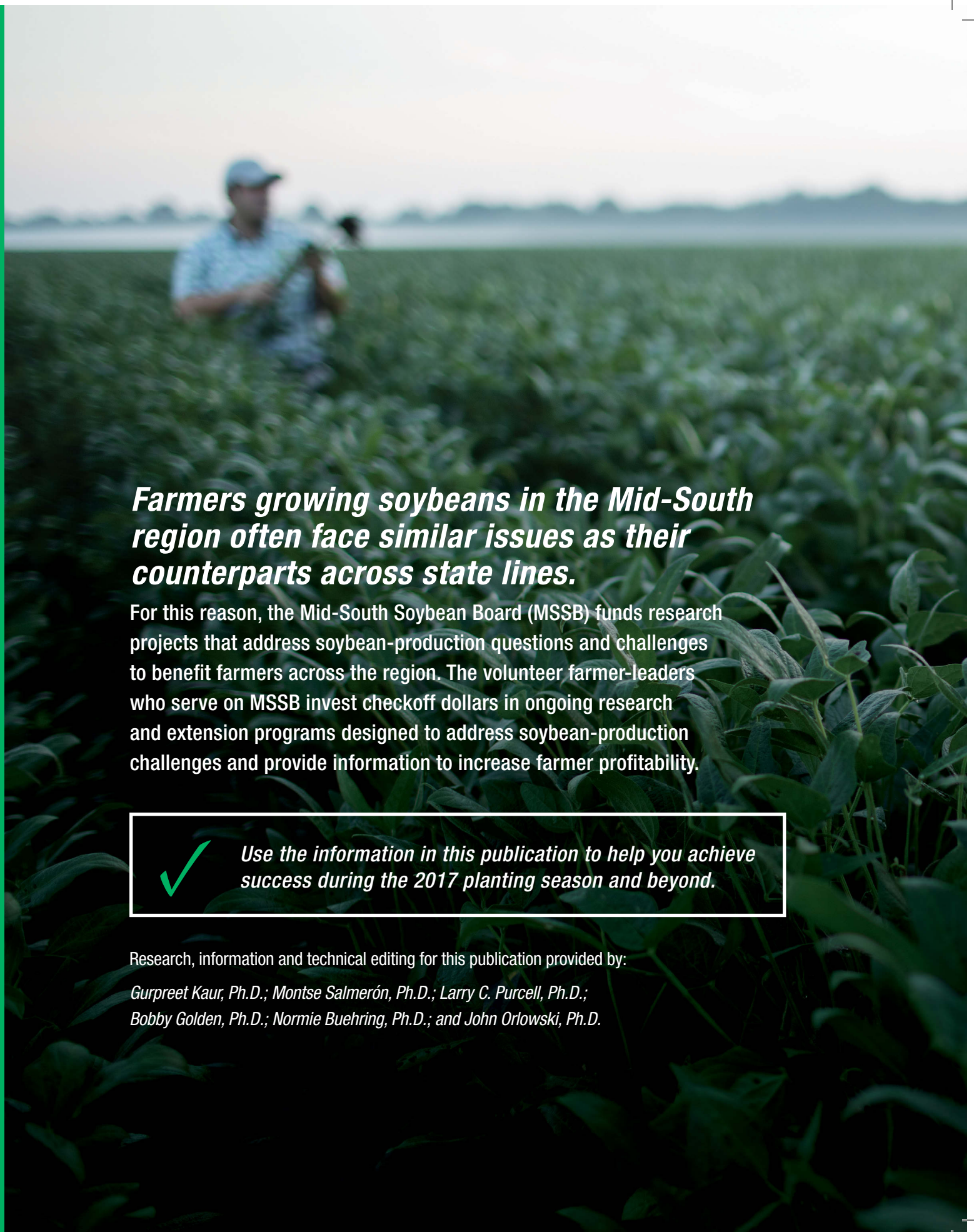

Farmers growing soybeans in the Mid-South region often face similar issues as their counterparts across state lines.

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 2017 planting season and beyond.*

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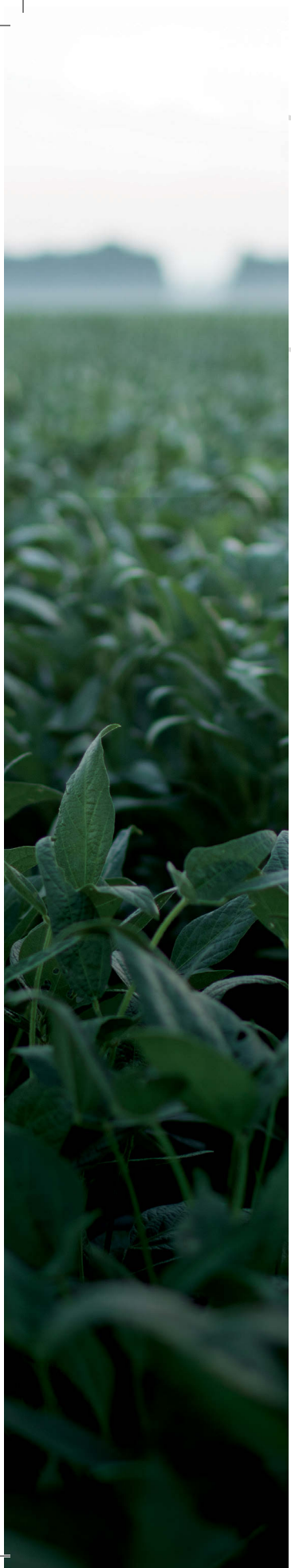


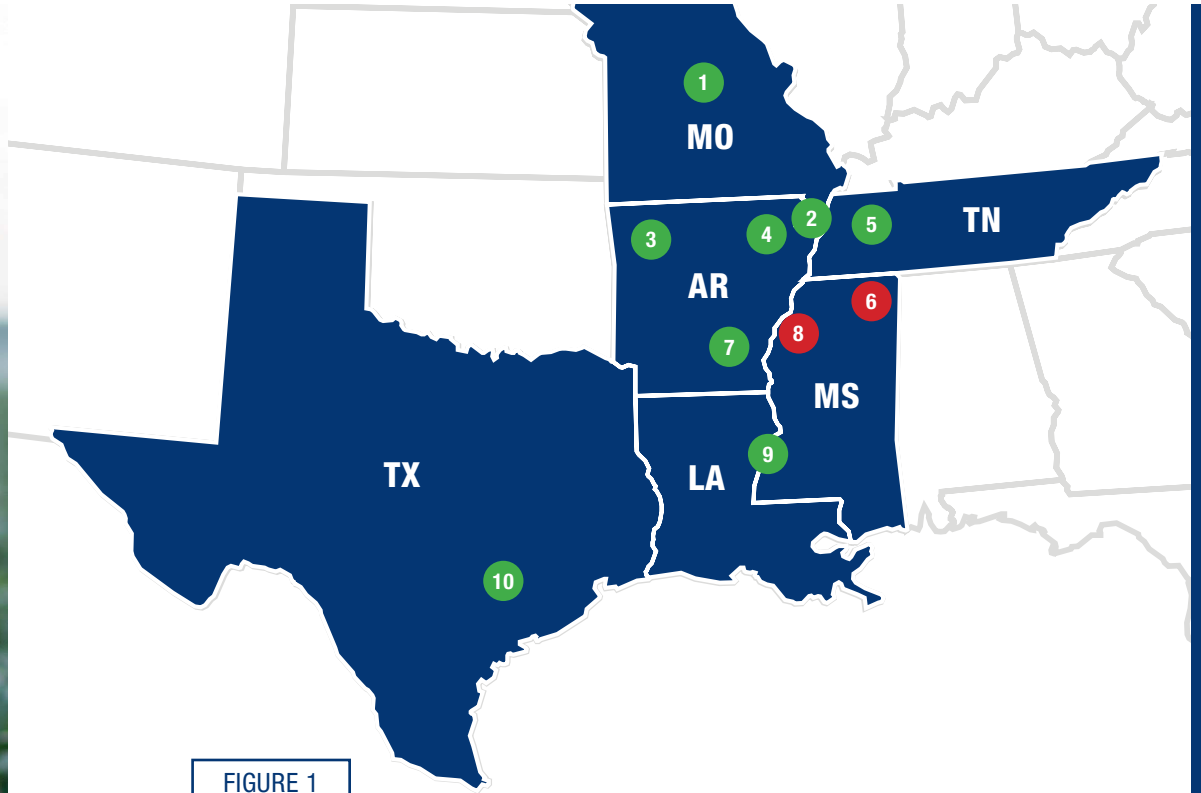


FIGURE 1

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 Verona and Stoneville, MS, (highlighted in red) are summarized in this report.

PLANTING DATE AND MATURITY GROUP REGIONAL PROJECT

The data presented in this report are part of a large, three-year regional project funded jointly by the United Soybean Board (USB) and the Mid-South Soybean Board (MSSB). The goal of this project was to study the effect of planting date, latitude and environmental factors on the choice of soybean maturity group (MG) under irrigated conditions in the Mid-South. Experiments were conducted across six states (AR, LA, MO, MS, TN, TX) at 10 locations from 2012 to 2014 (Figure 1), with four planting dates and four cultivars from each of the MGs 3 to 6. Soybean yield results from two Mississippi locations (Stoneville and Verona) are provided in this report.

BACKGROUND

One of the main factors that affects soybean (*Glycine max* [L.] Merr.) yield is planting date. Previous studies indicate that early planting dates can achieve higher soybean yields by avoiding late-summer droughts and reducing disease and insect-pest infestations. However, delays in planting after the optimum dates are common when double-cropping and in years when excessive rainfall delays the start of planting in spring. Delayed planting often reduces yield due to 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 dryland conditions by Egli and Cornelius (2009), yields started to decrease for planting dates after June 7 in the upper Mid-South (Arkansas, Kentucky, Missouri, Tennessee) and after May 27 for the deep

Mid-South (Alabama, Florida, Georgia, Louisiana, Mississippi, South Carolina). However, planting date recommendations for soybean production could be different under irrigated conditions than under dryland conditions. The choice of MG can be critical to mitigate the yield reduction associated with later planting dates. The MG choice can also be important for early planting dates, 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 of 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 MISSISSIPPI

APPROACH: EXPERIMENTS AND ANALYSIS

This three-year experiment was conducted from 2012 to 2014 at Verona (34.2° N, 88.7° W) and Stoneville (33.4° N, 90.9° W). Treatments consisted of four different planting dates and four cultivars from each of MGs 3, 4, 5 and 6. Planting dates ranged from March 21 to June 17 at Verona and March 20 to June 27 at Stoneville. The plots at Verona were planted with an 8-inch, twin-row planter on 38-inch beds. At Stoneville, the plots were planted on 30-inch single rows in 2012 and 2013, and in 20-inch rows on 80-inch beds in 2014. Experiments at both locations were planted on raised beds and furrow-irrigated.

Soybean yields were converted to a relative-yield basis in order to remove year and location effects, so that results from the three-year study could be compared across years (Figure 2). 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. At Stoneville, unusual environmental conditions (flooding, bird damage, etc.) resulted in yield data that was not

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 (PD) for each soybean maturity group (MG) and location. Data from a 3-yr planting date study at Stoneville and Verona, MS. Relative yields were obtained by dividing the yield of each cultivar within a location, year and planting date by the yield of the highest-yielding cultivar within a location and year.

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
Stoneville	**3**	(87)	(0.50)	(81)	(86)	(87)	(85)	(79)	(70)
	4	(100)	(0.46)	(99)	(100)	(98)	(95)	(87)	(79)
	5	(91)	(0.45)	(82)	(88)	(91)	(90)	(85)	(78)
	6	(78)	(0.28)	(69)	(74)	(77)	(78)	(76)	(72)
Verona	3	89	0.55	77 b	85 b	89 a	88 a	81 a	70 b
	4	100	0.31	97 a	93 a	89 a	85 a	81 a	77 a
	5	94	0.37	91 a	87 b	82 b	78 b	73 b	69 b
	6	80	0.32	78 b	74 c	71 c	68 c	64 c	61 c

†Same letters within a location and planting date column indicate similar yields at the 0.10 probability level. Similar yields within a location and planting date are also indicated by the blue shaded area.

**Data in parenthesis for Stoneville shows simulated yields with the DSSAT-CROPGRO model.*

representative. For this reason, potential soybean yields simulated with a crop simulation model are provided for this location in addition to measured yields. For the simulations, the DSSAT-CROPGRO model was calibrated for irrigated conditions in the Mid-South, with weather and management data from Stoneville. Detailed information from the model calibration and performance across management options and locations in the Mid-South can be found in the last reference by Salmerón et al.

BEST MG CHOICES TO MAXIMIZE YIELD AT DIFFERENT PLANTING DATES

At both locations, MG 4 cultivars had the greatest soybean yields across all planting dates (maximum relative yield of 100 percent), followed by MG 5 cultivars with 94 percent relative yield at Verona and 91 percent relative yield at Stoneville (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.

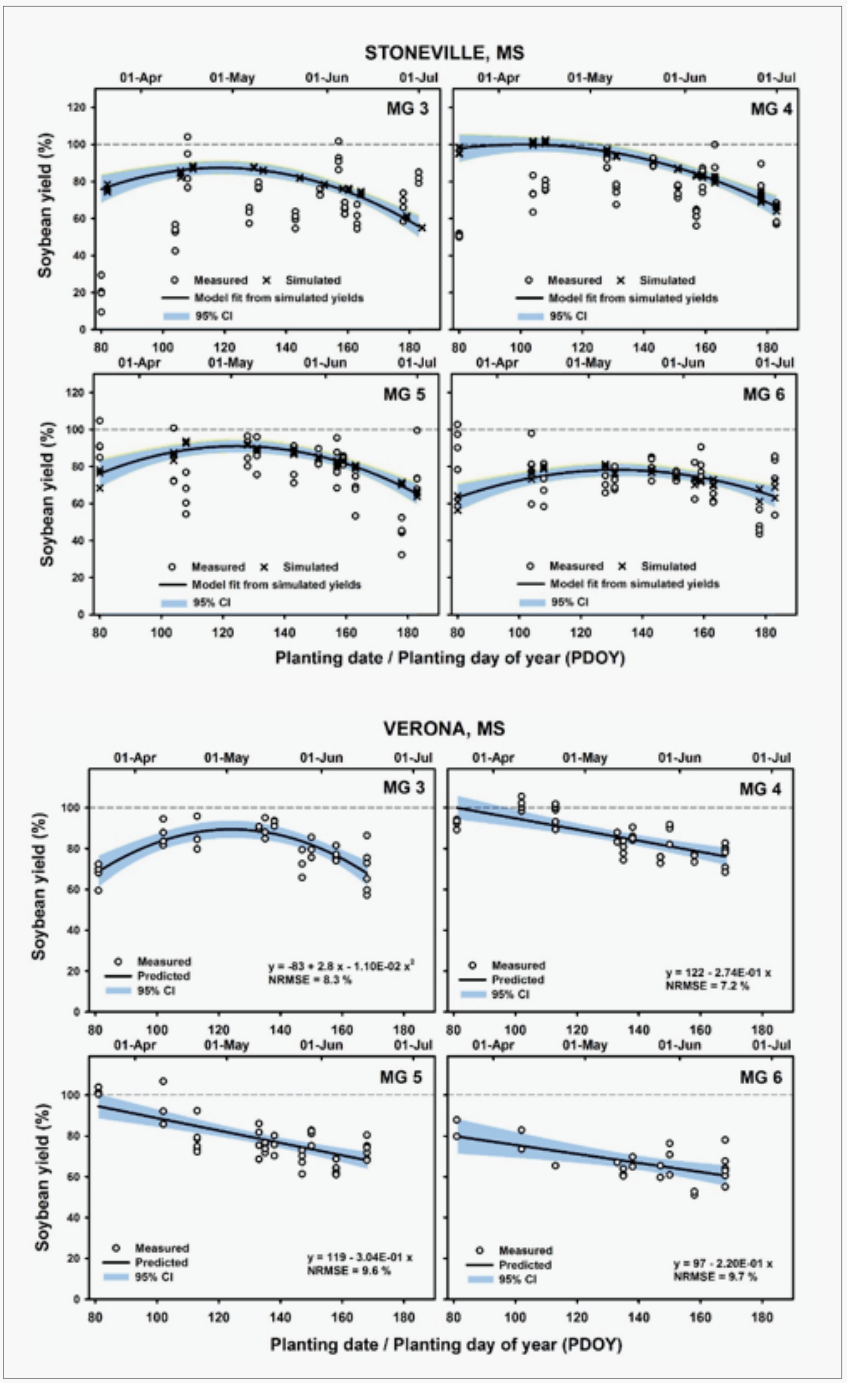


FIGURE 2

Simulated soybean relative yield versus planting date by MG from a three-year study at Stoneville, MS, (top panel) and soybean relative yield versus planting date by MG for Verona, MS, (bottom panel). The open symbols indicate observed data, the solid line shows the estimated relative yield for each MG and the blue shaded area represents the 95 percent confidence interval in the prediction of the relative yield model.

VERONA

The MG 4 and 5 cultivars had similar relative yields (91 percent to 97 percent) for early planting dates on April 1. For early planting dates on April 1, MG 5 cultivars can be used in place of MG 4 cultivars, but the MGs 5 will be in the field longer, creating a longer management period. For planting dates on April 15, MG 4 cultivars had 6-8 percent higher relative yields than MGs 3 and 4. MGs 3 and 5 had similar relative yields for planting dates on April 15. The MGs 3 and 4 cultivars had similar relative yields for planting from May 1 to June 1 (81 percent to 89 percent). The MG 4 cultivars had the highest relative yields for late-planting on or after June 15. For late-planting on June 15, MGs 3 and 5 had similar relative yields, but lower than MG 4 cultivars (69 percent to 70 percent). The lowest relative yield averaged over all planting dates was obtained for MG 6 (80 percent). Delaying the planting date from April 1 to June 15 resulted in 20 percent lower relative yield for MG 4. The relative yield was decreased by 8 percent for MG 3, when planting was delayed for one month from May 1 to June 1.

STONEVILLE

The MG 4 cultivars had higher simulated yields compared to MGs 3, 5 and 6 in all planting dates in April and May. The maximum simulated yield was obtained when MG 4 cultivars were planted on April 15, followed by April 1 and May 1. For late planting dates on June 1 and June 15, the MG 4 and 5 cultivars had similar yields (78 percent to 87 percent), but the MGs 5 will be in the field longer, creating a longer management period. The MG 3 cultivars were the second best choice after MG 4 and 5 cultivars for planting dates in June. Delaying the planting date by two months from April 15 to June 15, reduced yields of MG 4 cultivars by 21 percent. For all planting dates, MG 6 cultivars had the lowest simulated yields (72 percent to 78 percent).

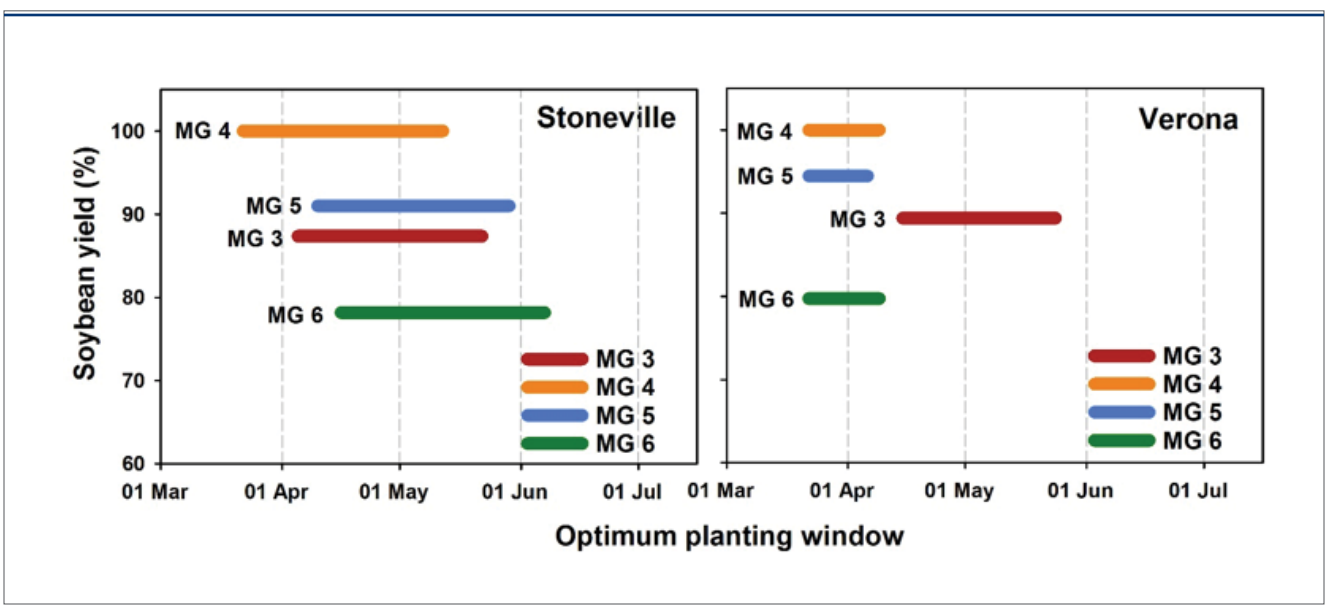
The MG 4 cultivars had higher yields for all planting dates at both locations. Consider these factors while making decisions on using MGs other than MG 4: seed costs and availability, spreading equipment and labor needs over a greater portion of the season, price incentives for different harvest dates, and irrigation and late-season management costs, among other considerations.

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 windows' was determined using data from Figure 2 that was within 95-100 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.

FIGURE 3

Optimum planting window by maturity group (MG) at Stoneville and Verona, MS. For this location, the MG 4 cultivar had the highest relative yield at the optimum planting window and other MGs had relative yields less than those of MG 4 cultivar.



VERONA

Maturity group 4 cultivars had the highest yields with a relative yield of 100 percent for an optimum planting window from late March to early April. The MG 5 and 6 cultivars had a similar planting window from late March to early April as MG 4, with relative yield of 94 and 80 percent, respectively. The yields of the MG 3 cultivars were 89 percent of MG 4 yields. However, the optimum planting window for MG 3 cultivars was much wider from mid-April to late May than MGs 4, 5 and 6.

STONEVILLE

The planting windows for all MGs at Stoneville were relatively wider than at Verona. The MG 4 cultivars were again the highest-yielding (relative yield of 100 percent), with an optimum planting window from late March to mid-May. MG 5 cultivars had an optimum planting window from early April to late May, and relative yields were 91 percent of those of MG 4 cultivars. MG 3 cultivars had maximum yields of 87 percent of MG 4 cultivars, with an optimum planting window from early April to late May. The optimum planting window for MG 6 cultivars was from mid-April to early June.

Overall, MG 4 cultivars were the highest-yielding (relative yield of 100 percent), with a wider planting window at Stoneville compared to Verona. The optimum planting windows of MG 5 and 6 cultivars were similar at Verona, and delayed at Stoneville, compared to MG 4 cultivars.

RATE OF YIELD DECLINE WITH DELAY IN PLANTING DATES

Delaying planting after the optimum planting window could result in yield reductions due to a shorter growing season, reduced sunlight interception and less-than-optimum environmental conditions. The yield decline rate was calculated for each MG according to the relationships obtained in Figure 2, when planting date was delayed from May 17 to June 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 MGs 3, 4 and 5 at Stoneville ranging from 0.45 percent to 0.50 percent per day. The yield reductions for MGs 4 and 5 were higher at Stoneville compared to Verona.

A tendency for greater yield reductions with a delay in planting date at the most southern latitudes was also observed across locations in the regional study. The yield reduction for MG 3 cultivars was a little higher at Verona (0.55 percent per day) compared to Stoneville (0.50 percent per day). The rate of yield decline for MG 6 cultivars was similar to MG 4 and 5 cultivars at Verona and was comparatively lower than MG 3 cultivars.

CONCLUSIONS

- ✓ The MG 4 cultivars had the highest relative yields at both locations. However, MG 4 yields were not different from MG 3 cultivars for planting windows from May 1 to June 1 at Verona. The yields of MG 5 cultivars were also similar to MG 4 cultivars for plantings on April 1 at Verona. At Stoneville, for late planting dates in June, MG 5 cultivars had yields similar to those of MG 4 cultivars. MG 6 cultivars had the lowest relative yields in general at both locations. Regardless of planting date, MG 6 cultivars did not realize the yield levels of cultivars from the other MGs. So, they should not be considered an option for maximum potential yield for any planting date.
- ✓ The optimum planting dates for obtaining maximum yields (Figure 3) were dependent on the location and MG. The optimum planting date for MG 4 cultivars ranged from mid-March to mid-May at Stoneville and from mid-March to early April at Verona. The optimum planting windows were wider for all MGs at Stoneville compared to Verona.
- ✓ The rate of yield decline due to delay in planting after May 17 in MG 3 to 5 cultivars averaged 0.42 percent and 0.39 percent per day at Stoneville and Verona, respectively (Table 1).
- ✓ Under scenarios of similar relative yields among MG cultivars, shorter-season cultivars could offer an incentive by reducing irrigation and late-season management costs, avoiding late-season stress (insect and disease pressure), and benefiting from earlier harvest dates and higher market prices.

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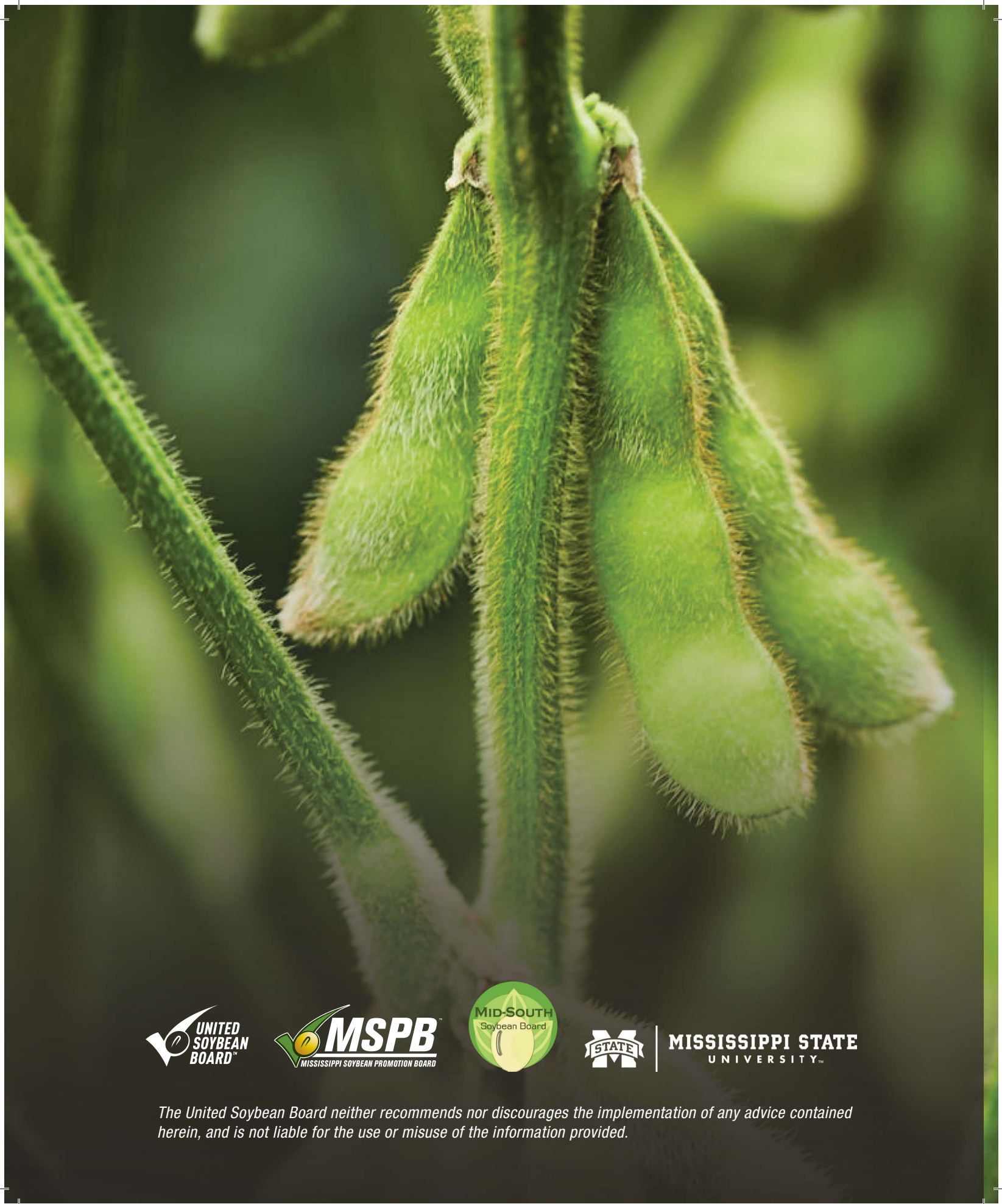

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