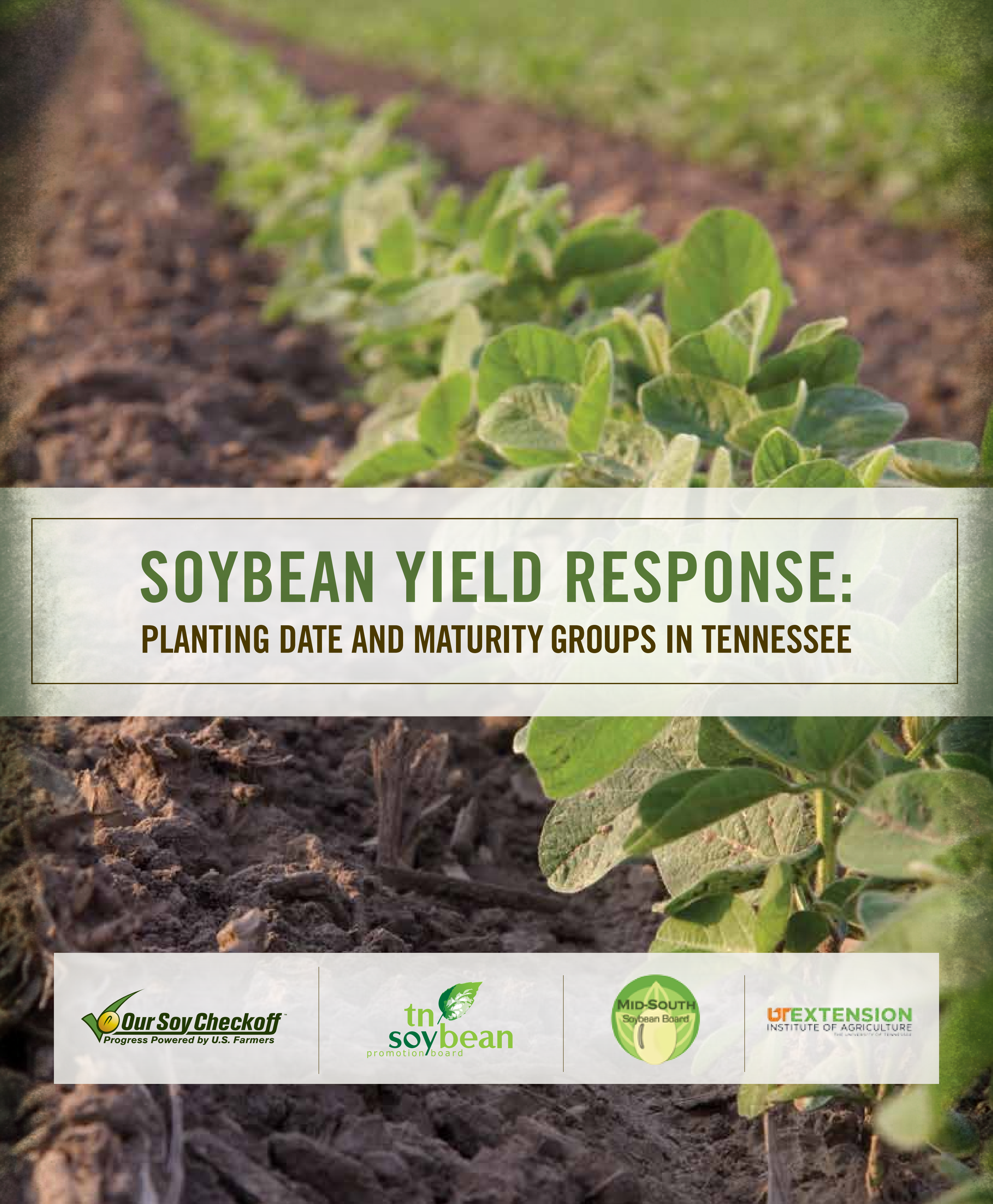

# SOYBEAN YIELD RESPONSE:

## PLANTING DATE AND MATURITY GROUPS IN TENNESSEE

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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 the Milan, Tennessee location are the focus of this report.

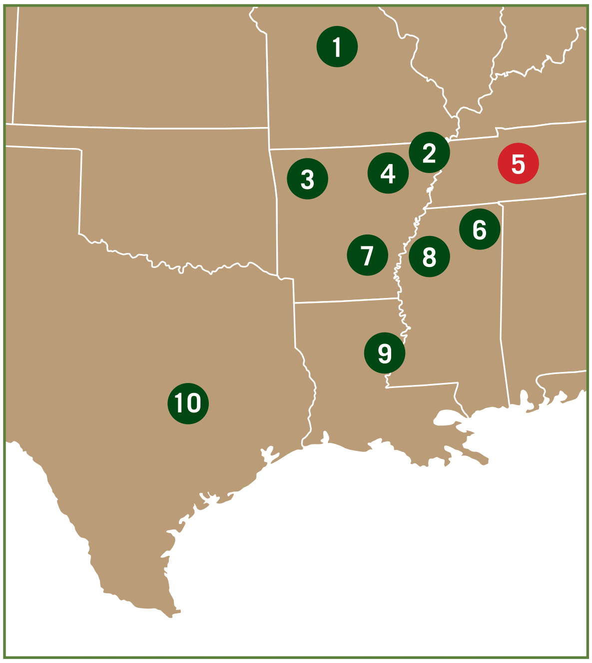


*Figure 1: Locations where field experiments were located in the planting date and maturity group regional project: (1) Columbia, MO; (2) Portageville, MO; (3) Fayetteville, AR; (4) Keiser, AR; (5) Milan, TN; (6) Verona, MS; (7) Rohwer, AR; (8) Stoneville, MS; (9) St. Joseph, LA; and (10) College Station, TX. Results from Milan, TN (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] Rainfed conditions are more common for soybean production in Tennessee, with approximately 30 percent of acres planted each year in late June or early July double-cropped following wheat. Irrigation is an option on less than 10 percent of acres in Tennessee. Some studies indicate that farmers achieve the highest soybean yields, even with irrigation, 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 TENNESSEE

### *APPROACH: EXPERIMENTS AND ANALYSIS*

At Milan, during 2013 and 2014, treatments consisted of four different planting dates and four cultivars within MGs 3, 4, 5 and 6. Planting dates ranged from April 22 to July 3. The seeding rate was 140,000 seeds per acre. Plots were planted on 30-inch rows in long-term no-till ground. The experiments were center-pivot irrigated according to the Tennessee MOIST irrigation scheduling program (www.utcrops.com/irrigation/irr_mgmt_moist_intro.htm).

Yields were converted to a relative-yield basis to remove year and location effects. This allows results from the two-year study to be compared (Figure 2). A relative yield of 100 percent indicates the highest possible yield of any cultivar in the experiment. Yields lower than 100 percent represent yields proportionally less than the highest yield. Figure 2 shows the relationship between relative yields and planting date for each MG.[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.

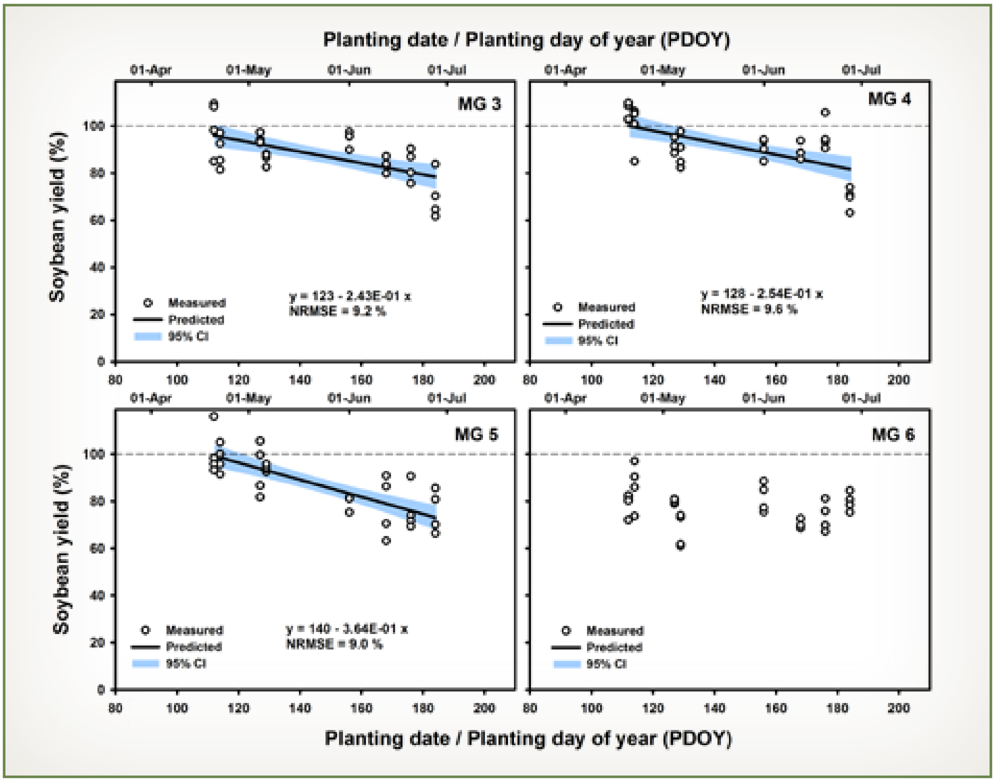


*Figure 2: Soybean relative yield versus planting date by MG from a 2-year study at Milan, TN. The open symbols indicate observed data; the solid line shows the estimated relative yield for each MG (equation provided in the figure), and the blue shaded area represents the 95 percent confidence interval 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.*

| 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 |
| Milan | 3 | 96 | 0.25 | - | - | 94 a | 90 a | 86 a | 83 ab |
| | 4 | 100 | 0.26 | - | - | 98 a | 94 a | 90 a | 86 a |
| | 5 | 99 | 0.37 | - | - | 96 a | 91 a | 85 a | 80 bc |
| | 6 | 80 | - | - | - | 79 b | 78 b | 77 b | 76 c |

*†Same letters within a location and planting date column indicate similar yields at the earliest planting date at the location.*
*††Date of relative max yield = April 22.*

*Table 1: Maximum relative yield, rate of yield decline with delay in planting date and estimated relative yield with different planting dates for each soybean maturity group (MG). Data from a two-year planting-date study at Milan, TN. The highlighted areas in the table indicate the MG choice(s) that would give the highest yield within a planting date..*

## BEST MG CHOICES TO MAXIMIZE YIELD AT DIFFERENT PLANTING DATES

Across all planting dates, MG 4 cultivars had the greatest yields (maximum relative yield of 100 percent), followed by MG 5 and then MG 3 (maximum relative yields of 99 and 96 percent, respectively). MG 6 cultivars did not respond to planting date and had a relative yield of 78 percent when averaged across all planting dates (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. Since the earliest planting date in the experiment at Milan was April 22, Table 1 shows estimated yields from May 1 to June 15.

For planting dates in early May, MG 3, 4 and 5 cultivars had similar relative yields (94 to 98 percent). With planting dates from May 15 to June 1, MG 3 and 5 cultivars had relative yields similar to the highest-yielding MG 4 cultivars. For late planting dates on or after June 15, MG 4 cultivars had the highest relative yields, which were similar to MG 3 cultivars, while MG 5 cultivars yielded 6 percent less.

## 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).

There was a yield decline in all cases except for MG 6 cultivars, which did not respond to planting date. For MG 3 and 4 cultivars, yields declined by 0.25-0.26 percent for each day of delay in planting (0.14 – 0.15 bu./ac. per day expressed on absolute yield values). In the case of MG 5 cultivars, yield declined at a rate of 0.37 percent per day, or 0.21 bu./ac. per day.

## 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 4 cultivars.

At Milan, maximum yields were obtained with the earliest planting date in the experiment on April 22. MG 4 cultivars were the highest-yielding on average, when planted from late April to mid May (Figure 3). MG 5 cultivars had maximum yields similar to those of MG 4 but a narrower planting window from late April to early May. MG 3 cultivars reached 96 percent of the yield of MG 4 cultivars and had a planting window similar to MG 4 cultivars from late April to mid May.  In the case of MG 6 cultivars, there was no response to planting date, and relative yields were on average 78 percent of those of MG 4 cultivars.

Overall, the results demonstrate the importance of early planting for higher yields.  Even if irrigation can alleviate moisture stress during later planting, it is still important to plant early in order to achieve maximum yields for MG 3 to 5 cultivars at Milan. MG 3 and 4 cultivars had similar optimum planting windows from late April to mid May, whereas MG 5 cultivars would be more suited for earlier plantings from late April to early May.

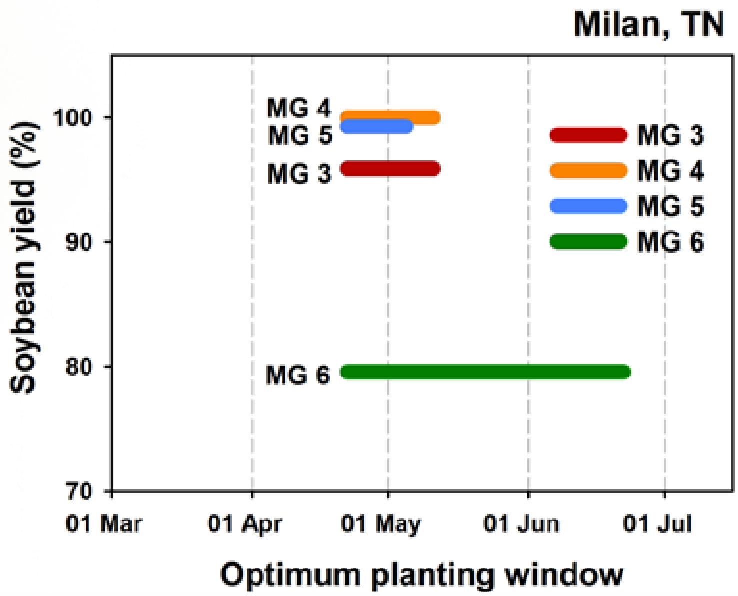


*Figure 3: Optimum planting window by maturity group (MG) at Milan, Tennessee. For both locations, MG 4 cultivars had the highest relative yield at the optimum planting window and other MGs had relative yields less than those of MG 4 cultivars.*

## SUMMARY OF FINDINGS

- Growers have multiple cultivar options when planting early. Relative yields were highest for MG 4 cultivars over all planting dates but similar to those of MG 3 and MG 5 cultivars in an irrigated system at Milan.
- The optimum planting dates to attain maximum yields (Figure 3) ranged from late April to mid May for MG 3 and 4 cultivars. Results indicated that MG 5 cultivars would be suitable for earlier planting dates from late April to early May.
- For late planting dates, results indicate that MG 3 and 4 cultivars tolerated a shorter growing season and late planting environment better than MG 5 cultivars under irrigation.
- Late planting had a greater negative yield impact on MG 5 cultivars, therefore early planting would be necessary to maximize yields of MG 5 cultivars in Tennessee.
- MG 6 cultivars had the lowest relative yields in general, regardless of planting date and did not have a significant response to planting date at Milan.
- The rate of yield decline when planting date was delayed past May 15 was 0.14-0.15 bu./ac. per day for MG 3 and 4 cultivars, and increased to 0.21 bu./ac. per day for MG 5 cultivars, indicating that early planting dates can be more critical for MG 5 cultivars compared to earlier maturities.
- 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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