

# **EFFECT OF PLANTING DATE AND MATURITY GROUP ON EMERGENCE, DEVELOPMENT, AND YIELD OF SOYBEAN**

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Year 2 of 2 year project

## **Justification:**

The occurrence of soybean rust in the USA in late 2004 caused Missouri farmers and researchers to consider soybean management strategies to reduce the impact of the disease on soybean yield. Because soybean rust does not over-winter in Missouri, the disease organism must move into the state from more southern regions. This means that if establishment in Missouri occurs, it will probably occur sometime during the growing season. The later in the soybean life cycle that rust occurs, the less the impact from the disease on yield. So, if the soybean crop could be managed to be further along in development when rust occurs we might be able to lessen the impact on soybean profitability.

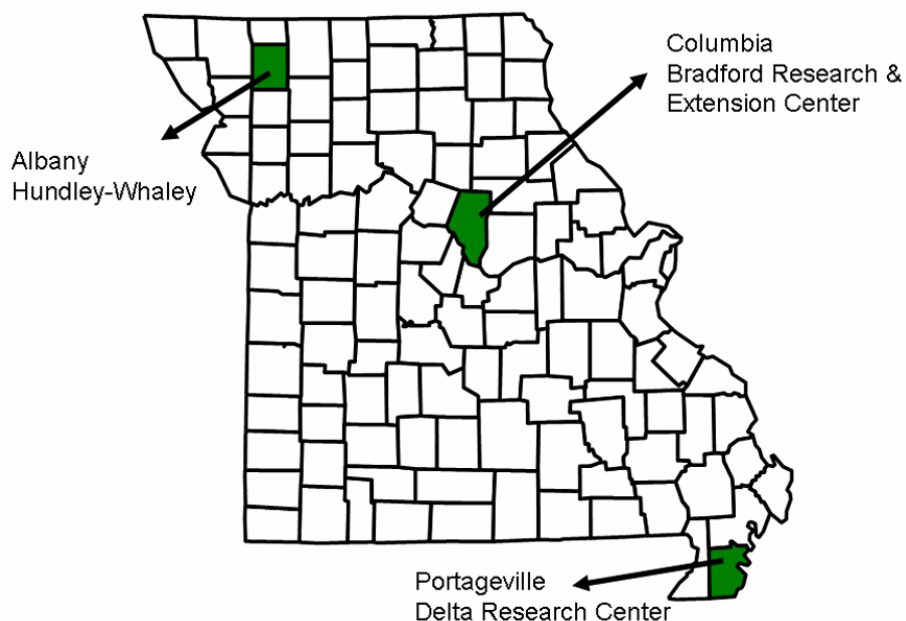
Two possible methods to reduce impact from rust on yield are planting on an earlier date and planting early-maturing varieties. We need to understand the effectiveness of these strategies on changing dates for key stages of development and their impact on yield in order to give best recommendations

## **Methods:**

This experiment was conducted at three locations: Albany in northwest Missouri, Columbia in central Missouri, and Portageville in southeast Missouri (Figure 1). To determine the effects of planting early-maturing varieties, performance of three adapted varieties were compared to the performance of three varieties in one and two maturity groups earlier than the adapted varieties. Varieties used at each location are listed in Table 1. For each location, three planting dates were used. At least one of the planting dates was more than several weeks earlier than considered normal for the location. Planting dates were April 24, May 12, June 6 at Albany; April 17, May 15, June 16 at Columbia; and April 17, May 15, and June 17 at Portageville.

At Albany and Columbia, plots were four 30-inch rows wide. The previous crop was corn. Plots were planted at Albany following tillage with a field cultivator. No tillage was performed at Columbia. At Portageville, the plot area was tilled and bedded for furrow irrigation. Plots were sprayed with the insecticide Karate at V1 stage. Row width at Portageville was 38 inches. Roundup Weathermax was used for post emergence weed control at all locations.

Plots were observed frequently and dates on which soybean plants achieved R1 (beginning flowering), R3 (beginning pod development), R5 (beginning seed-fill), and R7 (physiological maturity) stages of development were recorded. After leaf drop a random sample of plants were used to determine plant height from soil surface to stem tip. At all locations, the center two rows were harvested with a plot combine. Yield was corrected to 13% moisture.



**Figure 1.** Location of three sites for experiment.

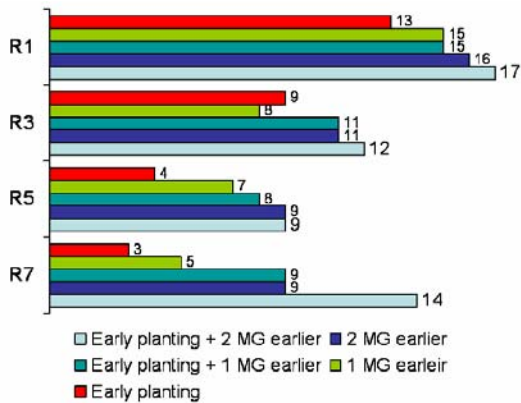
**Table 1.** Varieties and their maturity group classification used at Albany, Columbia, and Portageville in 2006.

Albany		Columbia		Portageville	
Variety	MG	Variety	MG	Variety	MG
Fontanelle Hybrids '7292 RR'	1	Fontanelle Hybrids '7292 RR'	1	Morsoy MFA '3304N'	3
Asgrow Seed 'AG1702'	1	Asgrow Seed 'AG1701'	1	Asgrow Seed 'AG3602'	3
Merschman Seeds 'Mars'	1	Merschman Seeds 'Mars'	1	Delta & Pine Land '3861RR'	3
Merschman Seeds 'Shawnee'	2	Merschman Seeds 'Shawnee'	2	Asgrow Seed 'AG4403'	4
Asgrow Seed 'AG2703'	2	Asgrow Seed 'AG2703'	2	DeKalb Seed 'DKB46-51'	4
Fontanelle Hybrids '8182 RR'	2	Fontanelle Hybrids '8182 RR'	2	Delta King Seed DK4866RR'	4
DeKalb Seed 'DKB36-52'	3	DeKalb Seed 'DKB38-52'	3	Delta King Seed DK5366RR'	5
Asgrow Seed 'AG3602'	3	NK Syngenta 'NKS37-N4'	3	Asgrow Seed 'AG5501'	5
Pioneer Hi-Bred '93M42'	3	Pioneer Hi-Bred '93M50'	3	Morsoy MFA 'RT 5903N'	5
Pioneer Hi-Bred '94M70'	4	Pioneer Hi-Bred '94M70'	4		
MFA Morsoy '4404'	4	MFA Morsoy '4402N'	4		
Asgrow Seed 'AG4404'	4	Asgrow Seed 'AG4404'	4		

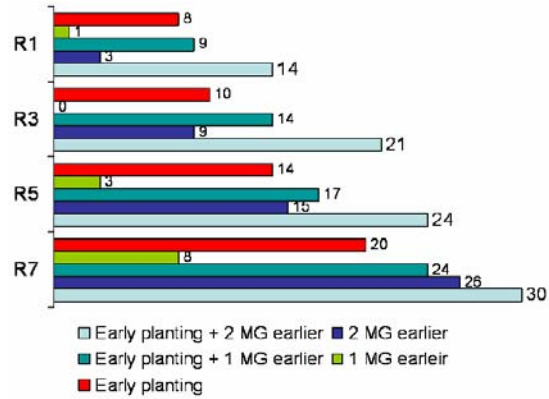
**Results:**

## Soybean development

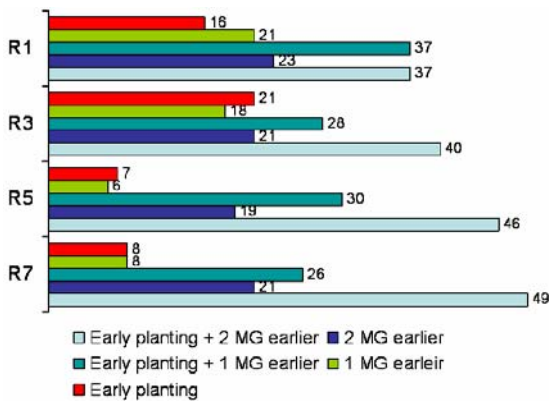
In order to assess the effects of these two strategies on dates for which soybean plants reached critical stages of development we averaged the dates for the three varieties of each maturity group. We selected the following combinations as “normal” planting date and adapted maturity group: May 12 and Maturity Group 3 for Albany; May 15 and Maturity Group 4 for Columbia; and May 15 and Maturity Group 5 for Portageville. The five combinations of strategies are compared to these normal planting dates and adapted varieties in Figures 2, 3, and 4.



**Figure 2.** Effects of planting earlier than normal, planting a variety one (1 MG) or two maturity groups (2 MG) earlier than adapted, or a combination of early planting and early maturity groups on dates upon which plants reached four stages of development at Albany. Values are averages of three varieties within a maturity group and are the number of days earlier than “normal”.



**Figure 3.** Effects of planting earlier than normal, planting a variety one (1 MG) or two maturity groups (2 MG) earlier than adapted, or a combination of early planting and early maturity groups on dates upon which plants reached four stages of development at Columbia. Values are averages of three varieties within a maturity group and are the number of days earlier than “normal”.



**Figure 4.** Effects of planting earlier than normal, planting a variety one (1 MG) or two maturity groups (2 MG) earlier than adapted, or a combination of early planting and early maturity groups on dates upon which plants reached four stages of development at Portageville. Values are averages of three varieties within a maturity group and are the number of days earlier than “normal”.

Both planting date and the use of early-maturing varieties affected the dates on which soybean plants reached key stages of development. The number of days between the “normal” planting date and the early planting date at Albany, Columbia, and Portageville were 19, 29, and 29. Planting soybean earlier than normal caused soybean plants to reach each of the stages of development earlier, but by fewer days than the planting date had been changed. For example, planting 29 days earlier at Columbia resulted in soybean plants flowering only 8 days earlier. Soybean plants are sensitive to photoperiod and this affected the timing of each stage of development regardless of planting date.

Planting a variety that was one and two maturity groups earlier than adapted had a smaller effect at Columbia than at the other two locations, especially for R1 and R3. Weather stress might have interfered with soybean development and the expression of development stages at this location. Combining early planting with an early-maturing variety had the greatest effect of timing of stages of development, but seldom were the effects additive.

Stage R3 might be the key stage of development for soybean in terms of timing of soybean rust and whether or not it is cost effective to spray a fungicide. The effects on the timing of R3 from the various strategies vary among the three locations. It is difficult to know the causes of these differences because the locations differ for latitude, varieties, and weather conditions. Albany is in the northwest portion of Missouri, a location that might have the least potential for soybean rust. Choosing a variety that is two maturity groups earlier than adapted and planting 19 days earlier than normal moved the R3 stage only 12 days earlier. However this same strategy, except that planting dates were 29 days earlier, moved the R3 stage 21 and 40 days at Columbia and Portageville. These effects are significant and could have an effect on the severity of soybean rust if it appears in Missouri late in the season.

### **Soybean yield**

A highly significant variety by planting date interaction for yield occurred at all three locations. This indicates that the effect of planting date on yield varied greatly among the varieties. Maturity group adaptation was at least partly responsible for these interactions. Averaged over all varieties grown at a location there were significant planting date effects at Columbia and Portageville, but not at Albany (Tables 2, 3, and 4).

At Albany, yields of the three Maturity Group 1 varieties were among the lowest yielding varieties for all three planting dates (Table 2). Yields for the Maturity Group 2 were also low for the first and second planting dates, but for the June 6 planting date they were equal to most of the Maturity Group 3 and 4 varieties. Yields for the unadapted varieties of Maturity Groups 1 and 2 increased in yield as planting date was delayed, but yield for the varieties in Maturity Groups 3 and 4 decreased as planting date was delayed (Figure 5). This yield response for the early-maturing varieties was unexpected because it was assumed that these varieties would perform best with earlier planting dates. However, a similar response was found in 2005, so if farmers are considering planting an early-maturing variety in north Missouri, they may want to consider delaying planting.

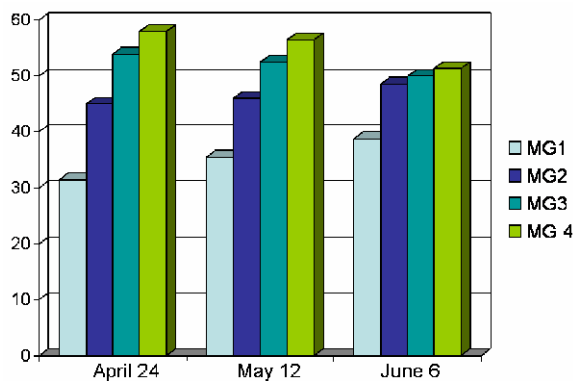
Although not beneficial for rust management, this information might be important if planting is delayed because of wet spring weather or if replanting is required.

**Table 2.** Yields for nine soybean varieties planted on three dates at Albany in 2006.

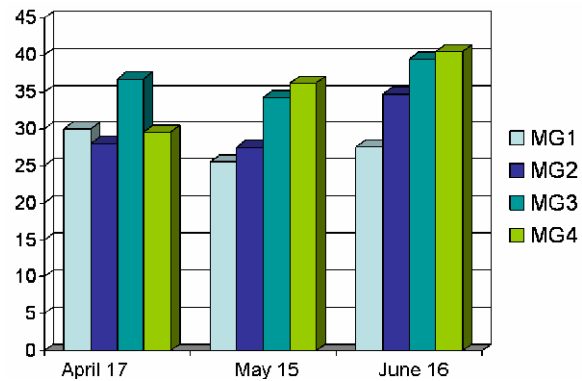
Variety	MG	Planting Date			average
		April 24	May 12	June 6	
Fontanelle Hybrids '7292 RR'	1	29.9h†	32.6g	39.9c	34.1g
Asgrow Seed 'AG1702'	1	36.2g	42.0f	40.2c	39.5f
Merschman Seeds 'Mars'	1	28.3h	31.9g	36.5c	34.1g
Merschman Seeds 'Shawnee'	2	44.0ef	44.8ef	47.3b	45.4e
Asgrow Seed 'AG2703'	2	47.6e	48.5de	50.4ab	48.8d
Fontanelle Hybrids '8182 RR'	2	43.3f	44.8ef	48.2ab	45.4e
DeKalb Seed 'DKB36-52'	3	49.7de	51.4cd	48.2ab	49.8d
Asgrow Seed 'AG3602'	3	53.6cd	52.4cd	48.7ab	51.6cd
Pioneer Hi-Bred '93M42'	3	58.4ab	53.5bc	53.0a	55.0ab
Pioneer Hi-Bred '94M70'	4	58.1abc	58.9a	50.9a	56.0a
MFA Morsoy '4404'	4	60.5a	57.9ab	50.3ab	52.9bc
Asgrow Seed 'AG4404'	4	55.4bc	52.9c	52.8a	57.0a
average of all varieties		47.6a§	47.1a	47.2a	

† numbers within a column (excluding averages of all varieties) followed by the same letter are not different (LSD 0.05).

§ numbers within this row followed by the same letter are not different (LSD 0.05).



**Figure 5.** Effects of maturity groups and planting dates on soybean yield at Albany. Values are the averages of three varieties within each maturity group.



**Figure 6.** Effects of maturity groups and planting dates on soybean yield at Columbia. Values are the averages of three varieties within each maturity group.

At Columbia, yields were greatly affected by dry and hot weather. Less than one inch of rain occurred at this location from late July to mid-August. High temperatures during that period were near 100F for most days. Soybean stage R5 occurred on August 5 and 8 for Maturity Group 3 and 4 varieties planted on May 15. So, the impact of the weather stress was greatest for the adapted varieties. Among the three planting dates the latest, June 16, produced the highest yield (Table 3). A significant rainfall event occurred on August 19. The timing of this rainfall event benefited most the later-maturing varieties planted on June 16.

For the earliest planting date, two Maturity Group 3 varieties produced the highest yield. There were no differences among the other 10 varieties. Again, weather stress probably affected yield performance. For the May 15 and June 16 planting dates, the Maturity Group 3 and 4 varieties generally yield more than the Maturity Group 1 and 2 varieties (Figure 6.). Pioneer brand 93M50 planted on June 16 was the only variety that did not fit this pattern.

**Table 3.** Yields for twelve varieties planted on three dates at Columbia in 2006.

Variety	MG	Planting Date			average
		April 17	May 15	June 16	
Fontanelle Hybrids '7292 RR'	1	31.0b†	26.8c	31.2cd	29.6c
Asgrow Seed 'AG1702'	1	30.4b	23.4c	23.8e	25.9d
Merschman Seeds 'Mars'	1	28.5b	26.7c	27.7de	27.6cd
Merschman Seeds 'Shawnee'	2	30.7b	27.6c	31.0cd	29.8c
Asgrow Seed 'AG2703'	2	26.8b	27.6c	35.8bc	30.1c
Fontanelle Hybrids '8182 RR'	2	26.6b	27.2c	37.3ab	30.4c
DeKalb Seed 'DKB38-52'	3	39.6a	40.4a	40.1ab	40.0a
NK Syngenta 'NKS37-N4'	3	42.5a	35.3ab	41.1a	39.6a
Pioneer Hi-Bred '93M50'	3	28.3b	27.1c	37.3ab	30.9c
Pioneer Hi-Bred '94M70'	4	27.4b	33.8b	42.6a	34.6b
MFA Morsoy '4402N'	4	29.7b	36.9ab	40.0ab	35.5b
Asgrow Seed 'AG4404'	4	31.8b	37.7ab	38.9ab	36.1b
average of all varieties		31.1b§	30.9b	35.6a	

† numbers within a column (excluding averages of all varieties) followed by the same letter are not different (LSD 0.05).

§ numbers within this row followed by the same letter are not different (LSD 0.05).

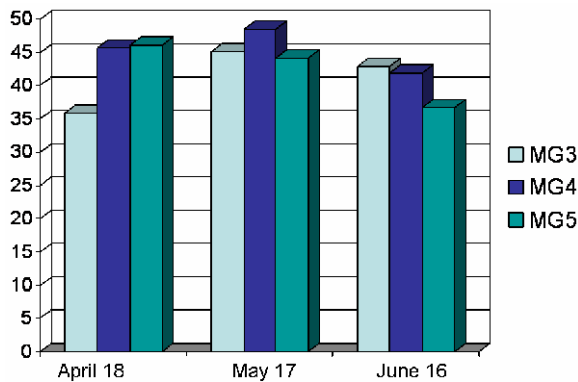
**Table 4.** Yields for nine varieties planted on three dates at Portageville in 2006.

Variety	MG	Planting Date			average
		April 17	May 15	June 17	
Morsoy MFA '3304N'	3	37.7e†	45.4b	43.3ab	42.1bc
Asgrow Seed 'AG3602'	3	29.9f	45.4b	40.5bc	38.6d
Delta & Pine Land '3861RR'	3	39.9cde	44.5b	44.5ab	43.0b
Asgrow Seed 'AG4403'	4	45.2abc	43.4b	42.6ab	43.7ab
DeKalb Seed 'DKB46-51'	4	47.8ab	43.7b	46.2a	45.9a
Delta King Seed DK4866RR'	4	44.0bc	53.0a	37.0cd	44.7ab
Delta King Seed DK5366RR'	5	43.8cd	41.9b	34.2d	40.0cd
Asgrow Seed 'AG5501'	5	49.5a	44.7b	39.9bc	44.7ab
Morsoy MFA 'RT 5903N'	5	45.1abc	45.9b	36.1cd	42.3bc
average of all varieties		42.5b	45.3a	40.5c	

† numbers within a column (excluding averages of all varieties) followed by the same letter are not different (LSD 0.05).

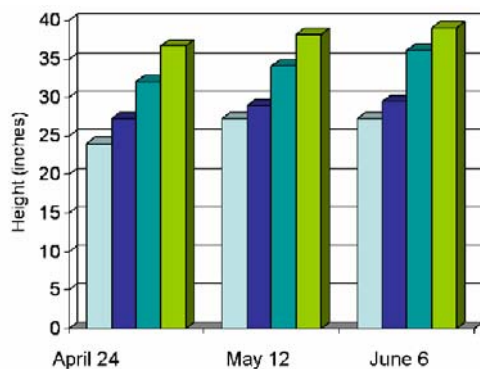
§ numbers within this row followed by the same letter are not different (LSD 0.05).

At Portageville, the May 15 planting date produced the highest yield, although the yield performance among the varieties was unusual (Table 4). One variety, Delta King Seed DK4866RR', produced the highest yield and there were no significant yield differences among all of the other varieties. For the April 17 planting date, the Maturity Group 3 varieties produced the lowest yield (Figure 7). However, for the June 17 planting date several Maturity Group 3 varieties were among the highest yielding varieties. We expected that Maturity Group 3 varieties would have performed best with an early planting date. That was not the case.

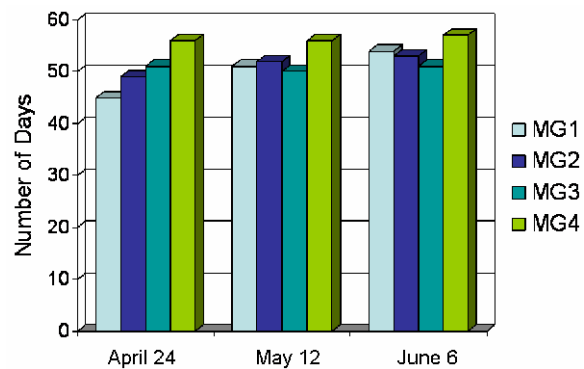


**Figure 7.** Effects of maturity groups and planting dates on soybean yield at Portageville. Values are the averages of three varieties within each maturity group.

The plant height might be used to understand why maturity groups differ for yield. Plant height is important because it is related to leaf area and the ability for plants to absorb light energy to produce sugars through photosynthesis. At Albany, early-maturing varieties were shorter than adapted varieties for all planting dates (Figure 8). This is a typical response to planting location by soybean because it is sensitive to photoperiod. The plant height relationships among varieties related well to the observed yield differences (Figure 5).

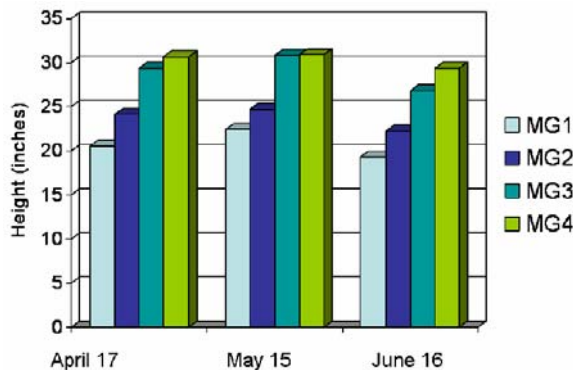


**Figure 8.** Effects of maturity groups and planting dates on plant height at Albany. Values are the averages of three varieties within each maturity group.

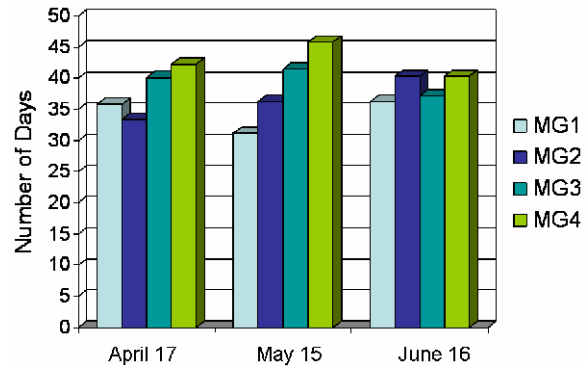


**Figure 9.** Effects of maturity groups and planting dates on the number of days for seed-filling at Albany. Values are the averages of three varieties within each maturity group.

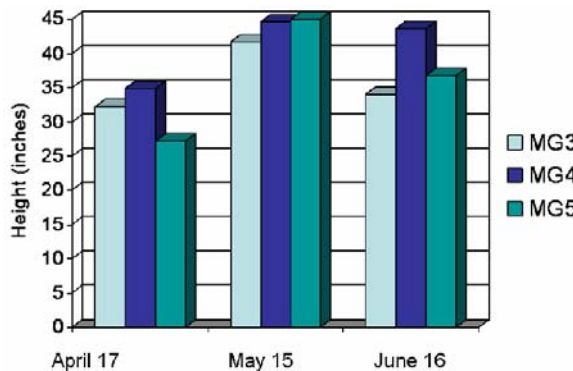
At Columbia, all varieties were shorter than normal because of the dry weather (Figure 10). On average, varieties of Maturity Groups 1 and 2 were less than 23 inches tall and did not produce enough leaf areas to fill in the inter-row area. Plant height results at Portageville were not as expected (Figure 12). For example, we expected Maturity Group 5 varieties to be taller than the all other varieties and that was not the situation for at least two of the three planting dates.



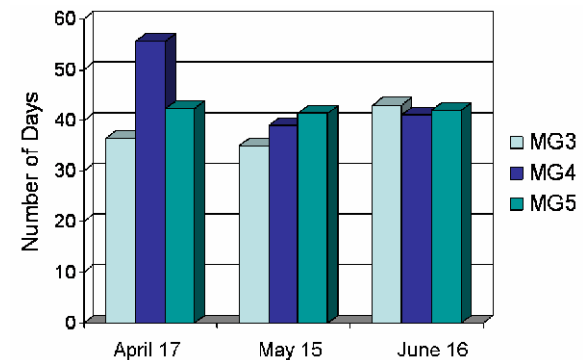
**Figure 10.** Effects of maturity groups and planting dates on plant height at Columbia. Values are the averages of three varieties within each maturity group.



**Figure 11.** Effects of maturity groups and planting dates on the number of days for seed-filling at Columbia. Values are the averages of three varieties within each maturity group.



**Figure 12.** Effects of maturity groups and planting dates on plant height at Portageville. Values are the averages of three varieties within each maturity group.



**Figure 13.** Effects of maturity groups and planting dates on the number of days for seed-filling at Portageville. Values are the averages of three varieties within each maturity group.

The number of days between stage R5 and stage R7 is the length of seed-filling. This number is also important in determining yield potential of varieties. Because soybean plants are sensitive to photoperiod, in general, early-maturing varieties will have shorter seed-filling periods than adapted varieties. At Albany and Columbia there was at least some relationship between length of seed-filling period and Maturity Group adaptation. There was little or no relationship at Portageville.

## Conclusions:

1. Although results varied by location, changing planting date 2.5 days was required for every one day earlier response for the critical soybean stage of development R3. In Portageville, only 1.4 days were needed for the same effect.
2. In north and central Missouri, varieties from two maturity groups earlier than adapted to the area reached R3 about 10 days earlier than adapted varieties.
3. In southeast Missouri, Maturity Group 3 varieties (indeterminate growth habit) flowered 21 days earlier than the determinate varieties of Maturity Group 5.
4. In north Missouri, Maturity Group 3 and Maturity Group 4 varieties yielded more than Maturity Group 1 and Maturity Group 2 varieties when planted on all three planting dates, although the differences were less for the latest planting date.
5. In central Missouri, Maturity Group 3 and Maturity Group 4 varieties yielded more than Maturity Group 1 and Maturity Group 2 varieties for the May 15 and June 16 planting dates. There was no difference among Maturity Group 1, Maturity Group 2, and Maturity Group 4 for the April 17 planting date. Weather stress affected yield potential at Columbia.
6. In southeast Missouri, highest yielding varieties were in Maturity Group 4 and Maturity Group 5 for the April planting date, Maturity Group 4 for the May planting date, and Maturity Group 3 for the June planting date.
7. One of the reasons that early maturing varieties yielded less than adapted varieties was that early-maturing varieties were shorter than adapted varieties. Early-maturing varieties also had shorter seed-filling periods, except at Portageville