

**Mississippi Soybean Promotion Board
Final Termination Report**

Title: Economics of Soybean Maturity Groups Yield Response to Insecticide Seed Treatments
With Early Planting Dates

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Abstract

Very limited information is available regarding soybean maturity group (MG) response to insecticide-seed-treatments and planting dates. The objective of this study was to evaluate the response of selected Roundup Ready MG III, IV and V varieties to a fungicide (APRONMAXX RTA) and an insecticide-fungicide seed treatment [APRON + CRUISER (5SF)] with three planting dates. Studies were planted in three 4-week planting intervals starting early to mid April through early to mid June at three locations (Verona, Starkville and Stoneville).

Although bean leaf beetle [*Ceratoma trifurcate* (Foster)] defoliation and thrips (*franklinelli spp.*) injury levels were very low at all three locations, the April planting most often showed more bean leaf beetle defoliation or thrips injury at V1 or V3 than May and June plantings, at all locations. APRON + CRUISER showed less defoliation and thrips injury than APRON alone at V1 and V3 with no differences between varieties. APRON + CRUISER produced 1.8, 4.3 and 2.1 bu/ac more than APRON alone with low (Starkville), medium (Verona) and high (Stoneville) yield environments, respectively. Averaged over locations, the APRON + CRUISER yield was 2.7 bu/ac. The average returns above the cost of the CRUISER seed treatment cost (\$8/ac) were \$8, \$14 and \$19/ac more than APRON alone using \$6, \$8 and \$10/bu soybean market grain prices.

There was a variety by planting date interaction for yield at all locations. At Starkville, all MG varieties' yields were higher with April plantings than May and June plantings. At Verona, AG 3906, the MG III variety, had the lowest yield of all varieties across all three planting dates. DP 5634, MG late (L) V variety, had the highest yield of all varieties planted in either April, May or June. The MG early (E) IV variety, AG 4403, MG L IV variety, Pioneer 94B73, and MG E V variety, DK 5058, had similar yields planted in either April or May. DP 5634 variety had the highest yield of all varieties planted in June, but was 2 to 3 weeks later than MG IV in maturity.

With supplemental irrigation, the delta location (Stoneville) indicated some similar MG variety yield responses as Verona. With the May planting, AG 3906, MG III, had the highest yield and was similar to Pioneer 94B73, MG L IV, DK 5058, MG E V, and DP 5634, MG L V. All varieties produced their lowest yield when planted in June. DK 5058 and DP 5634 produced their highest yield planted in April; and were not different from April planted AG 4403, and Pioneer 94B73. However, the MG V varieties usually mature 1 to 3 weeks later than the MG IV varieties and may require extra irrigations. AG 4403 and Pioneer 94B73 had equivalent yields planted in either April or May. However, in the May planting, these varieties were higher in yield than MG III (AG 3906), MG E V (DK 5068) and MG L V (DP 5634) varieties.

These data suggest that for maximum yield, the April planting with MG IV's in both North Mississippi and the Mississippi delta is the most desirable. The MG III varieties are best suited for May plantings for both locations. June plantings at both locations resulted in the lowest yield of all planting dates. The MG L V varieties in North Mississippi are best suited for April, May and June planting. However, in the delta the MG V's showed the highest yield response planted in April with about 15 and 40 bu/ac yield decline planted in May and June, respectively. All varieties showed yields of 15 to 30 bu/ac less when planted in June than April or May.

The APRON + CRUISER seed treatment has the potential for a very positive economic impact. If only 50% of the acreage of Mississippi's 2 million acres of soybeans were planted with APRON + CRUISER treated seed with an \$8/bu market price, the economic impact would be \$14 million. If you add a multiplier effect of 1.5, this would be equivalent to about \$21 million dollars of economic activity for Mississippi.

Introduction

The early season soybean production systems of planting in April instead of May and the utilization of fungicide seed treatments have had a positive impact on soybean yield and profitability. Mississippi Agricultural Statistical Service (MASS) reports (2003-2006) indicate that the percent of soybeans planted by April 15 increased from 15% in 2003 to 61% in 2006. Preliminary research in North Mississippi indicated that planting after April 15 maximized yield potential while planting earlier can result in reduced yield when cool and wet conditions occur in April and early May (Buehring et al. 2004). The MG IV varieties showed more sensitivity to earlier than April planting than MG V varieties. Little information is available regarding yield response differences among soybean MG III, IV and V varieties for insecticide-fungicide seed treatments with early and late plantings.

The economic yield benefit from an insecticide-fungicide seed treatment for control of a complex of early season soybean insect pests that include thrips and bean leaf beetle in early planted soybeans, particularly when cool weather occurs in the early growing season, has not been fully explored. Preliminary 2006 insecticide-fungicide seed treatment research planted before April 15 averaged 4 to 6 bu/ac higher than fungicide alone and yields for planting after April 15 was about 2.5 bu/ac higher than APRON (fungicide) alone (personal communication Angus Catchot, MSU Entomology and Plant Pathology Department). These preliminary results indicate insecticide-fungicide seed treatments have potential for early season aphid and bean leaf beetle control, and increased yield. However, little research has been conducted to determine whether soybean MG respond differently to insecticide-fungicide seed treatments over a range of early to late planting dates.

Objective

- 1) Evaluate the growth and yield response of selected MG III, MG E IV, MG L IV, MG E V and MG L V varieties to insecticide + fungicide seed treatments with 4-week planting intervals from early-mid-April to early-mid-June at 3 locations.
- 2) Identify soybean MG variety/insecticide-fungicide seed treatment and planting date combinations that produced the highest returns above seed and seed treatment costs.
- 3) Determine the optimum planting dates for soybean variety maturity groups.

Materials and Methods

The varieties used in these studies were: Asgrow AG 3906 (MG III), Asgrow AG 4403 (MG E IV), Pioneer 94B73 (MG L IV), Delta King DK 5068 (MG E V) and Deltapine DP 5634 (MG L

V). Due to AG 3906 (MG III) and DP 5634 (MG L V) seed being unavailable in 2010, AG 3803 (MG III) and DK 5606 (MG L V) were used.

Seeds were treated with either APRONMAXX RTA (fungicide) + CRUISER (5SF) (insecticide) or APRONMAXX RTA alone. The APRONMAXX RTA rate was 2.5 oz/100 lb seed. The CRUISER 5SF rate was 1.28 oz/100 lb seed. Fifty pounds seed was placed in a small concrete mixer and liquid (CRUISER and APRON) concentrate was added in small increments with a syringe during the mixing process until all liquid had been applied. The mixing process continued until the seed was dry. The treated seeds were planted early to mid-April, early to mid-May, and early to mid-June with 140,000 seed/ac in narrow rows at Verona (16-inch), and Stoneville (18-inch), and 38-inch rows at Starkville. Plot lengths were 30 ft with 4 replications.

The experimental design was a split-split plot with planting date as main plot, variety and seed treatment as the subplot with 4 replications. Years and replications with years were treated as a random variable. GLMMIX (SAS 9.2) procedure was used for each location analysis. Least significant differences at the 5% probability were used to separate treatment means.

The plots were rated for thrips injury (0-5 rating scale) and bean leaf beetle defoliation (0-100%) at V1 and V3 stage of growth. The thrips injury rating scale was 0 for no injury up to 5 equaled severe injury. Plots also were scouted for Asian Rust and stinkbugs, and appropriate pesticides were applied if needed. Maturity dates and plant height at maturity were recorded. Plots were harvested with a plot combine 5 to 10 days after their maturity (95% pods were brown). Seed weights and moisture were determined and plot yields were converted to bu/ac at 13% seed moisture.

Returns above the CRUISER seed treatment cost of \$8/ac were determined by subtracting the APRON seed treatment yield from the APRON + CRUISER yield; multiplying it by the grain market prices of \$6, \$8 and \$10/bu and subtracting the CRUISER seed treatment cost. The economic impact was based on 50% of the 2 million Mississippi soybean acreage would be treated with APRON + CRUISER instead of APRON alone, and an economic activity multiplier effect of 1.5.

Results and Discussion

Verona: Seed treatments showed no interactive effects with planting dates or varieties on yield, plant height at maturity or bean leaf beetle defoliation. The defoliation at V1 and V3 soybean growth stages were very low and ranged from 1.9 to 3.7% (Table 1). APRON alone had 3.0 and 3.7% defoliation at V1 and V3, respectively. This was significantly higher than 1.9 and 3.0% at V1 and V3 for APRON + CRUISER. Plant height of 35 inches for APRON + CRUISER was 2 inches taller than APRON alone. APRON + CRUISER yield was 50.3 bu/ac, 4.3 bu/ac more than APRON alone.

Yield, plant height at maturity and defoliation at V1 and V3 growth stage showed differences in planting dates (Table 2). The April planting yield of 51.4 bu/ac was equal to the May planting yield of 49.3 bu/ac; and both plantings were higher than the June planting yield of 45.3 bu/ac. The April planting, plant height of 29 inches, was shorter than the May planting plant height of

37 inches; but was not different from the June planting plant height of 35 inches. The April planting bean leaf beetle defoliation of 3.9 and 6.0% at V1 and V3, respectively, were higher than both May and June plantings with no differences between May and June.

Averaged over years and seed treatment, varieties showed differences in plant height at maturity and yield, with no differences in defoliation at V1 or V3 (Table 3). AG 3906 yield of 40.7 bu/ac was lower than all other varieties. DP 5634 had the highest yield 58.5 bu/ac and was higher than all other varieties. Pioneer 94B73 yield of 47.2 bu/ac was equal to AG 4403, but lower than DK 5068 and DP 5634. DK 5068 height of 38 inches was the tallest and AG 3806 was the shortest at 29 inches with other varieties' height of 34 inches.

There was a variety by planting date interaction for yields (Table 4). DP 5634 had similar yields planted April and May and were higher than planted in June. However, the DP 5634 June planting was higher than all other varieties. AG 3906 had higher yields planted in May than April and June. Pioneer 94B73 yield was lower than AG 4403, DK 5058 and DP 5634 planted in April, but showed no yield differences across the 3 planting dates. April and May planted AG 4403 and DK 5058 yields of 50.5 and 54.2 bu/ac, respectively were equal; but both were lower than DP 5634 planted in April, May and June. These results indicated for best yield results a MG III variety should only be planted in May; and MG E IV, MG L IV, MG E V and MG L V varieties may be planted in April or May. Although yields were lower for the MG L V variety planted in June, it had the highest yield of all maturity groups planted in June, but matures about 2 weeks later than MG E IV and MG L IV varieties (Table 5).

Starkville: The seed treatment effects were similar to Verona, with variety and planting dates showing no yield response to seed treatments. However, there was a yield difference between seed treatments (Table 6). The yields at Starkville were much lower than Verona due to drought stress. But the APRON + CRUISER yield of 28.3 bu/ac was 1.8 bu/ac more than APRON alone yield of 26.5 bu/ac. Even with the low yield, the economic returns for the APRON + CRUISER was about \$6/ac (\$8/bu, market price) more than APRON alone.

There was a variety by planting date interaction for yield (Table 7). Pioneer 94B73 produced higher yield than all varieties planted in April and was higher in yield than planted in May, and June. All varieties planted in May had similar and equal yields to Pioneer 94B73 yield of 31.7 bu/ac, except DP 5634 and DK 5068 which had yields of 19.5 and 24.3 bu/ac, respectively. All varieties planted in June showed low yields of 15 to 21 bu/ac. Averaged over years and varieties, the April plant yield of 36.1 bu/ac was higher than both May and June planted yields of 27.1 and 19.0 bu/ac, respectively. Averaged over planting dates, Pioneer 94B73 had the highest yield average of 31.9 bu/ac and was higher than all other varieties.

Stoneville: With supplemental irrigation, Stoneville had higher yields than Verona or Starkville. However, the seed treatment effects were the same as Verona and Starkville with no interactions with planting dates or varieties for yield. The APRON + CRUISER yield of 64.0 bu/ac was 2.1 bu/ac higher than APRON alone (Table 8). Thrips injury ratings were very low, and ranged from 0.9 to 1.6 at V3 growth stage. The rating of 0.9 for APRON + CRUISER was lower than the APRON alone rating of 1.6. The plant height at maturity of 35 inches for APRON + CRUISER

was one-inch taller than APRON alone treatment. Defoliation at V1 and V3 was 1.2% or less with no difference between seed treatments.

Planting date had a significant effect on yield, plant height and defoliation (Table 9). The April planting yield of 75.9 bu/ac was 6.4 bu/ac higher than May, and 32.5 bu/ac higher than the June planting. April and June plantings showed more defoliation than the May planting. This was the only location that showed the June planting was affected by defoliation.

Stoneville, like the other locations, showed a planting date by variety interaction for yield. However, there was no planting date by seed treatment or planting date by variety by seed treatment interactions for yield. The June planting yields were lower than April and May planting for all varieties (Table 10). With the June planting, DP 5634 had the lowest yield of 38.3 bu/ac and was less than AG 3906, AG 4403 and Pioneer 94B73. AG 3906, AG 4403, and Pioneer 94B73 showed no yield differences between April and May plantings. With April planting, DK 5058 and DP 5634 had the highest yields but were not different from AG 4403 and Pioneer 94B73. DK 5058 and DP 5634 planted in April had higher yields than with the May and June plantings. These data suggest that MG III varieties is best suited for May planting, while MG E IV and MG L IV varieties are best suited for April and May plantings. The MG E V and MG L V varieties are best suited for only April plantings. If you have to plant in June, then all MG varieties are suitable, except the MG L V varieties. However, with the MG V varieties, maturity with all planting dates usually were from 1 to 3 weeks later than MG IV varieties and may require extra irrigation compared to MG IV varieties (Table 11).

Returns above Cruiser seed treatment cost: The returns above the \$8/ac CRUISER seed treatment cost with \$6, \$8 and \$10/bu market prices are listed in Table 12. At \$6, \$8 and \$10/bu market prices, the returns of CRUISER seed treatment costs are \$8, \$14 and \$19/ac. If 50% of the 2 million Mississippi acres of soybeans in 2010, the economic effect at \$8/bu market price would be \$14 million. If we use a multiplier effect of 1.5, the total economic activity affect for the use CRUISER seed treatment would be \$21 million.

References

Buehring, N. W., R. R. Dobbs and M. P. Harrison 2004. Roundup Ready soybean varieties response to early planting. Annual Report 2003 of the North Mississippi Research and Extension Center. Mississippi Agricultural and Forestry Experiment Station Information Bulletin 405; 90-93.

Catchot, Angus. September 2006. Personal communication. Extension Entomologist, Department of Entomology and Plant Pathology, Mississippi State University.

SAS Institute. 2008. SAS/STAT 9.2 users guide. SAS Institute Inc., Cary, N. C.

U. S. Dept. of Agriculture, National Agricultural Statistics Service, Agricultural Statistics Board Crop Progress Reports, 2003-2006.

Table 1. Seed treatment effect on yield, plant height at maturity and defoliation at V1 and V3 growth stages, averaged over years (2008-2010), planting date and variety, Verona, MS.

Seed trmt	Yield	Mat	---- % Defoliation ----	
	bu/ac	Pl ht (in)	V1	V3
Apron	46.0 b ¹	33 b	3.0 a	3.7 a
Apron + Cruiser	50.3 a	35 a	1.9 b	3.0 b

¹Within column, numbers followed by the same letters are not significantly different at the 5% probability level.

Table 2. Planting date effect on yield, plant height at maturity and defoliation at V1 and V3 growth stages, averaged over years (2008-2010), seed treatment and varieties, Verona, MS.

Plant date	Yield	Mat	---- % Defoliation ----	
	Bu/ac	Pl ht (in)	V1	V3
April	51.4 a ¹	29 a	3.9 a	6.0 a
May	49.3 a	37 b	2.0 b	2.5 b
June	45.3 b	35 a	1.4 b	1.5 b

¹Within a column numbers followed by the same letters are not significantly different at the 5% probability level.

Table 3. Variety yields plant heights/maturity and defoliation response, averaged over years (2008-2010), planting date and seed treatment, Verona, MS.

Variety	MG	Yield	Mat	---- % Defoliation ----	
		Bu/ac	Pl ht (in)	V1	V3
AG 3906 ²	III	40.7 d ¹	29 c	2.4 a	3.5 a
AG 4403	E IV	47.5 bc	34 b	2.4 a	3.2 a
Pioneer 94B73	L IV	47.2 c	34 b	2.6 a	3.4 a
DK 5068	E V	49.3 b	38 a	2.3 a	3.0 a
DP 5634 ³	L V	58.5 a	34 b	2.5 a	3.4 a

¹Within a column, numbers with the same letters are not significantly different at the 5% probability level.

²2010 variety was AG 3803.

³2010 variety was AG 5606.

Table 4. Variety yield as influenced by planting dates, averaged over years (2008-2010), and seed treatments, Verona, MS.

Variety	MG	----- Planting dates -----		
		April	May	June
		----- Yield (bu/ac) -----		
AG 3906 ¹	III	35.6 i ³	46.1 defg	40.5 hi
AG 4403	E IV	50.5 bcd	49.1 cde	42.8 gh
Pioneer 94B73	L IV	45.8 efg	49.1 cde	46.8 def
DK 5058	E V	54.2 b	49.8 bcde	41.0 fgh
DP 5634 ²	L V	60.2 a	62.8 a	52.4 bc

¹2010 variety was AG 3803.

²2010 variety was AG 5606.

³Within yield and plant ht columns, number with the same letters are not significantly different at the 5% probability level.

Table 5. Planting date effect on variety maturity dates in 2008, 2009 and 2010, Verona, MS.

P. Date	----- Varieties -----				
	AG 3906	AG 4403	Pioneer 94B73	DK 5068	DP 5634
----- Maturity dates -----					
4/16/08	9/08	9/08	9/08	9/22	9/29
4/08/09	8/20	8/27	8/27	9/03	9/24
4/29/10	8/30	9/09	9/09	9/20	9/24
5/13/08	9/22	9/22	9/22	10/05	10/05
5/21/09	9/14	9/24	9/24	9/28	10/12
5/27/10	9/13	9/17	9/17	9/24	10/04
6/09/08	9/29	9/29	9/29	10/12	10/16
6/17/09	10/12	10/12	10/12	10/19	10/19
6/14/10	9/27	9/27	9/27	10/11	10/11

Table 6. Soybean yield response to seed treatments, averaged over varieties, planting dates and years (2008-2010), Verona, Stoneville and Starkville, MS.

Seed treatment	Verona	Starkville	Stoneville	AV
	Yield (bu/ac)			
Apron	46.0 b ¹	26.5 b	61.9 b	44.8
Apron + Cruiser	50.3 a	28.3 a	64.0 a	47.5

¹Within column numbers with the same letters are not significantly different at the 5% probability level.

Table 7. Soybean variety yield response to planting dates, averaged over seed treatments and years (2008-2010), Starkville, MS.

Variety	MG	Planting dates			AV
		April	May	June	
		Yield (bu/ac)			
AG 3906 ¹	III	32.1 b ³	29.6 bc	20.8 d	27.5 B ⁴
AG 4403	E IV	32.8 b	30.4 bc	18.9 de	27.4 B
Pioneer 94B73	L IV	42.9 a	31.7 b	21.1 d	31.9 A
DK 5068	E V	30.5 bc	24.3 cd	15.2 e	23.3 C
DP 5634 ²	L V	<u>42.0 a</u>	<u>19.5 de</u>	<u>18.7 de</u>	26.7 B
	AV	36.1 A ⁵	27.1 B	19.0 C	

¹2010 variety was AG 3803.

²2010 variety was AG 5606.

³Within planting date columns, numbers with the same letter are not significantly different at the 5% probability level.

⁴Within the average (over planting dates) column, numbers with same letters are not significantly different at the 5% probability level.

⁵The planting date average numbers with the same capital letters are not significantly different at the 5% probability level.

Table 8. Seed treatment effect on yield, plant height at maturity, thrips damage, and defoliation at V1 and V3 growth stages, averaged over years (2008-2010), planting date and varieties, Stoneville, MS.

Seed trmt	Yield bu/ac	Mat Pl ht (in) ²	% Defoliation ²		Thrips Injury ² V3
			V1	V3	
Apron	61.9 b ¹	34 b	1.2 a	1.0 a	1.6 a
Apron + Cruiser	64.0 a	35 a	1.1 a	1.0 a	0.9 b

¹Within column, numbers followed by the same letters are not significantly different at the 5% probability level.

²Averaged over 2 years (2009 and 2010).

Table 9. Planting date effect on yield, plant height at maturity and defoliation at V1 and V3 growth stages, averaged over years (2008-2010), seed treatment and varieties, Stoneville, MS.

Plant date	Yield	Mat	% Defoliation ²	
	Bu/ac	Plant height (in) ²	V1	V3
April	75.9 a ¹	29 c	1.4 a	1.2 a
May	69.5 b	40 a	0.6 b	0.05 b
June	43.4 c	34 b	1.5 a	1.6 a

¹Within a column, numbers followed by the same letters are not significantly different at the 5% probability level.

Table 10. Plant height at maturity as influenced by variety and planting dates, averaged over years (2008-2010) and seed treatment, Stoneville, MS.

Variety/s	MG	Planting dates			AV
		April	May	June	
		Yield (bu/ac)			
AG 3906 ¹	III	65.0 c ³	68.8 c	45.5 d	59.8 C
AG 4403	E IV	77.4 ab	75.2 ab	45.8 d	66.1 A
Pioneer 94B73	L IV	76.8 ab	71.5 bc	44.8 d	64.4 AB
DK 5058	E V	81.1 a	67.0 c	42.6 de	63.6 B
DP 5634 ²	L V	79.5 a	65.1 c	38.3 e	61.0 C

¹2010 variety was AG 3803.

²2010 variety was AG 5606.

³Within yield and plant ht columns, number with the same letters are not significantly different at the 5% probability level.

Table 11. Planting dates effect on variety maturity dates in 2009 and 2010, Stoneville, MS.

P. Date	Varieties				
	AG 3906	AG 4403	Pioneer 94B73	DK 5068	DP 5634
Maturity dates					
4/21/09	9/03	9/03	9/03	9/16	9/23
4/13/10	8/18	8/27	9/02	9/13	9/16
5/20/10	9/21	9/17	9/18	10/01	10/01
5/11/10	9/07	9/09	9/07	9/29	10/01
6/29/09	10/14	10/11	10/09	10/11	10/29
6/07/10	9/18	9/23	9/23	10/03	10/04

Table 12. Returns above Cruiser seed treatment cost (\$8/ac), using soybean grain market prices of \$6, \$8 and \$10/bu.

M. Price (\$/bu)	Returns (\$/ac) above Cruiser cost
6	8
8	14
10	19