Annual Report of Progress
to the
MISSISSIPPI SOYBEAN PROMOTION BOARD
For 1999

Project Title: Dynamic Approaches to Improve Soybean Yield in the Mississippi Delta

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This report consists of two sub-reports, which summarizes three major components for the research work that were conducted in the previous two years. It includes the following aspects: 1) the evaluation of growing early MG soybeans under different soil and water status; 2) the planting date, canopy development and phenological study on MG III soybeans; and 3) foliar application of nutrients and insecticide at reproduction stage to improve soybean yields.

Sub-report 1

Part I: Evaluation of growing early soybean varieties under different environmental conditions in the Mississippi

Objectives:

1. Introduce and identify the potential MG III soybean varieties that may grow and have a high yield under Mississippi Delta conditions
2. Investigate the yield potential of MG III soybeans under different soil conditions
3. Find the best culture practices for growing MG III soybeans

Work Accomplished:

Objective 1 and 2:

In 1998 and 1999 seasons, different maturity groups (ranging from III to VI) of soybean varieties have been planted on clay, mixed-loam, and sandy soils at the Delta Research and Extension Center, at Stoneville, MS (latitude about 32'30). Varieties of MG IV through VI were considered adapted in the region and were obtained from local resources. Varieties of MG III, however, were mostly introduced from the Northern states. In 1998, 16 varieties were introduced, and in 1999, 19 varieties were introduced in various experiments. Some of them were repeated varieties. The varieties are list in Table 1. (list of MG III varieties used in 1998 and 1999). The sources are listed as in Table 1.

Soybean seeds were planted with several different planting dates. The plots were four rows with 20-ft (in 1998) and 30-ft (in 1999) lengths, respectively, and both with 20-in row-spacing. The detailed varieties, plot configurations, and planting dates have been summarized on Table 2.

The experiments is used a completely randomized design with four replications in both years and in all plantings. The seed rate was at eight seeds per foot, which gave a population density of 209,000 seeds per acre. The plants were grown under furrow irrigated conditions. The irrigation started in late May. Both dates of irrigation and rainfall amount are provided in Table 3. The fields were cultivated twice to control weeds during growing season. No extra fertilizers had been applied at any time on the field at before and during the growing seasons. All other practices followed the recommended procedures for produce the maximum yield in the area.

Phenological development data was recorded in every vegetative and reproductive stage, from emergence (VC) to maturity (R8) by measuring of the average growing status of varieties within each maturity group. Eight plants from each plot were sampled to record the parameters, such as plant height, number of node, pod per plant, first fertile node, and height of the first fertile node. Seed size were also measured weight (gram) per 100 seed (randomly taken 300 seeds per plot). Data were analyzed using SAS program (SAS Institute, 1988).

Phenological development:

The effect of planting date on phenological development of maturity group III, IV and V soybeans are summarized in Fig. 1 (average of 1998 and 1999). The figure indicates that soybeans planted early experienced a relatively longer growing season and did not get significant early harvested proportionally as one might be expected, especially for those varieties of MG IV and V. Later planting resulted significantly shorter growing season. Different MGs have different phenological responses to planting date. The difference of early April-planting and the late May-planting was about 50 days; however, the difference of maturity dates of these two plantings for MG III, IV and V were about 30, 27, and 25 days, respectively. In the same plantings, maturity group III varieties also matured average about seven to 12 days earlier than those of MG IVs, and two to three weeks earlier than those of MG V.

The effects of planting date on phenological development are mainly due to two reasons. The first is temperature effect. The temperatures during early growing season are usually low. If the growing season was counted from planting, for an early April planted soybean, seed germination process took average of 10 to 14 days under cool soil temperature. On the other hand, May-planting soybean only took five to seven days to germinate when the moisture was on the right situation. The second factor is photoperiod effect. Early April planted soybeans grow under a relative shorter photoperiod environment that may promotes a shorter vegetative growth and lead to a shorter plant height. However, seed filling period may be extended. The key for a high yield is the balance of the vegetative growth and reproductive growth. On the other hand, late June or July planting should not be considered in a normal planting situation. Even only from the physiological reason, the short day-length would neither be favorable for vegetative nor reproductive growth, especially for early maturity groups.

Yield components:

Pod number: Pod number is one of the major yield components. They are coming from two parts of the plant, main stem and branch. The effect of planting date on number of main-stem pod per plant in 1999 can be showed in Figure-xp. From the figure, we can see a trend that over 50% of pod in early maturity groups are coming mainly from main-stem. Furthermore, when delaying planting date, the percentage of main stem pod increased, and it is the similar for all

maturity groups. Since most early maturity groups, such as MG III and IV, have indeterminate growth habit, branching is limited. Meanwhile, later MGs, such as MG V and VI are more of determinate natured, and they produce more branch and heavily depend on the branches to load pod. When delaying planting time, plants have reduced growing period due to shorter photoperiod. Therefore, branch growth and pod set also limited.

Plant height: April-planting led to a shorter plant height compared with May-planting in all the maturity groups (Figure 2.). The reason for this reduced plant height is due to earlier flowering under shorter photoperiod. For most of the adapted early MGs, late-April to early May-plantings usually lead to a maximum vegetative growth under irrigated conditions. Therefore, the yield potentials usually are higher than those plate plantings. However, for those relative later MGs, such as VI or VII, if planted too early, the may get over growth on vegetative stage, and can't have a good balance for having high yield later.

From Table 2, it is clearly showed that both of the years in 1998 and 1999 experienced severe drought stress during the summer growth periods. However, the patterns were a little different. In summer 1998, drought was occurred during the earlier growing season in June and July, when the most plants were gone through their vegetative stages. On the contrary, in 1999, the drought period were occurred in July and August, when most of the plants were in reproductive stages. Due to this difference, different maturity groups responded to the drought stress differently.

Analysis of yield components and yields:

Data of various yields and yield components (Table 3 to Table 10) showed that March planting was obviously too early for varieties of MG-III as well as MG-IV and MG-V. The early-planted soybeans grew under short photoperiod and resulted in an early flowering. Therefore, plants matured too early. The plant height was too short (Table 3), and the fertile nodes were too few to produce acceptable yield (Table 4). Soybeans of MG-III varieties planted in early April had higher yields compared with that planted in March (Table 10). However, compared MG-IV and V with the same planting date, the yields of MG III were still too low to be accepted. The average yield of MG-III varieties of late April planting was much closer to that of MG-IV and MG-V. Actually, the top variety, Eisenhower, had a yield higher than that of both of HBK 4600 (IV) and Hutcheson (V) (Table 10). Eight varieties in irrigated plots and six varieties in non-irrigated plots had a yield at 55 bu/A or higher (Table 10). Among other physiological characters, the data of some of the top performed varieties from MG III also showed compatible numbers (Table 3-9).

Reasons to have higher yields for plantings around late April and early May:

1) *Optimum day-length*: From early May to later June, the day-length increases continually and reaches the peak on June 21. When MG III varieties were planted around late April and early May, after seed germination, the vegetative growth experienced increased day-length. This long day-length helped vegetative growth and delayed flowering time. Therefore, by flowering time, plants have enough vegetative reserves to be used for reproductive needs later.
2) *Indeterminate nature*: Most of MG III varieties we used were indeterminate varieties. Therefore, even for plants flowered with a relatively shorter time (comparing with MG- IV and V), the vegetative growth continued. So, the final vegetative growth didn't reduce plants flowered early. Also due to the indeterminate nature, total main stem node number (Table 4) and total fertile node number (Table 6) of MG III varieties were no less than those of MG IV and MG V.

Objective 3:

From the data obtained in 1998 and 1999, it indicated that the following aspects are important when one want to grow MG III soybeans successfully.

First, planting date should be in the optimum window that is around mid-April and mid-May. Many people thought that early maturity varieties should be planted early which is not a correct concept according to the data has been obtained in the research at Stoneville. The phenological and physiological reasons behind this point will be discussed in a separate part in the late report.

The second, soil types affect the yield potential greatly. The data in two years indicated that the yield potential showed better on lighter soils. Light soil promoted a better early vegetative growth, which is very critical for early maturing soybeans. Under heavy clay soil condition, the stem of soybean plant does not elongate fast enough. Therefore, early maturity soybeans flower and set pod at a relatively lower position, which lead to a greater harvest-lost.

Thirdly, since early maturity soybeans matured earlier, the canopy is relatively smaller, especially on clay soil. Therefore, row-spacing is very important. According to the research results from the last two years, a 20-in (about 50 cm) row-spacing should be wide enough. Over 30-in row space would be too wide for MG-III soybeans.

The forth, irrigation will certainly increase the yield potential even for MG III soybeans. However, early maturing soybeans have a relative more advantages by maturing and being harvested earlier to avoid possible late season drought stress. On the other hand, weeds may be a problem if the beans are not harvest when the field moisture remains high.

The fifth, shattering is always one of the problems that growers may face when growing early soybeans in Mississippi. Early maturity soybeans usually have a shorter shattering life. That was basically true in this study. However, there are still some differences among varieties. Most varieties can hold seeds relatively well after maturity. It is noticed that MG III variety, Saline, had shattered earlier compared with other MG III varieties (Table 9). Data is still needed, since the individual varieties are changing at a very fast pace. In the future, shattering characteristics may be a breeding goal for breeders if the MG III become more popular in the South.

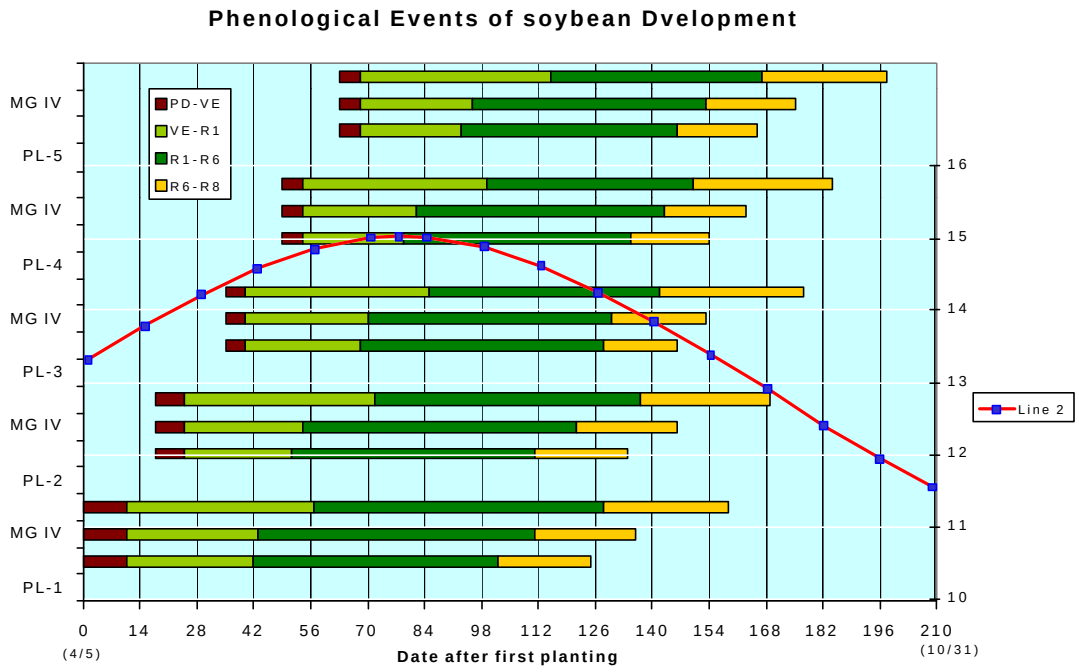
The sixth, seed quality of MG III varieties is one factor that still needs to be investigated. A separated study regarding this aspect is in progress in my lab. At present time, the realistic way to obtain the MG III varieties is order from the seed company from the north.

The seventh, March planting and early April plantings had weed problems more serious than that of late plantings. Plants were too short in very early plantings, especially in clay soil. That causes early exposure and more space for weed development after leaf senescence starting at R6 stage, especially for those plots in irrigated fields. The way to prevent this is to reduce the plant spacing if planted early and to choose varieties with taller stem and more vigor in vegetative growth.

SUMMERY

Based on the results in 1998 and 1999, several suggestions may be proposed for growing MG III soybeans in Mississippi. First is to select the varieties that possess good potential of physiological characters and yield potential. The second is to plant soybeans not too earlier. The best planting window may be between mid-April and mid-May. To avoid the weed problem in early plantings, soybeans may be better plant with a narrower row-spacing, such as 20-inch to 15-inch or narrower (such ad drill planting). Maturity Group III soybeans may be especially good for those non-irrigated fields.

Figure 1. Comparisons of phenological events among MG-III, IV, and V by calendar day



Legend notation:

PD - Time of planting, VE - Time of emergence, R1 - Time of flowering,

R6 - Time seed filling to the maximum, R8 - Time of maturity

Table 1. Planting date summary for experiments in 1998 and 1999

Planting	**Mar**	**April**		**May**		**June**	
1998	3/13	4/02	4/23	5/14	---	---	----
1999	---	4/09	4/23	5/09	5/24	6/07	6/30

Variety	**III**	**IV**	**V**	**VI**
1998	Saline (3.9*)	HBK 4600 (4.6)	Hucheson (5.6)	---------
	William-82 (3.9)			
1999	KS3469 (3.4)	PD4344 (4.3)	AG5401RR (5.4)	DP3640 (6.4)
	Saline (3.9)	AP4880 (4.8)	DP3588 (5.8)	PD6880 (6.8)

Table 2. Summary of rainfall and irrigation record during growing season at Stoneville, MS in 1998 and 1999

Month		Rainfall by half month (Inch)	Irrigation (Inch)	Monthly rainfall (Inch)	Normal month average (Inch)
April	4/01 - 4/15	0.86		4.35	5.36
	4/16 - 4/30	3.49			
May	5/01 - 5/15	0.03		4.62	4.95
	5/16 - 5/31	4.59	2.0		
June	6/01 - 6/15	1.29	1.5	1.59	3.73
	6/16 - 6/30	0.3	1.0		
July	7/01 - 7/15	4.7	1.5	4.7	3.66
	7/16 - 7/31	0	1.5		
August	8/01 - 8/15	0.36		0.71	2.27
	8/16 - 8/31	0.35			
September	9/01 - 9/15	2.33		2.9	3.4
	9/16 - 9/30	0.57			
Total			7.5	18.87	23.37

Table: Summary of yield performance of MG III varieties and their relative ranking on mixed soil in 1998. Bold- faced number indicating the yield is the same or higher than that of the average of check**.**

Variety	Irrigation	Non-irrigation	Average	Rank
Eisenhower	**68.1**	**62.5**	**65.3**	**1**
Macon	**60.9**	**60**	**60.4**	**2**
Saline	**61.4**	**59.2**	**60.3**	**3**
Madison	56.1	**61**	**58.6**	**4**
B93-09056	**58.1**	53.9	56	5
McKinley	54.8	56	55.4	6
Williams 82	55	54.8	54.9	7
AP 3702 RR	53.9	54.5	54.2	8
AP 3802 RR	48.8	**58.9**	53.8	9
Kennedy RR	54.2	56	53.1	10
AP 3880	52.3	52.9	52.6	11
Fillmore	45.3	55.3	50.3	12
Washington RR	50.7	47.9	49.3	13
Kennedy	45.2	52.7	49	14
Maverick	43.4	46.2	44.8	15
Williams	46.2	41.8	44	16
Check-Average[1]	57.7	57.6	57.7	

[1] Mean yield of total MG IV and V varieties that planted at the same time (The same for the following tables).

Table: Summary of yield performance of MG III varieties and their relative ranks on three soil types in 1999. Bold-faced number indicating the yield is the same or higher than that of the average of check**.**

Variety	*Mixed Soil	M-Rank	*Sandy Soil	S-Rank	Clay Soil	C-Rank	**Index Point	Balanced rank
9395	----	9*	**58.5**	**7**	34.7	11	58	10
93B82	----	**1***	**63.5**	**1**	**39**	**2**	9	1
A 3469	**72.1**	**3**	52.7	16	35	10	52	9
A 3904STS	64.7	10	**62.8**	**2**	**41.1**	1	24	2
AG 3701RR	63.8	12	**61.3**	**3**	36	7	48	8
AG 3901RR	**72.6**	**2**	**56.3**	**11**	**37.3**	**4**	27	3
CX 339c	60.1	15	**58.9**	**6**	35.2	8	60	11
CX 364c	**66.2**	**8**	**56.6**	**9**	32.8	15	70	13
CX 393c	**67.9**	**7**	**56.5**	**10**	**36.6**	**6**	42	6
CX 367cRR	**69**	**5**	**59.9**	**5**	**36.7**	**5**	30	4
Eisenhower	64.6	11	**58.4**	**8**	**37.4**	**3**	39	5
ES 3901	59	17	52.9	15	33.6	14	91	16
KS 3494	55.7	19	49.4	18	31.8	18	112	19
Maverick	----	16*	**53.9**	**14**	32.6	16	94	17
McKinley	63.1	13.5	**55.6**	**12**	32.3	17	90	15
Phoenix RR	**69.3**	**4**	**54.2**	**13**	33.6	13	60	11
Saline	63.1	13.5	46.0	19	33.8	12	82	14
Truman	**68**	**6**	**61.0**	**4**	35	9	43	7
Williams 82	----	18*	50.9	17	29.7	19	108	18
Check-	**63.0**		**53**		**36.5**			

*: Average yield of more than one field

**: Index Point = C-Rank*3+M-Rank*2+S-Rank (See text for the explaination)

Table 3. Accumulate growing degree-day (GDD, ^{o}C) required for each growing stage for different maturity groups at different planting dates.

			Growing stage			
Planting	Date	MG	PD - VE	VE - R1	R1 - R6	R6 - R8
1	3/13	III	64	280	1012	322
		IV	64	310	1077	459
		V	64	617	1396	578
2	4/02	III	72	327	1189	389
		IV	72	375	1253	513
		V	72	636	1349	510
3	4/23	III	81	381	1136	350
		IV	81	465	1319	503
		V	81	703	1288	467
4	5/14	III	98	593	1048	281
		IV	98	669	1119	324
		V	98	782	1140	432

Table 4. Comparison of **plant height** (cm) of soybean varieties (MG III, MG IV, and MG V) with four plantings in 1998.

Variety	P-1		P-2		P-3		P-4
	NI.	I	NI	I	NI	I	I
AP 3702RR	37.4	38.0	49.1	51.9	61.5	60.0	91.5
AP 3802RR	33.5	35.9	42.0	46.1	55.0	58.9	81.0
AP 3880	34.5	34.4	45.0	50.9	62.2	59.9	90.6
B 93-09056	34.3	39.6	42.7	48.6	54.6	56.3	78.5
Macon	30.1	35.2	45.0	45.2	61.1	61.8	90.3
Maverick	36.0	36.5	44.5	54.0	64.9	65.8	110.1
Saline	45.8	48.6	53.9	63.4	69.2	73.7	150.2
Williams 82	49.2	49.2	56.7	69.0	61.7	58.7	113.9
HBK 4600	**44.9**	**40.3**	**54.1**	**59.4**	**63.0**	**64.1**	**118.0**
Hutchinson	**50.6**	**54.2**	**43.3**	**49.3**	**48.9**	**46.9**	**95.0**
Washington			53.8	56.7	60.7	63.9	104.7
Williams			54.3	60.6	56.6	55.9	131.1
Eisenhower							97.1

* Due to single plot of planting 4, data may only be used as a reference (following tables are the same).

Table 5. Comparison of number of **main-stem nodes** of soybean varieties (MG III, MG IV, and MG V) with four plantings in 1998.

Variety	P-1		P-2		P-3		P-4
	NI.	I	NI	I	NI	I	I
AP 3702RR	12.8	38.0	13.8	14.0	15.2	15.0	18.3
AP 3802RR	11.7	35.9	13.6	13.1	13.3	14.6	17.4
AP 3880	11.6	34.4	12.3	12.7	14.9	14.4	15.9
B 93-09056	11.8	39.6	13.1	13.6	14.1	13.6	16.2
Macon	9.8	35.2	12.2	10.6	13.5	13.4	15.7
Maverick	11.5	36.5	13.6	14.3	15.5	15.2	18.0
Saline	14.9	48.6	14.9	15.2	16.2	16.7	21.2
Williams 82	13.4	49.2	13.9	14.5	14.7	14.3	17.9
HBK 4600	**15.0**	**40.3**	**14.6**	**13.8**	**15.5**	**15.2**	**18.4**
Hutchinson	**13.7**	**54.2**	**17.9**	**12.4**	**11.4**	**11.7**	**15.7**
Washington			14.0	14.1	15.0	14.4	20.3
Williams			14.6	14.3	14.7	14.8	19.0
Eisenhower							18.7

Table 6a. Comparison of **height (cm) of first fertile node** of soybean varieties (MG III, MG IV, and MG V) with four plantings in 1998.

Variety	P-1		P-2		P-3		P-4
	NI.	I	NI	I	NI	I	I
AP 3702RR	9.4	8.4	8.1	8.9	10.2	9.9	16.9
AP 3802RR	9.7	9.2	9.0	9.0	11.3	10.2	17.9
AP 3880	8.4	8.5	11.4	10.2	9.8	10.3	20.4
B 93-09056	10.7	10.4	10.9	10.2	10.5	10.8	20.2
Macon	7.9	7.8	9.4	11.4	9.1	10.8	21.4
Maverick	6.8	6.6	10.5	8.4	9.1	9.1	19.4
Saline	10.2	9.3	9.5	10.2	10.3	11.2	25.0
Williams 82	8.8	9.5	9.9	9.3	10.1	9.5	24.0
HBK 4600	**8.0**	**7.7**	**11.0**	**11.1**	**12.7**	**14.0**	
Hutchinson	**19.2**	**17.6**	**19.5**	**17.9**			
Washington			10.8	9.3	12.6	11.3	17.5
Williams			8.3	8.7	10.3	8.7	17.4
Eisenhower							17.5

Table 6b. Comparison of **number of total fertile node** of soybean varieties (MG III, MG IV, and MG V) with four plantings in 1998.

Variety	P-1		P-2		P-3		P-4
	NI.	I	NI	I	NI	I	I
AP 3702RR	10.1	10.4	11.3	11.2	12.2	12.0	13.3
AP 3802RR	9.2	10.0	10.8	10.8	10.2	11.7	9.7
AP 3880	9.9	9.8	9.9	10.5	12.3	11.6	11.2
B 93-09056	9.4	11.2	10.8	11.5	11.7	11.4	10.0
Macon	8.3	10.3	9.8	8.5	11.4	11.0	11.4
Maverick	9.8	12.2	10.3	12.1	13.0	12.5	12.4
Saline	11.7	12.5	12.7	12.7	12.8	13.1	12.6
Williams 82	**11.1**	**11.2**	**11.7**	**12.2**	**11.8**	**11.5**	**10.7**
HBK 4600	**12.3**	**12.0**	**10.9**	**9.6**	**11.2**	**10.3**	
Hutchinson	7.4	7.7	5.8	6.1			
Washington			11.2	11.9	11.3	11.1	15.7
Williams			12.3	11.9	11.6	12.0	13.1
Eisenhower							14.4

Table 6c. Comparison of position of **first fertile node** of soybean varieties (MG III, MG IV, and MG V) with four plantings in 1998.

Variety	P-1		P-2		P-3		P-4
	NI.	I	NI	I	NI	I	I
AP 3702RR	3.5	3.1	3.4	3.7	3.8	3.9	5.0
AP 3802RR	3.2	3.3	5.4	3.3	4.1	3.9	5.1
AP 3880	2.7	2.8	3.2	3.1	3.3	3.2	4.7
B 93-09056	3.1	3.1	3.2	3.1	3.5	3.3	5.6
Macon	2.6	2.4	3.1	3.0	3.1	3.4	5.2
Maverick	2.7	2.8	3.7	3.1	3.3	3.5	4.9
Saline	3.7	3.4	3.2	3.5	3.9	4.3	5.6
Williams 82	3.1	3.1	3.0	3.2	3.7	3.8	5.6
HBK 4600	**3.5**	**3.2**	**4.4**	**4.6**	**5.1**	**5.7**	
Hutchinson	**6.6**	**6.3**	**6.9**	**6.4**			
Washington			3.6	3.2	4.5	4.2	5.2
Williams			3.2	3.4	4.1	3.7	5.1
Eisenhower							5.2

Table 7. Comparison of **100 seed-weight (g)** of soybean varieties (MG III, MG IV, and MG V) with four plantings in 1998.

Variety	P-1		P-2		P-3		P-4
	NI.	I	NI	I	NI	I	I
AP 3702RR	17.6	17.2	16.0	16.0	13.3	14.0	11.9
AP 3802RR	16.7	16.5	15.4	16.8	12.5	13.4	11.5
AP 3880	17.4	22.1	14.9	17.2	12.9	13.5	11.9
B 93-09056	16.0	16.5	15.9	16.9	13.8	13.8	11.6
Macon	17.9	16.9	14.7	17.4	13.7	13.1	14.2
Maverick	15.3	14.5	11.7	13.7	11.0	11.9	10.8
Saline	15.4	15.8	13.4	14.1	13.0	11.8	10.9
Williams 82	15.9	16.3	13.4	15.9	13.2	11.9	12.2
HBK 4600	**14.5**	**14.6**	**14.3**	**13.6**	**13.7**	**14.1**	**15.7**
Hutchinson	**11.8**	**11.9**	**10.9**	**12.2**	**11.7**	**13.1**	**12.6**
Washington			12.4	15.1	12.7	12.4	12.7
Williams			13.1	15.9	12.0	12.3	12.6
Eisenhower				15.0		13.8	14.2

Table 8. Comparison of **pod number per plant** of soybean varieties (MG III, MG IV, and MG V) with four plantings in 1998.

Variety	P-1		P-2		P-3		P-4
	NI.	I	NI	I	NI	I	I
AP 3702RR	20.8	22.0	32.6	37.7	34.7	40.8	36.0
AP 3802RR	21.4	27.9	31.2	36.0	29.5	43.7	31.3
AP 3880	26.8	22.1	30.9	41.8	37.8	49.0	24.2
B 93-09056	20.8	28.7	33.5	41.6	36.2	40.8	30.0
Macon	19.6	25.8	34.0	24.1	38.8	40.3	38.3
Maverick	24.1	29.3	30.5	45.3	50.8	55.0	39.3
Saline	28.0	41.7	47.3	49.2	42.1	56.8	43.1
Williams 82	26.1	29.6	33.2	37.3	41.9	46.3	26.0
HBK 4600	**36.6**	**45.1**	**31.5**	**32.8**	**39.4**	**40.5**	**58.7**
Hutchinson	**40.5**	**50.4**	**41.0**	**42.3**	**51.9**	**59.4**	**56.7**
Washington			36.3	44.3	36.9	42.6	58.5
Williams			38.9	46.9	42.8	51.2	35.0
Eisenhower							50.5

Table 9. Scores of observation for shattering after maturity in some maturity group III soybean varieties in 1998.

Variety	MG	Maturity date	Date	Shattering Rate	
				Irrigation	Non-Irrigation
AP 3702 R	III	8/8	8/14	1	1
			8/24	1	2
			8/31	3	4
AP 3802 RR	III	8/13	8/14	1	2
			8/24	1	4
			8/31	5	5
AP 3880	III	7/29	8/14	1	2
			8/24	2	4
			8/31	5	5
B93-09096	III	8/10	8/14	1	1
			8/24	2	3
			8/31	4	5
Macon	III	7/29	8/14	1	2
			8/24	2	5
			8/31	5	
Saline	III	8/13	8/14	1	1
			8/24	2	5
			8/31	5	
William-82	III	8/12	8/14	1	1
			8/24	1	3
			8/31	4	5
Eisenhower	III	8/8	8/14	1	1
			8/24	2	2
			8/31	4	5
Kennedy	III	7/29	8/14	1	1
			8/24	2	3
			8/31	4	5
Kennedy RR	III	8/10	8/14	1	1
			8/24	3	4
			8/31	5	5
Madison	III	7/29	8/14	1	2
			8/24	3	5
Washington		8/12	8/14	1	1
			8/24	2	3
			8/31	4	5
Williams	I	8/12	8/14	1	1
			8/24	1	3
			8/31	3	4

Table 10. Yield summary of soybean varieties in three planting dates under irrigated (I) and non-irrigated (NI) conditions in 1998**.**

Variety	MG	Planting								
		Planting-1 (3/13/98)			Planting- 2 (4/2/98)			Planting- 3 (4/23/98)		
		NI	I	Average	NI	I	Average	NI	I	Average
Hutcheson	V	59.3	57.7	58.5	41.4	50.7	46.1	53.7	58.6	56.3
HBK 4600	IV	42.2	39.2	40.7	50.2	70.6	60.7	61.7	56.5	59.1
AP- 3702 RR	III	27.5	27.5	27.5	33.8	48.4	41.3	53.9	54.5	54.2

AP 3880	III	17.0	22.6	19.8	27.2	44.7	36.1	52.3	52.9	52.6
AP-3802 RR	III	15.6	23.4	19.5	32.6	53.7	43.3	48.8	58.9	53.8
B 93-09056	III	26.2	25.7	26.0	27.9	51.2	39.7	58.1	53.9	56.0
Eisenhower	III				36.2	49.4	42.8	68.1	62.5	65.3
Fillmore	III				21.7	44.1	32.9	45.3	55.3	50.3
Kennedy	III				23.8	46.9	35.3	45.2	52.7	49.0
Kennedy RR	III				24.0	45.6	34.8	54.2	56.0	53.1
Macon	III	13.7	23.7	18.7	20.6	37.0	28.9	60.9	60	60.4
Madison	III				30.1	50.8	40.5	56.1	61.0	58.6
Maverick	III	15.7	20.6	15.5	14.9	38.7	26.9	43.4	46.2	44.8
Mckinley	III				31.1	50.8	40.0	54.8	56.0	55.4
Saline	III	27.3	28.7	28	34.4	58.1	46.5	61.4	59.2	60.3
Washington RR	III				30.5	60.3	45.6	50.7	47.9	49.3
William-82	III	30.6	31.8	31.2	31.9	52.4	42.3	55.0	54.8	54.9
Williams	III				32.8	47.9	40.5	46.2	41.8	44.0

Sub-report II. Growing early MG soybeans under different environmental conditions in Mississippi

INTRODUCTION

Early soybeans have been introduced and adapted in the mid-south of the US in the recent years. Compared with those conventional late soybeans, early varieties have the growth and yield advantages by avoiding late season drought conditions. Several studies have been indicating that the very early soybean varieties have the yield potential in the mid-south. However, no information was documented regarding to the effects of soil type on soybean yield responses.

Traditionally, cotton has been viewed and treated as a higher return, a cash crop compared to soybeans. On average, gross income from cotton in the last 10 years has been almost $300 per acre higher than that of soybeans. However, high and increasing production costs for planting cotton have narrowed the potential net returns between the two crops. Current incentives for planting cotton are reduced by poor cotton price expectations and uncertain cotton insect control costs.

The inferior economic status of soybeans is therefore questionable. This development coupled with the planting flexibility provisions of the 1996 Farm Bill creates the possibility of planting soybeans on tradition cotton acreage.

Soybeans in Mississippi Delta are traditionally grown on clay soils. Cotton is usually grown on soils such as silt loam and sandy. Not much information is available on the yield response for soybeans grown on cotton soils in Mississippi. This kind of information would be very valuable to growers as well as soybean breeders and other researchers in Mississippi. The objectives of this study were: 1) To evaluate the yield potential of soybeans grown on mixed loam and sandy soils compared with clay soil; 2) To access the economic returns from growing early soybeans on better soils compared to that of growing cotton. This information will help farmers to make critical management decisions, and will provide more information on basic questions about soybean production on different soil types.

MATERIALS AND METHODS

Variety:

Table 11. Summary of yields (bu/A) of soybean varieties with different maturity groups (MG) under various soils and previous crop types in 1999.

Soil Type		Clay							Sand	
		Behind rice			Behind soybean[1]		Behind rice[2]			
Planting date		4/26	5/17		5/10		4/20	5/17	4/29	
Irrigation (I/NI)		NI	NI	I	NI	I	I	I	NI	I
Variety	MG									
9395	III	33.6	29.7	40.9	---	---	---	---	44.0	74.3
93 B 82	III	38.2	32.7	46.1	---	---	---	---	59.2	67.0
A 3469	III	31.1	25.1	48.7	7.4	26.4	43.3	53.8	39.1	56.1
A 3904STS	III	35.5	31.5	56.2	9.6	37.1	46.6	50.6	55.6	69.2
AG3901RR	III	38.1	29.7	44.2	6.8	35.2	53.7	64.0	57.6	73.7
AG3701RR	III	25.0	24.6	58.1	7.5	33.8	48.3	53.5	46.5	70.1
CX 339c	III	26.6	26.8	52.1	6.3	38.5	52.2	59.8	50.8	59.0
CX 364c	III	31.7	23.1	43.7	6.7	34.0	48.6	60.0	48.7	67.1
CX367cRR	III	31.6	28.7	49.7	7.2	36.7	48.7	51.7	52.2	60.3
CX 393c	III	32.2	24.8	52.8	5.3	35.6	48.7	52.3	51.7	71.5
Eisenhower	III	25.4	32.5	54.4	6.6	36.9	35.0	48.5	46.8	71.1
ES 3901	III	21.7	22.1	57.0	3.1	35.8	49.1	36.2	48.3	53.2
KS 3494	III	21.1	21.5	52.7	6.8	28.0	33.9	45.5	42.4	55.5
Maverick	III	29.8	23.8	44.3	---	---	---	---	37.1	67.8
McKinley	III	30.8	23.6	42.4	5.5	30.9	47.3	53.0	47.4	62.0
PhoenixRR	III	27.6	23.9	49.4	4.1	38.0	40.6	60.2	39.2	67.6
Saline	III	26.0	23.7	51.7	2.5	36.1	45.5	51.0	33.5	67.3
Truman	III	32.3	24.6	48.1	6.0	31.1	39.7	53.0	48.5	76.0
Williams82	III	18.9	19.7	50.4	---	---	49.1	58.7	38.1	68.1
AP 4880	IV	26.0	31.5	69.6	5.1	46.4	65.3	55.1	46.5	64.9
DP 3478	IV	24.7	27.7	65.3	4.0	46.6	61.0	48.8	41.7	67.8
DP4344RR	IV	27.1	34.0	50.2	---	---	62.2	51.1	58.5	75.6
DP 3588	V	20.7	21.3	50.0	5.0	45.3	63.4	47.6	45.3	67.8
DP 5655	V	20.3	23.4	62.7	---	---	68.9	58.7	53.9	64.7
Hutcheson	V	31.4	28.3	62.1	5.4	43.5	53.7	48.4	41.5	46.6
P 9511	V	25.4	20.1	44.4	4.7	51.3	73.3	41.4	33.5	71.4
Mean		27.2	25.3	50.2	5.6	35.7	49.3	50.4	45.0	64.0
LSD		3.2	3.8	7.7	1.3	2.3	5.9	7.0	7.0	12.3

[1]: Row space is at 20" instead of 30" of other test sites

[2]: Location at Steele Farm

Table 12. Comparison of average yields among the maturity groups under different conditions in 1999.

Soil Type	I/NI	Planting Date	MG-III	MG-IV	MG-V	MG-III Top5(Avg)	LSD	Remark
Sharkey Clay	NI	4/26	29.3	25.5	24.5	35.5	3.2	Behind Rice
	NI	5/17	25.9	31.1	23.3	31.2	3.8	
	I	5/17	49.6	61.7	54.8	55.7	7.7	
	I	4/20[2]	45.6	60.1	64.8	50.5	5.9	
	I	5/17[1]	53.2	51.7	49.0	60.5	7.0	
	NI	5/10	7.4	6.2	5.0	11.6	1.3	Behind Soybean
	I	5/10	34.8	45.5	46.7	37.4	2.3	
Sandy	NI	4/29	46.7	48.9	43.6	55.3	7.0	Behind Soybean
	NI	5/20	43.5	40.1	46.8	51.1	5.2	
	I	4/29	66.2	69.4	62.6	73.3	12.3	
	I	5/20	68.8	66.4	49.6	75.7	5.4	
Mix	I	5/14	65.3	71.5	59.6	70.2	5.0	Behind Soybean

[2] Location at Still Farm

Part-III. Phenological studies on soybean growth and development under field conditions in Mississippi.

Accomplishment of Individual Objectives

1. Document of basic information about soybean phenological development under field conditions in Mississippi

In the1998 growing season, the phenological events were recorded for all the soybeans that planted for maturity groups III to V. Planting dates ranged from mid- March to mid-May with an approximate three-week interval. The range of normal planting dates in Mississippi is between mid-April to mid-May. Since the MG VI were only planted in the fourth planting (on May 14), the summary table did not include its result. The maturity groups involved in the experiment were late III (Macon, William 82), early IV, late IV (HBK4600, TV-4479, AP 4880), early V (P 9511), and late V (Hutcheson, DP 3588). The dates of the phenological development, including emergence (VE), flowering (R1), maximum of seed filling (R6) and maturity (R8), for each planting date with different MGs (III to V) had been recorded (Table 1). The growing-degree-day (GDD, centigrade- C) required for different soybean growing period with different maturity groups (MG) has been summarized in Table 2.

2. Provide more information for building a useful soybean crop management model or database. Since this is the first year data, it would not be enough for a providing reliable information. At least another years work is needed to get a comparison and average. Then, the data may be used for modeling and/or put into the database that is in progress (in a separate project).

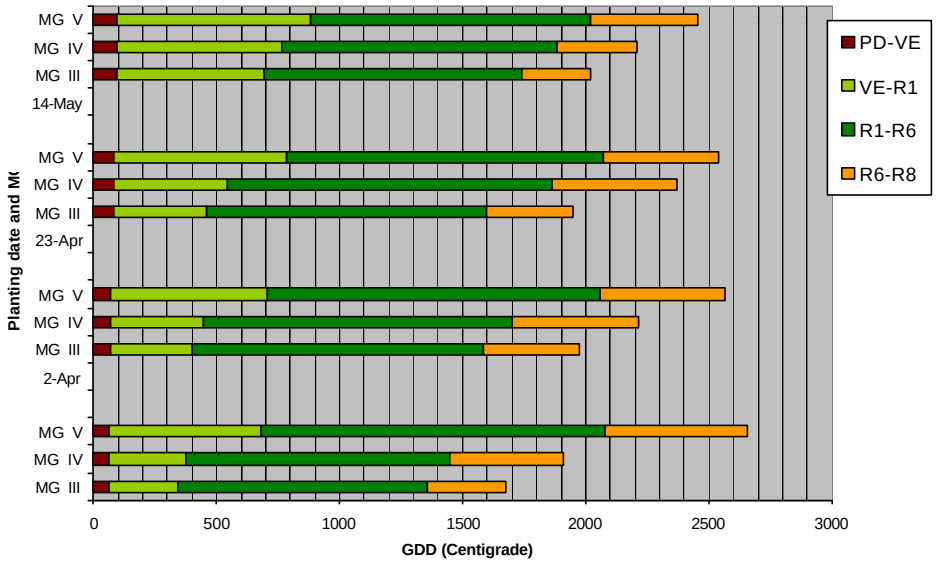
Table 1. Phenological events for different maturity groups at different planting dates in 1998

			Date of planting to maturity period			
Planting	Date	MG	VE	R1	R6	R8
1	3/13	III	3/27	5/01	7/01	7/18
		IV	3/27	5/04	7/06	7/30
		V	3/27	5/24	8/08	9/09
2	4/02	III	4/13	5/15	7/20	8/08
		IV	4/13	5/18	7/26	8/23
		V	4/13	6/02	8/14	9/12
3	4/23	III	5/02	5/27	7/28	8/16
		IV	5/02	6/01	8/11	9/08
		V	5/02	6/15	8/23	9/19
4	5/14	III	5/20	6/23	8/18	9/02
		IV	5/20	6/27	8/26	9/14
		V	5/20	7/03	9/02	9/28

Table 2. Summary of growing-degree-day (GDD, ^{o}C) required for different soybean growing period with different maturity groups (MG) at Stoneville, Mississippi in 1998. (VE- seed emergence, R1- flowering, R3- starting pod setting, R5-starting seed filling, R6-seed filling to the maximum, R8- maturity)

Growth period/GDD												
PD	MG		Variety	VE-V2	V2-V4	V4-V6	V6-V8	VE-R1	R1-R3	R3-R5	R5-R6	R6-R8
PD 3/13	III	3.7	Macon	191	82			280	137	336	238	462
		3.9	William82	191	82			280	249	496	322	362
	IV	4.2	(Estimate)	191	82			290	260	410	322	425
		4.6	HBK4600	191	82	91		310	290	465	323	460
	V	5.2	(Estimate)	191	82	80		450	340	376	500	534
		5.6	Hutcheson	191	82	77	179	617	448	247	701	578
PD 4/02	III	3.7	Macon	136	105	118		312	186	356	440	395
		3.9	William82	136	105	118		327	327	291	551	455
	IV	4.6	HBK4600	136	105	134		375	336	272	644	514
		4.7	TV-4479	144	105	134	141	488	296	246	494	663
	V	5.1	P 9511	144	105	134	141	539	680	195	456	487
		5.6	Hutcheson	136	105	169	169	616	520	202	649	510
PD 4/23	III	3.7	Macon	223	88	117		364	338	263	381	521
		3.9	William82	223	88	117		397	415	266	709	203
	IV	4.6	HBK4600	223	88	117	132	464	446	189	685	503
		4.8	AP 4880	208	223	122		519	507	479	400	467
	V	5.8	DP 3588	208	223	141	153	932	531	404	332	468
		5.6	Hutcheson	223	141	100	160	702	357	436	494	466
PD 5/14	III	3.7	Macon	206	141	171	171	612	271	279	479	263
		3.9	William82	206	141	171	134	669	296	293	422	294
	IV	4.6	HBK4600	206	141	171	134	688	360	251	489	285
		4.7	TV-4479	206	141	171	152	688	259	332	471	484
	V	5.1	P 9511	206	141	171	152	688	590	328	366	344
		5.6	Hutcheson	206	141	171	134	782	435	513	354	270

Figure 1. Comparison of accumulative growing degree-day (GDD) required for each period of soybean growth with different MGs at different planting time.



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