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Research Article

Soybean Yield along the Texas Gulf Coast during Periods of Variable Rainfall as Influenced by Soybean Cultivar and Planting Date

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Soybeans (*Glycine max*) can be planted along the upper Texas Gulf Coast from mid-March through May to take advantage of early season rains and to complete harvest before hurricane season and fall rains become a problem. When average to above average rainfall was received in May through July, yields were greater with the early April to mid-April planting; however, under high rainfall conditions throughout the season, the mid-April to early May planting produced the highest yields, with yields of over 4000 kg/ha. When rainfall was below normal, late March to early April plantings produced the greatest yields. When rainfall was above average, soybeans took longer to reach harvestability regardless of cultivar or plant dates, while under drought conditions the interval between planting and harvest was reduced. However, when planting was delayed, there was a greater risk of detrimental late-season effects from southern green stink bug (*Nezara viridula*) or the brown stink bug (*Euschistus heros*).

1. Introduction

Soybeans (*Glycine max*) are grown along the upper Texas Gulf Coast and this area has become the largest soybean production area in the state. Most of the soybeans are planted from mid-March through May and are categorized as early soybean production system (ESPS) plantings. Production components such as planting date and variety can be manipulated to counter the effects of various environmental factors on soybean development and yield [1–5]. The rationale for planting early is to avoid reproductive growth during periods of high temperatures in July and August, and to take advantage of late spring and early summer rains for maximum flowering, seed set, and seed filling [4, 6]. Stress can reduce soybean yield by reducing the number of pods, seeds, and seed mass [7, 8]. Both determinate and indeterminate soybean cultivars have reduced growth rates under drought stress and resume normal growth rates when such stress is removed [8]. This may be an important growth attribute to consider if producers expect considerable soil moisture deficits due to short, intermittent droughts during the growing season [5].

The objectives of this research were to identify the components of soybean production encompassing cultivar and planting date that could increase soybean yield along the upper Texas Gulf Coast depending on moisture conditions. This information will aid producers in adapting planting practices that will improve soybean yield and reduce the chance of yield reductions.

2. Materials and Methods

2.1. Field Studies. Field experiments were conducted in 2006 thru 2009 at two different locations (Wharton County (29.2° N, 96.3° W) and Victoria County (28.4° N, 96.5° W)) in the Texas soybean production area along the upper Texas Gulf Coast. These two areas are separated about 145 km apart (east to west). Soil types at the Wharton County locations were a Lake Charles Clay with a pH of 7.2, while the Victoria County locations were a Houston

Table 1: Soil temperature (°C) at the 2.5 cm depth at planting in Victoria and Wharton Counties.

2006				2007			
Victoria		Wharton		Victoria		Wharton	
Date	Temp	Date	Temp	Date	Temp	Date	Temp
Mar 14	21.1	Mar 15	18.9	Mar 28	23.3	Mar 17	20.6
Mar 28	20.6	Apr 4	26.7	Apr 16	20.6	May 2	26.7
Apr 11	23.9	Apr 18	28.9	May 1	26.7	—	—
2008				2009			
Victoria		Wharton		Victoria		Wharton	
Date	Temp	Date	Temp	Date	Temp	Date	Temp
Mar 17	22.8	Mar 24	21.1	Mar 23	21.7	Mar 24	22.8
Mar 28	23.3	Apr 8	28.3	Apr 6	20.6	Apr 7	20
Apr 21	24.4	Apr 23	28.3	Apr 21	24.4	Apr 24	25.6

black clay with a pH range of 7.4 to 7.7. These studies were in different fields each year but in the same general area. Fertilizer was applied by the grower as needed according to Texas Cooperative Extension recommendations for soybean. Plots were maintained weed-free throughout the growing season using a preemergence application of either a premix of S-metolachlor plus metribuzin (Boundary, Syngenta Crop Protection, Greensboro, NC, USA) at the rate of 1.12 kg ai/ha or pendimethalin (Prowl H_2o, BASF Corp, Florham Park, NJ, USA) plus imazethapyr (Pursuit, BASF Corp., Florham Park, NJ, USA) at 1.06 kg ai/ha plus 0.07 kg ai/ha, respectively, depending on location. Grass and broadleaf weed escapes were controlled with postemergence applications of clethodim (Select, Valent USA Corp., Walnut Creek, Calif) at 0.21 kg ai/ha and acifluorfen (Blazer, BASF Corp., Research Triangle Park, NC, USA) 0.84 kg ai/ha or lactofen (Cobra, Valent USA Corp., Walnut Creek, Calif) at 0.22 kg ai/ha, respectively. Postemergence herbicide applications included Agridex (Helena Chemical Co., 6075 Poplar Ave., Memphis, TN, USA) at the rate of 0.25% v/v. The number of postemergence herbicide applications varied from year to year depending on weed emergence problems.

Soybean cultivars (mid Group IV through early Group V) selected for the study were those that had shown promise in previous studies or had produced well in other soybean producing regions of Texas or surrounding states. Soybean seed was planted with a vacuum planter (Monosem ATI, Inc., Lenoxa, Kan) to provide a uniform seeding rate of 33 seed/m (55,847 seeds/ha) on a pair of rows with 97 cm centers. Three planting dates, approximately two to three weeks apart, were used each year with the first date around 15th of March depending on weather conditions. Planting dates in Victoria County in 2006 were March 14, March 28, and April 11; in 2007, March 28, April 16, and May 1; in 2008, March 17, March 28, and April 21; in 2009, March 23, April 6, and April 21. In 2006, planting dates in Wharton County were March 15, April 4, and April 18; in 2007, April 17 and May 2; in 2008, March 24, April 8, and April 23; and 2009, March 24, April 7, and April 24 (Table 1). Planting dates in 2007 were either delayed or eliminated due to above normal rainfall which was received during the normal March to April planting window and which prevented entry into fields. Pod height was measured in 2008 and 2009 prior to harvest with measurements taken from ground level to the point of attachment of the first pod attached at the lowest node. Five plants per plot were measured and an average recorded.

2.2. Determining Cultivar Maturity and Harvesting. Physiological maturity of soybean seed occurs when the accumulation of dry weight ceases [9]. This stage first occurs when the pod turns yellow or has completely lost their green color. With favorable drying weather, the soybeans lose moisture quickly [9]. For all cultivars, paraquat at 0.28 kg/ha was applied when at least 70% of the seed pods had reached a mature brown color or when the seed moisture was 25% or less [10]. These guidelines were adopted from the U. S. Gramoxone Inteon label [10] and used on all cultivars. Within 3 to 5 d when seed moisture was approximately 12%, plots were harvested with a small plot combine. At the 3 to 5 d interval, additional cultivars were checked for color and moisture content and if at the desired level, sprayed with paraquat.

2.3. Experimental Design and Data Analysis. The treatment design was a factorial arrangement using a randomized complete block design with a planting date and soybean cultivars as factors. To reduce harvesting difficulties, planting dates were kept separate by block and cultivars randomized within planting dates. Replicates were separated by 1.7 m, while planting dates were separated by 6.4 m. Each cultivar was replicated three times within each planting date with a soybean cultivar plot size of 2 rows (97 cm centers) by 9.1 m long. An analysis of variance was performed using the ANOVA procedure for SAS (SAS Institute. 1998. SAS user's guide. SAS Inst., Cary, NC) to evaluate the significance of planting date and soybean cultivar on soybean yield, pod height, and time interval from planting until harvest. The Fishers Protected LSD at the 0.05 level of probability was used for separation of mean differences. Since environmental conditions were different at each location and soybean cultivars varied from year to year due to availability, data are presented separately by location and years.

3. Results and Discussion

3.1. Soil Temperature at Planting. Soil temperatures were cooler at the Wharton County location than at the Victoria location at the early planting date (March) with the exception of 2009, while at the mid and late plantings, soil temperatures were cooler at the Victoria County location than at the Wharton location with the exception of the mid planting date in 2009 (Table 1).

3.2. Rainfall. Rainfall amounts for the growing season were variable for both areas (Table 2). Rainfall in 2006 for both locations was below normal in March, April, June, and August but were above average in May and July in Victoria County and July in Wharton County. Rainfall for 2007 can be characterized as exceptionally wet with high rainfall amounts for July at both locations. Both 2008 and 2009 can be classified as exceptionally dry years with 46 to 61% of the normal rainfall for March through August time period. In 2008, only July in Victoria County and August in Wharton County experienced above normal rainfall while in 2009 only the month of April in Wharton County experienced above average rainfall (Table 1). The above normal rainfall for the respective dates in 2008 came too late to be of any help during the 2008 growing season.

3.3. Soybean Cultivar Response to Planting Date

3.3.1. 2006. Delaying planting date in Wharton County until April 4 or April 18 improved soybean yield for most cultivars with the exception of AG 5301RR, DG 33B52RR, or UA 4805 whose yields either stayed approximately the same or were reduced as planting date was delayed (Table 3). An increase in yield from the first to the second planting was noted with CL 4955RR, DG 33B52RR, DG 37G52RR, DP 5110RR, HBK 4926, HBK 5025, HBK 5123RR, NK 452, and NKS 49-T1RR; however, yields with these cultivars decreased below the March 15 levels with the April 18 planting date. Several soybean cultivars planted on April 18 produced over 2400 kg/ha with Garst 4999RR producing over 3300 kg/ha. The cultivar HBK 5894 produced only 336 kg/ha while HBK 4926, HBK 5025, and NK 452 produced less than 850 kg/ha. The extremely low yield with HBK 5894 was due to this cultivar being a later maturing cultivar compared with the higher yielding late 4 or early 5 maturity group cultivars. Since seed filling begins approximately 80 days after planting [11] and moisture availability is very important to pod development, the above average rainfall in July probably accounted for the high yields with soybean planted early to mid April. Demand for water and nutrients is large throughout the rapid seed filling period and during this period, the soybeans acquire approximately 50% of the N, P, and K by redistribution from vegetative plant parts and about 50% by soil uptake and nodule activity [9].

Victoria County yields were low for all planting dates due to below average rainfall for March and April (Table 2). Although above average rainfall was received in May and July, the soybeans never fully recovered. When planted on March 14, 38% of the cultivars produced less than 800 kg/ha (Table 3). Yields did not improve with the second planting and many cultivars produced less than 600 kg/ha at the third planting. Only HBK 5025 produced over 1200 kg/ha at the first and second harvest; however, at the third harvest yield was less than 460 kg/ha.

3.3.2. 2007. Soybean yields, especially in Wharton County, were above average due to the excellent moisture conditions (Table 2) coupled with moderate summer temperatures (data not shown). At the April 17 planting date in Wharton County, soybean yields were over 2600 kg/ha for all cultivars with the exception of DG 33Y45RR, DG 3463RR, Santa Rosa, and Vernal (Table 4). Santa Rosa and Vernal are cultivars that are commonly used in the Lower Rio Grande Valley region of Texas and have produced excellent yields in that area of the state (A. Scott, personal communication). Soybean yields of over 4900 kg/ha were produced with HBK 5025, while HBK 5941 produced over 4200 kg/ha. Soybean yields at the May 2 planting date increased from the April 17 planting date for many cultivars with the greatest yield increase (108%) noted with Vernal. Several cultivars including HBK 4926, HBK 5025, HBK 5894, and HBK 5941 showed a yield decrease with the later planting date. The excellent yields with the May plantings can be attributed to the above average rainfall during the growing season (Table 2). This late planting occurred in a year with above average rainfall and fruiting occurred when soil moisture was adequate. In previous research across the southern US, the planting of early-maturing cultivars was shown to be less important under conditions of more plentiful rainfall during the growing season, especially during the seed-fill stage, than in years when rainfall was below normal [1, 7, 12].

At the Victoria County location, yields of over 2000 kg/ha for all cultivars, with the exception of Santa Rosa, were noted for the March 28 planting date (Table 4). The highest yield was with HBK 5425RR which produced over 3300 kg/ha. Yields at the second planting remained approximately the same or decreased for all cultivars with the exception of NC+ 4A81RR, NC+ 4A65RR, and Pioneer 94M71RR which showed a yield increase of 16 to 24%. Delaying planting until May 1 resulted in a yield decrease from the mid April planting date for all cultivars. Excessive rainfall during July accounted for some of the yield reductions noted with the later planting dates. It was estimated that waterlogging for as little as 2 d at the V4 growth stage can reduce soybean grain yield by 18% [11], while the reduction was 26% at the R2 stage [13]. According to VanToai et al. [14], waterlogging for 4 wk at R1 to R2 stages reduced the average grain yield of 84 soybean cultivars by 25%. Heatherly and Pringle [15] reported that 1 to 2 d of waterlogging caused by flood irrigation did not reduce soybean yield, but longer periods of waterlogging resulted in significant yield losses. Sullivan et al. [16] reported a negative correlation of flooding duration with soybean population, plant height, number of pods, and soybean yield. Also, soybean rust (*Phakopsora pachyrhizi*) was found in the test plots in early July and this may have contributed to reduced yields with the later planted soybeans.

Table 2: Monthly rainfall during the growing season at the study locations.

	2006		2007		2008		2009		20 yrs average	
Month	Victoria	Wharton	Victoria	Wharton	Victoria	Wharton	Victoria	Wharton	Victoria	Wharton
						Mm				
March	43.7	71.1	168.4	166.6	11.4	15.2	65.8	56.6	52.8	80.7
April	3.6	47.0	61.2	67.3	42.7	49.3	36.6	173.0	74.4	83.8
May	207.7	114.1	152.9	151.9	9.4	6.1	65.3	22.4	125.7	119.4
June	99.3	66.8	84.8	70.6	31.0	31.8	10.7	25.5	121.2	126.5
July	167.6	186.9	452.1	296.7	131.5	67.1	17.8	37.6	83.8	83.1
August	18.0	48.0	148.3	106.9	72.9	127.8	49.8	42.7	78.2	89.4
Total	539.9	533.9	1067.7	860.0	298.9	297.3	246.0	357.8	536.1	582.9

Table 3: Yield response of soybean cultivars to planting dates in Wharton and Victoria Counties, 2006.

Cultivar[a,b]		Wharton County			Victoria County		
	MG[a]	15 Mar	4 April	18 April	14 Mar	28 Mar	11 April
				Kg/ha			
AG 4703RR	4.7	652	1836	2832	572	834	229
AG 4801RR	4.8	1224	1573	2569	646	760	699
AG 4903RR	4.9	807	2501	2979	847	—	282
AG 5301RR	5.3	1520	686	1069	1164	551	363
Croplan 4655RR	4.6	1009	1661	3114	625	780	309
Croplan 4955RR	4.9	1406	2697	1917	968	—	289
Croplan 4992RR	4.9	726	1971	2838	753	—	585
DG 33B52RR	5.2	1634	1742	1177	968	605	679
DG 3481RR	4.8	1237	1540	3040	605	585	666
DG 36Y48RR	4.8	1675	2441	2885	753	—	820
DG 37G52RR	5.2	1843	3074	1876	908	901	625
DK 4866RR	4.8	1567	2448	2926	—	868	894
DK 5066RR	5.0	1567	2475	2663	—	—	—
DP 4919RR	4.9	894	1964	2448	841	975	538
DP 5110S (C)	5.1	1648	2448	1567	1096	1251	323
DP 5115RR	5.1	1022	2206	2058	995	—	377
DP 5414RR	5.4	2556	2656	2441	834	—	531
Garst 4612RR	4.6	794	1749	3019	814	874	720
Garst 4999RR	4.9	2334	3242	3369	780	—	720
HBK 4926 (C)	4.9	1782	2562	834	1137	989	242
HBK 5025 (C)	5	1769	2603	551	1715	1372	457
HBK 5123RR	5.1	1957	2253	1083	1042	—	498
HBK 5894 (C)	5.8	1554	1755	336	1304	336	87
NC+ 4A42RR	4.2	1836	2084	2616	693	834	551
NC+ 4A81RR	4.8	881	1721	1910	888	659	572
NC+ 465RR	4.6	1285	1648	2542	437	531	847
NC+ 5A15RR	5.1	881	1722	1910	551	659	572
NK 452 (C)	5.2	1883	2831	726	1157	1211	343
NKS 49-T1RR	4.9	1776	2428	1876	1029	807	114
Pioneer 94M90RR	4.9	1991	2273	2851	968	—	646
UA 4805 (C)	4.8	942	538	531	525	350	410
LSD (0.05)			437			215	

[a]Abbreviations: (C), conventional cultivars; MG, maturity group; RR, Roundup-Ready cultivars.
[b]Cultivar DG 5066RR not planted at Victoria County. Other locations or planting dates with "—" indicates not harvested.

Table 4: Yield response of soybean cultivars to planting dates in Wharton and Victoria Counties, 2007.

Cultivar[a]		Wharton		Victoria		
	MG[b]	17 April	2 May	28 Mar	16 April	1 May
			Kg/ha			
DP 4888RR	4.8	2770	3302	2596	2515	955
DP 4919RR	4.9	2845	3934	3194	2314	1802
DP 5110S (C)	5.1	2932	3806	2038	2018	955
DP 5115RR	5.1	2838	3228	2542	2455	955
DP 5335RR	5.3	2851	3450	2838	1856	538
DP 5414RR	5.4	3854	3887	2683	1809	955
DG 31R54RR	5.4	3161	3255	2468	1029	538
DG 33B52RR	5.2	3463	3901	2993	2024	955
DG 33P54RR	5.4	3047	3659	2280	1695	538
DG 33Y45RR	4.5	2515	3349	2697	2482	2246
DG 3463RR	4.6	1836	2643	2717	2899	1903
DG 39F51RR	5.1	3807	3679	2919	2475	955
HBK 4924RR	4.9	3806	3585	3147	2603	955
HBK 4926 (C)	4.9	3786	3275	2670	1520	982
HBK 5025 (C)	5.0	4916	4466	2435	1856	538
HBK 5123RR	5.1	3638	3921	2529	2314	955
HBK 5425RR	5.4	3242	3437	3396	1150	538
HBK 5894 (C)	5.8	3914	3221	2084	1668	538
HBK 5941 (C)	5.9	4291	3437	2495	1675	538
NC+ 4A42RR	4.2	2723	3140	2764	2287	1587
NC+ 4A81RR	4.8	3046	3147	2051	2388	1769
NC+ 4A65RR	4.6	2959	3275	2024	2576	2065
NC+ 5A15RR	5.1	3706	3517	2899	1910	955
NKS 46U6RR	4.6	3443	3739	2408	2145	1769
NKS 49H7RR	4.9	3564	3827	2529	2246	955
NKS 49Q9RR	4.9	3921	3921	2388	2293	955
NKS 49W6RR	4.9	3867	4049	3026	2690	955
NK 452 (C)	5.2	3013	3275	2791	2219	1130
Pioneer 94M71RR	4.7	3376	3975	2018	2501	1870
Santa Rosa (C)	—	0	0	0	0	0
UA 4805 (C)	4.8	3235	3975	2206	1628	1197
Vernal (C)	—	1715	3564	2421	538	538
LSD (0.05)		356			309	

[a]Abbreviations: (C), conventional cultivars; MG, maturity group; RR, Roundup-Ready cultivars.
[b]Santa Rosa and Vernal are not grouped into any maturity group (A. Scott, personal communication). No yield obtained with Santa Rosa.

3.3.3. 2008. Below average rainfall occurred at both locations with the exception of July in Victoria County or August in Wharton County which was too late to improve soybean yield (Table 2). With the early planting date in Wharton County, no cultivars produced over 1634 kg/ha (Table 5). Delaying planting date until April 8 resulted in a significant increase in soybean yield for all cultivars with the exception of Croplan 4955RR, HBK 4926, and all Hoegemeyer cultivars. However, when planting date was delayed until April 23, these cultivars, with the exception of Croplan 4955RR and Hoegemeyer 510NRS, showed a yield increase over the two earlier planting dates. A decrease in yield from the April 8 planting date was noted with Croplan 5007RR, DP 5414RR, HBK 5425RR, NKS 49H7RR, and Vernal when planted April 23.

At the Victoria County location, only HBK 5025 and Vernal produced yields of over 1500 kg/ha at the March 17 planting date (Table 5). Delaying planting date until March 28 resulted in an increase in yield over the March 17 planting date for Croplan 5007RR, DP 5414RR, HBK 4926C, HBK 5123RR, HBK 5425RR, NKS 49H7RR, NKS 49W6RR, NKS 52F2RR, and Vernal. Further delaying planting date until April 21 decreased soybean yields to less than 1300 kg/ha for all cultivars.

Table 5: Yield response of soybean cultivars to planting dates in Wharton and Victoria Counties, 2008.

Cultivar[a,b,c]		Wharton			Victoria		
	MG	24 Mar	8 April	23 April	17 Mar	28 Mar	21 April
				Kg/ha			
Croplan 4757RR	4.7	1130	1628	1749	—	—	—
Croplan 4955RR	4.9	1356	1567	1594	1103	1237	1005
Croplan 5007RR	5.0	868	2024	1728	1042	1533	847
DP 5335RR	5.3	1459	1897	2071	1244	1292	1090
DP 5414RR	5.4	1137	1822	1399	1069	1426	511
HBK 4926 (C)	4.9	1480	1668	1897	1190	1459	962
HBK 5025 (C)	5	1406	1843	1769	1587	1628	0
HBK 5123RR	5.1	1338	1614	1426	1217	1433	565
HBK 5425RR	5.4	1634	2037	1083	1096	1520	0
Hoegemeyer 422NRS	4.2	1103	1399	1614	1285	1056	1224
Hoegemeyer 425NRS	4.2	1103	1116	1876	1130	847	1163
Hoegemeyer 480NRS	4.8	1103	1163	1554	1130	726	948
Hoegemeyer 487NRS	4.8	1042	1150	2010	1258	1163	908
Hoegemeyer 510NRS	5.1	1224	1258	1426	1183	1156	1184
NC+ 5A31RR	5.3	1520	1917	1917	—	—	—
NKS 49H7RR	4.9	1345	2246	1688	1083	1459	1217
NKS 49W6RR	4.9	1493	1749	1823	1291	1527	1103
NKS 52F2RR	5.2	1291	1802	1863	854	1224	0
Pioneer 94M71RR	4.7	1271	1715	1715	—	—	—
Pioneer 94M80RR	4.8	1372	2179	2179	1271	1311	1184
Vernal (C)	—	1311	1769	1177	1661	1957	0
LSD (0.05)			262			182	

[a]Abbreviations: (C), conventional cultivars; MG, maturity group; RR, Roundup-Ready cultivars.
[b]Vernal is not grouped into any maturity group (A. Scott, personal communication).
[c]Cultivars Croplan 4757RR, NC+ 5A31RR, and Pioneer 94M71RR not planted in Victoria County. A "0" indicates no yield obtained with that cultivar.

Ashley and Ethridge [7] reported that lack of moisture had more of an effect on soybean yield when drought occurred from flowering to physiological maturity compared with the emergence to flowering period. Daytime temperatures were typical for both areas with 32 to 38°C for July and August (data not shown). The high temperatures undoubtedly also inhibited both vegetative and reproductive growth during the season [9].

3.3.4. 2009. Rainfall was below normal throughout the growing season (Table 2). Yields at the Wharton County location decreased as planting date was delayed due to lack of soil moisture (Table 6). Yields at the first planting were at least 1400 kg/ha for all cultivars with the exception of DG 36Y48RR, HBK 4926, HBK 5941, HBK 5123RR, HBK 5425RR, Pioneer 95Y20RR, TV 49R17RR, and Vernal. At the second planting, yields decreased for all cultivars with the exception of AG 5503RR, DG 36Y48RR, HBK 5941, HBK 5123RR, HBK 5425RR, Pioneer 95Y20RR, TV 55R15RR, and Vernal. At the third planting no cultivar yielded greater than 800 kg/ha.

Although rainfall was below normal at the Victoria County location, soybean yields were above 1400 kg/ha for many cultivars at the first planting date (Table 6). Several low rainfall events occurred at this location which maintained plant growth during the critical pod filling period. Yields at the second planting for many cultivars were not different from the first planting; however, yields did increase from the first to second planting for AG 4907RR, AG 5503RR, Croplan 4955RR, DG 37P49RR, DK 4866RR, DK 5068RR, NKS 49W6RR, NKS 51T8RR, TV 46R19RR, and TV 49R17RR while HBK 5941 showed a yield decrease (Table 6). All cultivars showed a decrease in yield, with the exception of HBK 4926RR and TV 49R17RR, when planting was delayed until April 21.

Although early maturing cultivars usually produce lower yields when compared with full-season cultivars at later planting dates, early planted, early maturing cultivars may produce superior yields by avoiding summer drought conditions [1, 11, 17, 18]. These cultivars would have passed the critical reproductive stages before stored moisture is exhausted, which ameliorates the effects of drought on crop growth [17].

3.4. Number of Days from Plant to Harvest. Generally, the later the planting date, the shorter the interval between soybean planting and harvest [19]. However, in the year with above average rainfall, trends toward a greater number of days from planting to harvest were noted. This is important in that the longer the plant is exposed to the elements,

Table 6: Yield response of soybean cultivars to planting dates in Wharton and Victoria Counties, 2009.

Cultivar[a,b]		Wharton			Victoria		
	MG	24 March	7 April	24 April	23 March	6 April	21 April
				Kg/ha			
AG 4907RR	IV	1708	1477	592	1433	1668	1359
AG 5304RR	V	1903	1380	673	1648	1802	1372
AG 5503RR	V	1513	1523	464	1251	1433	955
AG 5606RR	V	1506	1131	430	1540	1533	605
AG 5803RR	V	1520	1184	390	1668	1567	861
Croplan 4955RR	IV	1708	1297	302	1574	1802	1527
Croplan 4998RR	IV	1789	1455	699	1412	1453	1251
DG 36Y48RR	IV	1291	1107	0	1292	1332	1076
DG 37P49RR	IV	1849	1350	544	1292	1480	1278
DK 4866RR	IV	1688	1342	673	1433	1661	1466
DK 5068RR	V	1776	1387	673	1722	1957	1594
DP 4888RR	IV	1755	1417	699	1594	1722	1500
DP 5335RR	V	1964	1779	773	1634	1594	1318
HBK 494LL	IV	1513	1372	673	1533	1628	1291
HBK 4926 (C)	IV	1379	927	491	1513	1406	1251
HBK 5025 (C)	V	1694	1311	437	1681	1587	1177
HBK 5941 (C)	V	787	799	0	1634	1406	841
HBK 5123RR	V	1096	965	0	1473	1601	733
HBK 5425RR	V	1385	1417	182	1634	1776	767
NKS 48C9RR	IV	1715	1477	–	1587	1634	1446
NKS 49W6RR	IV	1883	1515	545	1661	1930	1285
NKS 51T8RR	V	1722	1493	800	1419	1607	1453
Pioneer 94Y90RR	IV	1473	1161	773	1513	1466	1258
Pioneer 95Y20RR	V	1130	1040	747	1406	1547	1318
TV 46R19RR	IV	1601	1229	592	1506	1715	1480
TV 49R17RR	IV	1332	1056	0	1190	1412	1412
TV 54R28RR	V	2092	1515	491	1419	1385	962
TV 55R15RR	V	1695	1606	673	1695	1560	679
Vernal (C)		592	694	0	1264	1190	639
LSD (0.05)			166			155	

[a]Abbreviations: (C), conventional cultivars; LL, Liberty Link cultivars; MG, maturity group; RR, Roundup-Ready cultivars. A "—" indicates cultivar not harvested; "0" indicates no yield for that cultivar.
[b]Vernal is not grouped into any maturity group (A. Scott, personal communication).

whether it is increasing chance of a hurricane or an increase in green (*Nezara viridula*) or brown (*Euchistus heros*) stinkbug populations, the greater the chance of yield loss.

3.4.1. 2006. At the Wharton County location, soybeans planted at the early plant date took 126 to 139 days from planting to harvest with the exception of NKS 49-T1RR which required 152 days (Table 7). At the April 4 plant date, most cultivars, with the exception of NKS 49-T1RR, were harvested 119 to 132 days after planting, while at the last planting date, days from planting to harvest were more variable and ranged from 118 to 148 days. The soybean cultivar NKS 49-T1RR took the greatest number of days from planting to harvest for all planting dates.

At the Victoria County location, the interval from planting to harvest was lower than the Wharton County location (Table 7). At the first planting, days from planting to harvest ranged from 106 to 125 days while at the second planting date, the interval was 111 days for all cultivars with the exception of DG 37G52RR and NKS 49-T1RR which required 140 days. At the April 11 planting date, Garst 4612RR and HBK 5123RR required only 97 days while NKS 49-T1RR required 132 days. All other cultivars required 126 days from planting to harvest.

3.4.2. 2007. The interval between plant date and harvest date was longer than in 2006, and this was due to the above average rainfall during the growing season (Table 2) and below normal temperatures (data not shown). These weather conditions slowed plant growth and therefore extended the growing season [7, 12, 19]. In Wharton County when soybeans were planted on April 17, the interval between plant

Table 7: Days from planting to harvest, 2006.

Cultivar[a,b]	Wharton County			Victoria County		
	15 Mar	4 April	18 April	14 Mar	28 Mar	11 April
	Number of days					
AG 4703RR	139	119	133	118	111	126
AG 4801RR	126	119	118	118	111	126
AG 4903RR	139	119	133	125	—	126
AG 5301RR	139	132	148	125	111	126
Croplan 4655RR	126	119	118	106	111	126
Croplan 4955RR	139	132	148	125	—	126
Croplan 4992RR	126	119	118	106	—	126
DG 33B52RR	139	132	148	125	111	126
DG 3481RR	126	119	118	106	111	126
DG 36Y48RR	139	119	133	118	—	126
DG 37G52RR	139	132	148	125	140	126
DK 4866RR	139	119	133	—	—	126
DK 5066RR	139	132	133	—	—	—
DP 4919RR	139	119	118	106	111	126
DP 5110S (C)	139	119	148	106	111	126
DP 5115RR	139	132	148	118	—	126
DP 5414RR	139	132	148	125	—	126
Garst 4612RR	126	119	118	106	111	97
Garst 4999RR	139	119	133	118	—	126
HBK 4926 (C)	139	119	148	125	111	126
HBK 5025 (C)	139	132	148	118	111	126
HBK 5123RR	139	132	148	125	—	97
HBK 5894 (C)	139	132	148	125	111	132
NC+ 4A42RR	126	119	118	106	111	126
NC+ 4A81RR	126	119	148	106	111	126
NC+ 465RR	126	119	118	106	111	126
NC+ 5A15RR	139	132	148	118	111	126
NK 452 (C)	139	132	148	125	111	126
NKS 49-T1RR	152	162	148	125	140	132
Pioneer 94M90RR	139	119	118	106	—	126
UA 4805 (C)	139	132	148	118	111	126
LSD (0.05)		6			4	

[a]For all cultivars, paraquat at 0.25 kg/ha was applied when at least 70% of the seed pods had reached a mature brown color and when seed moisure was 25% or less. Cultivars were harvested within 3 to 5 d when seed moisture was approximately 12%. Cultivar DG 5066RR not planted at Victoria County. Other locations or planting dates with "—" indicates not harvested.
[b]Abbreviations: C, conventional cultivars; NRS, RR, Roundup Ready cultivars.

and harvest ranged from 146 to 154 days for most cultivars with the exception of DP 5110S and DP 5115RR which required 162 days and Pioneer 94M71RR which required only 134 days (Table 8). At the May 2 planting date, most cultivars required 131 to 139 days, while similar trends as seen with the April 17 planting date were noted with DP 5110S, DP 5115RR, and Pioneer 94M71RR.

At Victoria County, the interval from planting to harvest decreased when planting date was delayed from March 28 to April 16 but increased when planting date was delayed until May 1. At the early planting date all cultivars required 124 to 138 days with the exception of Vernal which required 147 days. This compares with a shortened interval of 90 to 113 days for all soybean cultivars except Vernal planted on April 16. When planting was delayed until May 1, the interval from planting until harvest for most cultivars was at least 142 days; however, DG 33Y45RR, DG 3463RR, NC+ 4A65RR, NKS 46U6RR, and Pioneer 94M71RR required only 113 days. The extended interval for the later planted soybeans were due to the abnormally high rainfall received in July (Table 2), which slowed plant growth and development [20, 21]. When the soybean plant reaches beginning maturity, warm weather does not hasten maturity unless it causes water deficit stress and maturity is more strongly influenced by photoperiod [9].

Table 8: Days from planting to harvest in 2007.

Cultivar[a,b]	Wharton County		Victoria County		
	17 Apr	2 May	28 Mar	16 Apr	1 May
			Number of days		
DP 4888RR	154	139	138	113	146
DP 4919RR	154	139	124	104	142
DP 5110S (C)	162	146	138	113	146
DP 5115RR	162	146	138	113	146
DP 5335RR	154	139	124	113	146
DP 5414RR	147	132	124	113	146
DG 31R54RR	154	139	132	113	146
DG 33B52RR	146	139	124	113	146
DG 33P54RR	154	139	132	113	146
DG 33Y45RR	146	139	124	90	118
DG 3463RR	146	131	124	90	118
DG 39F51RR	147	139	124	104	146
HBK 4924RR	154	139	124	113	146
HBK 4926 (C)	146	131	124	104	142
HBK 5025 (C)	146	131	124	113	146
HBK 5123RR	154	139	138	113	146
HBK 5425RR	154	139	132	113	146
HBK 5894 (C)	154	139	138	113	146
HBK 5941 (C)	147	139	138	113	146
NC+ 4A42RR	146	131	124	104	142
NC+ 4A81RR	146	131	124	104	142
NC+ 4A65RR	147	139	138	105	113
NC+ 5A15RR	154	139	132	113	146
NKS 46U6RR	154	139	124	105	113
NKS 49H7RR	154	139	138	113	146
NKS 49Q9RR	147	132	138	104	146
NKS 49W6RR	146	131	124	104	146
NK 452 (C)	147	132	124	104	142
Pioneer 94M71RR	134	119	138	105	113
Santa Rosa (C)	—	—	—	—	—
UA 4805 (C)	154	139	124	104	142
Vernal (C)	154	139	147	145	146
LSD (0.05)	7			11	

[a]For all cultivars, paraquat at 0.25 kg/ha was applied when at least 70% of the seed pods had reached a mature brown color and when seed moisure was 25% or less. Cultivars were harvested within 3 to 5 d when seed moisture was approximately 12%. No yield obtained with Santa Rosa.
[b]Abbreviations: C, conventional cultivars; RR, Roundup Ready cultivars.

3.4.3. 2008. The interval between planting and harvest was reduced from 2006 and 2007 at both locations due to the dry, hot conditions [9, 11]. In Wharton County, at the early planting date, the interval varied from 115 to 133 days and was increased for Croplan 4757RR, Croplan 4955RR, DP 5335RR, DP 5414RR, HBK 5025RR, NC+5A31RR, NKS 49H7RR, and NKS 49W6RR when planting was delayed until April 8 (Table 9). At the April 23 planting date, the interval for most cultivars was between 103 and 112 days but 133 days for Croplan 4757RR, Croplan 4955RR, DP 5414RR, HBK 5425RR, NC+5A31RR, NKS 52F2RR, and Vernal.

In Victoria County, at the March 17 planting date, the interval was 105 days or less with all cultivars except Croplan 5007RR, HBK 5025, HBK 5425RR, NKS 52F2RR, and Vernal which required 129 to 140 days from planting until harvest (Table 9). When planting date was delayed until March 28, the interval decreased for HBK 5025, Vernal, and all Hoegemeyer cultivars with the exception of Hoegemeyer 487RR. When planting date was delayed until April 21, the interval between planting and harvest varied from 114 to 128 days except for the Hoegemeyer cultivars 422RR, 425RR, and 480RR which required 105 days from planting until harvest (Table 9).

Table 9: Days from planting to harvest in 2008.

Cultivar[a,b]	Wharton			Victoria		
	24 Mar	8 April	23 April	17 Mar	28 Mar	21 April
	Number of days					
Croplan 4757RR	119	127	133	—	—	—
Croplan 4955RR	119	127	133	105	116	114
Croplan 5007RR	133	127	112	129	129	114
DP 5335RR	119	127	112	105	116	114
DP 5414RR	119	127	133	105	129	128
HBK 4926 (C)	119	118	112	105	116	114
HBK 5025 (C)	119	127	112	137	129	—
HBK 5123RR	133	127	112	105	129	128
HBK 5425RR	133	127	133	129	129	—
Hoegemeyer 422NRS	115	104	103	100	94	105
Hoegemeyer 425NRS	115	104	103	100	94	105
Hoegemeyer 480NRS	115	104	103	100	94	105
Hoegemeyer 487NRS	119	118	112	100	108	114
Hoegemeyer 510NRS	115	118	112	100	94	114
NC+ 5A31RS	119	127	133	—	—	—
NKS 49H7RR	119	127	112	105	116	114
NKS 49W6RR	119	127	112	105	116	114
NKS 52F2RR	133	127	133	129	129	—
Pioneer 94M71RR	115	104	112	—	—	—
Pioneer 94M80RR	119	118	112	105	108	114
Vernal (C)	133	127	133	140	129	—
LSD (0.05)		6			5	

[a]For all cultivars, paraquat at 0.25 kg/ha was applied when at least 70% of the seed pods had reached a mature brown color and when seed moisure was 25% or less. Cultivars were harvested within 3 to 5 d when seed moisture was approximately 12%. Cultivars Croplan 4757RR, NC+5A31RR, and Pioneer 94M71RR not planted in Victoria County. A "—" indicates no yield obtained with that cultivar.
[b]Abbreviations: C, conventional cultivars; NRS, RR, Roundup Ready cultivars.

3.4.4. 2009. Although dry, hot conditions existed for the growing season, the interval between planting and harvest was not as great as that in 2008. The interval from planting until harvest for the early planting date in Wharton County was 112 to 119 days for all cultivars except Vernal which required 141 days (Table 10). With the April 7 planting date, the interval between planting and harvest either stayed the same or was reduced for all cultivars except HBK 5025 and HBK 5941. Soybean produced at the late April planting date required only 107 days from planting until harvest for AG 4907RR, DK 4866RR, DP 5335RR, NKS 48C9RR, and Pioneer 94Y90RR and 114 to 119 days for all other cultivars.

In Victoria County at the first planting date, Vernal required 135 days from planting until harvest while several cultivars required only 108 days. The cultivars AG 5606RR, AG 5803RR, HBK 5025C, HBK 5941C, and HBK 5425RR required at least 121 days from planting until harvest (Table 10). At the April 6 planting date, HBK 5123RR and Vernal required 126 days, while AG 5503RR, DG 37P49RR, and HBK 494LL only required 98 days. All other cultivars required 107 to 112 days from planting to harvest with the exception of AG 5606RR, AG 5803RR, Croplan 4955RR, and NKS 48C9RR which required 121 days. At the April 21 planting date, AG 5803RR, HBK 5941C, HBK 5425RR, and Vernal required 125 days, while most cultivars required 106 to 111 days.

Heatherly [2] reported that near Stoneville, MS, cultivars planted before 16 April took an average of 5 days longer to reach R1 (beginning bloom) than did cultivars planted after 16 April to 1 May. When cultivars were planted from May through June, the number of days to R1 decreased as planting date was delayed. Heatherly [2] concluded that the reproductive period of later-maturing cultivars would occur later in the season when stored soil moisture has been reduced, probability of rainfall is lower, and air temperatures are higher.

3.5. Pod Height. Pods that are produced along the lower nodes of the main stem may be left in the field at harvest due to the inability of harvest equipment to reach these pods. For every 1.3 soybeans left on a plant (at these populations), a loss in yield of 67 kg/ha occurs (A. Klosterboer, personal communication). Pod height was measured in 2008 and 2009.

3.5.1. 2008. At the Wharton County location, only HBK 5425RR, NC+ 5A31RR, and Vernal had a higher pod attachment point than the other cultivars at the first planting, while

Table 10: Days from planting to harvest, 2009.

Ciltivar[a,b]	Wharton			Victoria		
	24 Mar	7 April	27 April	23 Mar	6 April	21 April
	Number of days					
AG 4907RR	112	105	107	108	107	106
AG 5304RR	119	105	114	112	112	111
AG 5503RR	112	105	114	108	98	119
AG 5606RR	119	113	119	121	121	119
AG 5803RR	119	119	119	121	121	125
Croplan 4955RR	112	113	119	112	121	111
Croplan 4998RR	119	113	114	112	112	111
DG 36Y48RR	112	105	0	112	112	111
DG 37P49RR	112	113	114	112	98	111
DK 4866RR	112	105	107	108	112	106
DK 5068RR	112	105	114	112	107	111
DP 4888RR	112	113	114	112	112	111
DP 5335RR	112	105	107	108	112	111
HBK 494 LL	112	105	114	112	98	106
HBK 4926 (C)	112	113	114	112	112	111
HBK 5025 (C)	119	127	114	121	112	111
HBK 5941 (C)	112	119	0	126	112	125
HBK 5123RR	119	119	0	112	126	119
HBK 5425RR	119	105	119	121	112	125
NKS 48C9RR	112	113	107	108	121	106
NKS 49W6RR	112	113	114	112	107	111
NKS 51T8RR	119	105	114	112	112	111
Pioneer 94Y90RR	112	105	107	108	112	106
Pioneer 95Y20RR	112	105	114	108	112	111
TV 46R19RR	112	105	114	108	107	106
TV 49R17RR	112	105	0	108	107	106
TV 54R28RR	112	113	119	108	107	111
TV 55R15RR	119	113	119	112	112	119
Vernal (C)	141	127	0	135	126	125
LSD (0.05)		4			6	

[a]For all cultivars, paraquat at 0.25 kg/ha was applied when at least 70% of the seed pods had reached a mature brown color and when seed moisure was 25% or less. Cultivars were harvested within 3 to 5d when seed moisture was approximately 12%.
A "—" indicates cultivar not harvested; "0" indicates no yield for that cultivar.
[b]Abbreviations: C, conventional cultivars; LL, Liberty Link cultivars; RR, Roundup Ready cultivars.

at the second planting date several cultivars had a higher pod attachment point than the Hoegemeyer cultivars with the exception of Hoegemeyer 510NRS (Table 11). At the third planting date, Vernal had the highest point of attachment followed by HBK 5425RR and NC+ 5A31RR. Again, the Hoegemeyer cultivars, with the exception of Hoegemeyer 487NRS, had the lowest point of pod attachment.

At the first planting in Victoria County, Vernal had the highest point of attachment, while DP 5335RR, DP 5414RR, and NKS 49H7RR were higher than all cultivars with the exception of HBK 4926, HBK 5025, HBK 5425RR, NKS 52F2RR, and Pioneer 94M80RR (Table 11). At the second planting, similar trends were noted with Vernal while several cultivars had point of attachments 5.8 cm or greater (DP 5335RR, DP 5414RR, HBK 5123RR, HBK 5425RR, Hoegemeyer 425NRS, and Hoegemeyer 510NRS). At the third planting, DP 5414RR had the highest point of attachment, while DP 5335RR and HBK 5123RR had a higher point of attachment than most cultivars.

3.5.2. 2009. Generally, for cultivars that were common to plantings in both years, the point of first pod attachment was higher at both Wharton and Victoria Counties than seen in 2008, and this was the result of dry conditions. At the Wharton County location, at the first planting, HBK 5941 had the highest attachment point while Vernal was not different from twelve other cultivars (Table 12). Similar trends were noted with HBK 5941RR and Vernal at the second planting (Table 12). At the April 27 planting date, only AG 5304RR, AG 5606RR, DK 4866RR, Pioneer 95Y20RR, and TV 54R28RR point of attachment was less than 10 cm above the soil.

Table 11: Pod height from ground to first pod with three planting dates at two locations in 2008.

Cultivar[a]	Wharton			Victoria		
	24 Mar	8 April	23 April	17 Mar	28 Mar	21 April
			Cm			
Croplan C4757RR	2.5	5.8	10.2	—	—	—
Croplan C4955RR	3.3	2.5	8.4	2.5	3.3	6.9
Croplan C5007RR	2.5	6.9	4.3	2.5	2.5	4.3
DP 5335RR	4.3	8.4	9.4	8.4	5.8	9.4
DP 5414RR	4.3	5.1	8.4	6.9	6.9	11.9
HBK 4926 (C)	4.3	5.8	8.4	5.8	4.3	5.1
HBK 5025 (C)	4.3	6.9	5.8	4.3	4.3	—
HBK 5123RR	3.3	5.1	4.3	2.5	6.9	8.4
HBK 5425RR	5.1	5.1	10.2	4.3	5.8	—
Hoegemeyer 422NRS	2.5	2.5	2.5	2.5	2.5	2.5
Hoegemeyer 425NRS	2.5	2.5	2.5	2.5	6.9	3.3
Hoegemeyer 480NRS	2.5	2.5	2.5	2.5	2.5	2.5
Hoegemeyer 487NRS	2.5	2.5	5.1	2.5	3.3	2.5
Hoegemeyer 510NRS	2.5	5.1	3.3	2.5	8.4	5.8
NC+ 5A31RS	5.8	7.6	10.9	—	—	—
NKS 49H7RR	2.5	2.5	3.3	6.9	2.5	4.3
NKS 49W6RR	4.3	5.1	5.8	2.5	3.3	6.9
NKS 52F2RR	2.5	10.2	4.3	4.3	3.3	—
Pioneer 94M71RR	3.3	4.3	4.3	—	—	—
Pioneer 94M80RR	3.3	5.8	6.9	4.3	4.3	5.8
Vernal (C)	7.6	13.5	17	15.2	13.5	—
LSD (0.05)		2.3			3.8	

[a]Abbreviations: C, conventional cultivars; NRS, RR, Roundup Ready cultivars. Cultivars Croplan 4757RR, NC+ 5A31RR, and Pioneer 94M71RR not planted in Victoria County. A "—" indicates no yield obtained with that cultivar.

At the first planting in Victoria County, all cultivars with the exception of AG 5503RR, DK 4866RR, DK 5068RR, NKS 48C9RR, and TV 49R17RR produced a point of attachment greater than 6 cm above the soil (Table 12). At the April 6 planting date, AG 4907RR, DK 4866RR, HBK 5425RR, NKS 48C9RR, and all Terrell cultivars, with the exception of TV 55R15RR, produced the lowest pod set. At the April 21 planting date, Vernal produced an extremely high first pod set (29.7 cm); however, all cultivars with the exception of AG 5803RR, Pioneer 94Y90RR, and TV 54R28 produced a pod attachment at least 10.0 cm above the soil.

4. Summary

Some cultivars which have produced good to excellent yields in other soybean growing areas failed to produce under growing conditions found along the upper Texas Gulf Coast. Vernal, a cultivar that has produced excellent yields of over 3300 kg/ha under irrigated conditions in the Texas Lower Rio Grande Valley (A. Scott, personal communication), has been inconsistent under growing conditions found in this area. Also, the length of time from planting until harvest is an issue for producers who are concerned with stink bug population increases after grain sorghum (*Sorghum bicolor* L. Moench) harvest and the increased chance of hurricanes as the season progresses.

An advantage with growing Vernal is the height of the first pod set which allows for an easy harvest without any loss of soybeans pods. Many cultivars produce pods which are too low to the ground and the combines used to harvest the beans cannot cut the stem close enough to the ground to harvest all the pods. Under normal rainfall or whenever drought conditions occurred, a late March to mid-April plant date provided the best timing to optimize soybean yield regardless of cultivar (MG IV or V) for soybeans planted along the Texas Gulf Coast with a 28 to 29° N latitude. In earlier work, Grichar et al. [19] had reported similar results under normal rainfall conditions with different cultivars than used in this study. Under less than optimum growing conditions due to dry conditions, the early plantings took advantage of available soil moisture and produced yields of at least 1300 kg/ha. In a year of late summer rains, a May plant date produced excellent yields; however, stink bugs can become a problem. However, growers do not have the luxury of knowing moisture conditions before they plant so they should rely on data for a "normal" year. In contrast, Heitholt et al. [12] reported that a mid-March planting date was not desirable for north Texas (33° N latitude) due to stand loss and poor seedling growth associated with cold and wet weather conditions. They concluded that waiting until mid-May to plant soybeans in that region was less successful than planting in April. Bowers [1] also reported on similar work

Table 12: Pod height from ground to first pod with three planting dates at two locations in 2009.

Cultivar[a]	Wharton			Victoria		
	24 Mar	7 April	27 April	23 Mar	6 April	21 April
			Cm			
AG 4907RR	14.7	9.4	—	7.1	7.6	11.9
AG 5304RR	12.7	11.9	5.1	10.7	15.2	10.2
AG 5503RR	11.4	7.6	10.2	5.8	14.5	10.2
AG 5606RR	5.1	5.8	7.6	9.4	11.9	10.2
AG 5803RR	11.9	11.9	10.2	11.4	12.7	6.9
Croplan 4955RR	10.2	8.4	10.2	10.0	12.7	13.5
Croplan 4998RR	7.6	6.9	10.2	7.1	11.9	10.8
DG 36Y48RR	11.4	10.9	0	12	11.9	7.6
DG 37P49RR	7.6	8.4	10.2	12	12.7	10.9
DK 4866RR	7.6	8.4	8.4	4.3	6.9	7.6
DK 5068RR	10.2	9.4	10.2	5.6	12.7	10.2
DP 4888RR	10.2	11.9	12.7	6.9	11.9	10.9
DP 5335RR	10.2	8.4	13.5	7.6	14.5	10.2
HBK 494LL	10.7	10.2	12.7	8.3	13.5	10.2
HBK 4926 (C)	14.5	10.9	10.2	7.1	11.9	11.9
HBK 5025 (C)	10.2	14.5	15.2	9.4	14.5	17.0
HBK 5941 (C)	24.6	22.1	0	8.4	15.2	17.8
HBK 5123RR	11.9	13.5	0	8.1	13.5	11.9
HBK 5425RR	5.8	11.9	10.2	6.9	8.4	12.7
NKS 48C9RR	13.5	10.9	—	3.3	5.8	10.9
NKS 49W6RR	5.8	10.2	12.7	8.1	11.9	10.9
NKS 51T8RR	12.7	7.6	10.2	8.1	12.7	10.2
Pioneer 94Y90RR	10.2	10.2	10.2	8.1	10.9	9.4
Pioneer 95Y20RR	10.9	8.4	5.1	7.6	10.9	10.9
TV 46R19RR	14.0	10.9	12.7	8.4	5.1	10.9
TV 49R17RR	11.9	10.9	0	5.8	7.6	10.9
TV 54R28RR	5.1	5.8	5.1	7.6	5.8	5.1
TV 55R15RR	7.6	5.8	12.7	9.7	12.7	10.2
Vernal (C)	15.2	17.0	0	12.7	18.5	29.7
LSD (0.05)		4.3			5.8	

[a]Abbreviations: C, conventional cultivars; LL, Liberty Link cultivars; RR, Roundup Ready cultivars. A "—" indicates cultivar not harvested; "0" indicates no yield for that cultivar.

in North Texas and found that, in general, April plantings outyielded May plantings across all twelve cultivars. The use of MG V cultivars resulted in fruiting during hot, dry conditions normally found in July and August while the early maturing types fruited during June when soil moisture was adequate and temperatures were not as severe.

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