Peanut (*Arachis hypogaea* L.) Response to the Hormonal Plant Growth Regulator Early Harvest®

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ABSTRACT

Experiments were conducted from 1996 through 2001 in Georgia, North Carolina, and Texas to determine peanut response to the commercial plant growth regulator Early Harvest® (a commercial mixture of cytokinin, gibberellic acid, and indole butyric acid). Early Harvest (applied in the seed furrow) or Early Harvest TST (applied as a dry seed treatment) followed by four foliar applications (four-leaf peanut, initial pegging, 14 d after initial pegging, and pod fill), was compared to non-treated peanut in five, 13, and three experiments in these respective states. Early Harvest did not affect pod yield or gross economic value of peanut regardless of location, cultivar, or edaphic and environmental conditions. These data suggest that a spray program consisting of Early Harvest most likely will not improve pod yield or gross economic value of peanut.

Key Words: Cytokinin, gibberillic acid, gross economic value, indole butyric acid, pod yield.

Early Harvest, a commercial growth regulator containing cytokinin (110 mg/L), gibberellic acid (57 mg/L), and indole butyric acid (38 mg/L), is registered for use on peanut (*Arachis hypogaea* L.), cotton (*Gossypium hirsutum* L.), wheat (*Tritcum aestivum* L.), rice (*Oryza sativa* L.), and several other agronomic, vegetable, and fruit crops (Early Harvest product label, Griffin LLC, Valdosta, GA). Recommended rates for Early Harvest PGR range from 1.2 L/ha for seed furrow applications to as high as 2.8 L/ha for single foliar applications. The recommended application program for peanut includes seed furrow and four foliar applications for a total of 5.9 L/ha (Early Harvest label, Griffin LLC, Valdosta, GA).

Response of cotton to hormonal plant growth regulators has been variable. Wright *et al.* (2000) reported that hopper box treatments of Early Harvest TST (Griffin LLC, Valdosta, GA) followed by foliar applications of Early Harvest increased cotton lint yield. Crawford *et al.* (1996) reported increased dry weight of cotton seedlings following application of Early Harvest to the seed furrow. Zhao *et al.* (1998) reported variable response of cotton lint yield following Early Harvest application. In contrast, Early

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Harvest did not affect cotton seedling growth or yield components in other studies (Becker *et al.*, 1997, 1998; Millhollon and Walters, 1997; Bednarz and van Iersel, 1998). Becker *et al.* (1998) also reported that Early Harvest did not affect stand establishment or total root length.

The effect of Early Harvest or Early Harvest TST on peanut seedling growth, pod yield, market grade characteristics, and economic value has not been thoroughly evaluated. Other hormonal plant growth regulators such as PGR-IV (Micro Flo Co., Lakeland, FL), a mixture of 30 mg/L gibberellic acid, 27 mg/L indole butyric acid, and a proprietary fermentation broth, did not affect vegetative or reproductive growth of peanut (York *et al.*, 1996). The objective of this research was to determine if a spray program for Early Harvest recommended by the manufacturer increased pod yield and gross economic value of runner and virginia market-type peanut.

Materials and Methods

Methods Common to All States. Experiments were conducted in Georgia, North Carolina, and Texas to compare a program including seed treatment or in-furrow applications (North Carolina and Texas only) of Early Harvest followed by multiple foliar applications of Early Harvest to non-treated peanut. The treatment consisted of Early Harvest at 1.2 L/ha applied in the seed furrow or Early Harvest TST as a dry seed treatment at 1.8 g/kg seed followed by three foliar Early Harvest applications at 2.8 L/ha (four-leaf stage of peanut, initial pegging approximately 45 d after emergence, and 10 to 20 d after initial pegging) followed by one foliar application of 5.6 L/ha during pod fill (approximately 80 d after emergence). Early Harvest was applied in a 94 L/ha aqueous solution in the seed furrow or 145 L/ha to foliage using CO_2-pressurized tractor-mounted (in-furrow application) or backpack (foliar application) sprayers, respectively. Early Harvest was applied immediately after seed drop but before closure of the furrow by the press wheel. Early Harvest TST was applied as a hopper box seed treatment. A non-treated control was also included. Production and pest management practices, other than Early Harvest applications, were held constant over the entire test based on Coop. Ext. Serv. recommendations for the region.

A 500-g sample of pods, either as a composite mixture from all replications for a given treatment or as individual replications, was removed to determine the percentage of sound mature kernels (%SMK), the percentage of total SMK (%TSMK), and the percentage of other kernels (%OK) based on Cooperative Grading Service guidelines for peanut in all states (Peanut Loan Schedule, 2002, USDA-FSA-1014-3). In North Carolina, the percentage of extra large kernels (%ELK) was also used in determining market value ($/kg) based on the loan rate of peanut ($0.40/kg). Gross economic value ($/ha) for peanut was defined as the product of market value and pod yield.

The experimental design was a randomized complete block with four replications in all states. Data for pod yield and gross economic value were subjected to analysis of variance by state. Data for specific market grade characteristics were not subjected to analysis of variance because composite samples were used or because limited replication was available. These market grade characteristics were used to determine gross economic value. Specific treatment factors for cultivars are listed for each state in the following sections.

Georgia. Experiments were conducted in 1998 on sandy loam soil at the Southwest Georgia Res. and Educ. Center located near Plains, GA; in 1999, 2000, and 2001 at the Coastal Plain Exp. Sta. located near Tifton, GA; and in 2000 at the Southeast Georgia Res. and Educ. Center near Midville, GA. Experiments were conducted in conventionally tilled seedbeds with plot size of six rows (91-cm spacing) by 9 m. The runner market-type cultivars included in the experiment included Southern Runner in 1998; Georgia Green (all years); Virugard, C 99R, and Florida MDR 98 in 1999; and C-99R, Agra Tech 201, and Agra Tech 1-1 in 2000. The cultivar Georgia Green is planted on approximately 95% of hectarage in Georgia (Beasley, 2001). Peanut was dug in mid-Sept. based on optimum maturity as determined by the Hull-Scrape Maturity method. No attempt was made to distinguish among pod maturity of the different treatments. Peanut was allowed to air dry for 5 to 8 d following inversion prior to combining.

North Carolina. Thirteen experiments were conducted on sandy loam to loam soils in the Coastal Plain region of North Carolina from 1997 through 2000. Experiments were established in conventionally prepared seedbeds with plot sizes of four rows (91-cm spacing) by 15 m (1997 and 1998) or 10 m (2000). The virginia market-type cultivars NC 10C, NC-V 11, and NC 12C were planted in two, six, and five of the experiments, respectively. These respective cultivars represent approximately 3, 28, and 27% of peanut hectares planted in North Carolina (Spears, 2001). Peanut was dug and inverted in late September to mid October depending upon pod maturity and environmental conditions. No attempt was made to distinguish maturity among treatments. The center two rows of each plot were harvested after field drying for 4 to 7 d.

Texas. Experiments were conducted in 1996, 1997, and 1999 at the Texas Agric. Exp. Sta. near Yoakum, TX on a loamy fine sand soil. Experiments were conducted in conventionally tilled seedbeds. Plot size was two rows (91-cm spacing) by 7.5 m. The runner market-type cultivar GK-7 was planted during 1996 and 1997 with the cultivars Georgia Green and Tamrun 96 planted in 1999. The cultivar GK-7 was planted on 60% of the south Texas hectares in the mid-1990s while Georgia

Green and Tamrun 96 were planted on 60 to 70% of hectares in this region in more recent years (R. Lemon, Texas Coop. Ext. Serv., pers. commun.). Pest management and production practices other than Early Harvest applications were held constant over the entire experiment and were based on Texas Coop. Ext. recommendations. Peanut was dug and inverted in Sept. and was combined after air drying in the field for 5 to 8 d.

Results and Discussion

Georgia. No differences were observed in pod yield or gross value between non-treated peanut and the Early Harvest-treated peanut in 1998 and 1999 (P = 0.20, coefficient of variation = 16.1% and P = 0.60, coefficient of variation = 11.5%, respectively) (data not presented). Additionally, the interaction of cultivar by Early Harvest treatment was not significant in 1999 (P = 0.40, coefficient of variation = 11.5%) or 2000 (P = 0.13, coefficient of variation = 14.6%) (data not presented). Peanut yield following application of Early Harvest did not differ when comparing Early Harvest-treated and non-treated peanut. When pooled over cultivars, pod yield ranged 330 kg/ha lower to 1210 kg/ha higher when Early Harvest was applied (Table 1). Additionally, gross economic value for these respective treatments ranged from $133/ha to $483/ha.

North Carolina. The interaction of experiment by Early Harvest treatment was not significant for either pod yield (P = 0.88, coefficient of variation = 14.1%) or gross economic value (P = 0.94, coefficient of variation = 14.3%) (data not presented). Additionally, the main effect of Early Harvest treatment was not significant for pod yield (P = 0.41) or gross economic value (P = 0.59). When pooled over experiments, pod yield and gross value did not differ between Early Harvest-treated peanut and non-treated peanut (Table 2). Pod yield ranged from 850 kg/ha lower to 350 kg/ha higher when Early Harvest was applied compared with non-treated peanut (Table 1). Gross economic value ranged from $390/ha lower to $119/ha higher when comparing these respective treatments.

Texas. The main effect of Early Harvest treatment (P = 0.73, coefficient of variation = 14.8%), the interaction of year by Early Harvest treatment (P = 0.60), and the interaction of Early Harvest treatment by cultivar (P = 0.45) were not significant for pod yield or gross economic value (data not presented). Early Harvest did not affect

Table 1. Comparisons of differences in pod yield and gross value of peanut treated with Early Harvest to non-treated peanut.

Experiment	Year	Cultivar	Difference between treated and non-treated peanut[a]	
			Pod yield	Gross value[b]
			kg/ha	$/ha
Georgia				
1	1998	Georgia Green, Southern Runner	+ 1210	+ 483
2	1999	C99R, Georgia Green, Florida MDR 98, Virugard	- 120	- 48
3	2000	Agra Tech 1-1, Agra Tech 201, C99R, Georgia Green	- 330	- 133
4	2001	Agra Tech 1-1, Agra Tech 201, C99R, Georgia Green	- 150	- 59
5	2001	Georgia Green	+ 160	+ 62
North Carolina				
1	1997	NC 12C	+ 360	+ 113
2	1998	NC-V 11	+ 180	+ 39
3	1998	NC 12C	- 850	- 242
4	1999	NC 10C	+ 100	+ 91
5	1999	NC-V 11	- 300	- 119
6	1999	NC-V 11	- 100	- 88
7	1999	NC-V 11	- 50	+ 118
8	1999	NC 12C	- 90	+ 43
9	1999	NC 12C	+ 190	+ 47
10	1999	NC-V 11	- 390	- 200
11	1999	NC 10C	+ 100	+ 36
12	2000	NC-V 11	- 20	- 85
13	2000	NC 12C	- 250	+ 31
Texas				
1	1996	GK-7	+ 220	+ 87
2	1997	Georgia Green, Tamrun 96	+ 40	+ 16
3	1999	Georgia Green, Tamrun 96	+ 290	+ 112

[a]Positive value indicates that pod yield or gross value of peanut treated with Early Harvest exceeded that of non-treated peanut.
[b]Based on the loan rate for peanut at $0.40/kg farmer stock.

Table 2. Influence of Early Harvest application timing and rate on pod yield and gross economic value of peanut.[a, b]

State[c]	Pod yield		Gross economic value[d]	
	Control	Treated	Control	Treated
	------ kg/ha ------		------ $/ha ------	
Georgia	4690	4940	1797	1890
North Carolina	4380	4310	1726	1707
Texas	3080	3270	1214	1288
Pooled over states (weighted)	4270	4310	1669	1690

[a]Means for pod yield and gross value within a state are not significant at $P \leq 0.05$.

[b]The Early Harvest program consisted of Early Harvest at 1.2 L/ha applied in the seed furrow or applied as a seed treatment at 1.8 g/kg seed (North Carolina and Texas only) followed by three foliar applications at 2.8 L/ha (four-leaf stage of peanut, initial pegging approximately 45 d after emergence, and 10 to 20 d after initial pegging) followed by one foliar application at 5.6 L/ha during pod fill (approximately 80 d after emergence).

[c]Data for Georgia, North Carolina, and Texas are pooled over five, 13, and three experiments, respectively.

[d]Based on the loan rate for peanut at $0.40/kg farmer stock.

pod yield or gross economic return of peanut (Table 2). Peanut yield following application of Early Harvest did not differ when comparing Early Harvest-treated and non-treated peanut. When pooled over cultivars, pod yield ranged 40 kg/ha lower to 290 kg/ha higher when Early Harvest was applied (Table 1). Additionally, gross economic value for these respective treatments was $16/ha and $112/ha.

Summary. Collectively, these results suggest spray programs consisting of Early Harvest most likely will not increase pod yield or gross economic value of runner or virginia market-type peanut. These experiments were conducted over a 6-yr period with 21 site/year combinations under a wide range of environmental conditions, with nine runner market-type cultivars and three virginia market-type cultivars, and in situations where yield potential varied considerably (data not presented). Other plant growth regulators with constituents similar to those of Early Harvest did not affect pod yield, market grade characteristics, or gross value (York *et al.*, 1996).

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