Virginia Market Type Peanut (*Arachis hypogaea* L.) Response to the Nitrophenolic Plant Growth Regulator Chaperone®

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ABSTRACT

Experiments were conducted during 2004 and 2005 in Virginia and North Carolina to evaluate large-seeded, Virginia market type peanut response to a nitrophenolic plant growth regulator applied at 0.37 to 1.46 L/ha to peanut 45-60 DAP. Pod yield, percent extra large kernels (%ELK), percent total sound mature kernels (%TSMK), and crude protein levels of seed were not affected by the nitrophenolic plant growth regulator regardless of experiment (location and year). These experiments were conducted under a range of environmental and edaphic conditions with four cultivars. These data indicate that there is no benefit of applying the nitrophenolic plant growth regulator to Virginia market type peanut.

Key Words: plant growth regulator, nitrophenolic compound, crude protein.

Various plant growth regulators have been evaluated in peanut (*Arachis hypogaea* L.). York et al. (1996) reported that PGR IV® (Micro-Flo Co., Lakeland, FL), a hormonal plant growth regulator containing gibberellic acid, indolebutyric acid, and a fermentation broth, had no effect on either vegetative or reproductive growth. Beasley et al. (2004) reported that Early Harvest® (Griffin LLC, Valdosta, GA), a hormonal plant growth regulator containing cytokinin, gibberellic acid, and indolebutyric acid, did not enhance yield or economic value of peanut. Jordan et al. (2005) reported no yield increase following postemergence application of the harpin protein plant growth regulator Messenger® (Eden Biosciences Corp., Bothell, WA). Prohexadione calcium, a commercially available plant growth regulator registered for vegetative growth suppression in peanut, applied postemergence to peanut resulted in improved row visibility while yield response has been inconsistent (Culpepper et al., 1997; Faircloth et al., 2004).

Chaperone® (Agrivert, Inc., Osaka, Japan, formerly named Atonik®), a nitrophenolic plant growth regulator (NPPGR) containing sodium p-nitrophenolate (3.6 g/L), sodium o-nitrophenolate (2.4 g/L), and sodium 5-nitroguaiacolate (1.2 g/L), is registered for cotton (*Gossypium hirsutum* L.) as a protein transport inhibitor that increases the uptake of proteins necessary for plant growth and yield (Oosterhuis et al., 1995). Registered rates range from 0.365 L/ha (actual product) to 0.730 L/ha with a seasonal maximum of 1.46 L/ha to be foliar applied to cotton during the fruiting period. Guo and Oosterhuis (1995) stated that the NPPGR may enhance cotton growth and yield through increased assimilation (nutrient uptake, nitrate reduction, and photosynthesis), improved flow of assimilates, (translocation and cytoplasmic streaming) and increased cell integrity. Oosterhuis et al. (1995) reported that the NPPGR hastened cotton maturity by 7 d compared to the nontreated cotton; however, there were no differences in lint yield. Tomato (*Lycopersicon esculentum* L.) and strawberry (*Fragaria x ananassa*) yield response to the NPPGR has been inconsistent (Djanaguiraman et al., 2004; Zurawicz, 2004).

Peanut yield and grade response to the NPPGR has not been reported in the literature. Therefore, the objective of this research was to determine the effect of the NPPGR on pod yield, market grade factors, and crude protein level in kernels following application to Virginia market type peanut.

Materials and Methods

Field studies were conducted during 2004 at the Tidewater Agricultural Research and Extension Center located in Suffolk, VA, the Upper Coastal Plain Research Station located near Rocky Mount, NC, and in two separate fields at the Peanut Belt Research Station located near Lewiston-Woodville, NC (Table 1). Soil at Suffolk was a Goldsboro loamy sand (Fine-loamy, siliceous, subactive, thermic Aquic Paleudults); Rocky Mount was a Goldsboro sandy loam (Fine-loamy, siliceous, subactive, thermic Aquic Paleudults); and Lewiston-Woodville was a Norfolk sandy loam (Fine-

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Table 1. Location, year, cultivar, and soil type for each experiment.

Location	Year	Cultivar
Suffolk	2004	VA 98R
Lewiston	2004(1)	Gregory
Lewiston	2004(2)	NC 12C
Rocky Mount	2004	VA 98R
Suffolk	2005	VA 98R
Lewiston	2005	Gregory
Rocky Mount	2005(1)	VA 98R
Rocky Mount	2005(2)	Wilson
Total no. experiments	8	

loamy, kaolinitic, thermic Typic Kandiudults). In 2005, studies were conducted at the Tidewater Agricultural Research and Extension Center located in Suffolk, VA, the Upper Coastal Plain Research Station in two separate fields and in one location at the Peanut Belt Research Station on the same soil types as in 2004, respectively. A total of 8 experiments were conducted over a two year period, where a single experiment is defined as a specific combination of location and year (Table 1). Peanut cultivar was selected independently at each location. The objective of this research was to evaluate the NPPGR over a range of growing conditions for Virginia market type peanuts, thus cultivars were randomly selected based on location, planting date, and agronomic conditions.

Treatments consisted of the NPPGR at 0.37, 0.73, 1.1 or 1.46 L/ha applied between 45 and 60 DAP, depending on location. A non-treated control was also included for a total of 5 treatments in each experiment. The experimental design was a randomized complete block with 4 replications for each experiment. The NPPGR was applied in water immediately after mixing using a compressed air tractor sprayer (VA) or CO_2-pressurized backpack sprayer (NC) calibrated to deliver 140 L/ha using flat fan nozzles. Peanut was planted in conventionally-prepared, elevated beds spaced 91 cm apart and plot size was 4 rows wide by 9 m long. Pest control, fertility inputs, and agronomic practices other than the NPPGR application were implemented based on Cooperative Extension Service recommendations for each state.

Peanut pods were dug and vines inverted in late September or early October for optimal maturity and yield based on pod mesocarp color determination (Williams and Drexler, 1981). Pods were threshed after air drying in the field for 5 to 8 d. A 500-g sample of pods was removed from all experiments except those in Rocky Mount in 2005 to determine percent total sound mature kernels (% TSMK) and percent extra large kernels (% ELK) based on Cooperative Grading Service guidelines for Virginia market type peanut (USDA, Agricultural Marketing Service 2005). In 2004 and 2005 in Virginia, a 50-g sample of extra large kernels was analyzed for percent crude protein from experiments conducted at Suffolk (Kjeldahl 5.46, J. Leek Associates, Edenton, NC). Data for pod yield, %TSMK, %ELK, and percent crude protein were subjected to analysis of variance for the main effect of the NPPGR rate and interaction of the NPPGR rate x Experiment Means for significant main effects and interactions were separated where appropriate using Fisher's Protected LSD Test at $p \leq 0.05$.

Results and Discussion

The main effect of experiment was significant for pod yield, %ELK, and %TSMK, but not for crude protein (Table 2). Neither the main effect of the NPPGR rate nor the interaction of experiment x NPPGR rate was significant for pod yield, %ELK, %TSMK, and percent crude protein. Although individual experiments were significantly different, the NPPGR data are presented combined over experiments due to a lack of effect. When combined over the 8 experiments, the non-treated plots yielded numerically the highest at 5290 kg/ha, while peanut treated with the NPPGR yielded between 5020 and 5170 kg/ha (Table 3). Although

Table 2. Analysis of variance for pod yield, percent extra large kernel (%ELK), percent total sound mature kernel (%TSMK), and percent crude protein combined over experiments (locations and years).

Main effect or interaction	Pod yield	%ELK	%TSMK	%Crude protein
	p-value			
Experiment	0.0001	0.0001	0.0001	0.1093
NPPGR rate	0.2485	0.3708	0.5363	0.0652
Experiment x NPPGR rate	0.5887	0.3160	0.3160	0.8482
Coefficient of variation	10.0	7.2	3.8	1.9
No. experiments	8	6	6	2

Table 3. Effect of the NPPGR applied 50 days after emergence on pod yield, percent extra large kernel (%ELK), percent total sound mature kernel (%TSMK), and percent crude protein of Virginia market type peanut combined over experiments (locations and years)[a].

NPPGR rate	Pod Yield	ELK	TSMK	Crude Protein
L/ha	kg/ha		%	
0.37	5020a	41a	67a	24.5a
0.73	5050a	41a	67a	24.0a
1.10	5170a	42a	66a	24.5a
1.46	5070a	42a	67a	24.1a
0.00	5290a	43a	67a	24.1a
No. experiments	8	6	6	2

[a]Means within a column followed by the same letter are not significantly different according to Fisher's protected LSD test at $p \leq 0.05$.

no difference in yield was noted when comparing the NPPGR rate, variation in pod yield was noted between experiments (Table 3). Differences in yield most likely reflected differences in cultivar, edaphic and environmental conditions, and management associated with individual experiments.

No differences in %ELK were noted when comparing the NPPGR rates (Table 3). Ranges for these respective parameters over the rates of the NPPGR were 41 to 43% and 66 to 67%. When combined over experiments, %ELK was 42 and treatment means averaged over sites did not differ significantly (Table 3). When combined over the NPPGR rates, the highest %ELK values were noted at Lewiston-Woodville during 2004 (Table 4). In the remaining experiments, %ELK ranged from 28 to 39%. While environmental and management differences may have influenced %ELK, cultivar likely contributed most to differences observed across experiments. The cultivars Gregory and NC 12C generally yield higher %ELK than VA 98R or Wilson (Faircloth and Coker, 2005).

Percent total sound mature kernel was similar for all the NPPGR treatments, ranging from 66 to 67 (Table 3). Percent total sound mature kernel ranged from 61 to 76% when comparing experiments (Table 4). The highest %TSMK was noted at Lewiston-Woodville during 2004 for the cultivar Gregory. Additionally, the cultivar NC 12C yielded a high %TSMK. In contrast, lower %TSMK was noted in the other experiments, especially at Suffolk. Adequate moisture and heat units at the Lewiston-Woodville location in 2004 likely contributed to superior market grades.

Pods were analyzed at the Suffolk site in 2004 and 2005 for crude protein percentage. There were no differences for either year or treatment at the $p \leq 0.05$.

Summary

Differences in yield and grade were observed between individual experiments, however, in no single experiment did the addition of the NPPGR affect peanut yield or grade compared to the non-

Table 4. Experiment (location and year) means and least significant difference (LSD) values ($p \leq 0.05$) for pod yield, percent extra large kernel (%ELK), percent total sound mature kernel (%TSMK), and percent crude protein. [a]

Location	Year	Cultivar	Pod Yield	ELK	TSMK	Crude Protein
			kg/ha		%	
Suffolk	2004	VA 98R	4780c	28e	63d	24.0a
Lewiston	2004(1)	Gregory	5920a	61a	76a	-
Lewiston	2004(2)	NC 12C	4740c	51b	73b	-
Rocky Mount	2004	VA 98R	4120d	39c	68c	-
Suffolk	2005	VA 98R	5220b	38c	61e	24.6a
Lewiston	2005	Gregory	6270a	-	-	-
Rocky Mount	2005(1)	VA 98R	4500c	36d	69c	-
Rocky Mount	2005(2)	Wilson	5450b	-	-	-
No. experiments			8	6	6	2

[a]Means within a column followed by the same letter are not significantly different according to Fisher's protected LSD test at $p \leq 0.05$. Data are combined over the NPPGR rates.

treated. As previously mentioned, the differences in individual experiments most likely reflected differences in cultivar, edaphic and environmental conditions, and management associated with individual experiments. Therefore, over a broad range of growing conditions and management techniques, the application of the NPPGR had no benefit to Virginia market type peanut.

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