

# Influence of Virginia Market Type Genotype on Peanut Response to Weed Interference

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## ABSTRACT

Differences in the ability of cultivars to compete with weeds are not well-defined for peanut. Research was conducted in 2007 and 2008 to compare the growth and competitiveness of the virginia market type cultivars NC 10C, NC-V 11, NC 12C, Phillips, VA 98R, and breeding lines N99027L, N01013T, and N02020J under weedy and weed-free conditions. Weed-free peanut was established by applying preemergence and postemergence herbicides throughout the growing season supplemented by weekly hand removal of weeds. Clethodim was applied to weedy peanut to eliminate annual grass interference but not interference from broadleaf weeds and sedges. Weed-free peanut biomass, weedy peanut biomass, and weed biomass were not affected by genotype 10 weeks after peanut emergence. Although substantial yield loss was noted in presence of weeds, the percent yield loss did not vary by genotype when comparing weedy and weed-free yield. These data suggest that cultivar selection within virginia market type peanut will have limited utility in a comprehensive weed management strategy.

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Key Words: Cultural weed management, integrated weed management, weed suppression, weed tolerance, cultivar selection.

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The most rapidly expanding sector of the U.S. peanut industry is the organic peanut market (Lambb, 2007; Parker, 2007). In North Carolina, organic peanut buyers obtained most of their organic peanut from New Mexico peanut producers. Organic peanuts were paid a price premium of \$1.76 to \$3.30 per kg, which was more than twice the price for conventional peanut (Guerena and Adam, 2008). Peanut producers are unable to meet the demand for organic peanut. In 2005, there was an unmet need for almost 4000 metric tons of organic peanut in the U.S. (Culbreath, 2005).

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One of the biggest challenges to organic peanut production is weed control (Organic Farming Research Foundation, 2001).

Without herbicides as a management option, organic producers must rely on a diversity of tactics to reduce weed populations and subsequent interference (Liebman and Gallandt, 1997). Utilization of more competitive peanut cultivars may improve weed management in addition to tactics such as cultivation, plant population, and planting pattern. Cultivar selection is an important component of disease (Shew, 2009; Wynne *et al.*, 1991a), and insect (Sharma *et al.*, 2003) management programs in both organic (Branch and Culbreath, 2008) and conventional systems (Shew, 2009). A more competitive peanut cultivar could be useful for conventional peanut producers interested in reducing reliance on herbicides.

Genotypic differences in competitiveness for weeds have been identified for several crops including corn (*Zea mays* L.) (Wooley and Smith, 1986), cowpea (*Vigna unguiculata* L.) (Remison, 1978), rice (*Oryza sativa* L.) (Haefele *et al.* 2004), wheat (*Triticum aestivum* L.) (Ramsel and Wicks, 1988), and several other crops (Callaway, 1992). Genetic differences have been reported among peanut genotypes in tolerance to weed interference (Agostinho *et al.*, 2006; Hiremath *et al.*, 1997) and ability to suppress weed growth (Fiebig *et al.*, 1991). However, peanut genotype differences in competitiveness with weeds have rarely been investigated within virginia market type peanut genotypes grown in the mid-Atlantic U.S.

## Objectives

The objective of this investigation was to determine if differences exist among virginia market type peanut genotypes in weed competitiveness. Specific objectives are:

1. To determine if differences among genotypes exist in early-season canopy ground cover.
2. To determine if differences among genotypes exist in reduction of weed biomass.
3. To determine if differences among genotypes exist in reduction of peanut biomass due to weeds.
4. To determine if differences among genotypes exist in pod yield due to weed competition.

**Table 1. Characteristics of virginia market type cultivars and breeding lines evaluated under weedy and weed-free conditions.**

Genotype	Growth habit	Seed weight (g 100/seed)
N01013T	bunch-runner	89
N02020J	bunch-runner	98
N99027L	bunch	86
NC 10C	runner	80
NC 12C	semi-runner	87
NC-V 11	runner	83
Phillips	semi-runner	85
VA 98R	runner	86

## Materials and Methods

Experiments were conducted in North Carolina during 2007 and 2008 at the Upper Coastal Plain Research Station located near Rocky Mount on a Goldsboro sandy loam soil (fine-loamy, siliceous, subactive, thermic Aquic Paleudults). Peanut was planted in mid-May in conventionally-tilled raised seedbeds in rows spaced 91 cm apart at a seeding rate designed to achieve an in-row population of 13 plants/m. Two non-treated peanut rows separated two row experimental units. Plot length was 6 m. Aldicarb<sup>1</sup> was applied at 1.1 kg ai/ha in-furrow to control thrips (*Frankliniella* spp.). With the exception of weed control treatments, other management practices common for the region were utilized (Brandenburg, 2009; Jordan, 2009; Shew, 2009).

Eight peanut genotypes including the cultivars NC 10C (Wynne *et al.*, 1991b), NC-V 11 (Wynne *et al.*, 1991c), NC 12C (Isleib *et al.*, 1997), Phillips (Isleib *et al.*, 2006), and VA 98R (Mozingo *et al.*, 2000) and the breeding lines N99027L, N01013T, and N02020J (Table 1) were compared under weedy and weed-free conditions. These cultivars were chosen based on variation in seed size and growth habit within virginia market type genotypes. Weed-free subplots were maintained with an early-postemergence application of paraquat<sup>2</sup> at 0.14 kg ai/ha plus diclosulam<sup>3</sup> at 24 g ai/ha plus metolachlor<sup>4</sup> at 1.42 kg ai/ha plus nonionic surfactant<sup>5</sup> at 0.125% (v/v) 8 days after planting followed by clethodim<sup>6</sup> at 0.14 kg ai/ha plus crop oil concentrate<sup>7</sup> at 1.0% (v/v) in mid June. Additionally, weed escapes were removed weekly by hand throughout the season. Natural weed infestations were left unmanaged in weedy subplots where weed and peanut biomass were determined. Weedy plots where peanut pod yield was measured were treated with clethodim at 0.14 kg/ha plus crop oil concentrate at 1.0% (v/v) in mid June to limit natural weed infestations to broadleaf weeds. The decision to eliminate grass weeds in the weedy subplots designated for yield measurement was

made to avoid an overwhelming weed infestation which could preclude a mechanical pod harvest process. Herbicides were applied using a CO<sub>2</sub>-pressurized backpack sprayer calibrated to deliver 145 L/ha using regular flatfan nozzles<sup>8</sup> at 214 kPa.

Estimations of canopy cover were recorded with overhead photography 4 and 8 weeks after planting (WAP) in weed-free plots. Images were recorded with a Canon PowerShot A360 Digital Camera<sup>9</sup> (8.0 mega pixels) using a custom built camera stand to center and level the camera 2 m above the row of each weed-free plot. Plots were shaded during photography to avoid excessive shadow effects in image processing. The digital image size was 1.37 m wide and 1.87 m of the row, capturing approximately 23 plants in the row. The digital images were processed with Adobe Photoshop 5.0<sup>10</sup> to convert peanut canopy to black pixels and visible ground to white pixels. A Javascript pixel counting software<sup>11</sup> as described by Stewart *et al.*, (2007) was utilized to estimate the percent canopy coverage from the ratio of black pixels to the total number of black and white pixels. Weedy peanut biomass, weed-free peanut biomass, and weed biomass were harvested by hand at 10 WAP in the first experiment. Fresh weight was determined, subsampled and oven dried at 70 C for 5 days to determine total dry biomass. Differences in weed biomass between genotypes were measured with the hypothesis that less weed biomass indicated a more competitive peanut genotype. Weed species density data were recorded 12 WAP in weedy yield subplots. Because of the species variation in the weed population, a predicted percent yield loss due to weeds was estimated using the Herbicide Application Decision Support System<sup>12</sup> (HADSS) (Bennett *et al.*, 2003). HADSS predicted yield loss is based on the population density and competitive index of the weed species (Table 2). This HADSS predicted yield loss provided an overall weed competitive estimate through the predicted peanut pod percent yield loss estimate. Dominant weed species in 2007 and 2008 were common lambsquarters (*Chenopodium album* L.), ivyleaf morningglory [*Ipomoea hederacea* (L.) Jacq.], jimsonweed (*Datura stramonium* L.), and Palmer amaranth (*Amaranthus palmeri* S. Wats.) at a density of 0.5 to 2 plants/m<sup>2</sup>, 0.5 to 1 plants/m<sup>2</sup>, 0.5 to 2 plants/m<sup>2</sup>, 0.5 to 3 plants/m<sup>2</sup> respectively. Peanut were dug and vines inverted in early October for all test sites. Peanut were dug based on mesocarp color (Williams and Drexler, 1981). The entire subplot width was dug and inverted. Peanut pods and vines were air dried for approximately 1 week before threshing. Final pod yield was adjusted to 8% moisture. The HADSS yield loss estimation was

**Table 2. HADSS<sup>a</sup> (Bennett *et al.*, 2003) individual competitive indices (CI) for dominant weeds counted at 12 weeks after planting.**

Weed Species		
Common name	Latin binomial and authority	Competitive Index <sup>a</sup>
Broadleaf signalgrass	<i>Urochloa platyphylla</i> (Nash) R.D. Webster	1.8
Common lambsquarters	<i>Chenopodium album</i> L.	3.8
Common ragweed	<i>Ambrosia artemisiifolia</i> L.	5.2
Eclipta	<i>Eclipta prostrata</i> L.	1.8
Horsenettle	<i>Solanum carolinense</i> L.	1.1
Ivyleaf morningglory	<i>Ipomoea hederacea</i> (L.) Jacq.	3.2
Jimsonweed	<i>Datura stramonium</i> L.	5.8
Large crabgrass	<i>Digitaria sanguinalis</i> (L.) Scop.	0.2
Palmer amaranth	<i>Amaranthus palmeri</i> S. Wats.	4.0
Pitted morningglory	<i>Ipomoea lacunosa</i> L.	3.6
Prickly sida	<i>Sida spinosa</i> L.	1.2
Sicklepod	<i>Senna obtusifolia</i> (L.) H.S. Irwin & Barneby	3.6
Nodding spurge	<i>Chamaesyce nutans</i> (Lag.) Small	1.2
Yellow nutsedge	<i>Cyperus esculentus</i> L.	0.3

<sup>a</sup>Competitive index scale ranges from 0.1 (least competitive) to 10.0 (most competitive) in estimating percent yield loss.

compared with actual percent yield loss for each genotype. Differences between estimated yield loss and actual yield loss were determined with the hypothesis that a genotype resulting in less actual yield loss than predicted was indicative of a genotype with a greater tolerance to weed interference.

The experimental design was a split plot arrangement in a randomized complete block with eight replications. Main plots consisted of 2 rows 15.3 m in length for each peanut genotype. Subplots treatments, which were randomly assigned in position within the main plot, included a weed-free section for peanut pod yield measurement (6.1 m of 2 rows), a weedy section for peanut pod yield measurement (6.1 m of 2 rows), a weed-free section for digital photographic estimations of canopy coverage at 4 and 8 WAP and peanut biomass measurement at 10 WAP (3.05 m of 1 row), and a weedy section for peanut and weed biomass measurement at 10 WAP (3.05 m of 1 row).

Statistical analyses were performed using the SAS<sup>13</sup> statistical analysis software package. Results were reported separately for 2007 and 2008 for canopy cover at 4 and 8 WAP, HADSS predicted yield loss due to weed species and density, weed-free peanut biomass, weedy peanut biomass, weed biomass, peanut biomass reduction by weeds, weedy peanut yield, weed-free peanut yield, percent of weed-free yield reduced by weeds, and the difference in actual yield loss and HADSS predicted yield loss due to weeds. Separate year reporting was due to several significant year by genotype interaction effects on analyzed measurements (Table 3). Estimates of percent ground canopy cover at 4 and 8 WAP, HADSS predicted yield loss due to weeds, weedy and

weed-free peanut biomass, weed biomass, peanut pod yield in weedy and weed-free conditions, actual percent of yield loss due to weeds, and differences in HADSS predicted losses vs. actual percent yield losses due to weeds were factors measured only in weed-free or weedy conditions and therefore only analyzed for the effect of year, genotype, and year by genotype interactions (Table 3). Peanut biomass and peanut pod yield (Table 4) were measured in both weedy and weed-free conditions and were analyzed for the effect of management (weedy and weed-free conditions) and interactions of year and genotype with management. Means of significant main effects and interactions were separated using Fisher's protected LSD at  $P \leq 0.05$ .

## Results and Discussion

Differences in peanut canopy among genotypes were detected with overhead photography estimations of percent ground cover by canopy (Table 5). Canopy growth in 2008 at 4 and 8 WAP were severely reduced compared to growth in 2007 due to drier conditions early in the season and reduced ability to irrigate. The only early (4 WAP) difference in canopy coverage was detected in 2007. The smaller percent ground cover by NC 12C may have been due to delayed germination and the effect dissipated by 8 WAP. Variability in percent ground cover among genotypes was more pronounced later in the season (8 WAP). Genotypes N02020J, NC-V 11, Phillips, and VA 98R were in the largest canopy coverage group in both years. Stewart *et al.* (2007) found that overhead photography was well correlated with leaf area index ( $R^2 = 0.74$ ), a critical canopy characteristic for light competition (Gibson *et al.*,

**Table 3. Analysis of variance for the effect of year, genotype, and year  $\times$  genotype on peanut canopy cover, peanut biomass, HADSS (Bennett *et al.*, 2003) estimated yield loss due to weeds, peanut biomass, weed biomass, peanut yield in weedy and weed-free conditions, percent of weed-free peanut yield reduced by weeds, and difference in actual peanut yield loss and HADSS predicted yield loss at Rocky Mt., NC during 2007 and 2008.**

Source	Coefficient of variation	Year		Genotype <sup>a</sup>		Year $\times$ Genotype	
		F-statistic	P-value	F-statistic	P-value	F-statistic	P-value
Canopy cover at 4 WAP	26.4	1787.17	<0.0001	12.69	<0.0001	12.57	<0.0001
Canopy cover at 8 WAP	14.0	6494.09	<0.0001	4.00	<0.0007	3.97	<0.0007
HADSS <sup>a</sup> predicted yield loss due to weed species and density	30.3	16.58	<0.0001	1.01	0.4312	0.45	0.8684
Weed-free peanut biomass	27.7	191.22	<0.0001	1.31	0.2553	1.15	0.3411
Weedy peanut biomass	39.1	5.71	0.0188	1.23	0.2963	0.92	0.4962
Weed biomass	65.9	75.16	<0.0001	1.63	0.1372	2.48	0.0222
Peanut biomass reduction by weeds	60.7	128.56	<0.0001	1.28	0.2694	1.38	0.2215
Weedy peanut yield	18.4	6.34	0.0134	5.15	<0.0001	1.20	0.3129
Weed-free peanut yield	12.9	1.28	0.2603	5.22	<0.0001	3.32	0.0033
Percent of weed-free yield reduced by weeds	117.6	8.95	0.0035	1.11	0.3637	2.04	0.0572
Difference in actual yield loss and HADSS predicted yield loss	39.7	1.12	0.2930	1.09	0.3735	2.51	0.0205

<sup>a</sup>Genotype includes cultivars and breeding lines N01013T, N02020J, N99027L, NC 10C, NC 12C, NC-V 11, Phillips, VA 98R.

2003). However, increased canopy cover did not translate to improved weed suppression (estimated by weed biomass harvested at 10 WAP). The positive correlation between individual canopy coverage estimations and weed biomass suggests that weed biomass was increasing with more canopy coverage (Table 6). However, no significant correlation was detected between genotype mean values for canopy cover and weed biomass (data not shown). A similar pattern was present between weed-free peanut biomass and weed biomass with a strong correlation (0.65,  $P < .001$ ) at the plot level (Table 6), but not with mean values (data not shown). This pattern may be influenced by the inescapable consequence that plots with soil conditions capable of supporting more peanut canopy growth also may have supported more weed growth. Both 2007 and 2008 were drier than average years, potentially magnifying the effects of soil conditions on plant growth. Furthermore, no differences in weed biomass were detected among the

genotypes (Table 7) and there was no interaction between genotype and management (weedy and weed-free conditions) effects on peanut biomass (Table 4). The only indication of variation among genotypes in tolerance to weed interference was in the difference between weedy and weed-free peanut biomass in 2008 (Table 7). The genotypes N01013T, N02020J, NC 10C, and Phillips showed a reduction in peanut biomass due to weed presence, while the genotypes N99027L, NC 12C, NC-V 11, and VA 98R did not have a detectable reduction in peanut biomass due to weed interference. These findings could be interpreted as a possible variability among genotypes in tolerance to weed interference, but these differences were not consistently detected.

No differences among genotypes were detected for the densities of the dominant weeds associated with the genotypes (data not shown). The presence of some minor weeds was variable across each location (data not shown), thus HADSS was

**Table 4. Analysis of variance for peanut biomass harvested at 10 weeks after planting at Rocky Mt., NC during 2007 and 2008.**

Source	Peanut biomass		Pod yield	
	F-statistic	P-value	F-statistic	P-value
Year	141.72	<0.0001	0.92	0.3388
Genotype <sup>a</sup>	1.56	0.1476	9.28	<0.0001
Year $\times$ Genotype	1.03	0.4114	2.23	0.0332
Management <sup>b</sup>	243.14	<0.0001	99.71	<0.0001
Genotype $\times$ Management	0.88	0.5219	0.81	0.5838
Year $\times$ Management	89.37	<0.0001	6.86	0.0095
Year $\times$ Genotype $\times$ Management	0.93	0.4859	1.85	0.0786

<sup>a</sup>Genotype includes cultivars and breeding lines N01013T, N02020J, N99027L, NC 10C, NC 12C, NC-V 11, Phillips, VA 98R.

<sup>b</sup>Management includes weedy and weed-free conditions.

**Table 5. Digital imaging estimations of peanut canopy cover in weed-free conditions at 4 weeks after planting (WAP) and 8 WAP.<sup>a</sup>**

Genotype	Peanut canopy			
	4 WAP		8 WAP	
	2007	2008	2007	2008
	% ground cover			
N01013T	10.5 a	6.5 a	62.4 bc	15.5 bc
N02020J	11.0 a	6.5 a	70.0 a	16.0 ab
N99027L	10.5 a	7.1 a	58.0 c	13.5 cd
NC 10C	12.7 a	7.5 a	70.5 a	15.0 bc
NC 12C	4.7 b	5.5 a	65.8 ab	12.0 d
NC-V 11	10.2 a	8.0 a	67.1 ab	17.3 ab
Phillips	11.4 a	8.4 a	68.2 ab	18.3 a
VA 98R	12.4 a	6.7 a	72.2 a	15.5 ab

<sup>a</sup>Means within a year and measurement period followed by the same letter are not significantly different according to Fisher's Protected LSD Test at  $P \leq 0.05$ .

utilized to estimate a yield percent loss due to overall weed interference associated with each genotype. No interaction was detected between genotype and management (weedy and weed-free conditions) for peanut pod yield (Table 4), suggesting little to no differences between the genotypes in yield response to weed interference. However, the differences between weed-free and weedy peanut pod yield were variable between genotypes. NC 10C was the only genotype that showed no difference in yield due to weeds in both years (Table 8). N01013T, NC 12C, Phillips, and VA 98R showed no difference in yield due to weeds in 2008 only. Genotypes did not differ in the presence of weeds as shown by no differences in the HADSS predicted yield loss due to weeds associated with the genotypes (Table 8). Similarly, when comparing the yield loss percentage due to weeds

among genotypes, no differences were detected (Table 8). The difference between the HADSS predicted yield loss percentage and the actual percent yield loss was compared with the hypothesis that a larger difference between the predicted and actual yield loss might indicate a genotype more tolerant of weed interference. No such weed tolerant genotypes were detected in 2007 (Table 8). However, in 2008 several genotypes resulted in less yield loss than anticipated by HADSS (Table 8) with genotypes N01013T, NC 12C, NC-V 11, Phillips, and VA 98R resulting in the least yield loss as estimated from the weed species and densities growing with those genotypes.

In any discussion of competitive genotypes, the term competition itself must be addressed. Competition can be examined from two perspectives: suppressiveness and tolerance. Suppressiveness is the ability of a plant to reduce the biomass and/or reproductive production of plants in close proximity to a greater than expected extent. Tolerance is the ability of a plant to endure the close proximity of other plants and have a less than expected decrease in biomass and/or reproductive production. In this series of experiments, it was hypothesized that an increased canopy percent ground cover would indicate an advantage in competition for solar radiation and result in a reduction in weed biomass. While some differences existed between cultivars and breeding lines in the ground canopy cover, there were no differences in weed biomass. It was also hypothesized that less than expected peanut yield loss due to weeds would indicate a peanut genotype tolerant to weed interference. The HADSS predicted percent yield loss due to weed species competitive indices and densities measured was consistently higher than the actual percent yield loss in weed-free and weedy comparisons.

**Table 6. Pearson correlation coefficients for digital image estimations of peanut canopy cover in weed-free conditions at 4 weeks after planting (WAP) and 8 WAP, weedy peanut biomass, weed-free peanut biomass, weed biomass, weedy peanut pod yield, and weed-free peanut pod yield.<sup>a</sup>**

	Image (4 WAP)	Image (8 WAP)	Weedy peanut biomass	Weed-free peanut biomass	Weed biomass	Weedy peanut yield	Weed-free peanut yield
Image (4 WAP)	1	0.9227 ***	0.2045 *	0.7663 ***	0.5466 ***	-0.1414	0.1186
Image (8 WAP)		1	0.2480 **	0.7852 ***	0.5844 ***	-0.1744 *	0.0903
Weedy peanut biomass			1	0.2892 **	-0.1611	0.1843 *	0.0995
Weed-free peanut biomass				1	0.6537 ***	-0.2255 *	0.1939 *
Weed biomass					1	-0.2361 **	0.2948 ***
Weedy peanut yield						1	0.2551 **
Weed-free peanut yield							1

<sup>a</sup>Each correlation coefficient is calculated from 128 variable comparisons (pooled across 8 genotypes, 8 replications, and 2 years).

\*Correlation between two variables is significant with  $0.01 < P \leq 0.05$ .

\*\*Correlation between two variables is significant with  $0.001 < P \leq 0.01$ .

\*\*\*Correlation between two variables is significant with  $P \leq 0.001$ .

**Table 7. Comparison of peanut biomass under weedy and weed-free conditions and weed biomass.<sup>a</sup>**

Genotype	Peanut biomass				Weed biomass	
	2007		2008		2007	2008
	Weed-free	Weedy	Weed-free	Weedy		
	kg m <sup>-2</sup>					
N01013T	0.84	0.44 ***	0.42	0.28 *	0.27 a	0.19 a
N02020J	0.75	0.34 **	0.39	0.25 ***	0.66 a	0.23 a
N99027L	0.74	0.39 ***	0.41	0.32	0.40 a	0.17 a
NC 10C	0.95	0.36 **	0.46	0.34 **	0.54 a	0.15 a
NC 12C	0.90	0.34 ***	0.42	0.31	0.74 a	0.15 a
NC-V 11	0.75	0.28 **	0.45	0.32	0.45 a	0.22 a
Phillips	0.98	0.35 ***	0.41	0.33 *	0.70 a	0.09 a
VA 98R	0.86	0.30 ***	0.40	0.23	0.50 a	0.19 a

<sup>a</sup>Means within a year followed by the same letter are not significantly different according to Fisher's Protected LSD Test at  $P \leq 0.05$ .

\*Difference between weed-free peanut biomass and weedy peanut biomass is significant with  $0.01 < P \leq 0.05$ .

\*\*Difference between weed-free peanut biomass and weedy peanut biomass is significant with  $0.001 < P \leq 0.01$ .

\*\*\*Difference between weed-free peanut biomass and weedy peanut biomass is significant with  $P \leq 0.001$ .

Yield loss prediction models have been demonstrated to overestimate yield loss due to weeds in some cases (Willis *et al.*, 2006). This discrepancy was the same for all peanut genotypes tested, indicating no differences in weed tolerance.

Results from our research suggest few consistent differences among virginia market type genotypes in weed competitive ability. Virginia market type peanut cultivars seldom reach a canopy height more than 50 cm due to a morphological growth that is generally prostrate in habit (Mozingo *et al.*, 1987). Crop height is an advantageous characteristic for weed competition (Jannink *et al.*, 2000).

Weeds that are not controlled early in the season can often grow taller than peanut and can quickly overwhelm peanut even if differences in some morphological characteristics would be advantageous. Spanish and valencia market type peanut cultivar groups tend to have a more erect growth habit than virginia market types (Gregory *et al.*, 1951) and may compete more effectively with weeds. Hiremath *et al.* (1997) reported differences in cultivar tolerance to weed competition when comparing a virginia market type cultivar with a spanish and valencia market type cultivar. In their study, the highest yielding peanut was the virginia

**Table 8. Pod yield of selected cultivars and breeding lines under weed-free and weedy conditions in 2007 and 2008 at Rocky Mt., NC.<sup>a</sup>**

Genotype	Peanut yield				HADSS predicted yield loss <sup>b</sup>		Yield % loss <sup>c</sup>		Difference <sup>d</sup>	
	2007		2008		2007	2008	2007	2008	2007	2008
	Weed-free	Weedy	Weed-free	Weedy						
	kg/ha				%					
N01013T	3010	2320 **	2960	2610	67.2 a	63.3 a	21.6 a	10.6 a	45.6 a	52.7 bc
N02020J	2810	2000 *	3260	2540 *	68.6 a	58.6 a	27.3 a	21.1 a	41.3 a	37.5 ab
N99027L	3230	2640 **	3180	2470 ***	62.8 a	46.3 a	17.3 a	22.0 a	45.5 a	24.3 a
NC 10C	2620	2020	2780	2300	67.3 a	50.1 a	18.6 a	13.7 a	48.7 a	36.4 ab
NC 12C	2930	1930 ***	2320	2290	68.3 a	57.2 a	33.8 a	0.1 a	34.5 a	57.1 c
NC-V 11	3120	2730 **	3270	2670 **	65.7 a	57.6 a	12.2 a	18.6 a	53.5 a	39.0 abc
Phillips	3360	2670 **	2930	3000	65.8 a	40.5 a	19.3 a	-5.4 a	46.5 a	45.9 bc
VA 98R	3060	2460 *	2740	2440	65.5 a	51.6 a	19.0 a	8.5 a	46.5 a	43.1 bc

<sup>a</sup>Means within a year and measurement period followed by the same letter are not significantly different according to Fisher's Protected LSD Test at  $p \leq 0.05$ .

<sup>b</sup>HADSS (Bennett *et al.*, 2003) predicted yield loss is calculated as a percent loss of yield due to weeds based on the competitive index of each weed specie and its density associated with each peanut genotype.

<sup>c</sup>Yield % loss is calculated as [(weed-free peanut yield) - (weedy peanut yield)]/(weed-free peanut yield) \* 100%.

<sup>d</sup>Difference denotes the difference between the yield loss predicted by HADSS and the actual yield loss due to weeds.

\*Difference between weed-free peanut yield and weedy peanut yield is significant with  $0.01 < P \leq 0.05$ .

\*\*Difference between weed-free peanut yield and weedy peanut yield is significant with  $0.001 < P \leq 0.01$ .

\*\*\*Difference between weed-free peanut yield and weedy peanut yield is significant with  $P \leq 0.001$ .

market type in weed-free conditions. However, in the presence of weeds, the spanish and valencia market type cultivars out yielded the virginia market type. Agostinho *et al.*, (2006) showed weed tolerance differences among peanut cultivars in relation to the reduction of seed weight due to weeds but the influence of erect or prostrate growth was not consistent.

Other peanut characteristics have also been theorized to affect competitive ability. In another study, a runner type peanut cultivar was better able to avoid reductions of dry matter caused by common cocklebur (*Xanthium strumarium* L.) (Fiebig *et al.*, 1991). The researchers concluded that late maturity seemed to increase the weed tolerance ability of the peanut genotype but that such a characteristic was not preferable for many peanut producers.

## Summary

While differences may exist among peanut cultivar groups in weed competitive ability, our results indicate that peanut cultivar selection within virginia market type cultivars does not seem to be a promising weed management tactic by itself.

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## Sources of Materials

- <sup>1</sup>Temik 15G®. Bayer CropScience LP, Research Triangle Park, NC 27709.
- <sup>2</sup>Gramoxone INTEON herbicide®. Syngenta Crop Protection, Greensboro, NC 27419.
- <sup>3</sup>Strongarm Herbicide®. Dow AgroSciences, Indianapolis, IN 46268.
- <sup>4</sup>Dual Magnum Herbicide®. Syngenta Crop Protection, Greensboro, NC 27419.
- <sup>5</sup>Induce® nonionic surfactant. Proprietary blend of alkyl aryl polyoxyalkane ethers, free fatty acids, and dimethyl polysiloxane, 90%. Helena Chemical Company, Collierville, TN 38107.
- <sup>6</sup>Select 2EC herbicide®. Valent USA Corporation, Walnut Creek, CA 94596.
- <sup>7</sup>Agri-Dex® spray adjuvant. Proprietary blend of alkyl aryl polyoxyalkane ethers, free fatty acids, and dimethyl polysiloxane, 90%. Helena Chemical Company, Collierville, TN 38107.
- <sup>8</sup>8002 Spray nozzles. Spraying Systems Company, Wheaton, IL 60189-7900.
- <sup>9</sup>Canon PowerShot A360 Digital Camera (8.0 mega pixels), Canon 30-2, Shimomaru 3-chome, Ohta-ku, Tokyo, 146-8501, Japan.

- <sup>10</sup>Adobe Photoshop 5.0, Adobe Systems Incorporated, 345 Park Avenue, San Jose, CA 95110.
- <sup>11</sup>PixelCounter 1.0, a Javascript software developed at North Carolina State University, Raleigh, NC 27695.
- <sup>12</sup>HADSS™, “Herbicide Application Decision Support System,” is a trademark of North Carolina State University and is distributed by AgRenaissance Software LLC, P.O. Box 68007, Raleigh, NC 27613, www.AgRenaissance.com.
- <sup>13</sup>SAS software for Windows, Version 9.1.3. SAS Institute Inc., 100 SAS Campus Dr., Cary, NC 27513.

## Literature Cited

- Agostinho, F.H., R. Gravena, P.L.C.A. Alves, T.P. Salgado, and E.D. Mattos. 2006. The effect of cultivar on critical periods of weed control in peanuts. *Peanut Sci.* 33:29-35.
- Bennett, A.C., A.J. Price, M.C. Sturgill, G.S. Buol, and G.G. Wilkerson. 2003. HADSS™, Pocket HERB™, and WebHADSS™: Decision Aids for Field Crops. *Weed Technology.* 17:412-420.
- Branch, W.D. and A.K. Culbreath. 2008. Disease and insect assessment of candidate cultivars for potential use in organic peanut production. *Peanut Sci.* 35:61-66.
- Brandenburg, R.L. 2009. Peanut insect management. Pages 77-94. *in* 2009 Peanut Information. North Carolina Coop. Ext. Serv. Ser. AG-331. 132 pp.
- Callaway, M.B. 1992. A compendium of crop varietal tolerance to weeds. *American J. of Alternative Agric.* 7:169-180.
- Culbreath, L. 2005. Are they nuts? Southern researchers and farmers tackle organic peanuts. The New Farm on line at: <http://newfarm.rodaleinstitute.org/features/2005/1105/peanuts/culbreath.shtml>. Verified April 24, 2009.
- Fiebig, W.W., D.G. Shilling, and D.A. Knauff. 1991. Peanut genotype response to interference from common cocklebur. *Crop Sci.* 31:1289-1292.
- Gibson, K.D., A.J. Fischer, T.C. Foin, and J.E. Hill. 2003. Crop traits related to weed suppression in water-seeded rice (*Oryza sativa* L.). *Weed Sci.* 51:87-93.
- Gregory, W.C., B.W. Smith, and J.A. Yarbrough. 1951. Morphology, genetics, and breeding, pp. 62-70. *In* The Peanut - The Unpredictable Legume. Nat. Fert. Assoc., Washington, D.C.
- Guarena, M. and K. Adam. 2008. Peanuts: organic production. ATTRA. On line at [http://attra.ncat.org/new\\_pubs/attra-pub/PDF/peanuts.pdf?id=DC](http://attra.ncat.org/new_pubs/attra-pub/PDF/peanuts.pdf?id=DC) Verified April 24, 2009.
- Haefele, S.M., D.E. Johnson, D.M. Bodj, M.C.S. Wopereis, and K.M. Miezán. 2004. Field screening of diverse rice genotypes for weed competitiveness in irrigated lowland ecosystems. *Field Crops Res.* 88:39-56.
- Hiremath, S.M., A. Shiv Raj, A.S. Sajjan, M.Y. Kamatar, and M.B. Chetti. 1997. Effect of herbicides on weed control efficiency in diverse groundnut genotypes. *World Weeds.* 4:163-168.
- Isleib, T.G., P.W. Rice, J.E. Bailey, R.W. Mozingo, and H.E. Pattee. 1997. Registration of ‘NC 12C’ peanut. *Crop Sci.* 37:1976.
- Isleib, T.G., P.W. Rice, R.W. Mozingo, II, S.C. Copeland, J.B. Graeber, H.E. Pattee, T.H. Sanders, R.W. Mozingo, and D.L. Coker. 2006. Registration of ‘Phillips’ peanut. *Crop Sci.* 46:2308-2309.
- Jannink, J.L., J.H. Orf, N.R. Jordan, and R.G. Shaw. 2000. Index selection for weed suppressive ability in soybean. *Crop Science.* 40:1087-1094.
- Jordan, D.L. 2009. Peanut production practices. Pages 27-49. *in* 2009 Peanut Information. North Carolina Coop. Ext. Ser. AG-331. 132 pp.
- Lamb, M.C. 2007. The economics of organic versus conventional peanuts. 2006 Proc. Am Peanut Res. Educ. Soc. 38:92.
- Liebman, M. and E. Gallandt. 1997. Many little hammers: ecological management of crop-weed interactions. pp. 291-343. *In*: L.E. Jackson (ed.). *Ecology in Agricultural.* Academic, San Diego, CA.
- Mozingo, R.W., T.A. Coffelt, and J.C. Wynne. 1987. Characteristics of virginia-type peanuts released from 1944–1985. *Southern Coop. Ser. Bull. No. 326.*
- Mozingo, R.W., T.A. Coffelt, and T.G. Isleib. 2000. Registration of ‘VA 98R’ peanut. *Crop Sci.* 40:1202-1203.
- Organic Farming Research Foundation. 2001. Final results of the third biennial national organic farmers survey. On line at [http://offf.org/publications/pubs/3rdsurvey\\_results.pdf](http://offf.org/publications/pubs/3rdsurvey_results.pdf) Verified April 24, 2009.

- Parker, B. 2007. Organic peanut production in the US: the sheller's perspective. 2006 Proc. Am. Peanut Res. Educ. Soc. 38:92.
- Ramsel, R.E. and G.A. Wicks. 1988. Use of winter wheat (*Triticum aestivum*) cultivars and herbicides in aiding weed control in an ecofallow corn (*Zea mays*) rotation. *Weed Sci.* 36:394-398.
- Remison, S.U. 1978. The performance of cowpea (*Vigna unguiculata* (L.) Walp.) as influenced by weed competition. *J. of Agricultural Sci., Cambridge* 90:523-530.
- Sharma, H.C., G. Pampapathy, S.L. Dwivedi, and L.J. Reddy. 2003. Mechanisms and diversity of resistance to insect pests in wild relative of groundnut. *J. of Economic Entomol.* 96:1886-1897.
- Shew, B.B. 2009. Peanut disease management: Pages 95–120 in 2009 Peanut Information. North Carolina Coop. Ext. Ser. AG-331. 132 pp.
- Stewart, A.M., K.L. Edminsten, R. Wells, and G.D. Collins. 2007. Measuring canopy coverage with digital imaging. *Communications in Soil Science and Plant Analysis.* 38:895-902.
- Williams, E.J. and J.S. Drexler. 1981. A non-destructive method for determining peanut pod maturity, pericarp, mesocarp, color, morphology, and classification. *Peanut Sci.* 8:134-141.
- Willis, J.B., D.S. Murray, and S.W. Murdock. 2006. Validation of weed competitive indices for predicting peanut yield losses in Oklahoma. *Weed Tech.* 20:688-694.
- Wooley, J.N. and M.E. Smith. 1986. Maize *zea-mays* plant types suitable for present and possible bean *phaseolus-vulgaris* relay systems in Central America. *Field Crops Res.* 15:3-16.
- Wynne, J.C., M.K. Beute, and S.N. Nigam. 1991a. Breeding for disease resistance in peanut (*Arachis hypogaea* L.). *Annual Review of Phytopathology.* 29:279-303.
- Wynne, J.C., M.K. Beute, J. Bailey, and R.W. Mozingo. 1991b. Registration of 'NC 10C' peanut. *Crop Sci.* 31:484.
- Wynne, J.C., T.A. Coffelt, R.W. Mozingo, and W.F. Anderson. 1991c. Registration of 'NC-V11' peanut. *Crop Sci.* 31:484-485.