Effect of Continuous Seed Size Selection Among Two Runner-Type Peanut Cultivars[1]

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ABSTRACT

The major peanut (*Arachis hypogaea* L.) producing regions in the U.S. are currently faced with an increasing tomato spotted wilt tospovirus (TSWV) problem, and the most effective control is the use of resistant cultivars. This study was conducted to compare the field performance and TSWV disease intensity among different seed sizes of two runner-type cultivars. For three consecutive years, 1995-97, the effect of continuous seed size selection on yield, grade, and TSWV intensity among the two runner cultivars Georgia Green and Florunner was evaluated at the Univ. of Georgia Coastal Plain Exp. Sta. Sound mature kernels from both cultivars were divided into four seed sizes (jumbo, medium, No. 1, and the combined mill run check). Seed size selection pressure was applied to both cultivars each year. Seed stock for planting each year was obtained from the corresponding seed size produced the previous year. The results showed that the Georgia Green cultivar significantly out-performed the Florunner cultivar in yield, grade, dollar value, and had significantly less TSWV. Georgia Green had a similar percentage of jumbo seed, more medium seed, and fewer No. 1 seed than Florunner. Both runner-type cultivars responded similarly to continuous selection pressure with small but significant changes in seed size distribution over a relatively short 3-yr period.

Key Words: *Arachis hypogaea* L., groundnut, tomato spotted wilt virus, pod yield, grade quality, dollar value.

United States runner market-type peanut seeds normally are screened and sized after shelling into three basic commercial grade standards—jumbo runner, medium runner, and No. 1 runner (9). These milled peanut seeds represent size differences with the No. 1 seeds being the smallest and the jumbo seeds being the largest. Select runners are the combination of medium and No. 1 runners, and mill run runners equals the combination of all three commercial grades.

Many significant physiological and agronomical aspects have been previously associated directly with these various seed sizes (2,5,6,8). In general, planting the larger jumbo seed results in more vigorous seedlings and plants (6), occasionally producing higher yields and grades (5), better flavor and longer shelf-life (8), and plants with improved pesticide tolerance (2) when compared to smaller immature seed.

For the past two decades, Florunner has been the predominant runner-type cultivar in the U.S. (7). However, a runner-type cultivar Georgia Green, that has a high level of resistance to tomato spotted wilt tospovirus (TSWV), was recently released by the Univ. of Georgia (1). The major peanut-producing regions in the U.S. currently are faced with an increasing TSWV problem, and the most effective control is the use of resistant cultivars. The effect of TSWV on plant growth and development from these different seed sizes is not known.

Genetic shift might result from the continued practice of sizing and planting similar seed year after year. Such continuous selection pressure could cause a change in the usual distribution of jumbo, medium, and No. 1 seed among peanut cultivars. The objective of this study was to compare the field performance and TSWV disease intensity among plants from different seed sizes of two runner-type cultivars.

Materials and Methods

For three consecutive years, 1995-97, the combined effects of continuous seed size selection pressure and the presence of high TSWV disease intensity among two runner market-type cultivars, Georgia Green and Florunner, were evaluated. Florunner is a multiline runner-type peanut cultivar released in 1969 by the Univ. of Florida and currently is composed of three sister lines (7). Georgia Green is an F_4-derived pure line runner-type peanut cultivar released in 1995 by the Univ. of Georgia (1).

Foundation peanut seed stocks were the original sources of both cultivars during 1995. Seeds were divided on

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slotted screens (19.05 mm in length) into four different seed sizes. Combined mill run runner seeds were all sound mature kernels (SMK), excluding damaged and split seed riding a screen 6.35 mm in width. Jumbo runner seeds were SMK riding a screen 8.33 mm in width. Medium runner seeds were SMK riding a screen 7.14 mm in width but falling through a 8.33-mm screen. No. 1 runner seeds were SMK riding a screen 6.35 mm in width but falling through a 7.14-mm screen. Seed stock for each subsequent year was obtained from plants derived from corresponding size seed of the previous year. For example, jumbo runner seed planted in 1997 came from jumbo runner seed planted in 1996, and jumbo runner seed planted in 1996 came from jumbo runner seed planted in 1995. Continuous seed size selection pressure was applied uniformly to both cultivars each year.

A split-plot design with six replications was used, where cultivars were whole-plots and seed sizes were subplots. Comparative field evaluations were conducted on a Tifton loamy sand soil (fine-loamy, siliceous, thermic Plinthic Kandiudult) at the Coastal Plain Exp. Sta. agronomy research farm near Tifton, GA. Each plot consisted of two rows 6.10 m long by 1.83 m wide (0.81 m within and 1.02 m between adjacent plots), and seeds were spaced approximately 6.1 cm apart within each row. Planting dates were 5 May 1995, 10 May 1996, and 2 May 1997. Irrigation and standard cultural practices for optimal peanut production were followed each growing season. Harvest dates were 27 Sept. 1995, 2 Oct. 1996, and 25 Sept. 1997.

TSWV intensity ratings were determined for each plot immediately after peanut plants were dug and inverted at maturity in a manner similar to that described previously (4). Percentage of TSWV was based upon the number of 30-cm sections of row with one or more severely diseased plants divided by total number of 30-cm sections of row length. Plants with roots, pegs, or pods showing distinct stunting, discoloration, or necrosis typical of tomato spotted wilt virus were counted as severely affected. After picking with a small-plot thresher, pods were dried with forced air to 6% moisture content and hand-cleaned before weighing, shelling, and grading. In the grading process, total sound mature kernels (TSMK) equals the sum of sound mature kernels (SMK) and sound splits (SS). Dollar values were calculated based upon USDA peanut loan schedules for each crop year. Data from each test were subjected to analysis of variance, and Waller-Duncan's T-test (K-ratio = 100) was used for mean separation.

Results and Discussion

Significant ($P \leq 0.05$) year × cultivar (whole-plot) interaction was found for yield, grade, dollar value, and TSWV intensity, as well as distribution of jumbo and No. 1 runner seed (Table 1). Consequently, data for each year were analyzed separately for these variables. However, year × seed size (sub-plot) interaction was not found to be significant ($P > 0.05$). The data were pooled across years for a combined seed size analyses.

Pod yields and dollar values were higher among both cultivars in 1997 than in 1995 or 1996, primarily because of the lower TSWV intensity (Table 2). However, pod yields were significantly different between the two cultivars all 3 yr. Georgia Green had higher yield, total sound mature kernel (TSMK) grade, and dollar value than Florunner every year. Georgia Green had approximately half the TSWV disease intensity of Florunner. These results agree with previous TSWV findings for these two peanut cultivars (3). Greater and more consistent yield differences were due primarily to normal seeding rates and plant populations used in this study than in the earlier report (3). Georgia Green averaged 47% greater yield and 53% more dollar value than Florunner across the 3 yr.

No significant differences were found among the four runner seed sizes (jumbo, medium, No. 1 and the combined mill run SMK check) for yield, grade, dollar value, or TSWV intensity (Table 1). These findings are supported, in part, by previous yield and grade results obtained with Florunner (5). However for both cultivars in this study, there was a trend for the combined mill run SMK check to yield (4%) and grade (1%) better than any

Table 1. Mean squares from split-plot analysis of variance for TSWV intensity, pod yield, dollar value and grade characteristics among two runner-type peanut cultivars, Georgia Green and Florunner, 1995-97.

Source of Variation	df	TSWV intensity	Pod yield	Dollar value	Grade characteristics			
					TSMK	Jumbo	Medium	No. 1
Year (YR)	2	2227***	56273324***	4583269***	233***	379***	80***	122***
Rep within YR	15	39**	718130*	76583	6	10	14	4
Cultivar (CV)	1	4444***	80028466***	8411837***	284***	23	332***	160***
YR × CV	2	141***	3246820***	283724**	29*	61***	14	26***
Error a	15	15	304223	30742	2	8	4	1
Seed size (SS)	3	5	460919	51138	3	47***	34*	7*
YR × SS	6	8	189159	17791	3	5	3	1
CV × SS	3	25	164295	16252	1	13	4	2
YR × CV × SS	6	4	358182	40298	4	2	3	1
Error b	90	17	362348	44001	7	7	10	2

*, **, ***Denote mean squares significantly different at $P \leq 0.05$, 0.01, and 0.001, respectively.

Table 2. Three-year average TSWV intensity, pod yield, TSMK grade, and dollar value of Georgia Green and Florunner peanut cultivars.

Cultivar	TSWV intensity	Pod yield	TSMK grade	Dollar value
	%	kg/ha	%	$/ha
	1997[a]			
Georgia Green	18.8 b	6112 a	77.2 a	4500 a
Florunner	37.5 a	4021 b	74.4 b	2874 b
	1996			
Georgia Green	27.8 b	4270 a	77.0 a	3106 a
Florunner	57.0 a	3074 b	75.7 b	2200 b
	1995			
Georgia Green	34.2 b	3528 a	74.5 a	2723 a
Florunner	80.0 a	2342 b	70.1 b	1671 b

[a]Within each year and each column, means followed by the same letter are not significantly different at $P \leq 0.05$.

of the three individual seed sizes. Even though there were no significant differences in TSWV intensity among plantings from the seed sizes in this study (Table 1), reduced plant populations usually increase TSWV intensity (4). Smaller immature No. 1 seed size might have lower germination and emergence under adverse planting conditions than the larger mature seed.

Significant differences were found each year for the seed size distribution of Georgia Green and Florunner (Table 3). Georgia Green produced greater percentages of medium runner and fewer No. 1 runner seed than did Florunner. Georgia Green and Florunner were similar in the proportion of jumbo runner seed during 1996 and 1997; however, Georgia Green had significantly more jumbo seed than Florunner in 1995 when TSWV intensity was the highest.

Continuous selection pressure from planting the same

Table 3. Three-year seed size distribution percentage of two runner-type peanut cultivars, Georgia Green and Florunner.

Cultivar	Seed size distribution		
	Jumbo	Medium	No. 1
	%		
	1997[a]		
Georgia Green	15.16 a	48.86 a	6.15 b
Florunner	14.69 a	46.63 b	7.48 a
	1996		
Georgia Green	15.97 a	49.02 a	4.65 b
Florunner	17.25 a	46.40 b	5.86 a
	1995		
Georgia Green	12.73 a	47.62 a	6.55 b
Florunner	9.52 b	43.37 b	10.35 a

[a]Within each year and each column, means followed by the same letter are not significantly different at $P \leq 0.05$.

Table 4. Three-year continuous selection effect on seed size distribution percentages of mill run, jumbo, medium, and No. 1 runner-type peanut seed averaged across two cultivars, 1995-97.

Selection	Seed size distribution[a]		
	Jumbo	Medium	No. 1
	%		
Mill run (ck)	14.8 a	47.3 a	6.6 b
Jumbo	15.5 a	45.6 b	6.6 b
Medium	13.4 b	47.8 a	6.7 b
No. 1	13.1 b	47.3 a	7.5 a

[a]Within each column, means followed by the same letter are not significantly different at $P \leq 0.05$.

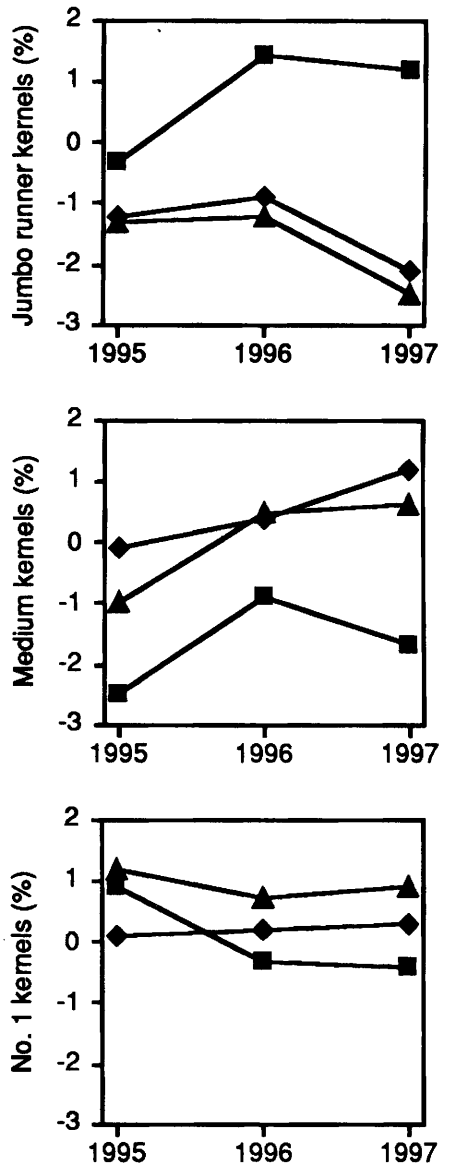

Fig. 1. Yearly effect on continuous selection of planted seed size on seed size distribution in harvested kernels. Values for jumbo runner kernels: (■), medium kernels (♦), and No. 1 kernels, (▲) expressed as deviations from values from mill run sound mature kernels (SMK).

size seed for 3 yr resulted in small but significant changes in seed size distribution (Table 4, Fig. 1). Continuous selection of jumbo runner seed size caused a significant reduction in medium runner seed when compared to the combined mill run SMK check. Continuous selection of medium seed size for 3 yr caused a significant reduction in percentage of jumbo runner seed versus the mill run SMK check. Finally, the continuous selection and planting of No. 1 seed for 3 yr caused a significant decrease in jumbo runner seed and a significant increase in the percentage of No. 1 seed when compared to the mill run SMK check. Three years is a relatively short time, but was sufficient to cause a significant change in seed size distribution for runner-type peanut cultivars.

In conclusion, the results from this study show that the new TSWV-resistant runner-type peanut cultivar Georgia Green significantly outperformed the formerly popular runner cultivar Florunner in yield, grade, dollar value, and TSWV intensity. Georgia Green had comparable percentages of jumbo runner seed, more medium runner seed, and fewer No. 1 seed than Florunner. Both cultivars responded similarly to continuous seed size selection pressure. Small but significant changes in seed size distribution resulted from planting the same seed size within a short 3-yr period.

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