Effect of Seed Size on the Performance of "Florunner' Peanuts[1]

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ABSTRACT

Rapid and uniform stand establishment of vigorous seedlings is basic to good crop performance. Seed size has been shown to be an important factor in the production of a number of agronomic crops. The objectives of this study were to determine the performance of various seed sizes of 'Florunner' peanuts (**Arachis hypogaea** L.) relative to the rate of emergence, seedling vigor, yield, and grade, when grown under field conditions, and to determine the size distributions of the seed harvested from these plantings. The seed were sized on a nested set of slotted screens of the following slot widths: 1) 8.53 mm, 2) 7.54 mm, 3) 6.75 mm, 4) 5.95 mm, 5) 5.16 mm and a standard slot length of 19.05 mm. Over 40% of the seed passed through the 8.53 mm screen and rode the 7.54 mm screen, and 90% or more of the seed rode the 6.75 mm or larger screen. Rate-of-emergence and seedling-vigor data were significantly affected by planted-seed size and positively associated with increased seed size. Significant differences in yield in favor of the larger seed sizes were noted in two of the three years of testing. When data were combined across years, significant difference for yield was obtained only between the smallest planted-seed size (5.16 mm) and the others. Grading-data responses were similar to those noted for yield. ELK values and 100-seed weight were significantly affected by planted-seed size, with a positive correlation of $r = 0.925$ between planted-seed size and 100-seed weight of harvested seed. Values for SMK and total meats indicated a highly significant year x size interaction. The planting-seed size had a significant effect on harvested-seed size some years, but the patterns of response were not consistent.

Additional index words: Groundnut, **Arachis hypogaea,** seed quality.

Rapid and uniform stand establishment with vigorous seedlings is basic to acceptable plant performance. Seed size has been shown to be an important factor in this respect for a number of agronomic crops (2,4,9,12,15,17).

Recent reports on various crops, other than peanuts (*Arachis hypogaea* L.), have shown varied responses to sizing of seed. Some have reported that larger seed sizes of a given cultivar were associated with higher seed protein, superior emergence, greater leaf area and vigor of seedlings, larger plants, and greater yield (1,4,9,15). Other studies have found variable or no response to sizing of soybeans (*Glycine max* (L)) Merr.) (10,17).

Responses to sizing of peanut seed have also been variable, with results frequently favoring the larger seed sizes, but not consistently so. Increased seed size within a given peanut cultivar has been associated with higher seed protein and amino acid content (8,18), increased seed physiological activity (5), greater emergence and seedling vigor (2,11,12,18), improved tolerance to pesticides (6,16), larger plant size (2,3,6,11,12,16,18), and increased yields (2,3,6,12,14,16). Rate of emergence, seedling vigor, and young plant size have consistently favored the larger seed. Yield and grade responses have generally been in favor of the larger seed sizes, but not invariably (2,3,11,12). Some of the inferior performance, particularly slower emergence, weaker seedling vigor, and yield, of smaller seed has been attributed to immaturity (2,3,11,12,18).

Peanuts are indeterminate in fruiting habit, and a wide range of seed size and maturity are often obtained at harvest. In a cultivar characterized by uniform seed size, large variations may be attributed to non-uniform maturity levels (late pegs resulting in smaller, immature seed) and/or highly variable environment during the fruiting season. However, genetic differences (variability) could occur for seed size in a given cultivar, so that the size (or size distribution) of seed planted could have a significant effect on the performance of that cultivar and the size of seed harvested (13).

Smaller seed sizes of some peanut germplasm has been associated with detrimental characters, such as albinism. Significantly more albinos occurred from the smaller seed-size classes, and fewer albinos occured from the larger seed sizes in one genetic study (7).

In a preliminary test conducted in 1971, utilizing Registered 'Florunner' seed, the larger-seed categories tended to produce greater yields, but statistically significant differences were net found for yield, grade, or plant counts.

The objectives of this study were to determine the performance of various seed sizes of 'Florunner' peanuts relative to the rate of emergence, seedling vigor, yield, and grade when grown under field conditions, and to determine the size distribution of seed produced by each of these seed sizes.

Materials and Methods

Foundation 'Florunner' seed were shelled (two lots in 1972 and 1973 and one lot in 1974) on a sample sheller and sized on a set of nested slotted screens of the following sizes: 5.16, 5.95, 6.75, 7.54, and 8.53 x 19.05 mm. The seed riding each screen size were weighed, and the relative distribution (%) of each size was determined. The number of seed per gram was determined for each seed size. These seed were planted in replicated tests (3-4 replication per test) in 4-row plots on May 10 and June 22, 1972, May 11, 1973, and May 23, 1974. The plots were 6.1 m long and 91.4 cm between rows, and seed were spaced 10.2 cm apart in the drill.

Various data were collected. Plant counts were taken

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at 10, 15, and 20 days after planting. Plant measurements were made approximately 21 days after planting. These measurements were plant width through the cotyledonary lateral branches, plant width at 90° from the previous measurement, and height of the center stem, selecting three normal plants randomly from each plot. These figures were used in the formula for the volume of a cone ($V = \pi/3\ r^2h$, where $r = 1/2$ average plant diameter, and $h =$ center stem height) to get an estimate of average plant size in cm^3.

Two rows of each plot were dug on each of two digging dates for each planting. The diggings were made approximately a week apart with a two-row Lilliston digger-shaker. The peanuts were allowed to cure in the windrow for 3-5 days and were picked with a plot picker. The pods were dried to approximately 8% moisture in burlap bags, and yield data were collected. Pod samples were then taken from each plot and grading data were determined. Additional 1000-gram pod samples from each plot were shelled and rescreened to determine the seed-size distribution of the harvested seed (seed weights were taken in 1972, but seed counts were made in 1973 and 1974).

Results and Discussion

Foundation 'Florunner' seed were shelled and sized for planting tests in each of the years 1972-74. These seed were all grown in North Florida using similar management practices. Table 1 gives

Table 1. Distribution (%) and seed count-per-gram of each seed-size of Foundation 'Florunner' planted in 1972 and 1973.

Screen Size (mm)	Seed distribution (%)[1/]			No. seed/gram[2/]		
	1972	1973	$\bar{x}$	1972	1973	$\bar{x}$
5.16	1.4 b	3.3 a	2.4	4.16	4.06	4.11
5.95	4.8 b	7.5 a	6.2	2.86	2.96	2.91
6.75	21.6 a	19.4 b	20.5	2.12	2.15	2.14
7.54	47.7 a	40.5 b	44.1	1.66	1.73	1.70
8.53	24.6 b	29.5 a	27.1	1.41	1.48	1.45
CK[3/]					1.87	1.87

[1/] Average of two seed lots each year, riding the indicated screen size; values appearing in the same row (seed size) and having different letters (a,b) are significantly different (0.05).

[2/] Average of two seed lots and five samples per seed-size class each year; no significant differences between years.

[3/] Check - all seed above a 5.95 mm slotted screen.

the relative distribution (%) by weight of these seed sizes and their seed counts per gram in 1972 and 1973. More than 40% of the seed rode the 7.54 mm screen and over 9% rode the 6.75 mm and larger screens. Over 95% of the seed 6.75 mm or larger in diameter were sound mature seed, as indicated by their full plump appearance and smooth testa. In contrast, essentially all of the seed collected on the 5.16 mm screen and approximately 50% of the seed on the 5.95 mm screen were immature. Significant differences in percentage of each seed size (relative distribution) were noted between the Foundation seed used to plant the 1972 tests compared to those used to plant the 1973 test. More seed were at the extremes (5.16 and 8.53 mm) in size for the 1973 test than the 1972 tests. This can probably be attributed to the more favorable rainfall pattern in 1971 (1972 test seed) than in 1972 (1973 test seed), which resulted in more favorable plant growth and pod development.

The plant count data, Table 2, followed a similar

Table 2. Average number of plants per plot for each seed size at 10, 15, and 20 days after planting Foundation 'Florunner', 1972-74.

Test Year	No. plants/plot[1/] — Seed size (mm): 5.16	5.95	6.75	7.54	8.53	CK
10-day count						
1972 (1)	177 d	187 c	205 b	213 a	214 a	216 a[2/]
1972 (2)	190 d	203 c	211 b	217 a	220 a	212 b
1973	121 c	139 b	156 a	161 a	160 a	164 a
1974	83 d	124 c	153 b	179 a	190 a	165 b
$\bar{x}$	143	163	181	193	196	189
15-day count						
1972 (1)	202 d	209 c	222 b	226 ab	230 a	226 ab
1972 (2)	199 d	210 c	216 b	219 b	225 a	218 b
1973	149 d	161 c	171 b	179 ab	181 a	175 ab
1974	91 e	130 d	159 c	186 b	212 a	175 b
$\bar{x}$	160	178	192	203	212	199
20-day count						
1972 (1)	209 d	217 c	224 b	226 ab	230 a	229 a
1972 (2)	203 d	209 c	218 b	220 ab	226 a	219 b
1973	197 b	208 a	209 a	213 a	211 a	209 a
1974	101 e	134 d	160 c	187 b	210 a	180 b
$\bar{x}$	178	192	203	212	219	209

[1/] 244 seed planted per plot.

[2/] Values appearing in the same row and not having any following letters in common are significantly different at the 0.05 level.

pattern for all tests. The rate of seedling emergence and final plant stands were significantly different among the seed-sizes for each test. There was a positive association between seed size and seedling emergence at all planting dates. The rate of emergence did vary, somewhat, according to vigor and germination potential of the seed used for each planting and possibly environmental conditions. Florida State Seed Laboratory germination test results indicated a germination potential of 81, 70, and 65% for seed used in 1972, 1973, and 1974, respectively. Twenty-day plant counts were greater than laboratory germination results, except for the two smallest seed sizes in 1974. The greatest differences in emergence among seed sizes were in 1974. This would indicate that seed sizing could have a greater effect on poor quality seed.

Environmental conditions could have been a factor in the results given in Table 2, but no control condition studies (i.e. growth chamber) were conducted. Soil temperatures at the 10 cm depth did not drop below 21 C during the first 10 days after planting any of the tests. The soil temperature did reach 40 C on the third day after planting the 1974 test, which could possibly reduce germination. Since 2.5 cm or more rainfall occurred less than a week before planting each of the tests, moisture was not a limiting factor at planting. Lack of rain for 12 days after planting could have influenced the 10- and 15-day plant counts for the 1973 test.

The smaller seed sizes had a greater percentage of plants emerging between 15 and 20 days than the larger sizes, and more seedlings continued to emerge from the smallest (5.16 and 5.95 mm) sizes after 20 days. Results in Table 2 agree with reported research findings for similar tests on peanuts (2,12,18). The increased vigor of larger seed sizes from a given crop cultivar has been attributed to the greater food reserve (cotyledon size) and protein (amino acid) content (8,11,12,18).

Table 3 gives the average plant size in cubic centimeters for each seed-size class. The differences in plant size were significant in all tests and followed the same trend as the plant count data. The plant sizes at 21-25 days after planting were positively correlated with seed size, with a highly significant r value of 0.9997. The 8.53 mm seed size produced the largest plants, and the 5.16 mm size produced the smallest plants at all planting dates. These differences were noticeable until the vines covered the row middles, and the most obviously different plants were the small ones from the two smallest seed sizes. There was a highly significant (0.01 level) year effect and year x seed-size interaction. This apparent interaction could be attributed to differences in growing seasons (rainfall, temperature, etc.), planting dates, and time (age) of plant measurement. The time (age) of plant measurement probably accounted for much of the difference in plant size (within a seed size) observed among plantings, especially since plants were growing rapidly at that stage. Cooler air temperatures for the May 1972 (low of 13 C) and 1973 (low of 11 C) plantings could have slowed plant growth. As indicated above, slight moisture stress may have retarded growth in the 1973 test. Other studies on peanuts have reported similar effects of seed sizes on seedling vigor (2, 11,12,18) and plant size (6,11,12,16,18).

Table 3. Average plant size (cm^3) obtained from each seed size of Foundation 'Florunner', 1972-74[1]

Seed Size(mm)	Planted: 5-10-72	6-22-72	5-11-73	5-23-74	$\bar{x}$
	Plant size (cm^3)[2/]				
5.16	86 d	143 e	62 e	178 d	117 d[3/]
5.95	143 c	206 d	117 d	379 c	211 c
6.75	192 b	292 c	183 c	533 bc	300 bc
7.54	205 ab	412 ab	236 b	667 b	380 b
8.53	232 a	478 a	289 a	986 a	496 a
CK	207 ab	354 bc	252 ab	672 b	371 b

1/ Plant size based on: $V = \frac{\pi}{3} r^2 h$, where r = 1/2 the average plant diameter through the lateral branches and h = center stem height.

2/ Measured on May 31 (21 days from planting), July 15 (23 days), June 4 (24 days), and June 18 (25 days), respectively.

3/ Values appearing in the same column and not having any following letters in common are significantly different at the 0.05 level.

The results for pod yield, Table 4, represent the average of two harvest dates and did not consistently follow the pattern of previous data. Highly significant differences (0.01) in yield were obtained for the two tests in 1972, only 0.05 significance was found in 1974, and no significant differences were found in 1973. Results in 1972 and 1974 favored the larger seed sizes, and the 5.16 mm seed, followed by the 5.95 mm seed, produced the lowest yield in each of these three tests. No significant differences in yield were noted among seed sizes 6.75 mm and larger in any year. Yield and seed size were significantly (0.05) correlated (r = 0.923). The year x seed-size interaction was not statistically significant, but the year effect was highly significant (0.01). The June 1972 planting produced much lower yields for all seed sizes than obtained for the other plantings.

Table 4. Effect of planted seed size on pod yield (kg/ha) of Foundation 'Florunner', 1972-74.

Seed Size(mm)	Planted: 5-10-72	6-22-72	5-11-73	5-23-74	$\bar{x}$
	Pod yield (kg/ha)				
5.16	4407 b	1888 b	4327	4698 b	3830 b[1/]
5.95	4812 ab	2399 ab	4497	5046 ab	4189 ab
6.75	5058 a	2642 a	4235	5387 ab	4331 a
7.54	5202 a	2757 a	4469	5247 ab	4419 a
8.53	5303 a	2710 a	4372	5622 a	4502 a
CK	5263 a	2587 a	4312	5180 ab	4336 a
			NS		

1/ Values in the same column followed by the same letter (a, b, etc.) are not significantly different at the 0.05 level.

Significant yield differences between the two harvest dates occurred only in 1973. The high level of *Cercospora* Leafspot in 1973 probably caused the lower yields on the second harvest. Based on the seedling vigor tests (plant size about three weeks after planting), yield differences among seed sizes were not as great as might be expected. In fact, in the 1973 study, smaller seed apparently compensated completely for their slower start.

Other studies on peanuts have also reported that larger seed sizes of peanuts often produce greater yields, but not consistently (2,3,12,14). Differences in yield among different sizes of sound mature seed are often not statistically significant (11,12).

Lower yields obtained from smaller seed sizes could result from the smaller, less vigorous plants being more vulnerable to stress factors. This could have been the case in the June 1972 test, since that growing season was dry in September and October. The smaller seedlings could also be more vulnerable to chemical damage, as reported in other tests on peanuts (6,16).

The grading data presented in Table 5 followed a trend similar to the yield data. Differences for all grading factors were highly significant (0.01) in 1972, not significant in 1973, and only significant for 100-seed weight (0.01) and SMK (0.05) in 1974. A combined analysis of variance (ANOVA) for the three years indicated that seed size had a highly significant (0.01) effect on Extra Large Kernels (ELK) and 100-seed weight but no effect on other grading factors. Seed size and 100-seed weights were significantly (0.05) correlated (r = 0.925) across years. Years had a significant effect on all grading factors, and a significant year x seed-size interaction was noted for Sound Mature Kernels (SMK), 100-seed weight, and total meats. The values generally favored the larger seed sizes, but the mean SMK (riding a 6.35 x 19.05 mm slotted screen) value, which has

Table 5. Average effect of planted seed size on various grading factors of Foundation 'Florunner', 1972-1974.

Grade Factor/year	Seed size (mm) 5.16	5.95	6.75	7.54	8.53	CK
	gms[1]					
SMK						
1972	131.2 c	131.9 bc	132.1 bc	136.7 ab	140.5 a	140.2 a[2]
1973	145.6 a	148.7 a	146.0 a	149.0 a	146.1 a	145.9 a
1974	152.0 a	149.2 ab	147.0 ab	145.8 b	145.5 b	147.7 ab
ELK						
$\bar{x}$ (1972-74)	32.2 c	33.0 c	36.3 b	38.7 ab	39.4 a	39.5 a
100-sd. wt.						
1972	67.1 c	69.2 bc	70.5 ab	71.3 ab	72.5 a	70.0 b
1973	55.7 a	56.3 a	55.8 a	56.0 a	56.1 a	54.9 a
1974	59.3 c	61.3 abc	59.0 c	60.7 bc	62.8 ab	63.3 a
Total meats						
1972	144.1 b	143.9 b	144.8 b	145.9 b	148.4 a	148.7 a
1973	161.4 a	163.0 a	161.1 a	163.0 a	162.6 a	162.0 a
1974	165.0 a	164.7 a	164.7 a	164.7 a	164.0 a	164.0 a

1/ Determinations made from 200 gm pod samples.

2/ Values followed by a common letter (a, b, etc.) are not significantly different (P = 0.05), within a given year (row).

Table 6. Effect of planted seed size on distribution (%) of harvested seed size of 'Florunner', 1973 and 1974.

Planted Seed Size (mm)	Distribution of harvest seed size (%) 5.16	5.95	6.75	7.54	8.53
	1973				
5.16	4.4	12.7	27.6	43.0	12.3
5.95	4.4	11.5	26.6	45.0	12.5
6.75	5.1	12.3	26.1	43.3	13.2
7.54	4.9	11.5	26.0	44.4	13.2
8.53	5.3	13.2	26.2	41.6	13.8
CK	5.4	13.3	26.8	41.4	13.2
Chi-square = 136.98 (**)[1]					
	1974				
5.16	3.9	6.8	23.1	41.9	24.3
5.95	4.5	6.0	19.9	43.6	26.1
6.75	4.8	6.4	17.9	43.5	27.4
7.54	4.7	6.8	16.7	42.6	29.2
8.53	4.7	5.4	15.6	44.9	29.5
CK	5.5	6.6	15.7	44.1	28.1
Chi-square = 298.80 (**)					

1/ Chi-square values calculated from actual counts.

the greatest effect on value per ton, showed no clear cut response to sizing. The 100-sced weights and ELK (riding a 8.53 x 25.40 mm screen) values indicate a tendency for the larger seed sizes to produce slightly larger seed. The net effect of seed sizing on the grading factors favored larger seed sizes slightly.

Table 6 gives the results of the 1973 and 1974 resizing evaluations, expressed in percentages by count. Chi-square tests for independence indicated that the planted seed size did affect the distribution of harvested seed size. However, as the data indcates, there were no consistent patterns. Significant differences occurred between years and between harvest dates within a year. Harvest dates x seed-size interactions were significant in 1973 and 1974 There was a tendency for the number of seed riding the 8 53 mm screen to increase as the planted-seed size increased. Other patterns were not consistent. The sample size (over 92,000 seed screened and counted in 1973 and over 47,000 seed in 1974) probably had a large effect on the results of the statistical tests. The differences in the distributions may have no practical importance.

The lower percentage of seed riding the 8.53 mm screen in 1973 compared to 1974 could be attributed to disease pressure. *Cercospora* leafspot was much more prevalent in the 1973 plots, resulting in severe pod loss at harvest. Under these conditions the larger pods would tend to be lost more readily.

Summary and Conclusions

Considering the overall results from these studies, positive correlations were noted between larger seed size of 'Florunner' and plant size (r = 0.9997), yield (r = 0.923), and 100-seed weight (r = 0.925). The differences among the seed-size categories 6.75 mm and larger were often not statistically significant. These larger sizes were composed primarily of sound mature seed. Seed which passed through the 6.75 mm screen were frequently immature and inferior in performance. Larger seed sizes of 'Florunner' may produce more favorable results under adverse conditions, since they tend to produce larger and more vigorous seedlings.

Differences in seed sizes of 'Florunner' should be due to stage of maturity and environmental conditions, but the possibility exists that genetic factors could be involved, especially since 'Florunner' is composed of three or four breeding lines (13). Considering its genetic composition, caution should be observed when sizing 'Florunner' seed over a period of years or selection cycles.

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