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An F_2 Yield Trial in Peanuts[1]

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ABSTRACT

An F_2 yield trial in peanuts (*Arachis hypogaea* L.) was conducted in 1978 to evaluate 25 entries in a six replicate randomized complete block design. Entries included progenies from sixteen intrasubspecific cross combinations and their representative parents: seven component lines of two U. S. cultivars, 'Florunner' and 'Florigiant', and two peanut introductions, 'Makulu Red' and '486 GKP'.

Progeny and parental performances were determined for eight quantitative traits: yield, fancy pods, meat content, total sound mature kernels, other kernels, extra large kernels, damaged kernels, and 100 seed weight.

Hybridization between adapted and unadapted genotypes led to a reduction in performance characteristics. However, cross populations were identified as having selection potential for improving yield and grade.

Key Words: Groundnut, Intrasubspecific cross combinations, *Arachis hypogaea* L.

Higher yield and grade performances are principal aims in breeding peanuts (*Arachis hypogaea* L.). To accomplish this goal, hybridization of selected parents has played an important role in developing numerous improved peanut cultivars (8).

The dominant cultivar in the Southeast (Alabama, Florida, and Georgia) and the Southwest (Oklahoma and Texas) production areas is 'Florunner' (10). In the Northeast (North Carolina and Virginia), the predominant cultivar is 'Florigiant' (3). Because of their proven performance, these two cultivars have established widespread acceptance in U. S. peanut production and would make desirable parents in a breeding program.

Concurrently, peanut lines from abroad have also achieved respectable and exciting performances (6). The 'Makulu Red' cultivar has given maximum farmer yields, and the '486 GKP' selected genotype the highest research plot yields reported in central Africa (11; G. L. Hildebrand pers. comm.). Thus the combination of these two germplasm lines with the adapted U. S. cultivars would seem to be advantageous in the development of a new cultivar with greater performance potential.

This study reports the results of an F_2 yield trial involving the parents and unselected progenies from cross combinations of the above mentioned peanut genotypes.

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Materials and Methods

Sixteen intrasubspecific crosses were made between selected component lines of U. S. cultivars, Florunner and Florigiant, and two introduced peanuts, Makulu Red (PI 371965) and 486 GKP (PI 274191). Florunner and Florigiant can each be classified as early generation composites of several sister lines (9), and we used four and three of these lines, respectively, as parents. Each of these nine parents is *A. h.* ssp. *hypogaea* var. *hypogaea*. The U. S. lines (female parents) were each crossed with Makulu Red and 486 GKP (male parents) and the latter two were reciprocally crossed, giving 16 hybrid populations, as previously described (2).

F_1 plants were space-planted in 1977 and manually harvested from field nursery plots (1.5 m^2 each) at the agronomy research farm near Tifton, Ga. In 1978, an F_2 yield trial was conducted at the same location in addition to the conventional progeny-row nursery for slection. The 16 F_2 populations and the 9 parents were tested in a randomized complete-block design with 6 replications. Each replicate was sown with 120 seed in two-row plots, 1.8 x 6.1 m. All entries were planted April 28, buty they were mechanically harvested as each entry matured during September or October. At harvest all plants within each two-row plot were bulked for each replicated entry. Standard culturla procedures were used throughout the growning season. Unfortunately F_1 seed supply limited intensive testing over environments and years.

Pod yields were obtained following artificial drying and cleaning. The following grade characteristics were determined using federal-state inspection service standards: percentages of fancy pods, meats (all shelled seed), total sound mature kernels (TSMK), other kernels (OK), extra-large kernels (ELK), and damaged kernels (DK), together with size (weight/100) of seed (12).

Data were subjected to least-squares analysis of variance using linear contrasts for evaluation of yield and grade results obtained on the 25 entries. Duncan's multiple-range test was used to separate entry means within groups for parents and cross populations.

Results and Discussion

The opportunity for an F_2 yield trial is fairly uncommon in peanuts because of the limited number of F_1 seed usually produced (4, 13, 14). In this study, an average of 714 sound and mature seed per F_1 plant was produced to generate a sufficient number of F_2 plants/cross for an F_2 yield trial (5).

Performance in the F_2 yield test differed significantly ($P = 0.01$) among the 25 entries for the eight traits (Table 1). Since the F_2 entries represent unselected populations from crosses between agronomically developed U. S. lines and locally unadapted peanut introductions, the average segregating cross populations were not expected to perform better than their homozygous, adapted parents. The component lines of Florunner and Florigiant ranked at the top for yield. However, the lowest-yielding adapted component line did not differ significantly from four of the F_2 cross populations.

From the least-squares analyses (Table 1), highly significant differences occurred for all performance characteristics among the nine parents and sixteen crosses. Significant differences were prevalent between adapted vs un-

Table 1. Mean squares from analysis of variance for performance characteristics among F_2 cross populations and parental genotypes.

Source	df	Yield (kg/ha)	Fancy (%)	Meat (%)	TSMK (%)	OK (%)	ELK (%)	DK (%)	Seed wt (g/100)
Total	149								
Blocks	5	605508**	52*	7**	24**	3.37**	178**	0.3313**	4
Genotypes[a/]	24	10411566**	5386**	76**	87**	2.17**	372**	0.7139**	472**
Among parents	8	12234402**	8584**	126**	145**	2.76**	627**	1.0316**	801**
Between adapted vs unadapted	1	79058409**	5488**	444**	581**	5.71**	787**	0.4051*	1288**
Among adapted	6	2022015**	10457**	93**	93**	1.20*	662**	0.9467**	843**
Between adapted vs adapted	1	7225639**	62716**	541**	541**	5.14**	3717**	5.3239**	4858**
Among adapted (FGT)	2	1630767**	1	5*	4	0.03	49	0.1356	45**
Among adapted (FRR)	3	548305	9	2	3	0.67	52	0.0283	36**
Between unadapted vs unadapted	1	6674721**	443**	10*	23**	9.19**	260**	2.1675**	61**
Among crosses	15	3527064**	4017**	46**	52**	1.98**	218**	0.5893**	303**
Between adapted x unadapted vs unadapted x unadapted	1	1617882*	2783**	231**	266**	1.09	77	0.0001	108**
Among adapted x unadapted	13	3941564**	4417**	35**	38**	1.98**	238**	0.6707**	329**
Male	1	41394430**	432**	23**	55**	12.81**	159**	1.0519**	110**
Female	6	956229**	9468**	71**	71**	1.35*	483**	1.1346**	632**
Between adapted vs adapted	1	2065048**	56751**	415**	412**	7.10**	2811**	6.3017**	3763**
Among adapted (FGT)	2	895610*	11	4	5	0.05	8	0.0719	1
Among adapted (FRR)	3	627036	11	1	1	0.30	25	0.1208	10**
Male x female	6	684754*	30	1	2	0.80	6	0.1433	62**
Between adapted vs adapted	1	556429	111*	1	2	2.42*	1	0.6552**	133**
Among adapted (FGT)	2	835948*	31	2	3	0.63	8	0.0419	94**
Among adapted (FRR)	3	626734	2	1	1	0.37	6	0.0402	16**
Between reciprocal unadapted x unadapted	1	47738	47	10*	19*	2.90*	99*	0.1200	169**
Between parents vs crosses	1	99096406**	353**	120**	139**	0.30	631**	0.0422	384**
Error	120	272283	20	2	3	0.49	20	0.0816	2

*, ** Significant at the 0.05 and 0.01 probability levels, respectively.

a/ FGT and FRR denote Florigiant and Florunner, respectively.

adapted, among adapted, between adapted vs adapted, and between unadapted vs unadapted parental lines.

Among crosses, significant differences were also found for all eight traits among adapted x unadapted, between males and females, and between adapted vs adapted female sources. Except for blocks and among F_2 progenies resulting from component lines of Florigiant used as female, highly significant differences were observed for gram weight of 100 seed.

Group comparisons of parental means show only differences in seed weight for the component lines of Florunner, and yield, % meat, and seed weight differences were detected among the three lines of Florigiant (Table 2). All performance characteristics differed significantly between the two unadapted introductions.

Within grouped cross populations most of the performance traits were fairly similar, except for yield and seed weight (Table 3). Highly significant differences were found within adapted x unadapted F_2 progenies involving 486 GKP as male parent for yield, and with the exception of Florunner x 486 GKP, within group comparisons were all highly significant for seed weight. The highly significant difference between reciprocal unadapted crosses for seed weight would suggest some nonadditive maternal effect.

Mean hybrid populations from 486 GKP as male and component lines of Florunner as females had significantly (P = 0.01) higher yield performances than F_2 entries involving Makulu Red as male and component lines of Florigiant as female parents, respectively. Since maximum variation occurs in the F_2 generation, these data suggest that the Florunner x 486 GKP cross combination would be the more desirable population for greatest yield selection potential. However one cannot completely exclude the other hybrid progenies due to transgressive segregation and alternative objectives for improving overall performance.

Regarding grade factors, crosses from Florigiant used as a female parent resulted in a highly significant increase of percent fancy pods, extra large kernels, damaged kernels, and seed weight. Distribution of F_2 pod sizes showed that peanut fruits riding a 1.508 cm (38/64 inch) presizer slot predominantly contributed to the increase of percent fancy pods. Crosses resulting from Florunner as a female parent had a significantly higher percent meats and total sound mature kernels.

Likewise, hybrid population means from either 486 GKP or Makulu Red as the pollen donor differed significantly for all grade factors. The difference was directly proportional to the larger male parental line for each factor, respectfully.

Wynne, et al. also noted that parental peanut lines performed significantly better than F_2 cross populations for

Table 2. Parental means and within group comparisons of performance characteristics from F_2 yield trial.[a/]

Parent[b/]	Yield (kg/ha)	Fancy (%)	Meat (%)	TSMK (%)	OK (%)	ELK (%)	DK (%)	Seed wt (g/100)
Adapted								
FRR 1	6334	2.5	77.6	74.4	3.0	18.9	0.2	52.2
FRR 2	6828	2.2	77.9	75.6	2.2	23.8	0.1	53.0
FRR 3	6228	3.9	78.0	75.1	2.7	25.9	0.1	56.8
FRR 4	6160	4.7	78.9	76.0	2.7	22.2	0.2	51.1
FGT 1	5098	81.6	70.0	67.1	2.0	38.7	0.8	72.1
FGT 2	6120	81.0	71.8	68.9	1.9	44.4	1.0	77.5
FGT 3	5430	81.6	70.8	68.1	1.9	42.1	0.7	75.4
Unadapted								
GKP	3864	18.6	69.0	65.7	2.2	44.7	1.1	53.1
MKR	2372	6.5	67.2	62.9	4.0	35.4	0.2	48.6

[a/]Means within groups followed by the same line do not differ significantly at the probability level obtained from ANOVA (Table 1) as determined by Duncan's new multiple-range test.

[b/]FRR, FGT, GKP, and MKR denote Florunner, Florigiant, 486 GKP, and Makulu Red, respectively.

Table 3. Cross population means and within group comparisons of performance characteristics from F_2 yield trial.[a/]

Cross[b/]	Yield (kg/ha)	Fancy (%)	Meat (%)	TSMK (%)	OK (%)	ELK (%)	DK (%)	Seed wt (g/100)
Adapted x unadapted								
FRR 1 x GKP	4540	10.4	74.6	72.0	2.4	34.3	0.2	50.3
FRR 2 x GKP	4956	7.6	74.5	71.8	2.4	32.2	0.2	50.9
FRR 3 x GKP	4055	9.6	74.6	71.9	2.2	34.2	0.4	52.4
FRR 4 x GKP	5032	8.4	74.6	71.9	2.2	32.4	0.5	51.5
FGT 1 x GKP	4394	64.6	70.4	67.2	2.1	44.8	1.0	66.7
FGT 2 x GKP	4547	62.8	70.1	66.6	2.2	43.5	1.2	65.1
FGT 3 x GKP	3552	64.3	70.3	67.5	1.8	46.1	1.0	70.3
FRR 1 x MKR	3006	7.2	73.4	69.6	3.6	31.1	0.2	52.2
FRR 2 x MKR	3196	5.3	73.1	69.8	3.0	30.5	0.3	52.6
FRR 3 x MKR	3141	6.4	74.4	71.0	3.2	32.2	0.3	51.6
FRR 4 x MKR	3059	7.0	73.8	69.7	3.7	27.6	0.3	48.4
FGT 1 x MKR	2907	57.0	70.0	67.1	2.2	43.3	0.7	62.8
FGT 2 x MKR	2994	59.0	68.2	65.1	2.4	41.7	0.6	64.7
FGT 3 x MKR	2945	54.1	68.7	65.4	2.7	41.7	0.5	59.0
Unadapted x unadapted								
MKR x GKP	3282	16.0	66.6	62.8	3.4	36.7	0.4	50.1
GKP x MKR	3408	12.0	68.4	65.3	2.4	42.4	0.6	57.6

[a/]Means within groups followed by the same line do not differ significantly at the 0.01 probability level as determined by Duncan's new multiple-range test.

[b/]FRR, FGT, GKP, and MKR denote Florunner, Florigiant, 486 GKP, and Makulu Red, respectively.

yield and other characteristics. They found that F_2 cross means were less than midparent values, especially among infraspecific crosses. However, a somewhat better F_2 performance was observed for a few intrasubspecific cross combinations (14).

Thus, as Allard (1) points out, "the problems involved are, first, identification of the hybrids most likely to give the highest proportion of superior segregates and, second, early evaluation of the segregates from the promising crosses." An F_2 yield trial would appear to differentiate intrasubspecific crosses by identifying superior hybrid combinations early in the breeding program. This would permit concentration of subsequent selection work within the most promising peanut populations as strongly recommended by Joshi (7). Since F_1 plants can be maintained easily via cuttings, the F_2 yield trial would also identify F_1's for convergent crossings and for backcross breeding to produce progenies with better opportunities for the breeder to select for superior genotypes.

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