PERFORMANCE AND HERITABILITY STUDIES ON SOME PEANUT LINES AND CULTIVARS

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SUMMARY: Thirteen selected peanut (Arachis hypogaea L.) lines and cultivars from the local germplasm collection were evaluated in two years in Serdang, Malaysia, to compare their performance and to estimate heritability of some of the important traits on the crop. The lines and cultivars were found to reveal quite a wide range of performance and genetic variability, as they were obtained from various different countries. Number of pods per plant, which showed high heritability and was positively correlated with yield, was identified to be a good criterion for selection to improve yield in peanut breeding. The lines and cultivars evaluated showed good potential for genetic studies and breeding programmes in the country.

Key Words : Arachis hypogaea L., germplasm, heritability.

INTRODUCTION

Peanut (*Arachis hypogaea L.*) is a popular annual crop mainly grown as an intercrop in small-holdings in Malaysia. Most of the varieties grown are those developed through selection from the adapted local landraces or those introduced from the neighboring countries. These varieties produced non-uniform yields, and varied greatly with places and times of planting (4). From these plantings, Malaysia produced fresh peanut yield of only 5.000 m. tons per year, with the average yield of only 3.333 kg/ha (2). In this country, peanut is still considered unexploited (5).

The plant breeding efforts towards improving peanut yields and developing better performing varieties in the country is still at the initial stage. Collections of genetic materials from other countries, followed by evaluation and adaptation to the local environment have been carried out. Crosses were also made to incorporate the suitable and favorable traits from the imported varieties into the locally adapted ones. Improvements in yield obtained so far have not been convincing.

This present study was conducted as part of the evaluation on the selected germplasm from the collection, previously found to have good potential to be used in breeding programmes. The objectives of the study were to determine the performance of some selected peanut lines and cultivars from the available collection, to estimate heritability of some of the important traits, and to determine correlations between these traits.

MATERIALS AND METHODS

The study was conducted at the Research Field of the Department of Agronomy and Horticulture, University Pertanian Malaysia, at Serdang. Thirteen lines and cultivars belonging to the Spanish, Virginia and Valencia types, which include

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some local ones and those imported from various countries over the world were evaluated in two years, 1990 and 1991, each in a Randomized Complete Block Design with three replications. Each plot measured 6 m x 4 m, with a harvest area of 4 m x 2 m. The planting density was 0.5 m between rows and 0.1 m between plants.

The plants were fertilized at the rate of 30 kg/ha N, 60 kg/ha P_2O_5, and 60 kg/ha K_2O, given in split application; at planting and four weeks after. Plote irrigated using the sprinkler system when necessary. The plants were harvested at maturity.

Data were taken from each entry on important characteristics, during the plant growth and after harvest. Pod yield refers to that taken immediately after harvest, while kernel yield and weight refer to those taken after drying at 35°C for one week (at about 15% moisture content in kernels).

Analyses of data from evaluations in both years were combined, since the test of homogeneity showed that the error variances were homogeneous. Analysis of variance (ANOVA) was conducted to determine the effects of lines and varieties, and broad-sense heritability estimates were obtained from the components of variance in the ANOVA table, using the relationship:

$h_B^2 = \sigma_g^2/\sigma_p^2$

where :

h_B^2 = broad-sense heritability;

σ_g^2 = genotypic variance; and

σ_p^2 = phenotypic variance (6).

Simple correlation coefficients between pairs of characteristics were calculated using the formula :

$$r_{xy} = \frac{\Sigma\left[(x-\bar{x})(y-\bar{y})\right]}{\sqrt{\left[\Sigma(x-\bar{x})^2\,\Sigma(-\bar{y})^2\right]}}$$

where r_{xy} = simple correlation coefficient between characters x and y.

RESULTS AND DISCUSSION

Performance of entries

Results obtained from the analysis of variance is shown in Table 1. There were significant differences among entries for pod yield, kernel yield, 100-seed weight, number of pods per plant and days to flowering (at<0.01). There was however, no significant difference in shelling percentage among the entries, averaged over the two years.

Mean values of each entry for every character is shown in Table 2.

Average over both years, Line 47-5 showed the highest pod yield (3872 kg/ha). This was followed by entries Sungai Siput, Red Indonesian, Acc 12, Goldin I, F 334-33 and Kuala Brang. Performance of Alabama, CES 2-25, Kedah, 79-2 and Tainang 7 were intermediate. Matjan had the lowest pod yield (1847 kg/ha).

Line 47-5 also had the highest kernel yield (1451 kg/ha), followed by Sungai Siput, Acc 12, Kuala Brang 2, F 334-33, Red Indonesian and Goldin 1. Kernel yields were moderate for Alabama, CES 2-25, Kedah and Tainang 7. Poorest yields were Line 79-2 and cultivar Matjan, with kernel yields of 732 and 756 kg/ha, respectively.

Shelling percentage was found significantly different among the entries only in 1990 evaluation (Table 2), where variety Red Indonesian gave the highest

Table 1: Mean squares in the analysis of variance for characteristics measured on 13 peanut lines and cultivars evaluated in two years.

Source of d. f. variation		Mean squares					
		Rod yield (kg/ha)	Kernel yield (kg/ha)	Shelling % (%)	100-seed wt. (g)	Pod no/plant	Days to flower (days)
Year (Y)	1	213^{ns}	2792357**	1532.31**	328.12*	45.08^{ns}	9.35*
Rep/Year	4	642142^{ns}	124723^{ns}	25.76^{ns}	10.66^{ns}	21.53*	1.10^{ns}
Variety (V)	12	2360640**	279129**	36.22^{ns}	88.58	34.91**	3.77**
YXV	12	1752072**	208439**	26.28^{ns}	16.22^{ns}	9.66^{ns}	2.32**
Error	48	429805	70449	54.31	17.36	6.26	0.45

** Significant at p < 0.01, * Significant at p < 0.05, ns: non-significant

result (69.7%). This character was found not to differ among entries in 1991, and also for the two-year average.

Line 79-2 had the heaviest kernels, with the average 100-seed weight of 48.9 g. This was followed by Alabama, 47-5, Kuala Brang 2, Goldin I, Sungai Siput, F 334-33, Matjan, and CES 2-25, which did not significantly differ in 100-seed weight from each other, but performed higher than that of Red Indonesian, Kedah and Tainang 7. Acc 12 had the lowest 100-seed weight (33.8 g).

Table 2: Means for characteristics measured on peanut lines and cultivars measured in two years.

Entries	Pod yield (kg/ha)			Kernel yield (kg/ha)			Shelling percentage (%)		
	Year:1990	1991	Mean	1990	1991	Mean	1990	1991	Mean
Matjan	1459e	2236cd	1847e	410d	1102ab	756e	58.7ab	70.9a	64.8a
Acc 12	2674bcde	3889a	3282abc	782cd	1522a	1152abcd	61.6ab	66.5a	64.0a
CES2-25	1593e	2799bcd	2196de	538d	1233ab	886de	62.6ab	71.8a	67.2a
Kedah	1726e	2494bcd	2110de	565d	1157ab	861de	62.5ab	72.8a	67.7a
Line 47.5	4926a	2819bcd	3872a	1572a	1330a	1451a	65.8ab	66.9a	66.3a
Tainang 7	2044de	2208cd	2126de	677d	1061ab	869de	60.1ab	76.2a	68.2a
Alabama	2644bcde	2313bcd	2479cde	840cd	1006ab	923cde	59.1ab	66.9a	63.0a
K. Brang 2	1985de	3221ab	2603bcde	591d	1497a	1044bcde	58.0b	71.1a	64.6a
Line 79-2	2252de	1927d	2089de	699d	766b	732e	60.4ab	67.6a	64.0a
Goldin I	3400bcd	2516bcd	2960bcd	881bcd	1030ab	956bcde	61.4ab	68.3a	64.9a
F 334-33	2407cde	2927bc	2667bcde	667d	1430a	1049bcde	63.0ab	75.9a	69.4a
Red Indonesian	3874bcde	2606bcd	3240abc	1308ab	1258ab	1283ab	69.7a	73.5a	71.6a
Sungai Siput	3956ab	2944bc	3450ab	1220abc	1279ab	1250abc	61.2ab	70.8a	66.0a

Entries	100-kernel wt. (g)			Pod no/plant			Days to flower (days)		
	Year:1990	1991	Mean	1990	1991	Mean	1990	1991	Mean
Matjan	40.2b	40.0bcd	40.1bcd	17.2ab	12.4bcd	14.8bc	28.3b	29.0ab	28.7b
Acc 12	32.3b	35.3d	33.8e	9.6de	13.6bcd	11.5cde	28.0b	29.3a	28.7b
CES2-25	38.8b	40.2bcd	39.5bcd	19.0a	18.1a	18.6a	26.0c	27.0d	26.5e
Kedah	35.8b	37.7d	36.7cde	13.9abcd	11.5bcd	12.7bcd	27.3bc	29.0ab	28.2bcd
Line 47.5	37.4b	46.5abc	42.0bc	15.0abc	11.2bcd	13.0bcd	27.3bc	30.0a	28.7b
Tainang 7	32.3b	39.0cd	35.6de	16.5abc	14.1bc	15.6b	28.0b	29.7a	28.3b
Alabama	39.8b	48.0ab	43.9b	13.2bcd	9.7d	11.5cde	28.0b	27.0d	27.5d
K. Brang 2	37.2b	46.5abc	41.9bc	13.2bcd	12.0bcd	12.6bcd	28.7b	28.3cd	28.5bc
Line 79-2	48.9b	49.0a	48.9a	11.4cde	9.5d	10.5de	30.3a	29.0ab	29.7a
Goldin I	40.1b	42.5abcd	41.3bc	7.9e	10.7cd	9.3e	27.7b	29.0ab	28.3bcd
F 334-33	38.0b	43.2abcd	40.6bcd	15.0abc	15.2ab	15.1b	27.7b	29.3a	28.5bc
Red Indonesian	36.6b	39.2cd	37.9cde	14.4abcd	11.1bcd	12.7bcd	28.0b	27.0d	27.5d
Sungai Siput	38.9b	42.7abcd	40.8bcd	15.5abc	12.8bcd	14.1bc	27.3bc	28.0c	27.7cd

Mean values followed by the same letter in the same column are not significantly different at $p < 0.05$, according to the Duncan's New Multiple Range Test.

Table 3: Estimates of broad-sense heritability for characteristics measured on 13 peanut lines and cultivars evaluated in two years.

Characteristics	Heritability		
Year	1990	1991	Combined
Pod yield/plant	0.17	0.20	-0.21
Kernel yield/plant	0.26	0.25	0.09
Shelling %	-0.15	-1.25	0.27
100-kernel weight	0.67	0.67	0.82
Pod number/plant	0.73	0.71	0.72
Days to flower	0.78	0.92	0.39

Line CES 2-25 had the highest average number of pods per plant (18.6 pods/plant). It was followed by Tainang 7, F 334-33, Matjan, Sungai Siput, 47-5, Red Indonesian, Kedah and Kuala Brang 2, which had higher number of pods per plant than Acc 12, Alabama and 79-2, while Golding I had the lowest (9.3 pods/plant).

The number of days to flowering different greatly among the entries (Table 2). Line CES 2-25 flowered the earliest (26.5 days), while Line 79-2 was latest (29.7 days).

From these varied performance of the entries it can be inferred that the lines and cultivars evaluated in this study represented quite a wide range of performance. This is supported by the fact that many of the entries were originated from various different countries, and therefore, in one way or another were affected by the new environment. With this range of performance they could be good sources of materials for genetic studies and breeding programmes.

Heritability

Broad-sense heritability estimates obtained from the lines and cultivars evaluated is shown in Table 3. One hundred-seed weight and number of pods per plant were found to have high heritability from the combined analysis, with estimates of 0.82 and 0.72 for the two characters respectively. The moderate estimate of heritability for days to flowering in the combined analysis (0.39), although its estimates in the individual year analyses were high (0.78 in 1990), and 0.92 in 1991), was probably due to the presence of significant year by entry interaction for this trait, as shown in Table 1. Low to moderate estimates of heritability were obtained in the combined analysis for the yield characters; 0.09 for kernel yield per plant, -0.21 for pod yield per plant, and 0.27 for shelling percentage. These results are in quite a good agreement with those found by Coffelt and Hammons (1) and Hammons (3) on peanut evaluations in the United States, where estimates of heritability were high for 100-kernel weight, pod length and

Table 4: Simple correlation coefficients among yield and yield components measured on 13 peanut lines and cultivars evaluated in two years.

Characters	Pod yield/ha	Kernel yield/ha	Pod yield/plant	Kernel yield/plant	Shelling %	100-Kernel wt.	Pod no./plant
Kernel yield/ha	0.54**						
Pod yield/plant	0.85**	0.32*					
Kernel yield/plant	0.51**	0.84**	0.59**				
Shelling %	-0.05	0.31	0.03	0.20			
100-Kernel wt.	-0.23	0.11	-0.10	0.22	0.17		
Pod no./plant	0.22	0.39*	0.36*	0.57**	0.20	-0.06	
Days to flower	0.09	0.10	0.05	0.08	-0.08	-0.02	-0.01

** Significant at $p<0.01$

* Significant at $p<0.05$.

number of pods per plant, but low for the other yield traits.

Correlations

The simple correlation coefficients between important traits from the combined-year analysis is shown in Table 4. Pod yield/ha was positively correlated with kernel yield/ha (r=0.54), pod yield/plant (r=0.85), and kernel yield/plant (r=0.51). Kernel yield/ha was positively correlated with pod yield/ha (r=0.54), kernel yield/plant (r=0.84), pod yield/plant (r=0.32), and number of pods/plant (r=0.57). However, 100-kernel weight, days to flowering and shelling percentage were found not to be correlated with all the other traits.

These relationships indicate that the trait, number of pods per plant, which was found to show higher heritability and positively correlated with yield traits such as pod and kernel yields per hectare, can be a good criterion to be used in selection programmes to improve yield of peanuts. One-hundred-kernel weight, although giving a high heritability estimate, however did not show good correlations with the yield traits, and thus, is not a good criterion for selection.

CONCLUSION

Lines and varieties evaluated represented quite a wide range of performance and genetic variability, as they were originated from various countries. With this range of performance they could be good sources for genetic studies and breeding programmes.

Number of pods per plant, which was found to show high heritability and positively correlated with yield traits can be a good criterion to be used in breeding and selection programmes to improve yield of peanuts.

REFERENCES

1. Coffelt TA and Hammons RO : Correlation and heritability studies of nine characters in parental and intraspecific-cross populations of Arachis hypogaea L. Olegineux, 29:23-27, 1974.

2. Food and Agriculture Organization : FAO Production Yearbook, 42:157, 1988.

3. Hammons RO : Genetics of Arachis hypogaea. In : Peanuts-Culture and uses. Amer Peanut Res and Educ Assn, Inc. Stillwater, Okla, USA, pp 135-173, 1973.

4. Lim ES and Othman H : The reproductive characters of four varieties of groundnuts (Arachis hypogaea L.,) Pertanika 7:25-31, 1984.

5. Saleh GB and Ramli MN : Unexploited legume crops in Malaysia and their future potential. Food Legumes and Coarse Grains Newsletter, No 14, FAO-UNDP, pp 9-19, 1990.

6. Simmonds NW : Principles of crop improvement. Longman Inc, NY, p 408, 1979.

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