Pak. J. Bot., 33(2): 191-196, 2001.

STABILITY ANALYSIS FOR POD YIELD IN GROUNDNUT (*ARACHIS HYPOGAEA* L.)

NAAZAR ALI, MALIK SHAH NAWAZ, M. YASIN MIRZA AND GHULAM RAZA HAZARA

Oilseeds Research Programme, National Agricultural Research Centre, Islamabad, Pakistan.

Abstract

Ten promising genotypes of groundnut were evaluated for their adaptiveness and stability performance at eight different locations during 1997. The G x E interaction was highly significant. The regression coefficients (b) ranged from 0.76 to 1.17 and deviations from regression (S^2d) ranged from 0.06 to 0.82. BM-28 and ICGV-86550 showed above average performance, unit slop and non significant deviation from regression and thus are suitable for wide range of environments. Four genotypes, Gori, ICG-7326, CINA and Chinese 68-4 possessed b < 1 and mean performance was also below average hence are suitable for poor environment. Out of all the tested genotypes, ICG-4993 had greater than unit regression coefficient (bi=1.14) and highest significant (S^2d) (0.82) indicating its unsuitability for wider cultivation.

Introduction

Different concepts of stability and techniques for computing stability parameters and partitioning of total variation due to genotype x environmental interaction have been proposed and compared in various crops (Finlay & Wilkinson, 1963: Eberhart & Russell, 1966: Shulka, 1972; & Freeman, 1973). In groundnut, the interpretations and statistics of Eberhart & Russell (1966) are commonly used for stability studies. Yadava & Kumar (1978) studied 15 genotypes for two stability parameters viz., regression coefficient (b) and deviation from regression (S^2d) and found that strain Faizpur 1-5 was a stable cultivar for both high pod yield and early maturity. In another study they found that both linear regressions and deviations were significant for maturity and fruit characteristics in bunch group of groundnuts (Yadava & Kumar, 1979). Singh *et al.*, (1975) reported significant differences in the linear component of the genotype x environment interactions, but non significant deviations from regression among 8 cultivars for yield. Khan *et al.*, (1998) also reported significant genotype environments for many traits in both linear and nonlinear components. They identified, ICGC-83 as stable variety for yield and ICG-7326 as stable variety for shelling percentage. Patil *et al.*, (1983) evaluated four promising bunch varieties of groundnut for yield performance and stability over four locations in Maharashtra. The variety JL-24 was found stable which performed consistently well under poor as well as good environmental conditions as compared to SB-X1. Moinuddin *et al.*, (1998) reported significant differences among environments and GXE interaction for all the traits studied in groundnut. They also reported significant effect due to environment linear for all characterstics. Variance due to genotype environment (linear) was also significant for number of branches and pod/plant. Sojitra & Pethani (1998) reported the importance of non-linear components of variance for 1000 pod weight and shelling percentage. Small pod variety (J-11) was reported widely adaptable and another bold pod varieties (GG-2 and Girnar) of groundnut were insensitive to change in environment. Schilling *et al.*, (1983) studied stability of two multilines and their four components in groundnut. The components of a multiline NC 77-7 showed significant variability for yield, regression coefficient and deviation from regression. However, the multiline performed in a stable manner with high yields and low deviation from regression. They further indicated that the mean yield, regression coefficients and deviation from regression were the useful parameters in the formation of multiline.

Groundnut is a major cash crop in rainfed areas of Pakistan which are divided into three categories (low, medium and high rainfall). Only 10% area is grown as irrigated in southern parts of the country. Annual production fluctuates due to sensitive behavior of the genotypes to different environmental conditions. Since a stable variety is desirable for its commercial exploitation over a vide range of environments, it is necessary to develop and / or identify superior genotypes which should be able to produce consistently better yields. The prime objective of the present study was to evaluate the promising groundnut genotypes for their adaptability and stability under different agro-climatic conditions in Pakistan before their release as commercial varieties.

Materials and Methods

Ten groundnut genotypes viz., SP-97, Gori, BC-12, BM-28, ICG-4993, ICG-7326, ICGV-86550, CINA, Chinese 68-4 and BARD-479 (Check) were evaluated for yield performance study at 8 locations during 1997 (Table 1). The experiment at each location was conducted in a randomized complete block design with 4 replications. Each entry was planted in a plot having 4 rows of 5 meter length. The row and plant spacings were kept 45 and 10 cm, respectively. Fertilizer dose (20:80 kg NP per hectare) was incorporated at the time of planting. The experiments were maintained in accordance with the recommended cultural practices. Data for pod yield per plot was taken in grams and converted to kg/ha.

A combined analysis of variance over locations was computed assuming replications and locations effects as random and genotypes were considered as fixed variable (Steel & Torrie, 1980). The genotype x environment effect sum of squares were partitioned and all effects were tested against appropriate error terms. A genotype which has high mean yield, a regression coefficient (b) close to 1.0 and deviation from regression (S^2d) near to zero, is defined as stable for yield. Yield stability parameters were computed following Eberhart & Russell Model (1966). An environmental index was computed for each testing site by subtracting grand mean of all experiments from the mean of all varieties in each environment. The mean of each variety was regressed upon the environmental index. Regression coefficients and the deviations from the regressions were obtained as parameters for evaluating the yield stability over environments.

Results and Discussion

Differences in mean yield performance of 10 groundnut genotypes were highly significant at all locations and indicated large amount of variability (Table 1). Highest pod yield was obtained at Attock (4.0135 t/ha) followed by Kark (3.5850 t/ha) and Bahawalpur (3.4989 t/ha), while the lowest yield was recorded at NARC (1.0923 t/ha). The yield ranking of genotypes varied with different environments. ICG-4993 was the

Table 1. Pod Yield (t/ha) of 10 groundnut genotypes at 8 different locations during 1997.

S.No.	Entry	NARC	Attock	Chakwal	Karak	Kohat	Faisalabad	Bahawal	Mingora	Mean
1.	SP-97	1.261 b	3.972 a	1.339 e	4.564 a	0.986 e	2.167 b	3.125 b	3.852 a	2.658
2.	GORJ	0.823 d	4316 a	1.273 f	2.414 c	0.869 f	2.444 c	2.739 c	1.444 a	2.040
3.	BC-12	0.842 d	4.284 a	2.741 a	4.566 a	0.681 a	3.125 a	3.014 b	3.852 a	2.888
4.	BM-28	1.164 b	3.790 b	2.845 a	5.036 a	1.403 a	2.514 b	4.125 a	3.333 a	3.026
5.	ICG-4993	1.039 b	4.432 a	2.210 c	3.277 b	1.056 c	2.264 d	5.319 a	1.778 d	2.672
6.	ICG-7326	1.661 a	3.827 b	1.770 d	3.683 b	1.319 d	2.375 d	3.264 b	2.296 c	2.524
7.	ICGV-86550	0.899 c	4.252 a	1.985 c	3.345 b	1.194 c	2.931 a	3.778 a	2.889 b	2.659
8.	CINA	1.251 b	3.113 d	1.031 f	3.059 c	0.736 f	2.111 d	1.903 a	3.778 a	2.123
9.	Chineese 68-4	0.992 b	3.532 c	1.124 f	2.744 c	0.833 f	3.014 a	3.111 b	3.778 a	2.391
10.	Bard-479	0.991 b	4.617 a	2.373 b	3.162 c	1.014 b	2.208 d	4.611 a	2.778 b	2.719
Location Mean		1.093	4.014	1.869	3.585	1.009	2.515	3.499	2.978	2.571

Means having same letters in a column do not differ significantly ($P<0.05$).

highest yielder (5.32 t/ha) at Bahawalpur followed by BM-28 (5.00 t/ha) and BARD-479 (4.61 t/ha) at Kark and Attock, respectively, whereas, SP-97 and BC-12 were at par (3.85 t/ha) at Mingora (Swat). Moreover, the same genotypes were at par in yield performance (4.57 t/ha) at Kark. So far as the differences in mean yield performance of different genotypes across environments is concerned, BM-28 was found the highest yielder (3.026 t/ha) followed by BC-12 (2.888 t/ha) and BARD-479 (2.710 t/ha). However, SP-97 and ICGV-86550 were at par yielding 2.658 t/ha.

Table 2. Pooled analysis of variance for stability of pod yield in 10 groundnut genotypes.

Source of Variation	DF	Mean Squares
Genotypes (G)	9	0.775*
Environment (E)	7	52.911**
Environment + G x E	70	1.665**
Environment (linear)	1	92.589**
G x E (linear)	9	0.201
Pooled deviations	60	0.369
SP-97	6	0.350
Gori	6	0.414
BC-12	6	0.379
BM-28	6	0.350
ICG-4993	6	0.825*
ICG-7326	6	0.100
ICGV-86550	6	0.065
CINA	6	0.520
Chinese 68-4	6	0.378
BARD-479	6	0.308
Pooled error	216	0.327

* = $P< 0.05$ and ** = $P< 0.01$.

Table 3. Stability parameters for 10 groundnut genotypes.

Genotypes	Mean Pod Yield (t/ha)	% Difference from average	b	S^2d	R^2
SP-97	2.658	3.38	1.12**	0.3496	0.85
Gori	2.040	-20.65	0.89**	0.4136	0.75
BC-12	2.888	12.33	1.17**	0.3792	0.85
BM-28	3.026	17.70	1.05**	0.3496	0.83
ICG-4993	2.672	3.92	1.14**	0.8240	0.71
ICG-7326	2.524	- 1.83	0.79**	0.1002	0.91
ICGV-86550	2.659	3.42	1.02ns	0.0649	0.96
CINA	2.122	-17.46	0.76*	0.5203	0.63
Chinese 68-4	2.391	- 7.00	0.93**	0.3784	0.78
BARD-479	2.719	5.76	1.13**	0.3075	0.86

* = $P< 0.05$
** = $P < 0.01$
ns = Non-signification

Pooled analysis of variance indicated significant genotype x environment interaction ($p<0.01$) that showed the influence of changes in environment on the yield performance of the genotypes tested (Table 2). Partitioning of G x E interaction into linear (Environment + G X E) and non linear (pooled deviations) components reflected that both were important in determining the differential response of genotypes to varying agro-climates. Highly significant environment linear item indicated that the response of genotypes to environments was controlled genetically. However, it is also obvious that the differences in the stability of genotypes are due to linear regression as the deviations from regression were non significant (Table 2). Similar findings have been reported by Khan *et al.*. (1988) and Ahmad *et al.*, (1996).

Eberhart & Russel (1966) suggested that a genotype may be said to be stable over different environments if it shows unit slope (b) with low deviation from regression (S^2d) and high *per se* performance. In the present investigation, the regression coefficients ranged from 0.76 to 1.17 (Table 3). One of the top yielder genotype (BM-28) followed by ICGV-86550 had slop around unity; whereas SP-97, BC-12, ICG-4993 and Check variety (BARD-479) had regression coefficient greater than unity and showed above average response. Four genotypes viz., Gori, ICG-7326, CINA and Chinese 68-4 possessed $b<1$ with low *per se* yield performance showing below average stability and are suitable for poor environments. Genotypes BM-28 and ICGV-86550 have regression coefficient near to unity, hence are well suited to wide range of environments. Genotype BC-12, SP-97 and BARD-479 with the regression coefficients greater than unity and above average yield performance contributed a lot to the G x E interaction and are suitable for favourable environments. Out of these tested genotypes, ICG-4993 had $b>1$ (1.14) and significant S^2d (0.82) indicating its unsuitability under varying environments. Similar results were reported by Sharma *et al.*, (1980), Faris *et al.*, (1981), Yadava & Kumar (1978), Patil *et al.*, (1983), Khan *et al.*, (1988) and Javed *et al.*, (1996).

The top yielding variety BM-28 (3.026 t/ha) showed unit regression coefficient (1.05) and non significant deviation from linearity. ICGV-86550 also showed above average yield performance, unit regression and non significant deviation from regression (Table 3). These two genotypes were found stable and desirable by using Eberhart & Russel Model (1966). Thus, BM-28 and ICGV-86550 may be recommended as future groundnut varieties for cultivation in wide range of environments.

References

Ahmad, J., M.H. Choudhery, S. Salahuddin and M.A.Ali. 1996. Stability for grain yield in wheat. *Pak. J. Bot.*, 28: 61-65.

Dhillon, S.S., K. Sing, and K.S. Brar. 1999. Stability analysis of elite strains in Indian mustard. *Proceedings of 10th International Rapeseed congress held at Camberra, Australia.*

Eberthart, S.A. and W.A. Russell. 1966. Stability parameters for comparing varieties. *Crop Sci.*, 6: 36-40.

Faris, M.A., M.R.A. de Araujo and M.de A. Lira. 1981. Yield stability of forage sorghum in Northeastren Brazil. *Crop Sci.*, 21: 132-134.

Finlay, K.W. and G.N.Wilkinson. 1963. The analysis of adaptation in a plant breeding programme. *Aust. Jour. Agric. Res.*, 14: 742-754.

Freeman, G.H. 1973. Statistical methods for the analysis of genotype environment interaction. *Heredity*, 31: 339-354.

Khan, A., M. Rahim, N.J. Malik and A. Khan. 1998. Phenotypic stability of pod yield and related characters in bunch type Peanut genotypes. *Sarhad J. Agric. Res.*, 14: 441-446.

Khan, M.I., N.A. Khan and A.S. Khan. 1988. Evaluation of different sorghum genotypes for stability in yield performance. *Pak. J. Agri. Res.*, 10: 237-243.

Moinuddin, H.H., B.G.S. Reddy, H.C.Lohithaswa, R.A. Sharief, Kulkarni and B.R. Patil. 1998. Stability for yield and its components in groundnut (*Arachis hypogaea* L.). *Indian J. Oilseeds Res.*, 15: 241.

Patil, P.S., S.S. Patil and A.B. Deokar. 1983. Stability of pod yield in bunch varieties of groundnut (*Arachis hypogaea* L). *Madras Agric. J.*, 70: 644-646.

Schilling, T.T., R.W. Mozingo, J.C. Wynne and T.G. Isleib. 1983. A comparison of peanut multilines and component lines across environments. *Crop Sci.*, 23: 101-105.

Sharma, S.M., K.K. Jain, R.C. Rai and N. Singh. 1980. Evaluation of yield level and stability performance of soybean genotypes. *Indian J. Agric. Sci.*, 50: 650-654.

Shulka, G.K. 1972. Some statistical aspects of partitioning genotype-environment components of variability. *Heredity*, 29: 237-245.

Singh, M., S.S. Bodwal and S.V.Jaswal. 1975. Stability of pod yield in groundnut. *Indian J. Agric. Sci.*, 35: 26-28.

Sojitra ,V.K. and K.V.Pethani. 1998. Phenotypic Stability for yield components in bunch groundnut. *Indian Journal of Legume Research*, 21: 213-216.

Steel, R.G.D. and J.H. Torrie. 1980. *Principles and procedures of statistics*, 2nd Ed. McGraw Hill Book Co., Inc. New York.

Yadava, T.P. and P. Kumar. 1978. Stability analysis for pod yield and maturity in bunch group of groundnut (*Arachis hypogaea* L). *Indian J. Agric. Res.*, 12: 1-4.

Yadava, T.P. and P. Kumar. 1979. Phenotypic stability for yield components and oil content in bunch group of groundnut (*Arachis hypogaea* L). *Indian J. Agric. Sci.*, 49: 318-321.

(Received for publication 27 October 1999)