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Short Communication

Genotype x environment interaction for pod yield and yield components of groundnut varieties in warm sub-humid climate and moderately acidic soil

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Groundnut is an important oilseed crop of India. In Orissa, it is grown in *kharif* season as rainfed crop and in *rabi* season either under residual moisture condition or under irrigated condition. More than 170 varieties of groundnut have been developed and released by 2009 but the farmers prefer to grow varieties like AK 12-24 and TMV 2 for both the seasons which are about 70 years old. So it is necessary to identify new variety which could perform more or less uniformly under both the seasons. In view of the better expression of certain characters under specific environmental conditions the stability analysis helps to isolate genotypes adapted to particular seasons [1]. Information about phenotypic stability is useful for selection of crop varieties as well as for breeding programmes [2-4]. The stability of yield in different groundnut genotypes are ultimately imparted through the stability of their different component characters in additive fashion.[5]. Therefore, this study was undertaken to evaluate groundnut varieties for stability of their pod yield and component characters of yield under both *kharif* and *rabi* seasons for two years.

The field experiments were conducted at Regional Research and Technology Transfer Station, Chiplima, Orissa University of Agriculture and Technology (latitude 20^0 21' N and longitude 80^0 55' E at an elevation of 178.8 m above mean sea level). The area is having warm sub-humid climate with moderately acidic sandy loam soil. The experimental materials comprised of fourteen groundnut varieties including two commercial checks (AK 12-24 and TMV 2) and one promising genotype, TG 38 C. These varieties were grown during *kharif* 2007, 2008 (rainfed), *rabi* 2007-08 (irrigated) and *rabi* 2007-08 (irrigated and mulched @ 55 kg paddy straw/100 m^2). The materials were sown in randomized complete block design (RCBD) with three replications. Each variety of three rows of 5 m length was planted at a spacing of 30 cm x 10 cm. Observations were recorded on plant height, shelling percentage, hundred kernel weight, kernel yield/ha and pod yield/ha. The genotype by environment interaction analysis was carried out with the model proposed by Eberhart and Russell [6].

The analysis of variances for the individual environments revealed significant differences for all the characters in all the four environments indicating existence of genetic differences among the groundnut varieties studied. Pooled analysis of variance for stability performance of different varieties showed highly significant differences for all the traits. Thus the varieties were significantly different for all the characters. The environments were random and variable which influenced the expression of most of the traits studied (Table 1). Pooled analysis of variance for genotype by environment interaction revealed the presence of significant differences among the genotypes and environments for all the characters. Mean squares due to variety x environment interaction were highly significant for all the traits when tested against pooled error. It revealed the significant differential response of the varieties to the changing environments. Further, mean square due to environment + (variety x environment) was also significant in pooled analysis of variance for genotype by environment interaction for all the traits. The environment linear component for studied characters was also significant. The significant mean

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squares confirmed that the environments were random and different and they exercised influence on the expression of the trait and this variation could have arisen due to the linear response of the regression of the variety to the environment. The mean square due to G x E (linear) were significant for the characters revealing that the behavior of the varieties could be predicted over the environments more precisely and accurately as the G x E interaction was the out come of the linear function of the environmental components. Similar results were also reported by Thaware [7].

The non linear component arising due to the heterogeneity measured as mean square due to pooled deviation was significant for pod yield and kernel yield revealing presence of non linear response of the varieties to the changing environments. The varieties differed with respect to the stability of pod yield and kernel yield making their prediction more difficult. However, the magnitude of linear component i.e. environment (linear) and variety x environment (linear) was quite higher than the non-linear component (pooled deviation) for most of the characters revealing that the prediction of stability could be reliable though it may get affected to some extent. The non linear component in plant height, shelling percentage and hundred kernel weight was non significant. It revealed that the G x E interaction for these traits was greatly influenced by environmental factors and there exists either no relationship or complex relationship between varieties and environmental effect making its prediction more difficult for these traits.

The estimates on the three stability parameters, mean performance (x_i), regression co-efficient (b_i) and deviation from regression (S^2d_i) for different traits are presented in Table 2. It is evident from the table 2 that the varieties AK 12-24, TG 37 A, JL 24, TMV 2, GPBD 4 and R 2001-3 having regression value nearer to unity and non significant deviation from regression for pod yield and kernel yield were highly stable for kharif (unfavorable) and rabi (favorable) season. Among theses stable varieties, R2001-3 exhibited highest mean pod and kernel yield. While AK 159 and Kissan having high mean pod and kernel yield along with b_i more than unity and non significant deviation (S^2d_i) signifies their stability for rabi season (irrigated and straw mulched). Variety TG 26 had high mean, b_i less than unit and non significant deviation (S^2d_i), which means it is suitable for rainfed kharif condition. The old varieties, AK 12-24 and TMV 2 are highly stable in yield performance in both the season having unit regression and non significant deviation. But their mean pod yield and kernel yield were less than the recently released variety, R2001-3.

For plant height OG 52-1, AK 12-24, TG 37 A, Dh 86 and Jawan having high mean values, b_i more than unit with non significant deviation (S^2d_i) indicating their below average stability. For the same trait, TAG 24, TMV 2 and Kissan were showing b_i near to unity and non significant S^2d_i indicating average stability. Variety TG 26, AK 159 and R2001-3 with b_i less than 1 and non significant deviation, were found to be above average stable for plant height.

High mean values with unity regression coefficient (b_i=1) and non significant deviation from regression (S^2d_i=0), variety AK 12-24, TG 37 A and TMV 2 were found to be highly stable for shelling percentage. For hundred kernel weight, highest mean values with regression value less than unity and non significant deviation from regression of OG 52-1 indicates above average stability for this trait. Except TG 26 and TG 38C all the varieties are found to be stable for hundred kernel weight with unity regression coefficient and non significant deviation from regression.

Table 1. Analysis of variance for yield and yield contributing traits under different environments

Source of variation	df	Mean squares				
		Plant height	Shelling percentage	Hundred kernel weight	Kernel yield	Pod yield
Varieties(G)	13	183.45*	20.75*	37.99*	12.30*	23.43*
Environment(E)	3	164.23*	1171.09*	171.97*	306.96*	371.85*
G x E	39	46.74*	2.74*	5.60*	3.16*	5.50*
Env. + (G x E)	42	162.72*	86.19*	17.48*	24.86*	31.67*
Env. (linear)	1	4992.68+	3513.27+	515.92+	920.88+	1115.55+
G x E (linear)	13	72.90+	6.25+	9.93+	5.90+	6.61
Pooled deviation	28	31.26	0.91	3.19	1.66*	4.60*
Pooled error	112	30.97	1.86	2.71	0.99	1.70

* Significant against pooled error m.s., + Significant against pooled deviation m.s. at 5 % level

Table 2. Stability parameters of groundnut varieties for yield and yield contributing traits

Variety	Plant height(cm)			Shelling percentage			Hundred kernel weight(g)			Kernel yield (q/ha)			Pod yield (q/ha)		
	xi	bi	S^2di	xi	bi	S^2di	xi	bi	S^2di	xi	bi	S^2di	xi	bi	S^2di
OG 52-1	54.2	1.63	-9.7	71.5	0.82*	-1.8	39.1	0.46	-2.3	11.4	0.97	3.2*	15.8	1.05	5.2*
AK12-24	52.8	1.64*	-23.7	74.0	1.00	-1.9	32.7	1.14	-2.0	10.8	1.09	0.7	14.3	1.08	0.9
TAG 24	38.1	1.02	-6.9	70.2	1.11	0.5	33.6	0.94	-1.2	8.8	0.54*	0.6	12.5	0.51	1.8
TG 26	34.0	0.60	-20.9	71.0	0.80	-1.1	32.4	0.37*	15.7*	12.3	0.66*	-0.3	17.3	0.70	1.5
TG 37A	56.1	1.60	-24.9	74.1	1.01	-1.6	31.3	1.22	-2.0	10.1	1.17	0.3	13.3	1.19	1.2
TG 38C	43.8	0.98	87.3*	66.1	0.64*	-1.8	25.0	0.01*	5.5	9.3	0.39*	2.5*	14.1	0.45*	7.8*
AK 159	49.3	0.77	22.4	68.4	0.97	0.0	32.5	1.59	-2.4	12.2	1.31*	-0.5	17.4	1.35	1.6
Dh 86	57.9	1.21	-5.1	72.8	1.19*	-1.6	29.9	1.37	0.45	10.2	1.01	1.3	13.5	0.90	3.9*
Jl 24	49.3	0.55	100.1*	70.7	1.13*	-1.8	34.0	1.61	1.7	12.0	1.03	-0.5	16.7	1.00	-0.9
TMV 2	51.7	1.04	-29.4	74.2	0.96	-1.8	31.7	0.70	-1.5	12.1	1.19	-1.0	16.0	1.18	-1.1
Kissan	52.8	0.99	-21.0	71.7	1.16*	-1.3	34.3	1.50	-2.4	12.9	1.44*	-0.2	17.5	1.39	1.9
Jawan	54.6	1.24	-29.9	69.8	1.13*	-1.2	31.8	1.62	-1.8	12.1	0.84	3.6*	17.4	0.86	14.9*
GPBD 4	50.5	0.08*	-10.1	69.9	1.09	-0.5	29.5	0.58	1.1	11.2	1.23	0.1	15.5	1.21	2.3
R 2001-3	47.7	0.64	-24.0	71.9	0.98	2.7	31.8	0.90	-2.1	15.9	1.13	-0.6	21.9	1.14	-0.4
S. Em ±	3.23	0.30		0.55	0.06		1.0	0.29		0.74	0.16		1. 24	0.24	

*Significant at 5 % level

Based on the mean performance, regression coefficient and deviation from regression values, it is concluded that the stability of yield is imparted in the varieties TG 37 A, TMV 2 and R2001-3 through the stability of plant height, shelling percentage, hundred kernel weight and kernel yield whereas in AK 12-24 and GPBD 4 through the stability of shelling percentage, hundred kernel weight and kernel yield. Yield stability in JL 24 is imparted through hundred kernel weight and kernel yield. Similar results were also reported by Senapati and Sarkar [5] where different groundnut genotypes were stable for yield through their different component characters. Some of the varieties have been identified to suit with stability of performance in kharif and *rabi* season in respect of pod and kernel yield and related traits. The variety R 2001-3 is found to be stable for both *kharif* and *rabi* seasons for pod and kernel yield, while varieties AK 159 and Kissan are found to be suitable for *rabi* season. The variety TG 26 is suitable for rainfed *kharif* season. AK 12-24 is highly stable across season for pod and kernel yield but less yielder than TG 26 and R2001-3 which are best varieties for *kharif* and *rabi* season respectively. In the present investigation, stable varieties identified (AK 12-24 and R2001-3) could be used to develop new strains with combinations of stable characters. Moinuddin et al.[4] and Padi,[8] also reported the similar findings where stability of yield components varied in compensating manner in different genotypes imparting them stability for yield.

References

1. **Bentur Mohan G., Parameshwarappa K. G. and Malligawad L. H.** 2004. Stability analysis in large seeded groundnut *Arachis hypogaea* L. genotypes for pod yield and its component traits. J. Oilseeds Res., **21**:17-20.
2. **Jackson P., Robertson M., Cooper M. and Hammer G. L.** 1996. The role of physiological understanding in plant breeding: From a breeding perspective. Field Crops Res., **49**: 11-37.
3. **Van W. and Hunt L. A.** 1998. Genotype-by-environment interaction and crop yield. Plant Breed. Rev., **16**: 135-178.
4. **Moinuddin H. H., Suryanarayana Reddy B. G., Lohithaswa H. C., Sheriff R. A., Kulkarni R.S. and Patil B. R.** 1998. Stability for yield and its components in groundnut (*Arachis hypogaea* L.) . J. Oilseeds Res., **15**: 238-241.
5. **Senapati B. K. and Sarkar G.** 2002. Genotype-environment interaction and stability of yield and yield components in groundnut (*Arachis hypogaea* L.) J. Oilseeds Res., **19**: 26-31.
6. **Eberhart S. A. and Russell S. A.** 1966. Stability parameters for comparing varieties. Crop Sci., **28**: 36-40.
7. **Thaware B. L.** 2009. Stability analysis for dry pod yield in Spanish bunch groundnut. Agri. Sci. Digest., **29**: 221-223.
8. **Padi Francis Kwame.** 2008. Genotype x environment interaction for yield and reaction to leaf spot infections in groundnut in semiarid West Africa. Euphytica, **164**: 143-161.