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Research Article

Identification of selection parameters for evaluating superior stable genotypes of groundnut (*Arachis hypogaea* L.)

Priyanka Kumari[1], Shashi Kiran Tirkey[1], Ekhlaque Ahmad*[2], C. S. Mahto[1], Jenny Priya Ekka[1] and Swapnil[1]

[1]Department of Genetics & Plant Breeding, Birsa Agricultural University, Ranchi-834006
[2]Zonal Research Station (*Birsa Agricultural University*), Chianki, Palamau-822102
***E-Mail:** ekhlaque.bau@gmail.com

Abstract
The pooled analysis of variance revealed highly significant differences between the genotypes for days to flowering, oil per cent and protein content. However, the environmental differences were found to be highly significant for all the characters. The genotype x environment (G x E) interaction was found to be highly significant for days to maturity and pod yield per plant. Both linear and non-linear components of environment were found to be highly significant for all the six characters studied. However, the linear component was found to be greater in magnitude than the non-linear component except oil per cent and protein content. Based on the consideration of stability parameters i.e. b_i=1, s^2d_i = 0 and high mean performance according to the model proposed by Eberhart and Russell (1966), five groundnut genotypes were found stable for days to flowering, eight genotypes stable for days to maturity, two genotypes showed stability for oil per cent, three genotypes for protein content, two genotypes for kernel yield per plant and only one genotype showed stability for pod yield per plant. The genotypes K-1802 and JSP-63 were found to be more stable for quality parameters *i.e.* oil per cent and protein content. Moreover, genotype Birsa bold was found to be stable for pod yield per plant and for kernel yield per plant, BAU-26 and BG-4 with consistent results were identified as stable genotypes which can be cultivated even in drought condition.

Keywords*:* Regression coefficient, G x E interaction, adaptability, environment, stability

INTRODUCTION

Groundnut (*Arachis hypogaea* L.) is an important legume and oilseed crop as its seed contains 44–56% oil and 22–30% protein on a dry seed basis (Savage and Keenam, 1994). It is the most important oilseed cash crop of tropical, sub-tropical and warm temperate regions of the world. It is the world's fourth most important legume crop grown mainly for its quality edible oil (44–56%) and third most important source of easily digestible protein (22–30%), (Encyclopedia of Agricultural science, 1994). India is the largest groundnut producing country in the world followed by China. In India, groundnut occupies 24% of the world area and contributes 20% in groundnut production but still deficit in productivity as compared to the world average. This low yield levels are attributed due to the uneven distribution of rainfall, low input use, lack of plant protections measures, use of low yielding varieties, abiotic stresses particularly drought and cultivation of crops on marginal and sub-marginal lands under rainfed conditions thereby limiting the crop growth and yield. Hence, adaptability as well as stability of the varieties becomes far more important. Moreover, the trait yield is a polygenically controlled complex trait that is determined by a number of yield components which are greatly affected by various environmental factors. Thus, ultimate need of the hour is to develop stable genotypes. Therefore, an attempt has been made in the present study to evaluate different groundnut genotypes across different locations to know the role of G x E interactions and also analyse the stability of genotypes for different traits. The objective of this research was to evaluate and identify stable genotypes for its wider adaptability over three different environments and for six characters namely days to flowering, days to maturity, oil per cent, protein content, pod yield per plant and kernel yield per plant by adopting Eberhart and Russell Model of stability analysis.

MATERIALS AND METHODS

The present research work was conducted in eighteen virginia groundnut genotypes (*Arachis hypogaea* L.) sown under three different locations i.e. groundnut experimental area, rainout shelter of Birsa Agricultural University, Ranchi and at experimental area of ZRS, Chianki during *kharif*, 2018. The genotypes were raised in a randomized block design with three replications under each location. The row to row and plant to plant spacing was 45 cm and 15 cm respectively at each location. However, genotypes evaluated under rainout shelter of BAU campus were subjected to drought stress during flowering, pegging and pod development stages whereas genotypes under other two locations were grown under rainfed conditions of Jharkhand. The fertilizer dose of Nitrogen, Phosphorus and Potassium applied at each location was in the ratio of 25:50:20 kg/ha and all other recommended agronomic practices were appropriately followed. The observations were recorded on six parameters (days to flowering, days to maturity, oil per cent, protein content, pod yield per plant and kernel yield per plant) at each location separately and were statistically analysed using of Eberhart and Russell (1966) model to identify stable groundnut genotypes.

RESULTS AND DISCUSSION

Data were analysed to test the significance of differences among various characters observed at each location. The results of pooled analysis of variance (**Table 1**) revealed highly significant differences between the genotypes for days to flowering, oil per cent and protein content which indicated the presence of remarkable genetic variation among the genotypes. Environmental differences were found to be highly significant for all the characters studied indicating the noteworthy role of environment on the genotypes. The genotype x environment (G x E) interactions were found to be highly significant for days to maturity and pod yield per plant which revealed that the interaction of genotypes varied with different environmental conditions existing at each location under the study. The existence of significant G x E interaction for days to maturity were also reported by Kumar *et al.* (1984) and Chavan *et al.* (2009). Both linear and non-linear components of environments were found to be highly significant for all the six traits studied but the linear component was found to be greater in magnitude than the non-linear component except oil per cent and protein content. The results are in accordance with the findings of earlier workers *viz.,* Prakash *et al.* (1984), Sojitra and Pethani (1998), Ali *et al.* (2001) Ahmad *et al.* (2008) and Reddy *et al.* (2016). Similar result was reported by Patil *et al.*(2014) for days to flowering, days to maturity and oil content while Mothilal *et al.* (2010) for kernel yield. Also, the results reported by Srinivas *et al.* (2016) for oil content are in accordance with the present observation.

The significance of non-linear component indicates the role of unpredictable portion of environment which might influence the traits under study (Joshi *et al.,* 2003). Further, the significance of linear component indicated that the regression coefficient estimated was different in various genotypes and for the characters studied.

Table 1. Stability ANOVA for six characters in 18 genotypes of groundnut under three locations

Source of variation	df	Days to flowering	Days to maturity	Oil content (%)	Protein content (%)	Pod yield / plant (g)	Kernel yield/ plant (g)
Rep within Env.	6	2.59	1.65	1.38	0.18	15.77	5.13
Varieties	17	6.79*	13.93	17.50*	8.46**	32.23	8.46
Env + (Var. x Env.)	36	8.57**	294.16***	100.29***	80.30***	111.71*	111.19***
Environments	2	120.26***	5229.62***	1554.90***	1352.15***	1483.45***	1800.96***
Var. x Env.	34	2.00	3.84**	14.72	5.48	31.02**	11.79
Environments (Lin.)	1	240.52***	10459.23***	3109.81***	2704.30***	2966.90***	3601.92***
Var. x Env. (Lin.)	17	2.68	7.56**	7.36	1.91	51.76***	15.11
Pooled Deviation	18	1.25	0.11	20.86	8.56	9.72	7.99
Pooled Error	102	0.24	0.48	0.31	0.81	3.31	0.95
Total	53	7.99	204.27	73.73	57.26	86.22	78.24

(* $P \leq 0.05$; ** $P < 0.01$; *** $P < 0.001$)

Taking into consideration the trait pod yield per plant, the genotype RG-625 showed high mean performance with regression coefficient significantly greater than unity indicating that it would be highly responsive and adaptable only to rich environment with no limitations and may fail drastically when grown under poor environmental conditions. In contrast, the genotype GJG-18, BAU-32 & Rajmungfali-2 showed high mean performance for pod yield per plant and regression coefficient more than unity along with highest and significant deviation from regression indicating that these genotypes would be less responsive to any environmental conditions and may fail to respond well even under favorable environments. However, the genotypes GJG-18 and PBS-212067 showed good performance for pod yield per plant but with negative value of regression coefficient indicating that these would be highly sensitive to rich environmental conditions but might be specifically adapted to poor environmental conditions.

On grouping of genotypes for different plant characters based on the simultaneous consideration of stability parameters like regression coefficient (b_i) and deviation from regression (s^2d_i) *i.e.* b_i=1, s^2d_i = 0 and high mean performance according to Eberhart and Russell Model, five genotypes were found stable for days to flowering, eight genotypes were found stable for days to maturity, but only two genotypes showed stability for oil per cent, three genotypes were found stable for protein content, two genotypes for kernel yield per plant and only one genotype showed stability for pod yield per plant (**Table 2**).

The genotypes K-1802 and JSP-63 are more stable for both the quality parameters i.e. oil per cent and protein content, moreover the stable genotypes for pod yield per plant and kernel yield per plant are Birsa bold and BAU-26 and BG-4 respectively which can be cultivated even in drought situation with consistent results whereas rest of the genotypes showed significant deviation from regression. Hence, these genotypes with the respective parameters were not much influenced by the environmental conditions and are more stable across the locations than other genotypes indicating less sensitivity to environmental changes and were better adapted to poor conditions and with wider adaptability.

Based on the simultaneous consideration of stability parameters according to Eberhart and Russell Model i.e. b_i = 1, σ^2d_i = 0 and high mean performances,

Table 2. Estimation of mean and stability parameters for six characters in 18 genotypes of groundnut at three locations

S. No.	Genotypes	Days to first flowering			Days to maturity			Oil content (%)		
		Mean	b_i	σ^2d_i	Mean	b_i	σ^2d_i	Mean	b_i	σ^2d_i
1	JSP-62	29.22	1.09	-0.32	130.17	1.14	-0.28	39.18	1.06	35.69
2	BAU-26	27.78	0.67	0.38	128.22	1.11	-0.36	37.65	0.99	15.37
3	K-1802	29.17	0.70	0.25	129.00	1.12	-0.33	37.40	1.04	0.35
4	BAU-29	28.00	0.61	0.68	128.72	1.01	-0.53	38.12	1.03	13.30
5	JSP-63	28.22	1.09	-0.32	129.28	1.14	-0.47	37.94	1.34	-0.37
6	BG-4	28.61	0.58	0.85	130.17	1.04	-0.47	37.72	0.77	0.58
7	GJG-18	25.17	1.79	3.77	129.28	1.09	-0.52	32.44	1.41	110.52
8	BAU-31	28.61	0.58	0.85	128.94	1.00	-0.52	35.70	0.86	17.94
9	RG-625	25.83	1.61	2.07	130.28	1.04	-0.54	38.48	1.04	8.05
10	PBS-212067	28.00	0.84	-0.36	132.39	0.88	-0.29	31.45	1.09	65.79
11	BAU-32	28.17	0.70	0.25	129.39	1.08	-0.53	39.18	0.77	7.85
12	RTNG-29	28.28	0.40	2.11	132.61	0.87	-0.25	37.49	0.87	12.82
13	JSSP-50	24.50	1.43	0.82	128.94	1.00	-0.52	37.00	0.77	33.37
14	BG-3 (C)	24.94	1.86	4.43	135.11	0.81	-0.49	32.74	0.63	1.58
15	Birsa Bold(C)	29.61	1.13	-0.28	130.39	1.08	-0.23	37.81	0.88	0.83
16	Rajmungfali-2 (C)	27.50	0.88	-0.27	131.83	0.85	-0.53	34.88	1.13	22.61
17	ICGS-76(C)	27.72	1.37	0.50	134.28	0.93	-0.52	39.86	1.13	12.89
18	M-335(C)	27.78	0.67	0.38	134.33	0.80	-0.48	37.17	1.20	9.64
	Population mean	27.62			130.74			36.79		

b_i: Regression coefficient; σ^2d_i: Deviation from Regression); (C): checks

Table 2. Continued

S. No.	Genotypes	Protein content (%)			Pod yield/plant (g)			Kernel yield /plant (g)		
		Mean	b_i	$\sigma^2 d_i$	Mean	b_i	$\sigma^2 d_i$	Mean	b_i	$\sigma^2 d_i$
1	JSP-62	33.16	0.93	16.18	22.57	1.59	7.51	8.63	1.13	5.83
2	BAU-26	36.28	1.00	-0.33	22.83	1.26	-1.55	9.17	1.06	-0.76
3	K-1802	37.74	1.06	-0.54	24.50	1.30	10.72	9.65	1.19	1.59
4	BAU-29	36.36	0.86	12.27	26.61	1.21	-3.62	10.57	1.18	-1.18
5	JSP-63	38.17	1.03	0.27	23.44	0.96	3.07	9.74	1.12	-1.03
6	BG-4	37.87	1.19	-0.77	26.10	1.37	9.89	9.95	1.17	-0.03
7	GJG-18	39.63	1.10	14.98	26.24	-0.17	31.38	11.84	0.84	61.36
8	BAU-31	37.58	1.01	5.67	21.36	0.56	-2.93	8.05	0.83	0.03
9	RG-625	35.42	1.12	1.48	29.78	1.91	-3.46	11.67	1.50	8.77
10	PBS-212067	37.94	0.85	16.12	20.21	-0.07	3.58	7.62	0.51	28.59
11	BAU-32	35.76	0.95	10.35	19.81	0.98	19.88	6.85	0.79	-0.93
12	RTNG-29	34.60	0.93	7.46	20.86	1.27	-0.62	7.49	0.90	-0.04
13	JSSP-50	37.42	1.10	10.42	18.79	0.27	-3.81	7.32	0.65	6.58
14	BG-3 (C)	34.33	0.85	17.02	19.80	1.19	4.28	7.73	0.94	0.39
15	Birsa Bold(C)	37.10	1.15	0.10	23.39	1.28	0.69	10.90	1.39	5.89
16	Rajmungfali-2 (C)	34.71	1.10	1.56	25.05	1.55	23.51	10.09	1.34	9.31
17	ICGS-76(C)	38.29	0.92	28.31	17.20	0.74	-0.29	6.73	0.70	-0.60
18	M-335(C)	36.71	0.84	-0.49	19.58	0.79	4.76	6.94	0.76	-1.13
	Population mean	36.62			22.67			8.94		

b_i: Regression coefficient; $\sigma^2 d_i$: Deviation from Regression); (C): checks

the genotypes K-1802 and JSP-63 were found stable for both the quality parameters i.e. oil and protein content, the genotype Birsa bold was found to be stable for pod yield per plant and the genotypes BAU-26 and BG-4 were stable for kernel yield per plant. Selection of drought tolerant genotypes can be done particularly for yield based on their stable performance under different environmental conditions. Furthermore, these stable genotypes may be exploited as donor sources for developing new tolerant varieties to combat with climate change. This might also be helpful to identify location specific stable genotypes with better expression of specific characters under a particular environment.

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