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ORIGINAL ARTICLE **OPEN ACCESS**

Stability analysis for yield and its component traits in Groundnut (*Arachis hypogaea* L.)

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ABSTRACT

Twenty-one groundnut genotypes along with two checks were evaluated for stability analysis and to know the role of G x E interaction of yield and its component traits in three replications over three different environmental locations. Analysis of variance exhibited significant G x E interaction for days to 50 % flowering, days to maturity and 100-kernel weight. The analysis of variance for stability revealed that variance due to environment (linear) was significant for days to maturity, kernel yield per plant and pod yield per plot. The G x E (linear) interaction was found to be significant for days to 50 % flowering, days to maturity and 100 kernel weights. The pooled deviation was found to be significant for days to 50 % flowering, days to maturity, number of matured pods per plant, shelling percentage, sound mature kernel and oil content. The studies on stability parameters revealed that none of the genotypes were stable for all characters, however the genotype ICGV-00191 for days to maturity, JL-24 for number of mature pods per plant, LGN-162 for oil content, TG-68 and LGN-176 for kernel yield per plant, ICGV-00191 for pod yield per plant possesses average stability as it showed more stable performance across the environment and it is widely adaptable to all environments.

Key words: *Groundnut, Stability, G x E interactions, Yield components.*

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INTRODUCTION

Groundnut (*Arachis hypogaea* L.) is the most important oilseed crop of tropical, sub-tropical and warm temperate regions of the world. It is commonly called as the king of vegetable oil, poor man's nut, peanut or monkey-nut. Groundnut is the 13th most important food crop of the world and world's 4th important source of edible oil and 3rd most important source of vegetable protein. Globally, 50 percent of groundnut produce is used for oil extraction, 37 percent for confectionary use and 12 percent for seed purpose. The principal peanut growing countries are India, China, Africa (Senegal and Nigeria), USA, Pakistan and Sri-Lanka. India ranks first in the world in terms of area. In India, it is being grown on an area of 5.33 million hectares with production of 7.4 million tones. India ranks second in the world regarding groundnut production, but still the country is in deficit in productivity as compared to the world average. The low yield levels are attributed to cultivation of crop on marginal and sub-marginal lands under rain fed condition, lack of plant protections and use of low yielding varieties etc. Under such situations and in the fluctuating environment, adaptability of varieties becomes far more important. Stability of a genotypes to environmental fluctuations is important for stabilization of crop production both temporally and spatially. Yield is polygenically controlled quantitative complex character resulting from interplay of various yield contributing characters, since greatly affected by environmental factors. Thus, for consistence performance of genotype over wide range of environments stability of genotype is essential. Therefore an attempt has been made in present study to evaluate different groundnut genotypes over different locations to know the role of G x E interactions and also to analyze the stability of genotypes for different traits.

MATERIAL AND METHODS

Twenty-one groundnut genotypes *viz.*, LGN-125, LGN-162, LGN-163, LGN-169, LGN-176, LGN-184, LGN-188, LGN-189, ICGV-00191, ICGV-00201, ICGV-00202, ICGV-00206, ICGV-00211, ICGV-00213, ICGV-241, ICGV-00247, ICGV-07211 and ICGV-99058 with two checks (LGN-1and JL-24) were obtained from Oilseeds Research Station, Latur. The experiments involving all twenty-one genotypes was laid out in Randomized Block Design (RBD) with three replications were at Oilseeds Research Station, Latur (E_1), Oilseeds Research Sub-Station, Ambajogai (E_2), and Agricultural Research Station, Badnapur (E_3) during *kharif*, 2018. The sowing was carried out at the spacing of 30 cm between rows and 10 cm between the plants. The method of sowing followed was dibbling. The gross plot size 6.5 x 0.90 m^2 while net plot size was 6.3 x 0.90 m^2.The recommended dose of fertilizer 25: 50: 00 NPK kg/ha was applied at the time of sowing. All other package of practices and plant protection measures to raise a good crop were timely and uniformly carried out. Five plants were selected from each treatment randomly for recording observations *viz.* days to 50% flowering, days to maturity, number of mature pods per plant, pod yield per plant, kernel yield per plant, selling percentage, 100 kernel weight, sound mature kernel, oil content, pod yield per plot. For the estimating the stability of genotypes, stability analysis was done as per the Eberhart and Russell model.

RESULTS AND DISCUSSION

The results of pooled analysis of variances for ten characters over three environment revealed that the mean square due to genotypes were highly significant for all characters studied indicated the degree of genetic variability present among the genotypes. The variance due to environment was significant for days to maturity and kernel yield per plant. The G x E interaction was highly significant for days to 50 % flowering, days to maturity and 100-kernel weight indicating the differential response of genotypes in expression of characters to varying environments (Table 1). The existence of significant G x E interaction for days to maturity reported by Kumar *et al*. [4] for days to 50 % flowering, days to maturity and 100-kernel weight. The existence of G x E interaction reported by Chavan *et al*. [2] for days to maturity and 100-kernel weight.

The analysis of variance for stability parameters revealed that the variance due to environment + (genotype x environment) interaction were significant for 100-kernel weight. The variance due environment (linear) was significant for days to maturity, kernel yield per plant and pod yield per plot indicated considerable differences among the environments and their predominant effect on traits. The genotype x environment (linear) interaction was also significant for days to 50 % flowering, days to maturity and 100-kernel weight. This indicated that the stability parameters regression coefficient estimated by the linear component of the response to change in environment was different for various genotypes for these characters.

The stability performance of genotypes for different yield and yield contributing characters across the environments, it was observed that the variance due to pooled deviation (non-linear) were highly significant for all the characters except 100-kernel weight, kernel yield per plant, pod yield per plant and pod yield per plot, indicating the role of unpredictable portion of environment influencing these traits. Similar result was reported by Patil *et al*. [8] for days to 50 % flowering, days to maturity, number of mature pods per plant, shelling percentage and oil content. Similar result reported by Srinivas *et al*. [7] for oil content.

Estimates of regression coefficients (bi) and the deviation from regression (S^2di) (Table 2) showed a wide range of values for each character. The phenotypic stability of the genotype was measured by three parameters. Namely, mean performance over the environments, linear regression and deviation from regression. A stable genotype should have high mean performance, unit linear regression (bi) and deviation from regression (S^2di) as small as possible.

In the present investigation estimates of stability parameters for 50 % flowering revealed that genotype LGN-188 was quite stable across the environment having regression coefficient near to unity (bi=1) and non-significant deviation from regression (S^2di), but identified as late flowering genotype. The genotype ICGV-00206 and ICGV-00191 had lower mean, regression coefficient greater than unity (bi>1) and non-significant (S^2di) indicates below average stability and it suitable for better environment. The genotype ICGV-99058, TG-8 and LGN-163 showed lower mean values, regression coefficient less than unity (bi<1) with non-significant deviation from regression (S^2di) and early flowering indicating above average stability and respond especially to poor environment. Similar result was given by Singh and Sinha [6].

For days to maturity the genotype ICGV-00191 possesses average stability and identified as an early genotype having low mean, regression coefficient near to unity (bi=1) and non-significant deviation from regression (S^2di) and it is widely adaptable to all environment. The genotype LGN-189 showed low mean, regression coefficient less than unity (bi<1) and non-significant deviation from regression (S^2di), it means that the genotype has greater resistance to environmental changes having above average stability and it suitable for poor environment. The genotype LGN-162 identified as below average stability and it suitable for better environment. These results are in accordance with earlier finding of Nazar *et al*. [5] and Kadam *et al*. [3].

Table 1: Pooled Analysis of variance for stability of yield and yield components in Groundnut

Source of variation	DF	Days to 50% flowering	Days to maturity	No. of matured pods/ plant	Shelling percentage (%)	100 kernel weight (g)	Sound mature kernel (%)	Oil content (%)	Kernel yield / plant (g)	Pod yield /plant (g)	Pod yield / plot (g)
		Mean sum of squares									
Genotypes	20	5.998**	25.125**	4.211**	122.475	47.663**	7.380**	0.3907*	1.8366**	3.957**	10488.69**
Environments	2	0.823	6.676**	0.185	33.947	0.320	0.707	0.044	1.402*	0.924	4074.45
Genotype x Environment	40	1.730**	1.980**	0.937	52.002	2.186**	1.960	0.150	0.344	1.151	1562.19
Environment + (G x E)	42	1.688	2.205	0.9017	51.1430	2.0976**	1.9005	0.1453	0.3948	1.1404	1681.82
Environment (linear)	1	1.651	13.353**	0.3709	67.8955	0.6412	1.4140	0.0883	2.8047*	1.8483	8148.91*
Genotypes x Environment (linear)	20	2.344*	2.729*	0.7255	34.9976	3.7907**	1.9774	0.1229	0.2887	1.2631	1665.27
Pooled deviation	21	1.064**	1.175**	1.095**	65.722**	0.5545	1.851*	0.1693**	0.3811	0.9899	1389.64
Pooled error	120	0.273	0.2820	0.4574	4.1579	1.9110	1.1136	0.0713	0.3430	0.7486	1666.5

*** Significant at 5% level. ** Significant at 1% level.**

For number of mature pods per plant the genotype JL-24 was recorded as quite stable across the environment having regression coefficient near to unity (bi=1) and non-significant deviation from regression (S^2di). Regarding shelling percentage the genotype LGN-176 showed higher mean, regression coefficient greater than unity (bi>1) and non-significant deviation from regression coefficient (S^2di) indicating below average stability and its better adaptability to favourable environment. The genotype

ICGV-00201 exhibited high mean coupled with regression coefficient less than unity (bi<1) and non-significant deviation from regression (S^2di) indicating that the genotype has resistance to environmental changes having above average stability and its better adaptability to poor environment.

Considering the trait, 100 kernel weight the genotype LGN-162 and ICGV-00191 showed high mean, regression coefficient greater than unity (bi>1) and non-significant deviation from regression coefficients (S^2di) indicating below average stability. So, they were adapted specifically to better environment. None of the genotype found above average stability.

Table 2: Estimates of stability parameters for pod yield and yield components in Groundnut.

Sr. No.	Genotype	Days to 50% flowering			Days to maturity			No. of mature pods / plant (g)		
		Mean	bi	S^2 di	Mean	bi	S^2 di	Mean	bi	S^2 di
1.	LGN-125	43.44	3.27	-0.17	112.22	1.48	-0.27	13.80	6.71	-0.41
2.	LGN-162	45.00	-4.49	1.013*	106.66	1.49	1.19*	12.80	8.51	-0.23
3.	LGN-163	44.66	-0.74	-0.10	114.88	0.89	-0.27	14.50	1.17	3.18**
4.	LGN-169	44.66	6.48	0.62	112.33	1.18	0.29	13.62	7.12	0.20
5.	LGN-176	43.66	6.49	0.60	108.33	-0.61	2.37**	15.12	2.00	1.31
6.	LGN-184	43.88	10.09*	-0.27	112.33	2.07	-0.11	12.40	-9.44	0.84
7.	LGN-188	46.88	0.26	0.90*	112.00	2.07	-0.11	13.02	1.50	-0.37
8.	LGN-189	40.33	5.75	-0.01	106.33	-0.58	0.39	11.80	-3.13	-0.38
9.	ICGV-00191	43.77	1.20	3.46**	106.88	0.88	0.63	11.95	-1.07	-0.43
10.	ICGV-00201	43.55	-5.69	0.34	110.66	2.09	3.82**	13.26	-8.74	0.05
11.	ICGV-00202	45.44	-9.17	-0.19	111.66	0.58	0.38	16.31	6.75	0.55
12.	ICGV-00206	43.22	1.20	1.90**	109.66	2.95	0.41	14.90	5.58	1.38
13.	ICGV-00211	44.88	6.55	0.18	111.44	2.65	0.65	12.57	5.98	-0.43
14.	ICGB-00213	43.44	7.55*	-0.27	113.00	-1.76	0.40	14.57	-3.64	3.03**
15.	ICGV-00241	44.00	-0.34	3.93**	107.33	-2.35	2.43**	14.71	11.83	2.93**
16.	ICGV-00243	44.11	-3.02	1.74**	112.66	-1.48	-0.13	14.62	-12.18	-0.25
17.	ICGV-07211	40.88	8.42*	-0.26	105.66	2.64	3.95**	14.31	6.89	2.65*
18.	ICGV-99058	43.66	-0.94	-0.13	110.00	4.72	2.47**	12.42	1.48	-0.43
19.	TG-68	42.66	-1.88	0.33	107.66	-2.65	1.26*	12.64	-1.87	0.42
20.	JL-24	43.11	-3.82	3.08**	112.11	4.14	-0.23	13.04	0.37	-0.44
21.	LGN-1	43.00	6.68	-0.26	108.66	2.37*	-0.29	13.53	-4.82	-0.24
	Mean	43.73			109.97			13.61		

***significant at 5 % level. ** significant at 1% level.**

Sr. No.	Genotype	Shelling percentage (%)			100 kernel weight (g)			Sound mature kernel (%)		
		Mean	bi	S^2 di	Mean	bi	S^2 di	Mean	bi	S^2 di
1.	LGN-125	49.61	-0.19	57.99**	30.27	-1.91	-1.09	89.91	5.35	-0.51
2.	LGN-162	52.66	1.11	194.88**	40.69	2.94	-1.35	88.87	3.90	0.46
3.	LGN-163	57.75	1.90	16.77*	40.81	-8.57	-1.39	86.55	-2.01	-0.11
4.	LGN-169	56.87	-0.81	125.14**	39.64	15.55	-1.47	91.05	-4.08	-0.93
5.	LGN-176	63.52	2.60	-0.47	39.46	17.31	-0.69	89.85	3.45	6.22*
6.	LGN-184	67.69	3.88	79.41**	32.57	-7.02	-1.61	88.51	0.19	1.55
7.	LGN-188	58.23	-1.11	13.79*	37.58	13.96	-7.72	87.74	4.09	0.08
8.	LGN-189	55.09	2.72	59.11**	37.32	-3.89	-1.65	89.14	-5.22	0.38
9.	ICGV-00191	44.63	1.06	8.27	39.23	2.04	-1.78	87.85	-5.75	4.45*
10.	ICGV-00201	60.08	-1.33	2.32	42.75	-1.29*	-1.85	90.60	-6.37	-0.96
11.	ICGV-00202	58.02	-4.08	29.29**	41.16	-2.18*	-1.85	90.38	7.34	3.62*
12.	ICGV-00206	57.40	1.95	3.18	35.71	-6.12	-1.77	87.47	5.02	-0.90
13.	ICGV-00211	73.11	8.16	17.25*	28.19	11.03*	-1.84	87.48	5.80	1.64
14.	ICGB-00213	65.47	3.30	129.95**	35.28	-17.84	-1.02	87.74	-4.33	0.53
15.	ICGV-00241	63.21	-0.60	139.46**	32.88	8.81	-1.64	91.69	6.88	0.34
16.	ICGV-00243	54.96	3.47	13.77*	30.79	0.69	-0.14	88.26	-8.29	1.62
17.	ICGV-07211	61.37	-6.53	73.57**	35.92	6.56	-1.18	89.87	1.24	-0.76
18.	ICGV-99058	62.45	4.80	206.87**	34.13	13.03	-1.63	87.82	-5.44	-0.97
19.	TG-68	66.69	-0.45	20.68*	38.84	9.48	-1.64	90.12	6.87	-0.07
20.	JL-24	57.18	3.89	0.32	39.73	-5.81	-1.81	90.11	4.75	-0.07
21.	LGN-1	61.81	-2.72	98.69**	36.00	-20.06	1.84	90.65	7.06	0.03
	Mean				36.62			89.22		

Table 2 contd.....

Sr. No.	Genotype	Oil content (%)			Kernel yield / plant (g)			Pod yield /plant (g)			Pod yield / plot (g)		
		Mean	bi	S^2 di	Mean	bi	S^2 di	Mean	bi	S^2 di	Mean	bi	S^2 di
1.	LGN-125	47.33	-3.76	0.08	7.00	2.80	-0.18	14.03	0.11	0.30	628.04	1.67	-1705.93
2.	LGN-162	47.78	0.12	0.03	6.49	4.53	-0.33	12.37	-3.15	1.71	557.09	3.86	-631.09
3.	LGN-163	48.26	1.11	0.31*	7.71	1.34	-0.10	13.35	-4.02	-0.53	601.00	1.51	793.27
4.	LGN-169	47.53	6.12	0.14	7.76	2.40	1.54*	13.57	-1.60	-0.73	610.70	0.68	-1328.29
5.	LGN-176	46.91	-0.32	-0.06	8.54	0.62	-0.21	13.60	3.52	0.42	625.25	-0.79	1304.51
6.	LGN-184	47.58	-0.46	-0.03	7.52	-0.12	1.13*	10.64	0.07	0.22	476.35	-1.98	-1640.34
7.	LGN-188	48.03	3.81	-0.01	7.30	-1.98	-0.05	12.47	3.11	0.51	561.28	-2.86	-557.75
8.	LGN-189	47.75	-2.99	-0.04	7.27	1.38	0.86	13.18	2.64	-0.42	539.96	6.79	-851.07
9.	ICGV-00191	47.67	7.64	0.01	6.10	0.45	-0.01	13.60	0.61	-0.57	598.74	2.42	-1678.27
10.	ICGV-00201	47.42	9.51	-0.05	8.51	0.19	-0.28	14.23	-0.31	-0.75	609.50	0.51	-9.79
11.	ICGV-00202	47.56	-2.24	1.80**	8.92	-0.94	0.74	15.25	-2.33	-0.44	684.18	1.82	-700.34
12.	ICGV-00206	47.51	3.83	-0.06	7.87	1.28	-0.30	13.70	-1.42	-0.77	593.95	2.80	503.58
13.	ICGV-00211	48.07	12.93	-0.01	7.99	2.33	-0.16	11.04	1.89	2.01	462.17	-0.09	-854.96
14.	ICGB-00213	48.13	-6.85	0.04	7.88	-0.38	-0.26	11.76	6.57	1.36	500.87	-0.86	-5.54
15.	ICGV-00241	46.88	-1.51	-0.05	8.11	2.67	-0.33	12.95	-4.38	0.56	603.15	0.90	-1073.28
16.	ICGV-00243	47.52	-1.02	-0.07	6.85	0.37	-0.21	12.32	3.62	-0.12	532.55	0.19	-1506.98
17.	ICGV-07211	47.96	-0.83	-0.07	8.26	1.87	-0.34	13.09	-4.60	2.48*	620.15	0.92	-1615.04
18.	ICGV-99058	47.91	2.10	-0.07	6.79	1.09	-0.18	11.16	8.24	0.18	466.96	0.79	1640.55
19.	TG-68	47.56	2.60	0.09	9.21	0.66	-0.25	14.13	7.41	-0.44	620.65	0.58	3806.21
20.	JL-24	47.60	6.14	0.00	7.44	1.01	-0.14	12.90	0.65	-0.62	575.75	-0.44*	-1715.40
21.	LGN-1	48.01	-12.64	0.11	7.68	-0.59	-0.30	12.40	4.37	0.04	549.05	2.60	981.43
	Mean	47.66			7.68			12.94			572.25		

***Significant at 5% level. ** Significant at 1% level**

Regarding sound mature kernel, the genotype ICGV-07211 showed high mean, regression coefficient greater than unity (bi>1) and non-significant deviation from regression coefficients (S^2di) indicating below average stability. So, they were adapted specifically to better environment. None of the genotype found average stable across the environment for this trait. Benture *et al*. [1] was reported similar result for sound mature kernel.

For oil content no significant variation was observed in environments. This indicates that this character is more stable in its expression. The genotype LGN-162 was quite stable across the environment having high mean, regression coefficient near to unity (bi=1) and non-significance deviation from regression coefficient (S^2di), so, they were adaptable to all environment. The genotype ICGV-07211 was recorded as above average stability and its better adaptability to poor environment.

Considering kernel yield per plant the genotype TG-68 and LGN-176 was quite stable across the environment having high mean, regression coefficient near to unity (bi=1) and non-significance deviation from regression coefficient (S^2di), so, they were adaptable to all environment. The genotype LGN-163, ICGV-00206 and ICGV-07211 had high mean, regression coefficient greater than unity (bi>1) and non-significant deviation from regression coefficient (S^2di) indicating below average stability and its better adaptability to favorable environment.

Pod yield per plant of genotype ICGV-00191 was quite stable across the environment having high mean, regression coefficient near to unity (bi=1) and non-significance deviation from regression coefficient (S^2di), so, they were adaptable to all environment. The genotype LGN-125 and ICGV-00201 had high mean, regression coefficient greater than unity (bi>1) and non-significant deviation from regression coefficient (S^2di) indicating below average stability and its better adaptability to favourable environment. Similar results were reported earlier by Bentur*et al*. [1] and Patil *et al*. [8].
Considering pod yield per plot the genotype ICGV-07211, ICGV-00241 and LGN-169 was quite stable across the environment having high mean, regression coefficient near to unity (bi=1) and non-significance deviation from regression coefficient (S^2di), so, they were adaptable to all environment for pod yield per plot. The genotype LGN-125, LGN-163 and ICGV-00202 had high mean, regression coefficient greater than unity (bi>1) and non-significant deviation from regression coefficient (S^2di) indicating below average stability and its better adaptability to favourable environment.

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