Stability analysis in groundnut for pod yield and its component traits

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SUMMARY

Evaluation of sixteen groundnut genotypes alongwith three checks in three replications under three environmental locations was carried out to know the role of G x E interaction and also to study the stability of the same genotypes. Environments in which genotypes were grown, differed significantly for days to maturity, number of mature pods per plant, shelling percentage, strong mature kernels, 100 kernel weight and late leaf spot severity. Genotypes x environment interaction variances were also highly significant for all the characters studied. The genotypes LGN-107, LGN-110, LGN-121, LGN-125, LGN-126, LGN-128, LGN-129, LGN-130, LGN-117, LGN-162, LGN-1 and AK-159 were stable over the environments for pod yield per plant. . Among them, LGN-110, LGN-112, LGN-115 and LGN-163 showed wider adaptability for shelling percentage. While LGN-111 and LGN-115 were adapted specifically to better environment and showed a high degree of stability for 100 kernel weight. Thus, present investigation helps to isolate genotypes adapted to particular location due to the better expression of certain characters under specific environment.

Key words : Stability, G x E interactions, Yield components and groundnut

Groundnut (*Arachis hypogaea* L.) is the most important oilseed crop of tropical, sub-tropical and warm temperate regions of the world. It is an annual legume crop, grown mainly for quality edible oil (40-50%) and easily digestible protein (25%) in its seeds. 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 the cultivation of crop on marginal and sub-marginal lands under rainfed conditions, low input use, lack of plant protections and use of low yielding varieties. Under such situations and in the fluctuating environments, adaptability of varieties becomes far more important. Also yield is polygenically controlled complex character and is determined by a number of yield components, since greatly affected by environmental factors. Thus, ultimately needs to develop stable genotypes. Therefore an attempt has been made in the present study to evaluate different groundnut genotypes across the locations to know the role of G X E interactions and also to analyze the stability of genotypes for different traits.

MATERIALS AND METHODS

Sixteen groundnut genotypes *viz.*, LGN-107, LGN-110, LGN-111, LGN-112, LGN-113, LGN-115, LGN-125, LGN-126, LGN-127, LGN-128, LGN-129, LGN-130, LGN-136, LGN-117, LGN-162 and LGN-163 with three checks (LGN-1, JL-220 and AK-159) were obtained from Oilseeds Research Station, Latur. A field experiment involving all the genotypes was laid out in Randomized Block Design (RBD) with three replications under rainfed conditions at Oilseeds Research Station, Latur (E_1), Pulses Research Station, Badnapur (E_2) and Oilseed Sub research Station, Ambajogai (E_3). The sowing was carried out at the spacing of 30 cm and 15 cm between the rows and plants, respectively. The method of sowing followed was dibbling. One plant per hill was maintained by thinning 15 days after sowing. The gross plot size was 5.0 m x 0.60 m, while net plot size was 4.8 m x 0.60 m. The recommended dose of fertilizers 25 kg N: 50 kg P_2O_5 per hectare was applied at time of sowing. All other cultural practices were undertaken to maintain healthy crop. Five plants were selected from each treatment randomly for recording observations *viz.*, days to maturity, number of mature pods per plant, pod yield per plant, kernel yield per plant, shelling percentage, 100 kernel weight, strong mature kernel percentage, oil content and late leaf spot severity. Data collected were subjected to two way analysis of variance and the stability parameters were computed following the model proposed by Eberhart and Russell (1966).

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RESULTS AND DISCUSSION

The results of pooled analysis of variances over environments (Table 1) revealed that the variance due to genotypes was highly significant except oil content indicating the presence of variability in the material. Similarly, environments in which the genotypes were

Table 1: Pooled analysis of variance for stability in genotypes of groundnut

Sr. No.	Source of variation	DF	Days to maturity	No. of mature pods per plant	Shelling percentage (%)	Strong mature kernels	100 kernel weight (g)	Oil content (%)	Late leaf spot severity	Kernel yield per plant	Pod yield per plant (g)	Pod yield per plot
	Mean sum of squares											
1.	Genotypes	18	21.9547**	14.1947**	29.7117**	10.9365**	35.9326**	0.1965	21.0669**	2.6709**	8.4208**	28805.62**
2.	Environment	2	93.6197**	13.7221*	215.291**	31.6135**	130.3537**	0.5555	0.0125*	1.4453	6.3772	26856.63**
3.	Genotype x environment	36	1.4224**	4.0354**	17.1196**	3.4351*	6.2102**	0.1582*	0.0031**	1.043**	3.3319**	7145.29**
3.	Environment (linear)	1	187.2395**	27.4443*	430.5878**	63.2269**	260.7074**	1.1109**	0.0249**	2.8905	12.7545	53713.24**
4.	Genotypes x environment (Linear)	18	0.5467	3.4904	25.2681*	4.0669	6.1402	0.2316*	0.0035	1.1631	3.5279	8846.61
5.	Pooled deviation	19	2.1771**	4.3393**	8.4845**	2.7244	5.9496**	0.0803	0.0026	0.8742**	2.9708**	5157.44**
6.	Pooled error	108	0.2347	0.5466	1.7317	2.0057	0.9842	0.0924	0.0024	0.3057	0.7306	1764.05

* and ** indicates significance of values at P=0.05 and 0.01, respectively

grown, were also differing significantly for days to maturity, number of mature pods per plant, shelling percentage, strong mature kernels, 100 kernel weight, late leaf spot severity. Genotypes x Environment interaction variances were also highly significant for all characters studied indicating the differential response of genotypes in expression of the characters to varying environments. The existence of G x E interaction for pod yield and its component characters have also been reported by Bentur *et al.* (2004) and Prakash Kumar *et al.* (1984).

Considering the stability performance of genotypes for different characters across the environments, it was observed that the variance due to non linear component of environments (pooled deviation) was significant for all the characters under study except strong mature kernel, oil content and late leaf spot severity, indicating the role of unpredictable portion of environment influencing this traits (Joshi *et al.*, 2003). Further, the environment (linear) was highly significant for all the characters except kernel yield and pod yield per plant, whereas the genotype x environment (linear) was also significant for shelling percentage and oil content. This indicated that the stability parameter regression coefficient estimated by the linear component of the response to a change in environment was different for various genotypes for the characters studied. The results were in accordance with Venkataramana *et al.* (2001) for oil content and by Deshmukh (2007) for shelling percentage.

Stability parameters like regression coefficient (bi) and deviation from regression (s^2di) indicated that the genotypes LGN-107, LGN-110, LGN-121, LGN-125, LGN-126, LGN-128, LGN-129, LGN-130, LGN-117, LGN-162, LGN-1 and AK-159 were stable over the environments for pod yield per plant as the deviation of these genotypes were non significant (Table 2). Expression of stability of genotype has been reported by Kandaswami *et al.* (1989). LGN-126 showed very high yield (14.14 g), non-significant S^2di and nearly unit regression (bi=1) which indicated its wide adaptability to all environments in this regards. Non significant S^2di, above average response (bi>1) and considerably high mean performance of LGN-128 and LGN-125 indicated their adaptability for favourable environment. The genotypes, LGN-129 and LGN-130 showed considerable degree of stability (S^2di non-significant) but below average mean and negative bi revealed their poor adaptability to specifically unfavourable environments. The estimates of stability parameters for days to maturity revealed that the genotype LGN-112 was quite stable across the environment with early maturity. Whereas genotypes, LGN-126, LGN-162 and LGN-163 were also stable, but identified as late genotype. Among

Table 2 : Estimates of stability parameters for ten characters in groundnut

Sr. No.	Genotype	Days to maturity (days)			Number of mature pods/ plant			Shelling percentage (%)			Strong mature kernel (%)			100-kernel weight (g)		
		Mean	bi	S^2di	Mean	bi	S^2di	Mean	bi	S^2di	Mean	bi	S^2di	Mean	bi	S^2di
1.	LGN-107	103.89	1.04	2.08**	12.98	1.21	-0.62	53.42	3.42	1.46	88.53	2.46	-1.14	29.62	1.10	4.55*
2.	LGN-110	102.00	1.13	2.17**	13.24	2.15	2.85*	58.31	1.13	-0.63	90.33	1.64	-0.37	32.86	1.39	-0.22
3.	LGN-111	103.33	1.01	7.35**	12.63	-1.37	-0.49	62.62	-0.31*	-1.80	95.54	-0.16	-0.77	41.09	1.39	-1.00
4.	LGN-112	102.56	0.93	0.37	15.11	0.32	14.2**	59.72	0.76	-1.33	92.98	0.59	-1.84	39.69	0.53	8.05**
5.	LGN-113	106.67	0.82	1.10*	13.14	-0.12	0.13	54.09	3.28	9.80*	91.18	0.97	0.81	33.64	1.16	-0.95
6.	LGN-115	107.33	1.23	2.77**	16.17	-0.31	0.29	57.46	1.07	-1.66	88.48	1.15	-0.75	35.23	1.49*	-1.00
7.	LGN-117	108.56	1.01	2.23**	15.29	1.24	8.18**	57.81	-0.6	8.91	90.99	0.7	-1.84	40.83	1.92	26.7**
8.	LGN-121	106.11	1.21	2.26**	12.04	-0.07	-0.25	57.61	-0.22	35.8**	88.89	2.67	12.09**	33.86	1.71	11.9**
9.	LGN-125	107.11	0.66	2.59**	15.77	3.76	-0.27	57.45	0.63	3.74	94.06	0.94	0.81	36.83	1.32	5.21*
10.	LGN-126	108.78	0.88	-0.19	18.79	-0.94	0.03	56.18	0.42*	-1.78	89.63	-0.09	-1.19	32.28	0.80	0.77
11.	LGN-127	109.56	0.67	0.25	21.23	1.44	17.7**	56.89	0.19	1.51	91.81	-0.67*	-1.92	34.09	0.19	-0.86
12.	LGN-128	103.22	1.01	5.82**	15.04	-0.52	5.94**	58.88	1.52	13.8**	92.04	-0.20	-1.84	40.10	0.54	3.34*
13.	LGN-129	107.11	1.06	2.97**	14.53	2.29	9.72**	54.77	1.62	22.8**	88.39	2.78	-1.36	34.86	2.41	-0.69
14.	LGN-130	101.89	1.03	2.08**	14.84	-1.28	-0.36	53.36	0.30	-1.38	91.59	-0.40	4.87	36.71	-0.29	2.12
15.	LGN-162	108.67	0.91	-0.23	14.46	1.81	-0.57	54.39	1.49	15.8**	92.13	1.78	-0.61	34.51	0.94	15.21**
16.	LGN-163	109.89	0.93	0.37	14.61	3.33	9.64**	57.84	0.80	2.04	92.58	2.09	1.47	33.16	1.04	-0.75
17.	LGN-1 (C)	107.33	1.08	0.91*	14.64	0.90	3.25*	65.90	-0.19	3.78	90.63	1.05	4.22	29.86	0.11	2.94*
18.	JL-220 (C)	102.56	1.69	2.01*	13.30	2.65	-0.51	55.28	1.59	-0.53	91.08	-0.29	-0.22	36.37	0.34	10.2**
19.	AK-159 (C)	105.33	0.67	0.01	16.14	2.51	1.83*	59.54	1.52	16.5**	91.45	1.99	4.36	31.33	0.91	8.38**
	Mean	105.89			14.95			56.95			91.19			35.10		

Contd…. Table 2

Table 2 contd…..

Sr. No.	Genotype	Oil content (%)			Late leaf spot severity			Kernel yield per plant (g)			Pod yield per plant (g)		
		Mean	bi	S^2di	Mean	bi	S^2di	Mean	bi	S^2di	Mean	bi	S^2di
1.	LGN-107	47.67	1.51	-0.06	6.35 (40.36)	0.41	-0.001	6.51	4.37	0.22	12.42	1.42	-0.71
2.	LGN-110	47.67	-1.41	0.08	6.42 (41.24)	2.44	-0.001	6.44	1.44	1.73*	10.77	3.7*	-0.75
3.	LGN-111	47.63	0.14	0.45*	6.87 (47.14)	-1.99*	-0.002	7.79	4.14	0.01	12.36	0.97	6.49**
4.	LGN-112	47.21	6.17	-0.08	5.92 (35.07)	1.54	-0.002	8.42	4.33	-0.29	13.86	1.61	3.51*
5.	LGN-113	47.66	0.37	-0.09	6.31 (39.82)	-0.41	0.001	6.27	5.27	1.33*	11.43	0.50	3.99**
6.	LGN-115	47.57	1.37	-0.09	6.94 (48.07)	1.21	-0.001	8.39	4.41	0.00	14.67	0.75	3.76*
7.	LGN-117	47.58	2.18	-0.07	0.91 (0.83)	3.11	-0.002	8.15	-0.77	-0.29	14.31	-0.63	-0.38
8.	LGN-121	48.09	1.37	-0.09	6.90 (47.60)	-0.80	-0.002	6.34	2.46	0.16	11.02	1.11	0.91
9.	LGN-125	47.64	2.27	-0.06	0.85 (0.74)	0.09	0.000	8.02	-0.02	-0.22	13.73	2.16	0.57
10.	LGN-126	47.66	2.61	-0.03	0.85 (0.72)	0.06	-0.001	8.07	-1.52*	-0.31	14.44	1.15	1.72
11.	LGN-127	48.04	-1.05	-0.09	0.94 (0.89)	0.45	-0.001	9.86	-4.10	3.27**	17.76	-4.96	17.6**
12.	LGN-128	47.21	3.62	-0.08	6.28 (39.44)	1.15	0.001	8.13	2.91	-0.30	13.91	2.29	1.80
13.	LGN-129	48.08	1.41	-0.08	5.87 (33.36)	4.62*	-0.002	6.84	2.24	0.81	12.43	-1.87	-0.67
14.	LGN-130	47.50	-2.08	-0.09	6.40 (40.73)	0.63	0.002	6.94	0.64	-0.04	12.86	-0.67	-0.35
15.	LGN-162	47.79	0.18	0.01	0.88 (0.78)	1.19	-0.002	7.40	-0.33	0.52	13.89	0.21	-0.05
16.	LGN-163	47.94	0.85	-0.08	0.90 (0.82)	2.40	-0.002	7.65	-2.18	-0.29	13.74	-0.11	2.65*
17.	LGN-1 (C)	47.67	0.90	0.06	6.34 (40.28)	3.29	0.005	7.33	-0.24	0.30	11.23	1.56	-0.69
18.	JL-220 (C)	47.88	-1.91	0.09	6.34 (40.26)	-0.81	0.011*	6.27	-1.84	3.74**	11.43	5.78	3.26*
19.	AK-159 (C)	48.02	0.07	-0.09	6.39 (40.79)	0.47	0.003	7.67	-0.21	0.28	13.00	4.02	-0.64
	Mean	47.71			4.67			7.50			13.38		

* and ** indicates significance of values at P=0.05 and 0.01, respectively

the nine genotypes which were stable for pod number, LGN-126 and LGN-115 had regression coefficient less than unity (bi<1) and high mean performance revealed better adaptability to poor environment where as LGN-125 had regression coefficient higher than one (bi>1) and higher mean performance revealed their adaptabilities to better environment. LGN-110, LGN-112, LGN-115 and LGN-163 possessed nearly unit response and high mean among thirteen genotypes, which were stable for shelling percentage indicating their desireness for wider adaptability for these characters. LGN-111, LGN-117 and LGN-1 were stable and possessed regression coefficient less than unity (bi<1) with high mean performance (Xi) suggesting their adaptability especially to poor environment. Almost all genotypes except LGN-121 were stable for strong mature kernels.

The genotypes, LGN-111, LGN-112 and LGN-128 exhibited negative regression coefficient (bi) value with high mean performance (Xi) value indicated their high suitability to poor environment, where as genotypes, LGN-162, LGN-163 and AK-159 exhibited their adaptability to favourable environment. LGN-111 and LGN-115 showed a high degree of stability with bi>1 for the trait 100 kernel weight indicated their adaptability specifically to better environment. The genotype, LGN-130 had negative bi value and non-significant S^2di as suggestive their adaptability specifically to poor environment. Considering high mean oil content and unit regression, genotypes LGN-163 was highly stable in its performance. Almost all genotype, except JL-220, exhibited stable performance for least late leaf spot severity (Chandra, 1995) while LGN-162 showed least late leaf spot severity, nearly unit regression and small deviation from regression revealing the wider adaptability. Where as the genotypes, LGN-117, LGN-125, LGN-126, LGN-127 and LGN-163 were found to be adaptable to either poor or better environments. LGN-111, LGN-112, LGN-115 and LGN-128 had bi >1 and high mean Xi suggesting their suitability for better environments in response to kernel yield per plant. Whereas LGN-117, LGN-125, LGN-126 and AK-159 had negative bi value with high mean performance suggesting their adaptability specifically to poor environment.

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