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GENOTYPE - ENVIRONMENT INTERACTION AND GENOTYPIC CORRELATIONS UNDER DIVERSE ENVIRONMENTS IN GROUNDNUT

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ABSTRACT

Fifteen groundnut genotypes were evaluated for their stability under eight environments. The magnitude of genotype environment interaction was low under rainfed conditions compared to irrigated conditions. Significant positive genotypic correlations obtained in the locationwise and seasonwise analysis indicated that the genes acting under rainfed conditions are similar in the particular location or season. Negative correlation coefficients indicated that the set of genes that acted under one location in irrigated conditions were not similar to that acted under irrigated conditions at another location. To realise optimum yield potential in groundnut ideal genotypes are to be identified suited to different locations as well as to different seasons as the set of genes operating under those conditions appear to be similar.

KEY WORDS : Groundnut, Stability, G x E Interaction, Correlation co- efficient

Seventy per cent of groundnut cultivation in India is confined to *kharif* season and remaining to irrigated *rabi* and summer seasons. There are striking year to year fluctuations in production which can be attributed to instability of genotypes, uncertainities of rainfall and moisture availability at critical growth phases, poor agronomy, pest and disease susceptibilities of cultivars in the rainy season (Swarnalata *et al.*, 1984). Many workers in groundnut reported presence of g x e interaction; it may mean that the best genotype in one environment may not be the best in another environment.

In this paper an attempt has been made to find out whether specific difference of environment had any effects on some genotypes than others: or whether there exist a change in the order or merit of a series of genotypes when measured under different environments and same sets of genes operate in different environments. as suggested by Comstock (1977). Falconer (1983) and Baker (1984).

MATERIALS AND METHODS

Fifteen genotypes developed in the research stations of Tindivanam, Vridhachalam, Bhavani sagar, Aliyarnagar and Coimbatore of Tamil Nadu Agricultural University were studied in three locations *viz.*, Paiyur, Tindivanam and Vridhachalam under irrigated conditions during 1984 (summer) and the same genotypes studied under rainfed conditions (*kharif*) in Tindivanam and Vridhachalam. Five different dates of sowings formed different environments. The genotypes were raised in three rows of 2 m long, adopting 30 cm between rows and 10 cm in the row, Uniform stand was maintained and standard recommended package of practices adopted.

The yield data of pod/plot were grouped as follows:

1. i. Irrigated sowings (Environment 1,2 and 3) 12 genotypes
   ii. Rainfed sowings (E4-E8) 3 replications

Table 1. Groundnut: Analysis of variance on eight individual environments

Source	df	E1	E2	E3	E4	E5	E6	E7	E8
I. i and ii									
Genotype	11	15502.1**	1806.0*	29638.7**	7420.9**	7603.0**	47912.3**	3226.5**	1628.5**
Error	22	457.2	429.9	683.0	1277.3	1461.6	484.6	265.2	695.9
II. i and ii									
Genotype	14		4014.5**	33157.1**	7481.0**	7359.0**		5549.2**	15038.8**
Error			390.8	595.6	144.5	438.6		236.7	674.9

11. i. Irrigated sowings (Environment 2 and 3)
15 genotypes

ii. Rainfed sowings (E. 4,5,7 and 8)
3 replications

The data on the yield were analysed for ndividual environments,

'ooled analysis for 12 genotypes comprising eight nvironments (irrigated and rainfed)

'ooled analysis for 12 genotypes comprising 3 nvironments (irrigated)

Pooled analysis for 12 genotypes comprising 5 environments (rainfed)

Pooled analysis for 15 genotypes comprising 6 environments (irrigated and rainfed)

Ebherhart and Russell (1966) model was used for stability analysis. Genotypic correlation was worked out as suggested by Falconer (1983). Rank correlation was worked out between mean 'di' and 'bi' utilising Spearman' s formula (Snedecor and Cochran, 1967).

RESULTS AND DISCUSSION

The variance between the genotypes was significant in all the environments (Table 1)

There was significant difference between genotypes and the environments. Locationwise pooled analysis indicated that the genotype x environment interaction component was very low in Tindivanam compared to Vridhachalam.

The genotypes did not differ under irrigated condition, whereas under rainfed conditions, they

Table 2. Stability

Genotype	Irrigated			Rainfed			Pooled		
	Mean	bi	$S^{-2}di$	Mean	bi	$S^{-2}di$	Mean	bi	$S^{-2}di$
VG.15	398.3	0.798*	44969.9**	355.9	0.802*	1527.5**	371.8	0.761	8317.3**
VG.18	458.1	0.733**	549.2**	419.0	0.861	575.5**	433.6	0.769	536.8**
VG.19	458.2	0.981	7167.0**	418.7	1.017	3873.0**	438.5	0.834	5249.0**
Ah.165/S	443.7	0.832	2493.1**	321.5	0.176**	5134.1**	379.8	0.517	7735.8**
Ah.728/S	392.5	0.543**	200.3	340.1	0.645	795.7**	359.7	0.618	398.4**
Ah.8407	523.4	1.721**	9792.6**	412.2	1.243*	791.8**	453.9	1.404	2520.5**
Ah.8457	404.6	0.855	-127.0	375.7	1.265*	311.1	386.5	1.013	1476.6**
BS.1	441.6	1.145	-11.5	415.9	1.643*	8675.0**	425.6	1.304	7126.9**
BS.2	488.6	1.098	199.1	342.3	1.026	718.3**	397.2	1.168	1388.7**
BS.8	422.9	0.820	156.6	317.9	0.722**	7866.1**	357.3	0.840	4456.4**
Co.1	527.7	1.313	8194.8**	342.0	1.140	1550.9**	411.6	1.368	4322.8**
Co.2	463.9	1.155	6231.1**	357.5	1.451**	4275.5**	397.4	1.350	3331.6**
Mean	451.9	1.000	-	372.4	1.000	-	403.3	0.995	
SE	58.4	0.088	-	28.3	0.008	-	24.2		

Table 3. Locationwise analysis for stability

Genotype	Tindivanam			Vridhachalam			Pooled		
	Mean	bi	$S^{-2}di$	Mean	bi	$S^{-2}di$	Mean	bi	$S^{-2}di$
VG.15	300.5	1.216	3050.29**	342.8	0.060**	8336.27**	321.6	0.361**	4387.55**
VG.18	346.7	1.086	293.11**	472.5	0.486**	768.01**	409.6	0.799	628.85**
VG.19	352.2	0.388**	-20.49	543.0	0.189**	1525.42**	447.6	0.920	3387.08**
Ah.165/S	319.3	1.242	591.24**	417.9	1.069	5994.22**	368.6	0.833	2263.37**
Ah.728/S	295.7	1.021	-92.67	373.7	0.292**	945.89**	334.7	0.540*	712.90**
Ah. 7284-10	291.4	0.356**	-66.53	346.5	0.066**	4624.83**	319.0	0.301**	1247.65**
Ah. 7610-A	260.9	1.308*	313.91**	412.4	1.394*	4761.81**	336.7	1.141*	1534.93**
Ah.8407	294.3	1.281*	1024.79**	544.0	1.494**	10757.06**	419.1	1.579	3450.25**
Ah. 8446	216.7	0.609	761.38**	476.1	1.767**	-259.42	346.4	1.601*	1918.47**
Ah.8457	269.5	1.079	-62.26	435.4	0.815	4369.90**	352.5	1.045	1180.10**
BS.1	292.5	0.889	704.22**	430.5	1.443*	1450.41**	361.5	1.039	1044.24**
BS.4	279.9	1.150	2537.47**	440.5	1.504**	-254.46	360.2	1.184	861.51**
BS.8	264.8	1.498*	7.50	434.7	0.926	43.81	349.8	1.143	286.53*
Co.1	283.4	1.105	4395.56**	419.0	1.714**	174.58	351.2	1.116	2419.43**
Co.2	251.8	0.763	4062.37**	449.0	1.785**	1841.94**	350.4	1.353	2533.51**
Mean	287.2	0.999		435.9	1.000		361.5	0.999	
SE								0.2017	

differed significantly. The environment (linear) was significant in irrigated, rainfed as well as in locationwise analysis. The genotype x environment ((linear)) was not significant under rainfed conditions as well as in locationwise analysis but under combined analysis of Tindivanam and Vridhachalam, it was significant. The pooled deviation was significant in locationwise as well as seasonwise analysis.

Five genotypes showed stability by registering non-significant $S^{-2}di$ values (Table 2, 3). In the combined analysis of rainfed and irrigated conditions, none of the genotypes recorded non-significant $S^{-2}di$ values and only on genotype Ah 165/8 registered significantly lower bi value. Five genotypes recorded non-significant $S^{-2}di$ values under Tindivanam conditions. In the pooled analysis of both locations all the genotypes registered significant $S^{-2}di$ values. The estimates of stability for pod yield in the present study showed that the genotype did not exhibit uniform linear response under all the environments. In the combined analysis of all the six environments, none of the genotype showed stability.

A specific difference of environment as suggested by Falconer (1983) had greater effect on some genotypes *viz.*, Ah 728/S,BS1, BS4 and BS8. These genotypes showed stability when raised under irrigated conditions than under rainfed conditions. Similarly, genotypes VG 19, Ah 728/S Ah 7284-10, Ah 8457 showed stability under Tindivanam location, while BS4 and CO 1 showed stability under the location Vridhachalam. Genotype Ah 8457 showed stability under irrigated and rainfed in the location Vridhachalam. Similarly the genotype BS8 which showed stability in both the locations of Tindivanam and Vridhachalam under irrigated conditions was unstable under rainfed conditions.

The rank correlation coefficient between mean values of different environment was not significant. It was significant for the bi values of rainfed and irrigated conditions and also bi values of Tindivanam and combined analysis bi value. Zero correlation was obtained between the $S^{-2}di$ values of irrigated and rainfed conditions. The rank correlation was significant between the $S^{-2}di$ values of rainfed and combined analysis as well as TMV and combined analysis. Significant rank correlation

was recorded between the mean and bi values of rainfed and combined analysis value.

The rank correlation showed a change in the order of merit of a series of genotypes when measured under different environments (Falconer, 1983). Baker (1984) is of the opinion that the understanding of the nature of genotype-environment interaction would be improved if researchers were to concentrate on the study of responses and differences in responses. The critical issue is whether or not response curves of two or more genotypes differ sufficiently that the cultivar show a real change in rank order. Comstock (1977) noted that there has been little discussion in the literature concerning changes in the rank of genotypes over environments.

Positive genotypic correlation was observed between the locationwise analysed data i.e., E1, E2 and E3 of Tindivanam and E4,E5 of Vridhachalam. Even under locationwise analysis, negative correlation was observed between E5 and E6 (rainfed) in Vridhachalam. Negative correlation was observed between the irrigated sowings of El at Tindivanam and E4 of Vridhachalam. Irrigated sowings at Tindivanam E1 recorded negative correlation between rainfed sowings E5 at Vridhcahalam. Similar negative correlation existed between the irrigated sowings of E4 at Vridhachalam and rainfed sowings of E2 and E3 at Tindivanam.

The existence of genotype x environment interaction, showed that the best genotype in one environment was not the best in another environment as was indicated by the genotypic correlation coefficient (Falconer, 1983). The character pod yield measured in different environments was regarded not as one character but as different. The physiological mechanisms are to some extent different and consequently the genes required for high performance are to some extent also different. Falconer (1983) suggested that if the genetic correlation is high, then performance in different environments represents very nearly the same character, determined by very nearly the same set of genes. If it is low, then the characters are to a great extent different and high performance requires a different set of genes.

Significant positive genotypic correlations obtained in the locationwise and seasonwise analysis indicated that the genes that acted under rainfed conditions are similar in the particular location or season. The set of genes that acted under Tindivanam conditions in irrigated conditions are not similar to that acted under irrigated conditions at Vridhachalam as was indicated by the negative correlation between E1 and E4.

Finlay and Wilkinson (1963) have suggested that gene controlling yield stability may differ from those controlling high yield. The present study showed that the genotypes that showed stability were not high yielders and the high yielders were found to be sensitive to environment and unstable. Different set of genes were found to operate in different locations and in different seasons. To realise optimum yield potential in groundnut, there is a need to identify ideal genotypes to different locations as well as to different seasons

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