

Stability Analysis for Yield and Quality Traits in Drought Tolerant Groundnut Genotypes

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Abstract A field experiment with 30 drought tolerant groundnut genotypes was taken up for studies on stability in performance with respect to yield and quality traits. The results revealed significance genotype \times season interaction against pooled error. Partitioning of the season + (genotype \times season) component into season (linear) revealed the significance of season (linear) component for all the traits studied. Normal *kharif* season was observed to be congenial for pod yield per plant, sound mature kernel percent, kernel yield per plant, oil and protein content, while early *kharif* was noticed to be favorable for days to 50% flowering and pods per plant. K1717 and K1802 genotypes were observed to be stable and superior for pod yield per plant, while K1899 and K1884 were found to be stable and superior for kernel yield per plant. Similarly, K1809 and Anantha were

observed to be stable with high oil content and suitability for cultivation across the groundnut growing *kharif* seasons prevalent in the zone.

Keywords Groundnut, Genotype \times season interaction, Quality, Stability, Yield.

Introduction

Genotype \times environment interactions are of major consequence to the breeders in the process of evolution of improved varieties. Larger the genotype \times season interaction, lesser is the probability of improvement through selection. The existence of G \times S interaction creates difficulty in the evaluation of promising new genotypes. Performance of crop varieties also varies widely with change in the sowing date or season. Hence, there is a need to identify stable varieties which perform consistently over different seasons, in addition to season-specific varieties for enhanced returns. In this direction, the present investigation was undertaken to assess the stability of 30 promising drought tolerant groundnut genotypes for yield, physiological and quality traits over the groundnut growing seasons of *kharif* prevailing in the scarce rainfall zone of Andhra Pradesh.

Materials and Methods

Experimental material for the present investigation comprised of 30 drought tolerant groundnut genotypes developed at Agricultural Research Station,

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Table 1. Stability analysis of variance (ANOVA) for yield components and quality traits over seasons in groundnut genotypes. *, **Significant at 5% and 1% levels, respectively.

Source of variation	Degrees of freedom	Days to 50% flowering	Pods per plant	Pod yield per plant	Mean sum of squares Sound mature kernel percent	Kernel yield per plant	Oil content	Protein content
Genotypes	29	2.00**	11.24**	4.33**	15.65**	2.13**	5.55**	2.88**
Season+								
(Genotypex Season)	60	0.68**	8.19**	12.72**	68.09**	7.84**	0.02**	0.03**
Season	2	14.05**	171.39**	305.15**	1963.64**	211.41**	0.42**	0.53**
Genotype x Season								
(Linear)	58	0.22**	2.56**	2.64**	2.73**	0.82**	0.10**	0.06***
Genotypex Season (Linear)	1	28.11**	342.78**	610.30**	3927.27**	422.82**	0.84**	1.05**
Pooled deviation	29	0.31**	2.95	1.45	4.50**	0.72	0.00	0.01**
Pooled error	300	0.13	2.10**	3.71**	0.93	0.88**	0.01	0.00
	87	0.13	0.88	0.66	2.10	0.21	0.02	0.02

Kadiri of Acharya N. G. Ranga Agricultural University. These genotypes were sown on 1st July for early *kharif*, 16th July for normal *kharif* and 6th August for late *kharif* crop. Each genotypes was sown in continuous two row plots of 5 m row length at a spacing of 30 cm between rows and 10 cm between plants within the row in a randomized block design with two replications for each date of sowing at Agricultural Research Station, Kadiri during *kharif* 2015. All recommended practices were followed to raise a healthy crop. Observations were recorded on yield components and quality traits, namely, days to 50% flowering, pods per plant, pod yield per plant, sound mature kernel percent, kernel yield per plant, oil and protein content. The observations were recorded from five randomly selected plants for each genotype, in each replication, while observations on days to 50% flowering, oil and protein content were recorded on plot basis. The pooled data across seasons was subjected to analysis of variance and the traits showing significant genotype x season interaction were subjected to Eberhart and Russell's stability analysis for estimating the stability parameters, namely, mean, regression co-efficient (b_i) and mean square deviation ($\overline{S^2d_i}$) for each genotype. Significance of the stability parameters were tested by Student 't' test.

Results and Discussion

The data collected on yield and quality characters on 30 drought tolerant groundnut genotypes over three dates of sowings was subjected to pooled analysis. The analysis of variance (Table 1) revealed significant mean squares to genotypes and seasons for kernel yield, yield components and quality traits studied in the present investigation, indicating the existence of significant variation among the genotypes studied in addition to considerable seasonal variance. Highly significant genotype x season interaction was also observed for the various traits, indicating a variable response of the genotypes to the different seasons studied. The existence of significant genotype x season interactions for yield, yield components and quality traits in groundnut crop were also reported earlier [1] for days 50% flowering, pods per plant, pod yield per plant, sound mature kernel percent, kernel yield per plant, oil and protein content.

A perusal of the results on stability ANOVA for yield and quality traits revealed the significance of genotype x season interaction against pooled error, indicating that majority of interaction was linear in nature and hence, forecast over seasons was pos-

Table 2. Estimation of seasonal indices for yield components and quality traits in groundnut.

Characters	Early <i>khariif</i>	Normal <i>khariif</i>	Late <i>khariif</i>
Days to 50% flowering	-0.706	0.044	0.661
Pods per plant	2.236	0.284	-2.519
Pod yield per plant	1.501	2.162	-3.663
Sound mature kernel	4.461	4.878	-9.339
Kernel yield per plant	1.197	1.845	-3.042
Oil content	-0.083	0.136	-0.053
Protein content	-0.064	0.152	-0.088

sible. Similar results were reported earlier [2]. The seasons+(genotypes \times seasons) interaction was also observed to be significant for all traits studied indicating considerable interactions of genotypes with seasons and also the distinct nature of seasons and genotype \times season interactions in phenotypic expression. Further, partitioning of the season +(genotype \times season) component into season (linear) revealed the significance of season (linear) component for all the traits, indicating that macro-seasonal differences were present under all the three seasons studied. The higher magnitude of mean sum of squares

Table 3. Distribution of stable genotypes ($S^2 d_i = 0$) with high mean on the basis of regression coefficient (b_i).

Characters	Poor season ($b_i < 1$)	Favo- rable season ($b_i > 1$)	Across the seasons ($b_i = 1$)
Days to 50% flowering	1	2	11
Pods per plant	-	-	12
Pod yield per plant	-	-	9
Sound mature kernel	-	4	12
Kernel yield per plant	-	-	11
Oil content	-	-	14
Protein content	1	-	13

for seasons (linear), compared to genotype \times season (linear) indicated that linear response of season accounted for major part of the total variation for all the traits studied and might be responsible for high adaptation of the genotypes in relation to yield and other traits. Therefore, prediction of performance of the genotypes over seasons is expected to be possible for the traits studied in the present investigation. Similar findings were reported earlier [3]. Further, the mean

Table 4. Details of promising and stable groundnut genotypes identified for cultivation across seasons.

Characters	\times	b_i	$\bar{S}^2 d_i$	Other stable traits observed for the genotypes
Pod yield per plant				
K1717	14.33	1.602	-0.200	Days to 50% flowering, sound mature kernel percent, yield per plant, oil content and protein content.
K1802	14.12	1.309	1.441	Days to 50% flowering, pods per plant, sound mature kernel percent, kernel yield per plant, oil content and protein content.
Kernel yield per plant				
K1899	9.425	1.217	0.474	Days to 50% flowering, pods per plant, sound mature kernel percent, oil content and protein content.
K1884	9.030	1.194	-0.173	Days to 50% flowering, pods per plant, sound mature kernel percent, oil content and protein content
Oil content				
K1809	48.40	0.726	-0.014	Days to 50% flowering, pods per plant, sound mature kernel percent, kernel yield per plant, oil content and protein content.
Anantha	48.40	0.550	0.041	Days to 50% flowering, pods per plant, pod yield per plant, sound mature kernel percent, kernel yield per plant, oil content and protein content.

squares due to genotype \times season (linear) were significant for days to 50% flowering, sound mature kernel percent and protein content. The significant genotype \times environment (linear) mean squares for various traits were also reported earlier [4]. The mean squares for pooled deviation (non-linear) were also significant for pods per plant, pod yield per plant, kernel yield per plant, indicating that both linear and non-linear components contributed to the genotype \times season interaction observed for these traits in the present investigation. This suggested that predictable as well as unpredictable components were also involved in the differential response of the genotypes for stability of the above traits. The findings are in conformity with earlier reports [1].

A perusal of the results on seasonal indices for yield and quality traits (Table 2) also revealed variable response of the seasons to the different traits studied. The positive and negative value of environmental index indicate the favorable and unfavorable situations, respectively for each character. In the present investigation, the range of environmental index values for different traits studied indicated that the selected environments were quite varied and contrasting with regards to their response for the traits. Similar variable congeniality of different seasons for yield and different yield contributing characters in groundnut was reported earlier [1]. In the present investigation, normal *kharif* was observed to be congenial for pod yield per plant, sound mature kernel percent, kernel yield per plant, oil and protein content, while early *kharif* was noticed to be favorable for days to 50% flowering and pods per plant.

In the present investigation, stable genotype was defined as one with high mean (\bar{x}), unit regression ($b_i = 1$) and minimum deviation from regression ($S^2 d_i = 0$). The number of stable genotypes identified for various traits studied along with the number of stable genotypes with high or desirable mean and their categorization as widely adaptable or adaptable for only favorable or poor environments, based on the regression coefficient, b_i value, is presented in Table 3. The results revealed maximum number of stable genotypes (30) for sound mature kernel percent, oil and protein

content and minimum for pod yield per plant (17). Further, genotypes with value greater than the general mean and non-significant deviation from regression were higher for sound mature kernel percent (16) and minimum for pod yield per plant (9). The study also revealed greater number of genotypes with wider adaptability across seasons for various traits studied, compared to genotypes adapted to specific season (poor / favorable). Nine genotypes (K1725, K1719, K1848, K1877, K1884, K1802, K1809, K1717 and K1718) were noticed to possess high pod yield per plant in addition to wide adaptability across the seasons studied. Similarly, 10 genotypes (K1725, K1719, K1848, K1878, K1847, K1886, K1877, K1899, K1884 and K1813) were noticed to possess high kernel yield per plant in addition to wide adaptability across the seasons studied. For oil content, 14 genotypes (K1886, K2047, K1800, K1805, K1809, K1811, K1812, K1813, K1814, K1815, Dharani, Kadiri 9, Kadiri-Harithandhra and Anantha) had recorded high oil content and wide adaptability across the seasons studied.

In conclusion, the present investigation revealed the potential of K1717 and K1802 genotypes for pod yield per plant ; K1899 and K1884 for kernel yield per plant ; K1809 and Anantha for oil content (Table 4) for cultivation across the groundnut growing *kharif* seasons prevalent in the zone. Further, these genotypes had also recorded stability for majority of yield components and quality traits along with superior mean performance and hence, may also be utilized in breeding programs aimed at incorporation of stability. The genotype, K1717, however, had recorded high kernel yield per plant, in addition to $b_i > 1$ and $S^2 d_i = 0$, indicating its suitability for favorable season alone, namely, normal *kharif* under the scarce rainfall zone conditions of Andhra Pradesh.

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