Electronic Journal of Plant Breeding, 1(2): 173-176 (March 2010)

Research Article

Phenotypic stability for kernel yield in groundnut (*Arachis hypogaea* L.)

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Abstract:
The yield stability of 16 Spanish bunch groundnut genotypes were evaluated in four seasons consecutively for kernel yield per hectare. Two genotypes viz., ICGV 92206 and ICGV 93392 were found to be stable for kernel yield as they possessed non-significant deviation from the regression with regression coefficient nearing unity.

Key words:
Groundnut, gxe interaction, yield

Introduction

Groundnut (*Arachis hypogaea* L.) is one of the most important oilseed crop cultivated in the semi-arid regions of India. Although several high yielding genotypes were developed, most of them continue to be an unpredictable cultivar showing inconsistency in pod and kernel yield over seasons, years and location, due to high genotype x environment interaction. Larger genotype x environment interaction reduces the progress of selection (Comstock and Moll, 1963). To reduce the effect of genotype-environment interaction, selection of stable genotypes that interact least with the environment is advisable to attain consistent yield. Thus, screening genotypes possessing buffering capacity under varying environmental condition has became an essential part of breeding programme. Several statistical procedures have been employed to study the stability of genotype to varying environment. Lewis (1954) introduced the term 'stability factor' to measure the phenotypic stability. According to him, greater the deviation of stability factor from unity, lesser the phenotypic stability. On the other hand, Francis and Kannenberg (1978) used the coefficient of variation (CV) of each genotype as a measure of stability. A high yielding genotype with a low CV was considered as stable variety. Other stability indices include Wrick's (1962) ecovalence, Shukla's (1972) stability variance and Perkins and Jinks (1968) regression coefficient. Finlay and Wilkinson (1963) considered regression coefficient and mean performance of genotypes as a useful criteria to measure the phenotypic stability.

In addition to the above two parameters, Eberhart and Russel (1966) introduced one more parameter viz., deviation from the regression line to characterize a stable genotype. With this background of various stability parameters, the present investigation was attempted to study the stability of short duration Spanish bunch groundnut genotypes for kernel yield under different environmental condition.

Material and methods

Experimental material for this study consist of 16 short duration Spanish bunch groundnut genotypes (*Arachis hypogaea* L. subsp. *fastigiata* var *vulgaris*) obtained from ICRISAT, Patancheru for the purpose of conducting International Short Duration Groundnut Varietal Trial at the New Farm of Regional Research Station, Vridhachalam. Sowing was done in 4 x 4 triple lattice design with three replications. The plot size was 5.0 m x 1.2 m with a inter and intra row spacing of 30 cm x 10 cm. The genotypes were evaluated in four seasons (Rabi/summer 1998-1999, Kharif 1999,

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Rabi/summer 1999-2000 and Kharif 2000). Recommended package of practices were followed to raise a healthy crop to tap the full genetic potential of the genotypes. Plot yield was recorded and kernel yield per hectare was calculated for the purpose of data analysis. A combined analysis of variance was used to determine the genotype x environment interaction. Considering Y_{ij} as the mean observation of i^{th} genotype in j^{th} environment, Eberhart and Russel (1966) used the following model to study the stability of genotypes under different environments.

Y_{ij} = $m + B_i I_j + ð_{ij}$ (i=1,2,…….t and j= 1,2,……s)

Y_{ij} = mean of the ith variety in jth environment

m = means of all the varieties over all the environment

B_i = the regression coefficient of the ith variety on the environmetal index which measures the response of this variety to varying environments.

I_j = the environmental index which is defined as the deviation of the mean of all the varieties at a given location from the overall mean.

Results and discussion

Analysis of variance combined over seasons for kernel yield is presented in Table 1. Mean squares due to genotypes, environments and to G X E interaction are significant. It indicates presence of substantial variation in the *per se* performance of all the 16 genotypes over environments and in the environmental means over test genotypes. Significant G X E interaction expresses differential performance of genotypes under different environments. Variance due to environment (linear) is non significant indicating non-linear variation among the environments. On the other hand, significant pooled deviation suggests that mean kernel yield of genotypes fluctuated significantly from their respective linear path of response to environments.

The mean kernel yield of all the genotypes across seasons ranged from 1051 kg/ha (Chico) to 1845 kg/ha (ICGV 92267) and the grand mean kernel yield was 1407 kg/ha (Table 2). Among the genotypes, mean kernel yield of seven accessions [ICGV 92267 (1845 kg/ha), ICGV 94361 (1831 kg/ha), ICGV 93388 (1712 kg/ha), ICGV 91155 (1573 kg/ha), VRI 3 (1534 kg/ha), ICGV 92218 (1495 kg/ha) and ICGV 93420 (1429 kg/ha)] were above the grand mean yield, while the rest gave below the grand mean kernel yield. In the present investigation the magnitude of regression coefficient (b_i) and deviation from regression (S^2d_i) varied among genotypes. According to Eberhart and Russel (1966), an ideal genotype would be the one with high mean yield, regression coefficient equal to unity (bi=1) and low deviation mean square ($S^2d_i = 0$).

Among the 16 genotypes, genotypes ICGV 92206 and ICGV 93392 recorded non significant squared deviation from regression and considered as stable genotypes. Both these genotypes recorded unity regression (non significant regression coefficient from unity) and hence considered as average responsive genotypes. Though the genotypes recorded low yield (1277 kg/ha and 1209 kg/ha), they respond consistently well in a wide range of environments. Naik and Dasaradha Rama Reddy (2004) reported similar results for pod yield in groundnut.

Hence from the foregoing discussion, it can be concluded that the genotype ICGV 92206 and ICGV 93392 were found to be stable genotypes and average responsive genotypes. These genotypes can be recommended to wide range of seasons with consistent yield. These two genotypes can be utilized in breeding programme for developing varieties with general stability.

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Table 1. Pooled analysis of variance for kernel yield (kg/ha) in groundnut.

Source of variation	df	Mean sum of square
Genotypes (G)	15	235002.67**
Environment (E)	3	736432.00**
G X E	45	53979.37**
E + (GXE)	48	96632.66
Environment (Linear)	1	2209296.00
G X E (Linear)	15	45972.53**
Pooled deviation	32	54359.33**
ICGV 91155	2	100921.75**
ICGV 92195	2	111945.67**
ICGV 92206	2	722.38
ICGV 92217	2	770.96.50**
ICGV 92218	2	96768.46**
ICGV 92222	2	89015.81**
ICGV 92229	2	46386.40**
ICGV 92267	2	16202.18*
ICGV 93370	2	19735.99*
ICGV 93382	2	52235.59**
ICGV 93388	2	65275.01**
ICGV 93392	2	4879.90
ICGV 93420	2	91979.73**
ICGV 94361	2	17350.33*
Chico	2	59582.27**
VRI 3	2	19651.23*
Pooled error	120	14439.98

*, ** significantly different at p=0.05 and p=0.01 levels respectively

Table 2. Estimates of stability parameters for kernel yield (kg/ha) in groundnut.

Genotype	Mean yield (kg/ha)	b_i	S^2d
ICGV 91155	1573	1.236	96108.4**
ICGV 92195	1251	0.521	107132.3**
ICGV 92206	1209	0.301*	-4090.9NS
ICGV 92217	1362	-0.474	72283.1**
ICGV 92218	1495	0.622	91955.1**
ICGV 92222	1395	0.921	84202.4**
ICGV 92229	1244	1.401	41573.0**
ICGV 92267	1845	1.472	11388.8*
ICGV 93370	1133	1.375	14922.6*
ICGV 93382	1176	1.763	47422.2**
ICGV 93388	1712	1.260	60461.6**
ICGV 93392	1277	1.708	66.5NS
ICGV 93420	1429	0.798	87166.4**
ICGV 94361	1831	1.188	12537.0*
Chico	1051	0.689	54768.9**
VRI 3	1534	1.214	14837.9*
Mean	1407	-	-

*, ** significantly different at p=0.05 and p=0.01 levels respectively