Assessment of Groundnut Genotypes for Genetic Variation, Disease Resistance and its Inter-relationship with Yield and its Component Characters

TN Lakshmidevamma and M Byre Gowda
All India Coordinated Research Project on Pigeonpea, University of Agricultural Sciences, GKVK, Bangalore-560 065 (Karnataka)

Information on genetic variability, heritability and genetic advance was derived from data on 14 characters in 81 genotypes of groundnut. PCV and GCV estimates were relatively high for number of branches, leaf spot severity, rust severity and bud necrosis incidence. High heritability coupled with high genetic advance was recorded for test weight, pod yield, leaf spot and rust and bud necrosis incidences. Correlation co-efficient of three diseases with yield and its component characters revealed highly significant positive correlation of leaf spot severity with rust severity and oil content but significantly negative with days to 50% flowering, days to maturity and test weight. Rust severity showed highly significant negative association with days to maturity and plant height. Bud necrosis incidence showed significant negative association with plant height. Screening of genotypes for disease resistance revealed that sources of resistance to leaf spot, rust and bud necrosis diseases are available in groundnut. Six genotypes showed higher yields combined with high resistance to leaf spot and rust over checks.

Key Words: Disease Resistance, Groundnut, Inter-relationship, Variability

The success of any crop improvement programme depends on the magnitude of genetic variability and the extent of heritable portion of desirable traits. Hence, knowledge on these lines is a pre-requisite for planning an effective breeding programme. Groundnut (*Arachis hypogaea* L.) is the most important oilseed crop of India, but its productivity is one of the lowest. Pod yield being a complex character, its expression is influenced by the interaction of various component traits, each controlled by a different set of hereditary factors. Since the effectiveness of the selection depends on the extent of genetic variability, an attempt has been made to evaluate groundnut genotypes for various characters.

Low productivity in groundnut is mainly attributed to the wide occurrence of major diseases like leaf spot, rust and bud necrosis. Hence, the genotypes were also screened for resistance against these diseases as well as their correlation with yield and its component characters was analyzed.

Material and Methods

The material selected for the present study comprised 81 genotypes of groundnut grown at GKVK farm, UAS, Bangalore, The field experiment was laid out in 9 x 9 simple lattice design with two replications. A spacing of 30 x 10 cm was maintained. All along the border, susceptible check (JL-24) for leaf spot and rust was planted. Observations were recorded on five randomly chosen plants for 14 quantitative characters, viz., day to 50% flowering, days to maturity, plant height, number of branches, number of pods, pod yield, kernel yield/ plant, shelling percentage, test weight, oil content, oil yield, leaf spot and rust severity and bud necrosis incidence. Analysis of variance was computed and the genetic parameters were calculated as suggested by Burton and Devane (1953). Heritability in broad sense was worked out as per the formulae suggested by Hanson *et al.* (1956) and genetic advance as suggested by Johnson *et al.* (1955). Correlation of diseases severity with other characters was estimated by using the procedure suggested by Al-Jibouri *et al.* (1958). Disease incidence was studied under field conditions by recording their severity at 50% pod filling stage. For leaf spot and rust, the per cent leaf area affected was computed and expressed as per cent leaf area affected in a given accession. For bud necrosis, number of infected plants and total number of plants in a genotype were counted and expressed as per cent incidence.

Results and Discussion

Analysis of variance revealed that the genotypes differed significantly for all the characters studied. The estimates of variability parameters are given in Table 1. Wide range of variation was observed for test weight, number of pods, plant height, oil content, shelling per cent, pod yield, kernel yield as well as for leaf spot, rust and bud necrosis diseases. Wide range of variation for these characters was also reported by Reddy and Gupta (1992), Khurram *et al.* (1998) and Salara and Gowda (1998).

Table 1. Estimates of range, mean, phenotypic and genotypic co-efficients of variability, heritability and genetic advance for 81 genotypes in groundnut

Characters	Range		Mean	Co-efficient of variability		Heritability (%)	Genetic advance as % of mean
	Min.	Max.		PCV(%)	GCV(%)		
Days to 50% flowering	34.00	44.00	37.00	07.71	06.61	86.50	12.67
Days to maturity	108.00	125.00	113.00	04.41	04.26	93.60	08.50
Plant height	26.59	45.99	36.30	12.07	10.52	76.00	18.88
No. of branches/plant	05.00	12.00	08.00	22.79	15.75	47.70	22.44
No. of pods/plants	15.00	28.00	21.00	17.13	10.51	37.60	13.26
Pod yield/plant	14.18	30.39	21.20	17.67	13.78	60.80	22.13
Kernel yield/plant	10.38	23.67	16.20	16.21	11.86	53.50	17.88
Shelling per cent	64.94	85.25	76.94	04.99	04.49	80.90	08.30
Test weight	27.59	66.97	44.99	17.69	17.38	96.60	35.18
Oil content	33.65	52.52	43.40	09.67	09.05	87.50	17.44
Oil yield/plant	04.75	09.29	06.98	15.90	12.00	56.40	18.49
Leaf spot severity	06.94	34.73	24.58	32.10	30.54	90.50	59.88
Rust severity	02.19	22.38	13.27	35.16	33.46	90.60	65.56
Bud necrosis incidence	00.69	27.51	13.47	50.77	47.54	87.70	91.68

The variability estimates in general revealed that the PCV was higher than the corresponding GCV for different characters, though the extent of difference between the two was relatively low. This narrow difference between PCV and GCV imply low sensitivity to environmental effects. The PCV and GCV estimates were relatively high for number of branches, number of pods, leaf spot, rust and bud necrosis incidences. High PCV and GCV estimate for number of pods were in accordance with Khurram *et al.* (1998). Moderate PCV and GCV estimates were observed for plant height, pod yield, kernel yield, test weight and oil yield, which were reported to be high by Uddin *et al.* (1995), Kumar *et al.* (1998) and Naik *et al.* (2000).

High heritability coupled with high genetic advance was observed for pod yield, test weight, leaf spot, rust and bud necrosis. Selection for these traits is likely to accumulate more additive genes leading to further improvement in their performance and hence, may be used as selection criteria. High heritability with moderate genetic advance was observed for days to 50% flowering, plant height and oil content. Moderate heritability with moderate genetic advance was observed for number of pod, kernel yield and oil yield indicating considerable influence of environment, so that simple selection will not be effective because of non-additive gene action. These results are in accordance with Udin *et al.* (1995), Naik *et al.* (2000) and Salara and Gowda (1998).

Since groundnut is most susceptible to major diseases (leaf spot, rust and bud necrosis), one of the major objective of groundnut breeding programme is to develop disease resistant cultivars with acceptable agronomic characters. For this, it is important to know the association of characters with the diseases. Correlation coefficient analysis (Table 2) indicated highly significant and negative correlation of leaf spot severity with days to 50% flowering, days to maturity and test weight indicating

Table 2. Estimates of phenotypic correlation co-efficients of 13 characters and two diseases

Characters	Leaf spot	Rust incidence	Bud necrosis
Days to 50% flowering	-0.540**	- 0.200	- 0.132
Days to maturity	- 0.706**	- 0.438**	- 0.190
Plant height	0.037	- 0.229*	- 0.349**
No. of branches/plant	- 0.038	0.086	0.068
No. of pegs/plant	0.158	0.131	0.190
No. of mature pods/plants	0.075	0.041	0.172
No. of immature pods/plant	0.153	0.125	0.109
Pod yield/plant	-0.180	0.083	- 0.001
Kernel yield/plant	- 0.144	0.113	0.050
Shelling per cent	0.190	0.130	0.083
Test weight	- 0.459**	0.091	0.140
Oil content	0.338**	- 0.034	- 0.039
Oil yield/plant	0.055	0.090	- 0.089
Leaf spot	–	0.393	0.124
Rust incidence	–	0.186	

*Significant at 5% level; **Significant at 1% level

Table 3. Number of genotypes categorized into different infection classes in groundnut

Disease incidence (%)	Category	Number of entries		
		Leaf spot	Rust	Bud Necrosis
0-5	Highly resistant	11	15	37
5.0 - 10	Resistant	7	59	30
10.1 - 25	Moderately resistant	35	11	14
25.1 - 50	Susceptible	28	-	-
50% and above	Highly susceptible	-	-	-

less susceptibility of late flowering/maturing types for the disease. Its association was positive and significant with oil content and rust severity. Rust severity showed significant negative association with days to maturity and plant height. Bud necrosis incidence showed significant negative association with plant height. The inter-correlations estimate indicate the simultaneous improvement of these traits by selection.

The entries were also screened for resistance against three major diseases. Of the 81 entries screened, 11 entries were highly resistant to leaf spot, 15 to rust and 37 to bud necrosis incidence (Table 3). Six genotypes *viz.*, JSSP-13, VG-9711, VG-9516, CSMG-919, Dh-992 and TNAU-281 had combined resistance to all the three diseases. These six genotypes were found to be late flowering and late maturing with moderate levels of pod yield, shelling percentage, test weight and oil content. Hence, they offer a promising source of resistance to be used in further resistant breeding programme. Buiel *et al.* (1993), Vasanthi and Naidu (1998) and Mukund *et al.* (1999) have also reported on varietal screening for resistance to these diseases.

The genotypes were compared with the checks (JL-24, TMV-2, VRI-2, K-134) for pod yield and disease resistance (Table 4). Six genotypes, *viz.*, JSSP-18, CSMG-919, M-13, JCGV-86532, JSSP-16 and VG-9516 showed higher yields combined with high resistance to leaf spot and rust over the checks indicating that simultaneous improvement for high yield and resistance to diseases is possible in groundnut. These genotypes can be recommended for further traits to examine their consistent performance.

Table 4. Genotypes having significantly higher yield along with higher disease resistance than checks in groundnut

Genotype	Pod yield	Leaf spot severity (%)	Rust severity (%)
Entries			
JSSP-18	31.00	15.00	5.0
M-13	30.50	11.00	7.0
ICGV 86352	27.10	17.00	1.0
CSMG 919	26.95	3.50	1.0
JSSP 16	26.80	11.00	5.0
J-38	26.30	20.00	7.0
VG 9516	25.35	2.00	4.0
Checks			
JL-24	23.65	25.00	5.0
TMV 2	23.15	24.00	5.0
VRI 2	23.30	19.00	6.0
K-134	19.25	30.00	9.0

References

Al-Jibouri HA, PA Miller and HE Robinson (1958) Genotypic and environmental variances in upland cotton of inter-specific origin. *Agron. J.* **50:** 633-637.

Buiel AAM, T Jacobs and JE Parlevliet (1993) Resistance in groundnut to peanut bud necrosis virus. Durability of disease resistance 207-210. *Current Plant Science and Biotechnology in Agriculture* **18:** 207-210.

Burton GW and GM Devane (1953) Estimating heritability in tall Fescue (*Festuca arundinaceae*) from replicated clonal material *Agron. J.* **45:** 478-481.

Hanson GH, HF Robinson and RE Comstock (1956) Biometrical studies and yield in segregating populations of Korea Tes Pedeza *Agron. J.* **48:** 267-282.

Johnson RW, HF Robinson and RE Comstock (1955) Estimates of genetic and environment variability in soybeans. *Agron. J.* **47:** 314-318.

Khurram B, A Naazar and SN Malik (1998) Estimation of variability and heritability for quantitative traits in groundnut *Sarhad. J. Agric.* **14:** 575-579.

Kumar R, J Ghosh and JN Sah (1998) Variability and correlation studies in mutant cultures. *J. Appl. Biol.* **8**: 20-23.

Mukund S Kulkarni, KH Anahosur and K Giriraj (1999) Screening Groundnut Entries against bud necrosis virus in Karnataka. *J. Oilseeds Res.* **16:** 159-160.

Naik KSS, PN Reddy and CDR Reddy (2000) Variability studies in F_2 populations of some sub specific crosses in groundnut *National Seminar on Oilseeds and Oils, Research and Development Needs in the Millennium* **2-4:** 93.

Reddy KR and RVS Gupta (1992) Variability and inter-relationship of yield and its component characters in groundnut. *J. Maharashtra Agric. Univ.* **17:** 224-226.

Salara BS and MVC Gowda (1998) Variability and correlation studies on segregating generation of inter sub specific crosses of groundnut (*Arachis hypogaea*) *Crop Improv.* **25:** 122-123.

Uddin MJ, MAZ Choudhury, MK Sultan and BN Mitra (1995) Genetic variability, correlation and path analysis in groundnut (*Arachis hypogaea* L.). *Bangladesh J. Sci. Industrial Res.* **30:** 235-241.

Vasanthi RP and PH Naidu (1998) Evaluation of advanced groundnut lines for resistance to late leaf spot. *Int. Arachis Newslet.* No. **18:** 14-16.