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Variability, heritability and genetic advance of some quantitative characters over the seasons in soybean

A.P. AGRAWAL, S.A. PATIL AND P.M. SALI MATH
Dept. of Genetics and Plant Breeding, University of Agrl. Sciences, Dharwad-580 005, Karnataka

Abstract : Genetic variability parameters like genotypic coefficient of variation (GCV) phenotypic coefficient of variation (PCV), heritability (h^2) and genetic advance as per cent of mean (GAM) were studied using the 196 soybean germplasm lines for six plant growth, four yield attributing and ten pod characters in three seasons. Genetic variability parameters for plant growth characters indicate high GCV for degree of indeterminate growth habit, plant height and branches per plant. Estimates of GCV were moderate for days to flower initiation, days to flower termination, whereas low for days to maturity. Heritability and genetic advance as percentage of mean were high for all the plant growth characters (except moderate GAM for days to maturity). With regard to seed yield and yield attributing characters, high estimates of variability parameters were observed in all the three seasons. GCV was high for some of the pod characters *viz.* individual pod weight, seed to pod shell ratio and pod shattering, but was moderate for seeds per pod, moisture content of pods at physiological maturity, pod length, pod thickness and pod shattering, whereas moderate for seeds per pod, moisture content of pods at physiological maturity, seed to pod shell ratio, pod width and P.T:PW. The pod characters *viz.* individual pod weight, seed to pod shell ratio, pod thickness, PT:PL and pod shattering expressed high GAM, whereas seeds per pod, moisture content of pods at physiological maturity, pod length, pod width expressed moderate GAM. ***(Key words : Genetic variability, Parameters, Soybean.)***

In any systematic plant breeding work, estimation of genetic variability is a prerequisite. The magnitude of variability in any population will be due to genetic and environmental factors, which can be partitioned using statistical methods. The estimation of genotypic and phenotypic coeffficient of variation is of primary importance to get an idea of relative extent of heritable and non-heritable variations. The estimates of heritability permits the greater effectiveness of selection by separating out the environmental influence from the total variability. Heritability estimates appears to be more meaningful when accompanied by estimates of genetic advance. Therefore, the experiment was conducted to know the variability, heritability and genetic advance of some quantitative characters over the seasons in soybean.

Materials and Methods

The experiment was conducted with 196 soybean germplasm lines in three seasons *viz. kharif* 1998 (K98), *rabi* summer 1999 (R/S99) and *kharif* 1999 (K99). The experiment was laid out in Balanced lattice design with two replications in a single row of three meter length with spacing of 45 cm and 15 cm inter and intra rows. Observations on six plant growth, four yield attributing and ten pod characters were recorded. The plant growth characters were days to flower initiation, days to flower termination of main stem, days to maturity, plant height and branches per plant, however degree of indeterminate growth habit was calculated in days as the difference between days to flower initiation and days to flower termination in main stem. The yield attributing traits were clusters per plant, pods per plant, 100 seed weight (g) and seed yield per plant (g). Pod characters were recorded on the five two seeded and five three seeded randomly selected pods. The characters were pod length (mm), pod width (mm), pod thickness (mm), ratio of pod thickness with pod width (PT:PW), ratio of pod thickness with pod length (PT:PL) and seeds per pod. The moisture content of pods at physiological maturity (per cent), individual pod weight (mg) and seed to pod shell ratio was recorded from the composite sample of 25 pods collected at physiological maturity. However pod shattering (per cent) was recorded on the seventh days after maturity as the ratio of number of shattered pods to total number of pods per plant on five randomly selected plants and expressed as per cent. Angular transformed values of pod shattering was used for the statistical analysis.

The genotypic coefficient of variation (GCV) and phenotypic coefficient of variation (PCV) were estimated using the method suggested by Burton and DeVane (1953). Heritability (h^2) was estimated as per the formula given by Hanson *et al.* (1956).

Results and Discussion

The results of genetic variability parameters for different character are presented in Table 1 and discussed hereunder.

Plant growth characters

The genotypic coefficient of variation value ranged form 6.47 to 42.70 per cent for days to maturity (during *kharif* 98) and plant height (during *kharif* 98). High GCV was obtained for degree of indeterminate growth habit, plant height and branches per plant indicating the presence of sufficient variability for selection. High GCV for degree of indeterminate growth habit is in accordance with the findings of Khurana and Sandhu (1972). High GCV for plant height and branches per plant was also reported by several researchers Rao *et al.* 1981; Mahajan *et al.* 1994 and Shrivastava and Shukla, 1998). Moderate GCV value for days to flower initiation and low for days to maturity is supported by most of the reports. However, the estimates of GCV and PCV of present investigation was closely in agreement with the findings of and Kalaimagal (1991).

The heritability estimates were more than 90 per cent for plant growth characters. High heritability for days to flower initiation was also reported by Bains and Sood (1980), Sarma and Abraham (1988), and Thorat *et al.* (1999). However, Tiwari and Bhatnagar (1991) reported high heritability for days to maturity. High heritability for the plant height was also reported by Mahajan *et al.* (1994), and Thorat *et al.* (1999).

The genetic advance as percentage of mean was high for plant height and branches per plant, moderate for days to flower initiation and low for days to maturity which are in agreement with the reports of Harer and Deshmukh (1991). The high genetic advance for degree of indeterminate growth habit was also reported by Khurana and Sandhu (1972). High heritability with high genetic advance for plant height, degree of indeterminate growth habit and branches per plant indicate that the expression of these characters may be due to additive gene effects. However, high heritability with moderate genetic advance for days to flower initiation and days to maturity limits the scope for selection.

Yield related characters

The seed yield and yield attributing traits expressesd high magnitude of GCV and PCV. The higher GCV for seed yield and related traits were in accordance with the reports of Sarma and Abraham (1988), Kalaimagal (1991), Harer and Deshmukh (1991).

High heritability observed for clusters per plant in the present study is in agreement with Rao *et al.* (1981), and Tsuchiya (1987). Similar findings for pods per plant were also reported by Sarma and Abraham (1988), and Singh and Singh (1999). Hundred seed weight showed high heritability which is in consonance with earlier reports of Tiwari and Bhatnagar (1991), and Thorat *et al.* (1999). The earlier researchers Sarma and Abraham (1988), and Singh and Singh (1999) reported high heritability for seed yield. The present findings are in accordance with their reports.

The estimate of genetic advance as percentage of mean was high for seed yield and yield attributing traits. But it was moderate for 100 seed weight, as compared to the other yield attributing traits. High GAM for seed yield and related characters was also reported by Harer and Deshmukh (1991), and Thorat *et al.* (1999). The high GAM with high heritability suggest a wide scope for selection and provides an opportunity for easy selection based on visual observations.

Pod characters

Seeds per pod, moisture content of pods at physiological maturity, pod length, pod width, pod thickness, PT:PL and PT:PW exhibited low to moderate GCV which limits the scope of selecion. The findings for these pod characters were in accordance with the reports by Caviness (1969), Khurana and Sandhu (1972), Bains and Sood (1980), and Thorat *et al.* (1999). The GCV was high for individual pod weight and seed to pod shell ratio, but lower than the pod shattering. The high GCV for individual pod weight was in agreement with the findings of Iglesias (1988), whereas Nakamura *et al.* (1987) reported high GCV for seed to pod shell ratio. Tiwari and Bhatnagar (1991) also observed the high GCV for pod shattering.

The heritability estimates were moderate for seeds per pod and seed to pod shell ratio. This is in agreement with the findings of Bains and Sood (1980), and Thorat *et al.* (1999) for seeds per pod. The heritability was more than 90 per cent for individual pod weight, pod length, pod thickness and PT:PL. Thorat *et al.* (1999) also observed high heritability for pod length. Similarly high heritability for pod width observed in the present study is in agreement with Bravo *et al.* (1980) and the high heritability for pod thickness did not match with their findings.The heritability of PT:PW differs with the seasons. The high heritability of pod shattering was also observed

Table 1. Genetic variability parameters for 21 quantitative characters in different seasons in soybean

Character	Season	GCV	PCV	h^2 (%)	GA	GAM (%)
Days to flower initiation	*kharif* 98	11.97	12.16	96.9	9.41	24.28
	R/ S'99	9.89	9.98	98.3	9.08	20.20
	kharif 99	13.04	13.31	95.9	10.23	26.32
Days to flower termination	*kharif* 98	13.28	13.40	98.3	14.66	27.13
	R/ S'99	12.55	12.61	98.9	15.23	25.68
	kharif 99	14.52	14.82	95.9	15.51	29.27
Degree of indeterminate growth	*kharif* 98	35.06	35.72	96.3	10.82	70.86
	R/ S'99	35.87	36.40	97.1	10.47	72.82
	kharif 99	38.31	39.18	95.6	10.9	77.16
Days to maturity	*kharif* 98	6.47	6.53	98.0	12.53	13.18
	R/ S'99	6.65	6.72	98.1	13.04	13.57
	kharif 99	4.75	4.98	91.0	8.73	9.34
Plant height (cm)	*kharif* 98	42.70	43.05	98.4	33.71	87.27
	R/ S'99	39.17	39.78	96.9	29.45	79.42
	kharif 99	41.03	42.77	92.0	29.34	81.10
Branches per plant	*kharif* 98	27.89	28.65	94.7	2.25	55.89
	R/ S'99	34.11	35.28	93.4	2.12	67.89
	kharif 99	32.95	33.86	94.7	2.68	66.05
Clusters per plant	*kharif* 98	36.27	37.17	95.2	18.07	72.90
	R/ S'99	39.79	41.08	93.8	15.28	79.38
	kharif 99	37.91	38.94	94.8	19.38	76.06
Pods per plant	*kharif* 98	34.58	35.59	94.4	44.92	69.21
	R/ S'99	41.43	42.62	94.5	38.96	82.96
	kharif 99	37.20	38.45	93.6	47.83	74.14
Seeds per pod	*kharif* 98	7.81	8.52	84.1	0.363	14.77
	R/ S'99	10.37	11.94	85.1	0.476	19.70
	kharif 99	9.03	9.99	81.6	0.412	16.80
100 seed weight (g)	*kharif* 98	19.71	20.17	95.5	5.44	39.68
	R/ S'99	20.22	21.22	90.8	4.41	39.69
	kharif 99	20.32	20.98	93.8	5.44	40.54
Moisture content of pods at physiological maturity (%)	*kharif* 98	9.38	10.65	77.5	9.29	17.01
	R/ S'99	9.89	12.11	66.8	9.46	16.65
	kharif 99	7.11	9.10	61.3	6.06	11.47
Individual pod weight (mg)	*kharif* 98	19.50	20.10	94.1	208.9	38.97
	R/ S'99	22.87	23.36	95.8	200.8	46.10
	kharif 99	21.75	22.39	94.3	199.1	43.49
Seed to pod shell ratio	*kharif* 98	21.64	23.53	84.5	0.700	40.97
	R/ S'99	19.34	20.78	86.4	0.595	36.99
	kharif 99	16.16	17.48	85.4	0.667	30.76
Pod length (mm)	*kharif* 98	8.72	8.79	98.3	7.59	17.81
	R/ S'99	8.67	8.77	97.8	7.35	17.66
	kharif 99	9.49	9.54	99.0	8.28	19.45
Pod width (mm)	*kharif* 98	7.95	8.45	88.6	1.48	15.42
	R/ S'99	8.32	8.64	92.8	1.53	16.50
	kharif 99	8.57	8.83	94.1	1.67	17.13

Character	Season	GCV	PCV	h^2 (%)	GA	GAM (%)
Pod thickness (mm)	*kharif* 98	11.10	11.68	90.3	1.19	21.72
	R/ S'99	17.15	17.57	95.3	1.80	34.48
	kharif 99	13.74	14.20	93.7	1.48	27.40
PT:PL	*kharif* 98	11.23	11.75	91.3	0.028	22.11
	R/ S'99	16.07	16.45	95.3	0.041	32.30
	kharif 99	13.86	14.30	93.9	0.035	27.66
PT:PW	*kharif* 98	9.25	10.63	75.6	0.095	16.56
	R/ S'99	14.99	15.53	93.5	0.169	29.86
	kharif 99	11.43	12.13	88.8	0.123	22.19
Seed yield per plant (g)	*kharif* 98	36.05	37.39	92.9	10.18	71.56
	R/ S'99	36.48	38.42	90.1	3.18	71.31
	kharif 99	35.38	36.64	93.2	10.51	70.35
Pod shattering (%)	*kharif* 98	44.39	44.76	98.1	32.64	90.46
	R/ S'99	42.64	43.33	96.8	39.84	86.41
	kharif 99	41.51	41.98	97.7	32.28	84.50

GCV - Genotypic coefficient of variation, PCV - Phenotypic coefficient of variation
h^2 - Heritability, GA - Genetic advance
GAM - GA as per cent of mean

by Caviness (1969), Tsuchiya (1987), Tiwari and Bhatnagar (1991).

The genetic advance as per cent of mean (GAM) was moderate for seeds per pod, moisture content of pods at physiological maturity, pod length and pod width. The moderate GAM for seeds per pod was supported by Harer and Deshmukh (1991), and Thorat et al. (1999). Moderate GAM for pod length was in agreement with the reports of Khurana and Sandhu (1972), Bains and Sood (1980). The GAM was high for individual pod weight, seed to pod shell ratio, pod thickness, PT:PL and pod shattering. The high GAM for podd shattering was also observed by Tiwari and Bhatnagar (1991). High heritability of pod length with moderate GAM indicates the comparatively lower genetic gain through selection. The high GAM coupled with moderate heritability for seed to pod shell ratio indicated the role of non-additive gene action. High GAM with high heritability for individual pod weight, pod thickness, PT:PL and pod shattering indicates the high genetic gain through selectins. Moreover, these estimates were highest for pod shattering, suggesting the best expected genetic gain and easy to select out the shattering resistant genotypes.

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Biological control of *Pythium aphanidermatum* - *Meloidogyne incognita* disease complex in brinjal with organic amendments

G. KARTHIKEYAN, SABITHA DORAISAMY AND C.V. SIVAKUMAR
Centre for Plant Protection Studies, Tamil Nadu Agricultural University, Coimbatore - 641 003, Tamil Nadu

Abstract : Biological control of *Pythium aphanidermatum - Meloidogyne incognita* disease complex in brinjal with organic amendment *viz.* farm yard manure and neem cake was evaluated in the field. The antagonisitic organisms used were *Trichoderma viride, T.harzianum* against pathogen and *Paecilomyces lilacinus* against nematode. The damping off incidence of brinjal was reduced in all the treatments, when the seeds were treated with antagonistic organisms and the soil was amended with the organic amendments 15 days before sowing *viz.* farm yard manure and neem cake at the rate of 20 t ha^{-1}. The dry shoot and root weights were higher in *T.viride* + farm yard manure treatment followed by *T.Viride* + neem cake treatment and the nematode gall-index was very much reduced in *P.lilacinus* + farm yard manure and in *P.lilacinus* + neem cake treatment *(Key words: Biological control, Pythium-Meloidogyne disease complex, Organic amendments)*

Brinjal is an important vegetable crop grown in India. It is ususally affected by the damping-off pathogen, *Pythium* sp. and also by root-knot nematode, *Meloidogyne* sp. Sometimes both the organisms are involved and cause disease complex. The non-availability of cheap and effective fungicides and nematicides is a major constraint in the management of *Pythium* sp. *and Meloidogyne* sp. and the existing control measures are becoming inadequate. Hence, the present investigation on biological control of *Pythium - Meloidogyne* disease complex in brinjal with antagonists and organis amendments was undertaken.

Materials and Methods

The biocontrol agents used in this experiment were *T.viride* and *T. harzianum* (antagonists against