

Variability, Correlation and Path Coefficient Analysis for Quality Seed Traits in Cowpea (*Vigna unguiculata* [L.] Walp.)

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Genetic variability, heritability, genetic advance, correlation and path coefficient analysis was studied for some quality seed traits in 50 diverse genotypes of cowpea. The range of variation was observed from 68.00 to 99.33 per cent for standard germination; from 10.73 to 20.07 cm for root length; from 21.33 to 35.73 cm for shoot length; from 696.76 to 2078.67 mg for fresh weight; from 12.67 to 270.67 mg for dry weight; from 0.25 to 2.60 dS/m for electrical conductivity and from 2478.13 to 4643.07 for vigour index in various genotypes. High estimates of GCV, PCV, heritability and genetic advance were observed for seedling dry weight and electrical conductivity. Path analysis studies revealed the maximum direct effect of seedling vigour, seedling dry weight and standard germination on seed yield. Hence, these quality seed traits should also be given due weightage along with other important contributing traits of seed yield.

Key Words: Cowpea, Genetic Advance, Heritability, Path Coefficient Analysis, Variability

Cowpea (*Vigna unguiculata* [L.] Walp.) is one of the important pulse crops which is used extensively in Indian vegetarian diet. Cowpea is a multipurpose crop and is grown as a grain legume mainly for dry beans, green vegetables, and also as forages, green manure and cover crop. Hampton and Tekrony (1995) stated that high seed vigour also leads to high grain yield potential. However, in cowpea, the studies on quality seed parameters are very scanty (Verma, 1978; Shridhar, 1994; Dahiya, *et al.*, 2001 a,b). Keeping in view the limited information available on these aspects, the present investigation was undertaken.

Materials and Methods

Three hundred seeds of each of the fifty genotypes were placed on sufficiently moistened rolled towel paper (BP) and kept in a germinator at 25±1°C. The final count of normal seedlings was made on 8th day (ISTA, 1999) and expressed in per cent. The root length and shoot length of 15 randomly selected normal seedlings taken from each genotype was measured in centimeters. The same seedlings were also used for weighing their fresh weight. After taking their fresh weight, the seedlings were kept for drying in hot-air oven at 80°C for 24 hrs to record their dry weight. For measuring electrical conductivity, one hundred fifty seeds of each genotype were soaked for 24 hrs in a 100 ml beaker containing 75 ml distilled water at 25°C. The electrical conductivity of the seeds leachate was measured with electrical conductivity meter and expressed as m mhos/cm or dS/m. The vigour index was calculated as: Vigour Index

= Standard Germination (%) X Seedling Length (cm)
where, Seedling Length (cm) = Root length (cm) + Shoot length (cm).

Results and Discussion

The analysis of variance revealed significant genotypic differences for all the traits studied (Table 1). The estimates of range and average performance for seven quality seed traits are presented in Table 2. The range of variation for standard germination was from 68.00-99.33 per cent. The lowest value of germination was recorded in GC-9714 and highest in GP-34, with an over all germination of 90.43 ± 1.63 per cent. Verma (1978) reported considerable amount of genetic variability for the area of first two leaves, initial 100-seed weight, seedling fresh and dry weight, normal seed germination and final 100-seed weight in cowpea. Dahiya *et al.* (2001a) reported that in cowpea the range for standard germination was from 33.33-94.00 per cent. The maximum root length was observed in CPD-15 (20.07 cm) and the minimum in HC 98-58 (10.73 cm). An average value for this trait was 13.73 ± 0.48 cm. Shoot length of seedlings varied from 21.33 cm to 35.73 cm with the maximum value observed in HC-98-24 and the minimum in TC-102. An average shoot length was 29.24 ± 0.67 cm. Dahiya *et al.* (2001a) reported a range of variation for root length (3.67-11.59 cm) and for shoot length (7.84-23.52 cm) in various genotypes of cowpea. Shridhar (1994) also reported significant amount of variability for root length. The range for fresh weight per seedling varied from 696.76 mg in HC 98-66 to 2078.67 mg

Table 1. Mean squares from analysis of variance

Source of Variation	d.f.	Standard germination (%)	Root length (cm)	Shoot length (cm)	Fresh weight/ seedling (mg)	Dry weight seedling (mg)	Electrical conductivity (dS/m)	Vigour index	Seed yield per plant (g)
Replications	2	47.02	2.06	0.66	2588.44	36.42	0.01	65608.51	1.34
Genotypes	49	224.89**	12.12**	24.24**	294808.25**	5002.34**	1.07**	784709.35**	60.60**
Error	98	8.00	0.69	1.34	1444.59	46.83	0.01	14685.27	3.31

Table 2. Range, mean, coefficient of variability, heritability and genetic advance for various quality seed traits in cowpea

Components	Standard germination (%)	Root length (cm)	Shoot length (cm)	Fresh weight/ seedling (mg)	Dry weight/ seedling (mg)	Electrical conductivity (dS/m)	Vigour index
Range	68.00-99.33	10.73-20.07	21.33-35.73	696.76-2078.67	12.67-270.67	0.25-2.60	2478.13-4643.07
Mean±SE	90.43±1.63	13.73±0.48	29.24±0.67	1344.50±21.94	58.27±3.95	1.07±0.04	3808.29±69.96
CD (5%)	4.59	1.35	1.88	61.68	11.11	0.12	196.66
G.C.V. (%)	11.73	14.21	10.24	23.49	69.75	55.73	13.30
P.C.V. (%)	12.36	15.45	10.98	23.66	70.74	56.19	13.68
H ² (B.S) (%)	90.05	84.58	87.02	98.55	97.24	98.36	94.59
G.A. (% of Mean)	22.94	26.92	19.68	48.04	141.69	113.86	26.65

in DCP-1. An average value for this character was 1344.50 ± 21.94 mg per seedling. The dry weight per seedling varied from 12.67 mg in HC 98-63 to 270.67 mg in DCP-1. The general mean value recorded for the trait was 58.27 ± 3.95 mg per seedling. Dahiya *et al.* (2001a) reported 25.06-27.30 mg variation for dry weight in cowpea. The electrical conductivity value varied from 0.25dS/m in GP-22 to 2.60dS/m in DCP-1. An over all mean value for this trait was 1.07±0.04dS/m. Dahiya *et al.* (2001b) reported that value for electrical conductivity in cowpea seed leachate varied from 12.13-42.00 mmhos cm⁻¹ seed⁻¹. The range of variation for vigour index was from 2478.13 in TC-102 to 4643.07 in HC 98-30. The general mean value for vigour index was 3809.29 ± 69.96. Dahiya *et al.* (2001a) reported that vigour index varied from 4.06-27.49 among different cowpea varieties. Shridhar (1994) also reported varietal differences for this trait in cowpea.

The estimates of genotypic and phenotypic coefficients of variation (GCV, PCV), heritability (broad sense) and genetic advance (% of mean) for various quality seed traits are given in Table 2. High estimates of GCV and PCV were observed for dry weight per seedling and electrical conductivity; moderate for fresh weight per seedling and low estimates for shoot length, vigour index, root length and standard germination. All the quality seed traits showed high estimates of heritability, whereas estimates of genetic advance were high only for dry weight per seedling and electrical conductivity and moderate for fresh weight. The characters showing high estimates of both heritability and genetic gain can thus

be improved through simple selection. Verma (1978) also reported high GCV and PCV for seedling fresh weight and dry weight and moderate to high heritability with high genetic advance for these traits in cowpea.

The genotypic and phenotypic correlation coefficients between eight characters are presented in Table 3. The standard germination per cent was found to be positively and significantly correlated with shoot length and vigour index. Seedling root length had positive and significant association with seedling dry weight while shoot length was positively and significantly associated with electrical conductivity. Dahiya *et al.* (2001a) also reported a significant and positive association of standard germination with seedling dry weight and vigour index. They also showed significant and positive association of root length with shoot length and vigour index and shoot length with vigour index. Verma (1978) reported a significant positive association of seedling fresh weight and dry weight with seed yield while Paul and Ramaswamy (1979) and Sinha *et al.* (1988) reported significant positive association between seedling dry matter production and seed weight.

The results of path analysis in the form of direct and indirect effects of seven seed quality traits on seed yield per plant are presented in Table 4. The standard germination per cent, vigour index and seedling dry weight although had non-significant positive association with seed yield per plant, yet vigour index had the maximum desirable direct effect on seed yield. Similarly, seedling dry weight and standard germination per cent also had desirable direct effects on seed yield. Vigour

Table 3. Genotypic (in parenthesis) and phenotypic correlation coefficients among seven quality seed traits in cowpea

Characters	Root length	Shoot length	Fresh weight per seedling	Dry weight per seedling	Electrical conductivity	Vigour index
Standard germination	(-0.204)	(0.318)	(0.017)	(-0.148)	(-0.055)	(0.803)
	-0.193	0.296*	0.015	-0.140	-0.059	0.767**
Root length		(-0.145)	(0.010)	(0.319)	(0.044)	(0.138)
		-0.140	0.008	0.280*	0.042	0.158
Shoot length			(0.021)	(-0.278)	(0.185)	(0.698)
			0.021	-0.254	0.164	0.687**
Fresh weight per seedling				(0.711)	(0.457)	(0.033)
				0.705**	0.450**	0.034
Dry weight per seedling					(0.444)	(-0.127)
					0.438**	-0.121
Electrical conductivity						(0.181)
						0.175

* Significant at P = 0.05

** Significant at P = 0.01

Table 4. Path coefficient analysis of seed yield and quality seed traits in cowpea

Characters	Standard germination	Root length	Shoot length	Fresh weight per seedling	Dry weight per seedling	Electrical conductivity	Vigour index	Genotypic correlation with seed yield per plant
Standard germination	0.235	0.109	-0.381	-0.192	-0.050	-0.008	0.714	0.230
Root length	-0.146	-0.213	0.118	-0.101	0.108	-0.066	0.237	0.101
Shoot length	0.136	0.141	-0.110	-0.002	-0.194	-0.026	0.307	-0.046
Fresh weight per seedling	0.018	-0.050	-0.054	-0.101	0.159	-0.064	0.080	0.092
Dry weight per seedling	-0.057	-0.311	0.320	-0.072	0.336	-0.062	-0.040	0.159
Electrical conductivity	0.058	-0.043	-0.279	-0.046	0.149	-0.140	0.118	0.123
Vigour index	0.247	-0.134	-1.054	-0.003	-0.043	-0.025	0.946	0.179

Residual effect = 0.1257

index and standard germination also had positive and desirable indirect effects on seed yield per plant via one another. In view of the present results, it is suggested that in addition to other morphological traits, these quality seed parameters should also be taken into account while breeding for high seed yield in cowpea.

References

- Dahiya OS, RC Punia, RS Sangwan, VP Sangwan and C Ram (2001a) Seedling vigour and its associated characters in cowpea (*Vigna unguiculata* (L.) Walp.) genotypes. *Forage Res.* **27**: 127-130.
- Dahiya OS, RC Punia, DP Deswal and RPS Kharb (2001b) Prediction of germinability of cowpea seed lots-a biochemical criteria. *Forage Res.* **27**: 213-215.
- Hampton JG and DM Tekrony (1995) *Handbook of Vigour Test Methods*. The International Seed Testing Association, Zurich.
- International Seed Testing Association (1999) International rules for seed testing. *Seed Sci. Technol.* **13**: 299-355.
- Paul SR and KR Ramaswamy (1979) Relationship between seed size and seed quality attributes in cowpea (*Vigna sinensis* L.). *Seed Res.* **7**: 63-70.
- Shridhar (1994) Studies on viability and vigour of seeds as influenced by maturity in cowpea (*Vigna unguiculata* (L.) Walp.). *Seed Res.* **22**: 66-68.
- Sinha NC, PN Mathur, RP Singh and SN Singh (1988) Effect of seed size on germination, seed vigour and physiological potential of cowpea. *Seed Res.* **16**: 41-46.
- Verma SR (1978) Studies on early testing in cowpea. *M.Sc. (Ag.) Thesis*, Department of Plant Breeding, CCS Haryana Agricultural University, Hisar.