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STUDIES ON STABILITY FOR YIELD COMPONENT CHARACTERS AND CORRELATION OF STABILITY PARAMETERS IN COWPEA *(Vigna unquiculata* (L.) Walp)*

G. KANDASAMY[1], S. RAJASEKARAN[2] and M. KADAMBAVANASUNDARAM[3]

In any breeding programme, it is necessary to screen and identify phenotypically stable genotypes which could perform more or less uniformly under different environmental conditions. In view of great significance the present study was under taken to investigate the stability of yield and component characters in cowpea. Since the association between stability parameters of yield and its components furnish information subjected to environmental variations (Jatasra and Paroda, 1981), an attempt was also made to compute correlation coefficients between stability parameters of yield and component characters in cowpea.

MATERIALS AND METHODS

A total of seven promising cultures and three related cultivars in cowpea with different geographic origin was assembled. All the ten genotypes were studied in nine different environments. The environments were created by sowing experimental materials at different dates, using three levels of nitrogen (0, 25, 50 kg/ha) in unilocation. All the plots received P_2O_5 at 50 kg/ha uniformly and both nitrogen and P_2O_5 were applied basally. The experiment was conducted at Nationel Pulses Research Centre, Vamban, Pudukkottai in a randomized block design replicated thrice. The experimental plot consisted of six rows of five metre each in each replication. A spacing of 45cm between rows and 15cm between plants in the row was adopted. Uniform irrigation, plant protection and cultural operations were followed in all the environments of the trial. Observations were recorded on clusters per plant, pods per plant. pods per cluster, pod length, seeds per pod and yield per plant. Following the methodology of Eberhart and Russell's model (1966) stability parameters were estimated. Correlation coefficients were computed in usual manner among different stability parameters mean, bi and Sdi^{-2} for yield and yield components.

RESULTS AND DISCUSSION

The analysis of variance showed that the environmental differences were highly significant, indicating

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1. Associate Professor, Regional Research Station, Vriddhachalam.

2. Associate Professor, Department of Agrl. Botany, Agrl. College and Research Institute, Madurai.

3. Professor, School of Genetics, Coimbatore.

TABLE 1 Stability analysis of variance for phenotypic stability in respect of yield and yield components.

	d. f.	Mean squares						
		Pods per plant	Clusters per plant	Pods per cluster	Pod length	Seeds per pod	100 grain weight	Yield per plant
1. Genotypic (G)	9	45.5342**	23.6679**	0.2467**	8.7117**	12.6207**	16.5001**	50.1535**
2. Environment (E)	8	11.5777*	4.9528*	0.1362	11.9667**	22.6814**	2.1813**	27.2792**
3. Genotype x Environment	72	4.3448**	2.1178**	0.0377**	0.5928**	0.9263**	0.4299**	4.8165**
4. Env. + (GXE)	80	5.0681	2.4013	0.0475	1.7302	3.1018	0.5943	7.0610
5. Env. (Linear)	1	92.614	39.622	1.089	95.734	181.4511	17.45	218.238
6. Genotype x Envi. (Linear)	9	4.8139	1.3256	0.0957	1.8983**	2.5655**	1.1009**	6.8527
7. Pooled deviation	70	3.5511**	2.0078**	0.0265**	0.3665**	0.6229**	0.2884**	4.0711**
8. Pooled error	162	0.1389	0.0932	0.0047	0.145	0.2709	0.0026	0.2008

* Significant at 5 per cent ** Significant at 1 per cent

diverse type of environments (Table 1). The genotype differences were also significant. The mean square due to regression (linear component of G x E interaction) was significant for pods per cluster, pod length, seeds per pod and 100 grain weight. This indicated that the genotypes differed in their regression on the environmental index. The non-linear component was also significant for the above traits, indicating that the prediction of all the genotypes included in the present study was rather not possible. Similar results have been reported by Paroda and Hays (1971) and Henry and Daulay (1983) in barley and clusterbeans respectively.

The genotype x environment (linear) component was not significant for pods per plant, clusters per plant and yield per plant, but the pooled deviation was highly significant which showed that the response of genotypes being studied was not predictable and non-linear components play an important role in the development of these characters. Bhatade and Bhale (1983) have reported similar results in cotton.

Three parameters of stability, namely high mean value, regression coefficient (bi) and deviation mean square (Sdi-2) were considered desirable criteria for identifying a stable genotype. The mean performance of the genotypes and the stability parameters of yield and yield components are presented in Table 2. All the ten genotypes did not exhibit uniform response and stability patterns for all the characters. The genotype C.152 was stable for pods per cluster and seeds per pod. KC.195 was stable for pods per cluster pod length and seeds per pod. The genotypes Co. 4, CoVu . 2, KC.15 and V 87 were stable for pod length and seeds per pod. CoVu . 4 was stable for pod length None of them was stable for yield per plant. In each genotype, three or more component characters were non-stable and perhaps contributed to the absence of yield stability in all the genotypes. That the components are easily upset by environmental changes may be the main reason for breeding a stable genotype in pulse crop in general. It will be interesting to study the hybrids of genotypes with stability for different yield components and their influence on yield stability. Among ten genotypes investigated Co.4, CoVu 4 and KC.195 were above average in mean performance with average response to different environmental conditions for yield. Although they are not stable, they can be expected to yield moderately on an average.

Simple correlation studies on different parameters of stability between yield per plant and yield components indicated that when mean is taken there is positive correlation between yield and pods per plant, clusters per plant, pods per clusters, pod length and seeds per pod (Table 3). When bi of these component characters and bi of yield are examined for correlation, correlation between yield

TABLE 2. Stability parameters of yield and yield components

Sl. No.	Genotypes	Pods per plant			Clusters per plant			Pods per cluster		
		Mean	bi	$S\bar{d}i^2$	Mean	bi	$S\bar{d}i^2$	Mean	bi	$S\bar{d}i^2$
1.	C.152	6.85	0.9110	1.2452**	5.37	0.8622	0.651**	1.31	0.506	0.0075
2.	Co.3	6.6	0.3350	1.4200**	5.24	0.9752	0.8178**	1.28	0.3232@	0.004
3.	Co.4	6.58	1.3606	0.3356**	4.81	1.3047	0.1559**	1.39	0.5207@	0.004
4.	CoVu.2	3.75	—0.214	2.9703**	2.78	—0.0785	1.523**	1.33	—0.1883@	0.023**
5.	CoVu.4	6.90	1.3998	1.3659**	5.42	1.3179	1.0327**	1.30	0.4105@	0.0011
6.	KC.15	4.21	0.3803	3.403**	3.44	0.7119	1.7884**	1.23	1.1240	0.0117**
7.	KC.195	10.6	2.4698	17.394**	7.77	1.7709	8.2868**	1.35	0.550	0.0017
8.	V.87	5.9	0.548	1.4236**	4.07	0.2507	0.397**	1.33	1.7815	0.0624**
9.	TVX.1576-OIE	2.33	1.0479	2.1801**	1.96	1.4294	3.2517**	0.83	2.7475@	0.0568**
10.	KC.199	5.34	1.2851	1.0026**	4.46	1.4569	0.418**	1.10	2.1864	0.0497**
	$\bar{m}$	5.91			4.51			1.25		
	S.E.	0.6663	0.6192		0.501	0.719		0.0575	0.4933	

Contd...

	Pod Length			Seeds per pod			100 Grain weight			Yield per plant		
	Mean	bi	Sdi^{-2}	Mean	bi	Sdi^{-2}	Mean	bi	Sdi^{-2}	Mean	bi	Sdi^{-2}
1. C.152	13.63	0.5841@	—0.0466	11.23	0.7102	0.0639	9.62	0.6197	0.0639**	6.67	0.824	0.9274**
2. Co 3	13.61	0.6094@	0.0055	11.23	0.5702@	—0.0347	9.52	0.6725	0.0577**	6.54	0.7779	0.7773**
3. Co.4	15.02	1.1825	0.1716	12.28	1.0739	—0.0342	10.73	0.9858	0.1501**	8.07	1.3824	1.4835**
4. CoVu.2	15.47	0.9329	0.2107	12.99	0.7076	0.3845	9.66	0.1390@	0.2068**	4.10	0.079	4.6512**
5. CoVu.4	16.04	1.1628	0.1063	13.04	1.5407@	—0.1156	11.74	1.0905	0.2795**	9.19	1.5808	2.6354**
6. KC.15	13.40	0.957	0.2038	10.03	1.2017	0.3221	11.09	0.0554	0.073**	3.74	0.5175	3.0887**
7. KC.195	13.43	0.8426	0.1684	9.65	1.1459	0.0081	13.64	2.8477@	1.0521**	10.45	1.9635	13.3806*
8. V.87	13.53	1.3928	0.1392	10.92	0.9049	0.0995	10.49	0.3632	0.2431**	5.88	0.7550	2.117***
9. TVX.1576OIE	14.90	1.9330@	1.2687**	11.38	1.5923	1.8873**	12.53	1.7849	0.6083**	3.31	1.2595	8.4201**
10. KG.199	13.71	0.4123@	0.1325@	10.29	0.5514	0.9394**	11.68	0.5664	0.1229**	5.45	0.0599	1.1267**
$\bar{m}$	14.27			11.29			11.07			6.34		
E. E.	0.214	0.1957		0.2790	9.1853		0.1899	0.4065		0.7134	0.4319	

't' test for 'b'

@ deviation from unity significant

'F' test for Sdi^{-2}

* Significant at 5 per cent

** Significant at 1 per cent

TABLE 3. Correlation coefficient among means of different characters

Sl. No.	Characters	Pods per plant	Clusters per plant	Pods per cluster	Pod length	Seeds per pods	100 grain weight	Yield per plant
1.	Pods per plant	1 000	0.956**	0.372**	—0.701**	0 144	—0.082	0.849**
2.	Cluster per plant		1.000	0.510**	0.069	0.111	—0.040	0.909**
3.	Pods per cluster			1.000	0.325**	—0.064	—0.326**	0.578**
4.	Pod length				1.000	0.894**	0.040	0.339**
5.	Seeds per pod					1.000	—0.208*	0.346**
6.	100 grain weight						1.000	0.136
7.	Yield per plant							1.000

* Significant at 5 per cent ** Significant at 1 per cent

TABLE 4 Correlation coefficients among bi's of different characters

Sl. No.	Characters	Pods per plant	Clusters per plant	Pods per cluster	Pod length	Seeds per plant	100 grain weight	Yield per plant
1.	Pods per plant	1.000	0.785**	—0.052	—0.078	0.248	0.732*	0.829**
2.	Clusters per plant		1.000	0.157	—0.015	0.336	0.678*	0.764**
3.	Pods per cluster			1.000	0.415	0.209	0.078	0.013
4.	Pod length				1.000	0.687*	0.225	0.195
5.	Seeds per pods					1.000	0.572	0.503
6.	100 grain weight						1 000	0.737*
7.	Yield per plant							1.000

* Significant at 5 per cent ** Significant at 1 per cent

TABLE 5 Correlation coefficients among Sdi²'s of different characters

Sl. No.	Characters	Pods per plant	Clusters per plant	Pods per cluster	Pod length	Seeds per plant	100 grain weight	Yield per plant
1.	Pods per plant	1.000	0.862**	—0.176	—0.023	—0.161	0.769**	0.779**
2.	Clusters per plant		1.000	—0.088	0.223	0.059	0.840**	0.863**
3.	Pods per cluster			1 000	0.473	0.587	0.085	0.067
4.	Pod length				1.000	0.801**	0.362	0.411
5.	Seeds per pod					1.000	0 177	0.225
6.	100 grain weight						1.000	0.866**
7.	Yield per plant							1.000

* Significant at 5 per cent ** Significant at 1 per cent

and pods per plant, clusters per plant and 100 seed weight only were significant (Table 4). Similarly when the $\bar{s}di^2$ are correlated, only the same three component characters are correlated with yield (Table 5). But the bi and the Sdi^{-2} value of pod length and seeds per pod are not correlation with bi and Sdi^{-2} value of yield. Only in these two component characters, based on stability parameters, six out of ten genotypes are stable. For the other two characters namely pods per plant and clusters per plant, which showed significant correlation with yield in their mean, there is no stable genotype. Apparently the lack of stability for the traits pods per plant, clusters per plant and 100 seed weight has resulted in the non-stability of yield. But stability for pod length and seeds per pod has not influenced the stability of yield. This indicates that stability of these two component characters need not necessarily lead to stability for yield. Stability for pods per plant, clusters per plant and 100 seed weight appears to be more imporant for stability of yield in cowpea.

In chickpea (Mehra and Ramanujam, 1979 and Mehra *et al.*, 1980) observed that the most important component for yield stability was the number of pods per plant and number of seeds per plant. In pigeonpea, pod length and grains per pod appeared to be stable yield components (Jagshoran *et al*, 1981). Bains and and Gupta (1974) also observed lack of relationship among the stability parameters of yield and its components in wheat suggesting independent genetic machanism controlling their response to environmental variation. Therefore any generalization regarding stability of a genotype based on the stability of component characters appear to be untenable. Yield stability appears to be a more complex character with certain compensation mechanism which needs further investigation.

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