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STABILITY ANALYSIS FOR YIELD AND ITS COMPONENTS IN PIGEONPEA [*CAJANUS CAJAN* (L.) MILLSP.] UNDER IRRIGATED CONDITIONS

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Abstract

An experiment was conducted to examine the stability analysis of the twenty advanced genotypes of pigeonpea including check WRP-1, during *kharif*-2012, 2013 and 2014 under irrigated condition at the Agricultural Research Station, Kalaburagi. Highly significant differences among varieties were observed for all the characters except primary branches. The variance due to Genotype × Environmental (G×E) interaction found significant for the characters like days to flower initiation, plant height number of seeds per pod and yield per plant. All the traits under the study except for 100 seed weight showed significant differences in different environment. The variance due to pooled deviation was highly significant for all the traits except for primary branches and number of seeds per pod, which reflect considerable variability in the material. Out of 20 genotypes studied four entries *viz.,* RVK-285, AKT-9913, JKM-189 and ICP-13579 were consistent and high yielding compared to local check for irrigated conditions.

Key words : Genotype × Environment (G × E), pigeonpea, stability.

Introduction

Pigeonpea [*Cajanus cajan* (L.) Millsp.] is an often cross pollinated (20-70%) (Saxena and Kumar, 2010), has diploid genome with 11 pairs of chromosomes (2n = 2x = 22) comprising a genome of 833.1 Mbp (Varshney *et al*., 2012). India is considered as the native of pigeonpea (Van der Maesen, 1980) because of its natural genetic variability available in the local germplasm and the presence of its wild relatives in the country. It is a short lived perennial shrub belonging to the economically most important tribe Phaseoleae and the subtribe *Cajanine*. It is being cultivated as an annual crop in Southern and South Eastern Asia, Eastern Africa, the Caribbean region and South and Central America. It is chiefly grown for its seeds which are consumed either as dry split peas (dhal), providing major source of protein and essential amino acids or as a green vegetable. Its stem is a good source of fuel wood.

Pigeonpea is the important grain legume, which occupies a major place in dietary requirement. It is cultivated in varied agro climatic conditions ranging from moisture stress and input starved conditions to irrigated conditions. Pigeonpea breeders look forward for widely adapted genotypes responsive to input intensive as well as input deficient agriculture in order to enhance production and productivity of the crop. Selection and yield testing are the two major phases of varietal development and the later one is highly influenced by the locations and years of testing. The magnitude of G × E interaction and its components has a direct bearing on the environmental domain of the varieties to be recommended for commercial cultivation. With this back ground, the present study was undertaken under irrigated situation in three locations to identify stable genotypes of pigeonpea for seed yield and its component traits.

Materials and Methods

The present experiment material comprised of 20 genotypes of pigeonpea including check WRP-1 received from Indian Institute of Pulse Research, Kanpur. The trials were conducted in a randomized block design with two replications in three seasons *viz*., *kharif*-2012, 2013 and 2014 grown under irrigated condition, two protective irrigation were given at flowering and pod filling stage. The plot size of two rows each with 4m length was followed with spacing of 75 cm between rows and 25

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cm between the plants. Observations were recorded on five randomly selected plants in each replication in each environment in respect of 12 different metric characters *viz.*, days to flower initiation, days to 50 per cent flowering, days to 80 per cent pod maturity, plant height (cm), number of primary branches per plant, number of secondary branches per plant, pod bearing length, number of pods per plant, number of seeds per pod, pod length (cm), 100-seed weight (g) and seed yield per plant. Stability analysis was carried out by using the stability model proposed by Eberhart and Russell (1966).

Results and Discussion

The Mean Sum of Squares (MSS) due to varieties were significant for all the characters except for primary branches (table 1). Whereas, MSS was significant for environments in respect of all the ten characters except days to maturity and 100 seed weight. The variance due to Genotype × Environmental interaction found significant for the characters like days to flower initiation, plant height number of seeds per pod and yield per plant indicating its major role in the expression of the trait and the performance of the genotypes for seed yield may be predicted across the environment with great precision (Kuchanur *et al.*, 2008). Significant Genotype × Environment interaction for seed yield and other traits has also been reported earlier (Manivel *et al.*, 1999). Environmental + (Genotype × Environment) interaction was significant for days to flower initiation, plant height, secondary branch, number of seeds per pod, pod length, number of pods per plant and seed yield per plant. The characters having significant environmental + (Genotype × Environmental) were considered for stability analysis. Hence, a total of seven out of twelve characters were subjected for stability analysis. While genotype × environmental (linear) were significant for all the characters except for primary branches, pod bearing length and pod length indicating the absence of genetic differences among varieties for regression on environmental indices and thus the further predication of genotypes would be difficult for these traits. The magnitude of Genotype × Environment component was greater than non-linear component for all the character indicating its major role in the expression of the trait and the performance of the genotypes for seed yield may be predicted across the environment with great precision (Kuchanur *et al.*, 2008). All the traits under the study except for 100 seed weight showed significant differences in different environment. The variance due to pooled deviation (non-linear) was highly significant for all the characters except for primary branches and number of seeds per pod which reflect considerable genetic variability in the material. Different measures of stability have been used by various workers earlier, Finlay and Wilkinson (1963) considered linear regression slopes as a measure of stability. Eberhart and Russel (1966) emphasized the need of considering both liner and nonlinear component of Genotype × Environment interaction in judging the stability of genotypes. Later Breese (1969), Samuel *et al.* (1970), Paroda and Hayes (1971) and Jatasra and Paroda (1978) emphasized that the linear regression could simply be regarded as a measure of response of a particular genotype whereas deviation around the regression line was the most suitable measure of stability. In the present study, the stability was assessed by the parameters suggested by Eberhart

Table 1 : Pooled MSS values for different quantitative traits over three environments.

Traits	Varieties	Env+(Var ×Env)	Environ-ments	Varieties × Environ-ment	Environm-ent (Lin)	Varieties × Environ-ment (Lin)	Pooled deviation
Days to flower initiation	365.45**	176.60**	1323.82**	116.24**	2647.65**	194.48**	36.06**
Days to 50 % flowering	354.82**	128.67	463.47**	111.05	926.94**	152.42*	66.20**
Days to 80% pod maturity	282.55**	74.27	112.54	72.25	225.09*	101.88*	40.49**
Plant height (cm)	523.30**	1590.08**	27489.13**	226.97*	54978.27**	337.49**	110.63**
Primary branches	4.92	3.6	24.151**	2.5	48.30**	2.58	2.31
Secondary branches	9.10**	8.17**	111.76**	2.71	223.52**	3.67*	1.67**
Pod bearing length (cm)	121.12*	58.02	115.35	55.01	230.71*	57.12	50.25**
Number of seeds per pod	0.18**	0.49**	8.52**	0.074**	17.05**	0.126**	0.022
Pod length (cm)	.356*	0.97**	16.44**	0.162	32.89**	0.176	0.140**
Number of pods per plant	2053.65**	1840.25**	8497.39**	1489.88**	16994.80**	2408.8**	542.41**
Yield per plant (gm)	175.66**	165.91**	2189.04**	59.42*	4378.088**	90.45**	26.97**
100 seed weight	9.49**	0.79	0.6	0.8	1.2	1.16*	0.43**

* & ** significant at 5% and 1% level respectively.

Table 2 : Mean and stability parameters in 20 genotypes of pigeon pea.

Traits	Days to flower intiation			Days to 50% flowering			Days to maturity			Plant height (cm)		
Genotypes	**Mean**	**bi**	**S2di**	**Mean**	**bi**	**S2di**	**Mean**	**bi**	**S2di**	**Mean**	**bi**	**S2di**
PUSA2001	73.00	1.28	46.12	79.66	1.53	44.39	138.50	4.76	-2.95	115.83	0.86	-4.81
JKM189	96.83	1.57	4.91	107.17	1.88	3.34	156.83	-1.00	-1.95	140.78	1.75	-8.05
BDN-2008-1	96.00	1.69	25.83	104.50	1.75	23.72	155.66	-1.98	128.05	131.77	1.33	-10.72
JKM-7	108.66	0.93	20.27	116.66	1.70	14.11	169.33	-0.47	25.82	144.05	1.62	17.44
WRP-1	84.00	2.09	2.13	89.50	3.40	51.70	147.50	-0.59	23.67	102.38	0.73	638.37
ICP 11477	82.12	-0.52	2.34	91.33	1.88	11.09	143.50	7.29	59.43	125.25	0.71	2.97
ICP 13579	111.33	1.00	210.46	119.16	1.10	298.89	166.83	0.37	5.71	131.27	0.76	-18.01
ICP 995	95.17	1.59	6.85	104.50	1.90	65.15	156.00	-0.65	31.79	131.67	1.01	-16.20
ICP 4575	93.00	1.65	-2.25	100.00	2.13	-3.10	151.00	-2.03	14.45	117.77	1.23	-12.53
ICP 14471	77.83	2.06	67.24	87.16	4.17	8.41	150.67	-0.86	100.90	120.33	1.31	-0.64
AKT 9913	92.16	0.78	-2.73	102.00	0.36	-2.72	154.66	2.85	121.10	133.55	1.06	37.45
ICP 348	95.50	1.16	9.29	104.50	1.03	11.60	161.16	1.42	8.49	113.72	1.18	0.71
ICP 7366	82.66	-0.03	3.26	92.16	-1.21	10.39	138.33	2.93	87.71	103.27	0.68	16.91
ICP 8840	102.00	1.46	-2.45	111.66	1.56	-3.15	166.83	-0.46	8.93	135.77	0.73	115.58
RVK 275	109.66	-1.73	112.24	115.16	-2.82	325.18	165.33	4.86	5.00	147.33	0.56	317.14
BENNUR LOCAL	85.83	-0.06	-2.03	92.50	-0.37	-0.01	142.16	4.22	4.76	120.44	1.00	-5.84
RVK 285	99.00	0.80	20.01	100.16	1.45	226.13	161.83	-2.49	3.39	150.00	1.36	-13.54
BDN 2008-12	93.33	-1.21	30.07	99.33	-1.73	28.62	147.00	4.96	-3.17	128.00	0.54	35.26
JSA 59	110.83	2.16	33.56	116.75	3.11	134.74	164.50	-3.72	113.99	132.88	62.00	152.51
BDN 711	89.17	3.33	80.41	106.16	0.95	12.26	150.75	0.59	-2.96	121.47	0.96	600.37
Population mean	93.908			102.004			154.396			127.38		

Table 2 continued...

Traits	Primary branches			Secondary Branches			Pod bearing length (cm)			Number of seeds /pod		
Genotypes	**Mean**	**bi**	**S2di**	**Mean**	**bi**	**S2di**	**Mean**	**bi**	**S2di**	**Mean**	**bi**	**S2di**
PUSA2001	7.61	0.20	-0.94	1.07	0.12	1.03	30.332	1.63	10.05	4.66	1.77	-0.06
JKM189	10.77	2.83	6.02	4.95	1.56	-0.34	36.75	6.08	-12.68	4.25	0.89	-0.06
BDN-2008-1	10.16	1.24	9.25	3.11	1.42	-0.61	38.58	2.31	-11.11	4.8	0.59	-0.05
JKM-7	9.35	2.31	-1.41	3.26	1.38	0.18	31.89	1.93	-13.84	4.57	1.09	-0.02
WRP-1	8.72	0.02	-1.29	0.54	-0.15	-0.36	39.71	0.02	130.21	4.22	0.59	-0.06
ICP 11477	7.34	1.93	-1.39	3.84	1.62	4.93	37.05	-2.52	58.49	4.25	1.1	0.01
ICP 13579	10.33	0.53	0.79	6.58	1.46	6.31	28.15	0.54	45.22	4.61	1.19	-0.02
ICP 995	10.39	1.71	0.79	4.89	0.90	0.09	26.69	2.62	58.66	4.3	1.02	-0.04
ICP 4575	10.72	1.65	-1.22	2.65	0.53	-0.47	21.94	1.99	-13.14	3.778	1.41	0.03
ICP 14471	8.81	0.91	-0.07	3.52	0.87	1.32	33.88	0.76	55.28	4.27	0.95	-0.04
AKT 9913	10.84	-0.70	9.15	6.11	1.04	-0.45	40	2.15	28.2	4.18	0.71	-0.04
ICP 348	10.55	-0.24	-1.20	6.50	1.15	-0.42	24.33	3.29	-9.42	4.03	0.75	-0.04
ICP 7366	8.72	-0.63	1.87	2.27	0.17	0.20	26.338	2.25	9.55	4.138	1.03	-0.04
ICP 8840	10.95	1.82	-0.37	6.05	2.08	0.47	35.002	2.09	172.73	4.32	0.85	-0.06
RVK 275	12.33	1.18	1.95	5.64	1.40	-0.60	30.55	0.56	-6.66	4.3	0.59	-0.05
BENNUR LOCAL	11.44	2.09	-0.85	5.26	1.22	1.86	32.302	-3.03	-13.52	4.25	0.66	-0.06
RVK 285	9.11	2.13	-1.14	3.94	1.08	2.83	41.33	1.39	20.33	4.49	0.88	-0.02
BDN 2008-12	9.39	0.29	0.06	4.47	1.03	0.12	36.02	-3.27	43.57	4.37	0.56	-0.06
JSA 59	9.28	0.28	-1.36	6.04	0.26	-0.31	20.72	-0.36	135.45	4.58	1.55	-0.06
BDN 711	8.67	0.45	-0.35	4.42	0.86	6.32	23.58	-0.42	30.48	4.68	1.83	-0.06
Population mean	9.77			4.26			31.76					

Table 2 continued...

Table 2 continued...

Traits	Pod length (cm)			Number of pods/plant			Seed yield per plant(g)			100 seed weight (g)		
Genotypes	Mean	bi	S2di	Mean	bi	S2di	Mean	bi	S2di	Mean	bi	S2di
PUSA2001	4.91	1.16	0.08	78.27	-0.16	977.71	19.23	0.16	3.11	9.53	1.48	0.35
JKM189	4.56	0.91	0.03	158.22	4.46	2652.4	42.58	1.37	23.59	10.66	6.97	0.03
BDN-2008-1	5.33	1.63	-0.04	129.77	2.34	-110.66	35.15	1.38	90.34	9.53	1.03	0.85
JKM-7	4.69	1.11	0.52	130.42	2.59	1020.16	33.92	0.32	3.10	9.44	-2.67	1.22
WRP-1	4.36	1.25	0.21	93.94	-0.41	514.56	35.89	1.09	-5.87	9.92	1.53	-0.09
ICP 11477	4.45	1.01	0.23	107.11	1.75	-17.03	29.37	0.55	92.74	8.30	-10.27	0.92
ICP 13579	4.83	1.03	0.07	163.00	2.33	-39.09	34.42	1.30	-4.90	8.23	2.23	0.08
ICP 995	4.47	0.94	-0.04	148.72	2.01	352.81	35.20	0.69	-9.65	8.07	2.54	-0.09
ICP 4575	4.06	0.42	0.01	109.61	0.75	-67.04	20.20	0.50	-4.87	8.13	2.59	0.2
ICP 14471	4.38	1.13	0.11	117.88	1.81	88.12	29.01	1.07	-6.66	8.95	-2.12	-0.11
AKT 9913	4.60	1.40	-0.04	165.77	-0.17	-71.22	40.59	1.53	-7.73	10.04	4.87	..49
ICP 348	4.13	1.07	0.00	156.61	3.09	57.99	32.80	1.67	-9.85	8.34	-1.89	1.56
ICP 7366	4.24	0.53	-0.01	113.61	-2.72	14.15	18.99	-0.53	0.72	8.04	-6.57	0.45
ICP 8840	4.55	0.54	-0.04	159.50	0.16	-35.82	37.12	1.67	31.61	9.49	2.95	0.28
RVK 275	4.75	0.99	0.37	146.44	0.57	2407.16	43.71	1.92	114.47	10.06	3.84	-0.01
BENNUR LOCAL	4.38	0.65	0.03	162.16	0.82	425.36	40.14	1.83	19.35	10.00	1.92	0.12
RVK 285	4.90	1.13	0.29	136.33	1.25	636.98	42.17	1.22	5.69	11.42	3.88	-0.11
BDN 2008-12	4.68	0.71	0.02	133.66	0.13	-90.63	41.67	1.02	14.55	9.12	7.4	-0.08
JSA 59	5.33	1.56	0.12	100.11	-1.96	-25.34	28.37	0.21	-6.56	16.10	4.16	0.17
BDN 711	4.87	0.82	0.01	111.16	1.35	-61.25	32.95	1.03	-2.21	9.60	-3.87	0.16
Population mean	4.62			131.11			33.70			9.65		

and Russel (1966).

The term stable genotype has been used for the average performance in all environments. Hence, such a stable variety has a high mean, unit regression and a minimum deviation from regression. Table 2 shows that the stability parameters for seed yield components. The genotypes RVK-285 (X = 42.713, bi=1.22 and S^2di= 5.69), AKT-9913 (X = 40.592, bi = 1.53 and S^2di = -7.73) and JKM-189 (X = 42.580, bi = 1.37 and S^2di = 23.5) had high mean, regression value around unity and minimum deviation from regression for the characters seed yield per plant and test weight. Therefore, these genotypes had not only better yield but also stable performance across the environments, while JSA-59 and PUSA-2001 are stable for days to maturity and ICP 4575, AKT-9913 and ICP-8840 are stable for days to flower initiation and days to 50% flowering. While RVK-285, ICP-13579 and JKM-189 were found to be a stable for number of seeds per pod, primary branches, secondary branches, pod bearing length, plant height, pod length and number of pods per plant across the environments with good stability under irrigated conditions.

From the present study, it can be concluded that the genotypes RVK-285, AKT-9913, JKM-189 and ICP-13579 were found to be a stable for seed yield and test weight across the environments with good stability for irrigated conditions and these genotypes can also be used as a donor parent for generating new breeding material for development of variety. However, this needs to be verified by testing the breeding lines over the season and over the locations for one more year under rain fed condition.

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