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Genetic analysis in cowpea (*Vigna unguiculata* L. Walp.)

Babul Verma and Deepanshu

Abstract

The current study, entitled "Genetic Analysis in Cowpea (*Vigna unguiculata* L. Walp.)," was carried out at the AICRP on vegetable crops, Horticultural Research cum Instructional Farm, Department of Vegetable Sciences, Indira Gandhi Krishi Vishwavidyalaya, Raipur (21.23760 N. 81.70550E) during 2019-20. The trial used a randomized block design (RBD) with 27 treatment combinations and three replications, with genotypes assigned at random in each replication. The results showed that among the twenty-seven genotypes examined, Kesli 4 (79.78* kg), Nandghat 2 (79.77* kg), and Kesli 7 (79.44* kg) had the highest green pod production. The genotypes Bardwar 4 (56.96 kg), B. Bazar (57.94 kg), and Bhakhara had the least yield (57.38 kg). Based on the mean performance of cowpea genotypes, the genotypes Kesli 4, Nandghat 2, and Kesli 7 were deemed the most promising in terms of green pod production per hectare. The PCV was slightly greater than GCV, illustrating the role of environment in the manifestation of numerous traits under investigation. High magnitude of GCV were observed for the characters viz., days to germination (30.34), number of flower cluster per plant (27) and number of primary branches (23.35). High magnitude of PCV were observed for the characters viz., days to germination (33.10), number of flower cluster per plant (33.42), number of primary branches (29.82), number of secondary branches (21.32) and pod length (21.70). High estimate of heritability was recorded for fruiting duration (95.72%), days to first flowering (95.08), days to first fruiting (94.28%), days to 50% flowering (93.89%), days to final picking (90.24%), days to germination (84.04%) and 10 pod weight (74.69%). Path analysis revealed a positive direct correlation with days to germination, plant height, number of primary branches, number of secondary branches, days to first flowering, days to 50% flowering, days to first fruiting, fruiting duration, days to final picking, number of flower clusters per plant, number of pods per cluster, pod length (cm), 10 pod weight, percentage of pod setting per cluster in the present study. The aforementioned characteristics had a great influence on yield and can be considered for future hybridization techniques.

Keywords: Cowpea, genotype, heritability, variability, GCV and PCV

Introduction

Cowpea [*Vigna unguiculata* (L.) Walp.] is an annual, autogamous, leguminous vegetable crop of India belongs to family leguminosae (Mackie and Smith, 1935) [7] with a chromosome number of $2n=2x=22$ (Darlington and Wylie, 1955). It is native to India (Vavilov, 1949) [22] but tropical and central Africa is also considered as secondary centre of origin where wild races are found (Ng and Marechal, 1985) [10]. There are mainly two types of cowpeas growing in India for grain and vegetable purposes. Generally, grain type cowpea varieties produce short pods with more number of seeds and mature early whereas vegetable type varieties produce long pods with less number of seeds and mature late and the pods remain tender and soft for longer period. Its young leaves, pods and grains contain vitamins and minerals which have fuelled its usage for human consumption and animal feeding (Nielson *et al.*, 1997) [11].

The vegetable improvement work was initiated few decades ago in India and has resulted in the development of a large numbers of improved varieties. There are still some vegetables, which are left unexploited though they have great potential in the Indian vegetable scenario. Cowpea is the one of them. This is possible only when diverse parents are available for breeding programme. The basic rational in crop improvement programme is the selection of parents. It is well known that there is a likelihood of getting better segregants, when the parents used in crossing are genetically diverged (Jain, 1975) [6]. The genetic variability means correlation and quantitative characters are utmost importance in selecting the desired genotypes for future breeding. For systematic breeding programme to develop high yielding types, information on genetic variability and inter relationship among different characters is prerequisite. This study will employ genetic parameters to determine the kind and level of

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variability in pod yield and pod yield-related characteristics.

Material and Method

The experiment was carried out at Indira Gandhi Krishi Vishwavidyalaya, Raipur during 2019-2020. The experiment was conducted in randomized block design having twenty genotypes in three replications. All the genotypes were collected from different parts of Chhattisgarh and are mentioned in the Table 1. For the analysis of this experiment observation recorded were days to germination of 1st seedling, plant height (cm.), primary branch, secondary branch, days to 1st flower emergence, days to 50% flowering, number of flower clusters per plant, days to 1st fruiting, number of pods per plant, number of pods per cluster, length of pod, pod weight, days to 1st picking, percentage of pod setting per cluster, fruiting duration, days to final picking, green pod yield per plant, number of seeds per pod, pod

colour and flower colour. Analysis of variance was done for partitioning the total variance into total variation due to the treatments and replications according to procedure Panse and Sukhatme (1957) [13]. Genotypic and phenotypic coefficients of variation were computed according to Burton and Dewane, (1953) [1] and were classified according to Robinson *et al.* (1949) [16]. The genetic advance and genetic advance as per mean that is, expected genetic gain was worked out by using the formula suggested by Lush (1949). Path coefficient analysis suggested by Wright (1921) [23] and illustrated by Dewey and Lu (1959) [4] was carried out separately to know the direct and indirect effects of the important component traits on fruit yield per plant. Standard path coefficients which are the standardised partial regression coefficient were obtained by solving the following set of 'P' simultaneous equations through the use of Doolittle technique as given by Goulden (1959) [5].

Table 1: List of Genotypes used in the experiment

Sl. No.	Name of varieties	Source of Genotypes
1	Local 1	Raipur, Chhattisgarh
2	Local 2	Raipur, Chhattisgarh
3	Local 3	Raipur, Chhattisgarh
4	Local 4	Raipur, Chhattisgarh
5	Red Seed Local 5	Raipur, Chhattisgarh
6	Black Seed Local 6	Raipur, Chhattisgarh
7	Local 7	Raipur, Chhattisgarh
8	KESLI 1	Village Kesli, Dist – B. Bazar, Chhattisgarh
9	KESLI 2	Village Kesli, Dist – B. Bazar, Chhattisgarh
10	KESLI 3	Village Kesli, Dist – B. Bazar, Chhattisgarh
11	KESLI 4	Village Kesli, Dist – B. Bazar, Chhattisgarh
12	KESLI 5	Village Kesli, Dist – B. Bazar, Chhattisgarh
13	KESLI 6	Village Kesli, Dist – B. Bazar, Chhattisgarh
14	KESLI 7	Village Kesli, Dist – B. Bazar, Chhattisgarh
15	KESLI 8	Village Kesli, Dist – B. Bazar, Chhattisgarh
16	KESLI 9	Village Kesli, Dist – B. Bazar, Chhattisgarh
17	BARDWAR 1	Village Bardwar, Dist – Raigarh, Chhattisgarh
18	BARDWAR 2	Village Bardwar, Dist – Raigarh, Chhattisgarh
19	BARDWAR 3	Village Bardwar, Dist – Raigarh, Chhattisgarh
20	BARDWAR 4	Village Bardwar, Dist – Raigarh, Chhattisgarh
21	BARDWAR 5	Village Bardwar, Dist – Raigarh, Chhattisgarh
22	NANDGHAT 1	Nandghat, Dist – Bemetra, Chhattisgarh
23	NANDGHAT 2	Nandghat, Dist – Bemetra, Chhattisgarh
24	HATHABANDH	Village Hathabandh, Dist – B. Bazar, Chhattisgarh
25	BHAKHARA	Bhakhara, Dist – Damatri, Chhattisgarh
26	B. BAZAR	B. Bazar, Chhattisgarh
27	KAWARDHA	Kawardha, Chhattisgarh

Results and Discussion

The analysis of variance demonstrated that most of the characters investigated under the current experiment demonstrated that mean sum of squares among treatment (genotypes) are significant except number of pods per cluster and pod length. This indicated the presence of high degree of genetic heterogeneity among different Cowpea genotypes. Table 2 show the result of the analysis of variance for all nineteen qualities investigated in this study. The number of primary branches was ranging from 3.33 to 9.66 with the grand mean of 6.68. On the basis of mean performance, the genotype Black seed local 6 recorded significantly highest plant height, Kawardha recorded significantly higher number of primary branches and number of secondary branches. B. Bazar recorded significantly highest days to first flowering, highest days taken to 50% flowering, highest days to first fruiting and highest fruiting duration, genotype Kesli 8 recorded significantly higher days for final picking, significantly highest percent of pod set per cluster,

significantly higher number of flower cluster per plant and significantly higher number of seeds per pod. The pod weight recorded significantly higher with the genotype Nandghat 2. The genotypes Kesli 4, Nandghat 2 and Kesli 7 recorded significantly highest green pod yield. The number of pods per plant, pod length was non-significant among different cowpea genotypes (Table 3).

Genotypic coefficient of variation and phenotypic coefficient of variation are basic measures of variability and widely used for assessment of variability. The PCV was slightly higher than corresponding GCV, which showed the impact of environment in the expression of various characters under study. GCV and PCV are graded as low (less than 10 percent), moderate (10-20 percent) and high (more than 20 percent) according to Sivasubramanian and Madhava Menon (1973). High magnitude of GCV were observed for the characters *viz.*, days to germination (30.34), number of flower cluster per plant (27) and number of primary branches (23.35). The parameters such as number of primary branches

(16.65), days to first flowering (13.36), 10 pod weight (15.73) and percentage of pod setting per cluster (11.47) recorded moderate magnitude of GCV. Low magnitude of GCV was recorded with the parameters such as days to 50% flowering (9.95), number of seeds per pod (9.39), days to first fruiting (9.25), plant height (8.54), number of pods per cluster (7.93), days to final picking (7.48), fruiting duration (7.27), and green pod yield per plant (6.68). High magnitude of PCV were observed for the characters *viz.*, days to germination (33.10), number of flower cluster per plant (33.42), number of primary branches (29.82), number of secondary branches (21.32) and pod length (21.70). The parameters such as number of seeds per pod (19.66), number of pods per cluster (18.76), 10 pod weight (18.20), percentage of pod setting per cluster (17.85), plant height (16.33), days to first flowering (13.70) and green pod yield (14.57) recorded moderate magnitude of PCV. Low magnitude of PCV was recorded with the parameters such as days to 50% flowering (9.52), days to first fruiting (9.52), days to final picking (7.88) and fruiting duration (7.43). Similarly high GCV and PCV were observed for green pod yield and pod length by Sreekumar *et al.* (1996)^[19]; for pods per plant, green pod yield, pod length and plant height by Chattopadhyay *et al.* (1997)^[2]; for green pod yield by Rajaravindran and Das (1997)^[14]; for plant height, primary branches per plant, secondary branches per plant, seed yield and green pod yield; for green pod yield, pods per plant, plant height and secondary branches per plant by Vardhan and Savithamma (1998)^[21]; and for pods per plant by Sawarkar *et al.* (1999)^[17] and Narayanakutty *et al.* (2003).

Heritability and genetic advance are the important genetic indicators that encourage the efficiency of selection in any improvement programme. Heritability is an important biometrical tool that measures the degree of variation in a population due to genetic variation in a phenotypic trait. However, genetic advance represents the improvement in the mean genotypic value of new population over parental population. As suggested by Robinson (1966), heritability in broad sense was estimated to be low (less than 50%), moderate (50-70%) and high (greater than 70%). For predicting the gain under selection, heritability (broad sense) estimates along with genetic advance are usually more valuable than the heritability value alone. The heritability estimates and genetic advance values for the various parameters of the present investigation are presented in Table 4.

High estimate of heritability was recorded for fruiting duration (95.72%), days to first flowering (95.08), days to first fruiting (94.28%), days to 50% flowering (93.89%), days to final picking (90.24%), days to germination (84.04%) and 10 pod weight (74.69%). Moderate heritability was recorded for number of flower cluster per plant (65.29%), number of primary branches (61.32%), number of secondary branches (60.94%) and the rest of the parameters such as plant height (27.35%), number of seeds per pod (22.82), green pod yield per plant (22.19), number of pods per cluster (17.86%), and pod length (5.05%) recorded lower heritability (Table 4). Similarly, higher heritability were observed by Sreekumar *et al.* (1996)^[19] for seeds per pod and days to 50 percent flowering; Chattopadhyay *et al.* (1996) for pods per plant,

green pod yield, pod length and plant height; Rajaravindran and Das (1997)^[14] for pod length, days to 50 percent flowering and green pod yield; Vardhan and Savithamma (1998 a) for primary branches per plant, green pod yield, pods per plant, plant height and secondary branches per plant; Sawarkar *et al.* (1999)^[17] for primary branches per plant; Narayanakutty *et al.* (2003 a) for fruit yield, pods per plant and weight of pods; and Resmi *et al.* (2004)^[15] for yield per plant, pods per plant and pod weight.

Genetic advance was expressed as percent of mean for comparing the progress in various characters of different genotypes. According to Johnson *et al.* (1955), the extent of genetic advance is classified as high (greater than 20 percent), moderate (20-10 percent) and low (less than 10 percent). The genetic advance of percent of pod set per cluster (8.93), plant height was (4.70), green pod yield per plant (4.52), days to germination (4.30), number of primary branches (2.51), number of secondary branches (2.32), number of flower cluster per plant (1.54), number of pods per cluster (1.39), number of seeds per pod (1.04) and pod length (0.30) recorded low genetic advance and the parameters such days to 50% flowering (16.60), days to first fruiting (16.52), days to final picking (16.02), days to first flowering (15.75), fruiting duration (13.53) and 10 pod weight (10.99). The genetic advances were ranging between least to moderate. Further, the genetic advances as percent of mean was computed and classified according to Johnson *et al.* (1955) as low (<10%), moderate (10-20%) and high (>20%). The genetic advances as percent mean recorded highest with the parameters *viz.*, number of flower cluster per plant (44.95%), days to germination (57.30%), number of primary branches (37.66%), 10 pod weight (28%), days to first fruiting (26.83%) and number of secondary branches (26.77%). Moderate level of genetic advances as percent of mean was recorded in the parameters such as days to 50% flowering (19.85%), percent of pod set per cluster (15.17%), days to final picking (14.65%) and fruiting duration (14.64%) and rest of the parameter recorded low genetic advance as percent of mean (Table 4).

Path coefficient analysis is an important and valuable statistical method, which is commonly used to distinguish the correlation coefficient into direct and indirect effects of independent variables on a dependent variable (Table 5). The genotypic path analysis on green pod yield showed that it was positive direct correlation with days to germination (4.301), plant height (4.729), number of primary branches (2.514), number of secondary branches (2.323), days to first flowering (15.754), days to 50% flowering (16.596), days to first fruiting (16.517), fruiting duration (13.529), days to final picking (16.021), number of flower cluster per plant (1.539), number of pods per cluster (1.389), pod length (cm) (0.299), 10 pod weight (10.986), percentage of pod setting per cluster (8.927), number of seeds per pod (1.039) and green pod yield (4.518). Narayanakutty *et al.* (2003 b) and Pal *et al.* (2004)^[12] found positive and direct effect for pods per plant. Tewari and Gautam (1989)^[20] found high direct positive effect on green pod yield through pods per cluster and days to 50 percent flowering. Similar findings were reported by Tewari and Gautam (1989)^[20] and Misra *et al.* (1994)^[8].

Table 2: Analysis of variance for yield and its components in cowpea genotypes

Sl. No.	Observations	Mean sum of square		
		Replication	Genotype	Error
		02	14	28
1	Days to germination	0.383	16.548**	0.985
2	Plant height	14.975	109.02*	51.199
3	Primary Branches	2.128	8.819**	1.532
4	Secondary Branches	4.335	7.596**	1.337
5	Days to 1st Flowering	1.272	187.71**	3.182
6	Days to 50% flowering	17.444	211.88**	4.496
7	Days to 1st fruiting	59.704	208.7**	4.14
8	Fruiting duration	2.605	137.21**	2.015
9	Days to final picking	8.753	208.33**	7.253
10	Number of flower cluster per plant	0.168	3.02**	0.454
11	Number of pods per cluster	7.875	19.339	11.703
12	Pod length	6.243	9.078	7.829
13	10 Pod weight	23.986	127.12**	12.9
14	Percentage of pod setting per cluster	188.61	201.35**	64.801
15	Number of seeds per pod	0.366	7.116*	3.771
16	Green pod yield per plant	340.33	141.09**	76.042

*Significant at 5% level of significant
** Significant at 1% level of significant

Table 3: Mean performance of cowpea genotypes

Genotype	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Local 1	4.33	50.91	5.65	8.80	50.00	75.00	83.00	87.33	105.00	2.20	17.47	12.91	35.47	47.53	72.01	12.92	Light purple	Dark green
Local 2	4.33	44.77	4.87	7.66	52.00	73.33	84.33	85.33	108.67	3.28	16.60	14.52	30.42	39.51	67.25	13.91	purple	Light green
Local 3	5.33	50.07	3.33	4.50	53.33	78.00	82.67	89.33	104.33	1.27	15.36	13.35	40.38	43.03	64.22	10.12	Light purple	Dark green
Local 4	7.33	48.86	3.87	7.77	61.67	86.33	89.33	94.67	109.67	1.15	20.67	11.90	45.45	63.02	72.39	11.81	Light purple	Dark green
Red Seed Local 5	7.33	50.35	5.84	8.31	57.00	82.00	86.67	92.00	106.33	1.56	19.76	13.83	45.26	62.37	68.10	12.20	Red	Dark green
Black Seed Local 6	5.67	64.39*	5.41	7.54	53.33	82.00	88.00	93.67	106.00	1.95	19.40	10.73	25.86	61.37	64.90	12.21	Black	Dark green
Local 7	6.00	47.88	4.06	6.69	56.33	81.00	91.00	94.67	106.33	1.87	23.09	12.90	40.78	69.44	58.66	11.08	Light purple	Dark green
KESLI 1	5.00	59.32	7.88	9.51	53.00	78.00	86.00	88.00	105.00	3.60	19.93	13.45	38.50	58.65	77.06	10.02	Light purple	Light green
KESLI 2	9.33	52.22	7.58	9.77	60.33	85.33	87.00	92.00	108.00	4.16*	21.35	14.19	39.30	62.35	65.96	11.42	Light purple	Light green
KESLI 3	8.00	54.04	6.77	7.44	45.67	74.33	81.00	83.00	98.00	2.52	19.27	15.70	33.85	61.41	64.59	14.06*	Light purple	Light green
KESLI 4	6.67	51.90	8.85	9.84	54.67	83.33	87.00	92.33	110.00	3.34	20.93	18.01	35.00	54.33	79.78*	12.99	Light purple	Light green
KESLI 5	7.67	52.75	5.13	7.28	61.00	85.00	92.33	91.67	113.00	1.39	17.73	13.87	33.36	66.45	71.99	10.28	white	Light green
KESLI 6	9.33	52.98	6.90	8.43	67.33	93.00	98.00	100.67	122.00	0.72	23.26	11.81	51.12	71.95*	61.47	7.64	white	Light green
KESLI 7	5.67	50.90	6.13	9.39	54.00	79.67	84.00	88.00	108.33	2.03	19.40	11.86	40.22	61.91	79.44*	9.28	white	Light green
KESLI 8	10.67	50.30	5.91	7.18	66.67	91.00	95.33	95.67	122.67*	1.41	18.17	11.98	41.00	62.36	68.88	10.65	Light purple	Light green
KESLI 9	10.33	50.40	6.08	7.62	65.00	92.33	98.00	102.67	118.00	2.09	20.87	14.33	39.53	58.79	69.72	11.58	white	Light green
BARDWAR 1	11.00	41.21	8.60	9.49	72.67	94.67	100.00	105.33*	121.67	1.84	17.94	15.20	32.09	50.07	76.38	13.28	white	Light green
BARDWAR 2	4.67	38.53	4.61	6.81	48.33	66.33	65.33	81.00	97.33	1.36	19.50	12.71	32.90	51.87	72.28	10.52	Light purple	Black
BARDWAR 3	8.00	51.85	8.74	11.26	62.33	89.33	95.00	93.33	106.00	2.29	18.91	14.60	33.56	51.99	69.24	12.45	Light purple	Black
BARDWAR 4	4.33	62.74	8.91	11.03	49.67	73.00	81.67	82.00	97.67	2.03	19.53	14.81	38.01	54.49	56.96	12.78	Light purple	Black
BARDWAR 5	8.67	40.45	8.21	9.17	57.00	81.00	87.67	84.67	100.00	1.95	20.38	13.08	39.65	63.98	66.25	10.70	Light purple	Black
NANDGHAT 1	9.00	47.61	7.28	8.97	59.33	85.67	87.33	91.00	104.00	1.35	22.64	10.51	43.20	71.48	61.18	9.32	Light purple	Black
NANDGHAT 2	11.00	57.08	6.98	9.77	68.00	91.33	95.00	98.00	122.00	1.98	27.54	11.39	52.85*	68.06	79.77*	10.80	Light purple	Black
HATHABANDH	5.00	53.08	7.91	9.62	49.00	72.67	83.33	89.33	98.00	2.23	22.98	11.58	47.76	64.66	63.76	9.49	Light purple	Greenish red
BHAKHARA	7.00	49.32	6.71	8.43	66.00	92.33	96.67	99.33	121.33	1.98	19.68	10.37	49.42	59.66	57.38	10.08	Light purple	Dark green
B. BAZAR	12.33*	56.85	8.36	10.32	77.00*	103.67*	110.00*	107.33*	112.67	2.82	20.13	14.33	39.72	51.77	57.94	11.42	white	Dark green

KAWARDHA	8.67	56.99	9.66*	11.68*	64.67	87.33	95.33	92.33	121.67	2.16	18.38	13.31	34.53	56.17	64.22	10.62	white	Greenish red
CV	13.22	13.92	18.54	13.33	3.04	2.54	2.28	1.54	2.46	19.98	17	21.15	9.16	13.68	12.85	17.27	-	-
SEm	0.99	51.20	1.53	1.34	3.18	4.50	4.14	2.02	7.25	0.18	11.70	7.83	12.9	64.80	76.04	3.77	-	-
CD @ 1%	2.17	NS	2.70	2.53	3.90	4.63	4.44	3.10	5.88	0.91	NS	NS	7.84	17.58	NS	NS	-	-
CD @ 5%	1.63	11.73	2.03	1.90	2.92	3.48	3.33	2.33	4.41	0.69	NS	NS	5.87	13.19	14.29	3.18	-	-
1. Days to germination	2. Plant height (cm)				3. Number of primary branches				4. Number of secondary branches				5. Days to first flowering					
6. Days to 50% flowering	7. Days to first fruiting				8. Fruiting duration				9. Days to final picking				10. Number of flower cluster per plant					
11. Number of pods per cluster	12. Pod length (cm)				13. 10 Pod weight (g)				14. Percentage of pod setting per cluster				15. Green pod yield per plant					
16. Number of seeds per pod	17. Flower colour				18. Pod colour													

Table 4: Genetic parameters of variation for yield and its component characters in cowpea genotype

Character	Range		Mean	Coefficient of variation		Heritability	G.A.	Genetic advance as % of mean
	Min.	Max.		G.C.V.	P.C.V.			
Days to germination	4.33	12.33	7.51	30.34	33.10	84.04	4.30	57.30
Plant height	38.53	64.39	51.40	8.54	16.33	27.35	4.73	9.20
Primary Branches	3.33	9.66	6.68	23.35	29.82	61.32	2.51	37.66
Secondary Branches	4.50	11.68	8.68	16.65	21.32	60.94	2.32	26.77
Days to 1st Flowering	45.67	77.00	58.72	13.36	13.70	95.08	15.75	26.83
Days to 50% flowering	66.33	103.67	83.59	9.95	10.27	93.89	16.60	19.85
Days to 1st fruiting	65.33	110.00	89.30	9.25	9.52	94.28	16.52	18.50
Fruiting duration	81.00	107.33	92.40	7.27	7.43	95.72	13.53	14.64
Days to final picking	97.33	122.67	109.4	7.48	7.88	90.24	16.02	14.65
Number of flower cluster per plant	2.00	4.18	2.09	27.00	33.42	65.29	1.54	44.95
Number of pods per cluster	15.36	27.54	20.03	7.93	18.76	17.86	1.39	6.90
Pod length	10.37	18.01	13.23	4.88	21.70	5.05	0.30	2.26
10 Pod weight	25.86	52.85	39.23	15.73	18.20	74.69	10.99	28.00
Percentage of pod setting per cluster	39.51	71.95	58.84	11.47	17.85	41.26	8.93	15.17
Number of seeds per pod	7.64	14.06	11.25	9.39	19.66	22.82	1.04	9.24
Green pod yield per plant	56.96	79.78	67.84	6.86	14.57	22.19	4.52	6.66

Table 5: Genotypic path coefficient analysis for fruit yield & its components in cowpea genotype

Parameter	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1	4.301	-0.129	1.377	0.896	4.046	4.024	3.562	3.484	3.011	-0.039	0.938	0.021	1.149	1.117	-0.408	-0.066
2	-0.436	4.729	2.607	3.274	-0.445	1.415	2.479	0.946	0.15	1.573	0.318	0.459	-0.161	1.598	-0.398	-1.425
3	1.103	0.618	2.514	2.458	0.945	1.03	1.168	0.469	0.379	0.858	0.504	0.605	-0.044	-0.056	0.137	-0.332
4	0.667	0.722	2.285	2.323	0.787	0.799	0.996	0.336	0.341	0.587	0.58	0.401	0.078	0.118	0.193	-0.126
5	13.099	-0.426	3.817	3.42	15.754	15.247	14.389	14.403	12.881	-1.482	2.28	-0.58	4.577	2.226	-2.226	-0.471
6	13.896	1.446	4.441	3.704	16.265	16.596	15.946	15.804	13.225	-0.305	2.813	-0.549	4.691	3.257	-1.804	-0.742
7	12.192	2.512	4.993	4.579	15.215	15.805	16.517	15.116	12.544	-0.239	1.734	-0.245	3.798	2.225	-1.086	-1.673
8	9.622	0.773	1.617	1.245	12.287	12.638	12.196	13.529	10.297	-1.284	2.114	-0.883	3.822	1.778	-1.58	-0.466
9	10.445	0.154	1.64	1.589	13.802	13.284	12.712	12.934	16.021	-0.193	1.133	-1.323	4.263	1.819	-2.303	1.708
10	-0.018	0.214	0.493	0.363	-0.211	-0.041	-0.032	-0.214	-0.026	1.539	-0.063	0.676	-0.735	-0.216	0.39	0.386
11	1.425	0.143	0.956	1.183	1.07	1.237	0.77	1.163	0.496	-0.209	1.389	-0.959	2.594	3.403	-1.174	-0.211
12	0.024	0.157	0.872	0.623	-0.207	-0.184	-0.083	-0.37	-0.441	1.696	-0.73	0.299	-1.429	-1.232	1.794	0.34
13	3.301	-0.137	-0.159	0.302	4.063	3.904	3.188	3.977	3.531	-4.587	4.907	-3.554	10.986	5.709	-5.513	-1.128
14	4.722	1.999	-0.296	0.672	2.907	3.987	2.748	2.721	2.217	-1.982	9.47	-4.505	8.398	8.927	-7.437	-1.618
15	-0.363	-0.105	0.152	0.23	-0.612	-0.465	-0.282	-0.509	-0.591	0.754	-0.688	1.381	-1.707	-1.565	1.039	0.299
16	-0.262	-1.678	-1.651	-0.673	-0.579	-0.855	-1.945	-0.672	1.959	3.334	-0.551	1.169	-1.563	-1.523	1.338	4.518
1. Days to germination	2. Plant height (cm)				3. Number of primary branches				4. Number of secondary branches				5. Days to first flowering			
7. Days to first fruiting	8. Fruiting duration				9. Days to final picking				10. Number of flower cluster per plant				11. Number of pods per cluster			
13. 10 Pod weight (g)	14. Percentage of pod setting per cluster				15. Number of seeds per pod				16. Green pod yield per plant							

Conclusion

According to the findings of the current study, the cowpea genotypes under consideration exhibited considerable genetic heterogeneity. Kesli-4, Nandghat-2, and Kesli-7 genotypes are thought to be acceptable genotypes for Raipur's climatic conditions based on mean performance for pod yield. Analysis of variance showing significant difference for all the characters under study, indicates that there was ample scope for selection of promising genotypes for yield improvement. Pod yield per plot was recorded high estimates of GCV and PCV, Days to first flowering was recorded for high

heritability, pod yield per plant and number of seeds per pod showing higher range of genetic advancement. Character association will provide the information on the positive or negative association of the characters with the yield. The characters which are highly significant and positively correlated with yield help to increase in the yield. Path coefficient analysis will also provide the information on the direct and indirect effect of 21 characters on yield. The characters of cowpea which having high positive and direct effect on yield, having high weightage during selection. Wide range of genetic divergence was noticed among the studied 27

genotypes of cowpea, and the genotypes included in cluster I and II are identified as distant genotypes. Hence, these genotypes can be utilized as parents in further hybridization programme.

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