Int.J.Curr.Microbiol.App.Sci (2019) *8*(8): 1510-1518

International Journal of Current Microbiology and Applied Sciences
***ISSN: 2319-7706* Volume 8 Number 08 (2019)**
Journal homepage: http://www.ijcmas.com

Original Research Article https://doi.org/10.20546/ijcmas.2019.808.177

Exploitation of Genetic Variability in F_2 Generations of Cowpea (*Vigna unguiculata* (L.) Walp) for Dual Purpose

Lakshmi[1*], K. Sridhar[2], S.K. Deshpande[1] and N.S. Kulkarni[2]

[1]Department of Genetics and Plant Breeding, UASD, Dharwad, India
[2]Indian Grassland and Fodder Research institute (IGFRI), SRRS, Dharwad, Karnataka, India

**Corresponding author*

Keywords

PCV, GCV, Heritability, Dual purpose, F_2 population, Cowpea

Article Info

Accepted:
12 July 2019
Available Online:
10 August 2019

A B S T R A C T

An experiment was conducted to estimate genetic variability, heritability and genetic advance expressed as per cent of mean in F_2 population of two crosses viz., DCS-47-1 × PL-1 and DCS-47-1 × PGCP-12 in cowpea. Analysis of variance revealed significant differences among the segregants tested for all the sixteen characters. High PCV and GVC were observed for number of secondary branches per plant, leaf to stem ratio, number of pods per plant, green fodder yield per plant, green fodder yield per metre row length and stover yield per plant in both the populations. Higher magnitude of broad sense heritability and genetic advance in percentage over mean noticed for secondary branches, days to first flowering, dry matter content, number of pods, number of seeds, pod length, seed yield, green fodder yield per plant as well as per metre row length and stover yield per plant in both F_2 populations. These characters might be governed by additive gene action, hence for direct selection for such characters would be helpful in further generations. Besides, a good number of desirable transgressive segregants were also isolated for green fodder yield/ plant and seed yield/plant from both F_2 populations.

Introduction

Cowpea is mainly grown in tropical and sub-tropical regions in the world for vegetable, seed and fodder purpose but lesser extent for dual purpose (grain and fodder).

Dual-purpose, the relative ratio of grain to fodder productivity of cowpea is one of the major factors affecting the adoption of new varieties in sub-Saharan Africa. Efforts have been made to improve either the fodder or the grain productivity separately. However, there is the need to develop a variety with both good grain and fodder productivity. There is no evidence that any farmer can grow cowpea for fodder alone (Langyintuo *et al.,* 2003). This suggests that, both grain and fodder are valuable. Therefore, the ratio of grain to fodder is very important to support the crop livestock integration system and adoption of varieties.

High level of genetic variation for the ratio of grain to fodder, otherwise known as dual-purposiveness, exists in cowpea (Roquib and Patnaik, 1990). Understanding the genetic control of different traits will facilitate

development of a viable breeding strategy for improved dual-purpose cowpea varieties with high grain and fodder yield. However, being a cleistogamous plant, a more detailed genetic study involving advanced F_2 generations will be useful for a breeding program.

A clear understanding of variability of various characters of the breeding materials is an asset to the plant breeder for selecting superior genotypes on the basis of their phenotypic expression. In this regards estimates of genotypic and phenotypic variance for various quantitative characters along with heritability and genetic advance expected by selection for yield and its components are useful in designing an effective breeding programme.

Materials and Methods

Plant materials

The experiment was laid out in medium deep black soil under rainfed condition at IGFRI, Southern Region Research Station, Dharwad during *Kharif*, 2016-17. The RBD was followed with two replications for evaluation of F_2 generations (DCS-47-1 × PL-1 and DCS-47-1 × PGCP-12) of cowpea. These generations along with parents and checks were sown during *kharif* season at a spacing of 60 cm × 20 cm accommodating twenty plants in a 4 m long row. Three checks were used in this present investigation. They are MFC-09-1 (Zonal check), BL-1 (National check) and EC-4216 (National check). Checks values were taken for all sixteen quantitative characters.

Observations

The observations were recorded on each tagged plants. 190 plants of F_2 population of DCS-47-1 × PL-1 and 170 plants of F_2 population of DCS-47-1 × PGCP-12 in cowpea for both fodder and grain yield components *viz*., plant height (cm), number of primary branches, number of secondary branches, leaf to stem ratio, days to first flowering, days to fifty per cent flowering, days to maturity, number of pods per plant, number of seeds per pod, pod length (cm), test weight (g), seed yield per plant (g), green fodder yield per plant (g), dry matter content (%), green fodder yield per meter row length (kg) and stover yield per plant (g) in F_2 segregating generations in each replication and superior segregants were selected.

Statistical analysis

Data recorded from both crosses of F_2 generations were statistically analyzed (Panse and Sunhatme) computed genetic parameters viz., phenotypic and genotypic coefficient variation was calculated as per the formula suggested by Burton and DeVene. Heritability (broad sense) was computed as suggested by Jhonson *et al.,* and genetic advance as per of mean was estimated according to Jhonson *et al.,*

Results and Discussion

Analysis of variance

Analysis of variance revealed highly significant mean of squares due to genotypes for all sixteen characters. Mean and variances worked out for sixteen quantitative characters. The mean performance of F_2 generations of crosses DCS-47-1 × PL-1 and DCS-47-1 × PGCP-12 were significantly higher than both the parents for most of the characters indicating that there might be more chance to select high potential progeny for dual purpose type in further segregating generations. But for some characters like number of primary branches, leaf to stem ratio, stover yield and dry matter content, the mean performance was lower when compared with their parents (Table 1 and 2). This might be due to lack of variability for those traits in their parents.

Isolation of superior segregants

Superior segregants were isolated for green fodder yield per plant, seed yield per plant, stover yield per plant and days to maturity (Table 3) since these traits directly contributes to the dual purpose nature of cowpea. It was observed that maximum per cent of superior segregants were obtained for seed yield per plant in F_2 population of DCS-47-1 × PL-1 cross in comparison to EC-4216. Whereas in the cross DCS-47-1 × PGCP-12 highest per cent of segregants were obtained for days to maturity indicating development of early types from this population. Thirteen and nineteen plants from DCS-47-1 × PL-1 and DCS-47-1 × PGCP-12 in F_2 populations were identified superior for all these traits (Table 3). The present findings were in agreement with reports of Uma and Salimath in cowpea, Dhole and Reddy in mung bean and Shivakumar *et al.,* in chickpea noticed transgrssive segregants for number of pods, number of seeds per pod, test weight and seed yield per plant.

Coefficients of variation

The results of the variance component in this study indicated that the PCV was higher that the GCV for all traits in both F_2 generations coupled with negligible differences which indicated less environmental influence on all the traits were studied (Fig. 1 and 2). The PCV and GCV were high for number of secondary branches per plant, leaf to stem ratio, number of pods per plant, green fodder yield per plant, green fodder yield per metre row length and stover yield per plant in both the populations Whereas, high PCV and GCV was recorded for seed yield per plant in F_2 of DCS-47-1 × PGCP-12 (Table 4). This implied that the trait are mostly governed by genetic factors with little role of environment in the genetic expression of these characters. Thus the selection of these traits on of the basis of the phenotypic value may effective and was confirmed with the earlier studies of Jana *et al.,* (1983), Girish *et al.,* (2006), Kumar *et al.,* (2013), Tigga *et al.,* (2014), Kharde *et al.,* (2014) and Inuwa *et al.,* (2012) and Mary and Gopalan (2006) for plant height, number of branches, number of leaves, leaf weight, stem weight and green fodder yield in cowpea.

Moderate PCV and GCV were recorded for plant height, days to first flowering, pod length, number of seeds per pod in both F_2 populations whereas moderate PCV and GCV noticed for days to fifty percent flowering in DCS-47-1× PL-1 and for dry matter content in DCS-47-1 × PGCP-12 (Table 4).

Similar results were observed by Kumar *et al.,* (2013), Tigga *et al.,* (2014) and Mary and Gopalan (2006) also reported similar trend for leaf to stem ratio, crude protein content and dry matter yield in F_3 generation.

Low PCV and GCV were recorded for days to maturity and test weight (Table 4). Interestingly narrow difference was observed for most of the characters indicating these characters were less influenced by environmental factors and predicts that amount of genetic variability was less for these characters.

The magnitude of broad sense heritability ranged from 45.26 per cent for number of primary branches per plant to 94.61 for dry matter content (g) in F_2 generation of DCS-47-1× PL-1 and 53.69 percent for primary branches per plant to 90.16 per cent in test weight (g) in F_2 generation of DCS-47-1 × PGCP-12 cross 1 (Table 4). Higher magnitude of broad sense heritability and genetic advance in percentage over mean noticed for secondary branches, days to first flowering, dry matter content, number of pods, number of seeds, pod length, seed yield, green fodder yield per plant as well as per metre row length, stover yield in both F_2 population (Fig. 2).

Table.1 Mean performance and variance in parents and F_2 population of DCS-47-1×PL-1 cross for sixteen quantitative characters in cowpea

Statistical parameters	Generation (Parental/F_2)	Plant height (cm)	Number of primary Branches	Number of secondary Branches	Leaf to stem ratio	Days to first flowering	Days to fifty per cent flowering	Days to maturity	Number of pods per plant
Mean	DCS-47-1	80.60	4.60	2.20	0.78	50.20	59.20	90.60	17.80
	PL-1	99.60	3.80	3.00	0.91	49.00	55.40	86.01	17.25
	F_2 (DCS-47-1 × PL-1)	109.30	4.20	3.10	0.81	59.40	63.40	99.40	26.22
Range	F_2 (DCS-47-1 × PL-1)	55 to 200	2 to 6	4 to 6	0.98 to 1.52	46 to 59	55 to 72	89 to 115	15 to 30
Variance	DCS-47-1	206.30	0.30	0.20	0.068	6.20	4.70	14.80	6.70
	PL-1	259.30	1.20	0.50	0.08	3.70	5.90	19.24	1.25
	F_2 (DCS-47-1 × PL-1)	477.06	1.37	2.21	0.16	42.30	55.30	81.11	29.24
	C.V. (%)	11.07	8.32	5.53	6.19	11.72	12.37	12.63	2.98
	S.Em. ±	0.85	0.90	0.57	0.60	1.60	0.14	14.06	0.28
	C.D. 5 %	2.47*	2.64	1.67*	1.77	4.66*	0.40*	40.96*	0.81*

Statistical parameters	Generation (Parental/F_2)	Number of seeds per pod	Pod length (cm)	Seed yield per plant (g)	Green fodder yield per plant (g)	Dry matter content (%)	Green fodder yield per meter row length (kg)	Stover yield per plant (g)	Test weight (g)
Mean	DCS-47-1	12.80	14.42	17.72	158.8	12.23	1.20	186.30	12.20
	PGCP-12	12.80	13.78	13.63	176.3	12.13	1.30	155.20	12.60
	F_2 (DCS-47-1 × PGCP-12)	16.08	16.72	22.19	267.30	11.50	1.50	168.60	14.90
Range	F_2 (DCS-47-1 × PGCP-12)	13 to 19	10 to 20	15.60 to 29.00	243 to 683	9 to 13	0.90 to 2.10	126.00 to 179.30	12.40 to 15.20
Variance	DCS-47-1	0.70	0.37	3.70	196.20	0.54	0.50	986.30	0.45
	PGCP-12	2.70	0.62	12.30	200.60	0.24	0.20	825.30	0.32
	F_2 (DCS-47-1 × PGCP-12)	5.70	4.01	20.31	512.30	7.23	0.90	2513.18	2.10
	C.V. (%)	5.36	5.08	12.62	4.65	4.57	10.89	11.52	6.17
	S.Em. ±	0.56	0.57	9.32	10.23	0.31	0.33	56.11	0.59
	C D 5 %	1.73*	1.78*	13.06*	0.32*	0.99*	0.46*	78.67*	1.68*

* Significant at 5 %

Table.2 Mean performance and variance in parents and F_2 population of DCS-47-1---PGCP-12 cross for sixteen quantitative characters in cowpea

Statistical parameters	Generation (Parental/F_2)	Plant height (cm)	Number of primary branches	Number of secondary Branches	Leaf to stem ratio	Days to first flowering	Days to fifty per cent flowering	Days to maturity	Number of pods per plant
Mean	DCS-47-1	80.60	4.60	2.20	0.78	50.20	59.20	90.60	17.50
	PGCP-12	74.77	4.03	1.20	0.91	53.00	60.00	95.00	15.80
	F_2 (DCS-47-1 × PGCP-12)	124.93	4.12	3.90	0.86	55.63	61.30	107.42	19.20
Range	F_2 (DCS-47-1 × PGCP-12)	100 to 253	2 to 5	3 to 7	0.43 to 1.45	54 to 65	60 to 75	92 to 119	14 to 22
Variance	DCS-47-1	206.30	0.30	0.20	0.06	6.20	4.70	14.80	6.70
	PGCP-12	126.80	2.10	1.00	0.02	15.30	16.35	19.24	3.70
	F_2 (DCS-47-1 × PGCP-12)	433.58	1.34	2.50	0.26	25.30	29.80	32.50	25.60
	C.V. (%)	6.96	7.48	6.58	7.96	10.25	13.25	13.52	4.57
	S.Em. ±	4.18	0.18	0.20	0.05	1.09	1.09	2.44	0.31
	C.D. 5 %	12.89*	0.57*	0.62*	0.18*	3.37*	3.37*	7.52*	0.98*

Statistical parameters	Generation (Parental/F_2)	Number of seeds per pod	Pod length (cm)	Seed yield per plant (g)	Green fodder yield per plant (g)	Dry matter content (%)	Green fodder yield per meter row length(kg)	Stover yield per plant (g)	Test weight (g)
Mean	DCS-47-1	12.80	14.42	17.72	158.80	12.23	1.20	186.30	12.20
	PGCP-12	13.43	16.28	14.56	147.00	12.24	1.10	152.30	13.20
	F_2 (DCS-47-1 × PGCP-12)	16.30	18.40	19.30	370.00	11.30	1.35	174.56	13.50
Range	F_2 (DCS-47-1 × PGCP-12)	10 to 20	14 to 19	15.20 to 26.30	350 to 750	10.20 to 15.60	1.00 to 2.50	120 to 181.20	12.30 to 13.90
Variance	DCS-47-1	0.70	0.37	3.70	196.20	0.54	0.40	986.30	0.45
	PGCP-12	1.56	1.77	12.30	254.30	0.89	0.30	829.30	0.86
	F_2 (DCS-47-1 × PGCP-12)	5.60	3.97	20.30	689.30	4.60	0.87	2683.90	2.53
	C V	5.36	5.08	12.62	4.65	4.57	10.89	11.52	6.17
	S.E	0.56	0.57	9.32	10.23	0.31	0.33	56.11	0.59
	C D 5%	1.73*	1.78*	13.06*	0.32*	0.99*	0.46*	78.67*	1.68

* Significant at 5 %

Table.3 Superior segregants observed in F_2 population for economically important characters over checks

Population	Number of plants	Green fodder yield per plant (g)	Seed yield per plant (g)	Stover yield per plant (g)	Days to maturity	Number of plants commonly superior for four characters
MFC-09-1 (Check-I)	-	354.20	26.90	176.30	109.55	-
BL-1 (Check-II)	-	279.60	20.31	164.90	125.30	-
EC-4216 (Check -III)	-	376.80	25.90	186.30	129.00	-
F_2 (DCS-47-1 × PL-1)	190	12 (6.31) [a] 16 (8.42) [b] 18 (9.47) [c]	23 (12.10) [a] 18 (9.47) [b] 29 (15.26) [c]	15 (7.89) [a] 7 (3.64) [b] 13 (6.84) [c]	16 (8.42) [a] 14 (7.36) [b] 20 (10.52) [c]	8 (4.2) [a] 11 (5.78) [b] 13 (6.84) [c]
F_2 (DCS-47-1 × PGCP- 12)	170	18 (10.58) [a] 16 (9.41) [b] 9 (5.29) [c]	20 (11.76) [a] 15 (8.82) [b] 18 (10.58) [c]	26 (15.29) [a] 13 (7.64) [b] 18 (10.58) [c]	30 (17.64) [a] 18 (10.58) [b] 12 (7.05) [c]	19 (11.17) [a] 17 (10.12) [b] 8 (4.70) [c]

a- superior segregants scored over check –I
b- superior segregants scored over check-II
c- superior segregants scored over check- III

Table.4 Estimation of genetic parameters for sixteen quantitative characters in F_2 of DCS-47-1 × PL-1 and DCS-47-1 × PGCP-12 crosses in cowpea

Sl. No.	Characters	DCS-47-1 × PL-1					DCS-47-1 × PGCP-12				
		PCV (%)	GCV (%)	h^2 (%)	GA	GAM (%)	PCV (%)	GCV (%)	h^2 (%)	GA	GAM (%)
1	Plant height (cm)	19.98	13.76	47.39	54.96	50.28	16.67	13.08	61.59	53.30	41.86
2	Number of primary branches per plant	27.87	18.75	45.26	0.78	13.52	28.10	19.08	53.69	0.90	21.84
3	Number of secondary branches per plant	47.96	43.99	74.16	1.23	39.68	38.12	32.53	72.85	1.20	30.77
4	Leaf to stem ratio	49.26	36.12	53.75	0.52	64.04	59.02	53.79	83.08	0.73	84.49
5	Days to first flowering	10.95	10.29	88.30	15.32	25.79	12.31	8.23	57.51	16.23	21.14
6	Days to fifty per cent flowering	11.73	11.15	90.42	9.23	14.56	8.91	7.16	64.68	11.59	18.91
7	Days to maturity	9.06	8.05	89.02	16.35	16.40	5.31	3.66	57.63	12.30	11.45
8	Number of pods per plant	20.62	19.17	86.41	17.00	64.84	26.35	23.52	79.69	18.30	95.31
9	Number of seeds per pod	14.85	12.44	70.18	10.25	63.74	14.52	12.97	79.82	7.30	44.36
10	Pod length (cm)	11.98	11.21	87.66	9.85	58.91	10.83	9.26	85.23	7.36	40.00
11	Seed yield per plant (g)	20.31	15.81	60.61	16.35	73.68	23.34	21.17	74.11	17.42	85.96
12	Green fodder yield per plant (g)	30.12	28.45	81.75	77.00	28.81	26.32	20.39	60.59	56.32	20.86
13	Dry matter content (%)	23.38	22.74	94.61	2.78	24.17	18.98	17.44	83.45	4.56	40.35
14	Green fodder yield per meter row length (kg)	34.11	32.14	89.29	1.06	62.39	31.05	29.30	89.85	0.80	56.95
15	Stover yield (g)	29.79	23.82	63.96	70.87	41.59	31.53	28.23	70.42	40.35	23.19
16	Test weight (g)	9.73	8.79	81.67	1.98	13.29	5.03	4.78	90.16	1.25	9.34

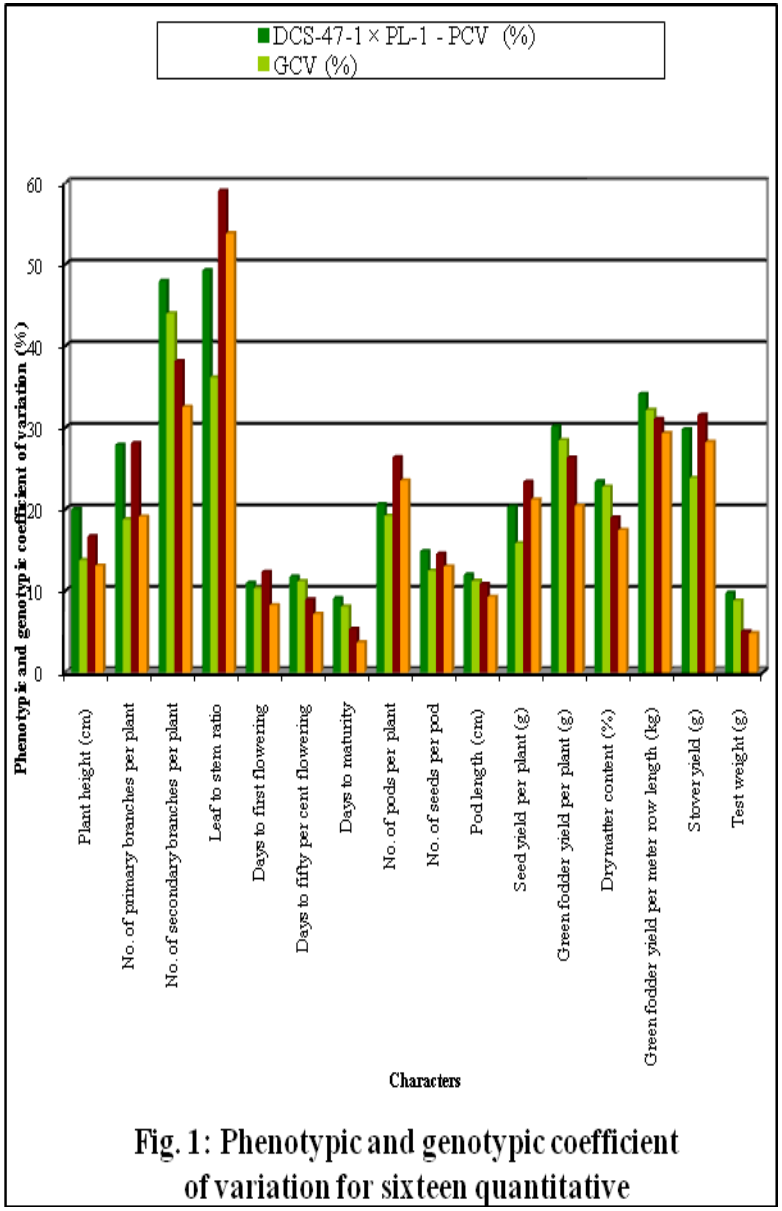

Fig. 1: Phenotypic and genotypic coefficient of variation for sixteen quantitative

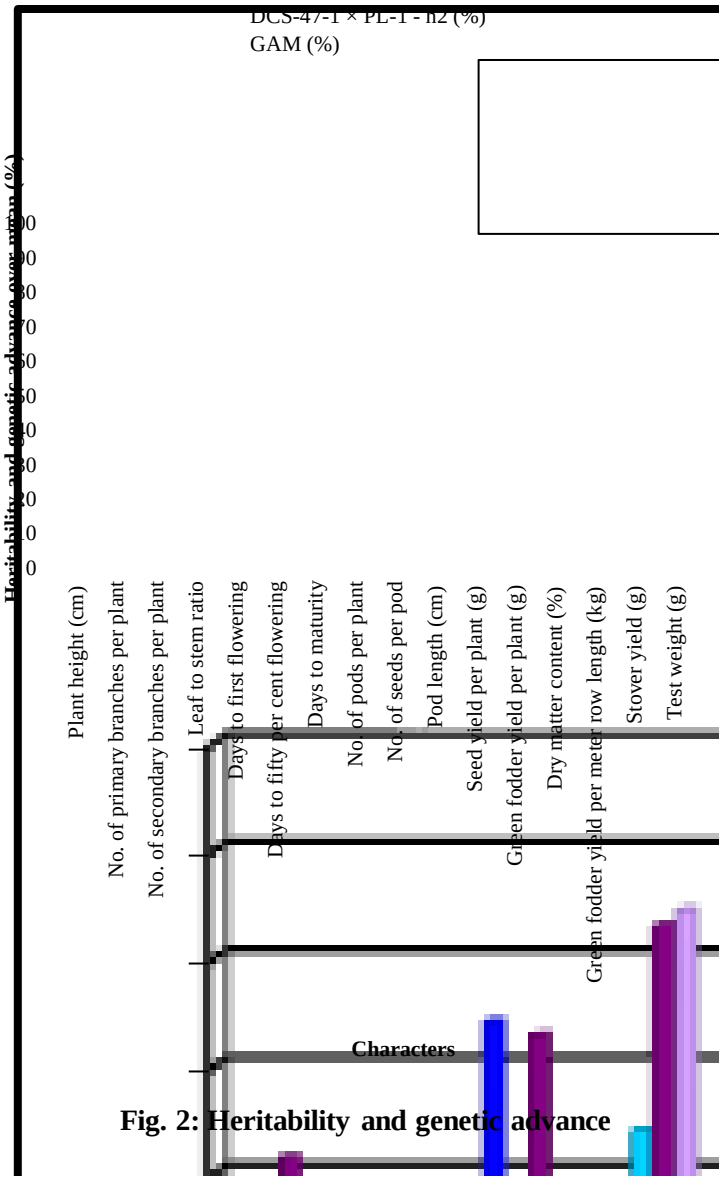

Fig. 2: Heritability and genetic advance

This predicts that the major role of genetic constitution in the expression of the character and such traits are considered to be dependence for genetic up gradation of cowpea and there is predominance of additive gene action and existence of moderate genetic variability suggest better scope for improvement of this character through selection. The results presented in this study were in accordance with reports of Borah and Khan (2001), Girish *et al.,* (2006), Lal *et al.,* (2007) and Anbumalarmathi *et al.,* (2005).

It can be concluded that analyzing the variability in segregating generations and making selection out of it for forwarding into further generations are key steps in varietal development. The populations developed for dual purpose types of cowpea in this study would help to recover more number of segregants in the succeeding generations and also provides greater scope for the further selections for future breeding programmes.

References

Anbumalarmathi, J., Sheeba, A. And Deepasankar, P., 2005, Genetic variability and interrelationship studies in cowpea [*Vigna unguiculata* (L.) Walp.]. *Crop Res*., 6: 517-519.

Anonymous, 2014, Food and Agriculture Organisation. 2014. www.fao.org/statistics/en/.

Burton, G. W. and Devane, E. M., 1953, Estimating heritability in tall fescue (*Festuca cirunclinaceae*) from replicated clonal-material. *J. Agron.,* 45: 378-481.

Dhole, V. J. and Reddy, K. S., 2011, Genetic analysis and transgressive segregation for seed weight and seed yield in F_2 populations of mungbean. *Electronic J. Plant Breed*, 2 (3): 384-391.

Girish G, Viswanatha, K. P., Manjunath, A. and Yogeesh, L. N., 2006, Genetic variability, heritability and genetic advance analysis in cowpea (*Vigna unguiculata* L. Walp.). *J. Env. Bio*, 24: 1172-1174.

Inuwa, H. A., Ajeigbe, S. G., Muhammed and Mustapha. Y., 2012, Genetic variability and heritability of some selected cowpea (*Vigna unguiculata* (L.) Walp.). *Adv. Agric*., 8 (4): 421-425.

Jana, S., Som, M. G. and Das, N. D., Studies in cowpea, Haryana J. Hort. Sci.12 (3-4): 224-226 (1983).

Johnson, H. W., Robinson, H. F. and Comstock, R. E., 1955, Genotypic and phenotypic correlations in soybean and their implications in selection. *J. Agron.,* 37: 477-483.

Kharde, R. P., Kale, V. S. and Bhogave, A. F., 2014, Genetic variability studies in cowpea. *Bioinfolet*., 11 (1): 113-118.

Kumar, P. K., Kumar, N. R., Muneeswari, T., Nagajothi, Lamror, R. and Kumari, U. R., 2013, Morphological and genetic variation studies in cowpea genotypes [*Vigna unguiculata* (L.) Walp.]. *Legume Res*., 15 (3): 754-761.

Lal, H., Rai, M., Shivkaran, Verma, A. and Ram, D., 2007, Multivariate hierarchial clustering of cowpea germplasm [*Vigna unguiculata* (L.) Walp]. *Acta Horticulturae*, 7: 413-416.

Mary, S. S. and Gopalan, A., 2006, Dissection of genetic attributes among yield traits of fodder cowpea in F_3 and F_4. *J. Appl. Sci. Res*., 2 (10): 805-808.

Mohammed, M. S., Russom, Z. and Abdul, S. D., 2010, Inheritance of hairiness and pod shattering, heritability and correlation studies in crosses between cultivated cowpea (*Vigna unguiculata* (L.) Walp.) and its wild (*var. pubescens*) relative. *Euphytica*, 171: 397-407.

Ombakho, M., and Tyagi, P. C., 1987, Genetic variability and association of component characters for seed yield in

cowpea [*Vigna unguiculata* (L.) Walp.]. Legume Res., 23: 92-96.

Padi, K. F. and Ehlers, D. F., 2008, Effectiveness of early generation selection in cowpea for grain yield and agronomic characteristics in semi-arid West Africa. *Crop Sci*., 48: 533-540

Salimath, P. M., Biradar, S., Linganagowda and Uma, M. S., 2007, Variability parameters in F_2 and F_3 populations of cowpea involving determinate, semi-determinate and indeterminate types. *Karnataka J. Agric. Sci.*, 20 (2): 255-256.

Shivakumar, M. S., Salimath, P. M., Suma S. Biradar, Timmanna, P. O. and Shridevi O., 2013, Assesment of variability and identification of transgressive segregants for yield and yield component traits in early segregating generations of chickpea. *Legume Genomics*, 4 (3): 22-26.

Tigga, K., K. D. Rakesh, Akash, S. and Pandey, R. L., 2014, Genetic variability in cowpea [*Vigna unguiculata* (L.) Walp.]. *Trend. Biosci*., 7(2): 98-100 (2014).

Uma, M. S. and Salimath, P. M., 2004, Transgressive segregants in segregating populations derived from different mating schemes in cowpea. *Legume Res*., 27 (4): 278 – 281.

How to cite this article:

Lakshmi, K. Sridhar, S.K. Deshpande and Kulkarni, N.S. 2019. Exploitation of Genetic Variability in F_2 Generations of Cowpea (*Vigna unguiculata* (L.) Walp) for Dual Purpose. *Int.J.Curr.Microbiol.App.Sci.* 8(08): 1510-1518. doi: https://doi.org/10.20546/ijcmas.2019.808.177