AJES ASIAN JOURNAL OF ENVIRONMENTAL SCIENCE
VOLUME 15 | ISSUE 1 | JUNE, 2020 | 13-18
DOI: 10.15740/HAS/AJES/15.1/13-18
ISSN-0973-4759
Visit us : *www.researchjournal.co.in*

RESEARCH ARTICLE

Phenotypic component parameters in cowpea for Bastar Plateau Agroecological conditions

Sunita Singh **and** Prafull Kumar

Article Chronicle :
***Received* :**
02.03.2020;
***Revised* :**
08.05.2020;
***Accepted* :**
24.05.2020

Key Words :
Leaf area,
Correlation,
Linkage, Cowpea

ABSTRACT : A field experiment was conducted during *Kharif* 2016-17 to estimate the phenotypic component parameters for twelve quantitative characters among 23 genotypes. Hundred seed weight showed significant positive correlation with leaf length (0.2723**), peduncle length (0.2649**), plant height (0.3623**), pod length (0.2419**), days to 1st flowering (0.3413**), days to 50 per cent flowering (0.3608**) and green pod yield per plant (0.6110**). On the other side, hundred seed weight showed significant negative phenotypic correlation with number of pod per plant (-0.2319**), number of primary branches (-0.3658**) and number of cluster per plant (-0.2946**). The green pod yield per plant exhibited highly significant positive association with leaf length (0.2596**), leaf width (0.3208**), plant height (0.3357**), 100 seed weight (0.6110**), days to 1st flowering (0.4082**) and days to 50 per cent flowering (0.4380**) but not correlated negatively with any characters. High correlation of green pod yield per plant with plant height, 100 seed weight, first flowering and 50 per cent flowering suggested that green pod yield could be raised by selecting for early maturing plant type having sufficient crop canopy. However, when crop is grown as leguminous fodder and green manuring purpose, breeding should be practiced for comparative higher canopy with higher crop growth rate and late maturing genotypes should be preferred.

HOW TO CITE THIS ARTICLE : Singh, Sunita and Kumar, Prafull (2020). Phenotypic component parameters in cowpea for Bastar Plateau Agroecological conditions. *Asian J. Environ. Sci.*, **15**(1): 13-18, **DOI: 10.15740/HAS/AJES/15.1/13-18.**

Author for correspondence :
Prafull Kumar
S.G. College of Agriculture and Research Station (I.G.K.V.),
Jagdalpur (C.G.) India
Email : prafull397@gmail.com

See end of the article for **Coopted authors'**

Cowpea Plant types are often categorized as erect, semi-erect or climbing. Most cowpea plants are indeterminate in growth habit. However, some of the newly developed early maturing varieties have a determinate growth phenotype. Early flowering cowpea genotypes can produce a crop of dry grain in 60 days while longer season genotype may require more than 150 days maturing, depending on photoperiod (Timko and Singh, 2008). Cowpea performs well on a wide variety of soil conditions, but performs best on well-drained sandy loams or sandy soils where soil pH is in the range of 5.5 to 8.3 which tend to be less restrictive on root growth. The plant is generally drought tolerant and when used in rotation with cereals, its ability to fix nitrogen helps restore soil fertility. The global production of cowpea is estimated at 5.24 million tons, of which over 64 per cent are produced In Africa (Pottorff *et al.*, 2012 and Anonymous, 2013). India is the largest cowpea producer in Asia and together with Bangladesh, Indonesia, Myanmar, Nepal, Sri Lanka, Pakistan, Philippines, Thailand, and other far eastern countries, there may be over 1.5 million hectares under cowpea in Asia (Anonymous, 2007). In India, the bean has occupied an area of 37.54 million hectares, with a total production of 1370.21 million tonnes (Anonymous, 2014) and the productivity of cowpea is 564 kg ha^{-1} (Kurer *et al.*, 2010). The largest cultivating states are Gujarat, West Bengal, Tamil Nadu, Andhra Pradesh, Kerala and Orissa. In Gujarat, vegetable cowpea occupied an area of 0.26 lakh hactares with an annual production of 2.83 lack metric tons green tender pods (Anonymous, 2014, Patel *et al.*, 2016). The yield level of cowpea in Chhattisgarh is low, which is mainly due to the non-availability of desirable high yielding, disease and insect resistant varieties and poor management practices. Hence, the high yield potential and quality are the main targets for effective breeding programme in this crop.

To give a better insight of ancillary characters under selection, correlation coefficient analysis are the tools, which are being effectively used for determining the rate of various yield components in different crops, leading to the selection of superior genotypes. On the other hand, a positive genetic correlation between two desirable traits makes selection easy for improving both traits simultaneously while the reverse is the case for negative correlation. The phenotypic correlations of yield with growth attributes become useful technique for crop improvement programmes to select the desirable traits.

Experimental Methodology

The experimental materials were grown in *Kharif* 2016-17 at Research Farm of S.G. College of Agriculture and Research Station, Jagdalpur (C.G.). The experiment was conducted in Randomized Block Design with three replications, comprised of 20 indigenous germplasm of cowpea, collected from Bastar zone of Chhattisgarh along with three local check varieties. The sowing of material was done in mid August 2016. Recommended fertilizer and other package of practices were adopted for better crop growth. The planting geometry was maintained at 20 x 50 cm and 23 rows were allocated per plot while 30 plants were planted in each row. Inter replication distance was maintained at 1m. Five competitive plants were selected at random from each plot average value of each character was calculated for each genotype in every replication. Phenotypic and genotypic correlation co-efficients were calculated for the characters by working out the variance components of each character and the covariance components for each pair of characters using the formula suggested by Al-Jibouri *et al*. (1958).

Experimental Findings and Discussion

Correlation coefficient analysis measures the mutual relationship between plant characters and determines the component character on which selection can be made for genetic improvement of yield. Thus investigation regarding the presence of component parameters and nature of association among themselves is essential and pre-requisite for improvement in yield. Moreover, correlation co-efficient provides a clear picture of the extent of association between a pair of traits and indicates whether simultaneous improvement of the correlated traits may be possible or not. However, positive correlations occur due to the changes of genes supplying precursors, on the other hand negative correlation arise due to competition among traits for common precursors which is restricted supply (Hemavathy *et al.*, 2015). Correlation co-efficient was worked out at phenotypic and genotypic levels for all possible combination of twelve yield and its attributing characters and are presented in Table 1.

Association studies among vegetative parameters with yield:

Among vegetative parameters, leaf length, leaf width and plant height were included. Leaf length exhibited significant positive correlation with leaf width (0.7248**), peduncle length (0.5204**), plant height (0.4037**), 100 seed weight (0.2723**), days to 1st flowering (0.4262**), days to 50% flowering (0.3194**) and green pod yield per plant (0.2596**) at both 5 per cent and 1 per cent level of significant at and phenotypic level. The leaf length correlating positively with the green pod yield per plant implies that the leaf length increases photosynthetic activities and turn pod number production the pod yield increase. Similar result obtain by Sahai *et al.* (2013) for positive correlation with leaf width and Meena *et al.* (2015) for positive correlation of leaf length with number of primary branch and 100 seed weight. Leaf width showed significant positive correlation with leaf length (0.7248**), peduncle length (0.3450**), plant height (0.2014*), 100 seed weight (0.2041*), days to 1st flowering (0.6953**), days to 50 per cent flowering (0.6349**) and green pod yield per plant (0.3208**) and significant negative correlation with pod length (0.3244**) at both 5 per cent and 1 per cent level of significant at genotypic and phenotypic level. The findings are in consonance with the Sahai *et al.* (2013) with leaf width and Meena *et al.* (2015) number of primary branches. In present investigation days to flowering was found to be significant positively associated with leaf width in contrast to investigation of Ajayi *et al.* (2014), where it had positive association of leaf width with days to first flowering. Plant height was found significant positively correlated with leaf length (0.4037**), leaf width (0.2014*), peduncle length (0.4246**), pod length (0.4032**), 100 seed weigh (0.3623**), days to 1st flowering (0.2139*), days to 50 per cent flowering (0.2527**) and green pod yield per plant (0.3357**) and significant negatively correlation with number of pod per plant (0.5311**) and number of cluster per plant (-0.3868**). Positive correlation of plant height with leaf length and leaf width enhances the biomass production which is best opportunity for fodder yield purpose. In some cases, when only environmental factors are operating, plant height increases but corresponding leaf area dose not and therefore fodder yield is reduced. Hence, it advocated that, population exhibiting canopy length, leaf length and leaf width are in some time must be retained (Srinivas *et al.*, 2017). Days to first flowering highly significant positive correlated with leaf length (0.4262**), leaf width (0.6953**), peduncle length (0.2284*), plant height (0.2139*), 100 seed weight (0.3413**), days to 50% flowering (0.8402**) and green pod yield per plant (0.4082**). Olawale *et al.* (2016) also reported positive correlation with 100 seed weight. The high significance genotypic and phenotypic correlations between days to first flowering and green pod yield per plant, days to 50% flowering, 100 seed weight indicate that genotypes which flower earlier produce more pods. Highly significant but negative correlation of blooming span with pod length (-0.2727**) was also found in study the result is in accordance with result of Santos *et al*. (2014) and Ullah *et al.* (2011). Days to 50 per cent flowering reported significant positive correlation with leaf length (0.3194**), leaf width (0.6349**), peduncle length (0.2412**), plant height (0.2527**), 100 seed weight (0.3608**), days to 1st flowering (0.8402**) and green pod yield per plant (0.4380**) and significant negatively correlated with pod length (-0.3648**). The association of days to 50% flowering with plant height and 100 seed weight are conformity with the result of Santos *et al.* (2014) and Srinivas *et al*. (2017). However days to 50 per cent flowering exhibited a significant negative correlation with green pod yield per plants, indicating early flowering would help to minimize the crop duration and lower crop duration is favorable for getting optimum green pod both with respect to quantity and quality (Sapara *et al*., 2014).

Association studies among pre-yield parameters:

Number of primary branches did not show significant correlation with any traits while Thorat and Gadewar (2013) registered the significant positive correlation of number of primary branches with leaf length, days to first flowering and significant negative correlated with peduncle length (-0.2117*) and 100 seed weight (-0.3658**). In continuation, the positive association of primary branches had also been reported by Selvakumar and Usha Kumari (2013) with days to 50 per cent flowering; Srinivas *et al.* (2017) with number of cluster, number of pod per plant and pod length. Peduncle length showed, both at 5 per cent and 1 per cent found from at phenotypic level, significant positive correlation with leaf length (0.5204**), leaf width (0.3450**), plant height (0.4246**), 100 seed weight (0.2649**), days to 1st flowering (0.2284*) and days to 50 per cent flowering (0.2412**) and did not correlated negatively with any traits. The results are in consonance with those of Ajayi *et al.* (2014) for leaf width (0.30**) and 100 seed weight (0.74**) but in contrast for days to first flowering. The present study suggested peduncle length should be intermediate and above the canopy, to hold the flowers and pods above the canopy and for easy visibility. However, it was observed that accessions with extra long peduncles were easily lodged by strong winds and which cause to drop flowers hence, it is necessary to find out the optimum level (Cobbinah *et al.,* 2011). Pod length exhibited significant positive association with plant height (0.4032**) and 100 seed weight (0.2419**) and significant negative correlation with number of pod per plant -0.4182**), leaf width -0.3244**), number of primary branches (-0.2117*), days to first flowering (-0.2727**) and days to 50% flowering (-0.3648**). Earlier demonstration by for association with pod length is in consonance with preseul study, *viz.,* Sharma *et al*. (2015) (0.583** with 100 seed weight); Selvakumar and Usha Kumari (2013) (0.865** with plant height) and patel *et* *al*. (2016) (-0.281** with number of pod per plant). However, opposite result are also in record for days to first flowering and number of pods per plant, which might be due to prevailing environmental conditions and internal genetic architecture. Further supplement of nutrients, minerals and photosynthesis sometimes also alter the coinheritance of traits. Number of cluster per plant expressed significant positive correlation with number of pod per plant 0.4609**) which are contrary to Sharma *et al.* (2017) and Srinivas *et al.* (2017). Remaining of characters showed nonsignificant association for plant height (-0.3868**) and 100 seed weight (-0.2946**), and are consistent with earlier reports of Thorat and Gadewar (2013).

Association studies among yield parameters:

Number of pods per plant was found significant and positively correlated with number of primary branches (0.3666**) and number of cluster per plant (0.4609**). Positive association of number of pod per plant with number of primary branches have been discussed earlier by Sahai *et al.* (2013). Number of pod per plant exhibited significant negative correlation with plant height (-0.5311**), Pod length (-0.4182**), 100 seed weight (0.2319**) and green pod yield per plant (-0.1992*) both at 5 per cent and 1 per cent level of significant at genotypic and phenotypic level. Similarly Meena *et al.* (2015) have reported significant negative correlation of number of pod per plant with pod length and 100 seed weight but Shanko *et al.* (2014) reported significant positive correlation for plant height. Hundred seed weight showed significant positive correlation with leaf length (0.2723**), peduncle length (0.2649**), plant height (0.3623**), pod length (0.2419**), days to 1st flowering (0.3413**), days to 50 per cent flowering (0.3608**) and green pod yield per plant (0.6110**). The finding of Olawale *et al.* (2016) for association of 100 seed weight with days to first flowering; Srinivas *et al.* (2017) with days to 50% flowering; Sharma *et al.* (2015) with green pod yield per plant; contributed the authenticity of our results. On the other side, hundred seed weight showed significant negative phenotypic correlation with number of pod per plant (-0.2319**), number of primary branches (-0.3658**) and number of cluster per plant (-0.2946**). It means that increase of number of pods per plant, number of primary branches and number of cluster per plan decreased the 100 seed weight (Mahbub *et al.*, 2015). The result of present investigation revealed that the green pod yield per plant exhibited highly significant positive association with leaf length (0.2596**), leaf width (0.3208**), plant height (0.3357**), 100 seed weight (0.6110**), days to 1st flowering (0.4082**) and days to 50 per cent flowering (0.4380**) but not correlated negatively with any characters. However, Sapara *et al.* (2014) reported the negative correlation with days to 50 per cent flowering. High correlation of green pod yield

Table 1 : Correlation among different characters in cowpea

	NP/P	LL (cm)	LW (cm)	NPB	PDL (cm)	PH (cm)	PL (cm)	NC/P	HSW (g)	DF	DFF	GPY/P (g)
NP/P		-0.1520	-0.0155	0.3666**	0.0717	-0.7344**	-0.5274**	0.6105**	-0.2943**	-0.1565	-0.0873	-0.1992*
LL (cm)	-0.0370		0.7480**	-0.3098**	0.6891**	0.5194**	0.1723	-0.1139	0.3667**	0.5259**	0.3755**	0.2607**
LW (cm)	0.0536	0.7248**		-0.0629	0.4576**	0.2418**	-0.3791**	-0.0508	0.2041*	0.8356**	0.7466**	0.3222**
NPB	0.1357	-0.0725	-0.0851		-0.1585	-0.3034**	-0.2546**	0.4419**	-0.6575**	-0.0919	0.0639	-0.2474**
PDL (cm)	0.0485	0.5204**	0.3450**	-0.1315		0.5010**	0.1720	-0.2552**	0.2740**	0.2486**	0.2658**	0.2030
PH (cm)	-0.5311**	0.4037**	0.2014*	-0.1407	0.4246**		0.4904**	-0.5385**	0.4022**	0.2383**	0.2793**	0.3771**
PL (cm)	-0.4182**	0.1054	-0.3244**	-0.2117*	0.1507	0.4032**		-0.3119**	0.2522**	-0.2995**	-0.4127**	-0.0176
NC/P	0.4609**	-0.0542	-0.0352	0.1101	-0.1635	-0.3868**	-0.1554		-0.4170**	-0.1020	-0.1010	-0.1676
HSW (g)	-0.2319**	0.2723**	0.1424	-0.3658**	0.2649**	0.3623**	0.2419**	-0.2946**		0.3522**	0.3690**	0.6810**
DF	-0.1394	0.4262**	0.6953**	-0.0394	0.2284*	0.2139*	-0.2727**	-0.0802	0.3413**		0.8469**	0.4581**
DFF	-0.0853	0.3194**	0.6349**	0.0360	0.2412**	0.2527**	-0.3648**	-0.0630	0.3608**	0.8402**		0.4688**
GPY/P (g)	-0.1347	0.2596**	0.3208**	-0.1064	0.1980	0.3357**	-0.0367	-0.0718	0.6110**	0.4082**	0.4380**	

Above diagonal value indicate genotypic correlation and below diagonal value indicate phenotypic correlation.
Critical value of 'r' at 5%= .1761 and that at 1%= .2289.
* and ** indicate significance of values at P=0.05 and 0.01, respectively
NPP= No. of pod per plant, LL= Leaf length, LW= Leaf width, NPB= No. of primary branches, PDL= Peduncle length, PH= Plant height, PL= Pod length, NC/P= No. of cluster per plant, HSW= 100 seed weight, DF= Days to 1st flowering, DFF= Days to 50% flowering, GPY/P= Green pod yield per plant.

per plant with plant height, 100 seed weight, first flowering and 50 per cent flowering suggested that green pod yield could be raised by selecting for early maturing plant type having sufficient crop canopy. However, when crop is grown as leguminous fodder and green manuring purpose, breeding should be practiced for comparative higher canopy with higher crop growth rate and late maturing genotypes should be preferred.

Conclusion:

From the forgoing study, it is evident that characters leaf length, leaf width, plant height, 100 seed weight and floristic components of plant were showed positive association with grain yield per plant, indicating that grain yield can be improved by selection based on these characters. Visible floral biological parameters exhibited negative association with harvestable biomass like vegetable and fodder yield hence comparative early flowering would help to minimize the crop duration which would eventually be useful tool to improve and maintain the quality and quantity of crop.

Acknowledgement:

The research work was part of M.Sc. Thesis and authors duly acknowledge the financial and technical support provided by Dean, SGCARS, Jagdalpur; Head, Department of GPB, IGKV, Raipur and Director Research Services, IGKV, Raipur.

Coopted Authors' :

Sunita Singh, S.G. College of Agriculture and Research Station (I.G.K.V.), **Jagdalpur (C.G.) India**

REFERENCES

Ajayi, A.T., Adekola, M.O., Taiwo, B.H. and Azuh, V.O. (2014). Character expression and differences in yield potential of ten genotype of cowpea (*Vigna unguiculata* L. Walp). *Internat. J. Plant Res.*, **4**(3):63-71.

Al-Jibouri, H.R., Miller, P.A. and Robinson, H.F. (1958). Genotypic and environmental variance in an upland cotton crop of inter specific origin. *Agron. J.*, **50** : 633-63.

Anonymous (2007). F.A.O.STAT database. Food and Agriculture Organization of the United Nations, Rome, Italy.

Anonymous (2013). FAOSTAT, Agricultural production, crop primary database. Food and Agricultural Organization of the United Nations, Rome.

Anonymous (2014). Directorate of Horticulture, Gujarat State.

Cobbinah, F.A. Addoquaye, M.O. and Asante, I.K. (2011). Characterization, evaluation and selection of cowpea [*Vigna unguiculata* (L.) Walp] accessions with desirable traits from eight regions of Ghana. *J. Agric. & Bio. Sci.*, **6**: 21-31.

Hemavathy, A., Thanga, S.N. and Anand, G. (2015). Genetic variability, correlation and path co-efficient studies on yield and its components in mungbean [*Vigna radiata* (L.)Wilezek]. *Legume Res.*, **38**(4): 442-446.

Kurer, S., Gangaprasad, S., Uma, M.S., Santhakumar, G. and Salimath, P.M. (2010). Genetic variability studies In F2 and F3 generation of cowpea [(*Vigna unguiculata* (L.) Walp)]. *Elect. J. Plant Breed.*, **1**(5):1344-1346.

Mahbub, M.M., Mamunur, R.M., Hossain, M.S., Mahmud, F. and Mir, K.M. (2015). Genetic variability, correlation and path analysis for yield and yield components in Soybean. *American-Eurasian J. Agric. & Environ. Sci.*, **15**(2):231-236.

Meena, H.K., Ram, K.K. and Singh, B. (2015). Character associatons between seed yield and its components traits in cowpea [*Vigna unguiculata* (L.) Walp.]. *Indian J. Agri. Res.*, **49**(6) : 567- 570.

Olawale, M.A. and Makinde, B.O. (2016). Phenotypic analysis of seed yield and yield components in cowpea [*Vigna unguiculata* (L.) Walp]. *Plant Breed. Biotech*., **4**(2):252- 261.

Patel, U.V., Parmar, V.K., Patel, P.B. and Malviya, A.V. (2016). Correlation and path analysis study in cowpea [*Vigna unguiculata* (L.) Walp.]. *Internat. J. Sci., Enrom. & Tech.*, **5** : 3897 – 3904.

Pottorff, M., Ehlers, J.D., Fatokun, C., Roberts, P.A. and Close, T.J. (2012). Leaf morphology in cowpea [*Vigna unguiculata* (L.) Walp]: QTL analysis, physical mapping and identifying a candidate gene using syntonic with model legume species. *BMC Genocs*, **13**: 234.

Sahai, G., Malviya, D.R. and Singh, U.P. (2013). Morphological traits association with fodder and seed yield in [*Vigna unguiculata* (L.) Walp]. *J. Enronml. Bio.*, **34**:139-145.

Santos, A., Ceccon, G., Davide, L.M.C. and Correa, A.M. (2014). Correlations and path analysis of yield components in cowpea. *Crop Breed. Appl. Biotechnol*., **14** : 82-87.

Sapara, G.K., Javiya, R.M. and Pokar, M.V. (2014). Genetic variability, heritability and genetic advance in vegetable cowpea [*Vigna unguiculata* (L.) Walp.]. *Internat. J. Pl. Sci.*, **9**(2):326 - 329.

Selvakumar, G. and Ushakumari, R. (2013). Association analysis in the Intersubspecific crosses of cowpea [*Vigna unguiculata* (L.) Walp.] and yard long bean [*Vigna* *unguiculata* (L.) Walp. spp. sesquipedalis]. *Elect. J. Pl. Breed.*, **4**(4) :1336-1339.

Shanko, D., Meheaselussie, A. and Habtamu, Z. (2014). Genetic variability and heritability of yield and related characters in cowpea [(*Vigna unguiculata* (L.) Walp]. *Res. Biotech.*, **4**(2) : 21-26.

Sharma, D., Mehta, N. and Singh, J. (2015). Early genetaion selection for green pod yield and its components in vegetable cowpea [*Vigna unguiculata* (L.) Walp.]. *Asian J. Hort.*, **10** (1) : 1 – 10.

Sharma, M., Sharma, P.P., Upadhyay, B., Bairwa, H.L. and Meghawal, D.R. (2017). Character association and path analysis in vegetable cowpea [*Vigna unguiculata* (L.) Walp.] germplasm line. *Internat. J. Curr. Microbial*, **6**(6):786 –795.

Srinivas, J., Kale, V.S., Nagre, P.K. and Meshram, S. (2017). Correlation and path analysis study in cowpea [*Vigna unguiculata* (L.) Walp.] genotypes. *Internat. J. Curr. Microbiol. App. Sci.*, **6**(6): 3305-3313.

Thorat, A. and Gadewar, R.D. (2013). Variability and correlation studies in cowpea [*Vignaunguiculata* (L.) Walp]. *Internat. J. Enroml. Rehabilitation & Conservation*, **4**(1):44-49.

Timko, M.P. and Singh, B.B. (2008). Cowpea, a multifunctional legume, In: Moore P.H. and Ming, R. (Eds.), Genomics of Tropical Crop Plants. Springer, New York, P. 227-257.

Ullah, M.Z., Hasan, M.J., Rahman, A.H.M.A. and Saki, A.I. (2011). Genetic variability, character association and path analysis in Yardlong bean. *SAARC J. Agric.*, **9**(2): 9-16.