Trends in Biosciences 10(6), Print : ISSN 0974-8431, 1407-1411, 2017

Identification of High Protein Cowpea (*Vigna ungiculata* L.Walp) Genotypes

P.S. SARATH* AND JIJI JOSEPH**

College of Horticulture , Kerala Agricultural University, Thrissur
email : Sharathps747@gmail.com; jijisanthosh@gmail.com***

ABSTRACT

Twenty two cowpea genotypes were evaluated at College of Horticulture, Kerala Agricultural University during 2014-2015. High variability was observed for yield, yield contributing characters and protein content. Grain yield per plant recorded high GCV, PCV, heritability and genetic advance. Protein content recorded low value for PCV, GCV and high heritability but low genetic advance. Number of seeds per pod had positive correlation with protein content. Days to flowering, number of pods per plant and grain yield per plant had negative correlation with protein content. Path analysis showed that number of seeds per pod exhibited high positive direct effect and yield per plant had indirect effect through number of seeds per pod to protein content. The genotypes of semi trailing types Anaswara, PKB-3 and PKB-4 and trailing types Vyjayanthi, Lola and Sharika with more than 100g grain yield per plant and protein content of more than 27 per cent are identified.

Key words *Cowpea protein, Variability, Heritability, Genetic advance, Correlation and path analysis*

Cowpea (*Vigna unguiculata* L. Walp) is one of the most important legume crops in the world and it is a major food crop in Africa, Latin America and India because of its high protein content (Singh, 2007). As a drought tolerant and warm weather crop, cowpea is well adapted to the drier regions of the tropics and is therefore an important famine food crop producing significant grain in dry years when all other crops fail (Ehlers and Hall, 1997). Cowpea is used as vegetable and grain crop and to lesser extent as a fodder crop. It is the most versatile pulse crop because of its weed smothering nature, drought tolerant characters, soil restoring properties and multi-purpose uses.

Cowpea protein is rich in the amino acids, lysine and tryptophan, compared to cereal grains, Therefore, its seed is valued as a nutritional supplement to cereal protein (Steel, 1985). Because of its high protein (about 23%), vitamins and minerals content, cowpea plays an important role in both human and animal nutrition. Review on the earlier research showed that little attention has been made on genetic improvement cowpea for protein content .

Consideration of genetic variability existing in a population is the basic requirement for effective crop improvement programme. In the present study, cowpea genotypes were screened to obtain a better estimate of the variability and gene action of yield , yield contributing traits and seed protein content which will be useful for selecting good parental lines in cowpea breeding programs for improved protein content.

MATERIALS AND METHODS

A total of 22 cowpea genotypes collected from various institutions (Table 1) were sown during August 2014 in randomized block design with two replications. Genotypes of bushy nature were raised in plots of five meter square and plants were raised at a spacing of 30 x 10 cm^2 . For trailing and semi trailing types three plants were raised in pits at a spacing of 2 x 2 m^2 and ten such pits were maintained per replication . All the cultural practices as per package of practice recommendations (KAU 2011) were followed to raise a normal cowpea crop.

Table 1

The traits days to flowering (df), number of pods per plant (pd), number of seeds/ pod (ns), test weight (tw), grain yield/plant (gy) and protein content by Lowrys method (pc) were observed. Observations were recorded on twenty five plants chosen at random in each entry and mean performance of various biometrical traits are presented in three catagories namely bushy, semi trailing and trailing. Differences for means of genotypes were computed using least significance differences test (LSD) at 0.05 level of probability. Estimation of genetic parameters like heritability, phenotypic and genotypic coefficient of variation and genetic advance as per cent of mean was done. Correlation between variables was done followed by path analysis between protein content and other variables to know the cause and effect relationship of these variables.

RESULTS AND DISCUSSION

Improvement of grain quality is a major objective of most breeding programs and the presence of diverse source material has been associated with progress in plant breeding (Singh, 2007). The variability among the vast number of different cultivars need to be properly documented for better management of cowpea breeding programs for improved protein cultivars. Exploitation of genetic potential of wild and close relatives of cowpea for enhancing protein content had not been well attempted and documented (Celestine *et al.,* 2013).

In the present study, analysis of variance revealed the presence of significant differences among genotypes for all the characters. The results are presented in Tables 2. Karpe *et al.* (2006) grouped cowpea genotypes based on the days to flowering. Genotypes which take less than 40 days to flower are considered as early type, while genotypes which flowered between 40-50 days as medium and more than 50 days considered as late . Among the 22 cowpea genotypes evaluated six genotypes were early to flower which is a desirable trait in cowpea. Among the early genotypes two were bushy and three were semi trailing and none of them were trailing. Bushy cowpea were early

Table 1. Genotypes of cowpea used for the study

Sl.no	Varieties	Source
1	Vellayani Jyothika	Kerala Agrl University
2	Bhagyalakshmi	Kerala Agrl University
3	Anaswara	Kerala Agrl University
4	Vyjayanthi	Kerala Agrl University
5	Lola	Kerala Agrl University
6	Kanakamony	Kerala Agrl University
7	Hridya	Kerala Agrl University
8	Kasikanchan	IIVR ,Varanasi
9	Sharika	Kerala Agrl University
10	Co-2	TNAU, Coimbatore
11	Co-4	TNAU, Coimbatore
12	Co-6	TNAU, Coimbatore
13	Co(cp)7	TNAU, Coimbatore
14	AV-5	UAS, Banglore
15	PKB-3	UAS, Banglore
16	PKB-4	UAS, Banglore
17	NBPGR- 1	NBPGR., Vellanikkara
18	NBPGR-2	NBPGR., Vellanikkara
19	NBPGR-3	NBPGR., Vellanikkara
20	CP-1	Local landrace
21	CP-2	Local landrace
22	CP-3	Local landrace

to flower followed by semi trailing and trailing types were generally late to flower. In bushy type Hridya (27.19 days) recorded minimum days to flowering and it was maximum for Co-6 with 51.14 days. Mishra *et al*. (2009) reported variation in days to flowering in bushy type cowpea and Sharma *et al*. (2013) reported variation in semi trailing types. In semi trailing type except CP-1 all other genotypes started flowering in 35-40 days.

The genotypes Vellayani Jyothika (58.24), Vyjayanthi (51.37) and Lola (60.07) of trailing type and AV-5 (60.31), PKB-3 (63.63) and PKB-4 (55.60) of semi trailing type had more than fifty number of pods. Bushy types with more number of pods can result in more yield per unit area as more number of plants can be accommodated. However, none of the bushy genotypes recorded more than 20 pods per plant. Variability in pods per plant was earlier noted by Singh, (2007) and Dalsaniya *et al.* (2013).

Karpe *et al*. (2006) classified cowpea based on the seeds per pod in to three groups, low seeded (< 10 seeds / pod), medium seeded (10 - 20 seeds / pod) and high seeded (> 20 seeds / pod). Seeds per pod is directly related to the length of pod (Santos *et al*., 2012) as length increases seeds per pod also increases which was not true with CP-1. Out of the 22 genotypes evaluated the four genotypes belonged to high seeded cowpea of which two were trailing (Vyjayanthi, Lola) and two were semi trailing (AV-5, PKB-3) . This clearly indicates that growth habit is having influence on the number of seeds per pod. Among the bushy type four were belonging to the low seeded cowpea, all other eight genotypes were medium seeded.

Variability in test weight of cowpea was reported by Sivakumar *et al*. (2013). Test weight for bushy type ranged from 6.81g to 13.53g. In the case of trailing type test weight was more than 12g, while three genotypes had more than 20g. The highest test weight of the group was shown by the trailing type where all the genotype had more than 18g for test weight.

Bhavesh *et al.* (2012) classified cowpea genotypes in to 3 catagories based on yield per plant as high (> 100g / plant), medium (50 - 100g / plant) and low yielding (< 50g/ plant) genotypes. In the present study among the 22 genotypes nine genotypes (PKB-3 (175.40g), AV-5 (166.34g), Lola (154.94g), Vyjayanthi(145.49g), PKB-4 (138.64g), Vellayani Jyothika (135.73g), Anaswara (117.72g), Sharika (100.24g) and Kanakamony (100.86) recorded high grain yield per plant among which five were trailing type and four were semi trailing type. Due to its determinate growth

Table 2a. Mean performance of bushy cowpea genotypes

Sl..no	Varieties	Days to flowering	No. of pods per plant	No. of seeds / pod	Test weight (g)	Grain yield/plant (g)	Protein (%)
1	Bhagyalaksmi	33.87^{d}	12.29^{cd}	14.03^{a}	9.935^{cd}	10.77^{e}	27.96^{a}
2	Co(cp)7	46.66^{b}	18.46^{ab}	12.29^{b}	13.2^{a}	12.38^{e}	20.34^{cde}
3	Co-2	44.45^{bc}	18.55^{ab}	14.11^{a}	12.03^{ab}	10.01^{e}	20.17^{de}
4	Co-4	41.04^{c}	18.93^{ab}	14.03^{a}	12.11^{ab}	10.01^{e}	20.89^{cd}
5	Co-6	51.14^{a}	19.9^{a}	11.79^{b}	13.05^{a}	11.385^{e}	20.89^{cd}
6	Hridya	27.19^{e}	18.05^{ab}	7.925^{d}	6.81^{d}	9.31^{e}	21.62^{bc}
7	Kasi kanchan	44.26^{bc}	18.3^{ab}	11.88^{b}	13.53^{a}	26.47^{d}	22.83^{b}
8	CP-2	45.94^{b}	16.67^{b}	11.9^{b}	11.89^{ab}	40.70^{a}	19.39^{ef}
9	CP-3	45.96^{b}	14.02^{c}	10.04^{c}	10.56^{bc}	34.26^{b}	19.43^{ef}
10	NBPGR 1	45.92^{b}	12.7^{cd}	8.93^{cd}	8.85^{d}	24.88^{d}	18.15^{f}
11	NBPGR 2	51.08^{a}	10.79d	9.79^{c}	10.08^{cd}	28.78^{cd}	19.77^{de}
12	NBPGR 3	41.13^{c}	16.875^{b}	8.88^{cd}	10.61^{bc}	32.74^{bc}	19.48^{e}

Table 2b. Mean performance of semitrailing cowpea genotypes

Sl..no	Varieties	Days to flowering	No. of pods per plant	No. of seeds / pod	Test weight (g)	Grain yield/plant (g)	Protein (%)
1	Anaswara	40.68^{b}	45.15^{c}	18.03^{ab}	15.2	117.72^{d}	27.60^{a}
2	Kanakamony	39.96^{bc}	41.21^{d}	18.04^{ab}	12.03	100.86^{e}	25.38^{b}
3	CP-1	55.08^{a}	16.07^{e}	13.77^{c}	13.43	54.63^{f}	20.65^{c}
4	AV-5	36.68^{d}	60.31^{a}	20.08^{a}	21.84	166.34^{b}	25.34^{b}
5	PKB-3	37.32^{cd}	63.63^{a}	20.1^{a}	21.90	175.40^{a}	28.5^{a}
6	PKB-4	37.33^{cd}	55.60^{b}	17.04^{b}	23.04	138.64^{c}	28.49^{a}

Table 2c. Mean performance of trailing cowpea genotypes

Sl..no	Varieties	Days to flowering	No. of pods per plant	No. of seeds / pod	Test weight (g)	Grain yield/plant (g)	Protein (%)
7	VellayaniJyothika	50.47	58.24^{a}	17.85	22.60	135.73^{a}	26.07
8	Vyjayanthi	52.83	51.37^{ab}	20.13	20.51	145.49^{a}	27.05
9	Lola	54.94	60.07^{a}	22.28	22.86	154.94^{a}	27.75
10	Sharika	49.2	45.16^{b}	18.79	18.95	100.24^{b}	27.1

Table 3. Estimates of genetic component of variation for different traits

Character	PCV	GCV	Heritability (%)	Genetic advance	Genetic advance as % of mean
Days to flowering	18.89	12.99	47.29	8.14	18.40
Pods per plant	69.08	50.96	54.41	18.83	77.43
Seeds per pod	31.94	26.77	70.22	6.75	46.22
Grain yield/ plant	96.35	84.06	76.12	113.49	151.09
Protein content	6.67	14.69	77.69	6.24	26.68

Table 4. Correlation between different variables

Characters	Days to flowering	No. of pods / plant	No .of seeds /pod	Grain yield /plant	Protein content
Days to flowering	1.000				
No. of pods / plant	-0.787	1.000			
No .of seeds /pod	0.481	-0.398	1.000		
Grain yield /plant	0.189	0.042	0.309	1.000	
Protein content	-0.768	0.656	-0.839	-0.566	1.000

Table 5. Matrix of direct and indirect effects, of traits to protein content

Characters	Days to flowering	No.of pods / plant	No. of seeds /pod	Grain yield /plant
Days to flowering	**-0.364**			
No. of pods / plant	0.367*	**0.161**		
No. of seeds /pod	0.152	0.683**	**0.798****	
Grain yield /plant	0.062	0.661**	0.878**	**-0.006**

Direct effect along the main diagonal.

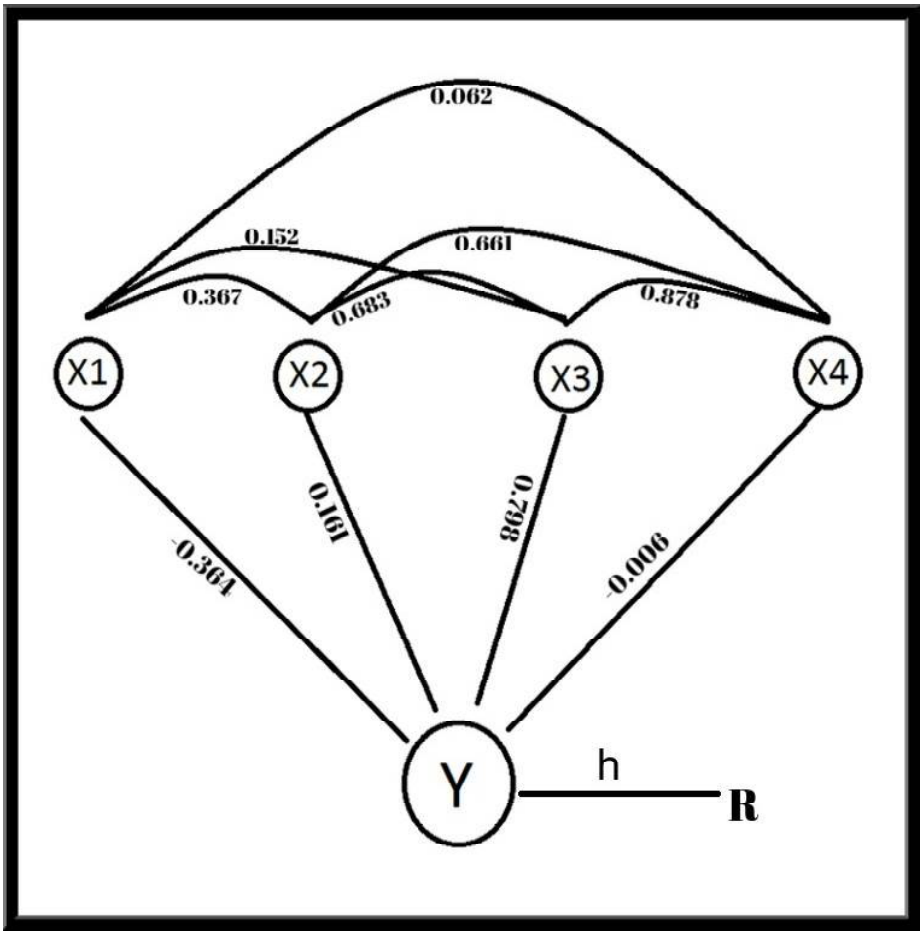

Fig. 1. Path diagram Y - protein content (effect),

X1- days to flowering, X2 -no of pods per plant, X3 - no of seeds per pod , X4 -grain yield per plant and R - Residual effect , h =1-r_{15}a-r_{25}b-r_{35}c-r_{45}d

=1-0.2089-0.0917.0.6751+0.00468 = 0.17

habit per plant grain yield was low in bushy type. However, the genotype CP-2 and CP-3 were having grain yield of more than 30g per plant. These genotypes can be used for high grain yield per unit area.

The cowpea genotypes showed high degree of variability in protein content. The seed protein content of the 22 genotypes ranged from 17.56 to 28.74 per cent with a mean value of 23.41 per cent. Among the 22 genotypes screened for seed protein content, seven genotypes PKB-3 (28.5%), PKB-4 (28.49%), Bhagyalaksmi (28.18%), Lola (27.75%), Anaswara (27.6%), Sharika (27.10%) and Vyjayanthi (27.05) had seed protein content of more than 25 per cent. Out of these genotypes, three each were trailing or semi trailing , while Bhagyalakshmi alone was bushy Even though, in Bhagyalakshmi per plant grain yield was low it can maintain a large population due to its bushy nature. Kumar and Sagwan, (2005), Karpe *et al*. (2006) and Chaudhari *et al*. (2013) too observed similar results.

Estimation of genetic parameters

Coefficient of variation provides a relative measure of variance among different traits. The estimates of PCV were higher than GCV implies the effect of environment on the trait. The traits like seeds per pod and days to flowering are less influenced by environment (Table 3). Grain yield per plant and seeds per pod recorded high PCV and GCV indicating presence of ample variability among the genotypes and possibility of improvement through simple selection (Mishra *et al*. (2009). Heritability plays an important role in deciding the suitability of breeding procedure on a character. The trait grain yield per plant recorded high heritability and genetic advance as per cent of mean. This implies that selection would be effective in improving yield (Guptha., 2010). Days to flowering and test weight exhibited low heritability along with low genetic advance indicating that breeding method other than selection is desirable for the improvement of these traits. Protein content exhibit low PCV, GCV high heritability and low genetic advance implies that selection is not desirable for improvement in protein content.

Table 3

Correlation studies

Correlation coefficient measures the absolute value of correlation between variables (Sharma *et al*. 2013). Days to flowering exhibited a high significant negative correlation with protein content indicating reduction in number of days to flowering may leads to increase in protein content. Number of seeds per pod had positive correlation with

protein content as presented in Table 4. Days to flowering, number of pods per plant and grain yield per plant had negative correlation with protein content indicated that simultaneous improvement of these characters with protein content is not possible .

Path analysis

Wright (1921) designed the method of path analysis for the purpose of path analysis for interpretation of a system of correlation coefficient in terms of paths of causation. In path analysis the correlation coefficient split up in to direct and indirect effects as shown in Table 5. In the case of days to flowering correlation coefficient value and direct effects are negative implies that there is negative association between protein content and days to flowering. As the correlation between grain yield per plant (-006) and protein content was negative, simultaneous improvement of grain yield per plant and protein content is not possible (Table 5). In case of pods per plant a positive correlation with grain yield per plant was observed , but the direct effects was negligible (0.16), in such situation the indirect causal factors can be considered simultaneously for selection. The association between number of seeds per pod and protein content was positive and the correlation coefficient was almost equal to its direct effect.This explains the true relationship and direct selection through this trait will be effective. The residual effect determines how best the causal factors account the variability of the dependent factor, (Fig. 1). Its estimate being 0.1638 means the variable explains about 83% of variability in the protein content and remaining variability contributed by some other factors which have not been considered here.

The proportion of the cowpea population that were of high protein content was low as revealed in this study. However, the genotypes of semi trailing types Anaswara, , PKB-3 and PKB-4 and trailing types , Vyjayanthi, Lola and Sharika with more than 100g grain yield per plant and protein content of more than 27 per cent can be made use of in breeding programmes to develop high protein genotypes without compromising on grain yield.

LITERATURE CITED

Bhavesh, P.,Desai, R. T. Bhavin, N. and Patel, P. B. 2012. Combining ability study for seed yield in cowpea (*V. unguiculata*). Bioscan, **8**(1): 139-142.

Celestine, A.A, Benjamin, E.U, Karl, J. K , Titus, F.E. and Josephine, O.A. 2013. Seed protein content variation in cowpea genotypes. *World Journal of Agriultural Sciences*, **1** (3): 094-099.

Chaudhari, S.B., Naik, M.R and Patil, S.S. 2013. Combining ability for pod yield and seed protein content in cowpea over environment. *Trends in Biosciences*, **6**: 395-398.

Dalsaniya, S.B., Poshiya, V.K and Davada, B.K. 2013. Genetic divergence in cowpea (*V. unguiculata*). *Crop Improvement,* **25**: 15-27.

Ehlers, J. D. and Hall, A.E. 1997. Cowpea (*Vigna unguiculata* L. Walp.). Field Crops., **53** :187–204.

Guptha, R.. 2010. Characterization of seed storage proteins in high protein genotypes of cowpea [*Vigna unguiculata* (L.) Walp.]. Physiology and Molecular Biology of Plants, **16**: 53-58.

Karpe, A. A., Naik, M. R., Bagade, A. B. and Desai, R.T. 2006. Combining ability studies in cowpea (*V. unguiculata*). Annual Review of Plant Physiology, **2**: 267-270.

KAU. 2011. *Package of Practices Recommendations: Crops* (14th Ed.). Kerala Agricultural University, Thrissur, 360p.

Kumar. and Sagwan, V.P. 2005. Combining ability for yield and different quality traits in vegetable cowpea (*V. unguiculata*). *Electr. J. Plant Breed.,* 12: 46.49.

Mishra, S.K., Singh, B.B., Chand, D. and Neena, K. N. 2009. Diversity for economic traits in cowpea (*V. unguiculata*). *African Journal of Agricultural Research*, **2**: 54-58.

Sharma, D., Mehta, N., Singh, J. and Guptha, C. R. 2013. Genetic study for some pod characters in vegetable cowpea (*V. unguiculata*). *Electronic Journal Plant Breeding*, **5**: 21-23.

Singh, B. B. 2007. Recent Progress in Cowpea Genetics and Breeding, Proceedings of Ist International Conference on Indigenous Vegetables and Legumes. M.L. Chadha (ed), 69-75.

Sivakumar, V., Ceiline, V.A., Duggi, S. and Magadum, S. 2013. Genetic variability and heritability studies in bush cowpea (*V. unguiculata*). Legume Genomics and Genetics, **4**(2): 21-26.

Steel, W.M. 1985. Cowpea (*Vigna unguiculata* L. Walp). *Journal of agricultural and Food Chemistry*, **18**(8): 520-538.

Wright, S. 1921. System of mating. *Genetics*, **6**: 111-118.

Received on 03-02-2017 *Accepted on 09-02-2017*