The Bioscan 11(2): 977-980, 2016 (Supplement on Genetics and Plant Breeding) www.thebioscan.com
AN INTERNATIONAL QUARTERLY JOURNAL OF LIFE SCIENCES

CORRELATION AND PATH ANALYSIS STUDIES FOR GREEN POD YIELD AND COMPONENT CHARACTERS IN WINGED BEAN [*PSOPHOCARPUS TETRAGONOLOBUS* (L.) DC.]

K. PRASANTH*, I. SREELATHAKUMARY AND V. A. CELINE
Department of Olericulture,
College of Agriculture, Vellayani, Thiruvananthapuram - 695 522, kerala, INDIA
e-mail: kpras.agri@gmail.com

KEYWORDS
Winged bean
Correlation
Path analysis
Genotypes
Variability

Received on :
18.10.2015

Accepted on :
27.04.2016

***Corresponding author**

ABSTRACT
Correlation and path analysis studies in 21 genotypes of winged bean for various quantitative characters revealed that pod yield per plant had highly significant and positive association with Pod length (0.740, 0.439), Pod girth (0.519, 0.335), Pod weight (0.676, 0.420) and pods per plant (0.960, 0.959) at both genotypic and phenotypic level, indicating mere possibility of improvement in these traits through simultaneous selection. Path analysis for pod yield revealed that traits like pods per plant (0.631), pod length (0.347), pod girth (0.229), days to first flowering (0.156) and days to final harvest (0.122) exhibited high positive direct effect on pod yield (rG = 0.960) and, pods per plant being the major contributing character. Days to first harvest being chief contributing character for pod yield with indirect positive effect through days to first flowering. Keeping in view the direct and indirect contribution of component traits towards pod yield per plant, the indirect selection on days to first flowering, days to first harvest, pod length and pods per plant in winged bean is suggested rewarding.

INTRODUCTION

Winged bean is one of the important vegetable crops whose potential is not yet completely exploited. All parts of this plant, *viz.,* immature pods (2.9-21.5% protein), ripe seeds (31.8 % protein), tender shoots (2.8-5.6% protein), flowers (2.92% protein), young leaves (3.24% protein) and tuberous roots (8-20% protein) are consumed as protein, calcium and iron rich vegetable (Shanmugavelu, 1989; Long *et al.* 1993; Neeliyara *et al.* 2001), hence is variously known as 'soya's rival' God-sent vegetable' and 'vegetable of twentieth century' (Peter, 1998). Though winged bean was introduced in India in 1979, it has not spread or cultivated widely despite its tremendous nutrition and diversified utility due to lack of concerted effort on crop improvement programmes.

The per capita availability of protein in the country is 28g/day, while WHO recommended it should be 80 g/day, consequently most serious problem of the malnutrition existing among the poor people, where most of the people have vegetarian diet and avoid the animal protein (Prasad *et al.,* 2013). It is needs to fulfill its demand through vegetable protein. Therefore, it is necessary to increase the production of winged bean in nontraditional areas, which could be done opting suitable, breeding methods.

Yield is a complex character and is associated with a number of component characters. The relationship of yield with other characters is of great importance while formulating selection programmes for improvement of yield. The genotypic correlation between characters provides a reliable measure of the genotypic association between characters and helps to differentiate the vital associations useful in breeding from non vital ones. Correlation coefficients reveal only the relation between yield and yield components and not the actual direct and indirect effects of the components on yield. Rate of crop improvement will be rapid if differential emphasis is given to the component characters during selection. Path coefficient analysis splits the genotypic coefficients into direct and indirect effects of the component characters on yield based on which crop improvement can be done more effectively. Breeding and selection programmes often encompass several characters simultaneously (Hill *et al.,* 1998). When considering several traits, it is desirable to choose individuals with the best combination of traits. Such base information is scarce in crop like winged bean. Variability has been noticed and reported previously for various quantitative traits in winged bean by Mohamadali and Madalageri, 2004a; Mohamadali *et al.,* 2005; Pan *et al.,* 2005; Mahto and Dua, 2009.

Hence, the present investigation was carried out to elicit information on character association of green pod yield with other attributes and their direct and indirect effect on green pod yield for yield improvement in winged bean and the paper deals with the above aspect.

MATERIALS AND METHODS

Present investigation was carried out at Department of

Olericulture, College of Agriculture, Vellayani, Thiruvananthapuram (Kerala) during 2013-2014. Twenty one winged bean genotypes collected from different sources (Table 1) were sown in rows at spacing of 125 cm between rows and 50 cm between plants. The experiment was laid out in randomized block design with three replications. Recommended cultural and management practices were followed for the better growth and development of the crop (KAU, 2011). Five plants were selected at random from each experimental plot for recording various observations on green vegetable pod yield and component characters. The data collected for all quantitative characters were subjected to analysis of variance according to the method suggested by Panse and Sukhatme (1985). Correlation coefficients were calculated at phenotypic and genotypic levels using the formulae suggested by Al. Jibouri *et al*. (1958) and path coefficient of various characters was calculated as per the procedure of Dewey and Lu (1959) to know the direct and indirect effects of the important component traits for green pod yield per plant.

RESULTS AND DISCUSSION

The results of the analysis of variance for different quantitative characters for 21 genotypes of winged bean were presented in Table 2. The results indicated that there is highly significant variation among the genotypes for almost all the characters under study, *viz*., vine length (cm), primary branches per plant, days to first flowering, days to 50 per cent flowering, days to first harvest, days to final harvest, pod length (cm), pod girth (cm), pod weight (g), pods per plant, and pod yield per plant (g). These results were in accordance with the previous results of Philip and Ramachandran (1986), Mohamadali and Madalageri (2004b), Nandan *et al*. (2010).

Correlation coefficient analysis measures the mutual relationship between various plant characters and determines the component characters on which selection can be based for genetic improvement in yield. A positive value of correlation shows that the changes of two variables are in the same direction, *i.e.,* high value of one variable are associated with high values of other and vice-versa. When correlation is negative the movements are in opposite directions, *i.e.,* high values of one variable are associated with low values of other (Kumar *et al*. 2010). The breeder is always concerned for the selection of superior genotypes on the basis of phenotypic expression. However for the quantitative characters, genotypes are influenced by environment, thereby affecting the phenotypic expression. Information regarding the nature and extent of association of morphological characters would be helpful in developing ideal plant type, in addition to the improvement of yield a complex character for which, direct selection is not effective.

The genotypic and phenotypic correlation studies were carried out for all the 11 characters to know the nature of relationship existing between vegetable pod yield and its component characters and are presented in Table 3 and 4. A negative non significant correlation was found between vine length and pod length and pod girth at both genotypic and phenotypic levels. It indicates that an association of two characters may, not only due to genes but also due to their influence of the environment. Days to first flowering was significantly and positively, correlated with days to 50 percent flowering, days to first harvest, and number of primary branches per plant while it showed negative correlation with pod weight and pods per plant. Days to 50 per cent flowering was significantly and positively, correlated with number of primary branches per plant and days to first harvest and was negatively correlated with pod length, pod girth, pod weight and pods per plant. Days to first harvest was significantly and positively correlated with primary branches per plant and which was negatively

Table 1: Source and place of collection of winged bean genotypes used in the study

Source	Number of genotypes	Genotypes
College of Agriculture, Vellayani	7	PT 1, PT2, PT 3, PT 4, PT 5, PT 20, PT 21
Idukki, Kerala	1	PT 6
Palakkad, Kerala	1	PT 7
College of Horticulture, Vellanikkara	12	PT 8 (Revathy), PT 9, PT 10, PT 11, PT 12, PT 13, PT 14, PT 15, PT 16, PT 17, PT 18, PT 19

Table 2: Analysis of variance (mean sum of squares) for growth and yield parameters in winged bean genotypes

Sources of variation/ character	Replication Df = 2	Treatment (genotype)Df= 20	Error Df= 40	SEm ±	CD (5 %)
Vine length (cm)	6349.0	14152.8**	1297.4	20.79	59.43
Primary branches/plant	12.206	19.882**	1.589	0.72	2.08
Days to first flowering	217.093	2453.884**	53.928	4.23	12.11
Days to 50 % flowering	151.031	2896.731**	33.545	3.34	9.55
Days to first harvest	608.375	2101.975**	35.065	3.41	9.77
Days to final harvest	98.000	695.275**	62.187	4.55	13.01
Pod length (cm)	0.575	12.333**	1.053	0.59	1.69
Pod girth (cm)	0.474	1.982**	0.107	0.18	0.54
Pod weight (g)	1.021	28.975**	2.385	0.89	2.54
Pods/plant	566.812	2660.800**	640.361	14.61	41.75
Yield/plant (g)	640.361	906210.000**	198487.600	257.22	735.16
Yield/plot (kg)	3.834	35.419**	4.579	1.23	3.53

* * Significant at 1% ANOVA

Table 3: Phenotypic correlation coefficients of different characters in winged bean

	X1	X2	X3	X4	X5	X6	X7	X8	X9	X10	X11
X1	1.00										
X2	0.870**	1.000									
X3	0.956**	0.832**	1.000								
X4	-0.018	-0.063	-0.054	1.000							
X5	0.316*	0.252*	0.257*	0.357**	1.000						
X6	0.583**	0.614**	0.670**	-0.146	0.038	1.000					
X7	-0.201	-0.345**	-0.196	-0.143	0.007	-0.244	1.000				
X8	-0.278*	-0.323*	-0.258*	-0.154	-0.019	-0.281*	0.556**	1.00			
X9	-0.390**	-0.437**	-0.381**	-0.087	0.025	-0.451**	0.745**	0.720**	1.00		
X10	-0.213	-0.318*	-0.280*	0.214*	0.133	-0.294*	0.378**	0.247	0.332**	1.000	
X11	-0.198	-0.327**	-0.265*	0.231*	0.216	-0.338**	0.439**	0.335**	0.420**	0.959**	1.000

X1. Days to first flowering, X2. Days to 50 % flowering, X3. Days to first harvest, X4. Days to final harvest, X5. Vine length (cm), X6. Primary branches/plant, X7. Pod length (cm), X8. Pod girth (cm), X9. Pod weight (cm), X10. Pods per plant, X11. Yield per plant (g)

Table 4: Genotypic correlation coefficients of different characters in winged bean

	X1	X2	X3	X4	X5	X6	X7	X8	X9	X10	X11
X1	1.000										
X2	0.876**	1.000									
X3	0.970**	0.843**	1.000								
X4	-0.031	-0.091	-0.072	1.000							
X5	0.364**	0.295*	0.298*	0.516**	1.000						
X6	0.721**	0.726**	0.800**	-0.094	0.074	1.000					
X7	-0.233*	-0.401**	-0.248	-0.127	0.083	-0.312*	1.000				
X8	-0.337**	-0.368**	-0.303*	-0.109	-0.034	-0.336**	0.616**	1.000			
X9	-0.497**	-0.533**	-0.488**	-0.114	-0.030	-0.500**	0.896**	0.869**	1.000		
X10	-0.355**	-0.482**	-0.442**	0.381**	0.189	-0.356**	0.657**	0.392**	0.546**	1.000	
X11	-0.324**	-0.476**	-0.402**	0.389**	0.310*	-0.405**	0.740**	0.519**	0.676**	0.960**	1.000

X1. Days to first flowering, X2. Days to 50 % flowering, X3. Days to first harvest, X4. Days to final harvest, X5. Vine length (cm), X6. Primary branches/plant, X7. Pod length (cm), X8. Pod girth (cm), X9. Pod weight (cm), X10. Pods per plant, X11. Yield per plant (g)

Table 5: Direct and indirect effect of yield and yield components of winged bean

Characters	Vine length	Days to first flowering	Days to first harvest	Days to final harvest	Pod length	Pod girth	Pod weight	Pods / plant	Genotypic correlation with yield
Vine length	**0.116**	0.057	-0.073	0.063	0.029	-0.007	0.006	0.119	0.310
Days to first flowering	0.042	**0.156**	-0.237	-0.003	-0.081	-0.077	0.100	-0.224	-0.324
Days to first harvest	0.034	0.152	**-0.244**	-0.008	-0.086	-0.069	0.098	-0.279	-0.402
Days to final harvest	0.060	-0.004	0.017	**0.122**	-0.044	-0.025	0.023	0.240	0.389
Pod length	0.009	-0.036	0.060	-0.015	**0.347**	0.141	-0.181	0.414	0.740
Pod girth	-0.004	-0.052	0.074	-0.013	0.214	**0.229**	-0.175	0.247	0.519
Pod weight	-0.003	-0.077	0.119	-0.014	0.310	0.199	**-0.202**	0.344	0.676
Pods / plant	0.022	-0.055	0.108	0.046	0.228	0.089	-0.110	**0.631**	0.960

Bold diagonal values shows direct effect

correlated with pod weight and pods per plant. Days to final harvest was significantly and positively correlated with vine length, pods per plant and yield per plant. primary branches per plant were significantly and negatively correlated with pod girth, pod weight and pods per plant. Pod length was significantly and positively correlated with pod girth, pod weight and pods per plant. Yield per plant showed strong positive association with pod length, pod girth, pod weight and pods per plant at both genotypic and phenotypic level and negatively correlated with days to first flowering, days to 50 per cent flowering and days to first harvest. Similar findings were reported by Mohamadali and Madalageri (2004).

Genotypic correlations were higher in magnitude than the phenotypic correlation indicating strong inherent relationship among the characters except few which could be due to modifying effects in the environment studied. If relationship is due to manifold effect of gene(s) it is difficult to separate these effects by selecting particular character so related (Das *et al.,* 1988). If correlation is due to genetic linkage, it is possible to reserve the association provided the linkage is not very close. It is therefore important to establish the genetic basis of correlation before launching any breeding programme.

Correlation coefficients only indicate relationships of independent variables without specifying cause and effect. Use of path analysis makes it possible to resolve the correlation and provides direct and indirect contributions of characters. As the correlation coefficient, it is not sufficient to explain true relationship for an effective manipulation of the character,

path coefficient was worked out. This enables breeders to specifically identify important component traits of yield and utilize the genetic stock for improvement.

The genotypic as well as phenotypic correlation coefficients between pod yield per plant and different traits were subjected to path coefficient analysis separately partitions into direct as well as indirect effects *via* various yield contributing characters (Table 5). Results of path analysis identified the positive, direct, effects of vine length, days to first flowering, days to final harvest, pod length and pods per plant on yield indicating there are main contributors to pod yield. Pods per plant exhibited the highest positive direct effect on pod yield followed by pod length and pod girth. Days to first harvest and pod weight exhibited negative direct effect on pod yield per plant. Days to first flowering exhibited indirect effect on yield through pod weight and vine length. Days to first harvest exhibited high negative direct effect on pod yield per plant and its positive and significant association with pod yield per plant was due to its high indirect positive effect through days to first flowering. Through present path analysis study in winged bean, it may be concluded that improvement in pod yield per plant could be bought by selection for component character like vine length, days to first flowering, pod length and pods per plant. The findings are in agreement with the findings of Mohamadali and Madalageri (2004b).

The residue obtained was 0.153 indicating that selected characters contributed the remaining 85 percent. Similar observations were made by earlier workers (Dahiya *et al*. 1991; Basavarajappa and Byre Gowda, 2004) in dolichos bean and Kumar *et al*. (2010) in snap bean.

So, it may be concluded from these findings that correlation alone may not give complete information but when used in conjunction with path coefficient analysis will give a better measure of cause and effect relationship existing between different pairs of characters. Similar conclusions were reported by many workers like Elshiekh *et al*. (2012); Kamleshwar (2013). Hence, based on the correlation and path coefficient analysis, it may be concluded that the indirect selection on days to first flowering, days to first harvest, pod length and pods per plant in winged bean is suggested rewarding.

REFERENCES

Al-Jibouri, H. A., Miller, P. A., Robinson, H. V. 1958. Genotypic and environmental variance and co-variances in an upland cotton cross of interspecific origin. *Agron. J.* **50:** 633-636.

Basavarajappa, P. S. and Byre Gowda, M. 2004. Assessment of field bean germplasm of southern Karnataka and isolation of elite genotypes. *Mysore J. Agric. Sci.* **38(4):** 474-479.

Dahiya, M. S., Pandita, M. L. and Vashistha, R. N. 1991. Correlation and path analysis studies in sem (*Dolichos lablab* var. *lignosus* L.). *Haryana J. Hortic. Sci.* **20(1-2):** 134-138.

Das, S. Y., Chakraborty, S. and Chakraborty, S. 1988. Genetic variation for seed yield and its components in green gram (*Vigna radiate* (L.) Wilczek). *Adv. Plant Sci.* **11(1):** 271-273.

Dewey, J. R. and Lu, K. H. 1959. A correlation and path co-efficient analysis of components of crested wheat seed production. *Agron. J.* **51:** 515-518.

Elshiekh, A. I., Abdel Wahab, H. A., Mohammed, E. A. R. and Ahmed, M. E. N. 2012. Path coefficient and selection indices in sixteen guar (*Cyamopsis tetragonoloba* L.) genotypes under rainfed. *Intl. J. Agric. Fores.* **2(1):** 79-83.

Hill, J., Becker, H. C. and Tigerstedt, P. M. 1998. *Quantitative and Ecological, Aspects of Plant Breeding, 1st. Ed.*, chapman and Hall, London.

Kamleshwar, K., Yogendra, P., Mishra, S. B., Pandey, S. S. and Ravi, K. 2013. Study on genetic variability, correlation and path analysis with grain yield and yield attributing traits in green gram (*Vigna radiata* (L.) wilczek). *The Bioscan.* **8(4):** 1551-1555.

KAU (Kerala Agricultural University) 2011. *Package of practices recommendations: Crops,* (14th Ed.). Kerala Agricultural University, Thrissur. p. 334.

Kumar, N. V., Lavanya, G. R., Singh, S. K. and Pandey, P. 2010. Genetic association and path coefficient analysis in mung bean *Vigna radiata* (L.) Wilczek. *AAB Bioflux.* **2(3):** 251-257.

Long, M. H., Qin, R. Y. and Uu, Z. G. 1993. Preliminary report on the main characteristics of a dwarf winged bean variety Gui Ai. *Chinese Veg.* **4:** 25-27.

Mahto, C. S. and Dua, R. P. 2009. Genetic divergence for yield contributing traits in winged bean. *Indian J. Plant Genet. Resour.* **22(3):** 239-242.

Mohamadali, A. and Madalageri, M. B. 2004a. Performance studies in winged bean (*Psophocarpus tetragonolobus* (L.) DC.) for green vegetable pod yield and its component characters. *Karnataka J. Agric. Sci.* **17(4):** 755-760.

Mohamadali, A. and Madalageri, M. B. 2004b. Correlation and path analysis studies for green vegetable pod yield and yield attributes in winged bean (*Psophocarpus tetragonolobus* (L.) DC.). *Indian J. Hort.* **61(4):** 335-337.

Mohamadali, A., Madalageri, M. B. and Patil, B. R. 2005. Evaluation of winged bean *P. tetragonolobus* (L.) Dc. genotypes for tuber yield and yield attributing traits. *Res. crops.* **6(2):** 274-276.

Nandan, R., Vaishnav, R. S., Srivastava, K. and Kumar, K. 2010. Genetic variability, heritability and genetic advance for yield components in winged bean (*Psophocarpus tetragonolobus* L.). *Asian J. Bio Sci.* **4(2):** 298-299.

Neeliyara, A. M., Indira, V. and Prasanna, K. P. 2001. Quality evaluation of winged bean genotypes. *J. Tropic. Agric.* **39(2):** 164-166.

Pan, R. S., Singh, A. K., Kumar, S. and Mathura Rai. 2005. Evaluation of winged bean hermplasm. *Indian J. Plant Genet. Resour.* **18(1):** 48-49.

Panse, V. G. and Sukhatme, P. V. 1985. *Statistical methods for agricultural workers.* 4th ed., ICAR, New Delhi.

Peter, K. V. 1998. *Genetics and breeding of vegetables.* ICAR. New Delhi. p. 170.

Philip, A. and Ramachandran, S. N. 1986. Genetic variability, heritability and genetic advance for some traits in winged bean. *Veg. Sci.* **13(1):** 49-54.

Prasad, Y., Kumar, K. and Mishra, S. B. 2013. Studies on genetic parameters and inter relationships among yield and yield contributing traits in Pigeonpea (Cajanus cajan (L.) Millsp.). *The Bioscan.* **8(1):** 207-211.

Shanmugavelu, K. G. 1989. *Production technology of vegetable crops. Oxford & IBH Publishing Co. Pvt. Ltd.,* New Delhi.