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CORRELATION AND PATH ANALYSIS IN CLUSTER BEAN [*CYAMOPSIS TETRAGONOLOBA* (L.) TAUB.] FOR VEGETABLE POD YIELD AND ITS COMPONENT CHARACTERS

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ABSTRACT
An experiment was conducted on 67 cluster bean genotypes to study the correlation among the vegetable pod yield components and their direct and indirect effects on the vegetable pod yield. This study helps in identifying the characters which mainly contributing to vegetable pod yield. Correlation analysis indicated that vegetable pod yield per plant was significant and positively associated with pod length (cm) (0.399, 0.321), pod breadth (cm) (0.497, 0.338), ten fresh pods weight (g) (0.501, 0.351) and pods per plant (0.453, 0.655). Genotypic path co-efficient analysis revealed that pod length (2.424) and pods per plant (1.210) exhibited positive direct effect and strong degree of association on vegetable pod yield per plant (0.399**, 0.453**) respectively. Phenotypic path coefficient shows that pods per plant (0.895), pod length (0.390), ten fresh pod weight (0.237) and pod breadth (0.110) had positive direct effect on vegetable pod yield per plant. Hence, this suggesting that the parameters viz., pods per plant, pod length, ten fresh pod weight and pod breadth may be considered as prime traits during the course of selection to have the higher potential of vegetable pod yields in case of cluster bean.

INTRODUCTION

Clusterbean [*Cyamopsis tetragonoloba* (L.) Taub] (2n = 14) is an under exploited leguminous vegetable belonging to the family Fabaceae. It is commonly known as Guar and is mainly grown in arid and semi arid regions of India. Guar is one of the most important and potential vegetable cum industrial crop, grown mainly for its tender vegetable pod purpose. Cluster bean tender pods are nutritionally rich in energy (16 kcal), protein (3.2 g), fat (1.4 g), carbohydrate (10.8 g), Vitamin C (49 mg) and iron (4.5 mg) for every 100 g of edible portion (Kumar and Singh, 2002). Hence, the crop has great potential for contributing to nutritive food, feed and forage needs in the tropical countries, where almost half of the world's under and malnourished population lives (Singh and Paroda, 1983).

In India, cluster bean occupies an area of 2.20 million hectares with a production of 0.60 million tonnes (Anon., 2009). It is mainly cultivated in North Indian states like Rajasthan, Haryana, Gujarat and Punjab but in South India it is being cultivated in very limited scale for vegetable purpose. From India, cluster bean is mainly exported to USA, Germany, Netherlands, Italy, UK, Japan and France etc. worth of about 200 million rupees annually (Singh *et al.*, 2009).

Keeping into view its importance as a vegetable, adaptability to arid drought conditions and its export potentiality, there is need for its improvement for vegetable pod yield and various other traits suited to specific agro ecological conditions of Northern Karnataka. Improvement made in crop varieties is mainly concentrated on increasing pod yield and yield attributing characters.

Yield is a complex character and is function of components of large number of contributing characters and their interactions. A study of correlation between different quantitative characters provides an idea of association. It could be effectively exploited to formulate selection strategies for improving yield and quality. Correlation study does not reveal the direct and indirect contribution of individual character towards yield. In order to have cleared picture of yield components for effective selection programme, it would be desirable to consider the relative magnitude of various characters contributing towards yield. The path coefficient technique developed by Wright (1921) helps in estimating direct and indirect contribution of various components in building up the correlation towards yield. Several path coefficient analysis have been conducted in guar, for vegetable pod yield purpose by Hanchinamani (2003); Girish (2012) and Shabarish and Dharmatti *et al.* (2014). On the basis of these studies, the quantum importance of individual characters is marked to facilitate the selection programme in cluster bean.

MATERIALS AND METHODS

The present investigation was carried out in the research block of the Department of Vegetable Science, College of Horticulture, Bagalkot (Karnataka) during March to June 2011, the research farm is situated in Northern dry zone (Zone-3) of Karnataka

state at 16º46× North latitude, 74º59× East longitudes. The average rainfall of South-West monsoon is about 360 mm, distributed over a period of four month (June to September) with 25 rainy days.

The material for the study comprised of 67 genotypes of cluster bean. The experiment was laid out in Randomized Block Design with two replications. Row to row and plant to plant distance was 45 cm and 20 cm respectively. Each treatment or genotype in each replication was represented by a single row of 3 meters length of fifteen plants in each row. The crop was raised in rainfed condition with all recommended agronomic package of practices to raise a good crop. Observations were recorded on three competitive and randomly selected plants in each replication for all the genotypes viz., plant height (cm), number of branches per plant, days to first flowering, days to fifty per cent flowering, days to pod maturity, pod length (cm), pod breadth (cm), ten fresh pod weight (g), pods per plant and pod yield per plant (g).

The correlation co-efficient among all character combinations at phenotypic (rp) and genotypic (rg) level were analyzed employing formula suggested by Al-Jibouri *et al.* (1958) and path co-efficient analysis was done by following Wright (1921) and Dewey and Lu (1959).

RESULTS AND DISCUSSION

Estimation of genotypic and phenotypic correlations is useful in planning and evaluating breeding programmes. In the present study the analysis of variance revealed highly significant differences for all 10 characters among the genotypes, indicating a good deal of variation among 67 genotypes of cluster bean.

Genotypic and phenotypic correlation of pod yield per plant (g) was found to be highly significant and positive with pod length (0.399, 0.321), pod breadth (0.497, 0.338), ten fresh pod weight (0.501, 0.351) and pods per plant (0.453, 0.655). Plant height showed significant positive association with pod yield per plant only at phenotypic level. This indicates that selection based on these traits may result in improved vegetable pod yield. Vidya and Sunny (2002) also reported similar result in yard-long bean. Similar findings were also reported by Hanchinamani (2003) for positive association of vegetable pod yield with pod length and pod breadth and Girish *et al.* (2012) for positive association of vegetable pod yield with pod breadth. Pods per plant exhibited positive and significant correlation with vegetable pod yield per plant in cluster bean, this result is corroborated with Shabarish and Dharmatti (2014)

In the present study, days to first flowering, days to fifty per cent flowering and days to pod maturity had negative and significant association at both genotypic and phenotypic correlations with pods per plant and vegetable pod yield. These results are in partial agreement with Girish *et al.* (2012) for negative significant association of vegetable pod yield with days to first flowering and days to vegetable pod maturity in cluster bean. Anjani *et al.,* 2009 also found the negative significant association of vegetable pod yield with days to fifty per cent flowering in french bean. This indicated that early flowering and early pod maturity decreases the pod yield.

Plant height showed positive and highly significant association with number of vegetable pods per plant (0.567, 0.387) at both genotypic and phenotypic level this result is in conformity with Rakesh *et al.* (2011) and Kamleshwar *et al.* (2013) in green gram. Plant height showed negative and highly significant association with days to first flowering, days to fifty per cent flowering, days to pod maturity, pod length (cm), pod breadth (cm) and ten fresh pods weight (g). This indicates that with the increase in plant height, there would be reduction in the pod maturity, pod length and pod breadth. Similar results were observed by Anjani *et al.* (2009) for pod length and ten fresh

Table 1: Matrix of Genotypic and Phenotypic Correlations for Vegetable Pod Yield and Component Characters in Cluster bean

@	TR	1	2	3	4	5	6	7	8	9	10
1	G	1.000	0.034	-0.792**	-0.751**	-0.515**	-0.571**	-0.506**	-0.470**	0.567**	0.100
	P	1.000	0.011	-0.565**	-0.502**	-0.364**	-0.378**	-0.269**	-0.267**	0.387**	0.176*
2	G		1.000	0.087	0.113	-0.215*	-0.171*	-0.068	-0.276**	0.164	-0.154
	P		1.000	0.088	0.117	-0.205*	-0.153	-0.039	-0.238**	0.086	-0.129
3	G			1.000	0.965**	0.682**	0.353**	0.303**	0.257**	-0.746**	-0.452**
	P			1.000	0.887 **	0.631**	0.320**	0.249**	0.211*	-0.554**	-0.347**
4	G				1.000	0.647**	0.261**	0.221*	0.138	-0.745**	-0.544**
	P				1.000	0.600 **	0.229**	0.194*	0.123	-0.513**	-0.350**
5	G					1.000	0.148	0.114	0.070	-0.523**	-0.383**
	P					1.000	0.145	0.101	0.073	-0.394**	-0.273**
6	G						1.000	0.838**	0.986**	-0.560**	0.399**
	P						1.000	0.729**	0.926**	-0.390**	0.321**
7	G							1.000	0.763**	-0.324**	0.497**
	P							1.000	0.691**	-0.224**	0.338**
8	G								1.000	-0.496**	0.501**
	P								1.000	-0.356**	0.351**
9	G									1.000	0.453**
	P									1.000	0.655**
10	G										1.000
	P										1.000

Critical r- 1% =0.222; 5% = 0.170; *Significant at 5%; ** Significant at 1% @ - Characters; TR – Type of correlation; G – Genotypic correlation; P – Phenotypic correlation; 1. Plant height (cm); 2. Number of branches per plant; 3. Days to first flowering; 4. Days to fifty per cent; 5. Days to pod maturity; 6. Pod length (cm); 7. Pod breadth (cm); 8. Ten fresh pods weight (g); 9. Pods per plant; 10. Pod yield per plant (g)

Table 2: Genotypic and Phenotypic Path Coefficient Analysis for Vegetable Pod Yield and its Component Characters

@		1	2	3	4	5	6	7	8	9	rG
1	G	0.429	-0.012	-0.620	0.271	0.083	-1.385	0.094	0.556	0.686	0.100
	P	0.066	-0.001	0.055	-0.048	-0.001	-0.147	-0.030	-0.063	0.346	0.176*
2	G	0.014	-0.352	0.068	-0.041	0.035	-0.416	0.013	0.326	0.199	-0.154
	P	0.001	-0.089	-0.009	0.011	-0.001	-0.060	-0.004	-0.056	0.077	-0.129
3	G	-0.340	-0.031	0.783	-0.348	-0.110	0.855	-0.056	-0.304	-0.902	-0.452**
	P	-0.037	-0.008	-0.097	0.085	0.002	0.125	0.027	0.050	-0.495	-0.347**
4	G	-0.322	-0.040	0.755	-0.361	-0.104	0.632	-0.041	-0.163	-0.901	-0.544**
	P	-0.033	-0.010	-0.086	0.096	0.002	0.089	0.021	0.029	-0.459	-0.350**
5	G	-0.221	0.076	0.534	-0.234	-0.161	0.359	-0.021	-0.082	-0.632	-0.383**
	P	-0.024	0.018	-0.061	0.057	0.004	0.057	0.011	0.017	-0.353	-0.273**
6	G	-0.245	0.060	0.276	-0.094	-0.024	2.424	-0.155	-1.166	-0.678	0.399**
	P	-0.025	0.014	-0.031	0.022	0.001	0.390	0.080	0.219	-0.349	0.321**
7	G	-0.217	0.024	0.237	-0.080	-0.018	2.031	-0.185	-0.902	-0.392	0.497**
	P	-0.018	0.003	-0.024	0.019	0.000	0.284	0.110	0.163	-0.200	0.338**
8	G	0.201	0.097	0.201	-0.050	-0.011	2.389	-0.141	-1.183	-0.600	0.501**
	P	-0.018	0.021	-0.020	0.012	0.000	0.362	0.076	0.237	-0.319	0.351**
9	G	0.243	-0.058	-0.584	0.269	0.084	-1.358	0.060	0.587	1.210	0.453**
	P	0.025	-0.008	0.054	-0.049	-0.001	-0.152	-0.025	-0.084	0.895	0.655**

Bold diagonal values indicate direct effect; Residual = 0.168 *Significant at 5% ** Significant at 1% rG. Genotypic correlation with vegetable pod yield per plant
G - Genotypic path coefficient analysis; P – Phenotypic path coefficient analysis; 1.Plant height (cm); 2. Number of branches; 3. Days to first flowering; 4. Days to fifty per cent flowering; 5. Days to pod maturity; 6. Pod length (cm); 7. Pod breadth (cm); 8. Ten fresh pod weight (g); 9. Pods per plant

pods weight in French bean and Girish *et al.* (2012) for days to first flowering and days to pod maturity.

The positive association of pod length with pod breadth (0.838, 0.729), ten fresh pod weight (0.986, 0.926), pod yield per plant (0.399, 0.321), days to first flowering (0.353, 0.320) and days to fifty per cent flowering (0.261, 0.229) at both genotypic and phenotypic level respectively. The results are in agreement with the earlier findings in cluster bean by Girish *et al.* (2012) for pod breadth and pod yield per plant.

Cause and effect relationship between yield and yield contributing characters were studied in details through path coefficient analysis. Path coefficient analysis performed to disclose the causes and effects of chain relationships of different yield contributing characters with yield. The estimates of direct and indirect effects of these characters on yield based on genotypic and phenotypic correlation are presented in Table 2

Path coefficient analysis showed that pod length (cm) and pods per plant had maximum direct effect on pod yield per plant.The high direct effect of the trait indicated its true relationship with pod yield and hence selection would be rewarding in yield improvement. Similar observations were made by Vidya and Sunny (2002) in yard-long bean and Rakesh *et al.*, (2011) in cluster bean. The fresh pod weight showed positive direct effect at phenotypic level towards pod yield per plant and had strong negative direct effect (-1.183) but it has high significant positive association with green pod yield (rG = 0.501). The positive association of the trait with yield was mainly due to indirect effect via pod length (2.389), days to first flowering and plant height (0.201). The improvement for the yield could be achieved by applying selection pressure through indirect selection of pod length, plant height and days to first flowering.

Pod breadth had positive significant correlation with vegetable pod yield but had moderately negative direct effect on vegetable pod yield. The highly significant positive association with yield was mainly because of its high indirect and positive effects through pod length (2.031) and days to first flowering (0.237). Under this circumstance, the indirect causal factors also need to be considered simultaneously for selection.

The present study indicated that, in selection programmes, the prime importance should be given to pods per plant and pod length (cm) for pod yield improvement in cluster bean since these characters recorded significant genotypic and phenotypic correlation with high direct effect on pod yield.

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