RESEARCH ARTICLE Agricultural Science Digest, Volume 44 Issue 5: 898-901 (October 2024)

Correlation and Path Coefficient Analysis in Cluster Bean [*Cyamopsis tetragonoloba* (L.) Taub.] Genotypes

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10.18805/ag.D-5385

ABSTRACT

Background: Climate change is a major challenge faced by the agricultural sector all over the world. Different adaptation and mitigation strategies are used to cope with these weather aberrations. Growing climate resilient crops and cultivars suitable for different regions is one of the adaptation strategy. Leguminous crops are well known for their resilience, adaptation and tolerance to adverse conditions, among these crops cluster bean is a hardy and drought tolerant crop extremely suitable for warm tropical regions. Hence identification and improvement of selected genotypes of cluster bean have paramount importance for combating the challenges possessed by the changing climatic scenario.

Methods: Thirty accessions of cluster bean were evaluated during 2018. The experiment was laid out in randomized block design with two replications. Statistical analysis was employed for estimation of correlation and path coefficients.

Result: The correlation analysis revealed that pod yield/plant had positive significant correlation with number of branches, number of pod clusters/plant, number of pods/plant and days to first harvest hence, selection of accessions having higher mean values for these traits could improve yield in cluster bean. Path analysis revealed that number of pods/plant had maximum positive direct effect on pod yield/plant followed by number of branches and plant height. Thus, while attempting selection for higher pod yield in cluster bean, number of pods per plant, number of branches and plant height have to be taken into account.

Key words: Cluster bean, Correlation, Path coefficient analysis, Pod yield.

INTRODUCTION

Agriculture all over the world have been hard hit by the impacts of climate change like flood, drought, erratic rainfall, heat and cold waves. Countries like India are more vulnerable in view of the dependence of majority of population on agriculture, excessive pressure on natural resources and poor mitigation strategies (Maheshwari *et al*., 2015). Suitable adaptation and mitigation strategies including use of climate resilient crops and cultivars for different regions are of paramount importance to cope with these aberrant weather conditions.

Leguminous crops are well known for their resilience, adaptation and tolerance to adverse conditions and they can come up well even in poor soils with less management practices (Gangadhara, 2013). Cluster bean [*Cyamopsis tetragonoloba* (L) Taub.] is an important leguminous vegetable belonging to the family Fabaceae (2n = 14). It is a hardy and drought tolerant crop extremely suitable for warm tropical regions. It's extensive tap root system imparts drought tolerance. It can serve as fodder and green manure crop, can enrich the soil by fixing atmospheric nitrogen (50-60 kg/ha) and add organic matter to the soil.

Tender pods are consumed as vegetable. They are rich in nutrients like protein, vitamin A, vitamin C, calcium and iron (Kumar and Singh, 2002). 100 g of edible pods contain 10.8 g of carbohydrates, 3.2 g of protein and 0.4 g fat. Even though it has great potential as a vegetable and industrial crop, it is not very popular in Kerala. Hence, there is a need for identification of cluster bean genotypes suitable for growing in Kerala. As climate change is posing threat to the food and nutritional security of the state, this is a crop, which has great scope in future.

Crop improvement programmes can be made more effective through knowledge of the interrelationship among yield and its component characters. Hence, knowledge of correlation and causation among yield and yield components is of paramount importance. Indirect improvement of a trait of interest is possible by improving another trait, if they are positively correlated.

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How to cite this article: Remzeena, A. and Anitha, P. (2024). Correlation and Path Coefficient Analysis in Cluster Bean [*Cyamopsis tetragonoloba* (L.) Taub.] Genotypes. Agricultural Science Digest. 44(5): 898-901. doi: 10.18805/ag.D-5385.

Submitted: 20-05-2020 **Accepted:** 31-08-2021 **Online:** 08-10-2021

MATERIALS AND METHODS

The present study was conducted in the Department of Vegetable Science, College of Agriculture, Vellanikkara, Kerala Agricultural University, Thrissur during 2018, in randomized block design with two replications. Thirty accessions of cluster bean collected from NBPGR, Jodhpur were used in the study. The seeds of each accession were

sown at a spacing of 45×45 cm in plots of 3×2.7 m^2. The crop was raised as per the Package of Practices Recommendations Crops, KAU (2016). Statistical analysis was employed for estimation of correlation and path coefficients. The correlation coefficients between different characters were worked out in all possible combinations according to the formula suggested by Johnson *et al.* (1955) and the results are presented in Table 1. In the path coefficient analysis the correlation among cause and effect is divided into direct and indirect effects of causal factors on effect factors. The principle and techniques suggested by Wright (1921) and Li (1955) for cause and effect system were adopted for analysis using the formula given by Dewey and Lu (1959). Data was analyzed using OPSTAT. The characters considered for path coefficient analysis were plant height, number of branches, days to first harvest, number of pod clusters /plant and number of pods per plant and the results are presented in Table 2.

RESULTS AND DISCUSSION

In the present study, yield was significantly positively correlated with number of pods/plant, number of pod clusters/plant, days to first harvest and number of branches. So, when selection is done for these characters, it would simultaneously improves yield. This is in confirmation with the results of Anandhi and Sunny (2006); Lakshmanan and Vahab (2011); Boghara *et al*. (2016); Muthuselvi *et al*. (2017); Gowd *et al.* (2020) and Sharma *et al.* (2021).

Plant height was significantly, positively correlated with number of pods/cluster and number of seeds/pod, it did mean that when we select accessions with more plant height, it would also result in more number of pods/cluster and number of seeds/pod. Similar results on plant height and number of pods/cluster were reported by Manivannan *et al*. (2015) and Muthuselvi *et al.* (2017) and Sharma *et al.* (2021). Plant height was negatively correlated with number of branches, days to 50% flowering, days to first fruit set and number of pod clusters/plant. Therefore it can be inferred that, accessions with more height will be having less number of branches, few pod clusters/plant and will be early in flowering and fruit set. These results were in agreement with the findings of Manivannan *et al*. (2015) and Muthuselvi *et al.* (2017) for number of branches and days to 50% flowering.

Number of branches were significantly and positively correlated with days to first harvest, number of pod clusters/ plant and number of pods/plant. Therefore it can be inferred that selection of accessions with more number of branches would also result in more number of pod clusters/plant,

Table 1: Genotypic correlation between yield and component characters in cluster bean.

	1	2	3	4	5	6	7	8	9	10	11	12	13
1	1**												
2	-0.673**	1**											
3	-0.459**	0.236	1**										
4	-0.464**	0.233	0.910**	1**									
5	-0.154	0.347**	0.114	0.101	1**								
6	-0.474**	0.754**	0.091	0.092	0.399**	1**							
7	0.913**	-0.764**	-0.438**	-0.443**	-0.499**	-0.618**	1**						
8	0.016	0.258*	-0.068	-0.065	0.492**	0.534**	-0.069	1**					
9	0.016	-0.166	0.054	0.045	-0.203	-0.249	-0.025	-0.486**	1**				
10	0.150	-0.128	-0.025	-0.034	-0.553**	-0.166	0.115	-0.468**	0.698**	1**			
11	0.015	-0.091	-0.027	-0.031	-0.268*	-0.265*	0.064	-0.563**	0.758**	0.704**	1**		
12	0.266*	-0.081	-0.092	-0.108	0.260*	-0.015	0.239	0.243	0.207	0.178	0.02	1**	
13	0.037	0.307*	-0.161	-0.158	0.422**	0.493**	-0.032	0.855**	-0.300*	-0.164	-0.118	0.21	1**

1. Plant height 2. Number of branches 3. Days to 50% flowering 4. Days to first fruit set 5. Days to first harvest 6. Number of pod clusters/plant 7. Number of pods/cluster 8. Number of pods/plant 9. Pod length 10. Pod girth 11. Pod weight 12. Number of seeds/pod 13. Pod yield/plant.

Table 2: Path coefficient analysis for pod yield and its component characters in cluster bean.

	Plant height	No. of branches	Days to first harvest	No. of pod clusters/plant	No of pods/ plant	No of seeds /pod
Plant height	**0.287**	-0.424	0.025	0.146	0.014	0.006
No of branches	-0.201	**0.607**	-0.057	-0.234	0.231	-0.002
Days to first harvest	-0.044	0.216	**-0.161**	-0.123	0.444	0.006
No of pod clusters/plant	-0.136	0.463	-0.064	**-0.307**	0.482	-0.001
No of pods/plant	0.005	0.155	-0.079	-0.164	**0.902**	0.006
No of seeds per pod	0.076	-0.045	-0.042	0.0046	0.219	**0.024**

Residual: 0.21512.

number of pods/plant and delayed harvest. So it implies that accessions with more number of branches were late in harvest however, they were high yielders. These results were in agreement with Singh *et al.* (2009); Anandhi and Sunny (2006); Lakshmanan and Vahab (2011); Gowd *et al.* (2020) and Sharma *et al.* (2021).

Days to 50% flowering was significantly and positively correlated with days to first fruit set. Both days to 50% flowering and days to first fruit set was found significantly and negatively correlated with number of pods/cluster. Therefore it was inferred that accessions with more days to 50% flowering had less number of pods/cluster. Similar results were reported by Manivannan *et al.* (2015). Days to first harvest was positively and significantly correlated with number of pod clusters/plant, number of pods/plant and number of seeds/pod. Therefore it can be inferred that those accessions which are late for first harvest have more number of pod cluster/plant, number of pods/plant and consequently higher pod yield/plant. However, days to first harvest was also significantly negatively correlated with number of pods/cluster, pod girth and pod weight.

Number of pod clusters/plant was significantly, positively correlated with number of pods/plant and pod yield/plant. It was inferred that selection of accessions with more number of pod clusters/plant would also have more number of pods /plant and more yield. Hence, accessions with more number of pod clusters/plant would be high yielders. Similar findings were reported by Anandhi and Sunny (2006); Lakshmanan and Vahab (2011); Boghara *et al.* (2016) and Sharma *et al.* (2021) for number of pods/cluster and number of pods/plant.

Number of pods/plant was significantly negatively correlated with pod length, pod girth and pod weight hence, those accessions with more number of pods will have shorter and small pods. This finding is in agreement with Boghara *et al.* (2016). Pod length was significantly and positively correlated with pod girth and pod weight. It does mean that when pod length increases it would also result in an increase in pod girth. This result is similar to the findings of Lakshmanan and Vahab (2011); Kumar *et al.* (2015). Hence, when selection is done for longer pods, it would also improve pod weight and pod girth.

Correlation alone cannot give a real picture of inter character association, so it becomes necessary to study the path coefficient analysis, which takes into account the cause effect relationship apart from the degree of relationship. Path analysis will indicate whether, the association of the yield related traits with yield is due to their direct effect, where direct selection can be made for improvement or is a consequence of their indirect effect via some other traits in such cases a breeder has to select the trait by considering the indirect effect. In the present study the yield contributing characters like number of pods/plant, had highest positive direct effect (0.902) on yield followed by number of branches (0.607) and plant height (0.287). Correlation was also positive for these characters. Hence, direct selection can be employed for these traits for yield improvement because direct positive effect implies the true relationship between traits. Positive direct effect with number of pods/plant and plant height was reported by Lakshmanan and Vahab (2018). Gowd *et al.* (2020) and Sharma *et al.* (2021) also reported positive direct effect of number of pods/plant on pod yield in cluster bean. Number of pod clusters/plant had positive significant correlation with pod yield/plant (0.493) but it has a negative direct effect (-0.307). This negative direct effect is counter balanced by indirect positive effect through number of pods/plant (0.482) and number of branches (0.463) making the association between number of pod clusters/plant and pod yield positive. These results are in line with the findings of Anandhi and Sunny (2006). Number of branches have a positive indirect effect on pod yield through number of pods/plant (0.231). Days to first harvest have significant positive correlation with yield (0.422), but path analysis revealed that it has a negative direct effect (-0.161) on pod yield/plant. This negative direct effect is compensated by the positive indirect effect on pod yield through number of branches (0.216) and number of pods/plant (0.444).

There is a high positive association between pod yield/plant and number of pods/plant, number of pod clusters/plant, number of branches, days to first harvest and plant height and the path analysis reveals that chief contributing characters towards pod yield/plant is number of pods/plant, number of branches and plant height. Hence, those accessions which grow taller with more number of branches and more number of pods have to be selected from the collected accessions. These accessions can be used as parents in the crop improvement programme for developing promising varieties or hybrids of cluster bean with high pod yield.

Conflict of interest

All authors declare that they have no conflict of interest.

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