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Correlation coefficient analysis for yield and its component traits in cluster bean [*Cyamopsis tetragonoloba* (L.) Taub.] for vegetable pod yield and seed yield parameters

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Abstract
The investigation was laid out in RBD with three replication during *kharif*- 2016 at the Horticulture research farm, Department of Horticulture SHUATS, Allahabad located in South-East part (Zone 4) of Uttar Pradesh. The significant difference among the genotypes for all the characters under study suggested that there was ample scope for selection of promising cluster bean genotypes for vegetable yield and seed yield improvement. The correlation coefficient at genotypic level is higher than corresponding phenotypic level, indicating that there is a strong association between these traits and pod yield genetically. Pod yield/plant showed significant and positive correlation with plant height 45 days, number of pods/plant and days to 50% flowering at both phenotypic and genotypic level. Seed yield/plant (g) showed non-significant and positive correlation with fruit cluster/plant, pod/cluster and 100 seed weight at both phenotypic and genotypic level.

Keywords: Cluster bean [*Cyamopsis tetragonoloba* (L.)], pod and seed yield and character association

Introduction
Cluster bean (*Cymopsis tetragonoloba*) belongs to tribe Indigoferae of family leguminosae. Cluster bean is an arid legume usually grown under resource constrained situations mostly in the arid and semi-arid regions. Cluster bean is a drought-tolerant annual legume grown on marginal and sub-marginal soils receiving low rainfall. Cluster bean cultivation is mostly in India, Pakistan, USA, Italy, Morocco, Germany, and Spain (Punia *et al*. 2009) [9]. In India, cluster bean occupies an area of 2.33 million hectares with pod production of 1.2 million tones with average productivity of 428 kg/ha. in North Indian states like Rajasthan, Haryana, Gujrat and Punjab. Whereas Rajasthan occupies the largest area (82.1%) under guar cultivation in the country. In Rajasthan districts like Jodhpur, Bikaner, Pali, Nagaur, Sri-Ganganagar and Hanumangarh are the major Guar trading markets. Hanumangarh and Ganganagar is the main production area for best quality guar beans, so called "Fast-Hydrating Guar". In south India, it is being cultivated for vegetable purpose. Correlation coefficient is a statistical measure which is used to find out the degree (strength) and direction of relationship between two or more variable. In plant breeding, correlation coefficient analysis measures the mutual relationship between various plant characters and determines the components characters on which selection can be based for genetic improvement in yield. A positive correlation between desirable characters is favorable to the plant breeder because it helps in simultaneous improvement of both the characters. A negative correlation, on the other hand, will hinder the simultaneous expression of both the characters with high values. In such situations, some economic compromise has to be made. The genetic improvement in dependent traits can be achieved by applying strong selection to a character which is genetically correlated with the dependent character. This is called correlated response (Al-Jibouri *et al.*, 1958) [1].

Materials and Methods
The experiment will be carried out at the Horticulture Research Farm, Department of Horticulture, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology and Sciences, Allahabad.

The experiment will be conducted in Randomized block design having 15 (genotypes) in three replications. The allocation of treatments of the individual plots using random number in each replication. In the present investigation, 15 genotypes will be grown in the *kharif* seasons of 2016-17 at the field experimentation Centre of the Department of Horticulture, Sam Higginbottom University of Agriculture, Technology & Sciences, Allahabad (U.P.). Experimental materials for this study consist of 15 genotypes of cluster bean (including check), collected from different sources University of Agriculture Sciences (GKVK) Bangalore, Chhattisgarh, Allahabad and RARI Durgapura Jaipur (Raj.).

Result

The results of the analysis of variance for different quantitative characters for 15 genotypes of cluster bean are presented in (Table 1). The results indicated that there is highly significant variation among the genotypes for almost all the characters under study. Vir *et al*., (2015) [11], kumar *et al.*, (2015) [3], Malaghan *et al.*, (2014) [4], Preeti *et al.* (2018) [10] Rai *et al.*, (2012) [6] also recorded highly significant difference among the cluster bean genotypes with respect to all the characters under studied.

Table 1: Analysis of variance for various characters in cluster bean genotypes

S. No	Source of Variance/ Characters	Mean Sum of Squares		
		Replications	Genotypes	Error
1	Days to 1st flowering	0.15	30.71*	2.53
2	Days to 50% flowering	7.22	30.41*	2.22
3	Plant height cm 45 days	3.05	237.69*	4.45
4	Plant height cm 90 days	2.68	728.95*	6.54
5	Branches/plant 45 days	0.49	16.78*	0.51
6	Branches/plant 90 days	5.9	53.93*	1.89
7	days to 1st pod picking	7.62	22.99*	5.55
8	10 fresh pod weight(g)	0.29	199.48*	4.90
9	Pod length(cm)	0.83	35.70*	0.60
10	Pod width(cm)	0.0032	0.021*	0.002
11	Fruit clusters/plant	1.09	257.31*	13.90
12	Number of pods/cluster	3.45	3.76*	1.56
13	Number of pods/plant	2.85	16249.54*	39.31
14	Pod yield/plant (g)	2.33	3947.11**	6.20
15	Pod yield/hactare (q)	5.06	647.34**	7.58
16	10 dry pod weight (g)	0.70	8.6**	0.33
17	Number ofseeds/pod	0.0037	1.89*	0.017
18	100 seed weight (g)	1.16	1.85*	0.60
19	Seed yield/plant (g)	5.72	135.13**	7.95
20	Seed yield/ha. (q)	3.54	50.20**	4.92

Character association or correlation is a measure of the degree of association between two characters. The phenotypic correlations indicate the extent of the observed relationship between two characters. This does not give true genetic picture of the relationship because it includes hereditary as well as environmental influences. Genotypic correlation provides an estimate of inherent association between genes controlling any two characters. Hence, it is of greater significance and could be effectively utilized in formulating an effective selection scheme. Therefore, in the present study, the genotypic correlation coefficients were worked out for cluster bean for vegetable pod yield and its components. Correlation studies on vegetable pod yield and its component traits revealed that the values of genotypic correlation coefficients were higher than phenotypic correlation coefficient this was in confirmation with Patel and Chaudhary (2001) [5]. This suggests the strong inherent association among the traits. The results of the correlation cofficient for different pod yield characters of cluster bean are presented in (Table 2). Pod yield/plant showed significant and positive correlation with plant height 45 days (0.88), number of pods/plant (0.88), days to 50% flowering (0.53), days to 1st flowering (0.50), plant height 90 days (0.46), 10 fresh pod weight (0.41), and pod length (0.39) which indicate strong association with these components traits, yield may easily pushed up suggesting the selection for these characters will be useful in improving vegetable pod yield. Days to 50% flowering showed significance and positive correlation with days to first pod picking (0.97), plant height 45 days (0.71), pod yield per plant (0.53), pod per plant (0.44) and pod length (0.43). Plant height 90 days showed significant and positive correlation with pod length (0.64), pod width (0.54), 10 fresh pod weight (0.47), pod yield/plant (0.46) and pods/plant (0.37) which indicates strong association with these characters with vegetable pod yield per plant. Branches per plant 90 days significant and negative association was observed with pod yield per plant (0.47), pod length (0.44), pod width (0.41), 10 fresh pod weight (0.35). Ten fresh pod weight showed significant and positive correlation with pod length (0.87), pod width (0.60) and pod yield per plant (0.41) which indicates strong association with these character with vegetable pod yield per plant. Therefore by increasing the value of these components traits, yield may easily pushed up suggesting the selection for these characters will be useful in improving pod yield per plant.

Pod length (cm) showed significant and positive with pod width (0.57) and pod yield per plant (0.39) which indicates strong association with these character with vegetable pod yield per plant. Pod width (cm) showed non-significant and positive with (0.10). The non-significant and negative association was observed with pods/plant (0.14). Pods/plant showed significant and positive with pod yield/plant (0.88) which indicates strong association with these character with vegetable pod yield per plant.

Table 2: Estimates of genotypic correlation coefficient (r_g) for vegetable pod yield and its component characters

Characters	1	2	3	4	5	6	7	8	9	10	11	12
1	1.00	0.99**	0.65**	0.11	-0.39*	-0.45*	0.95**	0.29	0.42*	-0.08	0.43*	0.50*
2		1.00	0.71**	0.10	-0.45*	-0.50*	0.97**	0.31	0.43*	-0.01	0.44*	0.53**
3			1.00	0.53**	-0.31*	-0.30	0.40	0.39*	0.45*	-0.00	0.81**	0.88**
4				1.00	-0.23	-0.17	-0.29	0.47*	0.64**	0.54*	0.37*	0.46*
5					1.00	1.00**	-0.15	-0.45*	-0.49**	-0.46*	-0.33*	-0.50**
6						1.00	-0.27	-0.35*	-0.44*	-0.41*	-0.30	-0.47*
7							1.00	-0.12	0.02	-0.29	0.33	0.21
8								1.00	0.87**	0.60**	0.09	0.41*
9									1.00	0.57**	0.21	0.39*
10										1.00	-0.14	0.10
11											1.00	0.88**
12												1.00

* and ** significant at 5% and 1% level of significance, respectively.

1. Days to 1st Flowering
2. Days to 50% Flowering
3. Plant height 45days (cm)
4. Plant height 90 Days (cm)
5. Branches/plant 45 days
6. Branches/plant 90 days
7. Days to 1st pod picking
8. 10 Fresh pod weight (g)
9. Pod length (cm)
10. Pod width (cm)
11. Pods/plant
12. Pod yield/plant (g)

The results of the correlation cofficient for different seed yield characters of cluster bean are presented in (Table 3). Seed yield/ plant (g) showed non-significant and positive correlation with fruit cluster/plant (0.29), pod/cluster (0.28) and 100 seed weight (0.02). The significant and negative association was observed with seed per pod (0.66) and 10 dry pod weight (0.54). Fruit cluster per plant showed significant and positive correlation with pod per cluster (0.99) which indicates strong association with these characters with seed yield per plant. Pods/cluster showed non-significant and positive correlation with 10 dry pod weight (0.17), seed yield per plant (0.28) which indicates strong association with these two character. 10 dry pod weight showed positive and significant correlation with seed per pod (0.43) which indicates strong association with these character with seed yield per plant. Seeds/pod showed non-significant and positive correlation with 100 seed weight (0.05). 100 Seed weight (g) showed positive and non-significant correlation with seed per pod (0.05). The significant and negative association was observed with pod/cluster (0.68) and fruit cluster/plant (0.62) which indicates that selection on the basis of these characters will not be beneficial. While it showed negative and non-significant with 10 dry pod weight (0.34). The results are in agreement with the earlier findings in cluster bean by Girish *et al*., (2012) [2], for number of clusters per plant, number of pods per cluster, dry pod yield per plant and hundred seed weight and Rakesh *et al*., (2011) [8] for seeds per pod in cow pea and Manggoel *et al*., (2012) [7] also reported similar result for number of pods per plant and 100 seed weight.

Table 3: Matrix of Genotypic Correlations for seed yield and component characters in cluster bean

Characters	Fruit clusters/ Plant	Pods/cluster	10 dry pod weight (g)	Seeds/pod	100 seed weight (g)	Seed yield/plant (g)
Fruit clusters/Plant	1.00	0.99*	0.15	-0.46*	-0.62*	0.29
Pods/Cluster		1.00	0.17	-0.34	-0.68*	0.28
10 Dry Pod Weight (g)			1.00	0.43*	-0.36	-0.54**
Seeds/ Pod				1.00	0.05	-0.66**
100 Seed Weight (g)					1.00	0.02
Seed Yield/Plant (g)						1.00

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