Correlation Studies in the Induced Mutant Population of Cluster Bean [*Cyamopsis tetragonoloba* (l.) Taub.]

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A B S T R A C T

Variability studies provide information on the extent of improvement possible in different characters, but they do not throw light on the extent and nature of relationship existing between yield and various contributory characters. Character association or correlation is a measure of the degree of association between two characters. A knowledge regarding the association of various characters among themselves and with economic characters is necessary for making indirect selection for improvement of economic characters. The gamma radiation induced 190 M_4 mutant lines of cluster bean [*Cyamopsis tetragonoloba* (L.) Taub.] obtained from Centre for Biotechnological Research (CBR), College of Horticulture, Bengaluru were used for the field experimentation at College of Horticulture, Mysore. Such collected 190 M 4 mutants of cluster bean were investigated for various yield and its associated characters. The data was recorded on number of days to 50 per cent flowering, number of days to 50 per cent maturity, number of days to harvest, plant height, number of branches per plant, pod breadth, pod length, number of pods per cluster, number of clusters per plant, number of pods per plant, ten pods weight (g), pod yield per plant (g), seeds per pod, seed yield per plant (g), 100-seed weight (g). Analysis of variance revealed highly significant difference among the mutants for all the characters studied. Correlation revealed highly significant and positive association of vegetable pod yield and other yield component characters. A positive correlation for pod yield with days to 50 per cent maturity, pod length (cm), pod width (cm), days for harvest, pods per cluster, pod clusters per plant, pods per plant, 10 pods weight (g), pod yield per plant (g), seeds per pod, seed yield per plant (g) and 100 seed weight (g). A non-significant but positive correlation was also observed with plant height and number of branches per plant.

Introduction

Correlation provides information on the nature and extent of relationship among the characters. The estimates of correlation coefficient among the different characters indicate the extent of direction of association. Correlation between characters are important

for three reasons in connection with (1) the genetic causes of correlation through the phenotypic action of genes, (2) the changes brought about by selection and (3) natural selection where the relation between quantitative traits and fitness is the primary agent that determines the genetic properties of that character in a natural population (Falconer, 1981). Yield is a complex character influenced by a large number of other component traits. A knowledge of the association between yield and its component traits and also between the component traits helps in improving the efficiency of selection.

Since there may not be gene for yield *per se* but for various yield components. Further, many of these yield contributing characters are interacted in desirable and undesirable direction. Hence, a knowledge regarding the association of various characters among themselves and with economic characters is necessary for making indirect selection for improvement of economic characters. Character association or correlation is a measure of the degree of association between two characters. Variability studies provide information on the extent of improvement possible in different characters, but they do not throw light on the extent and nature of relationship existing between yield and various contributory characters. As a rational approach for the improvement of yield, selection has to be made for components of yield.

Materials and Methods

The present experiment was carried out at the PG research block, College of Horticulture, Mysuru, during the year 2017- 18 involving the 190 M_4 mutant lines and three checks which were field evaluated in 8 blocks in an Augmented Block Design with repeated checks in each block. These mutants obtained from Centre for Biotechnology Research

(CBR) Department of BCI, COH, Bengaluru were planted at a spacing of 45 x 25 cm on 14th of June 2017. The experiment was laid out following the recommended package of practices of UHS, Bagalkot for cluster bean (Anonymous 2016). The data was recorded on number of days to 50 per cent flowering, number of days to 50 per cent maturity, number of days to harvest, plant height, number of branches per plant, pod breadth, pod length, number of pods per cluster, number of clusters per plant, number of pods per plant, ten pods weight (g), pod yield per plant (g), seeds per pod, seed yield per plant (g), 100-seed weight (g). All the data collected were subjected to analysis for drawing the conclusion.

Results and Discussion

Extent and nature of relationship existing between yield and its various contributing character is important. As a rational approach for the improvement of yield, selection has to be made for components of yield, since there may not be gene for yield *per se* but for various yield components. Further, yield contributing traits are interacted in desirable and undesirable direction. Hence, a knowledge regarding the association of various characters among themselves and with economic characters is necessary for making indirect selection for improvement of economic characters. Character association or correlation is a measure of the degree of association between two characters in a population of individual. The estimates of correlation coefficient among the different characters indicate the extent of direction of association. Correlations between characters are important for three reasons. (1) The genetic causes of correlation through the phenotypic action of genes, (2) changes brought about by selection and (3) natural selection where the relation between quantitative traits and fitness is the primary

agent that determines the genetic properties of that character in a natural population (Falconer, 1981). Yield is a complex character influenced by a large number of other component traits. A knowledge of the association between yield and its component traits and also between the component traits helps in improving the efficiency of selection.

In the present study the vegetable pod yield per plant exhibited positive and significant correlation with days to 50 per cent flowering, pod length, days to 50 per cent maturity, pod width, days for harvest, pods per cluster, pod cluster per plant, pods per plant, 10 pods weight, pod yield per plant, seeds per pod, seed yield per plant and 100 seed weight but it is positive and non-significant with plant height and number of branches per plant. These results were in confirmation with Mital and Thomas (1969), Brindha *et al.,* (1996).

The seed yield per plant exhibited positive and significant correlation with days to 50 per cent flowering, pod length, days to 50 per cent maturity, pod width, days for harvest, pods per cluster, pod cluster per plant, pods per plant, 10 pods weight, pod yield per plant, seeds per pod, seed yield per plant and 100 seed weight but it is positive and non-significant with plant height and number of branches per plant. These results were in confirmation with Tyagi *et al.,* (2000), Arumugarangarajan *et al.,* (2000), Motior *et al.,* (1997) and Saini *et al.,* (2010). Plant height showed positive and significant correlation with number of branches per plant. It exhibited positive and non-significant correlation with days to 50 per cent flowering, pods per cluster, pod cluster per plant, pods per plant, 10 pods weight, pod yield per plant, seeds per pod, seed yield per plant and 100 seed weight. But negative and non-significant correlation was shown by pod length, days to 50 per cent maturity, pod width, days for harvest which was in agreement with the report of Singh *et al.,*

(2004). Number of branches per plant showed positive and non-significant correlation with pods per cluster, pods per plant, pod yield per plant, seed yield per plant. It exhibited negative and non-significant correlation with pod length, days to 50 per cent maturity, pod width, days for harvest, pod cluster per plant, 10 pods weight, seeds per pod, and 100 seed weight. This was supported by Sakrajitjana and Das (1983), Patel and Choudhary (2001).

Differences between GCV and PCV were also found to be less for all the eleven traits indicating that these traits were less affected by environmental fluctuations. High values of GCV over PCV suggested that there is a possibility of improvement through direct selection for these traits among landraces. Based on the above results, it is suggested that in different accessions, characters with high genotypic variability *viz.,* plant height, number of branches per plant, number of clusters per plant, number of pods per cluster, seed size and hundred seed weight would be responsive to selection in the positive direction. Presence of variability in the population is a prerequisite for selection to be effective. Heritability estimates were high for all the characters studied. Similar results were obtained in previous study for the traits like days to 50 per cent flowering, number of primary branches per plant and hundred seed weight (91 per cent). If heritability of a character is very high, say 70 per cent or more, selection for such traits could be fairly easy. This is because there would be a close correspondence between the genotype and the phenotype due to the relatively small contribution of the environment to the phenotype according to Singh (2001). There was also a relatively high genetic advance as per cent mean for plant height, number of branches per plant, number of clusters per plant, number of pods per cluster, number of seeds per pod, pod length, seed size and hundred seed weight (Table 1 and 2).

Table.1 Correlation coefficients for selected quantitative traits in M4 mutants of cluster bean

	X_1	X_2	X_3	X_4	X_5	X_6	X_7	X_8	X_9	X_{10}	X_{11}	X_{12}	X_{13}	X_{14}	X_{15}
X_1	1.00	0.48**	0.49**	0.48**	0.51**	0.48**	0.49**	0.34**	0.34**	0.26**	0.37**	0.28**	0.38**	0.19**	0.40**
X_2		1.00	0.79**	-0.04	-0.02	-0.03	-0.02	0.07	0.04	0.11	0.02	0.10	0.02	0.12	0.00
X_3			1.00	-0.06	-0.06	-0.04	-0.05	0.00	-0.01	0.04	-0.06	0.02	-0.05	0.03	-0.08
X_4				1.00	0.95**	0.96**	0.95**	0.74**	0.73**	0.61**	0.85**	0.62**	0.85**	0.58**	0.80**
X_5					1.00	0.97**	0.99**	0.77**	0.75**	0.64**	0.83**	0.61**	0.88**	0.61**	0.84**
X_6						1.00	0.97**	0.77**	0.76**	0.65**	0.84**	0.64**	0.86**	0.62**	0.81**
X_7							1.00	0.78**	0.76**	0.64**	0.83**	0.61**	0.88**	0.62**	0.84**
X_8								1.00	0.63**	0.83**	0.67**	0.75**	0.68**	0.74**	0.72**
X_9									1.00	0.86**	0.71**	0.80**	0.72**	0.74**	0.66**
X_{10}										1.00	0.61**	0.88**	0.60**	0.82**	0.60**
X_{11}											1.00	0.68**	0.84**	0.65**	0.73**
X_{12}												1.00	0.59**	0.74**	0.58**
X_{13}													1.00	0.68**	0.75**
X_{14}														1.00	0.72**
X_{15}															1.00

* Correlation is significant at 5% level of significance   ** Correlation is significant at 1% level of significance

X_1=Days for 50% flowering
X_2=Plant height (cm)
X_3=Branches/plant
X_4=Pod length (cm)
X_5=Days for 50% maturity

X_6=Pod width (cm)
X_7=Days for harvest
X_8=Pods/cluster
X_9=Pod clusters/plant
X_{10}=Pods/plant

X_{11}=Ten pods weight (g)
X_{12}=Pod yield/plant (g)
X_{13}=Seeds/pod
X_{14}=Seed yield/plant (g)
X_{15}=100 seed weight (g)

Table.2 Estimates of variability for various quantitative traits among the M4 mutants of cluster bean

	Traits	Mean	Range		PCV (%)	GCV (%)	h^2	GA as % of mean
			Minimum	Maximum				
			26.00	38.00				
1	Plant height (cm)	54.85	33.80	96.60	29.57	25.13	72.20	43.63
2	Branches/plant	12.27	6.80	23.00	31.68	25.08	62.70	41.23
3	Pod length (cm)	9.96	0.00	13.85	33.76	32.36	91.80	63.74
4	Days for 50% maturity	48.00	0.00	58.00	31.75	31.61	99.10	64.80
5	Pod width (cm)	0.92	0.00	1.17	33.64	31.15	91.10	62.15
6	Days for harvest	61.58	0.00	75.00	31.66	31.54	99.30	64.70
7	Pods/cluster	6.07	0.00	11.50	39.59	39.52	99.60	81.15
8	Pod clusters/plant	11.91	0.00	20.10	40.49	40.41	99.60	83.10
9	Pods/plant	79.46	0.00	164.05	47.18	47.06	99.50	96.76
10	Ten pods weight (g)	36.76	0.00	62.70	37.72	35.87	90.40	70.35
11	Pod yield/plant (g)	206.62	0.00	368.72	49.17	49.05	99.50	99.10
12	Seeds/pod	5.77	0.00	8.40	36.72	34.40	87.80	65.33
13	Seed yield/plant (g)	13.33	0.00	29.16	48.68	48.50	99.30	98.94
14	100 seed weight (g)	4.33	0.00	7.92	37.45	37.27	99.00	76.72

h^2 - Broad sense heritability   GCV - Genotypic co-efficient of variation
PCV - Phenotypic co-efficient of variation   GAM -

Appendix: The details of various M4 cluster bean mutants used in the investigation

Sl. No.	Reference code	Mutant name	Sl. No.	Reference code	Mutant name	Sl. No.	Reference code	Mutant name
	A_1	80-17-1	2.	B_{63}	100-ST80-17	3.	D_{125}	100-16-6
4.	A_2	80-3-2	5.	B_{64}	100-10-17	6.	D_{126}	100-5-12
7.	A_3	80-24-3	8.	B_{65}	100-5-7	9.	D_{127}	100-5-15
10.	A_4	80-20-3	11.	B_{66}	100-10-4	12.	D_{128}	100-5-8
13.	A_5S	80-28-3	14.	B_{67}	100-5-14	15.	D_{129}	100-5-10
16.	A_6	80-6-6	17.	B_{68}	100-1-2	18.	D_{130}	100-22-7
19.	A_7	80-9-5	20.	B_{69}	100-ST80-23	21.	D_{131}	100-25-2
22.	A_8	80-6-5	23.	B_{70}	100-1-10	24.	D_{132}	100-10-3
25.	A_9	80-3-4	26.	B_{71}	100-1-5	27.	D_{133}	100-25-3
28.	A_{10}	80-17-5	29.	B_{72}	100-22-1	30.	D_{134}	100-2-3
31.	A_{11}	80-19-2	32.	B_{73}	100-21-2	33.	D_{135}	100-16-5
34.	A_{12}	80-17-2	35.	B_{74}	100-2-4	36.	D_{136} S	100-26-6
37.	A_{13}	80-18-17	38.	B_{75}	100-ST80-27	39.	D_{137}	100-26-1
40.	A_{14}	80-27-1	41.	B_{76}	100-ST80-3	42.	D_{138}	100-5-9
43.	A_{15}	80-17-3	44.	B_{77}	100-22-3	45.	D_{139}	100-25-5
46.	A_{16}S	80-18-3	47.	B_{78}	100-5-1	48.	D_{140}	100-5-2
49.	A_{17}	80-9-2	50.	B_{79}	100-75-7	51.	D_{141}S	100-26-4
52.	A_{18}	80-18-7	53.	C_{80}	100-5-13	54.	D_{142}	100-10-6
55.	A_{19}	80-3-1	56.	C_{81}	100-2-5	57.	D_{143}	100-21-1
58.	A_{20}	80-18-2	59.	C_{82}	100-2-7	60.	D_{144}	100-22-8
61.	A_{21}	80-3-3	62.	C_{83}	100-21-5	63.	D_{145}	100-10-1
64.	A_{22}	80-6-2	65.	C_{84}	100-22-6	66.	D_{146}	100-1-8
67.	A_{23}S	80-9-4	68.	C_{85}	100-2-6	69.	D_{147}	100-25-9
70.	A_{24}	80-28-7	71.	C_{86}	100-10-8	72.	D_{148}	100-2-1
73.	A_{25}	80-28-6	74.	C_{87}	100-26-5	75.	D_{149}	100-1-9
76.	A_{26}	80-23-3	77.	C_{88}	100-1-4	78.	D_{150}	100-5-3
79.	A_{27}	80-19-1	80.	C_{89}	100-16-7	81.	D_{151}	100-5-16
82.	A_{28}	80-20-6	83.	C_{90}	100-26-8	84.	D_{152}	100-25-1
85.	A_{29}	80-28-1	86.	C_{91}	100-16-3	87.	D_{153}	100-5-17
88.	A_{30}	80-24-5	89.	C_{92}	80-24-1	90.	D_{154}	100-10-2
91.	A_{31}	80-28-2	92.	C_{93}S	80-9-3	93.	D_{155}	100-2-2

94.	A_{32}	80-20-4	95.	C_{94}**S**	80-6-4	96.	D_{156}	100-ST80-22
97.	A_{33}**NP**	80-27-5	98.	C_{95}**NP**	80-18-5	99.	D_{157}	100-ST80-1
100.	A_{34}	80-20-2	101.	C_{96}	80-6-3	102.	D_{158}	100-ST80-4
103.	A_{35}	80-20-1	104.	C_{97}	80-17-4	105.	D_{159}**NP**	100-1-7
106.	A_{36}	80-27-2	107.	C_{98}	80-9-1	108.	D_{160}	100-25-9
109.	A_{37}	80-23-2	110.	C_{99}	80-3-5	111.	D_{161}	100-10-5
112.	A_{38}	80-27-3	113.	C_{100}	80-P58-7	114.	D_{162}	100-25-4
115.	A_{39}	80-27-4	116.	C_{101}	80-P58-9	117.	D_{163}	100-1-1
118.	B_{40}	100-21-3	119.	C_{102}**S**	80-P58-8	120.	D_{164}	100-16-1
121.	B_{41}	100-ST80-14	122.	C_{103}	100-P3-80-1	123.	D_{165}	100-16-2
124.	B_{42}	100-21-4	125.	C_{104}	100-P3-80-4	126.	E_{166}	100-MS2-5
127.	B_{43}	100-ST80-8	128.	C_{105}	100-P3-80-2	129.	E_{167}	100-MS2-3
130.	B_{44}	100-ST80-28	131.	C_{106}	100-P3-80-3	132.	E_{168}	100-MS2-1
133.	B_{45}	100-ST80-12	134.	C_{107}	100-A80-4	135.	E_{169}	100-MS2-2
136.	B_{46}	100-ST80-20	137.	C_{108}	100-A80-2	138.	E_{170}	100-MS2-4
139.	B_{47}	100-ST80-16	140.	C_{109}**NP**	100-A80-1	141.	E_{171}	100-MS2-6
142.	B_{48}	100-ST80-24	143.	C_{110}	100-A80-5	144.	E_{172}	80-P58-11
145.	B_{49}	100-ST80-7	146.	C_{111}	100-A80-3	147.	E_{173}	80-P58-3
148.	B_{50}	100-ST80-13	149.	C_{112}	100-PNB-1	150.	E_{174}	80-P58-4
151.	B_{51}	100-25-8	152.	C_{113}	100-PNB-2	153.	E_{175}	80-P58-10
154.	B_{52} **S**	100-5-19	155.	C_{114}	100-PNB-3	156.	E_{176}	80-P58-1
157.	B_{53}	100-ST80-21	158.	C_{115}	100-PNB-4	159.	E_{177}	80-P58-5
160.	B_{54}	100-ST80-15	161.	C_{116}	P58-7	162.	E_{178}	80-P58-2
163.	B_{55}	100-ST80-10	164.	C_{117}	100-ST80-5	165.	E_{179}	80-P58-6
166.	B_{56}	100-22-2	167.	C_{118}	100-ST80-9	168.	E_{180}	80-MN2-2
169.	B_{57}	100-ST80-19	170.	C_{119}	100-ST80-3	171.	E_{181}	80-MN2-6
172.	B_{58}	100-10-11	173.	C_{120}**NP**	100-ST80-2	174.	E_{182}	80-MN2-7
175.	B_{59}	100-ST80-25	176.	C_{121}	80-MN3-6	177.	E_{183}	80-MN2-1
178.	B_{60}**S**	100-ST80-18	179.	C_{122}	80-MN3-3	180.	E_{184}	80-MN2-4
181.	B_{61} **S**	100-ST80-6	182.	D_{123}	100-1-6	183.	E_{185}	80-MN2-5
184.	B_{62}	100-ST80-11	185.	D_{124}**S**	100-26-7	186.	E_{186}	80-MN3-5
187.	E_{188}	80-MN3-2	188.	E_{189}	80-MN3-1	189.	E_{187}	80-MN3-7
190.	E_{190}	80-MN3-3	191.			192.		

It was also reported high GAM coupled with high heritability for plant height, seed yield, hundred seed weight, harvest index and daily production rate indicated heritable nature of variation and scope for selection for these traits among the vegetable soybean genotypes. Johnson *et al.,* (1955) suggested that high heritability combined with high genetic advance as per cent mean is indicative of additive gene action and selection based on these parameters would be more reliable.

It is concluded as correlation revealed highly significant and positive association of vegetable pod yield and other yield component characters. A positive correlation for pod yield with days to 50 per cent maturity, pod length (cm), pod width (cm), days for harvest, pods per cluster, pod clusters per plant, pods per plant, 10 pods weight (g), pod yield per plant (g), seeds per pod, seed yield per plant (g) and 100 seed weight (g). A non-significant but positive correlation was also observed with plant height and number of branches per plant.

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