

Effect on Growth, Seed Yield and Quality of Cluster Bean [*Cyamopsis tetragonoloba* (L.) TAUB.] Seed cv. 'Pusa Navbahar' through Decapitation and Pgr's

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ABSTRACT

An investigation was carried out to study the response of growth, seed yield and its quality in cluster bean cv. 'Pusa Navbahar' to decapitation and spraying of plant growth regulators. The experiment was carried out with decapitation three treatments and spraying of three plant growth regulators (NAA, GA₃ and Thiourea) at flowering stage along with water spray as control. The treatment without decapitation showed the maximum plant height compared to other treatments. The maximum pods/plant and seed yield (kg/ha) was recorded under the treatment decapitation at 70 DAS. The treatment decapitation at 85 DAS and GA₃ (20mg/l) recorded significantly the highest leaf area/plant and similar trend was observed in LAI. The germination percentage, test weight and vigour index were found non-significant among the different treatment of decapitation. In case of PGR's the treatment GA₃ (20mg/l) noted the highest value of plant height and maximum value of seed yield followed by Thiourea (500 mg/l). Whereas, application of GA₃ (40mg/l) recorded significantly the highest germination percentage and vigour index. Test weight was found non-significant for PGR's treatments.

Key words: Decapitation, Vigour Index, PGRs, Seed yield, Cluster bean, Leaf area index

INTRODUCTION

Cluster bean [*Cyamopsis tetragonoloba* (L.) Taub.] is an important annual legume vegetable crop. It can be grown on soil of low fertility as well as drought prone arid and semi arid area of tropics and subtropics. Cluster bean is a warm season crop its grow well in both the seasons summer and rainy Pusa Navbahar is most popular variety of cluster

bean for vegetable purpose. It is grown for its young tender green immature pods, which are used as a nutritive vegetable. It is single stem and pods are about 15 cm in length, tender, green in colour and have less fibre. In Gujarat cluster bean is grown about 41,492 ha of land with the production of 3, 38,646 MT green pods during the year 2014-15².

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Due to the wide spread cultivation and nutritive important in our daily life demand for seeds requirement is increasing day by day but, availability of pure and good quality seeds is not satisfactory. Various attempts have been made to increase production of seed with better quality seed but, results are not satisfactory. Hence, the present experiment was carried out to study the response of growth, seed yield and its quality to source manipulation (Decapitation) and plant growth regulators in cluster bean.

MATERIALS AND METHODS

A field study was undertaken during *Kharif* season of 2012-2013, 2013-14 and 2015-2016 at Main Vegetable Research Station, Anand Agricultural University, Anand. The experiment was laid out in factorial randomized block design replicated thrice. Total 21 treatment combinations comprised of three treatments Decapitation (removal of terminal portion) without decapitation (D_1), decapitation at 70 days after sowing (D_2) and decapitation at 85 days after sowing (D_3) with the seven plant growth regulator treatments along with water spray as control. The plant growth regulators were NAA (20 and 40 mg/l), GA_3 (20 and 40 mg/l) and thiourea (500 and 1000 mg/l). All the concentrations of plant growth regulators were sprayed at flowering stage. Five tagged plant from each net plots were selected for measuring growth parameters and number of pods/plant. Seed yield from each net plot was weighed and then, it was calculated for hectare. Weight of 1000 seed was measured by counting the 1000 seeds at random and weighing them in electronics balance. Seed germination percentage and seedling vigour were assessed as per the ISTA procedure¹ at 10th days.

RESULTS AND DISCUSSION

The results obtained from the present study have been discussed in detail under following heads:

Response of decapitation treatments:

1. Plant height (cm)

The data presented in Table 1 showed significant different among the decapitation as

well as PGR's treatments for plant height in pooled data. Significantly the maximum plant height was recorded under the treatment without decapitation (D_1) (74.95 cm), while in case of PGR's treatments application of (G_4) GA_3 at 20 mg/l. recorded significantly the maximum plant height (80.26 cm) as compared to rest of the treatments, which were at par with treatments G_3 (NAA at 40 mg/l) (77.04 cm) followed by the treatment (G_5) GA_3 at 40 mg/l (76.89cm) on the pooled basis.

2. Number of leaves per plant

The data presented in Table 1 showed significant different among the decapitation as well as PGR's treatments for number of leaves per plant in pooled data. Significantly the maximum number of leaves per plant was recorded under the treatment decapitation at 85 DAS (D_3) (45.90), while in case of PGR's treatments application of (G_5) GA_3 at 40 mg/l. recorded significantly the highest number of leaves per plant (50.51), which were at par with treatments G_4 (GA_3 at 20 mg/l) (48.29).

3. Number of pods per plant

Data showed significant different among the decapitation as well as PGR's treatments for number of pods per plant in pooled data. Significantly the highest number of pods per plant was recorded under the treatment decapitation at 70 DAS (D_2) 160.00, while in case of PGR's treatments application of GA_3 at 20 mg/l (G_4) i.e. recorded significantly the highest number of pods per plant (125.58) as compared to rest of the treatments.

Interaction effect

Only the treatment combination D x G found significant for number of pods per plant in pooled data, treatment D_2G_4 (138.18) recorded the maximum number of pods per plant which was at par with the treatment D_2G_7 (130.41) (Table 2).

4. Leaf area (LA) per plant (cm^2)

Significantly the maximum LA / plant were recorded under the treatment decapitation at 85 DAS (D_3) 4738.74 cm^2 which were at par with treatment decapitation at 70 DAS (D_2) 4379.49 cm^2 on the pooled basis, while in case of PGR's treatments application of GA_3 at 20 mg/l (G_4) 5651.85 cm^2 recorded significantly

the maximum LA per plant, which was at par with the treatment application of GA₃ at 40 mg/l (G₅) 5486.52 cm² followed by application of Thiourea at 500 ppm (G₆) 5121.78cm² as compared to the rest of the treatments (Table 3).

Interaction effect

Only the treatment combination D x G found significant for LA per plant in pooled data. Treatment combination D₃G₄ recorded significantly the maximum LA per plant (6269.61 cm²) which was at par with the treatment combination D₃G₅ (6215.50 cm²), D₂G₄ (6126.83 cm²), D₂G₅ (5798.45 cm²) and D₃G₆ (5687.50 cm²) than the rest of the treatments in pooled data (Table 3).

5. Leaf Area Index (LAI)

The results showed the significant different among decapitation as well as PGR's for LAI in pooled data. Treatment decapitation at 85 DAS (D₃) (3.22) recorded significantly the highest LAI which was at par with Treatment decapitation at 70 DAS (D₂) (2.98) as compared to the rest of the treatments. In case of PGR's treatments application of GA₃ at 20 mg/l (G₄) (3.84) recorded significantly the maximum LAI which were at par with the treatment application of GA₃ at 40 mg/l (G₅) (3.73) followed by application of thiourea at 500 ppm (G₆) (3.48) (Table 3).

Interaction effect

The treatment combination D x G found significant in pooled over year for Leaf area Index. Treatment combination D₃G₄ (4.27) recorded significantly the maximum Leaf area Index which were at par with the treatment combination D₃G₅ (4.23), D₂G₄ (4.18), D₂G₅ (3.95) and D₃G₆ (3.86) (Table 4).

6. Dry weight of plant (g)

The data presented in Table 1 showed significant different among the decapitation as well as PGR's treatments for dry matter of plant in pooled data. Significantly the superior dry weight of plant was recorded under the treatment without decapitation (D₁) (79.17 g), while in case of PGR's treatments application of (G₅) GA₃ at 40 mg/l. recorded significantly the maximum dry weight of plant (74.27 g).

7. Seed Yield (kg/ha)

The results showed the significant different among decapitation as well as PGR's for seed yield in pooled analysis. Treatment decapitation at 70 DAS (D₂) (2174 kg/ha) recorded significantly the highest seed yield as compared to rest of the treatments. In case of PGR's treatments application of GA₃ at 20 mg/l (G₄) (2446 kg/ha) recorded significantly the maximum seed yield which was at par with the treatment application of thiourea at 500 ppm (G₆) (2326 kg/ha) (Table 1).

8. Germination (%)

The results showed non-significant different among decapitation, while, it was significant for PGR's treatments for germination in the pooled data. The PGR's treatment of GA₃ at 40 mg/l (G₅) recorded significantly the maximum germination (88.11 per cent) which was at par with the treatment application of GA₃ at 20 mg/l (G₄) (86.72 per cent) (Table 1).

9. Test Weight (g)

The results showed the different among decapitation was non-significant. The differences among the PGR's treatment for test weight were found significant. Significantly the maximum test weight was recorded with the treatment GA₃ at 40 mg/l (G₅) (43.02 gm) followed by the treatment application of GA₃ at 20 mg/l (G₄) (42.57 gm) and application of Thiourea at 1000 ppm (G₇) (42.24 gm) and rest of the treatments (Table 7).

10. Vigour Index-I

The different among decapitation as well as PGR's treatments for vigour index I was found significant. Treatment decapitation at 70 DAS (D₂) (9.49) recorded significantly the highest vigour index as compared to rest of the treatments. In case of PGR's treatments application of thiourea at 500 ppm (G₆) (10.54) which was at par with the treatment application of GA₃ at 20 mg/l (G₄) (9.78) and thiourea at 1000 ppm (G₇) (9.29) (Table 1).

11. Vigour Index-II

The different among decapitation was non-significant, while, it was significant for PGR's treatments for vigour index II. In case of

PGR's treatments application of GA₃ at 40 mg/l (G₅) (5.54) recorded significantly the maximum vigour index, which was at par with

the treatment application of GA₃ at 20 mg/l. (G₄) (5.49) (Table 1).

Table 1: Effect of decapitation and plant growth regulators on growth of cluster bean cv. 'Pusa Navbahar' (Pooled data of three years)

Sr. No.	Treatment	Pooled										
		Plant height (cm)	Number of leaves per plant	Number of pods per plant	Leaf area per plant (cm ²)	Leaf area Index	Dry weight of plant (g)	Seed Yield (kg/ha)	Germination (%)	Test Weight (g)	Vigour Index-I	Vigour Index-II
Decapitation												
1	D ₁ No decapitation (C)	74.95	44.86	110.5	3678.40	2.48	79.17	1967	84.93	42.16	8.31	5.36
2	D ₂ Decapitation at 70 DAS	72.08	43.76	160.00	4379.49	2.98	67.83	2174	83.88	42.32	9.49	5.29
3	D ₃ Decapitation at 85 DAS	69.11	45.90	108.00	4738.74	3.22	62.61	1813	84.45	42.19	7.79	5.36
	S. Em. ±	0.62	0.60	1.24	100.06	0.07	1.11	35.37	0.37	0.20	0.20	0.03
	CD @ 5%	1.74	1.69	3.96	280.20	0.20	3.13	99.04	NS	NS	2.55	NS
PGR's Treatment												
1	G ₁ (C)	63.74	39.89	98.40	2627.02	1.80	63.65	1403	84.33	41.57	6.11	5.33
2	G ₂ (NAA @ 20 mg/l)	66.37	42.67	120.61	3802.26	2.59	68.76	2018	82.94	42.09	7.64	5.24
3	G ₃ (NAA @ 40 mg/l)	77.04	45.87	122.40	3665.70	2.47	70.82	1807	82.56	41.95	7.60	5.22
4	G ₄ (GA ₃ @ 20 mg/l)	80.26	48.29	125.58	5651.85	3.84	68.34	2446	86.72	42.57	9.78	5.49
5	G ₅ (GA ₃ @ 40 mg/l)	76.89	50.51	124.88	5486.52	3.73	74.27	2057	88.11	43.02	8.37	5.54
6	G ₆ (Thiourea @500 mg/l)	73.33	44.56	121.50	5121.78	3.48	72.79	2326	83.39	42.11	10.54	5.29
7	G ₇ (Thiourea @1000 mg/l)	67.19	43.30	122.13	3503.67	2.37	67.16	1832	82.89	42.24	9.29	5.25
	S. Em. ±	0.95	0.92	1.98	152.84	0.11	1.70	54.02	0.56	0.30	0.30	0.04
	CD @ 5%	2.66	2.59	3.78	428.01	0.30	4.80	151.29	1.57	0.85	0.85	0.12
Interaction effect												
Y		NS	NS	NS	280.20	0.20	NS	NS	NS	NS	NS	NS
YxD		NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
YxG		NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
DxG		NS	NS	8.45	795.69	0.56	NS	NS	NS	NS	NS	NS
YDG		NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
CV%		6.84	10.69	14.63	18.61	19.23	10.42	14.15	2.80	3.01	14.95	3.27

NS=Non-significant

Table 2: DxG interaction effect on Number of pods/plant in cluster bean (Pooled data of three years)

Treatment / Decapitation	D ₁	D ₂	D ₃	Mean of Treat
G ₁ - Water Spray (C)	97.01	106.05	87.36	96.81
G ₂ - NAA (20 mg/l)	100.38	109.20	90.93	100.17
G ₃ - NAA (40 mg/l)	103.12	112.13	95.12	103.46
G ₄ - GA ₃ (20 mg/l)	128.10	138.18	99.34	121.87
G ₅ - GA ₃ (40 mg/l)	122.43	128.52	94.29	115.08
G ₆ -Thiourea (500 mg/l)	104.57	112.13	96.81	104.50
G ₇ -Thiourea (1000 mg/l)	120.96	130.41	92.19	114.52
Mean of Decapitation	110.94	119.52	93.73	
S. Em. ±				2.80
CD (P=0.05)				8.45
CV %				14.63

Table 3: DxG interaction effect on Leaf area per plant (cm²) in cluster bean (Pooled data of three years)

Treatment / Decapitation	D ₁	D ₂	D ₃	Mean of Treat
G ₁ - Water Spray (C)	2074.22	2220.83	3586.00	2627.02
G ₂ - NAA (20 mg/l)	3454.56	3806.11	4146.11	3802.26
G ₃ - NAA (40 mg/l)	3302.44	3924.17	3770.50	3665.70
G ₄ - GA ₃ (20 mg/l)	4559.11	6126.83	6269.61	5651.85
G ₅ - GA ₃ (40 mg/l)	4445.61	5798.45	6215.50	5486.52
G ₆ -Thiourea (500 mg/l)	4312.55	5364.89	5687.50	5121.78
G ₇ -Thiourea (1000 mg/l)	3599.89	3415.17	3495.94	3503.67
Mean of Decapitation	3678.40	4379.49	4738.74	
S. Em. ±				264.72
CD (P=0.05)				795.69
CV %				18.61

Table 4: DxG interaction effect on LAI in cluster bean (Pooled data of three years)

Treatment / Decapitation	D ₁	D ₂	D ₃	Mean of Treat
G ₁ - Water Spray (C)	1.43	1.53	2.46	1.80
G ₂ - NAA (20 mg/l)	2.36	2.59	2.82	2.59
G ₃ - NAA (40 mg/l)	2.17	2.67	2.56	2.47
G ₄ - GA ₃ (20 mg/l)	3.07	4.18	4.27	3.84
G ₅ - GA ₃ (40 mg/l)	3.00	3.95	4.23	3.73
G ₆ - Thiourea (500 mg/l)	2.92	3.64	3.86	3.48
G ₇ - Thiourea (1000 mg/l)	2.42	2.32	2.38	2.37
Mean of Decapitation	2.48	2.98	3.22	
S. Em. ±	0.19			
CD (P=0.05)	0.56			
CV %	19.23			

CONCLUSION

The data presented in Table 1 showed significant response of decapitation on growth parameters. Treatment D₁ (Without decapitation) recorded significantly the maximum plant height and dry weight of plant. This might be due to continuous growth of apical bud resultant number of pod as well as growth and ultimately dry matter. These results are in accordance with the finding of Yadav and Dhukia¹⁰ and Arora *et al.*⁴ in cluster bean. Treatment D₂ (Decapitation at 70 days after sowing) registered significantly the highest number of pods per plant, weight of 1000 seeds and seed yield. This might be due to checking of the vegetative growth phase and diversification of photosynthetic materials towards the source *i.e.* pods and seeds at optimum growth stage. These results are in accordance with findings of the Argall and Stewart³ in cowpea, Yadav and Dhukia¹⁰ and Yadav *et al.*¹¹ in cluster bean. Seed quality parameters Vigour index-I was found significantly the highest in treatment D₂. This result is in accordance with the findings of Sajjan *et al.*⁷. Germination percentage was found non-significant. Similar results were also found by Arora *et al.*⁴ in cluster bean.

Response of plant growth regulators:

Response of growth parameters found significant results to plant growth regulators (Table 1). Treatment G₄ (GA₃ 20 mg/ l) recorded significantly the highest plant height, number of pods per plant, leaf area per plant, leaf area index. This might be due to synergistic effect of GA₃ in stimulation of cell division and cell elongation, which ultimately affect overall growth of the plant. Similar

results were also recorded by Raghava *et al.*⁶ in cow pea and Singh *et al.*⁷ in cluster bean. Yield attributing traits were also found significant result (Table 1). Treatment G₅ (GA₃ 40 mg/ l) recorded significantly the maximum weight of 1000 seeds, germination percentage and vigour index-II. This might be due to stimulation of natural hormones by exogenous application of plant growth regulators which accelerate the overall growth of plant resultant more number of pods and increase size of seeds ultimately more yield with good quality seed. Similar results were also found by Hunje *et al.*⁵ in cow pea and Sharma *et al.*⁸ in cluster bean.

Interaction:

Interaction between source manipulation (Decapitation) and plant growth regulators found significant results for number of pods per plant leaf area per plant and leaf area index.

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