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Influence of PGRs on yield characteristics of cluster bean (*Cyamopsis tetragonoloba* L. taub)

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Abstract
The research project titled "Effect of PGRs on yield characteristics of Cluster Bean (*Cyamopsis tetragonoloba* L. Taub)" has been conducted. The effects of nine different PGR treatments at different percentage concentrations on cluster bean development and yield characteristics were investigated in the village of Khudmudi under CHRS Sankara Patan, Durg (C.G.) during the summer of 2024-2025.Ten treatments and three replications were used in the Randomized Block Design field trial. Thiourea, GA_3, and NAA were among the three replication. The foliar application of GA_3 @100 ppm (T_3) significantly enhanced the yield and economics of cluster bean. Yield attributing characters such as the highest number of pods per plant (33.43)), greatest average pod weight (1.74 g), the maximum pod yield per plant (58.17 g) and total yield (64.63 q/ha) were achieved in T_3, compared to the minimum values in the control (T_0).
The highest economic returns were also recorded in T_3 with a maximum gross return of Rs. 2,00,359.09/ha, net return of Rs. 1,46,599.09/ha, and benefit: cost ratio of 2.73. The results clearly indicate that foliar application of GA_3 @100 ppm is highly effective in improving the productivity, and profitability of cluster bean cultivation.

Keywords: Cluster bean, PGR, NAA, GA_3, economic

Introduction
The cluster bean, sometimes called guar, is a member of the papilonaceae subfamily and the leguminosae family. (*Cyamopsis tetragonoloba* L. Taub) is the botanical name for the cluster bean (2n=14). It is a tropical crop that needs temperatures between 30° and 35° degrees Celsius to germinate properly, and between 32^0 and 38^0 degrees Celsius to promote healthy vegetative growth. The plant needs long days for vegetative growth and short days for flowering because it cannot withstand shade. India has a unique position in the world's cluster bean production due to its climate, which is ideal for growing the crop. The top states in India for cluster bean cultivation are Rajasthan, Gujarat, Haryana, Uttar Pradesh, and Punjab. India is the world's top producer of cluster beans, accounting for between 75 and 80 percent of global production (Agril. Statistics at a Glance, 2018-2019). It is produced in 1.84 million tonnes on 4.603 million hectares of land in India, with a yield of 551 kg/ha (Ministry of Agriculture, GOI, 2020-2021). The vast endosperm of cluster beans contains 28-33% galactomannan gum. Due to its drought resistance, widespread use, and unique status in the commercial sector, it has become a highly valued cash crop in arid and semi-arid regions. Plant Growth Regulators (PGRs) can be used to increase the cluster bean crop's yield and quality. Natural plant growth hormones are classified into six groups. These include brassinosteroids, ethylene, gibberellins, cytokinins, auxins, and abscisic acid. They are crucial to a plant's growth and development. The plant growth regulators GA3, Thiourea, and NAA are the focus of this study. Cell elongation and cell division are significantly influenced by auxin NAA. A genus of fungus that produce "foolish seedling" disease inspired the name of gibberellins. Although roots and young leaves produce over 100 different gibberellins, GA3, or gibberellic acid, is the most often used type. Enhancing stem and internode elongation, promoting seed germination, producing enzymes during germination, and influencing fruit setting and growth are just a few of the numerous effects GA3 has on plant growth.

Materials and Methods

A study on the "Effect of PGRs on yield characteristics of Cluster Bean (*Cyamopsis tetragonoloba* L. Taub)" was carried out. In the summer of 2024-2025, nine distinct PGR treatments at varying percent concentrations were studied for their effects on cluster bean yield characteristics in the village of Khudmudi under CHRS Sankara Patan, Durg (C.G.).

Treatment details

Treatment notations	Treatment combinations
T_0	Control
T_1	GA_3 @50 ppm
T_2	GA_3 @75 ppm
T_3	GA_3 @100 ppm
T_4	Thiourea @500 ppm
T_5	Thiourea @1000 ppm
T_6	Thiourea @1500 ppm
T_7	NAA @30 ppm
T_8	NAA @45ppm
T_9	NAA @60 ppm

Climatic condition

Durg lies within the tropical climatic zone and receives the majority of its annual rainfall, ranging from about 1100 to 1276 mm, during the southwest monsoon season, primarily from June to October. Summers in the region are hot, with temperatures varying between 30°C and 47°C, whereas winters are mild, with temperatures ranging from 5°C to 25°C.

Results and Discussion

Yield parameters

The results revealed that the significant differences were observed among treatments for the highest number of pods per plant (33.43) was recorded in treatment T_3 (GA3 @100 ppm), similarly, the highest average pod weight (1.74 g) was recorded in treatment T_3 (GA_3 @100 ppm). The highest pod yield per plant (58.17 g) was obtained in treatment T_3 (GA_3 @100 ppm) and the highest total yield (64.63 q/ha) was achieved with treatment T_3 (GA_3 @100 ppm), in contrast to the lowest total yield (38.69 q/ha) obtained in the control treatment (T_0).

The superior performance of T3 (GA_3 @100 ppm) may be attributed to the stimulatory role of GA_3 in enhancing vegetative growth and reproductive efficiency, which resulted in the maximum number of pods per plant, higher average pod weight, and increased pod yield per plant. This cumulative effect ultimately translated into the highest total yield per hectare, while the control (T0) recorded the lowest yield. Similar yield-enhancing effects of GA_3 application in legumes have been reported by and Durge *et al*. (2021) [10] in pigeon pea, and Jayantibhai *et al*. (2022) [5] in cluster bean.

Table 1: Effect of PGRs on number of fruits per plant, average weight of fruits (g) pod yield per plant (g) and fruit yield per ha (q)

Treatment notation	Treatments	Number of pods per plant	Average weight of pod (g)	pod yield per plant (g)	Pod yield per ha (q)
T_0	Control	25.44	1.36	34.82	38.69
T_1	GA_3 @50 ppm	28.96	1.54	44.70	47.90
T_2	GA_3 @75 ppm	31.32	1.67	52.27	58.08
T_3	GA_3 @100 ppm	33.43	1.74	58.17	64.63
T_4	Thiourea @500 ppm	27.79	1.49	41.33	45.92
T_5	Thiourea @1000 ppm	28.67	1.56	44.63	49.58
T_6	Thiourea @1500 ppm	29.83	1.57	46.84	52.04
T_7	NAA @30 ppm	25.70	1.61	40.95	45.50
T_8	NAA @45ppm	27.87	1.64	45.70	50.78
T_9	NAA @60 ppm	30.66	1.63	50.07	55.63
S.E.(m) ±		0.62	0.03	1.09	1.15
CD at 5%		1.84	0.08	3.24	3.40

Economic parameter

The results revealed significant variation in cost of cultivation, gross return, net return, and B:C ratio under different PGR treatments. The maximum gross return (₹2,00,359.09), net return (₹1,46,599.09), and B:C ratio (2.73) were obtained with T3 (GA_3 @100 ppm), while the lowest values were recorded in the control (T_0). The superior economic performance of T3 may be attributed to the growth-promoting effects of GA_3, which enhanced pod yield per plant and overall productivity, thereby improving profitability. Similar positive economic impacts of GA_3 application in leguminous crops have been reported by Sharma *et al*. (2019) [9], Patel *et al*. (2025) [5].

Table 2: Effect of PGRs on economics of various treatments

Treatments notation	Treatment	Total cost of cultivation (Rs. /ha)	Gross return (Rs. /ha)	Net return (Rs. /ha)	B:C ratio
T_0	Control	49610.00	119948.30	70338.30	1.42
T_1	GA_3 @50 ppm	54960.00	148494.13	96209.13	1.84
T_2	GA_3 @75 ppm	56376.00	180032.84	127039.84	2.40
T_3	GA_3@100 ppm	57910.00	200359.09	146599.09	2.73
T_4	Thiourea@500ppm	53010.00	142350.62	91040.62	1.77
T_5	Thiourea @1000 ppm	54010.00	153711.20	101901.20	1.97
T_6	Thiourea @1500 ppm	55010.00	161325.95	109015.95	2.08
T_7	NAA@30ppm	52380.00	141047.93	90102.93	1.77
T_8	NAA@45 ppm	52410.00	157423.86	106413.86	2.09
T_9	NAA@60 ppm	52550.00	172452.31	121372.31	2.38

Conclusion

The findings of the present study indicate that the application of specific concentrations of Plant Growth Regulators can significantly enhance the growth and yield performance of Cluster Bean. The comparison of different treatments revealed that the foliar application of GA_3 @100 ppm was most effective in improving yield traits.

This treatment recorded the highest number of pods per plant (33.43), average pod weight (1.74g), average pod yield per plant (58.17g) and total yield (64.63q/ha).

It also resulted in the highest economic return, with a maximum net return and a favourable benefit-cost ratio (2.73). These results suggest that the use of foliar application of PGRs, can play a vital role in enhancing both productivity and profitability in Cluster Bean cultivation.

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