International Journal of Chemical Studies

P-ISSN: 2349–8528
E-ISSN: 2321–4902
www.chemijournal.com
IJCS 2020; 8(6): 1736-1738

Received: 17-08-2020
Accepted: 28-10-2020

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Effect of plant growth regulators on growth and yield of yard long bean (*Vigna unguiculata* L.) var. Shefali

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DOI: https://doi.org/10.22271/chemi.2020.v8.i6y.11016

Abstract
The experiment was carried out with RBD having thirteen treatments and three replication. All treatments exhibited superior growth and yield of yard long bean. Treatment T_3 - NAA 45 ppm found highly effective for growth parameter as it showed greatest plant height (134.06 cm), Pod length (41.79 cm), Pod yield per plant (312.54 g) and Pod yield per hac (203.97 q/ha), Whereas treatment T_1 – NAA 15 ppm shows highest no. of branches (10.33), treatment T_{10} CCC at 300 ppm shows highest, Days of first harvest (61), Therefore treatments T_3 and T_1 found highly effective as it improves vegetative growth and yield of the crop.

Keywords: CCC, 2, 4-D, NAA, net tunnel, PCPA, plant growth regulator, yard long bean

Introduction
Yard long bean (*Vigna unguiculata ssp. Sesquipedalis* L.) is one of the most important leguminous tropical vegetable crop. It is also called as chinese long bean, string bean, snake bean, snake pea, snap pea, bodi, bora, sitao, pea bean, asparagus bean and borboti and having chromosome number 2n = 2x = 22. Yard long bean is widely grown throughout Asia especially in the South and South East Asian countries and is originated in Africa. It is a vigorous climbing annual plant which produces long pods, ranging from 14 to 30 inches and harvested 60 days after sowing. They are cultivated for their strikingly long dropping pods which are used as vegetables (Rajani, D. 2009) [5].
This vegetable can be planted in a wide range of climatic conditions but are very sensitive to extreme cold. In India it is commercially cultivated in Kerala, Tamilnadu, Andhra Pradesh, Chhattisgarh, Bihar, Odisha, West Bengal, Assam And the North Eastern Hill region. It is highly self pollinated, vigorous climbing annual, growing up to a height of three to five meters producing blue to violet flowers after 8-10 weeks of sowing. The fleshy pendulous pods which may be white, light green, dark green, brownish red or purple are usually harvested while they are immature and eaten as green vegetables (Resmi and Gopalakrishnan, 2001) [6].
The role of plant growth regulators in enhancing the production of crop has been recognized and now the low cost technology has emerged as a boon for enhancing the agricultural production at an unprecedented rate. Application of Plant growth regulators improved the plant growth, flowering and pod yield in many vegetable crops. External application of plant growth regulators stimulate photosynthesis by increasing chlorophyll content, delaying senescence of leaves and regulating the metabolic activity or by enhance flower buds and check their abscission and thereby improve the yield.

Materials and Methods
A field experiment to study the ”Effect of plant growth regulators on growth and yield of yard long bean (*Vigna unguiculata L.*) under net tunnel condition” var. shefali. The experiment was carried out during *kharif* 2019-20 at Research farm of centre of Excellence on protected cultivation and precision farming, IGKV, Raipur.
The experiment consists of 13 treatment in Randomized Block Design with three replications. The treatment combinations are T_0 - Water spray, T_1 - NAA at 15 ppm, T_2 - NAA at 30 ppm, T_3 - NAA at 45 ppm, T_4 - 2, 4-D at 2 ppm, T_5 - 2, 4-D at 4 ppm, T_6 - 2, 4-D at 6 ppm, T_7 – PCPA

at 25 ppm, T_8 - PCPA at 50 ppm, T_9 - PCPA at 75 ppm, T_{10} - CCC at 300 ppm, T_{11} - CCC at 400 ppm, and T_{12} - CCC at 500 ppm. The first foliar spray was done at 30 days after planting in the morning hours. The second foliar application at 45 days and the third application at 60 days after planting was done. The uniform spraying was carried out with the help of the knapsack sprayer; the leaves on both sides were completely wet with the spray solution. The total amount of solution required to be sprayed on experimental plants was decided by representative yard long bean plants.

Results and Discussion

The result of present study clearly indicate that plant height, number of branches per plant, days to first flowering, days to first harvest, per cent flower set, day to 100 per cent fruit set, average fruit weight (g), average fruit length (cm), yield per plant (g), yield per plot (kg), total yield (q/ha), maximum total cost of cultivation, maximum and minimum net income, maximum and minimum gross income. were significantly increased by application of different plant growth regulator as compare to control. The mean values of different growth and yield parameters with respect to plant growth regulators are presented in Table 1.

The highest plant height was recorded under treatment treatment T_3 – NAA at 45 ppm (134.06 cm) followed by treatments T_1 - NAA at 15 ppm (133.23 cm), T_{10} - CCC at 300 ppm (132.73 cm), T_6 - 2, 4-D at 6 ppm (130.63 cm), T_2 - NAA at 30 ppm (129.2 cm), T_{11} - CCC at 400 ppm (128.8 cm), T_7 - PCPA at 25 ppm (126.86 cm), T_{12} - CCC at 500 ppm (126.33 cm), T_4 - 2, 4-D at 2 ppm (124.76 cm), T_8 - PCPA at 50 ppm (124.13 cm), T_9 - PCPA at 75 ppm (124.13 cm), T_0 - Water spray (121.43 cm), minimum plant height T_5 - 2, 4-D at 4 ppm (117.93 cm).

The maximum number of branches T_1 (10.33) per plant, which was followed by treatments T_3 - NAA at 45 ppm (8.66), T_7 - PCPA at 25 ppm (8.44), T_8 - PCPA at 50 ppm (7.99), T_9 - PCPA at 75 ppm (7.77), T_{11} - CCC at 400 ppm (7.66),T_5 - 2, 4-D at 4 ppm (7.66), T_{12} - CCC at 500 ppm (7.55), T_4 - 2, 4-D at 2 ppm (7.44), T_2 - NAA at 30 ppm (7.33), T_{10} - CCC at 300 ppm (6.22), T_0 – water spray (6.11). Whereas, the minimum number of branches was found in T_6 - 2, 4-D at 6 ppm (5.99) per plant.

The minimum number of days to first harvest were recorded in treatment T_{10} - CCC at 300 ppm (61) followed by treatments T_0 - Water spray (63.23), T_1 – NAA at 15 ppm (66.55), T_{11} - CCC at 400 ppm (66.77), T_3 - NAA at 45 ppm (69.25), T_4 - 2,4-D at 2 ppm (69.66), T_7 PCPA at 25 ppm (69.81), T_8 - PCPA ,at 50 ppm (70.22), T_2 – NAA at 30 ppm (70.44), T_{12} - CCC at 500 ppm (70.44), T_9 - PCPA at 75 ppm (70.55), Whereas, maximum days taken to 1st harvest was recorded in treatment T_5 - 2,4-D at 4 ppm (70.88).

The maximum pod length was recorded in treatment T_3 - NAA at 45 ppm (41.79 cm), followed by treatments T_{11} - CCC at 400 ppm (40.47 cm), T_{10} - CCC at 300 ppm (39.69 cm), T_7 - PCPA at 25 ppm (39.00 cm), T_4 - 2, 4-D at 2 ppm (38.66 cm), T_{12} - CCC at 500 ppm (38.49 cm), T_8 - PCPA at 50 ppm (38.26 cm), T_1 - NAA at 15 ppm (37.48 cm), T_6 - 2, 4-D at 6 ppm (37.40 cm), T_9 - PCPA at 75 ppm (37.19 cm), T_2 - NAA at 30 ppm (36.65 cm), T_5 - 2, 4-D at 4 ppm (35.50 cm), Whereas, the minimum pod length was recorded in treatment T_0 - Water spray (35.06 cm).

The maximum pod yield per plant was recorded in treatment T_3 - NAA at 45 ppm (312.54 g), followed by treatments T_1 - NAA at 15 ppm (306.02 g), T_9 - PCPA at 75 ppm (305.17 g), T_{11} - CCC at 400 ppm (303.71 g), T_5 - 2, 4-D at 4 ppm (303.56 g), T_8 - PCPA at 50 ppm (299.04 g), T_6 - 2, 4-D at 6 ppm (297.77 g) , T_{10} - CCC at 300 ppm (297.12 g), T_4 - 2, 4-D at 2 ppm (296.57 g), T_0 - Water spray (296.60 g), T_2 - NAA at 30 ppm (296.30 g), Whereas, the minimum pod yield per plant was recorded in treatment T_7 - PCPA at 25 ppm (295.94 g).

The maximum pod yield was recorded in treatment T_3 - NAA at 45 ppm (181.81 q/ha) which is followed by T_7 - PCPA at 25 ppm (175.51 q/ha), T_2 - NAA at 30 ppm (173.72 q/ha), T_{10} - CCC at 300 ppm (172.63 q/ha), T_{11} - CCC at 400 ppm (172.58 q/ha), T_1 - NAA at 15 ppm (171.64 q/ha), T_8 - PCPA at 50 ppm (169.65 q/ha), T_6 - 2, 4-D at 6 ppm (167.72 q/ha), T_4 - 2, 4-D at 2 ppm (167.22 q/ha), T_5 - 2, 4-D at 4 ppm (166.99 q/ha), T_0 - Water spray (166.83 q/ha), T_{12} - CCC at 500 ppm (164.62q/ha), Whereas, the minimum pod yield (122.12 q/ha) was recorded in T_9 - PCPA at 75 ppm (164.2 q/ha).

Table 1: Effect of plant growth regulators on growth and yield of yard long bean var. Shefali

Treatments	Plant height (cm)	No. of branches	Day to first harvest	Pod length (cm)	Pod yield per plant (g)	Pod yield (q/ha)
T_0 Water spray	121.43	6.11	63.22	35.06	296.60	166.83
T_1 NAA at 15 ppm	133.23	10.33	66.55	37.48	306.02	171.64
T_2 NAA at 30 ppm	129.20	7.33	70.44	36.65	296.30	173.72
T_3 NAA at 45 ppm	134.06	8.66	69.25	41.79	312.54	181.81
T_4 2,4-D at 2 ppm	124.76	7.44	69.66	38.66	296.56	167.72
T_t 2,4-D at 4 ppm	117.93	7.66	70.88	35.50	303.56	166.99
T_6 2,4-D at 6 ppm	130.63	5.99	69.99	37.40	297.77	167.72
T_7 PCPA at 25 ppm	126.86	8.44	69.81	39.00	295.94	175.51
T_8 PCPA at 50 ppm	124.66	7.99	70.22	38.26	299.04	169.65
T_9 PCPA at 75 ppm	124.13	7.77	70.55	37.19	305.17	164.20
T_{10} CCC at 300 ppm	132.73	6.22	61.00	39.69	297.12	172.63
T_{11} CCC at 400 ppm	128.80	7.66	66.77	40.47	303.71	172.58
T_{12} CCC at 500 ppm	126.33	7.55	70.44	38.49	295.81	164.62

Conclusion

The present investigation indicate that Naphthalene acetic acid (NAA) have a positive effect on growth attributes of yard long bean. Plant height was significantly influenced by 25, 50, and 75 days after sowing. The sprays of plant growth regulators are effective response in growth, and yield of yard long bean. The findings revealed that treatment T_3 NAA 45 ppm found highly effective for growth parameter as it showed greatest plant height (134.06 cm), Pod length (41.79 cm), Pod yield per plant (312.54 g) and Pod yield per hac (203.97 q/ha), Whereas treatment T_1 – NAA 15 ppm shows highest no. of branches (10.33), treatment T_{10} CCC at 300 ppm shows highest Days for first flowering (46.66), Days of first harvest (61). So it can be concluded that application of NAA helps to increase growth and yield

Acknowledgments
I express my thanks to the Head and staff members of Department of Vegetable Science, Indira Gandhi Krishi Vishwavidyalaya, Raipur, Chhattisgarh.

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