

Optimization of plant growth regulators on growth, yield and quality in chilli (*Capsicum annuum* L.)cv. Bidhan Chilli-4

ABSTRACT

Present experiment entitled “Optimization of plant growth regulators on growth, yield and quality in chilli (*Capsicum annuum* L.) in cv. Bidhan Chilli-4 was conducted at experimental farm of Horticulture and Post-harvest Technology, Palli Siksha Bhavana, Palli Shiksha Bhavana Visva Bharati West Bengal during *rab* season of 2020. The experiment was laid out in randomized block design (RBD) with three replications and ten treatments. The concentrations of treatments were T₁ = NAA 25 ppm, T₂ = NAA 50 ppm, T₃ = NAA 75 ppm, T₄ = GA₃ 5 ppm, T₅ = GA₃ 15 ppm, T₆ = GA₃ 30 ppm, T₇ = CCC 200 ppm, T₈ = CCC 400 ppm, T₉ = CCC 600 ppm and T₁₀, Control. The result of the study revealed that maximum plant height (30.96, 44.40, 54.06 and 67.01 cm at 30, 60, 90 and 120 DAT respectively), number of branches per plant (8.96, 13.43, 18.00 and 23.53 at 30, 60, 90 and 120 DAT respectively), plant spread (19.50, 30.96, 40.10 and 54.73 cm at 30, 60, 90 and 120 DAT respectively), flowers per plant (400.20), fruits per plant (144.33), fruit length (9.63 cm), Breadth of fruit (1.93 cm), yield per plant (399.43 g), yield per plot (98.74 kg/plot), yield per hectare (134.53 q/ha), ascorbic Acid (190.76 mg/100g), capsaicin (0.38%), capsanthin content (296.109 ASTA Unit), Oleoresin (11.57%) and minimum days required to 50% flowering (41.68 DAT), were recorded in treatment T₃- NAA (75 ppm).

Keywords: Chilli, plant growth regulator, NAA, GA₃ and CCC.

INTRODUCTION

Chilli (*Capsicum annuum* L.) is an important vegetable cum spice crop grown in almost all parts of tropical and subtropical regions of the world. It belongs to the family Solanaceae and originated from South America or Mexico. Where, it was domesticated around 7000 BC. The genus *Capsicum* includes 30 species, five of which are cultivated: *Capsicum annuum* L., *C. frutescens* L., *C. chinense* J., *C. pubescens* R. and *C. baccatum* L. (Patelet *al.* 2016). Despite being planted across the nation in a variety of agro-climatic zones, dry chilli is primarily grown in southern states. It is produced in large quantities throughout the nation, both under rainfed and irrigated conditions, on an area of 377 thousand hectares (NHB, Final Estimate 2018-19). The majority of the world's export of chillies comes from India. India exports chilli in the form of dry pods, chilli powder, and oleoresins to the USA, UK, Russia, Canada, Italy, Netherlands, Singapore, Saudi Arabia, UAE, and Germany. Major chilli producing states are Andhra Pradesh, Karnataka, Maharashtra, Odisha, Rajasthan, Tamil Nadu, and Madhya Pradesh.

The pungency of the chilli fruits is due to the presence of capsaicin content. The size of fruit ranges between 1 to 20 cm and has a variety of shapes, including thin, long, conical, and blocky with thick flesh. The majority of the cultivars grown in the nation have strong to mildly strong flavours. Chilli is employed in the food and beverage industries in the form of oleoresin, which allows for improved flavour and colour distribution in food. The vitamins C, B and K are abundant in green chillies. It is frequently used in the preparation of sauces, soups, pickles, curry paste, and curry powder. No other spice has possibly gained as much popularity or has become as essential to the everyday diet of the majority of people in the globe as the chilli. Chaudhary *et al.*, (2006).

After fertilizers, insecticides, and herbicides, plant growth regulators are called next generation agro-chemicals since they help achieve this. Plant growth regulators may be able to boost vegetable productivity. Premature bloom and fruit drop in chilli is a major issue in hot regions like Vidarbha. One of the main production bottlenecks for chillies is poor fruit set caused by hormonal imbalance brought on by a fast increase in atmospheric temperature, which has a direct impact on yield, (Vijayaraghavan, H., and Tamilselvi, C. 2014).

The growth regulators NAA, GA₃, and CCC all have positive effects on various crops. There is a dearth of knowledge regarding the effects of CCC, NAA, and GA₃ on chilli in Vidarbha. Hence, the suggested experiment was designed to examine the impact of NAA, GA₃, and CCC on chilli plant growth, yield, and quality enhancement, (Pandita *et al.*, 1980).

MATERIALS AND METHODS

The trial was performed during *Rabi* season of 2022-23 at experimental farm department of Horticulture, Palli Shiksha Bhavana Visva Bharati West Bengal, The experiment's was laid out in randomised block design (RBD) with three replications and ten treatment combinations *viz.* T₁= NAA 25 ppm, T₂ = NAA 50 ppm, T₃= NAA 75 ppm, T₄= GA₃ 5 ppm, T₅, = GA₃ 15 ppm, T₆ = GA₃ 30 ppm, T₇= (CCC 200 ppm), T₈= CCC 400 ppm, T₉ = (CCC 600 ppm), and T₁₀,= Control. The treatments were applied foliar at 30 DAT, 60 DAT, and 90 DAT. The crop was raised at the spacing of 60×30 cm in plot size of 2 ×1.75m. Standard culture practices recommended for chilli were followed uniformly in all experimental plots.

The following parameters were observed

Growth and yield parameters

Plant height, Number of branches per plant, Plantspreads (cm), Plantspreads (cm), Flowers per plant, Fruits per plant, Length of fruit (cm), Breadth of red fruit Yield per plant (kg), Yield per plot(kg/ plot), Yield per hectare(q/ha).

Quality Parameters-Ascorbic Acid (mg/100g), capsaicin (%), capsanthin content and oleoresin (%).

Statistical Analysis-

Experimental data was subjected to biometrical analysis as per the standard as procedure given by Gomez and Gomez (1984).

RESULTS AND DISCUSSION

A. Growth parameters

The plant height was measured at 30, 60, 90, and 120 days after transplanting. Application of plant growth regulators were found statistically significant at 30 DAT 60 DAT, 90 and 120 DAT. Treatment T₃ (NAA at 75 ppm) produced the highest plant height (30.96, 44.40, 54.06 and 67.01cm at 30,60, 90 and 120 DAT respectively.), followed by treatment T₆ (GA₃ at 15 ppm), (25.83, 37.73, 51.26and 56.96cm at 30,60, 90 and 120 DAT respectively), and the lowest plant height (24.73, 28.53, 42.00, and 48.53cm at 30,60, 90 and 120 DAT respectively) was recorded in treatment T₉ (CCC at 600 ppm). These findings are similar to Anolisaet *al.*, 2020.

A significant difference was recorded in number of branches with the application of various plant growth regulators at 30, 60, 90 and 120 DAT. maximum number of branches(8.96, 13.43, 18.00 and 23.53 at 30, 60, 90 and 120 DAT respectively)in T₃ (NAA at 75ppm)followed by treatment T₆ (GA₃ (30 ppm), (7.33, 11.13, 12.30 and 21.96 at 30, 60, 90 and 120 DAT respectively.)Lowest number of branches in T₁₀ (control) 6.86, 10.86, 15.53, 19.20 at 30, 60, 90 and 120 DAT respectively).

The spread of plant was recorded at 30, 60, 90 and 120 DAT, and showed significant differences due to application of the plant growth regulators. Maximum plantspread(19.50, 30.96, 40.10 and 54.73 cm at 30, 60, 90 and 120 DAT respectively) was found in treatment T₃(NAA at 75 ppm), which was found at par T₆(17.85, 28.86, 32.83 and 50.30 cm at 30, 60, 90 and 120 DAT respectively)cm. whereas, minimum (9.76, 19.0, 28.30 and 37.73cm) in plant spread was recorded in application of treatment T₁₀ (Control). These results are in line with the findings of Kalshyamet *al.*, (2011) and Chandini *et al.*, (2016) in chilli.

Significantly the minimum days(39.06) were required to 50% flowering in chilli plant was recorded in the treatment T₃ (NAA 75 ppm), followed by 40.43 with treatment T₁ (NAA 25

ppm). Whereas, the maximum 43.90 days were required to 50% flowering was recorded due to application of treatment T₇ (NAA 75 ppm). Similar results were also reported by Singh and Mukherjee (2000) in chilli, (Table 1.)

Yield and yield attributes.

Significantly the maximum number of flowers 400.20 per plant in chilli was recorded in the treatment T₃ (NAA 75 ppm), and followed by 390.96 treatment T₅ (GA₃ 15 ppm). However, the minimum 261.66 number of flowers per plant was recorded with treatment T₁₀ (Control).

Analysis of number of fruits per plant data have been shown in Table 2. Significantly the maximum 144.53 number of fruits per plant in chilli crop was recorded in the treatment T₃ (NAA 75 ppm), and followed by 129.20 with treatment T₄ (GA₃ 5 ppm), and the minimum 111.66 number of fruits per plant was observed in treatment T₁₀ (Control). Application of Naphthalene Acetic Acid at 50 ppm concentration and also the GA₃ at 30 ppm recorded significantly maximum number of fruits per plant. Similar results were also reported by Singh and Mukherjee (2000) in chilli

The data in respect of length of fruit indicated significant differences in respect of length of chilli fruit. The data from Table 2 clearly depicted that, significantly the maximum fruit length 9.63 cm length of fruit was obtained in the treatment T₃ and minimum 6.63 cm length of chilli fruit was recorded in treatment T₁₀ (Control).

The data from Table 2 clearly indicated that, significantly the maximum 1.93 cm breadth of fruit was recorded in the treatment T₃ (NAA 75 ppm), and minimum 1.13 cm breadth of chilli fruit was recorded in treatment T₁₀ (Control).

The information in table 2 showed that the treatment T₃ (NAA at 75 ppm) produced the significantly highest yield per plant (399.43 g), yield per plot (9.74 kg), and yield per hectare (134.53 q) in the chilli crop. However, it was noted that treatment T₁₀ (Control) produced the lowest yield of chilli fruit per plant (399.43 g), yield per plot (9.47 kg), and yield per hectare (134.53 q). This might be because NAA might be responsible for increasing photosynthetic activities within the plant, which may have led to more production of carbohydrates and related products, which are responsible for the increase in growth. These findings concur with those of Sultana *et al.*, (2006) studied in chilli.

Quality Parameters

Among the quality parameters, maximum ascorbic acid (190.76 mg/100 gm), capsaicin

(0.38%), capsanthin (296.10 ASTA unit), and oleoresin (11.57%) was reported with the application of T3- NAA (75 ppm) followed by T6- GA3(30 ppm), (ascorbic acid 175.65 mg/100gm, capsaicin 0.31 %, capsanthin content 250.50 ASTA unit, oleoresin 10.21%)and T9- CCC (600 ppm) (ascorbic acid 160.74 mg/100gm, capsaicin0.30 %, capsanthin content 213.94 ASTA unit, oleoresin 9.85 %). Whereas these all qualitative parameters were minimum in T10(ascorbic acid 110.22 mg/100gm, capsaicin 0.25 %, capsanthin content 201.16 ASTA unit and oleoresin 7.75 %), (Table 2.)

UNDER PEER REVIEW

Table1. Effect of plant growth regulators on growth parameters

Treatments	Plantheight (cm)				Numberofbranchesperplant				Plantspread(cm)				Days required to 50%flowering
	30 DAT	60 DAT	90 DAT	120 DAT	30 DAT	60 DAT	90 DAT	120 DAT	30 DAT	60 DAT	90 DAT	120 DAT	
T ₁ - NAA (25 ppm)	24.96	37.63	50.66	63.20	6.10	10.53	15.87	19.33	15.86	27.20	36.20	39.96	40.43
T ₂ - NAA (50 ppm)	25.30	37.10	49.10	59.53	6.00	10.53	14.20	16.76	16.06	25.63	31.33	49.10	42.86
T ₃ - NAA (75 ppm)	30.96	44.40	54.06	67.10	8.96	13.43	18.00	23.53	19.50	30.96	40.10	54.73	39.06
T ₄ - GA ₃ (5 ppm)	24.96	37.76	47.96	58.30	5.66	9.50	12.10	16.20	16.33	26.20	34.20	49.40	41.68
T ₅ - GA ₃ (15ppm)	25.43	38.33	50.26	61.53	6.66	9.43	14.53	19.10	13.10	26.63	35.20	52.20	43.50
T ₆ - GA ₃ (30ppm)	25.83	37.73	51.26	56.96	7.33	11.13	12.30	21.96	17.85	28.86	32.83	50.30	42.53
T ₇ - CCC(200ppm)	27.33	34.20	47.96	52.10	6.01	9.35	13.50	18.09	12.56	20.45	28.56	43.01	43.90
T ₈ - CCC(400ppm)	19.66	30.96	45.76	50.30	6.10	9.65	14.00	22.43	13.00	21.30	30.86	45.53	42.36
T ₉ - CCC (600ppm)	24.73	28.53	42.00	48.53	6.86	10.63	15.53	19.20	13.63	22.20	32.86	46.63	42.38
T ₁₀ - Control	17.83	30.96	47.20	54.33	5.86	8.40	12.53	15.06	9.76	19.00	28.30	37.73	40.63
CV%	3.30	3.60	3.70	4.67	5.50	2.74	3.18	4.94	2.78	6.09	4.98	3.76	2.09
CD%	1.40	2.12	1.40	2.15	2.90	1.90	1.67	2.52	0.87	3.15	2.87	2.20	2.53

Table 2. Effect of plant growth regulators on yield and quality parameters

Treatments	Yield							Quality			
	Flowers per plant	Fruits per plant	Length of fruit (cm)	Breadth of fruit	Yield per plant (g)	Yield per plot (kg/plot)	Yield per hectare (q/ha)	Ascorbic Acid (mg/100g)	Capsaicin (%)	Capsanthin Content (ASTA Unit)	Oleoresin (%)
T ₁ - NAA (25 ppm)	318.16	126.46	8.06	1.30	380.6	8.55	126.16	186.98	0.37	285.01	10.10
T ₂ - NAA (50 ppm)	333.86	126.56	7.86	1.63	359.61	7.35	129.48	189.98	0.37	290.28	10.76
T ₃ - NAA (75 ppm)	400.20	144.53	9.63	1.93	399.43	9.74	134.53	190.76	0.38	296.10	11.57
T ₄ - GA ₃ (5 ppm)	324.20	129.20	8.03	1.30	376.21	7.96	120.68	170.80	0.28	241.91	9.43
T ₅ - GA ₃ (15ppm)	390.96	127.81	8.33	1.36	369.68	6.26	125.65	172.60	0.29	247.98	9.96
T ₆ - GA ₃ (30ppm)	351.73	128.96	8.40	1.56	390.61	8.71	117.48	175.65	0.31	250.50	10.21
T ₇ - CCC(200ppm)	281.40	121.76	7.43	1.23	350.58	6.50	107.23	165.74	0.27	218.67	8.75
T ₈ - CCC(400ppm)	297.96	124.30	8.43	1.60	363.85	8.11	120.30	158.90	0.28	222.82	8.17
T ₉ - CCC (600ppm)	329.83	129.03	8.20	1.36	375.51	7.43	116.36	160.74	0.30	213.94	9.85
T ₁₀ - Control	261.66	111.66	6.63	1.13	330.58	6.25	100.88	110.22	0.25	201.16	7.75
CV%	5.91	4.20	3.05	1.09	2.43	2.09	3.61	4.09	3.54	3.14	2.94
CD @5%	3.09	2.56	1.48	0.87	1.65	2.45	2.43	2.65	1.28	1.39	1.10

CONCLUSION

Based on this study, it can be concluded that application of plant growth regulators significantly influenced the growth, yield, and quality parameters of chilli plants. Treatment T₃ (NAA at 75 ppm) consistently produced the highest plant height, number of branches, plant spread, number of flowers, and number of fruits per plant across all measured intervals. Additionally, T₃ resulted in the shortest time to 50% flowering. This treatment also achieved the highest fruit length, breadth, and yield per plant, per plot, and per hectare.

Regarding quality parameters, T₃ yielded the highest ascorbic acid content, capsaicin, capsanthin, and oleoresin levels. These results suggest that NAA at 75 ppm effectively enhances the photosynthetic activity and overall growth of chilli plants, leading to improved yield and quality. Treatments T₆ (GA3 at 15 ppm) and T₉ (CCC at 600 ppm) also showed positive effects, albeit to a lesser extent compared to T₃. The control treatment (T₁₀) consistently recorded the lowest values across all parameters, highlighting the significant impact of plant growth regulators on chilli cultivation. can be suggested to chilli growers

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