

Comparative study of the effect of plant growth regulators on growth, yield and physiological attributes of chilli, *Capsicum annuum* L cv Kashi Anmol

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ABSTRACT

A field experiment was conducted during Rabi 2014-2015 at the research field of Department of Biological Sciences, Sam Higginbottom Institute of Agriculture, Technology and Sciences, Allahabad, UP. The experiment consisted of 10 treatment combinations comprising plant growth regulators and their mode of application and was laid out in randomized block design with factorial concept having three replications. It comprised four different growth regulators viz NAA (40 ppm), GA₃ (50 ppm), brassinosteroid (50 ppm), 2,4-D (5 ppm) and water as control and two methods of application viz seed soaking for six hours and foliar application at flower bud initiation stage. Among the growth regulators, significantly maximum seed yield per plant (8.30 g), seed yield per fruit (0.35 g), average fresh weight of fruits per plant (39 g) and average dry weight of fruits per plant (19.67 g) were obtained in 40 ppm NAA (G₂) as against control (G₀). Similarly significant increase in seed yield and quality parameters were recorded in foliar spraying of growth regulators (M₂) over seed soaking for six hours (M₁) and also with foliar spraying of 40 ppm NAA at flower bud initiation stage (G₂M₂) over other treatment combinations.

Keywords: Growth regulators; NAA; GA₃; brassinosteroid, 2,4-D

INTRODUCTION

Chilli, *Capsicum annuum* L is very important for agricultural economy and also has great demand in processing industries. Chilli is rich source of vitamins A, C and E. Recently Russian scientists have identified Vitamin P in green chillies which is considered to be important as it protects from secondary irradiation injury. Hundred

grams of edible portion of capsicum provides 24 kcal of energy, 1.3 g of protein, 4.3 g of carbohydrate and 0.3 g of fat (Anon 2001). World's chilli area accounts for 1.5 million hectares and production around seven MT. The largest producer of chillies in the world is India accounting for production of 11.53 lakh tonnes in 2005-2006 followed by China with a production of around four lakh tonnes, Mexico with

around three lakh tonnes and Pakistan with three lakh tonnes (Anon 2008). The production of chilli is reduced due to flower and fruit drop which is caused by physiological and hormonal imbalance in the plants particularly under unfavourable environments such as extremes of temperature (Erickson and Makhart 2001). Studies on the effect of plant growth regulators on solanaceous fruit and vegetable crops have revealed that the application of some of the plant growth regulators is effective in reducing the flower and fruit drop thereby enhancing production of chilli per unit area per unit time. The varying responses of chilli to plant growth regulators have been reported by Balraj et al (2002). Hormones regulate physiological process and synthetic growth regulators may enhance growth and development of field crops thereby increased total dry mass of a field crop (Chibu et al 2000, Dakua 2002, Islam 2007, Cho et al 2008). Incorporation of plant growth regulators during pre-soaking, priming and other pre-sowing treatments in many vegetable crops has improved seed performance.

Typical responses to priming are faster and closer spread of times to emergence over all seedbed environments and wider temperature range of emergence leading to better crop stands and hence improved yield and harvest quality especially under suboptimal and stress growing conditions in field (Halmer 2004). Plant growth regulators (PGRs) have a

particularly interesting role in modern agriculture (Ashraf et al 2010). In Greece and other European countries the PGRs are commonly used on food crops (melon, pepper, celery etc) in order to improve and accelerate plant productivity. Brassinolides (0.5 ppm), NAA (40 ppm), IAA (10 ppm), SA (50 ppm) and Kinetin (50 ppm) were able to improve the total chlorophyll content, nitrate reductase activity, soluble protein and thereby pod yield in soybean (Senthil 2003). BRs are plant growth promoting natural products with structural similarities to animal steroid hormones. BRs are known to play a vital role in the regulation of ion uptake (Khripach et al 2000).

MATERIAL and METHODS

A field experiment was conducted in Rabi 2014-2015 at the research field of Department of Biological Sciences, Sam Higginbottom Institute of Agriculture, Technology and Sciences, Allahabad, UP situated at 25° 24' 42" N latitude, 81° 50' 56" E longitude and 98 m amsl. The climate at Allahabad is typical semiarid and subtropical which prevails in the eastern part of UP. The extremes of both summer and winter are experienced here while the minimum temperature in winter may reach 4°C and the maximum temperature in summer is up to 47°C. The experiment consisted of 10 treatment combinations comprising plant growth regulators viz G₀ (water as control), G₁ (NAA 40 ppm), G₂

(GA₃ 50 ppm), G₃ (brassinosteroid 50 ppm) and G₄ (2,4-D 5 ppm) and their mode of application viz M₁ (seed soaking with plant growth regulators for 6 hours) and M₂ (foliar spraying of plant growth regulators at flower bud initiation stage).

The experiment was laid out in randomized block design with factorial concept in three replications having 30 plots. Seeds were soaked in NAA (40 ppm), GA₃ (50 ppm), brassinosteroid (50 ppm), 2,4-D (5 ppm) and water for 6 hours and sown in the seed bed. For spraying of growth regulators at flower bud initiation stage, seedlings were raised in separate beds. Seeds were sown in rows 6 cm apart and 0.5 cm deep and were watered regularly until transplanting.

RESULTS and DISCUSSION

Maximum plant height after 90 DAT was found in treatment combination G₃M₂ (54.20 cm) followed by G₃M₁ (53.33 cm) with minimum in G₀M₁ (45.22 cm). Maximum number of branches was recorded in G₁M₂ (22.00) followed by G₁M₁ and G₃M₂ (21.00 each) as against 17.00 in G₀M₁ (Table 1).

The treatment combination of G₂M₂ recorded numerically higher chlorophyll A content in leaf (1.90 mg/g) followed by G₂M₁ (1.86 mg/g) and the lowest (1.25 mg/g) was recorded in G₀M₁ (Table 2). The treatment combination of G₁M₂ recorded

numerically higher chlorophyll B content in leaf (1.95 mg/g) followed by G₂M₂ (1.90) mg/g and the lowest (1.29 mg/g) was recorded in G₀M₁. G₂M₂ recorded numerically higher carotenoid content (1.84 mg/g) which was at par with G₂M₁ (1.83 mg/g) and the lowest (1.22 mg/g) was recorded in G₀M₁. Significantly maximum protein content (0.28 mg/g) was recorded in G₁M₂ and the lowest (0.14 mg/g) in G₀M₁.

Maximum number of fruits was recorded in G₁M₂ (26.67) followed by G₂M₂ (25.33) and the lowest (14.67) in G₀M₁. G₁M₂ (8.10 cm), G₃M₂ (8.10 cm), G₁M₁ (8.07 cm) and G₂M₂ (8.03 cm) recorded significantly highest fruit length all being on par with each other whereas lowest (7.23 cm) was found in G₀M₁. The treatment combination G₃M₂ recorded significantly highest (1.25 cm) fruit diameter whereas lowest (0.73 cm) was in G₀M₂ (Table 3).

The combination of G₁M₂ recorded significantly higher (8.30 g) seed weight per plant which was on par with G₂M₂ (7.80 g). The seed weight per fruit was highest in G₁M₂ (0.35 g), G₃M₂ (0.33 g) and G₂M₂ (0.32 g) the three being at par and lowest was in G₀M₁ (0.19 g). Fresh fruit weight was maximum in G₁M₂ (39.00 g), G₃M₂ (39.00 g), G₁M₁ (38.67 g) and G₂M₂ (38.33 g) all being at par and lowest in G₀M₁ (26.00 g). The highest dry fruit

Table 1. Effect of different plant growth regulators on plant growth attribute of chilli

Treatment	Plant height (cm)			# branches/plant		
	30 DAT	60 DAT	90 DAT	30 DAT	60 DAT	90 DAT
G ₀ M ₁	13.33	25.33	45.22	9.67	10.00	17.00
G ₁ M ₁	15.34	31.66	52.33	11.34	14.00	21.00
G ₂ M ₁	16.00	30.33	50.33	12.34	12.00	17.67
G ₃ M ₁	14.67	30.33	53.33	11.66	12.33	19.67
G ₄ M ₁	15.67	29.33	48.20	11.00	11.33	17.67
G ₀ M ₂	13.67	28.33	46.20	10.00	10.67	16.33
G ₁ M ₂	14.33	33.66	53.00	10.33	15.00	22.00
G ₂ M ₂	14.00	32.22	51.00	10.33	13.00	19.67
G ₃ M ₂	14.33	30.66	54.20	10.66	13.67	21.00
G ₄ M ₂	14.67	30.33	48.33	10.66	12.33	19.33
SEm±	0.42	0.43	0.38	0.44	0.34	0.43
CD _{0.05}	1.22	1.30	0.77	1.30	0.70	0.88

Table 2. Effect of plant growth regulators on bio-chemical attributes of chilli

Treatment	Chlorophyll A (mg/g)	Chlorophyll B (mg/g)	Carotinoid (mg/g)	Protein content (mg/g)
G ₀ M ₁	1.25	1.29	1.22	0.14
G ₁ M ₁	1.50	1.87	1.58	0.25
G ₂ M ₁	1.86	1.85	1.83	0.23
G ₃ M ₁	1.74	1.72	1.76	0.22
G ₄ M ₁	1.52	1.65	1.60	0.21
G ₀ M ₂	1.30	1.30	1.23	0.17
G ₁ M ₂	1.52	1.95	1.60	0.28
G ₂ M ₂	1.90	1.90	1.84	0.27
G ₃ M ₂	1.80	1.80	1.80	0.25
G ₄ M ₂	1.60	1.62	1.65	0.23
SEm±	0.023	0.018	0.017	0.004
CD _{0.05}	0.048	0.036	0.034	0.009

weight was observed in G₁M₂ (19.67 g) and lowest in G₀M₁ (10.67 g). 1000-seed weight was maximum and par in G₁M₂ (4.20 g), G₂M₂ (4.15 g), G₃M₂ (4.10 g) and G₄M₂ (4.05 g) and lowest in G₀M₁ (3.65 g), G₄M₁ (3.70 g) and G₃M₁ (3.80 g) the latter three being at par.

CONCLUSION

Treatment of NAA (40 ppm) was found to be optimum as it recorded better growth, higher fruit yield, seed yield and quality in paprika chilli cv Kashi Anmol. Foliar spray of growth regulators at flower

Plant growth regulators effect on chilli

Table 3. Effect of plant growth regulators on yield attributes of chilli

Treatment	# fruits/ plant	Fruit length (cm)	Fruit diameter (cm)	Seed wt/ plant (g)	Seed wt /fruit (g)	Fresh fruit wt (g)	Dry fruit wt (g)	1000- seed wt (g)
G ₀ M ₁	14.67	7.23	0.73	5.80	0.19	26.00	10.67	3.65
G ₁ M ₁	24.33	8.07	1.00	7.30	0.30	38.67	17.33	4.08
G ₂ M ₁	22.33	7.90	0.93	6.30	0.29	37.33	16.33	3.99
G ₃ M ₁	23.67	8.00	1.07	5.90	0.27	37.00	17.67	3.80
G ₄ M ₁	21.67	7.63	0.57	5.80	0.25	35.33	16.00	3.70
G ₀ M ₂	15.00	7.70	0.77	6.40	0.24	26.33	11.00	3.87
G ₁ M ₂	26.67	8.10	1.10	8.30	0.35	39.00	19.67	4.20
G ₂ M ₂	25.33	8.03	0.95	7.80	0.32	38.33	18.00	4.15
G ₃ M ₂	24.34	8.10	1.25	7.50	0.33	39.00	18.7	4.10
G ₄ M ₂	22.00	7.77	0.87	7.10	0.27	34.67	17.33	4.05
SEm±	0.480	0.101	0.031	0.344	0.020	0.390	0.413	0.086
CD _{0.05}	0.980	0.207	0.064	0.701	0.040	0.797	0.842	0.175

bud initiation stage was found to be optimum for obtaining higher fruit yield, seed yield and quality.

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