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## Effect of foliar application of biostimulants on growth and yield of chilli (*Capsicum annuum* L.)

Mamoni Deori, Anand Kumar Singh and Sonam Kumari

**Abstract**

A field experiment was conducted to study the “Effect of biostimulants on growth and yield of chilli (*Capsicum annuum* L.) cv. Kashi Anmol” during rabi season 2022-2023 at Vegetables Research Farm, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi, Uttar Pradesh, India. Among the various treatments, the foliar application of Dhanzyme Gold (Liquid) @600 ml/ha with two applications at 30 and 60 days after planting significantly increased the growth and yield attributes when compare to all other treatments. It recorded the highest plant height at 30 DAT (24.68 cm), at 45 DAT (34.96 cm) and at harvest (84.38 cm), maximum number of primary branches per plant at 30 DAT (6.98) and at harvest (13.47), minimum days to 50% flowering (58.02 days), number of fruits per plant (338.40), highest fruit length (7.82 cm), maximum fruit width (1.13 cm), highest fruit weight (3.66 g), maximum number of seeds per fruit (111.09 seeds), highest fruit yield (205.68 q/ha) and maximum test weight (2.95 g).

**Keywords:** Chilli, biostimulants, dhanzyme gold, growth and yield

**1. Introduction**

Chilli (*Capsicum annuum* L.) is the major species commercially grown in India both for green (vegetables) and as dry fruit (as spices). It is botanically ‘berry’ and belong to the family Solanaceae (Chadha, 2001) [2]. Chillies are highly nutritious, containing approximately twice the amount of vitamin C found in citrus fruits. Even after cooking, they retain about 70% of their vitamin C content. Dried chillies are an excellent source of vitamin A, β-carotene and bioflavonoids. The pigment capsanthin is responsible for the red colour of chilli and when chilli is heated, the pungent compound capsaicin (C<sub>18</sub>H<sub>27</sub>NO<sub>3</sub>) is released. Capsaicin is formed through the condensation of 3-hydroxy-4-methoxybenzylamine and decylenic acid. This compound emits a highly irritating vapour, causing the characteristic spiciness and heat of chilli peppers (Hazra and Som, 2005) [6]. The centre of origin of chilli is considered to be in South America. Chilli was first introduced to India by Portuguese near the end of the 15<sup>th</sup> century. The largest chilli growing states, which account for more than 80% of the total area and output are Andhra Pradesh, Karnataka, Maharashtra, Orissa, Tamil Nadu, Madhya Pradesh, West Bengal and Rajasthan. Andhra Pradesh has been in the lead both in terms of area and output, providing on average 25% of the total area and more than 40% to 50% of the overall production (Verma *et al.*, 2015) [14]. Major chilli growing countries are Mexico, Japan, Ethiopia, Uganda, Nigeria, Thailand, Turkey, Indonesia, China and Pakistan. Chilli has originated from the wild and weedy species *Capsicum annuum* var. *minimum*. There are a total of 20 wild species of the capsicum genus and 5 cultivated species. The cultivated species include *Capsicum annuum* var. *annuum*, *Capsicum annuum* var. *pendulum*, *Capsicum annuum* var. *chinense*, *Capsicum annuum* var. *frutescens* and *Capsicum annuum* var. *pubescens* (Swarup, 2016) [13]. Among the cultivated species, *Capsicum annuum* var. *annuum* is the most commonly grown commercially. Its somatic chromosome number is 2n=24. Polyploids with 2n=36, 48 and aneuploids with 2n=25 have been reported (Kumar and Peter, 2020) [7].

**2. Materials and Methods**

A field experiment was carried out to study the impact of biostimulants on growth and yield characters of chilli (*Capsicum annuum* L.) during 2022-2023 at Vegetables Research Farm, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi, Uttar Pradesh, India. The area is situated in the eastern region of Uttar Pradesh in the middle of the north alluvial plain on the left side of river Ganges.

It is situated at an altitude of 129.23 m above mean sea level with coordinates of 25° 264' North latitude and 83 °993' East longitude almost in the centre of Indo-Gangetic belt. The annual rainfall is about 700 to 1100 mm, most of which is received from July to September with scattered showers in winter from the North -East monsoon. During the course of investigation, the recorded maximum temperatures ranged between 25 °C and 42 °C, while the minimum temperatures ranged from 8 °C to 22 °C. The soil of experimental field was Indo-Gangetic alluvial in origin and it was sandy loam, coarse texture, good water holding capacity and slightly acidic to neutral pH range. The trial was laid out in Randomized Block Design (RBD) with eight treatments and three replications. Biostimulants were foliar sprayed at 6-8 leaf stage, at the time of fruit initiation and at the time of fruit development. Treatments involving different doses of Dhanzyme Gold (liquid) T<sub>1</sub> - @ 300 ml/L, T<sub>2</sub> - @ 400 ml/ha, T<sub>3</sub> - @ 500 ml/ha, T<sub>4</sub> - @ 600 ml/ha, T<sub>5</sub> - @ 700 ml/ha, T<sub>6</sub> - @ 800 ml/ha, T<sub>7</sub> - @ 900 ml/ha and T<sub>8</sub> - Control. Each treatment plot of 20 to 25 m<sup>2</sup> had 25 plants that were all treated to the same cultural practises throughout the trial. The experiment was carried out on chilli plants with a spacing of 60 × 50 cm<sup>2</sup>. The variety utilized in the trial was Kashi Anmol, which was produced in 2006 by the ICAR-Indian Institute of Vegetable Research in Varanasi. The days to 50% flowering were calculated from daily observations. It was estimated by calculating the number of days it took 50% of the plants (about 13 plants) in a particular plot to produce flowers for the first time. Plant height of 5 tagged plants from each plot was measured using a 90 cm long scale from the base to the terminal growth point of the stem, and the average height of the plant was calculated at 30, 45 (DAT) and at harvest. Similarly, at 30 and 45 DAT, the total number of branches growing from the main stalk of five tagged plants from each plot was counted. The total quantity of fruits per plant was estimated by picking fruits from previously tagged plants and counting them after each harvest. Five fruits were picked at random from each replication to determine fruit length (cm), wide (cm) and weight (g). The length and wide of five randomly selected fruits were measured using a digital Vernier calliper, and an average was calculated. The weight of these randomly picked fruits was measured using a digital weighing machine. A single fruit was picked at random from each plot and the total quantity of seeds was recorded. A total of 1000 seeds were removed from fruits and weighed on a digital weighing machine.

### 3. Results and Discussions

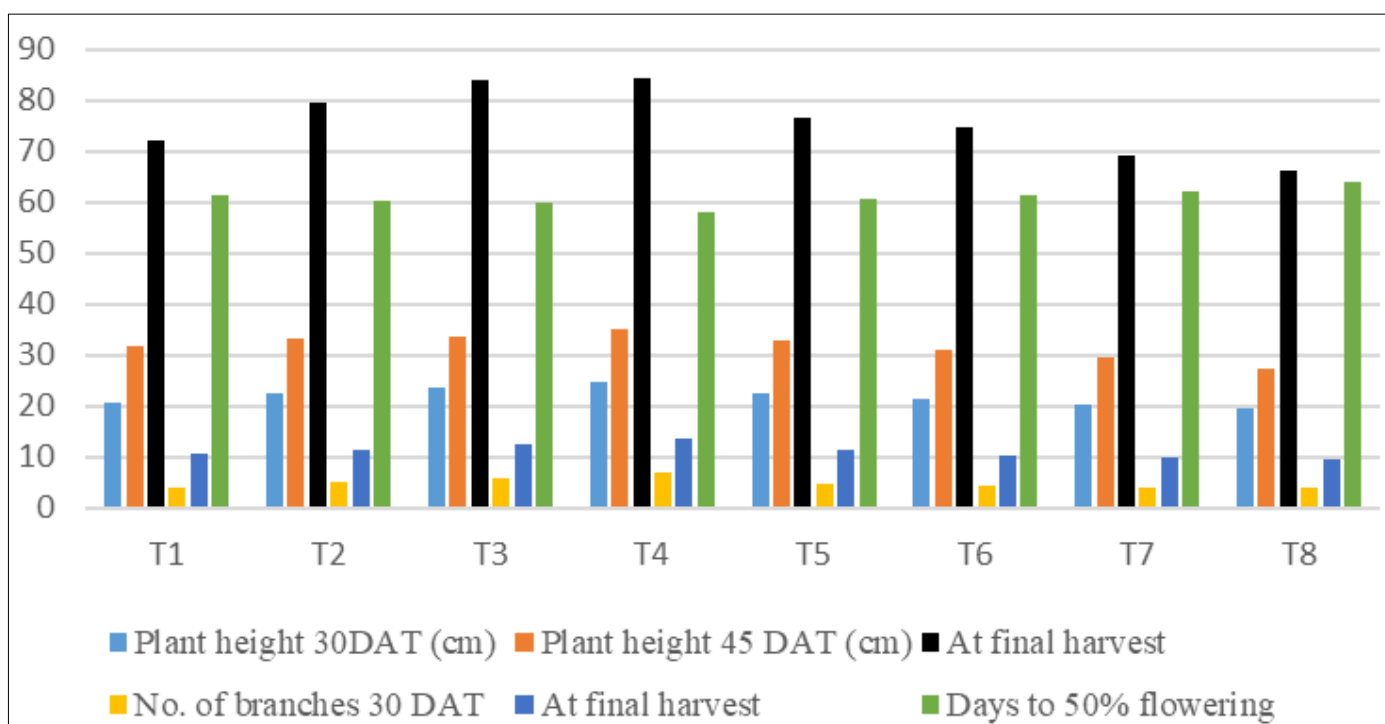
The outcomes derived from the conducted experiments are presented in Table 1 and Table 2. The results of the experiment are statistically examined and displayed in the relevant tables and figures. Biostimulants increased almost all growth and yield characteristics significantly. Plant height significantly increased in treatment T<sub>4</sub>- Foliar application with Dhanzyme Gold (liquid) @ 600 ml/ha (24.68cm), (34.96cm) and (84.38 cm) at 30 DAT, 45 DAT and at final harvest. Whereas, treatment T<sub>8</sub>- Untreated plant measured a minimum plant height of 19.67 cm, 27.32 cm and 66.33cm at 30 DAT, 45 DAT and at final harvest. The increased cell division, cell elongation and presence of auxin or auxin-like substances,

which either directly or indirectly affect plant development and other physiological processes, may be the causes of the increased plant height. These outcomes are in accordance with past studies in the fields of chilli by Ghoname *et al.* (2009)<sup>[4]</sup>, Fathima and Denesh (2013)<sup>[3]</sup>, Manas *et al.* (2014)<sup>[8]</sup> and Ruban *et al.* (2019)<sup>[9]</sup>. The number of primary branches was recorded maximum in T<sub>4</sub>- Foliar application with Dhanzyme Gold (liquid) @ 600 ml/ha × 2 applications at 30 and 60 days after transplanting (6.98) and (13.47) in all growth stages as compare to control plot. Increased branches may be the result of the foliar application of biostimulants, since biostimulants provide essential nutrients for plant growth and development. These results are in conformity with the earlier findings of Ghoname *et al.* (2009)<sup>[4]</sup>, Sarojnee *et al.* (2009)<sup>[11]</sup> in chilli, Fahima and Denesh (2013)<sup>[3]</sup> in hot pepper. The range of days to 50% flowering was 58.02 to 64.08 days. The earliest 50 percent flowering (58.02 days) was observed in T<sub>4</sub>- Foliar application with Dhanzyme Gold (liquid) @ 600 ml/ha × 2 applications at 30 and 60 days after transplanting. The delayed flowering (45.67 days) was observed in T<sub>8</sub> control plot. In the case of chillies, early flowering may be caused by the availability of balanced nutrients and the release of growth-promoting compounds from biostimulants, which promote early flower initiation. The results were similar with Ruban *et al.* (2019)<sup>[9]</sup> in chilli and Gitau *et al.* (2022)<sup>[5]</sup> in tomato. On application of treatment T<sub>4</sub>- Foliar application with Dhanzyme Gold (liquid) @ 600 ml/ha 2 applications at 30 and 60 days after transplanting, parameters including number of fruits per plant, fruit yield and yield (q/ha) and average fruit weight increased to a significant level (338.40 number of fruits per plant), (205.68 q/ha) and (3.66 g). While the control plot showed these parameters' minimal values. The improved fruit set may have resulted from higher pollen tube ovule penetration and postponed ovule senescence, which preserved the enhanced fruit set. The results are in agreement with Sarojnee *et al.* (2009)<sup>[11]</sup> in chilli, Sarhan (2011)<sup>[10]</sup> in potato and Sheetal *et al.* (2021)<sup>[12]</sup> in tomato. In terms of yield characteristics like fruit length (7.82 cm), fruit width (1.13 cm) and number of seeds per fruit (111.09 seeds), treatment T<sub>4</sub> also found to be superior to all other treatments. However, control proved to be minimum value. It's possible that the increased length of the fruit could be attributed to the presence of precursors of growth substances such as indole-3-acetic acid (IAA), which is a type of auxin, a class of plant hormones responsible for promoting cell elongation and growth. The results were in conformity with the previous works of Sarojnee *et al.* (2009)<sup>[11]</sup>, Arthur *et al.* (2022)<sup>[1]</sup> in chilli. The number of seeds is more in treatment with biostimulants application as compared to control as the application of biostimulants augmented the availability of nutrients and thus significantly increased the number of seeds per fruit. The application of Dhanzyme Gold (liquid) @ 600 ml/ha was recorded the highest test weight value (2.95 grams), followed by Dhanzyme Gold (liquid) @ 500 ml/ha (2.79 grams), whereas the minimum weight of 1000 seeds was recorded in treatment T<sub>8</sub>- Control plot (1.89 g). The substantial rise in seed test weight can be primarily attributed to the improved uptake of nutrients and the enhanced accessibility of these nutrients to the plants.

**Table 1:** Mean performance of various doses of biostimulants (liquid) on growth parameters of chilli

Treatments		Plant height (cm)			No. of primary branches		Days to 50% flowering
Dhanzyme Gold (liquid)	Dose (ml/ha)	30 DAT	45 DAT	At final harvest	30 DAT	At final harvest	
T <sub>1</sub>	300	20.58	31.92	72.14	3.98	10.81	61.27
T <sub>2</sub>	400	22.67	33.26	79.66	5.21	11.46	60.44
T <sub>3</sub>	500	23.66	33.70	83.91	5.99	12.63	59.93
T <sub>4</sub>	600	24.68	34.96	84.38	6.98	13.47	58.02
T <sub>5</sub>	700	22.47	32.78	76.55	4.87	11.41	60.60
T <sub>6</sub>	800	21.32	30.93	74.60	4.29	10.27	61.35
T <sub>7</sub>	900	20.22	29.67	69.16	3.96	9.88	62.20
T <sub>8</sub>	--	19.67	27.32	66.33	3.85	9.61	64.08
S.E.(m)	--	0.57	0.47	0.70	0.15	0.20	0.47
CD at 5%	--	1.73	1.43	2.14	0.47	0.62	1.45

T<sub>1</sub>- Dhanzyme Gold (liquid) @ 300 mL/ha foliar application × 2 applications at 30 and 60 DAT, T<sub>2</sub>- Dhanzyme Gold (liquid) @ 400 mL/ha foliar application × 2 applications at 30 and 60 DAT, T<sub>3</sub>- Dhanzyme @ 500 mL/ha foliar application × 2 applications at 30 and 60 DAT, T<sub>4</sub>- Dhanzyme Gold (liquid) @ 600 mL/ha foliar application × 2 applications at 30 and 60 DAT, T<sub>5</sub>- Dhanzyme Gold (liquid) @ 700 mL/ha foliar application × 2 applications at 30 and 60 DAT, T<sub>6</sub>- Dhanzyme Gold (liquid) @ 800 mL/ha foliar application × 2 applications at 30 and 60 DAT, T<sub>7</sub>- Dhanzyme Gold (liquid) @ 900 mL/ha foliar application × 2 applications at 30 and 60 DAT, T<sub>8</sub>-Control



**Fig 1:** Effect of biostimulants (liquid) on plant height, number of branches and days to 50% flowering

**Table 2:** Mean performance of various doses of biostimulants (liquid) on yield parameters of chilli

Treatments		Fruit length (cm)	Fruit diameter (cm)	Number of fruits per plant	Average fruit weight (g)	Fruit yield (q/ha)	Numbers of seed per fruit	Test weight of seeds (g)
Dhanzyme (liquid)	Dose (ml/ha)							
T <sub>1</sub>	300	7.20	0.90	304.37	3.26	189.31	98.36	2.25
T <sub>2</sub>	400	7.37	0.99	318.06	3.39	196.45	104.02	2.46
T <sub>3</sub>	500	7.40	1.02	333.98	3.51	203.47	106.97	2.79
T <sub>4</sub>	600	7.82	1.13	338.40	3.66	205.68	111.09	2.95
T <sub>5</sub>	700	7.34	0.95	316.98	3.36	194.63	102.21	2.34
T <sub>6</sub>	800	7.30	0.92	310.28	3.33	187.91	97.82	2.21
T <sub>7</sub>	900	7.21	0.91	297.98	3.24	186.77	95.40	1.99
T <sub>8</sub>	--	6.70	0.87	264.65	2.93	170.01	88.03	1.89
S.E.(m)	--	0.15	0.01	0.51	0.08	0.47	0.67	0.09
CD at 5%	--	0.45	0.04	1.57	0.24	1.43	2.06	0.29

T<sub>1</sub>- Dhanzyme Gold (liquid) @ 300 mL/ha foliar application × 2 applications at 30 and 60 DAT, T<sub>2</sub>- Dhanzyme Gold (liquid) @ 400 mL/ha foliar application × 2 applications at 30 and 60 DAT, T<sub>3</sub>- Dhanzyme @ 500 mL/ha foliar application × 2 applications at 30 and 60 DAT, T<sub>4</sub>- Dhanzyme Gold (liquid) @ 600 mL/ha foliar application × 2 applications at 30 and 60 DAT, T<sub>5</sub>- Dhanzyme Gold (liquid) @ 700 mL/ha foliar application × 2 applications at 30 and 60 DAT, T<sub>6</sub>- Dhanzyme Gold (liquid) @ 800 mL/ha foliar application × 2 applications at 30 and 60 DAT, T<sub>7</sub>- Dhanzyme Gold (liquid) @ 900 mL/ha foliar application × 2 applications at 30 and 60 DAT, T<sub>8</sub>-Control

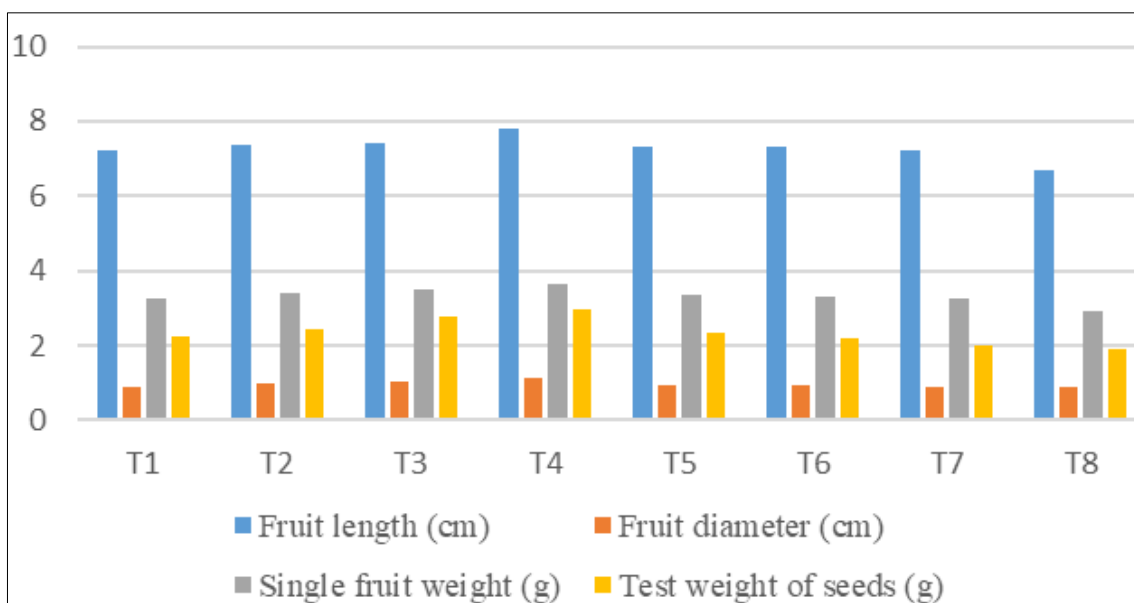


Fig 2: Effect of biostimulants (liquid) on fruit length, fruit diameter, average fruit weight and test weight of seed

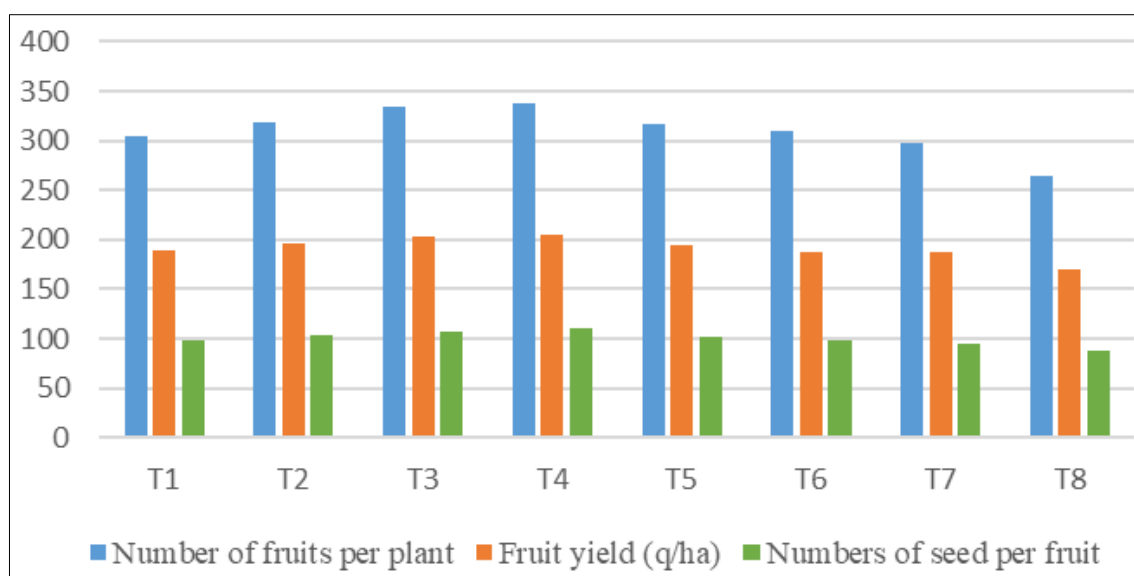


Fig 3: Effect of biostimulants (liquid) on number of seeds per fruit, number of fruit per plant and fruit yield

#### 4. Conclusion

The findings of the present investigation showed that using different concentrations of Dhanzyme Gold (liquid) increased the production, growth and yield characteristics of chilli. The foliar spray of Dhanzyme Gold (liquid) @ 600 ml/ha increased most of the growth and yield parameters as compared to other treatments. While the foliar spray of Dhanzyme Gold (liquid) at various dosages significantly differed in terms of quality parameters. Therefore, the application of Dhanzyme Gold (liquid) at 600 ml/ha can be recommended for further study in chilli cultivation.

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