



Effect of Different Quantities of Bio Stimulant on Chilli Growth, Quality and Yield

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

Article Information

DOI: 10.9734/IJPSS/2024/v36i64628

Open Peer Review History:

This journal follows the Advanced Open Peer Review policy. Identity of the Reviewers, Editor(s) and additional Reviewers, peer review comments, different versions of the manuscript, comments of the editors, etc are available here: <https://www.sdiarticle5.com/review-history/116253>

Original Research Article

Received: 27/02/2024

Accepted: 29/04/2024

Published: 02/05/2024

ABSTRACT

A present investigation was carried out with title “**Effect of different quantities of bio stimulant on chilli growth, quality and yield**” at the central research farm, Department of Horticulture, Naini Agricultural Institute, Sam Higginbottom University of Agriculture Technology and Sciences, Prayagraj, Uttar Pradesh during kharif, 2023-24 with a view to identify the effects of different doses of bio stimulant and its role in growth, yield and quality of Chilli variety NS-1701. The experiment was laid in the randomized block design with 9 treatments and 3 replications with different combination of different quantities of bio stimulant. The treatment T7 (3.0 L/hac. Amalgerol essence) performed best in terms of plant height (79.68), number of branches (8.53), days to first flower initiation (79.30), number of fruits per plant (122.36), fruit length (7.81), individual fruit weight (2.90gm), fruit yield per plant (258.13gm). The highest benefit cost ratio was found at 3.69 in the same treatment.

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Keywords: Amalgerol essence; benefit cost ratio; bio stimulant; fruit yield; NS-1701; performance; treatment.

1. INTRODUCTION

“Chilli (*Capsicum annum*) are berries belonging to family Solanaceae, it is one of the most valuable commercial crops grown in India and consumed as green (as vegetable) and dry fruit (as spice). It has its center of origin in American tropics. It is used as spice in a variety of cuisines all over the world as a basic ingredient. Capsicum not only gives attractive colour and flavour to the foods but also provides vitamin C, vitamin A, vitamin B complex, vitamin E and minerals. Capsaicin present in chilli pepper is used as medicine for treatment of many human diseases like Lumbago, Neuralgia, Rheumatic disorders and non-allergic Rhinitis, etc” [1].

“Chilli (*Capsicum annum* L.) is an important spice crop grown extensively in most parts of Maharashtra. The fruits are available in the market throughout year since chillies are produced in all the seasons in one or other part of the state. The production of chilli is governed not only by the inherent genetic yield potential but it is greatly influenced by several environmental factors and management practices. The production of chilli is adversely affected due to flower and fruit drop which is caused by physiological and hormonal imbalance in the plants particularly under unfavorable environments, such as extremes of temperature i.e., too low or high temperatures” [2].

“The plants have a green cylindrical herbaceous main stem that is semi-woody at the base and slightly pubescent; grow up to 1.5 m in height. Flowers are perfect, regular and composed of 6-7 sepals partially fused together. The androecium is composed of 7 equal stamens, bilocular and dehiscence inwards or terminal. The ovary is superior, of 2-3 carpels with a single style and stigma. The leaves are about 12 cm long and 7.5 cm wide and are unequal in shape. The fruit is a berry, usually consumed when they reach maturity. The fruit is hollow with many seeds, found in different colours like green, orange, white, yellow and red. Chillies get their colour from a colouring compound called capsanthin. The hot pungent taste is due to capsaicin and is widely cultivated from July to December in northern state of India” [3]. Chilli

flowers are self-pollinated, cross pollination occurs through bees, wasps, which is common when it is cultivated under field conditions.

“The combination of bio stimulants with other inputs such as fertilizers, pesticides, and herbicides can enhance their efficacy and reduce the negative impact on the environment. For example, the application of a bio stimulant containing amino acids, seaweed extract, and fulvic acid in combination with chemical fertilizers increased the yield of chilli and reduced the use of chemical fertilizers by 25%” [4]. Overall, the use of bio stimulants in chilli cultivation has shown promising results in improving plant growth, yield, and quality while reducing the dependence on synthetic inputs. However, further research is needed to optimize their application rates, timing, and formulations to achieve maximum benefits.

2. MATERIALS AND METHODS

2.1 Experimental Site and Location

The experiment was conducted during kharif season of the year 2023–24 at Horticulture Research Farm, Department of Horticulture, Naini Agricultural Institute, Sam Higginbottom University of Agriculture Technology and Sciences, Prayagraj. The experimental site is located in the sub-tropical region which is located at 25° 27' N latitude, 81° 56' E longitude and 98 m above the mean sea level.

2.2 Climate Condition

Area of Prayagraj district comes under subtropical belt in the south east of Uttar Pradesh, which experience extremely hot summer and fairly cold winter. The maximum temperature of the location reaches up to 46°C – 48°C and seldom falls as low as 4°C – 5°C. The relative humidity ranges between 20 to 94 per cent. The average rainfalls in this area are around 1013.4 mm annually.

2.3 Statistical Analysis

Statistical analysis the statistical analysis of the data was carried out using STATISTICA (7.0) software.

Table 1. Details of treatment combination

Treatment Symbol	Treatment Combination
T1	Control (RDF)
T2	Amalgerol Essence 0.5 L /ha. is added to the amount of water required for foliar spray. At different stages of plant (ABCD)
T3	Amalgerol Essence 1.0 L /ha. is added to the amount of water required for foliar spray. At different stages of plant (ABCD)
T4	Amalgerol Essence 1.5 L /ha. is added to the amount of water required for foliar spray. At different stages of plant (ABCD)
T5	Amalgerol Essence 2.0 L /ha. is added to the amount of water required for foliar spray. At different stages of plant (ABCD)
T6	Amalgerol Essence 2.5 L /ha. is added to the amount of water required for foliar spray. At different stages of plant (ABCD)
T7	Amalgerol Essence 3.0 L /ha. is added to the amount of water required for foliar spray. At different stages of plant (ABCD)
T8	Amalgerol Essence 3.5 L /ha. is added to the amount of water required for foliar spray. At different stages of plant (ABCD)
T9	Amalgerol Essence 4.0 L /ha. is added to the amount of water required for foliar spray. At different stages of plant (ABCD)

3. RESULTS AND DISCUSSION GROWTH PARAMETERS

Crop growth parameters in chilli were measured in terms of days to germination plant height (cm), Plant spread at 30, 60, 90 DAT and at Harvest are shown in Table 2. The maximum number of days taken to germination of plants with the treatment T2 (0.5 L/hac Amalgerol Essence) was 6.80 days and the minimum number of days to germination was found the treatment (control). The application of bio stimulants might have improved the soil physical and chemical properties and leading to the adequate supply of nutrients to the 4 plant which might have promoted the early germination. Similar Finding were reported [5].

Maximum height was reported 3.0 L/hac. (Amalgerol essence) (T7) with an average height of 79.68 cm followed by 2.5 L/hac. (Amalgerol essence) (T6) with an average height recorded 75.83 cm which was significantly higher from rest of treatments. All the treatments significantly increase plant height as compared to control. Minimum plant height 71.33 cm was recorded (T1). The present study was in line with Choudhary *et al.*, [3] who studied the effect of plant growth regulators on physiological parameters, soil temperature, picking patterns and yield in capsicum and reported that chili plants had higher plant height.

The highest number of primary branches per plant at 90 DAS was observed in 3.0 L/hac. (Amalgerol essence) (T7) (8.53) which were

statistically at par with all other treatments. All the different quantities of bio stimulant had the positive effect on generating and retaining higher number of branches per plant. Least number of primary branches per plant was recorded in control (T1) (5.40). Favorable weather and moisture of the soil are the important parameters affecting the number of branches per plant. It was concluded that a greater number of branches were recorded in bio stimulant treated plots as compared to control. It might be due to favorable microclimatic conditions and soil moisture conservation with the use of bio stimulants which results in better vegetative growth leads to increase in number of branches per plant. The present study finds support of [6].

The leaf area index of 186.21 was recorded with the 3.0 L/hac. (Amalgerol essence) (T7) application which was significantly higher as compared to rest of treatments. Minimum value of leaf area index 170.33 was reported (T1) which was significantly lower from rest of treatments.

It took about 79.30 days after transplanting which was significantly earlier from rest of treatments days after transplanting. Among different quantities of bio stimulant treatments minimum number of days taken to flower initiation was observed (T7) (79.30) followed by 2.5 L/hac. (Amalgerol essence) (T6) (80.20) and the further perusal of the data revealed application the minimum number of days were taken by plant to reach days to 50 % flowering by the 3.0 L/hac. (Amalgerol essence) (T7) took 85.73 days followed by 2.5 L/hac. (Amalgerol essence) (T6)

Table 2. Effect of different quantities of bio stimulant on plant growth regulators of chilli (*Capsicum annum L.*)

Sr no.	Treatments	Days to Germination	Plant height (cm)			
			30 DAT	60 DAT	90 DAT	At Harvest
T1	Control (RDF)	6.00	16.93	40.73	71.33	69.13
T2	Amalgerol Essence 0.5 L /ha.	6.80	17.60	41.87	72.47	69.38
T3	Amalgerol Essence 1.0 L /ha.	6.40	19.27	42.67	72.73	69.97
T4	Amalgerol Essence 1.5 L /ha.	6.67	19.60	43.00	72.93	70.13
T5	Amalgerol Essence 2.0 L /ha.	6.47	23.40	46.57	74.90	73.57
T6	Amalgerol Essence 2.5 L /ha.	6.13	23.67	47.00	75.83	74.54
T7	Amalgerol Essence 3.0 L /ha.	6.00	24.47	49.77	79.68	77.48
T8	Amalgerol Essence 3.5L /ha.	6.67	21.07	43.73	73.40	72.80
T9	Amalgerol Essence 4.0 L /ha.	6.53	20.27	43.13	73.13	71.90
F-Test		NS	S	S	S	S
S. Ed. ±		0.51	1.83	2.02	1.66	1.62
CD at 5%		1.09	3.89	4.29	3.52	3.44
CV		9.77	10.86	5.59	2.74	2.76

Table 3. Effect of different quantities of bio stimulant on plant growth regulators of chilli (*Capsicum annum L.*)

Sr no.	Treatments	Number of branches		Leafarea index	Days to 1st flowering	Days to 50% flowering
		60 DAT	90 DAT			
T1	Control (RDF)	3.40	5.40	170.33	83.00	90.50
T2	Amalgerol Essence 0.5 L /ha.	3.80	5.53	171.70	82.20	88.80
T3	Amalgerol Essence 1.0 L /ha.	4.00	5.80	173.73	80.20	87.27
T4	Amalgerol Essence 1.5 L /ha.	4.13	5.93	173.29	81.00	87.40
T5	Amalgerol Essence 2.0 L /ha.	4.93	6.33	183.61	82.13	87.50
T6	Amalgerol Essence 2.5 L /ha.	5.27	6.67	184.06	80.20	86.40
T7	Amalgerol Essence 3.0 L /ha.	5.67	8.53	186.21	79.30	85.73
T8	Amalgerol Essence 3.5 L /ha.	4.60	6.27	180.55	81.27	88.27
T9	Amalgerol Essence 4.0 L /ha.	4.40	6.00	175.55	81.20	88.20
F-Test		S	S	S	S	S
S. Ed. ±		0.26	0.39	4.26	0.75	0.89
CD at 5%		0.54	0.83	9.03	1.59	1.89
CV		7.00	7.64	2.94	1.13	1.24

Table 4. Effect of different quantities of bio stimulant on plant growth regulators of chilli (*Capsicum annum* L.)

Sr No.	Treatments	Fruit length (cm)	Fruit Weight(gm)	Fruit Diameter (cm)	Fruit Girth (cm)	No. of fruit/plant
T1	Control (RDF)	6.75	2.16	0.57	1.86	64.67
T2	Amalgerol Essence 0.5 L /ha.	7.08	2.17	0.58	1.87	68.60
T3	Amalgerol Essence 1.0 L /ha.	7.10	2.19	0.58	1.89	76.67
T4	Amalgerol Essence 1.5 L /ha.	7.14	2.18	0.58	1.91	79.87
T5	Amalgerol Essence 2.0 L /ha.	7.32	2.29	0.59	1.94	91.18
T6	Amalgerol Essence 2.5 L /ha.	7.72	2.52	0.60	1.95	101.78
T7	Amalgerol Essence 3.0 L /ha.	7.81	2.90	0.61	2.03	122.36
T8	Amalgerol Essence 3.5 L /ha.	7.29	2.25	0.59	1.93	82.36
T9	Amalgerol Essence 4.0 L/ha.	7.20	2.20	0.58	1.92	81.18
F-Test		S	S	S	S	S
S. Ed. ±		0.18	0.09	0.0043	0.021	3.81
CD at 5%		0.39	0.18	0.0091	0.044	8.08
CV		3.07	4.55	0.90	1.34	5.47

Table 5. Effect of different quantities of bio stimulant on plant growth regulators of chilli (*Capsicum annum* L.)

Sr No.	Treatments	Yield/ plant (gm)	Yield/ha.(q/ha)	Ascorbic acid (mg/100gm)	TSS (⁰ Brix)
T1	Control (RDF)	100.79	53.98	133.13	3.87
T2	Amalgerol Essence 0.5 L /ha.	105.40	54.89	134.33	4.07
T3	Amalgerol Essence 1.0 L /ha.	114.55	57.55	137.26	4.15
T4	Amalgerol Essence 1.5 L /ha.	125.68	58.26	137.78	4.43
T5	Amalgerol Essence 2.0 L /ha.	164.17	62.54	138.14	4.36
T6	Amalgerol Essence 2.5 L /ha.	191.21	65.23	144.03	4.66
T7	Amalgerol Essence 3.0 L /ha.	258.13	88.67	144.48	4.91
T8	Amalgerol Essence 3.5 L /ha.	150.44	61.94	137.92	4.38
T9	Amalgerol Essence 4.0 L /ha.	149.63	58.52	136.15	4.46
F-Test		S	S	S	S
S. Ed. ±		6.71	3.00	2.35	0.22
CD at 5%		14.23	6.37	4.98	0.46
CV		5.44	5.90	2.08	6.08

86.40 days after transplanting. "Consistency in availability of nutrients through bio stimulant means might have supplemented the additional nutrient requirement caused due to early flowering coupled with concomitant increase in flower number and consecutive fruit development" [7].

The observation regarding flowering viz., fruit length (cm), fruit Weight (g), fruit girth (cm), fruit diameter (cm), number of 5 fruits per plant, yield per plant (g), yield per ha (q), TSS and Ascorbic acid were shown in Table 3. Maximum fruit length was observed in 3.0 L/hac. (Amalgerol essence) (T7) (7.81cm), Maximum fruit Weight was observed in 3.0 L/hac. (Amalgerol essence) (T7) 2.90gm and minimum Weight observed with control treatment (2.16gm), Maximum fruit girth was observed in 3.0 L/hac. (Amalgerol essence) (T7) 2.03 cm and minimum fruit girth observed with control treatment (1.86 cm) and Maximum fruit diameter was observed in 3.0 L/hac. (Amalgerol essence) (T7) (0.61 cm). The reason of maximum fruit length might be due to increase in the production of leaves, ultimately in photosynthesis, higher amount of carbohydrates production and translocation from source (leaves) to sink (reproductive parts) resulted increase in fruit length observed by Saraswathi et al., [8].

The maximum number of fruits (122.36) was recorded in (T7) which was significantly higher from rest of the treatments. Among the rest of treatments number of fruits differ significantly which was as 3.0 L/hac. (Amalgerol essence) (T7) (122.36) and 2.5 L/hac. (Amalgerol essence) (T6) (101.78). The minimum number of fruits per plant i.e., 64.67 recorded in the control treatment which was lower significantly. Maximum fruit yield per plant i.e., 258.13 g was obtained in 3.0 L/hac. (Amalgerol essence) (T7) which was significantly higher from rest of the treatments followed by 2.5 L/hac. (Amalgerol essence) (T6) (191.21 g), and 2.0 L/hac. (Amalgerol essence) (T5) (164.17 g). The minimum fruit yield per plant i.e., 100.79 g recorded from the plot which was kept control (T1) and it was significantly lower from rest of treatments. The data showed that maximum yield of 88.67 (q/ha) with the treatment (T7) was reported using bio stimulants were followed by treatment (T6) with the value of 65.23 (q/ha). Minimum fruit yield of chili was recorded in weedy check (T1) 53.98 (q/ha) which was significantly lower from rest of treatments. "The popularity of bio stimulants in agriculture is

associated with the possibility of obtaining higher yields without the need to discontinue the production of ecological crops. According to numerous scientific studies, bio stimulants have a positive effect on yielding plants. The yield is usually determined as the amount of fruit obtained from one plant or plot. The yield depends on the type of bio stimulant used, the dose, the method of application, and the plant variety. Increased yield is often associated with improving the quality of vegetables or fruit. This is particularly important in organic farming, where artificial fertilizers cannot be used" [4].

"Among the various treatments, application 3.0 L/hac. (Amalgerol essence) (T7) maximum increase in ascorbic acid content of 144.38 mg/100g. The Followed by ascorbic acid content of (T6) 144.03 mg/100g. Similar finding of using these bio stimulant, fruit taste values improved significantly, as evidenced by the increase in the 6 level to an average of Ascorbic acid content" [9-12].

Among the treatment used T7 treatment with (4.91) and have highest TSS 0Brix which were significantly superior than T1 (Control) and other treatment. The maximum TSS value in Chilli was recorded in T7 with 4.91 0Brix and the minimum was recorded in T1 (Control) with 3.87 0Brix. "Bio stimulant can affect a number of the chemical properties of fruits and vegetables, including dry mass, acidity or vitamin content. The chemical composition of the fruit directly affects their palatability. It is assumed that fruits with a content of dissolved solids (SSC) above 120 Brix are characterized by an excellent taste [13-15]. In the first year of using bio stimulants containing the biopolymers of polysaccharides, humic and fulvic acids as well as carboxylic acids, the average value of SSC in apricots stood at 10.70 Brix. In the second year of using these bio stimulants, fruit taste values improved significantly, as evidenced by the increase in the SSC level to an average of 14.1 0 Brix" [9].

4. CONCLUSION

From the above experiment finding it may be concluded that the treatment of T7- 3.0 L/hac. (Amalgerol essence) was found to be best in the terms of growth viz, plant height, days to first flowering, days to 50% flowering, number of fruits per plant and in terms of yield viz, average fruit weight, Yield per plant, Yield per Hectare and in terms of quality viz, TSS and Ascorbic acid. The treatments T7, T6, T5, T8, T9, in the terms of the

economics give better result in comparing with the remaining one that is T1, T2, T3, T4, these treatments don't give good result in comparing with the other treatments. From above all the treatments T7 was the best treatment in all the perspective.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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