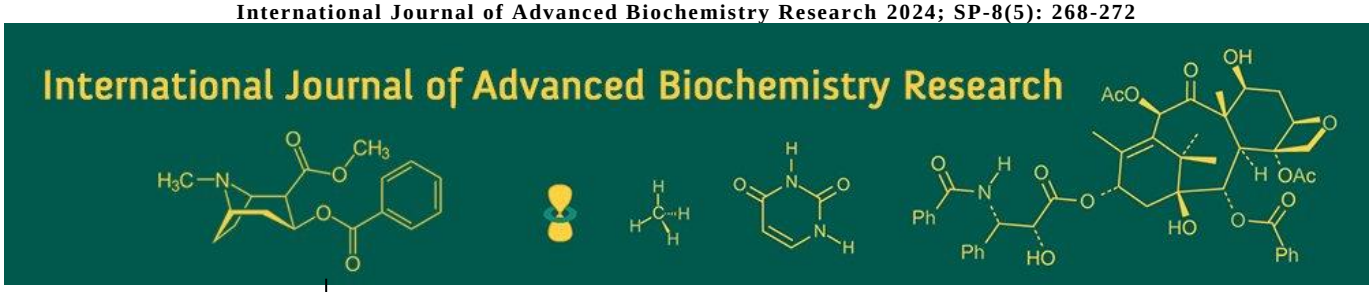

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Efficiency of different quantities of bio stimulant on chilli (*Capsicum annum* L.) crop under Prayagraj agro climatic condition

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Abstract
A present investigation was carried out with title "Efficiency of Different Quantities of Bio Stimulant on Chilli (*Capsicum annum* L.) crop under Prayagraj Agro Climatic Condition" 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 10 treatments and 3 replications with different combination of different quantities of bio stimulant. Under this experiment, over all, 10 treatments were taken including control. Different quantities of bio stimulant used comprised of Amalgerol Essence virtue all one at different doses of 0.4 L, 0.8 L, 1.2 L, 1.6 L, 2 L, 2.4 L, 2.8 L, 3.2 L and 3.6 L (1 hectare) and mix with water each. From the above experiment finding it may be concluded that the treatment of 3.2 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.

Keywords: NS-1701, bio stimulant, amalgerol essence, Chilli

1. Introduction
Chilli (*Capsicum annuum* L.) is a spice, a fruit vegetable widely cultivated in the world and which importance in human food is capital. It is a diploid (2n=24) species and genetically self-pollinated and chasmogamous crop whose flowers open only after pollination. However, 2 to 96% out-crossing was observed under open pollination. Originated from South and Central America, chilli, of the genus Capsicum, has more than 25 species of which only five (*C. annuum L., C. chinense Jacq., C. frutescens L., C. baccatum L. and C. pubescens Keep*.) are domesticated and cultivated (Costa *et al.*, 2009). Throughout the world, chilli is consumed fresh, dried or in powder. It is rich in proteins, lipids, carbohydrates 19.68 g, protein 13.46 g, dietary fibre 6.10 g, potassium 629 mg, calcium 65 mg, vitamin C 10.6 mg, vitamin A 26 µg, folate (B9) 633 µg and many other nutrients out of 100 g of edible portion. The fruits are an excellent source of health-related phytochemical compounds, such as ascorbic acid (vitamin C), carotenoids (provitamin A), tocopherols (vitamin E), flavonoids, and capsaicinoids that are very important in preventing chronic diseases such as cancer, asthma, coughs, sore throats, toothache, diabetes and cardiovascular diseases.
Chilli, India is the prominent exporter and producer consisting 40% of the total world production and exporting its 17% of total production. The major chilli growing states are Maharashtra, Andhra Pradesh, Karnataka, Orissa, Tamil Nadu, Madhya Pradesh, Rajasthan, West Bengal, Andhra Pradesh is the largest producer of chilli in India and contributes about 26% to the total area under chilli, followed by Maharashtra (15%), Karnataka (11%), Orissa (11%) and other states contributing nearly 22% to the total area under chilli. The liquid organic fertilizer (bio stimulant) is known to enhance and stimulate the translocation of photo assimilates there by helping in better retention of flowers and fruits. Besides this, the bio stimulant has the ability to cause accelerated growth in plants.

Chilli plays tasting role in human nutrition; pod contain high nutritive value.

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 fruits hollow with many seeds, found in different colors like green, orange, white, yellow and red. red chillies get their color from a coloring compound called capsanthin. The hot pungent taste is due to capsaicin and is widely cultivated from July to December in northern state of India.

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%. 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 25^0. 27^1 N latitude, 81^0. 56^1 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 ºC – 48 ºC and seldom falls as low as 4 ºC – 5 ºC. The relative humidity ranges between 20 to 94%. The average rainfalls in this area are around 1013.4 mm annually.

Table 1: Details of treatment combination

Treatment Notation	Treatment Details
T_1	Untreated control (water spray) 10t FYM, 120:60:50 NPK kg/ha
T_2	Amalgerol essence 0.4 L /ha. is added to the amount of water required for foliar spray. At different stages of plant.
T_3	Amalgerol essence 0.8 L /ha. is added to the amount of water required for foliar spray. At different stages of plant.
T_4	Amalgerol essence 1.2 L /ha. is added to the amount of water required for foliar spray. At different stages of plant.
T_5	Amalgerol essence 1.6 L /ha. is added to the amount of water required for foliar spray. At different stages of plant.
T_6	Amalgerol essence 2 L /ha. is added to the amount of water required for foliar spray. At different stages of plant.
T_7	Amalgerol essence 2.4 L /ha. is added to the amount of water required for foliar spray. At different stages of plant.
T_8	Amalgerol essence 2.8 L /ha. is added to the amount of water required for foliar spray. At different stages of plant.
T_9	Amalgerol essence 3.2 L /ha. is added to the amount of water required for foliar spray. At different stages of plant.
T_{10}	Amalgerol essence 3.6 L /ha. is added to the amount of water required for foliar spray. At different stages of plant.

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

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 minimum number of days taken to germination of plants with the treatment T_9 (3.2 L/hac Amalgerol Essence) was 6.13 days and the Maximum 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.

Maximum height was reported 3.2 L/hac. (Amalgerol essence) (T9) with an average height of 77.33 cm followed by 3.6 L/hac. (Amalgerol essence) (T_{10}) with an average height recorded 76.47 cm which was significantly higher from rest of treatments. All the treatments significantly increase plant height as compared to control. Minimum plant height 70.40 cm was recorded (T_1).

The highest number of primary branches per plant at 90 DAS was observed in 3.2 L/hac. (Amalgerol essence) (T9) (8.67) 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 (T_1) (6.00). 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.

Different quantities of bio stimulant treatments minimum number of days taken to flower initiation was observed (T9) (78.63) followed by 3.6 L/hac. (Amalgerol essence) (T_{10}) (82.40) 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 3.2 L/hac. (Amalgerol essence) (T9) took days followed by 3.6 L/hac. (Amalgerol essence) (T_{10}) 90.07 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.

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 3.2 L/hac. (Amalgerol essence) (T9) (7.93cm), Maximum fruit Weight was observed in 3.2 L/hac. (Amalgerol essence) (T9) 2.75gm and minimum Weight observed with control treatment (2.08gm), Maximum fruit girth was observed in 3.2L/hac. (Amalgerol essence) (T9) 2.03 cm and minimum fruit girth observed with control treatment (1.97 cm) and Maximum fruit diameter was observed in 3.2 L/hac. (Amalgerol essence) (T9) (2.00 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.

The maximum number of fruits (115.26) was recorded in (T9) which was significantly higher from rest of the treatments. Among the rest of treatments number of fruits different significantly which was as 3.2 L/hac. (Amalgerol essence) (T9) (115.26) and 3.6 L/hac. (Amalgerol essence) (T_{10}) (112.80). The minimum number of fruits per plant i.e., 60.19 recorded in the control treatment which was lower significantly. Maximum fruit yield per plant i.e., 292.56 g was obtained in 3.2 L/hac. (Amalgerol essence) (T9) which was significantly higher from rest of the treatments followed by 3.6 L/hac. (Amalgerol essence) (T_{10}) (230.30 g), The minimum fruit yield per plant i.e., 100.73 g recorded from the plot which was kept control (T_1) and it was significantly lower from rest of treatments. The data showed that maximum yield of 88.60 (q/ha) with the treatment (T9) was reported using bio stimulants were followed by treatment(T_{10}) with the value of 87.73 (q/ha). Minimum fruit yield of chilli was recorded in weedy check (T_1) 52.73 (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.

Among the various treatments, application 3.2 L/hac. (Amalgerol essence) (T9) maximum increase in ascorbic acid content of 142.45 mg/100g. The Followed by ascorbic acid content of (T_{10}) 141.11 mg/100g. Similar finding of using these bio stimulants, fruit taste values improved significantly, as evidenced by the increase in the 6 level to an average of Ascorbic acid content.

Between the treatment used T9 treatment with (4.71) and have highest TSS 0Brix which were significantly superior than T_1 (Control) and other treatment. The maximum TSS value in Chilli was recorded in T9 with 4.71 0Brix and the minimum was recorded in T_1 (Control) with 3.67 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. 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 14.10 Brix.

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

S. No.	Treatments	Days to Germination	Plant Height (cm)			
			30 DAT	60 DAT	90 DAT	At Harvest
T_1	Untreated control (water spray) 10t FYM, 120:60:50 NPK kg/ha	6.63	15.93	43.07	70.40	92.00
T_2	Amalgerol Essence 0.4 L/ha.	6.70	16.53	46.13	71.40	93.33
T_3	Amalgerol Essence 0.8 L/ha.	6.33	16.60	46.40	71.60	94.80
T_4	Amalgerol Essence 1.2 L/ha.	6.60	17.27	49.20	72.63	95.73
T_5	Amalgerol Essence 1.6 L/ha.	6.33	17.33	53.60	73.27	97.20
T_6	Amalgerol Essence 2 L/ha.	6.47	18.33	53.73	73.33	97.47
T_7	Amalgerol Essence 2.4 L/ha.	6.40	18.60	54.20	74.93	98.53
T_8	Amalgerol Essence 2.8 L/ha.	6.33	21.33	54.33	75.93	99.40
T_9	Amalgerol Essence 3.2 L/ha.	6.13	25.27	56.20	77.33	104.10
T_{10}	Amalgerol Essence 3.6 L/ha.	6.23	24.67	55.80	76.47	100.73
F-Test		NS	S	S	S	S
C.D. (5%)		0.90	1.94	3.11	2.51	5.48
S.E. (m)		0.30	0.92	1.48	1.20	2.61
CV		8.17	5.89	3.53	1.99	3.28

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

S. No.	Treatments	Number of branches		Days to 1st Flowering	Days to 50% Flowering
		60 DAT	90 DAT		
T_1	Untreated control (water spray) 10t FYM, 120:60:50 NPK kg/ha	4.53	6.00	83.07	90.07
T_2	Amalgerol Essence 0.4 L/ha.	4.80	6.07	82.53	85.80
T_3	Amalgerol Essence 0.8 L/ha.	5.00	6.20	80.33	85.13
T_4	Amalgerol Essence 1.2 L/ha.	5.07	6.33	80.40	86.47
T_5	Amalgerol Essence 1.6L/ha.	5.20	6.60	80.67	86.67
T_6	Amalgerol Essence 2 L/ha.	5.53	6.80	81.07	87.67
T_7	Amalgerol Essence 2.4L/ha.	6.27	7.00	81.47	87.07
T_8	Amalgerol Essence 2.8L/ha.	6.73	7.60	82.00	88.40
T_9	Amalgerol Essence 3.2L/ha.	7.53	8.67	78.63	83.47
T_{10}	Amalgerol Essence 3.6L/ha.	7.07	8.00	82.40	88.73
F-Test		S	S	S	S
C.D. (5%)		0.80	0.48	1.40	2.52
S.E. (m)		0.38	0.23	0.48	0.85
CV		8.07	4.03	2.05	1.69

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

S. No.	Treatments	Fruit Length (cm)	Fruit Weight (gm)	Fruit Diameter (cm)	Fruit Girth (cm)	No. of fruits per plant
T_1	Untreated control (water spray) 10t FYM, 120:60:50 NPK kg/ha	7.01	2.08	0.57	1.90	60.19
T_2	Amalgerol Essence 0.4 L/ha.	7.10	2.14	0.57	1.92	70.08
T_3	Amalgerol Essence 0.8 L/ha.	7.12	2.17	0.58	1.93	72.35
T_4	Amalgerol Essence 1.2 L/ha.	7.16	2.20	0.58	1.95	75.81
T_5	Amalgerol Essence 1.6L/ha.	7.19	2.25	0.58	1.96	79.68
T_6	Amalgerol Essence 2 L/ha.	7.25	2.31	0.59	1.95	83.70
T_7	Amalgerol Essence 2.4L/ha.	7.31	2.36	0.59	1.96	90.73
T_8	Amalgerol Essence 2.8L/ha.	7.39	2.45	0.60	1.97	97.97
T_9	Amalgerol Essence 3.2L/ha.	7.93	2.75	0.62	2.00	115.26
T_{10}	Amalgerol Essence 3.6L/ha.	7.75	2.65	0.61	1.97	112.80
F-Test		S	S	S	S	S
C.D. (5%)		0.38	0.11	0.01	0.02	6.70
S.E. (m)		0.18	0.05	0.00	0.01	3.19
CV		3.04	2.77	0.75	0.46	4.55

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

S. No.	Treatments	Yield/Plant (gm)	Yield/Hectare (q/ha.)	Ascorbic Acid (mg/100gm)	TSS (^{0}Brix)
T_1	Untreated control (water spray) 10t FYM, 120:60:50 NPK kg/ha	110.73	52.73	131.79	3.67
T_2	Amalgerol Essence 0.4 L/ha.	117.96	59.07	133.69	3.22
T_3	Amalgerol Essence 0.8 L/ha.	138.89	60.00	134.99	4.30
T_4	Amalgerol Essence 1.2 L/ha.	145.51	65.40	135.47	4.33
T_5	Amalgerol Essence 1.6L/ha.	152.33	70.20	136.93	4.38
T_6	Amalgerol Essence 2 L/ha.	160.91	71.13	137.20	4.40
T_7	Amalgerol Essence 2.4L/ha.	173.75	77.07	138.43	4.48
T_8	Amalgerol Essence 2.8L/ha.	193.62	81.13	140.71	4.56
T_9	Amalgerol Essence 3.2L/ha.	292.56	88.60	142.45	4.71
T_{10}	Amalgerol Essence 3.6L/ha.	230.30	87.73	141.11	4.63
F-Test		S	S	S	S
C.D. (5%)		54.28	9.05	5.23	0.59
S.E. (m)		25.84	4.31	2.49	0.28
CV		18.43	7.40	2.22	8.08

Conclusion

According to the current research, the use of Bio stimulant (*Amalgerol essence*) had a significantly positive impact on the growth and development of chillies. Among the various treatments that were evaluated, T_9 yield the most favourable results in terms of growth *viz*., plant height, number of primary branches, early flowering and maturation and yield *viz*., fruit weight, length of fruit, fruit girth, number of fruits per plant, and yield per plant. Furthermore, T_9 had the highest benefit cost ratio of 2.64. T_9 consisted of Amalgerol Essence 3.2 L /ha.

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