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Efficiency of different biostimulants on chilli crop under Prayagraj agro climatic conditions (*Capsicum annum L.*)

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Abstract

This experiment was carried out in the Horticultural Research Farm, Department of Horticulture, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj (U.P.) India from August 2022 to January 2023. The experiment was conducted in Randomized Block Design (RBD) with 25 treatments and 3 replications using Bio stimulants. T₁ control (Used none), T₂-Yalex @ 0.5 g/l, T₃-Yalex @ 1 g/l, T₄-Yalex @ 1.5 g/l, T₅-Leader @ 2 ml/l, T₆-Leader @ 2.5 ml/l, T₇-Leader @ 3 ml/l, T₈-Jackpot @ 2 ml/l, T₉-Jackpot @ 2.5 ml/l, T₁₀-Jackpot @ 3 ml/l, T₁₁-Robo @ 2 ml/l, T₁₂-Robo @ 2.5 ml/l, T₁₃-Robo @ 3 ml/l, T₁₄-Preet @ 8 kg/ha, T₁₅-Preet @ 9 kg/ha, T₁₆-Preet @ 11 kg/ha, T₁₇-Killer @ 2 ml/l, T₁₈-Killer @ 2.5 ml/l, T₁₉-Killer @ 3 ml/l, T₂₀-Action @ 2 ml/l, T₂₁-Action @ 2.5 ml/l, T₂₂-Action @ 3 ml/l, T₂₃-Radix @ 2 ml/l, T₂₄-Radix @ 2.5 ml/l, T₂₅-Radix @ 3 ml/l, from the present experiment it is found that Treatment 15 Preet @ 9 kg/ha resulted best in terms of maximum leaves, flowers, fruit weight and yield per plant followed by Treatment 20-Action @ 2 ml/l. In terms of benefit cost ratio T₁₅ (3.39) was found maximum whereas B: C ratio in T₂₃ (0.82) was the least.

Keywords: Chilli, bio stimulants, B: C ratio

Introduction

Chilli (*Capsicum annum L.*) is considered one of the most popular and widely grown spices in the world while more popular in Asia. Chili (*Capsicum annum L.*) is a spice, a fruit vegetable widely cultivated in the world. It is from the family of Solanaceae. It can be consumed green as well as in its dried form. It is generally self-pollinating, insect visitation is known to increase the fruit size and speed of ripening, as well as to ensure symmetrical development. No country in the world has so much area and production of chilli as in India. In the world green chilli is grown over an area of 14.53 lakh ha with a production of 190.39 lakh tones, accounting for a productivity of 131.02 q per ha. It is considered as one of the most popular and widely grown spices in the world while being more popular in Asia (Makari *et al.*, 2009) ^[21].

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. The pungent principle is Capsaicin, which is maximum in pericarp and seeds have negligible concentration (0.0005%). Colour is because of carotenoids i.e., red pigment in chillies is contributed by Capsanthin (35%), Capsorubin (6.4%) and Zeaxanthin (2.3%) (Osuna-Garcia *et al.*, 1998) ^[5]. It is rich in proteins, lipids, carbohydrates, fibers, mineral salts (Ca, P, Fe) and in vitamins A, D₃, E, C, K, B₂ and B₁₂. Unfavorable environments, such as extremes of temperature i.e. too low or high temperatures. It is a rich source of vitamin C. Most of Indian Chilli belongs to the genus *Capsicum*. There are estimated 1,600 different varieties of pepper throughout the world with five domesticated species including *Capsicum annum L.*, *Capsicum frutescens L.*, *Capsicum chinense L.*, *Capsicum baccatum L.* and *Capsicum pubescens L.* (Bosland and Votava, 2000) ^[25]. In India, only two species viz., *Capsicum annum L.* and *Capsicum frutescens L.* are well known and most of the cultivated varieties belong to *Capsicum annum*. This cultivated species has its unique place in the diet as a vegetable cum spice crop. India produced 21, 49, 000 tonnes of dry chilli from an area of 7,52,000 hectare and the productivity is t/ha.

The term "bio stimulant" was defined in the year 2018 farm bill as "a substance or microorganism that, when applied to seeds, plants, stimulates natural processes to enhance or benefit nutrient uptake, nutrient use efficiency, tolerance to abiotic stress, or crop quality and yield."

In recent years, greatest challenge is to produce an extensive organic fertilizer to reduce the effect of chemical fertilizers in the environment (Banger *et al.*, 2012) [24]. Even though inorganic fertilizers are vital for plant growth; their effects are tremendous and extremely harmful to our environment overall. At present, many countries are interested in organic agriculture. This shift has been increased the demand of various bio-products. Agricultural bio stimulants or plant bio stimulants are diverse bioactive substances used to enhance plant growth when applied in the small quantities. The usage of bio stimulant has greatly increased in recent years and its global market has been predictable to increase about \$ 2,241 million by 2018. Based on the bioactive prevalence, bio stimulants has been classified into three major groups namely, humic acids, seaweeds and amino acid containing products (Du jardin, 2015) [4].

Materials and Methods

The present investigation entitled “Efficiency of different Bio stimulants on chilli crop under Prayagraj Agro Climatic conditions (*Capsicum annuum*)” was carried out. The details of the materials to be used and methodology to be adopted during the course of study (2021-2022) are mentioned below.

Experimental site

The experiment was conducted in the Horticulture Research Farm, Department of Horticulture, Naini Agricultural Institute, Sam Higginbottom, University of Agriculture, Technology and Sciences, Prayagraj (UP) during 2022. All the facilities necessary for cultivation, including labour were made available by the department.

Experimental material

The experiment was laid out in randomized block design (R.B.D.) with replications of varieties. Chilli will be planted in the field at a spacing of 45 cm × 60 cm in plot of 2 m × 2 m size. Recommended dose of Plant Growth Regulators was applied. Normal cultural practices and plant protection measures were followed during the cultivation process. Plants were selected at random from each plot of a variety as representative sample for recording the data. Spades, rakes, watering cans, khurpi etc. were provided by the university on issuing it from the office.

Geographical location

The experiment was conducted in the Horticulture Research Farm, Department of Horticulture, Naini Agricultural Institute, Sam Higginbottom, University of Agriculture, Technology and Sciences, Prayagraj (UP) from 2022-2023. The experiment site is situated at an altitude of 25.4137°N and 81.8491°E at a mean sea level of 98 meters. The average rainfall of the region is 1013.4 cm. The soil is sandy loam in nature having the pH varying from 7-8 and is low in nitrogen and phosphorus.

Morphological details

Crop name: Chilli.

Botanical name: *Capsicum annuum*.

Edible part: Flowers and fruits with seeds.

Climate

Prayagraj has a sub-tropical climate prevailing in the South-East part of U.P, India with both extremes in temperature, i.e., the winter and the summer. In cold winters, the temperature sometimes as low as 0 °C in December to January and very hot summer with temperature reaching up to 46 °C in the months of May and June. During winter, frosts and during summer, hot scorching winds are also not uncommon. The average rainfall is around 1013.4 (cm) with maximum concentration during July to September months with occasional showers in winters.

Experimental design

The experiment was laid out in Randomized block design (RBD) with treatments replicated (3).

Total No. of plots: 75

No. of plants in each plot: 06

Character study

To prepare the critical analysis of the performance of the treatments the following growth, floral, yield and economic characters were recorded.

Number chromosome: 2n =24.

Origin: Mexico.

Fruit type: Berry.

Growth parameters

1. Plant height (cm) at 30, 60, 90 DAT
2. Plant spread (cm)
3. No. of leaves/plant (at harvest).
4. Average fruit length (cm)
5. Average fruit diameter (cm)

Floral parameters

No. of flowers/plant will subject to statistical analysis as per method of “Analysis of Variance” (Fisher). The significant and non-significant of treatment affect will judge with the help of F” variance ratio test calculated F” at 5% level of significance. For testing of hypothesis ANOVA table was used.

Days to 1 flowering

Days to 1 harvest

Yield parameters

1. Average Fruit yield per plant (g/plant).
2. Average fruit weight (g).

Quality parameters

1. No. of fruits/plant
2. TSS (brix)

Economics

1. Total fixed cost of cultivation
2. Material required in one hectare
3. Total Variable cost and Total cost of cultivation
4. Cost Benefit ratio

Statistical analysis

The experiment will conducted in Randomized Block Design. The data recorded during the course of investigation

Results

Efficiency of different bio stimulants on growth parameters of chilli

Sl. No.	Plant Height 30 Days	Plant Height 60 Days	Plant Height 90 Days	Plant Spread (cm)	No. of Leaves/Plant	Avg. Fruit Length (cm)	Avg. Fruit Diameter (cm)
T ₁	27.02	63.16	75.47	43.53	136.80	7.70	2.55
T ₂	34.42	70.56	82.87	44.66	177.67	7.86	2.64
T ₃	26.02	62.16	74.47	45.96	182.20	7.78	2.62
T ₄	31.42	67.56	79.87	46.58	127.73	7.75	2.56
T ₅	25.42	61.56	73.87	50.42	73.73	7.81	2.61
T ₆	33.37	69.51	81.82	58.95	185.93	7.48	2.69
T ₇	24.62	60.76	73.07	57.44	117.87	7.44	2.58
T ₈	26.37	62.51	74.82	55.15	116.87	7.62	2.56
T ₉	31.03	67.17	79.48	55.96	108.87	7.70	2.61
T ₁₀	23.02	59.16	71.47	49.55	105.87	7.73	2.58
T ₁₁	29.03	65.24	77.55	51.27	154.87	5.77	1.89
T ₁₂	29.60	65.74	78.05	47.68	146.87	7.63	2.31
T ₁₃	31.75	67.89	80.20	52.18	166.20	6.09	2.90
T ₁₄	25.19	61.33	73.64	49.98	105.10	7.30	2.53
T ₁₅	24.62	60.14	73.18	43.74	220.10	8.66	3.33
T ₁₆	32.22	68.34	80.78	44.87	105.10	8.33	3.42
T ₁₇	24.28	60.43	72.87	45.17	107.10	8.52	3.40
T ₁₈	31.22	67.34	79.78	46.79	110.40	8.70	3.34
T ₁₉	25.10	61.22	73.66	50.63	115.40	8.78	3.39
T ₂₀	30.77	66.89	79.33	59.16	158.10	8.81	3.40
T ₂₁	24.42	60.54	72.98	57.79	132.47	6.76	3.36
T ₂₂	26.42	62.54	74.98	55.50	145.60	8.26	3.34
T ₂₃	32.22	68.34	80.78	56.31	88.60	6.80	3.39
T ₂₄	33.22	69.34	81.78	49.90	125.13	6.69	3.36
T ₂₅	26.54	62.66	75.10	52.52	121.40	7.73	2.35
F-Test	S	S	S	S	S	S	S
S.Ed. (±)	0.017	0.018	0.048	0.20	14.99	0.00	0.00
CV	0.074	0.035	0.076	0.49	13.75	0.05	0.12

Efficiency of different bio stimulants on floral parameters of chilli

Sl. No.	No. of Flowers/Plant	Days to 1st Flower	Days to 1st Harvest
T ₁	184.20	39.39	62.48
T ₂	225.33	37.39	60.48
T ₃	229.80	38.98	62.07
T ₄	175.00	38.77	61.86
T ₅	121.47	42.67	65.76
T ₆	233.53	36.95	60.04
T ₇	133.33	42.88	65.97
T ₈	123.80	44.05	67.14
T ₉	142.80	39.16	62.25
T ₁₀	122.80	41.55	64.54
T ₁₁	208.80	40.07	63.16
T ₁₂	200.80	41.36	64.45
T ₁₃	220.13	43.44	66.53
T ₁₄	112.33	41.58	64.67
T ₁₅	274.33	40.62	63.71
T ₁₆	159.33	38.72	61.81
T ₁₇	131.33	40.38	63.47
T ₁₈	147.53	40.37	63.46
T ₁₉	133.53	44.06	67.15
T ₂₀	212.33	36.04	59.13
T ₂₁	179.87	44.31	67.40
T ₂₂	193.27	45.41	68.50
T ₂₃	98.93	40.33	63.42
T ₂₄	172.40	43.12	66.21
T ₂₅	169.13	40.70	63.79
F-Test	S	S	S
S. Ed. (±)	19.08	0.51	0.51
CV	13.56	1.55	0.98

Efficiency of different bio stimulants on yield parameters of chilli

Sl. No.	Avg. fruit Weight (g)	Avg. fruit yield/plant (g)
T ₁	3.23	562.29
T ₂	3.35	728.78
T ₃	3.29	719.44
T ₄	3.00	494.96
T ₅	3.11	347.67
T ₆	3.83	862.98
T ₇	3.20	400.81
T ₈	3.15	370.73
T ₉	3.05	410.82
T ₁₀	3.23	395.48
T ₁₁	2.95	589.41
T ₁₂	3.25	613.54
T ₁₃	3.94	820.33
T ₁₄	4.34	441.09
T ₁₅	4.49	1179.84
T ₁₆	3.79	559.91
T ₁₇	3.91	471.01
T ₁₈	3.83	518.92
T ₁₉	4.00	497.92
T ₂₀	3.95	799.49
T ₂₁	4.25	722.09
T ₂₂	4.43	806.82
T ₂₃	3.18	282.74
T ₂₄	3.47	562.83
T ₂₅	3.70	588.82
F-Test	S	S
S. Ed. (±)	0.12	7.46
CV	4.34	1.54

Efficiency of different bio stimulants on quality parameters of chilli

Sl. No.	No. of fruits/Plant	TSS
T ₁	177.27	3.41
T ₂	218.40	3.61
T ₃	222.00	3.83
T ₄	168.07	4.12
T ₅	113.67	3.64
T ₆	228.33	3.73
T ₇	127.27	3.29
T ₈	117.80	3.47
T ₉	134.80	3.94
T ₁₀	122.80	3.75
T ₁₁	199.80	3.46
T ₁₂	188.80	3.66
T ₁₃	208.13	3.88
T ₁₄	101.33	4.17
T ₁₅	262.33	3.69
T ₁₆	147.33	3.78
T ₁₇	120.33	3.34
T ₁₈	135.53	3.53
T ₁₉	124.53	3.99
T ₂₀	202.33	3.80
T ₂₁	192.07	3.24
T ₂₂	184.60	3.49
T ₂₃	90.27	4.28
T ₂₄	164.60	3.54
T ₂₅	161.33	3.29
F-Test	S	S
S.Ed. (±)	18.33	1.00
CV	13.71	0.08

Conclusion

It is concluded from the present study that the chilli was grown under the application of Bio stimulants where Preet (9 kg/ha and 11 kg/ha) (T₁₅, T₁₆) resulted as a more suitable treatment for maximum number of leaves/plant (220.10), maximum number of flowers/plant (274.33), maximum number of fruits/plant (262.33), maximum average fruit diameter (3.42 cm), maximum average fruit weight (4.49 g) and maximum average yield per plant (1.17 kg). Action (2 ml/l, 3 ml/l) (T₂₀, T₂₂) ranged second after Preet in performance for maximum plant spread (59.16 cm), days to 1st flowering (45.41), days to 1st harvest (68.50) and maximum average fruit length (8.81 cm) as compared to control (T₁). Maximum TSS concentration (T₂₃) (4.28) were attained through the application of Radix (2 ml/l, 2.5 ml/l). Yalex (0.5 g/l) (T₂) performed well in terms of maximum plant height (T₂) (62.83 cm). Biostimulants stimulates natural processes to enhance or benefit nutrient uptake, nutrient use efficiency, tolerance to abiotic stress for crop quality and yield. It is organic and cost is reasonable compared to other costly fertilizers which is easier for the farmers to acquire. Among the different treatments the highest Gross return (Rs/ha) (217443), Net return (Rs/ha) (153293), benefit cost ratio (3.39) was also obtained from treatment (T₁₅), that is Preet @ 9 kg/ha. It is concluded from the present study that the chilli was grown under the application of Bio stimulants where Preet (9 kg/ha).

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