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EFFECT OF BIOSTIMULANTS ON GROWTH AND YIELD OF GREEN CHILLI (*CAPSICUM ANNUUM* L.)

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Abstract– The field experiment was conducted to study the effect of bio stimulants on growth and yield of green chilli (*Capsicum annuum* L.) with nine treatments replicated thrice in a Randomized Block Design. Four different bio stimulants were used in this experiment *i.e*., yeast hydrolysate @ 3, 5, 7.5 ml/l; gluconates @ 3, 5, 7.5 ml/l; humic acid @ 4 ml/l and seaweed extract @ 5 ml/l. The results revealed that yeast hydrolysate @ 7.5 ml/l was found more effective in increasing the plant height, stem girth, leaf length, leaf width, number of branches and yield of green chilli.

INTRODUCTION

Chilli (*Capsicum annuum* L.) belongs to the family Solanaceae having chromosome number 2n=24 and it is native to Mexico. India is the largest producer, consumer and exporter of chilies in the world. Indian chillies are renowned globally for their distinct commercial qualities, particularly in terms of color and pungency. India's chilli production was estimated to be 46.84 lakh tonnes for the year 2022-23 as against 45.04 lakh tonnes in 2021-22. Telangana ranked 15th in area and 11th in production of green chilli *i.e*., 4.20 thousand hectares, 1.09 lakh tonnes respectively (Anonymous, 2022-23). In Telangana, the major chilli-growing districts include Khammam, Mahabubabad, Gadwal, Suryapet and Warangal (Rural).

Biostimulants are substances that are derived from plants or microorganisms, when applied to plants or soil, enhance plant growth, stress tolerance and crop quality (Jardin, 2015). Yeast extract (*Saccharomyces cerevisiae*) is a type of protein hydrolysate biostimulant, rich in phytohormones (such as gibberellins, auxins, and cytokinins), amino acids (like lysine and tryptophan), minerals and vitamins (Mokhtar *et al*., 2020). Humic acid supports both shoot and root growth and enhances nutrient uptake in vegetable crops. It acts as a bio stimulant and promote plant growth (Fathima and Denesh, 2013). Seaweed extracts have been shown to have anti-stress and biostimulant effects potentially playing a role under stress conditions (Jardin, 2015). Gluconate is a salt of gluconic acid which helps in increasing the efficiency of micro nutrients (Gourkhede *et al*., 2020) and increase the quality of produce.

High yielding varieties and hybrid chilli has got good market preference due to its size and appealing attractive colour (Chakravarthy and Mohan, 2023). Hence, there is a need to increase the production by boosting up the yield and also quality by using biostimulants.

MATERIALS AND METHODS

The present investigation titled "Effect of biostimulants on growth and yield of green chilli (*Capsicum annuum* L.)" was conducted during *rabi*

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season of the year 2023-24 in the Centre of Excellence for Fruits (COE) located in Mulugu, Siddipet (dist.), Telangana. The experiment was laid out in a Randomized Block Design (RBD) with nine treatments replicated three times with the plot size of 3m x 3m. Seedlings were raised in Hi-tech nursery at Centre of Excellence for Fruits (COE) in pro trays with 198 cells filled with cocopeat, perlite and vermiculite in the ratio 2:1:1 as growing media. The seeds were sown and kept in the seed germination chamber up to 2-4 true leaf stage and shifted to hardening chamber. The seedlings were transplanted at a spacing of 60 cm x 45 cm and uniform population was maintained by gap filling.

The soil in the experimental land was brought to fine tilth by three repeated ploughing followed by harrowing and levelling. Before harrowing, FYM @ 20 t/ha, neem cake @ 550 kg/ha and recommended fertilizer doses of 130:60:120 kg/ha NPK were applied in the form of urea, diammonium phosphate and muriate of potash, respectively. Half dose of N and full dose of P and K were applied at the final harrowing and mixed thoroughly in the soil. The remaining dose of N was top-dressed 45 days after transplanting. The maize seeds were sown 30 days before transplanting of chilli seedlings as barrier crop as well as trap crop around the borders of the experimental plot. The biostimulants were applied as foliar spray at every 15 days interval from the date of transplanting to 75 days (5 times).

The vegetative parameters *viz*., plant height, stem girth, leaf length, leaf width were recorded at 30, 60 and 90 days after transplanting whereas number of primary and secondary branches per plant were recorded at the time of final harvest. The yield was measured after every picking and statistical analysis was done by adopting the standard procedures of Panse and Sukhatme (1985).

RESULTS AND DISCUSSION

Plant height

The plant height was found non-significant at 30 DAT whereas at 60 and 90 DAT the results were significant. At 60 and 90 DAT, Yeast hydrolysate @ 7.5 ml/l (67.14, 74.11 cm) was found most effective in increasing the plant height and minimum values (54.23, 67.79 cm) were recorded in the control. Yeast is rich in amino acids and it contains cytokinin hormone, which is known to stimulate root activity and enhance vegetative growth during the early stages of plant development (Alali *et al*., 2017). These results were in line with the findings of Alali *et al*. (2017) in Tomato; Ruban *et al*. (2019) in Brinjal; El-Tohamy *et al*. (2008) on Eggplant and Asmaa *et al*. (2013) in Pea.

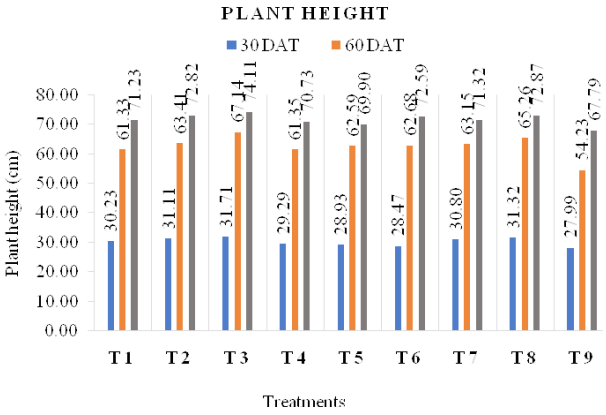

Fig. 1. Effect of biostimulant on plant height (cm) of green chilli at different intervals.

Table 1. Effect of biostimulants on plant height (cm) of green chilli at different intervals.

Treatment	Plant height (cm)		
	30 DAT	60 DAT	90 DAT
T_1: Yeast hydrolysate @ 3 ml/l	30.23	61.23	71.23
T_2: Yeast hydrolysate @ 5 ml/l	31.11	63.41	72.82
T_3: Yeast hydrolysate @ 7.5 ml/l	31.71	67.14	74.11
T_4 : Gluconates @ 3 ml/l	29.29	61.35	70.73
T_5 : Gluconates @ 5 ml/l	28.93	62.59	69.90
T_6: Gluconates @ 7.5 ml/l	28.47	62.68	72.59
T_7 : Humic acid @ 4 ml/l	30.80	63.15	71.32
T_8 : Seaweed extract @ 5 ml/L	31.32	65.26	72.87
T_9 : Control	27.99	54.23	67.79
S. Em. ±	1.52	1.80	0.95
C. D. @ 5%	NS	5.41	2.83

Stem girth

Amongst all the treatments, the Yeast hydrolysate @ 7.5 ml/l consistently resulted in the largest stem girth (6.75, 11.54, 14.62 cm) across all the intervals, indicating its potential effectiveness in promoting stem growth. The smallest stem girth (5.79, 9.51, 12.01 cm) was observed in control. The cytokinins presence in the biostimulants (Yeast hydrolysate) may have encouraged lateral meristem growth, resulting in an increase in stem girth (Anuja and Archana, 2012). Rania *et al*. (2011) in Kidney Bean; Ruban *et al*. (2019) in Brinjal; Abido and Seadh (2014) in Field bean reported the similar impact of biostimulants on stem girth.

Leaf length and width

The results indicated that maximum leaf length (6.63, 6.88, 7.00 cm) and leaf width (2.73, 2.79, 3.00 cm) was observed in Yeast hydrolysate @ 7.5 ml/l and minimum values were observed in control (leaf length-5.69, 5.73, 5.89; leaf width-2.29, 2.35, 2.44 cm). Leaf width was non-significant at 60 DAT. Yeast hydrolysate can increase the photosynthetic activity allowing for more efficient energy production, enabling cells to expand and increase leaf width; regulate hormone balance particularly auxins and cytokinins, promoting cell growth and differentiation resulting in leaf expansion; improve nutrient uptake and utilization, providing essential resources for leaf growth (El-Desuki and El-Greadly, 2006). The outcome is in line with the findings of Rania *et al*. (2011) in Kidney Bean; El-Yazied and Mady (2011) in Tomato; Mady (2009) in Faba beanand Fadia *et al*. (2019) in Cowpea.

Number of primary and secondary branches

Results infer that highest number of primary and secondary branches were observed plants treated with Yeast hydrolysate @ 7.5 ml/l (11.33, 19.07) and least number of primary and secondary branches (7.80, 12.40) were found in control. The increase was maximum in yeast hydrolysate treatment (T_3) as it stimulates cytokinins, which may have disrupted apical dominance, promoting the growth of

Table 2. Effect of biostimulants on stem girth (cm) of green chilli at different intervals

Treatment	Stem girth (cm)		
	30 DAT	60 DAT	90 DAT
T_1: Yeast hydrolysate @ 3 ml/l	5.81	10.57	14.03
T_2: Yeast hydrolysate @ 5 ml/l	5.99	10.47	13.22
T_3: Yeast hydrolysate @ 7.5 ml/l	6.75	11.54	14.62
T_4 : Gluconates @ 3 ml/l	6.05	10.47	12.38
T_5 : Gluconates @ 5 ml/l	6.26	11.00	13.03
T_6: Gluconates @ 7.5 ml/l	5.95	9.72	12.39
T_7 : Humic acid @ 4 ml/l	6.33	10.62	13.41
T_8 : Seaweed extract @ 5 ml/l	6.34	11.48	13.87
T_9 : Control	5.79	9.51	12.01
S. Em. ±	0.19	0.35	0.43
C. D. @ 5%	0.56	1.05	1.29

Table 3. Effect of biostimulants on leaf length (cm) of green chilli at different intervals.

Treatment	Leaf length (cm)		
	30 DAT	60 DAT	90 DAT
T_1: Yeast hydrolysate @ 3 ml/l	5.53	6.73	6.77
T_2: Yeast hydrolysate @ 5 ml/l	6.25	6.82	6.82
T_3: Yeast hydrolysate @ 7.5 ml/l	6.63	6.88	7.00
T_4 : Gluconates @ 3 ml/l	6.27	6.70	6.81
T_5 : Gluconates @ 5 ml/l	5.79	6.52	6.73
T_6: Gluconates @ 7.5 ml/l	5.94	6.57	6.68
T_7 : Humic acid @ 4 ml/l	6.00	6.67	6.67
T_8 : Seaweed extract @ 5 ml/l	6.42	6.85	6.88
T_9 : Control	5.69	5.73	5.89
S. Em. ±	0.19	0.21	0.20
C. D. @ 5%	0.58	0.63	0.59

Table 4. Effect of biostimulants on leaf width (cm) of green chilli at different intervals.

Treatment	Leaf width (cm)		
	30 DAT	60 DAT	90 DAT
T_1: Yeast hydrolysate @ 3 ml/l	2.64	2.63	2.66
T_2: Yeast hydrolysate @ 5 ml/l	2.69	2.74	2.80
T_3: Yeast hydrolysate @ 7.5 ml/l	2.73	2.79	3.00
T_4 : Gluconates @ 3 ml/l	2.68	2.69	2.71
T_5 : Gluconates @ 5 ml/l	2.39	2.67	2.73
T_6: Gluconates @ 7.5 ml/l	2.41	2.64	2.79
T_7 : Humic acid @ 4 ml/l	2.43	2.63	2.64
T_8 : Seaweed extract @ 5 ml/l	2.70	2.75	2.85
T_9 : Control	2.29	2.35	2.44
S. Em. ±	0.09	0.08	0.10
C. D. @ 5%	0.26	NS	0.29

secondary meristems and led to an increased number of branches per plant. Findings of Karak *et al*. (2023) in Potato; El-Shafey *et al*. (2016) in Faba bean and Mokhtar *et al*. (2020) in Faba bean have shown similar results.

Table 5. Effect of biostimulants on number of primary and secondary branches of green chilli plant.

Treatment	No. of primary branches per plant	No. of secondary branches per plant
T_1: Yeast hydrolysate @ 3 ml/l	10.80	16.20
T_2: Yeast hydrolysate @ 5 ml/l	11.00	17.87
T_3: Yeast hydrolysate @ 7.5 ml/l	11.33	19.07
T_4 : Gluconates @ 3 ml/l	10.00	14.07
T_5 : Gluconates @ 5 ml/l	10.07	15.60
T_6: Gluconates @ 7.5 ml/l	10.47	15.73
T_7 : Humic acid @ 4 ml/l	10.87	17.40
T_8 : Seaweed extract @ 5 ml/l	11.13	18.23
T_9 : Control	7.80	12.40
S. Em. ±	0.31	0.78
C. D. @ 5%	0.94	2.32

Yield per hectare

The highest fruit yield per hectare was observed in plants treated with Yeast hydrolysate @ 7.5 ml/l (32.93 t/ha) and lowest fruit yield per hectare was noticed in control (19.15 t/ha). Yeast hydrolysate improves the efficiency of nutrient absorption by enhancing root growth. This results in healthier plants with improved vigour and productivity. This leads to increased resilience and improved crop performance even under adverse conditions thereby increasing the yield (Chaudhari *et al*., 2023). Similar results were reported by El-Tohamy and El-Greadly (2007) in Snap bean and El-Tohamy *et al*. (2008) in Eggplant; Alali *et al*. (2017) in Tomato; El-Yazied and

Table 6. Effect of biostimulants on yield of green chilli

Treatment	Fruit yield per hectare (t/ha)
T_1: Yeast hydrolysate @ 3 ml/l	21.62
T_2: Yeast hydrolysate @ 5 ml/l	27.87
T_3: Yeast hydrolysate @ 7.5 ml/l	32.93
T_4 : Gluconates @ 3 ml/l	19.41
T_5 : Gluconates @ 5 ml/l	21.28
T_6: Gluconates @ 7.5 ml/l	21.54
T_7 : Humic acid @ 4 ml/l	23.35
T_8 : Seaweed extract @ 5 ml/l	28.13
T_9 : Control	19.15
S. Em. ±	0.90
C. D. @ 5%	2.71

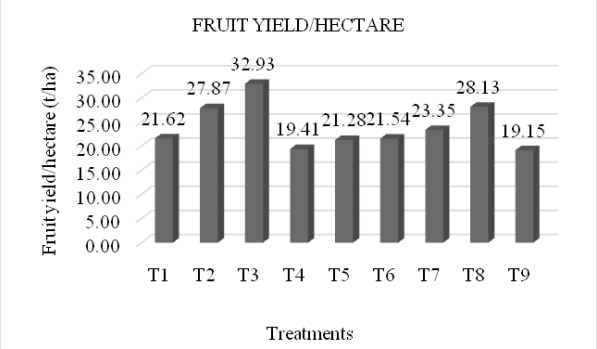

Fig. 2. Effect of biostimulants on fruit yield per hectare (t/ha) in green chilli

Mady (2012) in Broad bean and Choi *et al*. (2022) in Lettuce and Tomato.

CONCLUSION

The resultant data from the present investigation on the chilli plants treated with biostimulants has revealed that the more vegetative growth and yield

was observed in plants treated with Yeast hydrolysate @ 7.5 ml/l (T_3) as compared to other treatments.

Conflict of interest - None

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