



## **Effect of Plant Growth Regulators on Growth and Yield Attributes of Chilli (*Capsicum annum* L.)**

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### **Authors' contributions**

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

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## **ABSTRACT**

Chilli (*Capsicum annum* L) is a solanaceous crop which grows all year around known for its pungency and also having nutritional and medicinal value. The current research work took place at an agricultural field in Peddakurapadu, Guntur district, Andhra Pradesh, in October 2021. The experiment was set up in a randomized block design with Three (3) replications and Ten (10) different plant growth regulator are used as treatments and the work is done to investigate the effect of plant growth regulators on chilli crop. These plant growth regulators controls or modifies physiological processes in a plant. Foliar spray of plant growth regulators at different concentrations are used after 30 days and 40 days of transplanting and later after 7 days of second application data was collected and analyzed statistically.

**Keywords:** *Growth regulators; flowering; plant height; plant spread.*

## **1. INTRODUCTION**

Chilli (*Capsicum annum* L.) belongs to the solanaceae family and is India's most important commercial spice and vegetable crop. India is the world's leading producer and exporter of

chilli. In India, Guntur, in the state of Andhra Pradesh, produces 30% of chili production. Chilli is a tropical and subtropical crop that demands a warm, humid atmosphere. Capsasin, a phenolic acid component, is responsible for chilli's pungency. During the ripening stage,

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capsanthin is responsible for the brilliant red hue. Chillies are grown in all seasons in one or more parts of the country; thus, the fruits are available throughout the year. Chilli is also used as a folk remedy for toothaches, sore throats, coughs, wound healing, and parasite infections. It's also used as an antioxidant, antimicrobial, and immunological modulator, among other things.

Chilli production is determined by the cultivars' innate genetic yield potential, which is impacted substantially by environmental conditions and cultivation practices. The abrupt rise in air temperature causes hormonal imbalance. One of the most significant issues in chilli production is temperature. Poor fruit set is one of the key bottlenecks in chilli production, with severe weather conditions such as temperature and rainfall having a direct impact on productivity. Chilli yield is sometimes boosted by reducing flower drop, and this problem is often managed by selecting breeding lines that preserve a high proportion of blooms or by using physiological manipulation such as spraying plant growth regulators. Plant growth regulators are known to strengthen the source-sink interaction, increase photo assimilate translocation, and aid in the retention of flowers and fruits. Plant growth regulators cause plants to develop more quickly. Plant growth regulators are the next generation of agrochemicals after fertilizers, insecticides, and herbicides. Stem elongation, germination, dormancy, flowering, fruit development, cell division, and root expansion are all aided by plant growth regulators. Fruit and blossom drop, which is produced by physiological and hormonal imbalance in plants in unfavorable situations such as excessively low or high temperatures, reduces chilli production. One of the principal plant growth regulators, Chlormequat chloride is a highly persistent inhibitor of gibberellin production used to prevent vegetative growth and cell elongation. To observe the effect on morphological features, Chlormequat Chloride (CC) is used. The most effective methods for influencing plant behavior, yield, and yield distribution include plant density and the administration of Mepiquat Chloride (MC) as major cultural practices. Mepiquat chloride, a plant growth regulator, can control plant structure [1,2]. A natural plant growth regulator called triacontanol (TRIA) is utilized to increase agricultural productivity. We are primarily focusing on the morphological characteristics as well as the fruit dropping by using these hormones.

## 2. MATERIALS AND METHODS

The current research was carried out in the month of October 2021 on agricultural field in Pedhakurapadu, Guntur district, Andhra Pradesh, using the popular chilli cultivar 'Teja.' The randomized block design was used to lay out the experimental plot, which included 10 treatments and 3 replications. A total of 65 plants were planted in each plot at a spacing of 65x25 cm. At the time of field preparation, a basal dose of 216 grams N, 216 grams P<sub>2</sub>O<sub>5</sub>, and 216 grams K<sub>2</sub>O per 36m<sup>2</sup> was sprayed. DAP was sprayed at a rate of 990 grams per 36m<sup>2</sup> after 7 days of transplanting. Intercultural activities and plant protection measures were carried out according to crop recommendations. Untreated check, Paclobutrazol 25%w/v SC @ 3.6ml/36m<sup>2</sup>, Chlormequat chloride 50% SL @ 1.8ml/ 36m<sup>2</sup>, Mepiquat chloride 5% aqueous solution @ 2.25ml/36m<sup>2</sup>, Triacontanol 0.05% EC@ 3.6ml/36m<sup>2</sup> and 1.8ml/36m<sup>2</sup>, Ethephon 39SL (39%W/W) @ 1.35ml/36m<sup>2</sup> and 0.72ml/36m<sup>2</sup>, Amino acid @ 5.4ml/36m<sup>2</sup>, Gibberillic acid 0.01%L @ 2.25ml/36m<sup>2</sup> are the ten treatments used in our research. The goal of the research was to find the optimum growth promoter for improving chilli growth characteristics. In this experiment, foliar spray application method was used and to study the developments in Chilli crop and fruiting properties. Two applications were done after 30 days of transplanting and 40 days of transplanting and the observations were taken 7 days after second dose of application. The height of the plant was measured from the substrate level to its highest point (the last fully expanded leaf). According to the following criteria, the canopy compactness was assessed using the ratio between the lengths of the plant aerial component measured in both the longitudinal and transverse directions: values closer to one are presented as circular canopies. Each plant's total number of fruits and leaves at commercial maturity was counted. Mepiquat chloride, one of the PGRs in the 10 treatments, was administered at a rate of 2.25ml/36m<sup>2</sup>, 30 and 40 days after transplanting, and the information was gathered from randomly chosen and labelled plants. At 30 and 40 DAT, the internodal length was measured by taking the average of the distance between the second and third nodes from the base of the plant. At 30 and 40 DAT, 5 chilli plants were randomly chosen from each plot to count the number of branches. Each plot and replication's data were averaged, and this value was noted. Ethephon 30SL (39%w/w) at two concentrations of 1.35ml/36m<sup>2</sup>

and 0.72 ml/36m<sup>2</sup> and Gibberellic acid was applied as a foliar spray at a rate of 0.01 % L@2.25 ml/36 m<sup>2</sup>, and measurements of the plants' height, spread, and number of branches were made. Gibberellic acid increases the plant height reached the greatest value. This could be attributed to GA's responsibilities in boosting cell growth and cell division.

### 3. RESULTS AND DISCUSSION

The following are the findings of the study to determine the optimum growth promoter for improving chilli growth character. The influence of several plant growth regulators on plant height, spread, number of branches, and days to 25% flowering (Table 1). The plant's genetic makeup, hormonal levels, and the growing environment all play a significant role in the growth, development, and productivity of the chilli crop. PGRs responded more positively than farmers practices. Increased nutrient and water uptake may have boosted growth parameters, resulting in more photosynthesis and food material utilization for reproductive growth, such as higher fruit set percentage, more fruits per plant, more seeds per fruit, heavier seeds per fruit, and ultimately higher fruit yield. The height of the plant grows with the age of the seedlings. There is a big increase. Triacantanol application may have improved yield and its component characteristics due to the plant's increased ability to use food resources for reproductive growth (flowering and fruit set), improved photosynthetic efficiency and source-sink relationships, increased uptake of nutrients and water, decreased transpiration and respiration, and improved translocation and accumulation of sugar and other metabolites [3]. TRIA benefits plant growth, yield, photosynthesis, nitrogen fixation, enzyme activity, free amino acid levels, lowering sugar levels, and soluble protein levels [4-6]. Ethephon, also known as 2 chloroethyl phosphonic acid, is one of the plant growth regulators that is most frequently employed today. It is currently used to encourage pre and post-harvest ripening on fruits, vegetables, and grains. It also encourages fruit colour, leaf, flower, or fruit abscission, fruit ripening, fruit yield, germination, and flower induction. Two concentrations of tricontanol 0.5% EC were used: 3.6ml/36m<sup>2</sup> and 1.8ml/36m<sup>2</sup> are used where the application of Tricontanol (T5) 0.05 % EC@3.6ml/36m<sup>2</sup> (71.77cm) in Tricontanol (T5) results in a considerable increase in plant height, followed by Paclobutrazol (25%w/v) SC @ 3.6ml/36m<sup>2</sup> (62.47cm) in T2, and the least we

found in T1 (48.44cm) that is an untreated check. Experimental findings were based on Houtz RL et al. [7]. Plant spread in the east-west and north-south directions was the second observation have taken. The maximum plant spread in the east-west condition was achieved with Gibberellic acid 0.01% L @ 2.25ml/36m<sup>2</sup>, (T10) (48.38cm), followed by (T4), Mepiquat chloride 5% aqueous solution@2.25ml/36m<sup>2</sup> (61.36cm), and the lowest in the untreated check (32.77 cm). In the north-south condition, the highest is achieved by applying Gibberellic acid 0.01% L @ 2.25ml/36m<sup>2</sup> in T10 (45.27 cm), the next highest is achieved in (T2) by applying Paclobutrazol (25%w/v) SC @3.6ml/36m<sup>2</sup> (43.33 cm), and the lowest is achieved by leaving T1 untreated (38.33 cm). The experimental results were based on [8] earlier's findings. Gibberellic (T10) 0.01% L @2.25ml/36m<sup>2</sup> produced the maximum number of branches in Gibberellic (T10). Observing in all replications at regular time intervals yielded 28.88 branches, and the administration of Mepiquat chloride 5% aqueous solution @2.25ml/36m<sup>2</sup> yielded the second (26.66). Untreated check has the smallest number of branches (19.77). We also looked into the days leading up to 25% blossoming. Proteins are made up of amino acids, primarily. Protein synthesis in tissue is aided by amino acids. The creation of enzymes involves some amino acids. Amino acids (T9) is the highest we observed, which was achieved by applying amino acid @5.4ml/36m<sup>2</sup> (65.00), followed by (T3) (65.66), which was achieved by applying Chlormequat chloride 50 % SL @ 1.8ml/36m<sup>2</sup>. With an increase in GA3 level, plant's height and branch count both considerably increased. Cell elongation and cell division may have increased quickly in the meristematic zone. These findings are consistent with those of Rai et al. [9] and Gupta and Gupta [10]. As amino acids encourage flowering, which eventually enhances yield, they were administered at a rate of 5.4ml/36m<sup>2</sup> and 1.8ml/36m<sup>2</sup> of chlormequat chloride is applied as a foliar spray, to create a homogenous matrix, thoroughly and mechanically homogenise the mixture. Due to the necessity of separating chlormequat from chlorine that occurs naturally, it is challenging to identify chlormequat residues in plant material. However, due to its stability and polarity in acidic methanol, chlormequat get extracted extremely rapidly. If separation is not quantitative high blank values are discovered, which may result in false positive results and at last untreated check (71.66). The experimental results are consistent with Attoa GE et al. earlier findings [11].

**Table 1. Effect of plant growth regulators on growth attributes of chilli**

S. No	Tr. No	Treatment details	Plant height (cm)	Plant spread (cm)		No. of branches	Days to 25 percent flowering
				East-West	North-South		
1	T <sub>1</sub>	Untreated Check	48.44	32.77	38.33	19.77	71.66
2	T <sub>2</sub>	Paclobutrazol (25% w/v) sc @ 1000ml/ha	62.47	36.94	43.33	25.22	68.33
3	T <sub>3</sub>	Chlormequat chloride 50% SL@500ml/ha	53.50	43.09	42.29	25.22	65.66
4	T <sub>4</sub>	Mepiquat chloride 5% Aqueous solution@625ml/ha	61.36	44.99	40.44	26.66	67.33
5	T <sub>5</sub>	Triacantanol 0.05% EC@1000ml/ha	71.77	44.66	42.29	25.44	67.00
6	T <sub>6</sub>	Triacantanol 0.05% EC@500ml/ha	54.41	42.27	41.11	21.93	66.33
7	T <sub>7</sub>	Ethephon 39 SL(39%W/W)@375ml/ha	51.58	44.16	42.21	27.44	66.33
8	T <sub>8</sub>	Ethephon 39 SL(39%W/W)@200ml/ha	57.77	43.16	41.66	27.33	66.00
9	T <sub>9</sub>	Amino acid @ 1500ml/ha	50.27	38.11	39.44	21.88	65.00
10	T <sub>10</sub>	Gibberelic acid 0.01% L @625ml/ha	69.33	48.38	45.27	28.88	68.00
		S.E.m±	0.85	2.39	2.62	1.52	2.03
		C.D. at 5%	2.53	7.11	N.S.	4.52	6.03

**Table 2. Effect of different growth regulators on yield attributing parameters**

S. No.	Tr. No.	Treatment details	Fruit set (%)	No. of fruits per plant	Fruit length (cm)	Fruit diameter (cm)
1	T <sub>1</sub>	Untreated Check	72.03 (58.21)	480.00	6.25	3.36
2	T <sub>2</sub>	Paclobutrazol (25% w/v) sc @ 1000ml/ha	74.22 (59.59)	484.66	6.72	3.90
3	T <sub>3</sub>	Chlormequat chloride 50% SL@500ml/ha	79.12 (63.18)	551.22	6.84	4.04
4	T <sub>4</sub>	Mepiquat chloride 5% Aqueous solution@625ml/ha	80.69 (63.96)	627.88	8.18	4.09
5	T <sub>5</sub>	Triacantanol 0.05% EC@1000ml/ha	75.14 (60.10)	789.33	7.27	3.98
6	T <sub>6</sub>	Triacantanol 0.05% EC@500ml/ha	75.08 (60.21)	746.44	7.14	3.98
7	T <sub>7</sub>	Ethephon 39 SL (39%W/W)@375ml/ha	85.37 (67.53)	725.22	7.10	3.94
8	T <sub>8</sub>	Ethephon 39 SL (39%W/W) @200ml/ha	77.97 (62.04)	708.55	6.98	3.94
9	T <sub>9</sub>	Amino acid @ 1500ml/ha	84.47 (67.66)	707.22	8.00	4.07
10	T <sub>10</sub>	Gibberelic acid 0.01% L @625ml/ha	74.31 (59.60)	806.44	7.23	4.01
		S.E.m±	2.22	15.47	0.06	0.11
		C.D. at 5%	4.66	45.98	0.18	0.32

The effect of plant growth regulators on fruit set %, number of fruits per plant, fruit length, and fruit diameter is indicated in (Table 2).

Fruit and vegetable crops can absorb ethylene, ethephon (2-chlorethylphosphonic acid) can release to eventually speed up their growth processes. By enhancing or suppressing the growth promoters and growth retardants, respectively, the growth regulators are said to cause a rapid change in the phenotypes of plants and have an impact on their growth from seed germination to senescence. Growth stimulants aid in fruit ripening and may ultimately increase productivity and yield [12]. T7 which uses Ethephon 39SL (39%w/w) @1.35ml/36m<sup>2</sup> (85.37%), is followed by (T9), which uses amino acid@ 5.4ml/36m<sup>2</sup> (84.47%), and check plot has the lowest fruit set percentage (72.03%). The experimental results are consistent with Khurana D.S et al. earlier's findings [13]. We observed the highest number of fruits per plant (806.44) after applying Gibberellic acid 0.01 % L @ 2.25ml/36m<sup>2</sup> as treatment 10, which is almost identical to the result seen in T5 after applying Tricontanol 0.05 %EC @3.6ml/36m<sup>2</sup> (789.33), and the least fruit count observed in the untreated check (480.00). In terms of fruit length and diameter, we receive similar results. The application of Mepiquat chloride 5 percent aqueous solution @ 2.25ml/36m<sup>2</sup> resulted in the highest T4 (8.18 and 4.09 cms, respectively) and was followed by amino acid @ 5.4ml/36m<sup>2</sup> as T9. The experimental results are consistent with those of Balraj et al. and Gutam et al. In this treatment, the fruit length is 8 cm and the fruit diameter is 4.07 cm. Untreated check has the shortest fruit length (6.25cm) and the smallest diameter (3.36cm).

#### 4. CONCLUSION

The optimal treatments for enhanced plant growth and yield were proposed based on the above observations acquired from our investigation. Mepiquat chloride, T4 had the best outcomes among the treatments in terms of fruit length and diameter, therefore it's a good for higher yields. The Tricontanol 0.05% EC @ 3.6ml/36m<sup>2</sup> (T5) treatment performs best in terms of plant height, which aids in the production of massive branching. Ethephon 39 SL (39%w/w) @1.35ml/36m<sup>2</sup>, T7 showed the best results in terms of fruit set, which will be beneficial to farmers in terms of high yields. The T9, amino acid treatment produces the most flowering, which is another factor that will help

farmers achieve the optimum harvests. Finally, the treatment, Gibberellic acid T10 is demonstrated to be the most effective in terms of plant spread, producing the most branches and fruits per plant. Based on the observations, these treatments can be suggested for improved crop development and maximum yields [14,15].

#### COMPETING INTERESTS

Authors have declared that no competing interests exist.

#### REFERENCES

1. Reddy VR, Trent A, Acock B. Mepiquat chloride and irrigation versus cotton growth and development. *Agron J.* 1992;84(6): 930-3.
2. Cathey GW, Meredith WR. Cotton response to planting date and mepiquat chloride. *Agron J.* 1988;80(3):463-6.
3. Chaudhary BR, Sharma MD, Shakya SM, Gautam DM. Effect of plant growth regulators on growth, yield and quality of chilli (*Capsicum annuum* L.) at Rampur, Chitwan. *J Inst Agric Anim Sci.* 2006; 27:65-8.
4. Ries S. Triacontanol and its second messenger 9-b- L (-)-adenosine as plant growth substances. *Plant Physiol.* 1991; 95:986989.
5. Ries S, Savithiry S, Wert V, Widders I. Rapid induction of ion pulses in tomato, cucumber, and maize plants following a foliar application of L(+)-Adenosine. *Plant Physiol.* 1993;101(1):49-55.
6. Nagoshi T, Kawashima S. Effect of foliar application of triacontanol on growth and yield of rice plants. IV. Effect of triacontanol on the ripening of rice plants under shading and low temperature conditions. *Jpn J Crop Sci.* 1996;65(3): 437-44.
7. Houtz RL, Ries SK, Tolbert NE. Effect of triacontanol on chlamydomonas I. Stimulation of growth and photosynthetic CO<sub>2</sub> assimilation. *Plant Physiol.* 1985;79: 357-64.
8. Georgia O, Ilias I, Anastasia PG, Papadopoulou. Comparative study on the effects of various plant growth regulators on growth, quality and physiology of *Capsicum annuum* L. *Pak J Bot.* 2010;42:805-14.
9. Rai N, Yadav DS, Patel KK, Yadav RK, Asati BS, Chaudey T. Effect of plant

- growth regulators on growth, yield and quality of tomato (*Lycopersicon esculentum* Mill.). J Veg Sci. 2006;3:180-82.
10. Gupta PK, Gupta AK. Efficacy of plant growth regulators (IAA and NAA) and micronutrient mixture on growth, flowering, fruiting and shelf life of tomato (*Lycopersicon esculentum* Mill.). Bioved. 2000;11:25-9.
  11. Attoa GE, Wahba HE, Farahat AA. Effect of some amino acids and sulphur fertilisation on growth and chemical composition of *Iberis amara* L. plants. Egypt J Hortic. 2002;29:17-37.
  12. Tamilselvi VR. Impact of plant growth regulators and formulations on growth of chilli (*Capsicum annuum* L.). Plant Gene Trait. 2014;5(8):1-3.
  13. Khurana DS, Manchanda D, Singh K. Influence of naphthalene acetic acid on growth and fruit yield of chilli. Haryana J Hortic Sci. 2004;33(3/4):274-5.
  14. Balraj R, Kurdikeri MB, Revanappa. Effect of growth regulators on growth and yield of chilli (*Capsicum annuum* L.) at different pickings. Indian J Hortic. 2002a;59(1): 84-8.
  15. Gutam S, Koti RV, Chetti MB, Hiremath SM. Effect of naphthalene acetic acid and mepiquat chloride on physiological components of yield in bell pepper (*Capsicum annuum* L.). J Agric Res. 2009;47(1):53-62.

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