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Effect of Growth Regulators and Micronutrients on Growth and Quality Parameters of Tomato (*Solanum lycopersicum* L.)

Himasweta Nayak[1*], Sunil Kumar Dash[2], Gouri Shankar Sahu[1], Pradyumna Tripathy[1], Simanta Mohanty[3] and Swarnalata Das[4]

[1]Department of Vegetable Science, College of Agriculture, Odisha University of Agriculture and Technology, Bhubaneswar (Odisha), India.
[2]Vegetable Agronomist, AICRP on Vegetable Crops, Odisha University of Agriculture and Technology, Bhubaneswar (Odisha), India.
[3]Assistant Seed Research Officer, Seed Technology Research, AICRP – NSP (Crops), Odisha University of Agriculture and Technology, Bhubaneswar (Odisha), India
[4]Seed Production Officer, AICRP on Vegetable Crops, Odisha University of Agriculture and Technology, Bhubaneswar (Odisha), India.

(Corresponding author: Himasweta Nayak)*
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ABSTRACT: Growth regulators and micro nutrients play an imperative role enhanced plant growth and quality of the fruit. Sustainable crop production require the adoption of proper inputs for the growth and quality of the produce, hence to acquire the better understanding of use of growth regulators and micronutrients with its proper dose and method following experiment was done. An experiment was conducted to find out the effect of different plant growth regulators and micronutrients on tomato during the *rabi* season of 2019 at the AICRP on Vegetable Crops, College of Agriculture, Odisha University of Agriculture and Technology (OUAT), Bhubaneswar. The experiment was conducted on tomato variety Kalinga tomato-121. There were 12 treatment combinations with three replications using Randomized Block Design i.e. T_1: Borax @ 0.2%, T_2: Zinc sulphate @ 0.5%, T_3: Micronutrient mixture @ 0.5% (Multiplex Multimax), T_4: NAA 50 ppm, T_5: NAA 50 ppm + Borax @ 0.2%, T_6: NAA 50 ppm + Zinc sulphate @ 0.5%, T_7: NAA 50 ppm + Micronutrient mixture @ 0.5% (Multiplex Multimax), T_8: GA_3 50 ppm, T_9: GA_3 50 ppm + Borax @ 0.2%, T_{10}: GA_3 50 ppm + Zinc sulphate @ 0.5%, T_{11}: GA_3 50 ppm + Micronutrient mixture @ 0.5% (Multiplex Multimax), T_{12}: Control (without growth regulators and chemicals). According to the results, the maximum plant height (48.50 cm), number of leaves per plant (42.53), stem girth (3.20cm) and number of branches per plant (6.06) were found in treatment T_{11}- GA_3 50 ppm + Micronutrient mixture @ 0.5% (Multiplex Multimax) whereas the minimum for all the parameters were found in control. Minimum acidity % of tomato was recorded in treatment T_{11}- GA_3 50 ppm + Micronutrient mixture @ 0.5% (Multiplex Multimax) i.e. 0.43% and maximum acidity % was found in control-T_{12} (0.52%) From the above-mentioned investigations it can be concluded that use of GA_3 50 ppm + Micronutrient mixture @ 0.5% (Multiplex Multimax) is best for tomato cultivation during *rabi* season in Odisha condition.

Keywords: Tomato, Growth regulators, Micronutrients, NAA, GA_3, Borax, Zinc sulphate.

INTRODUCTION

Tomato (*Solanum lycopersicum* L.) is an important most widely and commercially grown crop almost throughout the world including tropical, sub-tropical and temperate regions. Tomatoes are an important part of the world's diet because they contain high levels of lycopene and minerals, which are beneficial to human health (Perveen *et al*., 2015). Tomato is a rich source of vitamins A and C and is referred to as 'poor man's orange'. It is a versatile vegetable and is consumed as raw or cooked. It is worldwide known as "No. 1 processing vegetable" because of its demand not only in processing sector but also as a vegetable and protective food.

A plant growth regulator (PGR), is an organic compound, either natural or synthetic, that modifies or controls one or more specific physiological process within a plant. They are sometimes referred to as plant hormones. PGRs are numerous chemical substances that profoundly influence the growth and differentiation of plant cells, tissues and organs. Plant growth regulators function as chemical messengers for intercellular communication. Plant growth substances are essential for growth and development of tomato plant. They play an important role in flowering, fruit setting, ripening and physiochemical changes during storage of tomato. GA_3 significantly increased growth characters, yield and also improved quality of tomato whereas NAA application increased total soluble solid percentage significantly (Pundir and Yadav 2001). Plant growth regulators promote root growth, water and

nutrients uptake helping the restoration of plant hormonal balance (Sivakumar, 2021).

Micronutrients have an important role in the plant activities and foliar application can improve the vegetative growth, fruit set and yield of tomato (Adams, 2004) by increasing photosynthesis of green plants (Mallick and Muthukrishnan 1980). Although in recent times balanced nutrition to the crop plants is being advocated through the use of organic manures, but that may be helpful only for low yield levels; for harnessing the higher yield potential, supplementation of micronutrients is essential (Reddy *et al*., 2018). Among micronutrients, Zn and B are important for plant nutrition. Zn plays important role on growth and development as well as carbohydrates, protein metabolism and sexual fertilization of plant (Vasconcelos *et al*., 2011) while B deficiency reduced yield and quality in tomatoes (Davis *et al*., 2003). Plant hormones and growth regulators are used in horticultural systems to manipulate development and floral initiation (Kupke *et al*., 2022). Considering the above discussed facts the present investigation is being undertaken to find out the effect of growth regulators and micronutrients on vegetative parameters of tomato (*Solanum lycopersicum* L.).

MATERIALS AND METHODS

The field experiment was conducted during the *rabi* season of 2019 at the AICRP on Vegetable Crops, College of Agriculture, Odisha University of Agriculture and Technology (OUAT), Bhubaneswar. The experiment was conducted on tomato variety Kalinga tomato-121. There were 12 treatment combinations with three replications using Randomized Block Design.

Treatments: T_1: Borax @ 0.2%, T_2 : Zinc sulphate @ 0.5%, T_3 : Micronutrient mixture @ 0.5% (Multiplex Multimax), T_4 : NAA 50 ppm, T_5 : NAA 50 ppm + Borax @ 0.2%, T_6 : NAA 50 ppm + Zinc sulphate @ 0.5%, T_7 : NAA 50 ppm + Micronutrient mixture @ 0.5% (Multiplex Multimax), T_8 : GA_3 50 ppm, T_9 : GA_3 50 ppm + Borax @ 0.2%, T_{10} : GA_3 50 ppm + Zinc sulphate @ 0.5%, T_{11} : GA_3 50 ppm + Micronutrient mixture @ 0.5% (Multiplex Multimax), T_{12} : Control (without growth regulators and chemicals)

The stock solution prepared by required weight of plant growth regulator and micronutrients was taken by using electronic balance and dissolving @ 1 mg L^{-1}.Foliar application was done at 15, 30 and 45 days after transplanting. All the recommended cultural practices were done during the period of experiment. The observations recorded plant height (cm), number of leaves per plant, stem girth, number of branches per plant and acidity % of tomato. Observations were recorded and statistical analysis of the data was worked out using Randomized Block Design.

RESULTS AND DISCUSSION

A. Effect of growth regulators and micronutrients on growth parameters of tomato

(i) Plant height. The plant height was recorded significantly maximum with treatment T_{11}- GA_3 50 ppm + Micronutrient mixture @ 0.5% (Multiplex Multimax) i.e. 48.50 cm (Table 1). The treatment T_7 and T_{11} were significantly superior from all other treatments. The plants under control (T_{12}) expressed minimum height i.e. 27.27 cm during respective year of study. Similar result was observed by Dixit *et al*. (2018); Shital *et al*. (2017); Singh *et al*. (2021).

(ii) No. of leaves per plant. The significant variation observed as the maximum number of leaves per plant found in T_{11}- GA_3 50 ppm + Micronutrient mixture @ 0.5% (Multiplex Multimax) i.e. 42.53 and minimum was found in control i.e. 26.62 (Table 1). The treatment T_7 and T_{11} were significantly different from all other treatments. Similar result was found by Jakhar *et al*. (2018); Reddy *et al*. (2018); Naga Sivaiah *et al*. (2013).

(iii) Stem girth. The highest stem girth was observed in T_{11}- GA_3 50 ppm + Micronutrient mixture @ 0.5% (Multiplex Multimax) i.e. 3.20 cm and the minimum stem girth was 2.21 cm which was observed in control (T_{12}) (Table 1). The treatment T_7, T_9 and T_{11} were significantly superior from all other treatments. Similar result was observed by Dixit *et al*. (2018) ; Pandey *et al*. (2022).

(iv) No. of branches per plant. Maximum number of branches were observed with treatment T_{11}- GA_3 50 ppm + Micronutrient mixture @ 0.5% (Multiplex Multimax) i.e. 6.06 and minimum number of branches per plant was observed in control-T_{12} (3.43) (Table 1). The treatment T_7 and T_{11} were significantly different from all other treatments. Similar result was found by Jakhar *et al*. (2018); Shital *et al*. (2017); Singh *et al*. (2021).

This increase in growth parameters might be due to characteristics virtue of growth regulators and micronutrients which promoted cell elongation, which has promoted the growth of all vegetative parts.

B. Effect of growth regulators and micronutrients on quality parameters of tomato

(i) Acidity %. Minimum acidity % of tomato was observed with treatment T_{11}- GA_3 50 ppm + Micronutrient mixture @ 0.5% (Multiplex Multimax) i.e. 0.43% and maximum acidity % was recorded in control-T_{12} (0.52%) (Fig. 1). Similar result was found by Verma *et al*. (2014).

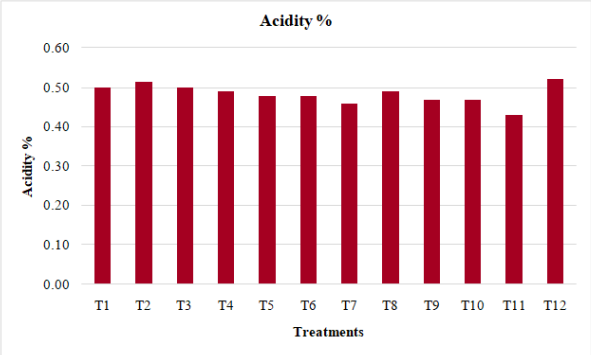

Fig. 1. Effect of growth regulators and micronutrients on Acidity % of tomato.

Table 1: Effect of growth regulators and micronutrients on growth parameters of tomato.

Treatments	Plant height (cm) (30DAT)	No. of leaves per plant (30DAT)	Stem girth (cm)	No. of branches per plant (30DAT)
T_1: Borax @ 0.2%	30.63	30.95	2.37	3.57
T_2: Zinc sulphate @ 0.5%	29.43	30.22	2.32	3.55
T_3: Micronutrient mixture @ 0.5% (Multiplex Multimax)	31.98	31.78	2.39	3.60
T_4: NAA 50 ppm	33.23	33.93	2.41	3.63
T_5: NAA 50 ppm + Borax @ 0.2%	36.27	37.07	2.53	4.33
T_6: NAA 50 ppm + Zinc sulphate @ 0.5%	35.11	36.71	2.47	3.81
T_7: NAA 50 ppm + Micronutrient mixture @ 0.5% (Multiplex Multimax)	45.40	40.71	3.11	5.73
T_8: GA_3 50 ppm	34.11	35.51	2.43	3.79
T_9: GA_3 50 ppm + Borax @ 0.2%	41.53	37.84	2.93	4.93
T_{10}: GA_3 50 ppm + Zinc sulphate @ 0.5%	40.93	37.56	2.78	4.53
T_{11}: GA_3 50 ppm + Micronutrient mixture @ 0.5% (Multiplex Multimax)	48.50	42.53	3.20	6.06
T_{12}: Control (without growth regulators and chemicals)	27.27	26.62	2.21	3.43
SE(m)±	2.25	1.59	0.12	0.27
CD (P=0.05)	6.60	4.67	0.35	0.79

CONCLUSIONS

It can be concluded that applying the plant growth regulators resulted increased vegetative growth of tomato. GA_3 50 ppm + Micronutrient mixture @ 0.5% (Multiplex Multimax) given a considerable influence on all the vegetative and quality parameters relating to plant height, number of leaves per plant, stem girth, number of branches per plant and acidity % among the various treatment combinations. Thus, applying the plant growth regulators like GA_3 and micronutrient mixture revealing which helps farmers in cultivating tomato in hostile climatic situation by making better availability of macro and micro nutrients and better metabolic activity. Ultimately the increased vegetative growth can lead to increased production of tomato and qualitative production of tomato.

FUTURE SCOPE

Future perspectives for the use and application of plant growth regulators and micronutrients in agriculture are promising, especially in the case of vegetable crops. Since tomato is a most important vegetable all over the world. A major challenge would be to understand how the information conveyed by these simple compounds is integrated during plant growth. In future for understanding of use of different plant growth regulators and micronutrients alone and in combinations further studies can be carried out.

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Conflict of Interest. None.

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