

Short Communication**EFFECTS OF PLANT GROWTH REGULATORS ON YIELD AND YIELD ATTRIBUTES OF TOMATO (*SOLANUM LYCOPERSICUM*)****B. Ahmed^{1*}, M. Sultana¹, M. Sumi¹, A.S. Mitu², R. Biswas³ and M.A.M. Hussien⁴**

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Abstract

A field experiment was carried out at Tuber Crops Research Sub Center, Seujgari, Bogura, Bangladesh to assess the effect of plant growth regulators on tomato during the winter season of 2020-2021. Four Plant Growth Regulators (PGRs) available in market viz., PGR₁ = Flora @ 20 ppm, PGR₂ = Protozim @ 20 ppm, PGR₃ = Vagimax and PGR₄ = Miraculan @ 20 ppm were used, and there was a control no use of PGR was used as control in the study. The experiment was conducted in RCBD with three replications. The growth and yield contributing characters significantly differed due to plant growth regulators. The maximum number of fruits/plant (65) was recorded from PGR treatment (application of Flora @ 20 ppm) while the minimum number of fruits/plant (25) was recorded from the control treatment (no application of plant growth regulators). Plant growth regulators had significant influence on growth and yield of tomato. The highest yield (36.21 t/ha) and highest Photosynthesis (Chlorophyll a, Chlorophyll b and Total Chlorophyll) was obtained from the application of PGR₁ = Flora @ 20 ppm plant growth regulator. The maximum Benefit Cost Ratio (BCR) (3.34) was also recorded from PGR₁ treatment, while the minimum BCR (1.66) was recorded from control (no application of plant growth regulators). Among the four PGRs i.e., application of Flora @ 20 ppm showed the best result in tomato production.

Keywords: Benefit cost ratio, Growth regulators, Tomato, Yield

Introduction

Tomato (*Solanum lycopersicum*) belonging to *Solanaceae* family is a vegetable crop grown in Bangladesh during winter. Its food value is very rich because of higher contents of vitamins A, B, and C including calcium and carotene (Alam *et al.*, 2010). It is much popular as salad in the raw state and is made soups, juice, ketchup, pickles, sauces, conserved puree, paste, powder and other products. In Bangladesh, there is a great possibility of increasing tomato yield per unit area with proper use of fertilizer (Kayum *et al.*, 2008; Khan *et al.*, 2014). Tomato requires large quantity of readily available fertilizer nutrient (Khayyat *et al.*, 2007). In absence of other production constraints, nutrient uptake and yield are very closely related. PGRs are chemicals which are used to modify plant

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growth such as increasing branching, suppressing shoot growth, increasing return bloom, removing excess fruit, or altering fruit maturity (Uddin *et al.*, 2009). PGRs have the positive and essential role for building up protoplasm and protein, which induce cell division and initial meristematic activity when applied in optimum quantity.

PGRs have largest effect on yield and quality of tomato. It also promotes vegetative growth, flower and fruit set of tomato. It significantly increases the growth and yield of tomato. Application of PGRs to the plants produces high tomato fruit yield and improves fruit quality whereas excessive application leads to luxuriant development of vegetative parts of the plant at the expense of reproductive growth (Mehraj *et al.*, 2014). In the local market, various companies sell their PGRs. However, studies on the market available PGRs for physiological efficiency, apparent growth recovery and their relation to yield potentiality on tomato are scanty. With the above background, the present study was undertaken to investigate the effect of PGRs on the yield, yield attributes and Benefit Cost Ratio (BCR) of tomato.

Materials and Methods

The experiment was carried out in Tuber Crops Research Sub Center (TCRSC) research field of BARI, Seujgari, Bogura, during the winter season (November 24, 2020 to March 30, 2021) to find out the effect of selected four plant growth regulators (PGR_0 = Control, PGR_1 = Protozim @ 20 ppm, PGR_2 = Flora@ 20 ppm, PGR_3 = Vagimax @ 20 ppm and PGR_4 = Miraculan @ 20 ppm) available in market of Bogura on BARI Tomato-14. The experiment was laid out in Randomized Complete Block Design (RCBD) with three replications. Twenty four days old seedlings were transplanted at a spacing of 60 cm \times 40 cm in the experimental plot on 24 November 2019. Manures and chemical fertilizers were applied at the rate of cow dung 20 t/ha, Urea 250 kg/ha, Triple Superphosphate (TSP) 200 kg ha, and Murate of Phosphate (MP) 150 kg/ha. Later the stock solution was diluted in distilled water to prepare the working solutions just before application. Spraying was performed early in the morning to avoid rapid drying of the spray solution due to transpiration. Data were collected from ten randomly selected plants from each plot viz., plant height (cm), number of fruits/plant, fruit length and diameter, average fruit weight (g) and yield/ha. The means were separated at 5% level of significance.

Chlorophyll determination

1. Preparation of the reaction solution: Pure acetone, pure ethanol and distil water (4.5:4.5:1) mix up them.
2. The RS and sample of fresh leaves (small pieces) in small tubes (100:1) mixed up and placed the tubes in dark until the color of leaf pieces converted into white.
3. Reading taken at 663 and 645nm for chlorophyll while for carotenoids at 470nm.
4. Calculation of Chlorophyll Determination (mg/g FW):
 - Chl. (a) = $(12.71 \times OD_{663} - 2.59 \times OD_{645}) / 100$
 - Chl. (b) = $(22.88 \times OD_{645} - 4.67 \times OD_{663}) / 100$
 - Total chlorophyll = Chl. (a) + Chl. (b)

The benefit cost ratio (or benefit-to-cost ratio) compared the present value of all benefits with that of the cost and investments. These benefits and costs were treated as monetary cash flows or their equivalents. The BCR was calculated to find out the comparison between each treatment. The BCR of tomato was calculated by using the following formula:

$$\text{BCR} = \frac{\text{PV}_{\text{benefits}}}{\text{PV}_{\text{costs}}}$$

Where,

$\text{PV}_{\text{benefits}}$ = present value of benefits

PV_{costs} = present value of costs

Results and Discussion

Plant height

Statistically significant variation was found in the plant height (cm) of tomato due to application of plant growth regulators (Table 1). The maximum plant height (52.66 cm) was recorded by application of Plant Growth Regulator (Flora @20 ppm), while the minimum plant height (24.45 cm) was recorded from control (no application of plant growth plant growth regulators). It might be due to the effect of plant growth regulators on plant growth which is supported by Choudhury *et al.*, 2013 and Ali *et al.*, 2015.

Table 1. Effect of PGR on yield and yield attributes of tomato

Treatment	Plant height (cm)	No. of fruits/plant	Fruit length (cm)	Fruit diameter (cm)	Individual fruit weight (g)	Yield (t/ha)
T ₁	52.66	65	2.86	3.25	40.35	36.21
T ₂	45.36	60	3.05	2.61	39.25	26.38
T ₃	44.59	55	3.21	2.57	36.89	32.31
T ₄	48.24	49	2.05	3.21	45.58	31.38
T ₅ (Control)	24.45	25	1.59	2.39	29.68	18.98
CV (%)	1.56	4.21	2.31	1.75	7.24	3.58

T₁=PGR₁ (Flora @ 20 ppm), T₂= PGR₂ (Protozim @ 20 ppm), T₃= PGR₃ (Vagimax @ 20 ppm), T₄= PGR₄ (Miraculan @ 20 ppm) and T₅= No PGR(Control)

Number of fruits per plant

Statistically significant variation was found in the number of fruits per plant of tomato due to application of plant growth regulators (Table 1). The maximum number of fruits per plant (65) was recorded from PGR treatment (application of Flora @ 20 ppm) while the minimum number of fruits per plant (25) was recorded from no application of plant growth regulators. It might be due to that flora enhanced fruit setting in tomato.

Fruit length

In case of fruit length (cm), statistically significant variation was found of tomato due to application of plant growth regulators (Table 1). The highest fruit length (2.86 cm) was recorded from PGR treatment (application of Flora @ 20 ppm) while the minimum fruits length was recorded from no application of plant growth regulators (Control).

Fruit diameter

In respect of fruit diameter (cm), statistically significant variation was found in tomato due to application of plant growth regulators (Table 1). The highest fruit diameter (3.25 cm) was recorded from PGR treatment (application of Flora @ 20 ppm) while the minimum fruit diameter (2.39 cm) was recorded from Control.

Individual fruit weight

Average individual fruit weight of tomato revealed statistically significant variation due to application of plant growth regulators (Table 1). The maximum average weight of individual fruit (45.58 g) was recorded from PGR treatment (application of Miraculan @ 20 ppm), while the minimum average weight of individual fruit (29.68 g) was recorded from Control.

Photosynthesis

It is observed that the photosynthetic element Chlorophyll-a, Chlorophyll-b and total chlorophyll was higher in treatment of PGR than the control treatment (Fig. 1). Among the PGRs, application of Flora @ 20 ppm gave the higher photosynthetic element production than other. Higher photosynthetic rate results in higher yield performance (Ahmed et al., 2021 (a), Ahmed et al, 2020, Ahmed et al, 2021(b)

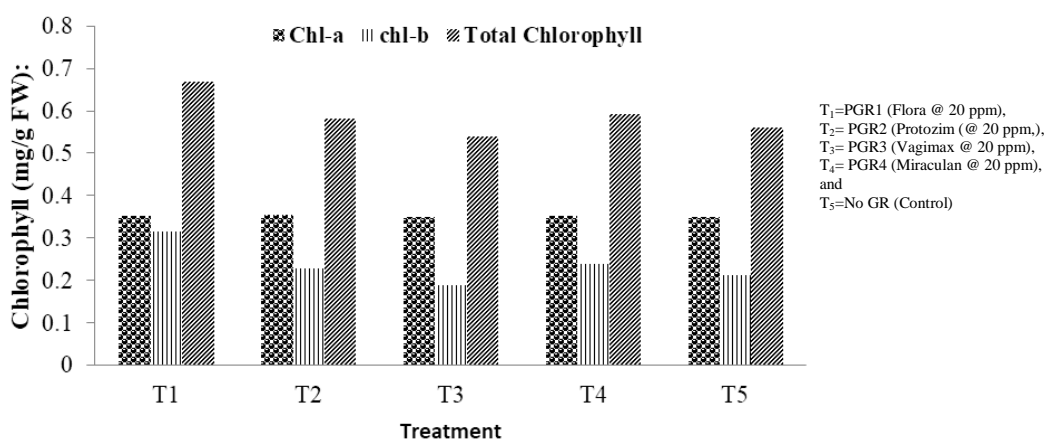


Fig. 1. Effects of different PGR₅ on photosynthesis of tomato

Yield

Statistically significant variation was found due to application of plant growth regulators in respect of yield of tomato (Table 1). The maximum yield (36.21 t/ha) was recorded from PGR treatment (application of Flora @20 ppm), while the minimum yield (18.98 t/ha) was recorded from no PGR application (Control) PGRs increased the number and weight of fruits/plant and thus increased yield of tomato (these findings were supported by Akand *et al.*, 2016; Mehdizadeh *et al.*, 2013; Isah *et al.*, 2014)

Benefit Cost Ratio (BCR)

The maximum Benefit-Cost Ratio (BCR) (3.34) was recorded from PGR treatment (application of Flora @20 ppm), while the minimum BCR (1.66) was recorded (Table 2) from Control treatment (no application of Plant Growth Regulators). Plant growth regulators increased yield and weight of fruit per plant and thus increased BCR of tomato (these findings were supported by Ahmed *et al.*, 2018).

Table 2. Effect of PGRs on the Benefit-Cost Ratio (BCR) of tomato

Treatment	Production Cost (ha ⁻¹)	Selling cost (Market price @ 40 tk kg ⁻¹)	Profit (Tk)	BCR
T ₁	650,000	2801,500	2151,500	3.34
T ₂	670,000	2391,900	1721,900	2.57
T ₃	660,000	2607,000	1947,000	2.95
T ₄	650,000	1904,500	1254,500	1.93
T ₅	600,000	1756,000	1156,000	1.66

T₁=PGR₁ (Flora @ 20 ppm), T₂= PGR₂ (Protozim @ 20 ppm), T₃= PGR₃ (Vagimax @ 20 ppm), T₄= PGR₄ (Miraculan @ 20 ppm) and T₅= No PGR (Control)

Conclusion

Plant growth regulators had significant influence on the growth and yield of tomato, Flora @ 20 ppm gave the highest yield, yield attributes and Benefit-Cost Ratio (BCR).

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