

# Effect of Plant Growth Regulators on Growth and Yield Parameters of Tomato (*Solanumlycopersicum* L.)

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## Abstract

The present investigation was undertaken during summer season of 2018 at Vegetable research farm of Department of Horticulture, Lovely Professional University, with a view to find out the suitable growth substances for increasing the yield. The experiment was laid in randomized block design with three replications using Golden shiv Variety and ten treatments i.e. NAA (10,15 and 20 ppm), GA3 (30,60 and 90 ppm) and interaction of NAA and GA3 (10ppm+ 30 ppm, 15 ppm+ 60 ppm, 20 ppm+ 90 ppm respectively). Results revealed that T7 (NAA @ 10 ppm+ GA3 @ 30 ppm) gives the highest average fruit weight ultimately it leads to maximum fruit yield (598.13 q/ha).

## Introduction

Tomato(*Solanumlycopersicum*L.)belongstothe familySolanaceae.Itwasintroducedto India by Portuguese. The native of tomato is said to be Peruvian and Mexican region. Tomato is one of the most largely produced vegetables over the world. It is universally occupying as the 'Protective food' and having the first position in terms of processing vegetable in the world. AmongvegetablestomatosecuresfourthrankinareaandfirstrankinproductioninIndia.Tomato isthemostimportantwarm-seasoncropanditcanbegrownallovertheworld.

Tomato is considered as protected food. It is good source of vitamin and minerals. The pulpandjuicearedigestibleandamildpromotesofgastricsecretionandpurifier.Vitamin C and antioxidant is abundant in tomato. Lycopene is present in tomato and it is useful for human blood. It protects againstcancer. Tomatoes are widely consumed vegetable all over the world because it is rich source of phytonutrients and more health benefits (Levy and

Sharoni,2004).Epidemiologicalstudiesadvisedthattheconsumptionoftomatoes and processed tomato product can reduce the risk of prostate cancer (Campbell *et al*,2004).

The type of PGR its concentration and method of application influences yield and quality. A large number of PGR are available in the market but their application rate (usually in little amount) may vary among different crops. So to increase the yield and quality standards, it is important to identify the most appropriate plant growth regulators. Plant growth regulators are organic compounds, different from nutrients that are released by plants in very little quantity in one location, and move to another location of the plant. Plant growth regulators may promote or modify the physiological processes of the plant. It improves the yield and quality of tomato by the genetic influence. They are widely used to promote the growth characters and yield by increasing the fruit number, fruit set and fruit size. Among them, naphthaleneacetic acid and gibberellic acid have been observed to show a significant response on tomato crop. Thus, it is very important to determine their concentration. So the, present investigation was conducted to find out the effect of NAA, GA3 and their interaction on growth and yield of tomato.

### **Material and methods**

The experiment was conducted in summer season of 2018 at Department of Horticulture, School of Agriculture, Lovely Professional University, Phagwara (Punjab) with Goldenshiv cultivar. Geographically area falls under central plain zone of the agro-climate zone of Punjab. The location of experimental site is of 31.24°N Lat., 75.70°E long and 252 meters MSL is altitude. Maximum and minimum temperatures during the growing season were 42°C and 15°C respectively, whereas relative humidity varied between 60 to 85 percent.

The experiment was laid out in RBD with three replications and 10 treatments along with one control viz. T<sub>1</sub> (NAA @ 10 ppm), T<sub>2</sub> (NAA @ 15 ppm), T<sub>3</sub> (NAA @ 20 ppm), T<sub>4</sub> (GA3 @ 30 ppm), T<sub>5</sub> (GA3 @ 60 ppm), T<sub>6</sub> (GA3 @ 90 ppm), T<sub>7</sub> (NAA @ 10 ppm+ GA3 @ 30 ppm), T<sub>8</sub> (NAA @ 15 ppm+ GA3 @ 60 ppm), T<sub>9</sub> (NAA @ 20 ppm+ GA3 @ 90 ppm) and T<sub>10</sub> (Control) by using the Goldenshiv cultivar. Total 10 parameters were recorded i.e. plant height at 30, 60 and 90 days (cm), number of branches at 30, 60 and 90 days, number of compound leaves, number of fruits per plant, average fruit weight (gm), fruit diameter (cm), pericarp thickness of

fruits (mm), fruit yield (q/ha), specific gravity ( $\text{g/cm}^3$ ) and TSS ( $^{\circ}\text{Brix}$ ). The mean of the data on different characteristics were used for further analysis by OPSTAT software.

### **Result and discussion**

In the present study different parameters were recorded and presented in Table 1 and 2. The important characters are described in following heads.

#### **Plant**

**Height(cm):** Plant height contributes in the determination of vegetative growth phase and ultimately increases the yield attribute of the crop. It was found that at 30, 60 and 90 days after transplanting treatment T<sub>6</sub> (GA<sub>3</sub>@90 ppm) showed the maximum plant height (26.20 cm, 53.33 cm and 58.26 cm respectively) of tomato plant over the all treatments. It was observed that the application of plant growth regulators significantly increased plant height. This is because of improper cell division and stem elongation and finally it gives the maximum plant height this result is supported by Sithu and Adeleke (1999).

**Number of Branches:** Application of GA<sub>3</sub> it improves cell elongation, growth of cell, respiration and nucleic acid metabolism. Data indicated that GA<sub>3</sub> at rate of 30 ppm showed maximum branches (12.33) at 30 DAT whereas interaction of NAA@15 ppm + GA<sub>3</sub>@60 ppm showed maximum branches (24.16). At 90 DAT T<sub>6</sub> (GA<sub>3</sub> @90 ppm) revealed maximum plant height.

**Number of compound leaves:** Significant result observed for the number of compound leaves per plant and it is reported that the treatment T<sub>4</sub> gives the maximum compound leaves at 30 DAT whereas treatment T<sub>5</sub> (GA<sub>3</sub> @ 60 ppm) at 60 DAT and 90 DAT gave the maximum result in terms of number of compound leaves (26.83) while treatment T<sub>1</sub> (NAA@10 ppm) reported as the minimum producer of compound leaves per plant at the time final recording of data (90 DAT).

**Number of fruits per plant:** The analyzed data result concluded that the treatment T<sub>6</sub> (GA<sub>3</sub>@90 ppm) showed the maximum number of fruits per plant (26.56) and the treatment T<sub>3</sub> (NAA @ 20 ppm showed minimum number of fruits per plant (5.38). It was found that the application of Gibberellic acid produced a maximum number of fruits per plant. This is because of GA<sub>3</sub> application increased fruit setting in tomato and it is also due to better transfer of nutrients from roots portion (source) to apical part (sink) of plant. This result is supported by Mehta and Mathi (1975).

**Average fruit weight:** On the basis of result, it is found that treatment T7 (NAA @ 10 ppm + GA3 @ 30 ppm) produced the maximum average fruit weight (99.17 g), whereas minimum was observed in T1 (NAA @ 10 ppm). By application of growth regulators it ultimately increased the average fruit weight than control. This result was also supported by Tiwari and Singh (2014) in their study. Weight of fruit is also an important component because this is very important for increasing the yield and acceptance of consumer's. This may be due to increased amount of photosynthesis and translocation of nutrients in all parts of plant ultimately increased the fruit weight. This result was also supported by Tomar et al. (2017) in their study.

**Fruit diameter:** Diameter 4.96 cm was observed in Treatment T7 (NAA @ 10 ppm + GA3 @ 30 ppm) while the treatment T1 (NAA @ 10 ppm) showed the minimum fruit diameter (3.40 cm).. This result successfully supported by Kumar *et al* (2014) and Rahman *et al* (2015) in their study that if diameter of fruit is more, more transfer of nutrients from source to sink, photosynthesis is more and it ultimately increased the yield.

**Pericarp thickness of fruits:** It is found that the control treatment pericarp thickness is maximum (7.66 mm) and minimum found in treatment T6 (GA3 @ 90 ppm) with pericarp thickness of fruit (4.33 mm).

**Fruit yield (q/ha):** It is found that the treatment T7 (NAA @ 10 ppm + GA3 @ 30 ppm) showed the maximum fruit yield (598.13 q/ha) while treatment T3 (NAA @ 20 ppm) reported as with minimum fruit yield quintal per hectare. It may be due to maximum average fruit weight which was also observed in T7. This result was also supported by Tiwari and Singh (2014).

**Specific Gravity (g/cm<sup>3</sup>):** Treatment T7 (NAA @ 10 ppm + GA3 @ 30 ppm) showed the maximum fruit specific gravity (1.05) while the treatment T6 (GA3 @ 90 ppm) declared as with minimum fruit specific gravity (0.67).

**Total Soluble Solid (°Brix):** Though it is positively significant result and it is revealed that treatment T1 (NAA @ 10 ppm) showed the maximum Total Soluble Solid while in treatment T9 (NAA @ 90 ppm + GA3 @ 90 ppm) minimum Total Soluble Solid is observed.

## Conclusion

In general, it was concluded that T7 (NAA @ 10 ppm + GA3 @ 30 ppm) was found superior followed by T6 (GA3@ 90 ppm) because it consists maximum value for yield and yield attributing characters.

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**Table 1: Effect of Plant growth Regulators on plant height, number of branches and number of compound leaves**

| Treatments      | Plant height (cm) |              |             | Number of branches |              |              | Number of compound leaves |              |              |
|-----------------|-------------------|--------------|-------------|--------------------|--------------|--------------|---------------------------|--------------|--------------|
|                 | 30 DAT            | 60 DAT       | 90 DAT      | 30 DAT             | 60 DAT       | 90 DAT       | 30 DAT                    | 60 DAT       | 90 DAT       |
| T <sub>1</sub>  | 26.20             | 53.33        | 58.26       | 7.00               | 14.41        | 19.75        | 6.16                      | 13.25        | 18.83        |
| T <sub>2</sub>  | 20.33             | 44.53        | 50.46       | 6.08               | 19.75        | 26.25        | 7.00                      | 14.33        | 20.75        |
| T <sub>3</sub>  | 22.80             | 43.06        | 48.53       | 5.41               | 14.33        | 20.83        | 7.83                      | 14.50        | 19.83        |
| T <sub>4</sub>  | 38.60             | 61.00        | 66.00       | 12.33              | 16.66        | 29.16        | 10.41                     | 18.58        | 24.91        |
| T <sub>5</sub>  | 37.86             | 59.93        | 65.20       | 11.41              | 22.33        | 28.50        | 9.91                      | 18.66        | 26.83        |
| T <sub>6</sub>  | 40.93             | 60.80        | 68.83       | 12.91              | 24.00        | 32.33        | 9.75                      | 18.16        | 24.41        |
| T <sub>7</sub>  | 28.06             | 56.46        | 62.53       | 7.75               | 23.08        | 29.66        | 8.00                      | 16.08        | 22.66        |
| T <sub>8</sub>  | 34.00             | 59.60        | 64.80       | 10.66              | 24.16        | 32.00        | 8.16                      | 16.33        | 23.00        |
| T <sub>9</sub>  | 29.33             | 56.40        | 62.26       | 10.50              | 24.00        | 30.58        | 9.25                      | 18.41        | 24.75        |
| T <sub>10</sub> | 37.26             | 61.80        | 67.46       | 7.83               | 15.75        | 23.25        | 6.00                      | 14.91        | 22.41        |
| <b>SE(m)</b>    | <b>2.28</b>       | <b>3.35</b>  | <b>3.22</b> | <b>10.66</b>       | <b>24.16</b> | <b>32.00</b> | <b>8.16</b>               | <b>16.33</b> | <b>23.00</b> |
| <b>CD (5%)</b>  | <b>6.83</b>       | <b>10.03</b> | <b>9.67</b> | <b>10.50</b>       | <b>24.00</b> | <b>30.58</b> | <b>9.25</b>               | <b>18.41</b> | <b>24.75</b> |

**Table 2: Effect of Plant growth Regulators on number of fruits per plant, Average fruit weight, fruit diameter, pericarp thickness of fruits, specific gravity, TSS and fruit yield (q/ha)**

| Treatments      | Number of fruits per plant | Average fruit weight (gm) | Fruit diameter (cm) | Pericarp thickness of fruits | Specific gravity (g/cm <sup>3</sup> ) | TSS (°Brix). | Fruit yield (q/ha) |
|-----------------|----------------------------|---------------------------|---------------------|------------------------------|---------------------------------------|--------------|--------------------|
| T <sub>1</sub>  | 11.69                      | 34.10                     | 3.40                | 5.00                         | 0.87                                  | 4.90         | 135.33             |
| T <sub>2</sub>  | 8.11                       | 54.92                     | 3.73                | 5.00                         | 0.99                                  | 4.80         | 164.26             |
| T <sub>3</sub>  | 5.38                       | 38.51                     | 3.50                | 5.33                         | 0.96                                  | 4.43         | 105.200            |
| T <sub>4</sub>  | 21.17                      | 60.40                     | 4.10                | 6.33                         | 1.00                                  | 4.50         | 367.86             |
| T <sub>5</sub>  | 25.37                      | 59.53                     | 3.56                | 5.66                         | 1.03                                  | 4.46         | 348.80             |
| T <sub>6</sub>  | 26.56                      | 59.51                     | 4.53                | 4.33                         | 0.67                                  | 4.30         | 418.00             |
| T <sub>7</sub>  | 23.79                      | 99.17                     | 4.96                | 4.66                         | 1.05                                  | 4.26         | 598.13             |
| T <sub>8</sub>  | 21.32                      | 71.13                     | 4.20                | 6.00                         | 1.02                                  | 4.43         | 397.73             |
| T <sub>9</sub>  | 23.04                      | 72.81                     | 4.26                | 6.33                         | 1.02                                  | 4.13         | 423.06             |
| T <sub>10</sub> | 9.02                       | 41.91                     | 3.86                | 7.66                         | 0.84                                  | 4.80         | 128.00             |
| <b>SE(m)</b>    | <b>2.97</b>                | <b>5.61</b>               | <b>0.11</b>         | <b>0.39</b>                  | <b>0.03</b>                           | <b>0.10</b>  | <b>38.03</b>       |
| <b>CD at 5%</b> | <b>8.9</b>                 | <b>16.81</b>              | <b>0.35</b>         | <b>1.16</b>                  | <b>0.10</b>                           | <b>0.31</b>  | <b>113.88</b>      |

Whereas= T<sub>1</sub> = NAA @ 10 ppm, T<sub>2</sub> =NAA @ 15 ppm, T<sub>3</sub> =NAA @ 20 ppm, T<sub>4</sub> =GA3 @30 ppm, T<sub>5</sub> =GA3 @ 60 ppm, T<sub>6</sub> =GA3 @ 90 ppm, T<sub>7</sub> =NAA @ 10 ppm+ GA3 @ 30 ppm, T<sub>8</sub>=NAA @ 15 ppm+ GA3 @ 60 ppm, T<sub>9</sub> =NAA @ 20 ppm+ GA3 @ 90 ppm and T<sub>10</sub> =Control