

## **Study of canopy regulation practices on tomato (*Lycopersicon esculentum* L.) cultivars**

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### **Abstract**

*A field trial was conducted to study the evaluation of canopy regulation practices in certain tomato (*Lycopersicon esculentum* L.) cultivars viz., Punjab Ratta (V<sub>1</sub>), Punjab Red Cherry (V<sub>2</sub>), Leader- 211 (V<sub>3</sub>), TS-15 (V<sub>4</sub>), Roma VF (V<sub>5</sub>), San Marza No. 3 (V<sub>6</sub>), Ronaldo (V<sub>7</sub>), Wild Cherry Tomato (V<sub>8</sub>), Royal England (V<sub>9</sub>) and Ayushman (V<sub>10</sub>) under different canopy regulation practices, viz., T<sub>1</sub> (Training and pruning) and T<sub>2</sub> (Untrained and unpruned) at the research farm of Lovely Professional University, Phagwara, Punjab. The experimental designed used was FRBD with 3 replications. Canopy regulation practices showed significant influence on the growth, yield and yield contributing parameters of tomato. Trained and pruned tomato plant was found superior for all parameters under study. Among the varieties, Wild Cherry tomato (V<sub>8</sub>) and Royal England (V<sub>9</sub>) were the best performing varieties of tomato under training and pruning practices in terms of almost all the growth parameters. However, the variety Ronaldo (V<sub>7</sub>) is superior for yield and yield attributing parameters.*

**Key words:** *Canopy, pruning, tomato, training and varieties*

### **Introduction**

Tomato (*Solanum lycopersicum* L.) is one of the most important “protective foods” because of its richness in vitamin A, B, nutritional properties containing lycopene an antioxidant, ascorbic acid and beta-carotene associating with the higher capacity to eliminate reactive oxygen species (ROS) and it helps in lowering the incidence of certain forms of human cancer. Tomatoes are used as a cooked vegetable, salad, soup, pickles, ketchup, puree, sauces, and unripe green fruits are used for the preparation of pickles and chutney (Khairul *et al.*, 2015). Therefore it is important to increase the production of tomato with good quality fruit, which could be achieved substantially through improved agronomic techniques like canopy regulation practices through pruning and training.

Pruning keep tomatoes free of side stems before the occurrence of first fruit cluster which encourage in setting good sized fruits. Training of plant from one to three stems by pruning other stems permits close planting, increase early yield of fruits, keep fruit from the ground and facilitate spraying and harvesting of fruits and also good aeration. On the other hand, improved varieties recommended for particular area is as important in getting higher returns. Therefore, evaluation of different varieties of tomato for their adaptability in the prevailing agro-climatic condition under different canopy regulation practices is need of the time.

### **Materials and methods**

The experiment was conducted at research farm of Lovely Professional University, Phagwara, Punjab, Kapurthala District, Punjab (India), situated at the latitude of 31.33<sup>0</sup> North and longitude of 75.58<sup>0</sup> East. The average minimum and maximum temperature during crop season i.e. from January to June vary from (12.4°C-33.4°C). Ten cultivars of tomato viz., Punjab Ratta (V<sub>1</sub>), Punjab Red Cherry (V<sub>2</sub>), Leader- 211 (V<sub>3</sub>), TS-15 (V<sub>4</sub>), Roma VF (V<sub>5</sub>), San Marza No. 3 (V<sub>6</sub>), Ronaldo (V<sub>7</sub>), Wild Cherry Tomato (V<sub>8</sub>), Royal England (V<sub>9</sub>) and Ayushman (V<sub>10</sub>) were evaluated under different canopy regulation practices, viz., T<sub>1</sub> (Training and pruning) and T<sub>2</sub> (Untrained and unpruned). The experiment was laid out in FRBD with three replications. The observations recorded were, plant height (cm), number of leaves/plant, Number of days to first flowering, Number of days to first fruiting, number of fruits/plant, fruit weight (g) and fruit yield/ha (q).

### **Results and discussions**

**Plant height(cm):** Canopy regulation practices had a significant influence on plant height of different varieties of tomato. Maximum plant height i.e. 32.14cm, 51.26 cm, 67.05 cm and 78.00 cm at 30, 45 and 60 days after transplanting respectively was found in T<sub>1</sub> (Training and pruning). The superior increase in plant height of tomato might be due to the removal of extra branches that lead to the supply of nutrients in the remaining branches. According to Singh *et al.* (2017) this might be due causing more nutrient flow towards apical tissues, the axillary branches which enhances light penetration there by forcing plant to grow taller.

The maximum plant height i.e. 44.50, 73.38cm at 30 and 45 DAT respectively was recorded in Wild Cherry Tomato (V<sub>8</sub>) followed by Punjab red cherry (V<sub>2</sub>) i.e. 38.83 and 68.73cm respectively. While, at 60 DAT, the maximum plant height was recorded in Wild Cherry Tomato (V<sub>8</sub>) i.e. 98.43

cm, followed by Punjab Red Cherry Tomato (V<sub>2</sub>) i.e. 90 cm. The highest plant height in Wild Cherry Tomato (V<sub>8</sub>) at all stages of growth might be associated with its genetic makeup or due to indeterminate characteristics.

**Number of leaves/plant:** The untrained and unpruned tomato plant recorded the maximum number of leaves/plant i.e. 25.92, 55.65 and 67.87 leaves at 30, 45 and 60 DAT respectively. The Untrained and unpruned tomato plant attain maximum number of leaves might be due to the maximum number of branches/plant which is directly proportional to maximum number of leaves/plant. The result is in close to conformity with the observations made by Yeasmin *et al.* (2018). Among the varieties, the maximum number of leaves/plant was recorded in Leader-211 (V<sub>3</sub>) i.e. 30.37 leaves, Ronaldo (V<sub>7</sub>) i.e. 65.83 leaves and SanMarza No.3 (V<sub>6</sub>) i.e. 75.83 leaves at 30, 45 and 60 DAT respectively. The highest number of leaves might be due to the bushy characteristics of the plant. The varietal difference for number of leaves/plant has been also reported by Elias and Damba (2013).

**Days to 1<sup>st</sup> flowering:** The earliest days to first flowering i.e. 29.91 days was observed in trained and pruned tomato plants as compared to untrained and unpruned tomato plants which might be related to the removal of branches leading to supply of nutrients in the remaining branches which has also provide better sunlight penetration. According to Singh *et al.* (2017), early shift in vegetative to reproductive stage with pruned plant might have attributed to earlier days to flowering. Among the varieties, earlier days to first flowering was recorded in Royal England (V<sub>9</sub>) i.e. 25.67 days, followed by Ronaldo (V<sub>7</sub>) i.e. 26.67 days. Whereas, maximum number of days was recorded in Roma VF (V<sub>5</sub>) i.e. 32.78 days. The earliest days to first flowering in Royal England (V<sub>9</sub>) might be associated with genetic characteristics. The varietal differences in days taken for first flowering were also reported by Mbonihankuye *et al.* (2013).

**Days to 1<sup>st</sup> harvesting:** The trained and pruned tomato plants (T<sub>1</sub>) recorded the minimum days to first harvesting i.e. 64.03 days as compared to untrained and unpruned tomato plants (T<sub>2</sub>) which might be related to earlier days to first flowering and fruiting. Similar findings were also reported by Khoshkamet *et al.* (2014), Yadav *et al.* (2017) and Singh *et al.* (2017). Among the varieties, earliest harvesting was done for Royal England (V<sub>9</sub>) 57.50 days, followed by Ronaldo (V<sub>7</sub>) i.e. 59.50 days. While, Roma VF (V<sub>5</sub>) took the maximum days to harvest i.e. 69.50 days.

**Number of fruits/plant:** The highest number of fruits/plant was recorded in T<sub>2</sub> (Untrained and unpruned) i.e. 35.37 fruits as compared to T<sub>1</sub> (Training and pruning) which might be due to more

number of reproductive branches leading to more number of subsequent flowers. Similar result was reported by Ara *et al.* (2007), Mbonihankuyeet *al.* (2013), Ali and Moniruzzaman (2017) and Yeasminet *al.* (2018). The maximum number of fruits/plant was recorded in Punjab Red Cherry Tomato (V<sub>2</sub>) i.e. 88.67 fruits which was at par with Wild red cherry tomato (V<sub>8</sub>) i.e. 88.47 fruits, followed by Ronaldo (V<sub>7</sub>) i.e. 22.67 fruits. The maximum fruits/plant might be associated with its indeterminate growth habit, bearing more number of reproductive branches resulting to more flowers/cluster and subsequently more fruits (Mbonihankuyeet *al.* 2013 and Moosaviet *al.* 2013).

**Fruit weight:** The maximum fruit weight i.e. 41.32 g was observed in trained and pruned plants and among the varieties under study, Ronaldo (V<sub>7</sub>) recorded the maximum fruit weight i.e. 60.27 g, followed by TS-15 (V<sub>4</sub>) i.e. 56.10 g. While, the minimum fruit weight i.e. 4.70 g was recorded in Wild Cherry Tomato (V<sub>8</sub>). Removal of the axillary bud improves the fruit size as a result of the supply of sufficient assimilates to all the fruits in case of trained and pruned plant (T<sub>1</sub>). According to Singh *et al.* (2017), increased uptake of more nutrients and buildup of sufficient photosynthesis enable the increased in size of fruits (length and diameter) which ultimately resulted in the increase fruit weight. While on the other hand untrained and unpruned plant tends to produce numerous branches which increase the competition for assimilates and results in producing smaller fruits.

**Fruit yield/ha:** The trained and pruned plants gave higher fruit yield/ha i.e. 269.15 q as compared to untrained and unpruned plants and the variety Ronaldo (V<sub>7</sub>) gave maximum yield/ha i.e. 368.85 q, followed by San Marza No. 3 (V<sub>6</sub>) i.e. 304.08 q which was found at par with TS – 15 (V<sub>4</sub>) i.e. 295.31 q. The maximum fruit yield/ha in T<sub>1</sub> (pruning and training) and the variety Ronaldo (V<sub>7</sub>) might have directly influenced by higher yield parameters such as number of fruits/plant, average fruit weight and yield/plant.

**Table 1: Effect of canopy regulation practices on plant height (cm), number of leaves, days to 1<sup>st</sup> flowering and 1<sup>st</sup> harvesting of tomato cultivars**

| Treatments                             | Plant height (cm) |        |        | No. of leaves/plant |        |        | Days to 1 <sup>st</sup> flowering | Days to 1 <sup>st</sup> harvesting |
|----------------------------------------|-------------------|--------|--------|---------------------|--------|--------|-----------------------------------|------------------------------------|
|                                        | 30 DAT            | 45 DAT | 60 DAT | 30 DAT              | 45 DAT | 60 DAT |                                   |                                    |
| Canopy regulation (T)                  |                   |        |        |                     |        |        |                                   |                                    |
| Trained & pruned (T <sub>1</sub> )     | 32.14             | 51.26  | 67.05  | 23.86               | 50.21  | 60.94  | 29.91                             | 64.03                              |
| Untrained & unpruned (T <sub>2</sub> ) | 30.08             | 49.76  | 63.19  | 25.99               | 55.65  | 67.87  | 30.21                             | 64.77                              |
| SE(m)±                                 | 0.12              | 0.06   | 0.34   | 0.14                | 0.48   | 0.27   | 0.11                              | 0.05                               |
| CD at 5%                               | 0.35              | 0.17   | 0.96   | 0.40                | 1.38   | 0.76   | 0.30                              | 0.14                               |
| <b>Cultivars (V)</b>                   |                   |        |        |                     |        |        |                                   |                                    |
| V <sub>1</sub>                         | 29.75             | 45.02  | 54.87  | 20.00               | 43.43  | 58.35  | 31.65                             | 65.50                              |
| V <sub>2</sub>                         | 38.83             | 68.73  | 90.17  | 27.02               | 59.82  | 69.65  | 31.76                             | 65.00                              |
| V <sub>3</sub>                         | 26.92             | 46.02  | 58.33  | 30.37               | 41.42  | 56.25  | 30.27                             | 63.50                              |
| V <sub>4</sub>                         | 28.53             | 46.40  | 56.77  | 20.68               | 41.42  | 59.37  | 30.82                             | 68.33                              |
| V <sub>5</sub>                         | 29.83             | 53.97  | 57.25  | 23.25               | 52.83  | 60.25  | 32.78                             | 69.50                              |
| V <sub>6</sub>                         | 28.08             | 37.88  | 54.83  | 27.50               | 60.75  | 75.83  | 28.17                             | 62.50                              |
| V <sub>7</sub>                         | 27.00             | 47.67  | 61.77  | 29.83               | 65.83  | 73.67  | 26.67                             | 59.50                              |
| V <sub>8</sub>                         | 44.50             | 73.38  | 98.43  | 29.30               | 65.57  | 69.95  | 30.99                             | 65.17                              |
| V <sub>9</sub>                         | 27.83             | 41.77  | 57.55  | 19.43               | 48.62  | 60.98  | 25.67                             | 57.50                              |
| V <sub>10</sub>                        | 29.83             | 44.25  | 61.25  | 21.50               | 49.63  | 59.75  | 31.80                             | 67.50                              |

|             |      |      |      |      |      |      |      |      |
|-------------|------|------|------|------|------|------|------|------|
| SE(m) $\pm$ | 0.27 | 0.13 | 0.75 | 0.31 | 1.07 | 0.60 | 0.23 | 0.11 |
| CD at 5%    | 0.78 | 0.38 | 2.16 | 0.90 | 3.08 | 1.71 | 0.67 | 0.31 |

**Table 2: Effect of canopy regulation practices on number of fruits/plant, fruit weight (g) and yield/ha (q) of tomato cultivars**

| Treatments                                      | Number of fruits/plant | Fruit weight (g) | Yield/ha (q) |
|-------------------------------------------------|------------------------|------------------|--------------|
| <b>Canopy regulation (T)</b>                    |                        |                  |              |
| <b>Trained &amp; pruned (T<sub>1</sub>)</b>     | 34.29                  | 41.32            | 269.15       |
| <b>Untrained &amp; unpruned (T<sub>2</sub>)</b> | 35.373                 | 36.57            | 231.88       |
| SE(m) $\pm$                                     | 0.18                   | 0.17             | 2.31         |
| CD at 5%                                        | 0.54                   | 0.50             | 6.63         |
| <b>Cultivars (V)</b>                            |                        |                  |              |
| <b>V<sub>1</sub></b>                            | 19.67                  | 40.43            | 214.73       |
| <b>V<sub>2</sub></b>                            | 88.67                  | 10.07            | 241.26       |
| <b>V<sub>3</sub></b>                            | 21.33                  | 36.84            | 213.34       |
| <b>V<sub>4</sub></b>                            | 19.50                  | 56.10            | 295.31       |
| <b>V<sub>5</sub></b>                            | 19.75                  | 46.66            | 266.31       |
| <b>V<sub>6</sub></b>                            | 21.17                  | 53.21            | 304.08       |
| <b>V<sub>7</sub></b>                            | 22.67                  | 60.27            | 368.85       |
| <b>V<sub>8</sub></b>                            | 88.47                  | 4.70             | 112.73       |

|                       |       |       |        |
|-----------------------|-------|-------|--------|
| <b>V<sub>9</sub></b>  | 22.17 | 39.99 | 239.86 |
| <b>V<sub>10</sub></b> | 22.33 | 41.15 | 248.69 |
| SE(m) <sub>±</sub>    | 0.42  | 0.39  | 5.15   |
| CD at 5%              | 1.21  | 1.12  | 14.83  |

**Conclusion:** Canopy regulation in tomato plant through pruning and training was found superior for growth and yield parameters and among the varieties, Wild Cherry tomato (V<sub>8</sub>) and Royal England (V<sub>9</sub>) were the best performing varieties of tomato in terms of almost all the growth parameters. However, the variety Ronaldo (V<sub>7</sub>) is superior for yield and yield attributing parameters.

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