# YIELD ANALYSIS OF TOMATO CROP UNDER CONTROLLED ENVIRONMENTUSING CALIBRATED DRIP IRRIGATION

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**Abstract**

A polyhouse is a greenhouse that uses a polycarbonate material, usually PVC as a cover that encapsulates an area that is segregated from the outside environment. An experiment is conducted on tomato crops, treated with 5 different treatments with predefined irrigation volumes for each treatment inside a polyhouse. The various treatments being, Treatment-1 (or) T-1: Recommended dosage of chemical fertilizers with 50% of the recommended volume of water, Treatment-2 (or) T-2: 50% the recommended dosage of chemical fertilizers with recommended volume of water, Treatment-3 (or)
T-3: 200% the recommended volume of water only, Treatment-4 (or) T-4: Recommended dosage of chemical fertilizers with 200% of the recommended volume of water, Treatment-5 (or) T-5: Recommended dosage of chemical fertilizers with recommended volume of water. In the end, the treatment with the maximum yield is concluded to have been the treatment with the most efficient treatment and irrigation.

***Keywords**:* Polyhouse, Greenhouse, Tomato, Nutrient management, Drip irrigation

## 1. Introduction

Polyhouse is a polycarbonate structure inside which crops can be grown in a controlled
environment, secluded from the exterior inhibiting factors. It is a building or house made of polyethylene (PVC). Its translucent glass-like nature, allows plants to thrive and flourish in
controlled environmental conditions. Md Rasel Parvej et.al, identified that the tomato crops that were grown inside the polyhouse yielded 81 t/ha against 57 t/ha of fruits when compared to the open field[1]. Also, Ganesan M noted that the yield was almost doubled inside the polyhouse when compared to open field cultivation [2].

Frequent irrigation of a crop positively affects
other crops require proper ventilation to attain phenological and physiological attributes of a crop. The frequency of irrigation was found to
positively affect the vegetative growth and fruit yield by Dr. Diogo de Faria[3]. However, this
applies only up to the point where the soil
a permanent wilting point. It was concluded by A.K. Saka et.al, That triangular planting system produces the highest yield in tomato only tomatoes, but all the other crops tend to show the same result. Praveen Kumar et.al, Stated that the yield obtained was 145.32 percent higher than conventionally cultivated capsicum[5]. D.S. Kaur Cheema P et.al, noted negligible damage to fruits that were yielded inside the protection of a polyhouse[6].

It has been established by N Ercan et.al, that lower temperatures below 10℃ negatively affect pollen count and viability thereby, negatively
affecting fruit set as well as the final yield of tomato[7]. Therefore it is necessary to keep the plants from cold temperatures (greater than 10°C).

For a crop, not only tomatoes but also any
an

optimum growth as well as a good yield. Ganesan M concluded that proper ventilation needs to be maintained during the day time either through ventilation gaps or ventilators to keep the
reaches greenhouse/polyhouse at the optimum
crops [4].

of the polyhouse provided a decent yield of tomatoes[8].

However, the analysis of yield of crops undera controlled environment with a predefined quantity of irrigation along with different variations of fertilizer treatments has not been experimented so far. In the current experiment, the major nutrients are provided to the crops through manual application Muriate of Potash (MOP) and Diammonium Phosphathe (DAP).

## 2. Experimental setup

The experiment is carried out by initially forming separate beds for each treatment and itsreplications. The layout of the experiment is as shown in Fig. 1. Each block in the layout

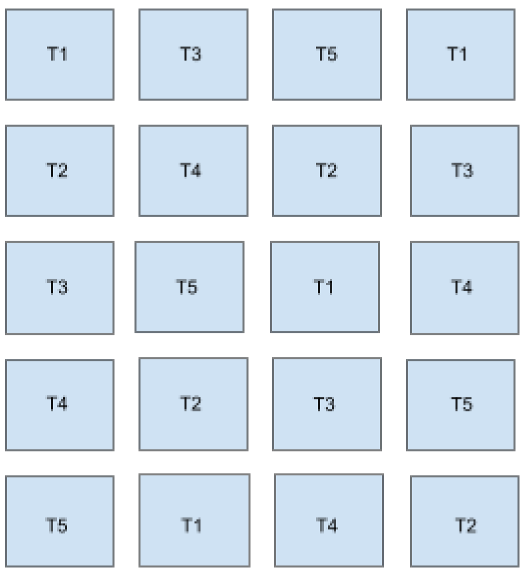


*Fig. 1. Experimental layout*

represents an individual treatment. The beds areformed in such a way that they are raised to a height of 20 cm and the upper face of a bed is ofdimension 110 cm*80 cm. Each bed is surrounded by a path of 30 cm to freely access individual beds. The dimensions of a bed are depicted in *Fig. 2* and *Fig. 3*.

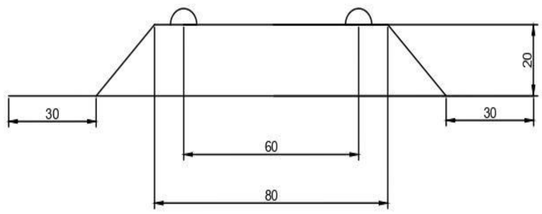


*Fig. 2. Elevation of a bed*

Once the beds are formed, healthy seedlingsare purchased and are transplanted to the beds. Each bed consists of a total number of 6 plants separated by a spacing of 45cm*60cm. Each plantis transplanted leaving a distance of 10cm from the edges of the bed. Spacing details of seedlings are depicted in *Fig. 3*. The circles represent each individual seedling.

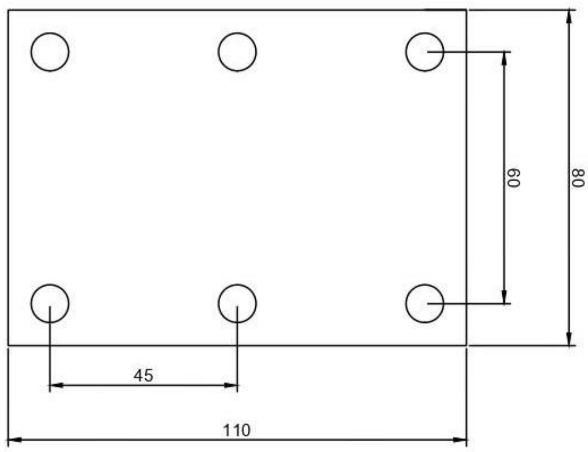


*Fig. 3. Top view of a bed*

Each treatment comprises a specific quantityof chemical fertilizers (MOP and DAP) and a predetermined volume of irrigation water in litre plant$^{-1}$ day$^{-1}$. Generally, the crop water requirement for a tomato plant is 0.5 litre plant$^{-1}$ day$^{-1}$. The irrigation chart for each treatment is mentioned in *Table 1*. However, the crops are irrigated thoroughly, manually for 7 days irrespective of treatments so that they can get through transplantation shock and achieve well established roots.

*Table 1. Irrigation chart*

| **Treatments** | **Volume of water** |
|---|---|
| Treatment-1 | 0.25 litre plant$^{-1}$ day$^{-1}$ |
| Treatment-2 | 0.50 litre plant$^{-1}$ day$^{-1}$ |
| Treatment-3 | 1 litre plant$^{-1}$ day$^{-1}$ |
| Treatment-4 | 1 litre plant$^{-1}$ day$^{-1}$ |
| Treatment-5 | 0.50 litre plant$^{-1}$ day$^{-1}$ |

Irrigation is carried out through a dripirrigation system. The emitters of the drip hose are calibrated in such a way that it emits the required volume of water to the crops over a duration of 15 minutes. This feat is achieved through the adjustment ofgate valves attached to each and every individual emitter. The water to be irrigated is split into recommended volume (0.50 litre plant$^{-1}$ day$^{-1}$), 50% of the recommended volume (0.25 litre plant$^{-1}$ day$^{-1}$) and 200% of the recommended volume (1 litre plant$^{-1}$ day$^{-1}$) and are administered to the crops of respective treatment beds.

*Table 2. Fertilizer chart*

| **Treatments** | **Quantity of fertilizers** |
|---|---|
| Treatment-1 | 29g DAP + 11g MOP |
| Treatment-2 | 14.5g DAP + 5.5g MOP |
| Treatment-3 | No fertilizers |
| Treatment-4 | 29g DAP + 11g MOP |
| Treatment-5 | 14.5g DAP + 5.5g MOP |

Fertilizers are applied manually over eachbed. The required quantity of MOP and DAP are calculated per plant, weighed and then applied carefully over each bed. The quantityof fertilizers are split into recommended dosage, half the quantity of recommended dosage and are administered to the respective treatment beds. Detailed chart of fertilizer application is mentioned in *Table 2.*

Once all of the above processes are completed, the biometric characteristics of random plants are noted starting from the 7th day from the day of transplantation up to the 70th day. The biometric readings consist of plant height, number of leaflets, compound leaf length, leaflet length, width of terminal leaflet, stem circumference, number of fruits, fruit length and fruit circumference for each and every treatment.

## 3.Result and discussion

**Treatment-1:** The following figures display the graphical representations of plant height (*Fig. 4*), number of leaflets (*Fig. 5*), leaf length, leaflet length and leaflet width (*Fig. 6*), circumference of the stem (*Fig. 7*), number of fruits (*Fig. 8*), fruit length and fruit circumference (*Fig. 9*) from Treatment-1 respectively.

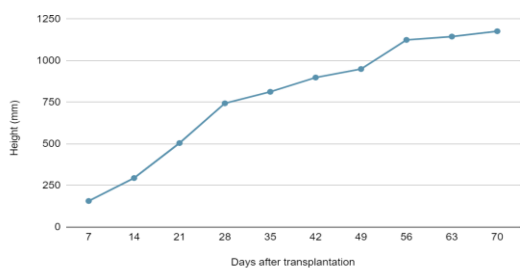


*Fig. 4. Plant height in T-1*

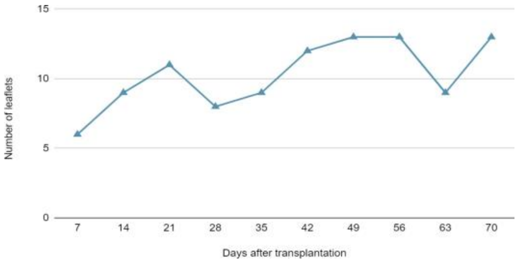


*Fig. 5. Number of leaflets in T–1*

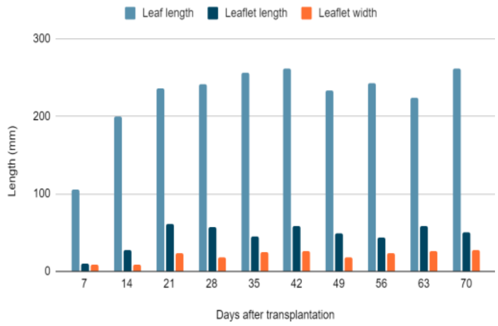


*Fig. 6. Leaf length, leaflet length and leaflet width*

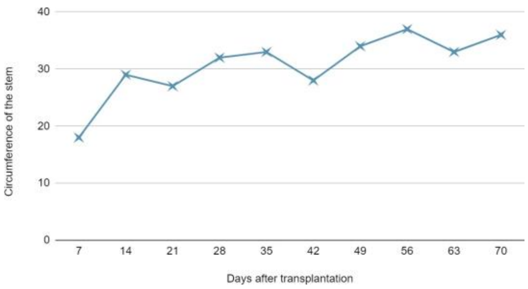


*Fig. 7. Circumference of the stem in T-1*

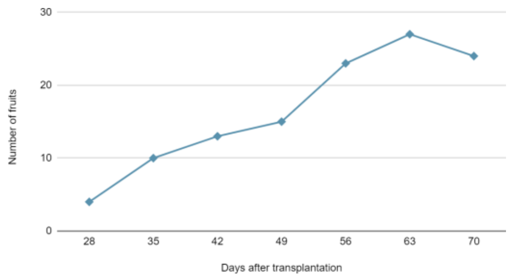


*Fig. 8. Number of fruits in T-1*

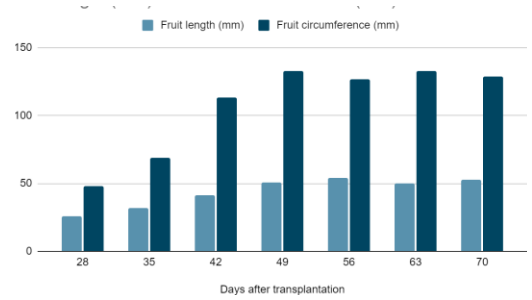


*Fig. 9. Fruit length and fruit circumference in T-1*

**Treatment-2:** The following figures display the graphical representations of plant height (*Fig. 10*), number of leaflets (*Fig. 11*), leaf length, leaflet length and leaflet width (*Fig. 12*), circumference of the stem (*Fig. 13*), number of fruits (*Fig. 14*), fruit length and fruit circumference (*Fig. 15*) from Treatment-2 respectively.

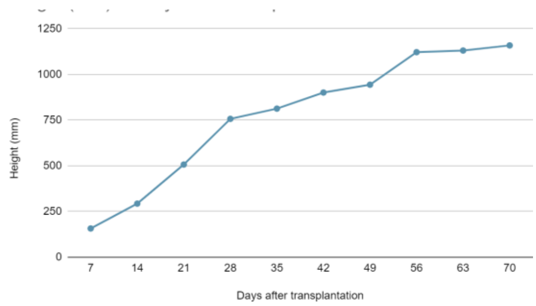


*Fig. 10. Plant height in T-2*

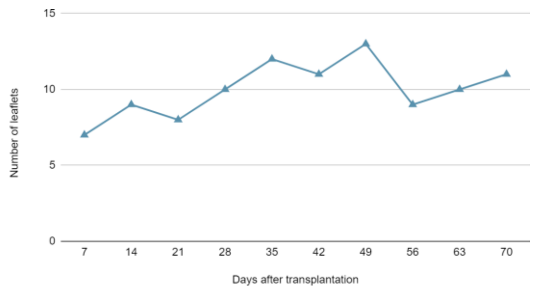


*Fig. 11. Number of leaflets in T–2*

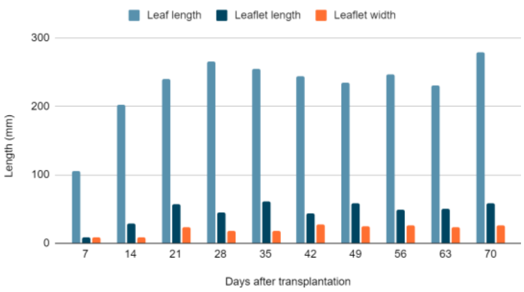


*Fig. 12. Leaf length, leaflet length and leaflet width in T-2*

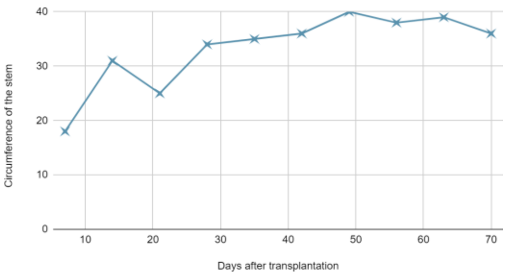


*Fig. 13. Circumference of the stem in T-2*

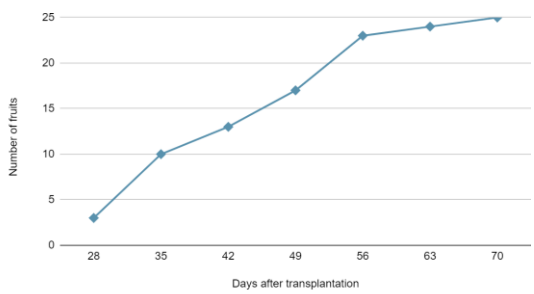


*Fig. 14. Number of fruits in T-2*

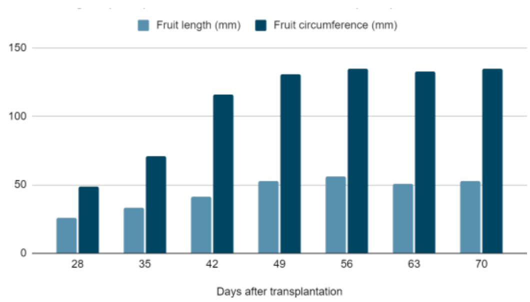


*Fig. 15. Fruit length and fruit circumference in T-2*

**Treatment-3:** The following figures display the graphical representations of plant height (*Fig. 16*), number of leaflets (*Fig. 17*), leaf length, leaflet length and leaflet width (*Fig. 18*), circumference of the stem (*Fig. 19*), number of fruits (*Fig. 20*), fruit length and fruit circumference (*Fig. 21*) from Treatment-3 respectively.

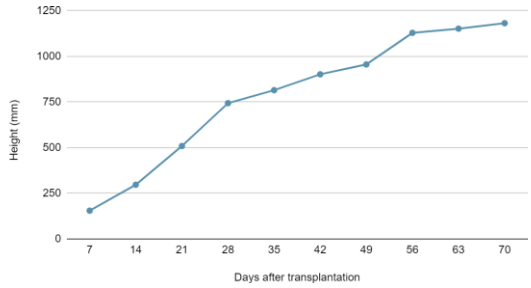


*Fig. 16. Plant height in T-3*

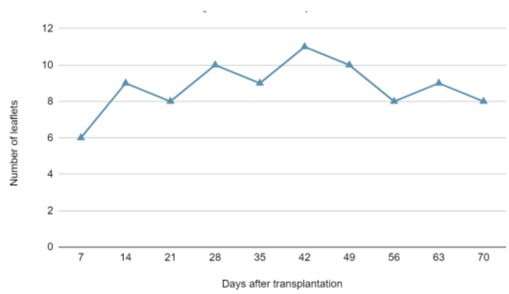


*Fig. 17. Number of leaflets in T–3*

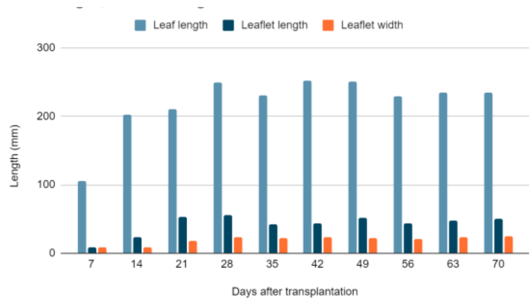


*Fig. 18. Leaf length, leaflet length and leaflet width in T-3*

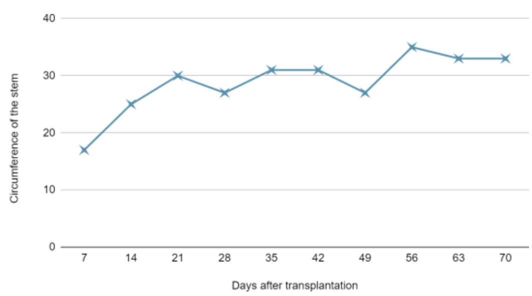


*Fig. 19. Circumference of the stem in T-3*

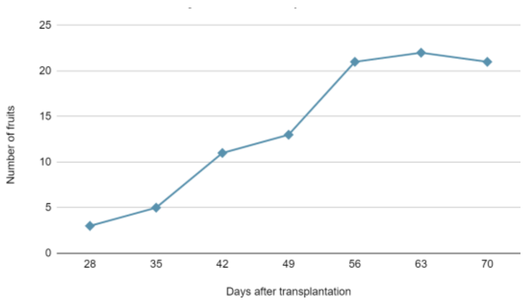


*Fig. 20. Number of fruits in T-3*

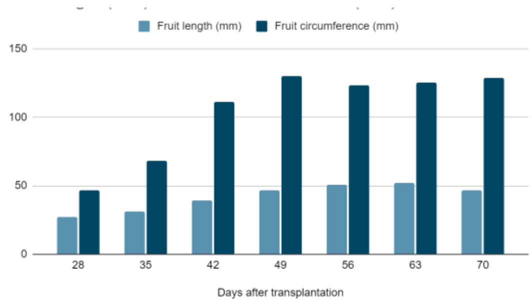


*Fig. 21. Fruit length and fruit circumference in T-3*

**Treatment-4:** The following figures display the graphical representations of plant height (*Fig. 22*), number of leaflets (*Fig. 23*), leaf length, leaflet length and leaflet width (*Fig. 24*), circumference of the stem (*Fig. 25*), number of fruits (*Fig. 26*), fruit length and fruit circumference (*Fig. 27*) from Treatment-4 respectively.

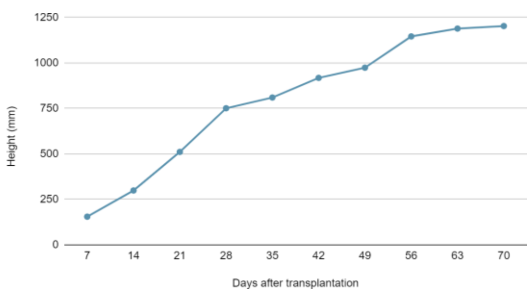


*Fig. 22. Plant height in T-4*

*Fig. 23. Number of leaflets in T–4*

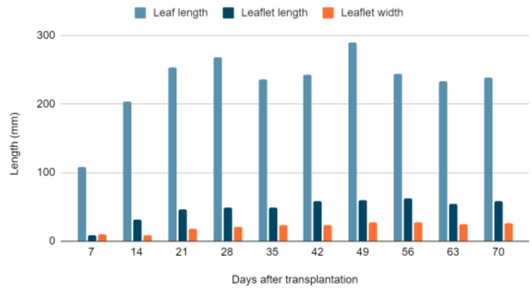


*Fig. 24. Leaf length, leaflet length and leaflet width in T-4*

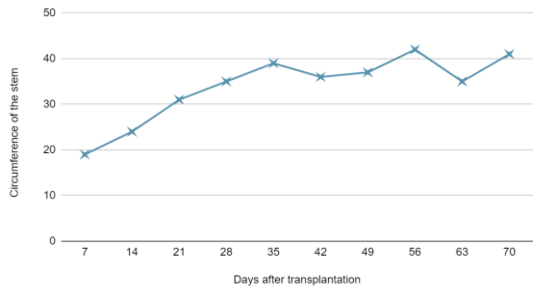


*Fig. 25. Circumference of the stem in T-4*

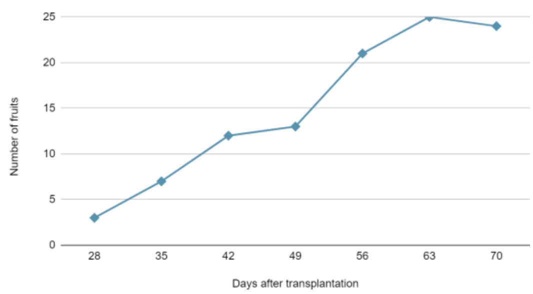


*Fig. 26. Number of fruits in T-4*

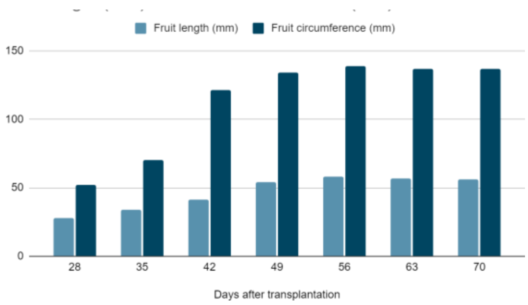


*Fig. 27. Fruit length and fruit circumference in T-4*

*Fig. 30. Leaf length, leaflet length and leaflet width in T-5*

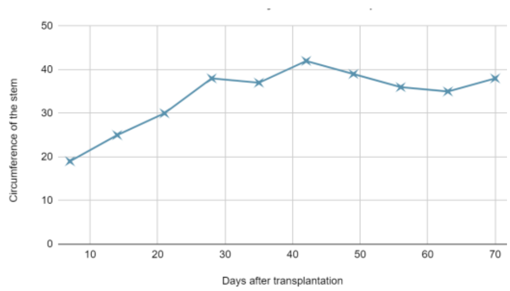


*Fig. 31. Circumference of the stem in T-5*

**Treatment-5:** The following figures display the graphical representations of plant height (*Fig. 28*), number of leaflets (*Fig. 29*), leaf length, leaflet length and leaflet width (*Fig. 30*), circumference of the stem (*Fig. 31*), number of fruits (*Fig. 32*), fruit length and fruit circumference (*Fig. 33*) from Treatment-5 respectively.

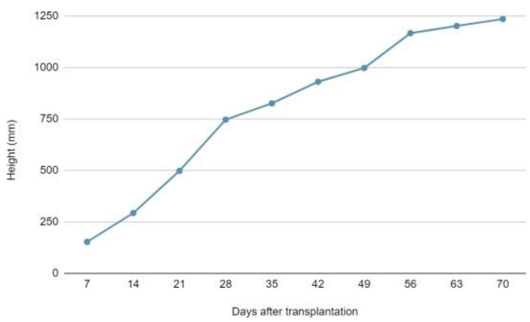


*Fig. 28. Plant height in T-5*

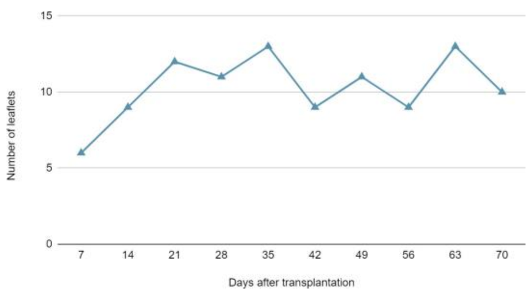


*Fig. 29. Number of leaflets in T–5*

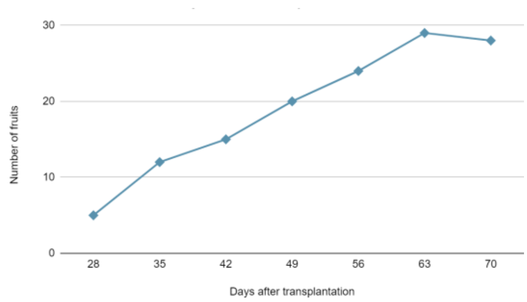


*Fig. 32. Number of fruits in T-5*

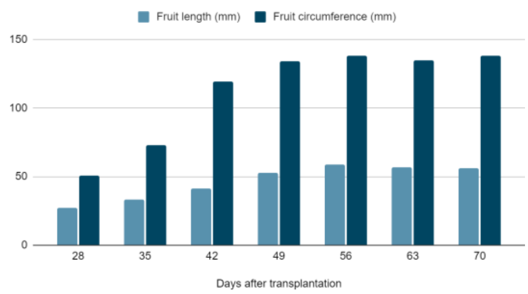


*Fig. 33. Fruit length and fruit circumference in T-5*

## 4.Conclusion

After thorough analysis of the biometric characteristics of the tomato crops from various treatments, it has been concluded that Treatment-5 or T-5 had the best phenotypic characteristics compared to any other treatments, with an overall height of 1248 mm, an average of 11 leaflets per compound leaf, average leaf length of 249 mm, average leaflet width of 67 mm, leaflet width of 26 mm, with the average stem circumference of 38 mm, maximum fruit count up to 39 numbers, and average fruit length and circumference of 125 mm and 49 mm respectively. However, Treatment-4 or T-4 had better leaf and leaflet characteristics and stem circumference, the overall fruit count and fruit characteristics was found out to be the best in Treatment-5 or T-5.

## REFERENCES

[1] Phenological Development and Production Potentials of Tomato underPolyhouse Climate-Md Rasel Parvej, Mehedi Hasan Khan, Md. Abdul Awal(2010)

[2] Effect of poly-greenhouse on plant micro climate and fruit yield of tomato-Ganesan M (2002)

[3] Irrigation frequency and substrate volume effects in the growth and yieldof tomato plants under greenhouse conditions-Dr. Diogo de Faria (2011)

[4] Effects of different planting systems and distances on the yield and qualityof greenhouse organic tomato-A.K.Saka, and S.Uzun (2017)

[5] Economic analysis of capsicum cultivation under polyhouse and open field conditions in Haryana-Praveen Kumar, RS Chauhan and R K Grover(2018)

[6] Off-season cultivation of tomatoes under net house conditions-D.S. Kaur Cheema P. and Kaur S (2004)

[7] The Effects of Low Temperature offruit set of Tomatoes-N. Ercan, H. Vural (1994)

[8] Effect of Poly-Greenhouse Models onPlant Growth and Yield of Tomato-Ganesan M