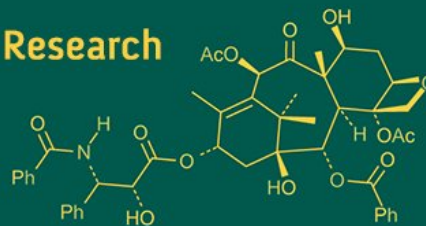


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Effect of eggplant (*Solanum melongena*) rootstocks on growth and yield performance of grafted tomato (*Solanum lycopersicum* L.) (cv. Pusa Ruby) under Bastar agro-climatic conditions

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Abstract

The study was carried out at the Krantikari Debridhur College of Horticulture and Research Station, MGUVV, Jagdalpur, Bastar (C.G.) research cum in structural farm in 2023-2024. It was set up using a randomized block design, with fifteen treatments that were reproduced three times each. They were transplanted in an open field after tomato cv. pusa ruby was splice-grafted onto rootstocks of Solmel, *Solanum torvum*, *Solanum xanthocarpum*, *Solanum indicum*, and *Solanum viarum*. Assessment of the impact of grafting eggplant rootstocks on tomato cultivars cultivated in Bastar (C.G.) was the aim of this study. The compatible rootstock and scion can be assessed based on the germination and survival percentage of grafted plants vegetative growth and yield of the scion. The tomato grafts of 30 days old pusa ruby + Solmel has highest germination and survival percentage of 83.07% and 76.67%. The graft, 30 days old pusa ruby + Solmel showed maximum plant height, days to first flowering, days to first fruiting and fruit yield gm plant⁻¹ was recorded 73.91, 26.43, 39.17, 40.53 and 1745.33 and maximum Fruit weight g fruit⁻¹ was observed in 30 days old pusa ruby + *Solanum torvum* (40.53) and maximum Fruit length cm fruit⁻¹ (3.05) was recorded in 30 days old pusa ruby + *Solanum xanthocarpum*.

Keywords: Tomato, pusa ruby, grafting, scion, rootstock, solmel, growth, yield

1. Introduction

The tomato (*Solanum lycopersicum* L.), one of the most significant crops in the *Solanaceae* (Night Shade) family, is native to the Andes region of South America, specifically Peru, Equador and Bolivia (Rick, 1969) [13]. The term "tomato" comes from the Spanish word "tomate". After China, India is the world's second-largest producer of horticulture crops. India, tomato was grown over an area of 0.873 MH in 2023-24 with an annual production of 21.238 MT (Anonymous 23-2024) [2]. It is mainly grown in Madhya Pradesh, Andhra Pradesh, Karnataka, Tamil Nadu, Orissa, Gujarat and West Bengal. Whereas, the area and production of tomato in Bastar was 0.001MH and 0.017 MT (Anonymous 2022-23) [1]. In Chhattisgarh tomato are mainly grown in Durg, Jashpur, Kondagaon, Raigarh and Bastar. The main goal of agriculture over the past few decades has been to boost crop productivity and yield in order to meet the growing global population's demand for food. Because of this, intensive cropping systems with few crop rotations which are particularly used for vegetable crops grown in open fields and under protection have led to the accumulation of harmful elements (biotic or abiotic) that can have a severe impact on yield and quality. Concerns about the environment and human health have resulted from the increased usage of input variables (water, chemical fertilizer, pesticides etc.) brought on by these unfavourable circumstances. A number of biotic and abiotic variables impact tomato cultivation, resulting in subpar development and decreased output (Pugalendhi *et al.*, 2019) [11]. Developing a new hybrid with all the desirable traits can be done to overcome the problems, but the time taken to develop such a hybrid is also considerable. Hence, grafting can be a better alternative to overcome those hindrances. Grafting has proven to mitigate some soil-borne diseases and abiotic stresses as well as improve plant growth, yield (Shipepe, B. T. and T. J. Msogoya, 2018) [15].

2. Method and material-

2.1 Experimental site

Field trial was carried out at Horticultural farm, Krantikari Debridhur College of Horticulture and Research Station (MGUVV) Jagdalpur, Bastar (C.G.) - 494001.

2.2 Rootstock and scion parameters

2.2.1 Germination percentage

The germination percentage of scion seeds as well as rootstocks seeds were calculated by dividing the number of seeds germinating to the total number of seeds sown multiplied by hundred.

$$\text{Germination percentage (\%)} = \frac{\text{Number of seeds germinated}}{\text{Total number of seed sown}} \times 100$$

2.3 Observation of grafted plant

2.3.1 Survival percentage

The total numbers of grafted seedlings survived in each treatment after transplanting were recorded and survival percentages of grafted seedlings were calculated.

Survival percentage of grafted seedlings =

$$\frac{\text{Number of grafted seedling survived}}{\text{Total number of grafted seedling}} \times 100$$

2.4 Growth and yield parameters

2.4.1 Plant height (cm)

The plant height of five randomly selected plants from each plot were measured from the ground level to the apical bud of the plant with the help of measuring tape.

2.4.2 Days to first flowering

In each treatment, the date of the first flower bud initiation was recorded, and the number of days counted from the date of transplanting was recorded as the days to first flowering.

2.4.3 Days to first fruiting

In each treatment, the date of first fruit initiation was recorded, and the number of days counted from the date of sowing was recorded.

2.4.4 Fruit weight (g)

The weight of fruits was measured at marketable stage from randomly selected plants from each plot at the time of peak harvest and average value was computed.

2.4.5 Fruit length (cm)

In each treatment, the length of five randomly selected fruits at marketable stage from each plot was measured longitudinally by vernier callipers from head end to blossom scar and the mean value was recorded in centimetres.

2.4.6 Fruit yield (Kg plant⁻¹)

Total weight of marketable fruits of each plant was recorded under full range of picking and was summed and averaged by dividing with the number of plants to get total yield plant⁻¹.

3. Result and Discussion

3.1 Rootstock and scion parameters

3.1.1 Germination (%)

The germination percentage of wild relatives of *S. melongena* (Rootstocks) and commercial tomato cultivar (Scion) is presented in table no. 1 it revealed significantly

highest germination was recorded under the treatment T₁₅: 30 days old pusa ruby + Solmel obtained the highest (83.07%) but it was statically at par with T₁: 20 days old pusa ruby + *Solanum torvum* (78.14), T₇: 25 days old pusa ruby + *Solanum xanthocarpum* (78.69%), T₉: 25 days old pusa ruby + *Solanum indicum* (78.83%), T₆: 25 days old pusa ruby + *Solanum torvum* (79.68%), T₁₂: 20 days old pusa ruby + *Solanum xanthocarpum* (80.46%), T₅: 20 days old pusa ruby + Solmel (80.73%), T₁₄: 30 days old pusa ruby + *Solanum indicum* (80.76%), T₁₁: 25 days old pusa ruby + *Solanum torvum* (81.19%), T₁₀: 25 days old pusa ruby + Solmel (82.17%) whereas, the lowest germination was noted under the treatment T₃: 20 days old pusa ruby + *Solanum viarum* (74.16%).

In the present investigation rootstocks seed sowed and observed that temperature was a critical factor which affected the germination. It was reported that germination was 85-98 per cent in all the rootstocks. The above result is in agreement with (Ibrahim *et al.* 2001) ^[7].

3.2 Observation of grafted plant

3.2.1 Survival percentage (%)

The data pertaining to the graft success percentage is presented in table no.1. Among the different graft combinations, the maximum survival percent was recorded in the treatment combination T₁₅: 30 days old pusa ruby + Solmel (76.67%) but it was statically at par with T₁₁: 30 days old pusa ruby + *Solanum torvum* (73.33%). Under these combinations the minimum survival percentage (48.33%) was observed under the treatment combination T₄ (20 days old pusa ruby + *Solanum indicum*).

Soltan *et al.* (2017) ^[17] reported that grafting success and the survival of the grafted plant depends on the cohesion between rootstock and scion (i.e., callus formation, vascular bundle differentiation and connectivity at the graft interface) that insure the balanced development of both scion and rootstock necessary for optimum horticultural performance.

3.3 Growth parameters

3.3.1 Plant height (cm)-

The data pertaining to the plant height percentage is presented in table no. 1. Maximum plant height was recorded in treatment T₁₅: 30 days old pusa ruby + Solmel rootstock (73.91 cm). Plant heights of treatment T₅: 20 days old pusa ruby + Solmel (64.49 cm) and T₁₀: 30 days old pusa ruby + Solmel (65.82 cm) rootstocks were also on par with each other. Minimum plant height was recorded in treatment T₄: 20 days old pusa ruby + *Solanum indicum* (49.12 cm).

Lee, (1994) ^[8] found that grafted plants were taller and more vigorous than self-rooted ones. Similarly, Rathod, (2017) ^[12] also recorded minimum plant height in self-rooted brinjal and maximum plant height was recorded in grafted brinjal (Mahyco-9 on *Solanum torvum*).

3.3.2 Days to first flowering

The data pertaining to days to first flowering showed significant differences among different graft combinations (Table no.- 1). The minimum days taken for first flowering was observed in the treatment T₁₅: 30 days old pusa ruby + Solmel (26.43 days) but which was on par with T₁₁: 30 days old pusa ruby + *Solanum torvum* (27.75 days), T₁₂: 30 days old pusa ruby + *Solanum xanthocarpum* (28.27 days), T₁₃: 30 days old pusa ruby + *Solanum viarum* (28.63 days), T₁₄:

30 days old pusa ruby + *Solanum indicum* (28.83 days), T₁₀: 25 days old pusa ruby + Solmel (30.60 days), T₆: 25 days old pusa ruby + *Solanum torvum* (31.27 days) and T₇: 25 days old pusa ruby + *Solanum xanthocarpum* (31.75 days). The maximum days taken for first flowering was recorded in the treatment T₄: 20 days old pusa ruby + *Solanum indicum* (37.01 days). Madhur *et al.* (2009) ^[10] stated that grafted plants need time to acclimatize in field condition where formation of graft union delays the early establishment of plant which may affect the reproductive organs without effecting vegetative growth in the grafted plants at early stages, later, grafted plants significantly influenced the flowering because of wild habit and vigorous root system of rootstock as wild cultivars have gregarious flowering nature. Vigorous plants by grafting extended the growth period and luxurious growth and delayed flowering.

3.3.3 Days to first fruiting

The data regarding the Days to first fruiting is presented in

table no.- 2. Among the different graft combinations early fruiting (39.17 days) was recorded under the treatment combination T₁₅ in which 30 days old pusa ruby + Solmel which was par T₁₁: 30 days old pusa ruby + *Solanum torvum* (43.58 days), T₁₂: 30 days old pusa ruby + *Solanum xanthocarpum* (44.03 days), T₈: 25 days old pusa ruby + *Solanum viarum* (44.90 days), T₁₃: 30 days old pusa ruby + *Solanum viarum* (44.93 days) and T₈: 25 days old pusa ruby + *Solanum indicum* (45.87 days). whereas, late fruiting (53.67 days) was observed in the combination T₄ (20 days old pusa ruby + *Solanum indicum*) which was par T₁₁: 30 days old pusa ruby + *Solanum torvum* (43.58 days), T₁₂: 30 days old pusa ruby + *Solanum xanthocarpum* (44.03 days), T₈: 25 days old pusa ruby + *Solanum viarum* (44.90 days), T₁₃: 30 days old pusa ruby + *Solanum viarum* (44.93 days) and T₈: 25 days old pusa ruby + *Solanum indicum* (45.87 days).

Table 1: Influence of graft combinations on germination percentage, survival percentage, plant height and days to first flowering in tomato

Treatments	Germination %	Survival %	Plant height (cm.)	Days to first flowering	Days to first fruiting
T ₁	78.47	55.00	56.35	34.07	47.78
T ₂	77.06	50.00	52.39	35.67	48.62
T ₃	74.16	49.17	51.62	36.70	50.67
T ₄	77.75	48.33	49.12	37.01	53.67
T ₅	80.73	63.33	64.49	35.17	48.08
T ₆	79.68	62.50	60.03	31.27	46.93
T ₇	78.69	56.67	55.73	31.75	47.15
T ₈	75.86	55.83	52.52	32.67	44.90
T ₉	78.83	52.50	51.17	33.07	51.63
T ₁₀	82.16	66.67	65.82	30.60	46.50
T ₁₁	81.20	73.33	63.23	27.75	43.58
T ₁₂	80.46	65.00	57.30	28.27	44.03
T ₁₃	76.03	64.17	58.58	28.63	44.93
T ₁₄	80.76	61.67	53.19	28.83	45.87
T ₁₅	83.07	76.67	73.91	26.43	39.17
S.E. m±	1.65	1.41	3.34	1.99	2.46
C.D. at 5%	4.78	4.10	9.73	5.81	7.15
C.V. (%)	3.61	4.07	10.04	10.84	9.07

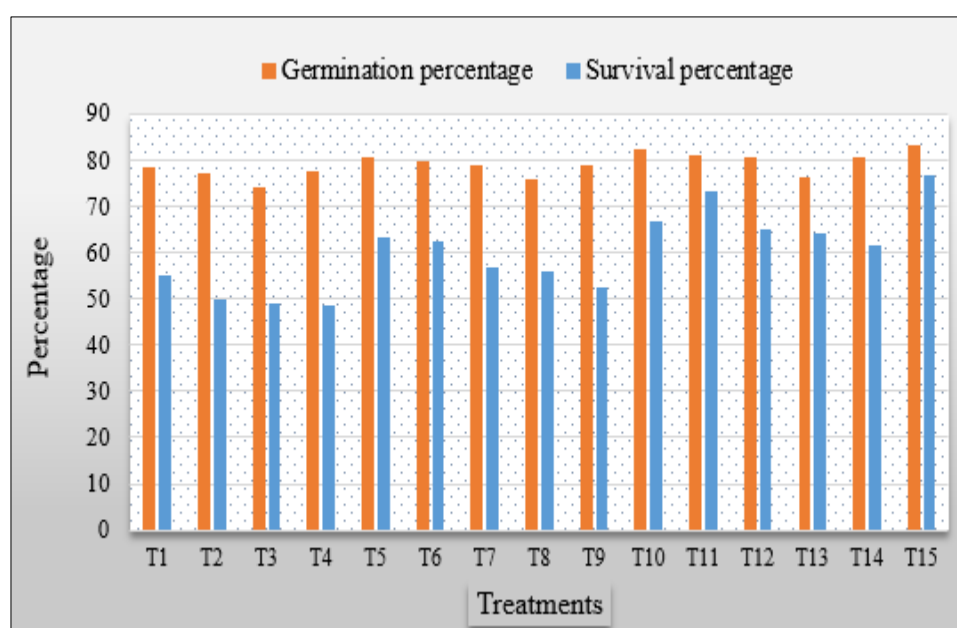


Fig 1: Germination and survival percentage of seedlings

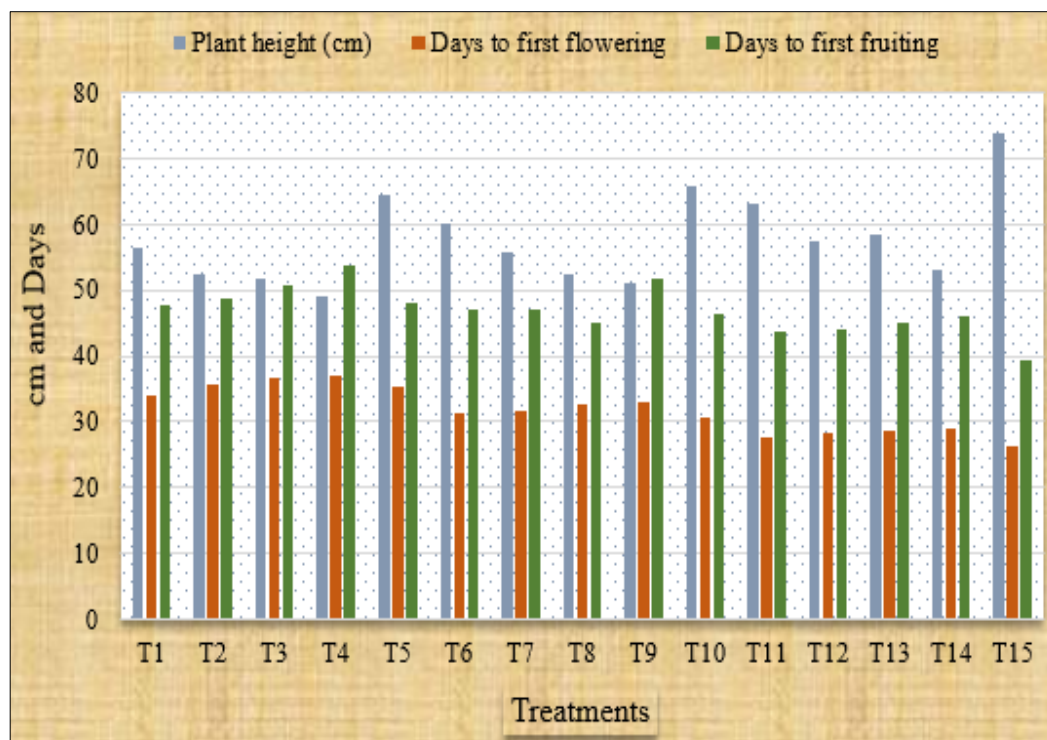


Fig 2: Effect of different eggplant rootstocks on plant height (cm), days to first flowering and days to first fruiting of grafted tomato

3.3.4 Fruit weight (g)

Data on average fruit weight is presented in table no.- 2. The results on average fruit weight revealed that there was a significant difference across all the treatments. The highest average fruit weight (40.53 g) is observed in the treatment T₁₁: 30 days old pusa ruby + *Solanum torvum* and was found at par with T₉: 25 days old pusa ruby + *Solanum indicum* (34.23 g), T₁₄: 30 days old pusa ruby + *Solanum indicum* (35.49 g), T₁: 20 days old pusa ruby + *Solanum torvum* (35.59 g), T₁₅: 30 days old pusa ruby + Solmel (37.16 g), T₆: 25 days old pusa ruby + *Solanum torvum* (37.19 g), T₁₃: 30 days old pusa ruby + *Solanum viarum* (37.80 g), T₁₂: 30 days old pusa ruby + *Solanum xanthocarpum* (37.86 g), T₁₀: 25 days old pusa ruby + Solmel (38.67 g) and T₅: 20 days old pusa ruby grafted + Solmel (39.86 g) whereas, the lowest average fruit weight (30.03 g) was reported in the 20 days old pusa ruby + *Solanum viarum* (T₃).

Tomato grafted onto *Solanum torvum* rootstock show higher fruit weight than *Solanum indicum* rootstock since it is a wild species with a vigorous root system, which follows the findings of Fullana-Pericas *et al.* (2018) [3].

3.4.5 Fruit length (cm)

The observations on the fruit length of fruit are presented in table no.- 2. All the treatments differed significantly for fruit length. The highest fruit length (3.50 cm) was recorded in the treatment T₁₂ (30 days old pusa ruby + *Solanum xanthocarpum*) which was at par with T₈: 25 days old pusa ruby + *Solanum viarum* (3.11 cm), T₁: 20 days old pusa ruby + *Solanum torvum* (3.18 cm), T₁₁: 30 days old pusa ruby + *Solanum torvum* (3.21 cm), T₇: 25 days old pusa ruby + *Solanum xanthocarpum* (3.23 cm), T₂: 20 days old pusa ruby + *Solanum xanthocarpum* (3.31 cm), T₆: 25 days old pusa ruby + *Solanum torvum* (3.35 cm), T₁₃: 30 days old pusa ruby + *Solanum viarum* (3.38 cm), T₁₀: 25 days old pusa ruby + Solmel (3.40 cm), T₅: 20 days old pusa ruby +

Solmel (3.42 cm) and T₁₅: 30 days old pusa ruby + Solmel (3.47 cm) whereas, the lowest fruit length (2.69 cm) was recorded in (T₁₄).

Compared to the non-grafted plants, respective fruit from grafted plants showed higher polar diameters. It is probably due to changes in the concentration of growth regulators or more supply of food nutrients etc., by rootstocks which lead to increased length of the fruit. The results agree with the findings of Hoyos *et al.* (2010) [6], Hossain *et al.* (2019) [5] and Singh *et al.* (2019) [16]. Rootstocks affected fruit length and it may be due to changes in the concentration of growth regulators induced by the rootstock. Similar findings were reported by Gisbert *et al.* (2011) [4].

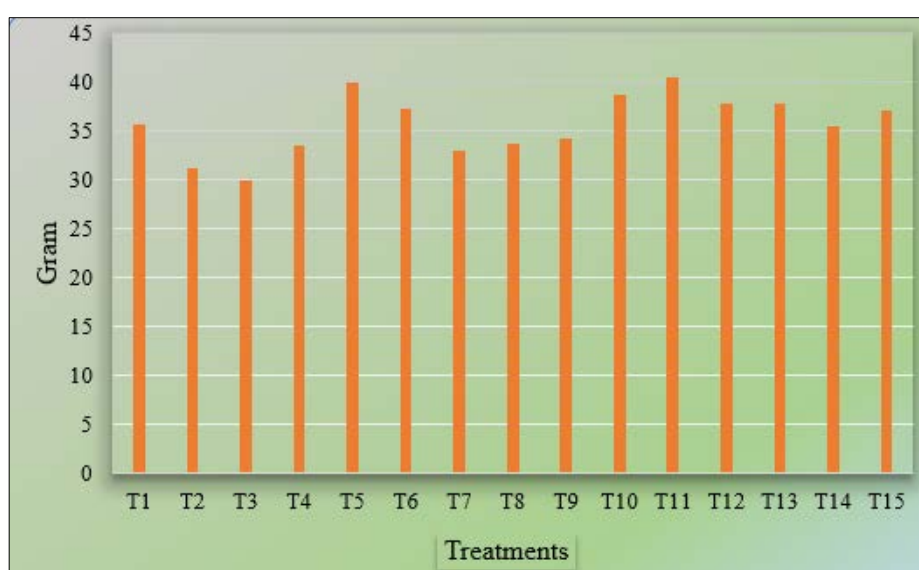
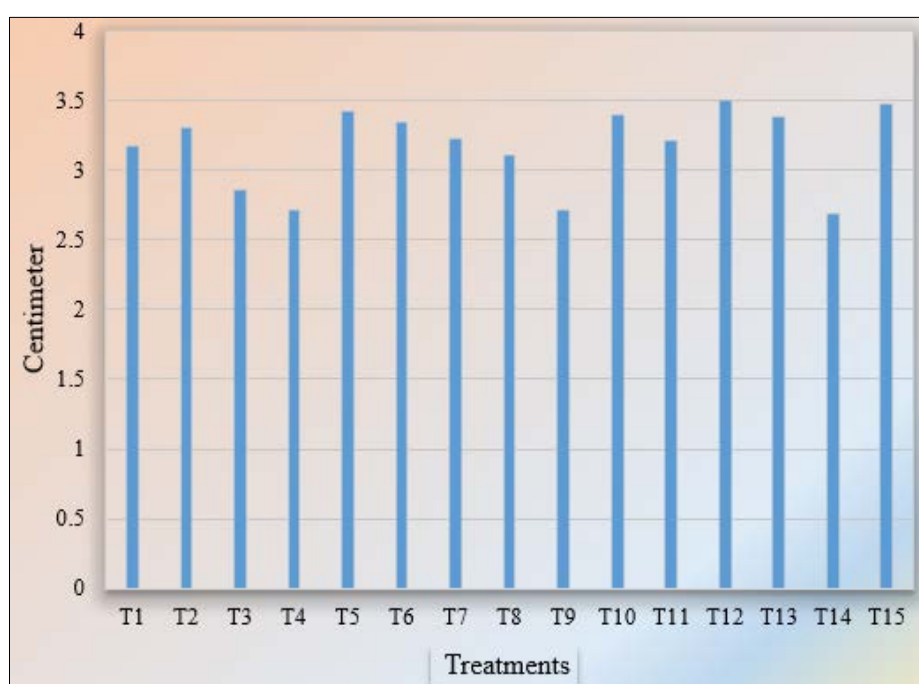
3.4.6 Fruit yield plant⁻¹

The observations on the Fruit yield per plant are presented in table no.- 2. Among all the combinations, maximum fruit yield per plant was recorded (1,745.33 g) in the treatment T₁₅: 30 days old pusa ruby + Solmel which was at par with T₅: 20 days old pusa ruby + Solmel (1,520.67 g), T₁₁: 30 days old pusa ruby + *Solanum torvum* (1,584.67 g), and T₁₀: 25 days old pusa ruby + Solmel (1,660.67 g) whereas, minimum fruit yield plant⁻¹ (724.33 g) was noticed in the treatment T₄: 20 days old pusa ruby + *Solanum indicum* respectively.

This could be as a result of increased fruit size, fruit weight and number of fruits in the grafted plants. It is well known that the root system of the plants affects vegetative growth and yield with the increase of water and nutrient uptake due to the vigorous root system of rootstocks (Lee 1994) [8] and thus grafting affects growth and ensures higher yields than in non-grafted plants. Maximum fruit yield obtained from eggplant rootstock in all experiments is likely due to eggplant being more vigorous. Schwarz *et al.* (2010) [14] also found that the root system of eggplant is more effective in water uptake than tomato root systems.

Table 2: Effect of graft combinations on fruiting time, fruit morphological traits and yield plant⁻¹ in tomato

Treatments	Fruit weight (g)	Fruit length (cm)	Fruit yield g plant ⁻¹
T ₁	35.59	3.18	1,171.00
T ₂	31.16	3.31	907.00
T ₃	30.03	2.86	809.67
T ₄	33.49	2.72	724.33
T ₅	39.86	3.42	1,520.67
T ₆	37.19	3.35	1,259.33
T ₇	33.03	3.23	988.00
T ₈	33.73	3.11	896.00
T ₉	34.23	2.72	791.00
T ₁₀	38.67	3.40	1,660.67
T ₁₁	40.53	3.21	1,584.67
T ₁₂	37.86	3.50	1,303.00
T ₁₃	37.80	3.38	1,168.00
T ₁₄	35.49	2.69	867.67
T ₁₅	37.16	3.47	1,745.33
S.E. m±	2.11	0.20	93.37
C.D. at 5%	6.13	0.58	271.86
C.V. (%)	10.21	10.89	13.94

**Fig 3:** Effect of grafting on fruit weight**Fig 4:** Effect of grafting on fruit length (cm)

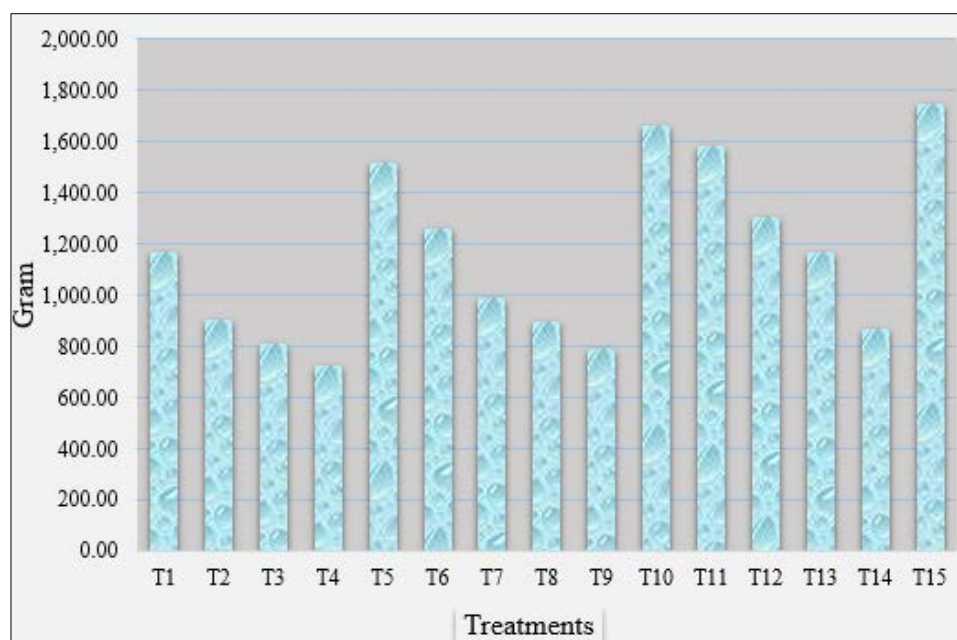


Fig 5: Graphical representation of the effect of grafting on fruit yieldg plant⁻¹

Conclusion

Significant variation was observed among the graft combinations for growth and yield traits. The treatment T₁₅ (30 days old pusa ruby + Solmel) consistently outperformed others by recording the highest plant height, earliest flowering and fruiting, maximum fruit length and fruit yield plant⁻¹ (1,745.33 g). Other effective combinations included T₁₀, T₁₁ and T₅, demonstrating the superiority of Solmel and *Solanum torvum* as rootstocks. The enhanced performance can be attributed to improved nutrient uptake, graft compatibility and the vigorous root system of the selected rootstocks, indicating their potential for improving tomato productivity through grafting.

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