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Evaluation of growth attributes, yield and quality of Pomato plants

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Abstract
Pomato is a grafted plant developed by grafting tomato as scion and potato as rootstock with an aim to achieve high growth, yield and quality from a single plant. In the present study grafting between tomato and potato was done during two consecutive years at the experimental orchard of Department of Horticulture, Allahabad School of Agriculture, Sam Higginbottom Institute of Agriculture Technology and Sciences, Allahabad. 30 days old tomato seedlings were veneer grafted in a 20 days old potato seedling. Successful graft union was achieved after 8-10 days of grafting. The grafted plants produced copious branches and flowers. The result also showed that maximum numbers of fruits per plant in tomato were 67.96 in T6, average fruit weight 50.37 gram in T1. Edible potato tubers were ready to harvest at 120-130 days after grafting and yielding about 1600 g of potato in graft combination T7. But after the end of the experiment, it may be suggested that farmers and any home gardener can practice this technique as an amazing contentment which may Fulfill home requirement to some extend for both tomato and potato.

Keywords: Grafting, Pomato, potato, rootstock, scion, tomato

Introduction
Pomato is a grafted plant created by grafting a tomato (*Solanum lycoper sicum* L.) scion on a potato (*Solanum tuberosum* L.) rootstock; whereas, tomato growing on its vine and potato tubers under the soil of the same plant. Both of species belonging to the family *Solanaceae* and share a common primary chromosome number, and thus having natural compatibility of graft. Grafting is an well-known technique to get better plant adaptation to a range of abiotic and biotic factors increase plant yield and quality. Grafting recital depends on compatibility of scion and rootstock. Vascular tissue of the scion and rootstock must make contact with each other to produce a successful graft. It is an economically important cash crop with high demand in the international market (Solieman *et al*., 2013) [12]. Nutritionally, tomato is an important source of vitamins, minerals, essential amino acids, sugars and dietary fibres. Its vitamin C content is particularly high (Kanyomeka and Shivute, 2005) [6] and is an excellent source of lycopene, a powerful antioxidant with anti-carcinogenic potential (Dagade *et al*., 2015; Tasnia *et al*., 2015) [4, 13]. Its balanced mixture of minerals, vitamins, antioxidants and carbohydrates earns it an excellent nutritional profile (Tasnia *et al*., 2015) [13]. The vegetable grafting is an alternative approach to overcome much important impediment related to vegetable production like fusarium wilt, bacterial wilt, nematodes, low and high temperature, flooding, site specific adaptability, fruits durability etc. (Kubota *et al*., 2008) [8]. Both the crops have a huge demand in the everyday life of Indian people and production is not augmented so far as per growing population. Scion and rootstock combination greatly prejudiced growth, yield and fruit quality and by applying grafting techniques resistance against low and high temperatures can be persuaded and also get better quality of the plant (Kumar *et al*., 2015b) [9]. Grafting technology can be employed by farmers that cannot afford soil steaming and pesticides as well as to reduce dependency on such chemicals. Today, grafting is also being employed to enhance crop response to a variety of abiotic stresses (Schwarz *et al*., 2010; Rivard and Louws, 2011) [11, 10], thereby improving growth, yield and fruit quality.
Growing potato and tomato as one plant offers huge benefits. Through them, small farmers can maximize use of their growing plots and thus lower the input costs. The resultant crops formed after the union of potato and tomato are more efficient than a single potato or tomato plant. Planting a tomtato plant also saves time and labor without affecting quality of produce. Pomato plants have been seen as a new technology to make food production more efficient, as

they maximize the amount of crops that can be produced on a piece of land or in a small urban environment like a balcony. The purpose of this study was to investigate the possible effects of different graft combinations on fruit and tuber yield and growth attributes of pomato plants, and to determine the best compatible union among different varieties of potato rootstocks and tomato scions.

Materials and Methods

The present investigation entitled "*Effect of potato and tomato on growth, yield and quality of pomato plants*" was carried out at the experimental orchard of Department of Horticulture, Allahabad School of Agriculture, Sam Higginbottom Institute of Agriculture Technology and Sciences, Allahabad conducted during the year 2015 and 2016 {fig. 1(a), 1 (b) and 2 (a), 2(b)}. Allahabad comes under subtropical climate zone prevailing in the *winter* and *summer*. It is situated at latitude of 25.85 ^{0}C N and longitude of 81.15 ^{0}E. The altitude of this place is 78 m from MSL. During the *winter* months, the temperature drops down as low as 1.0 ^{0}C while in the *summer* the temperature reaches above 45.0 ^{0}C.

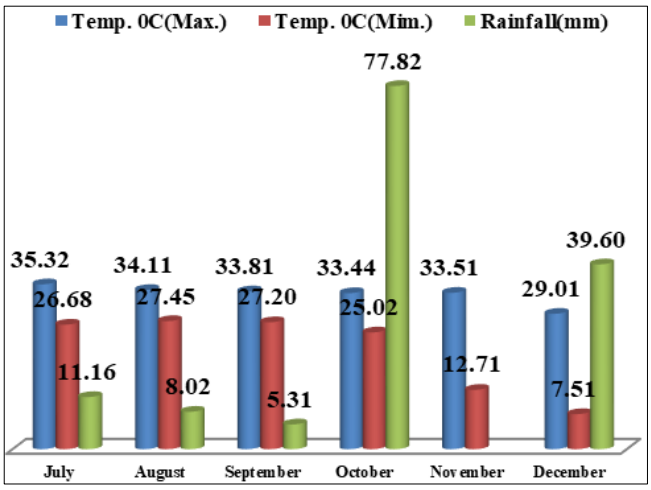

Fig 1(a): Month wise Tempture (0C) & Rainfall (mm) during 2015

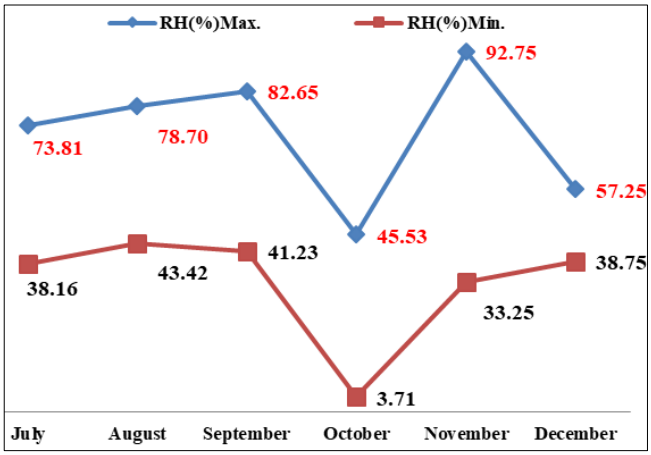

Fig 1(b): Month wise Relative humidity (%) during 2015

Hot desiccating winds are regular feature during *summers* whereas there may be occasional spell of frost during the winters. The average rainfall was above 900 mm, mostly during the monsoon of 2015 and 2016, with a few occasional showers during the winter months. The average maximum/minimum temperature/relative humidity during the experimental period was 32.2 ^{0}C/21.1 ^{0}C and 71%/33% in the year 2015, whereas, in 2016 it was 34.1 ^{0}C/22.0 ^{0}C and 73%/32%.

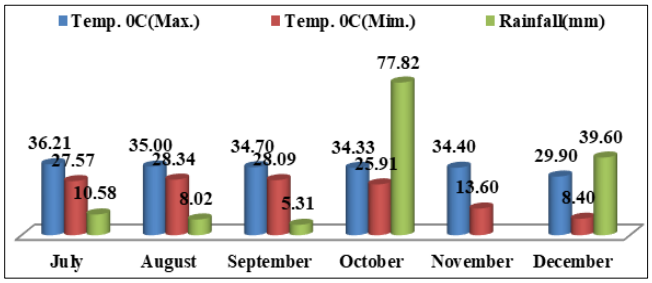

Fig 2(a): Month wise Tempture (0C) & Rainfall (mm) during 2016

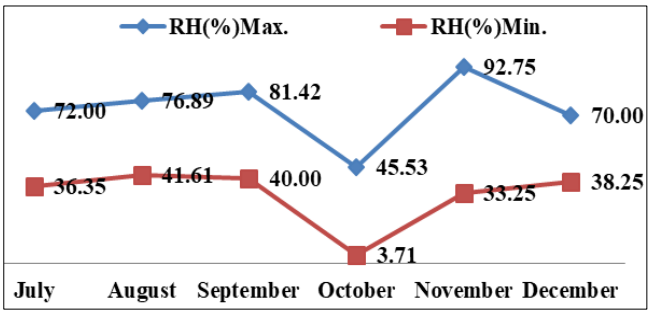

Fig 2(b): Month wise Relative humidity (%) during 2016

Grafting of seedlings

Tomato seedlings were veneer grafted to the potato rootstock in the field. Five to seven leaves of the potato seedlings were removed to a 6-8 inch height from the seedling base. The remaining shoot was removed by a cut with an angle of 35^0 using a sharp razor. The potato stem (2.5 mm in diameter) was bisected in the middle longitudinally approximately 4-5 mm deep using a sharp blade. The same diameter of tomato scion stem was removed from a seedling and the largest leaves were trimmed to minimize water loss. The lower edge of the scion stem was carefully sliced by two diagonal cuts to form a blunt wedge approximately 4-5 mm long. The wedge end of the scion was inserted into the bisected potato root stock. After placing the scion on the potato rootstock, grafting tape was used to fix the grafted position tightly together. Rootstocks and scion with similar stem diameters were chosen to increase the grafting success. After grafting, the pomato plants were covered by plastic cap for 7-8 days for recovery of the grafted plants. The grafted seedlings were watered regularly.

Details of grafting combination

Four varieties of potato, Kufri Pukhraj, Kufri Chipsona, Kufri Bahar and G-4 and two varieties of tomato, Pusa Ruby and Cherry Tomato, were used to make grafted combinations of pomato. The graft combinations were T_1 (Kufri Pukhraj+Pusa Ruby), T_2 (Kufri Chipsona+Pusa Ruby), T_3 (Kufri Bahar+Pusa Ruby), T_4 (G4+Pusa Ruby), T_5 (Kufri Pukhraj+Cherry Tomato), T_6 (Kufri Chipsona+Cherry Tomato), T_7 (Kufri Bahar+Cherry Tomato), T_8 (G4+Cherry Tomato) were selected. As control for tomato T_9 (Pusa Ruby) and T_{10} (Cherry Tomato) whereas, T_{9a} (Kufri Pukhraj), T_{10a} (Kufri Chipsona), T_{11} (Kufri Bahar) and T_{12} (G-4) were control for potato were used.The observations recorded were plant height (cm), average fruit weight (g), number of fruit per plant, TSS (^{0}Brix), fruit yield per plant (g) of tomato and in potato number of tubers per plant, average tuber weight (g)

and tuber yield per plant (g). The data were recorded every 30, 60, 90 days after transplanting and at maturity. Ascorbic acid content (mg/100 g) of tomato fruit was also determined by the procedure adopted by Lane and Eynon method (A.O.A.C., 1990) [3]. It was extracted from the tomato pulp by macerating 5.0 g of sample with extraction solution. The extract was filtered and volume made to 5.0 ml in volumetric flask. 5.0 ml of aliquot was taken and titrated against standardized dye 2, 6-dishlorophenol-indophenol till the light pink colour appeared at the end point. The obtained data were analysed and graph was prepared by Microsoft excel.

Results and Discussion

Both the crops belongs to same family plant so, the grafting between tomato and potato became success, which was about 81 percent and the graft union took 10-15 days to grow successfully. The result of plant height after 30, 60 and 90 days after transplanting was found maximum in Kufri Chipsona + Pusa Ruby combination, it was 19.64 cm, 85.37 cm and 101.29 cm respectively, 101.29 cm was the maximum height observed at harvesting and it was minimum 72.71 cm found in non-grafted cherry tomato (fig. 3). Similar results were also reported by Al-Harbi *et al*. (2016) [1] increased stem diameter, plant height and shoot fresh weight of grafted tomato as compared to non-grafted tomato. Regarding number of fruit per plant it was found maximum in combination T6 (67.96). The grafted plants produced higher fruits this may be due to the increasing in plant height of the plants. The present findings corroborated with the results of the Turhan *et al.* (2011) [14] who reported that the higher fruit weight in grafted plants in comparison to the controls. The maximum average fruit weight 50.37g was observed in T_1 (Kufri Pukhraj+Pusa Ruby) (fig. 4).

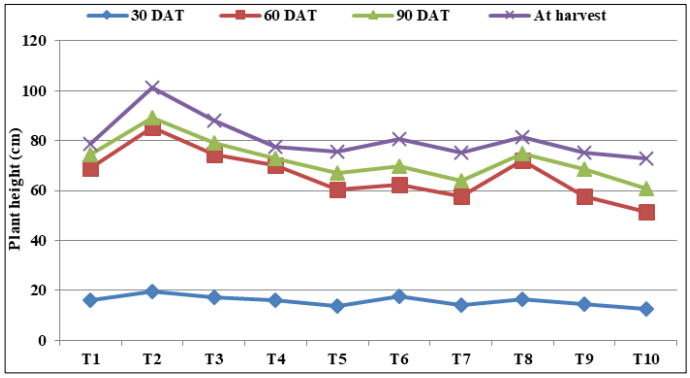

Fig 3: Plant height (cm) of tomato plant 30, 60, 90 and at harvesting days after transplanting

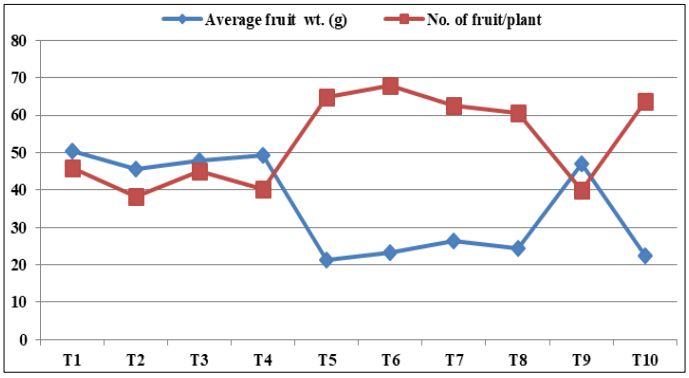

Fig 4: Average fruit weight (g) and number of fruit per tomato plant

The higher average fruit weight in grafted plants may be due to the potato rootstock provided the nutrients in sufficient and the higher nutrient use efficiency of grafted plants. The present findings corroborated with the results of the Turhan *et al*. (2011) [14]. The maximum ascorbic acid content 14.58 mg/100 g was recorded from the Kufri Pukhraj+Cherry Tomato during. The grafting combination (Kufri Bahar + Cherry Tomato) synthesized maximum total soluble solids 5.15 ^{0}Brix during the study (fig. 5).

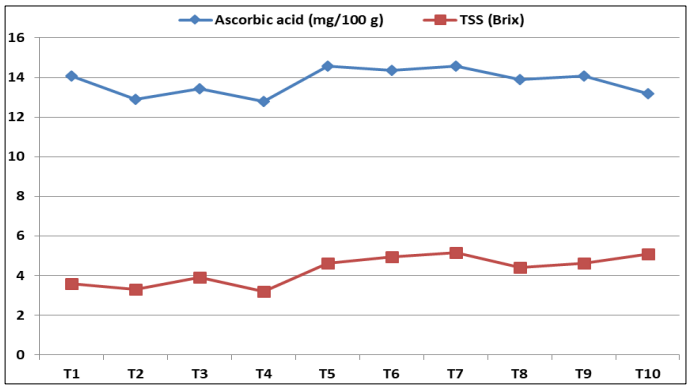

Fig 5: Ascorbic acid (mg/100g) and TSS (Brix) of tomato

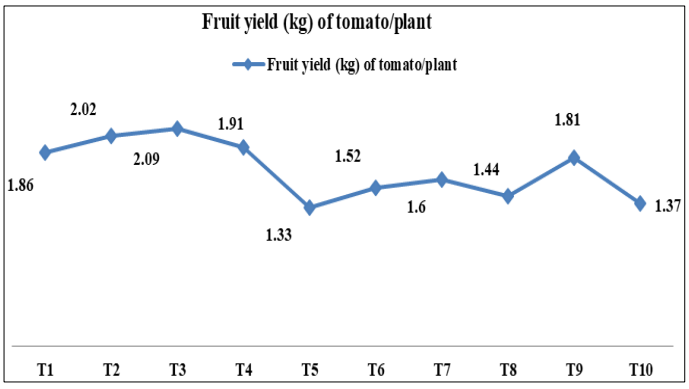

Fig 6: Fruit yield (kg) of tomato per plant

Graft combination Kufri Bahar+Pusa Ruby graft was observed highest tomato fruit yield per plant 2.09 kg, whereas, minimum 1.33 kg in treatment T_5 (fig. 6)

The fruit yield is the result of the cumulative effect of the various characters *viz*., plant height, number of fruits and average fruit weight.

Khah *et al.* (2006) [7] also observed an increase in height and yield for open field grafted tomato plant. The present study also recorded that number edible potato tuber per plant in graft combination, it was highest in Kufri Bahar+Cherry Tomato 20.35, whereas, its average weight per plant was 81.39 g (fig 7).

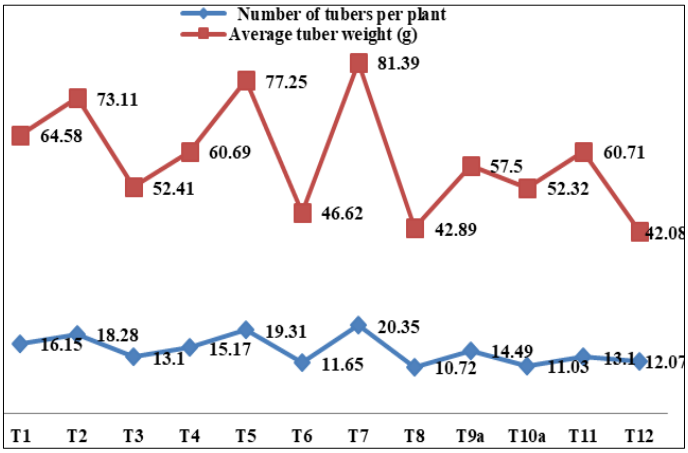

Fig 7: Number of potato tuber per plant and average tuber weight (g)

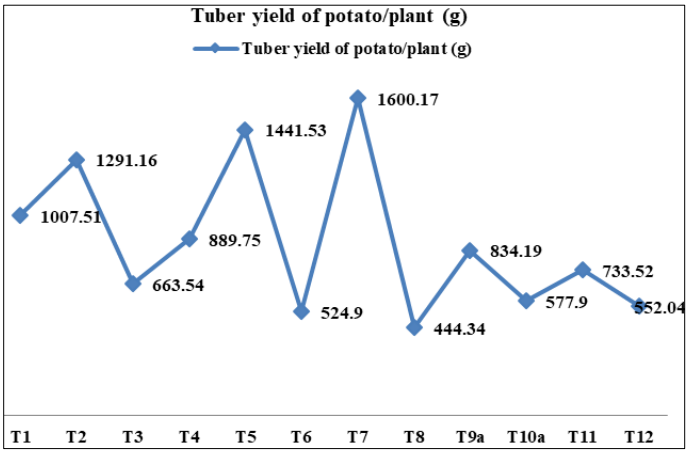

Fig 8: Tuber yield (g) of potato per plant

The grafted root stock produced significantly higher number of tubers as well as average tuber weight in comparison to non-grafted plant. Regarding the tuber yield of potato per plant, it was also observed highest in 1600 g in combination T_7 Tomato (fig. 8).

In summary, it has been shown that different varieties of tomato scions can be successfully grafted on potato rootstocks, and the specific combinations affects tuberization and fruit set in pomato plants. Development of the pomato plant among the same species grafts between potato and tomato is a pioneering idea to get better food crop production in the same plant. There is a balance of hormonal signalling between tuber formation, fruit development and growth attributes of a pomato plant (Anamul Arefin *et al*, 2019) [2]. In conclusion, grafting between tomato and potato plant was successful and produced fruits at aerial parts and tuber in underground portion from a single plant of pomato.

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