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Productivity of grafted tomato using different sources of eggplant rootstock

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Abstract

A study of the growth and productivity of tomato using different rootstock of eggplant was conducted at the experimental area of the College of Agriculture, Isabela state University, Echague Isabela. The study was laid out in a Randomized Complete Block Design. The treatments were as follows: T_1- Control (Non-grafted), T_2- Grafted onto a Rootstock of wild eggplant, T_3- Grafted onto a Rootstock of Hybrid Eggplant (Casino F1), and T_4- Grafted onto a Rootstock of Open Pollinated Variety (OPV) Eggplant (Aurora Green). The height of the plants at 20, 40, 60, and 80 days after transplanting were not influenced by the different eggplant rootstocks. The grafted plants regardless of rootstock obtained the highest number of branches and marketable fruits per plant. Significantly bigger fruit diameter, heavier marketable fruits per plant and per sampling area. The non- grafted plants obtained the lowest values in all the parameters gathered. The computed yield of tomato per 1,00 square meters using different sources of eggplant showed that the rootstock of wild eggplant obtained the heaviest fruit yield with 10.82 tons as well as the highest return on investment with 432.43 present.

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Introduction

Tomato (*Lycopersicum*) is one of the most popular and widely used vegetable in the world. The country's production compared to Asian and world production is relatively low. The crop can be grown in area that has slightly elevated and good drainage but it is highly seasonal. Farmers seldom plant during rainy season due to high risks exposure on flood and occurrence of pests and diseases. Most of the pests and diseases of tomato are common throughout the year therefore to be able to meet the demand and continue supply of tomato in the local market, alternative ways should be developed.

Grafting is a procedure which parts of the plants are joined together with the ultimate intention in making them unite and continue growing as one part. It is composite of parts derived from two or more crops (Hartman, 1975). Grafting tomato on different eggplant rootstock is one way of eliminating bacterial wilt, which is a very destructive disease of tomato. Numerous reports have suggested that grafting can successfully prevent verticillium wilt and wild species of eggplant have been demonstrated as potential rootstocks with high resistance to verticillium wilt (Bletsos *et. al.,* 2003). Research showed that grafted tomatoes in the eggplant rootstock yielded 21% higher than the ordinary tomato seedlings. It is hoped that the profitability of grafted tomato technology enhances the off-season production that will reduce the occurrence of sky high prices thus, making tomato price affordable to everyone's home and at the same time offering the growers better source of alternative enterprise.

Objectives of the study

Generally, this study was conducted to determine the growth and yield of grafted tomato using different sources of eggplant rootstock.

Specifically, it aimed to:

- Determine the scion-rootstock combination produced the highest fruit yield.
- Identify which treatment produced the highest yield.

Materials and methods

Securing of seeds

The seeds of hybrid eggplant and open-pollinated variety were procured in an authorized distributor in Echague, Isabela while the wild eggplant seeds were secured at Cordon, Isabela. The seeds of Tomato were secured in an accredited seed distributor at Santiago City.

Seedling production

The wild varieties of eggplant seeds were sown 15 days ahead of that of the OPV and hybrid varieties. The seeds were sown in a seedling tray with a well prepared and sterilized mixture of equal parts of organic fertilizer, carbonized rice hull and fine sand. The seedlings were provided with a makeshift roof with improvised transparent plastic and partial shade to protect from direct sunlight and to suppress the direct impact of heavy rainfall. Fungicide was sprayed at the rate of 1-2 tablespoon per 16 liters of water to prevent the possible attack of damping-off.

Production of grafted seedlings

One month old eggplant and two weeks' tomato seedlings were grafted and matched to the same diameter for best fit between the rootstock and scion. The stems were cut into a 30° angle using sterilized razor blade. The 10mm length latex rubber tube was used to unite the rootstock and scion ensuring that the cuts were in parallel. The latex rubber tube was gently pressed towards the rootstock and scion to completely in contact, displacing air within and served as sealant against intrusion of water, air and pathogens. The newly grafted seedlings were placed in a total shade area.

Grafted seedling management

The newly grafted seedlings were placed in a cool dry grafting chamber with high relative humidity. For the first three days, these were placed in a totally dark area to control rapid evapotranspiration. The grafted seedlings were gradually exposed to sunlight for hardening one week after grafting. Water was sprinkled to avoid water stress and pesticide was applied to prevent attack of insect pests and pathogenic microorganisms. The emerging buds below the grafting union were removed before transplanting.

Site selection

An upland area located at the experimental area of the College of Agriculture was used in the study.

The area was provided with a source of artificial irrigation and with proper drainage.

Soil sampling

The soil samples were collected randomly by simply digging the soil from the experimental area at 20 centimeters depth using shovel before land preparation. The soil samples were pulverized, and the foreign materials were removed. One kilogram of the sample was placed in a clear container and submitted to the Regional Soils Laboratories, Department of Agriculture, Ilagan, Isabela for analysis.

Land preparation

The area was plowed by plowing and harrowing twice with two weeks' interval by using hand tractor and Carabao drawn plow to eliminate weeds. Ridges were raised to 30cm with 75 centimeters apart.

Experimental layout and design

The experimental area was divided into three (3) equal blocks. Each block was further subdivided into four (4) equal plots with a dimension of 3.0m x 3.0m. The treatments were randomly distributed through the following randomization procedure for Randomized Complete Block Design. The treatments were as follows:

T1- Control (Non-grafted Tomato)

T2- Grafted onto a Rootstock of Wild Eggplant

T3- Grafted onto a Rootstock of Hybrid Eggplant (Casino F1)

T4- Grafted onto a Rootstock of OPV Eggplant (Aurora Green)

Application of fertilizer

The experimental plots were applied with chicken manure at the rate of one (1) ton per hectare. The application of 90-120-0 kg NPK ha^{-1} with basal application at 5.6 bags/ha 16-20-0 and 7 bags/ha 0-18-0. Side dressing was applied at the rate of 2 bags/ha urea.

Transplanting and replanting

The grafted seedlings were transplanted two weeks after grafting with 50 centimeters between hills and 75cm between ridges. One seedling was planted per pot hole. The seedlings were covered with fine thin soil and the base was gently pressed for plant anchorage and roots are in contact with the soil. The newly planted seedlings were irrigated if necessary. Missing hills were planted immediately to maintain the desired plant population.

Care and Management

Cultivation

Cultivation was done using hand tools. Off barring was done 15 days after transplanting and hilling up was done also 25 days after transplanting using shovel.

Crop protection

The occurrence of insect pests was applied using application of insecticide based on recommended rate.

Weed management

The weeds were removed immediately through hand-weeding.

Water management

The application of furrow irrigation was done as the need arose.

Staking

Each plant was provided with a stake to prevent it from lodging. The plants were trained specially the grafted ones to attach to the stake and to prevent bending to avoid rapture of the grafted tomato which may cause entry of pathogens that may cause infection to the plants.

Harvesting

The fruits were harvested at physiological maturity. Harvesting of samples was done per sample plant and per plot weighed and recorded immediately.

Collection of data

Plant height

The plant height of ten representative sample plants per treatment was measured at 20, 40, 60, and 80 days after transplanting. The heights were measured from the base of the plant up to the tip of the primary stem.

Number of lateral branches per plant

The branches of the sample plants were counted at the last priming. The total number of branches of the sample plants was divided by ten to get the average number of branches per plant.

Number of fruit per plant

Ten representative sample plants were considered per treatment. The number of fruits per sample was properly labeled, counted, and recorded every priming. All the fruits from the first priming up to the last priming were summed-up and divided by ten to obtain the average number of fruits per plant.

Fresh weight of fruits per plant

The fruits were weighed in every priming, and it was recorded. After the last priming, the weight of the fruits was recorded, summed-up and divided by the number of samples to obtain the average number of fruits per plant.

Computed fruit yield per 1,000 m²

The computed fruit yield per 1,000 square meter base from the average yield per sampling area was computed and expressed in kilograms per hectare as follows.

$$\text{Yield per Hectare} = \frac{\text{Yield per sampling Area (g)}}{\text{Sampling Area (m}^2\text{)}} \text{ x } 1{,}000\text{m}^2$$

Result and discussion

Plant height

The Plant height at 20 days after transplanting (DAT) insignificant result as obtained in Table 1. The mean heights ranged from 52.13cm to 53.20 centimeters which showed that the grafted as well as the non-grafted plants obtained similar heights.

Likewise, at 40 days after transplanting, the heights of the plants did not vary significantly among treatment means. The grafted tomato onto wild eggplant (T2), hybrid (T3), open pollinated variety (T4) rootstocks as well as the non-grafted tomato (T1) obtained comparable a mean value ranging from 92.00cm to 92.89 centimeters. The different rootstocks did not vary on the height of the plants at 60 days after transplanting with mean values ranging from 96.78cm to 97.47 centimeters.

No significant variation was observed among treatment means in terms of the height of the plants at 80 days after transplanting. The grafted and non-grafted plants regardless of the sources of rootstocks obtained a mean value ranging from 99.77cm to 99.97 centimeters.

No variations were noted on the height of the plants from 20 to 80 days after transplanting which was in contrary to the findings of Makam *et al.* (2005) that the rootstock and scion were exposed to stress condition due to grafting affected the height of the plants as well as the cultural factors.

Number of lateral branches

The number of lateral branches per plant was affected by the different eggplant rootstocks (Table 2). The greatest number of lateral branches per plant was produced by the grafted tomato onto wild eggplant rootstock (T2), Open Pollinated Variety (T4), and Hybrid eggplant rootstock (T3), with a mean value of 7.23, 6.70, and 6.43 respectively.

Number of marketable and non-marketable fruits

The number of marketable fruits per plant was significantly affected by the different eggplant rootstocks (Table 3). The tomato plant grafted onto a wild eggplant rootstock (T2), grafted onto Open Pollinated Variety rootstock (T4), and plants grafted onto Hybrid eggplant rootstock (T3) produced the greatest number of marketable fruits per plant with a mean value of 58.21, 56.13, and 57.10 fruits with a mean value of 47.13 fruits.

The above result is in conformity to the claimed of Kubuta *et al.* (2008) that grafting offers innovative cultural practices that can be used to manage cultural pressure with higher fruit yield.

In terms of the number of non-marketable fruits per plant, insignificant differences existed. The data indicated that the non-grafted plants produced comparable number of non-marketable fruits regardless of the rootstocks with a mean value of ranging from 4.64 to 4.15. The cause of non-marketable fruits in all treatments is due to the presence of tomato fruit worms, blossom end rot and sun scald due to excessive heat.

Fruit diameter

The fruit diameter as affected by different sources of rootstocks is presented in Table 4. Analysis showed that bigger fruits were produced from the grafted plants using different rootstocks.

The tomato grafted onto wild eggplant rootstock (T2) produced the biggest fruit with a mean value of 4.24 centimeters, yet comparable to the tomato grafted onto an OPV (T4) and grafted onto hybrid eggplant (T3) with a mean value of 4.20 and 4.70 centimeters respectively. The smallest fruit was obtained from the non-grafted plants with a mean value of 3.75 centimeters.

Bigger fruits on grafted tomato were noted because of increased fruit size which is in consonance to the findings of Passam *et al.* (2005) that tomato grafted onto eggplant rootstocks showed improved yields, increased fruit size and number compared to the non-grafted or control plants. Likewise, bigger fruits from grafted plants were found since reducing disease damage often can be achieved by grafting as cited by Paplomatas *et al.* (2002).

Weight of marketable fruits

Significant result was obtained in terms of the weight of marketable fruits per plant. The heaviest marketable fruit yield per plant was produced from the wild eggplant rootstock (T2) with a mean value of 4.06 kilograms, followed by the OPV rootstock (T4) with a mean value of 3.42 kilograms and the hybrid rootstock (T3) with a mean value of 3.27 kilograms. The non-grafted (T1) were the least in terms of weight of marketable fruits with 1.84 kilograms.

The consistency of grafting technology using wild eggplant, Open Pollinated Variety, and hybrid rootstock as a potential cultural production modality in producing bigger, more number and heavier weight of fruits which were strongly supported by Passam *et al.* (2005). Moreover, grafting can successfully prevent verticillium wilt and wild species of eggplant have been demonstrated as potential rootstocks with high resistance to verticillium wilt as cited by Bletsos *et al.* (2003).

Weight of marketable fruits per sampling area (kg/4 square meters)

Significant differences existed in terms of the weight of marketable fruits per sampling area as shown in Table 6. The grafted tomato onto a wild eggplant (T2) consistently produced the heaviest fruit yield per sampling area with 46.86 kilograms which is comparable to the rootstock of Open Pollinated Variety (T4), and hybrid eggplant (T3) with a mean value of 41.05 kilograms and 39.42 kilograms, respectively. However, the non-grafted tomato (T1) produced a marketable fruit comparable to the tomato grafted onto a hybrid Casino F1, with a mean value of 20.97 and 39.42 kilograms, respectively.

Computed fruit yield per 1,00 m²

The computed yield of tomato per 1,000 m² using different sources of eggplant rootstocks is shown in Table 7. The non-grafted plants (T1) had a mean of 4.91 tons, T2- wild eggplant with 10.83 tons, T3- hybrid eggplant with 8.72 tons and, T4- Open pollinated variety with a mean value of 9.12 tons.

Cost and return analysis

The productivity of Grafted tomato using the different rootstocks of eggplant was shown in Table 8. In descending order T2- Wild eggplant obtained the highest return with 432.43 percent, T4- OPV eggplant with 378.48 percent, T3- hybrid eggplant with 363.76 percent while the lowest was obtained by the non-grafted plants with 284.73 percent.

Conclusion

Based on the results, the grafted plants regardless of the rootstock produced more and heavier fruit yield. Therefore, grafting offers innovative cultural practices that can be used not only to manage soil borne disease but also enhance the growth and productivity of tomatoes. The different eggplant rootstocks used in the study could be a potential source to have longer time of priming but also make the plant resistant and an ideal crop management strategy to increase production.

Recommendation

Based on the results the use of wild eggplant is a potential source of rootstock in grafting tomato to obtained higher yield. The use of wild rootstock of eggplant is a potential cultural production modality to increase the productivity of tomato for off- season production. Hence it is recommended as a potential production strategy to increase yield per unit area.

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