

## Conference Paper

# Grafting of Tomato with Eggplant Rootstock at Penyabangan Village Payangan Subdistrict of Gianyar Bali

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## Abstract

Grafting on tomatoes is performed to obtain tomato plants that are resistant to bacterial wilt, waterlogging resistant, resistant to fusarium wilt and nematodes. Bacterial wilt caused by *Ralstonia solanacearum* causes the tomatoes grown in the rainy season to wilt and die. These bacteria live in the soil and invade plants through roots. To overcome this disease, grafting was carried out by using resistant eggplant as rootstock. This method is expected to reduce the attack of bacterial wilt diseases on tomato plants. The study was conducted in the village of Penyabangan Payangan Gianyar in FY 2014. This area was located at the plateau of AEZ wet climate. The experimental design used was a randomized block design (RBD) with two treatments and 10 replications. Materials used were tomato plants that have been joined with eggplant rootstock (grafted) and tomato plants without root stock (non-grafted) for comparison. The varieties used were varieties F1 Marta. In field applications, the scion was prevented from touching the ground while the rootstock was fully embedded into the ground. Based on the plant height, there was a slower growth of the grafted tomato plants compared with that of non-grafted one in the early stages of growth but became normal in generative phase. It was also found that the yield of the grafted tomato was lower (2.54 kg. tree<sup>-1</sup>) than that of the non-grafted one (3.19 kg.tree<sup>-1</sup>).

**Keywords:** grafting; tomatoes; eggplant; stem rot; bacterial wilt (alphabetic in order).

## 1. Introduction

Indonesia has two seasons, wet and dry. Each season has specific environmental condition. Cultivation of vegetables, especially tomatoes, in the dry season experience a high attack of insect pests, while in the rainy season there is wilt disease such as bacterial wilt caused by *Ralstonia solanacearum*. The disease causes the plant to wilt and die [1]. One of the methods to overcome this problem is the usage of grafting technology. Grafting is joining two different plants of the same family. In this case, tomato is used as the scion and eggplant, which is resistant to bacterial wilt, as the rootstock.

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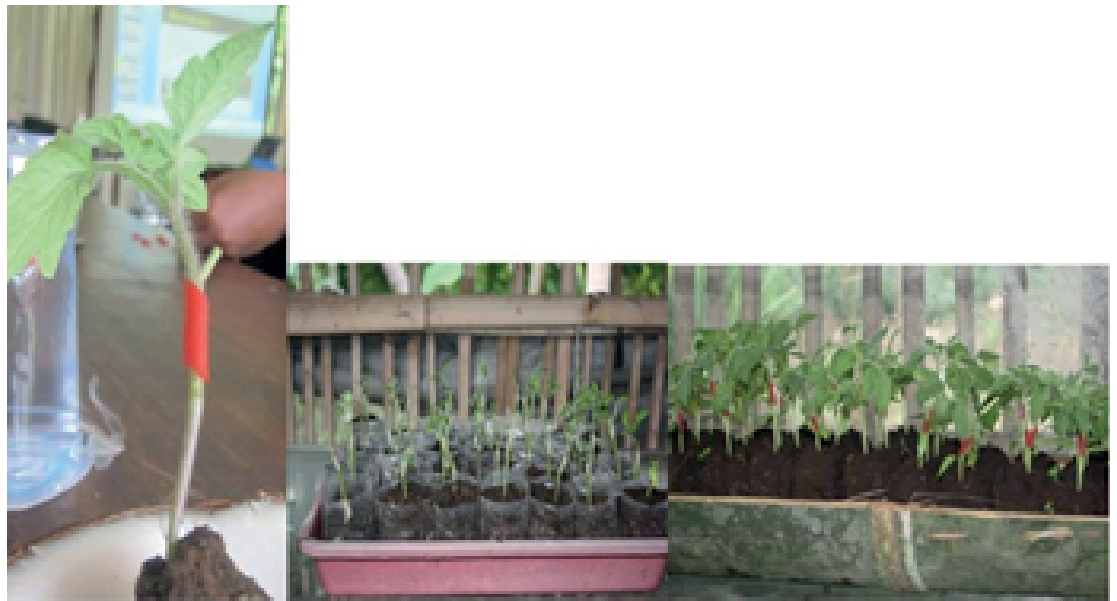
Tomato can be consumed as a vegetable or fruit either fresh or processed as ketchup. In general, the tomato can be grown in the lowlands to highlands. Tomatoes require soil that is loose, porous, fertile, soil acidity (pH) between 5-6, rainfall 750–1,250 mm / year, relative humidity of 80%. with an average temperature of 21°C. Cultivation method of tomato varies from region to region depending on soil conditions, altitude, agroclimate, habits, skills of farmers, and financing availability.

Important insect pests of tomato plant are fruit borer *Helicoverpa armigera* and *Heliothis* sp., Fruit fly *Bactrocera* spp., aphids, trips, and nematodes, whereas the diseases are plant wilt, leaf spot, late blight and Anthracnose. One way to control the wilt disease like bacterial wilt or root rot / stem rot is by grafting the stem of tomato plants with eggplant rootstock. The use of the grafting system using eggplant as rootstock is expected to be able to overcome the problems of wilt or root rot even in wet weather or in submerged plants.

There have been assessments on the use of grafting technology on tomatoes with eggplant rootstock [1, 2]. The purpose of the introduction of tomato grafting technology is to overcome the attack of tomato bacterial wilt disease that has been difficult to control so that the farmers can still produce tomatoes. This grafting technology is important to reduce the use of pesticides or chemical inputs applied by farmers.

For more eco-friendly agriculture, it is also important to manage land by introducing effective ways such as grafting technology which effectively stop the activities of bacterial wilt disease. In addition, farmers can get benefit from implementing off season technology for producing tomato because this wilt disease problem normally occurs during wet season where cultivating tomato is not possible to conduct. Because of its great benefit, the farmers need to develop the concept of integrated agriculture between livestock and crops as a holistic system to support the need of organic fertilizers for tomato crop [3, 4]. The integration of resources such as crops and livestock have showed that this integration can rise organic inputs to improve the level of land productivity, quality of production and farmers' income [5-8].

With the intensive application of chemical, there has been a decrease in the level of productivity of the soil. For example, in the early 1990s the average production of local tomato variety Arthaloka in production centre Tabanan was capable of producing about 5 kg tomatoes / tree, but then it decreased to about 2.5 - 3 kg / tree [9]. Therefore, the implementation of tomato grafting conducted by farmer in fields is in line with the target to improve production as the obtained tomato plants are resistant to bacterial wilt, waterlogging, fusarium wilt and also nematode. Bacterial wilt caused by *Ralstonia solanacearum* causes the tomato grown in the lowland areas in the rainy season suddenly become wilt and die. These bacteria live in the soil and attack plants after contact with the roots of tomato.



**Figure 1:** The process of grafting tomatoes until the plants were ready for planting.

## 2. Materials and Method

Research on the assessment of egg plant as root stock for tomato grafting was implemented at dry land Penyabanan Kerta village Subdistrict of Payangan Gianyar in 2014. Materials used in this study included tomato plant var. Marta (grafted), tomato plants without grafting for comparison, plastic HP, NPK fertilizer, organic fertilizer, and pesticides. Before planting, compost as a dose of 5 ton / ha was incorporated into the soil. Experiment was arranged in a randomized block design (RBD) with 2 treatments and 10 replications. The treatments were tomato grafting and its control (tomato without grafting). The size of plots used was 100 m<sup>2</sup> with a spacing used was 70 × 60 cm. Variables measured were plant height, number of branches, number of flowers per plant and yield per tree. Plant height measurement was done by measuring from the base of the stem to the highest top leaf. Measurements were taken at planting time, 7 DAP (days after planting), 20 DAP, 30 DAP, 40 DAP, 60 DAP, and terminated after first harvest. Data was statistically analysed using analysis of variance (ANOVA). If the treatment results were significantly difference then it was continued with LSD test at 5% [10].

## 3. Results and Discussion

Cultivation of the grafted tomato is done mainly when the tomato plants can not be cultivated during the rainy season on lands that have problems with bacterial wilt. The process of making the tomato grafting was done by connecting or uniting two types of plants / lines where eggplant was used for bottom plant and tomato as the above



**Figure 2:** Position rootstock (eggplant) at the time of planting a tomato plant.

**TABLE 1:** Comparison of plant height, number of branches, bunches of flowers and bunches of grafted and non-grafted tomato plants in the hamlet Penyabangan Payangan Gianyar.

No	Day After Planting	Tomat grafting				Non grafting			
		Height (cm)	No. of branches	flower bunches	fruit bunches	Height (cm)	No. of branches	flower bunches	fruit bunches
1	0	10	0	0	0	14	0	0	0
2	7	15	0	0	0	22	0	0	0
3	20	23	2	1	0	35	2	0	0
4	30	36	2	2	5	57	2	3	9
5	40	68	2	3	6	94	2	5	9
6	60	146	2	4	6	152	2	5	8
7	70	194	2	3	7	218	2	4	8

plant [2]. The bottom plant was then connected to the above tomato plant and tied together (Figure 1).

In planting grafted tomato plants, it is important to note that the position of connection (rod position) should not touch the ground (Figure 2). When this connection is touching the ground the roots will grow from rod position.

The observation of plant height showed a slower growth of tomato grafting compared with the non grafting (Table 1).

The above data shows that the grafted tomato plants in early stage had slower growth than the non grafting tomato, but approaching the generative phase the growth almost equal. The slow growth of tomato grafting in the early stage may be because by the plant was still in the adjustment stage to the environment [2]

TABLE 2: Productivity of grafted and non grafted tomato plants at Penyabangan Kerta village, of Payangan Gianyar subdistrict.

Time Harvest	Tomato grafting(kg/plot)	Tomato non grafting(kg/plot)
1	29.2	30.9
2	35.8	55.7
3	50.1	65.8
4	62.6	77.8
5	79.2	79.9
6	75.7	81.3
7	62.3	79.7
8	40.9	67.9
<b>Total</b>	<b>457.3</b>	<b>575.6</b>
<b>Average / tree</b>	<b>2.54a</b>	<b>3.19b</b>

where in the beginning the grafted plants were maintained in a growth chamber but then transferred to a plastic house.

From this data it appears that the productivity of the grafted tomato plant is lower than that of the non grafted one. Nevertheless, the grafted tomato plant was developed with the main aim to be grown in an area where there is an endemic of phytophthora and root rot. Therefore, this grafting technology is important for off season production (during the rainy season). The lower productivity may be caused by the influence of vegetative growth which was slower in grafted tomato than the non grafted one.

AVRDC [2] reported that the tomato plants with eggplant rootstock require higher soil water content than tomato plants without grafting. Low water content (30-35%) can cause calcium absorption not sufficient and this causes fruit rot. In addition, the high temperatures in the off-season tomato planting can reduce the formation of fruit, fruit weight and yield. In this study, the growing of the grafted tomatoes was conducted in a dry season. Although they were grown in paddy field but the factor of warmer temperatures in there resulted in lower production. The observations also showed that the grafted tomato plants produce longer period of harvest time, approximately 3 weeks longer than the non grafted tomato plants. In planting tomato, the aspect of environment should also be considered as the critical point for increasing the productivity of tomato plant. The high requirement of nutrient during planting (macro and micro elements) will enable the plants to increase its growth and generative phase [11]. High nitrogen levels in particular is required by the grafted tomato to stimulate the growth of vegetative phase [12].

## 4. Conclusion

It can be concluded that the grafted tomato plants produce lower yield compared to the non-grafted ones when they are grown in dry season. The yield the grafted tomato plants was 2.54 kg/tree, whereas the non-grafted was 3.19 kg/tree.

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