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RESEARCH ARTICLE

Study of Growth and Production of Tomato Cultivars In Response to Fruit Thinning at Tamansari, Tasikmalaya, West Java, Indonesia

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Abstract

Tomato is a horticultural crop that is widely cultivated in Indonesia because of its multipurpose uses. The prospect of marketing tomatoes is quite promising for local, national and export markets. The demand of tomato consumption has been increasing, but has not been supported by the availability of quality and quantity production. The area for tomato production has even been decreasing, especially in West Java, Indonesia. One of the causes of the low tomato production in Indonesia is due to the unavailability of superior varieties at the farm level, and very limited information on suitable farming technology. In addition, farmers have difficulty meeting supermarket and export standards because of the mismatch of the quality required by the market and the quality of the products. Efforts that can be made to improve the quality of tomato fruits includes the use superior varieties, and to apply better management of crop production. This study aims to determine the tomato variety which is suitable and high yielding to grow in Tamansari sub-district, Tasikmalaya, West Java, Indonesia, and to understand the effects of thinning fruit on tomato production. The study was carried out from August to November 2018 in Taman Sari, Tasikmalaya City, in a completely randomized design with tomato variety and fruit thinning as the treatments. The study used three tomato cultivars, “Betavila”, “Tymoti”, “Martha”. The levels of fruit thinning tested were 15%, 25%, and without fruit thinning as control. The results demonstrated that the choice of tomato variety and fruit thinning had very significant effects on the yield component of tomato. “Marta” is one of the suitable varieties suggested to be cultivated in the area in Tasikmalaya, and fruit thinning at 25% gave the highest fruit yield.

Keywords: fruit number, fruit size, manipulation, sink, source, vegetable crops

Introduction

Tomato is a horticultural crop that is widely cultivated in Indonesia because of its multipurpose uses including as vegetables, fruits, raw materials for the beauty and health industry. The prospect of marketing tomatoes is quite promising due to the high regional, national and export demands. The average consumption of tomatoes per person per week reached 0.085 kg, making it one of the favorite types of vegetables consumed by Indonesians besides spinach, kale, and long beans. Tomato consumption from year to year continue to increase, but have not supported by the availability of quantity and quality of products. According to Maboko et al. (2011) there are various factors that limits tomato production, including pest attack, adverse climate conditions, and improper cultivation methods.

Tasikmalaya is one of the tomato production centers in West Java. However, the yield of tomatoes in Tasikmalaya is still low (5,342,500 kg) compared to Garut (117,051,300 kg) and Bandung (49,718,800 kg) (BPS West Java, 2016). The low tomato production in Tasikmalaya can be caused by poor technical culture, inefficient and effective pest control, and the use of inappropriate varieties. One of the efforts to increase the yield of tomato production in Tasikmalaya is the use of superior varieties that have high production potential and have resistance to certain diseases to minimize the reduction in tomato production due to pest and disease attacks. Variety choices also have an essential role in getting optimal growth in

particular areas. Therefore, choosing the suitable variety adapted to the specific growing environment needs to be studied.

According to Sora (2018), different tomato varieties have different abilities to adapt to varying types of soil and agroecology. Regassa (2016) also stated that the limited information on adaptation of tomato varieties in a particular area is a limiting factor in increasing tomato production. Therefore, identification and information of varieties suitable for specific areas are crucial so that the targeted production of quality produce can be achieved.

On the other hand, the low quality of fruit produced by farmers causes tomato production had caused inability to compete in the local, national and international market because the flesh of the fruit had became soft after reaching the consumers, the size of the fruit is too small, easy to rot when stored, or the cracked fruit. One of the efforts to improve the quality of tomatoes is by reducing the number of fruit production per plant. Reducing the amount of fruit, or fruit thinning, is an inexpensive and easy cultivation practice that can be done by farmers to improve the quality of tomatoes, such as getting the uniform size of the fruit, has a relatively longer shelf life, and to avoid fruit cracking (Hesami et al., 2012).

Reducing the amount of fruits in plants could balance the carrying capacity of plants so that the size of the fruit produced is more uniform. Reducing the number of fruit per plant is a way to reduce the level of competition for the use of assimilation, while maximizing the storage of assimilates in the desired fruit organs during the generative phase (Johannes et al., 2016). Risda et al. (2017) also reported an increase in the yield component of tomato by fruit thinning.

Information related to fruit thinning is still minimal among farmers, so research related to the effectiveness of fruit thinning need to be conducted. This study aims to determine the suitable tomato varieties to grow in Tasikmalaya area, to study the effects of fruit thinning on tomato yield, and to determine the level (in percentage) of fruit thinning that gives maximum yield with optimal fruit size.

Material and Methods

This research was carried out from August to November 2018 in Taman Sari Subdistrict, Tasikmalaya City, West Java, Indonesia, with elevations ranging from 347-448 m above sea level. The average rainfall was around 302.67 mm per year, temperatures ranged between 18.8 ^{0}C-28.2 ^{0}C, and relative humidity 19% - 26.6%. The study was conducted using a completely randomized design with tomato variety and levels of fruit thinning as treatments. Three tomato cultivars were used, “Betavila”, “Tymoti” and “Martha”. Fruit thinning consists 15%, 25%, and without fruit thinning as control. Fruit thinning was conducted by first counting the total number of tiny fruits formed per plant, then removed 15 or 25% of the fruits using a scissor, at six weeks after planting. Each treatment was repeated three times totalling 27 experimental plots on the field. Data was analyzed using Analysis of Variance (ANOVA); significant effects between treatments were subsequently analyzed using Duncan’s New Multiple Range Test (DNMRT) at a significance level of p=0.05. Growth variable measured include plant height, stem diameter, fruit diameter, fruit thickness, weight per fruit, fruit weight per plant.

Tomato seedlings were transplanted to plant beds at 28 days after sowing with a spacing of 50 x 50 cm. Fertilizers used are NPK Mutiara and foliar fertilizer Gandasil that was applied fortnightly. Harvesting was conducted at nine weeks after planting. Fruit diameter was measured by cutting ripe fruit samples longitudinaly, then measured the diameter using calipers. Plant height was measured from ground level to the growing point. Stem diameter was measured using calipers. The average weight per fruit is obtained from the total weight of the fruit per crop divided by the number of fruits, whereas fruit weight per plant is derived from the total weight of fruit produced by each plant.

Result and Discussion

The tomato varieties tested had similar height at 6 week after planting (Table 1). Even though statistically was not significant, “Marta” showed the highest average height and stem diameter compared to “Tymoti” and “Betavilla” (Table 1).

Geographical location or altitude will affect the growth of tomato plants because in general plant growth is directly related to the environment. “Marta” demonstrates high adaptability so that it can be cultivated in the lowlands to the highlands, whereas “Betavila” and “Tymoti” were suitable for lowland areas. The vegetative growth of the indeterminate type will still occur even though it has entered the generative phase. In contrast, the determinate type has limited growth; vegetative growth will stop the generative phase. “Marta” is one of indeterminate’s hybrid tomatoes, so it had a higher vegetative growth compared to “Betavila” and “Tymoti”, which have

determinate growth types.

Tomato yield of the three tomato cultivars are presented in Table 2; there was no interaction between varieties and percentage of fruit thinning on tomato yield components. “Martha” had the highest average weight per fruit (79.28 g) and fruit weight per plant (261.16 g) compared to “Betavila” and “Tymoti” (Table 2).

Getachew et al. (2019) stated that differences in growth and yield of tomatoes are related to differences in the ecological distribution of tomato varieties. According to Sora (2018), different varieties have different capacities to adapt to different types of soil and agroecological conditions.

In addition to ecological factors, the genetic characteristics of each tomato variety affect yields. Zella et al. (2016) study in cucumber reported that from three local varieties of cucumber, Jember local variety has the highest yield and yield characteristics compared to Blitar and Malang local varieties. Novita et al. (2018) also stated that different varieties of cucumber grown in the same environment might have different yields.

The average fruit weight and fruit yield per plant with different levels of fruit thinning are in Table 3; there was no interaction between tomato variety and percentage of fruit thinning in affecting tomato yield components. Carli et al. (2011) also showed variations in the agronomical analysis of three tomato grown in different environments, and one of the three cultivars had larger fruit diameter compared to the others. The results of the study by Chernet and Zibelo (2014) also demonstrated variability in the diameter of tomatoes from nine varieties planted in the Tigray, Ethiopia.

Based on Table 2 and Table 3, it can be seen that the average weight of fruit and plant fruit weight were higher with fruit thinning treatment compared to without fruit thinning. It was clear that tomato plants that have more per fruits per truss had a reduced size, diameter, and weight of the fruit (Table 2 and 3).

A reduction in the number of fruits by 25% can increase the average weight of the fruit, likely due

Table 1. Plant height and stem diameter of three tomato varieties

Tomato variety	Height (cm)	Stem diameter (mm)	Height (cm)	Stem diameter (mm)	Height (cm)	Stem diameter (mm)
	week 2		week 4		week 6	
“Marta”	31.58	6.23	67.60	9.04	97.78	10.98
“Betavila”	29.28	6.01	64.03	8.98	93.86	11.22
“Tymoti”	26.54	5.64	55.07	8.63	81.80	11.08
	ns	ns	ns	ns	ns	ns

Note: ns = not significant according to the DMRT at α= 5%

Tabel 2. Weight per fruit and fruit weight per plant of three tomato hybrid varieties

Tomato variety	Average fruit weight (g)	Fruit weight per plant (g)
“Marta”	79.28 a	261.16 a
“Betavila”	56.98 b	202.69 b
“Tymoti”	45.58 c	216.80 b

Note: values followed by different letters in one column indicate significant differences with DMRT at α= 5%.

Table 3. Tomato yield with different levels of fruit thinning

Fruit thinning	Weight per fruit (g)	Fruit weight per plant (g)
Without thinning	54.99 b	190.49 c
15%	61.45 b	224.86 b
25%	65.37 a	265.31 a

Note: values followed by different letters in one column indicate significant differences with DMRT at α= 5%

to the increased accumulation of the photosynthates that eventually increase the quality and weight of the fruits (Table 3). Mostafa and Akkad (2011) also reported that fruit thinning on date palms could increase the size, weight, and proportion of fruit flesh while increasing the nutritional content of date fruits compared to without pruning. With fruit pruning, the number of fruits per truss will be limited. This is consistent with the statement of Patel et al. (2014) that by reducing the number of peach fruit per tree, the level of competition for nutrition will be lower among developing fruits, and the availability of photosynthates will increase so that the weight of the fruit will also increase. Adijaya and Yasa (2014) stated that the height/weight of the fruit will depend on the intensity of fruit thinning. Ainzworth and Bush (2011) stated that crop load is an important factor that affect fruit size, therefore removing some of the fruits is the most effective way to improve fruit size compared to without thinning.

Reduction in the number of fruits by 25% increased the total weight of the fruits (Table 3). With 25% fruit thinning, the leaf ratio to the number of fruits will increase, resulting in more optimal fruit growth by decreasing competition between fruits in the fight for assimilation. The more accumulation of assimilates that are distributed to storage organs such as fruit will increase fruit size, fruit diameter, fruit Weights, and quality of fruit. The weight of the 'Servo' tomato can increase to 93.81 g with a reduction in the number of fruits to four per bunch (Risda, 2017).

Fruit thinning of 25% resulted in the highest average fruit diameter (4.77 cm) and fruit thickness (0.82 mm) due to the lower level of competition between fruits (Table 3). With fruit thinning, plants have more space for optimal fruit growth and fruit formation; in addition, translocation, and use of assimilates to storage organs, will also be more efficiently. Similar results were reported in a tropical fruit salak (*Salacca zalacca*); the shape and size of Salak fruit are affected by the availability of nutrients and growing space during fruit development (Nurrochman et al. 2011).

By reducing the number of fruits per stem, the assimilation competition between fruits will be reduced (Johannes et al., 2016). In addition, pruning of parts of plants that are less productive results in more sunlight reaching the plants and promoted a more optimal photosynthesis. With fruit thinning the burden of the plant will be reduced, resulting in a better air circulation and created a better growing environment for the crops, leading to an improved quality and quantity of tomato production.

Other treatments related to flower and fruit depletion have been carried out on a variety of fruits to improve fruit quality (Forshey and Elfving, 1989; Guardiola and Garcia-Luis, 2000). One of them is the chemical thinning of olive fruit in Israel and California to increase fruit size (Krueger et al., 2002; Birger et al., 2008).

Webster and Spencer (2000) stated that to maintain maximum fruit growth and consistent harvest, the fruit load and number of fruits must be balanced with the area of the leaves and trees. A balanced fruit load will protect the tree from branch damage. Besides, according to Deniz and Fatih (2015) adjustment of fruit load per plant needs to be done to meet market demands due to variations in consumer preferences for larger fruit sizes.

This study has demonstrated that tomato "Marta" has higher fruit yield compared to the other two varieties, therefore this variety would be suitable for Tasikmalaya environment.

Conclusion

Tomato "Marta" had the best growth and the highest yield, therefore this variety is suitable for Tasikmalaya environment. Fruit thinning of 25% resulted in the highest yield components including the highest average fruit weight, total fruit weight, and larger fruit diameter.

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