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Growth And Yield Variability Performance In Ten Genotype Of Tomatoes *(Lycopersicum esculentum* Mill)

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Abstract

Efforts Availability of pest-resistant tomatoes, sweet taste, long-lasting fruit, is largely determined by the availability of various genetic sources of tomatoes and breeding methods. This study aims to determine the growth and yield of several tomato genotypes and to determine genotypes that have superior characters as a source of genes for crosses. The research method was a completely randomized design (CRD) with a single factor and three replications. The treatments consisted of 10 F1 hybrid tomato varieties, namely: Servo, Tymoti, Corona, Gustavi, Betavila, Marina, Biromaru, Bareto, Permata, and Ayuni. Observation parameters include: plant height, stem diameter, leaf shape, fruit shape, fruit color and sweetness level. The data obtained were analyzed using the analysis of variance (Anova), then the DMRT test was performed. The results showed that the genotype had a significant effect on plant height 4 and 5 mst. Gustavi tomatoes have a tall character, oval fruit shape. Bareto tomatoes have a high level of sweetness, round fruit shape, so they have high yield potential and are potential sources of genes for high production.

Keywords: Growth, yield, tomato genotype

INTRODUCTION

Tomato plants are horticultural commodities that have economic value and are widely consumed by the public because of their vitamin C content which is very useful in maintaining the body's immune system. Tomatoes contain natural antioxidants, namely lycopene, polyphenols, naringenin, and chlorogenic acid. In addition, tomatoes are low in calories and fat, but rich in carotenoids, lutein, sugar, vitamin A, vitamin C, folate, and potassium. Tomatoes are consumed by the public in the form of fresh fruit, processed foods, and cosmetics

This plant can be widely planted in the lowlands to the highlands (Setiawati et al., 2001 cit Aziz et al., 2017). Based on data from the Central Statistics Agency (2019), tomato production fluctuated by 1,024,949 tons (2016), 1,052,278 tons (2017), 1,079,681 tons (2018) and 1,372,000 tons. This shows that the amount of demand for tomatoes is higher than the amount of production so that consumer needs have not been met. The Covid 19 outbreak that hit Indonesia caused consumer demand to increase for the need for tomatoes. The reason for the decline in tomato production in Indonesia is that there are still at least varieties that have high yields. In addition, the development of high-yielding varieties is only suitable in the highlands.

In order to meet market needs, efforts are needed to increase tomato production. This increase can be done by creating superior varieties obtained from plant breeding. Superior tomato varieties can be assembled through a breeding program. The success of the tomato plant breeding program is largely determined by the availability of various genetic sources of tomatoes and the appropriate breeding methods. Information about genotype and phenotype diversity can be used for the next breeding stage

Tomato plants have a high diversity of fruit characters. The diversity of fruit characters consists of fruit size, fruit shape, fruit color, sweetness content, fruit cavity, and shelf life. Hybrid tomatoes have the advantage of uniform fruit shape and quality and high growth power. Plant traits can be known through the estimation of genetic parameters, so it is useful for determining the direction, methods and targets to be achieved through plant breeding programs

This research is a series of plant breeding activities that begins with collecting several varieties of F1 tomatoes which have various advantages, including pest resistance, large fruit, sweet taste and long lasting. From the results of the growth of several tomato genotypes, it is hoped that

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genotypes that have genetic diversity will be obtained. At least one growth character or yield quality character that has important agronomic characteristics. With a variety of tomato genetic material with different genotypes, it is expected to be a potential genetic source to support the success of plant breeding programs. A study needs to be done that can support the effectiveness of estimating genetic parameters of related tomato plants by comparing the phenotypic appearance of several tomato genotypes. The hypothesis that underlies this research is that there is at least one growth character and or one yield quality character that has high genetic diversity in the tested genotypes.

LITERATURE REVIEW

Tomatoes are annual plants, in the form of shrubs or shrubs with a length of up to 2 m. Taxonomically, tomato plants belong to Class Magnoliophyta, family Solanacea, genus Solanum, species Solanum lycopersicum and dicots (Jones, 2008 cit Purwanti and Khairunisa 2017). Tomato plants can grow well in the highlands (more than 700 m. The ideal temperature and a good effect on the color of tomatoes is between 24 - 28°C which is generally red evenly. Tomatoes can be grown on any type of soil, such as andosol, regosol, latosol, ultisol , and grumusol (Harjadi and Sunarjono, 2016)

qBased on the type of growth, tomato plants are divided into three types, namely: determinate, indeterminate and semideterminate types. The determinate type is characterized by growth ending with the growth of flower or fruit arrangements. Harvest age is relatively shorter and stem growth is fast. Indeterminate type of growth does not end with the growth of flowers and fruit. The harvest age is relatively long and the stem growth is relatively slow. Semideterminate type has characteristics between determinate and indeterminate growth type tomatoes. (Wiryanta, 2002). From the three types of growth, various shapes, colors, flavors and textures of tomatoes were produced

Tomato is a dicotyledonous plant that has a chromosome number of 24. The propagation of tomato plants is generative using seeds, has the characteristics of an autogamous plant or self-pollination. The tomato plant breeding program is aimed at obtaining and developing new varieties that have high yield potential, are resistant to pests and diseases and have good fruit quality according to consumer tastes. Plant breeding for the improvement of quantitative traits is generally carried out in several steps, namely the selection of parents of breeding materials, the formation of the basic population as selection material and the formation of lines as the selection unit (Syukur, 2019)

Tomato hybrids are produced by hand pollination, but pollination on one flower produces many seeds, so it is economically possible to produce hybrid seeds. F1 hybrids were developed based on the presence of hybrid vigor or heterosis symptoms by using the F1 generation plant population as production plants. In more advanced generations, segregation occurs so that the benefits of F1 heterosis are lost (Qosim, 2018)

Efforts to increase tomato productivity are also carried out by assembling superior varieties through plant breeding programs. One method of plant breeding programs that have been carried out is by crossing between tomato plants that have superior characters (Tursilawati *et al*, 2016). In the tomato plant breeding program, diversity greatly affects the agronomic properties and yield quality. Diversity is the difference in the appearance of characters contained in an individual. There are two types of diversity, namely genetic diversity and phenotypic diversity. Genetic diversity is influenced by genetic factors, while phenotypic diversity is influenced by genetic interactions with the environment (Rifda and Respatijarti, 2020). To determine the morphological diversity in a population, it is necessary to characterize plants.

The research of Wahyurini and Lagiman (2020) showed that the cultivation of Servo F1 and F2 tomatoes had high agronomic properties, when planted in soil: compost fertilizer (1:1) and the addition of *trichoderma* sp 40 g/tnm. The results of the research by Sutjahjo *et al* (2015) which tested the genotypic diversity of 30 local tomatoes showed that the variables of plant height, number of leaves, and percentage of live plants, total fruit number, fruit weight, and percentage of fruit breakage, in the tested genotypes showed wide genetic diversity. The genetic diversity of tomatoes is reflected in the various phenotypes of the shape and type of tomato fruit.

RESEARCH METHODOLOGY

The research was conducted at the Wedomartani Experimental Garden Greenhouse, Faculty of Agriculture, UPN "Veteran" Yogyakarta, with an altitude of 400 mdpl. The research started from April to July 2021. The materials used in this study were determinate tomato seeds, namely Servo, Tymoti, Corona, Gustavi, Betavila, Biromaru, Ayuni, Bareto, Marina, and Permata tomatoes. Compost planting media, plantera bag, vegetable pesticides, and furadan. The tools used are tray, drip irrigation system, bucket, stake, sprayer, hoe, ruler, caliper, refragtometer, Munsell color chart, scissors, rope, scales, label paper, and stationery.

The experimental design used was Completely Randomized Design (CRD) with a single factor and three replications. The treatments consisted of 10 F1 hybrid tomato varieties, namely: Servo, Tymoti, Corona, Gustavi, Betavilla, Marina, Permata, Ayuni Bareto, and Biromaru. There are 30 experimental units, each experimental unit 10 plants with 3 sample plants

Harvesting is done at the age of 60-80 HST or the fruit has shown of the red color. Observation parameters include: plant height, stem diameter, leaf shape, fruit shape, fruit color and sweetness content. The results of the quantitative trait observations were analyzed using analysis of variance with the F test at 5% level and if there was a significant difference, the DMRT (Duncan Multiple) test was performed. Range Test). Analysis of variance is used to determine the differences between genotypes in a character (Hastini et. al., 2017

FINDING AND DISCUSSION

Tomato research from 10 genotypes of several F1 hybrid tomato varieties showed different phenotypic performances on plant growth and yield parameters. The results of the analysis of plant height variance showed that several genotypes of tomatoes aged 2 weeks had no significant effect, but at the age of 4 and 6 weeks they had a significant effect on plant height. The data on the average plant height at the age of 2, 4 and 6 weeks can be seen in Table 1.

Table 1. Average plant height at the age of 2, 4 and 6 mst (cm)

Genotip	Plant height 2 mst	Plant height 4 mst	Plant height 6 mst
Servo	20,51 a	71,44 abc	107,11 ab
Tymoti	18,25 a	56,95 e	93,78 de
Corona	19,25 a	63,33 cde	106,22 ab
Gustavi	20,50 a	74,11 a	110,67 ab
Betavila	18,25 a	60,67 de	91,00 e
Marina	19,33 a	73,33 ab	102,566 cd
Permata	22,25 a	64,61 bcde	104,78 bc
Ayuni	21,59 a	65,61 abcd	109,11 ab
Bareto	20,17 a	68,33 abcd	115,22 a
Biromaru	20,67 a	66,61 abcd	104.00 bcd
Average	20,075	66,50	104,44

Note: The numbers in each column followed by the same letter indicate that there is no significant difference according to the DMRT test at 5% level.

Table 1 shows that there was no significant difference in plant height at the age of 2 weeks after planting, but at the age of 4 weeks and 6 weeks there was a significant difference. Tomato varieties Gustavi significantly higher than varieties Tymoti, Corona, Betavila and Permata, but not significantly different from varieties Servo, Ayuni, Bareto and Biromaru at the age of 4 mst. Tomato varieties of Bareto were significantly higher than varieties of Tymoti, Betavila, Marina, Permata, Biromaru, but significantly different from varieties of Servo, Corona, Gustavi, and Ayuni. Plant height in each variety increased at the age of 4 and 6 mst. Each variety has different plant characteristics, but the environment also affects plant height growth. Height growth in plants is related to elongation and cell division events. Height growth occurs within the intercalary meristems of the internodes. The segment lengthens as a result of the increasing number and enlargement of cells (Christy, 2020). In addition, environmental factors can be caused by an increase in environmental temperature during the generative phase or the emergence of flowers. High temperatures cause greater evapotranspiration so that plants become deprived of water and nutrients (Christy, 2020). Green house conditions that are not perfect cause low air humidity, watering through drip irrigation with watering time settings.

The parameters of stem diameter at 2 weeks, 4 weeks and 6 weeks showed that there was no significant difference between plant genotypes (Table 2). This indicated that all the lines had strong stems so that they had the opportunity to produce higher fruit weights. According to Bramasto and Kurniawati (2014) the greater the diameter of the stem, the greater the xylem as a carrier of nutrients and water from the soil, so that the more nutrients and water from the soil, the higher the quantity of photosynthesis which causes an increase in the formation of flowers and fruit.

Table 2. Average stem diameter (DB) at the age of 2, 4, 6 weeks and sweetness level (KK)

Genotip	Stem diameter 2 mst	Stem diameter 4 mst	Stem diameter 6 mst	Sweetness level 10 mst
Servo	5,24 a	9,21 a	9,88 a	6,83 a
Tymoti	4,67 a	9,41 a	10,30 a	5,78 a
Corona	4,63 a	8,34 a	9,18 a	6,17 a
Gustavi	4,86 a	8,46 a	9,36 a	6,67 a
Betavila	5,52 a	9,29 a	10,42 a	5,89 a
Marina	5,34 a	9,17 a	9,89 a	7,06 a
Permata	4,49 a	8,17 a	9,53 a	6,67 a
Ayuni	4,84 a	8,62 a	9,79 a	7,06 a
Bareto	5,42 a	8,79 a	9,80 a	7,50 a
Biromaru	5,32 a	9,13 a	9,89 a	6,80 a
Average	5,03	8,86	9,80	6,64

Note:The numbers in each column followed by the same letter indicate that there is no significant difference according to the DMRT test at 5% level.

One of the quality of fruit is determined by the level of sweetness of the fruit. Tomatoes have a sweetness level that is not significantly different between varieties ranging from 6 to 7 with a sour to sweet taste (Table 2). The sweetness of the fruit was measured using a hard refractometer. Fruit sweetness is controlled by genotype expression and environmental factors

In observing the characteristics of plants, leaf shape, fruit shape and fruit color have different characters. Table 3 shows most of the oval leaf shapes, pointed leaf tips and serrated leaf edges as in the Servo, Tymoti, Gustavi, Ayuni, Bareto and Biromaru varieties. Observations were made on leaves that had fully opened and were located in the center of the plant. In general, the leaves of tomato plants are oval in shape, the edges are jagged and form pinnate crevices that are slightly curved inward. Compound leaves on tomato plants grow alternately or arranged spirally across the stem of the plant (Fitriani,

2012). Classification of tomato leaf shape according to the book International Plant Genetic Resources Institute (IPGRI) (1996) shows that tomato plant leaves can be in the form of dwarf, potato leaf type, standard, peruvianum, pimpinellifolium, and hirsutum.

The fruit shape character (Table 3) shows genetic variation in all varieties, relatively many are round, such as Servo, Tymoti, Corona, Ayuni and Bareto varieties. The oval fruit shape is owned by the Biromaru variety, while Marina has an oval fruit shape. The classification of tomato fruit shapes according to the International Plant Genetic Resources Institute (IPGRI) (1996) that the shape of tomatoes consists of several shapes, flat, slightly flat, round, oval, heart-shaped, cylindrical, pyriform, ellipsoid

Table 3. Characteristics of leaf shape, fruit shape and fruit color.

Genotip	Leaf shape	Fruit shape	Fruit color
Servo	Oval pointed tip and jagged edges	round	4 R 4/10
Tymoti	Oval pointed tip and jagged edges	round	5 R 3/8
Corona	Egg round	round	5 R 3/8
Gustavi	Tapered oval, jagged edges	round heart	5 R 3/8
Betavila	Oval, notched edges	rounded cone	10 R 4/10
Marina	Oval, grooved and fingered	oval	10 R 4/8
Permata	Flat, leaf position	obovoid/bulat dan oval	10 R 4/8
Ayuni	Pointed oval	round	5 R 3/8
Bareto	Pointed oval	round	10 R 4/10
Biromaru	Pointed oval	oval/round heart	10 R 4/10

Noted: Leaf and fruit shape were observed based on plant phenotype; The color of the fruit is observed based on the Munssel Color Chart book

The color character of the fruit was observed in ripe fruit using the Munssel Color Chart book. All colors of tomatoes that have a uniform color, namely red. The color that often appears is R 4/10, namely the Servo, Corona, Betavila, Bareto and Biromaru varieties. The red color of the fruit indicates lycopene or as -carotene. This substance functions as an antioxidant, which is a free antidote that is beneficial for health. Tomatoes synthesize lycopene in large quantities during ripening, which is up to 90% of the total carotenoid fraction. (Novita *et al*, 2015). The diversity of fruit shapes and fruit colors from 10 tomato genotypes can be seen in Figure 1.

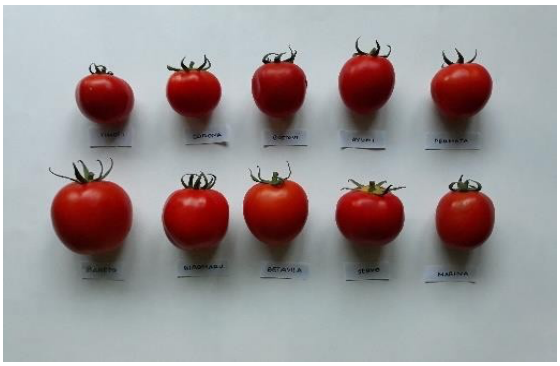

Figure 1. The variety of shapes and colors 10 genotipe tomatoes

CONCLUSION AND FURTHER RESEARCH

Genotype had a significant effect on plant height 4 and 5 mst. Gustavi tomatoes have a tall character, oval fruit shape. Bareto tomatoes have a high level of sweetness, round fruit shape, so they have high yield potential and are potential sources of genes for high production.

Genotypes that have the best results on several characters need further research to calculate high heritability values as selection material in the assembly of superior varieties.

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