

## The Effect of Seed Age and Variety Types on the Growth and Production of Tomato (*Solanum Lycopersicum* L.) Hydroponic Systems

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### ABSTRACT

The research aims to determine the effect of seed age and variety types on the growth and production of tomato plants (*Solanum lycopersicum* L.) with hydroponic systems. This research was conducted with factorial treatment and environmental design Completely Randomized Design (CRD) consisting of 2 factors. Factor I: The age of the seedlings (B) and Factor II. Kinds of varieties (V). The conclusion was that there was an interaction between the age of the seedlings and the variety of varieties in the observation variable for the increase in the number of leaves 28 day in the B2V1 treatment with an average yield of 15.00 leaves.

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## INTRODUCTION

### *Background*

Tomato (*Solanum lycopersicum* L.) was an annual plant in the form of a shrub which is a source of vitamins and minerals, besides being consumed as fresh tomatoes and for cooking seasoning, it is also processed as a raw material for the food industry such as fruit juice and tomato sauce. At this time many farmers use hydroponic farming methods (Wanosowati, 2011). This can be done in the yard of the house, narrow land or office, on campus, or other land. There are many types of hydroponic systems, one of which is drip irrigation hydroponics, also known as the Duck Bucket System, using the principle of a trickle or shower that circulates nutrient solutions to the plant root area so that plants get a continuous supply of nutrient water, saving more water and nutrients because they are given a little little by little (Umarie, 2020). According to (Purwati and Asga, 2011) in (Lanjarwati, 2018) most tomato varieties are only suitable for planting in the highlands, but the Agricultural Research and Development Agency has released tomato varieties for the lowlands, namely Ratna, Berlian, Mutiara and several other varieties. like Diana, Tiara, and Chung. However, it often happens that tomatoes are planted without paying attention to their quality, so the yield and quality of the fruit is very low. Therefore, to meet the increasing demand for tomatoes, research needs to be directed at increasing the yield and quality of tomatoes by planting high-yielding varieties.

The right seed variety and age was one of the determining factors for crop production in soilless cultivation systems. Little is known about suitable varieties and the effect of seedling age on tomato plants; therefore, it is necessary to do research on tomato plant growth at different seedling ages with several varieties. According to Ervina, et. al., (2016), plant growth is assumed to be the number of leaves formed. This can be interpreted that the seedlings can adapt well to their environment and are able to use nutrients, water, and CO<sub>2</sub> for the photosynthesis process, so that more and more leaves are formed.

### *Research purposes*

Knowing the interaction of seedling age and varieties on growth and production of Tomato (*Solanum lycopersicum* L.) hydroponic system

### *Hypothesis*

It was suspected that there was an interaction between the age of the seedlings and the variety of varieties on the growth and production of Tomato (*Solanum lycopersicum* L.) hydroponic systems.

Research by Megawati and Wasito, (2018), the demand for tomatoes tends to increase, in increasing yields it was necessary to use superior seeds and the right dosage of fertilizer, the age of the seedlings was 10 days after planting and cow manure of 10 tons/ha which was good for tomato production. Opinion Ervina, et. al., (2016), that the ability of flowers to form fruit depends on the ability of the female genital organs to receive pollen. The loss of flowers is generally an indication of the inability of the stigma to accommodate pollen grains.

## **THEORETICAL REVIEW**

Tomato (*Solanum lycopersicum* L.) was an annual plant in the form of a shrub which is a source of vitamins and minerals, besides being consumed as fresh tomatoes and for cooking seasoning, it is also processed as a raw material for the food industry such as fruit juice and tomato sauce. At this time many farmers use hydroponic farming methods (Wanosowati, 2011). This can be done in the yard of the house, narrow land or office, on campus, or other land. There are many types of hydroponic systems, one of which is drip irrigation hydroponics, also known as the Duck Bucket System, using the principle of a trickle or shower that circulates nutrient solutions to the plant root area so that plants get a continuous supply of nutrient water, saving more water and nutrients because they are given a little little by little (Umarie, 2020). According to (Purwati and Asga, 2011) in (Lanjarwati, 2018) most tomato varieties are only suitable for planting in the highlands, but the Agricultural Research and Development Agency has released tomato varieties for the lowlands, namely Ratna, Berlian, Mutiara and several other varieties. like Diana, Tiara, and Chung. However, it often happens that tomatoes are planted without paying attention to their quality, so the yield and quality of the fruit is very low. Therefore, to meet the increasing demand for tomatoes, research needs to be directed at increasing the yield and quality of tomatoes by planting high-yielding varieties.

The right seed variety and age was one of the determining factors for crop production in soilless cultivation systems. Little is known about suitable varieties and the effect of seedling age on tomato plants; therefore, it is necessary to do research on tomato plant growth at different seedling ages with several varieties. According to Ervina, et. al., (2016), plant growth is assumed to be the number of leaves formed. This can be interpreted that the seedlings can adapt well to their environment and are able to use nutrients, water, and CO<sub>2</sub> for the photosynthesis process, so that more and more leaves are formed.

## **METHODOLOGY**

The research was conducted at the green house PT. BISI International Tbk. which was located on Jl. Cokroaminoto No. 72A Tulungrejo, Kec. Pare, Kediri, which was held from April 2022 to August 2022. The research materials included various varieties of tomato seeds, water, AB Mix nutrition, labels, wicks, hydro tons, basins, rock wall. The tools used were 1 DBS hydroponic installation, knife, pH meter, ppm meter, tray, spray, meter, digital scale, book, ruler, measuring cup. This study used a completely randomized design (CRD) with 2 factorials. The first factor was the age of the seedlings which consisted of 3 levels and the second factor was the varieties which consisted of 3 levels, so that 9 combinations were obtained which were repeated 3 times. These two factors are: Factor I: Seedling age (B) consists of 3 levels, namely: B1: Seedling age 21 days, B2: Seedling age 28 days, B3: Seedling age 35 days. Factor II: Varieties (V) consisted of 3 levels, namely: V1: Corona 402 variety, V2: Comodor variety, V3 Fortuna 23 variety. Parameters analysed included: plant height, number of leaves, stem diameter, number of fruits, fruit weight. The data obtained from the observations of each variable are entered into the table for the F test with the method of

variance. If the two treatments given show an interaction in the combination treatment, then proceed with the 5% DMRT test. If there is no interaction then proceed with the 5% BNT test in the single treatment.

## RESULTS AND DISCUSSION

### *Plant Height Gain*

The results of the analysis of variance showed that the treatment of seedling age and variety did not interact with the first plant height. However, a single treatment of seedling age showed a very significant effect on the height increase of plants aged 14, 28, 42 day and various varieties showed a significant effect on the increase in plant height of 14 day.

Table 1. The Average Increase in Plant Height

Treatment	Average increase in plant height (cm)		
	14 day	28 day	42 day
Age of seedlings (B)			
B1	11,09a	57,80a	97,43a
B2	13,96a	68,70b	111,26b
B3	23,00b	78,11c	116,52b
<b>BNT 5%</b>	<b>3,65</b>	<b>6,64</b>	<b>6,68</b>
Kinds of varieties (V)			
V1	17,46b	68,06a	107,94a
V2	17,54b	70,39a	109,09a
V3	13,06a	66,17a	108,16a

Based on the data from the analysis of the 5% BNT test in Table 1, it shows that the single treatment of seedling age (B) had a very significant effect on the increase in plant height aged 14, 28, 42 days with the highest average being the B3 treatment and significantly different from the other treatments. Plant height will increase because the roots of the seedlings will be damaged, but due to the breaking of these roots it will stimulate the growth of new roots which are faster after the seedlings are planted in the field. Transferring plants that are too young will slow down their growth, because the seedlings have not been able to cope with unfavourable environmental conditions in the field.

Single treatment V2 (comodor variety) showed a significant effect at 14 days. The comodor variety gave better results than the corona and fortune varieties with the highest average of 17.54 cm. The difference in the appearance of plant height of various varieties is thought to be due to differences in the genetic characteristics of each variety and its environment, thus affecting differences in plant height. This is in accordance with the opinion of Anwar and Kurniawan, (2018) that each individual shows various growth and yields as a result of genetic and environmental influences, where genetic influence is the influence of heredity owned by each variety while environmental influence was the influence caused by habitat and environmental conditions.

### *Increase in Number of Leaves*

The results of the analysis of variance showed that the treatment of the age of the seedlings and the variety of varieties had a very significant interaction with the increase in the number of leaves at the age of 28 days.

Table 2. The Average Increase in Plant Height at the Age Of 28 Days

Treatment	The average increase in the number of leaves (strands)	
	28 day	
Interaction (B.V)		
B1V1	12,66bcd	
B1V2	14,83fg	
B1V3	11,50abc	
B2V1	15,00g	
B2V2	14,33efg	
B2V3	12,83de	
B3V1	20,33h	
B3V2	20,50h	
B3V3	22,00h	

### *Increase in Stem Diameter*

The results of the analysis of variance showed that the age of the seedlings and the variety of varieties did not interact with the increase in stem diameter. However, the single treatment of seedling age showed a very significant effect on the increase in stem diameter at 42 days.

Table 3. The Average Increase in Stem Diameter

Treatment	Average Increase in Stem Diameter (Cm)		
	14 days	28 days	42 days
Age of seedlings (B)			
B1	0,24a	0,24a	0,48a
B2	0,23a	0,23a	0,45a
B3	0,25a	0,21a	0,55b
<b>BNT 5%</b>	<b>0,0351</b>	<b>0,0350</b>	<b>0,0417</b>
Kinds of varieties (V)			
V1	0,23a	0,24a	0,49a
V2	0,24a	0,23a	0,48a
V3	0,25a	0,22a	0,50a

### *Number of Fruits Planted*

The results of the analysis of variance showed that the age of the seedlings and the variety of varieties did not interact with the number of fruits planted. However, the single treatment of seedling age and variety showed a very significant effect on the number of fruit plants.

Table 4. The Average Number of Fruit Plants.

Treatment	The Average Number of Fruit
Age of seedlings (B)	
B1	22,52a
B2	33,33b
B3	30,33b
<b>BNT 5%</b>	<b>6,03</b>
Kinds of varieties (V)	
V1	38,59b
V2	43,14b
V3	14,59a

Based on the data from the analysis of the 5% BNT test in Table 5, it shows that the single treatment of seedling age (B) had a very significant effect on the number of fruit plants with the highest average, namely the treatment of seedling age 28 days after sowing (B2) and was significantly different from other treatments. This agrees with Setyorini, et. al., (2009) stated that transplanting tomato plants 28 days after seedlings had higher plant growth and yields than plants transplanted at 21 days old. The formation of the number of fruits is more influenced by the success of flowers in pollination. The more flowers that are able to pollinate, the more fruit that can be produced.

#### *Planting Fruit Weight*

The results of the analysis of variance showed that the age of the seedlings and the variety of varieties did not interact with the fruit weight of the plants. However, the single treatment of seedling age and variety showed a very significant effect on the weight of the fruit planted.

Table 6. The average fruit weight of the plantations.

Treatment	The Average Fruit Weight (Gr)
Age of seedlings (B)	
B1	919,2a
B2	1294,6b
B3	1221,4b
<b>BNT 5%</b>	<b>263,10</b>
Kinds of varieties (V)	
V1	1334,4b
V2	1481,3b
V3	619,4a

Based on the data from the analysis of the 5% BNT test in Table 6, it shows that the single treatment of seedling age (B) had a very significant effect on fruit weight with the highest average, namely the treatment of seedling age 28 days after sowing (B2) and was significantly different from other treatments. This agrees with Setyorini, et. al., (2009) stated that the age of transplanting tomato plants 28 days after the seedlings had higher plant growth and yields than the

plants transplanted at the age of 21 days. a single type of variety (V) has a very significant effect on fruit weight with the highest average, namely the comodor variety treatment (V2) and is significantly different from other treatments.

Based on the data from the analysis of the 5% BNT test in Table 1, it shows that the single treatment of seedling age (B) had a very significant effect on the increase in plant height aged 14, 28, 42 days with the highest average being the B3 treatment and significantly different from the other treatments. Plant height will increase because the roots of the seedlings will be damaged, but due to the breaking of these roots it will stimulate the growth of new roots which are faster after the seedlings are planted in the field. Transferring plants that were too young will slow down their growth, because the seedlings have not been able to cope with unfavorable environmental conditions in the field.

Single treatment V2 (comodor variety) showed a significant effect at 14 days. The comodor variety gave better results than the corona and fortune varieties with the highest average of 17.54 cm. The difference in the appearance of plant height of various varieties is thought to be due to differences in the genetic characteristics of each variety and its environment, thus affecting differences in plant height. This is in accordance with the opinion of Anwar and Kurniawan, (2018) that each individual shows various growth and yields as a result of genetic and environmental influences, where genetic influence was the influence of heredity owned by each variety while environmental influence was the influence caused by habitat and environmental conditions.

Based on the data from the analysis of the 5% DMRT test in Table 2, it shows that the combination treatment B2V1, B3V1, B3V2, B3V3 showed the same good results, but the B3V3 treatment (seedling age 35 day with corona variety 402) was the best treatment for increasing the number of leaves 28 hst with an average of 20.33 strands. The combination of the treatment of seedling age 28 day and the corona variety 402 is the best treatment for tomato plants with a hydroponic system because it is taken from an early age with the same good results as longevity. This is due to the fact that the age of the tomato seedlings was 28 days, the plants will easily adapt to their environment, so that they were able to encourage better vegetative growth, as seen from the number of leaves that were formed more. The more leaves formed, the more stomata. CO<sub>2</sub> absorption in plants through stomata. CO<sub>2</sub> was needed by plants as a material for photosynthesis. The more stomata on the leaves, the more CO<sub>2</sub> that can be absorbed by the plants.

This can encourage plants to carry out photosynthesis which causes the amount of photosynthate to increase. The more photosynthate, the more it will encourage plants to carry out cell division and development, which will affect the number of leaves produced. This was also because the Corona variety was a semi determinate type of tomato which was characterized by faster development of productive branches. This was in accordance with the statement of Lukistasari et al., (2017) which states that the Corona 402 variety was a variety that has a semi determinate type or had the characteristic of plant stem growth ending with flower or fruit arrangements, the harvest period is relatively short and the plants were tall and the nutrients absorbed are used for generative growth while the

indeterminate type where the vegetative phase continues to grow even though it has entered the generative period. This causes the nutrients absorbed by plants to be used more for vegetative growth such as branches and leaves.

Based on the data from the analysis of the 5% BNT test in Table 4, it shows that the single treatment of seedling age (B) had a very significant effect on the increase in stem diameter at 42 days with the highest average being the B3 treatment and significantly different from the other treatments. Effect of seedling age on stem diameter at 42 days. Plants that have just been transferred need time to recover due to the transfer so that the roots have not actively absorbed nutrients for growth because the tomato seedlings aged 35 hss have adapted to the environment and have such a root system that the roots have functioned in absorbing hydroponic media. This agrees with Wasonowati, (2009) Age of 35-day seedlings increases the height of tomato plants. This was caused because the age of the seed affects the process of photosynthesis and absorption of nutrients by plant roots. New plants also need time to recover due to removal so that the roots have not actively absorbed nutrients. At the age of 35 days seedlings the plants are able to carry out photosynthesis optimally because they have a greater number and width of leaves than seedlings aged 21 day and 28 days, besides that the number of roots at the age of 35 days seedlings is more so that they can absorb nutrients optimally and grow faster.

Table 5 shows that each single treatment variety (V) had a significant effect on the number of fruit plants with the highest average single treatment V2 (comodor variety) with an average of 43.14 fruits. Corona and Comodor varieties were determinate types while Fortuna 23 was semi determinate type. Tomatoes with the semi determinate type have lower production compared to the determinate type, this is because the nutrients absorbed by plants are more widely used for vegetative growth such as branches and leaves (Wijayanti and Susila 2013). This agrees with (Kusumayati et al., 2015) that all the genotypes tested and the control varieties are determinate. In determinate plants, the fruit produced is more than the semi determinate growing type because the nutrients absorbed by the tomato plants with the semi determinate growing type are allocated to carry out vegetative growth such as leaves and branches so that it will affect plant productivity.

On the variable fruit weight per plant, the comodor variety produced more fruit than the corona and fortune varieties. These results are in accordance with Sulichantini's opinion. (2015) that if several varieties of plants with different potential are developed on land with the same fertility level and the same cultivation techniques, there will be differences in the growth and production produced. Different varieties have different genetic makeup so that the potential produced will also be different. Genetic differences in these plants cause differences in the formation of enzymes as catalysts for plant metabolic processes.

## CONCLUSIONS AND RECOMMENDATIONS

### *Conclusions*

Based on the results of the research that has been done, it can be concluded that:

1. There was a real interaction in the parameter of the increase in the number of leaves 28 day in the B2V1 treatment with an average yield of 15.00 strands.
2. The single treatment of seedling age 35 hss (B3) had a very significant effect on the parameter of plant height increase, an increase in the number of leaves of 14.42 hst and an increase in stem diameter of 42 day.
3. The single treatment of seedling age 28 day (B2) had a very significant effect on the number of fruits planted and the weight of the fruit planted.
4. The single treatment V2 (comodor variety) had a significant effect on the increase in plant height by 14 days, the increase in the number of leaves by 42 days, the number of fruits planted and the weight of the fruit planted.

### *Recommendations*

1. In hydroponic tomato cultivation, it is recommended to use the 28 days seedling treatment with the comodor 402 variety for optimal results.
2. It is necessary to carry out further research with various ages of seedlings and varieties on the growth and production of hydroponic tomato plants.

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