

The Effect of Agricultural Waste Composting on Vegetative and Generative Growth of Tomato Plants

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Abstract:- Tomatoes are horticultural crops that are in great demand by the public besides being rich in vitamins and minerals, tomatoes can also be used as a complement to a dish. The success of tomato cultivation is greatly influenced by cultivation techniques in increasing growth and production. For this reason, cultivation techniques are needed to increase growth by using organic fertilizer, namely compost. Where compost is the best soil improving material because it can improve the condition of dense soil to loose, besides that it can also improve the structure, pores and drainage of the soil. Compost is an environmentally friendly fertilizer and does not cause side effects. **Research objectives:** 1) measure the growth of tomato plants with various compost treatments on vegetative and generative growth, and 2) find out the best dose of compost for tomato plant growth. This study used a complete randomized design (RAL) with 4 planting media treatments, namely P0 (control / no compost treatment), P1 (25% compost + 75% mineral soil), P2 (50% compost + 50% mineral soil) and P3 (75% compost + 25% mineral soil).

The results showed that: 1) composting both P1, P2, and P3 treatments had a significantly different effect on vegetative and generative growth in the 1st month measurement but for the 2nd month there was no real difference for plant height increase and stem diameter increase, while significantly different in leaf number increase, and 2) the best compost dose for tomato plant growth was P2 treatment (ratio of 50% compost + 50% mineral soil) with an increase in plant height (1 month = 36.9 cm and 2 months = 26.35 cm), number of leaves (1 month = 10.7 leaves and 2 months = 4,038 leaves), stem diameter (1 month = 2,781 mm and 2 months = 4,038 mm), number of fruits 11 pieces and fruit weight 88 grams.

I. INTRODUCTION

Tomato cultivation carried out by the community in general uses inorganic fertilizers because it can increase rapid production but has risks or side effects that can reduce the plant's products and make the soil structure hard (Friska & Nasution, 2020). For this reason, public awareness is needed of the dangers and negative impacts caused by the use of chemicals in agriculture. People are increasingly wise to choose food that is safe for health and environmentally friendly. A healthy lifestyle "back to nature" needs to be encouraged to reduce unhealthy lifestyles and reduce the use

of inorganic fertilizers and other chemicals to switch to using natural fertilizers, namely compost known as organic farming (Anonymous, 2022).

Compost is an organic fertilizer that can be made with garbage or waste raw materials. Compost contains organic matter that is rich in nutrients, both macro and micro nutrients that can improve and fertilize the soil (Kartika, 2021). Agricultural land if given compost, soil health will be maintained and can increase fertility and plant growth. Agricultural waste is organic waste resulting from agricultural processes that are rich in nutrients and have not been utilized optimally. If allowed to accumulate without further treatment, it will cause new problems, namely environmental pollution, the appearance of unpleasant odors and causing diseases caused by rats, flies and cockroaches (Lina & Patty, 2021).

The handling of agricultural waste has been limited to burning and disposing of it to the final waste collection site, namely TPS, for that there needs to be an appropriate solution in overcoming the problem, namely by making compost. This composting is one form of supporting the concept of sustainable agriculture by utilizing natural materials such as waste that is not used as the main material for making compost.

Compost has the advantage of adding nutrients in the soil, improving soil structure and permeability and helping the movement of microorganisms in the soil which are useful for increasing plant growth and production. Composting has a real influence on vegetative and generative growth of plants, sweet corn plants can increase the appearance of male flowers and female flowers, cob length and number of seeds (Prasetyo, et al., 2014).. Application of some organic fertilizers on caisim plants (*Brassica campestris* var. *chinensis* L) can also increase plant growth both wet weight, width, height and leaf length (Abuyamin, 2016).

Likewise, Rahmi, (2016) explained that the application of manure and compost can increase the growth of kale and catfish dumbo in the aquaponics system. Based on this description, research was conducted on the effect of agricultural waste compost on vegetative and generative growth of tomato plants. From the results of this study, it is expected to provide input and benefits for tomato plant lovers to carry out cultivation techniques by utilizing agricultural waste to be composted as natural fertilizer and rich in nutrients.

➤ *Problems*

- Overcoming the environmental impact of conventional agriculture with solutions utilizing agricultural waste as compost.
- Utilizing agricultural waste into useful products, namely compost.
- Increase vegetative and generative growth of tomato plants with the addition of compost.

➤ *Special Purpose*

- Know the growth response of tomato plants to compost by observing the vegetative and generative growth of plants
- Know the best dose of compost for tomato plant growth

➤ *The Urgency Of Research*

Provide information to the community that the concept of organic farming can be applied among farmers by utilizing agricultural waste to be composted to increase soil and plant fertility and overcome the problem of fertilizer scarcity.

➤ *Special Specifications*

Getting compost formula from agricultural waste as organic fertilizer that can increase soil and plant fertility.

II. RESEARCH METHODS

A. *Time and Location*

The study began on June 1 to October 30, 2023 which included preparation of tools and materials, composting, analysis of compost nutrient content and application of compost with tomato plant tests.

B. *Tools and Materials*

The tools used are hoes, ajir, raffia ropes, hand sprayers, meters, buckets, drills, polybags, scales, and stationery. The materials used are tomato seeds, and compost.

C. *Research Design*

The design used is Random Design Lengkap (RAL) which consists of 4 planting media treatments, namely P0 (control / without compost treatment), P1 (giving 25% compost + 75% mineral soil), P2 (giving 50% compost + 50% mineral soil) and P3 (giving 75% compost + 25% mineral soil). Then all treatments were repeated 10 times.

D. *Research Procedure*

➤ *Compost*

- *Raw Material: Agricultural waste is minced using a machete*
- *MOL activator from fish bones with a ratio of MOL as much as 1 liter and 15 liters of water dissolved and added sugar as much as 150 gram.*

• *How It Works:*

Agricultural waste plus MOL activator is then stirred until evenly distributed and given water that has been mixed with activator until the water is 30%. What is the sign if the mixture of ingredients in the grip of the material coagulates and the water tests and if the fist is opened then the ingredients still clump, then the dough is piled on the floor and given a lid to be protected. In order for the quality of the compost produced to remain good, the compost pile must be protected from direct sunlight and huja.

• *Compost Parameters*

To get good compost quality, it is necessary to observe the composting process every day such as humidity, shape, smell, temperature and color until the compost dough is said to be finished.

➤ *Chemical Analysis*

Conducting nutrient analysis on compost includes: C/N ratio, N, pH, P, and K. Then a tabularis i tableis made.

➤ *Breeding*

Tomatoes are seeded first before transplanting into large polybags, with a duration of 1 month.

➤ *Planting*

Planting is done by putting seedling tomato seeds into polybags that have been filled with treatment and then watered with enough water. The location of the polybag is based on the research design.

➤ *Maintenance*

Maintenance includes manual watering and weed control which aims to maintain the moisture condition of the growing medium and plants avoid weeds.

➤ *Plant Observation Parameters*

The parameters observed include vegetative growth of plants observed 1 month and 2 months after transplanting as well as generative growth i.e. number of fruits and fruit weight.

III. RESULTS AND DISCUSSION

A. *Composting*

In the study, the time needed until the compost is mature / finished is around 37 days because the compost material comes from agricultural waste which is rather difficult to rot so that the composting process runs quickly. In the opinion of Rahman & Ngapiyatun (2021) that the different types of materials used to make compost can affect sooner or later the composting process takes place, where the harder and thicker a material is, the slower the decomposition process so that the compost will take longer. Conversely, if the raw materials are easily weathered, the compost will be finished faster.

The compost from the finished research was then analyzed for the nutrient content of the compost which included: C/N ratio, N, pH, P, and K, and compared with the Ministry of Agriculture standards.

Table 1 Nutrient Content of Compost

Parameters	Permentan Standard 261/KPTS/SR.310/M/4/2019	Compost Research Results	Information
pH H ₂ O	4-9	7,01	Meet standards
C-Organic (%)	Minimum 15	46,5238	Meet standards
C/N ratio	≤25	66,6221	Not yet up to standard
N (%)	Minimum 2	0,6983	Not yet up to standard
P (%)	Minimum 2	0,1133	Not yet up to standard
K (%)	Minimum 2	0,8357	Not yet up to standard

The nutrient content of compost from research results when compared with Ministry of Agriculture standards. Showing that the pH of H₂O and C-organic has met the standards, while for the content of C/N ratios, P, K and N has not met the standards for compost, it is suspected that the material used to make compost comes from agricultural waste which contains a lot of organic matter and nutrients so that the compost produced has a high pH. According to Nisa, (201: 6) that in decomposition activities of organic matter to become compost, there are several changes in nature, one of which is a change in the pH of the material used because there is a process of releasing acid from raw materials temporarily, and this will cause the pH to drop, as well as the production of ammonia from compounds containing N can increase pH at the beginning of composting. According to Zairinayati & Garmini (2021), microorganisms formed by MOL can decompose or break down coarse organic matter into small or fine into new structures that will be converted into nitrates.

MOL can be utilized to help the composting process, so composting does not take so much time. This is in accordance with the opinion of Zairinayati & Garmini (2021) stating that MOL is able to accelerate the process of decomposing organic compounds so that compost is faster and the nutrient content of compost can be more quickly utilized by soil and plants.

The degradation process of material into compost by microorganisms of the genus *Bacillus* occurs in the early phase of the composting process, where these microorganisms decompose organic components that are difficult to decompose such as cellulose and hemicellulose, improving the microenvironment and creating conditions for the community of microorganisms to gather, in the middle phase of the composting process of microorganisms of the genus *Bacillus* inactive and reactive in the final phase of the composting process (Zhou, et al., 2020). Research by Moreira et al., (2020) states that soil containing microorganisms of the genus *Bacillus* based on the results of physical and chemical tests of soil has nutrient content values such as Phosphat, Calcium, and Magnesium as well as organic matter in the soil better than without these microorganisms.

The C-Organic content of compost from the study is 46.5238, this value meets the standards of the Ministry of Agriculture. This indicates that organic matter as a source of microorganism energy is available sufficiently so that it can accelerate the process of cell multiplication and metabolism of microorganisms. According to Baroroh, (2015) that C-organic elements are elements that are needed by bacteria in supporting metabolic activities and trigger materials for cell formation and multiplication.

The C/N ratio relates to the quality and maturity of the compost. The compost from the study has a C/N ratio of 66.6221 and this has not met the Ministry of Agriculture's standards. This high C/N ratio indicates that if the compost produced is not fully mature so that if the compost is applied to the soil, plants cannot utilize these nutrients because the compost continues to undergo further decomposition processes until the compost is fully mature and can be absorbed by plant roots used for plant growth (Nurman, et al., 2019). During the composting process, decomposition of organic matter occurs, so that the CO₂ content decreases because it is released and the N element does not, this causes the C/N ratio to decrease. A low C/N ratio (close to the C/N ratio of soil) indicates that the compost produced is fully mature because the lower the C/N ratio means that the compost has decomposed completely and has become and vice versa (Mulati, et al., 2020).

From the results of compost research, it was obtained that the values of N, P, and K did not meet the standards, this is because the compost is not fully mature so that the nutrients have not been completely decomposed in addition to the raw materials used for agricultural waste which have complete nutrient content but low composition. According to Hadi (2019), the provision of raw materials from various sources with different concentrations will cause differences in nutrient levels both macro and micro contained by compost. This is also influenced by the fineness of the media in enumeration, as well as the reversal of the compost which is not optimal so that it has a real effect on the nutrient content of the compost (Arifin, et al., 2020).

Compost when applied to the soil will increase the availability of nutrients, although the composition is small but complete (Satwika, et al., 2021).

B. Vegetative and generative growth

➤ Vegetative Growth

Composting according to the treatment of tomato plants on the vegetative growth of tomato plants can be seen in the following table.

Table 2 Data on Vegetative Growth Increase of Tomato Plants (HST)

Treatment	Plant Height (cm)		Number of Leaves (strands)		Rod Diameter (mm)	
	1 Month	2 Months	1 Month	2 Months	1 Month	2 Months
P0	29.76 ^a	18.55 ^a	5.6 ^a	3.24 ^{AB}	3,159 ^b	3.24 ^a
P1	34.15 ^b	21.76 ^A	6.8 ^a	3,074 ^a	3,778 ^b	3,074 ^a
P2	36.9 ^b	26.35 ^A	10.7 ^{AB}	4,038 ^b	2,781 ^a	4,038 ^a
P3	36.62 ^b	26.85 ^a	10.7 ^{AB}	3,313 ^{AB}	3,749 ^b	3,313 ^a

Remarks : - P0 (control / without compost treatment), P1 (25% compost + 75% mineral soil), P2 (50% compost + 50% mineral soil) and P3 (75% compost + 25% mineral soil).

- Numbers followed by the same letter mean no real difference.

Based on table 2 above, it can be seen that the increase in height, number of leaves and diameter for measurements 1 and 2 months after planting based on fingerprints there is a real difference between P0 treatment and P1, P2 and P3 treatment. This difference is due to the P0 treatment, the planting medium used is purely marginal soil without the addition of compost as fertilizer so that plants only rely on nutrients contained in the soil, which is known that marginal soil has a low nutrient content, so it will affect plant growth, especially plant height, number of leaves and stem diameter. According to Pijar (2018) that the end of the wet weight of tomatoes on media without compost application is caused by the less than optimal availability of various nutrients on agricultural land. Meanwhile, the provision of bokasi (compost) causes the availability of nutrients, especially sulfates and nitrates derived from the results of raining

livestock manure which is processed into compost. In addition, composting on agricultural land can fertilize the soil, improve pores, soil structure, and the soil becomes loose and healthy (Raksun, 2018).

In the measurement of the 2nd month after planting, there is a lower growth increase than in the measurement of the 1st month after planting because at the age of 2 months after planting it enters the transition from vegetative to sexual growth so that vegetative growth decreases.

➤ Generative Growth

The generative growth of tomato plants which includes the number and weight of fruits is shown in the following table.

Table 3 Plant Generative Growth Increase Data

Treatment	Number of Fruits (fruits)	Fruit Weight (grams)
P0	3.4 ^a	27.2 ^A
P1	7.5 ^b	60 ^b
P2	11 ^c	88 ^c
P3	7.5 ^b	60 ^b

Remarks : - P0 (control / without compost treatment), P1 (25% compost + 75% mineral soil), P2 (50% compost + 50% mineral soil) and P3 (75% compost + 25% mineral soil).

- Numbers followed by the same letter mean no real difference.

C. Number of Fruits

The fruit count parameter shows a significant effect between P0 and other compost treatments, namely P1, P2, and P3. The highest average value at P2 was 11 pieces and the lowest was found at P0 at 3.4 pieces. There is a difference in the number of fruits between the control treatment and other treatments due to the addition of compost to tomato plants as fertilizer so as to increase nutrient content and increase plant generative growth, especially fruit formation. According to Kartika (2021) that soil organic matter (compost) not only affects the N content and alkaline, but also affects the strength of the soil in holding and releasing nutrients such as cations.

According to Amaliah, et al., (2020) that the benefits of applying compost to the soil include: 1) improving soil

conditions, namely soil aggregate, permeability, soil aeration, groundwater retention power, reducing soil erosion, soil does not move and crack during drought, 2) improving chemical properties, namely CEC, soil buffer, suppressing poisoning, fertilization efficiency, adding soil nutrients, forming chelates increase micronutrients, and 3) improve the energy sources of microorganisms. Phosphorus includes macronutrients that are very important for the generative growth of plants, namely fruit formation. Soil that is given compost, the soil will be fertile so that it can stimulate the formation of fruit on plants. Phosphorus contained in organic fertilizers also plays a role for plants in the process of preparing nucleic acids, respiration and photosynthesis as well as producing fruits. Phosphorus can also stimulate root development so that plants can withstand drought and can speed up the harvest period.

The results showed that different doses of compost would also affect the amount of fruit produced.

D. Fruit Weight

Composting affects the weight of the fruit. The highest average was found in the P2 treatment which was 88 grams and the lowest was found in the P0 treatment or without compost which was 27.22 grams and the lowest average was found in the control (P0). This difference is caused because the addition of compost can increase the nutrient content in the soil so that environmental conditions affect the process of fruit formation. According to Anonymous, (2022), a plant has the ability to provide good results if the environmental conditions are in accordance with what the plant wants, one of which is nutrients, and vice versa if the environment is not suitable, the plant cannot show its potential yield.

Control no composting showed a marked difference from the composting treatment. The highest average was found in P2 treatment, which was 88 pieces and the lowest was 27.2 pieces. This is thought to be due to the P0 treatment that there is no compost so that the growth of tomato plants nutrients are only obtained from media soil, namely marginal soil with low nutrient content so that it affects the weight of the fruit produced. This is according to Hermiati (2000), stating that each plant has different abilities in the process of growth and maintaining life because it is influenced by climatic and genetic factors of a plant so that the ability to grow plants varies.

IV. CONCLUSION

- Composting both P1, P2, and P3 treatments had a significantly different effect on vegetative and generative growth at the 1st month measurement after planting but for the 2nd month there was no real difference for height gain and stem diameter increase, and significantly different in the number of leaves.
- The best dose of compost for tomato plant growth is P2 treatment (ratio of 50% compost and 50% mineral soil) with increased plant height (1 month = 36.9 cm and 2 months = 26.35 cm), number of leaves (1 month = 10.7 leaves and 2 months = 4,038 leaves), stem diameter (1 month = 2,781 mm and 2 months = 4,038 mm), number of fruits 11 pieces and fruit weight 88 grams.

SUGGESTION

Further research is needed related to the dosage and variation of compost raw materials and test plants so that compost with high nutrient content is obtained in accordance with the standards of Permentan 261 / KPTS / SR.310 / M / 4/2019.

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