RESPONSE GROWTH AND YIELD OF GUSTAVI VARIETY TOMATO (*Solanum Lycopersicum* Mill) GUSTAVI VARIETY TO COW MANURE VERMICOMPOST AND NASA LIQUID ORGANIC FERTILIZER

ABSTRACT

Tomatoes (*Lycopersicum esculentum* Mill.) have quite high economic value. This can be seen in its advantages in fulfilling several important life functions. These functions include economic needs, health functions, and aesthetic functions. Apart from that, tomatoes also have the advantage of their distribution range. This plant can grow in tropical to sub-tropical areas without having to depend on the growing season. The market demand for tomatoes continues to increase, this cannot be separated from the role of tomatoes as an important horticultural commodity, especially as a vegetable crop. The research aimed to determine the response of growth and yield of tomato plants to the application of ~~vermicomos~~vermicompost and NASA POC and their interactions; and to obtain ~~vermicomos~~vermicompost doses and Nasa POC concentrations that are suitable for the growth and yield of tomato plants. The research was carried out from August 2022 to December 2022 in the Organic Rice Cluster area, Karang Anyar Village, Tanjung Palas District, Bulungan Regency, North Kalimantan Province, Indonesia. The research used a 4 x 3 Factorial Experiment in a Completely Randomized Design (CRD), with 5 replications. The first factor is the dose of vermicompost (V) consisting of 4 levels, namely: without vermicompost (v0), 450 g polybag^{-1} (v1), 900 g polybag^{-1} (v2), 1350 g polybag^{-1} (v3). The second factor is the NASA POC concentration (P) consisting of 3 levels, namely: without Nasa POC (p0), 1 ml l^{-1} water (p1), and 2.5 ml l^{-1} water (p2). The results showed that the response to plant height aged 14 and 21 days after planting, plant age at flowering, plant age at harvest, number of fruit per plant, weight of 1 fruit, and weight of fruit per plant were not significantly different from the application of vermicompost, Nasa POC and their interactions, except for the response The height of plants aged 28 days was very significantly different from the application of chicken manure vermicompost. The highest fruit weight per plant was produced in the treatment of 900 g polybag^{-1} vermicompost and 1 ml l^{-1} Nasa POC water.

Keywords: Vermicompost, Nasa POC, Tomato

I. INTRODUCTION

Tomato (*Solanum lycopersicum* L.) is a type of dual vegetable seasonal, which grows very quickly, namely 60-70 days after planting, so that in a relatively short time it can produce fruit. Many farmers cultivate this plant both in the lowlands and highlands because it has good prospects for being cultivated in fresh or fruit form. processed [1].

Tomatoes are a plant that provides many benefits for humans, the fruit can be consumed directly or made into various food preparations, and can also be an additional ingredient in beauty products. The many benefits of tomatoes make the demand for tomatoes continue to increase so that there is a great opportunity to increase income for farmers [2].

Soil types in the mainland area of East Kalimantan are dominated by Ultisols which are spread across the Central and Northern parts of East Kalimantan, in East Kalimantan the distribution of Ultisols is around 10.04 million ha or around 80% of the land area of East Kalimantan [3], the large area of Ultisols land could be an opportunity to use it as land for cultivating tomato plants. As fertile land decreases and demand for tomatoes increases, ultisol soil can be a solution for expanding cultivated land by improving land conditions appropriately. According to [4] Ultisol used as cultivation land is faced with very acidic conditions, and low nutrient and C-organic content. Therefore, effective ways are needed to increase soil fertility that are oriented towards a sustainable agricultural system through the application of organic fertilizer.

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Compost is an important organic fertilizer for plants, its use is increasingly being encouraged because it has three benefits, namely: benefits for the environment, soil, and plants, apart from that, compost is very helpful in solving environmental problems. For soil, compost can provide or add nutrients improve soil structure and texture, and store water. Vermicompost is an organic fertilizer made from the breakdown of organic materials with the help of microorganisms and earthworms. In the process of decomposition of compost material by earthworms, the decomposition results contain various nutrients and are rich in growth regulators that support plant growth. According to [5] vermicompost contains growth regulators such as gibberellin, cytokinin, and auxin, as well as the nutrients N, P, K, Mg, and Ca and *Azotobacter* sp. which is a non-symbiotic N-fixing bacteria that will help enrich the N elements needed by plants. Vermicompost also contains various micronutrients needed by plants such as Fe, Mn, Cu, Zn, Bo, and Mo [6].

Apart from providing vermicompost, to improve the growth and yield of tomato plants, you can also provide Liquid Organic Fertilizer (POC). Nasa POC is a fertilizer produced from natural ingredients such as animal protein, animal bones, and plant materials, resulting in a mixture of nutrients that are easily absorbed by plants and can improve land conditions. The element content in Nasa POC liquid organic fertilizer is N 4.15%, P2O5 4.45%, K2O 5.66%, C organic 9.69%, Fe 505.5 ppm, Mn 1931.1%, Cu 1179.8%, Zn 1986.1%, B 806.6%, Co 8.4 ppm, Mo 2.3 ppm, La 0 ppm, Ce 0 ppm, pH 5.61 [7].

The research aimed to determine the response of growth and yield of tomato plants to the application of vermicompost and Nasa POC and their interactions; and to obtain vermicomos doses and Nasa POC concentrations that are suitable for the growth and yield of tomato plants.

2. RESEARCH METHODOLOGY

2.1 Time and Place of Research

The research was carried out from May to October 2022 at the Organic Rice Cluster Farm, Karang Anyar Village, Tanjung Palas District, Bulungan Regency, East Kalimantan Province, Indonesia.

2.2 Materials and Tools

The materials used are topsoil, tomato seeds of the Gustavi variety, cow dung vermicompost, earthworms, Nasa POC, and natural pesticides to control plant pest organisms. The equipment used is a polybag measuring 40x40cm, a hoe, soil sieve, rubber gloves, hand-sprayer, seedling tray, plant scissors, rope or wood, paranet, label board, stationery, meter, and a digital scale.

2.3 Research Design

The research used a 4 x 3 Factorial Experiment in a Completely Randomized Design (CRD) with 5 replications. The first factor is the dose of vermicompost (V) consisting of 4 levels, namely: without vermicompost (v0), 450 g polybag^{-1} (v1), 900g polybag^{-1} (v2), 1350g polybag^{-1} (v3). The second factor is the NASA POC concentration (P) consisting of 3 levels, namely: without Nasa POC (p0), 1 ml l^{-1} water (p1), and 2.5 ml l^{-1} water (p2). Each 4x3 treatment combination was repeated 5 times, so there were 60 research units.

2.4 Research Activities

The research activities carried out were: preparation of planting media, sowing seeds, planting, giving vermicompost, giving Nasa POC, plant maintenance (watering, replanting, installing stakes, hilling, pest and disease control), and harvesting.

The application of vermicompost to each polybag is adjusted to the treatment dose (v0, v1, v2, and v3), given in stages, namely at the time of planting, the plants are 21 and 42 days after planting. The provision of Nasa POC in each polybag was adjusted to the treatment concentration (p0, p1, and p2) at 21, 35, 49, and 63 days after planting.

Harvesting tomatoes is done with the following characteristics: the green skin of the fruit changes to yellowish yellow, the edges of the old leaves dry out, the stems turn yellow, and the fruit is ready to be harvested. Harvesting is carried out in 5 stages at 1 week intervals.

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2.5 Observation Parameters

Data collected were plant height aged 14, 21, and 28 days after planting, age when the first flowers appeared, age at first harvest, number of fruit per plant, weight of 1 fruit, and weight of fruit per plant.

2.6 Data Analysis

To determine the effect of vermicompost and Nasa POC treatment and their interactions, an analysis of variance was carried out, if the results of the analysis of variance were significantly different (F count > F-table 5%) or very significantly different (F count > F-table 1%), then to compare The two treatment averages were further tested with the smallest significant difference test at the 5% level [8].

3. RESULTS AND DISCUSSION

3.1. Cow Manure Vermicompost

The results of variance analysis showed that the response to plant height aged 14 and 21 days after planting, plant age at flowering, plant age at harvest, number of fruit per plant, weight of 1 fruit, and weight of fruit per plant were not significantly different, except for the response to plant height at 28 days old which was different. very real regarding the provision of chicken manure vermicompost. The research results are presented in Table 1.

Table 1. Average Growth and Yield of Tomato Plants on Various Doses of Cow Manure Vermicompost

Vermicompost Treatments	Plant height (cm)			Plant age at flowering (DAP)	plant age at harvest (DAP)	Number of fruit per plant (fruit)	Weight of 1 fruit (g)	Weight of fruit per plant (g)
	14 DAP	21 DAP	28 DAP					
Anova Ragam	ns	ns	**	ns	ns	ns	ns	ns
0 g polybag^{-1} (v0)	30,74	63,66	88,97 d	33,70	83,30	29,00	108,09	608,90
450 g polybag^{-1} (v1)	32,43	67,94	92,25 c	34,60	84,70	20,67	122,37	466,84
900 g polybag^{-1} (v2)	32,46	69,87	99,26 b	32,30	83,60	34,33	122,66	740,03
1350 g polybag^{-1} (v3)	34,47	72,44	104,36 a	32,20	82,50	31,67	100,32	634,85

Source: Processed Research Data (2023).

Note: ns = not significantly different; ** = very significantly different, and DAP = days after planting

Based on the data in Table 1, shows that the administration of various doses of cow dung vermicompost (v1, v2, and v3) resulted in taller tomato plants, faster plant age at flowering and harvest, greater number of fruit, and higher weight of 1 fruit. fruit size and weight per plant were higher compared to the treatment without cow dung vermicompost (v0). This is because organic fertilizers such as cow dung vermicompost can improve soil properties. As stated by [9], vermicompost has direct and indirect effects on plants, among other things, it can improve the physical properties of the soil and provide the nutrients needed by plants. The use of vermicompost in plant cultivation systems has been proven to reduce the use of mineral fertilizers. [10] stated that the provision of vermicompost can influence increased plant growth and yield. The results of the research reported by [11] show that the application of vermicompost can improve the growth and yield of tomato plants, this is related to the greater uptake of P, K, Fe, and Zn nutrients. The results of other research reported by [12] stated that the best treatment was 100% solid vermicompost treatment with a dose of 600 g polybag^{-1} with an average total fruit weight of

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447.22 g plant^{-1}. The optimum dose for the 100% solid vermicompost application method was 709.50 g plant^{-1} and the maximum yield was 494.70 g plant^{-1}.

The results of the research also showed that treatment of vermicompost at a dose of 900 g polybag^{-1} (v2) tended to produce the highest number of fruit per plant (34.33), the largest weight of 1 fruit (122.66 g) and the highest fruit weight per plant (740.03 g), but after the vermicompost dose was increased to 1350 g polybag^{-1} (v3), the fruit yield of tomato plants tended to decrease. The results of this research are in line with the report by [12] that the weight of tomatoes in the treatment of 100% solid vermicompost and 100% liquid vermicompost followed a quadratic regression pattern, while the treatment of 50% solid vermicompost and 50% liquid vermicompost followed a linear regression pattern. This phenomenon was explained by [13] that plant growth and production will reach an optimum point if the factors supporting growth are in optimal condition, the elements are balanced, the right dose of fertilizer, and the required nutrients are available to the plant. Providing fertilizer according to the dosage and needs can increase yields, whereas giving too much fertilizer will reduce plant yields.

3.2. POC Nasa

The results of variance analysis showed that the response to plant height aged 14, 21, and 28 days after planting, plant age at flowering, plant age at harvest, number of fruit per plant, weight of 1 fruit, and weight of fruit per plant were not significantly different from Nasa POC treatments. The research results are presented in Table 2.

Table 2. Average Growth and Yield of Tomato Plants at Various Nasa POC Concentrations

POC Nasa Treatments	Plant height (cm)			Plant age at flowering (DAP)	plant age at harvest (DAP)	Number of fruit per plant (fruit)	Weight of 1 fruit (g)	Weight of fruit per plant (g)
	14 DAP	21 DAP	28 DAP					
Anova Ragam	ns	ns	ns	ns	ns	ns	ns	ns
0 ml l^{-1} water (p0)	32,78	66,97	95,94	32,40	84,20	27,00	115,74	583,97
1 ml l^{-1} water (p1)	32,38	65,95	95,84	32,50	82,60	32,25	116,37	663,31
1 ml l^{-1} water (p2)	32,41	71,03	96,88	34,80	83,70	27,50	115,73	585,69

Source: Processed Research Data (2023).
Note: ns = not significantly different; and DAP = days after planting

Although growth, fruit components, and fruit weight per tomato plant did not respond significantly differently to the giving of Nasa POC, the research results in Table 2 show that the giving of various concentrations of Nasa POC of 1 ml l^{-1} water (p1) and 2.5 ml l^{-1} water (p2) produces taller tomato plants, faster plant age at flowering and harvest, greater number of fruit, greater weight of 1 fruit and higher fruit weight per plant compared to treatment without Nasa POC (p0). This is because giving Nasa POC can increase the availability and uptake of nutrients by tomato plants. As stated by [14] Nasa POC is a liquid organic fertilizer produced by PT. Natural Nusantara. This formula is specifically designed to meet the complete nutritional needs of plants and is made purely from organic ingredients, containing macro and micronutrients and also growth stimulants. Apart from that, the benefits of Nasa POC are improving the quality and quantity of production as well as environmental sustainability, spurring growth, and stimulating flowering and fruiting for plants [15].

The results showed that the treatment of 1 ml l^{-1} water Nasa POC (p1) tended to produce the highest number of fruit per plant (32.25 pieces), the largest weight of 1 fruit (116.57 g), and the highest fruit weight per plant (663.31 g), followed by treatment with 2.5 ml l^{-1} water Nasa POC (p2) respectively 27.50 pieces; 115.73 g, and 585.69 g, and treatment without Nasa POC (p0), namely respectively; 27.00

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pieces; 115.74 g, and 583.97 g. This situation shows that giving Nasa POC up to a certain concentration can increase the fruit yield of tomato plants, but if the concentration of foliar fertilizer is increased again it can reduce the fruit yield of the plant. As stated by [16], in terms of giving foliar fertilizer, several things absolutely must be paid attention to, one of which is that the concentration made/given must be by the instructions, don't overdo it because it will have a bad effect on the plants. The research results are in line with those reported by [17] that giving Nasa POC up to a concentration of 3 ml l^{-1} water produces the highest fruit weight per plant, however, if the concentration is increased to 4, 5, and 6 ml l^{-1} water it can reduce fruit weight of tomato plants. The results of the research reported by [18] showed that the giving of various concentrations of Nasa POC (1, 2, and 3 ml l^{-1} water) resulted in higher tomato fruit weight per plant compared to treatment without Nasa POC. Fruit weight per plant increased with increasing Nasa POC concentration given.

3.4. Interaction between Vermicompost and Nasa POC

The results of variance analysis showed that the response to plant height aged 14, 21, and 28 days after planting, plant age at flowering, plant age at harvest, number of fruit per plant, weight of 1 fruit, and weight of fruit per plant were not significantly different from the interaction between vermicompost treatment with Nasa POC treatment. The research results are presented in Table 3.

Table 3. Average Growth and Yield of Tomato Plants in Various Combinations of Vermicompost Treatment and Nasa POC Treatment

Combination of Vermicompost and Nasa POC	Plant height (cm)			Plant age at flowering (DAP)	plant age at harvest (DAP)	Number of fruit per plant (fruit)	Weight of 1 fruit (g)	Weight of fruit per plant (g)
	14 DAP	21 DAP	28 DAP					
Anova Ragam	ns	ns	ns	ns	ns	ns	ns	ns
v0p0	30,38	60,12	89,45	33,00	84,40	23,00	120,05	473,92
v0p1	33,94	63,58	89,93	33,00	82,40	32,00	100,38	695,40
v0p2	27,94	67,28	87,52	35,00	83,20	32,00	103,76	657,37
v1p0	30,72	65,94	89,66	33,60	85,00	14,00	119,42	315,82
v1p1	30,60	67,73	89,57	32,60	83,20	29,00	118,41	650,96
v1p2	35,96	70,14	97,51	37,60	86,00	19,00	129,27	433,73
v2p0	31,58	69,45	95,22	33,60	85,50	30,00	123,98	727,65
v2p1	32,78	69,93	100,34	31,20	82,60	41,00	100,76	838,47
v2p2	33,00	70,24	102,23	32,20	82,60	24,00	143,23	694,65
v3p0	38,44	68,54	109,41	29,40	81,70	41,00	99,52	797,80
v3p1	32,34	72,35	103,44	33,00	82,80	35,00	105,92	557,00
v3p2	32,74	76,44	100,24	34,80	83,00	27,00	95,52	509,07

Source: Processed Research Data (2023).
Note: ns = not significantly different; and DAP = days after planting

The results of the research showed that the effect of the interaction between vermicompost treatment and Nasa POC had no significant effect on the growth and yield of tomato plants. This is supported by the independent influence of the two treatment factors which is also not significantly different. This situation shows that the vermicompost fertilizer factor and the Nasa POC concentration factor do not jointly influence the growth and yield of tomato plants. As explained by [8], if the influence of different interactions is not significant then it can be concluded that the treatment factors act independently of each other. The research results in Table 3 show that treatment with various doses of vermicompost combined with various Nasa POC tends to provide better growth and fruit yield of tomato plants compared to the combination of various vermicompost doses without Nasa POC. This is because the application of vermicompost can improve the physical, chemical, and biological properties of the soil

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and the application of Nasa POC can increase the availability of nutrients so that tomato plants can grow well and provide high yields.

The highest fruit yields were produced in combinations of various doses of vermicompost fertilizer with Nasa POC with a concentration of 1 ml l^{-1} water which tended to produce higher fruit yields on tomato plants, whereas if the concentration was increased to 2.5 ml l^{-1} water tended to reduce the number of fruit. weight of 1 fruit and weight of fruit per plant. This is because the Nasa POC concentration given is too large and has an unfavorable effect on tomato plants. As stated by [16], for foliar fertilizer to produce results as expected, the concentration given should not exceed the recommended concentration.

4. CONCLUSIONS

Based on the results of this research, it can be concluded that

1. Response of plant height 14 and 21 days after planting, plant age at flowering, plant age at harvest, number of fruit per plant, weight of 1 fruit, and weight of fruit per plant were not significantly different to the application of vermicompost, POC Nasa and their interactions, except for the response to plant height aged 28 days, there was a very significant difference in giving chicken manure vermicompost.
2. The highest fruit weight per plant was produced in the treatment of 900 g polybag^{-1} vermicompost and 1 ml l^{-1} water Nasa POC.

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