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The Effect of Variations in Sago Dregs Compost Dosage on the Growth and Productivity of Cucumber (*Cucumis sativus* L.) Plants on Marginal Land

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ABSTRACT

This study aimed to determine the effect of applying sago waste compost on the growth and yield of cucumber (*Cucumis sativus* L.) cultivated in marginal land. The research was conducted using a Randomized Block Design (RBD) with one factor and five levels of compost dosage: B0 (0 tons/ha), B1 (5 tons/ha), B2 (10 tons/ha), B3 (15 tons/ha), and B4 (20 tons/ha), each replicated three times. Observed parameters included leaf number, stem diameter, plant dry weight, fruit number, fruit weight, and yield. Data were analyzed using ANOVA followed by the LSD test at a 5% significance level. The results showed that the application of sago waste compost had no significant effect on the number of leaves, stem diameter, and plant dry weight. However, the 20 tons/ha treatment (B4) significantly affected fruit weight and yield at 52 days after planting, producing the highest yield of 23.687 tons/ha. The effect was not significant at 45 and 59 days after planting. These results suggest that sago waste compost can enhance cucumber productivity during the fruit-filling phase, even though it has no significant effect on vegetative growth.).

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1. Introduction

Cucumber (*Cucumis sativus* L.) is a fruit vegetable that grows by climbing or creeping and can be cultivated from lowland to highland areas up to 1000 meters above sea level (Amalia & Darmawati, 2021). Every 100 grams of cucumber fruit contains approximately 15 calories, 0.8 g protein, 30 mg phosphorus, 0.5 mg iron, 0.02 mg thiamine, 3 g carbohydrates, 14 mg acid, 0.3 mg vitamin A, 0.3 mg vitamin B1, 0.02 mg vitamin B2, and 8 mg vitamin C (Zhao et al., 2017). Its high nutritional content and refreshing taste make cucumber one of the most popular vegetables among consumers. However, the increasing market demand has not been matched by optimal production levels.

In Southeast Sulawesi, cucumber productivity remains lower than the national average. This is largely attributed to the region's marginal lands, characterized by low fertility and limited nutrient content (Permata et al., 2023). According to (Regassa et al., 2023) marginal soils exhibit poor quality due to several limiting factors such as slope, low organic matter, nutrient deficiency, low moisture, unbalanced pH, and accumulation of toxic elements. Furthermore, such soils generally have low water-holding capacity, high soil temperature during the day, and poor cation exchange capacity (Theresia & Sulistyaningsih, 2020).

To overcome these limitations, the use of inorganic fertilizers is often used as an alternative to increase crop productivity in marginal lands. However, continuous use of inorganic fertilizers can have a negative impact on the environment due to the accumulation of inorganic residues in the soil that are not proportional to the ability of plants to absorb nutrients. Efforts to increase cucumber growth and production on such land can be done by improving soil fertility through the addition of organic matter. Organic matter plays a role in improving the physical, chemical, and biological properties of soil, one of which is through the use of sago pulp waste (Putinella et al., 2022). Sago pulp has a high organic content, such as cellulose, hemicellulose, and a small amount of lignin, which can increase soil fertility and help improve soil structure. Sago pulp is a waste product from sago flour processing that is generally discarded, even though it has high potential as a compost material because it contains organic compounds that are necessary for plants. In addition, the use of compost from sago pulp can also reduce dependence on chemical fertilizers that have the potential to pollute the environment. Sago pulp compost contains macro and micro nutrients that are important for plant growth and can reduce dependence on chemical fertilizers (Kaya et al., 2022). Research conducted by (Zaimah & Prihastanti, 2012) shows the effect of sago pulp composting on strawberry plant growth, while (Putinella et al., 2022) research applies a similar study to corn plants. To date, the use of sago pulp fertilizer is still limited and not widely used by farmers in their farming activities. In addition, there is no clear information about the appropriate dosage for use in Southeast Sulawesi, especially for cucumber plants. Based on the background described above, the purpose of this study is to determine the effect of sago pulp compost on the growth and yield of cucumber plants.

2. Methods

2.1. Research Location

This research was conducted in Konda Subdistrict, South Konawe Regency, Southeast Sulawesi Province, Indonesia.

2.2. Tools and Materials

The tools used were hoes, machetes, buckets, hoses, cutters, rulers, calipers, analytical scales, knives, cameras, and writing instruments. The materials used were cucumber seeds, sago pulp, granulated sugar, water, raffia rope, EM4, stakes, waring net, and labels.

2.3. Research Method

2.3.1. Composting of Sago Pulp

The composting process begins with preparation, which involves gathering sago pulp waste, chicken manure, chicken feed, and EM-4. The first step is to take 100 kg of sago pulp and 10 kg of chicken manure, then mix them evenly on a tarp. Next, the pile is flattened to increase its surface area, then sprayed evenly with EM-4 solution. After that, chicken feed is added and mixed again until evenly distributed. Leave the mixture for about a month to ferment. During the fermentation period, stir the mixture every five days to allow air to enter and accelerate the decomposition process.

2.3.2. Experimental Design

This study used a randomized block design (RBD) with one treatment factor, namely the dosage of sago pulp compost fertilizer. The treatment consisted of five levels, namely:
B0 = without sago pulp fertilizer (control),
B1 = 5 tons[1] ha (2 kg/plot),
B2 = 10 tons[1] ha (4 kg/plot),
B3 = 15 tons[1] ha (6 kg/plot)
B4 = 20 tons[1] ha (8 kg/plot).
Each treatment was repeated three times, resulting in 15 experimental units. Each experimental plot measured 2 m × 2 m.

2.4. Observation Variables

The parameters observed in this study include:
a) Number of leaves (pieces), counted on plants aged 28, 35, and 42 days after planting (DAP) for all leaves formed.

b) Stem diameter (cm), measured at 28, 35, and 42 DAP using callipers on the second stem node from the base.
c) Dry weight of plants (g), determined by weighing all parts of the plant without fruit after drying in an oven at 70°C for 48 hours. Measurements were taken at the end of the study on four plant samples per plot.
d) Number of fruits (fruits/plant), counted at 45, 52, and 59 DAP for fruits that met the harvest criteria, namely bright light green in colour, straight in shape, undamaged, and medium in size.
e) Fruit weight (g), which is the total weight of fruit harvested from each plot at 45, 52, and 59 days after planting.
f) Yield (tons/ha), calculated based on the total fruit production from each plot at harvest time (45, 52, and 59 days after planting).

2.5 Data Analysis

The data were analysed using ANOVA, and if the calculated F > table F, it was followed by a 95% BNT test.

3. Results and Discussion

3.1. The Effect of Sago Residue Compost Fertilizer on the Growth of Cucumber Plants

Based on the results of the analysis of variance, the provision of sago dregs fertilizer had no significant effect on the number of leaves (culms of cucumber plants). From the results of observations, it was known that at each observation age (28, 35 and 42 Days After Planting (DAP)) the number of leaves increased for all treatments as shown in Table 1 and Figure 1.

Table 1. Effect of Sago Residue Compost Fertilizer Application on the Number of Cucumber Leaves (sheets)

Treatment	Observation Number of Cucumber Leaves (sheets)		
	28 DAP	35 DAP	42 DAP
B0 = control	6.917	12.250	17.500
B1 = 2 kg/plot	5.583	8.917	12.333
B2 = 4 kg/plot	5.500	8.833	13.417
B3 = 6 kg/plot	6.167	10.667	15.833
B4 = 8 kg/plot	6.750	10.917	15.583

Notes: B=control; B =2 kg/plot; B =4 kg/plot; B3=6 kg/plot; B4=20 8 kg/plot

Based on Table 1, the use of sago powder compost fertilizer had no significant effect on the number of cucumbers leaves on days 28, 35, and 42 after planting. Lestari et al., (2023) reported that the application of POC fertilizer made from pineapple peel and rice washing water had no significant effect on the number and leaf area of cucumber plants. This suggests that the nutrients and plant growth regulators in compost fertilizer are still insufficient to meet the needs of cucumber plants to increase the number of leaves. Karamina et al., (2020) states that nitrogen greatly affects the formation of broad leaves and high chlorophyll content, resulting in large amounts of carbohydrates for the vegetative growth of cucumber plants. Meanwhile, research (Muhammad et al., 2024) shows that the use of organic materials can affect the number of cucumbers leaves each week. Leaves are vegetative organs of plants that require optimal nitrogen nutrition to support their growth. Therefore, the more leaves there are, the better the potential for photosynthesis. The average number of leaves (stems) in each treatment shows a relatively uniform growth pattern among all treatments, as shown in Figure 1 below.

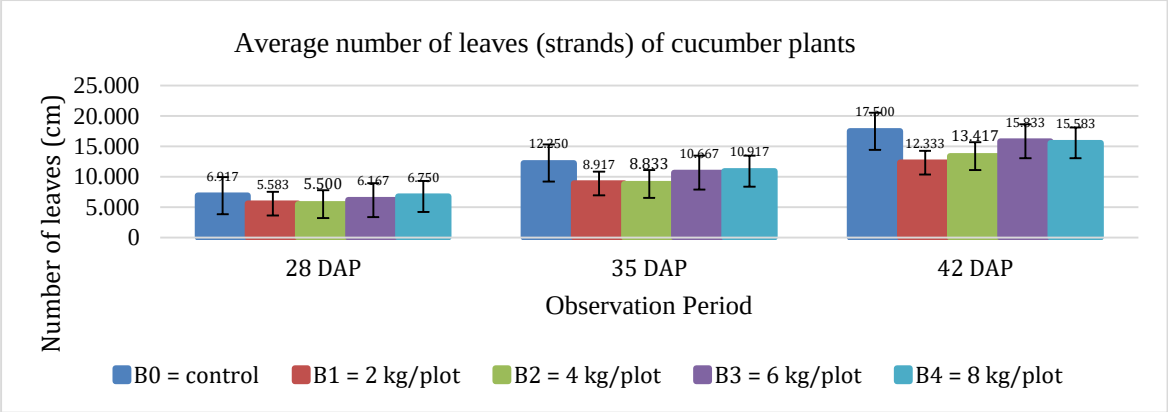

Figure 1. Increase in the Number of Cucumber Leaves Given Compost Fertilizer

In Table 2, the results of the analysis of variance of the effect of providing sago pulp compost fertilizer on the stem diameter (cm) of cucumbers show no significant effect on stem diameter at the ages of 28, 35 and 42 HST, as presented in Table 2 and Figure 2 below.

Table 2. Effect of Sago Residue Compost Fertilizer on Cucumber Stem Diameter (cm)

Treatment	Observation of stem diameter (cm)		
	28 DAP	35 DAP	42 DAP
B0 = control	0.775	0.898	0.956
B1 = 2 kg/plot	0.648	0.794	0.868
B2 = 4 kg/plot	0.730	0.827	0.953
B3 = 6 kg/plot	0.712	0.790	0.880
B4 = 8 kg/plot	0.790	0.828	0.977

Based on Table 2, the application of compost fertilizer made from sago pulp did not have a significant effect on the stem diameter of cucumber plants at 28, 35, and 42 days after planting. This indicates that the variation in the dosage of sago pulp compost applied was not able to significantly increase stem growth. The average stem diameter in each treatment shows a relatively uniform growth pattern among all treatments, as shown in Figure 2 below.

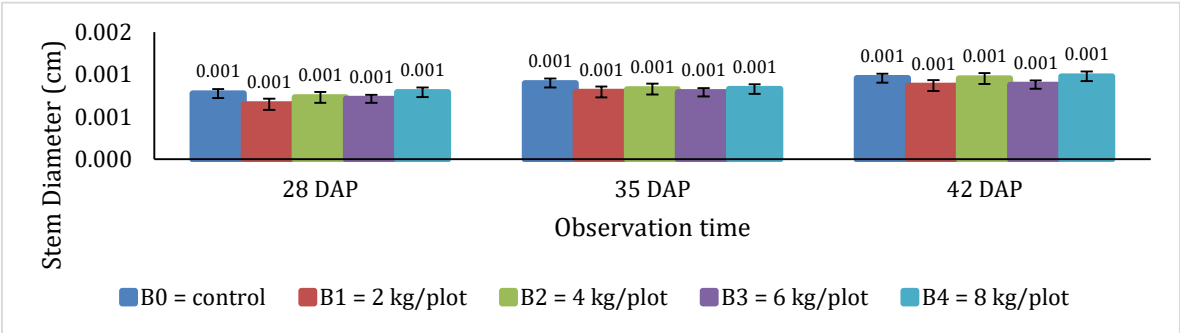

Figure 2. Increase in the diameter of cucumber stems fertilized with sago pulp compost

Meanwhile, in Table 3, the results of the analysis of the effects of providing sago pulp compost fertilizer on the dry weight of cucumber plants show no significant effect, as presented in Table 3 and Figure 3 below:

Table 3. Effect of Sago Residue Compost Fertilizer on Dry Weight (g) of Cucumber Plants

Treatment	Dry weight of plants (g)
B0 = control	43.648
B1 = 2 kg/plot	44.881
B2 = 4 kg/plot	44.885
B3 = 6 kg/plot	44.387
B4 = 8 kg/plot	45.696

Based on Table 3, the application of compost fertilizer made from sago pulp did not have a significant effect on the dry weight of cucumber plants at harvest. This indicates that the variation in the dosage

of sago pulp compost applied was not able to significantly increase plant biomass accumulation. The average dry weight of plants in each treatment, as shown in Figure 3, shows relatively uniform results among the various treatments tested.

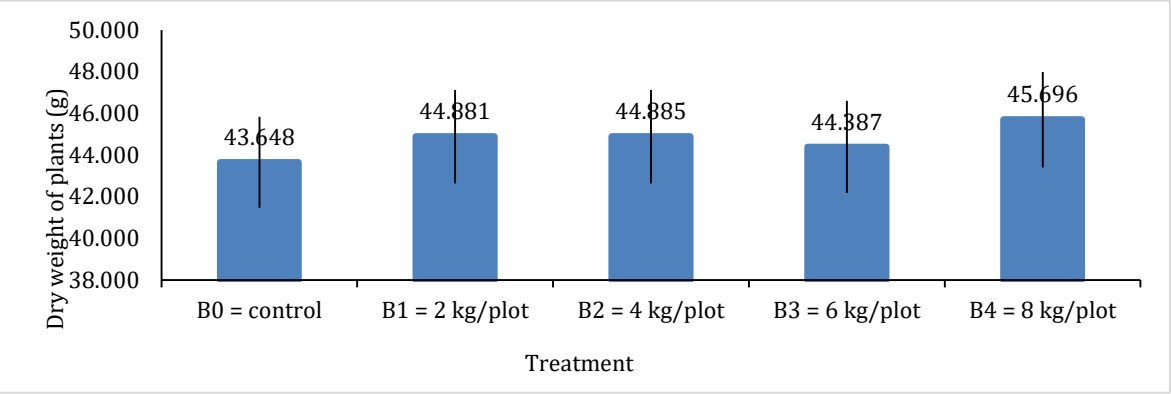

Figure 3. Dry Weight of Cucumber Plants Given Sago Residue Compost Fertilizer

Observations on the effect of applying sago pulp compost fertilizer to cucumber plants show that this treatment has no significant effect on the number of leaves, stem diameter, or plant weight. This condition is thought to be caused by the incomplete decomposition process of sago pulp, resulting in nutrients that are not optimally available to the plants. Consequently, the availability of nutrients that can be absorbed by the plants is limited and unable to support maximum growth.

Research results (Syakir, Bintoro, (2009) show that the C/N ratio of sago pulp compost ranges from 10 to 25. This C/N ratio indicates that the decomposition process of organic matter is slow, so that the release of nutrients also occurs gradually and takes longer. According to Arachis et al., (2015), the C/N ratio greatly affects the rate of decomposition of organic matter; materials with a low C/N ratio will decompose faster than those with a high ratio. This is in line with the findings of Widyabudiningsih et al., (2021), who stated that the higher the C/N ratio of the raw material, the lower the quality of the compost produced. Therefore, materials with a high C/N ratio require a longer fermentation process to produce good quality compost.

In addition to decomposition factors, the insignificant effect of sago pulp compost fertilizer on cucumber growth is also thought to be related to the presence of chemical fertilizer residues such as urea, SP-36, and KCl in the research field, which had previously been used intensively by farmers. This condition is in line with the results of studies by Anggraini et al., (2017) and Ahadiyat et al., (2021), which state that NPK fertilizer residues from the previous planting season can affect long-term soil fertility. Abebe et al., (2022) also emphasized that the continuous use of chemical fertilizers can leave nutrient residues in the soil that still contribute to plant growth in the next planting period.

3.2. The Effect of Sago Residue Compost Fertilizer on Cucumber Productivity

The results of data analysis in Table 4 show that observations of the number of cucumber fruits in various treatments of sago pulp compost doses indicate that there is no significant effect between treatments on the number of fruits produced at each observation time, whether at 45, 52, or 59 days after planting (DAP).

Data from measurements of the number of cucumbers during three observation periods, namely 45, 52, and 59 days after planting, showed different numbers of cucumbers. Table 4 shows that the average number of cucumbers increased during the harvest period 52 DA and decreased during the harvest period 59 DAP.

Table 4. Effect of Sago Residue Compost Fertilizer on the Number of Cucumber Fruits (Fruits)

Treatment	Number of Cucumber Fruits (Fruits)			Total number of fruits
	45	52	59	
B0 = control	1.383	1.417	1.205	3.905
B1 = 2 kg/plot	1.517	1.700	1.283	4.500
B2 = 4 kg/plot	1.467	1.467	1.300	4.304
B3 = 6 kg/plot	1.283	1.700	1.283	4.266
B4 = 8 kg/plot	1.767	1.707	1.400	4.874

The average increase in the number of cucumber plants given sago pulp compost fertilizer is presented in Figure 4 below.

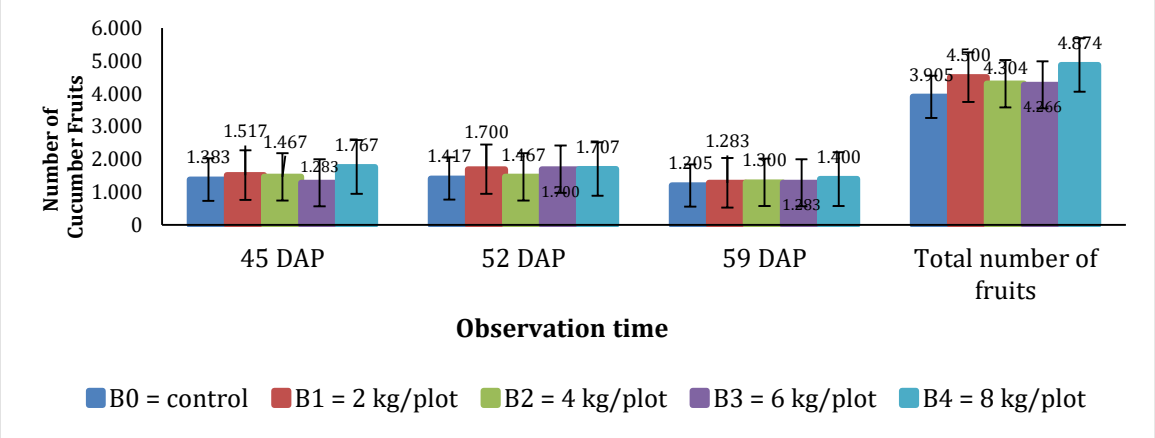

Figure 4. Increase in the Number of Cucumbers Given Sago Residue Compost Fertilizer

Descriptively, treatment B4 (the highest dose of sago pulp compost) produced the highest total number of fruits, namely 4,874 fruits, while the control treatment (B0) produced the lowest number of fruits, namely 3,905 fruits. However, the difference was not large enough to be considered statistically significant. The fruit formation pattern in all treatments was relatively similar, with the peak number of fruits occurring at 52 DAP and then decreasing at 59 DAP.

This trend indicates that the application of sago pulp compost has not been able to have a significant effect on the flowering and fruit formation processes of cucumbers. This is thought to be due to the sago pulp compost not being fully decomposed, resulting in low availability of essential nutrients for the plants. Suboptimal decomposition can cause nutrients such as nitrogen, phosphorus, and potassium to be unavailable for absorption by plants, thus having no significant effect on fruit formation. In addition, other factors such as plant genetics, soil physical and chemical properties, and environmental conditions during the growth period are also likely to play a more dominant role in determining the number of fruits produced (Karamina et al., 2020). These results are in line with research conducted by (Annisa & Gustia, 2018), which reported that the application of organic fertilizer does not always have a significant effect on fruit yield, as genetic factors and the physiological condition of plants play a greater role in the flowering and fruiting processes. Optimal growth components will contribute to increased crop yields.

Additionally, Sari et al., (2022) also explain that the availability of nutrients from organic materials has a greater effect on fruit size and quality than on the number of fruits formed, because nutrients tend to be used for fruit filling rather than for the formation of new flowers.

Table 5 presents data on the effect of sago pulp compost fertilizer on cucumber fruit weight at 45, 52, and 59 DAP, as well as the total fruit weight produced per plant. The data show variations in fruit weight for each fertilizer dose treatment, ranging from control (no fertilizer) to a dose of 8 kg/ha.

Table 5. Effect of Sago Residue Compost Fertilizer on Cucumber Fruit Weight (g)

Treatment	Cucumber Fruit Weight (g)			Total fruit weight
	45 DAP	52 DAP	59 DAP	
B0 = control	361.720	247.347^{c}	176.538	785.604
B1 = 2 kg/plot	365,493	429.891^{abc}	223.995	1019.378
B2 = 4 kg/plot	327.970	365.558^{bc}	203.478	897.006
B3 = 6 kg/plot	297.684	458.161^{ab}	276.631	1032.476
B4 = 8 kg/plot	364.287	568.494^{a}	260.458	1193.239
BNTα0.05	-	189.969	-	

Note: Numbers with the same letters indicate no significant difference in the 95% BNT test. confidence level

Figure 5 shows the relationship between the use of compost fertilizer from sago pulp and the weight of cucumber fruit at several observation times, namely on days 45, 52, and 59 after planting, as well as the total fruit weight. This graph shows changes in the weight of cucumber fruit with various doses

of compost fertilizer and also with different observation times. The total fruit weight was obtained by measuring all fruits harvested at 45, 52, and 59 DAP. The fruit weight at 45 DAP showed the cucumber harvest at that age, as did 52 and 59 DAP, which showed the fruit weight according to the time of harvest.

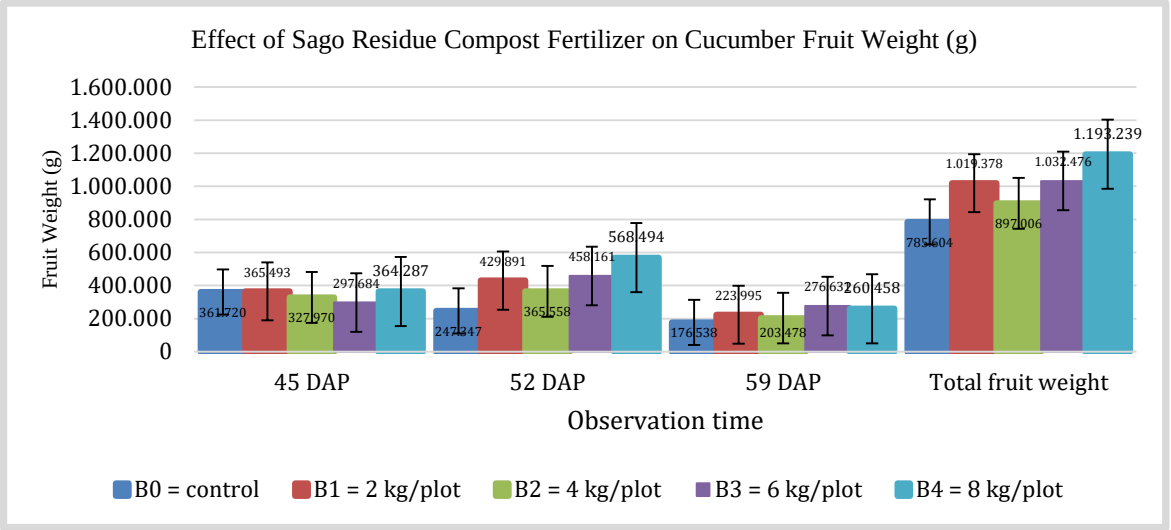

Figure 5. Effect of Sago Residue Compost Fertilizer on Cucumber Fruit Weight

The results of Table 5 show that the application of sago pulp compost fertilizer had a significant effect on cucumber fruit weight only at 52 days after planting, while at 45 and 59 days the effect was not significant. These data indicate that the effectiveness of organic fertilizer from sago pulp in increasing fruit weight is only apparent at certain growth stages, namely when the plants enter the fruit formation and filling stages.

Figure 5 shows the pattern of fruit weight change in each treatment. Fruit weight tended to increase from 45 days of age until it peaked at 52 days of age, then decreased at 59 days of age. This pattern indicates an optimal phase for fruit growth and filling, during which the plants were able to utilize the nutrients from the fertilizer to the maximum extent. The highest fruit weight was achieved in treatment B4 (20 tons/ha of sago pulp fertilizer) at 568.494 g, while the lowest fruit weight was found in the control (B0) at 247.347 g at 52 days of age.

The increase in fruit weight at higher fertilizer doses indicates that the additional nutrients from sago pulp compost are able to support cell formation and fruit filling more optimally. Fruit growth requires a lot of nutrients, which are mobilized and transported from the vegetative parts to the developing fruit. The nutrient in question is potassium, which supports growth and improves fruit quality. Potassium plays a role in moving photosynthates from the leaves to the roots and increasing the supply of energy for root growth and fruit size and quality development (Satriawi et al., 2019). The decrease in fruit weight at 59 days of age is likely due to fruit aging and a decline in plant resource allocation. Nazari et al., (2020) reported that the addition of organic matter such as compost can increase the availability of macro nutrients (N, P, and K) that play an important role in the process of fruit formation and filling. However, as the plant ages, physiological activities such as photosynthesis and translocation of assimilation products decrease, so that fruit weight tends to decrease in the final phase of growth (Lestari, 2020).

Table 6. Effect of Sago Residue Fertilizer on Yield (tons/ha) Cucumber

Treatment	Yield (tons/ha) Cucumber			Total Yield (tons/ha)
	45	52	59	
B0 = control	15.072	10.306^{c}	7.356	32.734
B1 = 2 kg/plot	15.229	17.912^{abc}	9.333	42.474
B2 = 4 kg/plot	13.666	15.232^{bc}	8.478	37.376
B3 = 6 kg/plot	12.404	19.090^{ab}	11.526	43.020
B4 = 8 kg/plot	15.179	23.687^{a}	10.853	49.719
BNTα0,05	-	7.915	-	

Note: Numbers with the same letters indicate no significant difference in the 95% BNT test. confidence level.

Observations on the effect of sago pulp compost fertilizer on cucumber yield are presented in Table 6. The results show that the average cucumber yield differed for each dose of sago pulp compost fertilizer used and for each observation period.

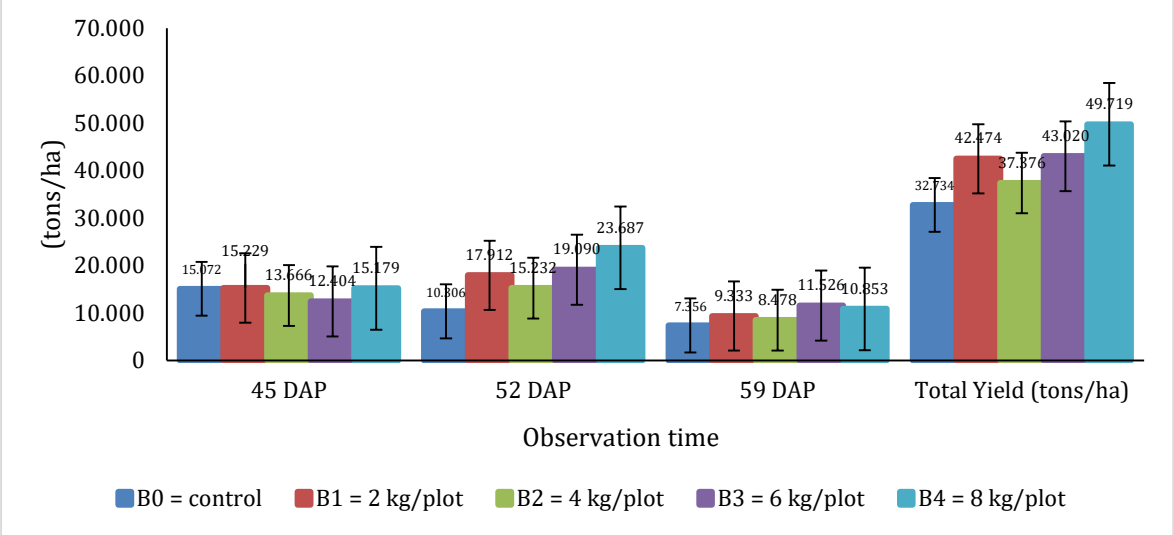

Figure 6. Effect of Sago Residue Compost Fertilizer on Cucumber Yield

The data in Table 6 shows that the application of sago pulp compost fertilizer had a significant effect on cucumber yield only at 52 days after planting, while at 45 and 59 days the effect was not significant. This is in line with the findings on fruit weight, which show that the optimal growth phase of cucumber plants occurs at around 52 days, when the plants are able to utilize the nutrients from the compost to the maximum extent.

The highest yield was achieved in treatment B4 (20 tons/ha of sago pulp fertilizer) at 23.687 tons/ha at 52 days, while the lowest yield was recorded in the control (B0) at 10.306 tons/ha. The increase in yield at higher fertilizer doses indicates that the application of sago pulp compost can increase plant productivity, particularly through an increase in fruit weight, even though the number of fruits did not change significantly.

Figure 6 shows the harvest yield trend from three harvest periods, which shows an increase up to 52 days of age, then a slight decrease at 59 days of age. This pattern indicates that the fruit filling and biomass accumulation phases peak at 52 days of age, and after that, fruit growth begins to decline due to plant aging or reduced resource allocation. Plant growth and yield are highly dependent on the proper use of fertilizer. Plants will not grow well if they do not receive the fertilizer that suits their needs (Kartika et al., 2025). Puspitasari & Elfarisna, (2018) stated that increasing the dose of organic fertilizer can increase crop yields through improved soil structure and increased nutrient availability in the generative phase, but the effect decreases when the plant enters the senescence phase.

Additionally, similar results were reported by Sandro, (2021), who found that the effect of organic matter on crop yield is more pronounced during the fruit filling phase than during the early or late production phases, as nutrient uptake and photosynthetic activity peak during the mid-generative phase.

4. Conclusion

Sago pulp compost fertilizer has no significant effect on the number of leaves, stem diameter, and dry weight of cucumber plants. This condition is thought to be due to incomplete compost decomposition and the presence of chemical fertilizer residues in the soil. Application of a 20 tons/ha dose resulted in the highest fruit weight and yield at 52 days after planting. This indicates the effectiveness of sago pulp compost in enhancing productivity during the fruit filling stage.

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