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Original Article

The effect of swallow guano application on the growth of mustard plants (*Brassica juncea* L.)

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Abstract

Research on the effect of swallow guano on the growth of mustard plants (*Brassica juncea* L) uses a dose that produces mustard plant growth (*Brassica juncea* L). Type of experimental research using a completely randomised design (CRD), X_0 (control), X_1 (122 grams), X_2 (245 grams) and X_3 (490 grams) each replicate 6. Data were analysed using analysis of variance based on the F test α5% and analysis of variance was conducted further Duncan Multiple Range Test (DMRT). Results F_{hit} and F_{tab}. Based on Anova Variance Test of 40 HST Measurement, all treatments studied had a significant effect (α = 0.05) on all parameters, namely plant height (11.893*), leaf length (14.310*), leaf width (5.106*), number of leaves (8.205*) and wet weight (30.681*). The results of the DMRT test on wet weight of X, X, X_{123} and Xo treatments are significantly different.

Keywords: growth, mustard plant, swallow guano

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Introduction

Organic fertiliser is a fertiliser made from the remains of living things that are processed through a decomposition process by decomposing bacteria. Organic fertiliser comes from plant parts, animal manure or organic waste that has gone through an engineering process, is solid or liquid, can be enriched with minerals and microbes that are useful for increasing the content of nutrients and organic matter and improving the chemical and biological properties of the soil. Organic matter contains essential nutrients for the soil and then accumulates as a food source for plants. The nutrient composition of organic fertiliser is highly dependent on the source of the base material. According to its source, organic fertiliser can be defined as coming from agricultural activities, which can be in the form of crop residues and livestock manure, for example swallow droppings (Hartatik, et al., 2015: 108).

Swallow guano is an organic fertiliser derived from swallow droppings. Guano comes from the Spanish word 'wanu' which means the faeces (feces and urine) of the seabird Larus argentatus, the bat Chiroptera and the swallow Collocalia vestita. Swallow droppings have the potential to be used as organic fertiliser for plants. The nutrient content in swallow guano is relatively high, even the highest compared to other natural organic fertilisers so that it is beneficial to plant growth and yield (Alfairisi, et al., 2021: 22).

Many people in Kabupaten Bombana are currently running swallow breeding businesses, especially in Poleang Subdistrict. This business is promising for swiftlet breeders because swiftlet nests are worth 8-12 million/Kg (150 nests) in the market. The consequence of swallow breeding is that it produces waste, namely swallow droppings. Waste from swallow droppings has not been utilised by swallow breeders and is just thrown away. Swallow droppings have the potential to be used as organic fertiliser for plants

Based on research by Hendrikus, et al. (2018: 1), swallow droppings (guano) contain elements of nitrogen, phosphorus, potassium, calcium, magnesium, sulfur and potassium which can provide growth, strengthen plant stems, optimise leaf growth, stimulate root strength and flowering and stimulate the process of plant fertilisation. According to Musahidin, et al. (2022: 47), other benefits of guano fertiliser can improve and enrich soil structure because 40% contains organic material, contains bacteria and microbiotic flora that are beneficial for plant growth and as a fungicide, swallow guano can significantly increase nutrients in plants. This is because the fungicide has a good cation exchange capacity (CEC), whichh make it easy for plants to absorb the useful elements in the fertilizer.

The use of swallow guano can significantly increase soil nutrient levels and meet nutrients for plants (Mardhiana, et al., 2022: 5). Based on data from the Southeast Sulawesi Central Bureau of Statistics (2021), the average production of mustard plants in Southeast Sulawesi has relatively decreased with a production of 9,621 ku/year with a harvest area of 102 ha, compared to production in 2019 reaching 11,238 ku/year and in 2018 reaching 11,910 ku/year with a harvest area of 547 ha (BPS Southeast Sulawesi, 2019). The nutrients needed to increase the production of mustard plants (*Brassica juncea* L.) are elements of nitrogen (N), phosphorus (P) and potassium (K), where phosphorus (P) fertiliser is able to increase soil productivity and provide food for plants. The nutrient element nitrogen (N) which helps the process of cell division and enlargement which causes young leaves to reach a perfect shape faster. The nutrient element potassium (K) plays a role in increasing the growth of meristem tissues The materials used in this

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study were water, mustard seeds, guano wallet and soil and as an activator that will affect the meristem for plant height growth (Mardhiana, et al., 2018: 4). Mustard plants are one of the plants that are popular among the public because they have great benefits and job prospects. Mustard plant (*Brassica juncea*) is one of the leaf vegetables, which is widely consumed by the people of Indonesia. This plant is very potential as a provider of important mineral elements needed by our body, because of its high nutritional value. Besides having high nutritional value, this mustard plant is also useful in efforts to overcome the problem of vitamin deficiency. Therefore, mustard plants are suitable to be developed in subtropical and tropical areas, but soil fertility is one of the obstacles to mustard growth. Organic fertilisers such as swallow guano can increase soil fertility and crop production, especially mustard plants (Nurlaela. 2023: 81) This study aims to determine the effect of swallow guano on the growth of mustard plants (*Brassica juncea* L.) and to determine the optimal or effective dose of swallow guano for the best growth in mustard plants (*Brassica juncea* L.).

Methods

Place and time of research

This research was conducted in 2022 in the Biology Education Laboratory of the Faculty of Teacher Training and Education, Halu Oleo University in Kendari City, Southeast Sulawesi, in 2022.

Methods

Growing mustard plants

Preparation of materials includes water, mustard seeds, swallow guano and soil. Choose treatments that suit the needs of mustard plants such as swallow guano application, X_0 (control), X_1 (122 grams), X_2 (245 grams) and X_3 (490 grams).

Care

Daily watering of mustard plants, fertilisation, land management such as providing loose soil and free of weeds and the land must get sunlight.

Measuring Vegetative Parameters

Measurements of plant height, leaf length, leaf width and number of leaves of mustard plants (*Brassica juncea L.*) were carried out 7 times and wet weight was weighed once on the last day. The first measurement was taken at 22 HST, the purpose of which was that when transplanting mustard plant seedlings, acclimatisation was carried out, namely the adjustment of a plant or organism to a new environment. The last measurement was taken at 40 HST (total age of mustard 40 days) starting from the seeding period which was carried out for 14 days.

Measuring Generative Parameters

Generative parameters include plant wet weight which is done when the mustard plants are harvested.

Data Analysis

This type of research is experimental research and the experimental design used is a completely randomised design (CRD) with 3 treatments, 1 control and 6 replicates so that the total number of samples is 24 plants. The treatment of swallow guano is:

X_0 = Swallow Guano (Control)
X_1 = Top soil 2,878 grams + Swallow guano 122 grams
X_2 = Top soil 2,755 grams + Swallow guano 245 grams
X_3 = Top soil 2,510 grams + Swallow guano 490 grams

Observations were made with two parameter measurements, namely vegetative parameters and generative parameters. Vegetative parameters include plant height, leaf width, leaf length, number of leaf blades. Observations were made when the plants were 22, 25, 28, 31, 34, 37 and 40 HST (Days After Planting). Generative parameters in the form of plant wet weight were carried out when the mustard plants were harvested. Data were analysed using analysis of variance based on the F test α5% and further tests using SPSS version 26. If the calculation results obtained the value of $F_{hit} > F_{tab}$, which affects the level of opportunity ($\alpha = 0.05$), then further Duncan Distance Test (Duncan Multiple Range Test-DMRT) was conducted (Hanafiah, 2010: 41).

Results

Plant Height

Figure 1.1 show the results of measuring the average mustard plant height of 3 treatmeents, 1 control, and 6 replicates for 40 HST with seven measurements.

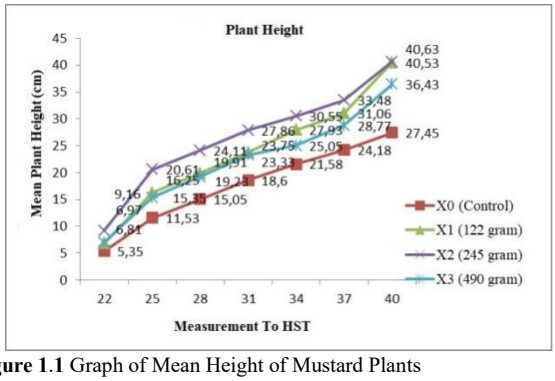

Figure 1.1 Graph of Mean Height of Mustard Plants

Based on Figure 1.1 the average height of mustard plants shows that between the treatment group and the control group from the 22nd measurement of HST to the 40th measurement of HST, the highest average plant height is found in X_2 (245 grams) with an average plant height of 40, 63 while the lowest average plant height is seen in X_0 (control) with a height of 27.45.

Leaf Length

The results of leaf length measurements of mustard plants from 3 treatments, 1 control and 6 replications for 40 HST with 7 measurements, obtained the average results of plant height which can be seen in Figure 1.2.

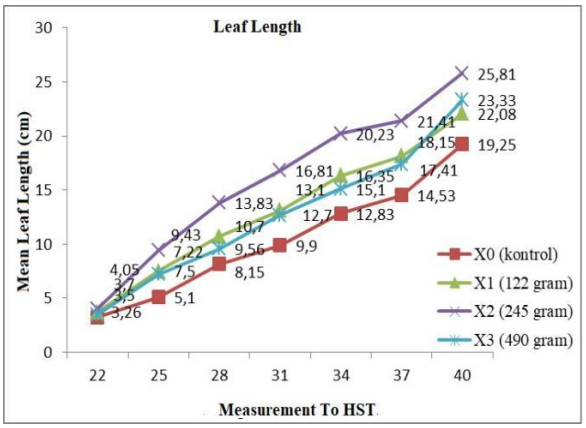

Figure 1.2 Graph of Mean Leaf Length of Mustard Plants

Based on Figure 1.2, the average leaf length of mustard plants shows that between the treatment group and the control group from the 22nd measurement of HST to the 40th measurement of HST, the longest average leaf length is found in X_2 (245 grams) with an average plant height of 25.81 cm while the shortest average leaf length is seen in X_0 (control) with a height of 19.25 cm.

Leaf Width

The results of measuring the leaf width of mustard plants from 3 treatments, 1 control and 6 replications for 40 HST with 7 measurements, obtained the average results of plant height which can be seen in Figure 1.3.

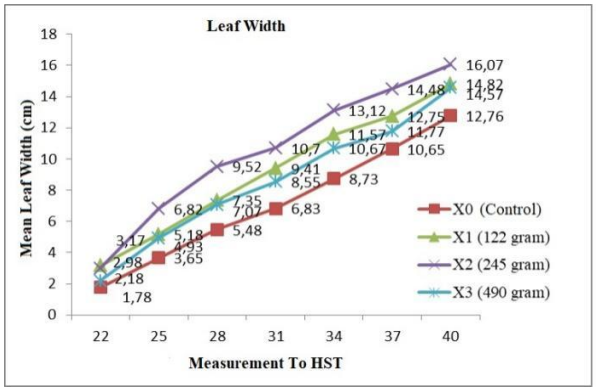

Figure 1.3 Graph of Mean Leaf Width of Plants

Based on Figure 1.3 the average leaf width of mustard plants shows that between the treatment group and the control group from the 22nd measurement of HST to the 40th measurement of HST, the widest average leaf width is found in X_2 (245 grams) with an average plant height of 16.06 cm while the narrowest average leaf width is seen in X_0 (control) with a height of 12.76 cm.

Number of Leaves

The average number of leaves of mustard plant was obtained from 3 treatments, 1 control, and 6 replicates for 40 HST with 7 measurements.

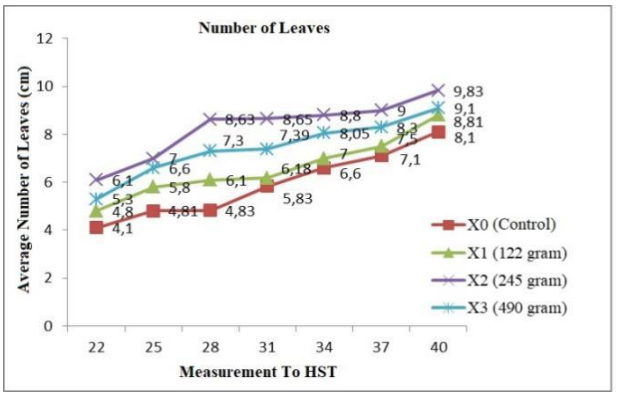

Figure 1.4 Graph of Average Number of Leaves Plants

Figure 1.4 show the average leaf number of mustard plants. Among the control groups from 22 HST to 40 HST, X_2 (245 grams) had the highest number of leaves, averaging 9.8 strands, while the least average number of leaves found in the treatment X_0 (control) with an average of 8.1 strands.

Wet Weight

In this study, data on mustard plant weight was obtained from 3 treatments, 1 control and 6 replications for 40 days, the results can be seen in Figure 1.5.

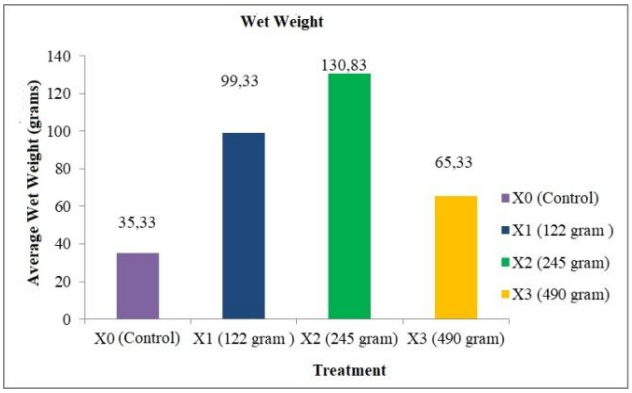

Figure 1.5 Graph of Average Wet Weight Plants

The average wet weight of mustard plants is as show in figure 1.5 is found in X_2 (245 grams) with a weight of 130.83 grams, while the lightest wet weight average is found in the X_0 treatment (control) with a weight of 35.33 grams.

Table 1. Results of F_{hit} and F_{tab} Based on Anova Variance Test of 40 HST Measurement

Measurement Parameters	F_{hit}	F_{tab}
Plant Height	11,893*	
Leaf Length	14,310*	
Leaf Width	5,106*	3,10
Number of Leaves	8,205*	
Wet Weight	30,681*	

Notes: * Significant

Based on the results of the analysis of variance (Anova) shown in table 4.1, all treatments studied had a significant effect ($\alpha = 0.05$) on all parameters.

Table 2. BJND Test Results on Growth Parameters Measurement to 40 HST

treatment	High Plant (cm)		Leaf Length (cm)		Leaf Width (cm)		Number of Leaves (blade)		Weight Wet (grams)	
	X	Test BJND	*X*	Test BJND	*X*	BJND test	*X*	BJND test	*X*	BJND test
X_0	17,68	a	10,44	a	7,38	a	5,90	a	35,33	a
X_1	25,57	c	12,97	b	8,82	ab	7,04	bc	99,16	c
X_2	26,60	c	15,92	c	10,52	b	7,73	c	130,83	d
X_3	22,08	b	12,62	b	8,28	a	6,35	ab	65,33	b

Notes: Numbers in columns marked with the same letter are not significantly different on the BJND test α = 0.05

The BJND test results of wet weight of treatments X , X , X_{123} and Xo were significantly different.

Discussion

The results of descriptive analysis showed that plant height, leaf length, and leaf width of mustard plants from the 22nd measurement of HST to 40-HST had an increasing growth along with the increasing age of the plant. The need for nutrients that can be utilised by mustard plants, especially in the vegetative phase growth to produce good growth. Mardhiana, et al. (2018: 4), nutrients in swallow guano are needed in the early stages of growth to plant height. The available nutrients will cause photosynthesis and metabolic processes that can increase plant activity in the vegetative growth process, as well as increase the growth of meristem tissues as activators in the process of carbohydrate synthesis so that plants will be able to grow well and be followed by an increase in leaf width, leaf length and plant height.

Based on the results of descriptive analysis, in plant height, the X_2 (245 grams) of swallow guano showed similar growth to other growth parameters, such as length, width, number of leaves, and wet weight. This indicates that the X_2 treatment (245 grams) has the highest growth, giving a greater average growth than the other treatments. This is because the nutrients provided are sufficient for the needs of mustard plants. This is in accordance with research conducted by Mardhiana, et al (2018: 2) that swallow guano has the potential it can be used organic fertilizer for plants because swallow guano contains nitrogen, phosphorus, potassium, calcium and magnesium which are good for mustard growth and yield.

Based on the results of the analysis of variance in the 40 HST measurement table, $F_{hit} > F_{tab}$ show that plant height, leaf length, leaf width, number of leaves and wet weight are obtained significant effect of swallow guano on mustard plant growth. This is because swallow guano has nutrients that plants need for mustard plant growth. This is in line with Arinong, et al (2014: 45), a plant will grow and reach high production levels if the essential nutrients needed by plants are in an optimal or sufficiently available and balanced state in the soil and the fulfilment of nitrogen, phosphorus, and potassium elements. According to Sundari and Sawalin (2019: 17) nitrogen is a macro and essential nutrient that is needed in large quantities and plays an important role in the formation of root, stem, and leaf tissues. Therefore, nitrogen is needed in relatively large amounts in every plant growth, especially in the vegetative growth stage.

Based on the analysis of variance further test of Duncan's Real Distance Difference (BJND) in the 40 HST measurement table shows that the treatment of X_1 (122 grams) and X_3 (490 grams) is not significantly different in length, width, number of leaves and weight of leaves, X_2 treatment (245 grams) was different because it had growth for all growth parameters. Treatment X_3 (490 grams) has a growth that tends to decrease than treatment X_1 (122 grams), this is because plants have a certain limit in absorbing nutrients. Based on research by Ralahalu et al, (2013: 5), giving too high a concentration of organic fertiliser will suppress growth or not spur plant growth in both the vegetative and generative phases.

Environmental factors that can affect the growth of mustard plants are water and light. Water availability is closely related to the process of nutrient absorption by plants in the metabolic process. Plants respond to the availability of water by increasing vegetative growth. During the vegetative growth period, plants need water to carry out cell division and expansion (Khoirunisa, et al., 2021: 143). Extreme weather conditions with high rainfall intensity will affect sunlight in the photosynthesis process. The photosynthesis process also requires good light to produce wide, fresh and light green leaves. According to Pramitasari, et al. (2016: 54) stated that evenly distributed light can be received by the leaves causing the assimilation process to accumulate more where the assimilate will be used as plant growth to form vegetative organs such as leaf width.

Conclusion

The study showed that swallow guano (245 grams/ 3 kg) gave the best effect on the growth of mustard plants (*Brassica juncea L.*) when compared with parameters such as plant height, length, width, number of leaves, and wet weight measuring parameters on plant height.

Acknowledgement

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Disclosure of interest

The authors report no conflict of interest.

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