Received: 26-06-2025 Accepted: 29-06-2025 Publish: 30-06-2025

THE EFFECT OF GUANO FERTILIZER APPLICATION ON THE GROWTH OF TOMATO PLANTS (*Solanum lycopersicum* L.)

Komalasari [1*], Ukky Maghfiroti [2], Cindy Fatika Sari [3], Chikal Santi Andarista[4]
[1*,2,3,4] Department of Biology, Faculty of Mathematics and Natural Sciences, Semarang State University, Indonesia
**Corresponding author*: komalasr012 @gmail.com
DOI:10.15408/aj.v19i1.48586

Abstract

The high market demand for tomatoes is driven by increasing public consumption from year to year. This high market demand encourages farmers to increase tomato production with superior quality. Guano fertilizer has strategic value for increasing productivity and quality of tomatoes. The use of environmentally friendly and easily accessible guano fertilizer will reduce farmers' dependence on relatively expensive chemical fertilizers, thereby increasing production cost efficiency. This study not only aims to identify the optimal dose of guano fertilizer for tomato growth, but also contributes to the development of a productive, efficient, and environmentally friendly agribusiness production system. This study used a Completely Randomized Block Design with a single factor: guano fertilizer dosage (0, 26, 51, and 71 g per pot), with nine replications, totaling 36 experimental units. The experiment was conducted in a greenhouse using soil media in 19 cm pots diameter, from March 13 to May 8, 2023. Guano fertilizer was applied once 10 days after planting (DAP). Observations on plant height, number of leaves, and leaf area were taken biweekly from 14 to 56 DAP. Data were analyzed using Analysis of Variance in SPSS, followed by Duncan's Multiple Range Test at a 5% significance level. The results showed that the dose of guano fertilizer that significantly affected the increase in plant height, leaf area and number of leaves of tomato plants was dose 2 of 51 grams.

***Keywords**: Guano, Fertilizer, Tomato, Productivity.*

INTRODUCTION

Tomatoes contain various important vitamins, including vitamin C, vitamin E, and lycopene, which are known for their antioxidants and have natural fiber that is beneficial for digestive health (Purwanto, 2018). The abundant nutritional content makes tomatoes a highly nutritious fruit and has various health benefits. Therefore, tomatoes have high market demand. The high market demand for tomatoes is driven by increasing public consumption from year to year. The Central Statistics Agency of Indonesia (2022) stated that tomato consumption by the household sector in 2021 reached 677.97 thousand tons, an increase of 6.93% or 43.96 thousand tons compared to 2020. Tomato consumption from the household sector contributed 44.81% of the total national tomato consumption. This high market demand encourages farmers to increase tomato production with superior quality.

The production of superior tomatoes can be done through various approaches, such as the application of the agricultural technology, the use of quality tomato seeds, effective control of plant pests, and the fulfillment of plant nutritional needs through fertilization. Currently, most farmers in Indonesia still rely on chemical inorganic fertilizers that can cause land degradation and decreased soil productivity. These negative impacts reduce the organic matter content of the soil, water holding capacity, soil pH, and disrupt the balance of the soil ecosystem (Purwanto, 2018). This has the potential to hinder increased production and quality of harvests, which ultimately affects the competitiveness of horticultural products in the market.

The use of organic fertilizers is a relevant alternative in supporting sustainable agribusiness. Organic fertilizers provide significant benefits in improving soil structure and porosity (Tao et al., 2024). One of the potential organic fertilizers is guano fertilizer from bat droppings that decompose naturally in caves. This fertilizer has very potential chemical characteristics as an organic fertilizer. Its high total nitrogen content, which is 8.20%, makes it a superior natural nitrogen source to support plant vegetative growth. In addition, the phosphorus (P_2O_5) content of 2.00% and potassium (K_2O) of 0.5% also support the generative phase and plant

Received: 26-06-2025 Accepted: 29-06-2025 Publish: 30-06-2025

resistance. The organic matter content (67.30%) is very high, which is useful for improving soil structure and increasing microbial activity. The C/N ratio between 8–15:1 indicates balanced nitrogen availability and allows rapid decomposition without nitrogen immobilization. Although guano's pH is acidic (4.00) and salinity is moderate (1.30%), its use remains promising in sustainable agricultural systems with proper management, such as adjusting soil pH (Karagöz & Hanay, 2020).

Previous studies have shown that the use of guano fertilizer has a significant effect on the growth of various horticultural plants. Maisarah & Fitriah (2022) reported that the experiment of 10 g/polybag of guano fertilizer was able to significantly increase plant height, number of leaves, and fresh weight of kale plants. Another study by Simon et al., (2024) showed that the addition of guano fertilizer was proven to have a positive impact on the growth and productivity of fenugreek plants (*Trigonella foenumgraecum*). Treatment with 50% guano combined with soil amendments resulted in the highest germination rate (99%) and the best plant growth, marked by a plant height of 16.3 cm and the highest number of leaves (10.33 strands) within 4 weeks.

Guano fertilizer has strategic value for increasing the productivity and quality of tomato fruit. The use of environmentally friendly and easily accessible guano fertilizer will reduce farmers' dependence on relatively expensive chemical fertilizers, thereby increasing production cost efficiency. This will have an impact on increasing farming profits, competitiveness of tomato products in the market, and supporting sustainable and market-oriented horticultural agribusiness practices. This study not only aims to identify the optimal dose of guano fertilizer for tomato growth, but also contributes to the development of a productive, efficient, and environmentally friendly agribusiness production system.

RESEARCH METHODS

Research Type and Design

This study employed a completely Randomized Block Design with a single factor, the dosage of guano fertilizer. The experiment consisted of four treatment levels and nine replications, resulting in a total of 36 experimental units. Observations were conducted at 14, 28, 42, and 56 days after planting (DAP). Treatment placement within each replication was randomized.

The guano fertilizer treatments were as follows:
T0: Tomato plants without fertilizer (control)
T1: Tomato plants with 26 g of guano fertilizer
T2: Tomato plants with 51 g of guano fertilizer
T3: Tomato plants with 71 g of guano fertilizer

The experiment was conducted in a greenhouse using planting pots with a diameter of approximately 19 cm. The growing medium used was soil purchased from a local agricultural shop. The following steps outline the research procedures:

Seed Germination and Transplanting

The soil medium was prepared and placed into pots. Tomato seeds were planted on March 13, 2023, with ten seeds per pot. Seeds were covered lightly with soil and watered sufficiently. After germination, three seedlings per pot were retained for further observation, while the others were removed and transplanted into separate pots.

Fertilizer Application

Fertilization was applied once, on March 23, 2023 (10 DAP), by evenly spreading the pre-weighted guano fertilizer according to the treatment dose. The fertilizer was then moistened with water to facilitate absorption.

Agribusiness Journal

Received: 26-06-2025 Accepted: 29-06-2025 Publish: 30-06-2025

Plant Maintenance
Routine care includes watering every morning and evening with manual weeding once a week. Weekly inspections for plant pests and diseases were also conducted.

Location and Time of Research
The location of this research is at the Green House LPPM Universitas Negeri Semarang . The time of this research was carried out for 56 days from March 13-May 8, 2023.

Data Analysis Technique
Plant Height
Measured from the base of the stem to the highest leaf tip using a ruler or measuring tape. Observations were taken biweekly from 14 to 56 DAP.

Number of Leaves per Plant
Counted manually every two weeks from 14 to 56 DAP.

Leaf Area
Calculated using the formula: LA = p × l; LA = leaf area (cm²), p = leaf length (cm), l = leaf width (cm). Measurements were taken every two weeks from 14 to 56 DAP. The observational data were statistically analyzed using the SPSS application through Analysis of Variance (ANOVA). If significant differences were found, the analysis was followed by Duncan's Multiple Range Test (DMRT) at the 5% significance level.

RESULTS AND DISCUSSION

Guano fertilizer is a good source of organic fertilizer for plants with high macro and micro nutrient content. Guano fertilizer needs to be given in high doses and requires a long decomposition process before the nutrients can be used by plants (Kurniawan & Jumini, 2018). The results of the study on the effect of guano fertilizer doses on tomato plant growth can be seen in **Table 1**.

Table 1. Documentation of Tomato Plant Growth with Guano Fertilizer Application at 56 DAP

Control			
Dose 1			

Received: 26-06-2025 Accepted: 29-06-2025 Publish: 30-06-2025

Dose 2			
Dose 3			

Source: Primary Data, 2023.

Plant Height

The results of the analysis of variance showed that there was an interaction in the treatment of guano fertilizer concentration at all ages of plant height, both at the age of 14 DAP, 28 DAP, 42 DAP, and 56 DAP. The 5% DMRT test showed that dose 2 had a significant effect on the height of tomato plants. Complete data can be seen in **Table 2.** The growth pattern of plant height between doses of guano fertilizer is presented in **Figure 1.** At the age of 14-42 DAP, tomato plants require more fertilizer to support vegetative growth. This happens because plants that maximize meristem cell division (young cells) cause an increase in height as the plant ages (Mooy et al., 2019). The highest content of guano fertilizer is the element N, which accelerates the growth rate of tomatoes. Guano fertilizer also has the element K which stimulates root and stem growth, the element Ca, which stimulates the hardening of plant stems to become strong and stimulates the formation of root hairs, and the element Mg which helps the process of providing proteins such as carbohydrates and proteins (Raharjo & Prihatiningrum, 2021). Therefore, guano fertilizer has the potential to be applied to tomato plants.

Table 2. Effect of Guano Fertilizer Dosage on Tomato Plant Height

Treatment	Tomato Plant Height			
	14 DAP	28 DAP	42 DAP	56 DAP
Control	6.75 a	13.51 a	20.26 a	48.22 a
Dose 1	7.86 b	15.73 a	23.6 b	49.55 a
Dose 2	**8.36 b**	**16.73 b**	**25.1 b**	**63.66 b**
Dose 3	7.51 ab	15.02 ab	22.53 ab	49.11 a

Source: Primary Data Analysis, 2023.

Agribusiness Journal
Received: 26-06-2025 Accepted: 29-06-2025 Publish: 30-06-2025

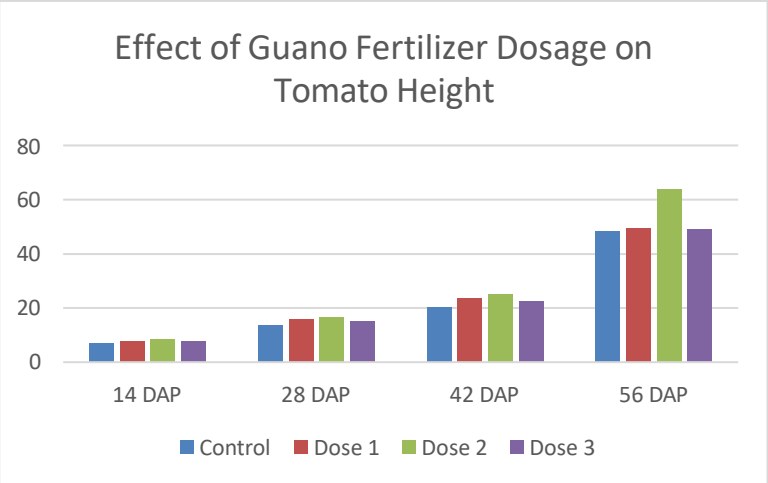

Figure 1. Effect of Guano Fertilizer Dosage on Tomato Plant Height

Leaf Area

The results of the analysis variance of leaf area calculations showed that the treatment of guano fertilizer concentration affected all plant ages, and dose 2 had the best effect on increasing the leaf area of tomato plants (**Table 3, Figure 2)**. Guano fertilizer contains a high level of nitrogen, which accelerates tomato growth and increases leaf area. Nitrogen plays a key role as a regulator in the distribution of photosynthetic products throughout the plant (Noor et al., 2023). In this study, several leaves necrosis. This is possible due to the influence of environmental factors. Anwar et al., (2015) stated that one of the components that determines the success of plant growth is the environment. During the study, it often rained and the weather tended to be humid with low light intensity so that the photosynthesis process was disrupted and the photosynthesis results were also low.

Table 3. Effect of Guano Fertilizer Dosage on Tomato Plant Leaf Area

Treatment	Tomato Plant Leaf Area (cm^2)			
	14 DAP	28 DAP	42 DAP	56 DAP
Control	7.9667 a	9.56 a	11.472 a	17.208 a
Dose 1	12.5778 b	16.86 b	20.232 b	30.348 b
Dose 2	**16.0844 d**	**24.1267 d**	**36.19 d**	**54.285 d**
Dose 3	14.05 c	18.8667 c	28.3 c	42.45 c

Source: Primary Data Analysis, 2023.

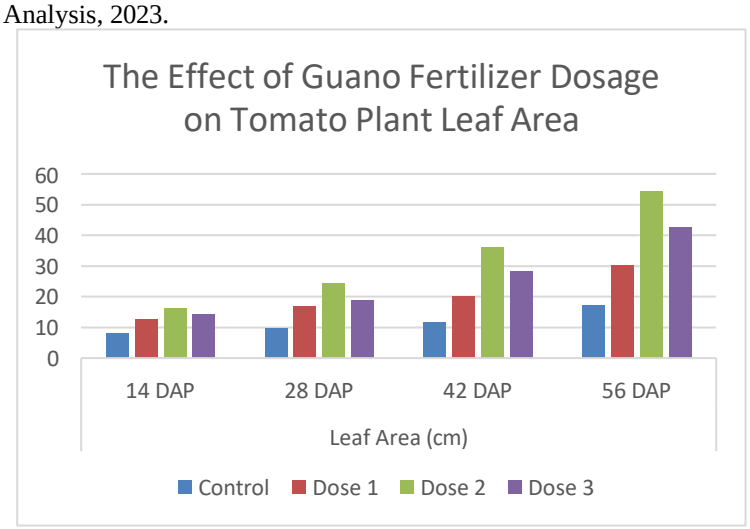

Figure 2. Effect of Guano Fertilizer Dosage on Tomato Plant Leaf Area

Agribusiness Journal
Copyright® State Islamic University (UIN) Syarif Hidayatullah Jakarta, 2025.
Received: 26-06-2025 Accepted: 29-06-2025 Publish: 30-06-2025

Number of Leaves

The results of the analysis variance in the treatment of guano fertilizer concentration on the number of leaves showed that the interaction had no significant effect at the age of 14 DAP, but had a significant effect at the ages of 28, 42 and 56 DAP. This is because guano fertilizer is an organic fertilizer that decomposes slowly so the possibility of macro or micro nutrients at 14 DAP tends to be small (Mooy et al., 2019; Raharjo & Prihatiningrum, 2021). After carrying out a further 5% DMRT test, there were real differences between the procedures; complete data can be seen in **Table 4**.

Table 4. Effect of Guano Fertilizer Dosage on the Number of Leaves of Tomato Plants

Treatment	Number of Leaves			
	14 DAP	28 DAP	42 DAP	56 DAP
Control	4.0 a	5.5556 a	6.2222 a	7.5556 a
Dose 1	4.0 a	6.0 b	8.1111 b	10.2222 c
Dose 2	**4.0 a**	**7.0 c**	**9.7778 d**	**12.6667 d**
Dose 3	4.0 a	6.2222 b	7.1111 c	8.8889 b

Source: Primary Data Analysis, 2023.

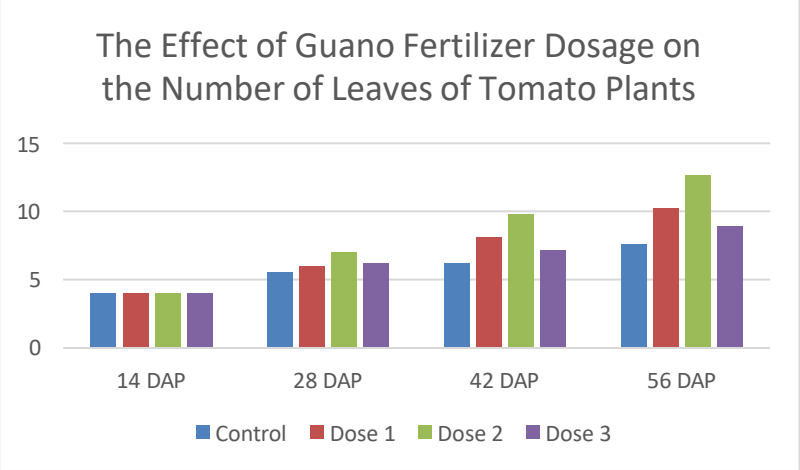

Figure 3. Effect of Guano Fertilizer Dosage on the Number of Leaves of Tomato Plants

Optimum Dosage of Guano Fertilizer for Tomato Plants

Maximum growth in tomato plants achieved when fertilizer is given at the optimal dose. This experiment shows that a dose of 51 g of guano fertilizer produces the maximum growth for all parameters, including plant height, number of leaves, and leaf area, compared to doses of 26 g and 71 g. This is because the amount of N nutrients at a dose of 51 g is sufficient to optimize tomato growth. The N content in guano fertilizer has the highest percentage compared to other nutrients. The dose of 26 g given to plants has not produced maximum growth in tomato plants. This is because the N received is not enough to the needs of plants in forming cells and regulating all physiological processes that occur during the growth period. Meanwhile, a dose of 71 g also showed less than maximum growth due to the availability of excess N in plants. Conditions below and above the adequacy range will cause symptoms of nitrogen deficiency and excess.

CONCLUSIONS AND SUGGESTIONS

The dose of guano fertilizer that significantly affected the increase in plant height, leaf area, and number of leaves of tomato plants was dose 2 (51 grams). Further research is needed with the same concentration, equipped with more parameters, to see the accuracy of the data.

Received: 26-06-2025 Accepted: 29-06-2025 Publish: 30-06-2025

REFERENCE

Anwar, M. R., Li Liu, D., Farquharson, R., Macadam, I., Abadi, A., Finlayson, J., Wang, B., & Ramilan, T. (2015). Climate change impacts on phenology and yields of five broadacre crops at four climatologically distinct locations in Australia. *Agricultural Systems*, *132*, 133–144. https://doi.org/10.1016/j.agsy.2014.09.010

Central Statistics Agency of Indonesia. (2022). *Statistik Hortikultura 2021*. Badan Pusat Statistik Indonesia [in Indonesia]. (Mei, 2023) Accessed via https://www.bps.go.id/id/publication/2022/06/08/44e935e8c141bcb37569aed3/statistik-hortikultura-2021.html

Karagöz, K., & Hanay, A. (2020). Effect of bat guano on cation exchange capacity, some macro nutrient content and reaction of soil (pH). *Atatürk Üniversitesi Ziraat Fakültesi Dergisi*, *51*(2), 140–144. https://doi.org/10.17097/ataunizfd.607312

Kurniawan, T., & Jumini, J. (2018). Pengaruh dosis pupuk Guano dan NPK terhadap pertumbuhan dan produksi tanaman Tomat (Lycopersicum esculentum Mill.). *Jurnal Ilmiah Mahasiswa Pertanian*, *3*(4), 26–33. https://doi.org/10.17969/jimfp.v3i4.9207

Maisarah & Fitriah. (2022). Pengaruh Pemberian Dosis Pupuk Guano terhadap Pertumbuhan dan Hasil Beberapa Varietas Tanaman Kangkung (Ipomea aquatica). *Perbal: Jurnal Pertanian Berkelanjutan*, *10*(1), 137–146. https://doi.org/10.30605/perbal.v10i1.1611

Mooy, L. M., Hasan, A., & Onsili, R. (2019). Growth and yield of Tomato (Lycopersicum esculantum Mill.) as influenced by the combination of liquid organic fertilizer concentration and branch pruning. *IOP Conference Series: Earth and Environmental Science*, *260*(1). https://doi.org/10.1088/1755-1315/260/1/012170

Noor, H., Ding, P., Ren, A., Sun, M., & Gao, Z. (2023). Effects of nitrogen fertilizer on photosynthetic characteristics and yield. *Agronomy*, *13*(6), 1550. https://doi.org/10.3390/agronomy13061550

Purwanto, S. (2018). *Pengaruh dosis pupuk bohasi paitan (Tithonia diversifolia) dan pupuk guano terhadap pertumbuhan dan hasil tanaman tomat (Lycopersicum esculentum Mill.) varietas marta 9 F1*.[Skripsi, UIN Sunan Gunung Djati Bandung].

Raharjo, S., & Prihatiningrum, A. E. (2021). Pengaruh Konsentrasi dan Frekuensi Pemberian Pupuk Guano Cair Terhadap Pertumbuhan dan Produksi Tanaman Tomat (Solanum lycopersicum var. Cerasiforme). *Jurnal Nabatia*, *9*(2), 1–13. https://doi.org/10.52046/biosainstek.v2i01.323

Simon, J., Pooja, V., & Khannam, A. (2024). Efficacy of Bat Guano as a Plant Fertiliser on Growth of Fenugreek (Trigonella foenum-graecum L.) in Sustainable Agriculture. *Journal of Agriculture and Ecology Research International*, *25*(6), 147–155. https://doi.org/10.9734/jaeri/2024/v25i6648

Tao, W., Shao, F., Yan, H., & Wang, Q. (2024). Microbial Organic Fertilizer Combined with Magnetically Treated Water Drip Irrigation Promoted the Stability of Desert Soil Aggregates and Improved the Yield and Quality of Jujubes. *Plants*, *13*(14), 1930. https://doi.org/10.3390/plants13141930