



Growth and Yield of Broccoli Vegetables (*Brassica oleracea* var. *botrytis* L.) on Types and Dosages of Manure

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Abstract

Broccoli is a vegetable commodity that has high commercial value and prospects in Indonesia, because of its role in fulfilling food, feed, and industrial needs. In cultivating broccoli plants, they still face production problems due to nutrient availability problems. Farmers generally use chemical fertilizers continuously. Continuous use of chemical fertilizers will increase soil acidity, damage the physical condition of the soil, reduce organic matter, make plants vulnerable to pests and disease, and reduce soil microbial life. Many consumers are interested in organic broccoli. The use of organic fertilizer as an alternative to chemical (inorganic) fertilizer can reduce environmental pollution and create healthy broccoli (*Brassica oleracea*) vegetable products. One of the organic fertilizers is manure which is a waste product from domestic animals such as chickens, goats, and pigs which are generally found in Tomohon City. Manure can be used to add nutrients, and improve the physical and biological properties of soil. The quality of manure depends on the animal and greatly influences crop yields. The research objectives are: (1) Studying the effect of the interaction between the type and dose of manure on broccoli growth and yield, (2) Obtaining the type and dose of manure that provides the highest growth and yield of broccoli, and (3) Get semi-organic broccoli by using a 25% dose of compound nitrogen, phosphorus, potassium (NPK) fertilizer. To achieve the above objectives, this research used a Factorial Randomized Block Design (FRBD) with 2 treatment factors and 3 replications the first factor was the type of manure (A) which consisted of A1: Chicken manure, A2: Goat manure, A3: Pig manure. The second factor is the dose of manure (B) which consists of B0: 125 kg NPK/hectare, B1: 20 manure/hectare, B2: 30 kg/hectare. The observation variables include plant height, number of leaves, diameter of broccoli per plant, and wet weight of broccoli per plant. Data analysis uses Analysis of Variance (ANOVA). If the results of the analysis show that there is an effect of treatment, then continue with the BNT test at the 5% level. The results showed that the treatment with goat manure at a dose of 20 tons/hectare and without manure at half the recommended dose of nitrogen, phosphorus, and potassium gave the highest number of leaves (18.67 and 19.67 leaves). The best broccoli crop diameter was treated with goat manure at a dose of 20 and 30 tons/hectare. The weight of the best broccoli crop in goat and pig manure at a dose of 20 tons/hectare was 47.67 grams.

Keywords: *Broccoli Produce; Manure; Semi-Organic; Broccoli Vegetables*

Introduction

Broccoli as a vegetable is in great demand among people, apart from being nutrient-dense, it is also an ingredient in various cooking menus and juice ingredients for healthy eating. The demand for broccoli is increasing with very fluctuating prices, but on average the price of broccoli is expensive. Sometimes broccoli vegetables are difficult to obtain so they do not meet consumer needs. For this reason, broccoli production needs to be increased.

Broccoli plants are vegetables with high nutritional value which have economic value so they can increase farmers' income. Broccoli is a vegetable commodity that has high commercial value and prospects in Indonesia because this plant has a main role in fulfilling the needs of food, feed, and industry at home and abroad. Broccoli is a vegetable that has high nutritional value and is very beneficial for human health. Broccoli contains several vitamins, including vitamins A, B1, B2, B5, B6, and E. Apart from that, it contains the elements Ca, Mg, Zn, and Fe and antioxidant substances (Gad & Moez, 2011)

Broccoli plants require a planting medium that has a loose and crumbly structure, for this reason, the addition of organic material in the form of manure is very necessary to obtain high plant yields. Providing manure in planting areas will make the soil structure looser so that plant roots can better absorb nutrients from the soil. Manure is an organic fertilizer that is complete in nutrient content because its presence is very important for forming plant parts during the vegetative and generative growth periods. The high and complete nutrient content means that organic fertilizer can be used as a source of nutrients for plants (Manik et al., 2021).

Organic farming is an agricultural technology that uses plant and animal waste as a soil amendment to improve the physical, chemical, and biological properties of the soil. Animal waste from cages has the potential to be used as fertilizer because it contains macro, and micronutrients and growth regulators. The results of the research showed that chicken manure organic fertilizer had the best effect on corn plants, namely the 10 tons/hectare chicken manure organic fertilizer treatment (Muktamar et al., 2016). MOL (*Local Microorganisms*) as a liquid organic fertilizer is very good for the environment because it does not cause environmental pollution and provides soil microorganisms which are useful in decomposing organic materials into fertilizer that is absorbed by plants.

The nutrient content in banana weevils is: Carbohydrates 76.57 (%), Water 18.97%, Fat 2.11%, Protein 0.32%, Calcium 717 mg/100g, Phosphorus 114 mg/100g, and Iron 0.13 mg /100 g (Masarirambi et al., 2012; Nurmalsari et al., 2023; Tumewu et al., 2018). Banana weevil moles contain the bacteria *Lactobacillus sp.*, *Pseudomonas sp.*, *Azospirillum*, *Azotobacter*, *Bacillus*, *Aeromonas*, *Aspergillus*, phosphate solubilizing microbes, and cellulolytic microbes (Kurniawan, 2018; Mukhlis, 2020). MOL will be used as a decomposer in making manure. MOL will be used as a decomposer in making manure to improve the quality of manure. Providing several concentrations of local microorganisms from banana weevils had a significant effect on the number of leaves of cocoa seedlings aged 8 WAP and had a very significant effect on the number of leaves of cocoa seedlings aged 12 WAP. There is a significant interaction between the planting media treatment and the 20% mole concentration (M2)(Sebayang et al., 2019). Banana weevils contain types of microbes that have been identified in the MOL of banana weevils, including *Bacillus sp.*, *Aeromonas sp* and *Aspergillus nigger* (Mukhlis, 2020). Local Microorganism Solution (MOL) is a solution resulting from the fermentation of various sources, both plant and animal. The MOL solution contains macro and micronutrients and also contains bacteria which have the potential to degrade organic matter, stimulate growth in plants, and act as pest and plant disease control agents. MOL will be used as a decomposer in making manure.

Tomohon has lots of chicken coops, pigs, and a little goat droppings. Different types of animals will also differ in the nutrient content available. Manure is very good for use in vegetable cultivation, but the nutrient content in manure is relatively low, so this fertilizer is needed in large quantities. To increase

crop production, the use of organic fertilizers such as manure can be combined or mixed with inorganic fertilizers or artificial fertilizers in the right composition. Purposeful research to (1) Study the effect of the interaction between type of manure and dosage on broccoli growth and yield. (2) Get a dose of manure to increase the growth and yield of broccoli on different types of manure. (3). Get semi-organic broccoli by using a 25% dose of compound NPK fertilizer. Providing manure using MOL as a decomposer is expected to increase broccoli growth and yield.

Method

A study was held in Kakaskasen two Tomohon from March–August 2023). The research used a Factorial Randomized Block Design (FRBD) with 2 treatment factors and 3 replications: the first factor was the type of manure (A) which consisted of A1: Chicken manure, A2: Goat manure, A3: Pig manure. The second factor is the dose of manure (B) which consists of B0: 125 kg/hectare compound NPK fertilizer, B1: 20 manure/hectare, B2: 30 kg/hectare. Observation variables include plant height, number of leaves, diameter of the broccoli crop per planting, and weight of the broccoli crop per planting. Data analysis uses Analysis of Variance (ANOVA). If the results show that there is an effect of treatment, then continue with the Smallest Real Difference (SRD) test at the 5% level. The materials and tools used are broccoli seeds, chicken, goat, and pig manure, compound nitrogen, phosphorus, potassium (NPK) fertilizer, Local Microorganism (MOL), measuring tape, scales, oven, soil processing tools, stationery, other materials and tools used.

Results and Discussion

Broccoli Plant Growth

The results of the statistical analysis showed that the type and dose of manure had an effect on the number of broccoli leaves but had no effect on the height of the broccoli plants. The type and dose of manure had a significant interaction with the number of broccoli leaves (Table 1). Treatment of goat manure (A2) at a dose of 20 tons/hectare and A0 (without manure; half the recommended NPK dose) gave the highest number of leaves (18.67 and 19.67 leaves). Goat manure has a C/N of 20-25, causing the weathering process to run well so that the nutrients contained in goat manure can be available to plants. Goat manure can provide macro (N, P, K) and micro (Ca, Mg, S, Na, Fe, Cu, Mo) nutrients (Hartati & Rachman, 2022).

Table 1. Interaction of type and dose of manure on the number of broccoli plant leaves

Treatment	B0	B1	B2
A1	15 .00a (a)	13.33a (a)	18.00b (b)
A2	18 .67b (b)	19.67b (b)	15.33a (a)
A3	16.00a (c)	13.33a (a)	18.33b (b)

SRD 5 % = 2.49

Note: Numbers followed by the same letter in the sign read horizontally are not significantly different based on the 5% BNT test. Numbers followed by the same letter not marked with read vertically are not significantly different based on the 5% SRD test.

Broccoli Yield

The results of statistical analysis show that broccoli yield, which consists of the diameter and weight of the broccoli crop, is influenced by the type and dose of manure. The interaction between the type and dose of manure has a significant effect on crop weight. The type and dose of manure had a significant interaction with the number of broccoli leaves (Table 2).

Table 2. Effect of type and dose of manure on broccoli crop diameter

Treatment	Broccoli Crop Diameter (cm)
A1	6 .52a
A2	7 .79b
A3	6 .26a
SRD 5 % = 0.99	
B0	4 .98a
B1	7 .37b
B2	8 .22b
SRD 5% = 0.99	

Note: Numbers followed by the same letter are not significantly different based on the SRD 5% test.

The best broccoli crop diameter was treated with goat manure doses of 20 and 30 tons/hectare (Table 3). The interaction between the type of manure and the dose has a significant effect, where goat manure at a dose of 20 tons/hectare gives the best fresh weight of broccoli.

Table 3. Interaction of type and dose of manure on wet weight of broccoli crops (g)

Treatment	B0	B1	B2
A1	13.33a (a)	34.00a (b)	57.67b (c)
A2	37.33b (a)	47.67ab (a)	35.67a (a)
A3	29,33ab (a)	56.00b (b)	58.67b (b)
SRD 5 % = 16.18			

Note: Numbers followed by the same letter in the sign read horizontally are not significantly different based on the 5% BNT test. Numbers followed by the same letter not marked with read vertically are not significantly different based on the 5% SRD test.

Providing 40 tons/hectare of goat manure had a better effect compared to other treatments. The highest fresh weight production was achieved in the treatment of 40 tons/hectare of goat manure, namely 13.25 tons/hectare (Panjaitan, 2020). The total weight of agricultural products also requires nutrients, especially Nitrogen, Phosphorus, and Potassium. Nitrogen is needed for the formation of chlorophyll which is useful for the photosynthesis process, and the formation of proteins and fats. The element phosphorus is also useful for stimulating root growth, forming a good root system in young plants to accelerate vegetative growth and plant yields (Patti et al., 2013). Broccoli plants apart from needing additional nutrients through the provision of goat manure also need inorganic NPK. The results of research using goat pens at a dose of 20 tons/hectare by giving half the recommended dose of NPK compound fertilizer gave a fresh weight of broccoli of 47.67 grams with a diameter of 7.79 to 8.22 cm. Half a dose of inorganic NPK fertilizer is not sufficient for the nutrient needs of broccoli plants. The results of the research: The combination of 800 kg hectare-1 NPK fertilizer+10 tons/hectare of goat pen

was able to increase broccoli yields by 203% or 6.85 tons compared to the control treatment, as well as increasing yields by 181% or 6.05 tons compared to the fertilizer treatment. Standard NPK fertilization on broccoli plants can be done with the recommended dose, namely urea 100 kg/hectare, TSP 250 kg/h, and KCl 200 kg/hectare. The crop weight obtained in this study was inadequate due to pest attacks (Patti et al., 2013; Sudarminto, 2015).

Conclusion

Manure at a dose of 20 tons/hectare and without manure at half the recommended dose of NPK gave the highest number of leaves (18.67 and 19.67 leaves). The best broccoli crop diameter was treated with goat manure at a dose of 20 and 30 tons/hectare. The weight of the best broccoli crop in goat and pig manure at a dose of 20 tons/hectare was 47.67 grams.

References

- Gad, N., & Moez, A. E. M. (2011). Broccoli Growth, Yield Quantity and Quality as Affected by Cobalt Nutrition. *Agriculture and Biology Journal of North America*, 2(2), 226–231. <https://doi.org/10.5251/abjna.2011.2.2.226.231>.
- Hartati, T. M., & Rachman, I. A. (2022). Pengaruh Pemberian Pupuk Kandang Kambing terhadap Pertumbuhan dan Hasil Tanaman Caisim (*Brassica campestris*) di Inceptisol. *Agro Bali : Agricultural Journal*, 5(1), 92–101. <https://doi.org/10.37637/ab.v5i1.875>.
- Kurniawan, A. (2018). MOL Production (*Local Microorganisms*) With Organic Ingredients Utilization Around. *Jurnal Hexagro*, 2(2), 36–44. <https://www.e-journal.unper.ac.id/index.php/hexagro/article/view/130>.
- Manik, F., Karo, B. B., Hutabarat, R. C., & Musaddad, D. (2021). Respon Tanaman Brokoli (*Brassica oleracea*) terhadap Pupuk Organik Cair. *Agriprima : Journal of Applied Agricultural Sciences*, 5(2), 122–130. <https://doi.org/10.25047/agriprima.v5i2.434>.
- Masarirambi, M. T., Dlamini, P., Wahome, P. K., & Oseni, T. O. (2012). Effects of Chicken Manure on Growth, Yield and Quality of Lettuce (*Lactuca sativa L.*) “Taina” under a Lath House in a Semi-Arid sub Tropical Environment. *J. Agric. & Environ. Sci*, 12(3), 399–406.
- Mukhlis. (2020). Pengaruh Berbagai Jenis Mikroorganisme Lokal (MOL) Terhadap Pertumbuhan dan Hasil Tanaman Bawang Merah Pada Tanah Aluvial. *Artikel Mahasiswa*, 1–23.
- Muktamar, Z., Fahrurrozi, Dwatmadji, Setyowati, N., Sudjtmiko, S., & Chozin, M. (2016). Selected Macronutrients Uptake by Sweet Corn under Different Rates Liquid Organic Fertilizer in Closed Agriculture System. *International Journal on Advanced Science, Engineering and Information Technology*, 6(2), 258–261. <https://doi.org/10.18517/ijaseit.6.2.749>.
- Nurmalasari, A. I., Rahayu, M., Budiastuti, M. T. S., & Kusumahendra, M. N. E. (2023). *Effectiveness of Biochar and Organic Fertilizer on Growth of Maize in Kayu Putih Agroforestry* (Vol. 1). Atlantis Press International BV. https://doi.org/10.2991/978-94-6463-128-9_2.
- Panjaitan, S. S. P. M. (2020). Pengaruh Pemberian Pupuk NPK Anorganik dan Pupuk Kandang Kambing Pada Pertumbuhan dan Hasil Tanaman Brokoli (*Brassica oleracea L.*). *Jurnal Produksi Tanaman*, 9(1), 25–31.

- Patti, P. S., Kaya, E., & Silahooy, C. (2013). Analisis Status Nitrogen Tanah Dalam Kaitannya Dengan Serapan N oleh Tanaman Padi Sawah di Desa Waimital, Kecamatan Kairatu, Kabupaten Seram Bagian Barat. *Agrologia*, 2(1), 78–79.
- Sebayang, N. S., Puspita, D. E., & Basri, S. (2019). Different Planting Media in Barangan Banana (*Musa Acuminata Colla*) Breeding in Southeast Aceh. *Indonesian Journal of Agricultural Research*, 1(3), 307–316. <https://doi.org/10.32734/injar.v1i3.473>.
- Sudarminto. (2015). *Peluang Usaha Tani Brokoli*. Pustaka Baru Press. Yogyakarta.
- Tumewu, P., Montolalu, M., & Tulungen, A. G. (2018). Aplikasi Formulasi Pupuk Organik Untuk Efisiensi Penggunaan Pupuk Anorganik NPK Phonska Pada Tanaman Jagung Manis (*Zea mays saccharata Sturt*). *Eugenia*, 23(3). <https://doi.org/10.35791/eug.23.3.2017.18961>.

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