

Effect of cow manure and increasing the dose of urea fertilizer on the growth of Mustard Greens (*Brassica juncea* L.)

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ABSTRACT

Mustard greens (*Brassica juncea* L.) are beneficial horticultural crops that are easy to cultivate, even at home; however, soil fertility remains a major challenge in their cultivation in Indonesia. Fertilization can improve the physical properties of the soil, enhance its WAPer retention capacity, and increase microbial activity, thus improving soil fertility. Cow manure is chosen for its advantages: it is easy to obtain, and the continuous availability of raw materials (cow dung) makes it convenient for farmers to acquire. The use of organic fertilizers needs to be balanced with the use of inorganic fertilizers. One such inorganic fertilizer is urea, which contains 46% nitrogen, essential for overall plant growth. This study aims to determine the appropriate dosage of cow manure, the correct dosage of urea, and the interaction between cow manure and urea on the growth and yield of mustard greens. The research employs a Randomized Block Design (RBD) with a factorial arrangement involving two factors. The first factor is the application of cow manure at three levels (S0: 0 tons/ha, S1: 15 tons/ha or 2160 g/plot, S2: 20 tons/ha or 2880 g/plot). The second factor is the application of urea at three levels (P0: 0 kg/ha, P1: 150 kg/ha or 2.4 g/plant, P2: 300 kg/ha or 4.8 g/plant). The results showed that giving 20 tons/ha of cow manure is the right dose to increase plant height, number of leaves, leaf area. The single treatment of urea fertilizer and the interaction between the administration of cow manure and urea fertilizer had no significant effect on plant height, number of leaves, and leaf area. The results of the studied indicate that the use of cow manure plays a greater role in supporting the growth of green mustard greens than the application of urea fertilizer.

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1. INTRODUCTION

Mustard greens (*Brassica juncea* L.) are one of the horticultural vegetable commodities in which the young leaves are utilized as food and provide various benefits and uses. In daily life,

mustard greens are not only consumed as a food ingredient but are also used for medicinal purposes (Kare et al., 2023).

Based on data from the Central Statistics Agency (2021), mustard green production in North Sumatra tended to decline in 2020-2021. In 2020, mustard green production was 75,424 tons/year, while in 2021 it was 74,908 tons/year. Meanwhile, the demand for mustard greens in Indonesia continues to increase, resulting in consumption needs and market demand not being met.

The cultivation of mustard greens is relatively easy, and this crop can even be grown at home. However, its cultivation also faces several constraints, particularly pests and diseases, such as armyworm infestations and leaf spot disease, which can cause economic losses and even lead to crop failure (Panunggul et al., 2022). Based on data from the Badan Pusat Statistik (2021), the production of mustard greens in North Sumatra tended to decline during the period 2020–2021. In 2020, mustard greens production reached 75.424 tons per year, while in 2021 it decreased to 74.908 tons per year. Meanwhile, the continuously increasing demand for mustard greens in Indonesia has resulted in the inability to fully meet consumption needs and market demand.

This condition indicates the need for efforts to increase mustard green production through the application of appropriate cultivation techniques, one of which is through effective fertilizer management. Providing cow manure can be useful as a source of humus, as a source of macro and micro nutrients, as a carrier of beneficial microorganisms and also as a growth stimulant. In addition, cow manure can increase the nutrient content in the soil and also has a good effect on the physical and chemical properties of the soil because it supports the life of microorganisms. Thus, manure has the ability to make the soil fertile (Sinaga, 2019).

The use of organic fertilizers derived from plant, animal, and human residues is an important effort to improve soil fertility, as the continuous application of organic fertilizers over the long term can maintain and enhance soil quality. One type of organic fertilizer that is widely available in the community is cow manure. Cow manure is selected because it has several advantages, including the ease of obtaining the material, the continuous availability of raw materials (cow feces), which greatly facilitates farmers' access, and its relatively low and affordable cost (Fitriana et al., 2022). In addition, cow manure contains 0.46% N, 0.83% P₂O₅, and 0.30% K₂O (Maryam et al., 2015). According to Gole et al. (2019), the use of cow dung has a significant effect on increasing plant height, number of leaves, leaf area, fresh weight and dry weight of mustard green plants.

The use of organic fertilizers needs to be balanced with the application of inorganic fertilizers. Inorganic fertilizers can increase the availability of essential nutrients in the soil and can be directly utilized by plants. One inorganic fertilizer that can be used is urea. Urea contains 46% nitrogen, which is highly required by plants to stimulate overall growth, particularly of stems, branches, and leaves (Timung et al., 2021).

Urea fertilizer (nitrogen) is more required by mustard greens than phosphorus and potassium fertilizers because mustard greens are leafy vegetable crops that require relatively large amounts of nitrogen to support optimal vegetative growth, such as the formation of abundant leaves with a fresh green color. Leaves are plant organs where food synthesis for plant needs occurs and where food reserves are stored; they contain chlorophyll, which plays an essential role in the process of photosynthesis (Suhastyo and Raditya, 2019).

Based on the description above, the author chose this title for the balanced use of organic and inorganic fertilizers, which is expected to increase the growth and production of mustard greens whose leaves are harvested, with the criteria of fresh green leaves and good for consumption.

2. METHOD

This research was conducted in Sei Semayang, Sunggal Subdistrict, Deli Serdang Regency, North Sumatra, utilizing a 10x10 m² plot of land at an elevation of ± 10 meters above sea level (masl). The research began in May until June 2024.

The materials used in this research were Tosakan variety mustard seeds, cow manure, urea fertilizer. The tools used are a hoe, ruler, sample pack, plastic rope, analog scales, digital calipers, WAPering can, label paper, hand sprayer, digital camera, stationery, calculator, knife, ruler.

This research used a Factorial Randomized Block Design (RBD) with 2 factors, namely: the first factor was the use of the provision of cow manure consists of 3 levels (S0: 0 ton/ha (control), S1: 15 ton/ha (equivalent 2.160 g/plot), and S2: 20 ton/ha (equivalent 2.880 g/plot), and the second factor was the urea fertilizer application using 3 levels (P0: 0 kg/ha (control), P1: 150 kg/ha (equivalent 2,4 g/plant), and P2: 300 kg/ha (equivalent 4,8 g/plant)).

Cow manure is given once according to the treatment, namely 5 days before planting, 10 days before planting, and 15 days before planting, by placing it in the planting hole with a depth of ± 10

cm according to the treatment dose. Meanwhile, urea is given twice, namely when the plants are 7 and 14 days old after transplanting, with half the treatment dose each time. The number of plants per bed is 9 plants, the number of samples per bed is 4 samples, the planting distance is 30 x 30 cm and the number of replications is 3. To compare means, the data were subjected to analysis of variance (ANOVA). Duncan's Multiple Range Test was used to identify the mean at a probability level of 5% using Microsoft Excel. Parameters observed were plant height (cm), number of leaves (sheet), leaf area (cm²).

3. RESULTS AND DISCUSSION

3.1 Plant Height (cm)

Equations should be placed at the center of the line and provided consecutively with equation numbers in parentheses flushed to the right margin, as in (1). The use of Microsoft Equation Editor or MathType is preferred.

Based on the results of the ANOVA test, it was found that the treatment of the cow manure treatment significantly affected plant height at 2, 3, and 4 weeks after transplanting (WAP). Meanwhile, urea fertilizer treatment and the interaction between the two did not significantly affect plant height at 2, 3, and 4 weeks after transplanting (WAP).

The results of the analysis of variance indicate that the application of cow manure had a significant effect on plant height. This is attributed to the nutrient content of cow manure, such as organic matter and nitrogen (N), which are sufficiently available for plant uptake. The addition of organic matter to the soil can increase soil cation exchange capacity and reduce the loss of nutrients applied through fertilization, thereby enhancing nutrient availability in the soil and improving fertilizer efficiency. The function of organic matter is to improve soil structure, increase the availability of N, P, and K nutrients, and enhance the soil's water-holding capacity (Rosadi et al., 2019). Syekhfani (2011) stated that the nutrient content of cow manure consists of 2.33% N, 0.61% P₂O₅, and 1.58% K₂O. Nitrogen plays a role in promoting plant growth and preventing stunted growth; phosphorus functions during the early growth stages to enhance root development, tiller formation, and accelerate flowering; while potassium serves to strengthen plant cell walls and plays a role in expanding the leaf canopy for photosynthesis (Winarso, 2011).

Table 1. The Height of Mustard Greens Plants in Response to Cow Manure and Urea Fertilizer Application at 2, 3, and 4 weeks after planting (WAP)

WAP	Cow manure	Urea Fertilizer			Mean
		0 kg/ha	150 kg/ha	300 kg/ha	
2	0 ton/ha	11,33	11,40	11,53	11,42a
	15 ton/ha	11,91	12,03	12,26	12,07b
	20 ton/ha	12,42	12,70	12,76	12,63c
	Mean	11,89	12,04	12,19	
3	0 ton/ha	17,82	17,93	18,01	17,92a
	15 ton/ha	18,25	18,28	18,51	18,34a
	20 ton/ha	19,09	19,52	20,13	19,58b
	Mean	18,38	18,57	18,88	
4	0 ton/ha	28,41	28,84	29,07	28,77a
	15 ton/ha	29,31	29,48	29,79	29,53b
	20 ton/ha	31,03	31,27	31,57	31,29c
	Mean	29,58	29,86	30,14	

Note: Numbers followed by different letters in different treatment groups are significantly different according to Duncan's Multiple Range Test at the 5% level.

3.2 Number of Leaves (sheet)

Based on the results of the ANOVA test, it was found that the treatment of cow manure treatment significantly affected the number of leaves at 2, 3, and 4 WAP. Meanwhile, urea fertilizer treatment and the interaction between the two did not significantly affect the number of leaves at 2, 3, and 4 WAP.

The results of the analysis of variance indicate that the application of cow manure had a significant effect on the number of leaves. This is because leaves develop at each node of the plant stem; therefore, the taller the plant, the greater the number of leaves produced. This finding is in accordance with the opinion of Setiono and Azwarta (2020), who stated that higher chlorophyll content and larger leaf surface area, which contain more chlorophyll, result from increased auxin production contained in cow manure. Furthermore, the distribution of auxin within the plant accelerates cell elongation and promotes plant growth, whereby increased plant height is accompanied by an increase in the number of leaves occupying the nodes along the stem. In

addition, potassium contained in cow manure is an essential nutrient after nitrogen. Potassium in plants is involved in photosynthetic activity through its role in regulating the opening and closing of stomata. When potassium availability is sufficient, photosynthetic activity proceeds optimally, which in turn affects the rate of photosynthate production. Photosynthates are simple carbohydrates that function as energy sources for growth. Therefore, optimal potassium content in the soil increases the energy available for growth, leading to an increase in leaf number and leaf area.

Table 2. The Number of Mustard Leaves in Response to Cow Manure Fertilization with Urea Fertilizer at 2, 3, and 4 WAP

WAP	Cow manure	Urea Fertilizer			Mean
		0 kg/ha	150 kg/ha	300 kg/ha	
2	0 ton/ha	4,14	4,28	4,44	4,29a
	15 ton/ha	4,52	4,59	4,68	4,60b
	20 ton/ha	4,70	4,79	4,88	4,79c
	Mean	4,45	4,55	4,67	
3	0 ton/ha	4,51	4,59	4,71	4,60a
	15 ton/ha	4,78	4,87	4,96	4,87b
	20 ton/ha	5,07	5,11	5,19	5,13c
	Mean	4,79	4,86	4,95	
4	0 ton/ha	7,83	7,92	8,03	7,93a
	15 ton/ha	8,38	8,41	8,44	8,41b
	20 ton/ha	8,63	8,70	8,80	8,71c
	Mean	8,28	8,34	8,42	

Note: Numbers followed by different letters in different treatment groups are significantly different according to Duncan's Multiple Range Test at the 5% level.

3.3 Leaf Area (cm²)

Based on the results of the ANOVA test, it was found that the treatment of cow manure significantly affected leaf area. Meanwhile, urea fertilizer treatment and the interaction between the two had no significant effect on leaf area.

The results of the analysis of variance indicate that the application of cow manure had a significant effect on leaf area. This finding indicates that plant growth is closely related to the application of organic fertilizer. According to Dinariani et al. (2014), the essential nutrients contained in cow manure are able to accelerate leaf growth, as well as increase leaf area and leaf number. This condition causes the photosynthesis process to proceed more rapidly and directly enhances carbohydrate formation as food reserves, which subsequently affects the total dry weight of the plant and the leaf area index.

Furthermore, Muntashilah et al. (2015) stated that nitrogen in plants promotes the growth of organs associated with photosynthesis, namely leaves. Plants that receive an adequate supply of nitrogen tend to form leaves with a wider lamina and higher chlorophyll content, enabling the plant to produce sufficient carbohydrates to support its vegetative growth.

Table 3. Effect of Mustard Leaf Area on Cow Manure Fertilizer Application with Urea Fertilizer

Cow manure	Urea Fertilizer			Mean
	0 kg/ha	150 kg/ha	300 kg/ha	
0 ton/ha	1225,55	1231,08	1234,58	1230,40a
15 ton/ha	1235,17	1240,28	1252,12	1242,52b
20 ton/ha	1331,45	1335,60	1336,75	1334,60c
Mean	1264,06	1268,99	1274,48	

Note: Numbers followed by different letters in different treatment groups are significantly different according to Duncan's Multiple Range Test at the 5% level

The results of the analysis of variance indicate that the application of urea fertilizer had no significant effect on plant height, number of leaves, or leaf area. This is presumably due to the inefficient use of urea, such as rapid leaching by rainfall or volatilization before being absorbed by plants, which can result in low nitrogen uptake. According to Achmad and Susetyo (2014), urea is the main basal fertilizer applied to crops. Urea fertilizer contains 45–56% nitrogen and belongs to the hygroscopic group of fertilizers, meaning it readily absorbs moisture from the air. Generally, urea fertilizer is in the form of prills (granular). However, urea has a drawback in that its nitrogen content is highly susceptible to volatilization and is easily soluble, causing nutrients to be rapidly lost. At an air humidity of 73%, urea can absorb WAPer vapor from the atmosphere and dissolve as moisture is drawn into the fertilizer.

This result is in contrast to the research of Abdullah et al. (2021) and Walida et al. (2020), which stated that the application of urea fertilizer was able to provide the best growth and production of mustard greens compared to treatments without the application of urea fertilizer. Urea

is a single fertilizer with a high N content, approximately 45-46%. The rapid dissolution of urea makes it readily available to plants. However, this characteristic can also be detrimental. If urea is applied on the surface and not incorporated into the soil, N loss to the air can reach 40% of the applied N. This is because the weakness of urea fertilizer is that it disappears quickly due to evaporation and washing because urea fertilizer is mobile (Ramadhani et al., 2016; Putra et al., 2015).

4. CONCLUSION

Giving 20 tons/ha of cow manure is the right dose to increase plant height, number of leaves, leaf area. The single treatment of urea fertilizer and the interaction between the administration of cow manure and urea fertilizer had no significant effect on plant height, number of leaves, and leaf area. Thus, the research hypothesis stating that cattle manure fertilizer affects the growth of green mustard is confirmed, whereas the effect of urea fertilizer is not proven to be significant. Based on the research results, cattle manure fertilizer is more effective in enhancing the growth of green mustard than urea fertilizer. Therefore, the fertilization of green mustard is recommended to prioritize organic fertilizers to support plant growth. For further research, it is recommended that urea be applied in moist but not flooded soil conditions, because urea is easily lost through volatilization and leaching, especially in conditions of high rainfall or soil with poor drainage.

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