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# The Effect of Different Doses of Vermicompost and Urea Fertilizer on Vegetative Growth of Corn (*Zea mays* L.)

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**Abstract:** This study aims to determine the effect of vermicompost, urea fertilizer and the interaction of vermicompost and urea fertilizer treatments on corn vegetative growth. The research design used was a 2-factor design. The first factor was the application of vermicompost and the second factor was the application of urea fertilizer which was carried out with 3 replications. The doses of vermicompost were 0, 0.5, 1.0, 1.5, and 2.0 kg. The doses of urea fertilizer were 0, 0.6, 1.2, and 1.8 g. The research data were analyzed using Anova. The results of the study were: Vermicompost treatment had a significant effect on stem height, number of leaves and leaf length but had no significant effect on leaf width and corn stem diameter; application of urea fertilizer could increase all measured corn growth parameters; interaction between urea fertilizer and vermicompost treatment had no significant effect on all measured corn growth parameters.

**Keywords:** Corn vegetative growth; Urea fertilizer; Vermicompost

## Introduction

Corn is a monocot with fibrous roots with clear stem nodes. Corn roots are small in size with a large number. Corn leaves are ribbon-shaped with a parallel leaf vein system. On one corn there are male flowers at the tip of the stem and female flowers in the leaf axils. Corn requires an open environment without shade in order to grow and produce optimally (Rochani, 2011).

Corn growth is influenced by genetic and environmental factors. One of the environmental factors that affects corn growth is the availability of nutrients in the soil that can be absorbed by plant roots. Increasing the availability of nutrients in the soil can be done by providing fertilizer. The types of fertilizers that can be applied are chemical fertilizers such as urea fertilizer. The disadvantage of using urea fertilizer is that it causes environmental problems if applied continuously for a long period of time. Kusmuljono (2009) explained that the simultaneous and continuous application of chemical fertilizers causes damage to soil structure. Likewise, Khomsan et al. (2016) explained that the intensive and excessive use of chemical fertilizers can cause the chemicals contained in the fertilizer to spread and cause negative impacts on the environment, namely soil pollution. To minimize the negative impacts of urea fertilizer, the application of urea fertilizer needs to be combined with organic fertilizer.

Organic fertilizer treatment in planting media can improve the physical and chemical properties of the soil so that it can increase plant growth and production. The results of research by Lawenga et al. (2015) showed that the provision of organic fertilizer can improve the physical properties of the soil, especially in soil bulk density, porosity and permeability. Likewise, Nuro et al. (2016) concluded that the application of organic fertilizers affects the chemical properties of the soil and the production of land kale. One of the organic fertilizers that can be used to increase plant growth is vermicompost. Vermicompost is an organic fertilizer that comes from the decomposition of organic materials

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with the help of microorganisms and worms. Vermicompost contains various nutrients that can support plant growth (Lingga, 2012).

Vermicompost contains C-Organic = 10.55%, Nitrogen = 1.07%, Phosphorus = 0.22%, Potassium = 0.30%, C/N = 9.85 and pH = 6.5. The content of these nutrients meets the Indonesian national standards as compost fertilizer (Afsiyah et al., 2021). Vermicompost contains nutrients needed by plants including nitrogen, phosphorus, potassium, calcium, magnesium, ferrum, manganese, cuprun and zencum (Geremu et al., 2020). It was further reported that the application of vermicompost had a significant effect on increasing the growth of red ginger, including leaf length, leaf width, number of shoots, rhizome length and rhizome weight. The application of 150 g of vermicompost is the best dose of vermicompost for red ginger (Lidar et al., 2021). Vermicompost application can increase the number of leaves, stem height, leaf area, wet weight and dry weight of green eggplant (Nurhayati et al., 2020; Putra et al., 2025).

Based on the description above, research has been conducted on the effect of differences in doses of vermicompost and urea fertilizer on corn growth. The objectives of this research are to determine the effect of vermicompost treatment on vegetative growth of corn, the effect of urea fertilizer treatment on vegetative growth of corn, the effect of interaction between vermicompost and urea fertilizer treatment on vegetative growth of corn.

## Method

The research was carried out from June to November 2024 with the following implementation stages: procurement of research tools and materials, producing vermicompost using earthworms fed cow feces, clean up trash and weeds on the experimental land, application of vermicompost carried out 2 days before planting corn, application of urea fertilizer carried out 16 and 32 days after planting, planting and maintenance of corn, collection of corn growth data carried out at the age of 64 and 65 days after planting, and analysis of research data.

The research design used was a 2-factor design. The first factor was the application of vermicompost consisting of 5 levels, namely: K0 = without vermicompost application, K1 = application of 0.5 kg of vermicompost for 1 $m^2$ of agricultural land, K2 = application of 1.0 kg of vermicompost for 1 $m^2$ of agricultural land, K3 = application of 1.5 kg of vermicompost for 1 $m^2$ of agricultural land, K4 = application of 2.0 kg of vermicompost for 1 $m^2$ of agricultural land. The second factor is urea fertilizer treatment consisting of 4 levels, namely: U0 = without urea fertilizer, U1 = treatment of 0.6 g urea fertilizer for 1 plant, U2 = treatment of 1.2 g urea fertilizer for 1 plant and U3 = treatment of 1.8 g urea fertilizer for 1 plant. Vermicompost and urea fertilizer were carried out with 3 replications. In this study there were 60 experimental units. The parameters of corn growth measured were stem diameter, number of leaves, leaf length and leaf width. Corn growth parameter data were analyzed using analysis of variance (Teutenburg & Shalabh, 2009).

## Result and Discussion

*Leaf Length*

Data collection of corn leaf length was carried out 64 days after planting. The average data of corn leaf length due to vermicompost and urea fertilizer treatments are presented in Figure 1.

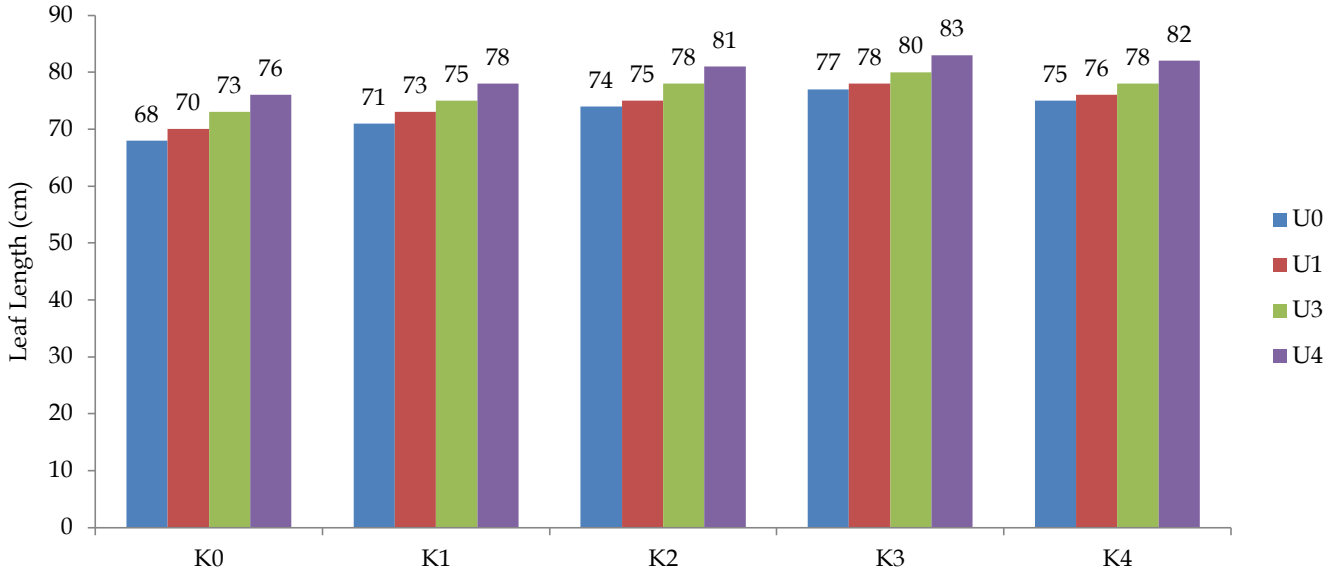


**Figure 1.** Average length of corn leaves

The data in Figure 1 shows that the treatment of 0 kg vermicompost combined with 0 g of urea fertilizer produced the lowest leaf length = 68 cm. Furthermore, increasing the dose of vermicompost and urea fertilizer given caused an increase in leaf length. The highest corn leaf length was 83 cm found in the combination of 1.5 kg vermicompost with 1.8 g of urea fertilizer. The results of Anova showed that the difference in urea fertilizer doses had a significant effect on the length of corn leaves. The difference in vermicompost doses had a significant effect on the length of corn leaves. The interaction of vermicompost and NPK fertilizer treatments did not have a significant effect on the length of corn leaves.

The increasing length of corn leaves due to the influence of urea fertilizer treatment is possible because urea is a source of nitrogen. Nitrogen is one of the important nutrients needed by plants. Nitrogen is needed by plants to produce protein and chlorophyll, maintain photosynthesis efficiency and stimulate plant vegetative growth (Mansyur et al., 2021). Nitrogen nutrients play a role in increasing leaf growth, with a greener color, thus increasing the rate of photosynthesis and plant growth (Nurhidayah, 2015). Nitrogen is a component of amino acids and protein. Thus, nitrogen plays a role in accelerating plant growth (Nugroho et al., 2024).

Vermicompost treatment can increase the length of corn leaves. This is because vermicompost contains macronutrients needed by plants. Vermicompost produced by earthworms fed with kale waste contains 0.35% nitrogen and 0.48 ppm phosphorus. Furthermore, vermicompost produced by earthworms fed with spinach waste contains 0.47% nitrogen and 46.94 ppm phosphorus. In addition, vermicompost also contains potassium (Elfayetti et al., 2017). The provision of vermicompost in the planting medium can increase N total, N available, C organic, cation exchange capacity, plant height, wet weight, dry weight, N tissue, and N absorption (Hanafi et al., 2023).

*Stem Height*

Stem height measurements were conducted 64 days after planting. The data obtained showed that stem height varied in each experimental unit. Avarage corn stem height data are presented in Figure 2.

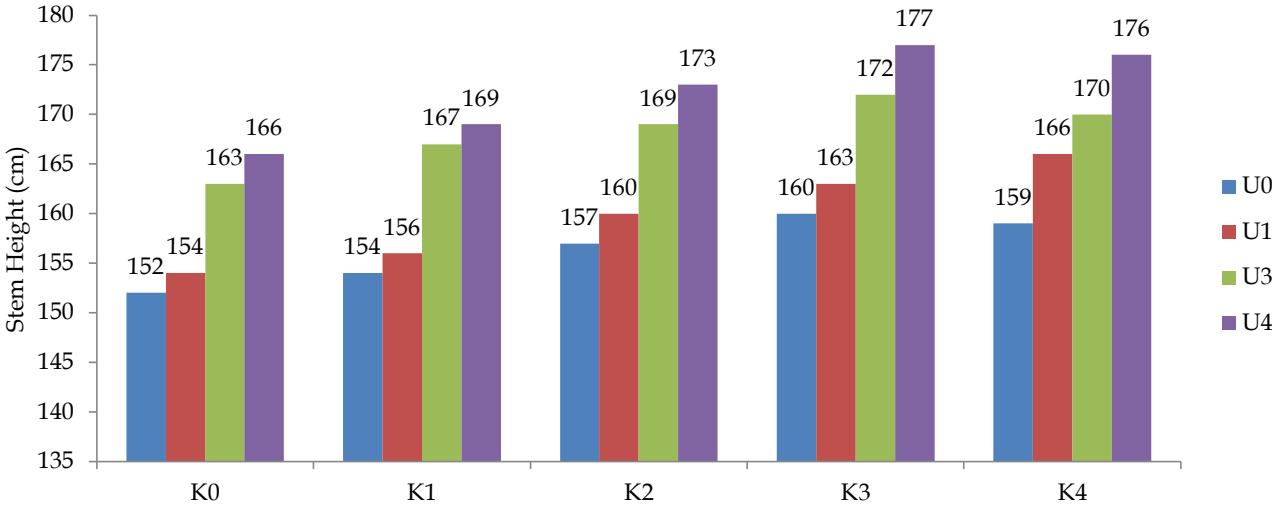


**Figure 2.** Average height of corn stem

In Figure 2 it can be seen that the lowest corn height is 152 cm, found in the treatment of 0 g urea combined with 0 kg vermicompost. Furthermore, the highest plant height is 177 cm, found in the combination of 1.5 kg vermicompost with 1.8 grams of urea. The results of Anova show that the difference in vermicompost doses has a significant effect on corn stem height. The difference in urea dosage significantly affected the height of corn stem. The interaction of vermicompost and urea fertilizer did not significantly affect the height of corn stem. The increase in the height of corn stem after vermicompost application occurred because vermicompost contains a number of macronutrients needed by corn.

Unito (2023) reported that vermicompost produced by earthworms fed rice straw contains Phosphorus = 0.21%, nitrogen = 0.32%, potassium = 1.21%. Earthworms fed fruit waste contain Phosphorus = 0.17%, nitrogen = 1.45%, potassium = 0.46%. Earthworms fed cow dung contain Phosphorus = 0.44%, nitrogen = 1.47%, potassium = 1.13%. Earthworms fed Grass Clippings contain Phosphorus = 0.28%, nitrogen = 1.51%, potassium = 1.18%, Earthworms fed Madre de cacao contain Phosphorus = 0.25%, nitrogen = 1.58%, potassium = 0.65%. Likewise, Soares & Purwaningsih (2014) reported that in vermicompost there is 0.63% nitrogen, 0.35% phosphorus, 0.2% potassium, 0.23% calcium, 0.003% manganese, 0.26% magnesium, 0.007% zinc, 0.79% iron, 0.21% organic matter and has a water storage capacity of 41%.

The increase in the height of corn stalks after urea fertilizer treatment is possible because urea contains nitrogen which plays an important role in supporting plant growth. Nitrogen is needed to form all amino acids and proteins needed by plants. Nitrogen is needed in the early vegetative growth of root, stem and leaf formation (Nurhidayah, 2015). Thus, nitrogen plays an important role in increasing the height of corn stalks.

The results of this study are supported by the results of other studies. Differences in dose of urea has an significant effect on stem height, leaf length, and fruit wet weight (Raksun et al., 2020). Urea fertilizer treatment has significant effect on the observed variables of plant height, number of leaves and wet weight of red spinach plants due to the treatment of using various doses of NPK compound fertilizer (Huda & Hidayati, 2022). Urea fertilizer treatment has a significant effect on plant height aged 10 and 30 days after planting, number of leaves aged 10, 20, and 30 days after planting and has a significant effect on the wet weight of mustard greens (Samini & Fatah, 2020). Urea fertilizer treatment had a significant effect on the height of the seedlings, the dry weight of the crown and the dry weight of the roots of oil palm seedlings.

*Number of Leaves*

Measurement of the number of corn leaves was carried out 65 days after planting. The average data of the number of corn leaves due to vermicompost and urea fertilizer treatments are presented in Figure 3.

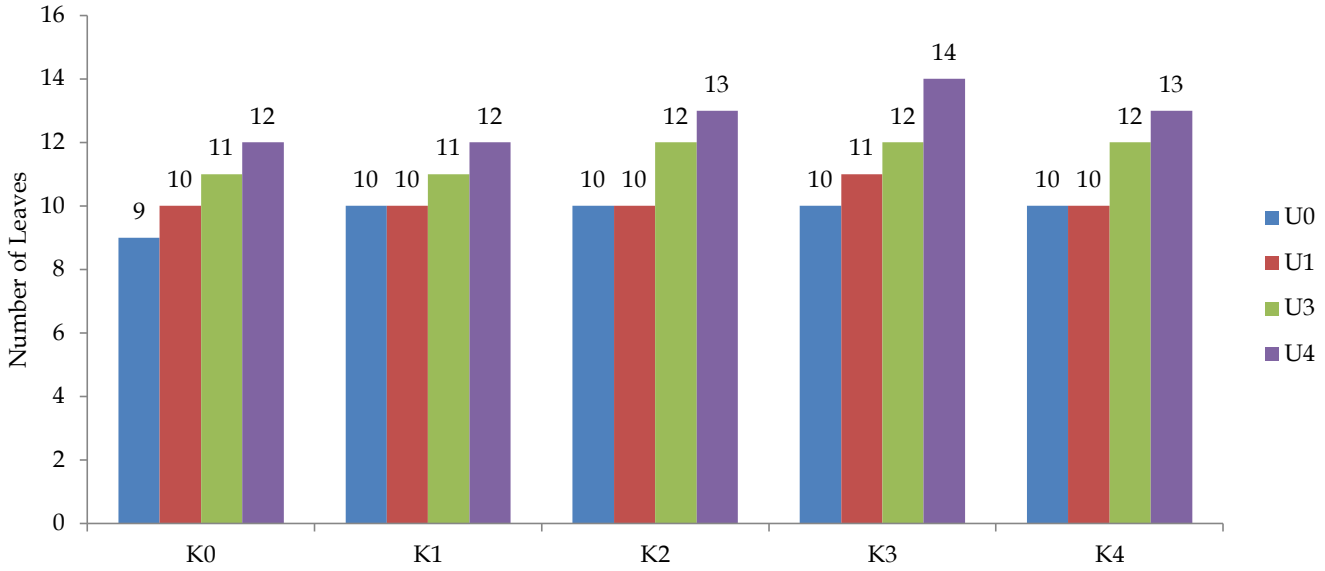


**Figure 3.** Average number of corn leaves

The average number of corn leaves can be seen in Figure 3. The data shows that the lowest number of leaves is 9 leaves, found in the treatment of 0 kg vermicompost combined with 0 g of urea fertilizer. The highest number of leaves is 14 leaves, found in the combination of 1.5 kg vermicompost and 1.8 grams of urea fertilizer. The results of the analysis of variance show that the application of vermicompost can increase the number of corn leaves. Urea fertilizer treatment can increase the number of corn leaves. The interaction of vermicompost and urea fertilizer treatments has no significant effect on the number of corn leaves.

The increase in the number of corn leaves due to urea fertilizer application was also observed in various studies. Urea fertilizer treatment significantly affected the number of leaves, number of branches, root length, root wet weight, total wet weight, root dry weight, and total dry weight of Alfalfa (Yuliawati et al., 2014). Sweet corn has a positive response to urea fertilizer treatment. Urea fertilizer application to sweet corn significantly affected the number of leaves, leaf width, plant height, stem diameter, dry weight and plant wet weight (Rukmana & Yudirachman, 2016; Basri et al., 2017; Masruroh et al., 2017). Urea fertilizer treatment can increase the number of leaves, plant height, leaf area, number of branches, number of stem segments and dry weight of iler plants. Providing 25% shade and a dose of 135 kg urea fertilizer for 1 hectare of agricultural land can increase the dry weight of iler plants (Mawardy & Karyawati, 2021).

The increase in total corn leaves due to vermicompost treatment is possible because vermicompost application can improve the physical, chemical and biological properties of the soil, as well as organic matter in the soil (Ceritoglu et al., 2018; Syarifinnur et al., 2022). Vermicompost application can increase total of nitrogen, available nitrogen, organic carbon, cation exchange capacity, plant height, fresh weight, dry weight, nitrogen of tissue and nitrogen absorption (Hanafi et al., 2023). Vermicompost contains organic carbon, total of nitrogen, C/N ratio and soil pH that meet the minimum standards for organic fertilizer quality according to the Regulation of the Minister of Agriculture of the Republic of Indonesia No. 1 of 2019 (Lokha et al., 2021). Vermicompost produced by earthworms fed a mixture of chicken manure, banana cobs and tofu dregs contains nitrogen = 2.72%, phosphorus = 0.80, potassium = 0.29%, and organic carbon = 9.76% (Andriawan et al., 2022).

In other studies, it was also found that the application of vermicompost had a significant effect on plant growth. Raksun et al. (2022) found that the use of vermicompost could significantly increase the number of leaves, stem height, leaf length, leaf width and stem diameter of long beans. The best dose of vermicompost for long beans is 18 tons per hectare. The use of vermicompost fertilizer can stimulate and increase the number of leaves, plant height and fresh weight of mustard greens (Lokha et al., 2021). Likewise, Akbar et al. (2018) reported that the application of vermicompost can increase the number of leaves, plant height and stem diameter of *Brassica oleracea* L., when compared to treatments without vermicompost. Vermicompost treatment had a significant effect on increasing the number of leaves, stem diameter, stem height, leaf length and leaf width of purple eggplant (Raksun & Merta, 2023). Application of urea fertilizer can significantly increase the wet weight, leaf length,

number of leaves and plant height of green mustard, addition of vermicompost to planting media can improve the wet weight, leaf length, number of leaves and plant height of green mustard (Raksun et al., 2024).

*Leaf Width*

Leaf width measurements were carried out when the corn was 64 days after planting. The average width of corn leaves due to different doses of vermicompost and urea fertilizer is presented in Figure 4.

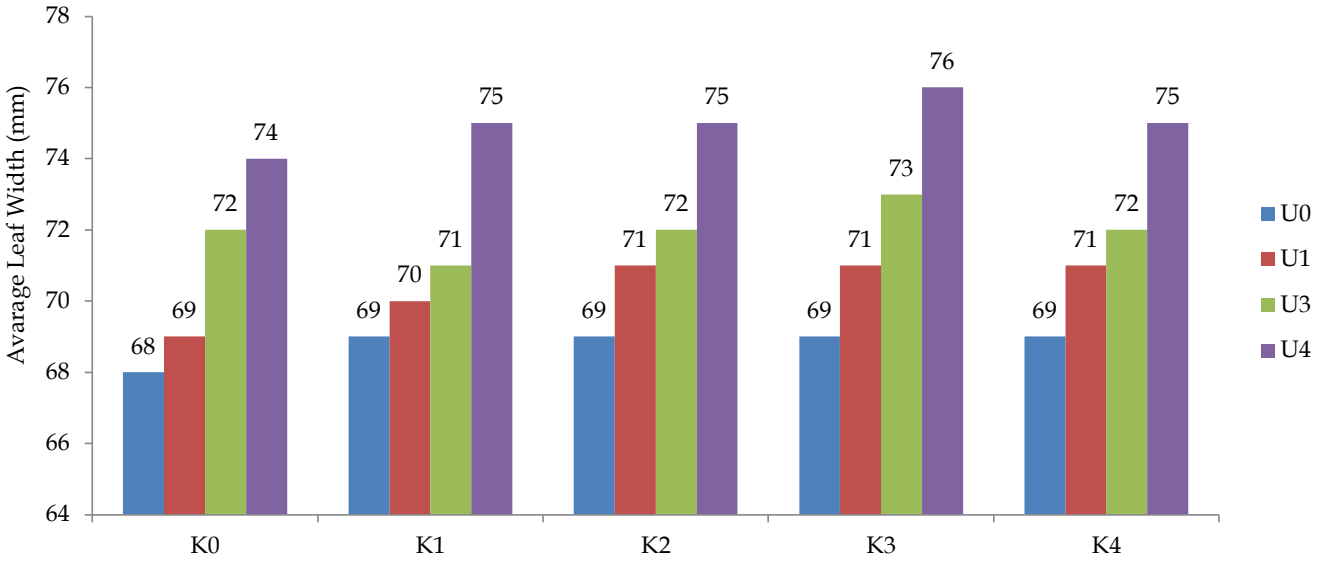


**Figure 4.** Average width of corn leaves

In Figure 4 it can be seen that increasing the dose of urea fertilizer causes an increase in corn leaf width. The combination treatment of 0 kg of vermicompost and 0 g of urea fertilizer produced the lowest leaf width, namely 68 mm. The highest corn leaf width was 80 mm, found in the combined treatment of 1.5 kg of vermicompost and 1.8 g of urea fertilizer. The results of variance analysis showed that urea fertilizer treatment had a significant effect on corn leaf width. Vermicompost treatment did not have a significant effect on corn leaf width. The interaction of vermicompost and urea fertilizer treatment had no significant effect on corn leaf width.

An increase in corn leaf width due to urea fertilizer treatment is possible because urea is a source of synthetic nitrogen. Nitrogen is an important nutrient needed by plants. Nitrogen is needed by plants to produce protein and chlorophyll, maintain photosynthetic efficiency and stimulate plant vegetative growth (Mansyur et al., 2021). Nitrogen nutrients play a role in increasing leaf growth, with a greener color thereby increasing the rate of photosynthesis and plant growth (Nurhidayah, 2015). The nitrogen nutrient is a constituent of amino acids, a constituent of protein, thus the nitrogen nutrient plays a role in accelerating plant growth (Nugroho et al., 2024). Providing urea has a real effect in increasing leaf width, wet weight and dry weight of kailan plants. Providing 300 kg of urea for 1 hectare of land showed the highest results in increasing leaf width, fresh weight and dry weight of kailan plants compared to other treatments (Susanti et al., 2021).

*Corn Stem Diameter*

The average diameter of corn stalks due to different doses of vermicompost and urea fertilizer is presented in Figure 5. This data shows that the average diameter of corn stalks has increased due to increasing doses of urea fertilizer. the lowest diameter was 26 mm, found in the combination treatment of 0 kg vermicompost and 0 g urea fertilizer. The highest stem diameter was 33 mm, found in the combination treatment of 1.5 kg of vermicompost and 1.8 g of urea fertilizer.

Analysis of variance showed that differences in urea fertilizer doses had a significant effect on corn stalk diameter. Differences in vermicompost doses had no significant effect on corn stalk diameter. The interaction of vermicompost and urea fertilizer treatment had no significant effect on corn stalk diameter. The real influence of urea fertilizer application on increasing the diameter of corn stalks is possible because urea fertilizer contains nitrogen which has an important role in supporting plant growth.

Nitrogen functions in increasing the growth of cultivated vegetation, increasing the rate of chlorophyll formation and leaf growth (Warisno & Dahana, 2018). Nitrogen plays a role in stimulating chlorophyll formation and plant vegetative growth and development (Rahmat, 2015; Susanti & Arrokman, 2022).

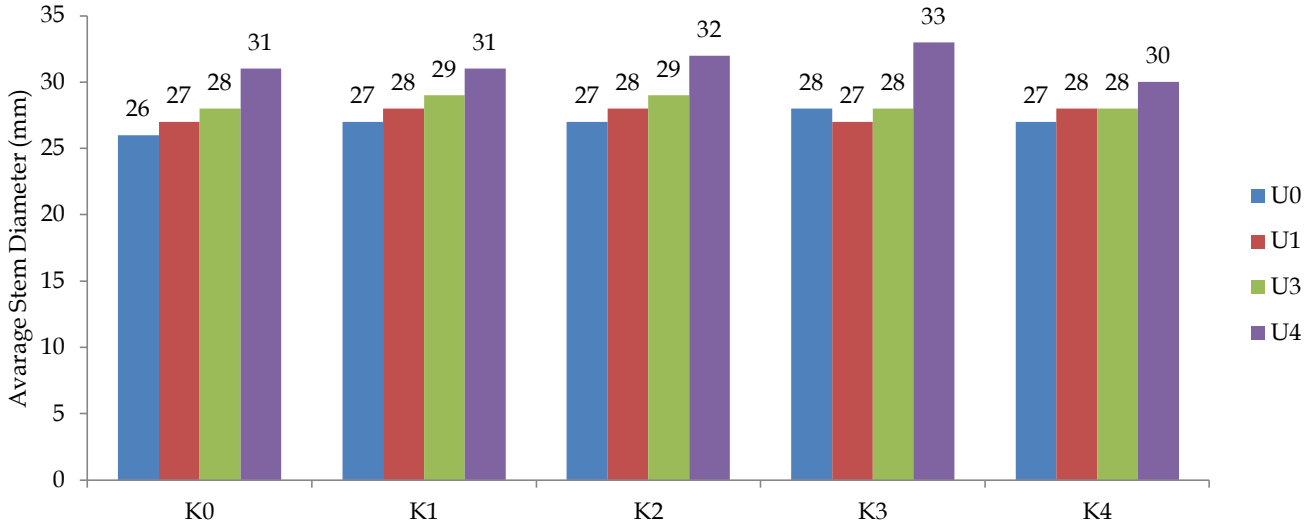


**Figure 5.** Average diameter of corn Stem

The results of this research are supported by a number of other studies. Application of urea fertilizer can increase spinach stem diameter at 1, 2, and 3 weeks after planting (Sebayang et al., 2021). The interaction of urea fertilizer and planting distance had a significant effect in increasing the stem diameter of *Hibiscus cannabinus* L. at the ages of 21, 35, 49, 63, 77, and 91 days after planting (Amiroh, 2014).

## Conclusion

In this study it can be concluded that application of vermicompost does not have a significant effect on leaf width and stem diameter but has a significant effect on leaf length, stem height and number of corn leaves, application of urea fertilizer can increase all measured corn growth parameters, the interaction of urea fertilizer and vermicompost treatment has no significant effect on stem diameter, leaf width, leaf length, number of leaves and height of corn stalks.

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**Authors Contributions**
This research was carried out by 4 researchers from Mataram University. The research was carried out in 8 stages, namely: procurement of tools and materials, making vermicompost, cleaning the research land from rubbish and weeds, application of vermicompost on the experimental land, urea fertilizer treatment, collecting data on corn growth, analyzing data, making reports and research articles. All research stages were carried out jointly by 4 research teams.

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**Conflicts of Interest**
The authors declare that there is no conflict of interest regarding the publication of this paper.

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