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GROWTH OF MUSTARD GREENS (*Brassica Rapa L.*) DUE TO THE APPLICATION OF UREA FERTILIZER WITH VARIOUS BIURET CONTENTS

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Abstrak. This research was conducted in Cikampek, Karawang Regency. The purpose of this study was to study the effect of various doses of nitrogen fertilizer on the growth and yield of mustard greens. This study was arranged in a randomized block design consisting of 7 doses of urea, namely: control (without fertilizer); 50 kg/ha; 100 kg/ha; 150 kg/ha; 200 kg/ha; 250 kg/ha and 300 kg/ha, each treatment was repeated three times so that there were 21 experimental units. The results showed that the administration of urea fertilizer had a very significant effect on the growth and yield of mustard greens (plant height, number of leaves, fresh weight and dry weight of plants) and the best dose of urea fertilizer could be achieved at a dose of 200 kg/ha.

Keywords: mustard, urea, various rates

I. INTRODUCTION

Mustard greens are vegetable commodities that have good commercial value and prospects. In addition to being reviewed from a climatological, technical and socio-economic perspective, they are also very supportive, so that they are feasible to be cultivated in Indonesia and this vegetable is a type of vegetable that is favored by all levels of society. The demand for mustard greens always increases along with the increasing population and awareness of nutritional needs. (Haryanto, et al. **[1]**). Based on agricultural statistics, mustard greens production achieved in Karawang in 2021 was 2928 tons/ha with a land area of 744 ha, this production is still lower when compared to mustard greens production in 2022 which was 5492 tons/ha with a land area of 894 ha. For mustard greens production in Karawang Regency in 2022, it was 496 tons/ha with a land area of 139 ha (BPS **[2]**). This low production is caused by the increasingly narrow planting area for mustard greens because some locations are used as food crop areas, resulting in decreased mustard greens productivity **[3]**. The part of the mustard plant that has economic value is the leaves, so efforts to increase production are attempted to increase vegetative products, so that to support these efforts, fertilization is carried out **[4]**. Mustard plants require sufficient and available nutrients for their growth and development to produce maximum production. One of the nutrients that plays a major role in leaf growth is Nitrogen. This nitrogen functions to increase vegetative growth, so that the leaves of the plant become wider, greener and of better quality (Wahyudi **[5]**). One of the sources of N that is widely used is Urea with a content of 45% N, so it is good for the growth process of mustard plants, especially plants whose leaves are harvested **[6]**. In addition, Urea fertilizer has hygroscopic properties that are easily soluble in water and react quickly, so that it is quickly absorbed by plant roots. The dose of Urea applied to plants will determine the growth of mustard plants (Lingga and Marsono **[7]**). Optimal nitrogen administration can increase plant growth, increase protein synthesis, chlorophyll formation which causes the color of the leaves to become greener and increase the ratio of root shoots. Therefore, optimal nitrogen administration can increase plant growth rate (Nur and Thohari **[8]**). Nitrogen administration at the right dose will increase plant growth, increase plant metabolism, protein formation, carbohydrates, as a result plant growth and production increase (Lakitan **[9]**). Based on the description above, it is necessary to conduct research on the effect of various doses of urea fertilizer on the growth and yield of mustard plants. Thus, it is expected to find the optimum dose to produce maximum plant height growth, number of leaves and fresh and dry weight mustard plant yields. This study aims to study the effect of various doses of nitrogen fertilizer on the growth and yield of mustard plants. The benefits of this study are as information material on the effect of various doses of nitrogen fertilizer on the growth and yield of mustard plants.

II. RESEARCH METHODS

The materials used in this study were mustard seeds of the Shinta variety and urea, KCl, and SP36 fertilizers. The tools used in this study were experimental boards, treatment labels, hoes, meters, scales, stationery, ovens and

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documentation tools. This study was conducted using a Randomized Block Design with urea fertilizer treatment consisting of 7 levels and 3 groups containing 21 experimental units: N0 = 0 kg urea/ha (Without Urea) N1 = 50 kg urea/ha (11.25 g) N2 = 100 kg urea/ha (22.5 g) N3 = 150 kg urea/ha (4.5 g), N4 = 200 kg urea/ha (33.75 g) N5 = 250 kg urea/ha (56.25 g), N6 = 300 kg urea/ha (67.5 g). Land Preparation. The land is cleared of weeds, then the soil is hoed to a depth of 30 cm and loosened. After that, beds are made with a height of about 30 cm as many as 21 plots with a size of each plot of 1.5 x 1.5 meters and a distance between plots of 30 cm. Planting. Planting is done directly by inserting the seeds into the planting hole provided with a planting distance of 25 x 25 cm then the hole is covered with soil.

Fertilizer Treatment. The application of Urea fertilizer is carried out in 2 stages, namely the first is given 7 days after planting as much as 75% of the treatment dose and the second 21 days after planting as much as 25% of the treatment dose. Maintenance. Maintenance activities are carried out, namely: Watering is carried out routinely in the morning and evening, at the beginning of growth, replanting is carried out by replacing damaged/dead plants with healthy seedlings which are reserve seedlings. The purpose of replanting is to maintain the number of plants, weeding is carried out once a week manually by pulling out weeds that grow around the mustard green plantation, pest and disease control is carried out by spraying Marsal insecticide for pests while for diseases it is sprayed with Decis fungicide.

Harvest. In terms of harvesting mustard greens, it is when they are 40 days old. First, by looking at the color of the plant, it is fresh green and the shape of the leaves is wide. The harvesting method is by removing the entire plant along with its roots. Observation Variables. The variables observed in this study were: plant height (cm), number of leaves, fresh and dry weight of the plant. Plant height (cm) measurements were carried out once a week, starting in weeks 1, 2, 3, 4 and 5. Plant height was measured from the base of the plant to the tip of the upper leaf, the number of leaves (strands) was calculated by the number of leaves that grew once a week, starting in weeks 1, 2, 3, 4 and 5, the fresh weight of the mustard plant (grams) was weighed, (all) starting from the roots to the tips of the leaves at harvest time using an analytical balance, the dry weight (grams) of the mustard plant was weighed, (all) starting from the roots to the tips of the leaves after being oven-dried for 3 days at a temperature of 800C with an analytical balance.

Data Analysis. To determine the effect of treatment on the observation variables, each observation was subjected to F (ANOVA) analysis. If there is a significant effect, a further test will be carried out with an honest significant difference (HSD) of 5% **[10]**.

III. RESULTS AND DISCUSSION

Plant Height. The results of the analysis of variance showed that the administration of urea at 2-5 WAP observations had a very significant effect on the average plant height. The average plant height of 2 WAP - 5 WAP is presented in Table 1.

Table 1. Average Plant Height (cm) at 2-5 WAP at Various Urea Fertilizer Doses.

Treatment	Week After Planting (MST)			
	2 MST	3 MST	4 MST	5 MST
N0 0 kg	10,30c	13,15cb	17,56c	20,66c
N1 50 kg	10,95c	14,40cb	19,25cb	28,64b
N2 100 kg	13,54b	15,09b	22,63ba	32,31ba
N3 150 kg	13,12b	17,72ba	23,31ba	33,68a
N4 200 kg	14,99a	21,18a	29,44a	36,74a
N5 250 kg	12,97b	19,04a	26,25a	29,73ba
N6 300 kg	13,11b	17,26ba	24,48ba	29,07b
BNJ 5%	0,70	3,14	3,97	4,30

Note: The average value followed by the same letter in the same column is not significantly different at the 5% BNJ test level.

Based on the results of the 5% BNJ test in Table 1. shows that in the treatment of urea fertilizer with a dose of 200 kg/ha (N4) taller plants were obtained, but at 3 WAP it was not different from the treatment of 150 kg/ha (N3), 250 kg/ha (N5) and 300 kg/ha (N6). In the observation of 4 MST it was not different from 100 kg/ha (N1), 150 kg/ha (N2), 250 kg/ha (N5), and 300 kg/ha (N6) and in the observation of 5 MST it was not different from 100 kg/ha (N2), 150 kg/ha (N3), and 250 kg/ha (N5) while the lowest plant height was in the control treatment N0. Based on the analysis of diversity, it showed that the urea fertilizer dose treatment had a very significant effect on plant height at 2-5 MST. The urea fertilizer dose of 200 kg/ha gave the highest plant growth results compared to other doses. This shows that the dose of urea fertilizer of 200 kg/ha is able to supply nitrogen according to the amount needed for growth and development in mustard plants, because the nitrogen contained in urea fertilizer is the most important nutrient, the plant's need for nitrogen is higher than other nutrients. This is in line with the opinion of (Erawan et al. **[11]**) that the N element functions in the vegetative growth of plants, nitrogen is an essential nutrient for cell division and elongation, so that N is a component of protoplasm that is abundant in tissues such as growing points. Number of Leaves. The results of the analysis of variance showed that observations of 2-5 MST had a very significant effect. The average number of leaves of plants 2-5 MST is presented in Table 2.

Based on the results of the 5% BNJ test in Table 2. shows that the urea fertilizer treatment with a dose of 200 kg/ha (N4) gave the largest number of leaves compared to other treatments, but at 2 MST it was no different from 100 kg/ha (N2), 150 kg/ha (N3) 250 kg/ha (N5) and 300 kg/ha (N6). The lowest number of leaves was found in the control treatment N0 (without urea).

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Table 2. Average Number of Leaves (strands) of Plants aged 2-5 MST

Treatment	Week After Planting (MST)			
	2 MST	3 MST	4 MST	5 MST
N0 0kg	5,04cb	7,03cb	9,07cb	10,80cb
N1 50kg	5,10b	7,67b	9,60b	10,40cb
N2 100kg	5,87a	7,93b	9,87b	11,80b
N3 150kg	6,20a	8,20b	10,27b	12,13b
N4 200kg	6,50a	8,80a	11,07a	13,40a
N5 250kg	5,93a	8,07b	9,93b	11,87b
N6 300kg	5,73ba	7,53c	9,27cb	11,27b
BNJ 5%	0,63	0,54	0,71	1,15

Based on the analysis of diversity, it showed that the urea fertilizer dose treatment had a very significant effect on the number of leaves at 2-5 MST. The urea fertilizer dose of 200 kg/ha gave the largest number of leaves compared to other doses. This shows that a dose of 200 kg/ha of urea fertilizer is able to supply the nitrogen element according to the amount needed for the growth and development process in mustard greens, because the nitrogen nutrient element plays a very important role in the vegetative growth of plants, for example the height of the plant and the number of leaves of mustard greens. This is in line with the opinion of Novizan **[12]** that the nutrients contained in Urea fertilizer are very useful for plants for growth and development, including: (1) making plants greener and fresher and containing lots of green leaf grains (Chlorophyll) which play a role in the process of photosynthesis, (2) accelerating plant growth (height, number of leaves, shoots, branches and others), (3) increasing the protein content of plants, (4) can be used for all types of plants, both food crops, horticulture, plantation crops, livestock businesses and fisheries.

Optimal nitrogen provision can increase plant growth, increase protein synthesis, chlorophyll formation which causes the color of the leaves to become greener and increase the ratio of root shoots. Therefore, optimal nitrogen provision can increase the rate of plant growth (Nur and Thohari **[8]**). Nitrogen provision at the right dose will increase plant growth, increase plant metabolism, protein formation, carbohydrates, as a result plant growth and production increase (Lakitan **[9]**). Nitrogen deficiency will cause plants to not grow optimally, while excess nitrogen produces soft/weak and vegetative young shoots, acidifies soil reactions, lowers soil pH, and is detrimental to plants because it will bind other nutrients so that they will be difficult for plants to absorb and fertilization becomes less effective and inefficient. in addition to inhibiting plant growth, it will also cause environmental pollution. Nitrogen is taken up by plants in the form of ammonium ions (NH4 +) and nitrate ions (NO3-) found in soil solution. Nitrogen nutrients can improve vegetative plant growth, where plants that grow in soil with sufficient nitrogen are greener (Triadiati et al. **[13]**). Limited provision of N in the soil has an impact on inhibiting or stopping plant growth (Rahardjo and Pribadi **[14]**). Fresh Weight. The results of the analysis of variance showed that the treatments tested had a significant effect on the fresh weight of mustard greens. The average fresh weight of plants in each treatment is presented in Table 3.

Table 3. Average Fresh Weight of Plants (g) at Various Doses of Urea Fertilizer.

Treatment	Average
N0 0 kg	49,27c
N1 50 kg	87,32b
N2 100 kg	116,03b
N3 150 kg	175,69a
N4 200 kg	205,76a
N5 250 kg	124,37b
N6 300 kg	118,07b
BNJ 5%	43,21

Note: The average value followed by the same letter in the same column is not significantly different at the 5% BNJ test level.

Based on the results of the 5% BNJ test in Table 3, it shows that the urea fertilizer treatment with a dose of 200 kg/ha (N4) provides a higher fresh weight compared to other treatments, while the lowest fresh weight is in the control treatment N0, but is not significantly different from the 150 kg/ha treatment (N3). Based on the analysis of diversity, it shows that the urea fertilizer dose treatment has a very significant effect on the average fresh weight. The urea fertilizer dose of 200 kg/ha provides the highest average fresh weight compared to other doses. This is because the water and nutrient content in the leaves is quite optimal, resulting in the highest fresh weight of the plant. This is in line with the opinion of Lahadassy et., al. **[15]**, to achieve optimal plant fresh weight, plants still need a lot of energy and nutrients so that the increase in the number and size of cells can reach optimal levels and allow for an increase in optimal plant water content, most of the fresh weight of the plant is due to water content. Water plays a major role in cell turgidity, so that leaf cells will enlarge.

Erawan et al. **[11]** divides the nutritional status in plant tissue and plant growth, namely, deficiency and sufficient. In the deficiency zone, the addition of nutrients results in increasing plant weight production, while in the sufficient zone, the addition of nutrients results in increasing the nutrient content in plant tissue but there is no increase in yield. According to Jumin **[16]**, the presence of nitrogen elements will increase the growth of vegetative parts such as leaves. This is in accordance with the opinion of Lingga and Marsono **[7]**, that the main role of nitrogen for plants is to stimulate overall growth, especially stems, branches, and leaves. Dry Weight. The results of the analysis of variance showed that the treatments tried had a very significant effect on the average dry weight. The average dry weight of plants in each treatment is presented in Table 4.

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Table4. Average Dry Weight of Plants (g) at Various Fertilizer Doses

Treatment	Average
N0 0 kg	7,19d
N1 50 kg	12,13c
N2 100 kg	15,15cb
N3 150 kg	18,16b
N4 200 kg	25,79a
N5 250 kg	20,06b
N6 300 kg	21,97b
BNJ 5%	3,31

Note: The average value followed by the same letter in the same column is not significantly different at the 5% BNJ test level.

The results of the 5% BNJ test in (Table 4) show that the administration of urea fertilizer at a dose of 200 kg/ha (N4) gave the highest dry weight compared to other treatments, while the lowest dry weight was in the control treatment (N0) and was different from other treatments. Based on the analysis of diversity, it shows that the urea fertilizer dose treatment has a very significant effect on the average dry weight. The urea fertilizer dose of 200 kg/ha gave the highest average dry weight compared to other doses. This shows that the photosynthesis process that occurs is better/more efficient because the increase in dry weight of plants is related to the existence of better plant growth conditions for the ongoing plant metabolic activities such as photosynthesis.

This is in line with the opinion of Prayudyaningsih and Tikupadang **[17]**, dry weight is an indication of successful plant growth, because dry weight is an indication of the presence of clean photosynthesis results that can be precipitated after the water content is dried. Dry weight indicates the ability of plants to take nutrients from the planting medium to support their growth. The increase in dry plant weight is related to plant metabolism or the existence of better plant growth conditions for the ongoing plant metabolic activities such as photosynthesis. Thus, the greater the dry weight indicates that the photosynthesis process is more efficient. The greater the dry weight, the more efficient the photosynthesis process that occurs and the productivity and development of tissue cells are higher and faster, so that plant growth is better. Nitrogen contained in urea fertilizer as a protein component plays a role in stimulating the division of meristem tissue and stimulating root growth and leaf development.

IV. CONCLUSION

The application of urea fertilizer at a dose of 200 kg/ha has a very significant effect on the growth of plant height, number of leaves and yield of mustard greens in fresh and dry weight and the best dose of urea fertilizer for mustard greens (Brassica Juncea L.) is at a dose of 200 kg/ha. Based on the results of the research that has been conducted, the author suggests that further research is needed using mustard greens from other varieties such as choho, summer fest and caigran and a dose of urea fertilizer of 200 kg/ha.

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