

Enhance a Yield of Cabbage by Adding Organic Fertilizer in Low Field Areas

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Abstract— Cabbage is a vegetable that contains lots of vitamins and minerals that the human body needs. One effort to increase the cultivation production of cabbage is to provide nutrients in the form of inorganic fertilizer, that is one of urea fertilizer that contains of 46% nitrogen. This paper aimed to investigate the response of growth and yield of cabbage in lowlands to the efficiency of nitrogen fertilizer with the addition of organic material. This research was conducted using randomized block design non-factorial with the treatment efficiency of urea fertilizer consists of 4 level that is efficiency of N 0% without granules fertilizer, efficiency of N 25% of the granules fertilizer, efficiency of N 50% with granules fertilizer, and efficiency of N 75% with granules fertilizer that is repeated 6 times. Results showed that the efficiency of nitrogen fertilization by 25% with the addition of organic fertilizers that is able to deliver growth and better results in all parameters of observation. Result of cabbage with nitrogen fertilization efficiency treatment of 25% with the addition of organic fertilizer gives higher yield in the amount of 42.46 tons.ha⁻¹, nitrogen fertilization efficiency treatment of 50% with the addition of organic fertilizers give a yield of 39.61 tons.ha⁻¹, nitrogen fertilization efficiency treatment of 75% with the addition of organic fertilizers give a yield of 3 tons.ha⁻¹, and nitrogen fertilization efficiency treatment of 100% without the addition of organic fertilizers give lower yield in the amount of 37.95 tons ha⁻¹.

Keywords— Cabbage, nitrogen, organic fertilizer.

I. INTRODUCTION

Cabbage is a vegetable that contains lots of vitamins and minerals that the Need human body needs. Minerals contained in cabbage include calcium, iron, phosphorus, and sulfur (Directorate of Vegetable, Ornamental and Various Plants, 2002). Ashari (1995) states that 100 g of cabbage leaves contain 93 ml of water; 1.5 g protein; 0.2 g fat; 4 g of carbohydrates; 0.8 g of fiber; 40 mg calcium; 0.5 mg iron; 30 IU of vitamin A; 0.05 mg thiamine; 0.05 mg riboflavin; 0.3 mg of nicotinamide and 40 mg of ascorbic acid. Sunarjono (2004) added that these vitamins act as regulatory and protective substances which are very important in the body and can maintain body health. Pracaya (2007) also states that cabbage can help digestion and neutralize acidic substances in the body. According to BPS data (2015), national cabbage production in the 2013-2014 period decreased production by 3.02%. Cabbage production in East Java also experienced a significant decline in production, namely 16.61% in the 2012-2013 period and increased by 1.93% in the 2014 period with an average productivity of 20.88 tonnes hectare⁻¹.

One of the efforts to increase production in cabbage cultivation is by providing nutrients to plants in the form of inorganic fertilizers, one of which is urea which contains 46% nitrogen. Nitrogen is a major nutrient, because it plays an important role in vegetative growth of plants, namely in the formation of roots, stems and leaves (Muchovej and Newman, 2004).

The plant's need for nitrogen is higher In comparison with other nutrients, nitrogen is a limiting factor for plant productivity. Lack of nitrogen will cause plants not to grow optimally, while excess nitrogen will not only inhibit plant growth but also cause pollution to the environment (Duan, et al., 2007). Continuous use of inorganic fertilizers on agricultural land can cause a decrease in soil quality and fertility because it affects soil biological conditions.

Efforts to increase soil fertility or land productivity sustainably include the provision of organic matter. Provision of organic matter is an action to improve the environment for plant growth because it can increase fertilizer efficiency (Adiningsih and Rochayati, 1988). Organic matter also functions as an ameliorant which can improve the amount and activity of microbes and nutrient sources in the soil to improve soil quality (Setyorini, 2005). To reduce the use of urea in large quantities, it is necessary to make efficiency by utilizing organic materials, one of which is the addition of organic fertilizer in the form of granules which are sold commercially. Commercial granule fertilizer is an organic fertilizer that contains about 15% organic matter with a C / N ratio of 15-25, so it is useful for improving soil structure and air conditioning (Petrokimia, 2014). The application of a combination of organic and inorganic fertilizers in general can minimize shortages and can increase the advantages of each of these fertilizers. Fertilization using This combination will provide benefits, including: (1) increasing the available nutrient content, (2) providing all nutrients in a balanced amount, (3) preventing nutrient loss, (4) helps in maintaining soil organic matter content, (5) organic matter residue will have a good effect on subsequent crops, (6) is more economical and (7) helps maintain soil ecological balance (Sutanto, 2002). Cabbage is a leaf vegetable that requires a lot of nitrogen to produce high quality and quantity of production.

II. METHOD OF RESEARCH

This research was carried out in the rice fields of Kedawung Wetan Village, Kec. Grati Pasuruan Regency at an altitude of ± 4 m above sea level with an average temperature of 22oC-31oC and a rainfall of 143 mm / month in June-September 2016. A tools used in the research include: soil tillers, long measuring instruments, calipers, digital scales, oven dryers and pesticide sprayers.

The materials used were: K-K Cross variety of cabbage seeds, granule fertilizer (petrogeanic), Urea, SP 36, KCl and Prevathon 50 SC insecticide and fungicide. The research was carried out using a non-factorial randomized block design with urea fertilizer efficiency treatment consisting of 4 levels and a combination with granule fertilizer which was repeated six times. Observations were made on growth and yield. Observations of growth included plant height, number of leaves, total dry weight of plants and leaf area. Yield observations included crop-1 head fresh weight, crop diameter and 1 hectare-1 cabbage fresh weight.

III. RESULT AND ANALYSIS

Plant height The treatment efficiency of nitrogen fertilization by 25% with the addition of organic fertilizers in Table 1. has a better effect on plant height. This is due to the efficiency of nitrogen fertilization of 25%, the cabbage plant needs will be fulfilled. The effectiveness of cabbage absorption on nitrogen fertilization is supported by the application of organic fertilizers which causes the soil to have a higher CEC so that it can bind NH₄ + and NO₃ so that it does not escape due to leaching or evaporation. Soepardi (1983) states that nutrient uptake by plants is strongly

influenced by nutrient levels and availability in the soil. Leiwakabessy (1988) also explained that the release of nitrogen from urea fertilizer into the soil can reach 10% -15%.

Another factor that affects nitrogen uptake by plants is soil pH. According to Smillie and Gershuny (1999), soil pH affects nutrient availability in the soil. Many nutrients in the soil are available at pH 6.2 - 6.8. Soil pH based on the analysis carried out in this research is worth 6.87 which can be an indicator that the soil can provide nutrients for plants so that fertilization efficiency can be carried out.

Treatment efficiency of nitrogen fixing by 100% (control) according to the recommendation without the addition of organic matter has a smaller effect on plant height. This shows that cabbage given more nitrogen fertilizer does not necessarily provide better growth and yields because of frequent washing due to rain irrigation and nitrogen volatilization due to the volatile nature of urea. Gonggo, Hasanudin and Indriyani (2006) explain that, giving urea fertilizer that is higher than the optimum requirement by ignoring the available nutrients in the soil causes a decrease in nitrogen absorption efficiency because it is not optimally utilized by plants.

TABLE 1. Plant Height, Number of Leaves, Total Dry Weight and Leaf Area at 42 DAS

Efficiency Nitrogen	Head Of Plant (cm)	Number of Leaves (Stand)	Total Dry Weight (g)	Leaf Area (cm ²)
control	9,24 a	12,84 a	19,61 a	2353,02 a
Nitrogen 25%	11,07 c	14,50 c	34,32 b	3979,14 b
Nitrogen 50%	10,44 bc	13,89 bc	27,50 ab	3102,44 ab
Nitrogen 75%	9,78 ab	13,25 ab	27,39 ab	2927,79 ab
BNT 5%	0,86	0,94	9,99	1066,91

3.1. Leaf Area.

This response to nitrogen fertilization efficiency showed that the treatment efficiency of nitrogen fertilization was 25% or 50% with the addition of organic matter which was able to produce more leaves. This shows that with the addition of organic matter, the availability of nitrogen for growth and development of the number of leaves is more fulfilled. The absorption of nitrogen by cabbage is more in the nitrogen efficiency treatment because it can be bound by the added organic material so that it can increase plant protein content. Nitrogen is important as an enzyme constituent which plays a very large role in the process of plant metabolism because enzymes are composed of protein.

As a complement to its role in protein synthesis, nitrogen is an inseparable part of the chlorophyll molecule and the provision of nitrogen in sufficient quantities will affect the optimal vegetative growth of plants and fresh green leaves (Sunu and Wartoyo, 2006). On the other hand, Marschner (1995) explains that nitrogen which cannot be absorbed by roots due to leaching in the soil so that its presence in plants is too low will reduce cytokinin activity. The decrease in

cytokinin activity causes disruption of protein metabolism in leaves because cytokinins will act as regulators in the formation of protein compounds in plants. Increased nitrogen uptake causes plant chlorophyll levels to be higher so that the rate of photosynthesis increases. The photosynthetic rate increases leading to the synthesis of carbohydrates also increase. Irwan et al., (2005) explained that the formation of carbohydrates caused by the rate of photosynthesis will increase plant vegetative growth including plant height growth and leaf formation.

3.2. Total Plant Dry Weight.

The treatment efficiency of nitrogen fertilization of 25% with the addition of organic matter was able to show a greater increase in total plant dry weight. This is because the optimal absorption of nitrogen in the presence of organic matter in the nitrogen efficiency treatment of 25% will produce maximum leaf area, the larger the plant leaf area, the greater the sunlight reception because the light is the energy source used to make photosynthate. In line with the research of Irwan et al., (2006), that the provision of urea fertilizer.

3.3. Crop Diameter

In Table 2. the treatment efficiency of nitrogen fertilization by 25% with the addition of organic fertilizers has a greater effect on crop diameter. This is due to the addition of organic fertilizers and the efficiency of nitrogen fertilization of 25% plants will be able to absorb nutrients optimally, due to better soil physical, chemical and biological properties. The diameter of the cabbage heads is higher in line with the development of the number and area of leaves and the total dry weight of the plants produced. The greater the number and area of leaves, the increase in total plant dry weight followed by an increase in plant crop diameter. Increasing the diameter of cabbage in the treatment efficiency of nitrogen fertilization by 25% with the addition of organic fertilizer is also influenced by the availability of nitrogen nutrients in the soil to form plant development. Soepardi (1983) stated that nitrogen nutrient was able to stimulate plant growth above the soil and one of them was increasing plant diameter. Wijaya (2008) also added that the supply of nitrogen nutrients affects plant growth, appearance, color and plant production.

TABLES 2. Crop Diameter, Crop-1 Fresh Weight and Hectare Crop Fresh Weight-1

Nitrogen Efficiency	Crop Diameter		Weight Of Fresh Krop Plant-1 (g)		Weight of fresh (Ton)	
Control	12,19	a	637,11	a	37,95	a
Nitrogen 25%	14,33	b	803,89	c	42,46	b
Nitrogen 50%	13,61	b	766,67	bc	39,61	ab
Nitrogen 75%	13,16	ab	649,72	ab	39,24	a
BNT 5%	1,30		121,33		2,69	

3.4. Fresh Weight of Crop

Crop-1 The fresh weight of plant crop-1 is the part of the plant consumed and one of the plant production parameters. The treatment of nitrogen fertilization efficiency of 25% and nitrogen efficiency of 50% with the addition of organic fertilizer was able to produce greater fresh weight of plant-1 crop. Plant fresh weight-1 is directly proportional to crop diameter and total plant dry weight. The greater the crop diameter and plant dry weight, the greater the production potential. The increase in crop fresh weight is supported by optimal plant growth due to the fulfillment of nutrient needs by plants. Nitrogen fertilization efficiency up to 50% of the recommended dosage is able to provide better growth than more urea fertilization (control) without the addition of organic matter. According to Winarso (2005) that if nutrients are met through fertilization to reach optimal requirements for plant growth, it will increase plant production. Meanwhile, 100% nitrogen fertilization treatment without organic fertilizer gave fresh weight of plant-1 crop-1 which was smaller and not different from nitrogen fertilization efficiency of 75% with organic fertilizers. This is because nitrogen in the soil is higher than the dose needed by the plant so that it will affect soil chemical properties such as acidity and soil compaction and there will be several processes that cause nitrogen

unavailability from the soil, namely the process of washing and evaporation. According to Wijaya (2008) that excessive nitrogen nutrient supply will reduce the efficiency of nitrogen absorption by plants due to leaching in the form of nitrate ions (NO₃⁻) and the evaporation of nutrients into the air in the form of N₂, NO₃ and ammonia (NH₃).

IV. CONCLUSION

The nitrogen fertilization efficiency of 25% with the addition of organic fertilizers was able to provide better growth and yields on all observed parameters. The yield of cabbage in the treatment of nitrogen fertilization efficiency of 25% with the addition of organic fertilizer gave a higher yield of 42.46 tonnes ha⁻¹, treatment efficiency of nitrogen fertilization was 50% with the addition of organic fertilizers gave a yield of 39.61 tonnes ha⁻¹, Efficiency treatment of nitrogen fertilization by 75% with the addition of organic fertilizer gave a yield of 39.24 tonnes ha⁻¹ and nitrogen fertilization treatment of 100% without organic fertilizers gave lower yields of 37.95 ton.ha⁻¹.

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