



The Scientific Study of Urea Fertilizer and Cow Manure Composition on The Growth and Yield of Kailan Plants

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ABSTRACT

There are determining factors in agricultural cultivation technologies that significantly affect plant development and productivity. Fertilization is one of the determining factors in agriculture. This research examines the composition of urea fertilizer and cow manure on kailan growth and yield. This research was conducted from 5 October 2021 to 30 November 2021 in Tunggulrejo Village, Jumapolo, Karanganyar, at an altitude of 700 meters above sea level with red latosol soil. This research used a single-factor Complete Randomized Block Design (RAKL) which consisted of 6 trials, and each was repeated four times to obtain 24 problems. The observational data were analysed using an F test with an error level of 5%. The treatment was continued with the DMRT (Duncan's Multiple Range Test) at an error level of 5% when there was an effect during the treatment. The variables used were plant height, number of leaves, leaf area, fresh plant weight, fresh crown weight, dry crown weight, fresh root weight, and dry root weight. The results of the research indicated that the composition of urea fertilizer and the application of cow manure had a significant effect on the growth of leaves of kailan plants; the best and highest number of leaves was 8 (F): Urea 0% + 100% cow manure per plot while the other parameters did not affect plants.

Keywords: *Composition, Fertilizer, Growth, Kailan Plants, Yield*

INTRODUCTION

Kailan, commonly known as *Brassica oleracea* L. can be divided into two types based on its leaf, smooth leaf kale and curly-leaf kale. Generally, Smooth-leaf kale is used as animal feed, while curly-leaf kale is used as a meal (Naiborhu et al., 2021). Kailan plants can be harvested in 40-50 days old after transplanting (Samadi, 2013b), but it is possible to harvest kailan during half of its age, around 20-30 days after planting. According to plant classification, kailan plant is classified into several categories, such as (1) Division: Spermatophyta; (2) Subdivision: Angiosperms; (3) Class: Dicotyledonae; (4) Family: Cruciferae; (5) Genus: *Brassica*; (6) Species: *Brassica oleracea* L.

Kailan is a vegetable with thick, flat, shiny, hard, bluish-green, and alternately arranged leaves. The leaves are long and wide like claim, while the colour of the leaves is like cauliflower in egg shape. Most Kailan vegetables have larger leaves, flat leaf surfaces, and blade leaves. In certain types, these spirally arranged leaves habitually overlap. The Kailan seeds are small round, brown to blackish black, and used as materials for propagating plants (Purniawati et al., 2021).

Kailan is a type of vegetable with many benefits as the primary source of minerals and vitamins for maintaining healthy bones and teeth, forming red blood cells (hemoglobin), and keeping the eye healthy. The protein contained in baby kailan helps to develop body tissues. It also has carotenoids as anti-cancer compounds (Samadi, 2013b). Kailan (*Brassica alboglabra*) is including in cabbage family (Cruciferae). Almost all parts of the kailan plant can be consumed, including its stems and leaves. In 100 grams of consumed kailan contains 7540 IU of vitamin A, 115 mg of vitamin C, and 62 mg of Ca, 2.2 mg of Fe (Siemonsma & Piluek, 1994). According to Dresselhaus research (2016), fertilization is the application of fertilizer to increase the supply of nutrients needed by plants to stimulate the production and quality of the produced crop yields. The chemical fertilizer is often used is urea as a source of N nutrient, while manure is the organic fertilizer from cow, goat, and chicken are usually used as the nutrition for plants.

Urea fertilizer is a hygroscopic fertilizer (that easily attracts moisture). The benefits of urea include its 46% nitrogen content, which is high, water solubility, ease of plant uptake, and comparatively low cost in comparison to other nitrogen fertilizers (Supriyadi & Kadarwati, 2017). For cabbage plants, 3 g/plant of urea fertilizer should be applied up to 5 cm from the stem around the plants. The suggested urea dosage for mustard greens is 3 g/plant, whereas the recommended urea dosage for radish plants is 6 g/plant (Sunarjono, 2016). On the other hand, there is no information on how much urea should be given to the kailan plant. This study aimed to discover the optimal urea dose to boost the vegetative growth of kailan plants. The proper application of urea fertilizer is anticipated to result in a more optimal result of vegetative development and plant yield. Vegetable plants are

hoped to yield healthy, fresh, and green leaves. Therefore, these plants should be given fertilizers that can stimulate green, fresh and crunchy leaves when consumed (Tini et al., 2019). Kailan requires large amounts of N nutrients. Nitrogen is the main nutrient for plant growth in vegetative formation, such as leaves, stems and roots. The use of nitrogen for plants are to increase plant growth, raise the protein levels and improve the quality of leaf-producing plants. The results of Susanti (2021) showed that a dose of 300 kg/ha (u2) urea are resulting in increasing leaf width, crown width, plant fresh weight, and dry weight of the plant.

Manure is fertilizer that comes from livestock pens, either in the form of solid manure (feces) mixed with food scraps or urine such as cows, pigs, goats and chickens. Manure is one of the fertilizers that can maintain the soil moisture when applied for a relatively long time, even though the nutrients contained in manure are lacking. Tioner Purba et al (2021) states that cow manure is a solid fertilizer that contains a lot of water and mucus. This fertilizer is a type of cold fertilizer that the decomposition process is very slowly and not forming the heat. This happens because cow manure hardens quickly and is difficult for water and air to penetrate. Cow manure has a low C/N ratio of 11. This means that cow manure contains a lot of nitrogen. In 1 ton of cow manure there is 1.5 kg of N; 2.0 kg P₂O₅; 4.0 k K₂O and 0.8 kg Mg. Adriani and Syahfari (2017) stated that the application of cow compost at a dose of 15 tons/ha had the best effect on the growth and production of green mustard plants of 28.72 tons/ha.

According to Jonathan Henri et al (2022) research, stated that the composition of the planting medium between soil and cow manure had a significant effect on the growth and yield of mustard greens, with the best Treatment being M2 (soil plus cow manure 1:2). Treatment of concentration of urea fertilizer by giving it through the leaves did not significantly affect the growth and yield of mustard greens. The interaction treatment between the composition of the growing media (mixture of soil plus cow manure) and the concentration of urea fertilizer had no significant effect, and no interaction occurred.

Meanwhile, according to Muhammad Saifullah Mukti et al (2017) research, it stated that plant length, number of leaves, leaf area, and total fresh weight of plants were all affected by the timing of manure application and the amount of urea fertilizer, however there was no interaction on fresh weight of plant portions that could be consumed, fresh weight harvested, or harvest index. The P1W1 treatment, which combined 100 kg of urea per hectare with cow manure applied one week before planting, had the best yield per hectare of 1.94 tons ha⁻¹.

On the other hand, according to Silvester et al (2013) in their research stated that administration of urea significantly affected growth and yield, plant height except age 10 and 20 days and the average number of leaf age 10 days, n₃ treatment with a dose (7,5 plot⁻¹) showed the highest weight of plants per hectare, 15.48 tons ha⁻¹, n₀ treatment (0 g plot⁻¹) showed the lowest weight of plants per hectare, 11,57

tons ha⁻¹ and (3). Interaction of chicken manure and urea fertilizers provide a very real effect on all parameters, but did not significantly affect plant height average age of 10 and 20 days and the average number of leaf age 10 days. Interaction p3n3 showed the greatest weight of plant per hectare 22.70 tons ha⁻¹, whereas p0n0 showed the smallest weight of plant per hectare of 6,45 tons ha⁻¹. It also supported by the research result from Sartono, Elly and sinta (2022) that the application of various types of biological fertilizers and cow manure did not significantly affect the growth and yield of chickpeas. Also, the environmental factors are play an important role in the growth and yield of chickpeas.

It is necessary to conduct research on the composition of urea fertilizer and cow manure on the growth and yield of kailan. Then the best composition of urea and manure can be identified for the plant's growth and creation. This research examines the composition of urea fertilizer and cow manure on kailan growth and profit.

LITERATURE REVIEW

Urea Fertilizer

Fertilizing is one technique to boost the production of fruit and vegetable crops. The application of fertilizer is the process of giving plants the nutrients they require to thrive. There are two categories of fertilizers: organic fertilizers and inorganic fertilizers. Urea fertilizer is one of kind inorganic fertilizers. According to Fajrin (2020) statement, urea fertilizer is fertilizer containing high levels of nitrogen (N) of 45%-56%. Nitrogen is a nutrient that is needed by plants. The nitrogen element in urea fertilizer is very beneficial for plants for growth and development. Another benefit of urea fertilizer is that it makes plant leaves greener, thicker and fresher. Nitrogen also helps plants have lots of chlorophyll. Due to the abundant chlorophyll, it will be easier for plants to conduct photosynthesis and also accelerate plant growth such as height, number of tillers, branches and others. In addition, urea fertilizer is also able to increase the protein content in plants. One day after the plants were transplanted, urea fertilizer was applied at the dosage specified for the treatment, i.e., 150 kg/ha (2.4 g/plant) for the control, and 300 kg/ha (4.8 g/plant). Spreading urea fertilizer on the soil's surface near to the roots and mixing it thoroughly is the process of application applied (Samini & Fatah, 2020).

Cow Manure

Another categories of fertilizer is organic fertilizer. Organic fertilizers may be applied as a primary fertilizer or a secondary fertilizer. One of them is compost, which is frequently utilized by people in rural areas since it is appropriate for use as fertilizer for vegetable crops and can be produced at home using animal manure.

Animal feces might be in their freshest form, combined with urine, or degraded into solid or liquid forms to create animal manure. It can originate from the feces of pigs, chickens, horses, goats, and cattle (Hartatik & Widowati, 2017). Several farmers divided the animal manure into two types, such as (1) Solid Manure and (2) Liquid Manure. The vast variety of nutrient levels in manure should be given special consideration. Various factors, including the kind of animal, its age, the type of food it consumes, its bedding, and how fertilizers are used, have a significant impact on the content of these nutrients.

Kailan Plants

Kailan or commonly known as *Brassica Oleraceae* is kind of leaf vegetable plants that have a function, namely as a vegetable and play a role in improving people's nutrition. Kailan has many benefits and is the main source of minerals, protein and vitamins which are useful for maintaining healthy bones and teeth, forming red blood cells (hemoglobin), and maintaining eye health. The protein contained in kailan is useful for forming body tissues. Kailan also contains carotenoids as anti-cancer compounds. The nutritional content in 100 g of kailan is Calories 35 cal; protein 3 g; fat 0.40 g; carbohydrates 6.80 g; fiber 1.20 g; Ca 230 mg; P 56 mg; Fe 2 mg; vitamin A 135 RE; vitamin B1 0.10 mg; vitamin B2 0.13; vitamin C 93 mg; and water 78 mg (Samadi, 2013). According to Central Bureau of Statistics (2021), it stated that in 2021, Indonesia would produce 727.467 tons of kailan. The amount of soil fertility to supply nutrients is one environmental aspect that affects the effectiveness of kailan cultivation.

RESEARCH METHODOLOGY

This research used a single factor Complete Randomized Block Design (RAKL) consisting of 6 types of treatment, each of which was repeated 4 times to obtain 24 types of treatment.

A: Control

B: Urea 100% + 0% cow manure (30 g urea + 0 cow manure per plot)

C: Urea 75% + 25% cow manure (22.5 g urea + 0.375 kg cow manure per plot)

D: Urea 50% + 50% cow manure (15 g urea + 0.75 kg cow manure per plot)

E: 25% urea + 75% cow manure (7.5 g urea + 1.125 cow manure per plot)

F: Urea 0% + 100% cow manure (0 g urea + 1.50 kg cow manure per plot)

Sidik Ragam's analysis of data is followed up with Duncan's Multiple Range Test when a therapy exhibits a substantial change. The research materials are kailan seed, urea fertilizer, cow manure, dolomitic lime [(Ca Mg (CO₃)₂]. While the research tools are hoe, ruler, stationery, tape measure and scales. The research was carried out from October 5 through November 30, 2021, at a 700-meter altitude in

the red latosol soil type of Tunggulrejo Village, Jumapolo, Karanganyar. The variables used are:

a) Plant Height (cm)

The measurement is from the stem base to the tip of the plant. The analysis was taken once a week starting from the 1st week after planting until the 5th week.

b) Number of Leaves (strands)

The calculation of the number of leaves is obtained by counting the number of leaves of each plant. The number of leaves counted is the leaf that has opened perfectly. The number of leaves was analyzed every week starting from the 1st week after planting until the 5th week.

c) Leaf Area (cm²)

The leaf area was calculated by gravimetric method. In this method, in principle, leaf area is estimated by weight comparison (gravimetry). This can be conducted by drawing the leaf to be estimated on a piece of paper, which results in a replica (copy) of the leaf. Then, cut out of paper and estimated it based on the ratio of the weight of the leaf replica to the total weight of the paper. The calculation of leaf area was conducted in 5th week

$$LD = W_r/W_t \times L_k$$

$$LD = \text{Leaf Area}$$

$$W_r = \text{Paper replica weight}$$

$$W_t = \text{Total paper weight}$$

$$L_k = \text{Total paper area}$$

d) Fresh Plant Weight

Fresh plant weight was obtained by weighing all parts of kailan plant after harvest.

e) Fresh Header Weight

Fresh crown weight was obtained by weighing all parts of kailan plant except the roots after harvest.

f) Dry Crown Weight

After harvesting, all parts of the plant except the roots were cleaned from dirt and dried in an oven at 60 C for 3 x 24 hours, then weighed.

g) Fresh Root Weight

Fresh root weight was obtained by weighing the roots of kailan after harvest.

h) Dry Root Weight

After harvesting, the roots were cleaned from dirt and dried in an oven at 60C for 3 x 24 hours, then weighed.

RESULT AND DISCUSSION

Kailan Plant Growth

Table 1. The Growth of Kailan Plants

Treat ment	Plant height	Fresh root weight	Fresh plant weight	Dry root weight	Dry canopies weight	Dry plant weight
A	15,8175	1,575	14,025	0,117	1,630	1,742
B	16,2125	1,875	21,725	0,340	2,607	2,972
C	18,3225	1,500	23,950	0,555	3,740	4,295
D	18,4350	2,550	22,600	0,545	4,670	5,215
E	18,5750	1,950	15,075	0,600	4,465	7,885
F	18,5775	1,800	16,775	0,305	5,120	5,425

Source: Processed Data

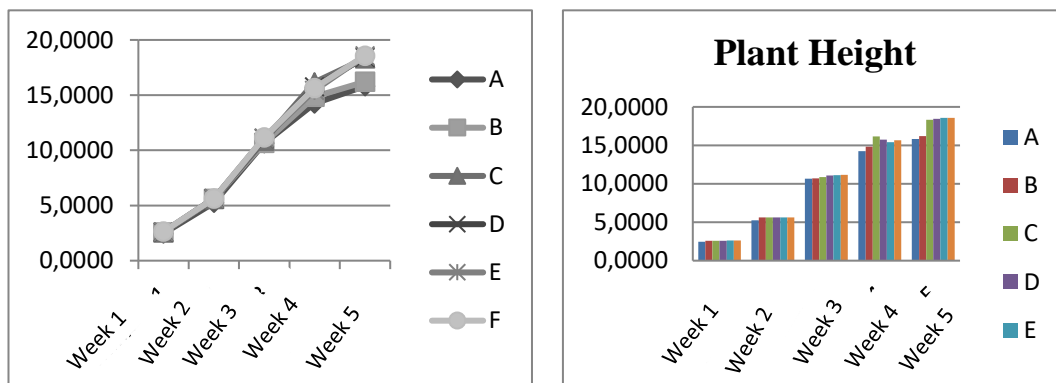


Figure 1. Plant Height Graph

Source: Processed Data

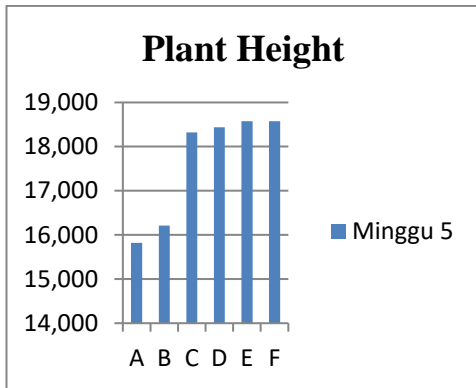


Figure 2. Plant Height Histogram

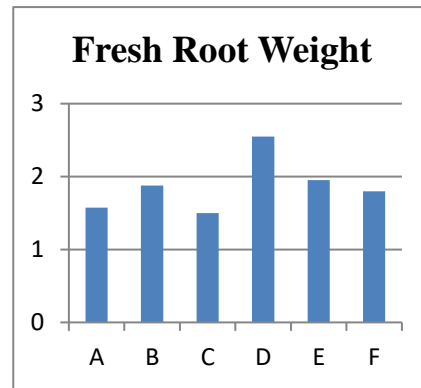


Figure 3. Fresh Root Weight Histogram

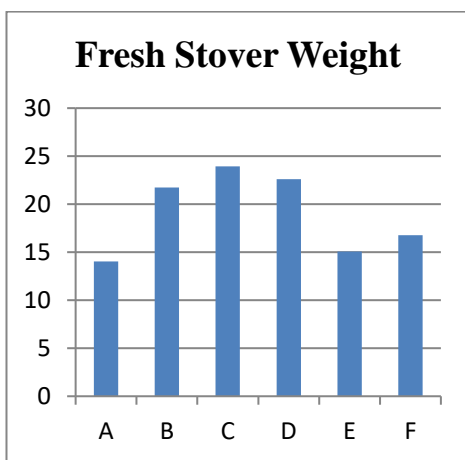


Figure 4. Fresh Stover Weight Histogram

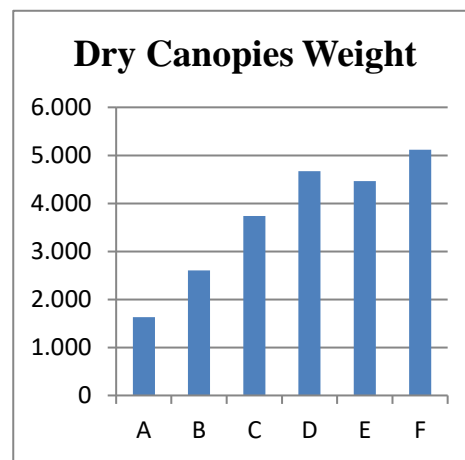


Figure 5. Dry Canopies Weight Histogram

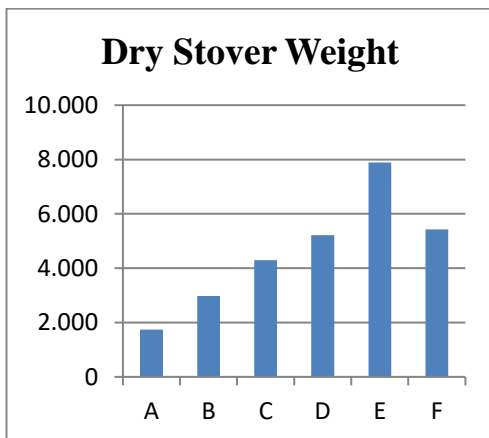


Figure 6. Dry Stover Weight Histogram

Source: Processed Data

Based on table 1 and clarified by Figures 1 to 6, the effect of the combination of urea fertilizer and cow manure cannot increase the growth of Kailan significantly

(real) in terms of the parameters of plant height, leaf area, fresh canopies weight, dry canopies weight, fresh roots weight, fresh stover and dry stover weight. This can be caused by the use of cow manure that has not been optimal even though the dolomite lime has been added. Since the cow manure includes in cold fertilizer, organic fertilizer is relatively washed away (by rainwater) along with the nutrients of urea fertilizer. According to Budi Mulyanto (2019) statement, the provision of lime (Dolomite) can increase/neutralize soil pH, then the Ca element can strengthen and grow (elongation), especially in the branches, stems and leaves of plants. Similarly, research by Puspita (2015), stated that the combination of cow manure (cow bio urine) and N fertilizer (urea) had the highest yield (growth) on the number of leaves of kailan plant.

Kailan Plant Harvest

Table 2. Yields of Kailan Plants

Treatment	Number of leaves	Leaf Area	Fresh canopies weight
A	7,00 ab	147,383 a	12,450 a
B	6,50 a	85,392 a	22,200 a
C	8,00 b	120,130 a	20,100 a
D	8,00 b	113,165 a	20,050 a
E	8,00 b	119,772 a	15,875 a
F	8,00 b	90,785 a	14,992 a

Source: Processed Data

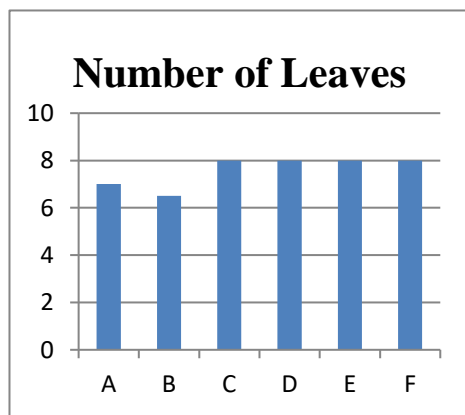


Figure 7. Number of Leaves Histogram

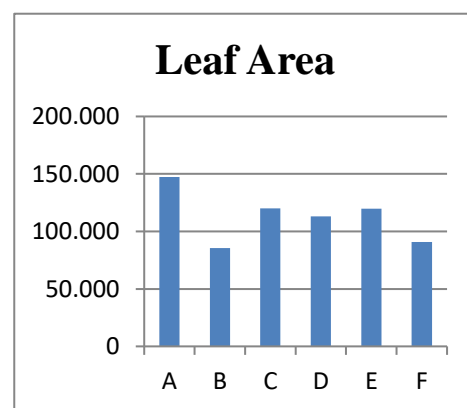


Figure 8. Histogram of Leaf Area

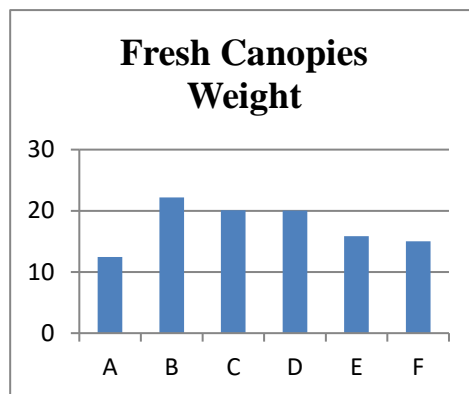


Figure 9. Fresh Canopies Weight Histogram
Source: Processed Data

Based on table 2 and explained by Figure 7, the effect of the combination of urea fertilizer and cow manure can only increase the growth of the number of leaves significantly compared to the control and without cow manure and other parameters. The effect of this fertilizer is not optimal even though the dolomite lime has been added, but it is more dominated by the role of cow manure than urea fertilizer (treatment C, D, E, F). Without the application of urea fertilizer, the number of leaves of kailan plant are continues to grow significantly (25% -100% cow manure or 0.375 kg – 1.500 kg cow manure). The reason is cow manure is considering as a cold manure, and organic fertilizer is relatively slow to be available and is relatively easily washed off by rain along with the nutrients of urea fertilizer.

The addition of dolomite lime, pH 7.7, which is relatively resistant or not easily washed off by rainwater, the presence of Ca in the soil is stable for strengthen and increasing the fertility (elongation/growth and development) of the number of leaves. Related to the genetic nature of Kailan, the number of leaves of Kailan can still grow and develop properly along with the support by environmental factors. According to Budi Mulyanto (Mulyanto, 2019), the provision of lime (Dolomite) can increase/neutralize soil pH, then the Ca element can strengthen and grow (elongation), especially in branches, stems and leaves of plants. In addition, based on research by Puspita (2015), stated that the combination of cow manure (cow bio urine) and N fertilizer (urea) had the highest yield (growth) on the number of leaves of kailan plant. The highest and best number of leaves were 8 stems obtained in treatment C with 75% Urea 75% + 25% cow manure (22.5 g urea + 0.375 kg cow manure per plot).

CONCLUSION

The results showed that the composition of urea fertilizer and the application of cow manure had a significant effect on the number of leaves of kailan plants, while the other parameters had no significant effect. This is evidenced by the results of research which states that the composition of urea fertilizer and the application of cow manure had a significant effect on the growth of leaves of kailan plants, the best and highest number of leaves was 8 (F): Urea 0% + 100% cow manure per plot while the other parameters had no effect on plants. Therefore, it is required to balance the dosage levels between the doses of urea fertilizer and animal manure (especially cow manure) in order to obtain abundant kailan crop yields.

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