The Effect of Chicken Manure Application on the Growth and Yield of Celery (*Apium graveolens* L.)

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Abstract. Celery (*Apium graveolens* L.) is a vegetable plant used as a food ingredient, especially in soups. Celery is also used as a medicinal plant because it can treat various ailments such as digestive disorders, prevent lymphatic disease, and treat fever and flu. Celery export volume decreased from 2015 to 2016 due to inappropriate cultivation techniques, particularly in fertilization. The purpose of this research was to determine the effect of chicken manure application on celery growth and yield, as well as to determine the appropriate dosage of chicken manure to increase celery growth and yield. This research was conducted from March to June 2025 in Leda, Bangka Leda Village, Langke Rembong District, Manggarai Regency, Nusa Tenggara Timur. A randomized block design (RBD) was used with four treatment levels, each containing chicken manure: 0 kg/plot, 1 kg/plot, 2 kg/plot, and 3 kg/plot. Data were analyzed using a scaled Analysis of Variance (ANOVA) and Duncan's test at the 5% level. The results showed that chicken manure application significantly affected plant height, number of leaf stalks, fresh weight per plant, and leaf chlorophyll content. A dose of 3 kg/plot of chicken manure yielded the best results in terms of plant height (13.90 cm), number of leaf stalks (5.36 stalks), fresh weight per plant (31.40 g), and chlorophyll content (23.77 mg/g).

Keywords: Celery; chicken manure; dosage; organic.

1 Introduction

Celery (*Apium graveolens* L.) is a vegetable used as a food ingredient, especially in soups. It is also used as a medicinal plant because it can treat various ailments such as digestive disorders, prevent lymphatic disease, treat fever, and flu [1].This is because celery has beneficial content for the body, according to the opinion of [2] that in 100 grams of raw celery contains 130 IU of vitamin A, 0.03 mg of vitamin B, 0.9 grams of protein, 0.1 g of fat, 4 g of carbohydrates, 0.9 g of fiber, 50 mg of calcium, 1 mg of iron, 0.005 mg of riboflavin, 0.003 mg of thiamine, 0.4 mg of nicotinamide, 15 mg of ascorbic acid, and 95 ml of water, and supported by the opinion of [3] that celery contains chemical compounds in the form of flavonoids, saponins, choline, tannins, essential oils, and apigenin for the basic ingredients of making herbal medicines. Based on this, it shows that celery has great potential to be developed in Indonesia.

Celery has high prospects for cultivation and marketing, particularly as an export commodity. Celery export volume in 2015 was 6,797 kg, while celery export volume decreased to 4,037 kg in 2016 [4]. Celery cultivation in Indonesia is not yet widely managed commercially, so it has

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not yet become a major vegetable commodity in Indonesia. This refers to data from [5], which states that there is no data on horticultural crop production in Indonesia, especially vegetables such as celery, which does not yet contain data on harvested area and celery production in Indonesia. According to [6], one of the most important cultivation factors that influences plant growth and development is the growing medium.

People still use chemical fertilizers for fertilization. Continuous use over several cultivation periods can deplete the soil's organic matter, disrupting the balance of organic matter for soil microbes, and thus reducing land productivity and crop production [7]. Furthermore, chemical fertilizers are very expensive on the market, increasing cultivation costs. One way to reduce chemical fertilizer use is by applying organic fertilizer from chicken manure.

Chicken manure has a higher nutrient and organic content than other manures [8]. These nutrients are macronutrients that are needed by plants to increase growth and development. The N nutrient element functions to increase the number of leaves and chlorophyll [9], the P element functions to accelerate fruiting and flowering, while the K element functions to strengthen cell walls to strengthen plant stems [10]. Based on the results of research by [11] that the application of chicken manure with a dose of 10 tons/ha can increase plant height (22.28 cm), number of leaves (16.50 strands), production per plant (27.13 g), production per plot of (113.78), and soil pH 6.60.

In this regard, it is necessary to study the potential of chicken manure to support the growth and yield of celery plants to be more optimal. The objectives of this study are as follows: (1) To determine the effect of providing chicken manure on the growth and yield of celery plants, (2) To determine the appropriate dose of chicken manure to increase the growth and yield of celery plants. In line with this, the hypothesis is proposed that the application of chicken manure fertilizer not only improves the availability of nutrients in the soil, but also significantly increases the stem diameter and economic weight of celery, with the assumption that higher doses will provide better results until reaching a certain nutrient saturation point.

2 Method and Materials

This research was conducted from March to June 2025 in Leda, Bangka Leda Village, Langke Rembong District, Manggarai Regency, Nusa Tenggara Timur. The materials used in this were hole punch, shovel, tape measure, tofa, machete, scale, ruler, chlorophyll meter, Amigo celery seeds, and chicken manure. This study used a non-factorial Randomized Block Design (RBD) with 4 treatment levels and 6 replications, resulting in 24 experimental units. The treatments were various doses of chicken manure, namely P0 (0 kg/plot), P1 (1 kg/plot), P2 (2 kg/plot), P3 (3 kg/plot).

The dosage justification used refers to [12] research results, which showed that a dose of 1 kg of chicken manure per plot with a planting distance of 30 cm x 20 cm had a positive effect on the number of leaves, tuber length, tuber diameter, and tuber weight per plot in carrots, a plant in the same family as celery. However, its effectiveness on celery has not been tested in plot form, only tested in hectares, so it often varies depending on local agro-ecosystem conditions. Testing various dosage levels in this study was conducted to evaluate whether there was a linear increase in yield or actually experienced a decline (the law of diminishing returns) at a certain level. This is important to provide precise fertilization recommendations that can balance the productivity of celery plant biomass with the efficiency of organic fertilizer use from chicken manure.

The research began with seeding, which lasted until the seeds were four weeks old. Seeding was carried out in seed trays using a mixture of chicken manure and soil in a 1:1 ratio. The mixture was placed in the seed trays, followed by soaking the seeds in water for one hour. According to [1] the purpose of soaking the seeds was to ensure full seeds. When soaked in water, the seeds would sink. Therefore, celery seeds that did not sink (float) were discarded and not used for sowing. After soaking and selecting full seeds, the seeds were dried for approximately 10 minutes on a tissue. After planting, the seeds were made into holes in the soil 2-3 cm deep in the seed trays. Land preparation and basic fertilizer application included chicken manure at the same dose of 2.5 kg per plot. Seedlings were planted in the research area at a spacing of 25 cm x 30 cm, with one seedling per hole, with a total of 18 plants per plot. Meanwhile, fertilizer application was carried out according to research [21], namely when the plants were 2 weeks after planting (WAP), 4 weeks after planting (WAP), and 6 weeks after planting (WAP). The dosage given was in accordance with the treatment in this study and was given by making a furrow next to the plant, so that there were 2 furrows in the bed, then the fertilizer was put into the furrow, then the furrow was covered again with soil.

Celery is harvested after 90 days after planting (DAP), when the leaves are lush, broad, and dark green. They have produced numerous leaf sheaths, reached a suitable height, and have produced shoots. Before harvesting, the plants are watered to facilitate uprooting. The plants are then carefully removed along with their roots and observed on each sample plant.

This study focused on observing the growth and productivity of celery plants in response to various doses of chicken manure fertilizer. Given resource limitations and the study's focus on practical agronomic aspects, this study did not include an in-depth analysis of soil chemical properties before and after treatment, nor did it conduct laboratory tests on the specific nutrient composition (macro and micronutrients) of the chicken manure fertilizer used. Success parameters were measured solely through vegetative growth indicators and crop yields in the field. Therefore, the mechanisms of nutrient changes in the soil and the efficiency of chemical nutrient uptake are beyond the scope of this study.

Observation parameters consisted of plant height, number of leaf stalks, fresh weight per plant, and chlorophyll content. Data were analyzed using Analysis of Variance (ANOVA) and Duncan's Multiple Range Test (DMRT) at the 5% level.

3 Results and Discussion

3.1 Plant Height

The results of the analysis of variance showed that various doses of chicken manure had a significant effect on the height of celery plants at the ages of 3 WAP, 5 WAP, and 7 WAP as shown in **Table 1**.

Table 1. Celery plant height at various doses of chicken manure fertilizer

Chicken Manure Fertilizer Dosage	Plant Height (cm)		
	3 WAP	5 WAP	7 WAP
P0 (0 kg/plot)	4.66 a	7.93 a	11.99 a
P1 (1 kg/plot)	4.77 ab	8.29 b	12.52 b
P2 (2 kg/plot)	5.06 bc	8.74 c	13.50 c
P3 (3 kg/plot)	5.27 c	8.92 c	13.90 c

Note: Numbers followed by the same letter and same column indicate an insignificant difference based on the DMRT test for Difference at 5%.

Chicken manure with a dose of 3 kg/plot (P3) produced the highest plant height of 5.27 cm at 3 WAP, 8.92 cm at 5 WAP, and 13.90 cm at 7 WAP (**Table 1**). The dose of 3 kg/plot of chicken manure is the optimal dose to increase plant vegetative growth. Based on research by [13], the application of 3 kg/plot of chicken manure can increase plant growth, especially plant height, because it has several nutrients in the form of N, P, and K.

According to [14] during the vegetative phase, plants require high levels of nutrients to increase productivity. High nutrient levels are found in higher fertilizer doses [15]. Chicken manure contains 2-3.17% N, 1.8-3.10% P, and 1.38-2.2% K [16]. The provision of organic fertilizer in the form of chicken manure into the soil is thought to be able to improve the biological, physical and chemical properties of the soil and can increase the nutrients in the soil. These three elements, namely N, P, and K, are macronutrients that are really needed by plants for vegetative growth, especially the nutrient N which influences stem elongation.

According to [17], nitrogen is a nutrient that plays a crucial role in plant growth and development and is most needed for the formation or growth of vegetative plant parts, such as plant height growth due to cell development, such as elongation and cell division. Supported by a statement from [18] that optimal nitrogen is essential for plant height growth, as N is a key component of protein, which is the building block of plant cells and tissues. The nitrogen absorbed by plants is converted into amino acids, which are then assembled into structural proteins [7]. These proteins are the main components of protoplasm (cell contents) and cell membranes. The more protein produced, the faster cell division occurs in the apical meristem (the growing point at the tip of the stem). This directly increases plant height. Applying high-nitrogen chicken manure, which increases protein sources, can also increase soil microbial populations, which support nutrient uptake by roots. This can enhance plant physiological and metabolic processes, leading to increased plant height.

3.2 Number of Leaf Stalks

The results of the analysis of variance showed that various doses of chicken manure significantly affected the number of celery leaf stalks at 3 WAP, 5 WAP, and 7 WAP, as shown in **Table 2**.

Table 2. Number of celery leaf stalks in various doses of chicken manure

Chicken Manure Fertilizer Dosage	Number of Leaf Stalks		
	3 WAP	5 WAP	7 WAP
P0 (0 kg/plot)	3.28 a	3.92 a	4.69 a
P1 (1 kg/plot)	3.52 b	4.11 b	4.97 b
P2 (2 kg/plot)	3.72 c	4.36 c	5.22 c
P3 (3 kg/plot)	3.78 c	4.50 c	5.36 c

Note: Numbers followed by the same letter and same column indicate an insignificant difference based on the DMRT test for Difference at 5%.

A dose of 3 kg of chicken manure/plot produced the highest number of leaf stalks, namely 3.78 stalks at 3 WAP, 4.50 stalks at 5 WAP, and 5.36 stalks at 7 WAP (**Table 2**). It is suspected that the dose of chicken manure of 3 kg/plot is the optimal dose to increase the vegetative growth of plants and the nutrient content in chicken manure can be utilized optimally by plants to help growth.Referring to [19] statement explained that plants will grow well and well if the nutrients needed by plants are available in a balanced and sufficient manner so that new leaf formation will be better. The nutrient content in chicken manure with a high dose causes more availability of nutrients that can be utilized in plant growth [20]. Quoting a statement from [21], chicken manure can stimulate plant growth, especially leafy vegetables, because chicken manure contains higher N nutrients compared to other manures.

The element N functions in the formation of chlorophyll, a green pigment that functions to capture sunlight energy to break down water and carbon dioxide into sugar, where sugar is used for the formation of plant organs such as leaves [22]. Plants that lack N can cause chlorosis (leaves turning yellow) which can inhibit the process of photosynthesis and the development of plant organs [23]. In addition, chicken manure contains 1.44% Mg [24]. The element Mg (magnesium) is an important element of the chlorophyll molecule to support increased photosynthate production which will be translocated to plant parts during the vegetative and generative phases, one of which is for leaf formation [25].

Mg also acts as an enzyme activator involved in plant metabolic processes such as protein and carbohydrate synthesis, where protein and carbohydrates are used as energy in the formation of meristem plant parts such as stems, leaves, and roots [24]. According to [17] the high and balanced availability of N and Mg nutrients in chicken manure can accelerate leaf formation, thereby facilitating photosynthesis and enabling smooth photosynthate translocation. Mg deficiency will cause interveinal chlorosis (leaf veins remain green but the areas between them turn yellow), which causes the plant to lack the energy to increase the number of leaves.

3.3 Fresh Weight per Plant

The results of the analysis of variance showed that various doses of chicken manure had a significant effect on the fresh weight per celery plant as shown in **Table 3**.

Table 3. Fresh weight per celery plant at various doses of chicken manure fertilizer

Chicken Manure Fertilizer Dosage	Fresh Weight per Plant (g)
P0 (0 kg/plot)	29.23 a
P1 (1 kg/plot)	30.14 b
P2 (2 kg/plot)	31.04 c
P3 (3 kg/plot)	31.40 c

Note: Numbers followed by the same letter and same column indicate an insignificant difference based on the DMRT test for Difference at 5%.

Chicken manure of 3 kg/plot (P3) produced the highest fresh weight per plant, namely 31.40 g (**Table 3**). It is suspected that the P3 treatment has the highest dose of chicken manure among the other treatments, resulting in higher nutrient absorption by plant roots during the growth process, resulting in higher fresh weight of a plant. The low fresh weight of a plant is thought to be due to the lack of nutrient availability in the soil that can be utilized by the plant. This is in line with the opinion of [26], that the fresh weight of a plant can be influenced by the optimal availability of nutrients in the soil and can be absorbed by plant roots. The lower the nutrient content in the soil, the more inhibited plant growth will be, especially in increasing the fresh weight of the plant.

According to [8], fresh plant weight is a combination of plant tissue growth and growth, such as plant height, leaf number, and leaf area. This is influenced by nutrient content and water content within the plant tissue cells. This statement is supported by [24], who stated that the nutrients that contribute to plant weight increase are K and Mn, which are found in chicken manure at 2.18% for K and 250 ppm for Mn.

The K nutrient element is a nutrient that plays a role in opening and closing stomata, where this process is useful in absorbing sunlight and minerals, so that if the plant lacks the K nutrient, the plant cannot open and close the stomata optimally, thus inhibiting the photosynthesis process which results in lower photosynthate results [27], this causes a decrease in weight in a plant.

Potassium or K is often referred to as a "quality regulator" because of its role in regulating cellular metabolism, which directly impacts plant weight. According to [26] K activates more than 60 types of enzymes involved in protein synthesis and starch formation. This directly increases biomass accumulation (plant weight). K is thought to function as a transporter of photosynthetic products (sugar/photosynthates) from leaves to storage organs (such as stems and roots). If this transport is smooth, the weight of plant organs will increase significantly.

Meanwhile, Manganese (Mn) is a micro nutrient that plants need in small amounts but can also be used to support the photosynthesis process. Manganese (Mn) can facilitate assimilation and provide electrons for the light reaction process of photosynthesis which will ultimately be used to produce sugar as an energy source in plant development such as increasing stem length, increasing leaf area and plant weight [16]. [8] also stated that another function of Mn is that it can activate various types of enzymes to help form proteins, where proteins are the building blocks of plant structures such as leaves, stems, roots, flowers and increasingly larger fruits. Mn also helps plants assimilate nitrogen. The interaction between N and Mn ensures the smooth formation of amino acids and proteins, which are the main building blocks of plant structure. This can increase dry matter (biomass) accumulation and accelerate plant growth and development.

3.4 Chlorophyll Content

The results of the analysis of variance showed that various doses of chicken manure had a significant effect on the chlorophyll content of celery leaves, as shown in **Table 4**.

Table 4. Chlorophyll content of celery leaves at various doses of chicken manure fertilizer

Chicken Manure Fertilizer Dosage	Chlorophyll Content (mg/g)
P0 (0 kg/plot)	13.95 a
P1 (1 kg/plot)	17.49 b
P2 (2 kg/plot)	21.98 c
P3 (3 kg/plot)	23.77 d

Note: Numbers followed by the same letter and same column indicate an insignificant difference based on the DMRT test for Difference at 5%.

The leaf chlorophyll content results in **Table 4** show that 3 kg of manure/plot (P3) produced the highest leaf chlorophyll content, at 27.33 mg/g. This is thought to be because the nutrient content in chicken manure can meet plant nutrient needs to promote growth. As stated by [28], plant growth can increase if nutrients are available in the soil. The higher the chlorophyll content in leaves, the higher the photosynthesis results, thus enhancing plant growth and development.

Chlorophyll formation is strongly influenced by the nitrogen content in chicken manure, which is 3.21% [24]. N forms the pyrrole unit in the chlorophyll structure, which forms a porphyrin ring [29]. N is also involved in the formation of early chlorophyll precursors, such as ALA (Aminolevulinic Acid), which is used in chlorophyll biosynthesis [30]. In line with previous findings, [31] stated nitrogen is the main component of amino acids that make up proteins and several enzymes such as reductase and synthase which are involved in the formation of aminolevulinic acid for the formation of chlorophyll.

Besides nitrogen, chicken manure contains other micro and macro elements, including magnesium [20]. Magnesium is the central atom in the chlorophyll molecule. If nitrogen is the "wall" of the molecule, then magnesium is the central atom. Chicken manure helps ensure a sufficient supply of magnesium for plants to maintain a stable chlorophyll structure. Chicken manure also contains micro elements such as manganese and iron, which act as catalysts [21]. Although not part of the chlorophyll molecule, manganese and iron are essential for chlorophyll biosynthesis. These two elements act as enzymes that accelerate the formation of chlorophyll units in the chloroplasts.

The organic matter in chicken manure is also thought to stimulate the activity of soil microorganisms, which can aid in the mineralization process, which converts nutrients bound in organic matter into inorganic forms that can be absorbed by roots (such as ammonium and nitrate) [1]. More efficient nutrient uptake is directly proportional to the rate at which plants produce chlorophyll. Based on this, it can be seen that the increase in chlorophyll content by chicken manure occurs through the mechanism of providing essential nutrients which are the main raw materials for forming green leaf substances.

4 Conclusion

Application of chicken manure to celery plants significantly affected celery growth and yield. A dose of 3 kg of chicken manure per plot resulted in the highest plant height (13.90 cm), the highest number of leaf stalks (5.36 stalks), the highest fresh weight per plant (31.40 g), and the highest chlorophyll content (23.77 mg/g). However, its effectiveness is greatly influenced by the variability of environmental factors such as light intensity, temperature fluctuations, and micro-humidity at the research site. Optimal environmental conditions act as a catalyst in accelerating the mineralization process of organic matter from chicken manure into plant-available nutrients.

From a broader application perspective, the use of chicken manure offers a sustainable fertilization solution that not only increases celery biomass productivity but also has the potential to be adapted to various types of marginal soil in other regions with appropriate dosage adjustments. These results provide a foundation for horticultural farmers to reduce their dependence on inorganic fertilizers, while supporting efforts to restore the physical and biological quality of soil in the long term within a broader organic farming system. However, further research is needed and combination with other organic fertilizers is needed to better understand the effectiveness of each organic fertilizer studied.

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