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Celery Plant Growth Response Given Organic Fertilizer with Banana Peel and Coconut Water

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Abstract: Celery (*Apium graveolens* L.) is a vegetable that has many health benefits because it contains nutrients and antioxidants that makes it popular among the public, but its production is relatively low. One way to improve the quality and quantity of celery plants is to provide liquid organic fertilizer (LOF) of banana peel and coconut water which contains essential nutrients such as calcium, phosphorus, nitrogen, potassium, magnesium, sodium, sulfur, sugar, protein, and two hormones. namely cytokinins and auxins which are needed in the growth of the plant. The study aims to analyze the growth response of celery plants given liquid organic fertilizer (LOF) from banana peel and coconut water. The type of research is an experiment with a complete randomized design (CRD) consisting of 7 treatments, namely (P0 = Control, P1 = 10% banana peel, P2 = 15% banana peel, P3 = 20% banana peel, P4 = 10% coconut water, P5 = 15% coconut water, and P6 = 20% coconut water), each treatment is repeated 6 times with a total sample of 42. The observed variables were plant height, number of leaves, and number of tillers measured at 6 WAP, 8 WAP, 10 WAP, and 12 WAP. Data analysis used ANOVA followed by a 5% significant BNT test with the help of the SPPS 25 program. The results of the research showed that the best growth was at the age of 12 WAP with a concentration of 20% organic fertilizer and banana waste organic fertilizer was more effective than coconut water in increasing the response of celery plant growth.

Keywords: Banana peel, celery, coconut water, Liquid Organic Fertilizer (POC).

Introduction

Celery is a vegetable that ha©s important benefits and also valuable export product. Celery also popular as a kitchen spice in various regions. This plant also has benefits in health and beauty sector because it contains various compounds such as saponins, flavonoids and polyphenols in its leaves (Permadi, 2006). The contents of celery are flavonoids, saponins, 1% tannin, 0.0033% essential oil, apigenin, choline, vitamins A, B, C, the bitter substance asparagine (Clements, et al., 2020). Celery plants have a bright future in the domestic and international markets as an export commodity with relatively high and stable prices. The development of celery cultivation has economic and social potential that able to increase farmers' income, community nutrition, employment opportunities, the agribusiness sector, environmental quality and preserve the environment. The population growth every year affect higher demand for vegetables and creating good opportunities to develop intensive celery cultivation. However, this plant production is still relatively low.

Samiati, *et al.*, (2020) Stated that farmers in Indonesia have not received serious attention in terms of commercial management, referring to information from the Central Statistics Agency (BPS) regarding vegetable

crop production in 2022, there is no data available regarding harvested area and Celery production nationally or locally is due to the cultivation of this plant still being on a small scale so production is relatively low. Increasing the productivity of celery plants does not only focus on quantity but on quality.

One of the efforts to increase the quality and quantity of celery is by fertilizing. Fertilization aims to increase the availability of nutrients and replace nutrient elements that have been reduced because plant growth, while productivity are very dependent on the availability of nutrients that can be absorbed by plants in an optimal and balanced manner. Modern agriculture currently relies heavily on the use of chemicals, including for fertilization, promotion of plant growth, as well as pest and weed control, most of these chemicals have potential negative impacts if used excessively and continuously, which can pollute the environment and threaten healthy human.

Revealed the negative consequences of using inorganic fertilizers such as stagnation in increasing productivity, low profits for farmers due to high input costs, environmental problems, as well as health problems and imbalances in nutrition and disease (Minami, 1997). Apart from that, it can also cause physical, chemical and biological damage to the soil. Using organic fertilizer can be a solution to reduce excessive dependence on inorganic fertilizer, because this organic material can improve physical, chemical and biological properties of the soil.

One of the ingredients for organic fertilizer is banana peel. Banana is a well-known plants in all regions of Indonesia and popular commodity in business fields. However, the processing leaves banana peel as a waste, even though banana peels can be used as organic fertilizer (Manis et al., 2017) Banana peel contains various nutrients which needed by plants, which is nitrogen. Nitrogen has an important role in protein formation. The main function of nitrogen for plants is to stimulate overall growth, especially in the stems, branches and leaves.

Banana peel contains 15% potassium and 12% phosphorus, which is higher than the flesh of the fruit. The large content of potassium (K) and phosphorus (P) in the banana peel can be used as a basic ingredient for fertilizer. Banana peels are especially the main source of potassium fertilizer with K2O content reaching 46-57% in dry conditions. Apart from the element phosphorus, banana peels also contain other elements such as magnesium, sulfur and sodium (Firdiani, *et a*l., 2022), according to Susetya (2017). Banana peels contain macro elements such as nitrogen (N), phosphorus (P), potassium (K), calcium (Ca), magnesium (Mg), and sulfur (S). In particular, the potassium (K) content of 15% and phosphorus (P) of 12% in banana peel is higher than in the flesh of the fruit. Apart from that, banana peels also contain microelements such as zinc (Zn) which plays a role in immunity and fertilization, as well as sodium (Na). In line with research by Nazari *et al*., (2023) that the application of kapok banana peel organic fertilizer increases the growth response of purple eggplant plants.

The banana peel waste used in this research was from ripe Kepok bananas, which can be identified by the yellow color of the peel. The part of the banana peel that used is the thick middle part, after cutting off the base and ends. Kepok banana peel waste contains nutrients that are good for plant growth, including potassium, phosphorus, calcium, magnesium, sodium and nitrogen. Therefore, banana peels have great potential for use as organic fertilizer. Apart from that, Kepok banana peel waste is quite abundant in Palu City, Central Sulawesi. Since Kepok banana is quite popular used in various food preparations such as fried bananas, banana chips and banana jam. By utilizing Kepok banana peel waste as liquid organic fertilizer is a relevant step to improve the economical value of banana peels while reducing waste and the use of inorganic fertilizers which can have a negative impact on plants. Based on the previous explanations, this research aims to analyze the growth response of celery given organic banana leaf peel fertilizer and coconut water, in addition to determine the optimum concentration to increase the plant growth response.

Materials and Methods

Location and time

This type of research is experimental

research which carried out at the Green House, Faculty of Agriculture, in February-May 2021.

Research design

The research design used a completely randomized design (CRD) consist of 7 treatments, namely (P0 = Control, P1 = 10% banana peel, P2 = 15% banana peel P3 = 20% banana peel, P4 = 10% coconut water, P5 = 15% coconut water, and P6 = 20% coconut water). Furthermore, each treatment was repeated 6 times with a total sample of 42. The materials that used in the research are sandy loam soil, liquid organic fertilizer from kapok banana peel waste and coconut water, celery plant seeds, 3 grams of NPK basic fertilizer and water which is used as a growth support material. Then, the tools used were a spade, jerrycan, measuring cup, earthen pot, soil sieve, 5 kg poly bag, arco, gas stove, hectare, ruler, camera, digital scale, blender, label paper and stationery.

The procedure of making fertilizer

The manufacturing process and measurements of ingredients that used were refer to the method used by Sari *et al.,* (2020). Production of liquid organic fertilizer begins by collecting ripe yellow kepok banana peels and young coconut water. The 10 kg of banana peels that had been collected were then cleaned using water. Next, the banana skin is cut into small pieces that the base and ends are separated. After that, the banana skin is mashed using a blender. Then, mashed banana peels and coconut water are put into a different container and mixed with 10 liters of water, 250 grams of brown sugar and 250 ml of EM4. After all the ingredients are mixed well, the mixture is stirred until evenly distributed, then put into a jerrycan and closed tightly. Next, the mixture was fermented for 14 days, which was indicated by the liquid changing color to brown and without a strong odor. After the fermentation process is complete, the liquid can be released via a tap attached to the bottom of the fermentation container.

Septirosya *et al.,* (2019) in their research made three different concentrations of liquid organic fertilizer solution from banana peel and coconut water, specifically 10%, 15% and 20%. Before use, each liquid fertilizer solution is diluted to a volume of 1000 ml. The process of making concentration is carried out using the following method: 1) 10% concentration: 100 ml liquid organic fertilizer + 900 ml of water, 2) 15% concentration: 150 ml liquid organic fertilizer + 850 ml of water, and 3) 20% concentration: 200 ml liquid organic fertilizer + 800 ml of water.

Data analysis

The data obtained from the research results were processed statistically using analysis of variance (ANOVA) and SPPS program ver. 25, then the BNT test will be carried out.

Results and Discussion

Plant height

Measurements of the average height of celery plants given organic fertilizer from banana peel waste and coconut water can be seen in Figure 1. The figure shows that organic fertilizer has a significant effect on celery plant height at the ages of 6 WAP, 8 WAP, 10 WAP, and 12 WAP with a significance of 0.000 <0.05 so that H1 is accepted, namely that there is an influence from the treatment of good organic fertilizer concentration on organic fertilizer. banana peel waste and coconut water.

It can be seen in Figure 1 that the average high yield of linear celery plants with concentrations of organic fertilizer and long growing times. This is because in both organic fertilizers there are elements necessary for plant growth. The contents of organic fertilizer can complement and stimulate cell division in plants. This is in line with the opinion of Phibunwatthanawong, T & Riddech (2019) that liquid organic fertilizers are made of nutrients important to plants as well as beneficial microorganisms that help in the recycling of organic material. The primary role of microorganisms is to decompose the substrate during the fermentation process. In the late phase of fermentation, liquid organic fertilizers contain phytohormones such as oxygen and cytokinin, organic acids, as well as soil-fertilizers that act as plant growth stimulants.

Tests of the slightest tangible difference showed significant differences between treatment at all growing times, both on banana peel organic fertilizer and coconut water. When viewed from coconut organic water fertilizers, the most effective treatment appeared at 20% concentration with 12 MST growing time. This is because coconut water contains various elements such as potassium and

calcium. According to research from Roza and Fifendedy (2019), it is believed that coconut water contains hormones such as oxygen and cytokinin that can stimulate plant growth. In addition to potassium, coconut water also contains minerals such as sodium (Na), calcium, magnesium, iron (ferum), copper, phosphorus, sulfur, and oxygen and cytokinin.

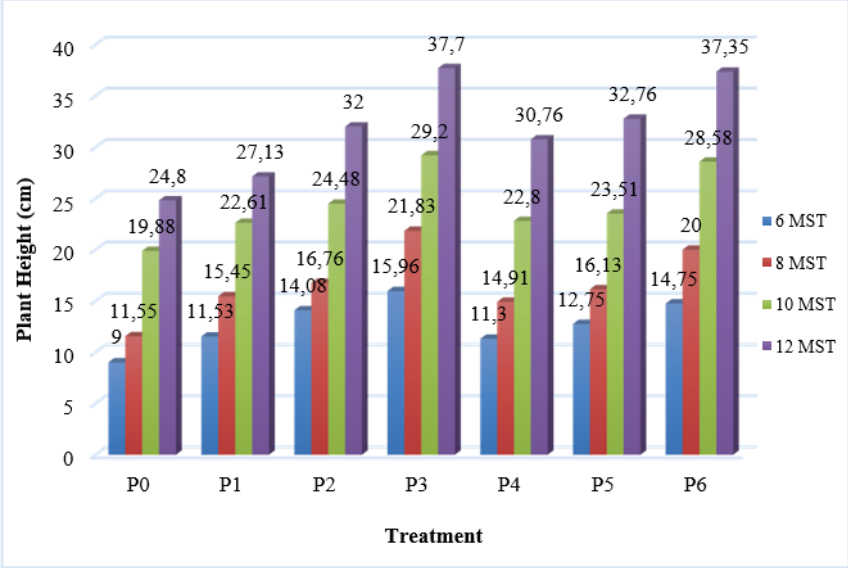

Figure 1. Celery plant height 6 MST, 8 MTS, 10 MTS and 12 MTS

The high growth of plants is caused by apical merysystem activity, and the survival of apical activity depends heavily on the availability of carbohydrates obtained through photosynthesis to support cell division. (Nyakpa et al.,1988 & Sulistyowati, 2011). Potassium accumulates at the growth point and plays a role in activating enzymes and photosynthesis processes so that plants will grow better. Magnesium (Mg) is one of the main minerals in the formation of plant chlorophyll. Magnesium plays a key role in phosphate metabolism, affecting respiratory processes, and activating enzymes such as transphosphorylase, dehydrogenase, and carboxylase (Amelia, *et al*., (2017). In addition, the nitrogen content plays a role in helping to boost the process of photosynthesis. The amount of chlorophyll is affected by nitrogen. Fadilah (2020) states that nitrogen is one of the main components in chlorophyll, accounting for about 60% of its composition. Besides, nitrogen is also part of the protein molecules, purines, pyrimidins, and porphyrins. The nitrogen conversion process, which is catalysed by the enzyme glutamine synthase, produces glutamic acid that acts as a precursor to the formation of porphyrin rings in the process of chlorophyll formation.

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Number of leaves

Average measurement of the number of leaves of celery plants given organic fertilizer from banana leather and coconut water can be seen in Figure 2. The figure shows the average increase in the number of leaves of celery plants on either the organic fertilizer of banana leather or coconut water. Based on anova tests on organic water fertilizers, the significance of 0.00 < 0.05 was obtained at variations in the planting time of 6 WAP, 8 WAP, 10 WAP and 12 WAP.

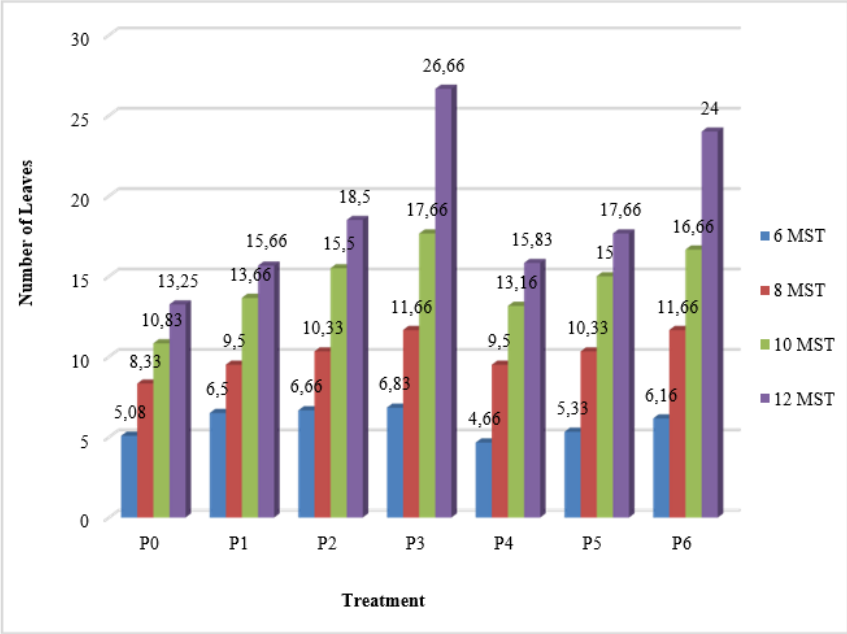

Figure 2. The total number of celery leaves is 6 WAP, 8 WAP and 10 WAP

The smallest real difference test is performed to see significant differences between treatments. Obtained between treatment differences real or significant with best treatment at P3 concentration (20%). The leaves serve as organs where plants produce food through photosynthesis, as well as as storage of food reserves. The presence of chlorophyll in the leaves is what allows the process of photosynthesis to occur. The more leaves the plant has, the more results the photosynthesis process produces. (Wulandari & Amin, 2021). The coconut water stimulates the systematic division of cells so that there is a high growth of plants, as they increase in height then form a node that becomes the site of leaf growth.

This growth is influenced by the presence of the cytokinin hormone found in coconut water. According to Nasution & Handayani, (2022) that the hormone cytokinin has the ability to stimulate leaf formation effectively. Cytokinin will induce cells to proliferate quickly, while oxygen will push cells into proliferation. The cell division process triggered by cytokinin and the cell growth triggers by oxyine are key factors in creating healthy growth. In coconut water, cytokinin is known to have the ability to inhibit leaf aging by reducing protein decomposition. The more leaves remain awake, the more likely it is to increase photosynthesis activity, which in turn will increase the number of leaves present.

According to Gardner *et al*., (1991) the provision of coconut water also has a significant impact on the number of leaves of plants. This is due to the content of growth regulators as well as the macro and micro nutrients found in coconut water, which are needed by plants. The increase in the number of leaves begins with the activity of cells in plant organs that undergo division into merysystematic cells, and subsequently produces more leaf growth. This condition is due to the plant's very young age and is still in the early growth process. In this initial process, growth is not even and tends to focus on one organ or tissue so that soil nutrients or nitrogen from photosynthesis are absorbed and used in certain tissues which in turn will inhibit the growth of other organs or tissues.

The number of leaves is one of the indicators of the vegetative development of plants, the growth of leaf numbers can be inhibited due to the deficiency of the nutrient element, especially nitrogen (N), which is very important for leaf formation in plants. According to Kusumaningrum (2007), growth can be centered on the tissue of the stem system, which produces cell enlargement through the division process that leads to an increase in plant size alone, besides the leaf formation is already maximum (climactic point) so that fertilization with different concentrations does not see its effect, as stated by Gardner *et al*., (1991) that the

growth of plants varies, with periods ranging from several days to years, depending on the type of plant or organ of its growth.

The responses at 8 WAP, 10 WAP and 12 WAP were obtained that P0, P1, P2, and P3 differed significantly or significantly, the best treatment at P3 with a 20% concentration of organic fertilizer of banana peel waste. It is predicted that there is a long addition to the intercalary system due to an increase in the number of cells so that the site of leaf growth also increases. In addition, leaves that are one of the indicators of vegetative development of plants require the elements N, P, and K in its development, as the opinion of (Janah *et al*., 2022) The number of leaves is influenced by the content of nutrient elements such as nitrogen (N), phosphorus (P), and potassium (K). Liquid organic fertilizers of the banana skin also contain this nutrient. The nitrogen element helps in the process of cell division and enlargement, which allows young leaves to reach perfect shape more quickly. In addition to the influence of the availability of nitrogen, the element phosphates also have an important influence in leaf formation. Phosphorus is a key part of plant metabolism because it helps to form the necessary phosphate sugar during the process of photosynthesis. When photosynthesis runs smoothly, plants can produce photosynthetic substances that support the growth and development of plants well.

Number of plant offspring

Average measurement of the number of leaves of celery plants given organic fertilizer from banana peel and coconut water can be seen in Figure 3. The figure shows the average number of celery leaves increasing linearly with the concentration of long-term organic fertilizer on the organic fertilizer of the banana skin waste. Based on the anova test showed a significance of 0.00 < 0.05, then H0 was rejected and H1 received, which means there was a significant influence of the organic fertilizer of banana leather waste on the number of cellar seedlings. The smallest real difference test performed showed each treatment was real different with the best treatment at 20% concentration and 12 WAP growing time.

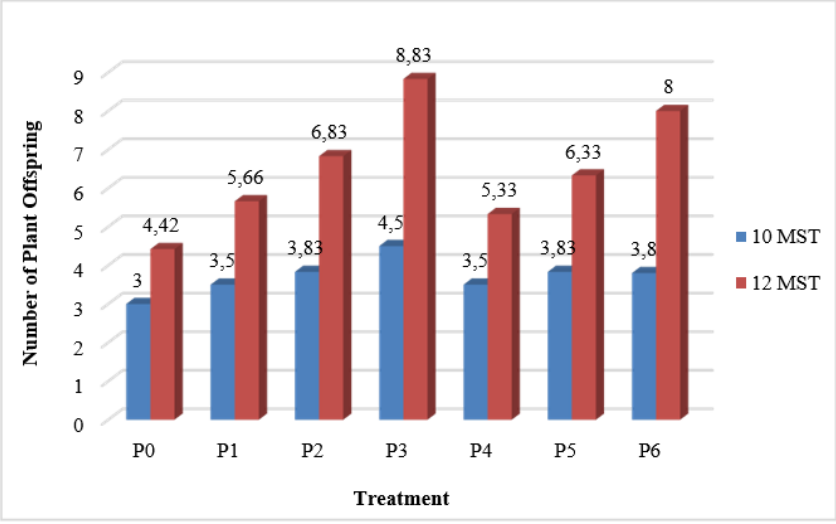

Figure 3. The Number of celery tillers 10 MST and 12 MST

This phenomenon can occur due to the content of coconut water that supports the growth of celery plants. In addition, the number of leaves in the celery plant also influences the increase in the formation of shoots because with more leaves on the plant can occur photosynthesis with maximum and increase the absorption of nutrients by the plant. In addition, coconut water contains the hormone cytokinin that plays a role in initiating the completion process of dormancy of side shoots, which in turn improves the reproduction of shoots. Cytokinin works in conjunction with oxygen in assisting shoots formation. The contents of auxin and citokinin in coconut waters play a crucial role in the process of cell division, which supports shoot formation.

Citokinin encourages cells to shoot rapidly, while auxine stimulates cell growth longitudinally. Cell division driven by cytokine and cell growth drived by auxin leads to shoots development. Cells undergoing division will undergo engineering which then results in differentiation and specialization. Macro nutrients such as nitrogen (N), phosphorus (P), and potassium (K), along with sufficient other micronutrients, can produce optimal plant growth.

According to Sitinjak (2019), phytohormones auxin and cytokinin collaborate in regulating a variety of plant growth and development processes, including regulation in the formation of shoots, stems, leaves, as well as roots. It covers various aspects, such as the production of hormones, the cessation of hormonal activity, the transportation, reception, and transmission of the hormone's signals. Auxin stimulates RNA polymerase, thereby enhancing RNA synthesis and ribosome accumulation, according to Guilfoyle *et al*., (1998) that exogenous hormones will stimulate substantial oxygen in mRNA, which is strongly correlated with gene expression and growth rate. While Werner *et al*., (2001) in his research revealed that cytokinin is a very specific type of hormone for plants, and this hormone has a central role in regulating cell cycles as well as affecting a large number of developmental processes. Cytokinin is also responsible for controlling cell division in the merysystem and primordia leaves, initiating the formation of chloroplasts, as well as facilitating the movement of nutrients.

As for the organic fertilizer of banana peel waste, the anova test showed at 10 WAP and 12 WAP obtained significance of 0.005 <0.005 and 0.00<0.05 which means that there is an influence of the biological fertiliser of the bananas skin waste on the number of cellar plant breeds. Based on the test, the smallest real difference at 10 MST appears to be P1, P2, and P3, no real difference, but compared to P0 real difference. This is supposed to be because the absorption of nutrients from organic fertilizers has not been optimized so that the treatment does not show significant differences (Setyamidjaya, 1986).

While at age 12 WAP obtained P0 data differs significantly from P1, P2, and P3 with best treatment at 20% concentration (P3). This is because the carbohydrates produced by the leaves as a product of the photosynthesis process can stimulate the formation of new organs, thus producing celery. The more leaves there are, the better the plant's ability to do photosynthesis, because the leaves can capture more sunlight during the photosynthetic process. The size of these photosynthesis results can also vary depending on the height of plants, the number of leaves, and the amount of offspring that appear (Harjadi, 1984). Plants require high macronutrient elements to support the growth of vegetative parts such as roots, stems, and leaves. When macro and micro-nutrients are not fully available, this can inhibit the growth and development of plants

Conclusion

Based on the results of the research that has been carried out, it can be concluded as follows: 1) The use of organic fertilizer made from banana peel waste and coconut water have a significant effect on celery plants on high plant parameters, number of leaves, and number of offspring, 2) The most effective concentration of organic fertilizer is made from banana peel waste and coconut water is 20% concentration both, which can increase plant height, number of leaves, and number of offspring, and 3) The organic fertilizer of banana peel waste is more effective than coconut water to enhance the growth response of celery crops to high plant parameters, number of leaves, and number of offspring.

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