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Implications of Cow Water Organic Pupil and Planting Media on The Growth of Celedri Plant (*Apium graveolens* L.)

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Abstract: : Celery (*Apium graviolens* L.) is often used as a spice and garnish for cooking. Celery has high potential for the future but is hampered by its cultivation on a small scale and productive management of celery farming in Indonesia is not yet possible. This study aims to determine the effect of a combination of planting media and liquid organic fertiliser derived from goat urine on celery plant growth. The research method used was a Factorial Randomised Group Design, with 2 factors: growing media composition (M) with three levels, and goat urine liquid organic fertiliser (P) with four levels. Variables observed included plant height, number of leaves, leaf area, plant wet weight, and chlorophyll analysis. The results showed that the application of goat urine liquid organic fertiliser had a significant effect on celery plant growth, including plant height, number of leaves, leaf area, and plant wet weight, with the optimal dose occurring at 400ml/L (P3). The composition of growing media also significantly affected the number of leaves, leaf area, and wet weight of plants, with the most optimal treatment using a mixture of soil, manure, and rice husk (M2). However, the composition of planting media did not show a significant effect on plant height. The interaction between the two factors also had a significant effect on the number of leaves and leaf area, but did not affect the height of celery plants.

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INTRODUCTION

Celery (*Apium graveolens* L.) is a member of the Apiaceae family, which is known as a type of vegetable that is very often used as a flavouring and garnish in various dishes. Celery is one of the important vegetable crops and has export value. Based on its value and popularity, celery is the second most important spice crop among many other spice crops (Rachmawati, 2019). Therefore, it is considered a luxury crop that is available all year round and is used as a diet food. Celery, a vegetable crop, finds its most fertile environmental conditions at an altitude of 900 MDPL, especially highlands. The subtropical zones of Asia and Europe are where celery grows.

In big cities, celery is still not cultivated very often because the climate is less favourable to the needs of the plant. According to data on Horticultural Production Statistics in 2014, cucumber, spinach, kale, and mustard greens are the most widely grown vegetables (Directorate General of Horticulture, 2014). To increase the productivity of celery cultivation, new ways must be taken. One way is by making Liquid Organic Fertiliser (POC) based on goat urine and using the soil provided for celery cultivation as a growing medium.

Optimal quality organic fertiliser can overcome nutrient deficiencies quickly. It is intended that plants and the components in them can immediately use the fertiliser solution placed on the soil surface, because organic fertiliser contains nutrients that are more optimal than those that have previously undergone decomposition. There are two types of organic fertiliser, namely liquid texture fertiliser and green fertiliser (Rahmadina and Putri, 2019). Because goat urine is quickly absorbed by plants and has a certain hormone composition that can encourage plant growth, liquid organic fertiliser made from goat urine can work faster (Aisyah, et al., 2011). According to research by Keke, et al. (2015) Goat urine waste is known to have an N value of 1.50%, P 0.13% ppm, K 1.80%, and H2O 85%. If proper processing and fermentation procedures are followed, this quantity proves to be maximum for restoring fertile soil and plants through organic processes.

Since most of the nutrients needed by plants come from the growing medium, which is then absorbed by the roots to support plant growth, the optimal growing medium is one that can provide nutrients consistently, maintain guaranteed humidity, and has an optimal drainage system as long as it still functions properly as a growing medium, the elements of growing media materials can be one or a combination of many media elements (Yusuf, 2017). A flexible and suitable growing medium that is able to retain water is essential for healthy plant growth. In order for plant life to continue and develop into mature plants, the physical condition of the soil is very important (Idris, 2020). The planting medium used is rice husk mixed with sand.

Chaff is a type of waste. Husk waste is generally understood as the materials discarded or left behind after the processing of agricultural products. Since the current use of rice husk is minimal, rice husk waste continues to cause environmental pollution. It is possible to loosen the soil with rice husk. In addition to being beneficial for soil looseness and fertility, organic fertiliser from rice husk also absorbs a lot of water, decomposes quickly, does not contain fungi, and is affordable (Sauli, 2022). The sand-textured growing medium is very easy to handle and has optimal aeration (availability of air space). However, because the soil has a narrow surface diameter, it will dry out quickly or have very little capacity to hold water. Straightening of the stems will be easy due to the large weight of the sand. Currently, sand is considered adequate and suitable for use as a growing medium, for the nursery process, and in supporting plant root growth (Asih, et al., 2020).

Methods

This research was conducted at the State Islamic University of North Sumatra, from July to September 2023. The tools used include polybag size 10 x 15 cm, meter, scales, spray, mobile phone camera, spectrophotometric instrument and stationery. Materials used included celery (*Apium graveolens* L.) seeds, goat urine liquid organic fertiliser, sand and husk soil. This study applies a factorial Randomised Group Design (RAK) experimental design consisting of two factors, where the first factor is the composition of planting media (M) consisting of 3 levels and the second factor is goat urine liquid organic fertiliser (P) consisting of 4 levels so that a total of 12 treatment combinations are obtained, with each combination repeated 3 times, so that in total there are 36 experimental units. The working procedures included celery seed sowing, preparation of planting media in polybags, application of goat urine liquid organic fertiliser, planting, watering, and weeding. Observation parameters included plant height, number of leaves, leaf area, plant wet weight and chlorophyll analysis. The collected data were analysed using SPSS software version 25, with Duncan's Multiple Range Test (DMRT) conducted if any treatment showed a significant effect.

Results and Discussion

Content Analysis of Goat Urine POC

Based on the results of laboratory tests at the University of North Sumatra, the values of Nitrogen, Phospor and Potassium content in goat urine organic fertiliser used during the study are as follows.

Table 1. N,P,K content of goat urine organic fertiliser

Result Parameter	
Nitrogen	0,12%
Phospor	0,22%
Potassium	1,06%

Based on table 1 above, the nutrient content of goat urine POC is N+P O +K_{252} O= 0.12%+0.22%+1.06% = 1.94% of the minimum quality standard of 4% (close to the quality standard). The presence of macro nutrients N, P, and K shows that goat urine POC is sufficiently developed to be utilised in celery plants. According to Febrianna (2018) stated that because liquid organic fertiliser has a varied nutrient content, especially containing macro nutrients of nitrogen, phosphorus, and potassium so that plants can more easily absorb them.

Plant Height

The application of goat urine liquid organic fertiliser showed a significant impact on celery plant height at 21 HST, but not significant at 14 and 28 HST. Meanwhile, the treatment of planting media composition and their interaction did not have a significant impact on plant height at the age of 14, 21, and 28 HST. Analysis of variance (ANOVA) with Factorial Randomised Group Design (RAK) resulted in the mean height of celery plants at the age of 21 HST. Celery plants as listed in Figure 1.

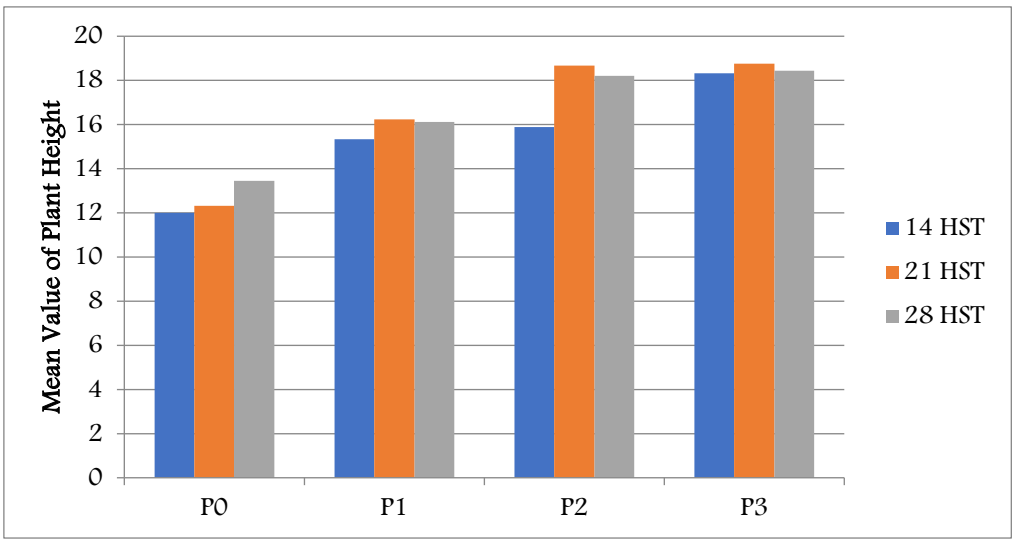

Figure 1. Celery Plant Height After Application of Goat Urine Liquid Organic Fertiliser

Based on the graph above, it can be seen that the celery plant height that has a real effect is in the P3 treatment (POC goat urine 400ml / L) at the age of 21 HST is the most optimal dose of fertiliser for plant height. Celery plants require certain nutrients contained in goat urine liquid organic fertiliser. Goat urine has three nutrients, namely potassium, phosphorus, and nitrogen. Due to the availability of nutrients, especially nitrogen (N) which is needed by plants to encourage vegetative development, plants grow higher (Sitepu, 2019).

The application of goat urine liquid organic fertiliser P0 has a significant effect with P1, P2 and P3. The highest celery plant height at the age of 21 HST was in the P3 treatment (400ml/L) reaching an average of 18.77 cm which had a significant effect with the P0 treatment (without treatment) reaching an average of 12.33 cm. P1 (200ml/L) reached an average of 16.22 cm and P2 (300ml/L) reached an average of 18.66cm. The application of liquid organic fertiliser made from goat urine as much as 400ml/L gave a significant effect because the nutrients and their concentration met the nutrient needs of the soil. Then, because the nutrients in goat urine POC have decomposed, plants can also absorb liquid organic fertiliser very quickly. The use of liquid organic fertiliser from goat urine alone has proven to be sufficient to support the growth of celery plant height without the need to rely on additional planting media. Meanwhile, the effect of the combination of planting media on plant height was minimal in all treatments. Thus, goat urine liquid organic fertiliser alone is sufficient to support the growth and development of celery plants, especially since the top soil itself contains adequate nutrients to meet the needs of plants.

There was no significant effect of the interaction between the composition of the planting media and the application of liquid organic fertiliser made from goat urine, but there was a significant effect on the application of goat urine organic fertiliser on plant height parameters. This is due to poor weather and continuous rain during the research process which makes it difficult to determine the best yield level, meaning that there is no real effect on plant height from the interaction of planting media with liquid organic fertiliser made from goat urine (Lala and Idris, 2022).

Number of Leaves

The effect of goat urine liquid organic fertiliser and growing media composition significantly affected the number of celery leaves at 14, 21, and 28 HST, while the interaction between the two factors was also significant. The results of analysis of variance (ANOVA) show the average number of leaves of celery plants in Figure 2.

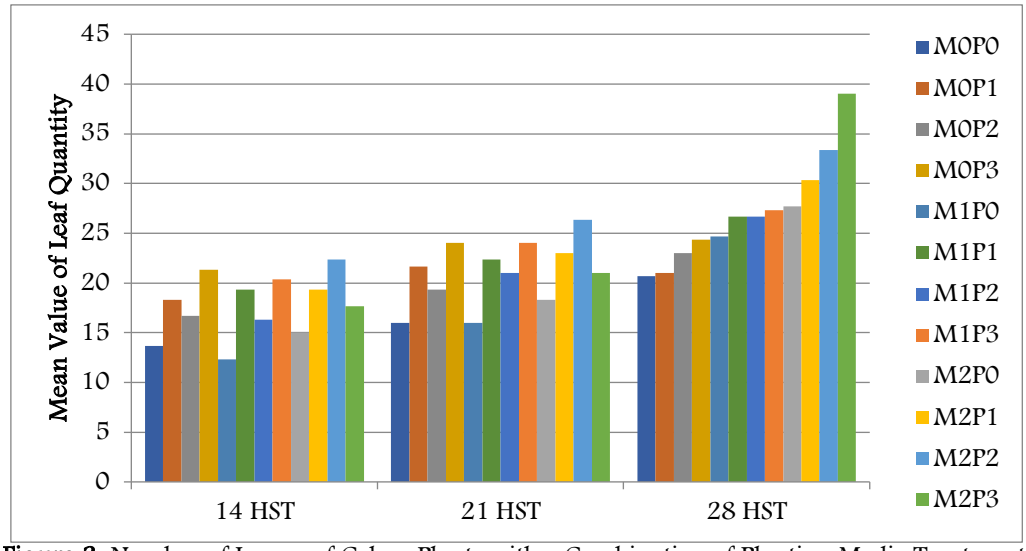

Figure 2. Number of Leaves of Celery Plants with a Combination of Planting Media Treatments And Goat Urine Liquid Organic Fertiliser

Graph 2 shows data on the quantity of celery plant leaves reaching its peak in the M2P3 treatment, using planting media (soil + manure + rice husk) with a dose of goat urine liquid organic fertiliser of 400ml/L, which is 39.00 strands. This indicates that the higher the dose of fertiliser given, the more optimal the vegetative growth of plants. This is because the nutrients of each fertiliser are able to increase the quantity of leaves on celery plants, rice husks can maintain the humidity of the planting media so as to provide enough water to support plant roots to grow and goat urine liquid fertiliser can add nutrients even though a small combination of planting media and goat urine liquid organic fertiliser significantly affects the quantity of celery plant leaves throughout the observation period. The highest mean quantity of leaves at 28 HST occurred in the M2 treatment (soil + manure + rice husk) with a mean of 28.16 leaves, while the lowest mean occurred in M0 (top soil) with a mean of 24.25 leaves. Meanwhile, the application of goat urine liquid organic fertiliser was highest in P3 (400ml/L) treatment with an average of 28.88 strands, and the lowest average occurred in P0 (without goat urine POC) with an average of 22.00 strands. This effect is due to the improvement of soil structure and the provision of nutrients needed by celery seedlings, which supports vegetative growth. In addition, nutrients contained in goat urine, such as nitrogen, phosphorus, and potassium, also accelerate leaf growth, particularly due to the large nitrogen requirement during the vegetative phase of the plant.

The interaction between the composition of planting media and goat urine liquid organic fertiliser has a significant effect on the quantity of celery leaves at the age of 28 HST. The best treatment was the combination of soil + manure + rice husk and goat urine liquid organic fertiliser dosage of 400ml/L (M2P3), with the average quantity of celery leaves reaching 39.00 strands. This shows that the M2P3 treatment is able to fulfil the nutritional needs of plants, thus supporting plant metabolism and contributing positively to plant growth and development. This is also because the mixed media of soil and rice husk has a large capacity to absorb and hold nutrient solutions, making it easily available to plants when needed. When rice husk is added to the planting media, fertilisation can be maximised. This includes improving soil physical characteristics (porosity and aeration) and binding nutrients for plants in nutrient-deficient situations. Water is absorbed by plant roots, which then use diffusion and osmosis to transfer nutrients to the planting material (Pratiwi, 2017).

The quantity of celery leaves increased when goat urine-based liquid organic fertiliser was applied. This is because plants get enough nitrogen, phosphate, and potassium. According to Rina (2015) the nitrogen component contributes to the colour of plant leaves and the development of photosynthesis-related organs in plants during their vegetative growth. Because nitrogen plays an important role in the formation of proteins, nucleic acids, nucleotides, and plant chlorophyll, its presence can accelerate the growth of celery leaves. Plants that contain a lot of N will have large leaves, increasing the leaf surface area available for photosynthesis. According to Hamli, et al (2015), the increase in potassium (K) content in POC is due to increased bacterial activity, which uses K in the substrate material as a catalyst. Plant metabolic activity is influenced by the availability of adequate and balanced nutrients.

Leaf Area

The application of goat urine liquid organic fertiliser and the composition of planting media had a significant effect on celery leaf area at 28 HST or harvest time. In addition, the relationship between the two factors also affected the leaf area of celery plants at the age of 28 HST. The results of analysis of variance (ANOVA) with Factorial Randomised Group Design (RAK) showed the average quantity of celery plant leaves recorded in Figure 3.

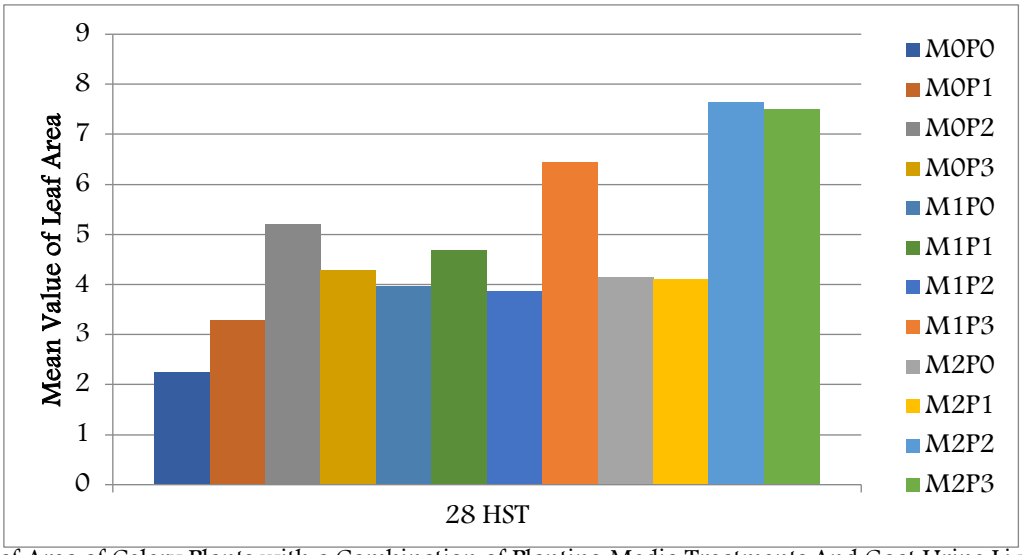

Figure 3. Leaf Area of Celery Plants with a Combination of Planting Media Treatments And Goat Urine Liquid Organic Fertiliser

In graph 3, it can be seen that the leaf area of celery plants reaches its peak with the best combination of planting media and liquid organic fertiliser in the M2P2 treatment, using soil, manure, and rice husk at a dose of 300ml/L. This is due to the important nutrient content in goat urine, supporting optimal vegetative growth of plants. The nitrogen content in goat urine has an important role in cell formation, so giving goat urine POC at the right dose can accelerate plant growth and development. Studies by Setiawan (2010) show that the use of organic fertilisers can improve soil structure, nutrient content, and accelerate the growth of microorganisms in the soil, which in turn improves the photosynthetic process of plants if these nutrients are available in adequate quantities.

The combination of planting media and the application of goat urine liquid organic fertiliser at the age of 28 HST, or at harvest time has a significant impact on the leaf area of celery plants. The results showed that the highest leaf area occurred in the M2 treatment (soil + manure + rice husk) with a leaf area reaching 5,849 cm^2 , while the lowest leaf area occurred in the M0 treatment (top soil) with an average leaf area reaching 3,752 cm^2 . The application of goat urine liquid organic fertiliser also affects the leaf area, where the highest leaf area is found in the P3 treatment (400ml/L) with a leaf area reaching 6.072 cm^2 , while the lowest leaf area occurs in the P0 treatment (without fertiliser) with an average leaf area reaching 3.456 cm^2 . It is intended that the planting media made from manure and rice husk can temporarily hold water and nutrients while supporting the plants. To maximise leaf area in celery plants, rice husks can maintain a high enough moisture level for the roots and not too high. They also provide enough macro space for respiration. The basic ingredient for making liquid organic fertiliser is goat urine, which is very useful for improving soil fertility and quality and increasing the quantity of microorganisms in it, so that the soil becomes more productive. Giving organic fertiliser can also stimulate plant growth and meet the nutritional needs of plants, so that leaves can grow more and wider with optimal quality. Goat urine POC has a nutrient content that includes potassium (K) of 1.06%, phosphorus (P) of 0.22%, and nitrogen (N) of 0.12%, which is sufficient to meet the needs of celery plants.

The interaction between the composition of planting media and the application of goat urine liquid organic fertiliser significantly affects the leaf area of celery plants. The optimal combination occurred in the use of planting media (soil + manure + rice husk) with the application of goat urine liquid organic fertiliser at a dose of 300ml/L in the M2P2 treatment, which showed an average leaf area of 7.63 cm^2 . This phenomenon is due to the high nutrient content in goat urine liquid organic fertiliser, including nutrients N, P, and K, which positively affect plant growth and stimulate vegetative growth. The phosphorus (P) content of 0.22% in goat urine POC helps in accelerating plant growth, while the nitrogen (N) content of 0.12% stimulates healthy leaf growth, improves plant quality, and develops soil microorganisms.

Plant Wet Weight

The effect of goat urine liquid organic fertiliser and type of planting media on the wet weight of celery plants at the age of 28 days after planting (HST) or at harvest. Analysis of variance (ANOVA) resulted in the mean quantity of celery plant leaves recorded in Figure 4.

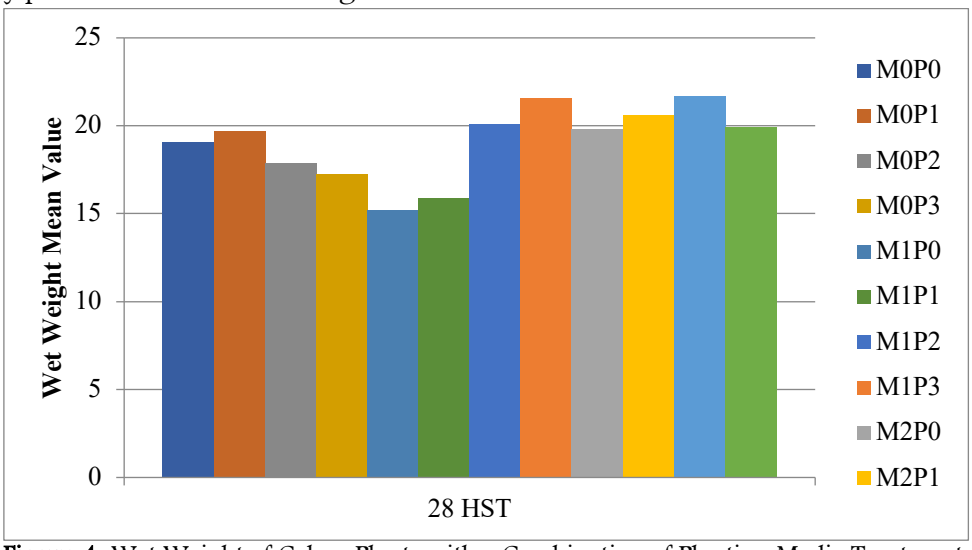

Figure 4. Wet Weight of Celery Plants with a Combination of Planting Media Treatments And Goat Urine Liquid Organic Fertiliser

Figure 4 shows that the 28 HST harvest results taken from three parts of the treatment that looked good at harvest time gave the highest value of plant wet weight in the M2P2 treatment. This is because compared to the top soil treatment alone, the plant height and quantity of leaves in the rice husk combination treatment have the highest average value. Research by Firdaus et al. (2018) states that plant weight results from the growth and expansion of its tissue cells, which include the quantity, size and height of its leaves. The growth and expansion of these cells is determined by the quantity of water and nutrients present in the cells that make up the tissue. High wet weight according to Sari and Fasta (2020) shows that plants can organise their body parts by absorbing nutrients and water in the growing media.

The combination of growing media and the addition of goat urine liquid organic fertiliser produced the highest wet weight of celery plants in the M2P2 treatment, using growing media soil + manure + rice husk, and goat urine POC dosage of 300ml/L, with an average wet weight of 21.73 grams. In contrast, the lowest wet weight was found in the M1P0 treatment, using planting media (soil + manure + sand) and without the application of goat urine POC, with an average wet weight of 18.25 grams. This happened because the planting media made from rice husks acted as a source of N to boost plant yields. According to (Aswar, et al., 2011), nitrogen directly contributes to protein synthesis and increased vegetative growth of plants causing greener leaves in plants growing in nitrogen-rich soil.

The water and nutrient contents of plant tissue cells affect the wet weight of celery plants. Thus, the availability of these substances has a significant effect on the wet weight of plants, which is measured when the plants are 28 days after planting (HST) or at harvest time. Since celery plants are able to absorb beneficial nutrients, the fresh weight of the plants will be affected if liquid organic fertiliser containing goat urine is applied, as a result photosynthesis increases and leaf size increases. The growth and production of cells in the roots, stems, and leaves, which affect the fresh weight of celery plants, depend on the process of photosynthesis. According to Rizal (2017) other growth traits including plant height, leaf quantity, and chlorophyll content are also correlated with an increase in plant wet weight. Leaf growth, stem length, and root system are all correlated with the rate of cell division and tissue formation.

Chlorophyll Analysis

The effect of goat urine liquid organic fertiliser and the composition of growing media on the chlorophyll content of celery leaves at the age of 28 days after planting or at harvest has been analysed. The average quantity of celery leaves from the results of analysis of variance (ANOVA) is listed in Figure 5.

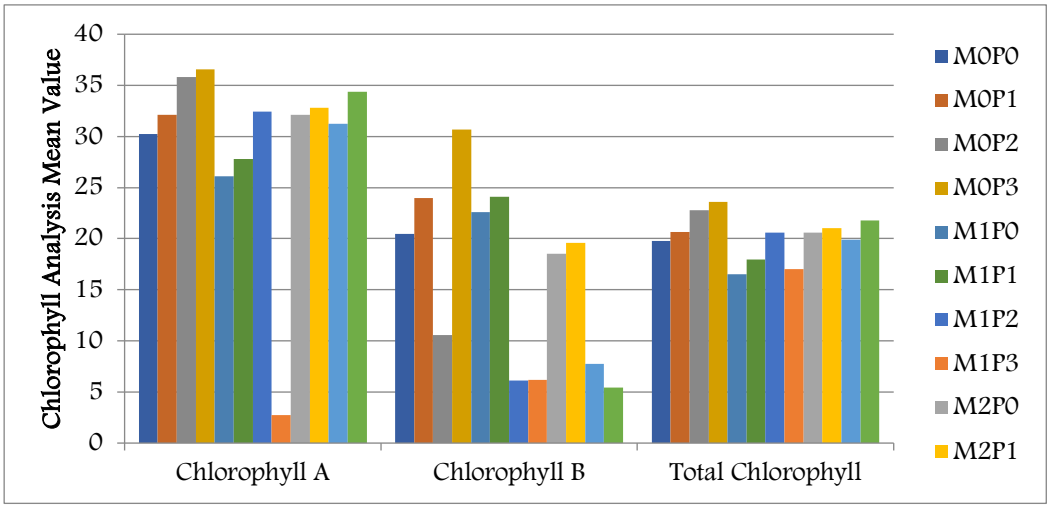

Figure 5. Chlorophyll Analysis in Celery Plants with the Treatment of Planting Media And Goat Urine POC

Figure 5 shows that compared to total and chlorophyll B levels, the higher chlorophyll level obtained from all treatments was chlorophyll A. To absorb sunlight, leaves usually produce chlorophyll whose quantity is determined by genetic and environmental factors. Nitrogen is the main component of chlorophyll (N). Important elements contained in the soil include nitrogen (N) for the formation of plant material, phosphorus (P) for root growth and development, potassium (K) for disease resistance in plants, and magnesium (Mg) for the chlorophyll part to absorb solar radiation to carry out photosynthesis. Based on the average value of chlorophyll, the difference in chlorophyll A and Chlorophyll B content was obtained, the content of chlorophyll A in all treatments gave high chlorophyll levels compared to chlorophyll B which gave low chlorophyll levels. This is because all leaf treatments with chlorophyll B experienced a decrease in photosynthetic rate because they were collected under unfavourable environmental conditions and were generally less able to capture sunlight. Light affects the conversion of protochlorophyllide to chlorophyll A which is further oxidised to produce chlorophyll B. Meanwhile, greater chlorophyll levels were produced by chlorophyll A in each leaf treatment. This is because the plant has higher levels of chlorophyll, which allows it to absorb sunlight more efficiently than chlorophyll B, thus increasing the rate of photosynthesis in each plant. Plant photosynthesis involves the use of both chlorophyll A and B. In its role as the antenna of photosynthesis, chlorophyll B collects light and transmits it to the reaction centre. Chlorophyll A is the main component of the reaction centre. The photosynthetic reduction process can then be carried out using the chemical energy present in the reaction centre. (Istri, 2020). Based on chemical analysis, goat urine POC used in this study contains 0.09% N-total, 0.20% P, and 0.67% K. These nutrients are crucial for plant growth, because nitrogen (N) plays a role in chlorophyll formation and protein synthesis, which are important elements in cell formation. Adequate chlorophyll in the leaves increases the plant's ability to absorb sunlight, accelerates the course of photosynthesis, and produces organic matter as energy for cell growth. In addition, chlorophyll production is affected by leaf surface area and the quantity of leaves produced during growth, as stated by Findi (2023).

Conclusion

Based on the results of the study, it can be concluded that the application of goat urine liquid organic fertiliser has a significant effect on plant height, number of leaves, and leaf area of celery (*Apium graveolens* L.), with an effective concentration at 400ml/L. The combination of planting media has a significant effect on the number of leaves and leaf area, but has no significant effect on the height of celery plants (*Apium graveolens* L.), the effective combination of planting media is in a mixture (soil + manure + rice husk).

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