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by Susylowati Susylowati

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EFFECT OF CONCENTRATION OF LIQUID ORGANIC FERTILIZER OF COW URINE ON THE GROWTH AND YIELD OF CELERY (*APIUM GRAVEOLENS* L.)

ALVERA PRIHATINI DEWI NAZARI[1*], SUSYLOWATI[2], DELMA PERANISA[3***]**

Agroecotechnology Study Program, Faculty of Agriculture, Mulawarman University, Jalan Pasir Balengkong, Kampus Gunung kelua, Samarinda 75119, East Kalimantan, Indonesia.

Corresponding author:SUSYLOWATI
Email: susy_rusdi2@yahoo.com

A B S T R A C T

Celery is widely used as a flavoring, mixture, and decoration of food, as well as beneficial for health, but its production is relatively low. One way to improve the quality and quantity of celery yields is by providing cow urine Liquid Organic fertilizers (LOF). The experiment was carried out from August until October 2021 in Sempaja Selatan Urban Village, North Samarinda District, Samarinda, East Kalimantan. Single factor experiment, cow urine LOF concentration consisted of 0, 150, 300, and 450 mL L^{-1}, arranged in a Completely Randomized Design and replicated ten times. The variables observed increased in: plant height, number of stems, number of leaves; number of tillers, fresh weight, and dry weight of the plant. Data were analyzed by analysis of variance, followed by the Least Significant Difference test at a 5% significance level. The relationship between plant dry weight with LOF concentration was determined by orthogonal polynomial regression analysis and correlation. The results showed that the effect of LOF concentration was significantly different in all observed variables. The concentration of 450 mL LOF L^{-1} gave the best effect on the growth and yield of celery. The results of regression and correlation analysis obtained a linear and positive relationship. The regression equation for plant dry weight and LOF concentration is ŷ = 2.701 + 0.009x, correlation coefficient 0.9947, and coefficient of determination 0.9895.

K E Y W O R D S

Celery, Cow Urine, Liquid Organic Fertilizer.

I. INTRODUCTION

Celery is a type of vegetable plant that is quite popular, in addition to being used as a flavoring, mixture and decoration of food, this plant is beneficial for health [1] because celery is rich in nutrients and antioxidants, including controlling blood pressure, weight, and blood sugar, maintaining heart health. and eyes, as well as the digestive tract, promote menstruation, and reduce the risk of developing cancer [2].

Data on harvested area and celery production in East Kalimantan Province in 2020 have not been found because the cultivation of this plant is still on a small scale, so its production is relatively low [3]. The development of celery cultivation has high economic and social potential for farmers, the community, and the state because it can support programs to increase farmers' income, improve community nutrition, expand job opportunities, develop agribusiness, preserve natural resources, and improve environmental quality [4].

Plants will grow and give maximum results if done with good cultivation techniques. One way to increase the quality and quantity of celery is by fertilization. The purpose of fertilizer application is to increase the availability and replace nutrients lost from the soil because plant growth and production is determined by the availability of nutrients that can be absorbed by plants in a complete and balanced manner [5].

Based on the constituent materials, fertilizers consist of inorganic fertilizers and organic fertilizers. Inorganic fertilizers are fertilizers derived from mineral materials produced by factories through physical and chemical processes into chemical compounds that are easily absorbed by plants, while organic fertilizers are fertilizers whose constituents are living matter that has been decomposed by decomposing bacteria. There are two forms of organic fertilizer, namely solid organic fertilizer and liquid organic fertilizer. Liquid Organic Fertilizer (LOF) is a solution resulting from the decomposition of organic materials derived from plant remains, animal waste, and humans containing more than one nutrient element [6]. The advantages of Liquid Organic Fertilizer are that it is easy to apply, the nutrients contained in it are more easily absorbed by plants, improve the quality of plant products, and reduce the use of inorganic fertilizers [7].

One type of LOF is cow urine LOF which is the result of fermenting liquid feces (urine) from mammals or poultry. The nutrient content of each type of animal manure is not the same, depending on the type of food and the age of the animal [8]. Cow urine containN, P, and K, as well as several other nutrients and growth regulators which are very important for plant growth and development, as well as increasing plant resistance to pests and diseases [9]. The nutrients contained in cow urine are nitrogen 1.4-2.2%, phosphorus 0.6-0.7%, potassium 1.6-2.1%, Ca, Mg, Na, Fe, Mn, Zn, Cu, and Cr, and 92% water [10], while natural growth regulators found in cow urine are Indole Acetic Acid (IAA), one of the auxin groups, as well as gibberellins and cytokinins. The results of research conducted by [11] on celery, [12] on cayenne pepper seeds, [9] on green beans, [13] on green spinach, and [14] on shallots showed that the LOF of cow urine had an effect on positive for plant growth. Cow urine can also act as a control for plant pests such as leafhoppers, walang sangit, rats, and borers because it has a distinctive odor. In addition, cow urine can function as a pesticide because it can kill a number of bacteria, viruses, and fungi. The results showed that cow urine can suppress the growth of pathogenic fungi of*Fusarium oxysporium* var. trifolii, *Rhizoctania solani* Khun., dan *Sclerotium rofsii* Sacc [15].

II. MATERIALS AND METHODS

2.1. Time and Place

The research was carried out from July to October 2021, located on Jalan Perjuangan 1, Sempaja Selatan Urban Village, North Samarinda District, Samarinda City, East Kalimantan Province.

2.2. Materials and Tools

The materials used in this study consisted of Amigo variety celery seeds, water, cow urine LOF, topsoil, husk charcoal, and chicken manure fertilizer.

The tools used are polybags measuring 35 cm x 35 cm, plastic for nursery measuring 7 cm x 25 cm, hoes, scales, meters, documentation tools, and stationery.

2.3. Experimental Design

A single factor experimental study, namely the concentration of cow urine LOF, was arranged in a completely randomized design, consisting of four treatments and ten replications. The treatment that was tried consisted ofp_0 = control (0 mL LOF L^{-1});p_1 = 150 mL LOF L^{-1};p_2 = 300 mL LOF L^{1}; p_3 = 450 mL LOF L^{-1}.

2.4. Research Procedure

1. Seed Nursery

The seeds to be used are selected first by soaking them in water with a temperature between 50-60°C for one hour. The seeds used are seeds that sink, while the seeds that float are discarded. Nursery media in the form of a mixture of topsoil and husk charcoal with a ratio of 2:1. Two seeds are sown per planting hole in plastic nursery that has been filled with seedling media. During the nursery maintenance is carried out, namely watering.

2. Preparation of Planting Media

The planting medium was prepared 10 days before transplanting. The planting medium used is topsoil taken at a depth of ± 30 cm and has been cleaned of dirt and weeds. The planting media was mixed evenly with chicken manure as basic fertilizer as much as 50 g per polybag, then put into polybags measuring 30 cm x 35 cm each weighing 5 kg. Furthermore, polybags are arranged according to the treatment layout with a distance between polybags of 30 cm x 30 cm.

3. Planting

Planting is carried out in the afternoon by making a hole in the center of the polybag as deep as ± 5 cm. Each polybag is planted with one celery seedling.

4. Giving Treatment

Liquid Organic Fertilizer (LOF) was applied when the seedlings were 7, 14, 21, 28, 35, 42, 49, and 56 days after transplanting (DAT). Application of LOF is carried out in the afternoon by watering evenly onto the growing media at a dose of 250 mL per plant.

5. Maintenance

Maintenance carried out includes replanting, watering, weeding, and controlling pests and diseases.

6. Harvest

Harvesting was carried out on celery that met the harvest criteria, namely plants aged 70 DAT and the leaves had developed and had quite a lot of stalks. Celery is harvested by dismantling the planting medium, then the celery roots are cleaned by washing with running water. The clean celery was collected for further observations according to the observed variables.

2.5. Observation Variable

The variables observed were increase in plant height, increase in the number of stems, and increase in the number of leaves, which were carried out at the age of 14, 28, 42 and 70 DAT, respectively, the number of tillers at harvest, fresh weight of the plant, and dry weight of the plant.

2.6. Data Analysis

The data were analyzed using analysis of variance, if the effect of LOF concentration in cow urine was significantly different, to compare the two treatment averages followed by the Least Significant Difference (LSD) test at the 5% level. The relationship between fresh weight and dry weight of plants with cow urine LOF concentration was determined by orthogonal polynomial regression analysis and correlation.

III.RESULTS AND DISCUSSION

3.1. Result

The results of analysis of variance showed that the effect of cow urine LOF was significantly different on all observed variables, namely increase in plant height, increase in number of stems, increase in number of leaves, number of tillers, plant fresh weight, and plant dry weight. Data recapitulation and data analysis results are presented in Table 1.

The results of orthogonal polynomial regression analysis and correlation showed that the relationship between plant dry weight and cow urine LOF concentration was linear and positive. The regression equation between plant dry weight and cow urine LOF concentration is $\hat{y} = 2.701 + 0.009x$, with correlation coefficient value (r) 0.9947 and coefficient of determination (R^2) 0.9895.

Table 1. Data Recapitulation and Results of Research Data Analysis The Effect of Concentration of Liquid Organic Fertilizer in Cow Urine on Celery Plant Growth and Yield

Concentration LOF (P) (mL L^{-1})	Increase in number of plant height (cm)				Increase in number of stems (trunks)				Increase in number of leaves (sheeets)				Number of tillers (tillers)	Plant fresh weight (g)	Plant dry weight (g)
	14 DAT	28 DAT	42 DAT	70 DAT	14 DAT	28 DAT	42 DAT	70 DAT	14 DAT	28 DAT	42 DAT	70 DAT			
Analysis of variance	**	**	**	**	**	**	**	**	**	**	**	**	**	**	**
p_0 = 0	4.17^a	9.14^a	8.66^a	11.39^a	2.70^a	4.90^a	5.44^a	14.33^a	8.10^a	13.30^a	18.20^a	34.50^a	2.20^a	17.70^a	2.82^a
p_1 = 150	5.73^b	10.42^b	10.72^b	13.92^b	3.60^b	8.50^b	9.44^b	18.89^b	9.00^{ab}	18.70^{ab}	26.60^{ab}	48.90^b	3.10^b	26.22^b	3.99^b
p_2= 300	7.01^c	10.51^b	12.51^c	16.01^b	4.00^b	8.70^b	11.67^b	21.33^b	9.60^b	19.20^b	28.70^b	55.70^b	3.70^c	35.36^c	5.19^c
p_3= 450	8.71^d	12.10^c	14.51^d	18.63^c	6.40^c	11.10^c	15.89^c	25.11^c	13.90^c	29.45^c	40.80^c	71.30^c	4.60^d	48.02^d	6.94^d
Value of BNT5%	1.17	1.03	1.68	2.22	0.84	2.20	3.33	3.64	1.51	5.97	13.46	20.76	0.76	5.46	0.99

Notes: The mean number followed by the same letter shows that it is not significantly different based on the LSD test at the significant level 5%.
** = the effect of different treatment is very significantly different

3.1. Discussion

The results of analysis of variance showed that the effect of LOF concentration in cow urine was significantly different for all observed variables, namely increase in plant height, increase in number of stems, increase in number of leaves, number of tillers, plant fresh weight, and plant dry weight (Table 1).

The effect of cow urine LOF was very significantly different on all observed variables because cow urine LOF contributed several macro and micro nutrients needed for plant growth and development, including N, P, K, Ca, Mg, Na, Fe, Mn, Cu, and Zn, as well as several growth regulators as stated by [9] that cow urine contains elements of N, P, and K, as well as several other nutrients and growth regulators which are very important for plant growth and development, as well as increasing plant resistance to attack. pests and diseases. [10] added that cow urine containsN (1,4-2,2%), P (0,6-0,7%), K (1,6-2,1%), Ca, Mg, Na, Fe, Mn, Zn, Cu, and Cr, as well as water 92%.According to [16], Liquid Organic Fertilizer of cow urine has great potential as a contributor of N, P, and K nutrients, because the nutrient content in it is higher than the solid manure.

The fulfillment of the needs of macro and micro nutrients as well as some growth regulators through the contribution of cow urine LOF causes the physiological processes of plants, especially photosynthesis, to run well, so that plant growth increases. Plant growth is caused by cell division, enlargement, and differentiation in meristem tissue as stated by [17] that vegetative growth occurs through three important processes, namely division, enlargement, and differentiation in meristematic tissue. [18] added that division consists of mitotic division and meiotic division. Mitosis occurs in meristem tissue and causes the formation of vegetative organs.

Cell division, enlargement, and differentiation require protein and carbohydrates in very large quantities, because proteins and carbohydrates are the main building blocks of cells (protoplasm and cell walls). Proteins are mainly composed of N. According to [19], N is the building block of amino acids, amides, proteins, nucleic acids, nucleotides, co-enzymes, hexamins, and others. N deficiency will cause limited cell enlargement and division [20]. The role of N for plants is to increase growth, amino acid and protein levels, and plant quality [21]. In addition to nitrogen, protein formation requires potassium which plays a role in converting amino acids into protein [19], K deficiency causes amino acid levels in plants to be high, while protein levels are low [22].

In addition, N together with Mg and micro nutrients Fe, Mn, Cu, and Zn, are indispensable in the formation of chlorophyll so that the photosynthesis process can take place vigorously, as stated by [22] that N together with Mg and Fe, as well as micro nutrients Mn, Cu, and Zn in very low levels play a role in the formation of chlorophyll which is very important for the ongoing process of photosynthesis. Carbohydrates resulting from photosynthesis are used as building blocks for cells and are the main substrate in the respiration process. The energy produced by respiration is used to carry out various processes in plants, including cell division. Some of the energy produced from the respiration process is in the form of heat, partly is the energy used to carry out various processes in plants, including the formation of organic compounds, osmosis, accumulation of salts, protoplasm flow, and cell division [22].

In addition to the above nutrients, P, K, and Ca have an important role in plant growth. According to [23], P, K, and Ca play a role in cell division. In addition to cell division, P's other roles include sugar phosphate components, nucleic acids, nucleotides, co-enzymes, phospholipids, and phytic acid, and play an important role in reactions involving ATP [19]. P element plays a role in albumin formation, flower, fruit, and seed formation, carbohydrate metabolism, root development, disease resistance, strengthens stems, and accelerates maturation, while K plays a role in plant physiological processes, root development, affects the absorption of other elements, and increase plant resistance to drought and disease [23], K also plays a role in carbohydrate metabolism, K deficiency causes inhibition of the photosynthesis process, otherwise the respiration process increases [22]. The role of Ca is as a component of the middle lamella of the cell wall, a cofactor for several enzymes related to the hydrolysis of ATP and phospholipids, and acts as a second messenger in metabolic regulation [19], Ca also plays a role in elongation [23].

In addition to nutrients, cow urine LOF contains IAA (one of the auxin groups), gibberellins, and cytokinins. Growth regulators regulate plant growth and development by influencing cell division, enlargement, and differentiation. The role of auxin is in root formation and works synergistically with gibberellins to stimulate cell elongation although with different mechanisms. This is reinforced by [24] who explained that the role of auxin is in root formation and promoting cell elongation, while gibberellins can stimulate plant stem elongation although the mechanism is different from auxin, while cytokinins are growth regulators that stimulate cell division. [22] added that cytokinins stimulate cell division, thereby promoting the growth of shoots and roots. Strong roots are needed for the strength and growth of shoots and shoots, as well as the absorption of water and nutrients needed by plants [20]. In addition, cytokinins also stimulate the formation of plant organs [24].

Nutrients along with water and CO_2 as well as light absorbed by chlorophyll are converted by plants through the process of photosynthesis into organic compounds. The availability of organic compounds in sufficient quantities with the action of growth regulators will stimulate cell division, enlargement, and differentiation. The division (increase in number) of cells and enlargement (increase in size) of cells causes an increase in protoplasm, so that plant growth increases. [17] explained that plant growth was reflected by an irreversible increase in size and dry weight due to the increase in protoplasm caused by an increase in the size and number of cells.

The results of the LSD test at the 5% level showed that there was a significantly different between the four LOF concentration treatments that were tried, namely 0, 150, 300, and 450 mL L^{-1}.Treatment 450 mL LOF L^{-1}gave the best effect on all observed variables, followed by cow urine LOF with a concentration of 300, 150, dan 0 mL L^{-1} (Table 1).The concentration of cow urine LOF that gave the best effect in this study (450 mL L^{-1}) was different from the results of previous studies. [11] stated that 50 mL cow urine liquid fertilizer gave the best effect on plant height and number of celery leaves. [9] found that 250 mL of cow urine LOF L^{-1} was the best concentration on plant height, number of leaves, number of pods, and weight of mung bean seeds, while the results of research [13] on green spinach showed that the optimum concentration of cow urine LOF was 100 mL L^{-1}. The difference in the results of this study was caused by differences in the nutrient levels of cow urine. Nutrient levels of animal manure are influenced by the age and activity of livestock, type of food, water consumed, environmental temperature, season, and so on[8; 25].

The results of orthogonal polynomial regression analysis and the correlation between plant dry weight and cow urine LOF concentration obtained a linear and positive relationship, with the regression equation $\hat{y} = 2.701 + 0.009x$, correlation coefficient (r) 0.9947,and coefficient of determination (R^2) 0.9895.The line graph of plant dry weight regression with cow urine LOF concentration is presented in Figure 1.

The dry weight of the plant was further analyzed by orthogonal polynomial regression analysis and correlation, because the dry weight of the plant is a measure of growth that shows the results of photosynthesis. Fresh weight is a quantitative measure of plant growth, but its value fluctuates in a day, depending on water conditions or plant humidity, while plant dry weight is a better measure for measuring plant growth because at least 90% of it is the result of photosynthesis[20; 26].

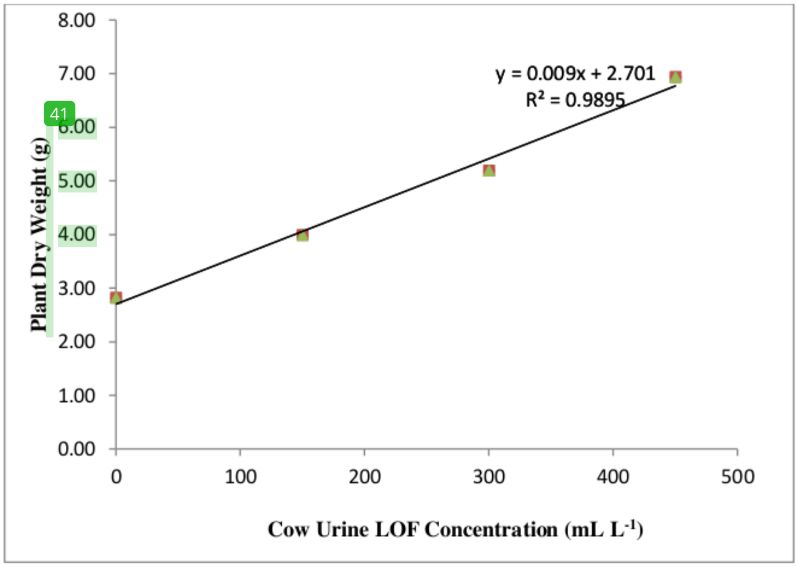

Figure1. Line graph of plant dry weight regression with cow urine LOF concentration

The regression equation and the correlation coefficient value showed that the relationship between plant dry weight was unidirectional and very closely related to the concentration of LOF in cow urine, plant dry weight increased with increasing concentration of LOF in cow urine. Based on the coefficient of determination, the dry weight of the plant was influenced by the concentration of LOF in cow urine of 98.95%, the remaining 1.05% was influenced by other factors. The linear relationship between plant dry weight and cow urine LOF concentration indicates that the plant lacks nutrients, so that the addition of more nutrients with increasing cow urine LOF concentration causes plant growth to increase. This is explained by [19] that in the range of low nutrient levels which is referred to as a deficiency area or a deficiency zone, plant growth will increase very sharply if more nutrients are given, so that their concentration in plants will increase.

CONCLUSION

Based on the results of research and data analysis and discussion, it can be concluded as follows:

1. Liquid Organic Fertilizers of cow urine with different concentrations gave very significantly different effects on all observed variables.
2. Liquid Organic Fertilizer of cow urine with a concentration of 450 mL L^{-1} gave the best effect on the growth and yield of celery plants.
3. The results of orthogonal polynomial regression analysis and correlation obtained a linear and positive relationship between plant dry weight and cow urine LOF concentration with the regression equation $\hat{y} = 2.701 + 0.009x$, correlation coefficient (r) = 0.9947, and coefficient of determination (R^2) = 0.9895.

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