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Effect Of The Dosage Of Cow Manure And Compound NPK Fertilizer On The Growth And Yield Of Borneo Lu Eggplant Variety At Lebak Stamped Swamp Land

Fetty Musriniwati[1], Bambang Fredrickus[2], Joko Purnomo[3]
[1](Master of Agronomy Student, Faculty of Agriculture, Lambung Mangkurat University, Indonesia)
[2,3](Faculty of Agriculture, Lambung Mangkurat University, Indonesia)

Abstract:
Background*: Eggplant (Solanum melongena L.) was an important vegetable commodity for the Indonesian community. Terong Borneo Lu, classified as a highly potential type of eggplant, adapted well to lowland areas and had the advantage of being registered as a local eggplant variety originating from Banjarbaru City, South Kalimantan. At that time, farmers generally performed inadequate fertilization, which consequently had a negative impact on soil properties and the overall environment.*
Materials and Methods*: This research was a field experiment on the dosage and types of fertilizers to obtain optimal results using a Completely Randomized Design (Rancangan Acak Lengkap) with 3 replications. The first factor was the application of four levels of organic manure, consisting of p0 = 0 t ha^{-1}, p1 = 5 t ha^{-1} (2,625 kg/plot), p2 = 7,5 t ha^{-1} (3,937 kg/plot), and p3 = 10 t ha^{-1} (5,25 kg/plot). Meanwhile, the second factor was NPK fertilizer with four levels, namely n0 = 0 kg ha^{-1}, n1 = 200 kg ha^{-1} (7 g/plot), n2 = 400 kg ha^{-1} (14 g/plot), and n3 = 600 kg ha^{-1} (21 g/plot).*
Results*: The research results showed that the effect of giving cow manure significantly differed on all growth parameters and eggplant yields.*
Conclusion: *The increase in doses of cow manure and NPK fertilizer showed a positive linear relationship, where the relative growth rate, plant growth rate, net assimilation rate, fruit diameter, fruit length, fruit quantity, fruit weight per plant, and fruit weight per eggplant plant also increased.*
Keywords*: fertilizer dosage, eggplants, swampy lowland fields, organic fertilizer, and NPK fertilizer.*

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I. Introduction

Eggplant *(Solanum melongena L.)* is an important vegetable commodity for the Indonesian community, consumed in the form of fresh vegetables or processed into various dishes. Eggplant contains relatively high nutritional content, making it suitable for consumption to meet dietary needs. Every 100g of raw eggplant contains 24 calories, 1,1g of protein, 0,2g of fat, 15mg of calcium, 37mg of phosphorus, 0,4mg of iron, 4 IU of vitamin A, 0,04g of vitamin B1, and 5g of vitamin C. Eggplant also has medicinal properties due to the presence of alkaloids solanine and solasodine (Soetasad *et al.*, 2003).

The varieties of eggplants cultivated by farmers in the lowland fields of South Kalimantan are diverse, including both superior and local varieties. The Borneo Lu eggplant variety is capable of adapting to lowland areas and possesses several advantages. Its eggplants are bright purple, shiny, and the fruit production can reach 7 to 9 kg or 122,5 to 162 tons per hectare. The production cycle lasts for more than 7 months after planting. The fruit has a sweet taste and is not bitter, and it flowers and bears fruit more quickly. The seeds are not numerous, and the plant is resistant to aphids. The fruit can be stored at room temperature for 6 to 15 days after harvest and is also resistant to gemini virus infections. This eggplant variety has been registered at the Plant Variety Protection and Agricultural Licensing Center (P2VTPP) with registration number 128/PVL/2014 as a local eggplant variety from Banjarbaru City, South Kalimantan.

The swampy land has great potential to be used as agricultural land, considering the vast expanse of swampy land in Kalimantan, which reaches 10,02 million hectares, comprising 2,30 million hectares of tidal swamp land, 2,94 million hectares of lebak swamp land, and 4,78 million hectares of peatland (Balitra, 2013). Kabupaten Banjar also possesses a considerable amount of swampy land, with 8,538 hectares of lebak swamp and 32,252 hectares of tidal swamp land (DTPH, 2020). Various crops can be cultivated in the lebak swamp land, including horticultural crops. Seasonal vegetables can be grown in lebak lands during the dry season, either when the land has dried or by using the surjan system in shallow lebak lands. One of the vegetables that can be developed in lebak lands is eggplant. (Raihana & Koesrini, 2017).

Balanced fertilization yields higher profits in agricultural cultivation. The latest research information on nutrient management in plants is crucial for farmers to enhance productivity (Magen, 2008). One efficient strategy in vegetable cultivation is to reduce production costs for each crop by using appropriate and suitable fertilizers according to optimal requirements (Adams, 1987). In a well-managed soil fertility program, five factors effect successful fertilization to ensure optimal plant growth. These factors are known as the five right fertilization aspects: right type, right dosage, right timing, right placement, and right method. The main nutrients required by plants are nitrogen (N), phosphorus (P), and potassium (K). Inadequate supply of any of these nutrients during plant growth will have negative impacts on reproduction, growth, and yield (Vine, 1953). Nitrogen, P, and K are essential factors that must always be available to plants since they play roles in plant cell metabolism and biochemistry (Nurtika & Sumarni, 1992). Nitrogen acts as a builder for nucleic acids, proteins, bioenzymes, and chlorophyll (Sumiati, 1989). Phosphorus acts as a builder for nucleic acids, phospholipids, bioenzymes, proteins, metabolic compounds, and is part of ATP, crucial for energy transfer (Sumiati, 1983). Potassium regulates ion balance within cells, contributing to various metabolic mechanisms such as photosynthesis, carbohydrate metabolism, translocation, protein synthesis, and respiration processes. Additionally, it enhances plant resistance to pests and diseases (Hilman & Noordiyati, 1988).

Farmers' fertilization practices are generally still not precise, as fertilizers are not being used rationally according to plant needs and soil nutrient availability. Fertilization is not based on soil testing results, resulting in unfavorable impacts on soil properties and the environment as a whole (Sabiham, 2006).

II. Material and Methods

This research was a field experiment about the dosage and types of fertilizer to obtain optimal results.

Study Design: This research was a field experiment using a Completely Randomized Design (CRD) with three replications. The first factor was the application of organic manure at four levels: p_0 = 0 t ha-1, p_1 = 5 t ha^{-1} (2,625 kg/plot), p_2 = 7,5 t ha^{-1} (3,937 kg/plot), and p_3 = 10 t ha^{-1} (5,25 kg/plot). The second factor was the application of NPK fertilizer at four levels: n_0 = 0 kg ha^{-1}, n_1 = 200 kg ha^{-1} (7 g/plant), n_2 = 400 kg ha^{-1} (14 g/plant), and n_3 = 600 kg ha^{-1} (21 g/plant).

Study Location: This research was conducted in Tambangan Village, Astambul District, Banjar Regency, South Kalimantan Province.

Study Duration: The research was conducted for 3 months from April 2022 to June 2022.

Procedure methodology

The observation was conducted on 7 plants per plot, namely 4 destructive and 3 non-destructive example plants, and the total number of plants in each experimental plot was 15. The observations were made on 4 example plants that were destructed, at the age of 5, 6, 7, and 8 weeks after planting. The example plants that were destructed were used for the observation of growth components, including Relative Growth Rate (RGR), Plant Growth Rate (PGR), Fruit circumference, Fruit length, Fruit count, Fruit weight per fruit, and Fresh fruit yield per plant.

Statistical analysis

The data analysis was conducted using the F Test (ANOVA) at the significance level of a = 0,05. If the analysis of variance for the tested treatments showed a significant effect, to determine which treatments are similar or different, the Duncan Multiple Range Test (DMRT) was further conducted at the significant level of a = 0,05.

III. Result and Discussion

The results of the analysis of various parameters on the relative growth rate (RGR), plant growth rate (PGR), net assimilation rate (NAR), fruit circumference, fruit length, number of fruits per plant, fruit weight per plant, and fruit weight per plant are presented in Table 1 and Table 2.

Table 1. The results of the variety analysis on RGR 4-5 (X1.1), RGR 5-6 (X1.2), RGR 6-7 (X1.3), PGR 4-5 (X2.1), PGR 5-6 (X2.2), PGR 6-7 (X2.3)

SK	db	Centre Square					
		X1.1	X1.2	X1.3	X2.1	X2.2	X2.3
P	3	1.06527**	11.2287**	9,5974**	136,543**	205,437**	211,98**
N	3	2.18345**	11.1316**	2,9466**	41,411**	68,240**	241,42**
P*N	9	0.11598**	0,0984 ns	0,1638 ns	2,617 ns	7,677 ns	13,64 ns
Error	32	1,91E-02	0,4272	0,3567	3m394	8,371	18,23

Table 2. The results of the variety analysis on NAR 4-5 (X3.1), NAR 5-6 (X3.2), NAR 6-7 (X3.3), Fruit Circumference (X4), Fruit Length (X5), Number of fruits/plant (X6), Plant fruit weight (X7), and Fruit weight/plant (X8)

SK	db	Centre Square							
		X3.1	X3.2	X3.3	X4	X5	X6	X7	X8
P	3	1043,98**	1088,96**	382,30**	25,066**	50,174**	4,2431*	4.49**	339.86**
N	3	670,19**	300,20**	99,59**	20,402**	18,138**	4,6319**	2.03**	215.11**
P*N	9	40,03 ns	7,75 ns	10,36 ns	5,202**	3,039*	0,4838 ns	0.64ns	4.6450 ns
Error	32	15,68	17,47	10,98	0,705	1,378	0,9792	0.21	7.5407

Description :

PRG = Plant growth rate

RGR = Relative growth rate

NAR = Net assimilation rate

ns = Not significant (F calculated < F table)

* = Significant effect (F observed > F table 0,05 < F table 0,01)

** = Highly significant effect (F observed > F table at 0.01

Relative Growth Rate

The analysis of variance showed interactions between the application of cow manure fertilizer and NPK fertilizer, and each single factor, cow manure fertilizer, and NPK fertilizer, significantly effected the relative growth rate (RGR) at 5-6 weeks after planting.

The application of cow manure fertilizer in combination with NPK fertilizer, at rates of 0 kg ha^{-1}, 200 kg ha^{-1}, 400 kg ha^{-1}, and 600 kg ha^{-1}, respectively, exhibited a positive linear relationship with the relative growth rate of eggplant plants during the observation period of 5-6 weeks after planting.

Plant Growth Rate

The growth rate of plants, according to Gardner et al., (1991), increased the weight of plants per unit area of land over a period of time.

Usually, plants produced assimilates that were stored as food reserves. Some of these results were used for the process of photosynthesis, and the rest were used for the formation of plant parts or yield components.

The interaction between the application of cow manure fertilizer and NPK fertilizer did not have a significant effect on the plant growth rate during the observations at 5-6 weeks after planting (WAP), 6-7 WAP, and 7-8 WAP. However, the individual factors of cow manure fertilizer and NPK fertilizer each had a highly significant impact on the plant growth rate (PGR) at 5-6 WAP, 6-7 WAP, and 7-8 WAP.

Net Assimilation Rate

According to Gardner et al. (1991), net assimilation rate is the average measure of leaf photosynthesis efficiency in a plant community.

Analysis of variance on the net assimilation rate (NAR) showed a significant interaction between the application of cow manure and NPK fertilizer, and each individual factor, cow manure, and NPK fertilizer, had a highly significant impact at 5-6 weeks after planting. The average effect of the interaction on the net assimilation rate of eggplant was observed at 5-6 weeks after planting.

Fruit Circumference

The interaction of providing cow manure fertilizer with NPK fertilizer, and the individual factors of cow manure fertilizer and NPK fertilizer, each had a significant effect on the fruit circumference of eggplant plants.

The fruit circumference showed an increase with the application of each treatment with cow manure at the rates of 0 t ha^{-1}, 5 t ha^{-1}, 7,5 t ha^{-1}, and 10 t ha^{-1}, and NPK fertilizer at the rates of 0 kg ha^{-1}, 200 kg ha^{-1}, 400 kg ha^{-1}, and 600 kg ha^{-1}. The fruit circumference was larger with the interaction of applying 10 t ha^{-1} of cow manure and 600 kg ha^{-1} of NPK fertilizer compared to the other treatments.

Fruit Length

The effect of the interaction between the application of cow manure and NPK fertilizer significantly differed in terms of the length of the eggplant fruits. Meanwhile, in the case of individual factors, both cow manure and NPK fertilizer showed highly significant differences.

The length of the fruits was greater with the interaction of applying 10 tons per hectare of cow manure and 600 kilograms per hectare of NPK fertilizer compared to other treatments. Based on the regression equation assumption, it was found that the effect of the interaction between the amount of cow manure and NPK fertilizer

exhibited a positive linear relationship, meaning that increasing the amount of cow manure and NPK fertilizer would enhance the length of the eggplant fruits.

Number of Fruits

An analysis of the variation in the cumulative fruit yield of Eggplant plants harvested three times showed that the interaction between the application of cow manure and NPK fertilizer did not have a significant effect. However, the individual factor of cow manure had a significant effect, and the NPK fertilizer had a highly significant effect.

The number of fruits per plant was higher with the application of 10 tons ha-1 of cow manure and 600 kg ha^{-1} of NPK compared to other treatments.

Weight per Fruit

The interaction of giving cow manure fertilizer with NPK fertilizer did not have a significant effect on the weight per fruit of eggplant plants. Meanwhile, the individual factors of cow manure fertilizer and NPK fertilizer each had a very significant effect on the weight per fruit of eggplant plants.

The weight per fruit of the plants was greater with the application of 10 tons ha^{-1} of cow manure and 600 kg ha^{-1} of NPK fertilizer compared to other treatments.

Yield (Fruit Weight per Plant)

An analysis was conducted on the results (fruit weight per plant) of eggplants, which showed that the interaction between the application of cow manure and NPK fertilizer did not have a significant effect. However, individually, both cow manure and NPK fertilizer had a highly significant impact.

IV. Conclusion

The effect of different cow manure fertilizer applications was very significant on all growth and yield parameters of eggplant. Increasing the dosage of cow manure fertilizer and NPK showed a positive linear relationship, where the higher the dosage, the relative growth rate, plant growth rate, net assimilation rate, fruit circumference, fruit length, fruit quantity, weight per fruit, and total fruit weight per eggplant plant also increased.

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