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RESEARCH ARTICLE

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Improvement of sandy soil productivity with chicken manure treatment and NPK fertilizer for eggplant plants

Saijo Saijo[1,*]

[1]Teaching Staff of the Agrotechnology Study Program, Faculty of Agriculture and Forestry, Palangkaraya Muhammadiyah University, Jl. RTA. Milono Km 1,5 Palangka Raya, Central Kalimantan, 73112, Indonesia
Correspondence
Saijo Saijo, Teaching Staff of the Agrotechnology Study Program, Faculty of Agriculture and Forestry, Palangkaraya Muhammadiyah University, Jl. RTA. Milono Km 1,5 Palangka Raya, Central Kalimantan, 73112, Indonesia. Email: saijo0674@gmail.com

Abstract
The aim of the study was to test and analyze the effect of chicken manure doses and NPK doses on the growth and yield of purple eggplant plants (Solanum melongena L) on sandy soil. The objectives of the study were as follows Research Garden of the Faculty of Agriculture, Muhammadiyah University of Palangkaraya, Palangka Raya City, Central Kalimantan. The research period is June-September 2023 using a completely randomized design with two treatment factors. The first factor is the provision of 3 levels of chicken manure and the second factor is 3 levels of NPK treatment. Each was is repeated 3 times., totaling 27 texts. It can be concluded from the results of the study effectiveness of treatment dose the chicken manure influences the growth variables (plant height, stem diameter, number of leaves), namely at the treatment dose of chicken manure 30 t ha^{-1}. The NPK dosage treatment had an effect on the yield components, both fresh fruit weight and harvest index, namely at an NPK dosage of 400 kg ha^{-1}. In the yield component variable, the highest fruit weight was 297 g $plant^{-1}$.

KEYWORDS
chicken manure, purple eggplant, NPK

1. INTRODUCTION

Eggplant (Solanum melongena L.) is a type of vegetable that is popular with Indonesian people. Nationally in 2018 the average consumption level was 2.71 kg capita-1 year-1, making eggplant an economic commodity to cultivate (Ministry of Agriculture, 2018). People like to consume it because it is nutritious, contains anti-cancer substances, contains minerals, vitamins, nutritional fiber, protein, anti-oxidants and phytochemicals. National eggplant productivity in 2017 was 12.19 t ha^{-1} Ministry of Agriculture (2018). Meanwhile in Central Kalimantan in 2017 it was 3.55 t ha^{-1} (BPS Central Kalimantan, 2018). Low production means the potential to increase productivity with cultivation techniques.

Sandy soil is soil that has the potential to become cultivation land, but has poor physical, chemical and biological properties because the level of nutrient availability is low, it is difficult to bind water and the organic matter content is low. Sandy soil in Palangka Raya City is also acidic (has a low pH) so ameliorant materials are needed to increase the soil pH and improve the physical and biological properties of sandy soil by adding dolomite lime and chicken manure (Saijo and Susilo, 2021).

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properties because the level of nutrient availability is low, it is difficult to bind water and the organic matter content is low. Sandy soil in Palangka Raya City is also acidic (has a low pH) so ameliorant materials are needed to increase the soil pH and improve the physical and biological properties of sandy soil by adding dolomite lime and chicken manure

Dolomite lime is given in a certain dose to increase the soil pH, so the addition of dolomite lime can increase soil pH and same time increase the availability of nutrients, especially Ca and Mg (Saputro et al., 2017) while the application of chicken manure in sandy soil is very appropriate because it can improve the properties of physics, chemistry and biology of soil. The compound fertilizer used to increase productivity in this research is NPK fertilizer.

The aim of the research was to test and analyze the effect of chicken manure doses and NPK doses on the growth and yield of purple eggplant plants in sandy soil. Sandy soil is soil that is poor in nutrients, has a low pH and minimal organic matter, so this research is important to carry out so that the productivity of sandy soil increases and cultivated eggplant plants produce optimal production.

The aim of the research was to test and analyze the effect of chicken manure doses and NPK doses on the growth and yield of purple eggplant plants in sandy soil

2. MATERIALS AND METHODS

2.1 Materials

Tools used in research include: hantractors for cultivating land, hoes, sieves, and analytical scales. The materials used were purple eggplant seeds of the LEZATA F1 variety, dolomite lime, chicken manure, NPK fertilizer, and sandy soil. Increase soil pH Research Garden of the Faculty of Agriculture, Muhammadiyah University of Palangkaraya, Palangka Raya City, Central Kalimantan. Research time is June-September 2023.

2.2 Data collection procedures

Research with a completely randomized factorial design with two treatment factors. The first treatment is giving 3 levels of chicken manure, namely: Chicken Manure: 10 t ha^{-1}, 20 t ha^{-1} and 30 t ha^{-1}. The second treatment provided 3 levels of NPK dose treatment. NPK 200 kg ha^{-1}, 300 kg ha^{-1} and 400 kg ha^{-1} Treatments totaling 9 treatment combinations. Each was repeated 3 times, resulting in a total of 27 treatment units.

Research Implementation

Before the research was carried out, the location was cleaned of weeds using a lawn mower, then the ground was leveled. Sowing the seeds uses sandy soil and chicken manure in the seedling tray. Plants were moved into small polybags after 14 days of sowing. The plants were moved into large polybags after they had 4 leaves and were 30 days old.

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Planting seeds is healthy and uniform seeds. Before putting the seeds in a large polybag, first make a planting hole, then plant the seeds in a large polybag and then water them. Dosing of chicken manure is given by mixing it evenly with the soil. The treatment dose is applied two weeks before planting according to the respective dose. NPK fertilizer was given twice. Half the treatment dose was given 3 days after planting, and half the dose was given to plants aged 21 days after planting.

Maintenance carried out includes: Regular watering twice a day in the morning and evening, Providing additional fertilizer in the first week and third week after the seeds are planted, the next maintenance is cleaning weeds around the plant area, pruning unproductive parts of the plant organs, controlling pests and diseases ending with cultivation. do the harvest. Purple eggplant plants are harvested when the purple eggplant plants are 55 and 60 DAP.

The observation variables in the research were: Plant height (cm), which was observed when the plants were 42 DAP by measuring with a meter from the base of the stem to the highest crown, Stem diameter (mm), observed at 42 DAP using a caliper, measured at the base of the stem at height 3 cm from the soil surface. Number of leaves is calculated at 42 DAP Count the number of fully open leaves. Number of fruits per plant is observed for the first and second harvested. Fresh weight of planted fruit (g) was observed twice at harvest and weighed on an analytical balance, namely the first and second, then the weights were added up. Harvest index (%), obtained by weighing the economic harvest results cumulatively (two harvests) and weighing the biological harvest results after harvest. The harvest index is calculated using the formula:

$$\text{Harvest Index} = \frac{\text{Economical Harvest Results}}{\text{Biological Harvest Results}} \times 100\%$$

2.3 Data analysis

Observation data were analyzed using analysis of variance (F test) at levels 5%. If the f test shows an effect of treatment, it is continued with a mean difference test using the Honestly Significant Difference (BNJ) test at levels 1% and 5% to determine the differences between treatments.

3. RESULTS AND DISCUSSION

3.1 Recapitulation of Variety Analysis Results

A recapitulation of analysis results effectiveness from chicken droppings NPK dosage and interactions is presented in Table 1.

Table 1. Recapitulation of the results of the analysis of the influence of chicken manure (K) and the NPK dose and the interaction (AN)

No	Observation	Age	Variety analysis results		
			C	N	CN
1	**Plant height**	42 DAP	**	nr	nr
2	**Stem diameter**	42 DAP	**	nr	nr
3	**Number of leaves**	42 DAP	**	nr	nr
4	**Number of fruits**	55 DAP	*	nr	nr
5	**Fresh weight of fruit**	55 DAP	**	*	nr
		60 DAP	*	nr	nr
6	**Harvest index**	60 DAP	rn	*	nr

Note: * = real effect, **= very real effect, nr= no real, C= Chicken manure, N = NPK, (CN)= Interaction of chicken manure and NPK fertilizer, Days after planting (DAP)

3.2 Plant height

Result of variety analysis of showed that giving chicken manure has a very real effect on plant height while NPK and a combination of treatment factors had no effect and no interaction occurred at the age of 42 DAP. Analysis results from average height of purple eggplant plants due to the application of chicken droppings are shown in Table 2.

Table 2. The test results of the average height of purple eggplant plants aged 42 DAP due to the influence of chicken manure application

Treatment	Plant height (cm)
Chicken manure 10 ton ha^{-1}	36.94^{a}
Chicken manure 20 ton ha^{-1}	41.83^{b}
Chicken manure 30 ton ha^{-1}	49.27^{c}
BNJ 5%	6.09

Note: Numbers followed by the same letter in the same row and column is no different markedly based on BNJ test 5%.

Based on the results of the average difference test, it shows that the height of plants aged 42 DAP the best treatment is the dose of treatment 30 ton ha^{-1}, very significantly different from the treatment of 10 ton ha^{-1} and 20 ton ha^{-1}. The highest plant growth is 49.27 cm.

The results of the analysis of plant height variation, NPK fertilizer dosage treatment did not affect the height of plants aged 42 DAP. The test results of the difference in average plant height due to NPK dosing are presented in Table 3.

Table 3. Test results of the average height of purple eggplant plants aged 42 HST due to the effect of dosing NPK

Perlakuan	Plant height (cm)
NPK 200 kg ha^{-1}	27.55
NPK 300 kg ha^{-1}	28.11
NPK 400 kg ha^{-1}	22.11
BNJ 5%	8.50

Note: Numbers followed by the same letter in the same row and column is no different markedly based on BNJ test 5%.

The table above shows that the test results of the average difference in plant height at the age of 42 DAP the best treatment is the dose 300 kg ha^{-1}, higher than the treatment dose 200 kg ha^{-1} and 400 kg ha^{-1}.

The results of the analysis of variation in purple eggplant plant height showed that chicken manure Fertilization has a big impact, namely at treatment dose 30 t ha^{-1}. This is thought to be because chicken manure is an organic fertilizer. The efficacy of organic fertilizers on plant growth, even at later stages, reflects their slow release, which guarantees the availability of nutrients for maximum duration plant (Diacono and Montemurro 2010; Jannoura et al. 2013; Lin et al. 2023). This property of organic fertilizer is reported to have a significant long-term positive impact on many plants. Based on these assumptions, the basic composition of the organic products used in this research is prepared in such a way as to provide a complete nutritional balance of Nitrogen, Phosphorus, and Potassium to plants either through mycorrhiza or organic-based ingredients (Balkrishna et al 2023). A balanced nutrition approach allows plants to regulate stomata opening and closing, movement of water vapor, oxygen, and carbon dioxide, as well as overall growth and yield (Amanullah et al. 2016; Xu et al. 2020). Several research results and the application of chicken manure fertilizer show that the plant responds best in the first season. Therefore, chicken manure contains three times more N than other manure (Musnawar, 2007).

3.3 Stem diameter

The results of the variety analysis showed that the treatment of chicken manure had a very real effect on the diameter while NPK and the combination of treatment factors had no effect and no interaction occurred at the age of 42 DAP. The test results of the average diameter of the stem of purple eggplant plants due to the application of chicken manure are presented in Table 4.

Table 4. The test results differ in the average diameter of the stem of purple eggplant plants aged 42 DAP due to the effect of applying chicken manure.

Treatment	Trunk diameter (mm)
Chicken manure 10 ton ha^{-1}	9.00^{a}
Chicken manure 20 ton ha^{-1}	10.41^{a}
Chicken manure 30 ton ha^{-1}	11.11^{b}
BNJ 5%	1.15

Note: Numbers followed by the same letter in the same row and column is no different markedly based on BNJ test 5%.

Table above shows that the test results of the average difference in plant stem diameter age 42 DAP the best treatment is the treatment maximum 30 tons ha^{-1}. number of leaves at 11.11 cm per plant,

very different from treatment of 10 t ha^{-1} and 20 t ha^{-1}.

The results of the analysis of variations in stem diameter showed that in treatment of chicken manure and NPK fertilizer and also the interaction of the two treatment factors, there was only one treatment that had a very significant effect, namely chicken manure at 42 HST with a fertilizer dose of 30 tons ha^{-1}. Produces a larger stem diameter compared to other chicken manure treatments, very significantly different from other treatments. This is supported by Napitupulu, D., & Winarto, L. (2010) that the N element in chicken manure. Protein synthesis can be increased by the formation of chlorophyll. Adequate N elements can facilitate plant metabolic processes which affect the growth of plant organs such as stems, leaves and roots.

Sulistyowati and Yunita (2016) reported that increasing the dose of manure had an impact on growth and yield of purple eggplant cultivars Mustang and Antaboga are not significantly different in plant height, number of leaves or stem diameter. and fruit weight did not increase as the dose of organic fertilizer increased. Besides apart from environmental factors, organic material fertilizer is applied also influences growth and development of plants (Usfunan, 2016).

Besides apart from environmental factors, organic material fertilizer is applied also influences growth and development of plants

3.4 Number of leaves

Results of analysis of variance showed that chicken manure treatment had a very real effect on the number of plant leaves while NPK and a combination of treatment factors had no effect and no interaction occurred age 42 DAP. Analysis results average difference in the number of leaves purple eggplant plants because the application of chicken manure presented in Table 5.

Table 5. The test results differ in average number of leaves purple eggplant plants aged 42 DAP due to the application of chicken manure.

Treatment	Number of leaves (sheet)
Chicken manure 10 ton ha^{-1}	12.55^{a}
Chicken manure 20 ton ha^{-1}	15.55^{a}
Chicken manure 30 ton ha^{-1}	16.77^{b}
BNJ 5%	3.23

Note: Numbers followed by the same letter in the same row and column is no different markedly based on BNJ test 5%.

Table 5 shows that the test results of the average difference in the number of plant leaves at the age of 42 DAP the best treatment is the treatment 30 ton ha^{-1} with the highest number of leaves at 16.77 strands per plant, very significantly different from the dose of treatment 10 ton ha^{-1} and dose 20 ton ha^{-1}.

Analysis results of variations in number of leaves showed that the chicken manure treatment Very significant effect at the age 42 DAP with a Fertilizing chicken manure dose of 30 ton ha^{-1} by producing a greater number of leaves compared to other chicken manure treatments, very significantly different from the 10 ton ha^{-1} treatment. and 20 ton ha^{-1}. This proves the higher the dose of chicken manure, the greater number of leaves produced. This is supported from the opinion of Napitupulu, D., & Winarto, L. (2010) that the N element in chicken manure can increase protein synthesis and chlorophyll formation. The availability of N elements in sufficient quantities can facilitate plant metabolic processes that affect the growth of plant organs such as stems, leaves and roots. Efficient nutrient absorption by Eggplant can be improved from adjusting quantity from primary branches.

Set the number of plant branches can be done by removing wild shoots and remains the main

branch, which will become well maintained. Main branch maintenance is carried out to regulate the balance between sources and sinking Eggplant production can be increased (Raden et al., 2009). According to Wartapa et al. (2009), increase the number of branches is one way Sort number of plant branches and the leaf area that can be obtained increase efficiency of photosynthesis and assimilation. Main branch maintenance can improve environmental conditions, for example temperature, humidity, light, air, so that the performance of photosynthesis improves.

Set the number of plant branches can be done by removing wild shoots and remains the main branch, which will become well maintained

3.5 Number of fruits

The results of analysis of variance showed that chicken manure treatment had a significant effect on the number of fruit planted. The results of the test for the difference in the average number of fruit in purple eggplant plants due to the application of chicken manure are presented in Table 6.

Table 6. The test results differ in the average number of purple eggplant plants 55 DAP due to the application of chicken manure.

Treatment	Number of fruits (pieces)
Chicken manure 10 ton ha^{-1}	2.44^{a}
Chicken manure 20 ton ha^{-1}	4.00^{ab}
Chicken manure 30 ton ha^{-1}	4.44^{b}
BNJ 5%	2.37

Note: Numbers followed by the same letter in the same row and column is no different markedly based on BNJ test 5%.

Based on the results of the analysis of variance presented in Table 6, it is known that the average number of fruit planted varies in 55 DAP, the best treatment was with the treatment dose 30 ton ha^{-1}, the treatment dose 10 ton ha^{-1} and 20 ton ha^{-1}.

Data from observations and analysis of variations in the number of fruit planted with purple eggplant showed that chicken manure treatment this has a very real influence on the number of fruits, while NPK fertilization and its combination had no effect at 55 DAP. From the results of the difference test in the average number of fruit planted at 55 DAP, the best treatment was the treatment with a dose of 30 ton ha^{-1} which produced a large number of fruit compared to other chicken manure treatments, very significantly different from 10 ton ha^{-1} treatment and 20 ton ha^{-1}. According to Ichsan (2015), sufficient nutrient availability will be transported and carried by water and used in all plant organs to increase number of fruit, fruit enlargement and weight on each plant. This research shows that giving chicken manure has significantly improved fruit quality compared to giving manure without manure. These results indicate that applying organic fertilizer can not only increase fruit results, but also necessary to improve fruit quality. Similar research results were also reported by previous eggplant researchers (Yuan, et al., 2021) and chili peppers (Capsicum spp.) (Chen, at., al. 2014). In summary, combining organic fertilizer with inorganic N can synergistically regulate fruit yield and quality of cherry tomatoes. However, information regarding the specific nutritional qualities of cherry tomatoes grown with organic fertilizer is still unclear and requires further research.

3.6. Fruit weight

Results from variance analysis showed that chicken manure treatment had a very real influence on the weight of the fruit planted, however, NPK has quite a large influence and the combination treatment factors had no effect and no interaction occurred at 55 DAP. The test results for the difference in average fresh fruit weight of purple

eggplant plants due to the application of chicken manure are presented in Table 7.

Table 7. Test results for differences in the average fresh weight of fruit planted with purple eggplant at 55 DAT due to the application of chicken manure and NPK doses

Treatment	Fruit weight (g)
Chicken manure 10 ton ha^{-1}	70.33^{a}
Chicken manure 20 ton ha^{-1}	93.56^{b}
Chicken manure 30 t0n ha^{-1}	119.33^{c}
NPK 200 kg ha^{-1}	92.56^{a}
NPK 300 kg ha^{-1}	82.56^{ab}
NPK 400 kg ha^{-1}	108.11^{b}

Note: Numbers followed by the same letter in the same row and column is no different markedly based on BNJ test 5%.

Table above onshows that the test results for the difference in the average fresh weight of fruit planted at 55 DAP, the best treatment is treatment with a treatment dose (30 ton ha^{-1}), which very significant different from treatments 10 ton ha^{-1} and 20 ton ha^{-1}. And the test results for the difference in the average fresh weight of fruit planted at 55 DAP, the best treatment was the treatment dose 400 kg ha^{-1}, significantly different from the treatment 200 kg ha^{-1} and the dose 300 kg ha^{-1}.

Data from observations and analysis of various fresh weights of purple eggplant planted fruit showed that chicken manure treatment had a very significant effect fresh weight of fruit harvested, while NPK has a significant effect and combination of treatment factors had no effect and no interaction occurred at 55 DAP. From the results of the difference test in the average fresh weight of planted fruit at 55 DAP, the best treatment was treatment A3 with a dose of 30 ton ha^{-1}, which was very significantly different from treatments 10 ton ha^{-1} and 20 ton ha^{-1}. Martinez et al. (1994) and Radziand Hisyamuddin. In 2021, it was discovered that plants given biological fertilizer containing chroococcum, lipoferum and NPK bacteria produced better plants terms of yield and weight. Apart from that, this inoculant can also cause flowers to bloom earlier than plants that are only given nitrogen.

Data from observations and analysis of variations in the fresh weight of purple eggplant planted fruit showed that treatment with NPK fertilizer already significant effect on the fresh weight of planted fruit, while chicken manure and a combination of treatment factors had no effect and no interaction occurred at 60 DAP. From the results of the average difference test, the best treatment was the N3 treatment 400 kg ha^{-1} which was significantly different from the treatment 200 kg ha^{-1} and with dose 300 kg ha^{-1}.

According to Ichsan (2015), sufficient nutrient availability will be transported and carried by water and used in all plant organs to increase amount of fruit, enlargement and weight of fruit planted. There was an increase in the total weight of fruit treated with NPK. However, chemically treated patches and controls showed blossom end rot. This is caused by the synergistic impact of excess nitrogen (Taylor et al. 2004). Apart from providing tolerance to several abiotic stresses such as drought and salinity, etc., Seed treatment with trichoderma as well improves physiological stress as aging and seed dormancy (Delgado-Sanchez et al. 2010, 2011).

3.7. Harvest index

Based on analysis of variance shows that NPK fertilization has a big impact the harvest index, while chicken manure and the combination of treatment factors had no effect and no interaction occurred. The results of the average difference test for purple eggplant harvest index due to NPK dosing presented Table 8.

Based on analysis of variance shows that NPK fertilization has a big impact the harvest index, while chicken manure and the combination of treatment factors had no effect and no interaction occurred

Table 8. Test results for differences in average harvest index due to NPK dosage

Treatment	Harvest index (g)
NPK 200 kg ha^{-1}	224.78^{a}
NPK 300 kg ha^{-1}	243.00^{b}
NPK 400 kg ha^{-1}	327.44^{b}
BNJ 5%	117.96

Note: Numbers followed by the same letter in the same row and column is no different markedly based on BNJ test 5%.

Average test scores Table 8 shows that the results of the average difference test for harvest index of highest. The fertilizer given is 400 kg ha^{-1}, significantly different from the 200 kg ha^{-1} treatment and the 300 kg ha^{-1} dose. Highest harvest index is 327.44%. Data from observations and analysis of various purple eggplant harvest indices showed that NPK fertilization has a big impact harvest index, while chicken manure and the combination of treatment factors had no effect and no interaction occurred. From the results of the average difference test harvest index, the best treatment was the treatment 400 kg ha^{-1} which produced a large harvest compared to other NPK dose treatments, significantly different from the treatment 200 kg ha^{-1} and with a dose 300 kg ha^{-1}.

Geremew et al. (2007) identified that the harvest index increased rapidly over time, but the harvest index increased more slowly over time and plants where fruit filling begins later the harvest index increases gradual with continuous replacement most of the present assimilate into leaf production and new stem growth. The harvest index is not influenced by irrigation rate. Data indicate the eggplant more tolerant of drought than solanaceous plants (Behboudian, 1977). Our yield index measurements do not include root biomass. But on water pressure conditions, eggplant may allocate increasing numbers of assimilate to root growth as occurs in other plants (Larcher, 1995). On habanero chilies, an irrigation level of 20% of available water results in a decrease in harvest indeks values (Quintal Ortiz et al., 2012). In tomatoes, there were no differences in total dry biomass and harvest index between control and irrigation treatments, but total dry biomass and yield level decreased significantly under regulated deficit irrigation (Lei et al., 2009); osmotic regulation caused by moderate water stress in partial root drought leading to normal water status and equal biomass levels.

4. CONCLUSION

The conclusion of the research is that the effectiveness of chicken manure dosage treatment affects growth indicators, namely. plant height, stem diameter and number of leaves at a chicken manure dose of 30 tons ha^{-1}. The effectiveness of the NPK fertilizer dose affects the yield components, i.e. fresh fruit weight and yield index at the NPK dose of 400 kg ha^{-1}. The heaviest fruit weight variable was 297 g plant^{-1} and the best yield rate was 5.74%.

CREDIT AUTHORSHIP CONTRIBUTION STATEMENT

Saijo Saijo: Conducted the research trial. Saijo Saijo: Supervised the trial. Saijo Saijo: Cosupervised the trial. Saijo Saijo: Technical assistance for lab analysis. Saijo Saijo: Statistical analysis and Proof reading and final editing.

CONFLICT OF INTEREST

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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