Research Article

Lia Amalia*, Raden Budiasih, Elly Roosma Ria, Raden Wahyono Widodo, Upit Kuswati

Fermented compost and N-fertilizer for enhancing the growth and productivity of purple eggplant on vertisols

<https://doi.org/10.1515/opag-2020-0084>

received January 3, 2020; accepted November 16, 2020

Abstract: The soil fertility and nutrient availability are limiting factors for growth and plant development. Fermented compost and nitrogen (N)-fertilizer are useful as sources of nutrients to support the growth of plant and microorganisms in soils. The combination of biological fertilizer and chemical fertilizer can support the concept of sustainable and integrated agriculture and minimize the adverse effects of chemical fertilizers. The research was conducted to get the recommended dose of fermented compost and N-fertilizer to increase the plant height and productivity of purple eggplant. The experiment was arranged as factorialized randomized block design and consisted of two factors and two replications, namely fermented compost dose (0, 5, 10, and 15 t ha⁻¹) and N-fertilizer dose (0, 75, 150, and 225 kg ha⁻¹). The observed responses were increase in plant height and productivity of purple eggplant. Compared to the control, the application of 15 t ha⁻¹ fermented compost and 225 kg ha⁻¹ N-fertilizer increased the plant height by 40.76% at 30 days after planting and 57.59% at 37 days after planting and increased the purple eggplant yield by 43.15%. BC ratio of the fermented compost (15 t ha⁻¹) is 1.16 and BC ratio of the N-fertilizer (225 kg ha⁻¹) is 1.09. Recommended dose to increase the plant height and productivity of purple eggplant in vertisol is 15 t ha⁻¹ of fermented compost and 225 kg ha⁻¹ of N-fertilizer.

Keywords: *Solanum melongena*, organic fertilizer, urea-fertilizer, vertisols

1 Introduction

The consumption of vegetables in the past 5 years has significantly decreased, and consumption level reduced to less than half of the recommended consumption level (Central Bureau of Statistics of the Republic of Indonesia 2015; Ministry of Agriculture 2015; BMKG 2017). Purple eggplant (*Solanum melongena* L.) is one of the important vegetable commodities needed in Indonesia. Although in Indonesia the productivity of the purple eggplant is about 32.64–34.11 ku ha⁻¹, for an area of one hectare 30 tons of purple eggplants can be produced (Rukmana 2006). National eggplant production tends to increase every year, but the eggplant production in Indonesia is still low and only accounts for about 1% of the world needs (Simatupang 2014).

Fertilization is one of the keys to success in improving eggplant production. Farmers generally use inorganic fertilizers to increase the growth and crop yield. However, lately there is an opinion that the increasing use of inorganic fertilizers has caused controversy, and even has created social, economic, and environmental problems, such as tensions between farmers, increased production costs, decreased quality of agricultural products, and decreased environmental quality because of water, soil, and air pollution. Dependence on excessive inorganic fertilizers leads to increase in expense and scarcity of inorganic fertilizers in the market. This condition results in farmers not using appropriate fertilizers or choosing to fertilize eggplant with just one type of fertilizer according to the available funds and the fertilizer available in the market. It was reported that unbalanced fertilizer, only nitrogen, tended to reduce crop yields and soil fertility.

According to Agbo et al. (2012), Maghfoer et al. (2013), Thingujam et al. (2016), Juhaeti and Lestari (2016), Okeowo et al. (2016), and Mostafa et al. (2017), eggplant is a plant that has a good response to fertilization. In general, plants that are applied with fertilizer, whether chemical, organic, or a combination of both, show better productivity than plants that are not applied with fertilizer.

* Corresponding author: Lia Amalia, Agricultural Faculty of Winaya Mukti University, West Java, 45362, Indonesia, e-mail: liaamalia@unwim.ac.id

Raden Budiasih, Elly Roosma Ria, Raden Wahyono Widodo, Upit Kuswati: Agricultural Faculty of Winaya Mukti University, West Java, 45362, Indonesia

Organic fertilizers are produced from weathering the remains of plants, animals, and humans. These organic fertilizers can improve soil structure, can increase soil absorption of water, can increase soil biological fertility, and are used as a source of nutrients for plants (Lingga and Marsono 2002; Kumar 2016; Kumar and Chopra 2016; Lasmini et al. 2018; Suwoyo et al. 2019). Bokashi is the result of weathering manure and other agricultural wastes whose processes are accelerated using microorganisms.

Use of inorganic fertilizers or artificial fertilizers need to be reduced because of remembering requests consumers who want products that are free artificial pesticides and fertilizers. Reduction of fertilizer inorganic applied in agricultural systems organic. This is known as semi farming organic. In semi-organic agriculture usage less inorganic fertilizer compared to use of organic fertilizer. This study significantly contributes to provide recommendations about the best dose fermented compost and nitrogen (N)-fertilizer to support the growth and productivity of eggplant on vertisol.

In the research of Hafizah and Mukarramah (2017), the best dose of cow manure used for growth and productivity of cayenne pepper is about 20 t ha^{-1} . A 200 g per plant dose of organic fertilizer biogas waste from cow manure influenced plant height, number of leaves, and age of harvest, whereas a dose of 250 g per plant affected fruit diameter, weight of plant fruits, and plant production. The results of the study of Mulyanti et al. (2015) showed that the administration of various types of bokashi affected the growth and the productivity of sweet corn. The results of the study of Kartina et al. (2019) showed that treatment using 35 t ha^{-1} chicken manure had the best effect in okra plant's height, number of flowers and fruits per plant, and mass of fruit per plant. According to Tufaila et al. (2014), applying bokashi fertilizer with cow dung at a dose of $5\text{--}7.5 \text{ t ha}^{-1}$ increased the growth and production of lowland rice. The treatment of cow feces bokashi fertilizer at a dose of 3 kg per plot on eggplant increased the plant height, fruit weight per plant, and weight of fruit per plot (Rianto et al. 2018). Furthermore, the results of the study of Zalna et al. (2018) showed that organic bokashi fertilizer manure influences the growth and yield of water spinach on almost all the parameters observed. The results of the research of Raksun and Mertha (2018) showed that bokashi can increase the purple eggplant production.

The combined application of organic fertilizers such as bokashi and inorganic N-fertilizer likely enhances eggplant growth and productivity. We assume that N is an ideal nutrient for eggplant's vegetative growth including leaves, stems, and roots, which may further improve with

adding organic fertilizers because of increase in soil microbial activity. Therefore, our study investigated the combined application of organic and inorganic fertilizers to increase eggplant production. This study significantly contributes to provide recommendations about the application dose of fermented compost and N-fertilizer to increase the plant height and productivity of purple eggplant.

2 Methods

The experiment was conducted in Ujungjaya District, Sumedang Regency, from May to September 2016. The materials used were purple eggplant seeds of Antaboga varieties, bokashi, urea, Curacron Insecticide, and Dithane M-45 Fungicide. The equipments were hoe, marker (sample), rapia rope, meter, handsprayer, bucket, fat sheet, label paper, thermometer, torch, calipers, scales, plastic bags, stationery, and camera.

Experimental design with factorial pattern consists of the following two factors: bokashi (B) consisting of four levels, such as b_0 = without bokashi, $b_1 = 5 \text{ t ha}^{-1}$, $b_2 = 10 \text{ t ha}^{-1}$, and $b_3 = 15 \text{ t ha}^{-1}$; and N-fertilizer consisting of four levels, such as n_0 = without N-fertilizer, $n_1 = 75 \text{ kg ha}^{-1}$, $n_2 = 150 \text{ kg ha}^{-1}$, and $n_3 = 225 \text{ kg ha}^{-1}$ which is repeated twice.

Bokashi is made as follows: EM₄, molasses/sugar, and water in a ratio of 55 mL:55 mL:5.5 L is added to cow manure 82.5 kg + rice husk 41.25 kg + bran 41.25 kg to form a mixture. The mound was covered with tarpaulin or thick plastic for 7 days. During the process, the temperature of the material is maintained between 40 and 60°C. If the temperature of the material exceeds 60°C, then the closing sack is opened, the dough material is flipped back, and the mound is closed again. After 7 days, tarpaulin or thick plastic can be opened. Making bokashi is said to be successful if the bokashi material is well fermented. The characteristics of bokashi are it will be overgrown by white mushrooms and a pleasant aroma. However, if bokashi produced smells bad, then the bokashi made is a failure. The bokashi that is ready should be used immediately. If the bokashi has to be stored, the bokashi must be dried first by aerating it on the floor. After drying, bokashi can be packed in plastic bags. Bokashi was made 8 days before the second tillage.

Furthermore, observations were made on the plant height (measured from the base of the stem to the highest leaf tip), length (measured from the base of the fruit to the tip of the fruit), diameter (three parts are measured

such as 1/4, 2/4, and 3/4 parts of the base of the fruit using a caliper and averaged), number of fruits (calculated at the time of harvest), weight of fruit per plant (observations were made at harvest time using a scale), and weight of fruit per plot (observations were made on five samples per plot).

3 Results and discussions

The results of the eggplant height data at 16, 23, and 44 days after planting (DAP) are presented in Table 1.

Bokashi cow manure dose of 15 t ha^{-1} provided the highest number of plant significantly different from other treatments. This result is in agreement with the studies of Zalna *et al.* (2018), Raksun and Mertha (2018), Harjadi (1991), Huruna and Maruapey (2015), and Sriyanto *et al.* (2015).

Variations in N-fertilizer treatment showed no significant effect on the plant height at 16 and 44 DAP. However, at the age of 23 DAP, the application of 75 and 225 kg ha^{-1} N-fertilizer showed a higher effect than other treatments. According to Syarief (1989), if the N content in plants is high, then the leaves of the formed plants will be maximal with the wider leaf sizes. With a higher number of leaves, photosynthesis can also be increased, as the leaves are organs where the process of plant photosynthesis takes place. The resulting photosynthate can be used as a raw material for further plant growth and development. According to Maghfoer *et al.* (2014), as the age of the eggplant plants increases, nutrient require-

ments, especially nitrogen (N), cannot be completely provided by the soil in which it grows. Providing bokashi cow manure can increase the availability and uptake of N elements needed for the vegetative growth of plants. As stated by Syarief (1989), the element nitrogen (N) is needed by plants to stimulate the vegetative growth of plants such as stems, roots, leaves, and branches. The bokashi and N-fertilizer interact with the height of the purple eggplant plants at 30 and 37 DAP (Tables 2 and 3).

From Tables 2 and 3, it can be seen that the treatment of 15 t ha^{-1} cow manure accompanied by 225 kg ha^{-1} N-fertilizer gives a highest plant height than the other treatments. In line with the results of the research of Safei *et al.* (2014), the type of organic fertilizer affects the height of the eggplant plants at the age of 45 DAP. This situation is caused by the addition of organic fertilizer that can affect the physical and biological properties of the soil; it can also improve the availability of nutrients for plants. The organic fertilizer can improve soil structure, improve the ability to retain water, improve soil biological properties and source of nutrients for plants (Prihantoro 1999).

The provision of organic material in the form of bokashi cow manure influences the improvement of physical, chemical, and biological soil properties. The availability of nutrients in the soil greatly affects the growth and development of roots and the ability of roots to absorb the nutrients. The development of a good root system determines the vegetative growth of plants, which ultimately determines the reproductive phase and yield of plants. In line with the opinion of Souza *et al.* (2017), bokashi cow manure contains macro- and micronutrients. The usefulness of bokashi cow manure for the soil

Table 1: Fermented compost and N-fertilizer on the plant height of the purple eggplant

Treatment	Average plant height (cm) at age		
	16 DAP	23 DAP	44 DAP
Bokashi compost			
b_0 (0 t ha^{-1})	13.37a	20.14a	47.60a
b_1 (5 t ha^{-1})	14.72b	22.95b	56.12b
b_2 (10 t ha^{-1})	14.49b	22.35b	54.10b
b_3 (15 t ha^{-1})	15.89c	25.70c	63.08c
N-fertilizer			
n_0 (0 kg ha^{-1})	14.22a	22.72a	54.01a
n_1 (75 kg ha^{-1})	14.68a	23.47b	57.99a
n_2 (150 kg ha^{-1})	14.56a	21.85a	53.60a
n_3 (225 kg ha^{-1})	15.01a	23.10b	55.28a

Note: the average number of treatments in the same column followed by the same letter shows no significant difference according to Duncan's multiple range test at a real level of 5%.

Table 2: Fermented compost and N-fertilizer on the plant height of the purple eggplant

B/N	Average plant height (cm)			
	n_0	n_1	n_2	n_3
b_0	30.25a	27.33a	26.49a	28.66a
	A	A	A	A
b_1	32.66a	35.99b	33.58ab	30.91a
	AB	B	AB	A
b_2	32a	38.66b	29.91bc	30.49a
	A	B	A	A
b_3	34.58a	39.5b	36.24c	42.58b
	A	BC	AB	C

Note: the average number lowercase letters (vertical direction) and uppercase letters (horizontal direction) the same shows not significantly different according to Duncan's multiple range test at a real level of 5%.

Table 3: Fermented compost and N-fertilizer on the plant height of the purple eggplant at 37 DAP

B/N	Average plant height (cm)			
	n_0	n_1	n_2	n_3
b_0	37.33a A	39.33a A	34.83a A	37.745a A
b_1	44ab A	36.33a A	45.245b A	41.415a A
b_2	41.58ab A	52.83b B	42.33ab A	39a A
b_3	49.165b AB	51.33b AB	47.41b A	58.83b B

Note: the average number lowercase letters (vertical direction) and uppercase letters (horizontal direction) the same shows not significantly different according to Duncan's multiple range test at a real level of 5%.

is physically increasing the soil porosity and biologically increasing the activity of microorganisms so that the process of overhauling organic material is faster in the soil. The bokashi cow manure provided to each treatment is different and the results also look different.

The result showed that there was no interaction between the bokashi treatment of the cow manure with N-fertilizer on the length and diameter of the fruit, and the number and weight of the fruit. Independently the influence of the bokashi dose of cow manure and nitrogen on the fruit length and diameter, the number and weight of the fruit plant (Table 4).

From Table 4, it was observed that providing bokashi cow manure can increase the fruit length per plant, which is higher and significantly different compared to the control. The 10 t ha^{-1} dose of bokashi increased the fruit diameter, number, and weight of the fruit per eggplant better than control (without giving bokashi). In line with the results of the research of Safei et al. (2014), the type of organic fertilizer affects the diameter and weight of the eggplants. Similar to the results of the research of Sriyanto et al. (2015), in the eggplant, cow manure influences the number of fruits per plant, fruit length, fruit diameter, and fruit weight per plant. In contrast to the research results by Huruna and Maruapey (2015), the provision of the organic fertilizer biogas waste cow manure affects the fruit diameter and the weight of the fresh fruit of plants, but does not affect the length and number of fruit per eggplant. Good vegetative growth will support a good generative phase (Budiman 2010). The results of the research of El-Semellawy and El-Koumy (2015) showed that the use of bokashi doses of 1.2 kg

Table 4: Fermented compost and N-fertilizer on length of fruit, diameter of fruit, number of fruit per plant, and weight of fruit per plant

Treatment	Average observation			
	Length of fruit (cm)	Diameter of fruit (cm)	Number of fruit per plant	Weight of fruit per plant (g)
Bokashi compost				
b_0 (0 t ha^{-1})	23.29a	3.50a	9.29a	1501.66a
b_1 (5 t ha^{-1})	25.13b	3.75ab	9.92b	1592.49a
b_2 (10 t ha^{-1})	26.21b	3.90b	10.25c	1744.16b
b_3 (15 t ha^{-1})	25.99b	3.73ab	10.21bc	1737.91b
N-fertilizer				
n_0 (0 kg ha^{-1})	24.46a	3.61a	9.67a	1567.91a
n_1 (75 kg ha^{-1})	25.48a	3.90b	10.17a	1702.49b
n_2 (150 kg ha^{-1})	25.20a	3.65ab	9.92a	1593.32a
n_3 (225 kg ha^{-1})	25.49a	3.72ab	9.92a	1712.49b

Note: the average number of treatments in the same column followed by the same letter shows no significant difference according to Duncan's multiple range test at a real level of 5%.

per 10 kg soil media gives better wet egg productivity results than other treatments.

Various N-fertilizer treatments showed no significant effect on the length and number of the fruit plants. The 75 kg ha^{-1} nitrogen treatment increases the diameter and weight of the eggplant fruit plants. The research results by Fawzy et al. (2016) showed that the fruit length, fruit diameter, and the eggplant productivity were highest in the nitrogen treatment of 100 kg ha^{-1} . Similarly, the results of El-Semellawy and El-Koumy (2015) in the eggplants showed that an increase in the rate of application of N to 150 kg ha^{-1} was in line with an increase in vegetative growth characteristics (plant height [cm] and number of leaves), plant fresh weight (g), fruit length, and diameter (cm). The results obtained by Sharmin and Rahman (2019) showed that the highest yield (18.0 t ha^{-1}) was obtained from the administration of 375 kg ha^{-1} urea, whereas the lowest yield (10.1 t ha^{-1}) was found in the control treatment (without urea administration).

Provision of nitrogen nutrients for plants makes the plant parts become green because they contain chlorophyll that plays a role in photosynthesis. The N-fertilizer is a macronutrient needed by plants. At the right dose, the N-fertilizer will have a good influence on plant growth and productivity. According to Iritani (2012), the availability of macro- and micronutrients in plants is one of the supporters of external factors in determining the

high rate of photosynthesis, so that it also determines the amount of assimilation obtained. Thus, it is suspected that the photosynthesis that runs perfectly with the help of light and the availability of adequate macro- and micro-nutrients have a good effect on plant height, number of fruits per plant, fruit length and diameter, and fruit weight of the plant (Rinsema 1983; Safei *et al.* 2014).

According to Sutejo (1994), the availability of nitrogen will stimulate the formation of chlorophyll in leaves and is part of the constituent of enzymes and chlorophyll molecules. Related to this, Iritani (2012) argued that the formation of leaves with chlorophyll in them results in more photosynthesis in plants. The results of the photosynthesis in the form of carbohydrates, proteins, fats, minerals, and vitamins will be higher. Good growth of the plant can be achieved if the nutrients affect growth in a balanced state. The application of 30% N-fertilizer along with compost is an effective nutritional management strategy to maintain N uptake and corn productivity, reduce N loss, and also increase soil fertility (Zhang *et al.* 2016).

The analysis results showed an interaction between the bokashi of cow manure treatment with nitrogen on the weights of the fruit plot (Table 5). From Table 5, it can be observed that the bokashi of cow manure treatment of 15 t ha⁻¹ accompanied by 75 kg ha⁻¹ N-fertilization has an effective and efficient effect in increasing the fruit weight of the purple eggplant per plot.

In the treatment with bokashi of cow manure, a dose of about 15 t ha⁻¹ with N-fertilizer 75 kg ha⁻¹ gives a better effect in increasing the fruit weight of the purple eggplant per plot. In contrast to the research results of Waskito *et al.* (2017), the composition of soil planting media + sand + cow manure with a dose of 150 kg N-fertilizer increases the plant height, number of leaves, weight of fruit crop per harvest, weight per fruit, and length and diameter of the eggplant fruit. In relation to the research of Maghfoer *et al.* (2014), treatment using the combination of 75% urea + 25% goat manure increased the plant growth and gave the highest fruit yield (49.2 t ha⁻¹) in comparison with combination using other fertilizer and 100% urea. This is because the plant needs for each nutrient differ depending on the availability of nutrients present in the soil. Generally this maximum productivity relates to all plant conditions and nutrient availability in the soil. It is said to be optimal if the elements are available in the right amount. Deficiency or excess of one nutrient will be able to reduce the efficiency of other nutrients (Lasmini *et al.* 2018; Raheem *et al.* 2019).

Based on the results of soil analysis on the experimental field (Appendix 1), the nitrogen element content

Table 5: Fermented compost and N-fertilizer on weight of fruits per plot

B/N	Average weight of fruits per plot (kg)			
	n_0	n_1	n_2	n_3
b_0	19.05a A	17.60a A	17.58a A	17.84a A
b_1	20.87a AB	20.57ab AB	18.18a A	23.34b B
b_2	18.96a A	22.39b AB	23.31b B	26.23b B
b_3	19.54a A	26.64c B	25.94b B	27.27b B

Note: the average number lowercase letters (vertical direction) and uppercase letters (horizontal direction) the same shows not significantly different according to Duncan's multiple range test at a real level of 5%.

included very low criteria, so that the addition of a dose of 75 kg ha⁻¹ N-fertilizer was sufficient in increasing the chlorophyll content in the leaves. The better growth due to combined fertilizer application assuming enhanced leaves chlorophyll content. Therefore, plants increase their rate of photosynthesis that likely produced sugar assimilates. As a result, we expected that this combination of fertilizer application increased the growth and productivity of eggplant.

This is presumably because providing the bokashi of cow manure and N-fertilizer at the right dose to the purple eggplant can increase the growth and productivity. Therefore, the physical, chemical, and biological conditions of the soil are better, besides that the increase in plant height in the treatment of the bokashi of cow manure and N-fertilizer is associated with an increase in N content in plants.

4 Conclusions

Treatment using the combination of 75% urea + 25% goat manure increased the plant growth and gave the highest fruit yield (49.2 t ha⁻¹) in comparison with combination using other fertilizer and 100% urea. Compared to the control, the application of 15 t ha⁻¹ fermented compost and 225 kg ha⁻¹ N-fertilizer increased the plant height by 40.76% at 30 days after planting and 57.59% at 37 days after planting and increased the purple eggplant productivity by 43.15%. This finding confirms that fermented compost and N-fertilizer can be applied to increase the productivity of purple eggplant.

Acknowledgments: The author would like to thank all those who helped out in the research activities until the publication of the paper, especially to the University of Winaya Mukti, the Rector, Dean of the Faculty of Agriculture, and their staff.

Conflict of interest: The authors declare no conflicts of interest.

References

- [1] Agbo CU, Chukwudi PU, Ogbu. Effects of rates and frequency of application of organic manure on growth, yield and biochemical composition of *Solanum melongena* L. (cv. 'Ngwa local') fruits. J Anim Plant Sci. 2012;14(2):1952–60. <http://m.elewa.org/JAPS/2012/14.2/Abstract4-agbo.html>.
- [2] BMKG. Climate and Food Security. Indonesian Food Security Monitoring Bulletin Volume 8, November. Special focus: trends in consumption and production of fruits and vegetables. BMKG; 2017. <http://bmkg.go.id/iklim/buletin-iklim.bmkg>.
- [3] Budiman E. Methods and efforts of eggplant cultivation. Bandung: CV Forum for Science and Technology; 2010.
- [4] Central Bureau of Statistics of the Republic of Indonesia. Production of vegetables and fruits in indonesia. Jakarta: CPM; 2015.
- [5] El-Semellawy EMH, El-Koumy HM. Response of growth and yield of eggplants (*Solanum melongena* L.) to organic mulches and nitrogen fertilization levels during late summer season. Egypt J Hort. 2015;42(2):853–64. doi: 10.21608/ejoh.2015.1336.
- [6] Fawzy ZF, El-Bassiony AM, Neama MM, Zaki MF. Comparison of nitrogen fertilizer sources and rates on growth and productivity of squash plants. Int J Pharm Tech Res. 2016;9(8):51–7. https://www.researchgate.net/profile/Mf_Zaki/publication/309118038_Comparison_of_nitrogen_fertilizer_sources_and_rates_on_growth_and_productivity_of_squash_plants/links/5a58b9e945851545026fb3f/Comparison-of-nitrogen-fertilizer-sources-and-rates-on-growth.
- [7] Hafizah N, Mukarramah R. Application of cow manure fertilizer on growth and yield of Rawit (*Capsicum frutescens* L.) in Rawa Lebak Land. Ziraah Maj Ilm Pertan. 2017;42(1):1–7. <https://ojs.uniska-bjm.ac.id/index.php/ziraah/article/view/636>.
- [8] Harjadi S. Introduction to Agronomy. PT. Jakarta: Gramedia; 1991.
- [9] Huruna B, Maruapey A. Growth and production of eggplant plants (*Solanum melongena* L.) in various dosages of organic biogas waste from cow manure. J Agrofor. 2015;X(3):217–26.
- [10] Iritani G. Vegetable Gardening. Yogyakarta: Indonesia Tera; 2012.
- [11] Juhaeti T, Lestari P. Growth, production and nutritional potential of enggano eggplant in various combinations of fertilization treatment. Ber Biol J Ilmu ilmu Hayati. 2016;15(3):303–13. https://e-journal.biologi.lipi.go.id/index.php/berita_biologi/article/view/2246.
- [12] Kartina AM, Utama P, Dimyati I. Response growth and yield of Okra (*Abelmoschus esculentus* L.) to giving dosage levels of chicken manure and variation of plants spacing. IOP Conf Ser Earth Environ Sci 1st Int Conf Agric Rural Dev. 2019;383(1):1–9. doi: 10.1088/1755-1315/383/1/012028.
- [13] Kumar V. Use of integrated nutrient management to enhance soil fertility and crop yield of hybrid cultivar of brinjal (*Solanum melongena* L.) under field conditions. Adv Plants Agric Res. 2016;4(2):1–9. doi: 10.15406/apar.2016.04.00130.
- [14] Kumar V, Chopra AK. Effects of sugarcane pressmud on agronomical characteristics of hybrid cultivar of eggplant (*Solanum melongena* L.) under field conditions. Int J Recycl Org Waste Agric. 2016;5(2):149–62. doi: 10.1007/s40093-016-0125-7.
- [15] Lasmini SA, Nasir B, Hayati N, Edy N. Improvement of soil quality using bokashi composting and NPK fertilizer to increase shallot yield on dry land. Aust J Crop Sci. 2018;12(11):1743–9. doi: 10.21475/ajcs.18.12.11.p1435.
- [16] Lingga P, Marsono. Instructions for use of fertilizers. Jakarta: Self-help Spreaders; 2002.
- [17] Maghfoer MD, Soelistyono R, Herlina N. Response of eggplant (*Solanum melongena* L.) to combination of inorganic–organic N and EM4. Agrivita. 2013;35(3):296–303. doi: 10.17503/Agrivita-2013-35-3-p296-303.
- [18] Maghfoer MD, Soelistyono R, Herlina N. Growth and yield of eggplant (*Solanum melongena* L.) on various combinations of n-source and number of main branch. Agrivita. 2014;36(3):285–94. doi: 10.17503/Agrivita-2014-36-3-285-294.
- [19] Ministry of Agriculture. Food consumption statistics. Data center and agricultural information system. Indonesia: Ministry of Agriculture; 2015.
- [20] Mostafa FAM, Taha HA, El-atta AA. Potentials of compost tea of certain botanicals for minimizing root-knot and reniform nematodes infection and altering chemical constituents in eggplant. Int J Entomol Nematol. 2017;3(2):62–9. <https://mail.premierpublishers.org/ijen/180920171615.pdf>.
- [21] Mulyanti SS, Made U, Wahyudi I. Effect of the administration of various types of bokashi on the growth and yield of sweet corn crops (*Zea mays saccharata*). e-J Agrotekbis. 2015;3(5):592–601. <https://www.neliti.com/publications/246655/pengaruh-pemberian-berbagai-jenis-bokashi-terhadap-pertumbuhan-dan-hasil-tanaman>.
- [22] Okeowo T, Sanni KO, Okeowo TA. Growth, yield performance and cost benefit of eggplant (*Solanum melogena*) production using goat and pig manure in Ikorodu Lagos Nigeria effect of plant residue Biochar on soil and crop growth view project production economics view project Kehinde Oseni Sa. Int J Sci Res Eng Stud. 2016;3(4):22–6. <https://www.researchgate.net/publication/303848788>.
- [23] Prihantoro H. Fostering vegetable plants. Jakarta: Penebar Swadya; 1999.
- [24] Raheem RA, Oladiran JA, Olowe VI, Ojo PO, Zidafamor EJ, Ishiaku OK, Dahir R. Effects of nitrogen fertilizer rates on the growth of two cultivars of african eggplant (*Solanum macrocarpon* L.) in Minna and Abuja, Nigeria. Int J Innov Sci Res Technol. 2019;4(7):846–53. <https://ijisrt.com/assets/upload/files/IJISRT19JL372.pdf.pdf>.
- [25] Raksun A, Mertha IG. The effect of bokashi on the production of purple eggplant (*Solanum melongena* L.). J Biol Trop. 2018;18(1):21–6. doi: 10.29303/jbt.v18i1.562.

- [26] Rianto B, Zulia C, Efendi E. Effect of cow manure bokashi fertilizer and solid fertilizer application on growth and yield of eggplant (*Solanum melongena*) in pot made from stem of oil pal. *Bernas Agric Res J.* 2018;14(3):17–23. <http://jurnal.una.ac.id/index.php/jb/article/view/368>.
- [27] Rinsema WT. *Fertilizers and fertilization methods*. Jakarta: Bhatara Script; 1983.
- [28] Rukmana. *Planting eggplant*. Yogyakarta: Canisius; 2006.
- [29] Safei M, Rahmi A, Jannah N. The effect of the type and dose of organic fertilizer on the growth and yield of eggfly plants (*Solanum melongena* L.) varieties of mustang f-1. *J AGRIFOR.* 2014;XIII(1):59–66. <http://ejurnal.untag-smd.ac.id/index.php/AG/article/view/549>.
- [30] Sharmin S, Rahman L. Optimization of nitrogen requirement for better growth and yield of brinjal (*Solanum melongena* L.). *Arch. Agric Environ Sci.* 2019;4(1):33–8. doi: 10.26832/24566632.2019.040105.
- [31] Simatupang. *Japanese vegetables*. Jakarta: Self-help Spreaders; 2014.
- [32] Souza AHC, Rezende R, Lorenzoni MZ, Seron CC, Hachmann TL, Lozano CS. Response of eggplant crop fertigated with dosages of nitrogen and potassium. *Rev Bras Eng Agríc Ambient.* 2017;21(1):21–6. doi: 10.1590/1807-1929/agriambi.v21n1p21-26.
- [33] Sriyanto D, Astuti P, Sajalu AP. Effect of cow manure dosage on growth and yield of purple eggped and green eggped plant (*Solanum melongena* L.). *Agrifor.* 2015;XIV(1):39–44. <http://ejurnal.untag-smd.ac.id/index.php/AG/article/view/1099>.
- [34] Sutejo MM. *Fertilizers and fertilizing methods*. Jakarta: Rineka Cipta; 1994.
- [35] Suwoyo HS, Tuwo A, Haryati H, Anshari H. Potential, characteristics and utilization of shrimp pond solid waste as organic fertilizer. *Int J Environ Agric Biotechnol.* 2019;4(2):411–21. <http://journal-repository.com/index.php/ijeab/article/view/521>.
- [36] Syarief ES. *Soil fertility and agricultural fertilization*. Bandung: Pustaka Buana; 1989.
- [37] Thingujam U, Pati S, Khanam R, Pari A, Ray K, Phonglosa A, Bhattacharyya K. Effect of integrated nutrient management on the nutrient accumulation and status of post-harvest soil of brinjal (*Solanum melongena* L.) under Nadia conditions (West Bengal), India. *J Appl Nat Sci.* 2016;8(1):321–8. doi: 10.31018/jans.v8i1.794.
- [38] Tufaila M, Yusrina, Alam S. Rice paddy growth and production in Ultisol Puosu Jaya Konda Sub-District, South Konawe. *Agroteknos.* 2014;4(1):18–25. <http://ojs.uho.ac.id/index.php/agroteknos/article/view/201>.
- [39] Waskito K, Aini N, Koesriharti. Effect of plant media composition and nitrogen fertilizer on growth and yield of eggplant plants (*Solanum melongena* L.). *Produksi Tanam.* 2017;5(10):1586–93. <http://protan.studentjournal.ub.ac.id/index.php/protan/article/view/545>.
- [40] Zalna D, Hadid A, Muhandi. Response of Growth and Yield of Kale (*Ipomea reptans* Poir) to Giving Organic Fertilizer Bokashi Cow Manure. *E-J Agrotekbis.* 2018;6(6):809–17.
- [41] Zhang Y, Li C, Wang Y, Hu Y, Christie P, Zhang J, Li X. Maize yield and soil fertility with combined use of compost and inorganic fertilizers on a calcareous soil on the North China Plain. *Soil Tillage Res.* 2016;155:85–94. doi: 10.1016/j.still.2015.08.006.