ROLE OF BOKASHI FERTILIZER IN INCREASING GROWTH AND YIELD COMPONENTS OF GROUNDNUT ON MARGINAL DRY LAND IN SOUTHEAST SULAWESI

PERAN PUPUK BOKASHI DALAM MENINGKATKAN KOMPONEN PERTUMBUHAN DAN HASIL TANAMAN KACANG TANAH PADA LAHAN KERING MARGINAL DI SULAWESI TENGGARA

Nini Mila Rahni[1*], Wa Ode Hervina[2], Syamsu Alam[3]

[1]Department of Agrotechnology Faculty of Agriculture Halu Oleo University, Kendari, Southeast Sulawesi, Indonesia
[2]Halu Oleo University Postgraduate Agronomy Study Program
[3]Department of Soil Science, Faculty of Agriculture, Halu Oleo University, Kendari, Southeast Sulawesi, Indonesia

*Correspondence: ninimasrul@yahoo.com

Accepted: May 17th, 2024/Revised: June 18th, 2024/Approved: July 18th, 2024

ABSTRACT

The low growth and production of groundnuts in Southeast Sulawesi are caused by land that is dominated by marginal dry land with low soil fertility. One of the efforts to overcome these problems is converting secondary vegetation into bokashi fertilizer, effectively improving soil's physical, chemical, and biological properties. This study aimed to determine the effect of bokashi fertilizer on the growth and yield of several ecotypes of groundnut plants on marginal dry land. This research was conducted in Baito-South Konawe. Laboratory analysis was conducted at the Agrotechnology Laboratory, Halu Oleo University, Kendari. A two-factor randomized block design was used in this study, namely: peanut ecotype and bokashi fertilizer dosage. Parameters observed were relative growth rate, leaf area index, net assimilation rate, productive branches, number of young pods, seed weight per plant, and 100 seed weight. The results showed that there was an interaction effect between the local groundnut ecotype Muna and bokashi fertilizer on the relative growth rate, leaf area index, net assimilation rate at 56 DAP, productive branches, number of young pods, seed weight per plant, and 100 seeds weight. The application of bokashi fertilizer 15 t ha^{-1} showed the best response on groundnut plants to the ecotypes of Wadaga, Parigi, and Lasehao.

Keywords: Bokashi, Groundnuts ecotype, Growth, Marginal land, Production.

ABSTRAK

Rendahnya pertumbuhan dan produksi tanaman kacang tanah di Sulawesi Tenggara disebabkan oleh lahan yang didominasi lahan kering marginal dengan kesuburan tanah yang rendah. Salah satu upaya untuk mengatasi permasalahan tersebut adalah dengan pemanfaatan limbah pertanian menjadi pupuk bokashi yang efektif memperbaiki sifat fisika, kimia dan biologi tanah. Penelitian ini bertujuan untuk menganalisis pengaruh pupuk bokashi terhadap pertumbuhan dan hasil beberapa ekotipe tanaman kacang tanah pada lahan kering marginal. Penelitian lapangan dilaksanakan di Kecamatan Baito, Kabupaten Konawe Selatan. Penelitian laboratorium dilaksanakan di Laboratorium Agroteknologi Universitas Halu Oleo, Kendari. Desain penelitian menggunakan rancangan acak kelompok dengan dua faktor

Cite this as: Rahni, N. M., Hervina, W. O., Alam, S. (2024). Role of bokashi fertilizer in increasing growth and yield components of groundnut on marginal dry land in southeast Sulawesi. *Jurnal Agro*, *11*(1), 161-171. https://doi.org/10.15575/34980

yaitu pertama faktor ekotipe kacang tanah dan kedua faktor dosis pupuk bokashi. Parameter yang diamati yaitu laju tumbuh relatif, indeks luas daun, laju asimilasi bersih, cabang produktif, jumlah polong muda, bobot biji per tanaman, dan bobot 100 biji tanaman. Hasil penelitian menunjukkan bahwa terdapat interaksi antara ekotipe kacang tanah lokal Muna dan pupuk bokashi dalam mempengaruhi laju tumbuh relatif, indeks luas daun, laju asimilasi bersih pada umur 56 HST, cabang produktif, jumlah polong muda, bobot biji per tanaman, dan bobot 100 biji. Pemberian pupuk bokashi 15 t ha^{-1} menunjukkan respon tanaman kacang tanah terbaik pada ekotipe Wadaga, Parigi dan Lasehao.

Kata kunci: Bokashi, Ekotipe kacang tanah, Lahan marginal, Pertumbuhan, Produksi.

INTRODUCTION

Groundnut (*Arachis hypogea* L.) is an essential crop with high economic value and popular among community. Apart from being a food ingredient, groundnuts also contain nutrients that are very good for health, such as folic acid 34%, vitamin E 23%, vitamin B1 12%, phosphorus 13%, magnesium, iron 13%, and potassium 6%, which are needed by the human body (Arya et al., 2016; Ravi et al., 2023).

Groundnut productivity in Southeast Sulawesi in 2020 was relatively low at 1.00 t ha^{-1}; in 2021, it decreased to only 0.80 t ha^{-1} (BPS, 2022). The main reason for this low production is marginal drylands with low soil fertility that dominates Southeast Sulawesi. Marginal land is characterized by low nutrient content, low CEC, high acidity, and low organic matter (Ahmadzai et al., 2022; Csikos and Toth, 2023; Mutammimah et al., 2020; Suwardi, 2019). Sub-optimal land management, poor-quality seeds, and low utilization of organic fertilizers exacerbate this condition.

Efforts to overcome these problems are utilizing local resources derived from nature, such as the use of secondary vegetation, agricultural residues, manure, bran, and some effective microbes with simple technology that can be converted into organic fertilizers, in this case, bokashi fertilizer which is practical, environmentally friendly and economic and can improve physical, chemical and biological properties on marginal land. Some research results show that a combination of two or more of these materials can increase the productivity of marginal land (Andayani et al., 2023; Luo et al., 2022; Ramlan, 2022). Rahni & Karimuna (2014) reported that making green manure plus fertilizer containing more than one microorganism inoculant can increase the growth and yield of groundnuts on marginal land. In addition, the application of compost from secondary vegetation and cow dung fertilizer increased groundnut and maize production (Karimuna et al., 2016).

In addition to appropriate organic fertilizers, selecting groundnut ecotypes is essential for cultivating marginal drylands. Previous research has shown that local Muna groundnut ecotypes such as the Wadaga ecotype, Parigi ecotype, and Lasehao ecotype are groundnut types that have a high level of adaptation to environmental stresses in both climate and marginal soils (Rahni & Karimuna, 2014).

Based on the description above, this research is necessary to determine the effectiveness of bokashi fertilizer on the growth and yield of several ecotypes of groundnut plants on dry land in Baito District, South Konawe Regency.

MATERIALS AND METHODS

This research was conducted in Baito, South Konawe at coordinates 04°13'23" S and 122°19'48" E. Laboratory analysis was carried out at the Agrotechnology Laboratory, Halu Oleo University, Kendari.

The research materials used were goat manure, sago pulp, Gamal leaves, rice husks, straw, EM4 solution, sugar, water, bran, and local Muna groundnut seeds. The tools used in this research were tarpaulins, a hoe, a shovel, a thermometer, a sack, a rapid rope, a scale, a dipper, a hose, a basin, a bucket, a spoon, a machete, and wooden blocks.

This research used a randomized complete block design with a factorial pattern of two factors. The first factor was the Muna local groundnut ecotype (E) which consisted of three types, namely Wadaga ecotype (E1), Parigi ecotype (E2), and Lasehao ecotype (E3). The second factor was bokashi fertilizer which consisted of four levels, namely without bokashi (B0), 5 t ha^{-1} (B1), 10 t ha^{-1} (B2), and 15 t ha^{-1} (B3). Each treatment was repeated three times, so there were 36 experimental units.

Land processing was followed by making research plots of 2.5 m x 3 m. The application dose of bokashi fertilizer was based on the optimum dose of the test results. The planting distance was 25 cm x 30 cm, with two seeds per hole. Watering was carried out according to the planting conditions. Two weeks after planting, thinning was carried out to select one plant per hole to be maintained until harvest. Replanting was done when the plants were seven days after planting (DAP) by replacing dead plants. Weeding was done every other day or adjusted to the growth of weeds. Pests and diseases were controlled with insecticides, pesticides, or fungicides according to the type of pests and diseases that attack.

Observational variables in this study included components of groundnut growth and yield, namely relative growth rate, leaf area index, net assimilation rate, productive branches, number of young pods, seed weight per plant, and 100 seed weight. Observation data were analyzed using variance analysis of the F test according to the design used. The results of variance that showed a significant effect were followed by Duncan's Multiple Range Test (DMRT) at the significant level $\alpha = 0.05$.

RESULTS AND DISCUSSION

Growth Component

Relative Growth Rate

The results of the analysis of variance showed that the application of bokashi fertilizer affected the relative growth rate of 56 DAP groundnut plants. The test results of each relative growth rate observation variable are presented in Table 1.

Table 1 shows that the interaction effect between local Muna groundnut ecotypes and bokashi fertilizer on the observation of relative growth rate at the age of 56 DAP was the highest in the Lasehao ecotype compared to other ecotypes. In the Lasehao ecotype, applying bokashi fertilizer 15 t ha^{-1} produced the highest relative growth rate. However, it was not significantly different from the application of bokashi fertilizer 10 t ha^{-1}, and the other two ecotypes showed an increase in the relative growth rate along with an increase in the dose of bokashi fertilizer applied. This shows that the more bokashi fertilizer given, the more the relative growth rate of groundnuts increases. This is because bokashi fertilizer can provide the organic matter in the soil so that the availability of nutrients needed by plants, especially N nutrients that play a role in the vegetative phase, is well available. In addition, at the age of 56 DAP, the applied bokashi fertilizer had been decomposed so that the availability of microorganisms in the soil increased.

Increased microorganisms create a good environment so that the nutrients and water plants need are available and that groundnut plants can grow optimally. The more doses of bokashi fertilizer given, the more N contained in bokashi fertilizer is received by plants. Nutrient N is an element needed by plants in the vegetative phase. N nutrient is the preparation of amino acids and chlorophyll pigment components that play a role in photosynthesis. This is in line with the opinion of Haryati & Vonnisye (2017); Mulyanto et al. (2018) who reported that the more doses of bokashi fertilizer given, the more N contained in bokashi fertilizer is received by plants.

Table 1. Effect of bokashi fertilizer application and local Muna groundnut ecotypes on the relative growth rate at 56 DAP

Ecotype	Bokashi				
	B0	B1	B2	B3	
E1	0.083^{b}	0.136^{b}	0.149^{b}	0.165^{b}	
	R	Q	PQ	P	
E2	0.098^{b}	0.149^{a}	0.180^{a}	0.182^{a}	2 = 0.0160
	R	Q	P	P	
E3	0.139^{a}	0.155^{a}	0.178^{a}	0.187^{a}	3 = 0.0168
	R	Q	P	P	
DMRT 5%		2 = 0.01851	3 = 0.01943	4 = 0.02002	

Notes: Numbers followed by unequal letters in the same column (a, b, c) and the same row (P, Q, and R) are significantly different at the DMRT level α = 0.05. E1: Wadaga ecotype, E2: Parigi ecotype, and E3: Lasehao ecotype. B0: no bokashi fertilizer, B1: 5 t ha^{-1} bokashi fertilizer, B2: 10 t ha^{-1} and B3: 15 t ha^{-1}.

Leaf Area Index

The results of the analysis of variance showed that the application of bokashi fertilizer affected the leaf area index in 56 DAP groundnut plants. The test results of each leaf area index observation variable are presented in Table 2.

Table 2 shows that the leaf area index of plants in the Lasehao ecotype was higher when compared to other ecotypes at all levels of bokashi fertilizer dosage. In the Lasehao ecotype, 15 t of ha^{-1} bokashi fertilizer produced the highest leaf area index but was not significantly different from the 10 t of ha^{-1} bokashi fertilizer application. In other ecotypes, the highest average was found at a dose of 15 t of ha^{-1} bokashi fertilizer, significantly different from other doses. This was because an increase follows the increase in the number of leaves in the leaf area related to nutrient absorption. In this case, at the age of 56 DAP, the bokashi fertilizer had been decomposed so that the availability of nutrients needed by plants increased which affected the increasing plant organs in both the vegetative and generative phases. The more nutrients available, the more the number and area of plant leaves increase. The increase in leaf area facilitates the photosynthesis process to run well to produce a lot of photosynthates, which can be distributed to all parts of the plant, increasing plant growth and production. This is in line with the opinion of (Cahyono & Tripama, 2014), reporting that the more doses of bokashi fertilizer given, the more the number and area of leaves produced.

Table 2. Effect of bokashi fertilizer application and local Muna groundnut ecotype on leaf area index at 56 DAP

Ecotype	Bokashi				
	B0	B1	B2	B3	
E1	0.747^{c}	1.000^{c}	1.026^{c}	1.150^{c}	
	S	R	Q	P	
E2	0.767^{b}	1.061^{b}	1.122^{b}	1.172^{b}	2 = 0.0027
	S	R	Q	P	
E3	0.807^{a}	1.119^{a}	1.189^{a}	1.369^{a}	3 = 0.0038
	R	Q	P	P	
DMRT 5%		2 = 0.025	3 = 0.027	4 = 0.027	

Notes: Numbers followed by unequal letters in the same column (a, b, c) and the same row (P, Q, R, and S) are significantly different at DMRT fundamental level α = 0.05. E1: Wadaga ecotype, E2: Parigi ecotype, and E3: Lasehao ecotype. B0: no bokashi fertilizer, B1: 5 t ha^{-1} bokashi fertilizer, B2: 10 t ha^{-1} and B3: 15 t ha^{-1}

The increase in the leaf area index of local Muna groundnut plants occurred due to applying bokashi fertilizer with the increased of dosage level to increase the source of organic matter on dry land, which could spur plants to thrive. The highest value of the leaf area index of local Muna groundnut plants was found in the Lasehao ecotype on applying 15 t of bokashi fertilizer ha^{-1}.

Net Assimilation Rate

The analysis of variance showed that the application of bokashi fertilizer affected the net assimilation rate in 56 DAP groundnut plants. The test results of each observation variable of the net assimilation rate are presented in Table 3.

Table 3 shows that the highest net assimilation rate was obtained in the Lasehao ecotype compared to other ecotypes, except at a dose of bokashi fertilizer of 15 t ha^{-1}, the highest in the Parigi ecotype but not significantly different from the Lasehao ecotype. The Lasehao ecotype was suspected to adapt to land conditions with low fertility levels. In addition, all ecotypes showed that the higher the dose of fertilizer applied, the higher the net assimilation rate of groundnut plants. The increased availability of organic matter in the soil can improve soil aggregation to increase the number of soil pores and ultimately becomes a suitable medium for plant growth because the reach of the roots is more comprehensive so that nutrient absorption is easier (Purwanto & Alam, 2020; Liang et al., 2023). With the expansion of root reach and increased nutrient uptake, plants can grow well, which in turn increases the dry weight of the plants produced. In line with the research of Ramadan & Prastia (2021), the nutrient N has a natural effect on plant growth which can stimulate the growth of roots, stems, and leaves and increase plant height to increase the dry weight of the plant crown.

Table 3. Effect of bokashi fertilizer application and local Muna groundnut ecotype on net assimilation rate at 56 DAP

Ecotype	Bokashi				
	B0	B1	B2	B3	
E1	0.0042^{a}	0.0060^{c}	0.0093^{c}	0.0125^{c}	
	S	R	Q	P	
E2	0.0030^{a}	0.0138^{b}	0.0192^{b}	0.0256^{a}	2 = 0.00136
	S	R	Q	P	
E3	0.0039^{a}	0.0207^{a}	0.0221^{a}	0.0238^{b}	3 = 0.00143
	R	Q	Q	P	
DMRT 5%		2 = 0.0015	3 = 0.0016	4 = 0.0017	

Notes: Numbers followed by unequal letters in the same column (a, b, c) and the same row (P, Q, R, and S) are significantly different at DMRT real level α = 0.05. E1: Wadaga ecotype, E2: Parigi ecotype, and E3: Lasehao ecotype. B0: no bokashi fertilizer, B1: 5 t ha^{-1} bokashi fertilizer, B2: 10 t ha^{-1} and B3: 15 t ha^{-1}.

Yield Components of Muna Local Groundnut Ecotypes

The analysis of variance showed that the application of bokashi fertilizer affected the yield components of local Muna groundnut ecotypes. The yield components of local Muna groundnut ecotypes tested in this study were productive branches, number of young pods, seed weight per plant, and 100 seed weight. Based on the variance analysis, it was found that there was an interaction effect between bokashi fertilizer and groundnut ecotype on productive branches, number of young pods, seed weight per plant, and 100 seed weight. The results of the different tests on yield component variables are presented in Table 4, Table 5, Table 6, and Table 7.

Table 4. Effect of bokashi fertilizer and Muna local groundnut ecotype on productive branch observation variable

Ecotype	Bokashi				
	B0	B1	B2	B3	
E1	4.778^{b}	7.111^{c}	7.667^{c}	9.556^{c}	
	R	Q	Q	P	
E2	4.889^{b}	8.000^{b}	10.444^{b}	11.000^{b}	2 = 0.127
	R	Q	P	P	
E3	5.333^{a}	8.556^{a}	10.889^{a}	11.889^{a}	3 = 0.121
	S	R	Q	P	
DMRT 5%		2 = 0.6315	3 = 0.6631	4 = 0.6833	

Notes: Numbers followed by unequal letters in the same column (a, b, c) and the same row (P, Q, R, and S) are significantly different at DMRT fundamental level α = 0.05. E1: Wadaga ecotype, E2: Parigi ecotype, and E3: Lasehao ecotype. B0: no bokashi fertilizer, B1: 5 t ha^{-1} bokashi fertilizer, B2: 10 t ha^{-1} and B3: 15 t ha^{-1}.

Table 4 shows that the interaction between Muna local groundnut ecotypes and bokashi fertilizer on the most productive branches was found in the Lasehao ecotype at a dose of 15 t ha^{-1} which was significantly different from other ecotypes and other dosage levels of bokashi fertilizer as well. However, the application of bokashi fertilizer in all ecotypes showed that the higher the dose of fertilizer applied, the more the number of productive branches of plants produced other than the control. This is because the more bokashi fertilizer given, the more organic matter is available in the soil, thus creating a good environment (Olle, 2020).

A good environment makes it easier for the soil to become loose, causing plant roots to develop sufficiently so that the absorption of nutrients and water needed for photosynthesis increases, ultimately increasing plant productivity. In this case, the number of productive branches increases. In line with the opinion of Raksun & Japa (2018), they reported that the decomposition of organic matter in the soil could increase nutrient availability, water storage capacity, soil buffer power, cation exchange, and soil texture for the better so that the resulting plant production increases, especially the number of productive branches. The more the number of productive branches produced, the more the number of groundnut pods produced. Patriani et al. (2022); Shikha et al. (2023) also reported that bokashi fertilizer can improve the physical, chemical, and biological properties of soil so that it can increase the number of plant root nodules.

Table 5. Effect of bokashi fertilizer and Muna local groundnut ecotype on the observation variable of several young pods

Ecotype	Bokashi				
	B0	B1	B2	B3	
E1	3.556^{a}	3.111^{b}	2.778^{b}	3.000^{a}	
	P	P	PQ	PQ	
E2	2.444^{c}	4.556^{a}	4.444^{a}	2.778^{b}	2 = 0.097
	Q	P	PQ	Q	
E3	2.889^{b}	3.000^{c}	2.556^{c}	2.333^{c}	3 = 0.092
	P	P	P	PQ	
DMRT 5%		2 = 0.4812	3 = 0.5053	4 = 0.5206	

Notes: Numbers followed by unequal letters in the same column (a, b, c) and the same row (P, Q, and R) are significantly different at the DMRT level α = 0.05. E1: Wadaga ecotype, E2: Parigi ecotype, and E3: Lasehao ecotype. B0: no bokashi fertilizer, B1: 5 t ha^{-1} bokashi fertilizer, B2: 10 t ha^{-1} and B3: 15 t ha^{-1}.

Table 5 shows that the interaction of local Muna groundnut ecotypes and bokashi fertilizer on the number of young pods in Wadaga, Parigi, and Lasehao ecotypes was the highest at 5 t ha^{-1} and not significantly different from 10 t ha^{-1} and without the application of bokashi fertilizer. However, the application of bokashi fertilizer 15 t ha^{-1} was similar to that of bokashi fertilizer 10 t ha^{-1}. This shows that applying higher doses of bokashi fertilizer can meet the needs of plants in the vegetative and generative growth phases (Rianti et al., 2021). The interaction of local Muna groundnut ecotypes and bokashi fertilizer on young pods was the highest in the Parigi ecotype and the application of 5 t ha^{-1} bokashi fertilizer which was significantly different from the application of 10 t ha^{-1}, 15 t ha^{-1}, and without bokashi fertilizer. This indicates that the Parigi ecotype does not need much fertilizer.

Table 6. Effect of bokashi fertilizer and Muna local groundnut ecotype on the observation variable of seed weight per plant

Ecotype	Bokashi				
	B0	B1	B2	B3	
E1	13.551^{c}	16.694^{b}	20.089^{b}	21.417^{c}	
	R	Q	P	P	
E2	19.673^{a}	19.674^{a}	19.779^{c}	22.549^{b}	2 = 0.365
	Q	Q	Q	P	
E3	16.012^{b}	19.423^{a}	22.298^{a}	25.758^{a}	3 = 0.347
	S	R	Q	P	
DMRT 5%		2 = 1.811	3 = 1.902	4 = 1.960	

Notes: Numbers followed by unequal letters in the same column (a, b, c) and the same row (P, Q, R, and S) are significantly different at DMRT real level α = 0.05. E1: Wadaga ecotype, E2: Parigi ecotype, and E3: Lasehao ecotype. B0: no bokashi fertilizer, B1: 5 t ha^{-1} bokashi fertilizer, B2: 10 t ha^{-1} and B3: 15 t ha^{-1}

In Table 6, the application of bokashi fertilizer to local Muna groundnut ecotypes on the variable of seed weight per plant is the highest in the Lasehao ecotype with the application of 15 t of bokashi fertilizer ha^{-1} which was significantly different from the dose of fertilizer and other ecotypes. However, the increase in seed weight per plant was significantly in line with the increase in the dose of bokashi fertilizer applied. Genetic factors influence the number of seeds per pod. The Lasehao ecotype is an ecotype whose number of seeds per pod is higher than the Wadaga and Parigi ecotypes, so the seed weight in the Lasehao ecotype is very influential. In addition to genetic factors, the number of seeds per pod is also influenced by the application of bokashi fertilizer. Mutammimah et al. (2020) reported that the availability of sufficient organic matter in the soil increases the availability of nutrients, especially those that play a role in the generative phase (nutrients P and K), so that pod formation and seed filling of groundnut plants increase. In line with the research of Rahni et al. (2019) reported that organic fertilizers in the form of compost plus, in this case, bokashi fertilizer contain complete nutrients because they generally contain almost all the nutrients needed by plants such as nutrients N, P, K, Ca and Mg which play an essential role in growth and pod formation and seed filling in plants.

Table 7. shows that the application of bokashi fertilizer to local muna groundnut ecotypes on the observation variable of 100 seed weight was the highest in the Lasehao ecotype at a dose of 15 t ha^{-1} which was significantly different from other ecotypes and other dosage levels of bokashi fertilizer as well. This is because the Lasehao ecotype has 1 to 4 seed pods; the number and shape of seeds significantly affect the weight of 100 plant seeds, so the more significant the seed size and the more the number of seeds, the higher the weight of the seeds produced. In addition to genetic factors that affect the increase in 100 seed weight in each plant is the availability of nutrients needed by plants; both macro and micronutrients are well available at the time of pod formation and filling, especially nutrients P and K, which play a role in increasing crop production. This is in line with the research of Phooi et al. (2022),

reporting that green fertilizer plus, in this case, bokashi fertilizer, can increase the content of nutrients that play a role in carbohydrate translocation for cob formation and seed filling in corn plants. Rahni & Karimuna (2014) also reported that applying bokashi fertilizer will ensure the availability of organic matter and nutrients needed by plants during pod formation and filling.

Table 7. Effect of bokashi fertilizer and Muna local groundnut ecotype on the observation variable of 100 seed weight

Ecotype	Bokashi				
	B0	B1	B2	B3	
E1	31.703^{c}	37.107^{c}	41.482^{c}	48.306^{c}	
	S	R	Q	P	
E2	50.698^{a}	54.443^{b}	56.500^{b}	57.996^{b}	2 = 0.400
	S	R	Q	P	
E3	44.386^{b}	55.278^{a}	57.938^{a}	60.830^{a}	3 = 0.381
	S	R	Q	P	
DMRT 5%		2 = 1.989	3 = 2.088	4 = 2.152	

Notes: Numbers followed by unequal letters in the same column (a, b, c) and the same row (P, Q, R, and S) are significantly different at DMRT fundamental level α = 0.05. E1: Wadaga ecotype, E2: Parigi ecotype, and E3: Lasehao ecotype. B0: no bokashi fertilizer, B1: 5 t ha^{-1} bokashi fertilizer, B2: 10 t ha^{-1} and B3: 15 t ha^{-1}

It is suspected that the higher the application of bokashi fertilizer, the better it affects the production of groundnut plants. This is because bokashi fertilizer can provide the nutrients needed by plants, especially P and K nutrients, which increase plant production. Giving bokashi fertilizer is one of the technologies in increasing groundnut production, especially on marginal dry land; bokashi fertilizer is also one of the environmentally friendly fertilizers and can improve soil conditions with low fertility. Mulyanto et al. (2018) reported that the increase in plant seed weight is influenced by the availability of sufficient nitrogen, which will help the formation of high-quality seeds; good quality will affect seed weight. In line with the research of Ansar et al. (2021); Gashua et al. (2022); Sofyan et al. (2023) that compost plus, in this case, bokashi fertilizer, contains complete nutrients needed by plants, such as nutrients N, P, K, Ca, and Mg, which play an essential role in growth and pod formation and seed filling in plants.

CONCLUSIONS

Based on the results of the research conducted, it can be concluded that the response of three local Muna groundnut ecotypes to bokashi fertilizer on dry land in South-Konawe Regency with the application of bokashi fertilizer plays a role in increasing the growth and yield component of groundnut plants on marginal dry land. The application of bokashi fertilizer 15 t ha^{-1} showed the best response of groundnut plants in the Wadaga, Parigi, and Lasehao ecotypes

REFERENCES

Ahmadzai, H., Tutundjian, S., Dale, D., Brathwaite, R., Lidderr, P., Selvaraju, R., Malhotra, A., Boerger, V., & Elouafi, I. (2022). *Marginal lands: potential for agricultural development, food security and poverty reduction*. Rome, FAO. https://doi.org/10.4060/cc2838en

Andayani, S., Hayat, E. S., & Mursalin, a. (2023). Effect of bokashi quail manure and rice husk biochar on soil pH and soybean plants growth. *IOP Conference Series: Earth and Environmental Science*, *1160*(1). https://doi.org/10.1088/1755-1315/1160/1/012023

Ansar, M., Bahrudin, Fathurrahman, Darman, S., Thaha, a. R., Angka, a. W., & Rahmadanih. (2021). Application of bokashi goat manure and organic liquid fertilizer to improve the growth and yield of Lembah Palu shallot variety. *IOP Conference Series: Earth and Environmental Science*, *681*(1). https://doi.org/10.1088/1755-1315/681/1/012047

Arya, S. S., Salve, A. R., & Chauhan, S. (2016). Peanuts as functional food: a review. *Journal of Food Science and Technology*, *53*(1), 31–41. https://doi.org/10.1007/s13197-015-2007-9

BPS. 2022. *Konawe Selatan dalam Angka 2022.* Badan Pusat Statistik Konawe Selatan.

Cahyono, B. H. & Tripama, B. (2014). Respons tanaman tomat terhadap pemberian pupuk bokashi dan pengaturan jarak tanam. *Agritrop Jurnal Ilmu-Ilmu Pertanian*. 1(1): 168–187. https://doi.org/10.32528/agr.v12i2.722

Csikós, N., & Tóth, G. (2023). Concepts of agricultural marginal lands and their utilisation: A review. *Agricultural Systems, 204*, 103560. https://doi.org/10.1016/j.agsy.2022.103560

Gashua, A. G., Sulaiman, Z., Yusoff, M. M., Samad, M. Y. A., Ramlan, M. F., & Salisu, M. A. (2022). Assessment of fertilizer quality in horse waste-based bokashi fertilizer formulations. *Agronomy*, *12*(4), 1–19. https://doi.org/10.3390/agronomy12040937

Haryati, B., & Vonnisye, V. (2017). Pengaruh Pupuk bokashi jerami padi terhadap pertumbuhan dan produksi tanaman kacang buncis (*Phaseolus vulgaris* L). *AgroSainT*, *4*(2), 64–68.

Karimuna, L., Rahni, N. M., & Boer, D. (2016). The use of bokashi to enhance agricultural productivity of marginal soils in Southeast Sulawesi, Indonesia. *Journal of Tropical Crop Science*, *3*(1), 1–6. https://doi.org/10.29244/jtcs.3.1.1-6

Liang, H., Yang, L., Wu, Q., Meng, C., Zhang, J., & Shen, P. (2023). Regulation of the C:N Ratio Improves the N-Fixing Bacteria Activity, Root Growth, and Nodule Formation of Peanut. *Journal Soil Science Plant Nutrient*, 23, 4596–4608. https://doi.org/10.1007/s42729-023-01376-3

Luo, Y., Gonzalez Lopez, J. B., van Veelen, H. P. J., Sechi, V., ter Heijne, A., Bezemer, T. M., & Buisman, C. J. N. (2022). Bacterial and fungal co-occurrence patterns in agricultural soils amended with compost and bokashi. *Soil Biology and Biochemistry*, *174*, 108831. https://doi.org/10.1016/j.soilbio.2022.108831

Mulyanto, F. D., Suminarti, N. E., & Sudiarso. (2018). Respon tanaman kacang tanah (*Arachis hypogaea* L.) pada berbagai aplikasi pupuk N dan kompos azolla. *Jurnal Produksi Tanaman*, *6*(5), 791–800.

Mutammimah, U., Minardi, S., & Suntoro, S. (2020). Organic amendments effect on the soil chemical properties of marginal land and soybean yield. *J. Degrade. Min. Land Manage*, *7*(4), 2263–2268. https://doi.org/10.15243/jdmlm

Olle, M. (2020). *Review:* Bokashi technology as a promising technology for crop production in Europe. *The Journal of Horticultural Science and Biotechnology,* 96(2), 145–152.

https://doi.org/10.1080/14620316.2020.1810140

Patriani, P., Hasanah, U., & Wahyuni, T. (2022). Bokashi application for organic farming in Manuk Mulia Village, Karo District. *Journal of Saintech Transfer*, *5*(1), 40–48. https://doi.org/10.32734/jst.v5i1.8851

Phooi, C. L., Azman, E. A., & Ismail, R. (2022). Role of organic manure bokashi improving plant growth and nutrition: A Review. *Sarhad Journal of Agriculture*, *38*(4), 1478–1484. https://doi.org/10.17582/journal.sja/2022/38.4.1478.1484

Purwanto, B. H., & Alam, S. (2019). Impact of intensive agricultural management on carbon and nitrogen dynamics in the humid tropics. *Soil Science and Plant Nutrition*, 66(1), 50-59. https://doi.org/10.1080/00380768.2019.1705182

Rahni, N., & Karimuna, L. (2014). Pengembangan bioteknologi pupuk hijau plus berbasis vegetasi sekunder untuk meningkatkan produksi kacang tanah lokal pada lahan kering marginal. *Agroteknos*, *4*(2), 95–101.

Raksun, A., & Japa, L. (2018). Aplikasi pupuk organik untuk meningkatkan pertumbuhan kacang tanah (*Arachis hypogaea* L). *J. Pijar MIPA*, *13*(2), 137–139. https://doi.org/10.1201/9781351072533

Ramadan, F., & Prastia, B. (2021). Pengaruh pemberian beberapa jenis bokashi terhadap pertumbuhan dan hasil tanaman terung (*Solanum melongena* L). *Jurnal Sains Agro*, *6*(1), 79–89. https://doi.org/10.36355/jsa.v6i1.504

Ramlan. (2022). Effect of bokashi fertilizer on increasing soil nutrients and growth of medicinal plants. *International Journal of Design and Nature and Ecodynamics*, *17*(3), 433–437. https://doi.org/10.18280/ijdne.170314

Ravi, S., Rangasami, S.R.S., Vadivel, N., Ajaykumar, R. and Harishankar, K. (2023). Growth and Yield Attributes of Groundnut (*Arachis hypogaea* L.) as Influenced by Tank-mix Application of Early Post Emergence Herbicides. *Legume Research*. https://doi.org/10.18805/LR-5147

Rianti, L., Pujiwati, H., Masdar, Hermansyah, & Widiyono, H. (2021). Growth and Yield of Soybean (*Glycine max* L. Merill) at Various Doses of Bokashi Fertilizer on Ultisol. *TERRA Journal of Land Restoration*, 4(2), 60-64. https://doi.org/10.31186/terra.4.2.60-64

Shikha, F. S., Rahman, M. M., Sultana, N., Mottalib, M. A., & Yasmin, M. (2023). Effects of biochar and biofertilizer on groundnut production: a perspective for environmental sustainability in Bangladesh. *Carbon Research*, *2*(1). https://doi.org/10.1007/s44246-023-00043-7

Sofyan, E. T., Gumelar, F. A., Yuniarti, A., Joy, B., & Wicaksono, F. Y. (2023). Effectiveness of water hyacinth compost and N, P, K, S fertilizer on S-available, S uptake, protein content, and yield of shallot in Inceptisols from Jatinangor. *Kultivasi*, *22*(1), 16–25. https://doi.org/10.24198/kultivasi.v22i1.38589

Suwardi. (2019). Utilization and improvement of marginal soils for agricultural development in Indonesia. *IOP Conference Series: Earth and Environmental Science*, *383*(1). https://doi.org/10.1088/1755-1315/383/1/012047