Jurnal Pertanian Terapan of JURNAL ROCE (AGROSCIENCE)
https://jurnal.rocewisdomaceh.com/index.php/roce e-ISSN : 3032-4505
Vol. 2, No. 2, Thn. 2025
https://doi.org/10.71275/roce.v2i1.118

COMBINATION OF BIOCHAR AS AMELIORANT AND VERMICOMPOST IN INCREASING THE YIELD OF RED ONION (*Allium ascalonicum* L.)

KOMBINASI BIOCHAR SEBAGAI AMELIANT DAN VERMIKOMPOST DALAM MENINGKATKAN HASIL TANAMAN BAWANG MERAH (*Allium ascalonicum* L.)

Rosnina A.G*[1], Nasruddin[1],, Halim Akbar[1],, Hasnan Habib D. Lubis[1], Usnawiyah[1]
[1]Agroecotechnology study program, Faculty of Agriculture,
Malikussaleh University

Correspondent Email : rosnina@unimal.ac.id

Abstract

Shallots are a horticultural product experiencing a rising demand, both as a culinary seasoning and as materials for the pharmaceutical industry. This research aims to investigate the effectiveness of biochar and vermicompost as soil amendments that can enhance the characteristics of suboptimal land to boost shallot yields. The study employed a factorial RBD with three replications. The first factor involved the dosage of factorial fertilizer with two observed variables: (i) Vermicompost (V0 = control, V1 = 1 kg /). The incorporation of vermicompost had a significant positive impact on plant height, leaf count, bulb quantity, root length, bulb dry weight, and bulb diameter. Conversely, the application of biochar alone significantly influenced plant height, the number of shallot bulbs, as well as the wet and dry weights of the shallot bulbs. The combination of vermicompost and biochar in a 2:1 ratio per plot proved to be the optimal mix for enhancing growth and productivity, thereby increasing the shallot harvest index.

Keywords: *Bioactivator, biochar, vermicompost*

Abstrak

Bawang merah merupakan produk hortikultura yang permintaannya terus meningkat, baik sebagai bumbu dapur maupun sebagai bahan baku industri farmasi. Penelitian ini bertujuan untuk mengkaji efektivitas biochar dan vermikompos sebagai bahan pembenah tanah yang dapat meningkatkan karakteristik lahan suboptimal untuk meningkatkan hasil bawang merah. Penelitian ini menggunakan RBD faktorial dengan tiga kali ulangan. Faktor pertama meliputi dosis pupuk faktorial dengan dua variabel pengamatan: (i) Vermikompos (V0 = kontrol, V1 = 1 kg/m). Penambahan vermikompos memberikan pengaruh positif yang signifikan terhadap tinggi tanaman, jumlah daun, jumlah umbi, panjang akar, berat kering umbi, dan diameter umbi. Sebaliknya, pemberian biochar saja secara signifikan memengaruhi tinggi tanaman, jumlah umbi bawang merah, serta berat basah dan kering umbi bawang merah. Kombinasi vermikompos dan biochar dengan rasio 2:1 per petak merupakan kombinasi optimal untuk meningkatkan pertumbuhan dan produktivitas, sehingga meningkatkan indeks panen bawang merah.

Kata kunci: Bioaktivator, biochar, vermikompos

INTRODUCTION

Red onion (*Allium ascalonicum* L.) is a horticultural product classified as a vegetable spice, often experiencing price fluctuations due to unstable availability and price volatility. Price fluctuations in red onions occur due to unstable market availability (Sarjani *et al*., 2018). To meet the demand for red onions, production can be increased through both intensification and extensification by utilizing suboptimal lands. The utilization of suboptimal lands should ideally be accompanied by efforts to improve soil characteristics, making them suitable for red onion cultivation. Similarly, Maulia *et al*. (2021) explain that the fertility status of dry lands is generally low across all soil types. Efforts to meet red onion consumption can be done through extensification by expanding the planting area on suboptimal land. As dry land typically has low fertility, soil amendments are needed to improve fertility and suitability for red onion cultivation.

Red onions have a soft, fibrous root system that requires fertile, loose soil with high organic matter content. Suitable soil for onion growth includes loamy or sandy loam with good drainage. To improve the physical properties of suboptimal land through soil amendment techniques, biochar application can increase the soil aggregation percentage, thereby enhancing both water porosity and drainage porosity. Biochar is a promising approach for managing agricultural waste and optimizing suboptimal and degraded soils (Nurida, 2014). According to Pakpahan (2020), the use of corn husks, rice husks, and durian peel to produce biochar not only reduces waste issues but also improves soil physical and chemical properties, thereby enhancing soil fertility.

To increase the availability of organic matter in shallot cultivation, vermicompost fertilizer can be added to the soil to enhance its fertility and improve soil quality. This fertilizer is derived from the decomposition of plant residues, such as rice straw, with the help of earthworms as decomposers to accelerate the degradation process of plant biomass. During the decomposition of compost materials by earthworms, the resulting decomposed material contains a variety of nutrients. It is rich in growth regulators derived from functional microbial communities that support plant growth and health. Additionally, vermicompost containing cellulose, hemicellulose, and complex lignin (Dwiputranto, 2013) can improve the status of Inceptisol soil from sub-optimal land to productive land. Vermicompost fertilizer is produced with the assistance of earthworm bioactivators (Lumbricus rubellus) through vermicomposting (Sucipto, 2012), which not only generates earthworm biomass during their reproduction but also produces vermicompost from earthworm excrement. Vermicompost contains N (3.85%), P (0.78%), and K (1.45%) in its composition. The C/N ratio produced is 10.51. Vermicompost fertilizer can enrich nutrient content and play a role in the formation of onion leaves (Patti et al., 2018). Growth regulators contained in vermicompost include gibberellin, cytokinin, and auxin, as well as nutrients such as N, P, K, Mg, Ca, and several micronutrients like Fe, Mn, Cu, Zn, B, and Mo (Mashur, 2001). Additionally, Azotobacter sp. is present as a non-symbiotic nitrogen-fixing bacterium that enriches the nitrogen required by plants. The use of compost fertilizer can increase onion production and quality, including shelf life, which is influenced by technical practices and the limited availability of fertile land, as well as the prolonged use of chemical fertilizers at high concentrations, which can reduce soil organic matter content and fertility.

Efforts are needed to maintain, improve, and mitigate the negative impacts of chemical fertilizer use, which can be partially offset by substituting vermicompost as an alternative to reduce dependence on and decrease the use of synthetic chemical fertilizers in red onion cultivation (Putri *et al*., 2012).

RESEARCH METHODS

This research will be conducted at the Research Farm of the Faculty of Agriculture, Universitas Malikussaleh. The materials used are red onion seeds of the Bima Brebes variety, vermicompost fertilizer, and biochar from rice husks. The tools used are a hoe, plastic rope, measuring tape, label paper, spray bottle, camera, and writing instruments. The experiment will use an RBD with a factorial pattern and three replications, with two factors:

Factor 1: Vermicompost fertilizer (V) consists of three levels; V0: Control, V1: 10 tons/ha (1 kg/plot), V2: 20 tons/ha (2 kg/plot) and rice husk biochar (B) consisting of: B0: Control, B1: 10 tons/ha (1 kg/plot), B2: 20 tons/ha (2 kg/plot). Thus, this study consists of 9 treatment combinations, each with three replications, resulting in a total of 27 experimental units.

Research Implementation

Seed Preparation

The seeds used are Brebes variety shallots, selected for uniformity and freedom from pests and diseases, then cleaned of their dried outer skin. The tips of the bulbs are cut off to 3/4 with a sterilized knife that has been soaked in 70% alcohol. The purpose of cutting the tip of the onion bulb is to facilitate the emergence of sprouts. The cut part of the bulb is left to dry, preventing it from rotting when planted.

Soil Preparation

Land preparation involves clearing plant debris and weeds, as well as loosening the soil to improve its texture. Soil preparation is carried out to a depth of 20 cm by turning and loosening the soil with a hoe to improve soil aeration. Plots are made measuring 2 m x 1 m, with a total of 27 plots. The distance between plots is 30 cm, and the distance between blocks is 50 cm, which also serves as drainage to allow water to flow, preventing it from pooling during rain.

Fertilizer application

Basic fertilizer is applied once at the recommended dosage when planting shallots in rows. The basal fertilizer application consists of Urea 0.125 g/g/g/plant, SP-36 0.3 g/g/g/plant, and KCl 0.2 g/g/g/plant. This basal fertilizer application is carried out at the time of planting. Application of vermicompost and rice husk biochar as soil conditioners is applied 7 DAP at the recommended dosage.

Planting

Planting is carried out by digging a hole 3 cm deep with a planting distance of 25 cm x 25 cm. The seedlings planted are those that have been cut the day before. The bulbs are planted upright in the planting hole and covered with fine soil. Each planting hole contains one shallot bulb. Shallots are planted in the morning.

Maintenance

The maintenance activities for shallot plants during the research were as follows:

1. Watering was carried out every morning and evening to maintain the moisture of the planting medium and meet the water requirements of the shallot plants using a watering can. Watering

was carried out by observing the condition of the soil and plants to ensure their needs were met.
2. Weeding is done by carefully removing weeds growing around the plants to avoid damaging the onion plants. Subsequent weeding is done regularly, depending on the growth of weeds.
3. Pest control is carried out on plants showing signs of pest infestation using mechanical methods. Fungal infections are controlled by spraying the plants evenly with fungicide.

Harvesting

Red onion plants can be harvested 60 days after planting, when approximately 60% of the leaves have dried and the bulbs are visible above the soil surface. Red onions are harvested by carefully pulling the entire plant out of the soil, thereby avoiding damage to the bulbs, which would reduce their quality.

Observations

Observations include: plant height, number of leaves, number of tillers, number of tubers, wet weight of tubers, dry weight of tubers, tuber diameter, and harvest index.

RESULTS AND DISCUSSION

Plant Height (cm)

The ANOVA showed that the application of vermicompost and biochar did not have a significant interaction on plant height. The application of vermicompost had a significant effect on plant height at 14 and 24 days after planting (DAP). The single factor of biochar application only had a significant effect on plant height at 14 DAP. The results of the analysis of variance for the application of vermicompost and biochar on plant height individually can be seen in Table 1.

Table 1. Average height of shallot plants treated with vermicompost and biochar fertilizers

Treatment	Plant Height (cm)				
	14 DAP	24 DAP	34 DAP	44 DAP	54 DAP
Vermikompos (V)					
V0 (0 kg/plot)	17.42 b	23.64 b	27.97 a	32.62 b	35.20 a
V1 (1 kg/plot)	18.3 ab	24.64 ab	28.09 a	33.68 ab	35.99 a
V2 (2 kg/plot)	19.25 a	25.44 a	29.56 a	35.77 a	37.76 a
Biochar (B)					
B0 (0 kg/plot)	17.66 b	24.18 a	27.73 a	32.24 a	34.91 a
B1 (1 kg/plot)	19.24 a	25.00 a	27.46 a	33.05 a	35.72 a
B2 (2 kg/plot)	18.06 ab	24.54 a	28.43 a	33.77 a	35.32 a

Note: Numbers followed by the same letter in the same column indicate no significant difference based on the DMRT test at the 5% level.

The data in Table 1 show that the addition of vermicompost fertilizer at a dose of 2 kg/plot is the optimal dose, resulting in the highest plant height value of 37.76 cm at 54 DAP, and the lowest plant height (35.20 cm) in plants without vermicompost fertilizer application.

https://jurnal.rocewisdomaceh.com/index.php/roce e-ISSN : 3032-4505
Vol. 2, No. 2, Thn. 2025
https://doi.org/10.71275/roce.v2i1.118

Meanwhile, the application of biochar alone at a rate of 1 kg/plot affected plant height, with the highest value being 35.72 cm. In contrast, the lowest plant height at 54 DAP was 34.91 cm, which occurred without the application of biochar.

Number of Leaves (pieces)

The ANOVA revealed that the interaction between vermicompost and biochar treatment had no significant effect on the number of leaves. The single factor of vermicompost treatment had a significant effect on the number of leaves at 14, 24, and 34 DAP, but had no significant effect at 44 and 54 days after sowing. The application of biochar had no significant effect on the number of leaves at any observation age. The results of the ANOVA for the number of leaves in response to the vermicompost and biochar treatments, individually, are presented in Table 2.

Table 2. Average Number of Leaves Due to the Use of Vermicompost and Biochar Fertilizers on Red Onion Plants

Treatment	Number of leaves (pieces)				
	14 HST	24 HST	34 HST	44 HST	54 HST
Vermikompos (V)					
V0 (0 kg/plot)	11.35 b	18.44 b	25.82 b	35.96 a	38.33 a
V1 (1 kg/plot)	12.84 ab	19.11 b	31.96 ab	37.75 a	39.32 a
V2 (2 kg/plot)	14.81 a	22.93 a	34.68 a	41.48 a	44.93 a
Biochar (B)					
B0 (0 kg/plot)	12.17 a	19.37 a	28.41 a	35.87 a	38.34 a
B1 (1 kg/plot)	13.96 a	20.96 a	32.17 a	37.80 a	40.53 a
B2 (2 kg/plot)	12.86 a	20.15 a	31.89 a	41.51 a	43.71 a

Note: Numbers followed by the same letter in the same column indicate no significant difference based on the DMRT test at the 5% level.

Based on Table 2, it can be seen that the highest number of leaves at 54 DAP was obtained in the 2 kg/plot vermicompost treatment, namely 44.93 leaves, while the lowest number of leaves was found in the 0 kg/plot vermicompost treatment, namely 38.33 leaves. The application of biochar resulted in the highest number of leaves, with 2 kg/plot yielding 43.71 leaves per plot. In contrast, the lowest number of leaves, 38.34 leaves, was observed in the control plants without biochar application.

Wet Weight of Tubers (g)

The ANOVA revealed that the interaction between vermicompost and biochar treatment had no significant effect on the wet weight of tubers per plot. The single factor of vermicompost treatment and the single factor of biochar treatment had a significant effect on the wet weight of tubers per plot. The results of the ANOVA on the wet weight of tubers per plot, due to the application of vermicompost and biochar fertilizers, are presented in Table 3.

Table 3. Average Wet Weight of Tubers Due to the Use of Vermicompost and Biochar Fertilizers in Shallot Plants

Treatment	Wet Weight of Tubers per Plot (g)
Vermikompos (V)	
V0 (0 kg/plot)	55.64 b
V1 (1 kg/plot)	64.83 ab
V2 (2 kg/plot)	75.98 a
Biochar (B)	
B0 (0 kg/plot)	53.02 b
B1 (1 kg/plot)	72.32 a
B2 (2 kg/plot)	71.11 a

Note: Numbers followed by the same letter in the same column indicate no significant difference based on the DMRT test at the 5% level.

Based on Table 3, it can be seen that the highest wet weight of tubers per plot was obtained with the application of vermicompost fertilizer (V2) at 2 kg/plot, which was 75.98 g. In contrast, the lowest wet weight of roots was obtained with the vermicompost fertilizer treatment (V0) at 0 kg/plot, which was 55.64 g. Biochar yielded the highest fresh weight of roots in the treatment (B1) at 1 kg/plot, which was 72.32 g, while the biochar treatment (B0) at 0 kg/plot yielded the lowest fresh weight of roots, which was 53.02 g.

Dry Weight of Tubers per Plot

The ANOVA revealed that the interaction between vermicompost and biochar treatment had no significant effect on the dry weight of tubers per plot. The single factor of vermicompost treatment and the single factor of biochar treatment had a significant effect on the dry weight of tubers per plot. The results of the ANOVA on the dry weight of tubers per plot, due to the single treatment of vermicompost and biochar fertilizer, are presented in Table 4.

Table 4. Average Dry Weight of Tubers per Plot Due to the Use of Vermicompost and Biochar Fertilizers on Shallot Plants

Treatment	Dry Weight of Tubers per Plot
Vermikompos (V)	
V0 (0 kg/plot)	51.12 b
V1 (1 kg/plot)	57.87 ab
V2 (2 kg/plot)	67.30 a
Biochar (B)	
B0 (0 kg/plot)	49.52 b
B1 (1 kg/plot)	64.37 a
B2 (2 kg/plot)	62.41 a

Note: Numbers followed by the same letter in the same column indicate no significant difference based on the DMRT test at the 5% level.

Based on Table 4, it can be seen that the highest dry weight of tubers per plot was obtained in the vermicompost fertilizer treatment (V2) at 2 kg/plot, which was 67.30 g. In contrast, the lowest dry weight of tubers per plot was obtained in the vermicompost fertilizer

https://jurnal.rocewisdomaceh.com/index.php/roce e-ISSN : 3032-4505
Vol. 2, No. 2, Thn. 2025
https://doi.org/10.71275/roce.v2i1.118

treatment (V0) at 0 kg/plot, which was 51.12 g. Biochar yielded the highest dry weight of tubers per plot in the treatment (B1) at 1 kg/plot, which was 64.37 g, while the biochar treatment (B0) at 0 kg/plot yielded the lowest dry weight of tubers per plot, which was 49.52 g.

Tuber Diameter

The ANOVA results showed that the vermicompost and biochar treatments did not have a significant interaction on the tuber diameter variable. The single factor of the vermicompost treatment and the single factor of the biochar treatment had a significant effect on the tuber diameter variable. The ANOVA results for the tuber diameter variable due to the vermicompost and biochar treatments individually can be seen in Table 5.

Table 5. Average Bulb Diameter Due to the Use of Vermicompost & Biochar Fertilizer on Shallot Plants

Treatment	Tuber Diameter (mm)
Vermikompos (V)	
V0 (0 kg/plot)	24.45 b
V1 (1 kg/plot)	26.23 ab
V2 (2 kg/plot)	26.77 a
Biochar (B)	
B0 (0 kg/plot)	24.53 b
B1 (1 kg/plot)	26.82 a
B2 (2 kg/plot)	26.10 ab

Note: Numbers followed by the same letter in the same column indicate no significant difference based on the DMRT test at the 5% level.

Based on Table 5, it can be seen that the highest tuber diameter value was obtained in the vermicompost fertilizer treatment (V2) at 2 kg/plot, which was 26.77 mm. In contrast, the lowest tuber diameter value was obtained in the vermicompost fertilizer treatment (V0) at 0 kg/plot, which was 24.45 mm. Biochar yielded the highest tuber diameter in the treatment (B1) at 1 kg/plot, which was 26.28 mm, while the biochar treatment (B0) at 0 kg/plot yielded the lowest tuber diameter, which was 24.53 mm.

The application of fertilizer as an organic material can enhance soil fertility, including increasing soil moisture infiltration, improving water-holding capacity, increasing nutrient availability, and providing primary nutrient sources such as N, P, and K for plants. Thus, organic materials introduced into the soil can create a better garden environment to enhance root absorption capacity. Potassium (K) is a nutrient required by plants during bulb formation. The formation of red onion bulbs originates from the enlargement of leaf layers, which then develop into red onion bulbs. A high potassium content causes potassium ions (K^+) to bind to water within the plant, thereby accelerating the photosynthesis process. The result of photosynthesis stimulates the formation of larger bulbs, thereby increasing the onion's dry weight. Soil conditions significantly influence root development, enhancing the roots' ability to absorb water and nutrients in large quantities, which indirectly impacts photosynthesis, respiration, and overall metabolic processes in the plant, thereby affecting growth.

https://jurnal.rocewisdomaceh.com/index.php/roce *e-ISSN : 3032-4505*
Vol. 2, No. 2, Thn. 2025
https://doi.org/10.71275/roce.v2i1.118

Plant Height

The application of 2 kg/plot of vermicompost fertilizer and 1 kg/plot of biochar showed a significant effect on the growth of shallots at 14 DAP and 24 DAP. This is likely due to the balanced and sufficient nutrient composition of the vermicompost fertilizer, combined with the presence of biochar as a soil conditioner that improves soil aggregate structure, allowing onion plant roots to penetrate the soil more easily and absorb nutrients, thereby enhancing vegetative growth. Nitrogen, as a macronutrient, is essential for plant growth and development. Pradnyawan et al. (2005) noted that nitrogen plays a crucial role in chlorophyll formation, enabling plants to utilize photosynthetic products for growth and development, including increased plant height. This aligns with Hardjowigeno (2003), who stated that nitrogen improves vegetative growth and plays a role in protein synthesis.

Plants require sufficient and balanced nutrients, particularly macronutrients and micronutrients, as well as efficient application of fertilizers in appropriate forms and doses. Its use can enhance plant growth and productivity. Vermicompost fertilizer contains complete nutrients but is slowly released to plants. This aligns with Novizan (2002), who states that plant growth will be more optimal if the required nutrients are available in sufficient quantities and meet the plant's needs.

The application of biochar has a significant effect on plant height at 14 days after sowing. This is because rice husk biochar plays a role in improving the physical and chemical properties of the soil, such as increasing the soil's ability to retain water, increasing organic carbon, and improving the availability of Ca and Mg in the soil. This aligns with the statement by Riadi et al. (2010), who noted that the application of rice husk charcoal can improve soil physical properties. Thus, the improved soil physical properties will influence potassium availability, and the rice husk charcoal will help enhance the uptake of phosphorus, calcium, and magnesium by the plants.

Wet Weight of Tubers per Plot

Vermicompost fertilizer treatment has a significant effect on the wet weight of tubers per plot. Optimal tubers are produced because the plants receive sufficient and appropriate nutrients, and the process of nutrient uptake or absorption from the soil occurs very well. The wet weight of tubers is influenced by the activity of plants in seeking nutrients in the soil. If nutrients are sufficient, biosynthesis proceeds smoothly, resulting in increased carbohydrate production and storage as food reserves, which enhances tuber wet weight. This aligns with Jakunda's (2020) assertion that the wet weight of red onions is significantly influenced by the availability of nutrients and water in the soil. Plant growth is more optimal when the required nutrients are available in sufficient quantities and accordance with the plant's needs.

Biochar treatment also significantly affects bulb wet weight per plot. Applying biochar derived from rice husks can increase bulb wet weight in red onion plants. Soil with good structure and adequate aeration allows plant roots to access nutrients and water more easily within the soil. Biochar application enhances the soil's water retention capacity, allowing the plant root system to more easily absorb nutrients and water from the soil. This aligns with Winarso (2005), who states that if nutrients are sufficient, biosynthesis proceeds smoothly, resulting in increased carbohydrate production and storage as food reserves, which in turn increases the plant's fresh weight.

Dry Weight of Tubers

Vermicompost fertilizer treatment had a significant effect on the dry weight of tubers per plot. Their wet weight influences the dry weight of tubers. During the vegetative growth phase, plants require N, P, and K, which are the most important nutrients and are sufficiently available in the soil to support plant growth, thereby significantly determining the weight of tubers produced by the plants. This aligns with the findings of Sinaga *et al*. (2016), who stated that potassium nutrients can increase the dry weight of red onion tubers, as potassium plays a role in photosynthesis—the process of forming new organic compounds that are transported to storage organs such as tubers.

Biochar treatment also significantly affects the dry weight of tubers per plot. Plant roots absorb nutrients from the soil, such as potassium, which is crucial for crop yield, as this nutrient has the most significant impact on crop yield. Potassium activates several enzymes and plays a crucial role in maintaining water balance within plants, facilitating carbohydrate transformation. Potassium, which is nearly as abundant as nitrogen, is highly demanded by plants during the development of red onions. In line with the findings of Damanik *et al*. (2010), it was stated that the application of biochar, when used appropriately, can control, support, and complement each other within the soil.

Tuber Diameter

The application of vermicompost fertilizer has a significant effect on tuber diameter. It is believed that the application of sufficient amounts of vermicompost will result in soil with high porosity, good aeration, good drainage, and water retention capacity. Vermicompost has particles with a large surface area, providing strong nutrient absorption and retention. This aligns with Faried *et al*. (2021), who found that vermicompost application significantly affects the number of red onion tubers produced. Tuber size is primarily influenced by the translocation of assimilates within the layers of the red onion tuber. The metabolic process of assimilation is significantly influenced by nutrient availability, which plants also utilize for growth and development. The availability of essential macronutrients, such as nitrogen, directly influences bulb growth and assimilate formation. This aligns with the findings of Sumarni & Hidayat (2005), who showed that bulb diameter increases when larger seed bulbs are used.

Applying biochar has a significant influence on the diameter of onion bulbs. Favorable soil conditions for shallot growth facilitate better nutrient uptake by the roots. Biochar enhances soil structure and aeration, allowing plants to absorb nutrients and water more efficiently. Its high cation exchange capacity further improves nutrient retention, resulting in enhanced plant development. The effectiveness of biochar-based soil conditioners enhances the water-holding capacity and facilitates the root uptake of nutrients such as N, P, and K. This aligns with Lakitan's (1996) findings that potassium enhances photosynthetic activity, enabling the translocation of photosynthates to generative organs, particularly during onion bulb formation.

Soil conditions are closely related to the nutrients that plants require. Decomposed biochar can increase cation exchange capacity. This serves as a basis for increasing base cations, thereby relatively reducing acid cations. Gani (2009) noted that the high availability of nutrients for plants is also a result of the direct increase in nutrients from biochar, leading to improved nutrient retention and changes in soil microbial dynamics. Furthermore, Aljun *et al*. (2010) stated that one of biochar's roles is as a habitat for the growth of beneficial microorganisms. A significant amount of biochar is required in the soil to adequately supply plant nutrients.

Biochar is more effective when applied in larger quantities. The decomposition process of biochar also proceeds at a slow rate. As a soil conditioner, biochar can persist in the soil for a long time, have a relatively long-lasting effect, or be relatively resistant to microbial attack, resulting in a slow decomposition process. This enables biochar to help retain nutrients within the soil.

CONCLUSION

Using 2 kg/plot of vermicompost fertilizer enhances plant growth and development, as well as increases the fresh weight, dry weight, and diameter of shallot bulbs at harvest. Meanwhile, biochar applied to the soil supports nutrient and water availability, thereby improving plant growth, fresh and dry bulb weight, and bulb diameter in shallots.

RECOMMENDATION

It is recommended to use vermicompost and biochar fertilizers to increase nutrient availability, thereby reducing the use of inorganic fertilizers in promoting onion growth and yield.

REFERENCES

Aljun, Y., Fikrinda, W., & Widowati, W. (2016). Biochar Residues and Their Effect on the Growth and Yield of Plants (*Solanum lycopersicum* L.) in Regosol. Journal of Soil. Faculty of Agriculture, 4(2).

Damanik, M. M. B., Bachtiar, E. H., & Fauzi, S. Hamidah Hanum. (2010). Soil Fertility and Fertilization.

Gani, A. (2009). The Potential of Biochar as a Component of Technology for Improving Agricultural Land Productivity. Food Crop Science and Technology, 4(1).

Mashur. (2001). Vermicompost (earthworm compost) High-Quality and Environmentally Friendly Organic Fertilizer. Agricultural Research and Technology Assessment Installation (IPPTP) Mataram Agricultural Research and Development Agency. Mataram. NTB. Indonesia.

Hardjowigeno, S. (2003). Ultisol Soil Science. New Edition. Akademika Pressindo, Jakarta.

Jakunda, A., Syahrudin, S., Suparno, S., & Asie, K. (2020). Growth and Yield of Red Onion (*Allium ascalonicum* L.) in Response to the Application of Bokashi Kalakai (*Stenochlaena palustris*) on Peatland Soil. AgriPeat, 21(2), 117-123.

https://jurnal.rocewisdomaceh.com/index.php/roce e-ISSN : 3032-4505
Vol. 2, No. 2, Thn. 2025
https://doi.org/10.71275/roce.v2i1.118

Lakitan, B. (1996). Physiology of plant growth and development. PT. Raja Grafindo Persada. Jakarta, 218.

Nurida, N. L. (2014). Potential Utilization of Biochar for Dry Land Rehabilitation in Indonesia.

Pakpahan, T. (2020). Study of the Chemical Properties of Inceptisol Soil with Biochar Application on the Growth and Production of Red Onions. Jurnal Penelitian Agrosamudra, 7(1), 1-8.

Putri, M., Sipayung, R., & Sinuraya, M. (2012). Growth and Production of Red Onions (*Allium ascalonicum* L.) with the Application of Vermicompost and Sheep Urine. Journal of Agroecotechnology. University of North Sumatra, 1(1), 93811.

Riadi, Y. A., & Zulfita, D. (2010). The Effect of Growing Medium Composition and Liquid Organic Fertilizer on the Growth and Yield of Green Bean Plants. Journal of Agricultural Science Students, 2(1): 1–9.

Maulia Rahmat Husni, Sufardi, Munawar Khalil. (2016). Evaluation of Soil Fertility Status in Several Soil Types on Dry Land in Pidie District, Aceh Province. Agricultural Student Scientific Journal

Sutejo, M. M., & Kartasapoetra, A. G. (1990). Fertilizers and Fertilization Methods. Rineka Cipta.

Sinaga, S. F., Simanungkalit, T., & Hasanah, Y. (2016). Growth Response of Red Onion (*Allium ascalonicum* L.) to the Application of Municipal Waste Compost and Fertilizer K. Online Journal of Agroecotechnology, 4(3), 2181-2187.

Winarso, S. (2005). Soil Fertility: The Foundation of Soil Health and Quality.