Utilizing Melastoma Compost (*Melastoma malabatrichum* L.) as a Sustainable Alternative to Synthetic Nitrogen Fertilizers in Shallot Cultivation

ABSTRACT

Aims: This studyexplores the potential of Melastoma compost (*Melastoma malabatrichum* L.) as a sustainable alternative to synthetic nitrogen fertilizers in shallot (*Allium ascalonicum* L.) cultivation.

Study design: This study was conducted from July to October 2024 at the Green House of the Department of Crop Production, Faculty of Agriculture, Bengkulu University, Indonesia, at an altitude of 10 meters above sea level.

Methodology: The experimental design was a Completely Randomized Design (CRD) with six treatments, each treatment was repeated 4 times. The treatments were: P_0: No fertilizer; P_1: 0% Melastoma compost(100% N, 100% P, and 100% K); P_2: 25% Compost (75% N, 100% P, and 100% K); P_3: 50% Compost (50% N, 100% P, and 100% K); P_4: 75% Compost (25% N, 100% P, and 100% K); P_5: 100% Compost (0% N, 100% P, and 100% K).

Results: The results indicated that plants receiving Melastoma compost exhibited improved growth characteristics, including greater plant height, greener leaves, and enhanced root dry weight. Additionally, yields were higher for plants treated with organic compost than those using synthetic fertilizers or without fertilization (control treatment). Soil analysis revealed increased nitrogen content and improved physical properties in Melastoma compost treatments. Melastoma compost significantly improved shallot growth and yield. Whether used alone or combined with synthetic fertilizers, Melastoma compost outperformed synthetic fertilizers applied without compost, which showed similar crop yield to control treatment. Melastoma compost can effectively replace or complement synthetic nitrogen fertilizers in shallot cultivation.

Conclusion: The study's findings indicated that Melastoma compost positively impacted both the growth and yield of shallots. Using compost, either by itself or combined with synthetic fertilizers, enhanced the growth and yield of shallots. Shallots that received only synthetic fertilizer, without adding Melastoma compost, exhibited growth and yield similar to those not fertilized plants (control treatment). Melastoma compost can be applied independently, without synthetic fertilizer, or in conjunction with synthetic fertilizers for growing shallots. Therefore, Melastoma compost can serve as a substitute for synthetic nitrogen fertilizer in shallot cultivation.

Keywords: Melastoma compost, Organic agriculture, Organic fertilizer, Organic shallot, Sustainable agriculture

1. INTRODUCTION

The Green Revolution significantly advanced agricultural development, leading to substantial growth in agricultural productivity over recent decades. However, this progress has brought about unintended environmental consequences. The widespread application of synthetic fertilizers, pesticides, herbicides, and intensive land management practices has caused long-term environmental harm, affecting soil, water, air, and living organisms. The increasing demand for agricultural land underscores the harmful effects of synthetic chemicals, such as the degradation of soil structure and the disruption of microbial ecosystems. Unsustainable modern farming practices can result in pollution, toxicity, health issues, and the destruction of organisms (Fathur*et al*., 2023).

Synthetic fertilizers adversely affect soil pH, often causing a decline due to the prolonged application of synthetic products like urea (Utami &Handayani, 2003). Yuniarti et al., (2018) found that the incresed in microbial activity reduces soil organic carbon levels. Soil fertility is strongly associated with the diversity of microorganisms; however, intensively cultivated soils relying on synthetic fertilizers typically exhibit reduced soil quality and lower microbial populations. Prolonged use of synthetic fertilizersexhibits a typical reduses in soil quality. The decreasing soil fertility highlights the need for innovative approaches to ensure a sustainable nitrogen supply for crops, such as shallots while preserving soil health (Muslimah, 2017).

Additionally, overuse of synthetic fertilizers and insufficient organic matter restoration contribute to land degradation, especially in Inceptisol. Sudirja*et al*., (2007) characterize Inceptisols as having low chemical fertility, with about 1.88% organic carbon and 0.15% total nitrogen. Implementing effective strategies, such as balanced fertilization and applying suitable technologies, can enhance the fertility and productivity of Inceptisol.

To mitigate the environmental challenges posed by synthetic fertilizers, alternative agricultural methods such as Low External Input Sustainable Agriculture (LEISA) offer promising solutions. LEISA emphasizes optimizing the use of locally available resources while minimizing reliance on external inputs to enhance productivity and profitability, all while preserving ecological balance (Fadilah *et al*., 2020). Using native resources, such as organic fertilizers from weeds, can support soil fertility conservation and promote sustained productivity.

Weeds, often competing with crops for essential nutrients and water, can adversely affect crop growth and yield. However, they can be transformed into compost or organic fertilizer, offering a sustainable alternative to synthetic nitrogen sources in agriculture (Susanto *et al*., 2018). Among these, *Melastoma malabatrichum* L. (Melastoma) is a promising candidate for organic fertilizer. It contains 2.27% nitrogen, 0.29% phosphorus, 1.10% potassium, 53.63% organic carbon, and a C/N ratio of 24, which it is important to develop the organic fertilizer (Syahid *et al*., 2020).

Nitrogen is essential for plant growth, particularly in supporting vegetative development, such as leaves, stems, and roots. A nitrogen deficiency in shallots can result in leaf chlorosis, wilting, and stunted growth (Triadiawarman*et al*., 2022). Incorporating weed compost within sustainable agricultural practices can boost crop productivity while improving soil quality (Muktamar *et al*., 2016; Setyowati*et al*., 2015). Additionally, growth media enriched with organic matter can enhance nutrient availability and improve soil structure (Kurnianingsih*et al*., 2019; Siregar*et al*., 2017). Although farmers commonly use synthetic fertilizers in shallot cultivation, they still use Melastoma compost as a substitute only to a limited extent, which highlighting the importance for additional research in this area

Overusing synthetic fertilizers has led to soil degradation, negatively affecting the environment and crop yields. To reduce dependence on synthetic fertilizers, environmentally friendly alternatives like organic fertilizers can be employed. Melastoma weed compost, rich in nitrogen, shows promise as an alternative to synthetic nitrogen fertilizers, particularly for shallot cultivation. This study aimed to evaluate the effects of combining synthetic and organic fertilizers on shallot growth and yield.

2. MATERIAL AND METHODS

2.1 Time, Location and Experimental Design

This study was conducted from July to October 2024 at the Green House of the Department of Agricultural Production, Faculty of Agriculture, University of Bengkulu, Indonesia at an altitude of 10 meters above sea level.

The experimental design was a Completely Randomized Design (CRD) with 6 treatments, each repeated 4 times. The treatments were as follows: P_0: No fertilizer; P_1: 0% Melastoma Compost (100% N, 100% P, and 100% K); P_2: 25% Compost (75% N, 100% P, and 100% K); P_3: 50% Compost (50% N, 100% P, and 100% K); P_4: 75% Compost (25% N, 100% P, and 100% K); P_5: 100% Compost (0% N, 100% P, and 100% K). 100%N equal to 285 kg urea/Ha, 100% P equal to 138 kg SP46/Ha while 100% K equal to 180 kg KCl/Ha.

2.2Composting Process

Composting Melastoma weeds startedby cutting them into small pieces, measuring 0.5–2 cm, using a shredding machine. The chopped material was then stacked, with cow manure incorporated into the pile's center to enhance the decomposition process. The pile was moistened by spraying 5 liters of EM4 solution and thoroughly mixed to ensure uniform distribution. It was then resprayed with EM4, followed by clean water to achieve the appropriate moisture level. Next,the pile was covered with a tarp. The compost was turned every three days. Once the composting was complete, it was sifted through a 0,5 cm mesh to remove larger stems and leaves. Lastly, the finished compost was weighed according to treatment needs and blended with soil for application. The analysis of Melastoma compost revealed the following composition: 46.4% organic carbon (C), 2.84% nitrogen (N), 0.54% phosphorus (P), 1.75% potassium (K), 3.57% calcium (Ca), 0.58% magnesium (Mg), and 0.81% sulfur (S). Additionally, it contained 1,858 mg/kg iron (Fe), 7.62 mg/kg copper (Cu), 96.6 mg/kg zinc (Zn), and 1,720 mg/kg manganese (Mn). The compost had a C/N ratio of 16.34, along with 4% cellulose, 38% lignin, 6% hemicellulose, and a pH of 7.81.

(a) (b) (c) (d)

Figure 1. Composting process, Melastoma before and after chopped (a), adding cow manure, EM-4 and water (b), decomposition process (c), Melastoma compost (d)

2.3 Soil medium preparation

The process started by collecting 150 kg of soil from a 0–20 cm depth, and air-dried for two days. The soil then was sieved and passed through a 5 mm screen for a planting medium. For the initial soil analysis, samples were taken using a zig-zag pattern with a soil probe. These samples were air-dried for two days and sieved again with a 5 mm mesh to ensure uniformity. The soil was then analyzed for total nitrogen (N), available phosphorus (P), potassium (K), pH, and texture. The initial soil analysis of Inceptisols shows the following nutrient content: total nitrogen (N) at 0.31%, available phosphorus (P) at 4.71%, exchangeable potassium (K) at 0.33%, soil pH at 4.63, and 19.29% clay, 25.67% silt, and 55.03% sand. The organic carbon (C-organic) content was 2.05%, with exchangeable calcium (Ca) at 0.56% and exchangeable magnesium (Mg) at 0.09%. After the analysis was complete, the planting medium was sieved once more, weighed according to the requirements, and portioned at 5 kg of soil per polybag.

Preparing the planting media started by weighing 5 kg of sieved soil for each polybag then measuring the required amount of Melastoma compost according to the specified treatment. The soil and compost were then thoroughly mixed until well mixed. Finally, the mixture was placed into 30cm x 40 cm polybags, ready for use.

2.4 Planting

Shallot bulb was to trim about one-third from the top portion, then the cut bulbs was sprinkled with anthracol before planting. Each polybag was planted with one bulb. After planting, the bulbs were gently moistened to support their growth.

2.5 Harvesting

Shallots are typically ready for harvest within 55 days, indicated by the leaves starting to yellow, the majority (around 80%) had drooped, the bulbs were fully formed and compact, and part of the bulbs was visible above the soil. The harvesting process involved carefully uprooting the entire plant to avoid damaging or leaving any bulbs. Once harvested, the shallots were left to dry for about two weeks.

2.6 Observed Variables

The plant variables included plant height at 6 WAP (cm), number of leaves per cluster at 6 WAP, leaves greenness, bulb number, bulb diameter (mm), bulb length (cm), bulb fresh weight (g), bulb dry weight (g), and root dry weight (g). After harvesting, the soil was sampled, air-dried, sieved using a 0.5 mm screen, and analyzed for total N using the Kyldahl Method.

2.7 Data Analysis

The observation data was analyzed statistically using Analysis of Variance (ANOVA) at 5%. If there is a significant difference, further test with Orthogonal Contrast with a level of 5%.

3. RESULTS AND DISCUSSION

Table 1 shows the growing media's pH and nitrogen (N) content after the research was completed. The soil pH in the control treatment (without fertilization) ranged from 4.47 - 4.73, with nitrogen content ranging from 0.24% - 0.27%. For the 0% compost treatment, the pH ranged from 4.32 - 4.84, and nitrogen content ranged from 0.23% - 0.26%. For the 25% compost treatment, the pH ranged from 4.57 - 4.64, with nitrogen content ranging from 0.24% - 0.28%. For the 50% compost treatment, the pH ranged from 4.45 - 5.07, and nitrogen content ranged from 0.26% - 0.30%. For the 75% compost treatment, the pH ranged from 4.45 - 4.49, with nitrogen content ranging from 0.24% - 0.29%. Finally, for the 100% compost treatment, the soil pH ranged from 4.55 - 4.71, and nitrogen content ranged from 0.27% - 0.32%. At the end of the study, the Ultisol growing media still had an acidic pH ranging from 4.00 - 5.00, and the nitrogen content was classified as low, with values ranging from 0.23% to 0.32%.

Table 1. Soil pH and Nitrogen (N) Content of the Growing Media after Harvesting

Treatments and Replication (R)	Soil pH	N (%)
Control (No fertilizer) R1	4.47	0.25
Control (No fertilizer) R2	4.55	0.27
Control (No fertilizer) R3	4.73	0.24
Control (No fertilizer) R4	4.56	0.25
0% Compost (100% N, 100% P & 100 % K) R1	4.84	0.24
0% Compost (100% N, 100% P & 100 % K) R2	4.40	0.26
0% Compost (100% N, 100% P & 100 % K) R3	4.32	0.26
0% Compost (100% N, 100% P & 100 % K) R4	4.62	0.23
25% Compost (75% N, 100% P & 100 % K) R1	4.61	0.27
25% Compost (75% N, 100% P & 100 % K) R2	4.58	0.26
25% Compost (75% N, 100% P & 100 % K) R3	4.64	0.28
25% Compost (75% N, 100% P & 100 % K) R4	4.57	0.24
50% Compost (50% N, 100% P & 100 % K) R1	4.58	0.26
50% Compost (50% N, 100% P & 100 % K) R2	4.45	0.28
50% Compost (50% N, 100% P & 100 % K) R3	5.07	0.30
50% Compost (50% N, 100% P & 100 % K) R4	4.58	0.27
75% Compost (25% N, 100% P & 100 % K) R1	4.49	0.29
75% Compost (25% N, 100% P & 100 % K) R2	4.46	0.28
75% Compost (25% N, 100% P & 100 % K) R3	4.45	0.28
75% Compost (25% N, 100% P & 100 % K) R4	4.49	0.24

100% Compost (0% N, 100% P & 100 % K) R-1	4.67	0.30
100% Compost (0% N, 100% P & 100 % K) R-2	4.60	0.32
100% Compost (0% N, 100% P & 100 % K) R-3	4.55	0.27
100% Compost (0% N, 100% P & 100 % K) R-4	4.71	0.27

Note: N: Nitrogen, P: Fosfor; K: Potassium, 100%N: 285 kg urea/Ha, 100% P: 138 kg SP46/Ha; 100% K: 180 kg KCl/Ha

The study indicated that shallots fertilized with synthetic fertilizer, organic fertilizer, or a combination of both showed better growth than those received no fertilization. The application of Melastoma compost led to improved plant growth compared to those fertilized solely with synthetic fertilizer, as evidenced by taller, greener plants with more leaves and higher root dry weight (Table 2).

Table 2. Effect of Melastoma compost and synthetic fertilizer combination on shallot growth characters.

Treatments	Plant height (cm) (6 WAP)	Leaves number (7 WAP)	Leaf greenness	Root dry weight (g)
P_0	30.50	21.50	29.55	0.13
P_1	31.25	27.25	35.17	0.16
P_2	32.95	27.00	38.30	0.18
P_3	37.00	29.75	40.47	0.29
P_4	37.95	31.75	49.92	0.31
P_5	40.87	35.50	53.50	0.31
Contrast		Probability		
P_0 vs P_1,P_2,P_3,P_4,P_5	<0.0001	0.001	0.0033	0.0024
P_0 vs P_1	0.5207	0.0603	0.3042	0.5653
P_0 vs P_5	<0.0001	0.0001	0.0003	0.0005
P_1 vs P_2	0.1549	0.9315	0.5641	0.6450
P_1 vs P_3	<0.0001	0.3950	0.3322	0.0079
P_1 vs P_4	<0.0001	0.1341	0.0125	0.0019
P_1 vs P_5	<0.0001	0.0101	0.0029	0.0019
P_2 vs P_3	0.0024	0.3504	0.6874	0.0215
P_2 vs P_4	0.0004	0.1151	0.0423	0.0054
P_2 vs P_5	<0.0001	0.0083	0.0104	0.0054
P_3 vs P_4	0.4176	0.4946	0.0925	0.5275
P_3 vs P_5	0.0033	0.0603	0.0248	0.5275
P_4 vs P_5	0.0199	0.2076	0.5100	10.000

Note: P0 : Control (No fertilizer), P1 : 0% Compost (100% N, 100% P & 100 % K), P2 : 25% Compost (75% N, 100% P & 100 % K), P3 : 50% Compost (50% N, 100% P & 100 % K), P4 : 75% Compost (25% N, 100% P & 100 % K), P5 : 100% Compost (0% N, 100% P & 100 % K).

Table 2 shows shallot yields were higher if fertilized with synthetic fertilizer, Melastoma compost, or a combination of both. However, applying synthetic fertilizer without adding Melastoma compost did not increase shallot yields. If we compare synthetic fertilizer and organic fertilizer (Melastoma compost 100%), the application of 100% compost produced a higher weight of shallots. Melastoma compost with a higher composition (P2, P3, P4, P5) produced taller shallots, as indicated by a higher bulb weight.

Table 3. Effect of Melastoma compost and synthetic fertilizer combination on shallot yield characters.

Treatments	Bulb number	Bulb diameter (mm)	Bulb length (cm)	Bulb fresh weight (g)	Bulb dry weight (g)

P_0	6.25	11.56	1.55	8.30	5.37
P_1	7.75	12.18	1.62	14.11	7.83
P_2	8.50	13.07	1.71	15.61	10.34
P_3	10.75	14.19	1.83	20.37	16.47
P_4	12.25	15.46	1.94	24.61	19.48
P_5	14.25	15.24	2.01	29.80	25.43
Contrast			Probability		
P_0 vs P_1,P_2,P_3,P_4,P_5	0.0048	<0.0001	0.0038	<0.0001	<0.0001
P_0 vs P_1	0.4118	0.2745	0.5320	0.0215	0.2832
P_0 vs P_5	0.0003	<0.0001	0.0004	<0.0001	<0.0001
P_1 vs P_2	0.6794	0.1250	0.4066	0.5243	0.2739
P_1 vs P_3	0.1102	0.0018	0.0548	0.0144	0.0011
P_1 vs P_4	0.0214	<0.0001	0.0073	0.0003	<0.0001
P_1 vs P_5	0.0019	<0.0001	0.0015	<0.0001	<0.0001
P_2 vs P_3	0.2237	0.0562	0.2443	0.0543	0.0130
P_2 vs P_4	0.0500	0.0004	0.0435	0.0011	0.0007
P_2 vs P_5	0.0047	0.0009	0.0100	<0.0001	<0.0001
P_3 vs P_4	0.4118	0.0327	0.3460	0.0828	0.1920
P_3 vs P_5	0.0656	0.0724	0.1110	0.0007	0.0008
P_4 vs P_5	0.2773	0.6906	0.4879	0.0373	0.0155

Note: P0 : Control (No fertilizer), P1 : 0% Compost (100% N, 100% P & 100 % K), P2 : 25% Compost (75% N, 100% P & 100 % K), P3 : 50% Compost (50% N, 100% P & 100 % K), P4 : 75% Compost (25% N, 100% P & 100 % K), P5 : 100% Compost (0% N, 100% P & 100 % K).

Tables 2 and 3 indicate that plants without fertilization (P0) exhibit lower growth, fewer leaves, and reduced greenness, including a smaller number of tubers per plant, smaller tuber diameter and length, and lower fresh and dry tuber weights per plant, as well as reduced dry root weight, compared to plants fertilized with Melastoma compost without synthetic fertilizer (P5). The growth differences in shallot yield between the P0 and P5 treatments are attributed to different factorssuch as nutrient availability, soil physical properties, and plant metabolic processes. In the P0 treatment, the insufficient availability of key nutrients like nitrogen (N), phosphorus (P), and potassium (K) hindered vegetative growth and the development of shallot bulbs. The Ultisol growing media contains 0.31% total nitrogen (low), 4.71% available phosphorus (very low), 0.33% exchangeable potassium (low), and a pH of 4.63 (acidic), which is less suitable for shallot growth. In contrast, Melastoma compost (P5) provides macro and micronutrients that promote healthy plant growth. In this study, the compost of Melastoma contains2.84% nitrogen (N), 0.54% phosphorus (P), 1.75% potassium (K), 46.4% organic carbon (C), 3.57% calcium (Ca), 0.58% magnesium (Mg), 0.81% sulfur (S), 1858 mg/kg iron (Fe), 7.62% copper (Cu), 96.6 mg/kg zinc (Zn), 1720 mg/kg manganese (Mn), a carbon-to-nitrogen ratio (C/N) of 16.34, 4% cellulose, 38% lignin, 6% hemicellulose, and a pH of 7.81. Anisyah*et al.*, (2014) study shows that using organic fertilizers, mainly compost, can increase the bulb weight of shallots. This is because organic materials can retain water (water availability), improve nutrient availability (soil chemical properties), and enhance microorganism activity in the soil, which helps build soil fertility biologically. As a result, the organic materials applied can increase the bulb weight produced.

In addition to supplying nutrients, Melastoma compost also enhances the physical properties of the soil by improving its porosity, water retention, and aeration. According to

Anisyah*et al*., (2014), organic fertilizers are beneficial as a source of nutrients for plants that can enhance production and help improve the soil's physical, chemical, and biological properties. Additionally, Prasetyo *et al*., (2014) stated that using organic fertilizers (both alone and in combination) significantly affects the physical properties of the soil, leading to a decrease in bulk density, an increase in soil porosity, and improvements in soil physical properties. These changes positively influence plant root development. Hence, improvements in the soil condition facilitate better root development, which in turn enhances nutrient absorption. Furthermore, the organic matter in the compost stimulates microbial activity in the soil, aiding in the decomposition of organic matter and the slow, steady release of nutrients. According to Nabila (2024), incorporating organic materials into the soil can facilitate deeper and broader root penetration, enhancing the plant's ability to absorb more water and nutrients.

In contrast, the P0 treatment lacks soil structure that supports nutrient uptake, leading to slower plant growth. Soil nitrogen (N) analysis revealed an increase in N levels with the addition of organic fertilizer, particularly in treatments P3 to P6. The lowest nitrogen value was observed in treatment P2, where no organic fertilizer was applied (0% compost + 100% N), resulting in a lower final soil N concentration. The total nitrogen content in the soil is greatly affected by the availability of soil organic matter (Minardi*et al*., 2009). Minardi*et al*., (2009) also noted that while NPK fertilizers are rapidly accessible to plants, they are prone to leaching and cannot be retained in the soil.

The deficiency of key nutrients in P0 leads to fewer leaves and reduced leaf greenness. Nitrogen content in compost is a crucial component of chlorophyll. A lack of nitrogen hinders chlorophyll production, resulting in suboptimal photosynthesis. According to Elfina*et al*., (2024), plants that lack nitrogen (N) have stunted growth and few tillers, and their leaves are pale yellow. Thus, nitrogen is necessary for plants because it is a primary nutrient for plant growth, especially in the stems, branches, and leaves. Nitrogen also plays an essential role in forming green leaf substances, which play an important role in the photosynthesis process and in the synthesis of proteins, fats, and various other organic compounds. This limited photosynthesis reduces energy production and carbon absorption, ultimately impacting the size and weight of the onion bulbs. On the other hand, Melastoma compost releases nutrients gradually that are required for growth of plants, supporting steady growth. This slow nutrient release from Melastoma compost results in more leaves, greener foliage, and larger tubers than plants lacking sufficient nutritional input.

Shallot plants that were only treated with synthetic fertilizer (P1) showed growth and yields similar to those of plants that received no fertilization (P0) (Tables 2 and 3). There were no significant differences in plant height, leaf count, leaf greenness, root dry weight, or the tubers' number, diameter, length, or weight. The growth and yield of shallots treated solely with synthetic fertilizer did not differ notably from those of unfertilized plants. While synthetic fertilizers typically provide high concentrations of macro-nutrients such as nitrogen (N), phosphorus (P), and potassium (K), their use without organic material can lead to nutrient imbalances in the soil. This is in accordance with research by Ichwan*et al*., (2024), which shows that plant height, number of leaves, number of tubers, and tuber weight are better with adding organic fertilizer, compared to only NPK fertilizer (100% NPK). Plant growth improves with reduced NPK fertilizer application. Soils deficient in organic matter often have a low cation exchange capacity (CEC), which reduces the efficiency of nutrient uptake by plants. Research by Firmansyah *et al*., (2013) indicates that combining organic and biological fertilizers can boost shallot bulb yields, whereas using chemical fertilizers alone does not significantly improve growth.

The prolonged use of synthetic fertilizers without adding organic materials can deteriorate soil physical properties, such as reduced soil aggregation and porosity. The low porosity of soil negatively affects root growth and water and nutrient absorption. According to Nita *et al*., (2017), one of the factors that can reduce soil porosity is the decreasing quality of the soil due to the use of synthetic fertilizers and reduced organic matter in the soil. Low soil porosity also impacts plant roots, thereby impacting plant growth. In contrast, incorporating organic material through compost enhances soil structure, boosts microbial activity, and provides essential plant micronutrients. According to research by Windri*et al*. (2016), combining organic and inorganic fertilizers can improve the quality and quantity of shallot plants. When applied without organic matter, synthetic fertilizers are more likely to be leached away or bound in forms that plants cannot absorb, especially in soils low in organic content. As a result, even when nutrient levels are high, plants cannot utilize them efficiently. Hidayat *et al*., (2013) found that adequate nitrogen availability supports plant metabolism, leading to increased stem growth and a higher number of leaves. This study shows that shallot plants fertilized only with synthetic fertilizers exhibited growth and yields similar to those of unfertilized plants due to nutrient imbalances, soil degradation, and poor nutrient absorption efficiency caused by the absence of organic matter. Therefore, synthetic fertilizers should be complemented by adding organic materials to ensure a balanced supply of nutrients and improve soil quality, thereby optimizing the growth and yield of shallot plants.

When comparing plants fertilized solely with synthetic fertilizer to those fertilized only with organic fertilizer (P1 vs P5), shallot plants receiving organic fertilizer show better growth and yield than those fertilized with synthetic fertilizer (Tables 2 and 3). This research indicates that organic fertilizers provide both macro and micronutrients that are gradually released, making them continuously available to plants. In contrast, nutrients from synthetic fertilizers are quickly accessible, which can lead to an initial surplus of nutrients but result in deficiencies at certain stages after application. Research by Windri*et al*., (2016) highlights that combining organic and synthetic fertilizers can enhance the quality and quantity of shallot plants. Using organic fertilizer increases the organic matter in the soil, improving soil structure, boosting cation exchange capacity (CEC), and stimulating soil microorganism activity. These improvements in soil structure facilitate better root development and more efficient nutrient absorption. However, the repeated use of synthetic fertilizers without organic matter can degrade soil physical properties and reduce microbial activity. Firmansyah *et al*., (2013) found that organic fertilizers positively influence the growth and yield of shallots. Fadilah*et al*. (2020) also showed that combining manure with inorganic fertilizers yielded good results for shallot growth, particularly for tuber shoots. Similar studies on the contribution of organic fertilizer to crop growth and yield have been reported on shallots (Nurjanah*et al*., 2024; Setyowati*et al*., 2024), oil palm (Supanjani*et al*., 2024), cantaloupe (Suprijono et al., 2024), soybean (Pujiwati*et al*., 2023), and green mustard (Setyowati*et al*., 2023). The findings of this study demonstrate that shallot plants fertilized with organic fertilizer (P5) exhibit superior growth and yield compared to those treated with synthetic fertilizer (P1) (Tables 1 and 2).

The orthogonal contrast test results revealed that shallot plants that were not fertilized had growth and yields similar to those fertilized with synthetic fertilizer. In contrast, the application of 100% Melastoma compost (P6) significantly improved the growth and yield of shallots. These findings suggest that Melastoma weed compost plays a crucial role in shallot plant development, likely due to the beneficial nutrients it contains. Melastoma weed has a soil pH of 7.9. It is rich in essential nutrients such as 1.55% nitrogen (N), 0.14% phosphorus (P), 0.16% potassium (K), 6,4% C, 3,57% Ca, 0,58% Mg, 0,81% S, 1858 mg/kg Fe, 7,52 mg/kg Cu, 96,6 mg/kg Zn, 1720 mg/kg Mn, 4% cellulose, 38% lignin, 6% hemiselulosa. The carbon to nitrogen (C/N) ratio of 20.59 indicates a favorable balance between carbon and nitrogen for decomposition. Given its nutrient content and optimal C/N ratio, Melastoma weed is an effective compost material that can enhance soil fertility and promote plant growth (Bernas, 2020).

4. CONCLUSION

The study's findings indicated that Melastoma compost positively impacted both the growth and yield of shallots. Using compost, either by itself or combined with synthetic fertilizers, enhanced the growth and yield of shallots. Shallots that received only synthetic fertilizer, without adding Melastoma compost, exhibited growth and yield similar to those not fertilized plants (control treatment). Melastoma compost can be applied independently, without synthetic fertilizer, or in conjunction with synthetic fertilizers for growing shallots. Therefore, Melastoma compost can serve as a substitute for synthetic nitrogen fertilizer in shallot cultivation.

DISCLAIMER (ARTIFICIAL INTELLIGENCE):

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc.) and text-to-image generators have been used during the writing or editing of this manuscript.

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COMPETING INTERESTS

The authors declare no conflict of interest regarding the publication of this article. Authors confirmed that the data and the article are exempt from plagiarism.

AUTHORS' CONTRIBUTIONS

All authors are the main authors who took part in designing this study. DinnaKhoirya, NanikSetyowati, and Zainal Muktamar, designed and wrote the original draft preparation., Kartika Utami, wrote and edited the initial manuscript., Marwanto and Sumardi, edited and reviewed the manuscript. The definitive manuscript has been read and approved by all authors. All authors have read and agreed to the published version of the manuscript

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