

Growth and Yield of Shallot (*Allium ascalonicum* L.) as Affected by Various Dosages of Coffee Husk Waste Compost

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ABSTRACT

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Shallot (*Allium ascalonicum* L.) is a high-value horticultural commodity with increasing consumption. The application of coffee husk compost as an organic fertilizer has potential to support sustainable agriculture due to its high organic matter and nutrient content. This study aimed to evaluate the effects and determine the optimal dosage of coffee husk compost on the growth and yield of shallot plants. The experiment was conducted using a Randomized Complete Block Design (RCDB) with five treatments and five replications, consisting of coffee husk compost applied at rates of 3 t ha⁻¹ (90 g polybag⁻¹), 6 t ha⁻¹ (180 g polybag⁻¹), 9 t ha⁻¹ (270 g polybag⁻¹), 12 t ha⁻¹ (360 g polybag⁻¹), and 15 t ha⁻¹ (450 g polybag⁻¹). Data were analyzed using analysis of variance, followed by the Least Significant Difference test at the 5% level. Parameters observed included including plant height, number of leaves, number of tillers, number of bulbs, total fresh weight, fresh leaf weight, fresh bulb weight, bulb diameter, sun-dried bulb weight, total oven-dried weight, oven-dried leaf weight, oven-dried bulb weight, and weight loss percentage. The results showed that coffee husk compost significantly affected several growth and yield parameters. The application rate of 12 t ha⁻¹ (360 g polybag⁻¹ per 10 kg of soil) produced the best growth and yield, with fresh bulb weight of 41.66 g, sun-dried bulb weight of 35.23 g, and oven-dried bulb weight of 16.78 g.

1. Introduction

Shallot (*Allium ascalonicum* L.) is a vegetable plant species originating from Pakistan with high adaptability to various climatic conditions, including cold, subtropical, and tropical environments. This plant is widely utilized as a flavoring agent in various food preparations and can even be consumed directly in its raw state [1]. The nutritional content of shallots includes fiber, potassium, folic acid, and vitamin C, accompanied by natural growth hormones such as auxins and gibberellins which function as growth regulators. Additionally, this plant contains essential minerals such as calcium and iron [2]. These various active compounds can be converted into pyruvic acid, ammonia, and allicin, which act as antibacterials, giving shallots functional value in traditional medicine [1]. As a strategic horticultural commodity, shallots contribute significantly not only to meeting household consumption needs [3], but also to the food processing industry, trade, and the improvement of farmers' income [4].

Shallot production in Indonesia over the last five years has shown an increasing trend despite fluctuations during the 2020–2024 period. According to Horticultural Statistics [5], national production was recorded at 1,815.45 thousand tons in 2020, increasing to 2,004.59 thousand tons in 2021, experiencing a slight decrease in 2022 to 1,982.36 thousand tons, then rising again in 2023 to 1,985.23 thousand tons, and reaching 2,085.72 thousand tons in 2024. Shallot consumption at the household level has also increased, with an average consumption of 2.861 kg per capita per year in 2024, projected to reach 2.936 kg per capita in 2025. Nevertheless, the national requirement estimated at 1.20 million tons in 2025 has not been fully met due to a deficit of approximately 23

thousand tons. Consumption data reported by BPS only covers household consumption, thus not yet accounting for usage in commercial sectors such as restaurants, hotels, and culinary businesses [6]. Furthermore, fluctuating shallot prices, particularly ahead of religious holidays [7], can often cause increased inflation rates and potentially hinder the national economy [8].

Amidst the increasing market demand for shallots, many farmers still rely on chemical fertilizers as the primary solution to accelerate plant growth and increase yields. Chemical fertilizers are considered practical and provide rapid effects, making them a top choice for farmers. However, excessive use of chemical fertilizers in agricultural practices can cause negative impacts on soil quality, such as decreased organic matter content, soil structure degradation, and reduced microorganism activity. To reduce this dependency, the application of organic fertilizer is a viable alternative. Organic fertilizer functions not only as a nutrient provider but is also capable of improving the physical, chemical, and biological conditions of the soil so that fertility can be maintained in the long term [9]. Physically, organic fertilizer can improve soil structure to become more friable, allowing plant roots to develop well in absorbing nutrients and water while enhancing the soil's water retention capacity. Chemically, organic fertilizers provide micro and macro nutrients required by shallot plants, and biologically, they can increase the activity of microorganisms in decomposing organic matter according to [10]. One organic material with the potential to be used as organic fertilizer is coffee husk waste.

Coffee husk waste is a type of solid organic waste produced in large quantities, both from plantation activities and the processing of coffee cherries into beans [10]. Coffee husk waste has not been utilized optimally, which can lead to foul odors and environmental pollution [11]. Therefore, the utilization of coffee husk waste is necessary to provide added value. Coffee husk waste contains organic matter and nutrients with great potential for use as fertilizer [11]. It contains 45.3% organic matter, 2.98% nitrogen, 0.18% phosphorus, and 2.26% potassium. The application of compost or organic matter can increase soil organic C levels; based on analysis results, the soil organic C value used ranged between 2.48% and 2.98% [12]. The application of coffee husk compost to Inceptisol will affect the chemical characteristics of the soil [13]. Increasing organic carbon levels in the soil will improve soil structure, increase water retention capacity, and support microorganism activity [14].

According to research [15], the addition of 90 grams of coffee husk compost to the planting medium had a very significant effect on the growth parameters of curly chili. The addition of coffee husk compost also provided maximum growth and development for curly chili. Research conducted [16] concluded that a cow manure treatment with a ratio of 5 kg soil : 1 kg cow manure was able to increase shallot production yields regarding fresh tuber weight per cluster (67.29g), tuber diameter (1.55cm), and dry tuber weight per cluster (61.58g). Research by [17] on a 10 ton/ha coffee husk waste treatment produced the highest number of tubers per cluster (9.67g) and tuber weight per cluster (48.73g); however, this was not significantly different from the 5 ton/ha treatment which yielded 9.27 tubers per cluster and a weight of 48.31g. Based on research by [18], it was concluded that the application of 12 ton/ha of organic guano fertilizer gave the best results for shallot growth and yield, with a fresh tuber weight of 34.91 g, sun-dried tuber weight of 33.86 g, and oven-dried tuber weight of 31.62 g.

This study aims to determine the extent to which coffee husk waste compost can provide a significant contribution to the vegetative growth and harvest yield of shallots. Furthermore, this research aims to identify the most effective dosage of coffee husk compost to produce optimal growth in terms of plant height, number of tillers, and fresh and dry weight of shallot tubers. By conducting systematic experiments, the results are expected to provide a clear picture of the effectiveness of coffee husk waste as an alternative organic fertilizer. This contributes not only to increasing shallot productivity but also supports efforts in agricultural waste management that are more beneficial and environmentally friendly.

2. Method

2.1 Research Time and Location

This study was conducted over a two-month period, from November 6, 2025, to January 4, 2026. The experimental site was located at Jl. Banteng Baru, Renon, South Denpasar, Bali (80234). Laboratory analysis was performed at the Agrotechnology Laboratory, Faculty of Agriculture and Business, Mahasaraswati University, Denpasar.

2.2 Materials and Equipment

The biological materials included shallot seeds (*Allium ascalonicum* L.) of the Bima Brebes variety and soil. Materials for organic fertilization consisted of coffee husk, Effective Microorganisms 4 (EM4), molasses, rice bran, banana corms, and rice-washed water. The equipment utilized included analytical scales, 50 x 50 cm polybags, watering cans, rulers, digital calipers, an oven for biomass drying, and documentation tools.

2.3 Experimental Design and Treatments

The research employed a Randomized Block Design (RBD) with five treatments and five replications, resulting in 25 experimental units. The treatments (K) consisted of various dosages of coffee husk waste compost per 10 kg of soil as follows:

K1 = 3 tons/ha (90 g/polybag) coffee bark waste / 10 kg soil

K2 = 6 tons/ha (180 g/polybag) coffee bark waste / 10 kg soil

K3 = 9 tons/ha (270 g/polybag) coffee bark waste / 10 kg soil

K4 = 12 tons/ha (360 g/polybag) coffee husk waste / 10 kg of soil

K5 = 15 tons/ha (450 g/polybag) coffee husk waste / 10 kg of soil.

2.4 Observation Variables

Thirteen variables were observed to evaluate growth and yield: Plant Height (g), Number of Leaves Per Plant (Strands), Number of saplings per plant (fruit), Number of tubers per plant (tuber), Total Fresh Plant Weight (g), Fresh Weight of Leaves (g), Fresh Tuber Weight (g), Tuber Diameter (mm), Dry Weight of Dry Tubers Per Plant (g), Total Oven Dry Weight (g), Dry Weight of Oven Leaves (g), Dry Weight of Oven Tubers (g), and Percentage of Weight Loss %.

2.5 Data Analysis

To determine the effect of the treatments, data were analyzed using the Analysis of Variance (ANOVA). If the treatments showed significant or highly significant effects, the analysis was followed by the Least Significant Difference (LSD) test at a 5% significance level to compare treatment means.

3. Results and Discussion

Based on the results of the study, the administration of several doses of coffee bark waste compost provides a diverse response to the growth and yield of the onion plant (*Allium ascalonicum* L.). Statistical analysis showed that the compost dose treatment had a very significant effect ($p < 0.01$) on the dry weight of the dried tubers, the dry weight of the tuber oven, the total oven dry weight of the plant, and the percentage of weight loss. A noticeable effect ($p < 0.05$) was found on plant height, number of leaves, fresh weight of leaves, fresh weight of bulbs, and dry weight of oven leaves. Meanwhile, an unreal effect ($p > 0.05$) was seen in the number of seedlings, the number of bulbs, the total fresh weight of the plant, and the diameter of the bulbs. Consistently, the treatment dose of 12 tons/ha (K4) showed the most optimal results in almost all observed parameters. (as shown in Tabel 1).

Table 1. Significance of various coffee husk compost applications on the growth parameters and yield of shallots.

Yes	Observation Variables	Notation
1	Plant Height (g)	*
2	Number of Leaves Per Plant (Strands)	*
3	Number of saplings per plant (fruit)	ns
4	Number of tubers per plant (tuber)	ns
5	Total Fresh Plant Weight (g)	ns
6	Fresh Weight of Leaves (g)	*
7	Fresh Tuber Weight (g)	*
8	Tuber Diameter (mm)	ns
9	Dry Weight of Dry Tubers Per Plant (g)	**
10	Total Oven Dry Weight (g)	**
11	Dry Weight of Oven Leaves (g)	*
12	Dry Weight of Oven Tubers (g)	**
13	Percentage of Weight Loss %	**

Description : ns : Non-significant effect ($p > 0.05$)

* : Significant effect ($p < 0.05$)

** : Highly significant effect ($p < 0.01$)

The results of the study showed that the provision of several doses of coffee husk waste compost generally gave various responses to the growth and yield of shallots (*Allium ascalonicum* L.). The treatment of coffee husk waste compost dosage had a very significant effect ($p < 0.01$) on the observed parameters, namely: dry weight of tubers in the sun, dry weight of tubers in the oven, total dry weight of plants in the oven, and percentage of weight loss. And gave a significant effect ($p < 0.05$) on the observed parameters, namely: plant height, number of leaves per plant, fresh weight of leaves, fresh weight of tubers, dry weight of leaves in the oven. And gave an insignificant effect ($p > 0.05$) on the observed parameters, namely: number of tillers, number of tubers, total fresh weight of plants, and tuber diameter. Overall, the treatment dose of 12 tons/ha or equivalent to 360 g/polybag (K4) showed the most optimal results in almost all observed parameters compared to other treatments, both in the vegetative growth phase and in the yield formation phase.

The results of statistical analysis showed that the K4 treatment produced the highest plant height of 48.20 cm, the highest number of leaves, namely 40.2 pieces, the number of tillers, namely 8.8 tillers, the highest number of tubers, 9.0 tubers, total fresh weight of plants 55.58 g, fresh weight of leaves 9.52 g, fresh weight of tubers 41.66 g, tuber diameter 17.86 mm, dry weight of tubers in the sun 35.23 g, total oven dry weight of plants 17.93 g, dry weight of leaves oven 1.00 g, dry weight of tubers oven 16.78 and percentage of weight loss 40.83%. The effect of the lowest dose of coffee husk waste compost treatment occurred in the K5 treatment which resulted in a plant height of 39.20 cm, a number of leaves of 25.6 pieces, a total fresh weight of 46.10 plants, and a tuber diameter of 17.05 and the K1 treatment which resulted in a number of tillers of 6.8 tillers, a number of tubers of 7.6 tubers, a fresh leaf weight of 7.36 g, a fresh tuber weight of 34.90 g, a sun-dried tuber weight of 26.78 g, a total oven-dry weight of 9.25 g of plants, an oven-dry weight of 0.73 g of leaves, an oven-dry weight of 8.37 g of tubers, a percentage of weight loss of 34.05%. In general, the coffee husk waste compost treatment with a dose of 12 tons/ha or equivalent to 360 g/polybag (K4) showed the most consistent and optimal results in almost all observed parameters, both in the vegetative growth phase and in the yield formation phase. The effect of coffee husk waste compost on vegetative growth significantly affected plant height and leaf number, but did not significantly affect the number of tillers. The results showed that the K4 treatment (12 tons/ha) produced the best growth with an average plant height of 48.20 cm and a leaf count of 30.2. This indicates that the dose of coffee husk waste compost is able to provide optimal nutrients, considering that coffee bean husk waste contains macronutrients N, P, and K. Based on the analysis, coffee husk compost has a nitrogen content of 2.98%, phosphorus 0.18%, potassium 2.26%, and organic C 4.53% [12]. The availability of nutrients from this compost plays a significant role in improving the initial soil condition which only has a

nitrogen content of 0.13%, phosphorus 37.22%, potassium 224.86%, and organic C 1.25%. Thus, the application of coffee husk compost can meet the plant's nutrient needs that are not optimally available in the soil.

The nitrogen content in the fertilizer applied plays a significant role in the growth and yield of shallots, as nitrogen plays a key role in stimulating overall growth, particularly stem growth, thus promoting plant height [19]. Nitrogen is a macronutrient that functions to stimulate vegetative growth, such as stems and leaves [20]. Furthermore, nitrogen is a key component in the formation of chlorophyll, which is crucial for photosynthesis [21]. Stated that a balanced application of macronutrients such as N, P, and K is essential for young plants because at this stage, they can stimulate vegetative growth, such as roots, stems, and leaves, thus increasing plant height [22]. Nitrogen plays a role in protein formation, while phosphorus and potassium play a role in root and leaf formation [23]. The higher the chlorophyll content, the greater the photosynthetic activity, resulting in sufficient energy production for plant tissue growth [24].

There were no significant differences in tiller number between treatments. This is likely because tiller formation in shallots is largely influenced by the genetics of the variety used and the initial nutrient reserves within the seed bulbs. According to [17], if basic nutrient requirements are met, increasing fertilizer doses does not always lead to an increase in tiller number.

Plant responses to yield components showed variations in bulb number, total plant fresh weight, leaf fresh weight, bulb fresh weight, and bulb diameter. Data showed that the K4 treatment showed a significant effect and produced the highest yields in leaf fresh weight (9.52 g) and bulb fresh weight (41.66 g). This increase in fresh weight was closely related to the greater number of leaves in this treatment. The greater the number of leaves, the greater the photosynthetic output (photosynthate), which is then allocated to bulb mass formation [25]. Nutrients in compost, such as potassium, also play a crucial role in regulating water absorption and optimizing tuber formation [26]. Statistical analysis showed that the treatment had no significant effect on total plant fresh weight, tuber number, or tuber diameter. This suggests that tuber physical dimensions are influenced not only by fertilizer application but also by environmental factors such as temperature, light intensity, and adequate water availability during the generative phase (tuber formation).

Table 2. The average value of plant height, number of leaves, number of seedlings, number of bulbs, total fresh weight, fresh weight of leaves, fresh weight of tubers at various doses of coffee bark waste compost.

Treatment	Plant height (cm)	Number of leaves	Number of saplings per plant (fruit)	Number of tubers per plant (tuber)	Total Fresh Plant Weight (g)	Fresh Weight of Leaves (g)	Fresh Tuber Weight (g)
K1	39,54 b	26,2 b	6,8	7,6	46,38	7,36 b	34,90 b
K2	40,74 b	27.8 ab	7.8	8.2	47,68	7,40 b	38,60 ab
K3	44.16 ab	28.2 ab	8.0	8.4	50,0	8,16 ab	39,46 ab
K4	48,20 a	30,2 a	8,8	9,0	55,58	9,52 a	41,66 a
K5	39,20 b	25,6 b	7,4	8.4	46,10	8,04 ab	36,16 b
BNT 5%	5,83	2,99	-	-	-	1,51	4,56

Description : The average value followed by the same letter after the number shows an intangible difference in the 5% BNT test level.

The application of coffee husk compost at a dose of 12 tons/ha (360 g/polybag) had a very significant effect and consistently produced the highest dry weight values for several dry weight parameters. The results showed that the sun-dried tuber dry weight reached 35.23 g, the total plant oven dry weight 17.93 g, the leaf oven dry weight 1.00 g, and the tuber oven dry weight 16.78 g. The

K4 treatment consistently produced the highest dry weight. Dry weight is a very important growth indicator because it reflects the amount of organic matter accumulated by plants through photosynthesis [20]. The nitrogen contained in compost acts as a protein constituent, while phosphorus and calcium contribute to stimulating meristem tissue division and leaf and root growth. This allows plants to optimally absorb nutrients and water, which are then utilized for tuber formation and cell differentiation [23]. The adequate nutrient availability of coffee husk compost supports the formation of proteins and carbohydrates that replenish plant tissue, increasing dry weight [27].

The weight loss percentage in this study was calculated based on the ratio of wet weight to dry weight after the drying process. The results in Table 4.2 show a highly significant effect, with the highest weight loss value being 40.83%. This weight loss indicates the volume of water released by tuber tissue during the drying process. This weight loss percentage is closely related to the dry matter content. According to [28], during the vegetative phase, growth also increases plant dry weight. The greater the number of leaves, the greater the amount of photosynthate produced during photosynthesis, which is then distributed throughout the plant, resulting in larger leaves and stems. This correlates with increased tuber weight. The more optimal the nutrient intake from compost, the denser the accumulation of photosynthate (dry matter) in the tubers. This results in a difference in the proportion between the weight of water lost and the weight [29], of the dry mass remaining after the drying process, thereby reducing weight loss [17].

The increased growth and yield in this study were also supported by improvements in the physical and chemical properties of the soil due to the addition of coffee husk compost. According to research [11], coffee husk compost contains macronutrients such as nitrogen, phosphorus, and potassium. Therefore, the organic matter in the compost can improve soil structure, making it looser and increasing the soil's water retention capacity. Loose soil conditions facilitate plant root systems to develop and absorb nutrients more effectively, ultimately supporting all plant metabolic processes [30].

Table 3. Average value of dry weight of dried tubers, total oven dry weight, dry weight of leaf oven, dry weight of tuber oven, percentage of weight loss at various doses of coffee bark waste compost.

Treatment	Tuber Diameter (mm)	Dry Weight of Dry Tubers Per Plant (g)	Total Oven Dry Weight (g)	Dry Weight of Oven Leaves (g)	Dry Weight of Oven Tubers (g)	Weight Loss Presentation (%)
K1	17,27	26,78 c	9,25 c	0,73 b	8,37 c	34,05 c
K2	17,37	30,38 bc	11,06 c	0,74 b	9,80 c	37,79 ab
K3	17,84	31,39 ab	15,35 b	0,87 ab	14,13 b	38,75 a
K4	17,86	35,23 a	17,93 a	1,00 a	16,78 a	40,83 a
K5	17,05	30,11 bc	11,15 c	0,86 ab	10,18 c	35,33 bc
BNT 5%	-	4,14	2,03	0,18	2,04	3,36

Description : The average value followed by the same letter after the number shows an intangible difference in the 5% BNT test level.

4. Conclusion

Based on the results of the above research, it can be concluded as follows: 1). The application of coffee bark waste compost has a very real effect ($p < 0.01$) on the parameters of dry weight of dried tubers, total oven dry weight of plants, dry weight of tuber ovens per plant, and percentage of weight loss. There was a real effect ($p < 0.05$) on several parameters tested, including plant height, number of leaves, fresh weight of leaves, fresh weight of tubers. And an unreal influence ($p > 0.05$) on the parameters of the number of seedlings, the number of plant bulbs, the total fresh weight of the plant, the diameter of the bulbs. 2). Applying coffee bark waste compost with a dose of 12 tons/ha (360 g/polybag) is able to provide the best growth and results with a fresh tuber weight of 41.66 g, dry weight of tubers 35.23 g, and dry weight of tuber oven 16.78 g

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