

## Growth and yield of three onion varieties on entisols-amended broadleaf weed compost and clay planting media

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### Abstract

Although traditionally grown in highlands, certain shallot cultivars have successfully adapted to coastal environments. This study aimed to assess the adaptability of shallot varieties in lowland areas and evaluate the combined effects of different planting media on shallot growth and yield. The research took place in Medan Baru, Kandang Limun Village, Muara Bangkahulu District, Bengkulu City, Indonesia, at an altitude of 15 meters above sea level. The experimental design was Completely Randomized Design (CRD) with two factors: shallot variety and planting media composition. The combination between variety and planting media composition significantly influenced several growth parameters, including plant height, number of leaves, bulb height and diameter, bulb fresh and dry weight, and bulb production. The variety Super Philip demonstrated superior adaptability to lowland conditions, exhibiting enhanced plant growth and higher yields compared to other varieties. Specifically, Super Philip showed increased plant height, leaf number, root dry weight, bulb diameter, bulb fresh and dry weight, and the crop yield. The planting media composed of 7.6 kg Entisols + 1.3 kg Clay + 1.1 kg broadleaf weed ameliorant (76%, 13%, and 11%, respectively) proved the most effective in promoting shallot growth and yield. These findings suggest incorporating clay and broadleaf weed compost into sandy coastal soils can significantly enhance shallot productivity.

**Keywords:** Ameliorant, entisols, planting media, shallot varieties

### Introduction

Shallots are an essential agricultural crop in Indonesia, with their productivity varying due to genetic and environmental factors. To boost shallot production, strategies include cultivating resilient varieties and expanding planting areas by enhancing soil fertility on marginal lands, such as coastal regions. Coastal soils face physical, biological, and chemical challenges, including numerous macropores that hinder water retention, leading to evaporation before plants can absorb it (Dokoochaki *et al.*, 2017) <sup>[5]</sup>. Additional issues are high soil temperatures day and night, low organic matter (Shi *et al.*, 2005) <sup>[27]</sup>, low macronutrient levels (0.02-0.08% total N, 100-150 ppm total P, and 0.09-0.2 cmol/kg K), low cation exchange capacity, and very low organic carbon and calcium levels (Rajiman *et al.*, 2008; Pangaribuan *et al.*, 2020) <sup>[24, 20]</sup>.

Shallots, however, need a crumbly soil structure with a balanced ratio of solid material and pores. The solid soil provides a foundation for root growth and development (Syawal *et al.*, 2015) <sup>[31]</sup>. Aziza (2013) <sup>[3]</sup> states that mixing planting media with sand and clay as a soil conditioner enhances shallot growth. To further improve this planting medium's biological, chemical, and physical properties, organic material is added as an ameliorant.

Limbongan and Maskar's (2003) <sup>[13]</sup> research showed that adding organic materials increased the dry weight of shallot bulbs compared to control. Using organic materials as soil amendments in coastal environments enhances shallot growth and yield (Mayun, 2007) <sup>[16]</sup>. Martarini (2022) <sup>[15]</sup> reported that using coastal soil without ameliorants resulted in a fresh bulb weight of only 2.8 tons/ha. Conversely, a planting medium consisting of 7.6 kg of coastal soil, 1.3 kg of Ultisols, and 1.1 kg of cattle manure (ameliorant) produced a fresh bulb weight of 10.5 tons/ha. Additionally,

using 7.4 kg of coastal soil, 1.5 kg of Ultisols, and 1.3 kilograms of ameliorant resulted in a fresh bulb weight of 11.3 tons/ha.

Selecting the right type of organic material for composting is crucial, as each type has advantages and disadvantages. It's important to consider the high and comprehensive nutrient content and the availability and accessibility of the material in large quantities. Broadleaf weeds are promising sources of organic material. *Stenochlaena palustris* and *Mimosa pudica*, both broadleaf weeds, can be used as compost raw materials (Sakiah *et al.*, 2018) <sup>[26]</sup>. The compost produced from these materials contains 21% - 32% organic carbon (C) and 1.38% - 2.28% nitrogen (N), with a carbon-to-nitrogen (C/N) ratio ranging from 10.64 to 20.76. *Chromolaena odorata* L. (Siam weed) also has significant potential as compost material for organic shallot cultivation in Indonesia. Siam weed contains essential nutrients: 2.56% nitrogen, 0.38% phosphorus, and 2.41% potassium. Using weeds as compost material not only reduces losses from plant-weed competition but also transforms harmful weeds into beneficial resources (Nugroho *et al.*, 2019) <sup>[19]</sup>. While shallot cultivation typically occurs in highland areas, it can be cultivated anywhere from lowlands to hills (Permadi, 1995) <sup>[21]</sup>. Since Bengkulu is located in the lowlands, selecting shallot varieties adapted to lowland environments is essential.

Previous research indicated that three out of ten tested shallot varieties were well-suited to lowland conditions: Thailand, SS Sakato, and Super Philip. Consequently, studying broadleaf weeds and clay as ameliorants in coastal soils to enhance shallot growth and yield is essential. This study aims to identify shallot varieties adapted to lowland conditions and determine the optimal composition of planting materials for maximizing shallot growth and yield.

## Materials and Method

### Site Location and Design

The research was conducted from January to May 2023 in Medan Baru Village, Bengkulu City, Indonesia, at 15 meters above sea level. The study was performed using polybags with a planting media volume of 10 kg. The experimental design was a Completely Randomized Design (CRD) with two factors and three replications. The first factor was the shallot variety (V), which included Thailand, SS Sakato, and Super Philip varieties. The second factor was the composition of the planting media (K), consisting of four levels: K1 = 10 kg E, K2 = 8.4 kg E + 0.9 kg C + 0.7 kg A, K3 = 7.6 kg E + 1.3 kg C + 1.1 kg A, and K4 = 7.4 kg E + 1.5 kg C + 1.3 kg A.

Note: E=Entisols, C=clay, A=ameliorant broadleaf weed

### Ameliorant Preparation

The broadleaf weed ameliorant was composed of 60 kg of *Chromolaena odorata*, 60 kg of *Tithonia diversifolia*, 30 kg of *Wedelia trilobata*, 40 kg of *Crotalaria juncea*, and 10 kg of *Ageratum conyzoides* L. The weeds were chopped into 2 cm pieces and composted with an Effective Microorganism (EM-4) solution and molasses, using a mixture of 200 ml EM-4, 200 ml molasses, and 10 liters of water. This mixture was evenly blended. Composting lasted for four weeks, with the composting media being incorporated once a week. The composting process was considered complete when the organic material turned black and crumbly. The next step was to air-dry the weed compost to prevent mold growth.

### Planting

The shallot seeds used for sowing were medium-sized, weighing between 3 and 8 grams per bulb. Before planting, the outer skin of the shallot seeds was peeled off, and 1/4 of the bulb's length from the tip was cut. The planting medium was prepared according to the treatment specifications, placed into a 10-kg polybag, and then incubated for two weeks. Dolomite was added to the planting medium one week before planting at a rate of 100 kg/ha (or 0.26 g/polybag), evenly spread on top of the medium. Fertilizers were applied during planting at 250 kg/ha ZA, 100 kg/ha Urea, 150 kg/ha SP-36, and 150 kg/ha KCl. Urea and ZA fertilizers were applied in two stages: 1/3 as a base fertilizer at planting and 2/3 as a supplementary fertilizer three weeks after planting (3 WAP).

### Harvesting

Shallots were harvested when the leaves turned yellow and dried out, when part of the bulbs emerged from the soil surface, and the bulb layers turned red, typically occurring approximately 70 days after planting (Wibowo, 2009) [32]. The study recorded various variables, including plant height (cm), number of leaves, number of tillers, number of bulbs, bulb length (cm), bulb diameter (cm), dry root weight (g), fresh bulb weight (g), dry bulb weight (g), bulb weight loss (%), and dry bulb yield (tons/ha). Additionally, soil variables such as water content, bulk density, permeability, and texture were observed. Climate data, including rainfall, air temperature, relative humidity, and solar radiation, were collected from the Meteorology, Climatology, and Geophysics Agency in Bengkulu, Indonesia, between February and May 2023.

## Data Analysis

Statistical data analysis was conducted using Analysis of Variance (ANOVA) at the 5% significance level. Significant interactions between treatment combinations were further assessed using Duncan's Multiple Range Test (DMRT) at a significance level of 5%. Additional LSD (Least Significant Difference) tests at a 5% significance level were performed to identify suitable shallot cultivars for lowland environments and to determine the optimal composition of the planting medium for shallots.

## Results and Discussion

**Table 1:** Soil analysis test

Medium composition	Soil moisture (%)	Bulk density (g/cm <sup>3</sup> )	Permeability (cm/jam)	Permeability criteria
K1	25.51	1.92	3.98	Moderate
K2			3.18	Moderate
K3			2.92	Moderate
K4			1.59	Low
Medium composition	Soil fraction			Soil texture class
	% sand	% clay	% silt	
K1	.89.27	6.55	4.19	Sandy
K2	81.81	6.82	11.37	Loamy sand
K3	75.95	8.74	15.31	Loamy sand
K4	73.55	11.04	15.41	Loamy sand

**Source:** Soil Science Lab. University of Bengkulu (2023)

The experimental planting medium consisted of a combination of coastal soil, notably from the Entisols order, clay, and broadleaf weed ameliorate. The coastal soil of the Entisols (K1) used in the study had a volume weight of 1.92 g.cm<sup>3</sup>, a medium permeability of 3.98 cm/hour, and a soil fraction of 89.27% sand, 6.55% clay, and 4.19% silt (sand texture class) (Table 1). The Entisols contained 0.19% N (low), 0.23% organic-C (medium), 0.28% me/100g soil K<sub>2</sub>O (low), 6.23 ppm P<sub>2</sub>O<sub>5</sub> (low), pH-H<sub>2</sub>O of 6.2 (slightly acidic), pH-KCl of 5.8 (slightly acidic), and CEC of 5.21 me/100g soil (low) (Bertham *et al.*, 2020) [4].

The composition of the K2 planting medium, which is a mixture of 8.4 kg Entisols + 0.9 kg clay + 0.7 kg broadleaf weed ameliorant, had a soil permeability of 3.18 cm/hour (medium) with soil fraction of 81.81% sand, 6, 82% clay (clay), and 11.37% silt or sandy loam textural classification. The planting medium of K3 (7.6 kg Entisols + 1.3 kg clay + 1.1 kg ameliorant) and K4 (7.4 kg Entisols + 1.5 kg clay + 1.3 kg ameliorant) had a sandy loam textural classification, similar to K2 (see Table 1).

Thus, incorporating broadleaf weed ameliorant and clay can affect the soil permeability and texture in all planting media treatments. Shallots require crumbly textured soil, such as clayey sand or silty clay, with a pH of 5.6-6.8, adequate drainage/aeration, CEC (cmol/100 g clay) > 16, base saturation > 35, organic C > 2, pH H<sub>2</sub>O of 6.0, and a high organic matter content. The soil types suitable for cultivating shallots are Latosol, Regosol, Grumosol, and Alluvial soils (Luta, 2020) [14].

### Variance Analysis

Differences in varieties and planting media composition had a significant effect on all observed variables. There was a combination effect between variety treatment and planting media composition on plant height, number of leaves, bulb

height, bulb diameter, bulb fresh weight, bulb air-dry weight, and bulb productivity (Table 2).

**Table 2:** Variance analysis of the influence of planting media composition on the growth and yield of several shallot varieties

Variables	F-calculated		Interaction	CV(%)
	Variety	Medium		
Plant height 6 WAP	93.07 **	11.95 **	8.20 **	5.67
Leaves number 6 WAP	62.08 **	31.98 **	5.27 **	14.19
Tiller number 6 WAP	145.93 **	4.81 **	1.29 ns	9.41
Bulb number	125.17 **	12.62 **	2.43 ns	10.71
Bulb height	106.85 **	27.80 **	4.86 **	5.69
Bulb diameter	59.44 **	114.51 **	8.19 **	6.7
Root dry weightT	23.72 **	50.38 **	1.81 ns	15.71
Bulb fresh weightT	29.04 **	57.76 **	5.07 **	24.27
Bulb air dry weightT	28.49 **	57.60 **	4.80 **	24.77
Bulb productivity	28.45 **	57.52 **	4.80 **	24.78
F Tabel 5%	3.40	3.01	2.51	5.67

**Note:** T=Transformation ( $\sqrt{x + 0, 5}$ ), \*\*=highly significant, ns=no significantly different, CV=Coefficient variation

**The Combination Effect of Variety and Planting Media Composition on Shallot Growth and Yield**

**Plant height and Leaves number**

The Thailand variety reaching the tallest of 33.66 cm was grown in K3 planting media. This height was not significantly different from the plants grown in K4 but was greater than those grown in K1 and K2. The SS Sakato and Super Philip varieties achieved the greatest heights when grown in K4 planting media. Their heights were not significantly different from those in K3 but were greater than those in K1 and K2 (Table 3)

**Table 3:** The combination effect of varieties and planting media composition on plant height and leaf number

Variety	Medium composition			
	K1	K2	K3	K4
Plant height (cm)				
Thailand	19.58 c B	21.86 b B	33.66 a B	32.73 a B
SS Sakato	26.91 c A	31.84 b A	33.29 ab B	35.86 a B
Super Philip	26.19 c A	34.18 b A	43.89 a A	44.00 a A
Leaf number				
Thailand	19.11 b B	19.17 b B	45.11 a A	39.28 a B
SS Sakato	21.17 a B	20.72 a B	25.83 a B	24.67 a C
Super Philip	31.17 c A	39.11 b A	51.33 a A	53.78 a A

**Note:** Numbers followed by the same lowercase letter in the same row are not significantly different in the 5% DMRT test, and numbers followed by the same capital letter in the same column are not significantly different in the 5% DMRT test., K1 = 10 kg Entisol, K2 = 8.4 kg Entisol + 0.9 kg Clay + 0.7 kg ameliorant, K3 = 7.6 kg Entisol + 1.3 kg Clay + 1.1 kg ameliorant, K4 = 7.4 kg Entisol + 1.5 kg Clay + 1.3 kg ameliorant.

The variety's response to the K1 planting media composition was similar to its response to K2, while the response to K3 was similar to K4. On K1 planting media, the SS Sakato variety achieved the highest shoot height, which was not significantly different from the Super Philip variety but was significantly different from the Thailand variety.

Conversely, on K2, K3, and K4 planting media, the Super Philip variety produced the highest shoot height.

In the K3 treatment, the Thai variety produced the highest number of leaves, similar to K4 and greater than K1 and K2. The SS Sakato variety had the highest leaf number in K3, though this was not significantly different from K1, K2, or K4. Additionally, the Super Philip variety produced the most leaves in K4, with a leaf number not significantly different from K3 but notably higher than K1 and K2 (Table 3).

On planting media K1, K2, K3, and K4, the Super Philip variety produced more leaves than the other varieties. In the K3 treatment, the Super Philip variety yielded more leaves than the SS Sakato variety, while the Thai variety produced the fewest leaves in K1.

**Bulb height and Bulb Diameter**

The Thai variety produced the longest bulbs in the K4 planting media, longer than those in K1 and K2. The SS Sakato variety's bulb height in K4 was comparable to the other media compositions. On K3 media, the Super Philip variety produced bulbs taller than those in K1 and K2. The Super Philip variety had the highest bulb height among all the planting media compositions evaluated (K1, K2, K3, and K4). Conversely, with the K1 planting media, the Thai variety produced the shortest bulbs (Table 4)

**Table 4:** The combination effect of varieties and planting media composition on bulb height and bulb diameter

Variety	Medium composition			
	K1	K2	K3	K4
Bulb height (cm)				
Thailand	1.87 b B	1.96 b C	2.34 a B	2.36 a C
SS Sakato	2.42 a A	2.55 a B	2.55 a B	2.65 a B
Super Philip	2.45 c A	2.87 b A	3.38 a A	3.33 a A
Bulb diameter (cm)				
Thailand	1.17 b B	1.28 b B	2.10 a B	2.06 a B
SS Sakato	1.61 c A	1.95 b A	2.04 b B	2.47 a A
Super Philip	1.43 c A	2.04 b A	2.75 a A	2.69 a A

In the K3 planting medium, the Thai and Super Philip varieties had bulb diameters of 2.10 cm and 2.75 cm, respectively, which were larger than those in the K1 and K2 compositions. The SS Sakato cultivar reached the highest bulb diameter in the K4 treatment. The Super Philip variety produced the largest bulb diameter in the K3 treatment, whereas the Thai variety had the smallest bulb diameter in the K1 treatment (Table 4)

**Bulb fresh weight, Bulb dry weight, and Bulb productivity**

The fresh weight of the bulbs is a biological characteristic of shallots regulated by water content after harvest. Table 5 shows the combination effect between variety and planting media composition on the bulb fresh weight variable. Thai and Super Philip types exhibited larger bulb fresh weights in K3 (53.04 g and 88.23 g, respectively) than in K1 and K2. Compared to K1, the SS Sakato cultivar in K4 produced a higher fresh weight of bulbs (42.91 g) (Table 5). This study's findings align with descriptions of the Thai and

Super Philip varieties, which generate bulb weights ranging from 30-80 g to 50-200 g.

**Table 5:** The combination effect of varieties and planting media composition on bulb fresh weight, bulb dry weight (g) and bulb productivity (ton/ha)

Variety	Medium composition			
	K1	K2	K3	K4
Bulb fresh weight (g)				
Thailand	10.96 b A	13.37 b B	63.04 a B	56.03 a B
SS Sakato	13.70 b A	22.29 ab A	33.67 a C	42.91 a B
Super Philip	16.80 c A	38.75 b A	88.23 a A	86.84 a A
Bulb dry weight (g)				
Thailand	8.98 b A	11.25 b A	55.74 a B	49.32 a B
SS Sakato	11.34 b A	19.03 b A	29.61 ab C	38.10 a B
Super Philip	14.53 b A	25.63 b A	77.83 a A	76.00 a A
Bulb productivity (ton/ha)				
Thailand	2.03 b A	2.55 b B	12.62 a B	11.17 a B
SS Sakato	2.57 b A	4.31 b B	6.71 ab C	8.63 a B
Super Philip	3.29 c A	7.74 b A	17.63 a A	17.21 a A

**Note:** Numbers followed by the same lowercase letter in the same row are not significantly different in the 5% DMRT test, and numbers followed by the same capital letter in the same column are not significantly different in the 5% DMRT test., K1 = 10 kg Entisol, K2 = 8.4 kg Entisol + 0.9 kg Clay + 0.7 kg ameliorant, K3 = 7.6 kg Entisol + 1.3 kg Clay + 1.1 kg ameliorant, K4 = 7.4 kg Entisol + 1.5 kg Clay + 1.3 kg ameliorant.

On K1 media, none of the studied cultivars produced significantly different bulb weights. In K3, the Super Philip cultivar had the maximum fresh bulb weight, 88.23 g. The Thai variety at K1 generated the lowest fresh bulb weight, 10.96 g. According to Mehran *et al.* (2016) [17], the gene potential of a shallot plant is maximized when environmental conditions are favorable for plant growth.

Table 5 indicates that the Thai and Super Philip varieties have heavier bulb dry weights in the K3 planting media than K1 and K2. Conversely, the SS Sakato cultivar achieves a greater dry weight in K4 than in K1 and K2. Across all planting media compositions, the Super Philip variety produced the highest dry-weight bulbs. This suggests that a corresponding increase in dry bulb weight accompanies an increase in fresh bulb weight.

Dry bulb yield (tons per hectare) is a crucial factor for the success of shallot farming. Table 5 shows that the Thai and Super Philip varieties produce more bulbs in K3 compared to K1 and K2. The SS Sakato variety achieved the highest dry bulb yield in K4, significantly differing from K1 and K2. The productivity of bulbs from the Thai and Super Philip varieties aligns with their descriptions, yielding 12-16 tons/ha and 17.60 tons/ha, respectively. However, the SS Sakato variety yields less than its described potential of 17.52-30 tons/ha.

## Discussion

With a planting media composition of 7.6 kg Entisols + 1.3 kg clay + 1.1 kg broadleaf weed ameliorant (K3), the Super

Philip variety (V3) exhibits better shallot growth and yield. This is evident in the shoot height, number of leaves, bulb height, bulb diameter, bulb fresh weight, bulb dry weight, and bulb production. These findings suggest that adding broadleaf weed ameliorant and clay can enhance the structure of Entisol. According to the soil test, K3 media has a soil fraction composition of 75.95% sand, 8.74% clay, and 15.31% silt, indicating that adding organic ameliorant can change the texture class from sand to sandy clay.

In addition to improving soil structure, the application of ameliorant reduced soil permeability from 3.98 cm/hour to 2.92 cm/hour (Table 1). This reduction in soil permeability enhances the soil's ability to retain water and nutrients, promoting shallot development. These findings align with Erlangga *et al.* (2023) [7], who reported that adding clay to coastal soil can increase soil stability, improve soil aggregates, and boost water-holding capacity. The decomposition of organic materials also contributes nutrients to the soil and increases its cation exchange capacity. Adding clay can enhance soil aggregate stability, raise soil porosity, and improve water retention in sandy soil, thereby increasing water availability. Shallots thrive in crumbly soil with a medium to clay texture, such as loamy sand, sandy loam, or silty clay.

Ameliorants derived from broadleaf weed compost are highly nutrient-rich. *Chromolaena odorata* weed contains 7.76% nitrogen (N), 1.10% phosphorus (P), and 5.79% potassium (K), improving soil quality and shallot production (Laana *et al.*, 2020) [12]. *Crotalaria juncea* have 5.25% N and 69.55% organic matter at 14 days after planting and 2.49% N and 66.78% organic matter at 45 days. *Tithonia diversifolia* weed, containing 3.3-5.5% N, 0.2-0.5% P, and 2.3-5.5% K, enhances soil chemical characteristics. Using *T. diversifolia* compost increases the number of leaves, tillers, plant height, roots, and shallots' fresh and dry weights (Khairunnisa *et al.*, 2019) [11]. Riyanto's (2021) [25] research shows that applying organic material from broadleaf weeds increases the shoot height of shallots. Broadleaf weed compost provides organic N, P, K, and C nutrients, which promote plant growth.

Plant height indicates plant growth resulting from cell division and elongation, especially at the top of the plant (Aprisa *et al.*, 2020) [1]. The nitrogen (N) nutrient from ameliorants helps activate plant cells in photosynthesis, thereby increasing plant height (Putra *et al.*, 2015) [22]. Additionally, the formation of leaves is influenced by the availability of N and phosphorus (P) in the planting medium. Kasim *et al.* (2021) [10] stated that shallots receiving additional N will produce more and broader leaves. Generally, an increase in the shoot height of shallots is accompanied by an increase in the number of leaves (Putrasamedja *et al.*, 2014) [23]. Research also showed that the Super Philip variety grown in the K3 planting medium achieved a higher shoot height (43.89 cm) and more leaves (51.33) than other media. The variation in shoot height and the number of shallot leaves is influenced by the genetic characteristics and adaptability of the variety to the growing environment (Kasem *et al.*, 2021) [10].

Variations in the size of shallot bulbs result from the interaction between genetic factors and environmental conditions (Harahap *et al.*, 2022) [9]. Bulb size is also related to the number of leaves. Elisabeth *et al.* (2013) [6] reported that the number of leaves formed affects the size and weight of shallot bulbs. As more leaves form, the leaf area

increases, enhancing the leaves' ability to capture sunlight for photosynthesis, leading to greater production of photosynthates. These photosynthates are then transported to the onion bulb. The increase in bulb height is consistent with the rise in bulb diameter. Generally, shallot bulbs with greater height also have a larger diameter (Kasim *et al.*, 2021) <sup>[10]</sup>. This research indicates that the Super Philip variety grown in K3 planting media produces a higher bulb height (3.38 cm) and bulb diameter (2.75 cm) than other varieties.

The fresh weight of shallot bulbs is a biological measure influenced by the water content after harvest, while the dry weight is an economic measure and is lighter than the fresh weight. The dry weight of bulbs is affected by nutrient availability; the more nutrients the roots absorb, the better the bulb development and the higher the dry weight (Riyanto, 2021; Aprisa *et al.*, 2020) <sup>[25, 1]</sup>. Research also demonstrated that using broadleaf weed ameliorant and clay in Entisols created a better planting medium for shallots, as evidenced by improved soil structure. Melinda (2022) <sup>[18]</sup> reported a close relationship between the fresh and dry weights of shallot bulbs, with a high fresh weight leading to a high dry weight (Kasim *et al.*, 2021) <sup>[10]</sup>. The research confirmed that a higher fresh bulb weight results in a higher dry weight.

Dry bulb yield (ton/ha) is crucial in successful shallot agricultural production. According to Asrijal *et al.* (2018) <sup>[2]</sup>, shallot growth and production are influenced by the potential of seedlings from appropriate varieties. Additionally, shallots thrive and produce well when optimal growing conditions, climate, and soil fertility are met. Each variety has unique advantages and adaptations, resulting in diverse shallot characteristics. Fertile planting media enhance the potential for higher shallot yields. The size, number, and weight of the bulbs determine shallot productivity, which is directly related to the weight of the bulbs produced (Sinaga *et al.*, 2013; Firmansyah, 2018) <sup>[28, 8]</sup>. The study found that the Super Philip variety grown in K3 planting media had higher yields (17.63 ton/ha) than the Thai and SS Philip varieties.

In the planting media composition of 10 kg Entisols (K1), the Thai variety (V3) exhibited the lowest growth and yield of shallot plants, as indicated by lower shoot height, number of leaves, bulb height, bulb diameter, bulb fresh weight, bulb dry weight, and overall production. Soil analysis results show that Entisols without the addition of ameliorant (K1) consists of 89.27% sand, 6.55% clay, and 4.19% silt, classifying it as sandy soil with a permeability of 3.98 cm/hour (Table 1). High permeability leads to significant nutrient leaching and low nutrient and water retention, hindering shallot growth (Sugianto & Jayanti, 2021) <sup>[30]</sup>. With amelioration, soil structure and nutrient availability are improved, resulting in suboptimal shallot growth and low production (Siregar, 2021) <sup>[29]</sup>.

## Conclusions

The Super Philip variety, grown in a mixture of 7.6 kg of Entisols, 1.3 kg of clay, and 1.1 kg of broadleaf weed ameliorant, demonstrated superior growth and yield of shallots compared to the Thai and SS Sakato varieties and other planting media combinations. The Super Philip variety exhibits greater adaptability to lowland conditions than the SS Sakato and Thai varieties. The recommended planting media composition for optimal shallot growth is 7.6 kg of

Entisols, 1.3 kg of clay, and 1.1 kg of broadleaf weed ameliorant. This research finding contributes to the improvement of shallot cultivation in Entisols from coastal region.

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