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EFFECT OF VERMICOMPOST KASCING PLUS AND ECO ENZYME APPLICATION ON THE GROWTH OF CLOVE SEEDLINGS UNDER NURSERY CONDITIONS

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Abstract

The availability of healthy and vigorous seedlings is a crucial factor in supporting successful clove cultivation. This study aimed to evaluate the effect of vermicompost Kascing Plus combined with eco enzyme on the growth of clove seedlings under nursery conditions. The experiment was conducted using a randomized block design with nine treatments and three replications. Treatments consisted of different application rates of vermicompost Kascing Plus combined with eco enzyme, along with a urea fertilizer treatment as a comparison. Seedling growth was assessed based on plant height, stem diameter, and number of leaves, observed at two week intervals from two to ten weeks after planting. Selected soil chemical and biological properties, including organic carbon, total nitrogen, C over N ratio, microbial activity, and soil pH, were analyzed at the beginning and end of the experiment. The results showed that the combined application of vermicompost and eco enzyme significantly influenced clove seedling growth. Moderate application rates produced more balanced vegetative growth, reflected by higher plant height, thicker stems, and greater leaf numbers compared to the control treatment. Excessive application rates did not result in proportional growth improvement. These findings indicate that vermicompost Kascing Plus combined with eco enzyme can be utilized as an organic based fertilizer input to support clove seedling production and promote more sustainable nursery management practices in clove producing areas.

Keywords: Clove Seedling, Eco Enzyme, Nursery Management, Vermicompost

Abstrak

Ketersediaan bibit cengkeh yang sehat dan vigor merupakan faktor penting dalam mendukung keberhasilan budidaya cengkeh. Penelitian ini bertujuan untuk mengevaluasi pengaruh aplikasi vermikompos Kascing Plus yang dikombinasikan dengan ekoenzim terhadap pertumbuhan bibit cengkeh pada kondisi pembibitan. Penelitian disusun menggunakan Rancangan Acak Kelompok dengan sembilan perlakuan dan tiga ulangan. Perlakuan terdiri atas berbagai dosis vermikompos Kascing Plus yang dikombinasikan dengan ekoenzim, serta satu perlakuan pupuk urea sebagai pembandingan. Pertumbuhan bibit diamati berdasarkan parameter tinggi tanaman, diameter batang, dan jumlah daun yang diamati setiap dua minggu sejak dua hingga sepuluh minggu setelah tanam. Sifat kimia dan biologi tanah terpilih, meliputi C organik, N total, rasio C dan N, aktivitas mikroorganisme, dan pH tanah, dianalisis pada awal dan akhir penelitian. Hasil penelitian menunjukkan bahwa aplikasi vermikompos dan ekoenzim secara kombinasi berpengaruh terhadap pertumbuhan bibit cengkeh. Dosis aplikasi sedang menghasilkan pertumbuhan vegetatif yang lebih seimbang dibandingkan perlakuan tanpa pupuk organik, ditunjukkan oleh peningkatan tinggi tanaman, diameter batang, dan jumlah daun. Pemberian dosis yang terlalu tinggi tidak selalu meningkatkan pertumbuhan secara proporsional. Hasil ini menunjukkan bahwa vermikompos Kascing Plus yang dikombinasikan dengan ekoenzim berpotensi digunakan sebagai input pupuk organik untuk mendukung produksi bibit cengkeh dan pengelolaan pembibitan yang lebih berkelanjutan di daerah penghasil cengkeh.

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Kata kunci: Bibit Cengkeh, Ekoenzim, Pembibitan, Vermikompos



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1. INTRODUCTION

Clove is an important plantation crop in Indonesia and plays a significant role in rural livelihoods, particularly in producing regions such as Bali. The success of clove cultivation is strongly influenced by the availability of healthy and vigorous seedlings during the nursery stage, as early growth performance determines plant establishment and long term productivity in the field (Mulyani *et al.*, 2020; Rahman *et al.*, 2021). Poor seedling development may result in delayed growth, reduced tolerance to environmental stress, and suboptimal yield potential.

Soil fertility is a key factor affecting seedling growth and development. In many smallholder nursery systems, inorganic fertilizers such as urea are commonly applied to stimulate vegetative growth due to their rapid nutrient availability. However, continuous reliance on inorganic fertilizers without organic amendments may lead to declining soil organic matter, reduced microbial activity, and lower nutrient use efficiency (Agegnehu *et al.*, 2017; Chen *et al.*, 2018). Organic fertilizers, on the other hand, contribute to improved soil structure, enhanced nutrient retention, and stimulation of soil biological processes that support sustained plant growth (Ravindran *et al.*, 2018).

Organic fertilizer Kascing Plus is a vermicompost derived from the decomposition of organic materials through the activity of earthworms. Vermicompost is known to contain readily available nutrients, humic substances, and beneficial microorganisms that contribute to improved soil fertility and plant growth. Several studies have reported that vermicompost application can enhance seedling growth by improving nutrient availability, stimulating microbial activity, and improving soil physical properties (Arancon *et al.*, 2004; Lazcano and Dominguez, 2011; Singh *et al.*, 2020). In addition, eco enzyme solutions produced through the fermentation of organic wastes have attracted attention as soil amendments due to their potential role in stimulating soil microbial processes and nutrient transformation (Arun and Sivashanmugam, 2015; Nazim and Meera, 2017). The combined application of vermicompost and eco enzyme may provide complementary benefits for seedling growth by improving both chemical and biological soil properties. However, scientific evidence regarding their combined effects on clove seedling growth remains limited.

Several studies have reported that the integration of organic inputs into nursery management can improve plant growth parameters such as plant height, stem diameter, and leaf number during early growth stages (Liu *et al.*, 2021; Yulnafatmawita *et al.*, 2019). Improved growth responses are often associated with enhanced soil nutrient availability and increased microbial activity. However, plant response to organic amendments is highly dependent on application rate and nutrient balance. Excessive or unbalanced application may not result in proportional growth improvement and may even inhibit nutrient uptake or seedling development (Zhang *et al.*, 2020).

Therefore, this study aimed to evaluate the effects of different application rates of organic fertilizer Kascing Plus combined with eco enzyme on the growth of clove seedlings under nursery conditions. Seedling growth responses were assessed based on plant height, stem diameter, and

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number of leaves, along with changes in selected soil chemical and biological properties. The results of this study are expected to provide scientific evidence supporting the use of organic based fertilizer inputs as an alternative or complement to inorganic fertilization for clove seedling production and to promote more sustainable nursery management practices in clove producing areas.

2. MATERIALS AND METHODS

2.1 Materials

The materials used in this study consisted of clove seedlings, soil growing media, vermicompost Kascing Plus, eco enzyme solution, and urea fertilizer. Clove seedlings of uniform size and age were selected to minimize variability in initial plant growth. The soil used as the growing medium was collected from the topsoil layer at a depth of approximately twenty centimeters, air dried, and sieved prior to use.

Kascing Plus used in this study was a vermicompost produced through the decomposition of organic materials by earthworm activity. The vermicompost served as an organic fertilizer source providing nutrients and organic matter to the growing media. Eco enzyme solution was prepared from the fermentation of organic household waste and applied as a liquid amendment according to the treatment levels. Urea fertilizer was used as an inorganic nitrogen source and served as a comparison treatment.

Chemical reagents required for soil analysis were prepared for the determination of organic carbon using the Walkley Black method, total nitrogen using the Kjeldahl method, C/N ratio calculation, soil respiration analysis for microbial activity, and soil pH measurement using the H₂O method at a ratio of 1:2.5. Equipment used in this study included standard agricultural tools, plant growth measurement instruments, and laboratory equipment for soil chemical and biological analyses.

2.2 Methods

2.2.1 Experimental Design and Treatments

The experiment was conducted under nursery conditions using polybags with a capacity of ten kilograms. A randomized block design was applied with nine treatments and three replications, resulting in a total of 27 experimental units. The treatments consisted of different application rates of vermicompost Kascing Plus combined with eco enzyme, including K0 (control without organic fertilizer), K1–K7 (500–3500 g vermicompost Kascing Plus combined with 5–35 ml eco enzyme per polybag), and one inorganic fertilizer treatment using urea (KA). Each experimental unit consisted of one clove seedling grown in a polybag containing five kilograms of soil.

The treatments comprised different application rates of vermicompost Kascing Plus combined with eco enzyme solution, as well as a urea fertilizer treatment used as a comparison. Vermicompost and eco enzyme were applied in increasing doses according to the treatment structure, while the urea treatment received no organic amendments. Treatment details and application rates are presented in Table 1.

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Tabel 1. Treatment of Organic Fertilizer Plus Vermicompost (POKPlus) and Ecoenzyme (EE) and Urea Fertilizer in clove nurseries

No	Treatment Code	Soil (g pot ⁻¹)	(POKPlus) (g pot ⁻¹)	Eco-enzyme (ml pot ⁻¹)	Urea Fertilizer (g pot ⁻¹)
1	K0	5000	-	-	-
2	K1	5000	500	5	-
3	K2	5000	1000	10	-
4	K3	5000	1500	15	-
5	K4	5000	2000	20	-
6	K5	5000	2500	25	-
7	K6	5000	3000	30	-
8	K7	5000	3500	35	-
9	Ka	5000	-	-	100

2.2.2 Soil Preparation and Fertilizer Application

Soil was collected from the topsoil layer at a depth of approximately twenty centimeters, air dried, and sieved prior to use. Five kilograms of prepared soil were placed into each polybag. Vermicompost Kascing Plus was added according to the respective treatment rates and thoroughly mixed with the soil to ensure uniform distribution.

Clove seedlings were transplanted into the prepared polybags following soil amendment. Eco enzyme solution was applied after planting according to the treatment levels. Irrigation was carried out as needed to maintain suitable moisture conditions for seedling growth.

For the urea treatment, fertilizer application was conducted twice. The first application was performed one week after planting at a rate of forty grams per polybag diluted in two hundred fifty milliliters of water. The second application was carried out four weeks after planting at a rate of sixty grams per polybag diluted in four hundred milliliters of water.

2.2.3 Plant Maintenance

Plant maintenance activities included routine watering based on plant requirements and daily observation of seedling condition. Pest presence was monitored regularly, and mechanical control was applied when necessary to prevent pest interference with plant growth.

2.2.4 Observation of Plant Growth and Soil Properties

Plant growth observations were conducted every two weeks starting from two weeks after planting until ten weeks after planting. The measured growth parameters included plant height, stem diameter, and number of leaves per plant.

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Soil chemical and biological properties were analyzed at the beginning and at the end of the experiment. The observed parameters included organic carbon content determined using the Walkley Black method, total nitrogen measured using the Kjeldahl method, C/N ratio calculated from organic carbon and total nitrogen values, soil pH, and EC measured using the H₂O method at a ratio of 1:2.5.

2.2.5 Statistical Analysis

The collected data were analyzed using analysis of variance to evaluate the effects of treatments on plant growth and soil properties. When significant differences were detected, Duncan's Multiple Range Test was applied at the five percent significance level to compare treatment means.

3. RESULTS AND DISCUSSION

3.1 Effect of Organic Fertilizer and Eco Enzyme on Plant Height

The application of vermicompost Kascing Plus combined with eco enzyme significantly influenced the height growth of clove seedlings during the observation period. Plant height increased progressively from two to ten weeks after planting across all treatments, although the magnitude of growth differed depending on the applied treatment. Seedlings receiving organic fertilizer treatments generally exhibited higher growth rates compared to the control treatment without organic amendments.

Table 2. Increase in Plant Height (cm) of Clove Seedlings after Treatment

No	Treatment	Beginning	2 W Increase	4 W Increase	6 W Increase	8 W Increase	10 W Increase
1	K0	86,27 ±0,00 a	86.60 ±0,35 a	58.67 ±0,12 a	56.33 ±0,58 a	88.13 ±0,17 a	88.73 ±0,26 a
2	K1	75,30 ±0,00 a	77.27 ±0,84 a	63.00 ±0,76 a	64.33 ±0,21 a	78.13 ±0,12 a	79.00 ±0,57 a
3	K2	78,10 ±0,00 a	78.60 ±0,17 a	36.00 ±1,10 a	40.33 ±0,68 a	80.93 ±0,46 a	81.73 ±0,66 a
4	K3	77,03 ±0,00 a	77.80 ±0,99 a	39.00 ±2,34 a	44.67 ±0,83 a	79.97 ±0,30 a	80.17 ±0,51 a
5	K4	74,50 ±0,00 a	73.67 ±2,25 a	56.67 ±0,66 a	69.00 ±0,80 a	75.77 ±0,38 a	75.93 ±0,15 a
6	K5	65,17 ±0,00 a	66.17 ±0,36 a	28.00 ±0,15 a	24.00 ±0,95 a	69.27 ±0,46 a	69.80 ±0,49 a
7	K6	79,27 ±0,00 a	81.17 ±0,56 a	64.33 ±0,20 a	82.67 ±0,68 a	84.27 ±2,46 a	84.57 ±0,17 a
8	K7	82,60 ±0,00 a	85.10 ±1,65 a	40.00 ±1,36 a	40.00 ±0,26 a	87.23 ±0,26 a	87.63 ±0,20 a
9	KA	74,67 ±0,00 a	77.00 ±2,02 a	72.67 ±0,68 a	62.67 ±0,31 a	79.23 ±0,45 a	79.80 ±0,40 a

Notes: W = Week

The positive response of seedling height to vermicompost application can be attributed to improved nutrient availability and enhanced soil physical conditions. Vermicompost is known to supply readily available nitrogen and other essential nutrients while improving soil aeration and water holding capacity, which support root development and shoot elongation (Arancon *et al.*, 2004; Lazcano and Dominguez, 2011). In addition, eco enzyme application may have contributed to increased microbial activity and nutrient transformation in the growing media, thereby supporting plant growth (Arun and Sivashanmugam, 2015).

However, higher application rates did not always result in proportional increases in plant height. This suggests that excessive organic input may not further enhance early vegetative

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growth and may lead to suboptimal nutrient balance. Similar findings were reported by Liu *et al.* (2021), who emphasized the importance of appropriate organic fertilizer dosage to optimize seedling growth.

3.2 Effect on Stem Diameter Growth

Stem diameter increased steadily with plant age in all treatments, indicating normal seedling development. Treatments receiving vermicompost and eco enzyme generally produced thicker stems compared to the control treatment, particularly at later observation stages. Stem diameter is an important indicator of seedling vigor and structural strength, which are essential for successful transplanting.

Table 3. Increase in Stem Diameter (mm) of Clove Seedlings after Treatment

No	Treatment	Beginning	2 W Increase	4 W Increase	6 W Increase	8 W Increase	10 W Increase
1	K0	6.13 ±0,00 a	6.37±0,23 a	6.37±0,00 a	6.30 ±0,17 a	6.37 ±0,00 ab	6.37±0,58 a
2	K1	5.80 ±0,00 a	5.83±0,06 a	5.97±0,23 a	6.03 ±0,31 a	6.07 ±0,00 c	6.23±0,58 a
3	K2	7.15 ±0,00 a	6.90±0,15 a	7.00±0,00 a	7.03 ±0,46 a	7.03 ±0,00 c	7.07±0,00 a
4	K3	6.33 ±0,00 a	6.40±0,06 a	6.43±0,06 a	6.33 ±0,00 a	6.33 ±0,00 bc	6.33±0,58 a
5	K4	5.73 ±0,00 a	5.93±0,00 a	5.83±0,00 a	5.83 ±0,00 a	5.83 ±0,06 c	5.87±0,00 a
6	K5	5.57 ±0,00 a	5.63±0,06 a	5.67±0,06 a	5.93 ±0,46 a	5.93 ±0,06 c	5.97±0,00 a
7	K6	5.80 ±0,00 a	6.30±0,52 a	6.30±0,00 a	6.37 ±0,26 a	6.43 ±0,06 bc	6.50±0,00 a
8	K7	6.90 ±0,00 a	6.50±0,06 a	6.60±0,00 a	6.73 ±0,40 a	6.73 ±0,06 c	6.80±0,00 a
9	KA	6.00 ±0,00 a	6.93±0,17 a	6.97±0,06 a	6.97 ±0,00 a	7.07 ±0,00 a	7.07±0,00 a

Notes: W = Week

Improved stem diameter under organic fertilizer treatments may be associated with enhanced nutrient uptake and improved soil biological activity. Vermicompost has been reported to increase the availability of calcium and potassium, which contribute to cell wall formation and stem strengthening (Singh *et al.*, 2020). Although the urea treatment supplied readily available nitrogen and showed comparable stem diameter at certain observation periods, organic treatments tended to promote more stable and consistent growth patterns. This stability is advantageous for nursery-grown seedlings (Agegnehu *et al.*, 2017).

3.3 Effect on Number of Leaves

The number of leaves varied among treatments during the observation period, with organic fertilizer treatments generally producing more leaves than the control. Increased leaf production reflects improved photosynthetic capacity and nutrient status of the seedlings. Vermicompost contains humic substances and beneficial microorganisms that can stimulate leaf initiation and expansion through hormonal and nutritional mechanisms (Lazcano *et al.*, 2013).

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Table 4. Increase in Number of Leaves of Clove Seedlings after Treatment

No	Treatment	Beginning	2 W Increase	4 W Increase	6 W Increase	8 W Increase	10 W Increase
1	K0	48.00 ±0,00 a	58.67±3,06 ab	56.33±2,89 ab	64.00 ±8,50 a	64.00 ±3,61 a	64.33±2,08 a
2	K1	45.67 ±0,00 a	63.00±23,80 a	64.33±6,66 ab	63.67 ±1,15 ab	71.67 ±5,29 a	81.67±5,20 a
3	K2	42.33 ±0,00 a	36.00±5,03 ab	40.33±16,44 ab	40.00 ±4,04 ab	32.67 ±17,21 a	43.00±16,17 a
4	K3	47.67 ±0,00 b	39.00±5,51 b	44.67±9,81 ab	45.67 ±1,73 ab	46.00 ±2,08 a	50.33±7,57 a
5	K4	45.67 ±0,00 a	56.67±25,36 ab	69.00±22,28 ab	66.33 ±3,79 ab	73.33 ±6,24 a	79.67±8,62 a
6	K5	29.33 ±0,00 a	28.00±0,58 ab	24.00±4,36 ab	28.33 ±6,81 ab	31.00 ±3,06 a	36.33±4,73 a
7	K6	68.67 ±0,00 a	64.33±2,31 ab	82.67±27,79 a	76.67 ±12,29 b	80.00 ±11,85 a	91.67±6,51 a
8	K7	36.00 ±0,00 a	40.00±3,61 ab	40.00±0,00 ab	47.67 ±6,11 a	51.67 ±37,04 a	53.00±39,43 a
9	KA	58.67 ±0,00 a	72.67±13,89 ab	62.67±9,00 b	71.33 ±8,96 a	60.33 ±12,00 a	61.33±3,61 a

Notes: W = Week

The combined application of vermicompost and eco enzyme likely enhanced biological activity in the growing media, supporting sustained nutrient release and leaf development. Similar responses have been reported in studies involving organic amendments applied to nursery crops, where increased leaf number was associated with improved soil fertility and microbial activity (Yulnafatmawita *et al.*, 2019; Zhang *et al.*, 2020).

3.4 Changes in Soil Chemical Properties at the End of the Experiment

3.4.1 Soil pH and Electrical Conductivity

Soil pH and electrical conductivity measured at harvest time showed variation among treatments receiving different application rates of vermicompost Kascing Plus combined with eco enzyme (Figure 1). In general, the application of organic amendments tended to maintain soil pH within a favorable range for clove seedling growth. This indicates that vermicompost application did not cause excessive soil acidification or alkalization during the nursery period.

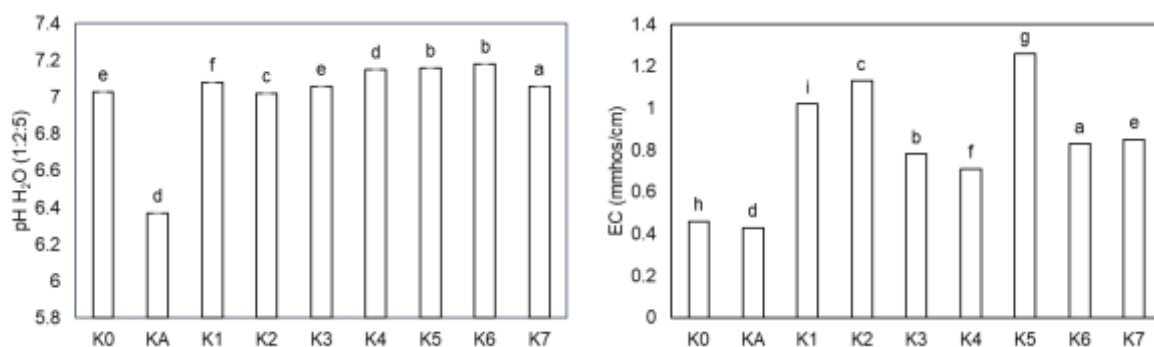


Figure 1. Soil pH and EC at Harvest time

Electrical conductivity values varied among treatments but remained within acceptable limits, suggesting that the application of vermicompost and eco enzyme did not result in excessive salt accumulation in the growing media. Organic fertilizers typically release nutrients gradually, which helps prevent rapid increases in soil salinity compared to inorganic fertilizers (Agegnehu *et al.*, 2017). These results indicate that the combined application of vermicompost and eco enzyme was environmentally safe for nursery soil conditions.

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3.4.2 Soil Organic Carbon and Total Nitrogen

Soil organic carbon and total nitrogen content at harvest time differed among treatments, reflecting the influence of organic input rates on soil nutrient status (Figure 2). Treatments receiving vermicompost showed higher organic carbon levels compared to the control treatment, indicating improved organic matter accumulation in the growing media.

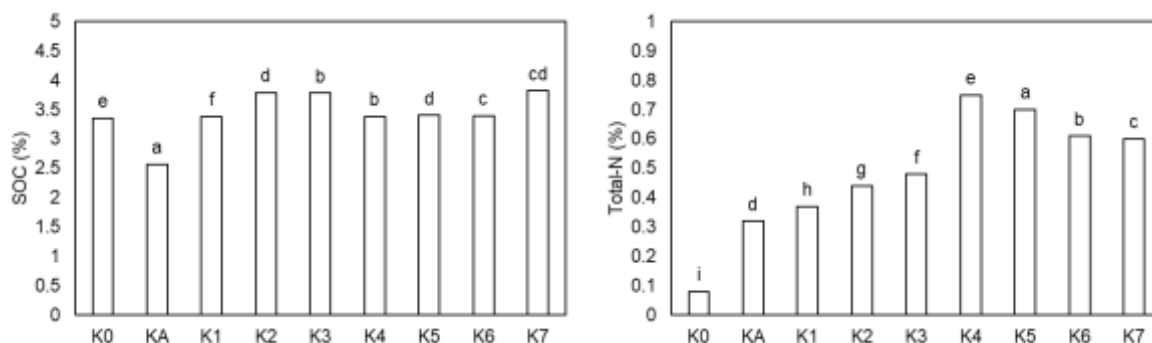


Figure 2. SOC and Total-N at Harvest time

An increase in total nitrogen content was also observed in treatments amended with vermicompost. Vermicompost is known to supply nitrogen in organic and mineral forms, contributing to improved nitrogen availability while reducing nutrient losses (Liu *et al.*, 2021). The combined increase in organic carbon and total nitrogen suggests enhanced soil fertility conditions that support sustained seedling growth.

3.4.3 Soil C/N Ratio

The soil C/N ratio at the end of the experiment varied among treatments and was influenced by the proportion of organic amendments applied (Figure 3). Treatments receiving moderate rates of vermicompost combined with eco enzyme tended to show more balanced C/N ratios, indicating improved organic matter decomposition and nutrient mineralization.

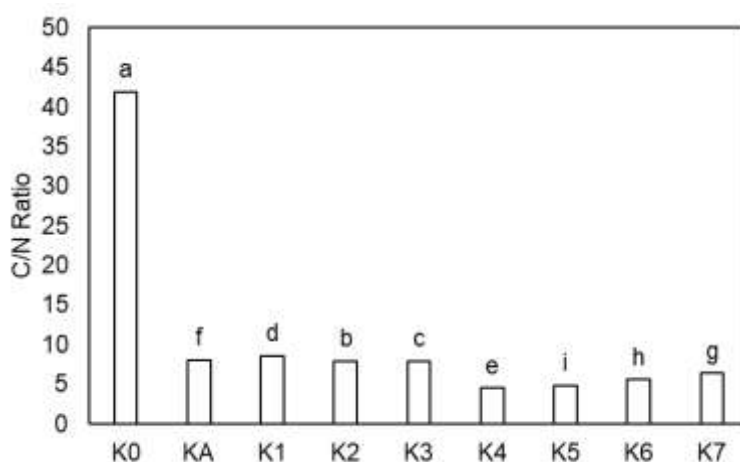


Figure 3. C/N Ratio at Harvest time

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A balanced soil C/N ratio is essential to avoid nitrogen immobilization and to ensure adequate nutrient availability for plants. Lower and stable C/N ratios observed in organic amendment treatments suggest enhanced microbial activity and more efficient nutrient cycling within the growing media (Zhang *et al.*, 2020). These results support the role of vermicompost and eco enzyme in improving soil chemical quality during the clove seedling nursery phase.

3.5 Implications for Organic Nursery Management

The results indicate that the combined application of vermicompost Kascing Plus and eco enzyme positively influenced clove seedling growth, as shown by increased plant height, stem diameter, and number of leaves. Growth responses were dependent on application rate, with moderate doses producing more balanced vegetative development.

Organic amendment treatments also improved soil chemical properties at the end of the experiment. Soil pH remained within a favorable range, electrical conductivity did not indicate excessive salt accumulation, and increases in soil organic carbon and total nitrogen were accompanied by more balanced soil C/N ratios. These changes support improved soil fertility and sustained nutrient availability for seedling growth.

Overall, the combined use of vermicompost and eco enzyme offers a practical approach to improving seedling performance and soil quality while supporting sustainable nursery management in clove producing areas.

4. CONCLUSION

This study demonstrated that the combined application of vermicompost Kascing Plus and eco enzyme influenced both clove seedling growth and soil chemical properties under nursery conditions. Differences in application rates resulted in varying responses in plant height, stem diameter, and number of leaves, indicating that seedling growth was closely related to the proportion of organic inputs applied.

Moderate application rates of vermicompost combined with eco enzyme produced more balanced vegetative growth compared to lower or excessive application rates. In addition to enhancing plant growth, organic amendment treatments improved soil chemical characteristics at the end of the experiment, including increased soil organic carbon and total nitrogen content, more stable soil C over N ratios, and acceptable soil pH and electrical conductivity levels. These results indicate that appropriate organic fertilizer dosage supports both seedling vigor and soil quality.

Overall, the findings confirm that vermicompost Kascing Plus combined with eco enzyme can be utilized as an organic based fertilizer input to support clove seedling production in nursery systems. The use of locally available organic materials offers a practical approach to improving seedling quality while promoting sustainable soil management and environmentally friendly agricultural practices in clove producing areas.

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