



Evaluation of compost prepared from different crop residues and weeds as media for tomato seedling production and the activity of induction enzymes

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ABSTRACT

This study was conducted with the aim of utilizing agricultural residues and harmful environmental weeds to transform them into a sustainable agricultural input by preparing compost to be used as a medium for producing healthy and robust vegetable seedlings. The study investigates the effects of compost media prepared from okra plant residues (*Abelmoschus esculentus*), wheat straw (*Triticum aestivum*), camelthorn (*Alhagi graecorum*) and wild reed (*Phragmites australis*) on growth characteristics of tomato seedlings, and the enzymatic activity of polyphenol oxidase, peroxidase and chitinase induced in tomato seedlings. The results showed that the compost prepared from okra residues provided the highest germination rate for tomato seeds, reaching 94.79%, followed by the reed compost with a germination rate of 92.70%. The wheat straw compost gave the lowest germination rate for tomato seeds at 87.49%. Additionally, the okra residue compost treatment significantly outperformed other treatments in terms of seedling height, stem diameter, chlorophyll content, leaf area, dry weight of the shoot system, and dry weight of the root system, achieving values of 20.60 cm plant⁻¹, 4.17 mm plant⁻¹, 15.61 mg.g⁻¹, 115.07 cm² plant⁻¹, 0.92 g plant⁻¹, and 0.31 g plant⁻¹, respectively. followed by the Alhagi compost, wheat straw, and reed treatments, while commercial peat moss recorded the lowest values. Moreover, the okra residue compost provided the highest concentration of nitrogen, phosphorus, and potassium, reaching (3.47, 0.34, and 3.16)%, respectively. Furthermore, the okra residue compost exhibited the highest enzymatic activity of polyphenol oxidase, peroxidase, and chitinase, reached to (2.62, 3.41, and 2.58) unit.ml⁻¹, respectively.

تقييم الكومبوست المحضر من ادغال وبقايا محاصيل مختلفة اوساطاً لإنتاج شتلات الطماطة وفعالية انزيمات الاستحثاث

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الخلاصة

يهدف استغلال المخلفات والادغال الزراعية الضارة بالبيئة وتقليل عبئها على المزارعين وتحويلها الى واحد من مخلفات الزراعة المستدامة وذلك بتحضير كومبوست يستخدم كوسط لإنتاج شتلات خضر صحية وقوية، تم اجراء هذه الدراسة لمعرفة تأثير اوساط الكومبوست المحضرة من مخلفات بقايا نبات الباميا (*Abelmoschus esculentus*) و تين الحنطة (*Triticum aestivum*) و العاقول (*Alhagi graecorum*) والقصب (*Phragmites australis*) في نسبة الانبات وبعض صفات النمو لشتلات نبات الطماطة ومحتواه من العناصر المغذية NPK فضلاً عن الفعالية الانزيمية لإنزيمات متعدد الفينول اوكسديز وانزيم البيروكسديز وانزيم الكايتنيز المستحثة في شتلات الطماطة، اظهرت النتائج بأن وسط كومبوست مخلفات الباميا قد أعطى أعلى نسبة انبات لبذور الطماطة إذ بلغت 94.79% تلاه وسط كومبوست القصب الذي اعطى نسبة انبات بلغت 92.70% فيما أعطى وسط كومبوست تين الحنطة ادنى نسبة انبات لبذور الطماطة إذ بلغت 87.49%، كما اظهرت النتائج تفوق معاملة كومبوست مخلفات الباميا معنوياً في ارتفاع وقطر الساق الشتلات وتركيز الكلوروفيل والمساحة الورقية والوزن الجاف للمجموع الخضري والوزن الجاف للمجموع الجذري إذ اعطى (20.60 سم نبات¹ و 4.17 ملم نبات¹ و 15.61 ملغم غم⁻¹ و 115.07 سم² نبات¹ و 0.92 غم نبات¹ و 0.31 غم نبات¹) تلتها معاملات كومبوست العاقول ثم تين الحنطة ثم القصب واعطى وسط البيتموس التجاري اقل القيم، وقد اعطى كومبوست مخلفات الباميا أيضاً أعلى تركيز لعنصر النيتروجين والفسفور والبوتاسيوم إذ بلغت (3.47 و 0.34 و 3.16%) على التتابع، كما اظهرت النتائج ان كومبوست مخلفات الباميا قد اعطى أعلى فعالية لإنزيم متعدد الفينول اوكسديز وانزيم البيروكسديز وانزيم الكايتنيز إذ بلغت (2.62 و 3.41 و 2.58 وحدة /مل) على التتابع.

الكلمات المفتاحية: بقايا المحاصيل ، الأدغال النباتية ، الكومبوست ، أوساط الشتلات ، الفعالية الإنزيمية.

INTRODUCTION

The accumulation of crop residues and the spread of weeds, along with current management practices such as burning, relocating or leaving them in the field, often place a burden on farmers, as it covers vast areas of farmland, and is a refuge for insects and rodents, and emits bad odors, therefore all these practices are harmful to the environment (Medina *et al.*, 2015). Annually, massive amounts of agricultural waste are generated worldwide, and their poor management contributes to significant environmental pollution and health issues (Rashwan *et al.*, 2023). It is estimated that global plant waste production amounts to approximately 2 billion tons annually (Ghoreishy *et al.*, 2018). Crop residues are highly valuable natural resources when properly utilized and can support human livelihoods and well-being. Therefore, managing agricultural waste efficiently by converting it into compost can provide a useful medium for seedling production and edible mushroom cultivation, in addition to its use as a fertilizer in organic farming (Khalid *et al.*, 2025). Compost serves as a rich source of nutrients that improves soil fertility and quality while nourishing plants (Aldory *et al.*, 2020). These practices are considered key inputs for sustainable agriculture (Imran *et al.*, 2022; Hashim *et al.*, 2022; Zaidan *et al.*, 2024). The production of healthy and vigorous vegetable seedlings is crucial for achieving high and early yields, especially for crops that propagate through seedlings such as tomatoes (AL-Kurtany *et al.*, 2023), eggplants (Shaimaa *et al.*, 2023) peppers, and lettuce, this method offers a great opportunity for early production, economizing seed use, achieving higher yields, and eliminating diseased or weak seedlings (Javed *et al.*, 2022).

Pathogens transmitted through seedling media and soil pose a major problem. Bortolini *et al.* (2020) and Setti *et al.* (2019) demonstrated that compost is widely used in nursery sectors due to its positive effects on seedling quality and growth, as well as its bio-stimulatory effects. Additionally, compost has suppressive effects on pathogenic microorganisms and improves physical and chemical properties when mixed with peat. Compost also reduces the occurrence of root diseases due to its antagonistic effects on

pathogens such as *Verticillium dahliae*, *Fusarium oxysporum*, and *Fusarium oxysporum f. sp. melonis* (Ronga et al., 2021).

The present study aimed to evaluate compost prepared from okra residues, Alhagi, wheat straw, and reed in terms of certain growth parameters of tomato seedlings and the activity of inducible enzymes.

MATERIALS AND METHODS

An experiment was conducted in the greenhouses of the Agriculture College / Tikrit University, on 6th February 2022. The objective of this study was to evaluate four types of compost as growth media for tomato seedling production and compare them with the commonly used commercial peat moss medium.

Preparation and setup of basic requirements for the experiment

The essential materials for the experiment were prepared. Plastic trays were purchased from local markets, each tray consisted of 32 wells (5.6 cm in diameter and 6.7 cm in height). The greenhouse was prepared through leveling, adjusting, and sterilizing, with a plastic tunnel installed inside the greenhouse. The trays were then filled with four types of compost (Alhagi compost, wheat straw compost, okra waste compost, and reed compost), in addition to the commercial peat moss. Table 1 provides details on the physical, chemical, and biological properties of the compost types and commercial peat moss. After filling the trays, the compost and peat moss were moistened with water to stabilize the medium inside the tray cells before sowing the seeds.

Experiment Implementation

The seedling production experiment was carried out used a Completely Randomized Design (CRD) with five treatments, each replicated three times, resulting in a total of 15 trays. Tomato seeds of the JOLLANAR F1 variety, of Chinese origin, were sown in the plastic trays containing the growth media, with one seed per cell in all trays. Irrigation was carried out regularly using a backpack sprayer and monitored daily. No fertilizers or growth stimulants were applied throughout the 50-day growth period. Afterward, samples were collected for measurements, including germination rate (%), seedling height (cm plant⁻¹), stem diameter (mm), leaf area (cm² plant⁻¹), dry weight of the shoot system (g plant⁻¹), dry weight of the root system, chlorophyll content, and the estimation of nitrogen, phosphorus, and potassium in the shoot system of the seedlings according to the methods specified in Mahadevan and Sirdhar (1986).

Table 1: Physical, Chemical, and Biological Properties of the tested Growth Media

Medium Type	pH	EC ds m ⁻¹	C (%)	N (%)	P (%)	K (%)	C/N	Log. of Bacterial Count gm ⁻¹	Log. of Fungal Unit gm ⁻¹	Log. of Actinomyc etes Unit gm ⁻¹
Commercial Peat Moss	6.5	0.35	39.98	0.97	0.16	0.93	41.21	3.54	1.32	3.02
Okra waste compost	7.60	3.11	33.90	2.27	0.47	1.88	14.93	7.12	3.82	10.11
Alhagi compost	7.55	3.31	34.12	2.20	0.44	1.80	15.50	6.59	3.58	11.04
Wheat straw compost	7.52	3.19	35.39	2.05	0.38	1.77	17.22	6.12	3.87	10.62
Wild reed compost	7.31	3.23	34.08	2.11	0.35	1.64	16.10	5.11	3.64	10.23

(EC = Electrical Conductivity, C = Carbon, N = Nitrogen, P = Phosphorus, K = Potassium, C/N = Carbon to Nitrogen Ratio.)

Systemic Induced Resistance in tomato Seedlings

Preparation of Enzymatic Filtrate

One gram of root system was collected from each treatment 14 days after application. The sample was thoroughly washed with distilled water and dried using filter paper. Each sample was ground using a ceramic mortar placed in an ice bath. Then, 5 mL of phosphate

buffer solution (pH 6) was added, and the mixture was filtered using Whatman No. 1 filter paper. The filtrate was transferred into 10 mL test tubes and centrifuged using a refrigerated centrifuge at 4°C with a speed of 10,000 rpm for 20 minutes. The precipitate was discarded, and the supernatant, representing the enzymatic filtrate, was collected (Hassan *et al.*, 2022).

Estimation of Peroxidase activity

The peroxidase was estimated following the method of Mahmoud and Hassan (2023). A reaction mixture was prepared by adding 2.5 mL of guaiacol- hydrogen peroxide solution and 0.1 mL of the enzymatic filtrate from each treatment. The absorbance of the reaction mixture was measured using a UV-Spectrophotometer at a wavelength of 470 nm. The enzyme unit was defined as the change in absorbance of 0.01 per minute.

Estimation of Polyphenol Oxidase a activity

Polyphenol oxidase was estimated following the method of Mahmoud and Hassan (2023). A reaction mixture was prepared by adding 2.5 mL of catechol solution to 0.1 mL of the enzymatic extract from each treatment. The absorbance of the reaction mixture was measured using a UV-Spectrophotometer at a wavelength of 470 nm. The enzyme unit was defined as the change in absorbance of 0.01 per minute.

Estimation of chitinase activity

The method of Mahmoud and Hassan (2023) was followed to estimate chitinase activity. The reaction mixture consisted of 0.5 mL of chitin solution 1% and 0.5 mL of the enzymatic filtrate from each treatment. The mixture was incubated at 30°C for two hours. After incubation, 1 mL of DNS (3,5-dinitrosalicylic acid) was added, and the mixture was placed in a water bath at 100°C for 5 minutes. The tubes were then cooled, and the absorbance was measured using a spectrophotometer at 540 nm. The standard curve of N-acetylglucosamine was used to estimate the enzyme activity, where the enzymatic activity was defined as the amount of enzyme required to release 1 micromole of N-acetylglucosamine per minute under the given reaction conditions.

RESULTS AND DISCUSSION

Figure 1 illustrates the effect of different growth media on the germination rate of tomato seeds. The data clearly shows that the type of growth medium significantly influenced germination rates. The highest germination rate 94.79% was observed in the okra waste compost medium, followed by reed compost and commercial peat moss, with germination rates of 92.70% and 91.66%, respectively. However, the difference between okra waste compost and the other two media was not statistically significant. In contrast, the germination rates for Alhagi compost and wheat straw compost were 89.58% and 87.49%, respectively.

The similarity in germination rates across the different media can be attributed to their favorable physical properties, such as texture, bulk density, and water-holding capacity, making them suitable environments for seed germination. Additionally, the pH and salinity levels of the media were appropriate, which further influenced germination rates. The microbial activity in the compost may have also contributed by producing growth regulators like cytokinins, which stimulate seed germination, and gibberellins, which help break seed dormancy. Auxins, such as IAA, may also promote germination and root initiation, while the secretion of hydrolytic enzymes by microorganisms might have supported the growth of seed embryos. These findings are consistent with the results of

previous studies by Díaz-Pérez *et al* (2009), Atif *et al* (2016), and Alramli and Alkurtany (2022), who investigated the effect of different compost types on the germination rates of watermelon and tomato seeds. They found that compost outperformed peat moss in promoting germination.

Figure 2 shows the effect of different growth media on the height of tomato seedlings after 50 days from sowing. The data reveal that okra waste compost significantly outperformed all other media in promoting seedling height, yielding the tallest seedlings. It was followed by Alhagi compost, wheat straw compost, and reed compost. All local composts significantly exceeded the commercial peat moss medium in seedling height, with percentage increases over the commercial medium of (48.95, 37.59, 26.64 and 7.95) %, respectively As in the picture 1. The increase in seedling height observed in the okra waste compost can be attributed to its higher content of readily available nutrients—namely N, P, and K—as shown in Table 1. When absorbed by seedlings, these nutrients positively affect plant growth. Nitrogen is essential for the synthesis of proteins, enzymes, nucleic acids, and protoplasm, as well as for the rapid division of cells, which results in enhanced plant growth and height. Phosphorus also plays a key role in promoting seedling growth by contributing to energy compounds and increasing the number and size of cells, which in turn boosts seedling height. Potassium is crucial for the division and elongation of meristematic cells and enhances enzyme activity, all of which positively influence plant height. These results align with the findings of Mazuela *et al.* (2012) and Alam *et al.* (2024), who demonstrated the positive impact of compost on plant growth. The enhanced seedling height in compost-treated plants could also be attributed to the beneficial microorganisms present in compost. These microbes are capable of nitrogen fixation, solubilization of phosphorus and potassium compounds, and the production of hormones and growth regulators such as indole acetic acid (Abd and Alkurtany 2023), which promotes cell elongation, stimulates division, and enhances apical dominance, thereby increasing stem elongation and seedling height. Moreover, the microbes produce important compounds for plant growth, such as volatile compounds, vitamins, and amino acids, which stimulate seedling growth by improving nutrient availability and absorption, ultimately contributing to increased seedling height (Vial *et al.*, 2011; Stella and Sashikala, 2016).

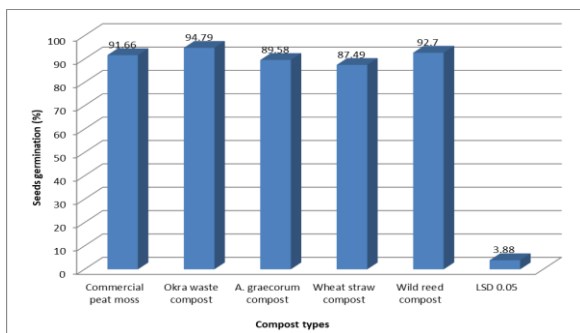


Figure (1) Effect of medium type on Germination (%) of tomato seeds

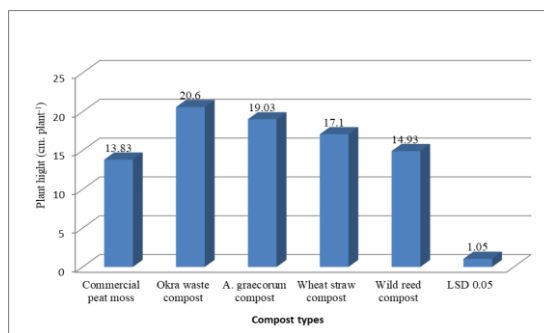
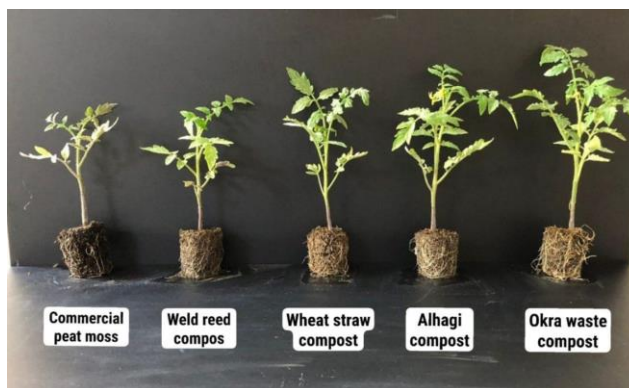


Figure (2) Effect of medium type on plant height (cm plant⁻¹) of tomato seedling after 50 days from sowing.



Picture (1) Effect of medium type on plant height (cm plant⁻¹) of tomato seedling after 50 days from sowing.

Figure 3 illustrates the effect of different growth media on the stem diameter of tomato seedlings (mm plant⁻¹) after 50 days from sowing. The data indicate that okra waste compost significantly outperformed all other media in terms of stem diameter, yielding the highest average diameter of 4.17 mm plant⁻¹, followed by Alhagi compost, wheat straw compost, and reed compost, which had average stem diameters of 3.99 mm, 3.74 mm, and 3.59 mm plant⁻¹, respectively, compared to the commercial peat moss medium, which recorded the lowest average stem diameter of 3.48 mm plant⁻¹.

The increase in stem diameter of seedlings growing in okra waste compost can be attributed to the higher availability of nutrients in this medium, particularly nitrogen and potassium, which significantly influence the synthesis of carbohydrates and their subsequent transport to various parts of the plant, leading to an increase in stem diameter. Additionally, the microorganisms present in the compost enhance the availability of nutrients, facilitating their absorption by the seedlings and thereby promoting both growth and stem diameter. Furthermore, these microorganisms produce auxins, which contribute to cell elongation, cell expansion, and increased cell division, resulting in thicker and wider stems. These findings are consistent with the results reported by Olowoake (2018) and Abdel-Razzak *et al.* (2019).

Figure 4 illustrates the effect of different growth media on the leaf area of tomato seedlings (cm² plant⁻¹) after 50 days from sowing. The data indicate that the leaf area was significantly influenced by the type of medium used. The highest average leaf area of 115.07 cm² plant⁻¹ was observed in seedlings grown in okra waste compost, while Alhagi compost, wheat straw compost, and reed compost produced average leaf areas of 104.69 cm², 90.52 cm², and 82.98 cm² plant⁻¹, respectively. In comparison, the commercial peat moss medium yielded the lowest average leaf area of 78.20 cm² plant⁻¹. The superior leaf area in tomato seedlings grown in okra waste compost can be attributed to the medium's nitrogen content (as shown in Table 1), which promotes vegetative growth and development by facilitating the synthesis of essential proteins and increasing cell division. This positively impacts leaf area and its expansion. Additionally, the phosphorus content in the medium plays a crucial role in leaf area development, as it is vital for forming cell membranes. The potassium content in the compost enhances enzymatic activities and regulates the process of photosynthesis, leading to increased cell growth and division, which ultimately results in a larger leaf area and more leaves per seedling. Iron also plays

an important role in this process, aligning with the findings of researchers Adamu. (2014) and Anuada (2024).

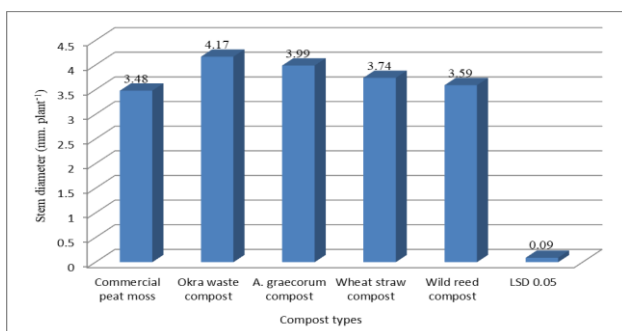


Figure (3) Effect of medium type on stem diameter of tomato seedlings (mm plant⁻¹) after 50 days from sowing

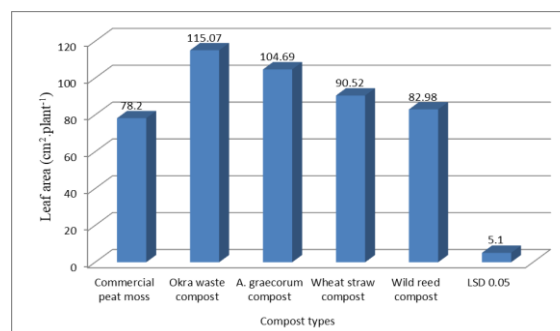


Figure (4) Effect of medium type on the leaf area of tomato seedlings (cm² plant⁻¹) after 50 days from sowing

The results presented in Figure 5 demonstrate the significant effect of the growth medium on the dry weight of the shoot system of tomato seedlings (g plant⁻¹). The okra waste compost yielded the highest average dry weight of 0.92 g plant⁻¹, followed by Alhagi compost at an average of 0.83 g plant⁻¹, wheat straw compost with an average of 0.72 g plant⁻¹, and reed compost at 0.64 g plant⁻¹. In contrast, the commercial peat moss medium produced the lowest average dry weight of 0.60 g plant⁻¹. The increased dry weight of the shoot system in seedlings grown in okra waste compost can be attributed to the phosphorus content of the compost, which plays a significant role in plant development, positively influencing the dry matter accumulation in seedlings. Phosphorus enhances root and shoot growth (Barker and Pilbeam, 2015), facilitating root growth and spread, thereby improving the root's efficiency in nutrient absorption due to the availability of nutrients, which is reflected positively in the dry weight of the seedlings. Additionally, nitrogen contributes significantly to the growth of the shoot system, as it is involved in the synthesis of nucleotides, proteins, nucleic acids, and various compounds crucial for seedling growth. Potassium also plays a vital role in increasing the dry weight of the shoot system by positively impacting plant height, leaf area, and photosynthetic efficiency, leading to an increased dry matter content in the seedlings. These findings align with those of researchers Olowoake (2018) and Imran *et al.* (2022). Moreover, the ability of microorganisms present in the compost to solubilize phosphate and potassium compounds, fix nitrogen, and secrete certain hormones and growth regulators enhances seedling growth and, consequently, increases their dry weight (Imran *et al.*, 2021; Hasan *et al.*, 2024).

The results presented in Figure 6 indicate a significant advantage of okra waste compost in the dry weight of the root mass of tomato seedlings compared to other media. The okra waste compost yielded the highest average dry root weight of 0.31 g plant⁻¹, whereas the dry root weights for Alhagi compost, wheat straw compost, and reed compost were 0.28, 0.24, and 0.21 g plant⁻¹, respectively. In contrast, the commercial peat moss medium produced the lowest average dry root weight of 0.19 g plant⁻¹. The superiority of okra waste compost in dry root weight can be attributed to the medium's texture and physical properties, which facilitated the easy spread and penetration of roots and their absorption of available nutrients. This advantage may also stem from the phosphorus

content of the medium, which encourages the formation of a dense and deep root system, thereby enhancing the uptake of water and nutrients, particularly nitrogen and potassium, which play essential roles in metabolic processes within the plant. These elements are involved in carbohydrate synthesis, photosynthesis, and various other vital biochemical processes. All these effects positively influence seedling growth, resulting in increased dry weight of the root mass. This finding is consistent with the results reported by Abdel-Razzak *et al.* (2019) and Rashwan *et al.* (2023).

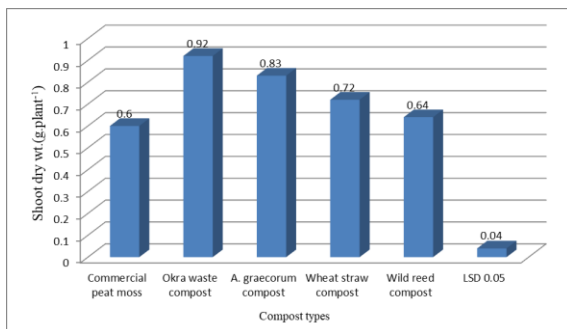


Figure (5) Effect of medium type on dry weight of the shoot system of tomato seedlings (g plant⁻¹) after 50 days from sowing

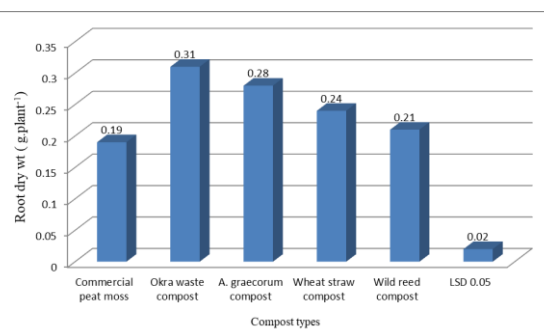


Figure (6) Effect of medium type on Dry Weight of the Root system of tomato seedlings (g plant⁻¹) after 50 days from sowing

The results in Figure 7 demonstrate the significant effect of the growing medium on the chlorophyll content in tomato seedlings. The okra waste compost medium yielded the highest chlorophyll at 15.61 mg.g⁻¹, while Alhagi compost had a concentration of 14.43 mg.g⁻¹. Wheat straw compost and reed compost recorded chlorophyll contents of 13.18 mg.g⁻¹ and 11.57 mg.g⁻¹, respectively. In contrast, the commercial peat moss medium resulted in the lowest chlorophyll of 9.26 mg.g⁻¹. The differences between all media were statistically significant.

The superior chlorophyll concentration in seedlings grown in okra waste compost can be attributed to the medium's nitrogen content. Nitrogen is a crucial component of chlorophyll molecules, as it is essential for the formation of proteins and amino acids that contribute to the development of chloroplasts. Nitrogen is also a key component of the porphyrin ring in chlorophyll, with 51% of leaf nitrogen being incorporated into chlorophyll pigments. Furthermore, potassium plays a role in activating enzymes that promote chloroplast formation. In addition to these nutrients, beneficial microorganisms present in compost may enhance chlorophyll synthesis. For example, they can produce (IAA), which influences chlorophyll formation and metabolism. These microorganisms can also produce iron-chelating compounds, increasing the availability of iron for chlorophyll synthesis by facilitating the formation of amino levulinic acid and supporting the conversion of Mg-Protoporphyrin IX methyl ester into Protochlorophyllide, which are intermediate steps in chlorophyll biosynthesis (Taiz & Zeiger, 1998). These findings are consistent with those of Ghoreishy *et al.* (2018), who found that wheat straw compost enhanced chlorophyll content in tomato seedlings.

Figure 8 illustrates the significant effect of the growing medium on the nitrogen concentration (%) in the vegetative part of tomato seedlings. Okra waste compost significantly outperformed the other media, providing the highest nitrogen concentration at 3.47%. Alhagi compost, wheat straw compost, and reed compost yielded average

nitrogen concentrations of 3.13, 2.68, and 2.39 %, respectively, compared to the commercial peat moss medium, which resulted in the lowest average concentration of 2.29%. The increased nitrogen concentration in seedlings grown in okra waste compost can be attributed to the essential nutrients contained in the medium, which enhance the plant's efficiency and ability to absorb nitrogen, thus elevating its levels in tomato seedlings. Additionally, potassium plays a crucial role in enhancing the seedlings' capacity to utilize nitrogen, thereby increasing its absorption rate. Moreover, the microorganisms present in the compost contribute to nitrogen fixation, making atmospheric nitrogen more available to the seedlings. These microorganisms also secrete growth regulators, including auxins, gibberellins, and cytokinins, which promote nutrient uptake by the plants, subsequently improving nitrogen absorption and increasing its concentration within the seedlings (Pepe *et al.*, 2013; Hasan *et al.*, 2024). These results align with the findings of Alam *et al.*, (2024).

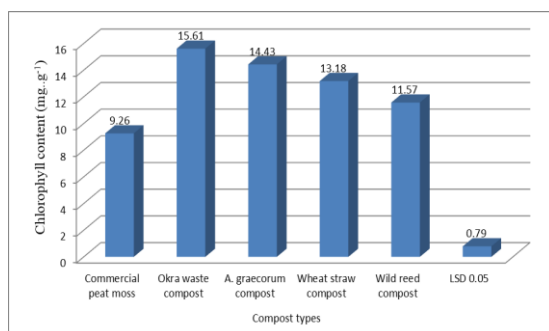


Figure (7) Effect of medium type on Chlorophyll content of tomato seedlings

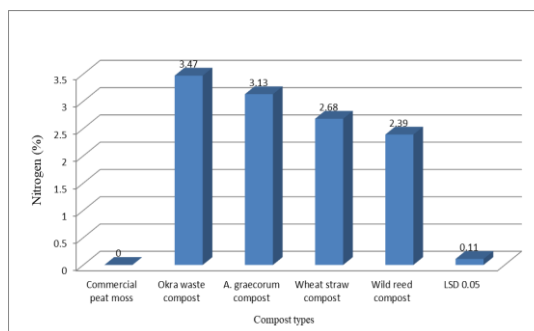


Figure (8) Effect of medium type on Nitrogen content of tomato seedlings

The effect of the growing medium on phosphorus concentration (%) in the vegetative part of tomato seedlings is illustrated in Figure 9. The results indicate a significant influence of the medium type on phosphorus concentration. Okra waste compost significantly outperforming all other media, yielding P concentration of 0.34%. This represents a percentage increase of 54.54% compared to the commercial peat moss, which provided phosphorus concentration of 0.22%, while Alhagi compost, wheat straw compost and reed compost yielded a P concentration of 0.31, 0.27, and 0.24%, respectively.

The observed increase in P concentration in certain media can be attributed to the high phosphorus content of okra waste compost. Phosphorus is well-known for its role in promoting root growth and expansion, which enhances nutrient absorption by seedlings, particularly phosphorus, due to the increased surface area of the root absorption zone. Additionally, the microorganisms present in the compost have the capability to dissolve phosphate compounds, thereby increasing phosphorus availability and absorption by the tomato seedlings. They also produce chelating compounds for iron and (IAA), which improve seedling growth and enhance nutrient absorption, including phosphorus, ultimately leading to increased phosphorus concentration (Samuel & Muthukaruppan, 2011; Nath *et al.*, 2017). This finding is supported by results of Ghoreishy *et al.* (2018).

The results presented in Figure 10 illustrate the effect of the growing medium on potassium concentration in the vegetative part of tomato seedlings. The data indicates that there is a significant difference in potassium concentration among seedlings growing in different media. Okra waste compost provided the highest average potassium concentration

at 3.16%. In contrast, Alhagi compost, wheat straw compost, and reed compost yielded average concentrations of 2.87, 2.52, and 2.23 %, respectively, compared to the commercial peat moss medium, which had the lowest average concentration of 2.10%. This difference can be attributed to the readily available potassium content in the compost medium, as indicated in Table 1, and its subsequent absorption by the seedlings, leading to accumulation in the vegetative part. Additionally, the microorganisms present in the compost have the ability to dissolve potassium compounds, increasing their availability in the root zone of the seedlings. These microorganisms also release plant growth regulators that promote seedling growth and enhance nutrient absorption, particularly potassium. Furthermore, their capacity to fix nitrogen and dissolve phosphorus contributes to increased availability and absorption of these nutrients, which ultimately supports improved seedling growth and potassium concentration within the tomato plants (Setiawati & Mutmainnah, 2016). These findings align with those reported by Alam *et al.* (2024).

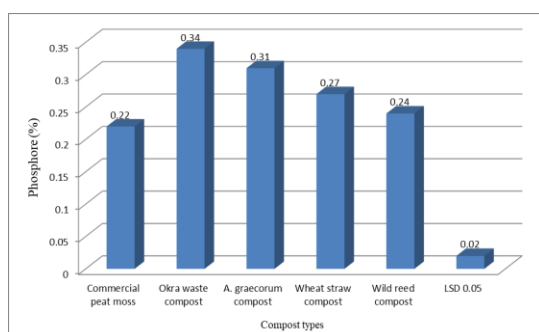


Figure (9) Effect of medium type on Phosphorus content of tomato seedlings

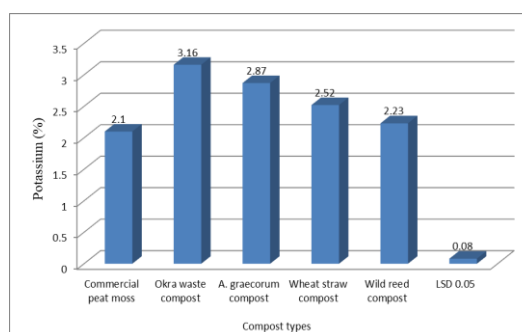


Figure (10) Effect of medium type on Potassium content of tomato seedlings

Figure 11 illustrates the activity of the enzyme polyphenol oxidase induced in tomato seedlings growing in various media. The results indicate that the type of medium significantly affects the activity of the induced polyphenol oxidase. The highest enzyme activity was observed in the okra waste compost, which significantly outperformed the other media, achieving an enzyme activity of 2.62 unit.ml⁻¹. In comparison, Alhagi compost, reed compost, and wheat straw compost exhibited enzyme activities of 2.25, 1.81 and 1.86 units/mL, respectively. The commercial peat moss medium showed the lowest induced polyphenol oxidase activity at 1.27.

Figure 12 illustrates the activity of the peroxidase induced in tomato seedlings grown in various media. The results clearly indicate that the type of medium has a significant effect on the activity of the induced peroxidase enzyme. The highest enzyme activity was observed in the okra waste compost medium, achieving an enzyme activity of 3.41 units/mL, followed by Alhagi compost, which showed an enzyme activity of 3.04 units/mL, while wheat straw compost and reed compost exhibited enzyme activities of 2.65 and 2.62 units/mL, respectively. The commercial peat moss medium demonstrated the lowest induced peroxidase activity at 2.06 units/mL.

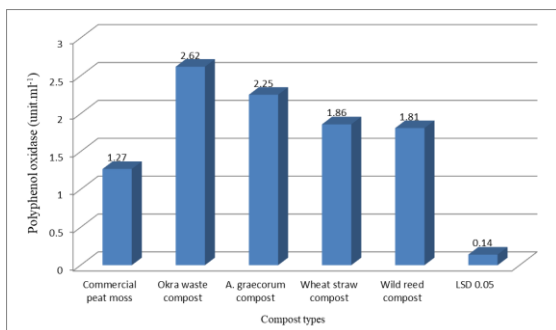


Figure (11) Effect of medium type on Polyphenol Oxidase activity of tomato seedlings

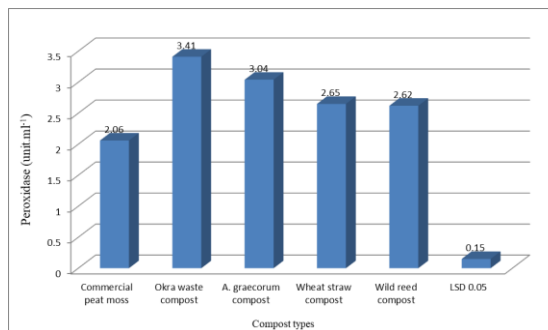


Figure (12) Effect of medium type on Peroxidase activity of tomato seedlings

Figure 13 illustrates the activity of the chitinase enzyme (units/mL) induced in tomato seedlings grown in various media. The results indicate that the type of medium has a significant effect on the induced chitinase enzyme activity. The local media showed higher enzyme activity in tomato seedlings compared to the commercial peat moss medium, with values of (2.58, 2.17, 1.77, and 1.73) unit.mL⁻¹ for okra waste compost, Alhagi compost, wheat straw compost, and reed compost, respectively. In contrast, the commercial peat moss medium exhibited the lowest enzyme activity at 1.14. The increased activity of the three induced enzymes in the seedlings grown in compost media, particularly the superiority of okra waste compost, can be attributed to the compost's provision of both biotic and abiotic conditions that influenced the enzymatic activity of the roots. Blaya *et al.* (2015) indicated that the improvement of both biological and physical properties of the growth medium can stimulate disease resistance genes in seedlings, subsequently leading to the activation of resistance-inducing enzymes in the roots. This aligns with findings from several studies (He *et al.*, 2020; Sahni and Prasad, 2020; Ahmed *et al.*, 2021; Ahmed *et al.*, 2022) who observed that the use of compost enhances the activity of polyphenol oxidase, peroxidase, and chitinase enzymes in the roots and leaves of various plants, including tomatoes and cucumbers.

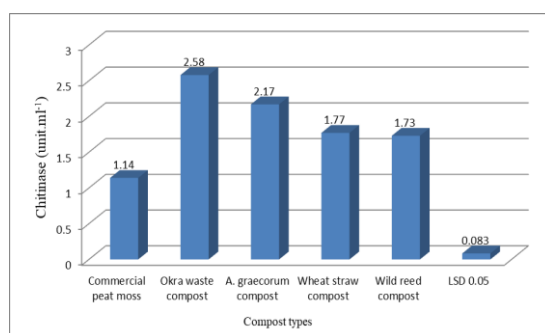


Figure (13) Effect of medium type on Chitinase activity of tomato seedlings.

CONCLUSION

Agricultural waste and weeds can be effectively utilized and transformed into an environmentally friendly product that contributes to the growth and yield of tomato crops. Local compost media outperformed the commercial peat moss medium in most growth characteristics. Okra waste compost provided the highest values for most growth traits.

The results also indicate that all types of compost can be used as media for seedling development, facilitating safe disposal of waste and reducing its negative environmental impacts, thereby contributing to sustainable agricultural practices.

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