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Okra Growth by Using Tamarind as Organic Fertiliser

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Abstract

Fruit waste is a significant issue affecting various stages of the food supply chain, from production to consumption. Fruit waste refers to the loss or disposal of fruits that are still edible but are discarded due to various reasons. This wastage occurs in both developed and developing countries and has detrimental environmental, economic, and social consequences. This study aims to evaluate the effectiveness of tamarind seed and tamarind shell as an organic fertilizer for Okra plant growth. By using Energy Dispersive X-ray Spectrometer (EDS) and Scanning Electron Microscopy (SEM) image, the presence of the element nitrogen (N) was only present in the tamarind shell by 9.65%. The growth for length and diameter is prominent by tamarind seed as fertilizer and for thickness, the tamarind shell has increased the growth by 43.4%. From this study, it can be concluded that the element nitrogen may not contribute to the overall growth of a plant but rather to certain criteria. This study offered important insights into the results of the composting project and offer suggestions for future composting and sustainable waste management initiatives.

1. Introduction

A natural or manufactured material called fertiliser contains chemical components that help plants grow and produce more. Fertilisers either restore chemical elements that previous crops removed from the soil or increase the land's inherent fertility. For healthy, green plants, fertiliser is essential. Single fertiliser, compound fertiliser, mixed fertiliser, and complete fertiliser are the four categories into which fertiliser is separated. A single fertiliser is one that provides just the one essential nutrient that plants require. One fertiliser contains either potassium, nitrogen, phosphorus, or both [1]. Due to their eco-friendliness, usability, non-toxicity, and affordability, bio-fertilizers have now shown to be very successful substitutes for chemical fertilisers. It enables plants to use naturally occurring nutrients that are abundant in the soil or environment and serves as a complement to agrochemicals. Biofertilizers are best defined as biologically active products or microbial inoculants viz., formulations containing one or more beneficial bacteria or fungal strains in easy-to-use and economical carrier materials which add, conserve, and mobilize crop nutrients in the soil. In other words, biofertilizer is a substance that contains living microorganisms which when applied to seed, plant surfaces, or soil colonizes the rhizospheres or the interior of the plant and promotes growth by increasing the availability of primary nutrients to the host plant [1].

One way to close the gap in global food supply and distribution is to reduce food waste, which has a significant influence on sustainability goals [2]. There are several ways to implement food waste management. One of them is home composting, which uses a natural decomposition process that takes place at room temperature and atmospheric pressure to handle organic food waste in a way that is the least harmful to the environment. Organic matter, nitrogen, phosphorus, potassium, and other chemical and physical parameters were assessed [3]. Food processing industries produce waste products, including solid waste, which are raw materials with lower economic values than repurposing. These wastes can be considered valuable by-products if technical means are available, and the value of the resulting goods exceeds reprocessing costs. The composition of waste in food processing facilities is significantly influenced by product type and production method. Canning sector waste has high sugar and starch content, while meat processing waste has high fat and protein content. Variations in waste amount and volume depend on the time of year, making it challenging to maintain a constant working process.

Tamarind (Tamarindus indica) is a globally produced tree crop that is economically significant yet underutilised. Due to their various applications and market demand, the tree and its processed products are traded in many cities and villages. In Malaysia and other parts of the world, the tamarind tree or its products are known by a variety of different vernacular names [4]. Almost every part of the tree is utilized in some way, including for food (such as drinks, jams, and curries), medicine, textiles, wood, fodder, and fuel. In Malaysia and other parts of the world, the tamarind tree or its products are referred to by a variety of different vernacular names [4]. Almost every component of the tree is utilized in some way, including food (such as drinks, jams, and curries), medications, textiles, wood, fodder, and fuel. Tamarind seed extracts can inhibit cancer-related signal pathways and induce antioxidant enzymes [5]]. Although very little has been done with tamarind fruit seed, it has a wide range of possible uses, including as an ingredient in food compositions. The remarkable gelling and adhesive qualities of decorticated seed powder make a wide range of uses in the food and pharmaceutical industries conceivable, as proven by the number of research articles and patent applications [6]. Okra is a tropical crop valued for its palatable green seed pods. It is also known as lady's finger, okra, bamia, and gumbo. It is a popular health food as it has high fiber vitamin C, folate, protein, calcium, and potassium content. Okra is renowned for having higher antioxidant content. Additionally, it helps alleviate goiter and is a great source of iodine. Fruits are beneficial for treating chronic dysentery, spermatorrhoea, and genitor-urinary problems [7].

2. Materials and Methods

The flow of this study is presented in **Fig. 1**. From tamarind fruit, was separated into tamarind seed and tamarind shell and grinded into fine powder. Two sizes for each tamarind seed and tamarind shell used in this study were classified as coarse powder (1.0µ) and fine powder (0.5µ). The tamarind shell for course powder is labeled as TSh1 whereas for tamarind seed is as TS1. The fine powder for tamarind shell and seed is labeled as TSh0.5 and TS0.5 respectively. Once a week, approximately 7g of tamarind seed powder and tamarind shell was then sprinkled on Okra plant soil for plants A, B (tamarind shell), plant C, D(tamarind seed), and plant E, and F for control. The growth of the Okra plant for both tamarind seed and tamarind shell was monitored for 8 weeks.

Fig. 2 and Fig. 3 shows the procedure for preparing the tamarind seed and tamarind shell sample for EDS and SEM analysis respectively.

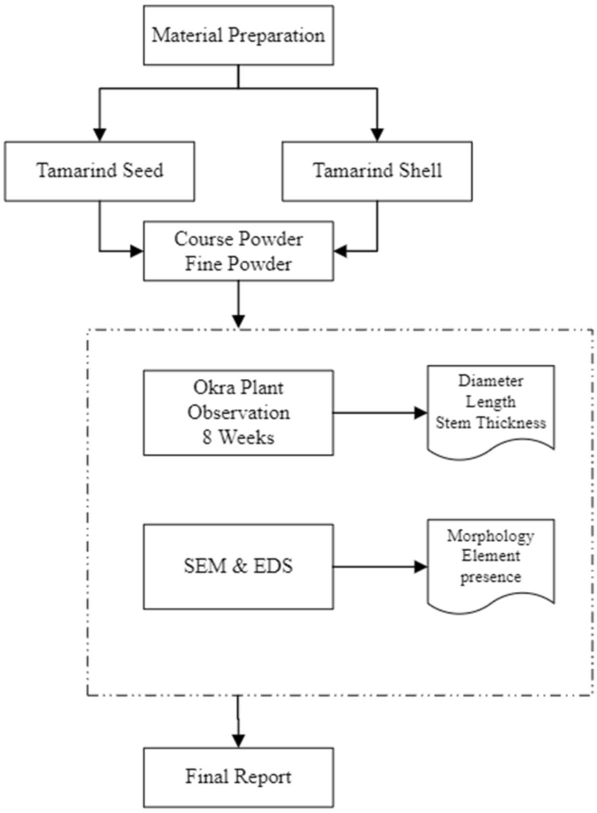


Fig. 1 *Flow chart of the study*

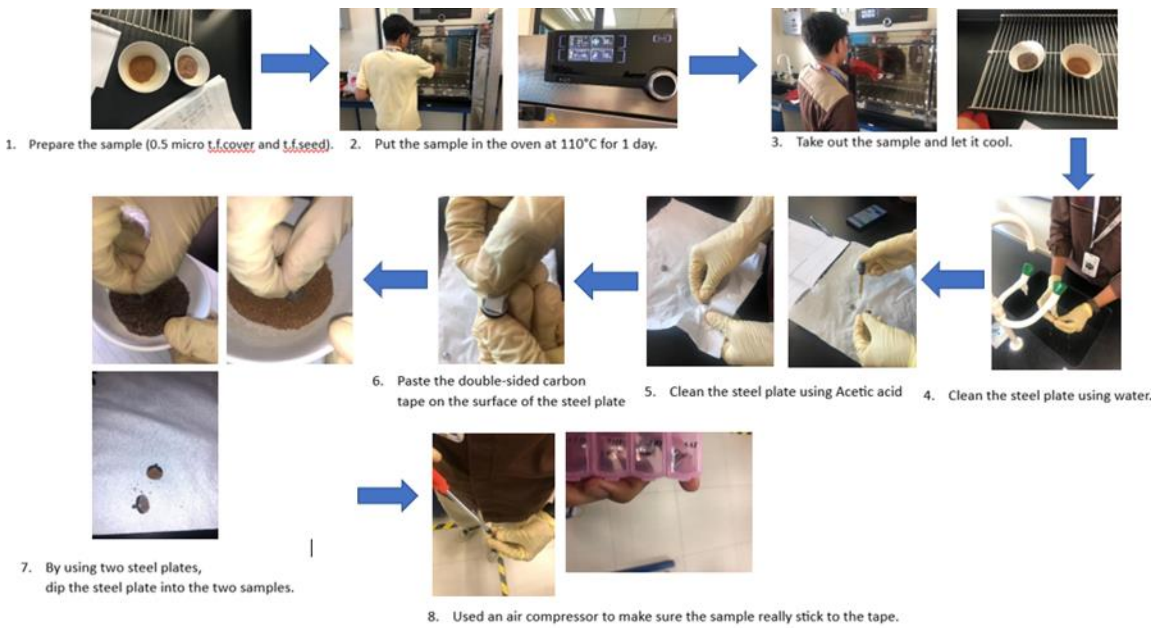


Fig. 2 *Procedure of preparing the sample for the test.*

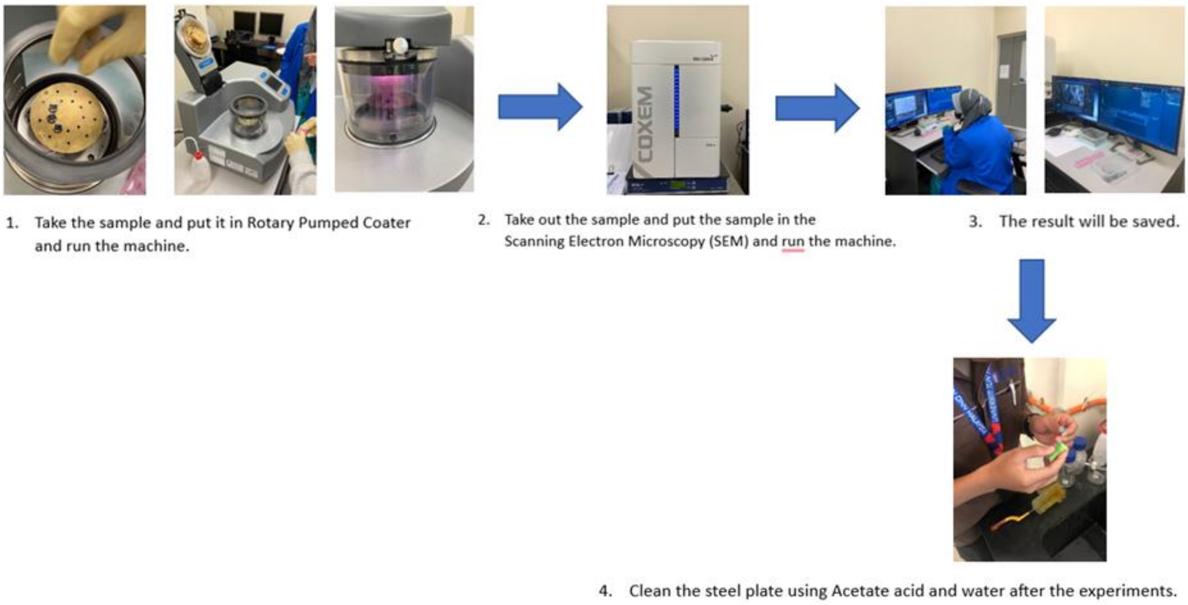


Fig. 3 *Procedure of coating and running the SEM test.*

2.1 Materials

The step by step of this study were presented as in **Fig. 4**. The fish and chicken protein waste were gathered from Pasar Tani Pagoh Jaya. The other materials needed were brown sugar, Yakult, and water. Brown sugar act as food for the microorganisms, Yakult act as an additional component in the compost as it promotes optimal plant growth and water for the mixing agent. All these ingredients were then mixed with the ratio of 5:1:10 and be prepared for the anaerobic process as shown in **Fig. 5**.

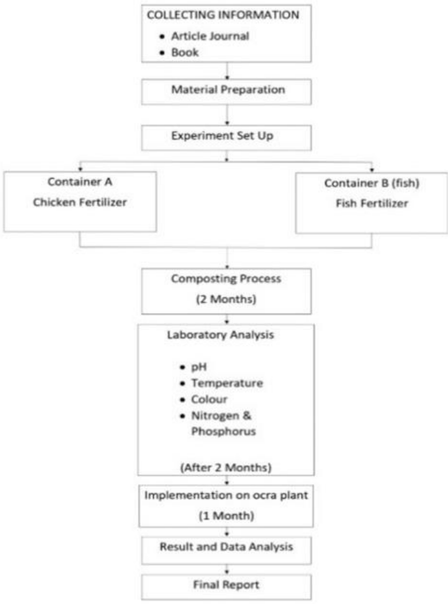


Fig. 4 *Flow chart of study*

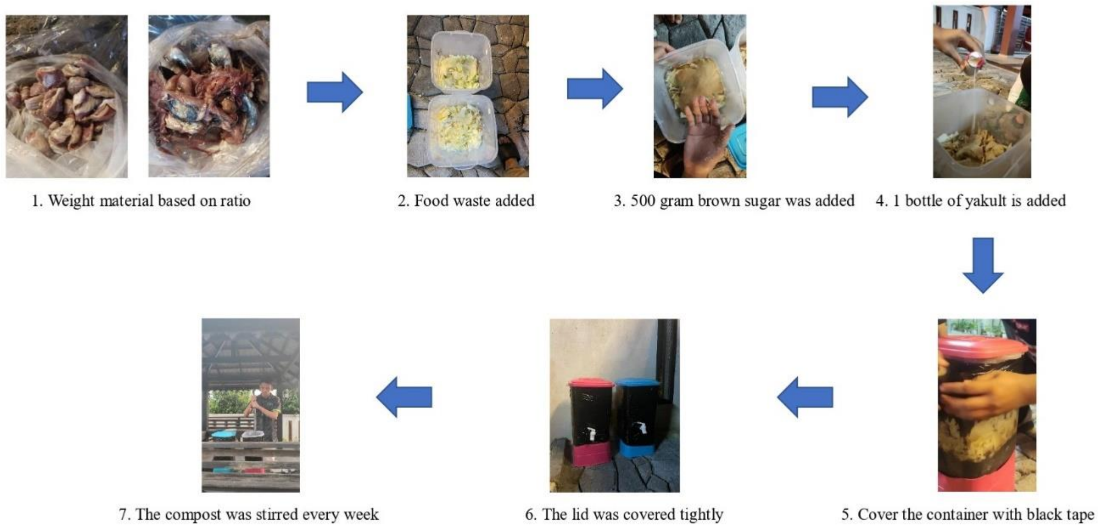


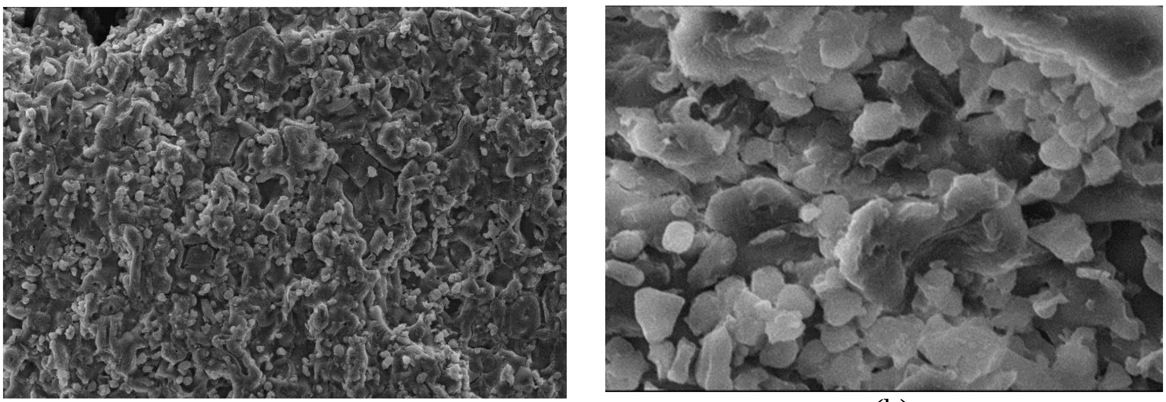
Fig.5 *Anaerobic composting procedure*

3. Results and Discussion

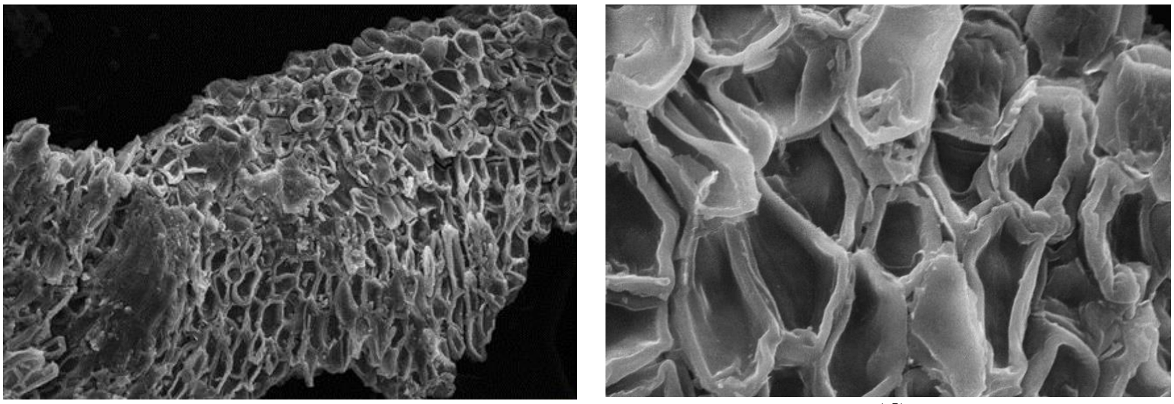
The goal of this study is to compare the growth of the Okra plants by using an organic fertilizer that is tamarind fruit seed and shell. The result of Okra plant growth, tamarind seed, and tamarind shell properties were discussed.

3.1 Morphology of Tamarind Seed and Tamarind Shell

The morphology for tamarind seed and tamarind shell obtained from SEM analysis is presented in **Fig. 6**. Based on the images, it shows both tamarind seed and shell have inhomogeneous structures. The Tamarind shell is more porosity than the tamarind seed which explains the tamarind shell is softer than the tamarind seed. The sizes of the particle observed for tamarind seed is ranging between 2.5 - 30µm and for tamarind shell the diameter of the pores ranges from 10 - 20µm.



(a) (b)

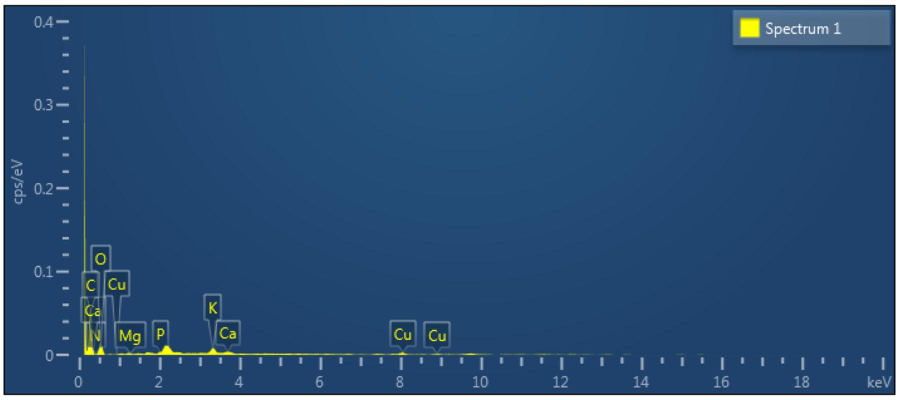


(c) (d)

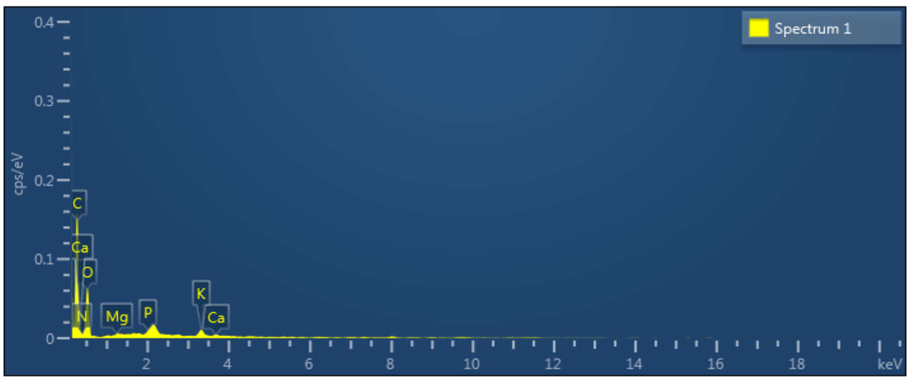
Fig. 6 *SEM analysis; (a) Tamarind seed 500 magnified, (b) Tamarind seed 2500 magnified, (c) Tamarind shell 500 magnified (d) Tamarind shell 2500 magnified.*

3.2 Elemental Composition of Tamarind Seed and Tamarind Shell

As determined by EDS, the prominent element discovered in tamarind seed and tamarind shell is presented in **Table 1**. **Fig. 7** shows the EDS image analysis for tamarind seed and tamarind shell respectively. The elements detected are oxygen (O), magnesium (Mg), nitrogen (N), potassium (K), calcium (Ca), phosphorus (P), and carbon (C). The C percentage in both tamarind seed and tamarind shell is higher compared to other elements. This may be due to the experimental setup where carbon was used to cover the sample. The second highest percentage in tamarind seed and shell is O where 44.13% and 27.72% respectively. The other elements show no significant difference between tamarind seed and tamarind shell. The N content percentage in tamarind shell is 9.65% whereas no N element is detected in tamarind seed. While the phosphorus content of both tamarind seed and tamarind shell is 0.00%. Given that tamarind peel has a higher nitrogen concentration than tamarind seeds, tamarind shell fertilizer probably promotes tree growth and according to [8], it is possible that tamarind seed fertilizer does not affect the growth of the tree [8].



(a)



(b)

Fig. 7 *EDS spectrum image for; (a) tamarind seed, (b) tamarind shell*

3.3 Okra Plant Growth

For a total duration of eight weeks, the Okra plant criteria such as length, diameter, and thickness were observed. **Fig. 6** to **Fig. 8** shows the length, diameter, and thickness of growth for each plant. The average growth of the Okra plant without any fertilizer is 15.95cm, 6.91cm, and 1.28cm in length, diameter, and thickness respectively. The growth for every criterion for all plants has increased each week yet on average, the TS1 has the highest percentage growth in length by 22.2% followed by TS0.5 with 14.4% (**Fig. 6**). As for the growth for diameter, TS0.5 has the highest increase with 3.92% followed by TS1 with 3.83% (**Fig. 7**). Although through the EDS analysis, N element was detected in tamarind shell and it is expected to have boosted the overall growth of the Okra plant, it may have contributed only to the thickness of a plant as only TS1 has the significant growth increased by 43.4% followed by TS0.5 with 28.5% (**Fig. 8**).

(a)

(b)

(c)

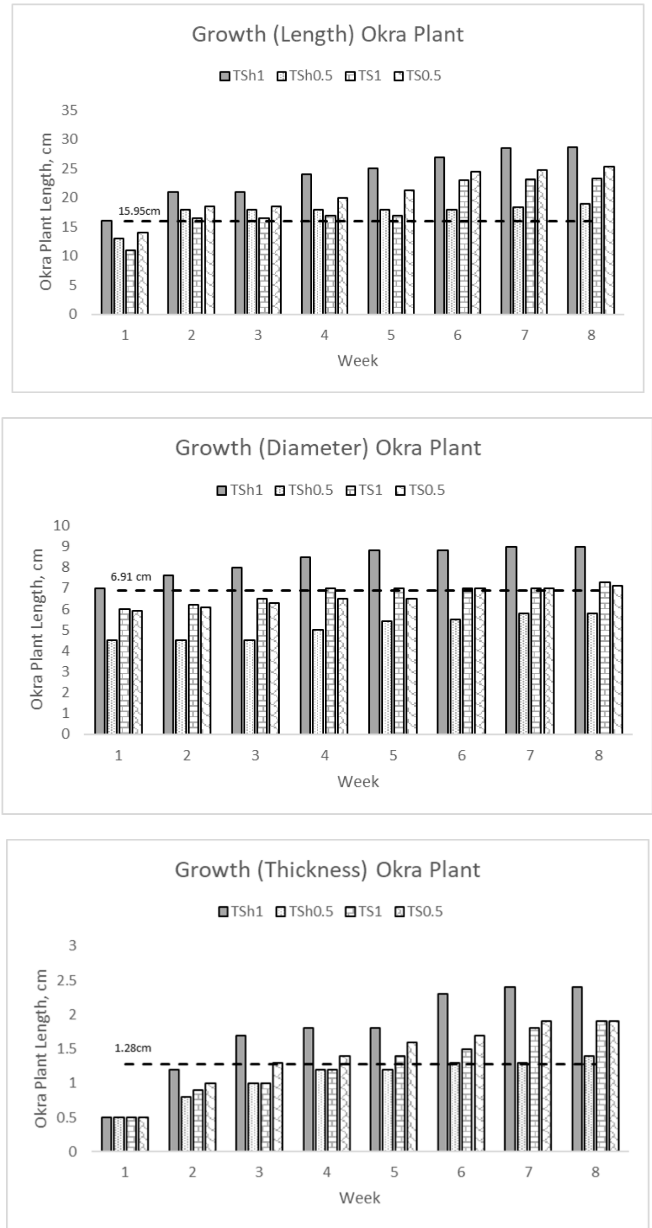


Fig. 8 *Okra plant growth for eight weeks for (a) Length, (b)Diameter and (c) Thickness*

4. Conclusion

Two types of organic fertilizer were investigated in this study: tamarind seed and tamarind shell. The performance of both materials was observed for eight weeks on the growth of the Okra plant in terms of its length, diameter, and thickness. By using the SEM analysis, the morphology of tamarind seed and shell can be justified and the element that exist in both tamarind seed and shell can also be known using EDS analysis. From the observation, the presence of nitrogen elements, may not contribute to the overall growth of a plant but rather only for certain criteria. Where the criteria growth for length and diameter using tamarind seed is more prominent than tamarind shell, the thickness of Okra plant using tamarind shell as fertilizer shows a significant increase of 43.4%. A difference of 20% from tamarind seed fertilizer. This study offered important insights into the results of the composting project and offer suggestions for future composting and sustainable waste management initiatives.

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Conflict of Interest

Authors declare that there is no conflict of interests regarding the publication of the paper.

Author Contribution

The authors confirm contribution to the paper as follows: ***study conception and design, data collection, draft manuscript, draft manuscript preparation:*** *Muhammad Najmi Abd. Hadi, Muhammad Hazim Hasnan, Nurul Afiz Che Hasan, Nor Farah Atiqah Ahmad. All authors reviewed the results and approved the final version of the manuscript.*

References

[1] Mazid, M., & Khan, T. A. (2015) Future of bio-fertilizers in Indian agriculture: an overview, *International Journal of Agricultural and Food Research, 3(3)*, 10-23.

[2] Rahul B Ingle, & Dr. Anoop D Shirbhate. (2021) A Review on Food Produce Waste Into Fertilizer, *International Engineering Journal For Research & Development, 6(ICMRD21),* 4. https://doi.org/10.17605/OSF.IO/8YX64

[3] Bratovcic, A., Zohorovic, M., Odobasic, A., & Sestan, I. (2018) Efficiency of food waste as an organic fertilizer, *International Journal of Engineering Sciences & Research Technology, 7(6), 527*-530.

[4] Chimsah, F. A., Nyarko, G., & Abubakari, A. H. (2020) A review of explored uses and study of nutritional potential of tamarind (Tamarindus indica L.) in Northern Ghana, *African Journal of Food Science, 14(9),* 285-294.

[5] Rao, A. S., Kumar, A. A., & Ramana, M. V. (2015) Tamarind seed processing and by-products. *Agric. Eng. Int.: CIGR J, 17,* 200-204.

[6] Murugan, M., & Subramanian, E. (2006) Studies on defluoridation of water by Tamarind seed, an unconventional biosorbent. *Journal of water and health, 4(4),* 453-461.

[7] Bhupenchandra, I., Basumatary, A., Choudhary, A. K., Kumar, A., Sarkar, D., Chongtham, S. K., & Rajawat, M. V. S. (2022) Elucidating the impact of boron fertilization on soil physico-chemical and biological entities under cauliflower-cowpea-okra cropping system in an eastern Himalayan acidic Inceptisol. *Frontiers in Microbiology, 13,* 996220.

[8] Razaq, M., Zhang, P., Shen, H. L., & Salahuddin. (2017) Influence of nitrogen and phosphorous on the growth and root morphology of Acer mono. *PloS one, 12(2),* e0171321.