Journal of Tourism, Hospitality and Environment Management
EISSN: 0128-178X JTHEM
Volume 10 Issue 42 (December 2025) PP. 12-20
DOI 10/35631/JTHEM.1042002

JOURNAL OF TOURISM, HOSPITALITY AND ENVIRONMENT MANAGEMENT (JTHEM)
www.jthem.com

THE EFFECT OF FRESH TEA WASTE FERTILISER (NON-COMPOST) ON MINT PLANTS GROWTH

Farah Najihah Razali[1*], Nur Fatin Ayuni Kamaruzaman[2]

[1] STEM Foundation Centre, Universiti Malaysia Terengganu, Malaysia
Email: farahn@umt.edu.my
[2] Faculty of Agrotechnology & Food Science, Universiti Malaysia Terengganu, Malaysia
Email: fatinayuni477@gmail.com
[*] Corresponding Author

Article Info:

Article history:
Received date: 30.09.2025
Revised date: 15.10.2025
Accepted date: 11.11.2025
Published date: 01.12.2025

To cite this document:

Razali, F. N., & Kamaruzaman, N. F. A. (2025). The Effect of Fresh Tea Waste Fertiliser (Non-Compost) on Mint Plant. *Journal of Tourism Hospitality and Environment Management, 10* (42), 12-20.

DOI: 10.35631/JTHEM.1042002

Abstract:

Mint plant is widely used in cooking and also medicinal use. Hence, ability to increase their production will meet the demand of mint plant in the market. There are various of organic fertilisers available and one of them is tea waste fertiliser. However, majority of the waste fertiliser used in studies were the composted one. This study highlights the effect of fresh tea waste (non-composted) on the growth of mint plant (number of leaves and number of branch and the w of this study is to determine the optimum concentration of fresh tea waste fertiliser on the growth of three groups of mint plant (T0, T1 and T2) in a period of 8 weeks. T0 is the control group, whereas T1 and T2 were supplemented with fertiliser at different concentration. Soil pH measures were taken to study if fertilisers had brought any effect on the plant soil pH. The results showed that there were significantly change in plant growth between the group of studies, rather it affects negatively. Both T1 and T2 showed a noticeable reduction in number of leaves and branches. Fresh tea waste supplies organic nitrogen and micronutrients and can increase soil organic matter however, it contains tannins and polyphenols that can be phytotoxic at high level. This explains the negative results shown in this study. Even though some studies recorded the drop in soil pH as tea can acidify the soil, however this study recorded that some fluctuation in soil pH but it rather insignificant. In short, we see some potential of fresh tea waste as an eco-innovative fertiliser that can support plant growth but some modification of the formulation of the fertiliser is needed in order to produce the positive results.

Keywords:

Tea Waste, Mint, Fertiliser

Journal of Tourism, Hospitality and Environment Management
JTHEM
EISSN: 0128-178X
Volume 10 Issue 42 (December 2025) PP. 12-20
DOI 10/35631/JTHEM.1042002

Introduction

Today's agricultural practice demands the sustainable and eco-friendly concept. This had spurred increasing interest of using the organic residues as the fertiliser as to promote the circular economy concept. According to the Sadi (2021), there are at least 168 million tons of biomass annually produce in Malaysia alone including oil palm waste, rice husk, coconut husk etc. Malaysians consume tea daily and is reported that the exports in volume rose from approximately 1035 tons in 2006 to 7291 tons in 2022 (Mohd Pakri, 2024). Tea waste which is generated abundantly by both household consumption and tea processing industries, represent one such underexploited residue. While majority of the tea waste went to landfills, some of the tea wastes were reused to treat water (tea as bioabsorbent to remove lead ions from waste water) (Revichandran & Baharuddin, 2022; Kabir et al., 2021). Also, there is a reported article using the tea waste as an alternative filler for natural rubber (Hayeemasae & Ismail, 2020). However, many of the studies were in small scales and not commercialise or widely applied.

Tea wastes are rich in organic carbon, nitrogen and various micronutrients as well as bioactive compounds (polyphenols and tannins), potentially making them suitable as a fertiliser. This will be a waste if one fails to utilise the nutrient within the tea waste. There were limited studies pointing out the high-value application of tea waste in agriculture. It remains poorly understood. Most studies focus on composted or processed forms rather than fresh/untreated waste (Wang et al., 2024; Tarashkar et al., 2023).

The uncertainties associated with fresh tea waste include phytotoxicity from tannins and polyphenols (Cakmak et al., 2024; Unyay et al., 2025), potential soil acidification (Sial et al., 2019; Alekseeva et al., 2011) and uneven nutrient release. Because of these risks, most research has shifted to composted tea amendments rather than fresh residues. This knowledge gap constrains the adoption of fresh tea waste as a practical organic fertiliser.

Given the widespread availability of tea waste and the growing demand for environmentally friendly fertilisation methods, it is crucial to quantify the direct effect of fertiliser on crops. In particular, mint plant are economically important aromatic and medicinal herbs whose growth, biomass and chemical composition are sensitive to soil fertility and nutrient supply (Tepecik et al., 2022)

The significance of this research is multifold. First, empirical evidence on using fresh tea waste can support waste-to-resource approaches, reduce disposal of tea residues and promote circular economy practices. Second, it may offer growers a low-cost and locally available organic fertiliser alternative to synthetic fertiliser. Finally, findings could inform similar application to other aromatic or medicinal crops with comparable nutrient and sensitivity profiles.

Therefore, the objective of this study is to evaluate of applying fresh tea waste as an organic fertiliser on growth parameters of mint. Secondly, to assess potential adverse effects related to soil pH shift, which might related to the phytotoxicity that may affect the growth of mint.

Journal of Tourism, Hospitality and Environment Management
EISSN: 0128-178X
JTHEM
Volume 10 Issue 42 (December 2025) PP. 12-20
DOI 10/35631/JTHEM.1042002

Literature Review

Tea Waste as an Agricultural Resource and its Effect on Soil Properties

The drive toward sustainable agriculture emphasised the recycling of organic waste materials as low-cost, eco-friendly alternatives to chemical fertiliser. Valorisation of organic waste is therefore a critical step in promoting soil health and food security. Tea waste is rich in organic carbon, nitrogen and polyphonic compound. In Malaysia, even though is it remain unreported, but authors believed that the tea waste were underutilised on its application beyond composting or biosorption. Unlike the composted tea waste, fresh forms may provide both immediate nutrient inputs and potential inhibitory effects on seed germination and early growth of plants.

Studies indicate that the waste can enhance soil fertility by supplying macronutrients (nitrogen, phosphorus and potassium) and improving organic matter levels. Its organic carbon content promotes microbial activity and water retention, contributing to better soil health (Sial et al., 2019; Tarashkar et al., 2013). However, fresh tea waste may also lower the soil pH and release polyphenols, which can negatively affect microbial balance and plant root development when applied excessively (Yuan et al., 2017).

Plant Growth Responses to Tea Waste Application

The impact of tea waste on plants varies by crop and applications. Positive effects such as increased biomass, leaf area and chlorophyll content have been reported when moderate amount of tea waste were applied to crops like cowpea and capsicum (Ibrahim & Abed, 2018). Conversely, excessive use of fresh tea waste has been associated with phytotoxic effects, including reduced germination and inhibited growth, likely due to its high caffeine and tannin concentration (Tarashkar et al., 2023). Mint plant, as economically valuable aromatic herb is widely cultivated for culinary, and other industrial purposes. Their growth and particularly secondary metabolites which is essential oil yield are highly depending on their soil nutrient status, which, to extrapolate depending on fertiliser used. Organic fertiliser such as compost and manure had been shown to enhance both biomass and essential oil yield in mint (Al-Amri et al., 2021). Recent studies also demonstrate that different fertilisation regimes significantly influence mint's essential oil composition and nutrient uptake (Tepecik et al., 2024). However, there remains limited research on the specific application of tea waste to mint crops.

Journal of Tourism, Hospitality and Environment Management
EISSN: 0128-178X
JTHEM
Volume 10 Issue 42 (December 2025) PP. 12-20
DOI 10/35631/JTHEM.1042002

Materials and Methods

Overall Flow Chart of Methodology

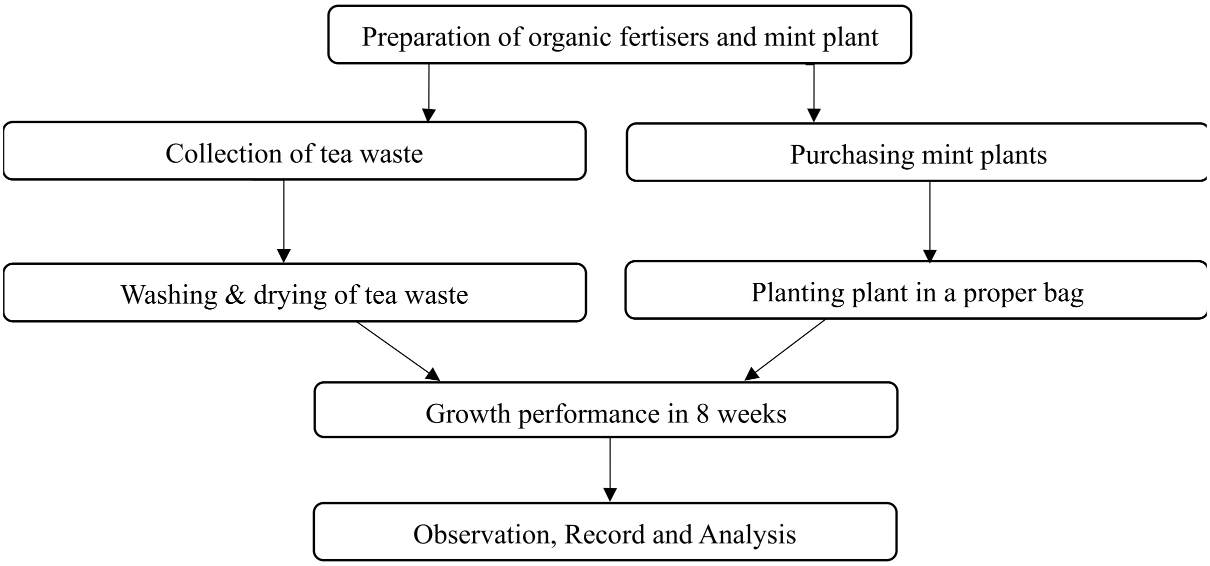

Figure 1: The Flowchart of Overall Methodology

Preparation of Fresh Tea Waste Fertiliser

The tea waste was washed thoroughly to remove any impurities within the spent tea waste (Figure 2). The washing and cleaning process was repeated several times until the leachate become nearly colourless. This is a very crucial steps as this will reduce the caffeine content in the tea leaves, as excessive caffeine may inhibit plant growth (Zaine, 2023). Afterwards the tea waste was oven-dried at 70 °C for 24 hours, ensuring drying without significant loss of nutrient content. Once dried the tea waste was stored in a sealed container and kept in a dry and airtight container until further use. This is to prevent the moisture absorption.

Figure 2: Tea Waste Post-Cleaning Process

Journal of Tourism, Hospitality and Environment Management
JTHEM
EISSN: 0128-178X
Volume 10 Issue 42 (December 2025) PP. 12-20
DOI 10/35631/JTHEM.1042002

Data collection

Mint plants were selected as test subjects to evaluate the effectiveness of organic fertilizer in this study. A total of three groups (labelled as T0, T1 and T2) with three replicates each were studied (Figure 3). Each group received either no fertilizer at all (control group, T0) or fertilisers with different ratio (T1 and T2). The tea waste fertilizer were applied twice per week during the 8-week cultivation period, commonly reported in previous studies (Kavitha & Subramaniam, 2020; Salim et al., 2023). Data on the number of branches and leaves were recorded weekly for 8 weeks. In mint (*Mentha* spp.), plant height is not a reliable indicator of growth performance because the species typically grows as a low-stature, spreading herb rather than a tall, upright plant. Instead, parameters such as the number of branches and number of leaves provide more accurate measures of vegetative growth and biomass accumulation. Branch proliferation directly reflects the plant's ability to expand its canopy, while leaf production is closely associated with photosynthetic capacity and overall vigor. Since mint is primarily cultivated for its foliage, these traits are also agronomically significant, serving as direct indicators of yield quality and productivity (Nurmalasari et al, 2025). The summary of the fertiliser application is listed in Table 1. Soil pH reading were taken weekly

Figure 3: Mint Plants Under Different Treatment.

Table 1: Fertiliser Application In Different Three Groups Of Mint Plant

Treatment	Description	Composition of soil and tea waster fertiliser
T0	No fertiliser is added	1:0
T1	Tea waste fertiliser	1:1
T2	Tea waste fertiliser	1:2

Results and Discussion

Figure 4 illustrates the weekly progression of leaf number in mint plants, recorded over successive weeks. In the early stages, the saplings showed vigorous growth, with each plant producing more than 20 leaves. This performance likely reflected their healthy initial condition and the inherent resilience of young mint plants (Alam et al., 2017).

Journal of Tourism, Hospitality and Environment Management
JTHEM
EISSN: 0128-178X
Volume 10 Issue 42 (December 2025) PP. 12-20
DOI 10/35631/JTHEM.1042002
However, the experimental treatments — specifically branch fragmentation and the application of fresh tea waste fertilizer — induced visible stress and reduced plant vitality. Breaking branches may have disrupted structural stability and photosynthetic efficiency. Since mint relies on its branching system to support leaf production and nutrient transport, excessive trimming or damage can inhibit development and trigger stress responses such as reduced leaf expansion, stunting, or leaf abscission (Chishti et al., 2013).

The use of fresh, undecomposed tea waste further exacerbated these effects. Fresh organic residues often contain phytotoxic compounds such as caffeine, tannins, and elevated ammonia, which are known to negatively affect plant growth and soil microbial balance (Morita et al., 2024; Çakmak et al., 2024). Moreover, because the material had not been composted, decomposition occurred directly in the soil, consuming oxygen and creating localized anaerobic zones or chemical imbalances that can damage roots and suppress overall plant performance (Sial et al., 2019).

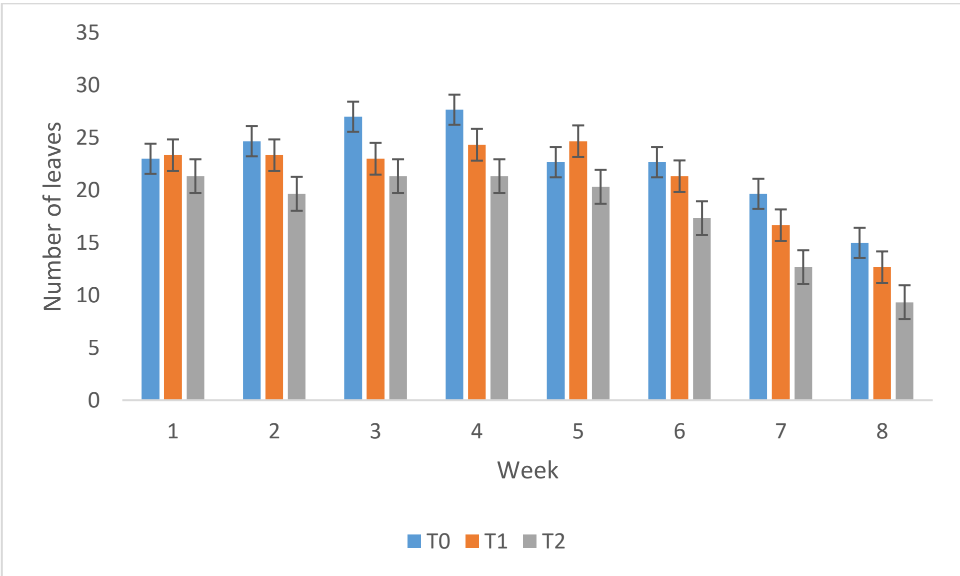

Figure 4: Number Of Leaves Under Three Different Treatments Over A Period Of 8 Weeks

To date, there were no known reported studies to explain the relationship between the reduce number of branches over supplemented with fresh tea waste fertiliser. But there *are* several plausible mechanisms by which fresh tea waste could cause branch number to drop. One of them is microbial effects. Fresh organic wastes can bring in microbes, or stimulate microbial activity that consumes oxygen or releases harmful metabolites. If root pathogens or suppressive microbes become more active, branch formation might be reduced.

Journal of Tourism, Hospitality and Environment Management
JTHEM
EISSN: 0128-178X
Volume 10 Issue 42 (December 2025) PP. 12-20
DOI 10/35631/JTHEM.1042002

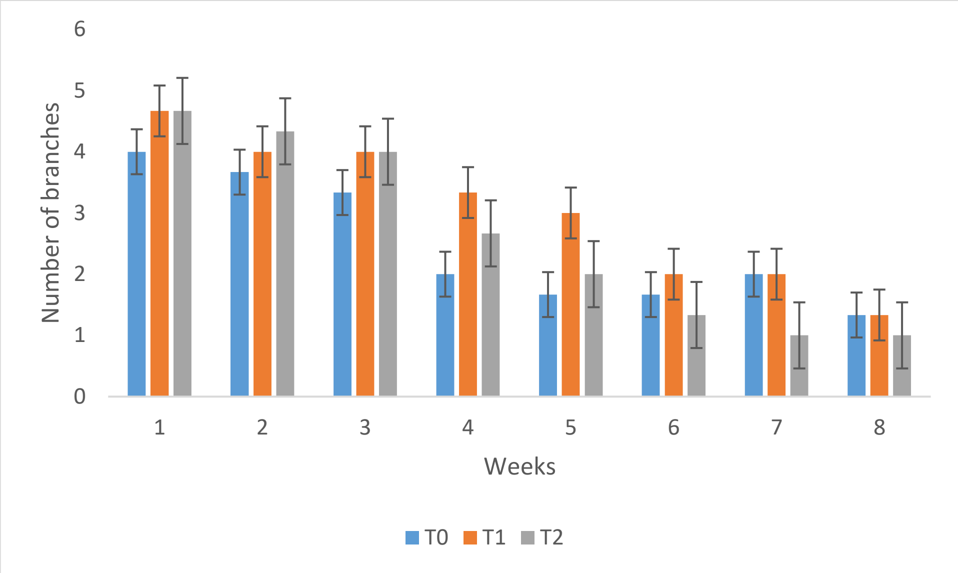

Figure 5: Number Of Branches Under Three Different Treatments Over A Period Of 8 Weeks

There were no significant change ($p > 0.05$) in soil pH upon supplemented with the fresh tea waste fertiliser (Figure 6). This is could be due to this reason. When fresh tea waste is applied to soil, it often causes an initial drop in soil pH, because the waste contains organic acids and polyphenolic compounds that release H^+ ions into the soil solution. For instance, Tarashkar et al. (2023) found that tea waste charcoal (TWC) reduced the pH of alkaline soils (initial pH ≈ 8) upon amendment (Tarashkar et al., 2023). Over time, as microbial decomposition proceeds, some of the acidity is neutralized by mineralization, consumption of protons, and soil buffering reactions. Soils contain buffer systems (e.g. exchangeable bases on clay and organic matter) that resist drastic pH changes, and over weeks to months the pH "recovers" partially toward the original value. That is why there was no significant change in the soil pH over weeks and over different treatment.

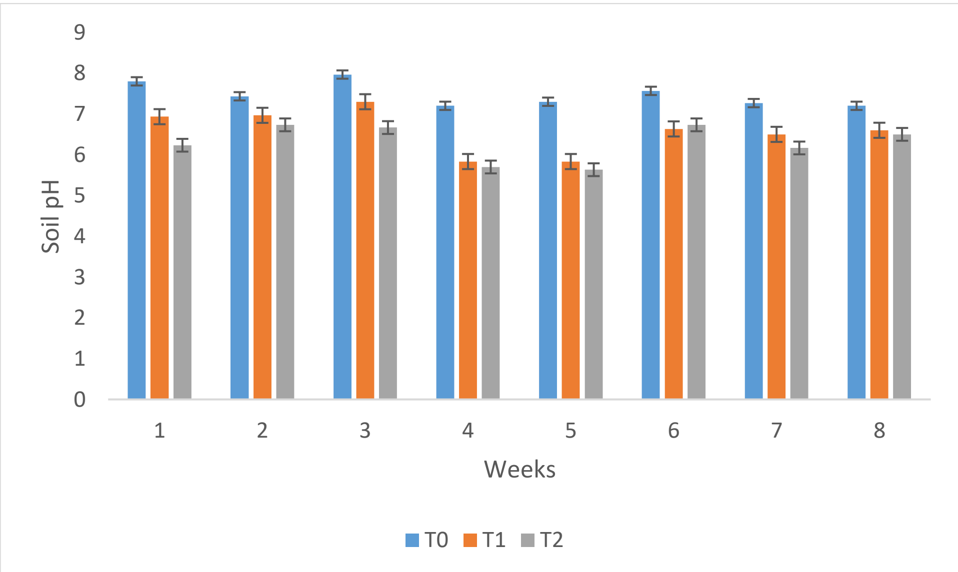

Figure 6: Soil Ph Under Three Different Treatments Over A Period Of 8 Weeks

Acknowledgements

Special appreciation goes to the laboratory staff and technical assistants at STEM Foundation Centre for providing the necessary facilities and assistance during the experimental work. I would also like to extend my gratitude to my colleagues and friends, for their helpful discussions, motivation, constructive feedbacks and cooperation in overcoming challenges during this project.

References

Alam, M. K., Islam, M. S., Rahman, M. M., & Hossain, M. A. (2017). Growth and yield of mint (*Mentha spicata* L.) as affected by organic and inorganic fertilizers. *International Journal of Agronomy and Agricultural Research, 10*(2), 22–29.

Al Amri, S. (2021) Response of Growth, Essential Oil Composition, Endogenous Hormones and Microbial Activity of *Mentha piperita* to some organic and Biofertilisers Agents. *Saudi Journal of Biological Science* (28), 5435-5441

Alekseeva, T., Alekseev, A., Xu, R. K., Zhao, A. Z., Kalinin, P. (2011) Effect of Soil Acidification induced by a Tea Plantation on Chemical and Minerological Properties of Alfisols in Eastern China. *Environmental Geochemical Health,* (33) 137-148

Cakmak, T. G., Saricaoglu, B., Ozkan, G., Tomas, M., Capanoglu, E. (2024) Valorisation of Tea Waste: Composition, Bioactivity, Extraction Methods and Utilisation. *Food Science Nutrition,* (12), 3112-3114)

Chishti, S. A., Shah, A. H., & Kaloo, Z. A. (2013). Effect of organic manures and chemical fertilizers on growth and yield attributes of mint (*Mentha arvensis* L.). *International Journal of Scientific and Research Publications, 3*(4), 1–5.

Hayeemasae, N., Ismail, H. (2019) Utilisation of Tea Waste as an Alternative Filler for Natural Rubber. *Jurnal Teknologi. (*82) 109-115

Ibrahim, N. S., Abed, R. B. (2018) Effect of the Organic Fertilisation by Using Home Tea Residue and the Bio fertilisation with *Aspergillus Niger* Fungus on the Growth and Yield of Chili Pepper (*Capsicum Annuam*). *Journal od Biology, Agriculture and Healthcare,* (8), 1-9

Kabir, M. M., Mouna, S. S. P., Akter, S., Khandaker, S., Didar-ul-alam, M., Bahadur, N. M., Mohinuzzaman, M., Islam, M. A., Shenashen, M. A. (2021). Tea Waste Based Natural Adsorbent for Toxic Pollutant Removal from Waste Samples. *Journal of Molecular Liquids* (322) 1-16

Kavitha, D., & Subramanian, S. (2020). Utilization of organic waste tea as compost and its effect on plant growth. *International Journal of Recycling of Organic Waste in Agriculture,* (9), 45–52.

Mohd Pakri, M. A., Suhaimee, S., Mohammad Nor, N. A. A. (2024) Transformation of the Tea Industry in Malaysia. Food and fertiliser Technology center for the Asian and Pacific Region Agricultural Policy Platform.

Morita, R., Yamamoto, K., Kondo, M., & Nishimura, S. (2024). Co-composting bamboo powder and tea leaves: Effects of polyphenols on composting dynamics and phytotoxicity. *Waste Management, 168,* 71–80.Nurmalasari, P. A. I., Nurfiansyah, P. H. M. M. F. (2025) Growth and Yield of Mint (*Mentha spicata)* as Affected by Composition of Charcoal Husk and Organic Fertiliser. *Planta Tropika.* (13) 15-25.

Revichandran, T., Baharuddin, N. H. (2022). Simulation Study of Lead Removal from Wastewater by Using Tea Waste as Biosorbent. *London Journal Press.* (22),39-49

Journal of Tourism, Hospitality and Environment Management
JTHEM
EISSN: 0128-178X
Volume 10 Issue 42 (December 2025) PP. 12-20
DOI 10/35631/JTHEM.1042002
Sadi, T. (2020) The Challenges in Repurposing Food Wastes and Other Residuals for Agriculture. Food and fertiliser Technology center for the Asian and Pacific Region Agricultural Policy Platform

Salim, M., Ahmad, N., & Yusoff, W. M. W. (2023). Effect of compost tea on the growth performance of selected herbs. *Horticulturae*, 9(3), 984.

Sial, T. A., Liu, J., Zhao, Y., Khan, M. N., Lan, Z., Zhang, J., Kumbhar, F., Akhtar, K., Rajpar, I. (2019) Co-application of Milk tea Waste and NPK Fertilisers to Improve Sandy Soil Biochemical Properties and Wheat Growth. *Molecules,* (3), 423

Tarashkar, M., Matloobi, M., Qureshi, S., Rahimi, A. (2023) Assessing the Growth-Stimulating Effect of Tea Waste Compost in Urban Agriculture While Identifying the Benefits of Household Waste Carbon Dioxide. *Ecological Indicators,* (151) 1-11

Tepecik, M., Esetlili, B. C., Ozturk, B., Anac, D., (2022) Effect of Different Fertilisers on Peppermint- Essential and Non-Essential Nutrients, Essential Oils and Yield.

Tunklova, B., Jenicek, L., Malatak, J., Neskudla, M., velebil, J., Hnilicka, F. (2022). Properties of Biochar Derived from Tea Waste as an Alternative Fuel and its Effect on Phytotoxicity of Seed Germination for Soil Applications. *MDPI,* (15) 1-16.

Unyay, H., Altay, H. O., Perendeci, N. A., Szufa, S., Ozdemir, F., Angelidaki, I. (2025) Valorisation Potential of Black tea Processing Wastes for Bioactive Compounds Recovery and Renewable Energy Production. *Journal of Environmental Chemical Engineering,* (13)1-13

Wang, Z., Ahamd, W, Zhu, A., Zhao, S., Ouyang, Q., Chen, Q. (2024) Recent advances review in tea waste: High-value Application, Processing Technology and Value-added Products. *Science of the Total Environment.* (946)

Yuan, S., Zhang, N., Wu, X., Qian, Y., Chen, X., Raza, W., Li, X. (2017) Effects of pruned Material, Extracts and Polyphenols of Tea on Enzyme Activities and Microbial Community Structure in Soil. *Soil Science and Plant Nutrition.* (63) 607-615

Zaine, M. Z., Abu Shah, M. N., Juan, D. (2023). Performance Study of Tea Waste as Nutrient Rich Organic Fertilisers. *Borneo Engineering & Advanced Multidisciplinary International Journal*, 116–121.