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ORIGINAL RESEARCH

Growth performance of roselle (*Hibiscus sabdariffa*) under application of food waste compost and Fe_3O_4 nanoparticle treatment

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Abstract

Purpose Utilization of food waste as composting materials offers a sustainable solution to manage waste and reduce reliance on fertilizers.

Method This study is focused on the efficiency of food waste compost and the effect of the addition of magnetite (Fe_3O_4) nanoparticles on the growth and heavy metals uptake by roselle (*Hibiscus sabdariffa*) for the cultivation period of 127 days. Five different treatments were applied, namely soil (S), food waste compost (F), a mixture of soil and Fe_3O_4 (SM), a mixture of soil and food waste compost (SF), and a mixture of soil, food waste compost, and Fe_3O_4 (SFM).

Results After 127 days of cultivation, the plant height averaged at 803 mm with 26 leaves produced across all treatments. Total leaf area, fruit production, and biomass yield were different ($P < 0.05$) among the treatments. Roselle crops grown under soil and food waste (SF) media produced the highest yield (12.15 g/plant), the most number of fruits (11 fruits/plant), and the highest leaf area (1200 cm^2/plant). The accumulation of heavy metals in plant tissues was lower than the toxicity levels. There was no difference in the heavy metal content in all growing media, except for Ni, Mn, and Pb. Roselle crops applied with Fe_3O_4 showed no difference ($P > 0.05$) from its control (without Fe_3O_4) in relation to growth performance.

Conclusion The findings of this study showed that food waste can be applied in composting to promote plant growth. Therefore, it can be considered as a substitute for chemical fertilizers. Meanwhile, the application of Fe_3O_4 appeared to be experimental-condition dependent.

Keywords Food waste · Magnetite · Organic fertilizer · Plant growth · Soil amendment

Introduction

Food waste (FW) surplus, which is estimated to be over one million tons every year, is commonly managed via landfilling. Landfilling is regarded as an environmentally unsustainable solution due to its high energy requirement and large land space utilization (Moh and Manaf 2014; Chew et al. 2018). In Malaysia, FW is classified under municipal solid waste, which accounts for 45% of the total waste produced (Manaf et al. 2009; Aja and Al-Kayiem 2014). Landfilling has been the most preferred technique for handling 80–95% of the municipal solid waste in Malaysia (Aja and Al-Kayiem 2014). According to Jereme et al. (2013), Malaysians end up throwing up to 930 tons of unconsumed food daily, and most of these food wastes are generated by households, wet and night markets, restaurants, hotels, and others.

As opposed to landfilling, composting may offer a sustainable and eco-friendly solution to overcome these issues, apart from enhancing soil productivity, yield, and growth of crops (Petersen et al. 2003), and reducing reliance on fertilizers (Lin et al. 2013). Many countries have considered turning FW into compost as a way to overcome disposing FW in landfills or incineration (Cerda et al. 2018). Composting can be regarded as an effective way to handle FW by turning them into value-added products for agricultural application. By converting FW into compost, the organic contents in FW, such as carbohydrates, starch, cellulose, proteins, lipids, as well as nutrients (e.g., nitrogen and phosphorus) can be utilized as organic fertilizers or as soil amendments.

Various factors may, however, contribute to the quality of FW compost as the sources of FW vary by their heterogeneous compositions, sources, and the eating habits of

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