Optimizing Waste Management Practices: Incorporating Fly Ash in In-Vessel Composting of Agricultural and Municipal Solid Waste

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Abstract:

The present research was aimed to utilize the organic waste comprising the agricultural and municipal solid wastes (MSW) with fly ash (FA) in a sustainable manner through an in-vessel composting system, thereby producing a nutrient rich soil conditioner i.e., compost. Initially, the assessment of FA as a potential additive for in-vessel composting of agricultural waste was conducted.

It was perceived that the substrate combination of 20 % FA, 30 % kitchen waste (KW), 50 % biomass waste (BW) and 5 % jaggery is the best combination and is also proposed to utilize these combinations for reducing the bioavailability of heavy metals thereby enhancing the soil productivity. Subsequently, the effect of FA on compost quality was ascertained by assessing the microbial and enzymatic activities in the in-vessel composting system.

It was observed that the substrate combination of compost comprising 50 % BW, 30 % KW, 20 % FA, and 50 g jaggery exhibited maximum microbial and enzymatic activities with a good

compost quality. In the next set of experiment, the combined effect of FA and garbage enzymes (GE) on rapid composting of organic solid wastes was analysed and it was found that the substrate with a combination of 20 % FA, 50 g jaggery with brown and household waste in the ratio 9:1 showed better results in terms of organic matter degradability and C: N ratio (13.68) of the final product.

A high-rate thermophilic composter (HRTC) was designed and developed indigenously using the locally available materials. Four identical units of HRTC were fabricated which were exposed to different temperatures of 40 ℃, 45 ℃, 55 ℃, and 65 ℃, respectively by keeping the aeration rate and organic waste feedstock composition constant. From the results, it was found that the temperature exposure of 55 ℃ and maintaining the moisture content 70 % for nine days with artificial ventilation of ambient air at the rate of 4 litre per minute (LPM) in the HRTC for the complete composting cycle was found to be best performing combination.