ABSTRACT

Rapid industrialization and urbanization has resulted into a drastic escalation in waste generation, disposal of which has become a major concern. Moreover, it has amplified the burden on agriculture sector for increased crop productivity, resulting which farmers have aggravated the use chemical pesticides, and fertilizers to increase their productivity and protect crops from disease causing pathogens. This modern farming practice has resulted into serious human health and environmental impacts. It has therefore become essential to switch over to environmental friendly methods for waste disposal and plant nutrition and disease management. Acknowledging the ubiquitous nature of microorganisms and their importance in natural environments, utilizing their potential to mitigate these problems can be an encouraging approach. Composting is a microbiological process for converting waste into a nutrient rich product (humus/compost). However, a rapid composting method that employs the use of bioinoculants for compost production in short duration is need of the hour. Waste generated from oil industries (non edible oil cakes) also opens great avenues in the field of composting and agriculture. In this context, the current work investigated the potential of some efficient microorganisms (Trichoderma asperellum, Paecilomyces variotii, Azotobacter chroococcum, Pseudomonas fluorescens and Lactobacillus casei Shirotai), earthworms and non edible oil cakes in rapid composting of kitchen waste and plant disease management.

Interaction studies between the selected microbial consortia revealed that all the three bacteria viz., L. casei Shirola, P.fluorescens and A. chroococcum, showed positive interaction with the fungi (P. variotii and T. asperellum). However negative interaction was seen between the two fungi viz., T.asperellum and P. variotii, which clarified that these two fungi couldn’t be employed together for rapid composting. The interaction of earthworms with microbes and non edible oil cakes were also found to be positive. Microbial consortium involving the lignocellulolytic fungi P.variotii and T.asperellum separately along with three bacteria L. casei Shirola, P.fluorescens and A. chroococcum, earthworms and jatropha cake (1%) produced quality compost within a reduced time span (60 days). The nutrient contents (TKN,
Pav, Kav) and the degradation components (cellulose, hemicellulose) were found to be far better than the other treatments involved. L. casei Shirota played an important role in eliminating foul odor during composting and also reduced the E.coli count in the final compost generated. Application of talc based formulations of the selected microorganisms also resulted in production of quality compost. All the microbes (bacteria and fungi) recorded a count of 10^6 cfu/g till 6 months after which the count declined.

Amongst the non edible oil cakes (karanja, neem, mahua and jatropha cake), jatropha cake emerged as the best non-traditional solid substrate for culturing microorganisms and producing lignocellulolytic enzyme (celluase and xylanase) by solid state fermentation. Optimization studies under controlled lab conditions revealed that P. varioti recorded highest cellulase (Fpase: 27.37 IU/g; CMCase: 383.95 IU/g) and xylanase (4842.93 IU/g) activities on deoiled jatropha cake. Combination T3 i.e. P. varioti as the lignocellulolytic fungus along with the three bacteria (L. casei Shirota, P. fluorescens, and A. chroococcum) gave the highest xylanase activity (10.656 IU/g) whereas, T4 with T. asperel lum as the lignocellulytic fungi along with the three bacteria gave highest FPase (6.52 IU/g) and CMCase (7.71 IU/g) activities during the vermicomposting of kitchen waste. Emergence and role of black solder flies (BSF) larvae in waste decomposition disclosed that they have an important role in solid waste decomposition but generate a low nutrient content product. The earthworms also did not survive in the presence of these larvae.

Amongst all the selected efficient microorganisms, both the fungi (P. varioti and T. asperel lum) emerged as potent candidates as biocontrol organisms against wilt causing pathogens viz., Fusarium oxysporum and Verticillium dahliae. T. asperel lum showed better antagonism with inhibition percentage of 72 and 66% in dual plate assay followed by 63.23 and 56.48 % in non volatile assay and 33.38 and 53.38% in volatile assay against F. oxysporum and V. dahliae respectively. High cell wall degrading enzymes viz., chitinase (202.68 µ moles/ml/min) and β-1, 3 glucanase 381.48 µ moles/ml/min) were produced by T. asperel lum. GC-MS studies also revealed the production of volatile antifungal metabolites by both the biocontrol fungi (T. asperel lum and P. varioti).
Amid all the vermicomposts produced, vermicompost IV (Derived from *A. chroococcum*, *P. fluorescens*, *L. casei* Shirota, *T. asperellum* and 1% jatropha cake) gave excellent results for growth parameters of tomato plant in terms of plant height (66.33 cm), biomass (48.00 g) and fruit yield (118.04 g). Highest disease reduction against *Fusarium* and *Verticillium* wilt was also attained by vermicompost IV.

This current study revealed that the integration of bioinnoculants and jatropha cake played a pivotal role in rapid composting of kitchen waste and produced quality compost in 60 days. The compost produced had dual role of providing plant nutrients and as a biopesticide against *Fusarium* and *Verticillium* wilt.