Abstract

The proliferation of terrestrial weeds, such as *Ageratum conyzoides*, *Parthenium hysterophorus*, and *Lantana camara*, presents noteworthy ecological and economic complexities on a worldwide scale. In this study, an attempt has been made to convert these invasive, toxic terrestrial weeds into a value-added agricultural product. The study has been performed in three distinct phases. Phase I comprises the biodegradation of the terrestrial weeds through the rotary drum composting (RDC) process and the assessment of heavy metals (HMs) in bioavailable, leachable, and chemical speciation fractions in the course of the RDC process. The RDC process was efficient in increasing the nitrogen, phosphorus, and potassium contents and competent in reducing the lignocellulosic biomass in the final compost product. The RDC was efficient in reducing the bioavailable and leachable fractions of HMs. Furthermore, chemical speciation study reveals the increase in HMs concentration in residual fraction (F5). Phase II comprises the toxicity assessments, such as phytotoxicity, cytotoxicity, and genotoxicity assays, during the RDC of terrestrial weeds. The assays conform to the optimal dose of 25% of the compost product in the soil. This phase also includes the identification, quantification, and transformation of toxic organic compounds during the RDC of terrestrial weeds. Toxic organic compounds such as stigmasterol, caryophyllene oxide, farnesene, ageratochromene, and diethyl phthalate have been reduced in the final compost product. Phase III comprises the application of terrestrial weeds compost (TWC) onto the soil through pot study and field-scale study approaches. The application of TWC to the soil and plants has shown an increase in soil organic carbon, cation exchange capacity, germination rate, yield rate, and reduction in HMs and have not detected toxic organic compounds in the fruits of *Abelmoschus esculentus* and *Solanum lycopersicum*. The study presented in this thesis can efficiently treat toxic terrestrial weeds, improve soil health, and be used as a soil conditioner.

Keywords: Terrestrial weeds; Rotary drum composting; toxic organic compounds; Heavy metals; toxicity assessments; GC-MS; GC-FID; dosage optimization