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Research article

Indigenous biobed to limit point source pollution of imidacloprid in tropical countries

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ABSTRACT

Point pollution of pesticides originating from the washing of spraying machines could be controlled by biobed system and it is in use in temperate countries. The biobed system is yet to be established in tropical countries. An indigenous biobed system was prepared using local resources like rice straw, farm yard manures (FYM) and paddy field soil to suit the tropical climate. Lowermost 3 cm layer of the biobed system was filled with rice husk biochar to prevent leaching of pesticides from the system. This model system was tested with high doses of imidacloprid (178 mg/column), a commonly used pesticide against number of insect-pests in different crops, for its degradation. The bio-mix trapped a major part of the imidacloprid on the top most layer of the biobed column and only a very small part of imidacloprid recovered from the leachate. The biobed system could degrade 70.13% of applied imidacloprid within 15 days of the experiment and only 5.27% of the total pesticide recovered 90 days after incubation. Addition of biochar layer adsorbed imidacloprid from the outgoing leachate from the biobed column. Biomixture boosted microbial activity more particularly fungal population, which might be responsible for imidacloprid degradation. Microbial biomass carbon, and soil enzymes indicated faster dissipation of imidacloprid from the top layer of the biobed. This simple but efficient biobed system using local resources can fulfill the need of the small and marginal farmers of Asian countries for pesticide decontamination.

1. Introduction

Application of synthetic pesticides is most widely practiced method to improve the crop production, and makes food affordable. The cost of food production might be doubled without the application of pesticides (Wu and Sardo, 2010). Simultaneously, mishandling of pesticides can contaminate both ground and surface water (Schulz, 2004). The point source contamination is major threat to environment as the amount of pesticides released from the spraying equipment can heavily affect the water source. De Wilde et al. (2010) reported 40–90% of the surface and ground water contamination is because of washing and cleaning of spraying equipment and vehicles. In addition to water, the pesticides also get accumulated in soil. This may lead to change in soil physio-chemical properties. There is an urgent need to tackle the point pollution originating from the farm field. Mostly, pesticides are removed from waste waters through adsorption mechanism using low cost adsorbents like resins, activated charcoal etc. (Kyriakopoulos et al., 2006; Kyriakopoulos and Doulia, 2007). This method is not suitable for degradation of pesticides to non-toxic metabolites. Whereas, bio-mixtures or biobed systems are being used widely for decontaminating pesticides. Biobed is a Swedish innovation for safer pesticide handling (Spliid et al., 2006). It is inexpensive, simple and efficient way to control the pesticide contamination on a particular area. At present it is more developed and implemented in several countries by different names. This technology has higher pesticide degradation capacity due to enhanced microbial activity.

The component of biomixtures in biobed system should be efficient enough to trap and degrade pesticides in shorter period by the promotion of increasing microbial activity (Castillo and Torstensson, 2007). The original Swedish biomixture contains wheat straw, soil and peat at the volumetric ratio of 50:25:25. In biobed system, the straw is the main substrate which harbors microbes to degrade pesticides. The straw acts

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