MINIMIZING ON-FARM POINT SOURCE CONTAMINATION OF PESTICIDES USING THE "BIOBED" METHOD

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ABSTRACT

Microorganisms play a vital role in maintaining the environmental quality through their metabolic activities. The highly versatile metabolic capabilities of fungi and bacteria can be used to reclaim polluted ecosystems. A variety of biological, chemical, and physical methods have been used for degradation and detoxification of pesticides. However, conventional clean- up methods are costly and not always effective. Agrochemical storage and handling practices have been targeted as a potential point source contamination of soil and groundwater. Use of "biobed" to contain and biodegrade pesticides may be a cost-effective alternative. A biobed is an in-ground treatment unit designed to contain spills of pesticides and degrade the chemicals through microbial activity. Microbial activity may be enhanced by altering conditions conducive to degradation. In this study, the technical potential of using biobed was evaluated in a series of *ex-situ* experiments using small scale biobeds with mixtures of "top soil, peat, and straw" as substrate. Herbicides used included glyphosate, atrazine, acetochlor, and metolachlor, the most widely used herbicides for agronomic crops. The herbicide-degrading potential of the biobed substrate mixtures was determined by analyzing sub-samples to measure residual herbicide concentrations. The greatest concentration of herbicide residue found when organic matter was included in the biobed media, especially when 50% of the media volume comprised of peat. The results of enzyme activity indicated that addition of straw as carbon source in the biobed media enhanced acid and alkaline phosphatases activities and the activity was correlated with the amount of straw added.

Keywords: Point-source contamination, pesticides, biobed, enzyme activity

INTRODUCTION

Pesticide pollution problem arise not only from deliberate use in agriculture ("non-point" source), but also, from accidental spillage, improper storage, handling and disposal of pesticides. This includes improper disposal of wastes from clean up of pesticide application equipment and storage containers, leaks at

pesticide dumpsites, and discharge of wastes from production facilities. Such contamination can occur on large commercial farms and on small farms ("point" source). Objectives included : 1) Determine the influence of organic matter on the degradation of selected pesticides under biobed conditions; 2) Determine the enzyme activities of the biobed media as related to the pesticide degradation.

MATERIALS AND METHODS

Soil samples (Aeric Fluvaquents) were collected from Lincoln University's Carver Farm in Jefferson City, Missouri. Small-scale biobeds were constructed using stainless steel containment trays. The biobed media was prepared as described by Torstensson, (1997). Soil was mixed with peat and straw as sources of organic matter. The combinations used in the study are presented in Table 1. Pesticides, glyphosate, atrazine, acetochlor, and metolachlor were applied to the media in solutions prepared at label rates, and incubated under controlled conditions. Pesticide residue were measured using a pesticide analyzer (Ohmicron RPA III portable photometer) and appropriate reagent kits. Enzyme activities were measured using methods described by Tabatabai (1994).

RESULTS

Results indicate that degradation of all tested herbicides was rapid and extensive. Biobed appears to be a technically sound alternative for containment and degradation of pesticides at mixing and loading facilities. The degradative performance of biobeds toward several of the most commonly used herbicides in the U.S. was exceptional, particularly for the most heavily used herbicide in the U. S., atrazine. The results of enzyme activity indicated that addition of straw as carbon source in the biobed media enhanced acid and alkaline phosphatases activities and the activity was correlated with the amount of straw added. In general, enzyme activity is indication for enhanced respiration rate and microbial population which in turn explains the enhanced degradation of the hebicides under different biobed composition.

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