ADSORPTION AND DEGRADATION OF PESTICIDES IN A BIOMIX USABLE AS BIOBID

Monaci E.¹, Vischetti C.¹, Capri E.², Nicelli M.², Cardinali A.¹, Trevisan M.², Casucci C.¹, Perucci P.¹

¹ Department of Environmental Sciences and Crop Production – Università Politecnica Marche-Ancona – Italy
² Institute of Agricultural and Environmental Chemistry – UCSC – Piacenza – Italy

INTRODUCTION

Biodig is an economic and easy bio-prophylaxis system filled with a mixture of topsoil, peat and straw (25%-25%-50%) designed to prevent water bodies from pesticide ‘point sources’ contamination. In order to adapt this biological system to a vineyard farm in Italy it needs to find a peat-substitute organic substrate for degrading pesticides mixtures at high concentrations. Organic residues (urban waste or garden compost, agricultural residues etc.) contain numerous and diverse active micro-organisms. This high variability means a high probability that a pesticide can encounter in a degrading microbial pool. Further municipal waste compost showed a good pesticides retention capacity.

RESULTS AND DISCUSSION

Adsorption and Degradation rate

The adsorption parameters found for CH were one hundred times higher than M.
M and CH showed half-lives values higher in the biomin than in soil.
No concentration effect was found in the degradation rate between CH(10) and CH(50).

The co-application of the two pesticides had a synergistic effect on CH degradation rate reducing CH half life from 87.7 to 57.7 days and from 88.8 to 56.8 days in (M(100)+CH(10)) and (M(100)+CH(50)) treatments respectively. No synergistic effect was found for M.

MATERIALS AND METHODS

A biomix constituted by urban waste-garden compost, vine-branch and topsoil (40/40/20 v/v, 2 mm, 60 WHC, pH 7.6, C/N = 13.58) was treated with:
- Chlorpyrifos \(K_{we} = 4.7\); solubility \((H_2O) = \text{1.4 mg/L}\) at 10 and 50 ppm (\(CH(10); CH(50)\)
- Metlaxyl \(K_{we} = 1.65\); solubility \((H_2O) = \text{6.4 g/L}\) at 100 ppm (\(M(100)\)
- their co-application: \([M(100)+CH(10)]; [M(100)+CH(50)]\)

and incubated at 20°C for 1, 7, 14, 21, 35, 65, 90 and 120 days

Untreated biomix samples in the same experimental conditions was used as control.

Studies of:
- Adsorption parameters: batch-equilibrium experiments (CaCl2 0.02M/biomix): M (1, 2, 4, 8 ppm): CH (2, 5, 10, 50, 100 ppm)
- Degradation parameters
- Biochemical parameters:
  Microbial Biomass Carbon (MBC) = Fumigation-Extraction (FE) method

Total Hydrolic Activity = FDA-Hydrolysis

RESULTS AND DISCUSSION

Total Hydrolic Activity (T.Hy.A.)

An initial increase of FDA-hydrolysis was observed in all treated samples. However after 7-14 days of incubation T.Hy.A. returned on the same level of the control value except in CH(50) where FDA-hydrolysis remained 20% lower for all the incubation period. It was hypothesized that: 1) the initial activity increase was due to the hydrolyses released by microbial cells death; 2) a T.Hy.A. inhibition effect exerted by the highest CH concentration on a part of the biomix microflora.

Microbial Biomass - C

The MBC patterns observed were different for each pesticide and their co-application. In particular CH(50) caused the highest MBC initial decreases (after 1 day) when individually applied ( - 60% of MBC initial value) and in co-application with M (- 40% of MBC initial value). Anyway this parameter returned at the control value when total pesticides residues reached 40% of the initial concentration, except for M(100) where MBC remained lower (about 60% of the control value) for all 120 days of incubation.

It was hypothesized the presence of two different CH and M tolerant/degrading microbial pool that seemed to show a synergistic degradation activity when the two pesticides are co-applied.