PESTICIDE PERSISTENCE AND ENZYME ACTIVITIES IN SOILS AMENDED WITH VERMICOMPOSTS FROM WINERY WASTES

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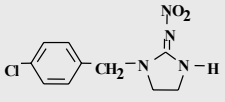
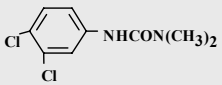
OBJECTIVES

1. To evaluate the effect of vermicomposts, from winery wastes, on the transformation rate of diuron and imidacloprid in a Mediterranean soil.
2. To determine the effect of both pesticides on soil enzyme activities (Dehydrogenase, urease, β-glucosidase and phosphatase) as bioindicators of soil quality.

IMIDACLOPRID



DIURON



EXPERIMENTAL DESIGN

An incubation experiment was carried out using a calcareous, silty clay loam soil (Chromic Vertisol) with low organic carbon (0.93%) and pH 8.2 (S). New vermicomposts (Table 1) obtained from spent grape marc (GM) and vinasse biosolids-vine shoot (Bvs) were used as organic amendments.

Soil samples (40g), in triplicate, unamended and amended with the two vermicomposts at 5% were homogenized in glass flasks. Imidacloprid (I) and Diuron (D) were added, separately, at normal dosage (3.2 μg g^{-1} dry weight) and homogenized. Soil samples without pesticides were used as controls. Soil samples were watered at 80% field capacity and incubated at 20ºC. At different incubation times (0, 3, 7, 14, 32 and 47 and 61days), three pots of each treatment (S, SGM, SBvs, SI, SGMI, SBvsI, SD, SGMD, SBvsD) were taken. Samples of each pot were divided into three parts: one part was extracted for pesticide analysis with ACN:Water(60:40), another with water and third part was stored in a plastic vial at 4°C until enzyme activities were determined.

ANALITICAL MEASUREMENTS

Carbonates, texture, pH, COT, NKT: MAPA, 1986

Lignin, celullose and hemicelullose: Goering and Van Soest, 1970

total extractable carbon (TEC) Humic acids (HA): Dabin, 1971

Chromatographic analysis (HPLC-DAD): Romero et al., 2006.

Dehydrogenase and Urease: García et al., 1997; Nannipieri et al., 1980.

β-glucosidase and phosphatase: Nannipieri et al., 1982

Table 1. Characteristic of the vermicomposts from winery wastes

	pH	TOC g kg^{-1}	TEC g kg^{-1}	HA g kg^{-1}	TKN g kg^{-1}	Lign. g kg^{-1}	Hemic. g kg^{-1}	Cel. g kg^{-1}
GM	6.8	344	62	35	16.0	434	68	103
Bvs	7.3	295	247	146	26.0	255	108	69

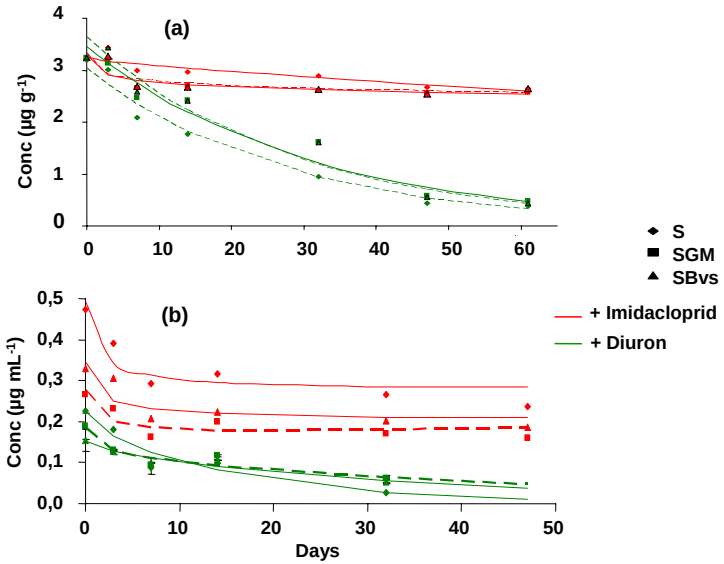


Figure 1. Experimentals data and theoretical curves of imidacloprid and diuron remained in the no amended (S) and amended soil samples (SGM and SBvs) (a) and in their corresponding aqueous solutions (b).

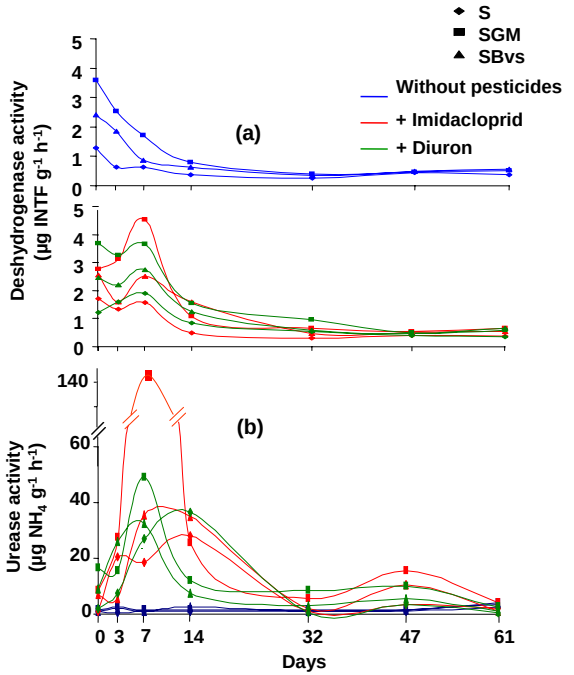


Figure 2. Evolution of dehydrogenase (a) and urease activities (b) in the no amended (S) and amended soil samples (SGM and SBvs) in presence of imidacloprid and diuron.

RESULTS

•Degradation kinetics of diuron and imidacloprid revealed different persistence and bioavailability of these pesticides in the soil samples. Degradation curves fit biphasic model (Hoerl equation) adequately ($R^2 > 0.767$; $P<0.01$) except for the diuron reamined in the soil samples that fit also a monophasic equation (Figure 1a and 1b).

•The addition of the vermicompost to the soil initialy enhanced the dehydrogenase activity following the sequence SGM > SBvs > S (Figure 2a), thereafter declined slowly during the first 14 days and then stabilized.

•The dehydrogenase activity, as a measurement of the total microbial activity, in presence of both pesticides increased in the three soil samples during the first 7 days, decreasing quickly in the next seven days, and remaining constant after 47 days of incubations (figure 2a).

•Vermicomposts did not modify the soil urease activity. Nevertheless, the addition of the pesticides increased this activity during more than 14 days (Figure 2b). The great increment obtained at day 7 for imidacloprid can be due to its imidacloprid-urea metabolite which promoted the synthesis of new enzyme.

•Significant correlations were obtained between the pesticide concentrations in the aqueous extracts of the soils samples and the urease activity.

•No effect was observed in the soil β-glucosidase and phosphatase activities neither the addition of vermicomposts or pesticides.

CONCLUSIONS

1. Imidacloprid persisted longer than diuron in the soil samples.
2. Recent residues of imidacloprid and diuron were more available to be enzymatically degraded than older residues.
3. Vermicompost initially enhanced the deshidrogenase activity in the amended soil samples and both pesticides increase this activity.
4. Imidacloprid and diuron stimulated the urease activity, being this effect more pronounced when the soil had been amended with vermicompost from spent grape marc.
5. Urease activity explained 100% and >80% of the variability in the concentrations of diuron and imidacloprid, respectively, in the soil aqueous samples.

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