DEGRADATION OF PACLOBUTRAZOL IN TROPICAL SOILS

Célia Maria Maganhotto de Souza Silva; Elisabeth Francisconi Fay; Vera Lúcia Ferracini
Embrapa Meio Ambiente, Rodovia SP-340, Km 127,5, Caixa Postal 69, Jaguariúna, SP. CEP 13820-000. celia@cnpma.embrapa.br

Abstracts: In northeast of Brazil, the paclobutrazol. has been widely developed for cropping manipulation to mango tree, to spread production and exploit better prices during the off-season. In spite of this popular use, no studies on its environemntal fate, in this soils, have been reported. The purpose of this study was to investigate the potential of tropical soils of brazilian northeast with and without previous exposure to paclobutrazol to degrade the growth regulator. Different soils, with and without a history of paclobutrazol treatment, were collected in commercial mango tillage for export, in Petrolina, Pernambuco state. The enrichment medium contained 8µg.g^{-1} of paclobutrazol and: K_2HPO_4, 0.8; KH_2PO_4, 0.2; $MgSO_4$-$7H_2O$, 0.2; $CaSO_4$, 0.1; $(NH_4)^2SO_4$, 2.5; and $(NH_4)_6 Mo_{24}$-$4H_2O$, 0.001, was used to isolate microorganisms. The depletion of the substrate was evaluated after 7, 15, 30, 60 and 90 days of cultivation. Soil with paclobutrazol history demonstrated better capacity degradative when collected at deep 20cm.

INTRODUCTION

Xenobiotics are, by definition, unnatural compounds that are synthetized by the man. This behavior in soil is governed by various parameters. Of primary importance are the chemical, structural, and physical properties of the molecules themselves, such as their water solubility, dissociation constants, and vapor pressure. This compounds generally have no, or at least transitory effects on soil microflora when applied at recommended rates (Schäffer, 1993). At excessive concentrations the effects can be either inhibitory or stimulatory. The microbial population in soil at such a site may be eliminated , significantly reduced or otherwise altered. Microbes may have adapted to the presence of potentially toxic compounds and can survive by degrading them.

The paclobutrazol [(2RS, 3RS) -1- (4-chlorophenyl)-4,4-dimethyl-2-(1H- 1,2,4-triazol-1-yl) pentan-3-ol] is one class of plant growth regulators that affect both vegetative and reproductive components of fruit tree growth (Tomlim, 1994). This compound is subject to degradation in soils trated with the growth regulator. This fact has been demonstrated in eight agricultural soils collected in Tasmania (Jackson et al., 1996). The ability of several bacterias to degrade paclobutrazol in pure and mixture cultures also been demonstrated, and the results indicated that the growth rate of all enriched isolates on this compound was slow, all growth curves being diauxic. Also been demonstrated the combinated effects of organic pollutant on microbial activities of a loam soil (Gong et al., 1996). Joint effects of paclobutrazol were not significant, and may be covered by others biotic or abiotic factors.

In northeast of Brazil, paclobutrazol has been found to have particular value on mango and has been widely developed for growth control to reduce prunning, and for cropping manipulation to spread production to exploit better prices during the off-season. Then more and more farmers are

switching to the use of this organic compound to manage their mango crop each year. In spite of this popular use, no studies on its environemntal fate, in this soils, have been reported.

The purpose of this study was to investigate the potential of tropical soils of brazilian northeast with and without previous exposure to paclobutrazol to degrade the growth regulator.

EXPERIMENTAL

Different soils, with and without a history of paclobutrazol treatment, were collected in commercial mango tillage for export, in Petrolina, Pernambuco state. The enrichment culture technique was used to isolate microorganisms from soil. The enrichment medium contained $8\mu g.g^{-1}$ of the test compound paclobutrazol (PP-333) and ($g.L^{-1}$ of distilled water): K_2HPO_4, 0.8; KH_2PO_4, 0.2; $MgSO_4$-$7H_2O$, 0.2; $CaSO_4$, 0.1; $(NH_4)^2SO_4$, 2.5; and $(NH_4)_6$ Mo_{24}-$4H_2O$), 0.001, pH 7.05. They were inoculated with 10g dry weight of soil. Cultures were supplemented with 0.5% yeast extract.. Each flask contained 100mL of the culture were incubated with shaking (30°C, 180rpm, orbital shaker), for 3 days, in order to allow the biomasses to grow and reach 140mg ± 10% (dry weight). At this satge, samples from a 3-days-old culture (growth in enrichment medium) were placed in 250mL Erlenmeyers flasks, containing 100mL of enrichment medium suplemented with PP-333, to give initial densities of 10^4 or 10^5 cells per mL. The process was repeated more one time.

The depletion of the substrate was evaluated after 15, 30, 60 and 90 days of cultivation. Each serie of experiments was run at least in triplicate and cell-free flasks were incubated for abiotic degradation assessment. The dissipation of the product was monitored by HPLC.

RESULTS AND DISCUSSION

Assessment of paclobutrazol degradation: as shown in the Table 1, the results obtained demonstrated that there was a variation in the values of the degradation rates of paclobutrazol. The soil with history of application of the compound (C) appeared to be the most efficient in their degradation, and the degradation percentage ranged from 35 to 43% for 60 and 90 days after application. It is possible that the repeated use could give raise to adaptation of the soil microflora which is the responsible for the accelerated biodegradation.

The results also revelated that the paclobutrazol was easily biodegradeted at the depth of 20-cm. This fact can be attributed to the depth of applicaton of the compound in the field, that is done at 15-cm of depth. So, in this site there is an increased activity of degrading microorganisms due the adaptation of them.

In soil without paclobutrazol treatment history, the results demonstrated that the process of degradation began to occur within of 90 days after the application of compound. However, in Lins'soils (D), the dissipation of paclobutrazol were similar to the soil with history of application. The most probably reason for this fact was the differences in regard to the soil texture. Thus the adsorption sites in the soils studied could differ and affect the biodisponibility of the growth regulator.

In general, the degradation rates of paclobutrazol tend to be low. It is oportune to mention that this product is, specifically, designed to sustain their effect over a long period of time.

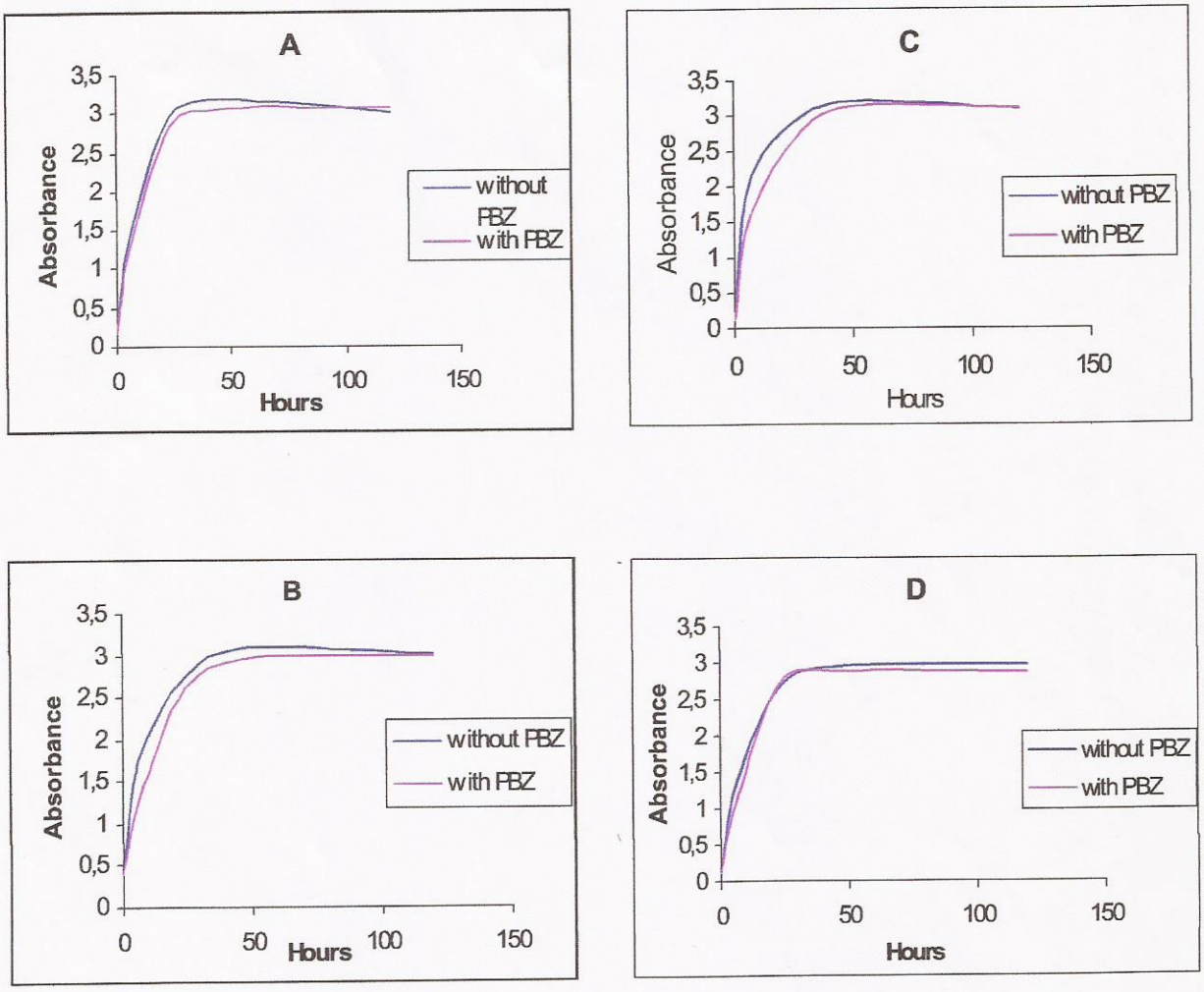

Figure 1: Bacteria growth in culture medium with and without paclobutrazol (PBZ). A) soils without history of application, colected in the depth of 20-40cm; B) soils without history of application, colected in the depth of 0-20cm; C) soils with history of application, colected in the depth of 20-40cm; D) soils colected in Lins, São Paulo State, without history of application, in the depth of 20-40cm.

Table 1: Recovery of paclobutrazol (%) in mineral culture medium, supplemented with the paclobutrazol and cultured with the different soils: A) soils without history of application, colected in the depth of 20-40cm; B) soils without history of application, colected in the depth of 0-20cm; C) soils with history of application, colected in the depth of 20-40cm; D) soils colected in Lins, São Paulo State, without history of application, in the depth of 20-40cm.

Days	Soils			
	A	B	C	D
15	89,03	84,15	94,33	102,76
30	97,23	80,21	102,26	106,05
60	81,03	89,28	65,70	75,13
90	73,36	79,21	57,85	67,83

Assessment of growth of mixed culture: nearly all the mixed culture bacteria grew well in paclobutrazol presence when it was used as a sole source of carbon. As seen in Figure 1, a lag phase of growth was observed in these cases, most likely indicating inductive character of the degradation process. The initial adaptation phase was of 24 hours. The most efficient mixed cultures were collected in Lins'soils and Petrolinas's soil with history of application of paclobutrazol.

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