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Assessment of pesticide contamination in soil samples from an intensive horticulture area, using ultrasonic extraction and gas chromatography–mass spectrometry

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Abstract

In order to reduce the amount of sample to be collected and the time consumed in the analytical process, a broad range of analytes should be preferably considered in the same analytical procedure. A suitable methodology for pesticide residue analysis in soil samples was developed based on ultrasonic extraction (USE) and gas chromatography–mass spectrometry (GC–MS). For this study, different classes of pesticides were selected, both recent and old persistent molecules: parent compounds and degradation products, namely organochlorine, organophosphorous and pyrethroid insecticides, triazine and acetanilide herbicides and other miscellaneous pesticides. Pesticide residues could be detected in the low- to sub-ppb range (0.05–7.0 $\mu g\,kg^{-1}$) with good precision (7.5–20.5%, average 13.7% R.S.D.) and extraction efficiency (69–118%, average 88%) for the great majority of analytes. This methodology has been applied in a monitoring program of soil samples from an intensive horticulture area in Póvoa de Varzim, North of Portugal. The pesticides detected in four sampling programs (2001/2002) were the following: lindane, dieldrin, endosulfan, endosulfan sulfate, 4,4′-DDE, 4,4′-DDD, atrazine, desethylatrazine, alachlor, dimethoate, chlorpyrifos, pendimethalin, procymidone and chlorfenvinphos. Pesticide contamination was investigated at three depths and in different soil and crop types to assess the influence of soil characteristics and trends over time.

Keywords: Ultrasonic extraction; Pesticides; Herbicides; Soil; Contamination

1. Introduction

Great productivity gains can be achieved in agriculture using the adequate pesticides. Indeed, they are needed to meet the world's demand on foodstuffs and no other alternative can compete to be used in such a large scale. Slow degradation of pesticides in the environment and extensive or inappropriate usage by farmers can lead to environmental contamination of the water, soil, air, several types of crops and indirectly to humans [1,2].

Chlorinated pesticides (OCPs) are very toxic and persistent compounds in the environment. Although most of them have been banned decades ago, they can still be found in the environment even in remote regions; thus, they are still of great concern [3]. The organophosphorous insecticides (OPPs) and triazine herbicides are among the most commonly used and detected pesticides around the world; thus, monitoring is important from an agricultural and environmental point of view [4–6]. Pesticides is a family of compounds in continuous evolution in terms of chemical synthesis; some of the recent chemicals such as dinitroanilines, chloroacetamides, dicarboximides, acylalanines, regarded as safer to the environment can be found in high-quantities in soils, conversely to the previously referred groups.

Soil is the principal reservoir of environmental pesticides, thus representing a source from which residues can be released to the atmosphere, ground water and living organisms

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