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REVIEW ON RESIDUES OF DELTAMETHRIN AND PROFENOFOS IN CROP AND SOIL

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Abstract
Pesticides' striking effort in preventing crop loss has led to their acceptance and expanded use throughout the world. However improper and injudicious use of pesticide leaves harmful pesticide residues on the crop and soil. Pesticide residues are regularly tested by the monitoring system .Pesticide residues may pose significant risks to human beings and environment if it exceeds the maximum residues levels (MRLs). Insecticides Deltamethrin and Profenofos are widely used for the control of various insects in crops. Understanding the adsorption, desorption and mobility of these pesticide metabolites is an important aspect of assessing the environmental fate of pesticides. Therefore, keeping in view of the above discussions the available literature is related to residues of Deltamethrin and Profenofos in crops and soil has been reviewed.
Key words: Deltamethrin ,Profenofos , MRLs, Pesticide residues

INTRODUCTION

Pesticides' striking effort in preventing, crop loss has led to their acceptance and expanded use throughout the world. pesticides should be selected on the basis of minimum mammalian toxicity to minimize the residual toxicity level in agricultural commodities[1] Synthetic pyrethroids are known to have a high insecticidal activity, low toxicity in mammals and no residue in biosphere[2] pyrethroids are usually degraded by one or more biotic and abiotic processes i.e. metabolic degradation by plants, animals and microorganisms and degradation by light (photolysis). According to study by Narahashi T.(2001),pyrethroid insecticides are rapidly metabolized and excreted in mammalian systems . Deltamethrin S- α –cyno-3- phenolxybenzyl (1R,3R)-3-(2,2-dibromovinyl)-2,2-dimethilcyclopropanecarboxylate a synthetic pyrethroid is active against a wide range of insects that attack crops and animals and has been recommended for foliar application on various vegetable and field crops [3]. Deltamethrin intoxications due to oral exposures were rarely reported in the literature.Studies have shown that Deltamethrin has little tendency to leach in ground water due to strong tendency to bind to soil organic matter.Deltamethrin behaviour, bioefficacy, sorption, movement, persistence and degradation in soil, sediment and water have been widely studied [4].For the past three decades, OP pesticides have been the insecticides most commonly used by professional pest-control bodies and homeowners [5]They are less persistent in the environment when compared with organochlorine pesticides and thus pose less long-term health risks to nontarget aquatic organisms and humans. Profenofos, an organophosphate is a broad spectrum, non-systemic foliar insecticide and acaricide. It is effective against a wide range of chewing and sucking insects and mites on various crops (Reddy and Rao, 2008). Intensive agricultural practices have often included the use of pesticides to enhance crop yields, but the improvement in yield is sometimes concomitant with the occurrence and persistence of pesticide residues in soil and water. Pesticides may reach the soil through direct application to the soil surface, incorporation in the top few inches of soil, or during application to crops.The amount of pesticide that migrates from the intended application area is influenced by the particular chemical's properties: its propensity for binding to soil, its vapour pressure, its water solubility, and its resistance to being broken down over time. Pesticide residues constitute a danger to soil microfauna and microflora and their toxic effects manifest on humans when bioaccumulation occurs along the food chain after initial plant uptake . Improper and injudicious use of pesticide leaves harmful pesticide residues on the crop and soil. There is efficient monitoring system which regularly tests food items for pesticide residues to ensure that it does not exceed (MRLs) and there is no potentially adverse effect on humans and environment. Exceeding the MRL can indicate over-use of pesticides to prevent adverse effects on public health it is a must to establish control measures in order to ensure MRLs to be respected .Therefore, keeping in view of the above discussions the available literature is related to residues of Deltamethrin and Profenofos in crops and soil has been reviewed.

RESIDUES OF DELTAMETHRIN AND PROFENOFOS IN CROPS AND SOIL

An attempt has been made to review the work undertaken by various researchers elsewhere in the world on pesticides residue in crops and soil

[6] In his study reported that the residues of deltamethrin (0.004%) were found below the maximum residue limit in grains and pod covers of pigeon pea at harvest when compared to fenvalerate in pigeonpea

[7] In his work on pigeon peas reported that Deltamethrin residues were detected on plant only up to 7th day, while the residues of other insecticides persisted till the 9th day after spraying. The order of dissipation was deltamethrin > endosulfan > cypermethrin > fenvalerate with half life values as 1.5, 1.7, 1.8 and 3.43 days, respectively. At harvest, residues of cypemethrin and endosulfan were detected in pod shell while in seed samples, residues of only endosulfan were present.

Dikshit (2002) worked on the stability and persistence of deltamethrin on various pulses concluded that the insecticides did not affect the germination of treated pulse seed.

A study carried out on 3 volunteers given a single oral dose of 3 mg of deltamethrin reported the maximum plasma concentration in 1-2 h and a half-life 10-11.5 h. 10-26% of the dose was excreted via feces and 51-59% via urine over 5 days. [8]

[9] In studies showed that most of the samples did not contain any residues of the nine selected pesticides (one is deltamethrin) and were within the limits set by the WHO.

Deltamethrin is hydrophobic compound and has a low mobility in soils. This property causes strong sorption to soil organic matter, and limited its leaching into groundwater (Oudou and Hansen 2002).

In soil, deltamethrin undergoes various dissipation processes and is degraded via hydrolysis, photolysis, and microbial activity with half life ranged from 11 to 72 days, depending on the soil type and oxygen availability (Elliott 1989; WHO 1990)

Degradation of deltamethrin is slower under anaerobic or sterile conditions, indicating important role of soil microorganisms in this process (Chapman et al. 1981; Zhang et al. 1984; Grant and Betts 2004).

[10] Reported half-lives under aerobic laboratory conditions for deltamethrin in sandy loam or silt loam soil ranges from 11-72 days.In anaerobic soil conditions, the half-life of deltamethrin ranges from 31-36 days.

[10] Reported that Deltamethrin degrades via hydrolysis, photolysis, and microbial action. It is not susceptible to photo-oxidation, and is more persistent in soils with a high clay or organic matter content.

In 2006, the United States Department of Agriculture (USDA) Pesticide Data Program (PDP) analyzed 9030 samples of fruits and vegetables for deltamethrin and its parent compound, tralomethrin. Of the samples tested, only one sample had detectable residues and the amount detected was eight times less than the U.S. EPA tolerance level.

Deltamethrin and other pyrethroid-degrading bacteria were found in various genera such as Micrococcus (Tallur et al. 2008), Pseudomonas (Grant et al. 2002; Jilani and Khan 2006; Fulekar 2009), Sphingobium (Guo et al. 2009), Ochrobactrum (Chen et al. 2011a), Streptomyces (Chen et al. 2011b, 2012a), Stenotrophomonas (Chen et al. 2011c), and Bacillus (Chen et al. 2012b).

[11] In his work reported that the adsorption-desorption studies demonstrate that cypermethrin and deltamethrin possesses a stronger affinity to the silt clay soil than peat soil while mobility evaluation of the two insecticides showed cypermethrin to be highly mobile as compared to the less mobile deltamethrin.

Chaaieri-Oudou and Bruun- Hansen (2002) reported that the sorption of four pyrethroids in soil followed the order: Lambda-cyhalothrin> Deltamethrin>Cypermethrin> Fenvalerate .

Selim and Zhu(2002) reported that cumulative leaching of deltamethrin was small and ranged from only 3 to 8% of that applied .

In study conducted by Muhammad Atif Randhawaet al (2008) concluded deltamrthrin residue reduced below maximum residue limit after washing and peeling on selected vegetables may be due to non persistent nature of deltamethrin.

Wiles & Jepson (1994) also determined that pyrethroid residues are more persistent on leaves, and that plant-dwelling insects may therefore be exposed to pyrethroid residues longer than soil dwelling invertebrates.

Authors concluded that soil microorganisms were largely responsible for the more rapid rate of degradation in natural soils. There is some evidence that the byproducts of pyrethroid degradation are more mobile in soils than are the parent compounds (Kaufman 1981, Lee 1985). However, these compounds are likely to be significantly less toxic than the parent insecticide.

Residues of deltamethrin, fenvalerate, permethrin and phenothrin were detected and were shown to be highly persistent on stored wheat. Residues accumulated in the bran fractions were reduced in white flour during milling (Bengston *et al.*, 1983)

Washing of chickpea grains reduced the Deltamethrin residues by 15.69% from an initial level of 0.051 ppm (Lal & Dikshit, 2001).

It has been reported that 8 days after treatment, more Deltamethrin was recovered from an organic soil than from a sandy soil (Chapman and Harris 1981). The interaction of deltamethrin with soil would decrease the bioavailability and thus the biodegradation of this insecticide

[12] depicted a half life of 2.9-3.3 days of profenofos with a correlation coefficient of 0.996 and 0.91 while it was used at 40 and 80 g/ha against cauliflower pest. The residues deposits depicted were 0.390 and 0.692 mg/kg at zero day interval, 0.291 and 0.583mg/kg after one day and 0.062 and 0.114 mg/kg after 8 days of treatment by showing 70.6-71.0% degradation after fifth day of treatment.

Nath *et al.*, (2005) depicted that the profenofos dissipated at the highest rate of 98.4% on 7th day of its application.

Renuka *et al.*, (2006) in his studies depicted that initial deposits of profenofos were traced in the ranges of 2.00 and 2.76 ppm and dissipated below the detectable limits

Dharma *et al.*, (2007) depicted that 92-94% profenofos was dissipated with the 30 days of application

According to US-EPA ARCHIEVE DOCUMENT 2006 environmental fate studies show that profenofos is not persistent, particularly in neutral and alkaline soils. Hydrolysis is the major route of dissipation in neutral to alkaline environments. Photolysis is not a major pathway while biotic processes aerobic and anaerobic metabolism become important after the initial hydrolysis. Profenofos metabolizes rapidly in aerobic and anaerobic conditions and dissipates in neutral to alkaline soils with a half-life of several days. Little data exists for acid soils, although it can be inferred that profenofos dissipates at a slower rate.

Saadatullah Malghani (2009) studied the role of bacteria *Burkholderia gladioli* on pesticide biodegradation as well as on profenofos.Bioremediation of profenofos-contaminated soil was examined using soil treated with 200 ug g-1; profenofos resulted in a higher degradation rate than control soils without inoculation. In a mineral salt medium (FTW) reduction in profenofos concentration was 90% within 96 hours of incubation.

Inorganic pesticides and doses applied also affect the residual concentration in soil (Ramika *et al.*, 2012).

Residue level of profenofos is reduced during freezing and juicing of tomatoes when tomatoes were contaminated at level of 1 ppm(Abou-Arab, 1999)

10th International Working Conference on Stored Product Protection Deltamethrin residues through the food chain industries concluded, the use of deltamethrin to protect grain is effective, reliable and meets the requirements of the food industries. As the level of deltamethrin found in the smanufactured products is very low or below the limit of quantification (below the European MRL),

In 2006, Bai Y. *et al.*, concluded that the OP pesticide residues were present in fruits and vegetables in Shaanxi area of China.

[13] The tested samples were found 100% contaminated with low but measurable amounts of pesticide residues. Among the four major chemical groups, residue levels of organophosphorous insecticides were highest followed by carbamates, synthetic pyrethroids and organochlorines. About 32% of the samples showed contamination with organophosphorous and carbamate insecticides above their respective MRL values

An article from Delhi presents the development of a multiresidue method for the estimation of 30 insecticides, 15 organochlorine insecticides and six organophosphorus insecticides, nine synthetic pyrethriods and two herbicides and their quantification in vegetables. The monitoring study indicates that though all the vegetable samples were contaminated with pesticides, only 31% of the samples contained pesticides above the prescribed tolerance limit [14]

An experiment conducted to estimate the residues of four synthetic pyrethroids and monocrotophos recommended a waiting period of 2 days for deltamethrin, cypermethrin and permethrin as the rate of dissipation was faster and 5 days for fenvalerate and monocrotophos on okra fruits [15]

42 samples were found to be contaminated with low but measurable amount of residues belonging to three major chemical groups namely OC,OP and SP but found below their maximum residue limits in 50 farm gate

samples of cauliflower in punjab (Kousik and Balwinder, 2010)

Jinky Leilanie Del Prado Lu in his analysis of two sampling periods (2008 and 2010). Deltamethrin and Profenofos residues did not exceeded the maximum residue limit for soil samples insecticide residues were not detected in the crop samples.

A.W. Tejada *et al.,* in his study to determine the impact of continued use of profenofos on soil properties in a cotton field. Cconcluded that the effect on microbial population was minimal. Basal respiration was not affected by profenofos treatment

Tahir Anwar,1 et al., Residues of organophosphate (OP) and organochlorine (OC) pesticides were monitored in soil Samples Profenofos was not detected in any soil sample.

CONCLUSION

Residue analysis provides a measure of the nature and level of any contamination within the environment and its persistence. Prolonged use of pesticide will promote pest resistance, each time when higher doses are applied. Recommended application frequencies, dosage and the duration between the last application of the pesticide and harvest needs to be followed. Continuous monitoring for pesticide residue in food crop is desirable in order to protect the end user from health hazards. Dietary exposure to pesticide residues exceeding MRLs values may lead to acute or chronic adverse health effects. Measures must be taken to ensure that the use of pesticides during food production leaves residues in food as low as practically achievable, whereby minimizing the potential risk to public health.

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