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EHAVIOUR OF SOME SYNTHETIC PYRETHROIDS IN PLANT AND SOIL

BY

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INTRODUCTION

During the last decade a new group of agricultural insecticides, the synthetic pyrethroid, has emerged as a complement to the organochlorine, organophosphate and carbamate pesticides. Pyrethroids proved several distinguishing characteristics among other insecticide groups, i.e. long residual activity, high efficiency to insects, broad spectrum of insecticidal activity, comparatively low application rates required for insect control, . . . etc. Synthetic pyrethroids are recommended in Egypt as dual purpose agents for controlling both the cotton leafworm, *Spodoptera littoralis* (Boisd.) and the bollworms, *Pectinophora gossypiella* (Saund)and *Earias insulana* (Boisd.) infesting cotton plants since 1976 - 1977 season.

Soybean is one of the most important leguminous crop all over the world. Soybean seeds have a high nutritional value representing a very important source of food for humans and animals. Commercial soybean production in Egypt began in the early 1970's and the cultivated area has increased remarkably year after year. The area concerned reached 145.000 feddans (4200 m^2) in 1982. To achieve national food security programme of Egypt, the current 5-year plan is to increase soybean cultivated area up to 250,000 feddans in 1987 (Hassan *et al.*, (1985)).

The cotton leafworm *S. littoralis* (Boisd.) and the spider

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mite Tetranychus atlanticus (Mc G.) are the most important pests attacking soybean plants and significantly affecting productivity in Egypt. Although the chemical control represents the main approach for this goal, yet the crop and its products are exposed to contamination by the long persisting residues of sprayed insecticides.

Accordingly, the present study was aimed to investigate the persistence of some synthetic pyrethroids (cypermethrin, deltamethrin and fenvalerate) on sprayed leaves of soybean under field conditions. The bio-residual activity against the 4 th instar larvae of the cotton leafworm was also studied. Moreover, the residues of used pyrethroids in mature soybean seeds and extracted oil were determined. The contamination rate of soil cultivated by sprayed plants was also cheked.

The degradation pattern of used pyrethroids as affected by the exposure to different temperatures, UV-light and sunlight was studied in the laboratory. Such experiments were done with technical as well as formulated products. Also the downward movement of tested pyrethroids in three types of Egyptian soil i.e., clay, sandy loam and loamy sand under leaching conditions was considered. Moreover the adsorption behaviour of tested pyrethroids on the soils was investigated. Finally, the effect of used synthetic pyrethroids on some microflora species inhibiting soil was estimated.

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REVIEW OF LITERATURE

I- Persistence and residual activity of pyrethroids on different plants:

Ohkawa *et al*., (1977) found that when (+)-trans and (+)-cis permethrin were applied to the leaf surface of bean plants they were readily metabolized. The half-life was about 7 days and 9 days, respectively for trans and cis permethrin. Both permethrin isomers and their metabolites hardly moved from the application site to other parts of the plants.

Gaughan and Casida (1978) found that about 30 % of the ^{14}C was lost within one week after application of (^{14}C) permethrin to cotton leaves in the field. The ^{14}C loss in subsequent periods was 12 % between the first and second weeks, $\sim$7 % between the second and third weeks, and $\sim$10 % between the third and sixth weeks. In green house studies they found that the permethrin isomers degraded about twofolds more rapidly on bean as compared to cotton foliage.

Harris *et al*., (1978-a) found that pyrethroids were considerable more persistent; at the 140 g a.i./ha application rate, residues of $>$ 0.1 ppm of permethrin, WL 41706 and WL-43467 were still present on celery 21 days after treatment.

Harris *et al*., (1978-b) found that in field tests, permethrin, WL 41706 and WL 43775 controlled three spp. of cutworms at rates as low as 70 g a.i./ha when applied as rye

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foliage, preplanting soil surface and postplanting treatments. Similar control was obtained with chlorpyrifos at 560 -1120 g a.i./ha. However, residues of tested pyrethroids of chlorpyrifos were detected on tobacco or onions 57 and 83 days, respectively after treatment.

Estesen *et al.*, (1979) studied the dislodgable residues ($\mu g/cm^2$) on cotton leaves treated with certain insecticides. Fenvalerate, permethrin and decis initially retained activity and then after 96h, lost 35, 53 and 68 %, respectively of their original levels.

Mcdonald (1979) found that in greenhouse tests, permethrin, fenvalerate, cypermethrin and fenpropanate at 0.14-0.28 kg/ha as sprays to barley plants gave control of army cutworm *Euxoa auxiliaris* (Grote) comparable to endrin at 0.28 kg/ha. As soil treatments, the pyrethroids were more effective than endrin at comparable rates of application.

Ruzo and Casida (1979) found that under the greenhouse conditions, the half-life of decamethrin on cotton plants was 1.1 weeks. Decamethrin degraded more rapidly, under the field than under the greenhouse conditions.

Jain *et al.*, (1980) studied the persistence of fenvalerate on cotton when applied as a 0.05 % spray 6 times at 17-day intervals at the rate of 500 litre/ha against bollworms in India. The percentage damage by bollworms in treated plots

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was less than 4 as compared with 67 in untreated plots. However, excessive residues were found in cotton seed (0.62 ppm), lint (1.20 ppm) and leaves (16.0 ppm) in open bolls at the time of harvest.

Leeper and Reissig (1980) studied the persistence of 4 insecticides in controlling the pear psylla *Psylla pyricola* (Foerster) Fifty percent mortality occurred at aproximately 20 days for fenvalerate, 13 days for permethrin and 6.86 days for amitraz. Phosalone provided poor control in this respect.

Ohkawa *et al*., (1980) studied the metabolic fate of fenvalerate in bean plants under laboratory conditions. When fenvalerate was applied to the leaf surface at 10 µg per leaf, it disappeared with half-life of approximately 14 days. Fenvalerate underwent decarboxylation, ester cleavage, hydrolysis of the CN group to COOH group, hydroxylation at 2'- and 4'- phenoxy positions, conversion of the alcohol moiety to 3-phenoxybenzyl alcohol and 3-phenoxybenzoic acid, and conjugation of the resulting carboxylic acids and alcohols with sugars.

Wright *et al*., (1980) examined the metabolism of cypermethrin in lettuce plants grown and treated twice under outdoor conditions with ^{14}C-cyclopropyl labeled material. The application rate at each treatment was equivalent to 0.3 kg/ha. At harvest, 21 days after the last application, the plants contained mainly unchanged cypermethrin (33 % of the total radiolabel percent) and polar materials (54 %) which were

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shown to be conjugates of trans-2(2',2'-dichlorovinyl)-3,3 dimethyl cyclopropane carboxylic acid. One of these was identified as the B,D-glucopyranose ester.

Greenberg (1981) found that when the cottonseed crop received two sprays of 300 and 600 g a.i. of fenvalerate/ha at 10 days intervals, the average values of fenvalerate residue in cotton seeds were 0.012 ppm for the lower rate and 0.053 ppm for the higher rate of application at 77 days after the last application.

Nimbelkar and Ajri (1981) determined the residual toxicities of permethrin, cypermethrin, fenvalerate and deltamethrin on okra by bioassaying first instar larvae of the okra pest Earias vittella (F.). They found that cypermethrin had the maximum residual toxicity, its LT_{50} being 20. 58 days as compared with 20.05 days for deltamethrin, 17.18 days for fenvalerate and 13.75 days for permethrin.

Bajzath (1982) studied the persence of residues of cypermethrin on apple and peach. He concluded that cypermethrin was quasipersistent, i.e. fast decay occured the first week but the rate of decay tended to decrease thereafter . Residues <1 mg/kg cypermethrin were found at first week following application.

Braun et al., (1982) found that cypermethrin, fenvalerate and permethrin all applied at the rate of 0.08 kg/ha,

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disappeared rapidly on both celery and lettuce, while the residues fell below 0.1 mg/kg within 8 - 14 days on celery and within 3 - 7 days on lettuce.

Buholzer and Mabrouk (1982) concluded that results of bioassays and field trials on Spodoptera littoralis (Boisd.) revealed that fenvalerate, cypermethrin, and decamethrin had a high intrinsic activity, but a low activity against field populations. A reason for this is their lacking penetration into the leaf, resulting in poor control of early instars.

Cole et al., (1982) studied the degradation of the pyrethroids tralomethrin, tralocythrin, deltamethrin and cypermethrin when applied to individual leaves of cotton plants at about 0.3 ug/leaf. They found that degradation was similar for all tested compounds.

Dejonckheere et al., (1982) studied the residues of permethrin and deltamethrin applied on autumn-and spring-grown lettuce in glasshouse. When applied at the normal prescribed dose rates of 25 and 12.5 g/ha, $<$ 1 mg/kg of either compounds, was found in the lettuce at harvest, even when applied only a few days before harvest.

El-Sayed et al., (1982) studied the persistence of permethrin, cypermethrin, decamethrin and fenvalerate on cotton plants. The residue half life values were 110.4 , 62.4, 91.2 and 136.8 hrs for the above mentioned pyrethroids,

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respectively. Mature seeds collected 45 days after application contained no detectable amounts of any of the four pyrethroids.

Yearin and Mueller (1982) evaluated the insecticidal activity of permethrin and cypermethrin formulations against soybean looper (Pseudoplusia includens (Wlk.)), Heliothis, velvetbean caterpillar (Anticarsia gemmatalis (Hüber)), green clover worm (Plathypena scabra (F.)), three cornered alfalfa hopper (Spissistilus festinus (Say)), and bean leaf beetle (Cerotoma trifurcata (Först)) in soybean. With the exception of one permethrin treatment, (0.05 lb/acre against soybean looper), all treatment markedly reduced the population level of each species at both 24 and 48 h post treatment in comparison to untreated controls.

Agnihotri et al., (1983) found that in general, the rate of dissipation of the tested pyrethroids was lower than that of quinalphos or pirimphos methyl. The maximum residue levels of permethrin and cypermethrin (0.5 ppm) were detected at 7 days on okra and 15 days on chilli, while fenvalerate (0.2 ppm) at 10 and 25 days on okra and chilli, respectively. For onions, residues of all the used insecticides were below the maximum residues limit within one hour after application.

Atique and Rashid (1983) reported that the evaluated pyrethroids were ineffective against whitefly at all spray intervals (15, 20 and 25 days). On the other hand jassid population and bollworm damage was significantly lower in pyrethroid treatments as compared to triazophos and the untreated

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check. Also pyretroids were ineffective 15 days after spray during September when temperatures were 22.75 - 37^{o}C.

Awasthi and Anand (1983-a) found a faster rate of dissipation of residues for all the tested pyrethoids as compared to quinalphos. The half-life value for pyretnoids ranged between 1.0 and 2.2 days against 4.5 - 5.7 days for quinalphos. The persistence of these pyrethroids at effective application rates was 7 days for fenvalerate and permethrin, 5 days for deltamethrin, whereas quinalphos lasted for 15 days.

Awasthi and Anand (1983-b) studied the persistence of certain pyrethroids and quinalphos on cauliflower during winter. Insecticides were sprayed at their recommended concentrations along with a 20 times higher of each. Permethrin persisted for $>$ 21 days, with RL_{50} of 2.6 and 3.5 days; fenvalerate persisted for 15 days with RL_{50} of 4.7 and 5.2 days and cypermethrin persisted for 10 days, with RL_{50} of 2.2 and 2.8 days. Quinalphos had a 15 day persistence, with RL_{50} of 2.9 and 5.6 days, respectively. The waiting periods were: fenvalerate 9.35 and 15.6; permethrin 22.7 and 29.4 days; cypermethrin 8.3 and 12.8 days; and quinalphos, 20.0 and 21.0 days, respectively.

Charmillot and Blaser (1983) studied the persistence of acephate, phosmet and deltamethrin used in the control of the fruit-peel tortricid Adoxophyes orana (Fisch. v. Roesl.).They found that the efficiency of the compounds remained above 90%

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for about 40 days (after the second application) for phosmet and $>$ 100 days for deltamethrin.

Chen et al., (1983) found that deltamethrin was highly effective against infestations with lepidopterous larvae and cicadellids on tea. Degradation on tea shoots in the field was very slow and penetration was very weak. When applied at a rate of 0.44 - 0.73 g a.i./m μ (0.067 ha), the half-life in fresh leaves and made tea was 2.8 days. The degradation rate of residues during tea manufacture was low (about 29.79 %) because of low vapour pressure. Less than 1 % of the residues were removed from made tea by the infusion technique. It was recommended that the permitted residue level in made tea should be 2 ppm.

Dobrin and Hammond (1983) studied the residual toxicities of certain insecticides against adult *Epilachina varivestis* Mulsant (Coleoptera : Coccinellidae) on soybeans. Permethrin and cypermethrin were active for 14 days when treated at 0.11 and 0.04 kg of a.i./ha. These two pyrethroids apperently provided further protection to soybeans by repelling the adults.

Harris et al., (1983) found that trichlorfon and acephate insecticides gave acceptable control against hornworm. Acephate provided some degree of residual activity, whereas trichlorfon did not. Permethrin, fenvalerate, cypermethrin and deltamethrin applied at $\leqslant$ 70 g/ha were at least as

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