

RESIDUES AND PERSISTENCE OF SOME ORGANOPHOSPHORUS INSECTICIDES APPLIED TO CABBAGE PLANTS

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Cabbage plants grown in a field experiment were sprayed with E.C. formulations of malathion, pirimiphos methyl and prothiofos at the rates of 570, 600 and 750 gm a.i. per feddan, residues of the three insecticides were analysed by GLC. Results revealed that initial deposits was varied; the highest deposit was that of malathion followed by pirimiphos methyl, and the lowest initial deposit was that of prothiofos. Initial deposits on inner leaves were less than the outer leaves.

Prothiofos showed more persistence than malathion, the least persistent toxicant was pirimiphos-methyl. Persistence of the toxicants was lower on inner leaves, probably owing to lower initial deposits.

Deposits were within the permissible limits after 12, 12 and 15 days for malathion, pirimiphos-methyl and prothiofos respectively, while on inner leaves, these intervals were 6, 8 and 12 days for the same insecticides respectively.

KEY WORDS: Persistence, Organophosphoric compounds, Cabbage

INTRODUCTION

Integrated Pest Management (IPM) programs were introduced in order to minimize dependence solely of chemical control for pests with all its undesirable side effects on the environment. Such effects would include the health hazards of human exposure to traces of these toxicants which may be of no acute effect, but chronic exposure may result in deleterious health hazards. Unfortunately, no IPM programs were developed for most of the vegetable crops in Egypt. Accordingly it is imperative to determine the time lapse between insecticidal application and harvest, necessary for the residues of insecticides to fall below the tolerance limits indicated either by national (EPA) or international (FAO-WHO joint committee) organizations.

Cabbage is a popular vegetable crop in Egypt, which is grown in more than one season and usually attacked by aphids, white flies and several species of lepidopterous larvae. Three insecticides are recommended for use on this crop; malathion against aphids, prothiofos and pirimiphos-methyl against mixed infestations. Literature exhibited that some researches were carried out to identify and estimate the deposit

on and in the outer and inner leaves of cabbage plants so as to determine the interval between spraying and harvest required for the safe use of this crop.

MATERIALS AND METHODS

1. Insecticides

Malathion:

S-1, 2-bis (ethoxycarbonyl) ethyl O, O dimethyl phosphorodithioate. It was used in the form of E.C. formulation under the trade name of Carbofos, 57% a.i. at the recommended dose of 1 litre/feddan.

Pirimiphos-methyl:

O-(2-diethylamino-6-methyl pyrimidin-4-yl) O, O-dimethyl phosphorothioate. It was used in the form of E.C. formulation under the trade name of Actellic 50% a.i. at the recommended rate of 1.2 litre/feddan.

Prothiofos:

O-2, 4-dichlorophenyl O-ethyl S-propyl phosphorodithioate. It was used in the form of E.C. formulation under the trade name of Tokuthion 50% a.i. at the recommended rate of 1.5 litre/feddan.

2. Spraying and Sampling

Cabbage plants (Brunsuck variety) were transplanted in field plots in areas of 3 × 3.5 m. Each plot contained around 25 plant. The growing plants were treated with the pesticides under investigation at the recommended doses after the formation of plants head. For each pesticide, three plots were used and the plots were distributed in a complete randomized design.

Representative samples were taken randomly after 1, 24, 72, 144, 216, 288 and 360 hrs of spraying for the outer leaves. However, samples from the inner leaves were taken after 1, 144 and 216 hrs of pesticides application. The collected samples were placed in a deep freezer at -18 °C until analysis.

3. Determination of Pesticide Residues

Extraction

Pesticide residues were extracted according to the procedures of Steinwandter (1985) and concentrated under vacuum to 2-3 ml.

Clean up

The concentrated extract was transferred quantitatively to glass beaker with 20 ml of n-hexane and mixed with 5–10 gm activated charcoal and 2 gm anhydrous sodium sulphate and the slurry was allowed to settle. The clear layer of the slurry was transferred to a suitable chromatographic column (fitted with a stopcock and packed with silica gel) and allowed to pass slowly through the column (30 drops/min). The charcoal was washed 6 times with 20 ml n-hexane each and passed through the column. The combined extract was evaporated under vacuum to dryness and transferred quantitatively with n-hexane to 10 ml volumetric flask to be used for injection in GC.

Gas chromatography injection

Pye unicom series 304 GC equipped with N/P detector and pyrex glass column packed with OV.17 on 80/100 mesh chromosorb was used for determination of pesticide residues. The applied temperature was 260, 255 and 265 °C for injection, column and detector, respectively. Flow rate of nitrogen carrier gas was 30 ml/min. Under these conditions, the retention times were 2.99, 2.90 and 4.80 minutes for malathion, pirimiphos-methyl and prothiofos, respectively.

An external standard analysis was used to calculate the recovery rate of pesticide residue. The area of the peak corresponding to pesticide was corrected according to percent recovery to indicate residues determination expressed as ppm or mg/kg.

RESULTS AND DISCUSSION

1. Residues in outer leaves

Data presented in Table (1) and Figs. (1), (2) and (3) demonstrate the residues of the applied insecticides in outer leaves of cabbage plant up to 360 hrs (15 days) of spraying. Malathion showed the maximum initial deposit on cabbage leaves. In this consideration, the estimated residues were 47.32, 41.63 and 36.18 ppm after one hr of treatment for malathion, pirimiphos methyl and prothiofos, respectively. The obtained differences in the initial deposits may be attributed to the variations in the formulations. As expected, a gradual and continuous deterioration of the

Table 1 Residues and Persistence of Some Organophosphorus Insecticides in the Outer Leaves of Cabbage Plant

Time after application (in hrs)	Malathion		Pirimiphos Methyl		Prothiofos	
	Concentration (ppm)	% of loss	Concentration (ppm)	% of loss	Concentration (ppm)	% of loss
1	47.32 ± 1.50	0.00	41.63 ± 1.71	0.00	36.18 ± 2.74	0.00
24	36.16 ± 1.26	34.16	28.29 ± 1.53	32.04	27.83 ± 1.28	23.08
72	21.96 ± 0.26	53.60	11.36 ± 0.71	72.71	20.05 ± 1.38	44.59
144	14.25 ± 1.17	69.89	2.88 ± 0.26	93.31	9.53 ± 1.59	73.65
216	7.34 ± 0.87	84.49	2.07 ± 0.45	95.03	6.08 ± 1.08	83.19
388	1.70 ± 0.29	96.41	0.99 ± 0.26	99.38	2.13 ± 0.66	94.11

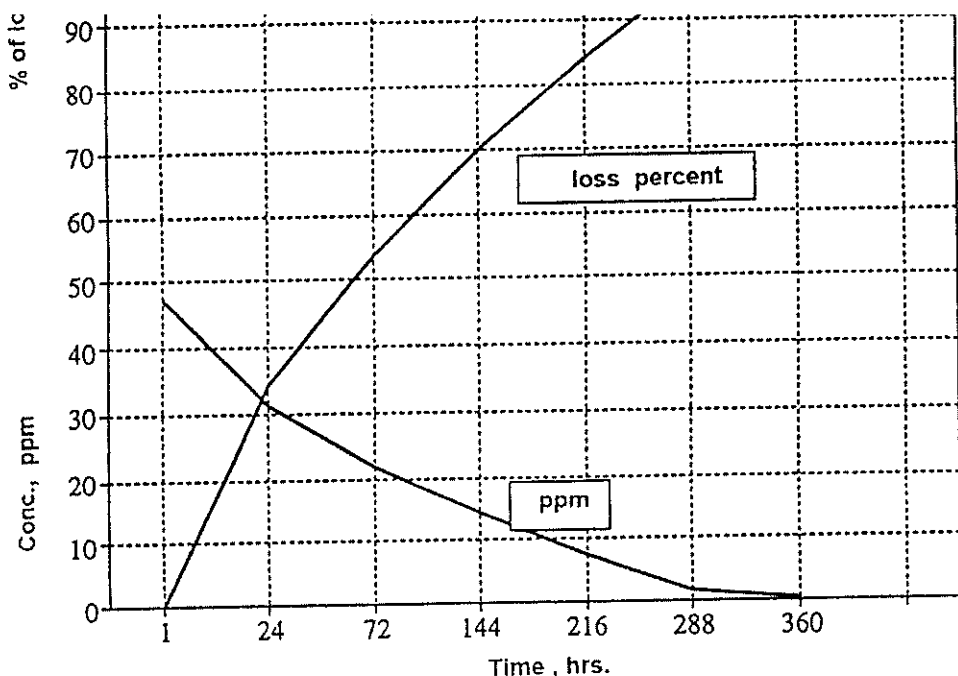


Fig. 1 Persistence and degradation of malathion in outer leaves of cabbage plant.

pesticide residues in and on the treated plants was observed as a function of time after application. In this respect, the magnitude of loss was recorded to be 34.16, 32.04 and 23.08% after 24 hrs of spraying, however it reached to 53.60, 72.71 and 44.59% after 72 hrs of treatment for malathion, pirimiphos-methyl and prothiofos, respectively. Thus, a sharp decline of residues occurred in pirimiphos methyl followed by malathion, however, a comparatively slow rate of degradation was noticed for prothiofos. In later determinations, additional decrease in the amount of pesticide residues took place after 144 and 216 hrs of application, however, the rate of degradation was slower as compared with the first period of 72 hrs after pesticides application. The minimum residue values were attained by the time of 288 hrs (12 days), however, all the applied organophosphorus insecticides became undetectable at the final experimental period, i.e. 360 hrs (15 days) after applications. Generally, the persistence and stability of the treated pesticides in outer leaves of cabbage plant could be arranged as the following order: prothiofos > malathion > pirimiphos methyl.

2. Residual impact in inner leaves

Table (2) demonstrate the residues and penetration of the studied pesticides in the inner leaves of cabbage plant. Malathion residues were detected only after one hr of application, however, no deposits could be found at the experimental time of 144

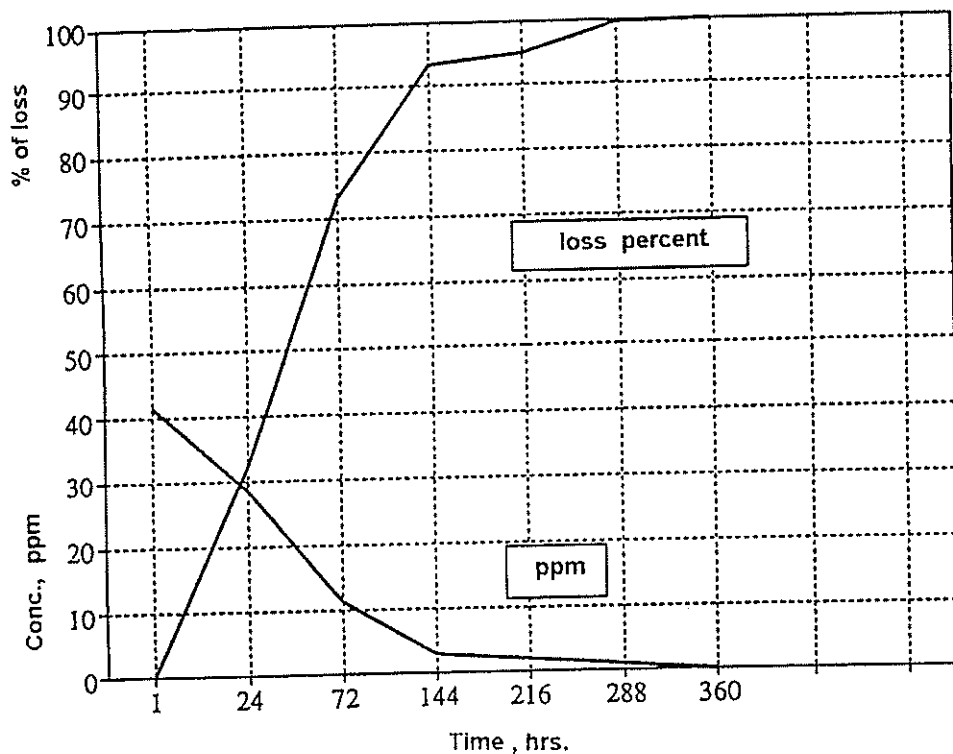


Fig. 2 Persistence and degradation of pirimiphos-methyl in outer leaves of cabbage plant.

and 216 hrs. That means poor penetration of such toxicant into the inner leaves of cabbage head. The insecticide pirimiphos-methyl was detected in the samples harvested at 1 and 144 hrs after spraying, while, it became undetectable after 216 hrs of application. On the other side, prothiofos existed in inner leaves of cabbage plant up to 216 hrs (9 days) after treatment, indicating more stability and penetration of that pesticide. It may be deduced that the persistence and penetration of such agrochemicals into the inner leaves of cabbage plant could be ranked as follows: prothiofos > pirimiphos-methyl > malathion. This trend could be supported by the findings of Talekar *et al.* (1977) that deposits of prothiofos were the most persistent residues among fourteen insecticides applied to chinese cabbage. From the above mentioned data, it could be observed that the sprayed insecticides deteriorated in and on the outer and inner leaves of cabbage plant. However, different rates of degradation were recorded between the individual pesticides throughout the time course of the experiment. Naturally, such variation should be attributed to the chemical and physical properties as well as the configuration of the pesticide molecule in relation to the capability of the tested plant to break-down such environmental chemicals.

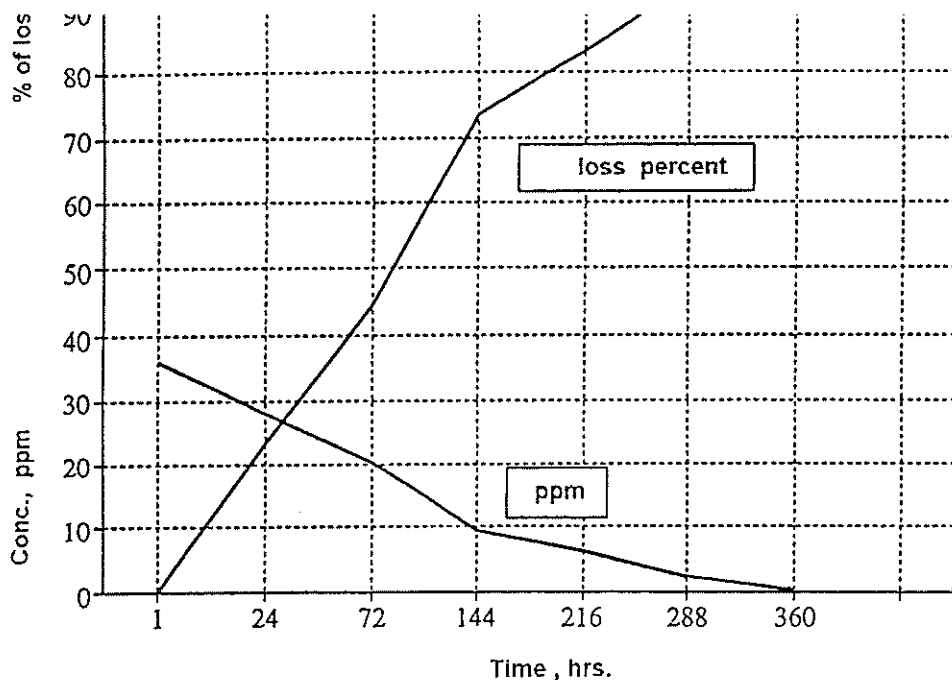


Fig. 3 Persistence and degradation of prothiofos in outer leaves of cabbage plant.

Table 2 Residues of Some Organophosphorus Insecticides in the Inner Leaves of Cabbage Plant

Time after application (in hrs)	Malathion (ppm)	Pirimiphos methyl (ppm)	Prothiofos (ppm)
1	0.798	3.270	4.328
144	UND	0.78	0.642
216	UND	UND	0.068

UND: Undetectable by the method used in this work

use the outer leaves of cabbage plant commercially after 12, 12 and 15 days of application, however, the inner leaves could be utilized after 6, 8 and 12 days of spraying with concern to the insecticides malathion, pirimiphos methyl and prothiofos, respectively as the recommended limits could be reached. In this connection, previous studies mentioned that deposits of malathion were completely degraded after 10 and 14 days of treatment for tomato (Trabulsi and Kamel, 1983) and okra (Jacob and Verma, 1984) plants. Either malathion and pirimiphos methyl were undetectable in and on tomato fruits (Ahmed *et al.* 1991) after 12 days of application, while they disappeared from tomato leaves after 15 days of spraying.

Further investigations reported that residues of pirimiphos methyl attain the permissible limit after 14 days of application when applied to onion plant (Hegazy *et al.*, 1988).

References

1. Ahmed, S.M.; Shams El-Din, A.M.; Abdel Salam, N.K.; El-Kheshin, M.K. and Khalil, H.K.: Studies on some organophosphorus insecticides on tomato plants. *Annals of Agric. Sci. Moshtohor*, **29**, 1791–1802 (1991).
2. Al-Samariee, A.I.; El-Hafez, E.; Abdel Majed, K. and Bassmy, M.A.: The chemical control of the lesser date moth, *Bactrachedra Amydrauka* Meyr, and residue levels of organophosphate insecticides in dates. *Pesticides Sci*, **25**, 227–230 (1988).
3. Anon: Codex Alimentarius Commission FAO and WHO food. Standard Program, Vol. 12 (2) Supplement (1989).
4. Hadjidemetrious, D.G.: Persistence of pirimiphos methyl in stored potatoes. *Bull. Envir. Cont. Toxic.* **41**, 292–303 (1988).
5. Hegazy, M.E.; Kandil, M.A.; Abdel-Razik, M. and Diab, M.M.: Residues fate of three organophosphorus pesticides on onion. *Annals of Agric. Sci. (Cairo)*, **33**, 1299–1307 (1988).
6. Jacob, S. and Verma, S.: Persistence of malathion on Okra. *Ind. J. Agric. Sci.*, **54**, 993–996 (1984).
7. Nikolov, N.K.: Comparative toxicological evaluation of some insecticides against *Agrotis ipsilon* Hufn., *Agrotis exclamationis* L. and *Amathes nigrum* L. *Gradinarskai Lozarske Nauka*, **17**, 43–50 (1980).
8. Steinwandter, H.: Universal 5-min. On line method for extracting and isolating pesticide residues and industrial chemicals. *Fresenius Z. Anal. Chem.*, **322**, 752–754 (1985).
9. Talekar, N.S.; Sun, L.T.; Lee, E.M.; Chem, J.S.; Lee, T.M. and Lu, S.: Residues behaviour of several insecticides on chinese cabbage. *J. Econ. Entomol.*, **70**, 689–602 (1977).
10. Trabulsi, I.Y. and Kamel, A.A.: Effect of environmental conditions on the amount of malathion residue. *J. Fac. Sci., King Saud Univ.*, **14**, 273–280 (1983).

