RESULTS AND DISCUSSION

1- Persistence of Malathion, Pirimiphos-methyl and Diazinon on and in Some Vegetables :

The insecticides malathion, pirimiphos-methyl and diazinon were sprayed onto tomato, cucumber, green pepper, eggplant, okra, cabbage and snap bean plants grown either under greenhouse or open field conditions at the rates of 1.5, 1.5 and 1 L/fed., respectively. The corresponding active ingredients used per fed. were 855, 750 and 600 g. The three insecticides were either sprayed once or more. Representative samples of the insecticide-treated fruits or leaves and untreated ones were taken from the different treatments 1hour as well as 1, 3, 7 and 14 days post insecticidal treatment and analyzed for insecticide residues. The obtained results are presented in Tables (1, 2, 3, 4, 5, 6, 7 and 8 and graphically illustrated in figures (1, 2, 3, 4, 5, 6 and 7).

1.1- Residues on and in tomato fruits :

Residues of malathion, pirimiphos-methyl and diazinon on and in tomato fruits at different intervals from insecticidal application either once or three times under the greenhouse conditions are shown in Table (1) and Fig. (1).

Data show that the amount of each insecticide (active ingredient) in tomato plants increased with increasing number of insecticidal applications. The initial deposits ranged from 2.2 to 2.8 ppm and 2.38 to 4.1 ppm one hr after the *1st* and the *3rd* application, respectively. The highest amounts of residues were detected in malathion-treated fruits, and the lowest amounts with diazinon. It is obvious that the residues of the three insecticides were decreased progressively as time lapsed from the onset of the insecticidal treatments. Dissipation percentages of the parent compounds of malathion, pirimiphos-methyl and diazinon ranged between 39.3 to 98.6 %, 55.6 to 98.5 % and 63.6 to 90.9 % during two weeks from the *1st* spray. The corresponding values were 51.5 to 91.2 %, 2.8 to 87.4 % and 14.7 to

Table (1) : **Residues (ppm) and dissipation (%) of malathion, pirimiphos-methyl and diazinon on and in tomato fruits at different intervals after the first and three insecticidal applications in the greenhouse.**

Days after treat-ment	Malathion		Pirimiphos-methyl		Diazinon	
	R	D	R	D	R	D
After the first application						
Initial*	2.8	0.0	2.7	0.0	2.2	0.0
1	1.7	39.3	1.2	55.6	0.8	63.6
3	0.3	89.3	0.8	70.4	0.4	81.8
7	0.2	92.8	0.14	94.8	0.3	86.4
14	0.04	98.6	0.04	98.5	0.2	90.9
$T_{1/2}$	1.3		0.9		0.75	
After three application						
Initial*	4.1	0.0	3.97	0.0	2.38	0.0
1	1.9	51.5	3.86	2.8	2.03	14.7
3	1.5	60.8	2.6	34.5	1.6	32.8
7	0.4	86.5	0.9	77.3	0.8	66.4
14	0.2	91.2	0.5	87.4	0.4	83.2
$T_{1/2}$	0.9		4.5		5.1	

*** Samples were taken one hour after treatment.**

R : Residues **D : Dissipation**

$T_{1/2}$ **: Half life values (days)**

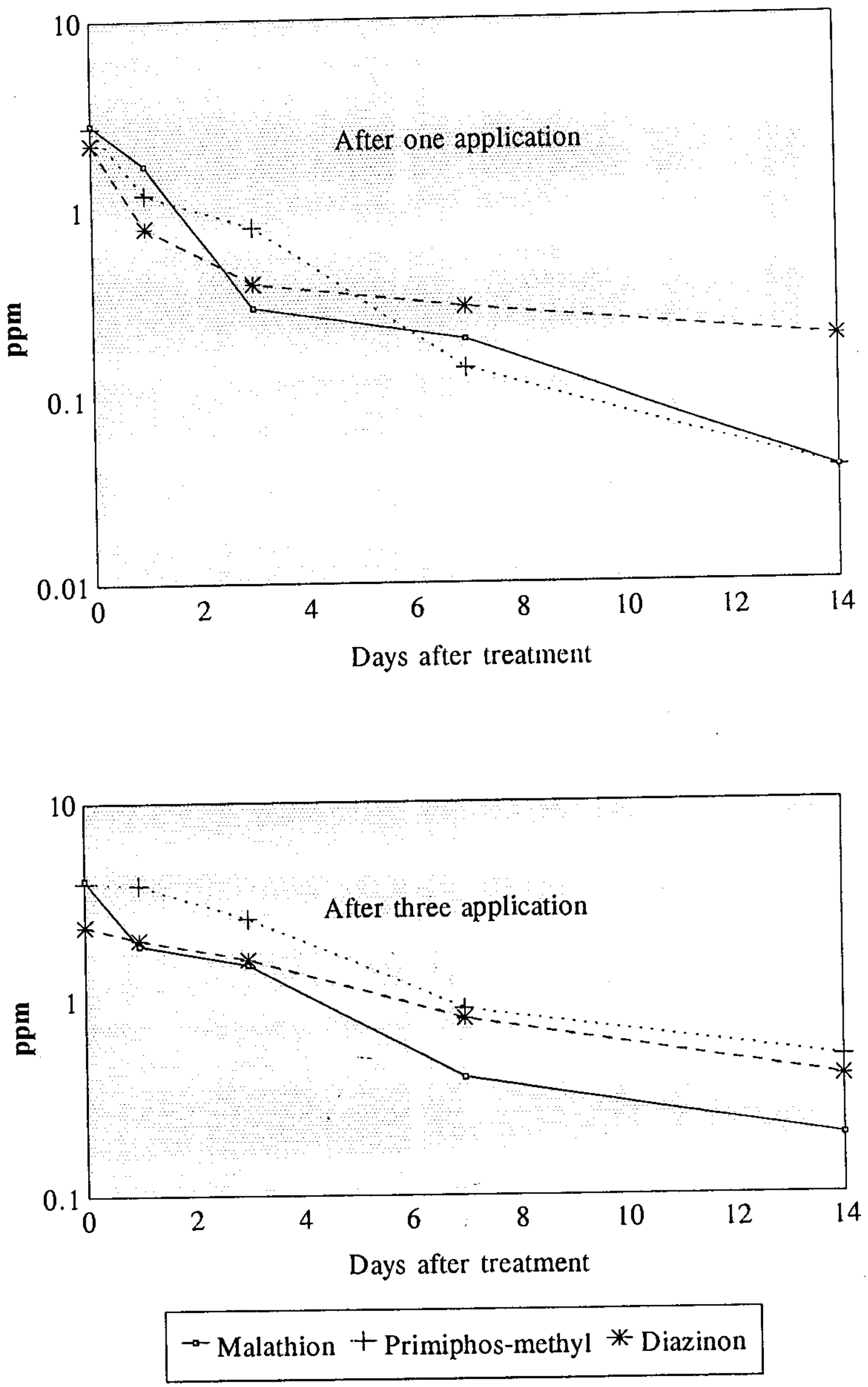


Fig. (1) : Residues of malathion, pirimiphos-methyl and diazinon on and in tomato fruits at different intervals following treatment after one and three application in the greenhouse.

83.2 % (Table 1). Data also indicate that the rate of diazinon dissipation was much higher than that with pirimiphos-methyl and malathion; dissipation percentages 1*hr* after the 1*st* spray were 63.2, 55.6 and 39.3 for diazinon, pirimiphos-methyl and malathion, respectively.

Less than one ppm of each of the three insecticides were found on and in the tomato fruits which reflect the differences between the three insecticides, after three days from insecticidal application, as regard their dissipation. One week after the 1*st* spray, amounts of residues ranged between 0.14 to 0.3 ppm; these amounts represent 5.2 to 13.6 % of the initial deposits. In other words, the majority (ca. 90 % or more) of the initial deposits disappeared after one week from insecticidal treatment. Half life values ($T_{1/2}$) were 1.3, 0.9 and 0.75 days which indicate that malathion was the highest persistent compound.

Curiously enough to note that the picture differed greatly when the three insecticides were sprayed three times. The initial deposits were much higher than that with fruits sprayed once. One day after insecticidal application, more than 50 % of malathion deposits were disappeared, whereas negligible amounts of diazinon (1.7 %) as well as pirimiphos-methyl (2.8 %) was dissipated, which is in contrary with the figures obtained when the plants were sprayed once. Three days after insecticidal treatments, dissipation percentages were 60.8, 34.5 and 32.8 for malathion, pirimiphos- methyl and diazinon, respectively. The corresponding figures with using these insecticides once were 89.3, 70.4 and 81.8 % which reflect the great differences between the three insecticides as regard their rates of dissipation when the number of sprays are concerned.

The half life values with using the insecticides three times were 0.9, 4.5 and 5.1 days for malathion, pirimiphos-methyl and diazinon; the corresponding figures with using the insecticides once were 1.3, 0.9 and 0.75 days. Seven days

Table (2) : Residues (ppm) and dissipation (%) of malathion, pirimiphos-methyl and diazinon on and in cucumber fruits at different intervals after the first and three insecticidal applications in the greenhouse.

Days after treat-ment	Malathion		Pirimiphos-methyl		Diazinon	
	R	D	R	D	R	D
After the first application						
Initial*	12.9	0.0	13.8	0.0	11.6	0.0
1	10.5	18.6	12.1	12.3	10.2	12.1
3	4.7	63.6	3.7	73.2	2.40	79.3
7	0.05	99.6	0.05	99.6	0.04	99.3
14	0.04	99.7	0.03	99.8	0.02	99.8
$T_{1/2}$	2.4		2.2		2.1	
After three application						
Initial*	14.5	0.0	15.7	0.0	14.8	0.0
1	13.3	8.0	13.6	13.4	13.4	9.5
3	5.4	62.8	4.3	72.5	3.4	77.1
7	0.3	97.9	0.2	98.7	0.2	99.7
14	0.05	99.7	0.04	99.8	0.03	99.8
$T_{1/2}$	2.6		2.3		2.3	

* Samples were taken one hour after treatment.

R : Residues D : Dissipation

$T_{1/2}$: Half life values (days)

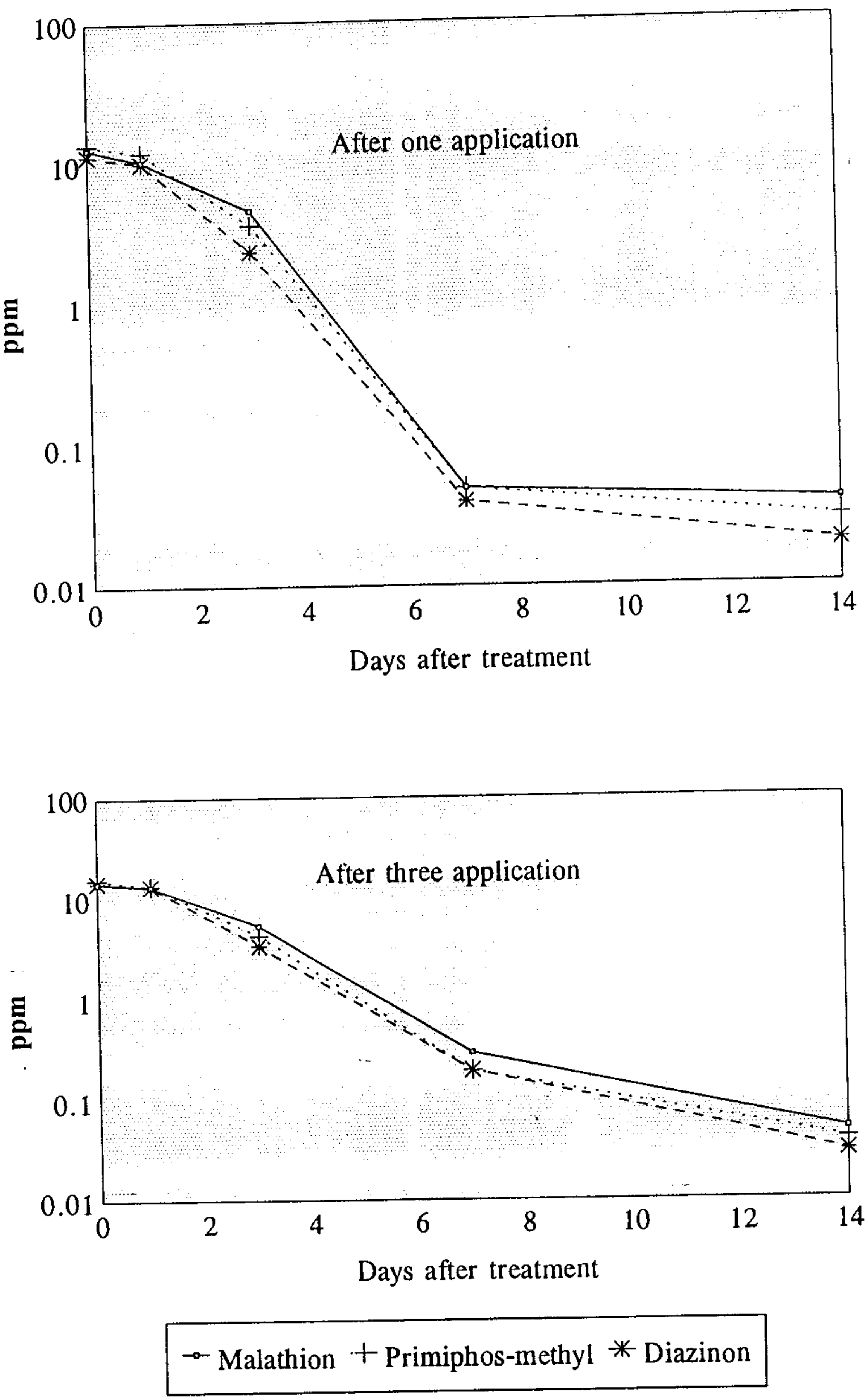


Fig. (2) : Residues of malathion, pirimiphos-methyl and diazinon on and in cucumber fruits at different intervals following treatment after one and three application in the greenhouse.

two surfaces may play an important role in this respect. Data show that the residues of these insecticides decreased sharply during the 1*st* seven days from insecticidal treatment; dissipation percentages ranged between 63.6 to 79.3 and 99.3 to 99.6 after 3 and 7 days from insecticidal application once (Table 2 and Fig.2). Negligible amount of residues of each insecticide was retained on and in the insecticide- sprayed cucumber fruits after 14 days from spraying (Fig. 2). The calculated times needed to dissipate 50 % of the initial deposits were 2.4, 2.2 and 2.1 days for malathion, pirimiphos-methyl and diazinon, respectively.

Again, and as has been found with tomato, the intensive use of insecticides resulted in higher amounts of insecticides on and in the insecticide- treated cucumber fruits just after spraying compared with values detected when the insecticides were sprayed once (Table 2). Contrary, the figures obtained in the insecticide-treated tomato fruits, did not show great difference between spraying the three insecticides once or three times as far as the rate of dissipation concerned; it is obvious that the three insecticides behave similar (Fig. 2); the $T_{1/2}$ ranged between 2.3- 2.6 days.

The maximum residue limits (MRLs) of malathion, pirimiphos-methyl and diazinon on cucumber fruits are 0.5, 1.0 and 0.5 ppm (**CAC, 1996**). Data presented in Table (2) show that insecticides-treated cucumber fruits could be harvested after 6.6, 6.0 and 6.5 days from spraying. With spraying the three insecticides 3 times, malathion-, pirimiphos-methyl- and diazinon- treated cucumber fruits could be harvested after seven days from spraying.

1.3- Residues on and in green pepper :

Data presented in Table (3) show that the initial deposits on and in the green pepper fruits were much higher than those detected on and in insecticides-treated tomato fruits although the plant species belong to the same family, *i.e.*

Table (3) : Residues (ppm) and dissipation (%) of malathion, pirimiphos-methyl and diazinon on and in green pepper fruits at different intervals from insecticidal application.

Days after treat-ment	Malathion		Pirimiphos-methyl		Diazinon	
	R	D	R	D	R	D
Initial*	14.80	0.0	10.40	0.0	10.00	0.0
1	10.70	27.7	3.70	70.20	9.00	10.0
3	2.90	80.4	1.50	85.6	2.20	78.0
7	0.70	95.3	1.20	88.5	0.70	93.0
14	0.05	99.7	0.20	98.1	0.20	98.0
$T_{1/2}$	1.9		0.7		2.2	

* Samples were taken one hour after treatment.

R : Residues D : Dissipation

$T_{1/2}$: Half life values (days)

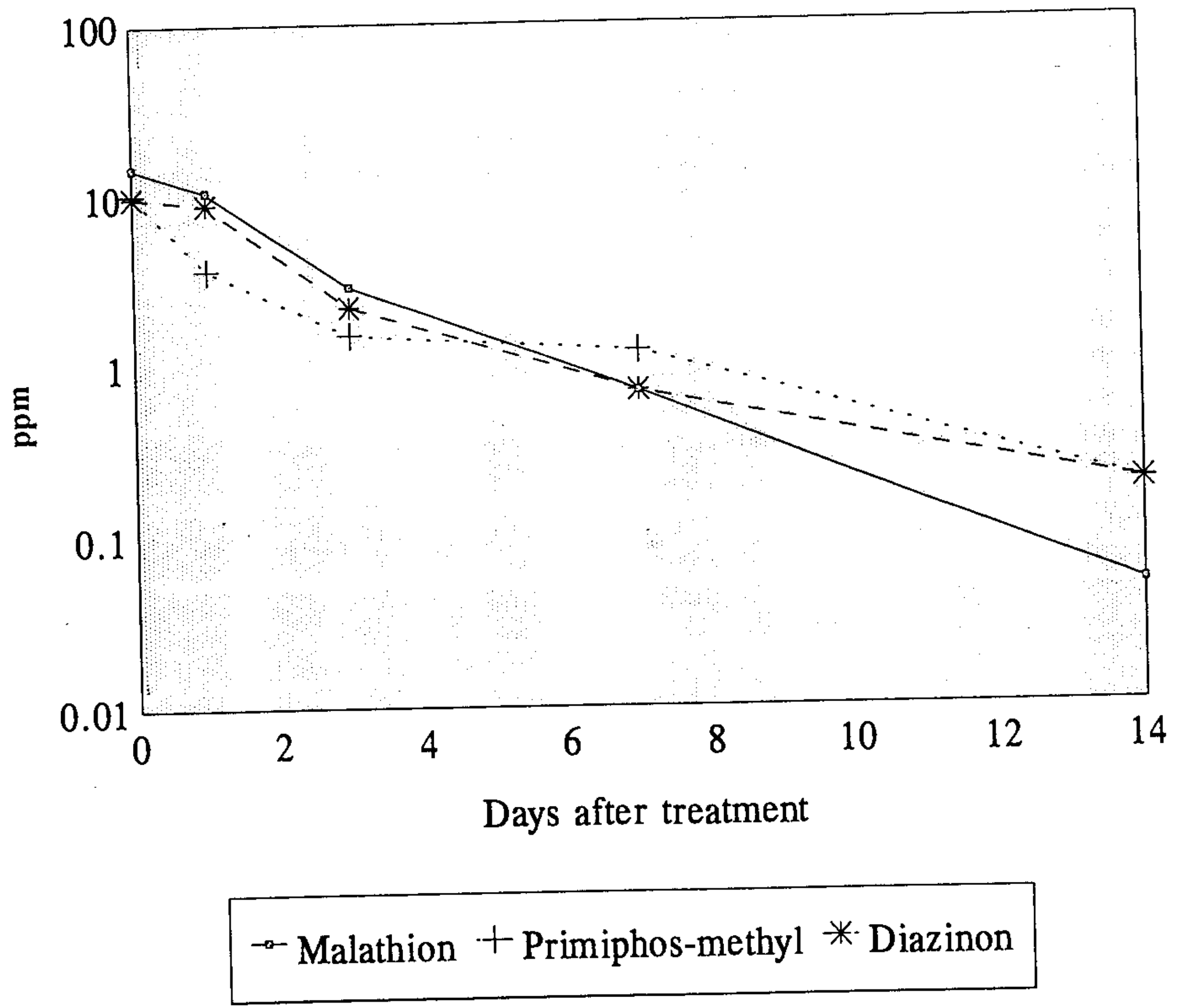


Fig. (3) : Residues of malathion, pirimiphos-methyl and diazinon on and in green pepper fruits at different intervals following treatment.

Family Solanaceae and the same amounts of active ingredients were used. Regardless the families to which the cucumber and pepper belong, the initial deposits in insecticide-treated pepper fruits were, however, similar or slightly higher than those detected in insecticide-treated cucumber. During the 1*st* three days after insecticidal application ca. 80 % of the initial amounts of the three insecticides were disappeared. After further 4 days, *i.e.*, one week post spraying ca. 90 % of the initial amounts and even more were dissipated. Two weeks after insecticidal treatment, negligible amounts of the parent compounds were still present in and on the fruits; 0.3, 1.9 and 2.0 % of the initial amounts malathion, pirimiphos- methyl and diazinon were still present in cucumber fruits.

It is clear that, the rate of dissipation of the three insecticides was different. One day after spraying 10, 27.7 and 70.2 % of initial amounts of diazinon, malathion and pirimiphos-methyl were disappeared which reflect the high stability of diazinon compared with short lived insecticides, respectively, as reported by the (**CAC, 1996**), pirimiphos-methyl (Fig. 3). The half life times were 0.7, 1.9 and 2.2 days for pirimiphos-methyl, malathion and diazinon, respectively.

The maximum residue limits for malathion, pirimiphos-methyl and diazinon on green pepper fruits are 0.5, 1.0 and 0.5 ppm. Based on these figures; malathion-sprayed pepper fruits and pirimiphos-methyl- sprayed ones could be harvested after ca. 10 and 9 days, respectively. With diazinon-sprayed green pepper, the safety period must be longer than 9 days (Fig. 3).

1.4- Residues on and in eggplant fruits :

Data presented in Table (4) show that the amounts of malathion, pirimiphos-methyl and diazinon assayed just after spraying were much lower than those detected in cucumber and pepper fruits. Theses amounts of active ingredients

Table (4) : Residues (ppm) and dissipation (%) of malathion, pirimiphos-methyl and diazinon on and in eggplant fruits at different intervals from insecticidal application.

Days after treat-ment	Malathion		Pirimiphos-methyl		Diazinon	
	R	D	R	D	R	D
Initial*	3.90	0.0	0.70	0.0	0.60	0.0
1	1.80	53.9	0.30	57.2	0.30	50.0
3	0.10	97.4	0.03	95.7	0.03	95.0
7	0.03	99.2	0.02	97.1	0.02	96.7
14	0.01	99.7	0.01	98.6	0.01	98.3
$T_{1/2}$	0.9		0.9		1.0	

* Samples were taken one hour after treatment.

R : Residues D : Dissipation

$T_{1/2}$: Half life values (days)

were 3.9, 0.7 and 0.6 mg per kg fruits for the various insecticides, respectively. Such magnitude reduction in insecticides deposits could be attributed to the indirect exposure of eggplant fruits to spray solution; it is known that eggplant fruits are hidden under the leaves. Also, the smoothness of eggplant fruits make the droplets of the sprayed insecticide run away from the fruits surfaces.

It is clear that 50 % and more of the initial amounts of each insecticide was disappeared after one day from spraying. After the 3*rd* day more than 95 % of the sprayed insecticides were dissipated which reflect the high rate of dissipation within the 1*st* 3 days from spraying (Fig. 4). Residues of the three insecticides ranged between 0.02 to 0.03 ppm after 7 days from spraying. The T_{50} values of the three insecticides were 1 day or less. In other words, the three insecticides could be considered as short lived insecticides as far as eggplant fruits are concerned.

The maximum residue limits of malathion, pirimiphos-methyl and diazinon in eggplant fruits are 0.5, 1.0 and 0.5 ppm (**CAC, 1996**). Based on these figures, the safety periods of malathion, pirimiphos- methyl and diazinon-sprayed eggplant fruits are 3, zero and one day, respectively.

1.5- Residues on and in okra fruits :

Data in Table (5) show that malathion and pirimiphos-methyl dissipated slowly during the 1*st* 3 days after spraying. The corresponding dissipation percentages were 16 and 17.4; and 34.7 and 41.3 after 1 and 3 days from spraying. Sharp decrease in residues took place after the third day, percent dissipation was more than 97 % (Fig. 5). Diazinon behaved different; 63.6 % of the initial deposit was dissipated, followed by gradual loss until the 7*th* day. The corresponding T_{50} values were 3.9, 3.2 and 0.8 days which reflect the persistence of the latter insecticide.

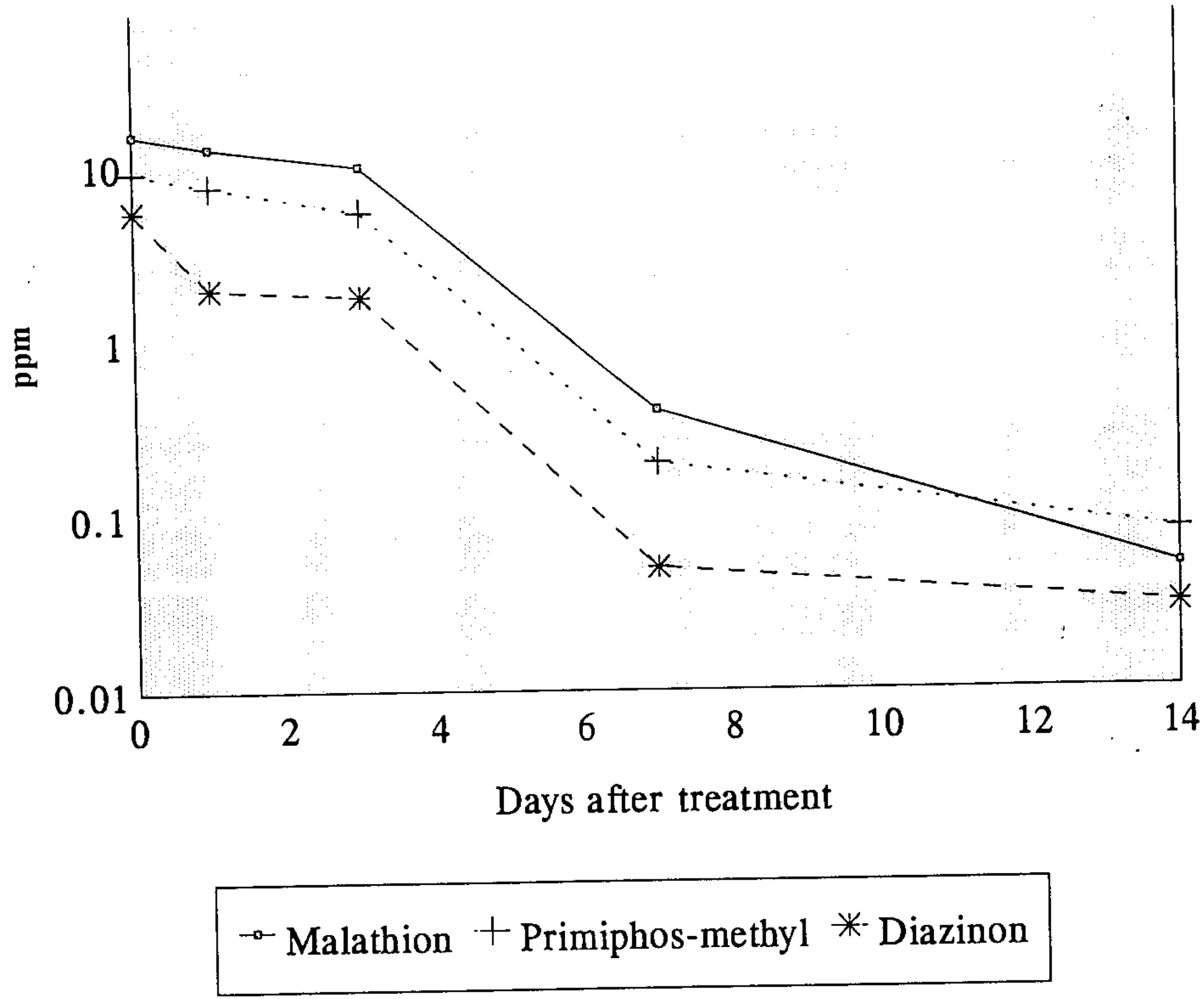


Fig. (5) : Residues of malathion, pirimiphos-methyl and diazinon on and in okra fruits at different intervals following treatment.

The maximum residue limits of malathion, pirimiphos-methyl and diazinon in okra fruits are not included in the Codex Alimentarius Commission (1996). With this way, it is difficult to refer to the safety period after which the insecticide-treated okra fruits is harvested.

1.6- Residues on and in cabbage leaves :

Residues of the three used insecticides on and in fresh and boiled cabbage leaves as well as the rates of dissipation are presented in Tables (6 and 7) and illustrated in Fig. (6). Representative samples were taken from the whole leaves, *i.e.*, the external and the internal ones. To achieve this, the heads of the insecticide-treated cabbage plants (the whole plant) was divided into two halves and each half was divided vertically into small sections. With this way, the sprayed and unsprayed leaves were represented.

Data in Table (6) show that high amounts of the used insecticides were found one hr. after application. The initial deposits of malathion, pirimiphos-methyl and diazinon in case of the fresh leaves were 26.9, 18.8 and 23.7 ppm, respectively. Such high residues may be due to the wide surface of cabbage leaves exposed to spray solution.

Dissipation percentage after one day from spraying were higher in pirimiphos-methyl and diazinon than that of malathion; the corresponding percentages were 60.6, 58.7 and 19. Sharp decrease took place in malathion residues during the next 7 days; residues of malathion were, however, similar to those of pirimiphos-methyl and diazinon. Negligible amounts of each of the three insecticides were still retained in cabbage leaves after 14 days from spraying (Fig. 6). T_{50} values were 1.8, 0.8 and 0.9 days for malathion, pirimiphos-methyl and diazinon, respectively.

Table (6) : Residues (ppm) and dissipation (%) of malathion, pirimiphos-methyl and diazinon on and in unboiled and boiled cabbage leaves at different intervals after insecticidal application under the normal field condition.

Days after treatment	Malathion				Pirimiphos-methyl				Diazinon			
	Unboiled		Boiled		Unboiled		Boiled		Unboiled		Boiled	
	R	D	R	D	R	D	R	D	R	D	R	D
Initia*	26.90	0	13.80	0	18.80	0	11.50	0	23.70	0	12.30	0
1	21.80	19.0	11.00	20.3	7.40	60.6	3.70	67.8	9.80	58.7	7.10	42.3
3	10.90	59.5	2.20	84.1	3.70	80.3	1.60	86.1	5.10	78.5	2.70	78.1
7	0.80	97.0	0.40	97.1	0.60	96.1	0.14	98.8	0.70	97.1	0.20	98.4
14	0.04	99.9	0.01	99.9	0.09	99.5	0.04	99.7	0.06	99.8	0.04	99.7
$T_{1/2}$	1.8				0.8				0.9			

Samples were taken one hour after treatment

R : Residues D : Dissipation

Table (7) : Percent reduction of malathion, pirimiphos-methyl and diazinon in boiled cabbage leaves.

Days after treat-ment	Malathion		Pirimiphos-methyl		Diazinon	
	R	D	R	D	R	D
Initial*	13.80	48.7	11.50	38.8	12.30	48.1
1	11.00	59.1	3.70	80.3	7.10	70.0
3	2.20	91.8	1.60	91.5	2.70	86.7
7	0.40	98.5	0.14	99.3	0.20	98.0
14	0.01	99.9	0.04	99.8	0.04	99.7

* Samples were taken one hour after treatment.

R : Residues

D : Dissipation values were calculated in this table from the initial deposits of the unboiled cabbage leaves.

$T_{1/2}$: Half life values (days)

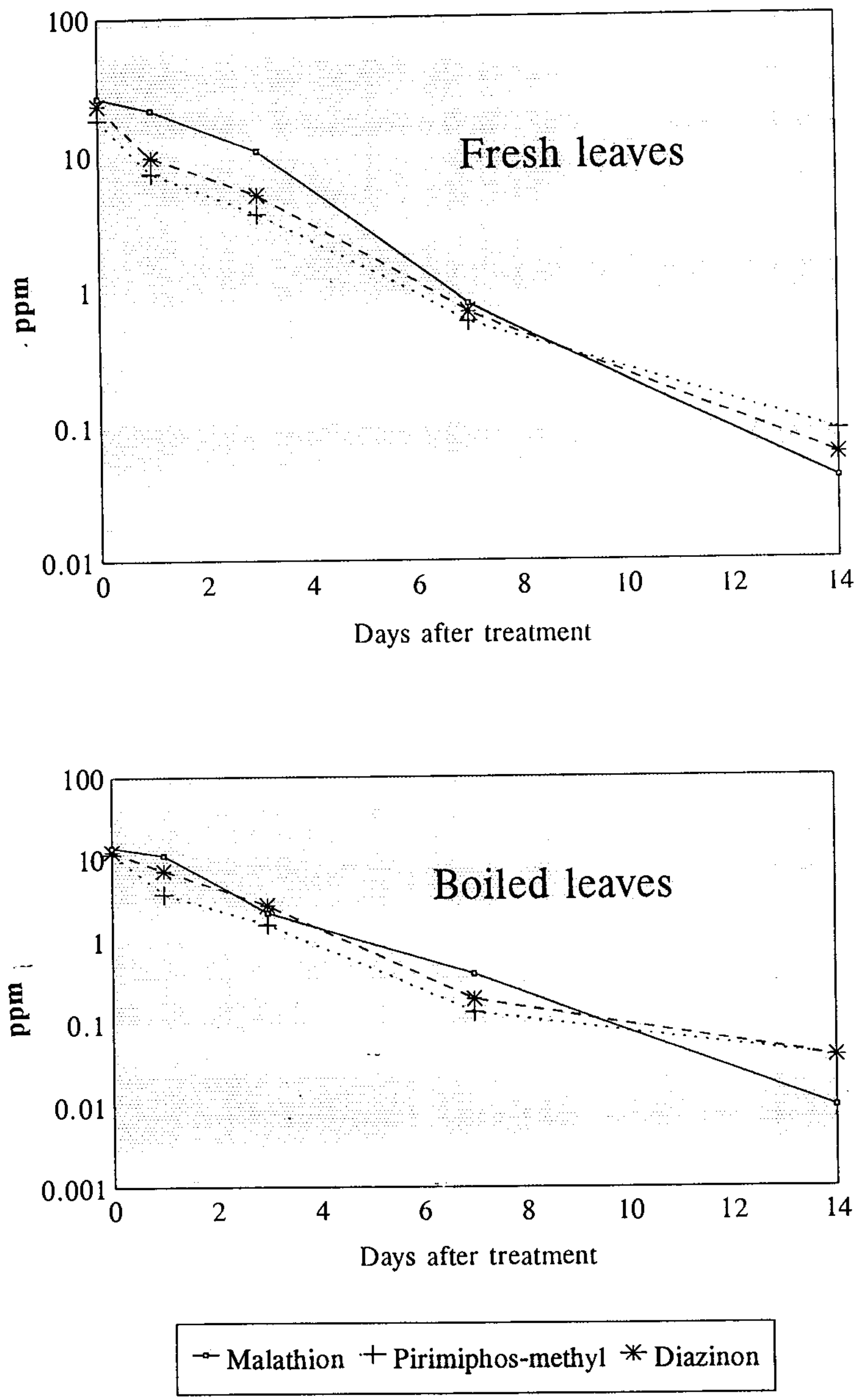


Fig. (6) : Residues of malathion, pirimiphos-methyl and diazinon on and in fresh and boiled cabbage leaves at different intervals following treatment.

The maximum residue limits of malathion, pirimiphos-methyl and diazinon on and in cabbage leaves are 8, 2 and 0.7 ppm, respectively. Based on these figures, sprayed cabbage plants must not be harvested before 4.1, 5.2 and 9.0 days from malathion, pirimiphos-methyl and diazinon spraying.

It is obvious that, boiling the insecticides- treated cabbage leaves resulted in high levels of loss in insecticides residues (Table 7). Loss percentages, due to boiling of the initial samples, were 48.7, 38.8 and 48.1 % for malathion, pirimiphos-methyl and diazinon, respectively. Boiling resulted, however, in approximately 90 % loss in insecticides residues in samples taken 3 days after application. Negligible amounts of residues were still found in boiled samples taken 14 days after spraying; amounts of residues were 0.01 mg malathion, 0.04 mg pirimiphos-methyl and 0.04 mg diazinon per kg boiled leaves.

Regarding to thermal degradation of pesticides in raw agricultural commodities, most papers describe, however, a reduction in the amounts; **Lichtenstein *et al.* (1965), Farrow *et al.* (1968), Lamb *et al.* (1968), Talekar *et al.* (1977), Bayarri *et al.* (1994), Nagayama (1996), Tag El-Din *et al.* (1996) and Zidan *et al.* (1997).**

Talekar *et al.* (1977) indicated that loss of insecticide residues by boiling was due to the relatively greater water loss than insecticide loss. They stated that water loss was the major cause in this respect; the loss in weight amounted to 60 %. The degree of loss of malathion decreased by 47 %. The degree of loss of malathion either due to washing or cooking, was not related to the binding nature of the insecticidal compounds with plant constituents.

Bayarri *et al.* (1994) showed that reduction in pesticide residues by thermal processing in three commercial cuts of lamb (37-56 %) was due to converting of parent compounds to specific metabolites.

Nagayama (1996) stated that during cooking process, the insecticide residues are decreased. Some of these residues are translocated into the cooking water from the raw foodstuffs due to their polarity.

Tag El-Din and Salama (1996) demonstrated that reduction of Rubigan-treated potatoes residues due to boiling was 61 % of the initial residues. They indicated that such reduction in the parent compound was due to hydrolysis and heat degradation.

Since virtually the majority of vegetables are cooked before consumption, information regarding the effects of cooking on the fate of several of these insecticides is important. Such information should be considered while fixing the tolerance limits..

1.7- Residues on and in snap bean pods :

Data in Table (8) show that the amounts of malathion, pirimiphos-methyl and diazinon in the initial samples were 22.0, 14.2 and 9.5 mg/kg snap bean pods. After one day from spraying, high amounts of the sprayed insecticides were dissipated. Dissipation percentages ranged between 60.1 to 78.9 after 7 days from spraying; more than 90 % of the sprayed insecticides were disappeared. in other words, the three insecticides dissipated sharply from the treated pods (Fig. 7). T_{50} values were 0.8, 0.8 and 0.7 days in malathion, pirimiphos-methyl and diazinon-sprayed snap bean pods.

The maximum residue limits of malathion, pirimiphos-methyl and diazinon in snap bean pods are 2.0, 2.5 and 0.5 ppm (**CAC, 1996**). Based on these figures, insecticide-sprayed snap bean pods can be harvested after about 8, 11 and 11 days from malathion, pirimiphos-methyl and diazinon-spraying.

Table (8) : Residues (ppm) and dissipation (%) of malathion, pirimiphos-methyl and diazinon on and in snap bean pods at different intervals from insecticidal application.

Days after treat-ment	Malathion		Pirimiphos-methyl		Diazinon	
	R	D	R	D	R	D
Initial*	22.00	0.0	14.20	0.0	9.50	0.0
1	8.80	60.9	4.90	65.5	2.00	78.9
3	3.40	84.9	2.00	85.9	0.80	91.6
7	2.10	90.6	0.90	93.6	0.60	93.7
14	0.20	99.0	0.10	99.3	0.07	99.2
$T_{1/2}$	0.8		0.08		0.07	

* Samples were taken one hour after treatment.

R : Residues D : Dissipation

$T_{1/2}$: Half life values (days)

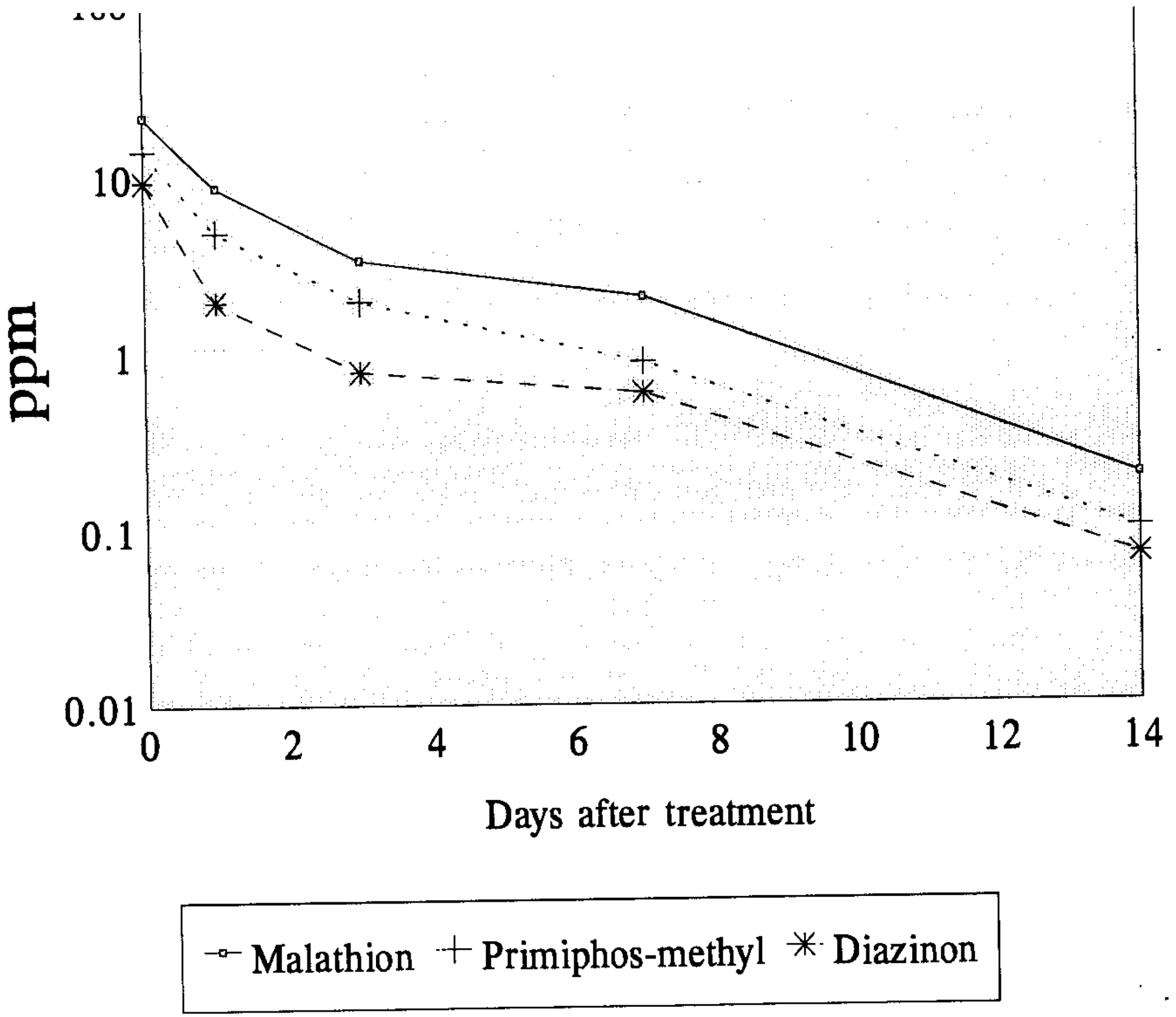


Fig. (7) : Residues of malathion, pirimiphos-methyl and diazinon on and in snap bean pods at different intervals following treatment.

As mentioned before, dissipation of the three used insecticides from the seven vegetable crops after 24 hours from spraying differed greatly from crop to another using the same insecticide or with using different insecticides onto one crop (Table 9). Loss percentages ranged between 6.9 to 53.9, 2.8 to 70.0 and 4.5 to 78.9 in malathion, pirimiphos-methyl and diazinon treatments, respectively. Such fluctuations in loss figures may be due to differences in the rates of insecticides permeability via the external layer of the fruits, which results in protecting the sprayed insecticides from photo and thermal degradation, or to differences between the plant species in the capacity of metabolizing the penetrated amounts of the insecticides.

The obtained results show, however, that loss of pirimiphos-methyl and diazinon in treated vegetable fruits was higher than malathion during the first day with the exception of tomato and eggplant fruits. Also, it is obvious that eggplant fruits revealed the highest capacity to rid off treated insecticides; 50 % or more of the initial deposits were disappeared after 24 hrs. On the other hand, cucumber displayed poor capacity in metabolizing the three used insecticides; loss percentages, after 24 hrs, were 8.0, 13.4 and 4.5 in malathion, pirimiphos-methyl and diazinon deposits.

As expected, loss percentages in insecticides residues increased as the time lapsed from spraying. Loss percentages ranged between 34.7 & 97.4, 34.5 & 95.7 and 32.8 & 95.0 after three days from spraying. Ca. 90 % of the insecticides disappeared from sprayed fruits after 7 days from spraying with the exception of tomato fruits in which loss percentages were 86.5, 77.3 and 66.4, reflect the lower capacity of tomato; compared with the other investigated fruits, in metabolizing pirimiphos-methyl and diazinon 7 days after treatment.

Table (9) : Percentages in loss of malathion, pirimiphos-methyl and diazinon in treated vegetable fruits one day, 3 days and 7 days after insecticidal spraying.

Type of crops	Loss (%) at the indicated (days) after spraying		
	Malathion	Pirimiphos-methyl	Diazinon
	One day		
Tomato	51.5	2.8	14.7
Cucumber	8.0	13.4	9.5
Green pepper	27.7	70.2	10.0
Eggplant	53.9	57.2	50.0
Okra	16.0	17.4	63.6
Cabbage	19.0	60.6	58.7
Snap bean	60.9	65.5	78.9
	3 days		
Tomato	60.8	34.5	32.8
Cucumber	62.8	72.5	77.1
Green pepper	80.4	85.6	78.0
Eggplant	97.4	95.7	95.0
Okra	34.7	41.3	67.3
Cabbage	59.5	80.3	78.5
Snap bean	84.9	85.9	91.6
	7 days		
Tomato	86.5	77.3	66.4
Cucumber	97.9	98.7	99.7
Green pepper	95.3	88.5	93.0
Eggplant	99.2	97.1	96.7
Okra	97.3	97.8	99.1
Cabbage	97.0	96.1	97.1
Snap bean	90.6	93.6	93.2

Data also show that the components of the plants and the formulation some of the used insecticides, the rate of application, the crop species and the surface area of the same weight of the same crop play an important role in level of the initial deposits of insecticides.

The obtained results coincide with those reported by several investigators (e.g. **Hegazi *et al.*, 1989; Shahin *et al.*, 1989; Abdallah *et al.*, 1993; Haggag, 1994; Soliman, 1994 and Abdel-Rahman, 1996).**

Shoker (1997) studied the effect of sunlight on the degradation of four organophosphorus insecticides namely pirimiphos-methyl, fenitrothion and prothiofos. It was found that pirimiphos-methyl was the most sensitive compound whereas prothiofos was the most tolerant one; the other two compounds occupied an intermediate position. The corresponding loss percentages after one hour from exposure to sunlight were 45.18, 5.48, 6.13 and 0.82. After 24 hrs there were no great differences between the four insecticides in this respect; loss percentages ranged between 86.77 and 98.52.

Curiously enough to note that when the author studied the effect of temperature and UV-rays separately, it was found taht both factors displayed negligible effect. With temperature (40°C), corresponding loss percentages were 2.60, 1.32, 1.62 and 0.96; and 23.75, 16.19, 17.25 and 12.96 after one and 24 hrs, respectively. Regarding UV-rays, the corresponding figures were 10.01, 4.04, 5.37 and 3.83. The loss was much more obvious as time lapsed from the onset of exposure; loss percentages were 78.97, 39.46, 42.47 and 48.30.

Antonious and Snyder (1994) showed that loss of mainly to volatilization which may reduce initial retention and half life.

The obtained results showed that picking-up of the three insecticides differed from crop to another although the same amounts of active ingredients of each insecticide was used. The same phenomenon were noticed by **Shoker (1997)** when moloukhia leaves, green beans pods and cucumber fruits were sprayed with pirimiphos- methyl, fenitrothion, malathion and prothiofos.

2- Persistence of Malathion, Pirimiphos-methyl and Diazinon on and in Various Fruits :

In this set experiments the insecticides malathion, pirimiphos-methyl and diazinon at the rates 1.5, 1.5 and 1.0 L/fed. were used, respectively. The corresponding used active ingredient per feddan were 855, 750 and 600 g. Each of the three insecticides was sprayed once at time of fruiting. The amounts of the formulated insecticides were diluted with canal water using 400 L/fed. Treated crops were; grape, peach, pear, apricot, fig and guava. Residues of the forementioned insecticides were detected one hr as well as 1, 3, 7 and 14 days after insecticidal application. the obtained results are presented in Tables (10, 11, 12 and 13) and graphically illustrated in Figures (8, 9, 10, 11, 12, 13 and 14).

Results showed that the amounts of each insecticide detected one hr after spraying differed greatly from crop to another although the same rate of active ingredient was used for all the seven crops. In other words, picking-up of each insecticide differed from crop to another. This phenomenon may be due to the morphological and chemical characteristics of the fruit surface.

It is known that the intensity of the waxy layer and the partition coefficient of the insecticide play an important role in picking up of an pesticide on the plant surface. Amounts of malathion, pirimiphos-methyl and diazinon present in one kg fruits ranged between 3.3 to 35.5, 2.7 to 20.2 and 1.2 to 15.2 mg. Samples of insecticide-sprayed grape leaves, either the fresh or boiled leaves contained magnitude amounts of pesticides, compared with those contained in the fruits. Amounts of malathion, pirimiphos-methyl and diazinon detected in fresh and boiled grape leaves were 10.7, 9.5 & 9.6 and 6.7, 8.6 & 8.7 times higher than those present in the insecticide sprayed fruits. Each quantitative increase in amounts of insecticides is due to differences in surface area of each of the leaves and fruits exposed to spraying as well as the morphology and chemistry of the sprayed surfaces target.

It is obvious that, the lowest amounts of the three sprayed insecticides were picked up by pear fruits, where apricot picked-up the highest amount of each insecticide. The crop fruit species behave similar in this respect. the six fruits could be arranged descendingly according to picking up sprayed insecticides as follows : apricot, grape, fig, peach, guava, and pear.

2.1- Malathion residues :

Data in Table (10) show that residues of malathion, located externally on fruit surface or internally, diminished as time lapsed from spraying until the 14*th* day. Reduction in the parent compound is due to physical degradation, mechanical removal and to less extent to volatilization, which takes place on the external amounts, as well as biodegradation to the penetrated amounts. Loss percentages one day after malathion spraying on the six crops differed greatly from crop to another which reflect the capacity of each plant species to metabolize malathion. Loss percentages, as presented in Table (11), were 57.5, 14.7, 24.2, 44.8, 76.2 and 19.0, respectively, in grape-, peach-, pear-, apricot-, fig-, and guava- sprayed fruits. These figures show, however, that fig fruits displayed the highest capacity to metabolize malathion, whereas peach ones displayed the lowest bioactivity. Such fluctuation in the capacity of each plant species to metabolize any xenobiotic is due to the titer of metabolizing enzymes which result in activation or detoxication. Such assumption is based on the similarity of the activity of the extrinsic factors mentioned before. The capacity of the fruits to degrade malathion differed from period to another at which detection of residues was carried out. Loss percentages in malathion-sprayed grape were 57.5, 18.8, 66.1 and 90.2, respectively, after 1, 3, 7 and 14 days from

Table (10) : Residues (ppm) of malathion, pirimiphos-methyl and diazinon on and in grape fruits, grape leaves, peach, pear, apricot, fig and guava.

Crops	Residues at the indicated periods (in days) after insecticidal spray														
	Initial*			1			3			7			14		
	m	p	d	m	p	d	m	p	d	m	p	d	m	p	d
Grape fruits	35.1	14.1	11.3	14.9	8.9	6.6	12.1	3.3	2.6	4.1	2.9	0.9	0.4	0.4	0.2
Grape leaves (unboiled)	374.9	133.4	108.0	168.7	38.9	23.7	161.3	36.8	22.6	19.4	5.6	5.3	12.3	4.7	4.1
Grape leaves (boiled)	234.9	120.7	98.2	120.3	36.3	21.7	115.3	30.3	20.5	10.3	2.6	2.3	4.5	1.9	1.9
Peach	11.6	9.9	8.9	9.9	8.3	6.2	8.2	7.1	3.7	2.5	1.7	0.7	0.13	0.1	0.05
Pear	3.3	2.7	1.2	2.5	1.9	0.9	1.7	1.8	0.8	0.6	0.9	0.4	0.4	0.6	0.3
Apricot	35.5	20.2	15.2	19.6	14.3	8.1	5.6	4.1	1.2	0.4	0.4	0.08	0.3	0.2	0.04
Fig	16.8	12.3	10.0	4.0	3.9	2.0	2.6	1.5	0.5	2.4	1.2	0.3	0.4	0.4	0.1
Guava	8.9	9.3	6.8	7.21	7.91	4.9	2.63	1.72	1.01	0.4	0.32	0.21	0.2	0.11	0.05

* Samples were taken one hour after treatment.

m : malathion, p : pirimiphos-methyl, d : diazinon

Table (11) : Rates of loss (%) in malathion, pirimiphos-methyl and diazinon residues present in some fruits at different periods from spraying.

Fruits	Loss (%) at the indicated period (days) after spraying			
	1	3	7	14
Malathion				
Grape	57.5	18.8	66.1	90.2
Peach	14.7	17.7	69.5	94.8
Pear	24.2	32.0	64.7	33.3
Apricot	44.8	71.4	92.9	25.0
Fig	76.2	35.0	7.7	83.0
Guava	19.0	63.5	84.8	50.0
Pirimiphos-methyl				
Grape	36.9	62.9	12.1	86.2
Peach	16.2	14.5	76.1	94.1
Pear	29.6	5.3	50.0	33.3
Apricot	29.2	71.3	90.2	50.0
Fig	68.3	61.5	20.0	66.7
Guava	14.9	78.3	81.4	65.6
Diazinon				
Grape	41.6	60.6	65.4	77.8
Peach	30.3	40.3	81.1	92.9
Pear	25.0	11.1	50.0	25.0
Apricot	46.7	85.2	93.3	50.0
Fig	80.0	75.0	40.0	66.7
Guava	27.9	79.4	79.2	71.4

spraying. The figures presented in Table (12) show that the six crops behave different in this respect; ca. 50 % or more of the initial amounts of malathion were dissipated from sprayed grape, apricot and fig fruits compared with 14.7, 24.2 and 19.0 % in peach, pear and guava, respectively, which reflect the superiority of the 1*st* group in this respect compared with the inferiority of the second group. The picture differed greatly after two days, *i.e.*, 3 days from the onset of spraying; the group of fruits that revealed higher capacity in metabolizing malathion displayed, however, lower bioactivity. The same trend in behaviour took place during the other two periods. Such irregularity in the bioactivity of the six crops can be elucidated to the fluctuation in the metabolizing enzymes as well as the interference of the present metabolites at the time of detection which may affect the titer of the metabolizing enzymes, *i.e.*, induction effect.

Based on the accumulative figures of dissipation percentages presented in Table (12), data show that dissipation percentages increased progressively until the end of the experimental period, *i.e.*, the 14*th* day after spraying. Dissipation percentages ranged between 57.6 to 98.9, 14.7 to 98.9, 24.2 to 87.9, 44.8 to 99.3, 76.2 to 97.6 and 19.1 to 97.7, respectively, in malathion-sprayed grape, peach, pear, apricot, fig and guava fruits. Data show that the corresponding amounts located on and in these fruits were 0.40, 0.13, 0.40, 0.30, 0.40 and 0.2 mg/kg fruits.

Data show that malathion dissipated gradually from malathion-sprayed grape fruits until 14*th* day from spraying at which 1.1 % were still retained in grape fruits. More than 50 % were dissipated after one day from the onset of spraying. With this way, malathion could be considered as a short lived insecticide in grape fruits.

Table (12) : Accumulaive dissipation (%) of malathion, pirimiphos-methyl and diazinon on and in grape fruits, grape leaves, peach, pear, apricot, fig and guava.

Crops	Dissipation (%) in insecticide residues at the indicated period (days) after insecticidal spray												T_{50} (days)		
	1			3			7			14					
	m	p	d	m	p	d	m	p	d	m	p	d	m	p	d
Grape fruits	57.5	36.9	41.6	65.6	76.6	76.6	88.4	79.2	91.9	98.9	97.8	98.2	0.9	1.0	1.5
Grape leaves	55.7	70.9	78.4	57.7	72.5	79.4	95.9	95.9	95.6	97.9	96.5	96.6	0.9	0.7	0.6
Peach	14.7	16.2	30.3	29.3	28.3	58.4	78.4	82.8	92.1	98.9	98.9	99.4	4.6	4.5	2.3
Pear	24.2	29.6	24.9	48.5	33.3	33.3	81.8	66.7	66.6	87.9	77.8	74.9	3.2	5.0	5.0
Apricot	44.8	29.2	46.7	84.3	79.7	92.1	98.9	98.0	99.5	99.3	99.0	99.8	1.2	1.8	1.2
Fig	76.2	68.3	80.0	84.5	87.8	95.0	85.7	90.2	97.0	97.6	96.8	99.0	0.7	0.7	0.6
Guava	19.0	16.1	27.9	70.8	77.5	85.3	95.5	96.8	97.1	97.7	98.9	99.3	2.0	1.9	1.7

m : malathion, p : pirimiphos-methyl, d : diazinon

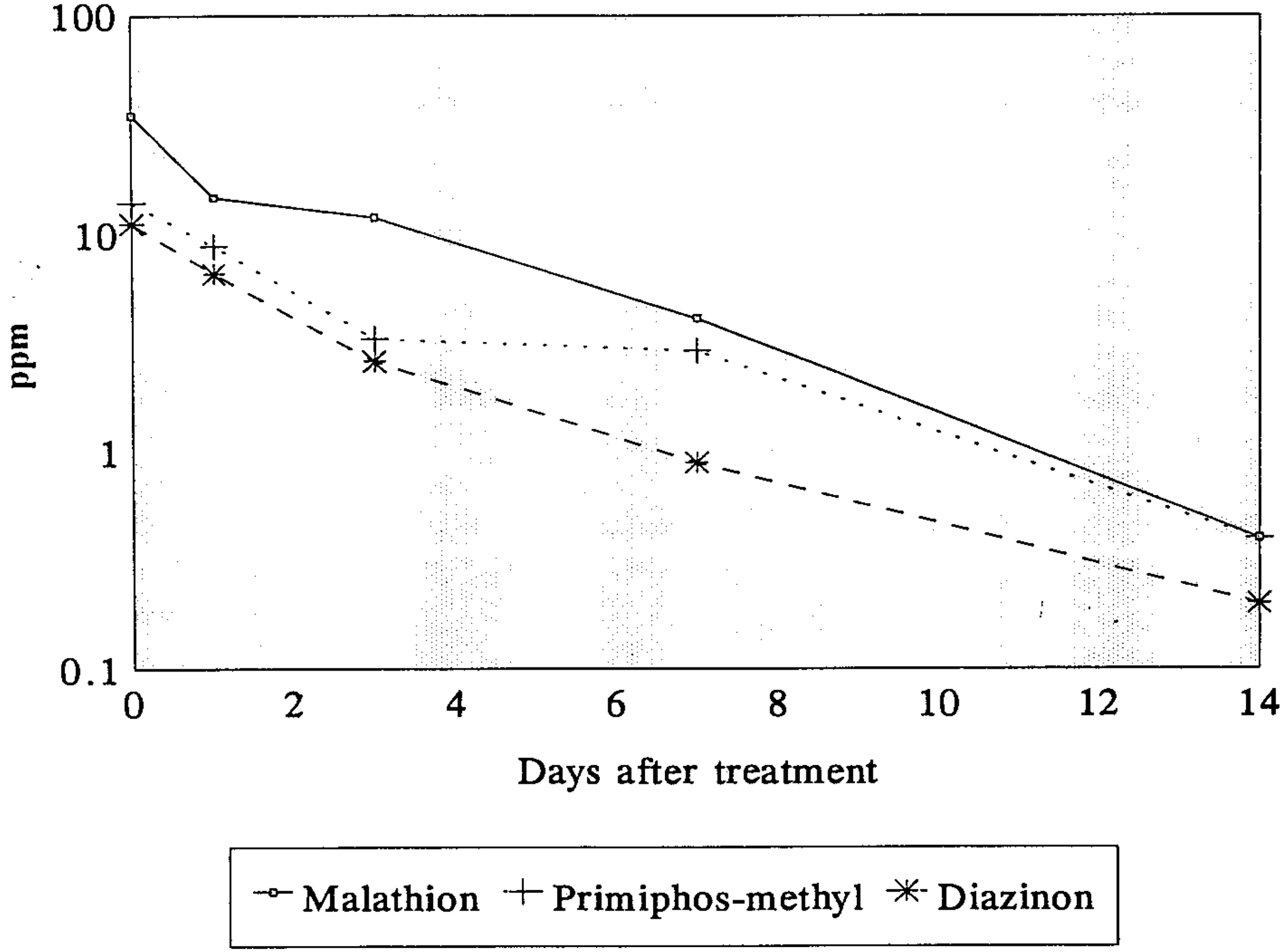
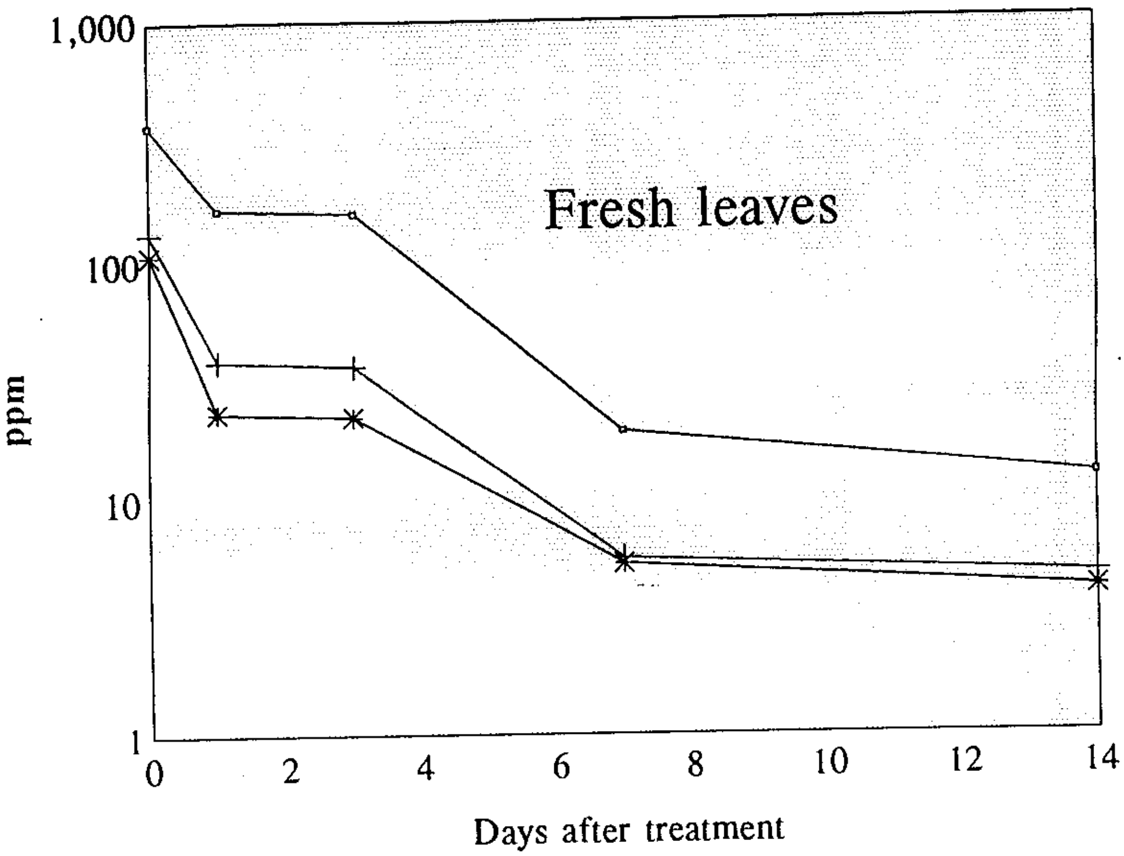


Fig. (8) : Residues of malathion, pirimiphos-methyl and diazinon on and in grape fruits at different intervals following treatment.



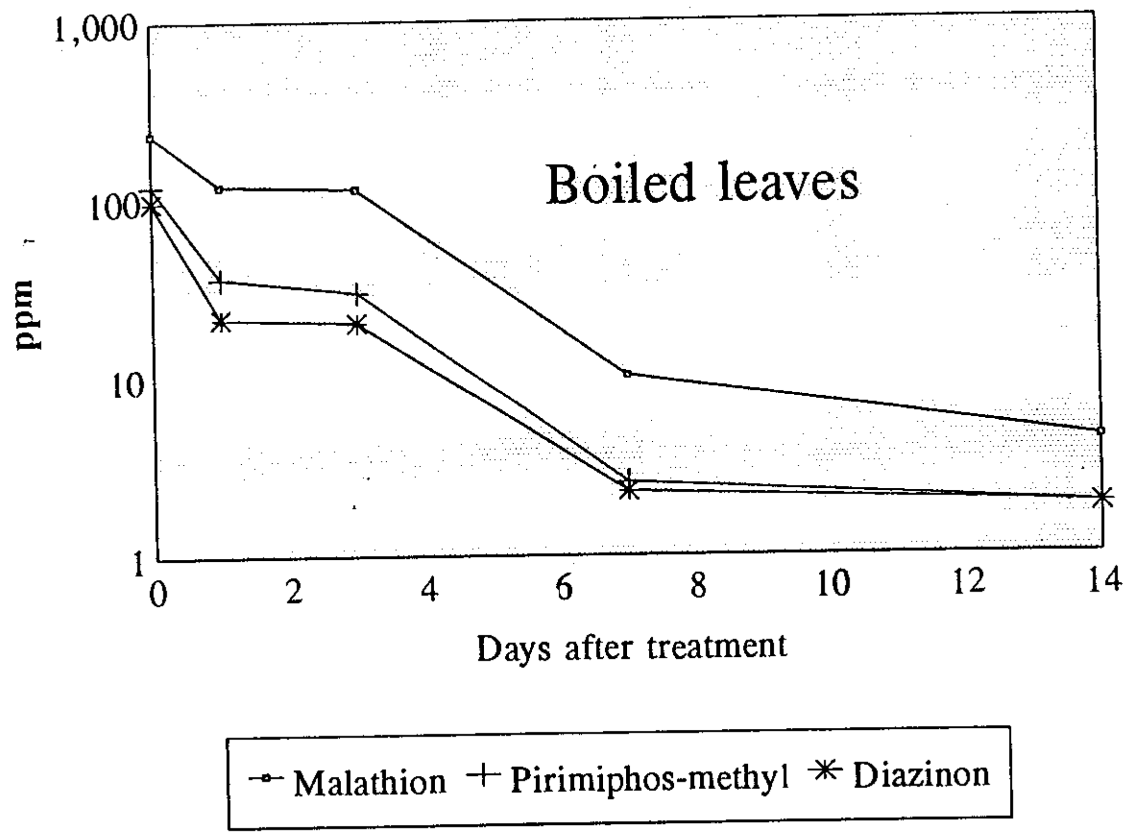


Fig. (9) : Residues of malathion, pirimiphos-methyl and diazinon on and in fres and boiled grape leaves at different intervals following treatment.

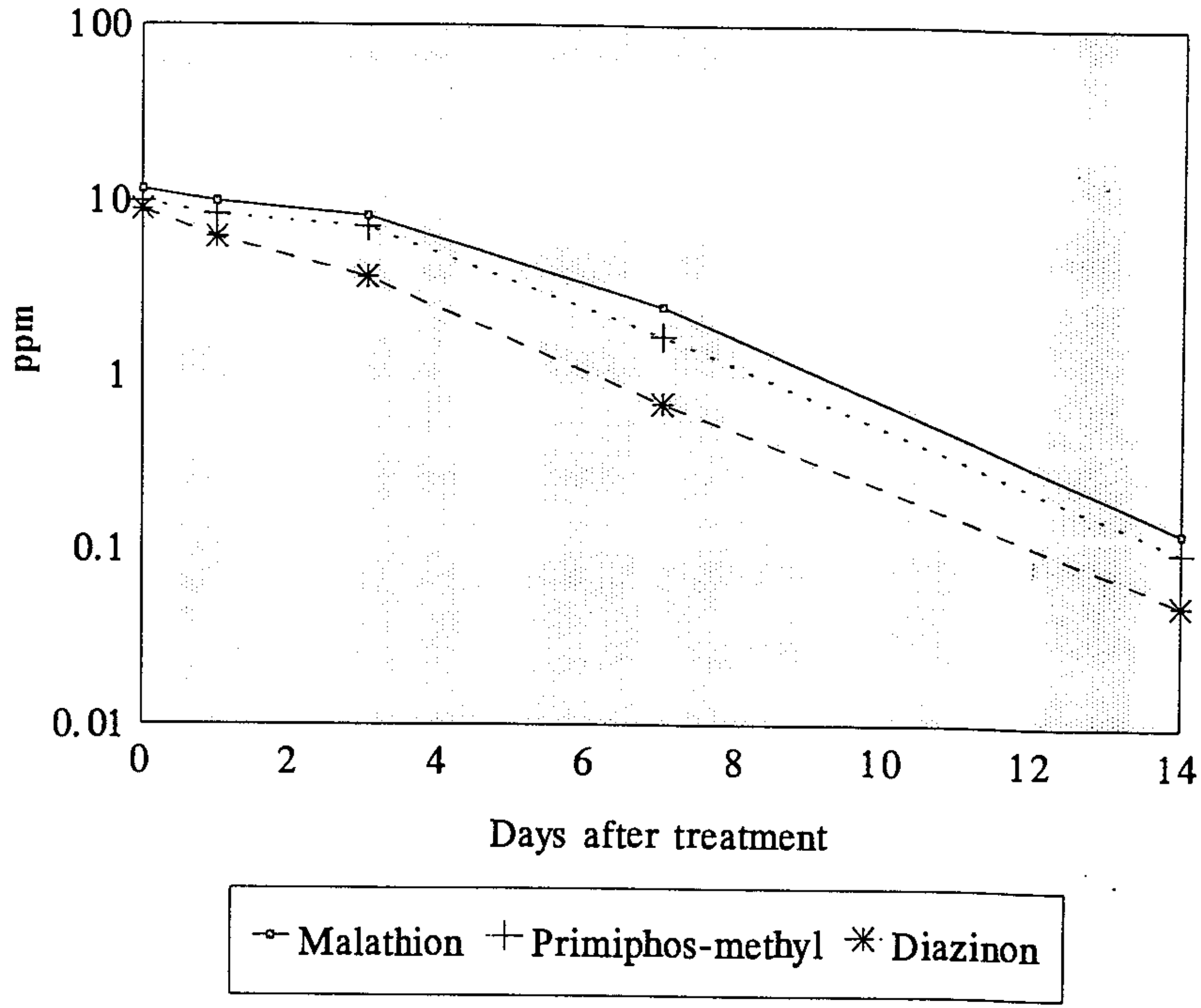


Fig. (10) : Residues of malathion, pirimiphos-methyl and diazinon on and in peach fruits at different intervals following treatment.

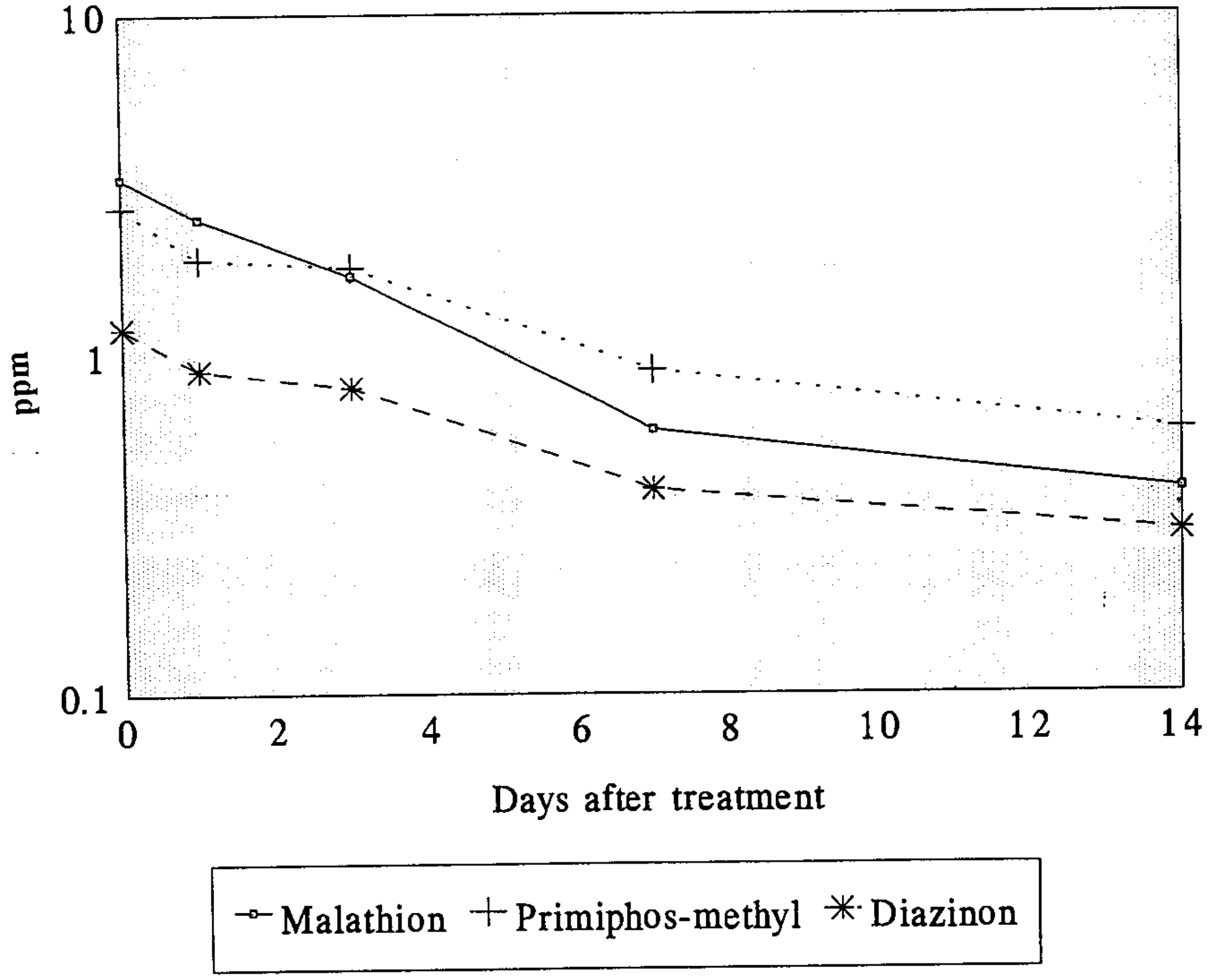


Fig. (11) : Residues of malathion, pirimiphos-methyl and diazinon on and in pear fruits at different intervals following treatment.

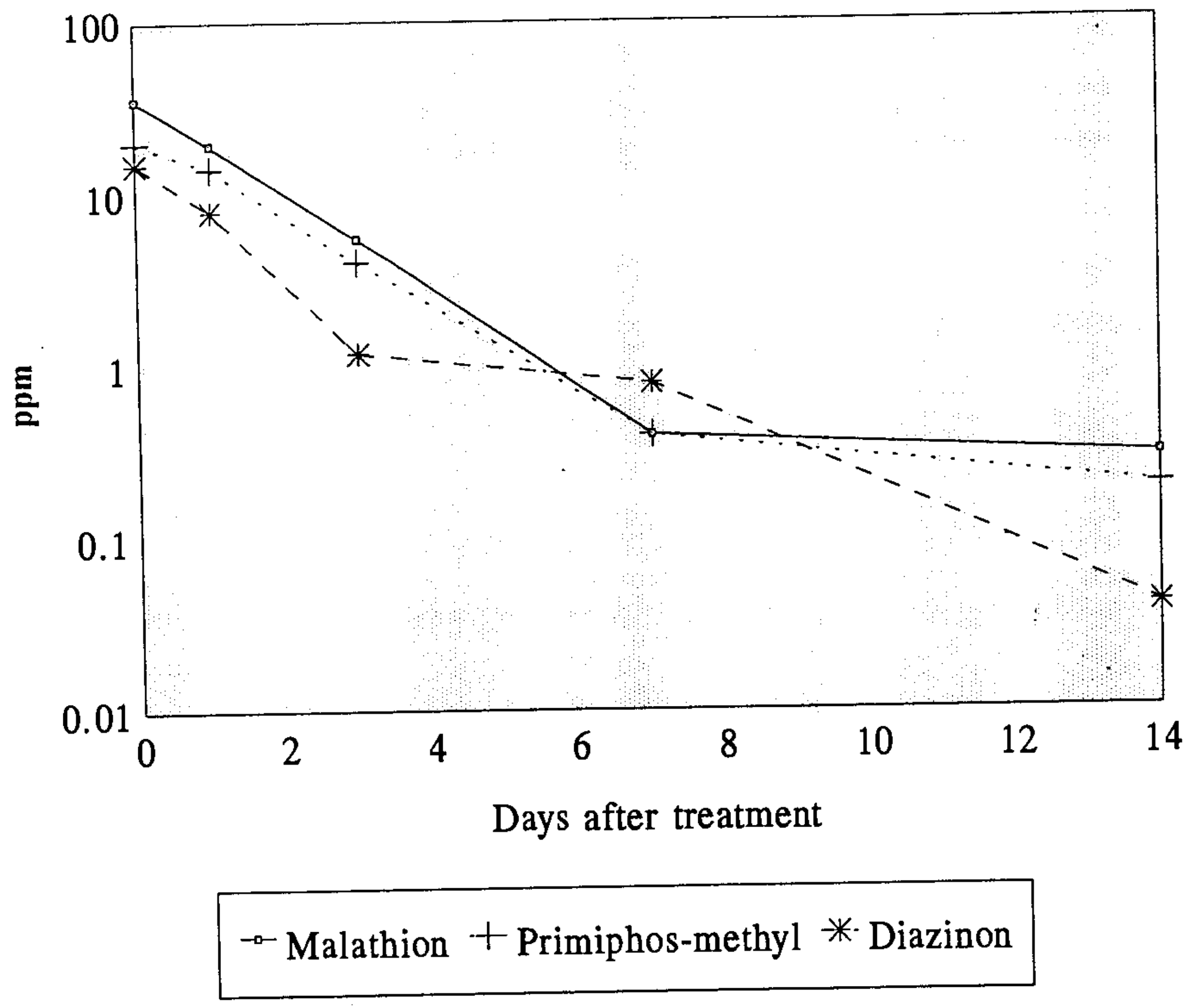


Fig. (12) : Residues of malathion, pirimiphos-methyl and diazinon on and in apricot fruits at different intervals following treatment.

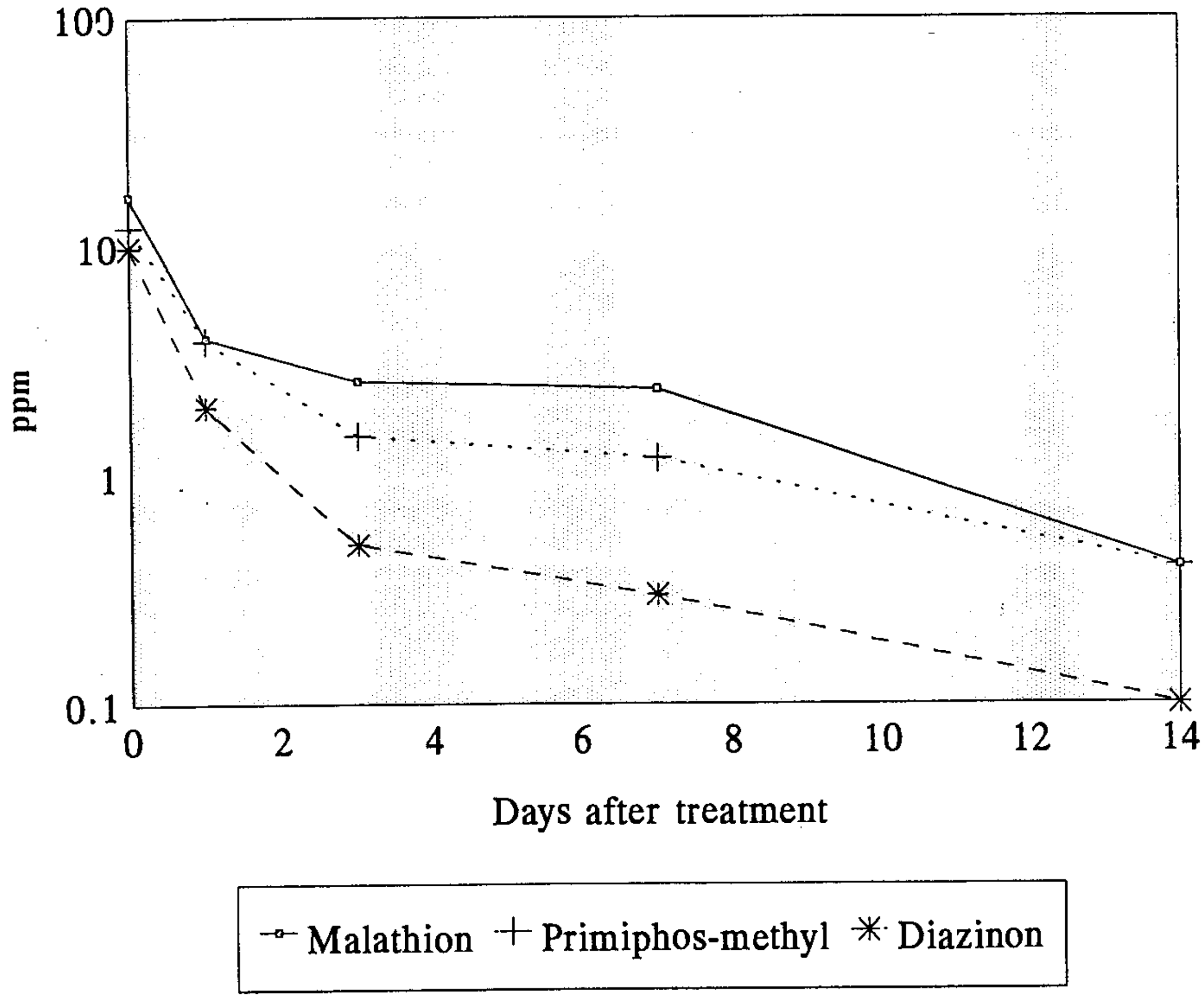


Fig. (13) : Residues of malathion, pirimiphos-methyl and diazinon on and in fig fruits at different intervals following treatment.

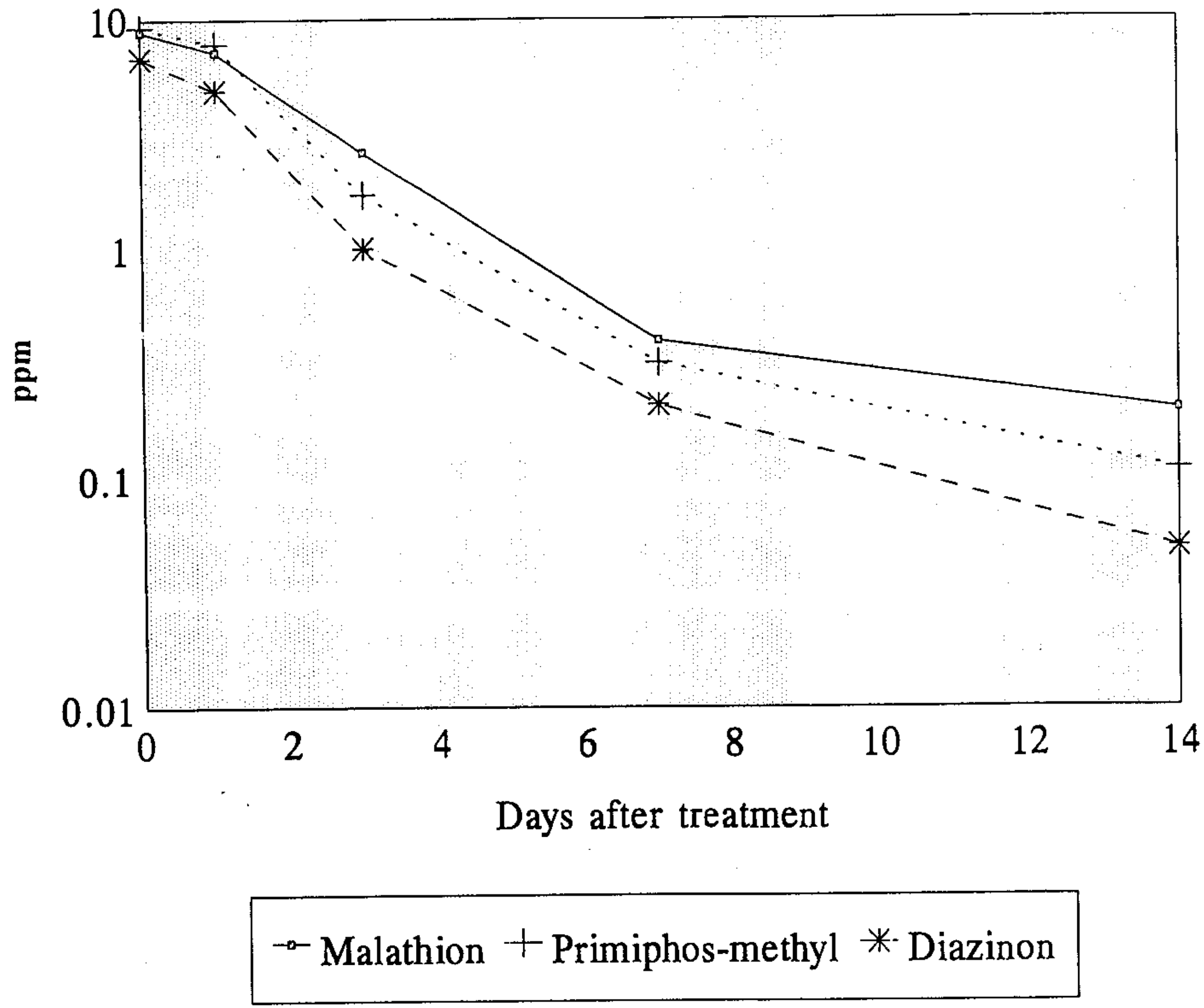


Fig. (14) : Residues of malathion, pirimiphos-methyl and diazinon on and in guava fruits at different intervals following treatment.

The picture differed greatly with peach. Dissipation of malathion was slight during the first three days and reached 29.3 % then sharply increased to 78.4 and 98.9 % after 7 and 14 days from spraying. these figures show that malathion, however, was more stable in peach fruits than in grape fruits. Differences in the capacity of the enzymes involved in the metabolism may elucidate such differences.

Pear occupied an intermediate position during the first 3 days. In the 14*th* day, higher amount of malathion (0.4 mg/kg fruits) were still present in the fruits which reflect, however, the high stability in pear fruits compared with grape and pear fruits, based on the initial deposits.

Dissipation of malathion in apricot fruits was, however, higher than that in the preceding 3 fruits; ca. 85 % dissipated after 3 days from spraying.

The highest rate of dissipation was recorded in fig fruits, 76.2 % of malathion was disappeared after 1 day from spraying which reflect the high capacity of this plant species in metabolizing malathion. On the other hand, malathion dissipation in guava was slight during the first day from spraying followed by sharp increase in dissipation during the next two days (70.8 %); after 7 days percent dissipation was 95.5 %.

Based on the average of dissipation during the first 3 days, the six fruit species can be descendingly arranged according to their capacity to metabolize malathion as follows : fig, grape, apricot, guava, pear and peach. The six fruit species can be, however, descendingly arranged according to persistence of malathion in the fruit tissues as follows : peach, pear, guava, apricot, grape and fig. In other words, fig fruits revealed the highest capacity to metabolize malathion, whereas peach was the inferior in this respect. The other four fruit species lie inbetween.

The capacity of each plant species to metabolize pirimiphos-methyl differed greatly from period to another since the external factors affecting dissipation are, however, similar during the whole experimental period. loss percentages in pirimiphos- methyl-sprayed grape fruits were 36.9, 62.9, 12.1 and 86.2, respectively, after 1, 3, 7 and 14 days from spraying (Table 11). One day from the onset of spraying, loss percentages ranged between 14.9 to 68.3; fig fruits revealed the highest bioactivity (68.3 %), whereas guava revealed the lowest bioactivity (14.9 %) compared with the other four fruits which occupied an intermediate position.

Data in Table (12) show that pirimiphos-methyl behaved similar to malathion in all the six fruits. Again, and as has been found with malathion, the first three days were the most critical period at which dissipation differed from fruit species to another; dissipation percentages ranged between 16.1 to 68.3 and 28.3 to 87.8 %, respectively after 1 and 3 days from spraying. the differences after the *7th* and *14th* days were greatly narrowed; dissipation percentages ranged between ca. 80 to 98 after the *7th* day. Differences were negligible after the *14th* day and ranged between 96.5 to 98.9 %. Dissipation of pirimiphos-methyl in pear during the *7th* and *14th* days was completely different than the figures recorded with the other 5 fruit species; the corresponding dissipation percentages were 66.7 and 77.8 which reflect the high persistence of this compound in pear fruits. Based on the average of dissipation during the first three days, the six fruit species can be descendingly arranged according to persistence of pirimiphos-methyl in the fruit tissues as follows : peach, pear, guava, apricot, grape and fig. It is obvious that this arrangement was similar to that of malathion with the exception of grape and apricot in which the position was exchanged.

Data in Table (12) and Figs. (8, 9, 10, 11, 12, 13 and 14) show that the half lives of pirimiphos-methyl in grape, peach, pear, apricot, fig and guava were 1.0, 4.5, 5.0, 1.8, 0.7 and 1.9 days, respectively.

According to **CAC (1996)**, the maximum residue limits of pirimiphos-methyl in pear is 2 ppm. Based on this data in Table (10) show that pirimiphos-methyl- treated fruits can be harvested one day after spraying. The other five crop fruits must not be harvested unless the analysis show that those fruits are free from any residues of pirimiphos-methyl.

2.3- Diazinon residues :

The residues of diazinon on and in the six fruits after different periods of spraying are presented in Table (10). Data show that the initial deposits were lower than those of malathion and pirimiphos-methyl. Amounts of the initial deposits in and on fruits ranged between 1.2 to 15.2. Again, and as has been found with the other two insecticides, there is no relation between the low amount of the used active ingredient of diazinon, compared with the other two insecticides, and the reduction of uptake on the fruit surfaces. reduction in the amount of the active ingredient of diazinon, compared with malathion, was 29.8 % whereas reductions in uptake were 67.8, 23.3, 63.6, 57.2, 40.5 and 23.5 in grape, peach, pear, apricot, fig and guava fruits. Such incompatibility may be due to differences in the morphology and chemistry of fruit surfaces as well as differences in the ingredients of the additives of the used formulation which play an important role in this respect. it is worth to mention that the partition coefficient of the used active ingredient is also involved in the uptake of any pesticides.

As mentioned before the initial deposits fluctuated greatly from crop to another although the same amount of active ingredient were used for all the six plant species. Exactly, the three insecticides were used based on specific rate of each insecticide (1.5, 1.5 and 1.0 lit. of malathion, pirimiphos-methyl and diazinon/fed., respectively). Each rate of the pesticide was diluted with specific volume of diluent agent (water canal). At the same time, the size of sprayed plant surfaces differed greatly from crop to another. With there way, the amount of deposits which reach onto plant surfaces, including the fruits surfaces differed greatly which may through some light on the fluctuation of the initial deposits.

Data in Table (11) show that disappearance of diazinon from the fruits one day after spraying was higher than that of pirimiphos-methyl and malathion. The highest loss (80 %) was observed in fig fruits , whereas the lowest loss took place in pear, guava and peach, the corresponding percentages of loss were 25.0, 27.9 and 30.3, respectively. More than 40 % of the applied insecticide was dissipated from grape and apricot fruits.

Two days later, and with the exception of pear and fig dissipation was sharply increased and ranged from 40.3 to 85.3 % which show that the *1st* 3 days from spraying is the critical period (Table 12). After 7 and 14 days from spraying rates of loss ranged between 40.0 to 93.3 and 25.0 to 92.9 %, respectively.

Reviewing the data presented in Table (12) and Figs. (8, 9, 10, 11, 12, 13 and 14) show that the half lives of diazinon in grape, peach, pear, apricot, fig and guava were 1.5, 2.3, 5.0, 1.2, 0.6 and 1.7 days. These figures clearly show that diazinon could be considered as short lived insecticide in fig compared with pear in which diazinon persisted for extreme longer period.

Based on the loss during the *1st* three days, the six fruits species could be arranged descendingly according to their ability to rid of diazinon as follows : fig, apricot, grape, guava, peach and pear. It is clear that the same arrangement was found with pirimiphos-methyl with the exception of peach and pear in which the position was exchanged.

According to **CAC (1996)**, MRL of diazinon in peach is 0.7 ppm. Thus, the sprayed fruits can be harvested after one day. The MRLs of diazinon in the other five fruits species are not included in the codex. With this way, these fruits must not be harvested unless the diazinon is completely disappeared from sprayed fruits.

In conclusion, and based on the residues of the three insecticides detected during the first 3 days, data presented in Table (10), obviously indicate that fig fruits was the most active fruits in metabolizing the three insecticides; dissipation percentages ranged between ca. 70 to 80/day after spraying. The least active fruits in this respect were peach and guava; the corresponding dissipation percentages were, however, less than 20 %. The other fruit species viz. apricot, grape and pear lie inbetween.

Effect of Boiling on Insecticide Residues on and in Grape leaves :

It is obvious, as could be noticed in Table (10), that magnitude amounts of malathion, pirimiphos-methyl, or diazinon were detected in one kilogram of fresh grape leaves, compared with the amounts of each of the three insecticides detected in the same weight of grape fruits. Such variations are mainly due to differences in the surface areas of leaves and fruits (in specific weight) exposed to deposits of the sprayed insecticides, differences between fruits and leaves in picking up droplets of insecticides and to less extent to variation in mechanical loss. Amounts of malathion, pirimiphos-methyl and diazinon detected in fresh leaves 1 hr after spraying were 10.7, 9.5 and 9.6 times higher than those detected in the same weight of fruits. Amount of malathion was higher (2.8 times) than that of pirimiphos-methyl. This remarkable difference do not correlate with the corresponding used amounts of active ingredient (855 and 750 g). This phenomenon is mainly due to dissipation percentages ranged between ca. 70 to 80 % one day after spraying. The least active fruits in this respect were peach and guava; the corresponding dissipation percentages were, however, less than 20 %. The other fruit species *viz.* apricot, grape and pear lie inbetween.

As mentioned before, the rate of loss in insecticides in case of fruits increased, however, with increasing the time lapsed between the onset of insecticidal spray and the assessment of residues, *i.e.*, time dependent. The picture differed greatly in case of leaves. Curiously enough to note that, as could be noticed in Table (13), that rates of loss were very high after 1 and 7 days from application with each of the used insecticides and very low during the 3*rd* and 14*th* day; loss percentage ranged between 55 to 88 and 4.4 to 36.6 during the 1*st* and 3*rd*; and 2*nd* and 4*th* periods, respectively. Fluctuation in the level of insecticides metabolites as well as their rates of metabolism may play a significant role in this phenomenon. Differences between fruits and leaves as regard rates of insecticides loss, could be considered as organ specificity which affect, however, the metabolism of xenobiotics which does correlate with the physiology of the specific organ due to differences in the intrinsic factors involved in making the different organs capable to get rid of these xenobiotics.

Data in Table (10) clearly show that boiling grape leaves resulted in loss in insecticide residues. Such loss differed from insecticide to another during the whole experimental period as well as from period to another with each insecticide. Loss was slight in samples picked-up 1 hr (initial), 1 and 3 days after spraying and high in samples taken during the last two periods. Boiling malathion-treated leaves picked up 1 hr, 1 and 3 days resulted in higher rates of loss compared with those of pirimiphos-methyl and diazinon; such wide difference was not observed during the last two periods of assessment.

In conclusion, the obtained data show taht thermal degradation is considered as reasonable factors in removing insecticides from the edible parts of the plants. The significance of thermal degradation depends on the chemical structure of the compound involved as well as time lapsed between spraying and assay.

Table (13) : Rates of loss (%) in malathion, pirimiphos-methyl and diazinon residues in fresh and boiled grape leaves as well as grape fruits at different periods from from spraying.

Insecticides	Loss (%) at the indicated period (days) after spraying														
	Initial (1 hr)			1			3			7			14		
	Fruit	Leaves		Fruit	Leaves		Fruit	Leaves		Fruit	Leaves		Fruit	Leaves	
	-	Un.	B.	-	Un.	B.	-	Un.	B.	-	Un.	B.	-	Un.	B.
Malathion	-	-	37.3	57.5	55.0	28.7	18.8	4.4	28.5	66.1	88.0	46.9	90.2	36.6	63.4
Pirimiphos-methyl	-	-	9.5	36.9	70.8	6.7	62.9	5.4	17.7	12.1	84.8	53.6	86.2	16.1	59.6
Diazinon	-	-	9.1	41.6	78.1	8.4	60.6	4.6	9.3	65.4	76.5	56.6	77.8	28.6	53.7

B. : boiled   Un. : unboiled

3- Monitoring of Insecticide Residues in Some Agricultural Products :

In this set of experiments, the residues of chlorinated hydrocarbon insecticides and two types of organophosphorus compounds namely malathion and pirimiphos-methyl in two grains (wheat and shelled rice), and six vegetables (potato, tomato fruits, cucumber fruits, green pepper fruits, eggplant fruits and cabbage leaves), and three fruits (peach, apricot and guava) were monitored. These products were obtained from three different markets located in Kalyubia Governorate (Shobra, Tukh and Benhaduring 1995), from which 99 samples were taken. The obtained results are exhibited in Tables (14, 15, 16, 17, 18, 19, 20, 21, 22, 23 and 24).

Data show that all samples (grains, vegetables and fruits) were contaminated with α and β-HCH, as compared with93.3 % in case of γ-HCH. Total contamination with HCH derivatives were 96.96.

With DDT, out of 29 samples only 4 samples were free from contamination with DDT and DDT derivatives; in other words 87.9 % of the samples containing different levels of DDT derivatives.

The contamination of the amounts of the active ingredients (mg/kg) in the grains ranged between 6 and 20 ppb. The highest amount were found in shelled rice obtained from Benha market whereas the lowest amounts were found in the same crop obtained from Shobra market. These figures reflect the fluctuation of the active ingredient, present in the same product, to another. With vegetables, the amount of the active ingredient, detected in the grains and ranged between 2 to 63.3±2.2 ppb. Cabbage leaves and eggplant fruits contained the highest amount of residues; 73.3 and 48 μg/kg, respectively. The lowest level of contamination was found in the fruits and ranged between 1 to 10 μg/kg. The highest fluctuation in level of residues of α and β-HCH was found in guava fruits and ranged between 1-7 μg/kg; the fruits obtained from Benha market contained the highest amounts of residues (7 μg) compared with 1 amd 2 μg in Tukh and Shobra markets.

The level of contamination with the most toxic isomer lindane was, however, much higher than the other two isomer (α and β-HCH). Wheat contained higher amounts, with a mean of 50 μg/kg, then shelled rice with a mean of 14.3 μg. With vegetables, the means of lindane residues were 33.3, 2.0, 23.3, 11.6, 30.0 and 2.0 μg/kg. These figures show that potato tubers and eggplant fruits contained the highest amounts of residues whereas tomato fruits and cabbage leaves contained the lowest amounts. It is obvious that although cabbage leaves in Shobra and Tukh market were free from γ-HCH isomer, the other two isomer were found in significant amounts (30.0, 2.0 and 63.3 μg/kg in Shobra, Tukh and Benha, respectively).

Although peach fruits contained negligible amounts of lindane (1.3 μg/kg), guava fruits especially those obtained from shobra market, contained significant amounts (53.3 μg/kg). Apricot fruits contained 10.3 μg/kg.

Contamination with DDT and DDT derivatives accounted to 87.9 %, four samples (eggplant, apricot and guava fruits obtained, respectively, from Shobra, Benha and Shobra as well as Benha markets) were free from contamination. Data show that wheat contained high amounts of DDT and DDT derivatives (46 μg/kg), whereas shelled rice contained lower amounts (6.3 μg/kg). Vegetable commodities contained different levels. the means of residues were 33.3, 20.0, 4.3, 13.3, 1.7 and 62.0 μg/kg in potato, tomato, cucumber, green pepper, eggplant fruits and cabbage leaves. Cabbage leaves obtained magnitude amounts of residues (150 μg/kg). Curiously enough to note that there is wide range in DDT residues present in the same product obtained from different markets. DDT residues in cabbage leaves obtained from Shobra, Tukh and Benha markets were 30, 6 and 150 μg/kg, respectively.

Contamination percentages with aldrin, dieldrin and endrin were 54.5, 51.5 and 42.4. The corresponding means of residues were 1.6, 1.3, 0.0, 4.0, 6.3, 20.0, 0.0, 0.0; 2.3, 2.0, 5.5, 3.7, 14.3, 0.0, 0.0, 5.3, 0.0, 1.3, 1.3; and 0.0, 1.0, 0.0, 5.0, 3.0, 15.0, 37.0, 4.0, 0.0, 1.3, 0.0 in wheat, shelled rice, potato, tomato, cucumber, green pepper, eggplant, cabbage leaves, peach, apricot and guava fruits. As mentioned before, reasonable percent of the analyzed samples (ca. 50 %) were uncontaminated. Potatoes, eggplant fruits, cabbage leaves and guava fruits were also free from contamination with dieldrin. The same phenomenon were found, however, in wheat, shelled rice, cucumber fruits, eggplant, cabbage leaves, apricot fruits, guava fruits, in endrin assay.

With organophosphorus ca. 91 and 61 % of samples were contaminated with malathion and pirimiphos-methyl, respectively. As expected, amounts of OP residues were much higher than those of chlorinated hydrocarbons and ranged between 0 to 500 µg/kg. Amounts of malathion residues were, however, similar in wheat and rice with an average of 70 and ca. 77 µg/kg, respectively. Rice seeds was free from pirimiphos-methyl residues whereas each kg of wheat seeds obtained from the three markets contained 50 µg a.i. Contamination of vegetables and fruits with two compounds differed from compound to another as well as from market to another. The average amounts of malathion residues detected in potato, tomato, cucumber, green pepper, eggplant, cabbage, peach, apricot and guava were 136.6, 10.0, 16.6, 23.3, 70.0, 50.0, 200.0, 313.3 and 75.0 µg/kg. The corresponding amounts of pirimiphos-methyl were 23.3, 70.0, 76.6, 70.0, 0.0, 53.3, 0.0, 280.0 and 0.0. Figures presented in tables (16, 17, 18, 19, 20, 21, 22, 23 and 24) show that peach fruits contained the highest amounts of malathion residues (500 µg/kg), whereas tomato fruits obtained from Tukh and Benha markets, and guava fruits obtained from Shobra market, were contaminant. With pirimiphos-methyl, apricot fruits obtained from Tukh market contained magnitude

Table (14) : Mean and standard deviation of some chlorinated and organophosphorus insecticide residues (ppb) in wheat.

Market	α+ BHCH	Lindane	DDTs	Aldrin	Dieldrin	Endrin	Malathion	pirimiphos-methyl
Shobra	9.0±1.6	40±10.0	48.0±1.4	1.0±0.0	1.0±0.0	ND	80±14.0	10.0±1.4
Tukh	14.0±2.3	60.0±2.4	80±8.1	2.0±0.8	5.0±1.4	ND	100.0±14.0	40.0±8.1
Benha	10.0±1.4	50.0±3.7	10.0±2.0	2.0±0.0	1.0±0.0	3.0±0.8	30.0±8.0	100±8.1
Mean	11.0±2.2	50.0±8.1	46.0±28.6	1.6±0.17	2.3±1.8	3.0±0.8	70.0±29.0	50.0±37.0

- Figures were average of three samples

ND : Not detectable

Table (15) : Mean and standard deviation of some chlorinated and organophosphorus insecticide residues (ppb) in shelled rice.

Market	α+ BHCH	Lindane	DDTs	Aldrin	Dieldrin	Endrin	Malathion	pirimiphos-methyl
Shobra	6.0±0.8	3.0±0.8	8.0±3.5	1.0±0.0	ND	ND	100.0±8.1	ND
Tukh	10.0±1.6	30.0±14.0	3.0±1.4	2.0±1.0	1.0±0.0	ND	30.0±14.0	ND
Benha	20±0.0	10.0±8.1	8.0±2.1	1.0±0.0	3.0±1.4	ND	100.0±14.0	ND
Mean	12.0±5.8	14.3±11.0	6.3±2.3	1.3±0.4	2.0±1.0	0	76.6±32.0	0

- Figures were average of three samples

ND : Not detectable

Table (16) : Mean and standard deviation of some chlorinated and organophosphorus insecticide residues (ppb) in potatoes.

Market	α+ BHCH	Lindane	DDTs	Aldrin	Dieldrin	Endrin	Malathion	pirimiphos-methyl
Shobra	3.0±0.8	30.0±8.0	2.0±0.8	ND	1.0±0.0	4.0±1.6	200.0±20.0	20.0±8.0
Tukh	2.0±0.8	20.0±8.0	6.0±2.1	ND	ND	6.0±2.0	110.0±16.0	30.0±16.0
Benha	4.0±0.8	50.0±14.0	7.0±0.8	ND	10.0±8.0	5±0.8	100.0±10	20.0±10.0
Mean	3.0±0.8	33.3±12.0	5.0±2.1	0	5.5±4.5	5.0±0.8	136.6±40.0	23.3±4.7

- Figures were average of three samples

ND : Not detectable

Table (17) : Mean and standard deviation of some chlorinated and organophosphorus insecticide residues (ppb) in tomato fruits.

Market	α+ BHCH	Lindane	DDTs	Aldrin	Dieldrin	Endrin	Malathion	pirimiphos-methyl
Shobra	1.0±0.0	2.0±0.0	20.0±8.0	8.0±2.1	30.0±8.0	4.0±1.4	30.0±1.4	80.0±16.0
Tukh	5.0±1.4	3.0±0.8	10.0±1.4	2.0±0.8	8.0±1.4	2.0±0.0	ND	70.0±8.0
Benha	6.0±0.8	1.0±0.0	30.0±8.0	2.0±1.4	5.0±1.4	3.0±0.8	ND	60.0±14.0
Mean	4.0±2.1	2.0±0.8	20.0±8.0	4.0±2.8	14.3±11.0	3.0±0.8	30.0±1.4	70.0±8.0

- Figures were average of three samples

ND : Not detectable

Table (18) : Mean and standard deviation of some chlorinated and organophosphorus insecticide residues (ppb) in cucumber fruits.

Market	α+ BHCH	Lindane	DDTs	Aldrin	Dieldrin	Endrin	Malathion	pirimiphos-methyl
Shobra	6.0±1.4	20.0±0.0	4.0±1.4	ND	ND	ND	20.0±0.0	100.0±24.0
Tukh	9.0±0.8	30.0±8.0	8.0±0.8	1.0±0.0	ND	ND	20.0±8.0	50.0±14.0
Benha	10.0±8.0	20±14.0	1.0±0.0	18.0±0.8	ND	50±8.0	10.0±0.0	80.0±21.0
Mean	8.3±1.6	23.3±4.7	4.3±2.8	9.5±8.5	-	50.0±8.0	16.6±4.7	76.6±20.0

- Figures were average of three samples

ND : Not detectable

Table (19) : Mean and standard deviation of some chlorinated and organophosphorus insecticide residues (ppb) in pepper fruits.

Market	α+ BHCH	Lindane	DDTs	Aldrin	Dieldrin	Endrin	Malathion	pirimiphos-methyl
Shobra	30.0±21.0	5.0±1.4	10.0±0.0	50.0±14.0	ND	ND	10.0±0.0	80.0±29.0
Tukh	10.0±0.8	20.0±8.0	10.0±0.0	10.0±0.8	ND	50.0±8.0	20.0±8.0	60.0±14.0
Benha	20.0±8.0	10.0±0.0	20.0±8.0	ND	ND	60.0±14.0	40.0±21.0	ND
Mean	20.0±8.2	11.6±6.0	13.3±4.7	30.0±20.0	0	55.0±5.0	23.3±12.0	70.0±10.0

- Figures were average of three samples

ND : Not detectable

Table (20) : Mean and standard deviation of some chlorinated and organophosphorus insecticide residues (ppb) in eggplant fruits.

Market	α+ BHCH	Lindane	DDTs	Aldrin	Dieldrin	Endrin	Malathion	pirimiphos-methyl
Shobra	10.0±8.0	20.0±8.0	ND	ND	ND	ND	180.0±14.0	ND
Tukh	3.0±0.8	10.0±0.0	4.0±0.8	ND	6.0±1.4	ND	20.0±8.0	ND
Benha	48.0±1.6	60.0±20	1.0±0.0	ND	10.0±1.6	4.0±1.4	10.0±0.0	ND
Mean	20.3±19.0	30.0±20.0	2.5±1.5	0	8.0±2.0	4.0±0.0	70.0±70.0	0

- Figures were average of three samples

ND : Not detectable

Table (21) : Mean and standard deviation of some chlorinated and organophosphorus insecticide residues (ppb) in cabbage leaves.

Market	α+ BHCH	Lindane	DDTs	Aldrin	Dieldrin	Endrin	Malathion	pirimiphos-methyl
Shobra	30.0±14.0	ND	30.0±8.0	ND	ND	ND	30.0±8.0	50.0±8.0
Tukh	2.0±0.8	ND	6.0±1.6	ND	ND	ND	100.0±20.0	10.0±0.0
Benha	63.3±2.2	2.0±0.8	150.0±40.0	ND	ND	ND	20.0±0.0	100.0±16.0
Mean	31.7±25.0	2.0±0.0	62.0±60.0	0	0	0	50.0±35.0	53.3±36.0

- Figures were average of three samples

ND : Not detectable

Table (22) : Mean and standard deviation of some chlorinated and organophosphorus insecticide residues (ppb) in peach fruits.

Market	α+ BHCH	Lindane	DDTs	Aldrin	Dieldrin	Endrin	Malathion	pirimiphos-methyl
Shobra	3.0±1.6	2.0±10.0	10.0±1.6	1.0±0.0	3.0±0.8	1.0±0.0	40.0±14.0	ND
Tukh	1.0±0.0	1.0±0.0	4.0±1.6	ND	ND	2.0±0.8	500.0±14.00	ND
Benha	1.0±0.0	1.0±0.0	10.0±1.6	2.0±0.8	1.0±0.0	1.0±0.0	60.0±8.0	ND
Mean	1.6±0.9	1.3±0.5	8.0±2.8	1.5±0.5	2.0±1.0	1.3±0.5	200.0±200.0	0

- Figures were average of three samples

ND : Not detectable

Table (22) : Mean and standard deviation of some chlorinated and organophosphorus insecticide residues (ppb) in peach fruits.

Market	α+ BHCH	Lindane	DDTs	Aldrin	Dieldrin	Endrin	Malathion	pirimiphos-methyl
Shobra	3.0±1.6	2.0±10.0	10.0±1.6	1.0±0.0	3.0±0.8	1.0±0.0	40.0±14.0	ND
Tukh	1.0±0.0	1.0±0.0	4.0±1.6	ND	ND	2.0±0.8	500.0±14.00	ND
Benha	1.0±0.0	1.0±0.0	10.0±1.6	2.0±0.8	1.0±0.0	1.0±0.0	60.0±8.0	ND
Mean	1.6±0.9	1.3±0.5	8.0±2.8	1.5±0.5	2.0±1.0	1.3±0.5	200.0±200.0	0

- Figures were average of three samples

ND : Not detectable

Table (23) : Mean and standard deviation of some chlorinated and organophosphorus insecticide residues (ppb) in apricot fruits.

Market	α+ BHCH	Lindane	DDTs	Aldrin	Dieldrin	Endrin	Malathion	pirimiphos-methyl
Shobra	3.0±0.8	20.0±10.0	20.0±8.0	ND	1.0±0.0	ND	240.0±20.0	100.0±30.0
Tukh	2.0±0.8	10.0±3.2	40.0±10.0	4.0±0.8	2.0±0.8	ND	380.0±30.0	700.0±140.0
Benha	10.0±1.6	1.0±0.4	ND	20.0±10.0	1.0±0.2	ND	320.0±40.0	40.0±14.0
Mean	5.0±3.5	10.3±7.0	30.0±10.0	12.0±8.0	1.3±0.4	0	313.3±57.3	280.0±297.9

- Figures were average of three samples

ND : Not detectable

Table (24) : Mean and standard deviation of some chlorinated and organophosphorus insecticide residues (ppb) in guava fruits.

Market	α+ BHCH	Lindane	DDTs	Aldrin	Dieldrin	Endrin	Malathion	pirimiphos-methyl
Shobra	2.0±1.4	110±16.0	ND	1.0±0.0	ND	ND	ND	ND
Tukh	1.0±0.4	20.0±8.0	20.0±0.0	ND	ND	ND	70.0±8.0	ND
Benha	7.0±2.6	30.0±14.0	ND	ND	ND	ND	80.0±14.0	ND
Mean	3.3±2.6	53.3±40.0	20.0±0.0	1.0±0.0	0	0	75.0±5.0	0

- Figures were average of three samples

ND : Not detectable

amounts (700 µg/kg), whereas pepper fruits obtained from Benha market, eggplant fruits, peach fruits, and guava fruits were free from any contamination.

Reviewing the figures of MRLs presented in Tables (14-24), show that although the majority of the commodities obtained from the three markets located in Kalyubia governorate were contaminated with chlorinated hydrocarbon and organophosphorus restudies, the figures of residues were much lower than the corresponding acceptable residue limits (**CAC, 1996**).

As indicated by **Finlayson and Macarthey (1973)** residue of organochlorine insecticides could be absorbed by roots or leaves, metabolized and translocated in non-insecticidal amounts to leave persistent and undesirable residues at harvest, the detected residues of organochlorines in wheat grains, could be due to their persistence, accumulation in the soil and adsorption by plant roots (**Polizu *et al.*, 1972**).

It is known that organochlorines had been banned in agriculture since 1970 due to their long persistence and deleterious effect on the environment. Regardless of the high acute toxicity of some parent compounds of these compounds, the continuous exposure of the organisms especially the vertebrates, resulted in untolerable health problems. The problem is that not only the parent compounds are responsible on such side effects, but also their metabolites and isomers which, however, had low or negligible acute toxicity. Such hazards of these metabolites are due to their role in inducing the monooxygenases as well as other enzymes which increase the toxicity of other pollutants. The recent development of trace analysis resulted in the knowledge of their persistence in all sections of the environment. They are not only persistent, but also lipophilic and thereby accumulate in plants, animals and human tissues.

As mentioned before, all vegetables and fruits as well as wheat and rice were contaminated with hexachlorocyclohexane (α and β- isomers) and the majority of the samples (93.9 %) were contaminated with γ-isomer. DDT contaminant came next and contaminated most samples (87.9 %). Samples contaminated with cyclodienes were less than the other two classes of chlorinated hydrocarbon (49.5 %).

Seibel and Ocker (1979) showed that residues of DDT, alpha HCH and aldrin were detected in very few samples of wheat and rye crops during the period of 1974-1975 in Germany; only one out of 200 samples exceeded the allowed tolerance level.

Ezz and Abdel-Gawad (1985) reported that there is no control of residues of pesticides in the agriculture products, food-animal, feed and environment in Egypt, and some of the highly toxic and persistent pesticides which are reputed to be carcinogenic and their use has been banned in some countries are still used in Egypt.

Dogheim *et al.* (1986) found that hexachlorocyclohexane (α and β) was the main compound contaminating certain plants of medical importance; its residues in five samples exceeded the allowed maximum residue limits. DDT came next and contaminated most samples but to levels similar to or lower than the allowed limits. Lindane and dieldrin residues were within the permitted limits.

El-Lakwah *et al.* (1989a) determined the residues of some organochlorine insecticides (total DDT, alpha, beta and gamma HCH isomers, dieldrin, dieldrin, endrin, methoxychlor) and the two organophosphorus insecticides malathion and pirimiphos-methyl in grain, grain products, pulses, fenugreek, soybean, potatoes, meat and cheese. The samples were collected from different places. It was found that all samples of the various foodstuffs were contaminated with the three isomers of HCH. DDT-residues were detected at different levels in the majority of the samples. The two cyclodiene insecticides endrin and dieldrin as well as methoxychlor were found in some samples, and only one of them (wheat bran sample) contained endrin residues above the tolerance level. Few samples were contaminated with malathion and pirimiphos-methyl. The percentage of the samples with values of alpha and beta-HCH residues above the legally allowed tolerance level was wheat 55 %, maize 19 %, rice 62 %, millet, 50 %, paddy rice 73 %, barley 82 %, wheat meal 38 %, maize 19 %, rice 62 %, millet 50 %, paddy rice 73 %, barley 82 %, wheat meal 38 %, maize meal 78 %, wheat bran 92 %, rice bran 100 %, bread 78 %, beans 6 %, white beans 15 %, French beans 20 %, lupines 25 %, lentils 25 %, fenugreek 67 %, soybean 14 % and potatoes 83 %. The percentage of the samples recorded with higher lindane residues exceeding the safety limit values was potatoes 42 %, wheat bran 25 %, bread 22 %, wheat 13 %, maize meal 111 %, paddy rice 10 %, wheat meal 61 %, beans 3 % and maize 2 %. The percentage of the samples detected containing DDT residues above the tolerance level was potatoes 50 %, wheat bran 33 %, rice bran 25 %, fenugreek 17 %, wheat 15 %, soybean 14 %, maize meal 11 %, French beans 10 %, rice 8 %, lentils 8 %, wheat meal 6 %, paddy rice 3 %, beans 3 % and maize 2 %. the results revealed that a great number of the tested foodstuffs was contaminated with alpha, beta, gamma-HCH isomers as well as DDT. The contamination rate with alpha and beta-HCH was significantly higher than with gamma-HCH (lindane).

El-Lakwah *et al.* (1989b) determined organochlorine insecticide residues in potato samples, which had been collected from various markets in Egypt. It was found that all potato samples contained alpha, beta and gamma isomers of HCH. Residues of γ-isomers ranged between 0.01 to 1.04 ppm. Eighty three percent of the tested samples were about 64 times higher than that of the tolerance level; the remaining sample contained 10 mg residues per kg potato which was beyond the tolerance level. DDT residues were inspected also in all samples; 50 % of the samples contained 4.48 ppm which were about 90 times higher than the tolerance level. Eight percent of the samples were contaminated with the cyclodiene insecticide aldrin.

Mukherjee and Gopal (1992) showed that India is still among a few developing countries where organochlorines are still used for controlling pests due to economic constraints. They also stated that the residues of DDT and HCH are known to find their way into milk and milk products.

El-Lakwah *et al.* (1994a) detected the residues of some organochlorine insecticides and two organophosphorus insecticides in home-produced wheat stored in the shounas of the PBDAC/BDACs. A total of 48 samples were taken from different localities at delivery of the wheat stocks from the shounas to the mills during the period of October 1993 to February 1994. It was found that all samples contained low levels of alpha nd beta HCH in range from 0.001-0.005 ppm. lindane residues were detected also in all wheat samples; only 16.7 % of the samples contained higher levels than the MRL. None of the samples contained aldrin or dieldrin residues. Only six samples contained low levels of endrin, whereas all the samples were contaminated with DDT with amounts lower than the MRL (0.001-0.028 ppm). Very low levels of pirimiphos-methyl residues were found in 54 % of the samples and none of them approached the MRL. Malathion residues were found in 58 % of the samples with amounts below the MRL (0.05-2.8 ppm).

El-Lakwah *et al.* (1994b) detected the residues of some organochlorine and organophosphorus insecticides in home-produced potatoes used for consum-ption just after harvest as well as after storage. It was found that organochlorine residues (α and β and γ-HCH, aldrin, dieldrin, endrin and DDT) in potatoes consumed directly after harvest were in the accepted levels. On the other hand, the majority of stored potatoes contained amounts of HCH isomers, and DDT higher than the maximum residue limits of the FAO. Organophosphate residues (pirimiphos-methyl and malathion) were below the permissible limits.

Abd El-Daiem and Hussein (1995) found that vegetables and fruits samples collected from four Egyptian Governorates contained various amounts of chlorinated hydrocarbon residues namely, β and γ-HCH, heptachlor, aldrin, γ-chlordane, o,p-DDE, o,p-DDT and p,p-DDT; plant variety and locality proved important in this respect. All detected amounts of insecticide residues were within the acceptable levels.

El-Lakwah *et al.* (1995) determined the residues of some organochlorine and organophosphorus insecticides in home-produced tomatoes and cucumber in two Egyptian Governorates. Results showed that most of the tested samples contained very low amounts of alpha and beta- HCH, lindane and DDT, below the acceptable limits of the FAO. Aldrin, dieldrin and endrin residues were found frequently in a few number of investigated samples, below the acceptable limits. residues of α and β-HCH were found to be higher than the acceptable limit on, only, two samples f cucumbers. The organophosphorus insecticides pirimiphos-methyl and malathion were detected in most of the tomato and cucumber samples at very low levels below the allowed maximum residue limits.

Mukherjee and Gopal (1996) detected residues in baby food, animal feed and vegetables. It was found that milk samples contained low level of organochlorine insecticide residues, often near the detection limit. DDT was detected in most samples of baby milk food. The author showed that DDT was still used in cow sheds which explains the contamination of baby milk with compound. Five out of six samples (whole milk) contained amounts of DDT higher than the MRL (0.05 μg/g). HCH isomers were detected in substantial amounts in baby milk food. In milk powder, the gamma content was below the permissible limit (MRL < 0.004 μg/g) in four out of six samples. The author showed that this is due to a higher water solubility of lindane in comparison to its stereoisomers.

The samples of baby milk had average residue levels ranging from undetectable to 0.225 μg/g for DDT and from 0.002 to 0.102 μg/g for HCH.

In animal feed and its components, average DDT residues ranged from non-detectable to 0.25 μg/g-HCH residues were much less than DDT (α and β and γ-isomers) ranged from 0.007 to 1.86 μg/g. Malathion residues on cauliflower were 0.30 μg/g. The authors stated that although pesticides are detected in these food commodities, they are not present in such significant amounts that they may pose health hazard except in case of milk. They added also that if the need based application of pesticides is made in recommended dosage and appropriate pesticide is used specific for the crop insect pest and disease and proper disposal transportation and storage is adhered to the problem of environmental pollution will not be a threat.

Figures presented in the literatures up to 1997 and this work show that wide range of foodstuffs are contaminated with organochlorine pesticides. They are among other chemicals used to control ectoparasites and other animal skin diseases. Contamination may thus arise from direct treatment with pesticides, through ingestion of contaminated forage crops or pasture of the adsorbance of their residues onto plants via rain and air. Because of their high persistent and toxic nature, the OCPs are known contaminants of the environment. Being lipophilic, they are stored in the body fat of man and animals **(Osibanja and Adeyeye 1997)**. Hence, there is need for their continued monitoring in the environment. In developed countries, surveillance and monitoring programmes in foodstuffs and the environment are carried out on routine basis.