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Evaluation of some organophosphorus insecticides against *Dacus cucurbitae* Coquillett on peach†

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Abstract Toxicity and persistence of fenitrothion, fenthion, malathion, methyl parathion, and trichlorphon applied at 0·05% (400 g/ha) were evaluated on peach fruits (*Prunus persica* L.) against the neonate larvae of *Dacus cucurbitae* Coquillett in two seasons (1977–78). Fenitrothion and methyl parathion were highly toxic materials followed by fenthion and malathion, while trichlorphon was the least toxic. Fenitrothion was highly persistent (12 days) followed by methyl parathion (7 days). All the insecticide residues were within the acceptable limits at the time of harvest.

Keywords. Organophosphorus insecticides ; toxicity ; persistence.

1. Introduction

Fruit fly, *Dacus cucurbitae* Coquillett, is a serious insect pest of peach (*Prunus persica* L.) in Himachal Pradesh. The crop sustains severe injuries by the larvae when the fruits are about to ripen and render these unfit for human consumption. There is a possibility of preventing the oviposition of the fruit fly on the peach fruits by giving a protective cover spray of an effective insecticide. Pruthi (1969) Myburgh (1961), Sampaio *et al* (1966), Peretz *et al* (1966), Nagappan *et al* (1970), Anonymous, (1975) and Sharma *et al* (1973) reported that the pest could be controlled by a number of less persistent insecticides by such sprays. None of these reports are, however, based on detailed experimentation of intrinsic toxicity to the neonate larvae of fruit fly, persistence of effective toxicity or consumers' safety following their applications. Taking these as objectives in view, the present contribution reports the results of evaluation of the effectiveness of two spray schedules of fenitrothion, fenthion, malathion, methyl parathion and trichlorphon on peach against the neonate larvae of fruit fly.

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2. Materials and methods

Commercial formulations of five organophosphorus (OP) insecticides *viz.* fenitrothion, fenthion methyl parathion, malathion and trichlorphon were sprayed on peach trees (cv 'Webcock') in an orchard of the Department of Horticulture, Himachal Pradesh Agricultural University, Palampur, with the help of a foot sprayer (Maruti make) to 'run-off' at the recommended rates of 0·05% concentration(400 g/ha). The experiment was conducted in a randomized block design taking single-tree plots for a replication. There were 18 trees for 5 treatments and a control which were replicated 3 times. The trees were 6-7 years of age with 6 m planting distance in a hexagonal system. All the other horticultural operations and fertilizer applications followed in the orchard were according to the recommendation of the package of practices for horticultural crops, Himachal Pradesh (Anonymous 1975). The trees were first sprayed on 21 May 1977 and again sprayed on 4 June 1977. Samples were collected at 0-day (immediately after the fruits were dried), 1, 3, 5, 7 and 14 days following treatments. The samples were later processed for estimating the deposits. The experiment was repeated with two sprays of the above insecticides at the same concentration in 1978 at the same location with another set of 18 trees having similar age and bearing. The first spray was given on 18 May 1978, and the second on 1 June 1978. The sampling intervals were same as in the first year.

Eight fruits were randomly collected from all around the periphery of each treated tree per treatment at each interval for residue analysis. Before extraction, the weight of the sample was recorded and the surface area of each fruit was determined by Turrell's (1946) method. The deposits of the respective fruit samples of each insecticide were extracted in redistilled solvents (benzene for fenitrothion, fenthion, methyl parathion and trichlorphon, and CCl_4 for malathion), by taking a sample of 8 fruits in a wide mouthed stoppered glass bottle (capacity 1L) and sufficient solvent was added so as to cover the fruits. Volume of the solvent was recorded and the bottle was labelled before shaking on a shaking machine for one hour. The extract was filtered into another container to which sufficient quantity of anhydrous sodium sulphate was added to remove the moisture and stored in a refrigerater until analysed. The extracts were then subjected to bio- and chemical assays. For bioassay (table 1), adult males of *Drosophila melanogaster* Meig. were taken as test insects and the rest of the procedure was the same as reported by Thakur and Hameed (1980). For chemical assays, the extracts of fenitrothion and methyl parathion were cleaned up by the method of Thornburg (1963); for malathion, Hameed and Rattan Lal's method (1971), and for fenthion and trichlorphon, the method of Jain *et al* (1974a) were used. Results of the quantitative estimations obtained by bioassay were verified by standard chemical methods. For fenitrothion and methyl parathion, the procedure o Averell and Norris (1948) was used and for malathion the method of Sutherland (1964) was used. Fenthion and trichlorphon residues were assayed by the method of Jain *et al* (1974a). Standard calibration curves were drawn separately for each insecticide. Recovery of each insecticide was studied in two different ways. Firstly, the insecticides were recovered from the surface deposits and secondly, as total residues. Insecticides were more satisfactorily recovered from the surface of the fruits than from the whole fruits (total residues). Fenitrothion recovered

Table 1. Dosage-mortality response of insecticides to *Drosophila melanogaster.*

Insecticide	Regression equation	LD_{50} (μg)	Fiducial limits
Fenitrothion	$Y = 1\cdot6038x + 2\cdot5246$	0·0035	0·0030 0·0041
Fenthion	$Y = 1\cdot7825x + 1\cdot6888$	0·0720	0·0624 0·0832
Malathion	$Y = 1\cdot7758x + 0\cdot7684$	0·2415	0·2098 0·2780
Methyl parathion	$Y = 1\cdot8650x + 1\cdot0484$	0·1315	0·1166 0·1482
Trichlorphon	$Y = 2\cdot2240x + 0\cdot9507$	0·4739	0·4204 0·5342

In none of these cases the data were found to be significantly heterogeneous at $P = 0\cdot05$.
Y = Probit kill ; x = log conc. (μg/2ml) $\times 10^4$ for fenitrothion and 10^3 for rest of the insecticides.

to the extent of 85·9–89·6% (surface deposit) and 83·3–86·0% (total residue), fenthion 82·6–83·1% (surface deposit) and 82·5–83·5% (total residue), malathion 93·3–96·2% (surface deposit) and 90·3–91·7% (total residue), methyl parathion 92·3–93·3% (surface deposit) and 91·1–92·4% (total residue), and trichlorphon 80·2–80·8% (surface deposit) and 78·9–80·7% (total residue).

Peach fruits were harvested on 23 June 1977 and 23 June 1978 in the 1st and 2nd seasons respectively. Residues were later extracted by macerating them in a Waring blender with equal quantity of anhydrous sodium sulphate in a known volume of solvent. The slurry so obtained was decanted, filtered and cleaned up as per the method reported by Thakur and Hameed (1980). Intrinsic toxicity of the deposits of the 5 OP insecticides to the neonate larvae of fruit fly (table 3) was also determined by bioassay and the actual amount of insecticides in the deposits so formed from their commercial formulations, giving the desired toxicity, was determined chemically and by bioassay.

Half-life values of each insecticide on peach were worked out on the basis of the formula of Hoskins (1961). Safety interval (days) was determined on the basis of formula given by Thakur and Hameed (1980). Effective life of each insecticide was found out by substituting the value of log LD_{90} to the Y of time deposit regression equations.

1. Results and discussion

Residue-film method of bioassay was very satisfactory (table 2) as it could detect residues of fenitrothion as low as $0\cdot50\ \mu g/cm^2 \times 10^{-3}$ compared with $416\ \mu g/cm^2 \times 10^{-3}$ by the colorimetric method of Averell and Norris (1948). Fenitrothion

Table 2. Sensitivity of bio and chemical assays.

Insecticides	Bioassay $\mu g/cm^2 \times 10^{-3}$		Chemical assay $\mu g/cm^2 \times 10^{-3}$	
	Surface deposit	Total residue	Surface deposit	Total residue
Fenitrothion	0·5005	0·5160	399·9553	416·3180
Fenthion	16·6366	16·7454	714·6489	707·2002
Malathion	49·0888	49·9509	495·4271	527·6732
Mathyl parathion	29·0868	29·4828	191·0425	193·0698
Trichlorphon	155·4194	159·3025	1052·4938	1046·2320

Table 3. Toxicity of insecticide deposits to the neonate larvae of *Dacus cucurbitae*.

Insecticide	Regression equation	LD_{50} ($\mu g/cm^2$)	Fiducial limits ($\mu g/cm^2$)	LD_{90} ($\mu g/cm^2$)	Fiducial limits ($\mu g/cm^2$)
Fenitrothion	$Y = 1\cdot8837x + 1\cdot4404$	0·0776	0·0594 0·1014	0·3715	0·2090 0·6758
Fenthion	$Y = 1\cdot7465x + 1\cdot2891$	0·1333	0·0997 0·1780	0·7219	0·3755 1·3868
Malathion	$Y = 1\cdot4011x + 1\cdot8860$	0·1669	0·1160 0·2403	1·3715	0·5777 3·2562
Methyl parathion	$Y = 1\cdot4353x + 2\cdot1853$	0·0914	0·0637 0·1312	0·7145	0·3455 1·4784
Trichlorphon	$Y = 1\cdot7913x + 0\cdot8080$	0·2189	0·1631 0·2938	1·1366	0·6112 2·1135

Y = Probit kill. In none of these cases the data were found to be significantly heterogeneous at $P = 0\cdot05$.
x = log conc. $\times 10^3$ $\mu g/cm^2$.

was a highly toxic material to the vinegar flies (table 1) which increased the sensitivity of the method. Fenitrothion and methyl parathion were also highly toxic (table 3) to the larvae of *D. cucurbitae* followed by fenthion and malathion, while trichlorphon was the least toxic material. Toxicity of deposits on the basis of minimum effective level (m.e.l.), i.e., LD_{90} value (Gratwick and Tew 1966) were : fenitrothion > methyl parathion > fenitrothion > trichlorphon > malathion.

Table 4. Extent and magnitude of insecticide deposits in relation to their toxicity to the neonate larvae of *Dacus cucurbitae*.

Insecticide (at 0·05% conc.)		Initial deposit ($\mu g/cm^2$)			
		First season 1977		Second season 1978	
		First spray (21-5-1977)	Second spray (4-6-1977)	First spray (18-5-1978)	Second spray (1-6-1978)
Fenitrothion	1.	6·570	6·967	7·404	7·748
	2.	84·66	89·78	95·41	99·84
	3.	17·68	18·75	19·93	20·85
		(1 :5)	(1 :5)	(1 :5)	(1 :5)
Fenthion	1.	7·105	7·011	7·205	7·356
	2.	53·30	52·59	54·05	55·18
	3.	9·84	9·71	9·98	10·19
		(1 :5)	(1 :5)	(1 :5)	(1 :5)
Malathion	1.	6·946	7·088	7·122	7·165
	2.	41·62	42·47	42·67	42·93
	3.	5·06	5·17	5·19	5·22
		(1 :8)	(1 :8)	(1 :8)	(1 :8)
Methyl parathion	1.	7·167	7·157	9·014	8·939
	2.	78·41	78·30	98·62	97·80
	3.	10·03	10·02	12·61	12·61
		(1 :8)	(1 :8)	(1 :8)	(1 :8)
Trichlorphon	1.	6·060	6·086	7·198	7·170
	2.	27·68	27·80	32·88	32·75
	3.	5·33	5·35	6·33	6·31
		(1 :5)	(1 :5)	(1 :5)	(1 :5)

1. Initial deposits, (average of bioassay and chemical assay).
2. Number of times the initial deposit exceeding the LD_{50} value *vide* table 3.
3. Number of times the initial deposit exceeding the m.e.l. (LD_{50}) value *vide* table 3.

Figures in parentheses are ratios between m.e.l. and intrinsic toxicity of deposits.

The results were in agreement with the findings of Hameed *et al* (1980). The deposits of all the insecticides in general were high, much in excess to their respective m.e.l. (table 4). The deposits of fenitrothion, for example, on peach fruits gave deposits of 6·57-7·75 $\mu g/cm^2$ (tables 6 and 7) in two sprays of the two seasons which were in excess of its m.e.l. (0·3715 $\mu g/cm^2$, table 3).

Similarly, the deposits of fenthion and methyl parathion were about 10-11 times in excess of their m.e.ls. But the deposits of malathion and trichlorphon were minimum i.e. only about 5-6 times in excess of m.e.ls. when compared with their respective LD_{50} values. The deposits of fenitrothion were far in excess (92 times) of their intrinsic toxicity (LD_{50}) followed by methyl parathion (86 times), fenthion (54 times), malathion (43 times) and trichlorphon (30 times). These observations showed that all these chemicals provided adequate deposits for the

Table 5. Threshold of toxic action of insecticide deposits to the neonate larvae of *Dacus cucurbitae*.

Insecticides recommended dose 0·05 (a.i.)	Deposits of insecticides on 14th day ($\mu g/cm^2$)			
	First season (1977)		Second season (1978)	
	First spray	Second spray	First spray	Second spray
Fenitrothion	0·224 (80·8)	0·267 (84·4)	0·300 (86·6)	0·288 (85·8)
Fenthion	0·062 (28·1)	0·052 (23·8)	0·111 (44·5)	0·121 (47·1)
Malathion*	0·108 (39·6)	0·159 (48·9)	0·146 (46·8)	0·202 (54·6)
Methyl parathion	0·102 (52·7)	0·095 (51·0)	0·115 (55·7)	0·113 (53·3)
Trichlorphon	0·049 (12·2)	0·038 (8·7)	0·066 (17·6)	0·056 (14·4)

* Deposits of insecticides on 7th day.
Figures in parentheses are corresponding probable kill of *Dacus cucurbitae* larvae *vide* regression equations given in table 3.

control of insects. Although the initial deposits of fenitrothion and methy parathion in general were in excess of their intrinsic toxicity, the margin between m.e.l. and intrinsic toxicity (LD_{50}) of the deposits (mentioned in ratios) was the highest only with methyl parathion and malathion followed by fentitrothion, fenthion and trichlorphon. Thus, it can be concluded that the deposits of fenitrothion followed by methyl parathion provided comfortable margins when compared either with their LD_{90} of LD_{50}.

The residues of insecticides on the 14th day (tables 6 and 7) when subjected to the respective regression equations (table 3), corresponding per cent kill of the neonate larvae of fruit fly was obtained (table 5). The deposits of 0·30 $\mu g/cm^2$ of fenitrothion in the 1st spray (2nd season) on the 14th day following treatment (table 5) gave 87% mortality of the larvae, followed by methyl parathion, fenthion and trichlorphon. Malathion, however, after 7 days did not afford more than 55% mortality of the insect.

Results of the field experiments on the persistence of 5 OP insecticides are summarized in tables 6 and 7. Chemical estimations in all the cases approximately agreed well with the data obtained from the bioassay of field-sample extracts. Data of the two estimations of each insecticide in both the seasons were also positively correlated to each other. During the 1st season, bioassay and chemical estimation of the deposits of 5 OP insecticides sprayed twice at an interval of 15 days on peach fruits showed the higest deposit with methyl parathion on 0-day (i.e. 7·17 and 7·16 $\mu g/cm^2$) for the 1st and 2nd spray, respectively followed

Table 6. Persistence of insecticide deposits in peach fruits (first season, 1977), two sprays.

Insecticide	Method of estimation	No. of sprays	Deposit (μg/cm²) following treatment at					
			0-day	1-day	3-day	5-day	7-day	14-day
Fenitrothion	Bioassay		6·46	2·64	1·89	0·87	0·58	0·21
	Chem. assay	I	6·68	2·84	1·82	0·86	0·60	0·24
	$r = 0·9994$		(6·57)	(2·74)	(1·85)	(0·86)	(0·59)	(0·22)
	Bioassay		6·94	2·64	1·73	0·83	0·69	0·28
	Chem. assay	II	6·99	2·69	1·89	0·79	0·60	0·25
	$r = 0·9995$		(6·97)	(2·66)	(1·81)	(0·81)	(0·64)	(0·27)
Fenthion	Bioassay		7·30	2·61	2·00	1·22	0·73	0·08
	Chem. assay	I	6·91	2·71	2·00	1·07	0·78	0·04
	$r = 0·9603$		(7·10)	(2·66)	(2·00)	(1·14)	(0·75)	(0·06)
	Bioassay		7·16	2·84	1·91	1·12	0·71	0·07
	Chem. assay	II	6·86	2·74	1·94	1·24	0·66	0·03
	$r = 0·9994$		(7·01)	(2·79)	(1·93)	(1·18)	(0·68)	(0·05)
Malathion	Bioassay		7·02	2·02	0·86	0·38	0·10	BDL
	Chem. assay	I	6·91	1·92	0·76	0·33	0·11	BDL
	$r = 0·9999$		(6·95)	(1·97)	(0·81)	(0·35)	(0·11)	
	Bioassay		7·12	1·81	0·85	0·37	0·16	BDL
	Chem. assay	II	7·06	1·73	0·91	0·38	0·15	BDL
	$r = 0·9998$		(7·09)	(1·77)	(0·88)	(0·38)	(0·16)	
Methyl parathion	Bioassay		7·13	3·38	2·35	1·04	0·79	0·11
	Chem. assay	I	7·21	3·31	2·29	1·08	0·79	0·09
	$r = 0·9998$		(7·17)	(3·34)	(2·32)	(1·06)	(0·79)	(0·10)
	Bioassay		7·18	3·07	2·12	0·86	0·63	0·09
	Chem. assay	II	7·13	3·10	2·23	0·85	0·64	0·09
	$r = 0·9998$		(7·16)	(3·09)	(2·18)	(0·85)	(0·63)	(0·09)
Trichlorphon	Bioassay		6·03	2·62	1·59	0·84	0·27	0·05
	Chem. assay	I	6·09	2·63	1·67	0·83	0·27	BDL
	$r = 0·9884$		(6·06)	(2·63)	(1·63)	(0·83)	(0·27)	(0·05)
	Bioassay		6·07	2·54	1·54	0·71	0·20	0·04
	Chem. assay	II	6·10	2·67	1·51	0·63	0·21	BDL
	$r = 0·9996$		(6·09)	(2·61)	(1·52)	(0·67)	(0·21)	(0·04)
Surface area (sq. cm) of one peach fruit**		I	30·59	31·31	32·06	32·67	34·13	36·60
		II	37·97	39·01	39·62	40·72	42·30	45·65
Percentage increase in fruit size over zero day sample		I	0	2·35	4·80	6·80	11·57	19·65
		II	24·12	27·52	29·49	33·11	38·28	49·23

r = Coefficient of correlation significant at $P = 0·01$.
* Average of 3 replications
** Average of 120 fruits.
BDL = Below detectable limits
Figures in parentheses are average of bioassay and chemical assay

Average weather conditions	Temp. °C		RH	Rainfall (mm)
	Max.	Min.		
1st spray	29·93	20·79	55·35	3·73
2nd spray	27·40	18·89	61·90	3·32

Table 7. Persistence of insecticide deposits on peach fruits (second season, 1978) two sprays.

Insecticide	Method of estimation	No. of sprays	Deposits ($\mu g/cm^2$) following treatment at					
			0-day	1-day	3-day	5-day	7-day	14-day
Fenitrothion	Bioassay		7·42	2·86	1·85	1·10	0·83	0·30
	Chem. assay	I	7·39	2·97	1·83	1·04	0·84	0·30
	$r = 0·9998$		(7·40)	(2·91)	(1·84)	(1·07)	(0·84)	(0·30)
	Bioassay		7·67	2·88	1·76	1·08	0·85	0·28
	Chem. assay	II	7·83	3·02	1·91	1·05	0·77	0·30
	$r = 0·9995$		(7·75)	(2·95)	(1·83)	(1·06)	(0·81)	(0·29)
Fenthion	Bioassay		7·17	2·67	2·00	1·23	0·85	0·10
	Chem. assay	I	7·24	2·79	2·15	1·26	0·79	0·12
	$r = 0·9998$		(7·20)	(2·73)	(2·08)	(1·25)	(0·82)	(0·11)
	Bioassay		7·27	2·92	1·96	1·03	0·70	0·10
	Chem. assay	II	7·44	2·79	1·39	1·04	0·51	0·14
	$r = 0·9993$		(7·36)	(2·85)	(1·39)	(1·03)	(0·60)	(0·12)
Malathion	Bioassay		7·15	1·73	0·87	0·42	0·15	BDL
	Chem. assay	I	7·10	1·56	0·85	0·43	0·14	BDL
	$r = 0·9997$		(7·12)	(1·64)	(0·86)	(0·42)	(0·15)	..
	Bioassay		7·20	1·40	0·85	0·36	0·19	BDL
	Chem. assay	II	7·13	1·44	0·85	0·37	0·22	BDL
	$r = 0·9999$		(7·16)	(1·42)	(0·85)	(0·36)	(0·20)	
Methyl parathion	Bioassay		9·13	3·62	2·71	1·26	0·96	0·12
	Chem. assay	I	8·89	3·71	2·59	1·41	0·93	0·12
	$r = 0·9994$		(9·01)	(3·67)	(2·65)	(1·32)	(0·95)	(0·12)
	Bioassay		9·06	3·25	2·32	1·15	0·69	0·12
	Chem. assay	II	8·81	3·17	2·25	1·08	0·65	BDL
	$r = 0·9999$		(8·94)	(3·21)	(2·24)	(1·12)	(0·67)	(0·12)
Trichlorphon	Bioassay		7·22	2·81	1·97	1·24	0·43	0·07
	Chem. assay	I	7·17	2·87	2·07	1·30	0·47	0·06
	$r = 0·9998$		(7·20)	(2·84)	(2·02)	(1·27)	(0·45)	(0·07)
	Bioassay		7·20	2·65	1·91	1·06	0·35	0·06
	Chem. assay	II	7·14	2·87	1·88	1·13	0·33	0·05
	$r = 9992$		(7·17)	(2·76)	(1·89)	(1·10)	(0·34)	(0·06)
Surface area (sq. cm.) of one peach fruit**		I	25·13	27·21	27·88	28·69	29·96	31·21
		II	31·41	32·00	32·66	33·06	33·73	36·60
Percentage increase in fruit size over zero day sample		I	0	8·28	10·94	14·17	19·22	24·19
		II	24·99	27·34	29·96	31·56	34·22	45·64

r = Coefficient of correlation significant at $P = 0·01$
* Average of three replications
** Average of 120 fruits
BDL = Below detectable limits
Figures in parentheses are average of bioassay and chemical assay

Average weather conditions	Temp. °C		RH	Rainfall (mm)
	Max.	Min.		
1st spray	33·54	20·96	27·17	1·44
2nd spray	32·02	22·35	46·41	2·14

Table 8. Biological performance of insecticide on peach.

Insecticides (at 0·05% conc.)	Initial deposit in (μg/cm²)	Initial deposit in (ppm)	Half life (days)	Effective life (days)	Harvest time residues (ppm)	Recommended tolerance level (ppm)	Safety interval (days)
			First season (1st spray) 1977				
Fenitrothion	6·570	12·898	3·1	10·35	..	0·50[1]	14·47
Fenthion	7·105	13·987	2·3	5·95	..	0·50[2]	10·64
Malathion	6·946	13·239	1·3	2·15	..	6·00[3]	1·44
Methyl parathion	7·167	14·258	2·4	6·65	..	1·00[4]	9·25
Trichlorphon	6·060	12·620	2·1	4·00	..	0·205[5]	12·35
			First season (2nd spary) 1977				
Fenitrothion	6·967	14·166	3·3	10·85	0·172	0·50[1]	15·77
Fenthion	7·011	14·120	2·1	6·30	0·023	0·50[2]	10·21
Malathion	7·088	13·334	1·4	2·25	B.D.L.	6·00[3]	1·61
Methyl parathion	7·157	14·952	2·4	6·65	0·020	1·00[4]	9·25
Trichlorphon	6·086	12·525	1·9	3·35	0·136	0·20[5]	11·62
			Second season (1st spray) 1978				
Fenitrothion	7·404	14·774	3·4	11·60	..	0·50[1]	16·48
Fenthion	7·205	14·047	2·5	7·10	..	0·50[2]	12·20
Malathion	7·122	13·536	1·4	2·35	..	6·00[3]	1·65
Methyl parathion	9·014	17·771	2·4	7·30	..	1·00[4]	9·93
Trichlorphon	7·198	13·428	2·2	4·60	..	0·20[5]	13·17
			Second season (2nd spray) 1978				
Fenitrothion	7·748	14·980	3·3	11·65	0·233	0·50[1]	16·14
Fenthion	7·356	13·668	2·5	6·60	0·024	0·50[2]	12·12
Malathion	7·165	13·456	1·5	2·15	B.D.L.	6·00[3]	1·77
Methyl parathion	8·939	17·609	2·4	6·90	0·018	1·00[4]	9·90
Trichlorphon	7·170	13·284	2·1	4·30	0·188	0·20[5]	12·61

* Average of bio and chemical assays. Recommended tolerance level [1] Anon. (1976), [2] Anon. (1972), [3] Anon. (1970) [4] Anon. (1969)' [5] Anon. (1976 b).
BDL = Below detectable limit.

by fenthion, malathion and fenitrothion. Trichlorphon gave the lowest deposit (i.e. 6·06 $\mu g/cm^2$) for the 1st spray and 6·09 $\mu g/cm^2$ for the 2nd spray (table 6). The deposits of all these insecticides dissipated quickly up to the 1st day and thereafter, the degradation was gradual. In the case of malathion, fast dissipation of the deposits occurred and no residue could be estimated after the 7th day following the treatment. The results were in agreement with the findings of Deshmukh and Singh (1975) and Singh (1977). The figures of average weather condition during this period are given in table 6. The deposits decreased as the ambient temperature and the size of the fruits increased.

In the second season (table 7) maximum initial deposit of 9·0 $\mu g/cm^2$ (1st spray) and 8·94 $\mu g/cm^2$, (2nd spray) were obtained with methyl parathion, which was followed by fenitrothion, fenthion, trichlorphon and malathion. The deposits were slightly more because of the absence of rain.

The relative persistence of 5 OP insecticides on peach expressed as half-life values, revealed that fenitrothion was a highly persistent insecticide. It also provided maximum period of protection against the peach fruit fly larvae (10–11 days) following either of the two sprays (table 8). Methyl parathion was found to be the next highly persistent insecticide giving adequate initial deposits and providing about a week's protection following each spray. This chemical therefore could be considered as the next best insecticide with a safety interval of 9 days. Comparing the biological performance of trichlorphon and malathion, trichlorphon was more persistent than malathion, but it was of little benefit owing to its low intrinsic toxicity to the fruit fly levae. Safety interval of trichlorphon (12–13 days) was more than fenthion, malathion and methyl parathion, because of its low tolerance level fixed on peach fruits. Safety interval of 16–17 days was found for fenitrothion (table 8). Of the 5 OP insecticides, tested in the present investigation, fenitrothion (in two spray schedule) outclassed the rest of the insecticides, provided protection against the neonate larvae of fruit fly for about 12 days and the peach fruits were safe for consumption after 14–16 days following each spray. Insecticide residues at the time of harvest of peach in both the seasons were much below the acceptable tolerance limits.

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