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Assay of some systemic insecticides against *Hyadaphis erysimi* (Kalt.) on *Brassica campestris* L., var. *sarson* Prain

D N VAIDYA, S F HAMEED and N P KASHYAP
Department of Entomology-Zoology, College of Agriculture, Palampur 176 062

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Abstract. Five systemic organophosphorus insecticides were tested for their intrinsic toxicity in laboratory and persistence of their field-weathered deposits following spray on *sarson* crop (*Brassica campestris* L., var. *sarson* Prain) at recommended concentrations against mustard aphid *Hyadaphis erysimi* (Kalt.). Phosphamidon and demeton-S-methyl proved to be sufficiently toxic compounds and provided protection to the crop for more than 3 days. Thiometon compared to dimethoate was a less toxic insecticide but relatively more persistent. Formothion was found to be the least toxic and least persistent insecticide.

Keywords. Systemic insecticides; toxicity and persistence.

1. Introduction

Mustard aphid (*Hyadaphis*=*Lipaphis*) *erysimi* (Kalt.) is a serious pest of crucifers almost throughout the Northern India. In Himachal Pradesh, *sarson* (*Brassica campestris* L., var. *sarson* Prain.) is grown not only for oil seed but it also serves as an important source of nectar for honey bees during February to April. The leaves of the young crop are often taken for cooking as vegetable. The crop sustains heavy damage from the aphid in most places particularly in Kulu and Kangra valleys. The aphid causes damage not only directly by feeding on leaves, twigs and inflorescence but also indirectly by the secretion of honeydew, on which a sooty mould develops.

The pest has been reported to be controlled by a number of systemic insecticides under field conditions in Haryana and Rajasthan (Gupta 1971; Sharma and Joshi 1972). Field trial at Kanpur showed that dimethoate was the most effective insecticide against the pest compared to diazinon, parathion, malathion or nicotine sulphate (Srivastava *et al* 1972). Experiments on the persistence of toxicity of some insecticides have also been reported (Rout and Senapati 1967; Chand *et al* 1971 and Sharma and Saxena 1972); while relative toxicity of insecticides following direct sprays on the insect under Potter tower was reported by Sarup *et al* (1969), Deshmukh and Sharma (1972) and Singh and Malhotra (1975). Notwithstanding the reported large number of results on the chemical control of the pest, none can be considered for spray under an entirely different agro-climatic condition of Himachal Pradesh. Moreover, none of the insecticides, reported effective elsewhere, can be singled out as best because they either lack in information such as toxicity of the deposit to the pest on the treated surface or no information is given on their persistence under field condition. A combined field and laboratory study of the toxicity and persistence of field-weathered deposits of some easily available systemic insecticides was therefore considered imperative against the pest to obtain more detailed information on the performance of insecticide than is normally available either from field trials or laboratory assessment of the relative toxicity of the insecticides. Sprays were applied to *sarson* crop and the toxicity of both fresh and naturally weathered deposits were obtained and presented in this contribution.

2. Materials and methods

Toxicity of insecticide deposits was determined, by the bioassay technique described by Cranham and Tew (1971), using last instar nymphs of *H. erysimi* (characterised by the presence of wing pads) from a fundatrigenous population maintained on young potted *sarson* plants. Three ml of spray solutions of the commercial formulations were sprayed in a Potter tower on to the dorsal surface of a *sarson* leaf disk (3·6 cm dia) at a deposit of 2 mg ($\pm 5\%$) cm^{-2} of wet spray. The estimated deposits per regression equations (table 1) in $\mu g\ cm^{-2}$ for LD_{50}, LD_{90} and confidence intervals of all the insecticides were calculated on that basis.

Aphids were confined on treated leaf disks in a glass cage. This consisted of a ring, 18×15mm, sealed with paraffin wax to the central portion of the disk, within which were placed five last instar nymphs of *H. erysimi*. The top was closed with a weighted disk of nylon cloth and the glass cage with the leaf disk was then transferred to a moistened filter paper having constant access to the water to prevent desiccation of the leaf. The test material was stored for 24 hr at 27 ± 1°C and $70 \pm 5\%$ RH before mortality counts were made. Moribund insects were considered as dead. After preliminary experiments the range of toxicity (90 to 10%) for 5 concentrations, replicated 5 times for each insecticide was determined, the data were corrected by Abbott's (1925) formula and subjected to probit analysis (Finney 1952).

Commercial formulations of 5 systemic insecticides, listed in table 3, were sprayed to 'run-off' (using a double barrel pump) on 20.12.1976 in plots measuring $9 \times 2{\cdot}5$ sqm when the plants were in half bloom stage.

Persistence of toxicity of each insecticide on treated plants was assessed by randomly plucking the leaves from upper, middle and lower portions at various intervals following treatment. Leaf disks of 3·6 cm dia were taken from 2 leaf subsamples and a glass cage (18×15 mm) was fixed in the central portion of each leaf disk. The test aphids were confined on the disks as described earlier. Mortality counts were recorded for each insecticide until the field-weathered deposits exhibited a corrected % mortality around 10 to 20% (table 2). The age of the deposit was calculated from the time of releasing the aphid in the leaf disk. The data were subjected to analysis of variance from which 95% confidence intervals were calculated, the deposits were later worked out by means of a dosage-mortality regression equation of the insecticides (table 1) taking into account the mean deposit value as described earlier.

The values of deposits ($\mu g/cm^2$) of each insecticide were plotted on x axis corresponding to respective time interval as y axis (figure 1) and consequently the effective lives of insecticides were derived from the days corresponding to their 'minimum effective levels' i.e. LD_{90} values.

Table 1. Toxicity of insecticides

Insecticides	LD_{50} (μg ai cm^{-2})	95% confidence limits (μg ai cm^{-2})	LD_{90} (μg ai cm^{-2})	95% confidence limits (μg ai cm^{-2})	Dosage (ppm)—mortality regression equations
Phosphamidon	0·0102010 (5)	0·0087 – 0·0118	0·022910 (11·4)	0·0166 – 0·0314	Y=3·6512x – 1·2350*
Demeton-S-methyl	0·0144554 (7·2)	0·0125 – 0·0166	0·030062 (15)	0·0230 – 0·0392	Y=4·0207x – 2·4730*
Dimethoate	0·032812 (16·4)	0·0270 – 0·0398	0·089956 (45)	0·0558 – 0·1446	Y=2·9281x – 1·4859*
Thiometon	0·042176 (21)	0·035 – 0·050	0·115088 (57·5)	0·074 – 0·177	Y=2·9387x + 1·1086
Formothion	0·112988 (56·5)	0·086 – 0·148	0·42956 (215)	0·231 – 0·797	Y=2·2078x + 1·1323

Heterogeneity: X^2(3df) non-significant at P=0·05 in all the cases. Y=Probit kill
x=log concentration (ppm)
*x=log concentration ×10 (ppm)
Figures in parentheses are corresponding concentrations expressed in ppm (vide regression equations).

3. Results and discussion

Experiments on the intrinsic toxicity of the deposits of insecticides on the basis of their LD_{50} values (table 1), showed that phosphamidon and demeton-S-methyl were highly toxic to *H. erysimi*, dimethoate and thiometon were intermediate and formothion was the least toxic chemical.

The results on the order of toxicity of the present investigation differs slightly from the findings of Sarup *et al* (1969) and Singh and Malhotra (1975) who claimed phosphamidon and dimethoate as the two highly toxic compounds followed by other 34 insecticides tested by former authors and 18 insecticides by the latter. Deshmukh and Sharma (1972) found demeton-S-methyl followed by phosphamidon as the most toxic compounds among the 19 insecticides tested by them against the pest. These differences may be because of the variation in the testing methods and conditions and also because they had used adults of the aphid from field populations.

A better guide to likely field performance of insecticides is their minimum effective levels (m.e.l.) i.e., LD_{90} (Gratwick *et al* 1965; Gratwick and Tew 1966). Of the compounds tested there is no difference in the ranking order except that phosphamidon and demeton-S-methyl became more closer to each other, compared to their LD_{50}'s and formothion drifted far apart from its preceding insecticide. The deposits of demeton-S-methyl and thiometon seems to be relatively more persistent compared to the other insecticides tested (table 2). Formothion dissipated fastest compared to the other chemicals (figure 1). Comparison of persistence levels of insecticides in conjunction with their m.e.ls indicated that phosphamidon provided protection to the crop for more than 4 days followed by demeton-S-methyl (2·5 days, table 3). Thiometon being inherently a less toxic material its persistence was of little benefit. Consequently, the effective life of thiometon was only for a day. Dimethoate on the other hand, a moderately toxic compound was much less persistent than phosphamidon, demeton-S-methyl or thiometon, while formothion proved to be

Table 2. Persistence of toxicity of field-weathered deposits of OP insecticides *sarson* on leaves against *Hyadaphis erysimi*.

Hours/days after spray	Mean corrected % kill (average of 10 replications ±95% confidence limit.)				
	Formothion	Dimethoate	Phosphamidon	Thiometon	Demeton-S-methyl
0 hr	77±3·4	91±2·8	100±0	93±3·4	100±0
1 Day	33±3·4	—	—	—	90±0
2 Days	—	—	96±2·8	—	—
3 ,,	22±3·4	68±3·4	—	—	—
4 ,,	18±3·4	32±3·4	93±3·4	—	—
5 ,,	12±3·4	24±2·8	83±3·4	60±0	—
6 ,,	—	17±3·4	24±2·8	—	—
7 ,,	—	—	—	25±0	—
8 ,,	—	—	—	—	71±2·8
9 ,,	—	—	11±2·8	—	—
10 ,,	—	—	—	12±3·4	—
13 ,,	—	—	—	9±2·8	42±3·4
16 ,,	—	—	—	—	37±3·4
21 ,,	—	—	—	—	13±3·4

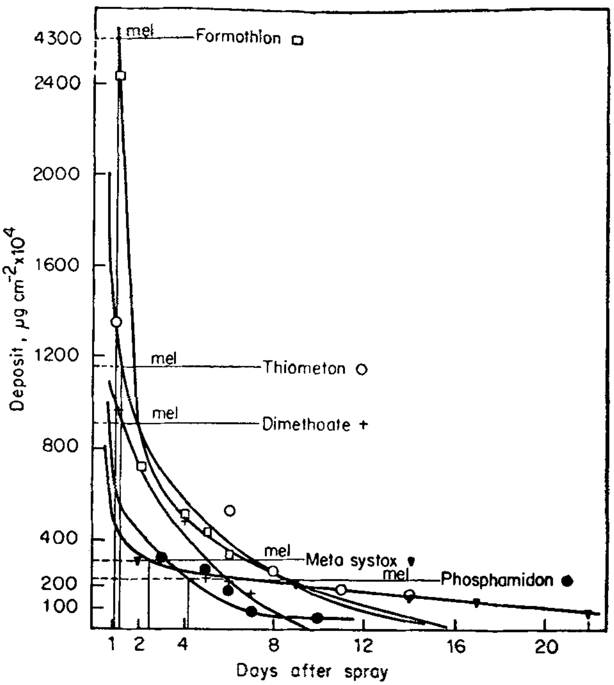

Figure 1. Dissipation of some systemic insecticides on *sarson.*

Table 3. Biological performance of insecticides against *H. erysimi.*

Insecticides	Percent *ai* sprayed	Effective life (days) vide figure 1
Dimethoate	0·030*	c. 1·0
Formothion	0·050**	<1·0
Demeton-S-methyl	0·025*	2·5
Phosphamidon	0·025*	>4·0
Thiometon	0·025**	c. 1·0

*Recommended by Package of Practices for Rabi crops in H.P. 1976-77 p. 58.
**Recommendations of the manufacturing/formulating firms.

a least toxic and least persistent insecticide and therefore cannot be considered against the pest at the recommended dosage. There were negligible variations in the temperature and humidity conditions during the course of investigations and it is unlikely that these factors played any significant role in the toxicity or persistence of deposits of these insecticides.

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