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PERSISTANCE OF TOXICITY OF PHOSPHAMIDON, DICROTOPHOS, OXYDEMETON METHYL AND DIMETHOATE TO MUSTARD APHID (LIPAPHIS ERYSIMI) FOLLOWING SOIL APPLICATION

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Abstract. A method for estimating the efficacy and residual toxicity of systemic insecticides to mustard aphid by soil application is described, using mustard plants grown in polythene begs.

The method was used to compare four insecticides phosphamidon, oxydemeton methyl, dicrotophos and dimethoate at 3 rates of application.

Phosphamidon was the most, and dimethoate least effective insecticide tested.

Aphids of bewildering diveristy cause severe losses in a wide range of crops. Various research workers have recommended different control measures. Harding[4] tried many insecticides and found oxydemeton methyl, and phosphamidon effective against melon aphid by spray method. Linnacus *et al.*[6] found that phosphamidon and dimethoate were effective when applied to the foliage but phosphamidon granules applied to the soil were ineffective. Shorey[9] found that disulfoton controlled green peach aphid up to 3 months after application as granules, dust or drenches. Fariduddin *et al.*[2] demonstrated that phorate and disulfoton were effective up to 7 days after treatment by granular application. Certain insecticides such as phorate and formothion have been found to provide effective control of mustard aphid by foliar, soil and seed treatment. Chand *et al*[7] and Gupta[3] found that menazon has much longer residual effect than phosphamidon, dimethoate, methyl demeton (metasystox) and dicrotophos by granular application.

Although many insecticides have been used the selection of a control method demands attention to ecological and economic factors. Mustard is the primary oil seed crop and is the major source of edible oil for human consumption in our country, thus we undertook trials with four commonly used pesticides, i.e. oxydemeton methyl (Metasystox-R), dicrotophos (Bidrin), phosphamidon (Dimecron) and dimethoate (Perfekthion) to determine their effective doses and their residual toxicity against mustard aphid after soil application of emulsifiable concentrates.

Materials and Methods

(a) Mustard plants grown in polythene bags.

(b) Nutrient solution[5] consisting of: KNO_3 (20.2%), 20 ml; $Ca(NO_3)_2$ (34.0%), 20 ml; $MgSO_4.7H_2O$ (18.4%), 20 ml; $NaH_2PO_4\ 2H_2O$ (20.8%), 10 ml; and Water made up to 1000 ml.

(c) Insecticides: phosphamidon 100% WSC, dicrotophos 85% WSC, dimethoate 65% technical grade, and oxydemeton methyl 92.7% analytical grade.

The mustard plants growing in polythene bags (8 × 12 in) containing 3.5 lb/bag river bed sand were used for the tests when 53-days old and bearing 5–6 leaves. Plants were first given water (20 ml/bag) and nutrient solution (10 ml/bag) and then treated with insecticide by measuring 10 ml of the appropriate aqueous dilutions on to the soil using a pipette. Three dilutions containing 0.01, and 0.005 0.001% active ingredient of each of the four insecticides were tested. Ten plants were treated with each dilution.

Before the application of the insecticide the plants were watered and were given nutrient solution. Immediately after application of insecticide an equal number of adult aphids (30 per plant) were clipped on the leaves of the treated plants with the help of especially designed cages.[8] Three replicates were used for each dilution and for control. Pest mortality resulting from the translocated insecticides was observed at intervals of 1, 3, 6, 24 and 48 hr after treatment. No pest mortality was observed after 1, 3 and 6 hr exposure. At the same time separate replicated batches of insects were allowed to remain exposed to the treated plants continuously for 24 and 48 hr for studying residual toxicity of the insecticide. This part of the experiment was continued till insects mortality fell to negligible limit.

Results and Discussion

Results obtained on the basis of exposure of aphids for periods of 24 and 48 hr to the plants treated with three different concentrations of the four insecticides are presented in Table 1.

It appears that the lowest dose (0.001%) is practically ineffective when the insects are given 24-hr exposure to treated plants (Table 1). Exposure of insects for 48 hr at this dose, however, indicates some degree of effect on the mustard aphid.

At 0.005% dosage level, 24-hr exposure produces some pest mortality in the case of dicrotophos and oxydemeton methyl while the other two compounds give no encouraging results. Exposure for 48 hr in this case, however, gives pest mortality in the range of 86–90% up to 8th, 9th, 10th, and 15th day of application of dimethoate, oxydemeton methyl, dicrotophos and phosphamidon respectively.

TABLE 1. INCREASE AND DECAY OF INSECTICIDAL ACTIVITY OF PLANTS TREATED WITH PHOSPHAMIDON, DICROTOPHOS, OXYDEMETON METHYL AND DIMETHOATE.

Exposure began days after treatment		1	2	3	6	7	8	9	10	13	16	17	20
Insecticidal concn		% *Mortality of Insects After* 24–*hr Exposure to Plants.*											
Phosphamidon	0·001%	6·6	16·6	53·6	20·0	13·3	6·6	—	—	—	—	—	—
	0·005%	16·6	75·0	66·6	63·6	66·6	66·6	20·0	15·0	16·6	20·0	30·0	10·0
	0·01 %	78·5	93·3	86·6	86·6	93·3	73·3	43·3	50·0	33·0	43·3	33·0	23·0
Dicrotophos	0·001%	13·0	10·0	23·3	6·6	6·6	6·6	—	—	—	—	—	—
	0·005%	20·0	66·6	88·0	50·0	46·6	33·3	13·3	15·0	16·6	13·3	13·3	4·5
	0·01 %	73·0	83·3	83·3	80·0	56·6	63·3	20·0	40·0	33·3	16·6	13·3	3·3
Oxydemeton methyl	0·001%	30·0	20·0	16·6	10·0	6·6	—	—	—	—	—	—	—
	0·005%	66·6	80·0	90·0	50·0	50·0	50·0	16·6	15·5	16·6	13·3	6·6	6·6
	0·01 %	76·6	93·3	96·6	70·0	96·6	70·0	30·0	30·0	23·3	16·6	20·0	13·3
Dimethoate	0·001%	6·6	13·3	6·6	3·3	—	—	—	—	—	—	—	—
	0·005%	10·0	26·6	66·6	26·6	6·6	6·6	6·6	5·0	6·6	10·0	6·6	3·3
	0·01 %	23·3	83·3	83·3	43·3	13·3	13·3	10·0	10·0	10·0	13·3	10·0	6·6

Exposure began days after treatment		2	5	7	8	9	10	12	15	17	19
Insecticidal concn		% Mortality of Insects After 48–hr Exposure to Plants									
Phosphamidon	0·001%	20·0	50·0	83·3	80·0	73·0	40·0	20·0	6·6	—	—
	0·005%	100·0	83·0	100·0	90·0	100·0	93·3	90·0	90·0	75·0	56·6
	0·01 %	100·0	100·0	100·0	100·0	100·0	96·6	93·3	90·0	86·6	76·6
Dicrotophos	0·001%	90·0	60·0	66·6	50·0	20·0	13·3	6·6	—	—	—
	0·005%	100·0	86·6	100·0	96·6	96·6	86·6	66·6	60·0	56·6	56·6
	0·01 %	100·0	100·0	100·0	100·0	96·6	90·0	86·6	86·6	80·0	73·3
Oxydemeton methyl	0·001%	93·3	86·6	50·0	46·6	46·6	30·0	10·0	—	—	—
	0·005%	100·0	96·6	86·6	86·6	86·6	56·6	56·6	53·3	46·6	40·6
	0·01 %	100·0	100·0	93·3	90·0	90·0	90·0	90·0	73·3	83·3	50·0
Dimethoate	0·001%	90·0	80·0	46·6	13·3	13·3	—	—	—	—	—
	0·005%	93·3	86·6	90·0	86·6	70·0	66·6	40·0	33·3	33·3	33·3
	0·01 %	100·0	100·0	96·6	93·3	90.0	66·6	63·3	63·3	55·0	46·6

TABLE 2. LC 50's OF PHOSPHAMIDON, OXYDEMETON METHYL, DICROTOPHOS AND DIMETHOATE.

Insecticide	Day after treatment	Hetrogenity X2	Regression equation	LC% 50	Fiducial	Limit
Phosphamidon	1st	9·949	2·400x + 0·555	0·0071	0·0115	0·0043
	3rd	1·012	0·879x + 4·128	0·0009	0·0030	0·00026
	6th	0·293	1·845x + 2·290	0·0028	0·0041	0·0019
Oxydemeton methyl	1st	0·388	1·168x + 3·384	0·0024	0·0064	0·00089
	3rd	0·412	2·961x + 1·179	0·0019	0·0028	0·0019
	6th	nil	1·813x + 1·906	0·005	0·0074	0·0031
Dicrotophos	1st	1·103	2·000x + 1·351	0·0066	0·0093	0·0045
	3rd	1·401	1·690x + 2·715	0·0019	0·0031	0·00126
	6th	0·062	2·356x + 1·063	0·0046	0·0061	0·0034
Dimethoate	1st	0·720	0·829x + 2·505	0·1023	0·3555	0·028
	3rd	0·447	2·543x + 0·907	0·0033	0·0044	0·0025
	6th	1·110	1·418x + 1·898	0·0151	0·0339	0·0066

At the highest dosage level of 0.01%, 24-hr exposure gives 80–93% kill of the pest nearly upto about 7–8 days in case of all the insecticides except dimethoate which gives upto 83% kill for three days only. With 48-hr exposure of pests at this dosage level phosphamidon, dicrotophos and oxydemeton methyl provide upto 92–100% pest mortality till 17th day of application whereas dimethoate kills 90% pest on 9th day of application whereafter its effectiveness sharply declines.

In all the three situations it would appear that dimethoate is the least toxic insecticide among the four compounds tested. Among the other three insecticides some difference is observed in toxicity when insects are exposed to the treated plants for 24 hr probably due to difference in the rate of uptake and translocation of the products. Exposure of insects to treated plants for 48 hr, however, gives slight edge to phosphamidon over others at all the three dosage level (Table 1). The LC50 values calculated on the basis of exposure of aphids to treated plants for 24 hr during the first week of the experiment give similar indications (Table 2). It is thus evident that order of toxicity of the four insecticides to mustard aphids is Phosphamidon >dicrotophos> oxydemeton methyl> dimethoate.

Aphids infest agricultural crops in the form of relatively immobile colonies. From the practical point of view it is desirable that an insecticide selected for their control should be capable of not only eradicating the pest but should also protect the crop from reinfestation for as long as possible. Both these objective ends seem to be achieved by using phosphamidon, dicrotophos or oxydemeton methyl which remain effective upto 17 days after application.

In these experiments the insecticides were applied in aqueous solution to the soil suggested that these insecticides may be employed for protecting mustard crops from pest infestation under pratical conditions.

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