

PERSISTENCE OF PHORATE AND ITS RESIDUAL TOXICITY TO *APHIS CRACCIVORA* KOCH. IN COWPEA

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Enzymatic assay of internal residues of phorate in cowpea *Vigna sinensis* following application of the insecticide as granules with seed at 1, 2 and 3 kg a.i. / ha showed that residues of the toxicant persisted within the plants upto 49 days following the application. On the 56th day there was no residue of the insecticide either in the leaves or in the pods. The mortality of *Aphis craccivora* exposed to the plants treated with the granules was 100 per cent upto 14 days with 1 and 2 kg a.i. / ha and upto 21 days with 3 kg a.i. / ha. The mortality showed a gradual reduction corresponding to the reduction of the internal residue of the insecticide, there being no mortality on 56th day of insecticide application. Application of phorate granules at 2 kg a.i. / ha, with the seeds is considered an effective and safe method for protecting cowpea from infestation by *A. craccivora* upto 8 weeks of its growth.

INTRODUCTION

Phorate is widely recommended for the control of sucking pests affecting pulse crops (NEEL *et al.*, 1967; GOULD *et al.*, 1969; HAGEL, 1970; CHANG, 1971; NARESH & THAKUR, 1972; MATHUR *et al.*, 1974; SHASHI VERMA, 1975; BHATTACHARJEE *et al.*, 1975). In recommending phorate for insect control on edible crops it is necessary to ascertain the persistence of the toxicant within the plants. This has already been done with various pulse crops in various centres (SHASHI VERMA, 1975; SHASHI VERMA & PANT, 1975; BHATTACHARJEE *et al.*, 1975).

The present paper embodies the results of estimations of phorate residues made in *Vigna sinensis* grown in the red soil of Kerala State. The variety used is a high yielding cultivar called 'Philippines' which is generally cultivated for vegetable purpose. Studies on the residual toxicity of the insecticide to *Aphis craccivora*, the most important pest of the crop, have also been made.

MATERIALS AND METHODS

The cowpea plants were raised in pots (30 cm x 30 cm) using 20 kg of soil per pot. The soil was collected from a spot known to be uncontaminated by insecticide applications. The soil in each pot was mixed with 200 g of farm yard manure. A single seed was sown in each pot. The different doses of phorate in the form of granules were applied together with the seeds in quantities calculated for each pot. Pots were watered every morning and evening. Twentyfive days after sowing the plants were fertilised with 2g ammonium sulphate per pot.

The internal residues of phorate within the plants were determined chemically following the enzymatic methods of SUTHERLAND *et al.* (1964). For these assays 10 g samples of apical portion of the plants under the various treatments were collected at weekly intervals and extracted for the residues. Residues of the toxicant in the pods also were assessed.

To study the toxicity of the internal residues of phorate to *Aphis craccivora* adults of the aphid were exposed to apical parts of the plants under the different treatments on the same occasions as the plant parts were collected for chemical assays of the residues and mortalities observed. The apical parts of the plants were cut out placed in specimen tubes

TABLE 1. Residue of phorate in cowpea in ppm at different intervals

Doses of phorate (kg. ai./ha)	Intervals in days							
	7	14	21	28	35	42	49	56
1 ..	24.40	27.00	16.4	8.2	0.36	0.30	0.17	ND
2 ..	25.04	33.00	24.4	16.2	0.56	0.36	0.23	ND
3 ..	26.20	43.00	32.0	21.9	0.65	0.54	0.30	ND

ND — Not detected.

TABLE 2. Percentage mortality of *A. craccivora* on cowpea at different intervals after phorate application

Doses of phorate (kg. ai./ha)	Intervals in days							
	7	14	21	28	35	42	49	56
1 ..	100	100	80	60	46	17	0	0
2 ..	100	100	83	83	50	37	0.3	0
3 ..	100	100	100	96	60	37	1.0	0

TABLE 3. ANOVA (after angular transformation)

Source	S. S.	D. F.	M.S.S.	F
Total	..	62162.27	62	
Block	..	268.94	2	134.47
Treatment	..	1586.57	2	793.29
Period	..	56293.27	6	9382.21
Treatment x period	..	1828.56	12	152.38
E	..	2184.93	40	54.62

** Significant at 1% level

CD for comparing treatments = 4.609
 periods = 7.041
 combinations = 12.195

Means : $T_1 = 51.53$, $T_2 = 59.97$, $T_3 = 63.80$
 Periods : $p_1 = 90$, $p_2 = 90$, $p_3 = 73.20$, $p_4 = 67.85$
 $p_5 = 46.31$, $p_6 = 32.12$, $p_7 = 2.55$

and adults of the aphid reared on plants in field cages released on them. Mortality counts were made 24 hours after exposure on the plants.

RESULTS

Table 1 gives the amounts of phorate persisting within the plants at different intervals after application and when applied at different doses. It may be observed that with each dose there is an increase in the insecticide contents of the plants upto 14th day after the application. From the 14th day a steady decrease in the internal residues of the toxicant is in evidence.

However, a very abrupt and drastic reduction in the insecticide residues is registered between the 28th and the 35th day of insecticide application. There is no detectable residues on the 56th day in any of the doses under study. Estimations of internal residues of pods on 56th day also did not show any detectable residues of the insecticide.

Table 2 gives toxicity of internal residues of phorate in the cowpea plants to *Aphis craccivora* exposed to the plants at different intervals after the insecticide application. It may be observed that there is cent per cent

TABLE 4. Per cent mortality of *Aphis craccivora* corresponding to internal residues of phorate in cowpea

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
Phorate residue (ppm)	43.0	33.0	32.0	27.0	26.2	25.04	24.4	24.4	21.9	16.4	16.2	8.2	0.65	0.56	0.54	0.36	0.36	0.30	0.30	0.23	0.17
Per cent mortality	100	100	100	100	100	100	100	83	96	80	83	60	60	50	37	46	37	17	1	0.3	0.0

mortality of the aphids upto 2 weeks in the case of doses of 1 and 2 kg a.i./ha and upto 3 weeks in 3 kg a.i./ha. Thereafter gradual reduction in mortality is in evidence. There is, however, an abrupt and substantial reduction in the mortality on the 35th day after the insecticide application; mortality becomes insignificant on the 49th day.

The analysis of variance table (Table 3) shows that there is no significant difference in the toxicity of phorate residues to the aphid when used at the dosages of 2 and 3 kg a.i./ha. There is, however, significant difference between the mortality caused by the dose of 1 kg a.i./ha and that of the two higher doses. As regards the mortality variations with reference to intervals after insecticide application the analysis of variance shows that in general the mortalities differ significantly between the different occasions.

DISCUSSION

Results of studies presented show that residues of phorate applied in soil with the seeds persist within cowpea plants upto a period of 49 days following application. On the 56th day of treatment no residue is detected even at the highest dose of 3 kg a.i. per hectare. Analysis of pods also has indicated absence of any residue on the 56th day. The pods will be ready for harvesting usually at the 8th week following sowing. As the acceptance for phorate on food crops is on "no residue at harvest basis" application of the granule together with the seeds as has been done in the present studies is a safe treatment for cowpea. Comparable results have been reported by previous workers on other pulse crops. Thus SHASHI VERMA (1975) and SHASHI VERMA & PANT (1975) could detect residues of phorate in 'moong' and 'arhar' upto a period of about 50 days and 62 days respectively. BHATTACHARJEE *et al.* (1975) using phorate granules before seed placement

and as side dressing 4 weeks after initial application @ 2.5 gm/meter row, observed no residues in leaves, straw or grain of soybean at the time of harvest. The lower phorate contents of plants on the 7th day than on the 14th day appears to be due to lack of proper root system on the 7th day enabling absorption of the toxicant.

Table 4 gives the mortalities of *A. craccivora* corresponding to the different internal residues of phorate. It is seen that the mortality of the aphid is cent per cent for an internal residue of 24.4 ppm and above, of the toxicant. As the internal residue contents decrease below 24.4 ppm the mortality of the aphid also decreases correspondingly. On the 56th day of insecticide application there is no detectable residue in the plant and there is no mortality in the aphids also.

Application of phorate granules with seeds is seen as an effective and safe method for protecting cow pea plants upon a period of 7 weeks. A dose of 2 kg a.i./ha has proved itself effective for the purpose. These findings have special significance as the cowpea variety under studies is one which is used as a vegetable and is harvested continuously.

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