

RESIDUAL TOXICITY AND RESIDUES OF SOME INSECTICIDES IN/ON GRAM

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ABSTRACT

Sprays of monocrotophos 0.08%, endosulfan 0.07%, dimethoate 0.03%, phosphamidon 0.05% and permethrin 0.005% on gram gave more than 90% kill of the larvae of *Heliothis armigera* Hubn. upto 3 days. Residual toxicity was noticed upto 30 days for monocrotophos, endosulfan and permethrin and upto 21 days for dimethoate and phosphamidon. On the basis of LT_{50} values the order of residual toxicity was : monocrotophos > permethrin > endosulfan > phosphamidon > dimethoate.

The residues of endosulfan and monocrotophos were found to persist for 25 days on gram leaves and for 21 days on gram pods, but the residues reached below tolerance limit of 2 ppm for endosulfan and 1 ppm for monocrotophos in 15 days on gram leaves and in 9 days in gram pods, indicating waiting period for consumption of leaves and pods for vegetable purpose. No residue in grains at harvest was detected.

INTRODUCTION

Gram, *Cicer arietinum* L. is an important pulse crop of India and gram pod borer (*Heliothis armigera* Hubn.) is one of the important pests (Sithanatham et al., 1983). In gram, the losses due to pod borer only were found to be 6.1 to 9.4 per cent in Punjab (Singh and Singh, 1975), 7 to 22 per cent in Kanpur and upto 50 per cent loss (Sithanatham et al., 1983).

A number of insecticides have been tested in the field against the pest complex of gram but the residual toxicity of some important insecticides has not been studied in detail. Since the leaves of gram (in initial stage) and pods and seeds are consumed by human beings, the study of the residues of insecticides on this crop was carried out so as to set a proper waiting period.

MATERIAL AND METHODS

The experiments were conducted at Agronomy Farm of the Rajasthan College of Agriculture, Udaipur during 1983-84 (first year) and 1984-85 (second year).

In the first year the experiment on the residual toxicity of 5 different insecticides in gram crop against the larvae of *Heliothis armigera* Hubn. was conducted. There were 6 treatments including control, each replicated thrice in plots 5 m x 4 m. The

gram cv 'Dohad yellow' was sown on 16 October, 1983 at the rate of 80 kg per hectare by dibbling in rows 30 cm apart. The sprays of 0.08% monocrotophos, 0.07% endosulfan, 0.03% dimethoate, 0.05% phosphamidon and 0.005% permethrin were done in 3 randomly selected plots, for each insecticide at the time of flowering of the crop. The samples of treated gram plants were periodically brought to the laboratory and were kept in glass jars. Larvae of *H. armigera* were reared in the laboratory and 20 full grown larvae were released in each jar. Mortality counts were made after 48 hours of exposure. The data were recorded (Table 1), and were subjected to Probit Analysis (Finney, 1981) for calculating LT_{50} (lethal time in days upto which 50% kill was noticed) values.

During second year (1984-85) the residue estimation was done. The gram variety 'Dohad yellow' was sown on 12 November, 1984 and the sprays of endosulfan 0.07% and monocrotophos 0.07% were done on March, 1985.

The leaves and pods were plucked periodically at random from different plants in a plot, to give a final sample of 50 g after quartering. They were finally chopped and crushed with a glass pestle and mortar by adding 5 g of anhydrous sodium sulphate. Single solvent extraction was resorted to by using hexane as solvent for the extraction of endosulfan residues and chloroform for monocrotophos residues. A 1:4 ratio of sample to solvent (wt/vol) was used for the extraction. Each crushed sample was transferred into a 500 ml erlenmeyer conical flask. The pestle and mortar used for crushing the sample was washed three times with 10 ml of solvent per washing and the washings were added in the conical flask containing crushed sample. Rest of the required volume of solvent was added in the flask. The flask containing samples and solvents were shaken for one hour on motorised shaker and thereafter the extract filtered through whatman filter paper No. 1. Clean up of the extracts was done by passing through a column containing 4 cm layer of adsorbent mixture (equal parts of magnesium oxide, activated charcoal and celite) sandwiched between 2 cm layer of anhydrous sodium sulphate. After passing the extract through this column, three washing each with 10 ml of solvent were given to the column and all the washings and original filtrate were collected and concentrated on water bath and processed for residue determination.

For the determination of endosulfan residues, the method of Butler et al. (1962) as modified by Maitlen et al. (1963) was followed, while the method of Getz and Watt (1964) was adopted for monocrotophos residues. More than 90% residues of both endosulfan and monocrotophos were recovered from the fortified samples of gram leaves and pods.

RESULTS AND DISCUSSION

The residual toxicity of 0.08% monocrotophos, 0.07% endosulfan, 0.03% dimethoate, 0.05% phosphamidon and 0.005% permethrin against larvae of *Heliothis*

armigera Hubn. was assessed and the data are presented in Table 1. All the five insecticides gave more than 90% kill of the larvae upto 3 days of treatment. More than 50% kill was also noticed in all the treatments upto 9 days and thereafter mortality decreased. Dimethoate and phosphamidon gave no toxicity at 25 days interval whereas other three insecticides were found to give 10% mortality even at 30 days sampling. LT_{50} was found in the order : monocrotophos > permethrin > endosulfan > phosphamidon > dimethoate.

Table 1

Per cent mortality of *Heliothis armigera* larvae due to residual toxicity of insecticides on gram foliage

| Insecticide | Mortality on days after treatment | | | | | | | LT_{50} |
|-----------------------|-----------------------------------|-----|----|----|----|----|----|-----------|
| | 0 | 3 | 9 | 15 | 21 | 25 | 30 | |
| Monocrotophos 0.8% | 90 | 90 | 80 | 40 | 40 | 30 | 10 | 16.30 |
| Endosulfan 0.07% | 90 | 90 | 60 | 30 | 30 | 30 | 10 | 14.18 |
| Dimethoate 0.03% | 100 | 90 | 50 | 30 | 15 | 0 | 0 | 11.54 |
| Phosphamidon 0.05% | 100 | 100 | 60 | 20 | 15 | 0 | 0 | 11.99 |
| Permethrin 0.05% | 100 | 100 | 70 | 30 | 25 | 20 | 10 | 14.91 |

LT_{50} —Lethal time in days giving 50% mortality.

The results given in Table 2 indicate that the spray of 0.07 per cent endosulfan on gram plant gave about 8.6 ppm deposits in leaves which dissipated by more than 50

Table 2

Residues of endosulfan and monocrotophos in gram leaves

| Days after treatment | Endosulfan 0.07% | | Monocrotophos 0.08% | |
|----------------------|------------------|-------------|---------------------|-------------|
| | Residues (ppm) | Reduction % | Residues (ppm) | Reduction % |
| 0 | 8.582 | — | 9.520 | — |
| 3 | 3.628 | 57.73 | 4.648 | 51.18 |
| 9 | 1.926 | 77.56 | 1.827 | 80.81 |
| 15 | 0.648 | 92.45 | 0.699 | 92.66 |
| 21 | 0.270 | 96.86 | 0.346 | 96.37 |
| 25 | BDL | 100.00 | BDL | 100.00 |

BDL—Below detectable level

per cent within 3 days, more than 90 per cent in 15 days and almost 100 per cent in 25 days. The spray of 0.08 per cent monocrotophos spray over gram plant gave the initial deposit of 9.5 ppm which also dissipated in the same manner that is, there was very fast degradation within 3 days and also the residues could not persist beyond 25 days.

Comparatively higher initial deposits of 11.58 and 13.07 ppm endosulfan with 0.07% spray of endosulfan were recorded in mung bean (Verma and Pant, 1976; Vyas, 1977). In case of monocrotophos, Dutta (1977) could get 3.69 ppm deposits on cowpea with 0.04% monocrotophos spray which is approximately half of the deposits obtained in gram leaves (9.5 ppm) with 0.08% monocrotophos spray.

The observation of rapid dissipation of residues within first few early days is also confirmed by the findings of Aharanson and Resnick (1972) who also observed rapid degradation of monocrotophos in the first 3 days in tomato, pepper, lemon and oranges. In mung bean also Verma and Pant (1976) reported more than 50% dissipation of endosulfan residues within 24 hours of spray.

Table 3
Residues of endosulfan and monocrotophos in gram pods

| Days after treatment | Endosulfan 0.07% | | Monocrotophos 0.08 | |
|----------------------|------------------|-------------|--------------------|-------------|
| | Residues (ppm) | Reduction % | Residues (ppm) | Reduction % |
| 0 | 7.631 | | 8.213 | |
| 3 | 4.115 | 46.08 | 3.586 | 56.34 |
| 9 | 1.012 | 86.74 | 0.938 | 88.58 |
| 15 | 0.316 | 95.86 | 0.112 | 98.64 |
| 21 | BDL | 100.00 | BDL | 100.00 |

BDL—Below detectable level.

In case of gram pods the initial deposits of 7.631 ppm endosulfan and 8.213 ppm monocrotophos were obtained. The dissipation rate was little higher in pods than in leaves as it took 21 days to reach below detectable level whereas in case of leaves 25 days were required for 100 per cent dissipation.

From the consumption point of view, it could be inferred that gram leaves and pods sprayed with 0.07% endosulfan could only be utilized after a waiting period of 9 days as after this period the residues reached below the tolerance limit of 2 ppm. In case of monocrotophos if tolerance limit of 1 ppm is considered it can be said that the leaves can be utilized after 15 days whereas pods could be consumed after 9 days only.

It is also interesting to note that on final harvest neither endosulfan nor monocrotophos residues were detected in grains of gram.

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