

Response of *Cryptolaemus montrouzieri* Muls (Coccinellidae: Coleoptera) to Commonly used Pesticides in Vineyards

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ABSTRACT

Sixteen pesticides were tested against grubs, pupae and adults of the coccinellid predator, *Cryptolaemus montrouzieri* Muls. The predators were exposed to treated grapevine leaf and the mortality was recorded after 24 h of exposure. Dichlorvos (0.20%), chlorpyrifos (0.05%) and fish oil rosin soap (4g/litre) were found to be safe to the grubs and adults. Adults did not emerge from pupae exposed to monocrotophos (0.05%) and dimethoate (0.06%). The study on the residual toxicity revealed that residues of monocrotophos remained toxic to the predator for more than 20 days. Diazinon and methyl parathion showed lower residual toxicity to *C. montrouzieri*. All the commonly used fungicides proved harmless to the predator.

KEY WORDS: *Cryptolaemus montrouzieri*, pesticides, response

Cryptolaemus montrouzieri Muls. (Coccinellidae: Coleoptera) popularly known as mealybug destroyer has been suggested as a promising biocontrol agent for the grape mealybug *Maconellicoccus hirsutus* (Green) in South India (Ranga Reddy and Lakshminarayana, 1986; Satyanarayanamurthy, 1982). Application of pesticides in vineyards is very common to control pests and diseases. A study was undertaken to determine the safety of different pesticides to the predator, *C. montrouzieri*.

MATERIALS AND METHODS

The predatory beetle *C. montrouzieri* was reared on mealybug infested pumpkin fruits in the laboratory as outlined by Chacko *et al.* (1978). Sixteen pesticides used commonly in vineyards were tested at recommended doses to determine their toxicity to the larvae, pupae and adults of *C. montrouzieri*. The pesticides and the concentration used were monocrotophos 0.08% (Nuvacron 40 SC), dichlorvos 0.20% (Nuvan 100 EC), dimethoate 0.06% (Rogor 30 EC), Oxydemeton methyl (Metasystox 25 EC), methyl parathion 0.10% (Metacid 50 EC), chlorpyrifos 0.05% (Coraban 20 EC), diazinon 0.05% (Delzinon 20 EC), phosalone 0.07% (Zolone 35 EC), fish oil rosin soap (25g/litre), dicofol 0.05% (Kelthane 18.5 EC), copper oxychloride 0.30% (Blitox 80%),

mancozeb 0.20% (Dithane M.45 75% WP), sulphur 0.30% (Sulfex 80 WP), captafol (Foltaf 80 WP), carbendazim 0.10% (Bavistin 50 WP) and Bordeaux mixture 1% (5 : 5 : 50). The pesticides were diluted with water to get the desired concentrations. An untreated check with tap water was maintained in the following experiments conducted with 17 treatments and four replications in completely randomised block design.

The pesticides of known concentration were separately sprayed on potted grapevine plants. Four leaves from each treated plant were removed and held in glass vials. Ten adult beetles (3 day-old) were exposed to the treated leaf surface in a glass vial (20 x 30 cm). The mouth of the vial was covered with muslin cloth and held in position with rubber bands. Mortality of adults was recorded after 24 h of exposure. Adults were fed with 50 per cent honey solution during the study period. Similarly, the second instar predatory grubs were exposed to the treated leaf infested with mealybugs. Observation was made on the mortality of grubs after 24 h. Ten three-day-old pupae of the predator were spread on a glass plate and directly sprayed with the pesticides. After drying in the shade, the pupae treated with each pesticide were kept separately in glass vials for adult emergence.

Based on the toxicity data, six insecticides were selected to study further their residual

effect on second instar larvae and adults. Both the larvae and adults were exposed to the treated leaf surface at weekly intervals until the insecticides became non-toxic. The mortality of larvae and adults was recorded after 24 h of exposure. The potted grapevine plants which received sprays were kept in open space to expose to the natural weather conditions.

RESULTS AND DISCUSSION

Among the different insecticides, dichlorvos, chlorpyrifos and fish oil rosin soap were found to be totally innocuous to the grub (Table 1). The other insecticides *viz.*, monocrotophos, dimethoate, oxydemeton methyl, diazinon, methyl parathion and phosalone caused 95-100% mortality of grubs after

TABLE 1. Effect of pesticides on different stages of the predator, *C. montrouzieri*

| Treatment | % mortality after 24 hr. | | % emergence from treated pupae |
|---------------------|--------------------------|---------|--------------------------------|
| | Grub* | Adult** | |
| Monocrotophos | 100.0 | 100.0a | 0.0 |
| Dichlorvos | 0.0 | 0.0e | 95.0 |
| Dimethoate | 100.0 | 100.0a | 0.0 |
| Oxydemeton methyl | 100.0 | 100.0a | 87.5 |
| Methyl parathion | 95.0 | 87.5d | 95.0 |
| Diazinon | 97.5 | 82.5c | 97.5 |
| Chlorpyrifos | 0.0 | 0.0e | 95.0 |
| Phosalone | 100.0 | 95.5b | 97.5 |
| Fish oil rosin Soap | 0.0 | 0.0e | 95.0 |
| Copper oxychloride | 0.0 | 0.0e | 100.0 |
| Mancozeb | 0.0 | 0.0e | 97.5 |
| Sulphur | 0.0 | 0.0e | 97.5 |
| Captafol | 0.0 | 0.0e | 100.0 |
| Carbendazim | 0.0 | 0.0e | 97.5 |
| Bordeaux mixture | 0.0 | 0.0e | 97.5 |
| Dicofol | 0.0 | 0.0e | 9.75 |
| Check (water) | 0.0 | 0.0e | 9.75 |

* Differences between the means not significant.

** Means followed by same letters are not different statistically ($P = 0.01$) by L.S.D.

24 h of exposure. The remaining chemicals (fungicides/acaricides) were safe to the larvae.

Monocrotophos, dimethoate and oxydemeton methyl were highly toxic to adults inflicting 100 per cent mortality, whereas dichlorvos, chlorpyrifos and fish oil rosin soap were non-toxic. A mean mortality of 95.5, 87.5 and 82.5 per cent was observed with phosalone, methyl parathion and diazinon, respectively. Adults did not emerge from the pupae treated with monocrotophos and dimethoate. The emergence of adults varied from 87.5 to 100 per cent with the remaining chemicals.

The data on the residual toxicity to the grubs indicated that monocrotophos was highly toxic and inflicted 100 per cent mortality up to the 14th day (Table 2). Mortality of grubs dropped to an insignificant level only on the 28th day. The residues of dimethoate and phosalone were innocuous to the grubs on 21st day of the treatment. Methyl parathion and diazinon were toxic only on the first day of treatment. They inflicted 13.3 —10.0 per cent mortality respectively on the 7th to 8th day.

The residues of monocrotophos persisted causing 90 per cent mortality of adults on the 21st day (Table 3) but on the 28th day, only 16.7 per cent mortality was observed. The residues of dimethoate and phosalone caused 76.7 per cent adult mortality on the 14th day of treatment. Thereafter, both the insecticides remained safe to the adults. Oxydemeton methyl residue was less toxic by the 14th day though highly toxic up to 7th day of treatment (Table 3). Diazinon had become less toxic to the adults on the 7th day of treatment itself, recording only 3.3 per cent mortality while on the same day methyl parathion inflicted 16.67 per cent adult mortality. Subsequently, these insecticides were non toxic to *Cryptolaemus* adults.

Of the 16 pesticides tested in the present study, three, namely dichlorvos, chlorpyrifos and fish oil rosin soap were totally non-toxic to the larvae, pupae and adults of *C. montrouzieri*. The present result with dichlorvos (0.20%) is in conformity with the observation

TABLE 2. Residual toxicity of some insecticides to the adults of *C. montrouzieri*

| Treatment | Percentage mortality of grubs | | | | | Mean |
|-------------------|-------------------------------|-----------------|-----------------|----------------|--------------|----------------|
| | Days after treatment | | | | | |
| | 1 | 7 | 14 | 21 | 28 | |
| Monocrotophos | 100.0 (90.0) | 100.0 (90.0) | 100.0 (90.0) | 80.0 (63.9) | 3.3 (6.6) | 76.7 (68.1) |
| Dimethoate | 100.0 (90.0) | 93.3 (77.8) | 16.7 (23.9) | 0.0 (0.6) | 0.0 (0.6) | 42.0 (38.6) |
| Oxydemeton methyl | 100.0 (90.0) | 100.0 (90.0) | 86.7 (68.9) | 0.0 (0.6) | 0.0 (0.6) | 57.3 (50.0) |
| Methyl parathion | 93.3 (77.8) | 10.0 (15.3) | 3.3 (6.6) | 0.0 (0.6) | 0.0 (0.6) | 21.3 (20.1) |
| Diazinon | 100.0 (90.0) | 13.3 (21.2) | 0.0 (0.6) | 0.0 (0.6) | 0.0 (0.6) | 22.7 (22.6) |
| Phosalone | 96.7 (83.9) | 46.7 (43.1) | 16.7 (23.9) | 0.0 (0.6) | 0.0 (0.6) | 32.0 (30.4) |
| Mean | 98.3 (86.9) | 60.6 (56.2) | 37.2 (35.7) | 13.3 (11.1) | 0.6 (1.6) | 42.0 (38.3) |

(Figures in parenthesis are angular transformed values)

| | 'F' value | C.D. (P=0.05) |
|--------------------------|-----------|---------------|
| Insecticides (A) | 182.59** | 3.96 |
| Days after treatment (B) | 684.19** | 3.61 |
| Interaction (A × B) | 35.34** | 8.86 |

**Significant (P = 0.01)

TABLE 3. Residual toxicity of some insecticides to the adults of *C. montrouzieri*

| Treatment | Percentage mortality of adults (days after treatment) | | | | | Mean |
|-------------------|---|-----------------|-----------------|----------------|----------------|-----------------|
| | 1 | 7 | 14 | 21 | 28 | |
| Monocrotophos | 100.0 (90.0) | 100.0 (90.0) | 100.0 (90.0) | 90.0 (71.9) | 16.7 (23.9) | 81.3 (73.1) |
| Dimethoate | 100.0 (90.0) | 100.0 (90.0) | 76.7 (61.3) | 10.0 (15.3) | 0.0 (0.6) | 57.3 (51.4) |
| Oxydemeton methyl | 100.0 (90.0) | 100.0 (90.0) | 13.3 (21.2) | 0.0 (0.6) | 0.0 (0.6) | 42.7 (40.87) |
| Methyl parathion | 93.3 (77.8) | 16.7 (22.3) | 0.0 (0.6) | 0.0 (0.6) | 0.0 (0.6) | 21.9 (20.4) |
| Diazinon | 90.0 (71.7) | 3.3 (6.6) | 0.0 (0.6) | 0.0 (0.6) | 0.0 (0.6) | 18.7 (15.9) |
| Phosalone | 100.0 (90.0) | 100.0 (90.0) | 76.7 (61.3) | 0.0 (0.6) | 0.0 (0.6) | 55.3 (48.5) |
| Mean | 97.2 (84.9) | 70.0 (64.8) | 44.5 (39.1) | 16.7 (14.8) | 2.8 (4.5) | 46.2 (41.7) |

(Figures in parenthesis are angular transformed values)

| | 'F' value | C.D. (P = 0.05) |
|--------------------------|-----------|-----------------|
| Insecticides (A) | 299.73** | 3.89 |
| Days after treatment (B) | 627.16** | 3.56 |
| Interaction (A × B) | 45.04** | 8.71 |

**Significant (P = 0.01)

of Satyanarayanamurthy (1982) who found dichlorvos (0.10%) to be the safest chemical requiring one day interval for the release of *C. montrouzieri*. The non-toxic nature of chlorpyrifos observed in the present study also agrees closely with the observation of Morse and Bellows (1986). Monocrotophos and methyl parathion caused 100 per cent mortality of grubs and adults on the day of treatment. This is in conformity with observations made by Seker Glu and Vygun (1980), Chacko *et al.* (1979) and Samuel *et al.* (1981).

During the present study, the residues of monocrotophos remained toxic to the beetles for a long time compared to other insecticides. This is in agreement with the results obtained by Satyanarayanamurthy (1982) who recommended not to release the beetles upto 20 days after spraying with monocrotophos. In the present investigation, diazinon was found to be toxic to *Cryptolaemus* only on the first day of treatment. A similar observation was made by Meyerdirk *et al.* (1982) who recorded a low residual toxicity of diazinon to the adult beetles. Dimethoate in the present study, proved toxic to the larvae and adults upto 14 days of treatment. On 21st day of application, it did not cause any appreciable mortality. This finding is in agreement with that of Bellows *et al.* (1985) who have also found dimethoate non-toxic to the adult beetles after 20 days of the treatment.

All the acaricides and fungicides tested in the present study proved to be safe to the larvae, pupae and adults of *C. montrouzieri*. They can be used in an integrated control programme. The use of dichlorvos and chlorpyrifos can be integrated with the release of the predator for the control of mealybug and other pests of grapevine.

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