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# Laboratory and field efficacy of selected insecticides against mealy bug *Phenacoccus solenopsis* Tinsley infesting cotton*

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**Abstract:** Bioefficacy of some selected insecticides was evaluated against mealy bug, *Phenacoccus solenopsis* Tinsley in laboratory as well as in field condition at B. A. College of Agriculture, Anand (Gujarat), India during the year 2006-07. Out of nine different insecticides evaluated, profenophos (0.05 %), triazophos (0.04 %) and carbaryl (0.2 %) found to be most effective for *P. solenopsis* in both laboratory and field conditions. Spraying of profenophos could register significantly highest (2759 kg/ha) seed cotton yield followed by triazophos (2679 kg/ha) and carbaryl (2644 kg/ha). Incremental Cost Benefit Ratio (ICBR) was maximum (1: 21.70) from triazophos treatment followed by profenophos (1:18.64) and carbosulfan (1:18.29).

**Key word**s : Cotton mealy bug, *Phenacoccus solenopsis*, insecticides

## Introduction

The mealy bug, *Phenacoccus solenopsis* Tinsley (Pseudococcidae : Hemiptera) has been observed damaging cotton crop very seriously from 2004-05 in Gujarat (Jhala *et al*. 2008). Presently, this pest has attained national significance. In 2005 and 2006 it has caused heavy loss in Gujarat itself and later in Punjab and Haryana. Being a polyphagous pest, it is found to feed on number of cultivated and other crops including weeds (Patel *et al.* 2009). *P. solenopsis* has been considered as an emerging pest in many cotton ecosystems especially in *Bt* cotton and therefore suitable management strategies have to be developed. Use of insecticides is one of the integral part in its management. Many insecticides with diverse mode of action are available in market. Evaluation of insecticides for their efficacy against a particular insect pest is therefore essential. With this intense, the present study on evaluation of bio-efficacy of some insecticides against mealy bug, *P. solenopsis* was carried out and the results obtained are presented here.

## Materials and methods

The bioefficacy of selected insecticides against mealy bug, *P. solenopsis,* was assessed through a laboratory as well as field studies at Biocontrol Research Laboratory and Agronomy farm, B. A. College of Agriculture, Anand during 2006-07. For the purpose of laboratory study, fresh tender cotton leaves were collected from unsprayed cotton fields and washed thoroughly with distilled water. The petiole of each leaf was wrapped with wet cotton wool to keep the leaves turgid for longer period. Such leaves were placed individually in petridish (9.0 ×1.0 cm). Nine insecticides (at field recommended concentration) and water spray as control treatment were replicated thrice. The spray was achieved through hand atomizer till drift. Then the treated leaves were dried under fan at room temperature. Ten healthy laboratory reared third instar nymphs of *P. solenopsis* were released on each treated leaf for enforced feeding. Mortalities of nymphs were recorded at 24, 48 and 72 hours after release. The mortality (Table 1) data thus obtained were corrected with respect to control mortality analysis applying Abbott's formula (Abbott, 1925).

The field experiment was carried out during *Kharif* 2007 with same treatments replicated thrice to fit into randomized block design. Seeds of Hybrid – 10 a conventional cotton variety were sown during last week of June at a spacing of 90 cm × 60 cm. Gross and net plot size was 5.4 × 4.8 $m^2$ and 2.7 × 3.6 $m^2$, respectively. All the recommended agronomical practices, except insecticidal sprays were followed for raising the healthy crop. Insecticidal treatments were imposed twice *i.e.* first spray at 130 days after sowing when the mealy bug population appeared in cotton crop and second spray was applied at 40 days after first spray with reappearance of mealy bugs in field. The spraying was done with the help of knapsack sprayer having duromist nozzle with a spray fluid of 700 to 750 lit/ha.

The observations for mealy bugs were made from three (upper, middle and bottom) leaves at top one third portion of the randomly selected tagged five plants. Population at lower side of leaf only was considered for observations. Such observations were made prior as well as 1, 3, 5 and 7 days after each spray. Then the data were converted to mean per cent mortality (Henderson and Tilton, 1955) and presented in Table 2 along

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with yield for bioefficacy comparison. Economics (Table 3) of different insecticides used in present study were also calculated based on the cost of plant protection and net gain over untreated check.

**Results and discussion**

Bioefficacy of different synthetic insecticides evaluated against mealy bug, *P. solenopsis* in laboratory conditions revealed that the treatment of profenophos (0.05 %) found to be significantly superior over rest of the treatments (69.36 % mortality) at 24 hours after treatment (Table 1). Triazophos (0.04%) and carbaryl (0.2 %) found to next in the order of efficacy both being equally effective. Endosulfan (0.07 %), cypermethrin + ethion (0.045 %) and quinalphos (0.05 %) proved less effective with only 35.41 to 40.01 % mortality. Similar trend of effectiveness was observed at 48 hours after treatment also. Profenophos maintained its superiority even at 72 hours after spray by registering significantly highest (92.74 %) mortality of *P. solenopsis* over rest of the treatments. Triazophos (84.82 % mortality) proved to be next best to profenophos and differed significantly from remaining treatments. Carbaryl (0.2%) and carbosulfan (0.025%) could also show considerable performance against *P. solenopsis* through 75.41 to 77.44% mortality. Endosulfan (0.07%) and quinalphos (0.05%) remained to be less effective, whereas the treatment of cypermethrin + ethion (0.045%), thiodicarb (0.3%) and methomyl (0.04%) found to mediocre in their effectiveness to mealy bug. The mean mortality of mealy bug achieved through different insecticides was 82.32 % (profenophos) and 73.67 % (triazophos) as most significant treatments.

In field study the population of *P. solenopsis* influenced by first spray revealed (Table 2) maximum (89.77%) mortality of the pest in plots treated with profenophos (0.05%) followed by triazophos (85.97%) and carbaryl (84.00). These three treatments proved significantly superior over rest of the insecticides evaluated. Quinalphos (0.05%) and thiodicarb (0.3%) found to be less effective for mealy bugs as they could register significantly lower (60.82 to 63.43%) mortality. Similar trend of bioefficacy was noticed during second spray. The pooled results computed for both the sprays could clearly show most significant effect of profenophos over rest of the treatments with 90.54% mortality of *P. solenopsis.* Triazophos (0.04%) also found to be better following profenophos. Carbaryl and carbosulfan were equally effective and registered 80.55 to 82.10 % mortality. Quinalphos and thiodicarb remained inferior in controlling the mealy bug population. Endosulfan, methomyl and cypermethrin + ethion found intermediate in their action and these treatments differed statistically to each other. The incidence in control plot was in the range of 25 to 30 mealy bugs per leaf. From bioefficacy results obtained from the laboratory as well as field study, it could be concluded that the profenophos, triazophos and carbaryl found to be effective against *P. solenopsis.* In past, the effectiveness of carbaryl (0.05%) against *Phenacoccus insolitus* on egg plant has been reported by Bhatti *et al.* (1975). Profenophos (0.05%) and triazophos (0.05%) have rendered higher mortality of *Ferrisia virgata* Cockerell compared to many

Table 1. Bio-efficacy of selected insecticides against cotton mealybug, *P. solenopsis* in laboratory

| Treatments | Mortality (%) at hrs after treatment | | | Mean |
|---|---|---|---|---|
| | 24 hrs | 48 hrs | 72 hrs | |
| Endosulfan (Thiodan) | 35.41 | 46.63 | 53.64 | 45.16 |
| 35 EC 0.07% (2ml/L) | (36.52)* | (43.07) | (47.09) | (42.22) |
| Carbosulfan (Marshal) | 54.32 | 69.50 | 77.44 | 67.43 |
| 25 EC 0.025% (1ml/L) | (47.48) | (56.48) | (61.64) | (55.20) |
| Cypermethrin + Ethion(Nagata) | 37.97 | 51.57 | 64.74 | 51.47 |
| 45 EC 0.045% (1ml/L) | (38.04) | (45.90) | (53.57) | (45.84) |
| Quinalphos (Ekalux) | 40.01 | 48.20 | 57.11 | 48.43 |
| 25 EC 0.05% (2ml/L) | (39.24) | (43.97) | (49.09) | (44.10) |
| Triazophos (Hostathion) | 61.32 | 73.15 | 84.82 | 73.67 |
| 40 EC 0.04% (1ml/L) | (51.54) | (58.79) | (67.07) | (59.13) |
| Carbaryl (Sevin) | 58.77 | 70.80 | 75.41 | 68.52 |
| 50WP 0.2% (4g/L) | (50.05) | (57.29) | (60.27) | (55.87) |
| Methomyl (Lannate) | 49.65 | 59.03 | 67.00 | 58.65 |
| 40 SP 0.04% (1g/L) | (44.80) | (50.20) | (54.94) | (49.98) |
| Profenophos (Curacrone) | 69.36 | 81.76 | 92.74 | 82.32 |
| 50 EC 0.05% (1ml/L) | (56.39) | (64.72) | (74.37) | (65.16) |
| Thiodicarb (Larvin) | 45.05 | 56.23 | 67.20 | 56.27 |
| 75 WP 0.3% (4g/L) | (42.16) | (48.58) | (55.06) | (48.60) |
| S. Em + | 1.03 | 1.61 | 1.75 | 0.75 |
| CD at 5% | 3.06 | 4.77 | 5.20 | 2.20 |
| C. V. (%) | 3.96 | 5.34 | 5.21 | 5.30 |

* Figures in parenthesis are arc sine transformed values.

Table 2. Effect of different insecticides on mealybug, *P. solenopsis* in field and yield of seed cotton

| Treatments | *Mean % mortality (Spray) | | Pooled | Yield (kg / ha) |
|---|---|---|---|---|
| | First | Second | | |
| Endosulfan (Thiodan) | 68.78 | 71.16 | 69.99 | 1901 |
| 35 EC 0.07% (2ml/L) | (56.03)** | (57.52) | (56.78) | |
| Carbosulfan (Marshal) | 80.17 | 80.91 | 80.55 | 2617 |
| 25 EC 0.025% (1ml/L) | (63.56) | (64.09) | (63.83) | |
| Cypermethrin + Ethion (Nagata) | 77.42 | 76.58 | 77.00 | 2118 |
| 45 EC 0.045% (1ml/L) | (61.63) | (61.06) | (61.34) | |
| Quinalphos (Ekalux) | 60.82 | 63.09 | 61.96 | 1941 |
| 25 EC 0.05% (2ml/L) | (51.25) | (52.59) | (51.92) | |
| Triazophos (Hostathion) | 85.97 | 87.13 | 86.56 | 2679 |
| 40 EC 0.04% (1ml/L) | (68.00) | (68.98) | (68.49) | |
| Carbaryl (Sevin) | 84.00 | 80.10 | 82.10 | 2644 |
| 50WP 0.2% (4g/L) | (66.42) | (63.51) | (64.97) | |
| Methomyl (Lannate) | 74.85 | 71.45 | 73.16 | 2353 |
| 40 SP 0.04% (1g/L) | (59.90) | (57.70) | (58.80) | |
| Profenophos (Curacrone) | 89.77 | 91.29 | 90.54 | 2759 |
| 50 EC 0.05% (1ml/L) | (71.35) | (72.83) | (72.09) | |
| Thiodicarb (Larvin) | 63.43 | 64.90 | 64.17 | 2257 |
| 75 WP 0.3% (4g/L) | (52.79) | (53.67) | (53.23) | |
| Control (Water spray) | - | - | - | 1631 |
| S. Em + | 0.82 | 0.83 | 0.58 | 36.17 |
| CD at 5% | 2.46 | 2.49 | 1.69 | 107.47 |
| C. V. (%) | 6.12 | 4.79 | 5.50 | 2.74 |

* Mean of four observations

** Figures in parenthesis are arc sine retransformed values.

other insecticides tested in laboratory (Atodaria, 1998). Similarly Shafqat Saeed *et al.* (2007) reported profenophos 50 EC as best insecticide in laboratory condition, whereas methomyl 40 SP and profenophos 50 EC proved effective against mealy bug *Phenacoccus gossypiphilous* a new pest of cotton in Pakistan. Jhala *et al.* (2008) from Gujarat also reported the effectiveness of the carbaryl 0.2% and profenophos 0.1% against *P. solenopsis* on cotton. All these reports are in agreement with the above discussed results.

Data (Table 2) on seed cotton yield revealed that all the insecticidal treatments yielded significantly higher yield over untreated check. Plots treated with profenophos (0.05%) registered significantly highest (2759 kg/ha) yield than rest of the treatments evaluated, except triazophos, carbaryl and

Table 3. Economics of different treatments evaluated against *P. solenopsis* on cotton

| Sl. No. | Treatments | Cost of insecticides (Rs/L or Kg) | Total quantity of insecticides required (L or Kg/ha) | Total cost of plant protection (Rs/ha) | Yield (kg/ha) | Net gain over control (Kg/ha) | Realization over control (Rs/ha) | ICBR | NICBR |
|---|---|---|---|---|---|---|---|---|---|
| 1 | Endosulfan 0.07% | 285 | 2.8 | 1398 | 1901 | 270 | 7425 | 1: 5.31 | 1: 4.31 |
| 2 | Carbosulfan 0.025% | 630 | 1.4 | 1482 | 2617 | 986 | 27115 | 1: 18.29 | 1: 17.29 |
| 3 | Cypermethrin + Ethion 0.045% | 400 | 1.4 | 1160 | 2118 | 487 | 13392 | 1: 11.54 | 1: 10.54 |
| 4 | Quinalphos 0.05% | 400 | 2.8 | 1720 | 1942 | 311 | 8552 | 1: 4.97 | 1: 3.97 |
| 5 | Triazophos 0.04% | 521 | 1.4 | 1329 | 2680 | 1049 | 28847 | 1: 21.70 | 1: 20.70 |
| 6 | Carbaryl 0.2% | 424 | 5.6 | 2974 | 2644 | 1013 | 27857 | 1: 9.36 | 1: 8.36 |
| 7 | Methomyl 0.04% | 1100 | 1.4 | 2140 | 2353 | 722 | 19855 | 1: 9.27 | 1: 8.27 |
| 8 | Profenophos 0.05% | 760 | 1.4 | 1664 | 2759 | 1128 | 31020 | 1: 18.64 | 1:17.64 |
| 9 | Thiodicarb 0.3% | 1900 | 5.6 | 11240 | 2257 | 626 | 17215 | 1: 1.53 | 1: 0.53 |
| 10 | Control | - | | | 1631 | - | - | - | - |

carbosulfan. Latter three treatments also produced better yield (2617 to 2679 kg/ha) and were statistically at par. Endosulfan treated plots produced significantly least (1901 kg/ha) yield followed by quinalphos (1941 kg/ha) as they were inferior in controlling mealy bug incidence. The treatments of methomyl and thiodicarb found to be mediocre in its performance.

Economics of various insecticidal treatments evaluated under present study (Table 3) revealed that maximum (1: 21.70) Incremental Cost Benefit Ratio was found in the treatment of triazophos followed by profenophos (1:18.64) and carbosulfan (1:18.29). The treatment of cypermethrin + ethion, carbaryl and methomyl registered ICBR ranging from 1:9.37 to 1:11.54. On the other hand minimum (1:1.53) ICBR was calculated in the treatment of thiodicarb followed by quinalphos (1:4.97) and endosulfan (1:5.31). The economics of different insecticidal treatments against *P. solenopsis* has not been reported in available literature and hence the present finding lack comparison. However, profenophos, chlorpyriphos etc. insecticides have been used largely in Punjab and Haryana recently to combat outbreak of *P. solenopsis* successfully. The field and laboratory results from present study could conveniently be validated on large scale bases. The conservation of natural enemy complex prevailing in field could not be ignored while extended these results as recommendations.

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