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# Effect of insecticides on the post-embryonic development in *Rhynocoris marginatus* (Fabricius) (Heteroptera: Reduviidae)

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**ABSTRACT: The effect of sub-lethal concentrations of monocrotophos, dimethoate, methyl parathion, quinalphos and endosulfan in the post-embryonic developmental characteristics *viz.* stadial period, body weight, fecundity and longevity of *Rhynocoris marginatus* (Fabricius) was studied. All the insecticides except endosulfan increased stadial period, decreased body weight, fecundity and longevity.**

**KEY WORDS**: Insecticides, post-embryonic development, *Rhynocoris marginatus, sub-lethal* concentration

*Rhynocoris marginatus* (Fabricius) is a reduviid predator of various economically important insect pests, such as *Anomis flava* Fabricius, *Achaea janata* Linnaeus, *Helicoverpa armigera* (Hübner), *Spodoptera litura* Fabricius, and *Mylabris pustulata* Thunberg (Prabakar, 1994; Sahayaraj, 1994). These predators occur in diverse habitats in agroecosystems and are being exposed to insecticides that are used to control insect pests. Although, insecticides are evaluated for their control potential against particular insect pests, their effects on biology and physiology of non-target beneficial insects like reduviids are neglected. This prompted the authors to study the effect of sub-lethal concentrations of the commonly used insecticides namely monocrotophos, dimethoate, methyl parathion, quinalphos and endosulfan in cotton agroecosystem on the post embryonic development of the reduviid predator *R. marginatus*.

## MATERIALS AND METHODS

Adults of *R. marginatus* were maintained in laboratory at Entomology Research Unit, St. Xavier's College, Palayankottai from January 1994 to December 1996 in plastic containers (80 ml) at 30 ± 2° C, relative humidity

ranging from 75-80 per cent and photoperiod between 11-13h on C. *cephalonica*. Preliminary studies were conducted with each insecticide to find out $LC_{50}$ for III instar nymphs for 48h duration and 1/10 values of the 48h. $LC_{50}$ of each insecticide was considered as sub-lethal concentration. They were 0.002, 0.041, 0.0009, 0.0044 and 0.0123 per cent for monocrotophos, dimethoate, methyl parathion, quinalphos and endosulfan, respectively. Cotton leaves were cut to the size of containers (5x5 cm) and the sub-lethal concentration of each insecticide was sprayed over such cut leaves, separately using hand sprayer. Sprayed leaves were dried for about 10 minutes under ceiling fan and placed over moist paper to keep them turgid in fresh container. Three such leaves were placed inside each container with the ventral surface of leaves facing upward (Nagia *et al.*, 1990). Fifteen III instar nymphs were exposed to the sub-lethal dosage of each insecticide, separately.

A control set up was maintained with fifteen III instar nymphs and they were exposed to water sprayed cotton leaves. The experimental as well as control individuals were maintained at room temperature ($29 \pm 1^{\circ}$ C). The concentration of the insecticide was maintained continuously for 20 days. Each day the insecticide sprayed leaves were replaced with fresh insecticide sprayed leaves. Insecticides exposed categories of nymphs were reared up to adult. Stadial period and body weight of the test IV and V instar nymphs and adults were recorded. All the variations caused by the insecticides in stadial period and weight were first analyzed by one way analysis of variance (SAS Institute, 1988) to determine if differences existed among treatment means. When significant differences among treatment means were found, the differences between individual treatment means were tested by Tukey's multiple range comparison test (Tukey, 1953). Statistical significance was determined by setting the aggregate type I error at $P< 0.05$ for each set of comparisons.

Four sub-lethal concentrations of each insecticide were tested to understand the effect of insecticides on the longevity and the fecundity. Since any concentration higher than 1/10 of the 48h $LC_{50}$ caused mortality in prolonged exposure, adult 96h $LC_{50}$ concentration was considered as one toxic unit and 1/3, 1/6, 1/9 and 1/12 of the 96h $LC_{50}$ concentrations as sub-lethal.

Adult males and females aged below 10 days were selected from the laboratory culture. Sixty such adult predators with equal number of males and females were used for each insecticide. Fifteen adult predators were also maintained as control. Insecticide exposure was carried out as described earlier for 20 days. Males and females of each experimental category and control were paired and monitored to record fecundity. The total number of eggs laid by a female during its life span, and longevity were recorded. Data were subjected to Students 't' test to find out the effect of insecticides.

## RESULTS AND DISCUSSION

The effect of the sub-lethal concentrations of five insecticides on stadial period of *R. marginatus* is given in Table 1. The III stadium was extended from 7.40±0.21 days (control) to 8.94±0.25 (monocrotophos), 8.07± 0.21 (dimethoate), 9.2 ± 0.2 (methyl parathion) and 8.0±0.17 (quinalphos) days. But endosulfan reduced the stadium (7.25± 0.13 days). All the insecticides had extended the period of IV and V stadium. Methyl parathion had the highest effect followed by monocrotophos, quinalphos, dimethoate and endosulfan. Conney *et al.* (1966) reported insecticidal blocking of hydroxylation process that might have reduced the hormone level necessary for moulting. Ouye and Knutson (1957) also reported that malathion delayed emergence of house flies pupae.

The effect of insecticides on body weight of IV and V instar nymphs and adult is presented in Table 2. All the insecticides except endosulfan reduced body weight of the IV and V instar nymphs and adults. Methyl parathion caused the highest reduction in body weight from 38.33±1.98, 90.83±2.82 and 143.67±11.30mg to 32.33±1.28, 77.50±1.99 and 129.83±8.99 mg in IV and V instars and adults, respectively. Javid and All (1984) reported impairment of respiration and metabolic processes that are reversible with time, as the possible reasons for weight loss. Morrison and Brown (1954) attributed such reduction in body weight to inhibition of cytochrome oxidase. O'Brien (1957) reported some inhibition of glycolytic and tricarboxylic metabolic pathways for reduction of body weight in cockroach.

Table 1. Effect of sub-lethal concentration of insecticides on the stadial period of *R. marginatus*

| Insecticide | Stadial period (days) | | | |
|---|---|---|---|---|
| | III-IV | IV-V | V (male) | V (female) |
| Control | 7.40 ± 0.34$^{bc}$ | 12.91 ± 0.48$^{bcd}$ | 45.60 ± 1.36$^{ac}$ | 49.33 ± 3.10$^{ac}$ |
| Monocrotophos | 8.94 ± 0.25$^{a}$ | 14.71 ± 0.24$^{ab}$ | 49.67 ± 1.43$^{a}$ | 54.13 ± 1.65$^{a}$ |
| Dimethoate | 8.07 ± 0.21$^{ab}$ | 14.00 ± 0.33$^{ad}$ | 47.00 ± 1.79$^{ab}$ | 51.67 ± 1.87$^{a}$ |
| Methyl parathion | 9.20 ± 0.20$^{a}$ | 15.17 ± 0.32$^{a}$ | 51.51 ± 1.25$^{a}$ | 54.60 ± 0.93$^{a}$ |
| Quinalphos | 8.00 ± 0.17$^{ab}$ | 14.17 ± 0.27$^{ac}$ | 48.40 ± 1.29$^{a}$ | 50.14 ± 0.96$^{ab}$ |
| Endosulfan | 7.25 ± 0.13$^{bc}$ | 12.67 ± 0.28$^{cd}$ | 40.57 ± 0.61$^{bc}$ | 43.40 ± 1.99$^{bc}$ |

Means with same alphabet in a column are not significantly different at P<0.05 by Tukey test

Table 2. Effect of sub-lethal concentrations of insecticides on body weight of *R. marginatus*

| Insecticide | Body weight (mg) | | |
|---|---|---|---|
| | IV instar | V instar | Adult |
| Control | $38.33 \pm 1.98^{ab}$ | $90.83 \pm 2.82^{ac}$ | $143.67 \pm 11.30^{a}$ |
| Monocrotophos | $36.67 \pm 2.11^{ad}$ | $82.00 \pm 2.73^{bcd}$ | $134.17 \pm 8.79^{a}$ |
| Dimethoate | $37.83 \pm 1.66^{ac}$ | $89.00 \pm 2.68^{ac}$ | $142.83 \pm 11.15^{a}$ |
| Methyl parathion | $32.33 \pm 1.28^{bcd}$ | $77.50 \pm 1.99^{d}$ | $129.83 \pm 8.99^{a}$ |
| Quinalphos | $36.33 \pm 1.45^{ad}$ | $85.33 \pm 2.29^{ad}$ | $141.17 \pm 9.78^{a}$ |
| Endosulfan | $40.50 \pm 1.65^{a}$ | $93.17 \pm 1.92^{a}$ | $146.17 \pm 10.72^{a}$ |

Means with same alphabet in a column are not significantly different at $P<0.05$ by Tukey test

Table 3 presents the variations caused by sub-lethal concentrations of different insecticides on fecundity and longevity in *R. marginatus*. All the insecticides except endosulfan negatively affected fecundity. The highest tested concentration of methyl parathion caused maximum reduction in fecundity (from 175.17± 10.11 in control to 74.0 ± 4.27). The reduced fecundity might be due to inhibition in food intake. Khowaja *et al.* (1994) reported similar reduced egg output in *D. cingulatus* by monocrotophos.

Methyl parathion, monocrotophos, dimethoate and quinalphos reduced longevity whereas endosulfan increased the same. Methyl parathion (highest concentration) caused maximum reduction in male and female longevity from 130.0 ± 6.66 and 125.67 ± 7.39 days (in control) to 76.17 ± 4.64 and 79.0 ± 3.56 days, respectively. Endosulfan enhanced male and female longevity to 162.33 ± 11.57 and 146.83 ± 13.01 days, respectively. Increased respiration and release of a paralysis inducing stress factor by the insecticides may account for the decrease in longevity. Lucky (1968) explained this phenomenon through 'hormoligosis hypothesis'. Similar observations were made on German cockroachs by Haynes (1988), Hamilton and Schal (1990), and Abd-Elghafar and Appel (1992).

These studies suggest that the commonly used insecticides namely monocrotophos, dimthoate, methyl parathion, quinalphos and endosulfan in the agroecosystems could affect stadial body weight, fecundity and longevity of the non-target predator *R. marginatus*.

Table 3. Effect of sub-lethal concentrations of insecticides on fecundity and longevity of *R. marginatus*

| Insecticide | Concentration (%) | No. of eggs laid | Longevity (days) | |
|---|---|---|---|---|
| | | | Male | Female |
| Control | - | 175.17 ± 10.11 | 130.00 ± 6.66 | 125.67 ± 7.39 |
| Monocrotophos | 0.0160 | 99.50 ± 3.25*** | 89.00 ± 6.94*** | 81.17 ± 7.21 ** |
| | 0.0080 | 99.83 ± 3.74 * | 95.83 ± 6.42*** | 89.33 ± 5.41 ** |
| | 0.0053 | 99.83 ± 3.74 * | 100.50 ± 6.81*** | 94.67 ± 5.41 ** |
| | 0.0040 | 103.33 ± 5.81 * | 110.33 ± 8.44*** | 101.33 ± 6.44*** |
| Dimethoate | 0.0283 | 121.17 ± 6.89 ** | 117.00 ± 6.35*** | 120.50 ± 4.66 ** |
| | 0.0142 | 125.83 ± 6.86 ** | 121.17 ± 6.06*** | 123.33 ± 4.89 * |
| | 0.0094 | 129.83 ± 9.50*** | 126.67 ± 5.40*** | 128.17 ± 5.60 ** |
| | 0.0071 | 132.50 ± 10.64*** | 129.17 ± 5.39*** | 129.67 ± 4.68 ** |
| Methyl parathion | 0.0037 | 74.00 ± 4.27*** | 76.17 ± 4.64*** | 79.00 ± 3.56*** |
| | 0.0018 | 84.17 ± 5.04 ** | 81.50 ± 4.63*** | 77.00 ± 3.61*** |
| | 0.0012 | 87.17 ± 4.11*** | 89.50 ± 3.78*** | 86.50 ± 3.38 ** |
| | 0.0009 | 91.67 ± 3.42*** | 92.33 ± 3.82*** | 90.17 ± 4.43*** |
| Quinalphos | 0.0273 | 103.00 ± 5.89*** | 104.00 ± 5.73*** | 99.50 ± 7.03 ** |
| | 0.0137 | 106.17 ± 7.07 | 109.00 ± 7.64*** | 98.50 ± 6.72 ** |
| | 0.0091 | 108.67 ± 7.59 ** | 113.67 ± 5.55 ** | 107.00 ± 6.76 * |
| | 0.0068 | 114.50 ± 4.38*** | 117.33 ± 5.96 * | 107.83 ± 6.47 ** |
| Endosulfan | 0.0630 | 142.50 ± 8.66 | 162.33 ±11.57*** | 146.83 ± 13.01 * |
| | 0.0315 | 153.83 ±13.87 ** | 147.83 ± 9.40 * | 139.17 ± 8.61 ** |
| | 0.0210 | 157.00 ± 9.77*** | 139.67 ± 6.28*** | 134.17 ± 4.88 ** |
| | 0.0158 | 161.33 ±11.09*** | 137.17 ± 5.28 ** | 133.17 ± 7.71*** |

Significance is shown at 5%*, 1%** and 0.1%*** levels of probability

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