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Relative Safety of Buprofezin and Insecticides to *Encarsia shafeei* a Parasite of Cotton Whitefly *Bemisia tabaci* Genn.*

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ABSTRACT

The chitin synthesis inhibitors, buprofezin and diflubenzuron were tested for their safety in comparison with the insecticides *viz.*, phosalone (0.08%), triazophos (0.08%), monocrotophos (0.07%) and endosulfan (0.07%) against *Encarsia shafeei* Hayat, a parasite of *Bemisia tabaci* Genn. Buprofezin and diflubenzuron were safe to the adult parasites even at a high dose of 0.1%. When the parasite larvae were exposed to the treatments, buprofezin suppressed the adult emergence at high concentrations of 0.05 and 0.1%. Invariably, all the insecticides were toxic to the larvae and adults of parasite. Considering the extent of toxicity to adult parasites, phosalone was less toxic than the other insecticides. Against immature stage of the parasite, endosulfan, phosalone and monocrotophos were equally toxic. Triazophos was highly detrimental to both adult as well as immature stages of the parasite.

KEY WORDS : Buprofezin, diflubenzuron, *Encarsia shafeei*, *Bemisia tabaci*, phosalone, endosulfan, triazophos, monocrotophos

In India, in the recent years, the whitefly *Bemisia tabaci* (Genn.) attained the status of a very serious pest, and several reasons have been attributed for the outbreaks. There is need for target-specific insecticides, which will harmoniously fit into the integrated pest management programme. The natural enemies especially the aphelinid parasites, play an important role in the suppression of *B.tabaci* population. Beevi *et al.* (1987) reported remarkable parasite activity by the Aphelinids, *Encarsia shafeei* Hayat and *Eretmocerus mundus* Merect that extended up to a maximum of 88 per cent on *B.tabaci* on brinjal. A maximum parasitism of 85 per cent by *Encarsia* sp. and *Eretmocerus* sp. in cotton fields during 1984 in Guntur has also been reported (Natarajan *et al.*, 1986). Various workers have reported a decline in parasitism following insecticidal application in cotton (Sharaf, 1982; Bindra *et al.*, 1983; Gerling, 1986).

A new insect growth regulator, buprofezin (2-tert-butylimino-3-isopropyl-5 phenyl 3-4, 5,6 tetrahydro 2-H 1, 3,5 - thiadiazin -4- one) is reported to be highly selective against homopteran pests and has high larvicidal activity against the whiteflies *Trialeurodes vaporariorum* (Westwood) and *B.tabaci* (Naba *et al.*, 1983; Yasui *et al.*, 1985; 1987; Ishaaya *et al.*, 1988, 1989). In an earlier study, buprofezin was found highly effective against nymphs of *B.tabaci* in glass house tests on cotton (Beevi and Balasubramanian, 1988). Hence, studies were undertaken to assess the relative safety of buprofezin to the parasite *E.shafeei* in comparison with other insecticides which are in use in cotton ecosystem.

MATERIALS AND METHODS

The effect of buprofezin, diflubenzuron and the insecticides *viz.*, phosalone, triazophos, monocrotophos and endosulfan to

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E.shafeei, a parasite of *B.tabaci* was evaluated by exposing the adults and larvae of the parasite to different concentrations of test chemicals. Toxicity of pesticides to the adult parasite was tested by dry film technique (Wilkinson *et al.*, 1975). Monocrotophos 0.07%, phosalone 0.08%, endosulfan 0.07%, triazophos 0.08% and buprofezin at various concentrations from 0.01 to 0.1 per cent and diflubenzuron at 0.05 and 0.1 per cent were used. Filter paper strips (7 x 2.5 cm) were dipped in the pesticide solutions and air - dried for 20 min. An untreated check was maintained by dipping the filter paper in distilled water. A self adhesive paper (4 x 1 cm) was affixed inside the glass tube (10 x 3 cm) and honey droplets were placed. Filter paper soaked in insecticide solution was then introduced into glass tubes. Ten freshly emerged adult parasitoids were introduced into each glass tube and the open end was closed with muslin cloth. Each treatment was replicated thrice. Mortality of the parasites was recorded at one, two, four, five, six and 24 h of exposure and per cent mortality worked out.

Third instar *B.tabaci* nymphs on forty five day-old cotton seedlings raised in plastic cups were exposed to the parasite in rearing cage and allowed for oviposition for 24 h. On the 5th day of oviposition, the parasitised nymphs were exposed to insecticides by dipping the leaves in the supension for 20 seconds. Before the treatment, the initial count of parasitised nymphs was recorded. The treated plants were covered with a mylar film cage (30 x 10 cm) and observed for emergence of adult parasites. The pupal cases with round emergence holes were counted for number of adults emerged and calculated the percentage. The entire study was carried out in the glass house at 28 ± 2° and 65 ± 10% RH. The percentage values were transformed into corresponding angles (arc sin $\sqrt{\text{percentage}}$) for statistical analysis.

RESULTS AND DISCUSSION

The susceptibility of adult parasites to the residual contact toxicity of different pesticides varied significantly. The insect chitin synthesis inhibitor diflubenzuron (0.1%) was found to be safe and no significant difference in mortality was observed as compared to control even after 24 h of adult exposure. No adverse effect was noticed in the case of buprofezin for the first 6 h. In 24 h, the mortality was 16.67 and 13.33 per cent at 0.1 and 0.05 per cent buprofezin as compared to 10 per cent mortality in untreated (Table 1). Among the insecticides tested, triazophos was highly toxic and caused 60 per cent mortality within one h of exposure and complete mortalilty after 4 h of exposure. Endosulfan caused 46.67 per cent mortality within one h and 96.67 per cent by six h of exposure. Phosalone was found to be least toxic to the adult parasites. The mortality data over different periods indicated a significant variation in toxicity among the different insecticides and the order of safety is diflubenzuron > buprofezin > phosalone > monocrotophos > endosulfan > triazophos.

The parasite emergence was not adversely affected by buprofezin at lower concentrations of 0.01 and 0.02% and diflubenzuron at 0.1 and 0.05 per cent when the immature stage of the parasite was exposed. At higher concentrations of 0.03, 0.05 and 0.1 per cent buprofezin, the adult emergence was significantly reduced to 80.37, 72.37 and 71.41 per cent respectively as compared to 96.59 in control 14 days after treatment. Triazophos was highly toxic to the parasite larvae as there was only 4.75 per cent adult emergence. The other insecticides were all on par and the mortality ranged from 58.33 to 62.27% (Table 2). The overall mean values indicate that phosalone, monocrotophos and endosulfan were comparable with buprofezin 0.05 and 0.1 per cent in terms of their toxicity to the parasite larvae.

Diflubenzuron was reported to be safer to the natural enemies (Brown and Respico, 1981; Purcell and Granett, 1985). Diflubenzuron acts primarily as a stomach rather than a contact poison without any systemic activity (Mulder and Gijswijit, 1973). This may be the reason for the high degree of safety of diflubenzuron to *E.shafeei*.

Table 1. Effect of buprofezin and insecticides on adults of *Encarsia shafeei* (Means of three observations)

Insecticides	Conc. (%)	Percentage mortality						Mean
		Duration of exposure (h)						
		1	2	4	5	6	24	
Phosalone	0.08	26.67 (30.99)	36.67 (37.22)	63.33 (52.78)	76.67 (61.22)	93.33 (77.71)	93.33 (77.71)	65.00 (56.27)
Triazophos	0.08	60.00 (50.77)	76.67 (61.22)	100.00 (90.00)	100.00 (90.00)	100.00 (90.00)	100.00 (90.00)	89.45 (78.67)
Monocrotophos	0.07	36.67 (37.22)	53.33 (46.92)	60.00 (50.85)	86.66 (68.85)	90.00 (71.56)	96.67 (83.85)	70.55 (59.88)
Endosulfan	0.07	46.67 (43.08)	76.67 (61.22)	76.67 (61.22)	86.66 (68.85)	96.67 (83.85)	96.67 (83.85)	80.00 (67.01)
Buprofezin	0.10	0.01 (0.57)	0.01 (0.57)	0.01 (0.57)	0.01 (0.57)	3.31 (6.15)	16.67 (23.85)	3.34 (5.38)
Buprofezin	0.05	0.01 (0.57)	0.01 (0.57)	0.01 (0.57)	0.01 (0.57)	3.31 (6.15)	13.33 (21.15)	2.78 (4.93)
Diflubenzuron	0.10	0.01 (0.57)	0.01 (0.57)	0.01 (0.57)	3.31 (6.15)	3.31 (6.15)	10.00 (18.44)	2.78 (5.40)
Control	0	0.01 (0.57)	0.01 (0.57)	0.01 (0.57)	0.01 (0.57)	6.67 (12.29)	10.00 (18.44)	2.79 (5.50)
	Mean	21.26 (20.54)	30.42 (26.11)	37.51 (32.14)	44.17 (37.15)	49.59 (44.80)	54.58 (52.16)	39.59 (35.38)

Figures in parentheses are values of arcsin $\sqrt{p}$

C.D. (P = 0.05) for periods = 3.04
" treatments = 3.51
" interaction = 8.60

From the biochemical studies conducted with buprofezin - treated insects, the exact mechanism responsible for mortality of larvae was identifed as the strong inhibition of chitin synthesis from N- acetyl glucosamine (Izawa *et al.*, 1985; Uchida *et al.*, 1985). Hence buprofezin is lacking the direct killing action on the adult insects (Heinrichs *et al.*, 1984; Yasui *et al.*, 1985). This may be the reason for its high level of safety to adults of *E.shafeei*. Buprofezin was found to be an effective contact poison against the sucking insects and it lacks any systemic or translaminar activity (Anon., 1983; Beevi and Balasubramanian, 1988). A slight reduction of parasite emergence from treated - parasitised nymphs may be as a consequence of its toxic effect on *B.tabaci* nymphs due to its exposure in the early stage.

The adverse effect of several commonly used insecticides on the biotic agent of *B.tabaci* is well established. Many organophosphorus and synthetic pyrethroids were highly toxic to the bioagents of *B.tabaci* (Sharaf, 1982) and affected the regulatory capability of the biological agents of whitefly such as *Eretmocerus* sp. and *Encarsia* sp. (Mayerdirk *et al.*, 1986). The predator and parasite activity were not noticed by Reddy *et al.* (1986) in Andhra Pradesh who attributed this to the high insecticidal pressure applied throughout the crop growth. Among the insecticides tested, phosalone was found to be the least toxic. The relatively low level of toxicity of phosalone to the adults of *Encarsia (= Prospaltella) perniciosi* was reported by Masoodi *et al.* (1987). Since the field control of *B.tabaci* could be achieved with 0.02% buprofezin (Beevi and Balasubramanian, 1988) without any adverse effect on early stage of the parasites, buprofezin would form

Table 2. Effect of buprofezin and insecticides on *Encarsia shafeei* larvae

Insecticides	Conc. (%)	Cumulative per cent emergence on day		Mean
		10	14	
Phosalone	0.08	42.43 (40.64)	62.27 (52.11)	52.35 (46.38)
Triazophos	0.08	1.05 (3.76)	4.75 (10.51)	2.90 (7.14)
Monocrotophos	0.07	27.33 (31.41)	58.33 (49.80)	42.83 (40.61)
Endosulfan	0.07	28.25 (31.98)	59.22 (50.37)	43.73 (41.17)
Diflubenzuron	0.10	28.59 (32.15)	96.15 (78.72)	62.37 (55.44)
"	0.05	37.74 (37.89)	96.80 (80.13)	67.27 (59.01)
Buprofezin	0.10	26.93 (31.26)	71.41 (57.67)	49.17 (44.47)
"	0.05	29.54 (32.84)	72.37 (58.31)	50.96 (45.58)
"	0.03	38.91 38.45)	80.37 63.74)	59.64 (51.10)
"	0.02	40.44 (39.50)	90.63 (72.44)	65.54 (55.98)
"	0.01	42.58 (40.71)	95.09 (78.02)	68.84 (59.37)
Control	0	32.54 (34.77)	96.59 (79.81)	64.57 (57.29)
	Mean	31.36 (32.95)	73.67 (60.97)	52.52 (46.96)

Figures in parentheses are values of arcsin $\sqrt{p}$

C.D. (P = 0.05) for periods = 0.14
" treatments = 0.34
" interaction = 0.48

an ideal component in integrated pest management of cotton whitefly.

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