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Biosafety of Flufenzin and Fenpyroximate to certain beneficial arthropods

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ABSTRACT: Laboratory bioassays using contact filter test with flufenzin @ 60, 80, & 100g a. i. / ha, fenpyroximate @ 15, 20, & 25g a. i. / ha and dicofol @250g a. i. / ha conducted for safety of phytoseiid-mite (*Amblyseius tetranychivorus* Gupta), lacewing (*Chrysoperla carnea* Stephens), forager-bee (*Apis cerana indica* Fabricius) and earthworm (*Eisenia foetida* Savigny) revealed that dicofol was most harmful among them. Flufenzin was slightly harmful to them while fenpyroximate was safe. Under field conditions, the abundance of phytoseiid-mites indicated similar results; however, fenpyroximate was observed to be moderately toxic. Field microbial biomass-carbon was found on par with each other, indicating their safety to soil microbes.

KEY WORDS: Fenpyroximate, filter-paper test, flufenzin, safety to beneficials

INTRODUCTION

Emphasis on chemical control of mites is now being laid on low risk acaricides active at low field doses, which have a controlled action span and less non-target effect. New generation acaricides with novel chemistries are being developed and claimed to be selective against target mite species with a little or no effect on beneficials. Since conservation of beneficial fauna/ flora being of immense importance, there is felt need to investigate them for environmental safety.

MATERIALS AND METHODS

New molecules *viz.*, Flufenzin 200 SC (Tetrazine-analogue: MGR) and Fenpyroximate 5 EC (Pyrazole: METI-compound) claimed to be more selective and potent acaricides with minimum impact on beneficial/environment were evaluated along with Dicofol (standard-check). Single application was given with flufenzin; fenpyroximate and dicofol at dosage (concentration) with 60 (0.012%), 80 (0.016%) and 100 (0.020%); 15 (0.003%), 20 (0.004%) & 25 (0.005%) and 250 (0.05%) g a. i. / ha, respectively. Field studies were undertaken (Summer 2003) on brinjal crop (var.-*Krishna*) during the fruiting phase under field condition within endemic pockets. Experiment was conducted in a randomized block design, having three replicates and eight treatments, inclusive of untreated control consisting net plot size of 6.0 x 4.5 M with 0.75 x 0.60 M spacing. Field abundance of phytoseiid-mites was counted in terms of number of motile mites on tagged leaves from pre-selected brinjal

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plants. Counts were taken prior to application and on 3, 7, 14 and 21 days thereafter. Data on counts in respect of each of the evaluation dates were transformed to $\sqrt{(n+1)}$ value and data were analysed statistically. Four weeks thereafter, soil samples were brought to laboratory for assessment of biological action of acaricides on soil-microbial population. Impact on soil microbes was measured as microbial biomass-carbon by fumigation–extraction method.

Cultures of representative beneficial arthropods *viz.*, phytoseiid-mite (*Amblyseius tetranychivorus* Gupta), green lacewing (*Chrysoperla carnea* Stephens), forager honeybee (*Apis cerana indica* Fabricius) and earthworm (*Eisenia foetida* Savigny) were maintained separately within laboratory/glasshouse. Lab-toxicity was studied using contact filter paper technique @ 10 individuals (adult mix-sex/ worker)/ replicate. Each of the test concentrations/ treatments was replicated thrice. Observations on mortality were recorded at 24, 48 and 72 hours after treatment for forager-bee, earthworm and phytoseiid-mite, respectively. However, for lacewing, first-instar grubs were fed with *Corcyra*-eggs treated with test concentrations @ 10 eggs/ grub and observations on mortality were recorded 72 hours after treatment. Per cent mortality was computed, subjected to arcsine-transformation, and then to statistical analysis.

RESULTS AND DISCUSSION

1. Field-toxicity

Data on abundance of phytoseiid-mites are presented in Table 1. Pre-treatment mean population of motile-mites was noticed in the range of 7.33 to 10/ leaf. Third day after application, the population in untreated-control was on par with all three dosages of flufenzin while it sharply declined in dicofol, and in all three dosages of fenpyroximate populations were almost in similar range. Four days thereafter, it was observed to be slightly increased in dicofol, all three dosages of fenpyroximate and higher dosage (100 g a. i./ ha) of flufenzin, and was on par with each other. In comparison, mite populations in control and lower dosage (60 g a. i./ ha) of flufenzin were almost same while in intermediate dosage (80 g a. i./ ha) of flufenzin, it was slightly reduced. Two weeks after application, populations in control and lower dosage of flufenzin were statistically on par.

Table 1. Impact of acaricides on abundance of predatory-mites on brinjal

Acaricide	Dose(g a. i. / ha)	Mean motile-mites per leaf days after-treatment				
		0	3	7	14	21
1. Flufenzin	60	9.00 (3.16)	9.33 (3.21)	10.67 (3.41)	8.67 (3.11)	11.67 (3.56)
2. Flufenzin	80	8.00 (2.98)	8.33 (3.04)	7.67 (2.93)	5.67 (2.56)	9.00 (3.16)
3. Flufenzin	100	8.67 (3.11)	9.33 (3.21)	1.00 (1.41)	2.67 (1.91)	7.67 (2.94)
4. Fenpyroximate	15	8.33 (3.03)	1.00 (1.41)	1.67 (1.63)	3.33 (2.06)	6.33 (2.69)
5. Fenpyroximate	20	7.33 (2.84)	0.33 (1.14)	1.33 (1.52)	2.67 (1.90)	5.00 (2.43)
6. Fenpyroximate	25	9.33 (3.20)	0.33 (1.14)	0.67 (1.28)	2.33 (1.82)	4.00 (2.23)
7. Dicofol	250	10.00 (3.31)	0.33 (1.14)	0.67 (1.28)	1.67 (1.63)	3.67 (2.16)
8. Control	-	9.67 (3.26)	10.00 (3.30)	10.33 (3.35)	11.00 (3.46)	12.00 (3.60)
SEM ±		0.16	0.15	0.11	0.12	0.12
CD (P=0.05)		0.50	0.47	0.34	0.35	0.37

Figures in parentheses are arcsine-transformed values.

In comparison, there was a slightly increase in population of lower and intermediate dosage of flufenzin and lower dosage of fenpyroximate. However, populations remained to be significantly declined in dicofol, higher and intermediate dosage of fenpyroximate and higher dosage of flufenzin, which were on par. One week thereafter, populations in dicofol, and higher and intermediate dosage of fenpyroximate remained declined, which were statistically on par. Populations in lower dosage of fenpyroximate and higher dosage of flufenzin were on par with each other. Similarly, control and lower dosage of flufenzin were statistically on par.

Amongst the test acaricides, most harmful effect was exhibited by dicofol till two weeks after its application. One week thereafter, the population was gradually increased. All three dosages of fenpyroximate were found moderately harmful. Flufenzin at 80 and 100 g a. i./ ha had shown harmful effects particularly between 1-2 weeks after application. In comparison, its lower dosage (60 g a. i./ ha) was observed to be safer. Field application of fenpyroximate @ 15 g a. i./ ha against *Typhlodromus pyri* Scheuten reported to be less harmful (Decraeke and Sterk, 1992) and at 20 g a. i./ ha found to be slightly harmful (Sterk, 1994). Former dosage did not show any adverse effect on *Amblyseius andersoni* (Forti *et al.*, 1994) and on *Amblyseius womersleyi* (Park *et al.*, 1996). Population of field prevailing phytoseiid-mites declined by 80 per cent, after one week of application of fenpyroximate at 25 g a. i./ ha (Sato *et al.*, 1995) while flufenzin at 80 g a. i./ ha did not exhibit any adverse effect on the population (Pap *et al.*, 1994).

2. Influence on soil microbial biomass-carbon

Data on MB-C in soil obtained from plots treated with test acaricides ranged from 180.3 to 230.3 ig/ g soils (Table 2), which were found statistically non-significant; exhibiting that they do not influence the soil microbial activity. The results obtained in respect of flufenzin and fenpyroximate are in agreement with that of Ferenczi *et al.* (1998) and White *et al.* (2001).

3. Lab-toxicity to predatory mite

Data on mortality of lab- reared adult phytoseiid- mite (*Amblyseius tetranychivorus*) reveal that dicofol was found most toxic (Table 3). All three dosages of fenpyroximate caused mortality in the range of 36.67 to 56.67 per cent exhibiting moderate toxicity. In comparison, flufenzin was observed to be less susceptible, mortality in all three dosages ranged from 6.27 to 16.67 per cent. Under

Table 2. Estimation of microbial biomass-carbon (MB-C) in soil collected from brinjal field

Acaricide	Dose (g a. i./ha)	Soil wet wt. (g)	Oven-dry wt. (g)	Soil H_2O content (%)	MB-C (µg/g soil)
1. Flufenzin	60	10.4	7.5	25	225.7
2. Flufenzin	80	11.0	8.2	21	223.3
3. Flufenzin	100	11.5	8.4	23	219.3
4. Fenpyroximate	15	10.5	7.8	19	210.7
5. Fenpyroximate	20	12.0	8.9	23	200.3
6. Fenpyroximate	25	10.4	7.6	20	190.3
7. Dicofol	250	11.0	8.1	24	180.3
8. Control	-	10.5	7.7	22	230.3
SEM ±					10.09
CD (P=0.05)					N.S.

lab-conditions against *Neoseiulus californicus* (Mc Gregor), fenpyroximate at 15g a. i. / ha reported to be moderately harmful (Curckovic *et al.*, 1997) and at 20g a. i. / ha was found to be more harmful (Muther, 1998) while at both the dosages, it was observed to be less harmful (Sato *et al.*, 2002). However, at 20g a. i. / ha dosage, it was found moderately harmful to *Iphiseiodes zuluagri* (Reis *et al.*, 1998), *Neoseilus chilenensis* (Curckovic *et al.*, 1999) and *Amblyseius andersoni* (Laffi and Brevilacqua, 1999). Dicofol (250g a. i./ ha) reported to be more harmful (Reis *et al.*, 1999; Laffi and Brevilacqua, 1999).

4. Lab-toxicity to lacewing

Data on mean per cent mortality of larvae of lacewing (*Chrysoperla carnea*) (Table 3) reveal that dicofol was more harmful. All three dosages of fenpyroximate and the higher dosage of flufenzin (100 g a. i. / ha) were observed less harmful, which were on par. Lower dosage of flufenzin (60 g a. i./ ha) was found relatively safe. Treng and Kao (1997) reported that fenpyroximate (25g a. i. / ha) was harmless exhibiting < 50 per cent larval mortality of green-lacewing (*Mallada basalis*) that is in agreement with to the present findings.

5. Lab-toxicity to honeybee

Data in respect of forager-bee (*Apis cerana indica*) mortality reveals that dicofol was found extremely harmful while higher & intermediate dosages of fenpyroximate and flufenzin were slightly toxic (Table 3). Lower dosage of fenpyroximate and flufenzin resulted in equal (23.33%) mortality. The slight toxicity observed herein might be due to other ingredients used within formulation, which needs to be tested along with technical grade.

6. Lab-toxicity to earthworm

Data in respect of mortality of adult earthworm (*Eisenia foetida*) (Table 3) reveal that dicofol being an organochlorine observed to be more harmful. In comparison, all three dosages of fenpyroximate and flufenzin were safer. Lower dosage (60g a. i./ ha) of flufenzin was found on par with untreated control, recording no mortality. Result obtained in respect

Table 3. Lab-toxicity of acaricides to beneficial arthropods

Acaricide	Dose (g a. i. /ha)	Mean per cent mortality (hours after-treatment)			
		72	72	24	48
		Predatory mite-adult (*A. tetranychivorus*)	Lacewing-larva (*C. carnea*)	Forager bee (*A. cerana indica*)	Earthworm- (*E. foetida*)
1. Flufenzin	60	6.67 (12.29)	6.67 (12.29)	23.33 (28.78)	0.00 (0.00)
2. Flufenzin	80	10.00 (15.00)	13.33 (17.71)	26.67 (30.79)	3.33 (6.14)
3. Flufenzin	100	16.67 (23.36)	16.67 (23.36)	33.33 (34.93)	13.33 (21.14)
4. Fenpyroximate	15	36.67 (37.14)	13.33 (21.14)	23.33 (28.78)	6.67 (12.29)
5. Fenpyroximate	20	46.67 (42.99)	20.00 (26.07)	26.67 (30.79)	10.0 (18.43)
6. Fenpyroximate	25	56.67 (48.93)	26.57 (30.29)	36.67 (36.93)	16.67 (23.36)
7. Dicofol	250	90.00 (71.57)	86.67 (68.86)	96.67 (82.65)	93.33 (77.11)
8. Control	-	3.33 (6.14)	3.33 (6.14)	6.67 (12.29)	0.00 (0.00)
SEM ±		3.14	3.67	2.54	3.20
CD (P=0.05)		9.53	11.14	7.72	9.70

Figures in parentheses are arcsine-transformed values.

of dicofol is in agreement with that reported by Roberts and Dorough (1984). Since the rate of mineralisation and adsorption of organic molecules of pesticide mostly depends upon clay and organic matter contents prevailing within soil, it was felt that fenpyroximate/ flufenzin may prove still safer under field conditions.

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