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Safety of pesticidal sprays to natural enemies in chilli (*Capsicum annuum* L.)

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ABSTRACT: A study was conducted to assess the safety of three acaricides (Propargite 57 EC, Ethion 50 EC and Fenpyroxymate 5 SC), one insect growth regulator (Buprofezin 25 SC), four botanical pesticides (Neemgold 0.15 EC, Neem seed kernel Extract 5%, *Clerodendron inermae* aqueous leaf extract 5%, *Vitex negundo* aqueous leaf extract 5%), and formulations of two bioagents *Verticillium lecanii* and *Paecilomyces fumosoroseus* to natural enemies associated with yellow mite, *Polyphagotarsonemus latus* (Banks) in chilli under field condition. The natural enemies observed were predatory coccinellid, *Coccinella septempunctata* Linnaeus, and the predatory mites, *Amblyseius ovalis* (Evans) and *Amblyseius longispinosus* (Evans). The botanical pesticides and formulations of bioagents were quite safe to predatory coccinellids and mites at tested doses. Among the synthetic acaricides, fenpyroxymate was quite safe to both predatory mite and coccinellid species and recorded on par results with the bioagents and botanical pesticides. Buprofezin and Neemgold were intermediate in their safety to predators.

KEY WORDS: Acaricides, botanical insecticides, chilli, microbial insecticides, natural enemies, safety

INTRODUCTION

Chilli (*Capsicum annuum* L.) is an indispensable condiment as well as vegetable in every household of India. India contributes one fourth of the world's production of chilli with 1.018 million tonnes from 0.915 million hectares (Peter and Nybe, 2002). One of the factors responsible for low yield in chilli is the ravage caused by insect and mite pests. Out of over 21 insect and non-insect pests of chilli, the yellow mite, *Polyphagotarsonemus latus* (Banks) is most destructive (Butani, 1976), causing 25 per cent yield loss (Ahmed *et al.*, 1987). Kareem *et al.* (1977) reported that chilli crop failed to yield due to the infestation by *P. latus* at flowering and fruiting stage of the crop.

For the control of *P. latus*, several conventional acaricides are sprayed. In spite of using these conventional acaricides, the yellow mite has attained the key pest status of chilli. Although commonly used insecticides with acaricidal action give some control, their application becomes a threat to predators. Keeping in view the above observations, the present study was conducted to know the natural enemies associated with the yellow mite and the safety of the pesticide sprays to the natural enemies.

MATERIALS AND METHODS

The experiment was carried out at the main research station (MRS), University of Agricultural Sciences (UAS), Dharwad under rainfed conditions during *kharif* 2001. Seedlings of chilli variety "Byadagi kaddi" were procured from MRS Dharwad nursery and transplanted during the first fortnight of July in plots of size 5.4 X 4.5m with 90 X 90cm spacing. Each plot had a density of 30 plants. All the management practices were followed as per the package of practices, UAS, Dharwad. A common spray with dimethoate 30 EC was given to the experimental crop at two weeks after transplanting to keep the thrips infestation under check and the crop was kept unsprayed till the imposition of treatments for mite.

Three acaricides, propargite (2.5 ml l^{-1}), ethion (2 ml l^{-1}), fenpyroxymate (1 ml l^{-1}), one insect growth regulator, buprofezin (0.5 ml l^{-1}), four botanical pesticides, neem gold (3 ml l^{-1}), neem seed kernel extract (5%), *Clerodendron inermae* (5%), *Vitex negundo* (5%), two bioagent formulations, Verticel (*Verticillium lecanii*)(5g l^{-1}) and Priority (*Paecilomyces fumosoroseus*)(5 g l^{-1}) were sprayed on chilli crop at 60 days after transplanting (DAT) because of the late mite infestation during the experimental period followed by second round of spray at three weeks interval to evaluate the safety of pesticide sprays to natural enemies. Dicofol 18.5 EC (2.5 ml l^{-1}) was used as standard.

Plant material

Seeds of neem (*Azadirachta indica* A. Juss.), leaves of *Clerodendron inermae* and *Vitex negundo* collected from the farm premises of Agriculture College, Dharwad were chosen for the study. The extracts were prepared using water as solvent.

Microbial and synthetic pesticides

Commercial formulations of *Verticillium lecanii* obtained from Excel Industries Limited, Secunderabad and *Paecilomyces fumosoroseus* supplied by T. Stanes and Company Limited, Coimbatore were used in the study. Fenpyroxymate and Buprofezin supplied by Rallies Research Centre, Bangalore were used in the experiment. All the other pesticides were procured from the retail pesticide shop in Dharwad.

Observations

Predatory populaton was recorded on five plants selected at random in each plot. Six leaves on the top canopy of each selected plant was observed for counting the predatory mites in the field using 20x-magnifying lens and recorded as predatory mites/leaf. The sample plants were observed to count the number of predatory coccinellid and recorded as coccinellids/plant. Counting was done a day before, and one, three, seven and 21days after spray. The count at 21days after first spray was recorded as pre-count for the second round of spray. The experiment was laid out in a complete randomized block design and the data collected on population of natural enemies in the first and second spray were pooled and were subjected to the analysis of variance (ANOVA) after square root transformation.

RESULTS AND DISCUSSION

Two species of predatory mites, *i. e. Amblyseius ovalis* and *Amblyseius longispinosus* and the predatory coccinellid, *Coccinella septempunctata* were observed feeding on yellow mite, *Polyphagotarsonemus latus* on chilli foliage during the period of study.

Safety to predatory coccinellid, *Coccinella septempunctata*

The pooled data on predatory coccinellid population are presented in Table 1. Before the initiation of the pesticide treatment, the mean coccinellid population did not differ significantly among the treatments (ranged from 0.27 to 0.35 coccinellids/plant). One day after the spray, the coccinellid population reduced significantly (ranged from 0.0 in treatments with propargite and ethion to 0.31 in *Vitex negundo, Verticillium lecanii* and *Paecilomyces fumosoroseus*) as against 0.4 in untreated control. However, the aqueous extracts of all the plant products and microbial pesticides

Table 1. Safety of treatments tested against *P. latus* to *Coccinella septempunctata* in chilli ecosystem

Sl. no.	Treatment	Number of coccinellids/ plant after spray			
		Pre-count	*1 DAS	3 DAS	7 DAS
1	Dicofol 18.5 EC @ 2.5 ml/l	0.32 (0.91)	0.04 ^{c} (0.73)	0.08 ^{c} (0.75)	0.10 ^{c} (0.77)
2	Propargite 57 EC @ 2.5ml/l	0.31 (0.90)	0.00- ^{c} (0.71)	0.00 ^{c} (0.71)	0.10 ^{c} (0.77)
3	Ethion 50EC @ 2ml/l	0.27 (0.87)	0.00 ^{c} (0.71)	0.03 ^{c} (0.73)	0.10 ^{c} (0.77)
4	Fenpyroximate 5 SC @ 1ml/l	0.28 (0.88)	0.10 ^{bc} (0.77)	0.15 ^{bc} (0.80)	0.18 ^{bc} (0.82)
5	Buprofezin 25 SC @ 0.5ml/l	0.27 (0.87)	0.17 ^{bc} (0.82)	0.15 ^{bc} 0.80)	0.27 ^{b} (0.87)
6	Neemgold 0.15 EC @ 3ml/l	0.28 (0.88)	0.23 ^{b} (0.85)	0.20 ^{bc} 0.84)	0.32 ^{ab} (0.91)
7	NSKE 5%	0.33 (0.91)	0.30 ^{ab} (0.90)	0.33 ^{ab} (0.91)	0.37 ^{ab} (0.93)
8	*Clerodendron inerme* leaf extract 5%	0.28 (0.88)	0.27 ^{ab} (0.87)	0.30 ^{ab} (0.90)	0.35 ^{ab} (0.92)
9	*Vitex negundo* leaf extract 5%	0.33 (0.91)	0.31 ^{ab} (0.90)	0.32 ^{ab} (0.91)	0.35 ^{ab} (0.92)
10	*Verticilium lecanii* @ 5 g/l	0.34 (0.92)	0.31 ^{ab} (0.90)	0.38 ^{ab} (0.94)	0.33 ^{ab} (0.91)
11	*Paeciliomyces fumosoroseus* @ 5g/l	0.35 (0.92)	0.31 ^{ab} (0.90)	0.31 ^{ab} (0.91)	0.32 ^{ab} (0.91)
12	Untreated control (No spray)	0.31(0.90)	0.40 ^{a} (0.95)	0.47 ^{a} (0.98)	0.49 ^{a} (0.99)
	SEM±	-	0.03	0.04	0.03
	CD (P=0.05)	NS	0.09	0.12	0.09
	CV (%)	8.64	7.86	10.86	7.28

* DAS - Days after spray
NS - Non-significant
Figures in parentheses are $\sqrt{x + 0.5}$ values.
Means followed by same letter in a column do not differ significantly by DMRT (P=0.05).

were on par with untreated control. Among the acaricides, fenpyroxymate was safer (0.1coccinellids/ plant) compared to dicofol, propargite and ethion. The insect growth regulator, Buprofezin (0.17/plant) and Neem gold (0.23/plant) were also on par with fenpyroxymate. Similar trend was observed among various treatments including untreated control at three days after spray. Seven days after spray, the predatory population started increasing gradually (ranged from 0.03 in propargite to 0.47 in untreated control and 0.1 in propargite and ethion to 0.49 in untreated control at 3 and 7 days after spray, respectively). Neem gold (0.32/ plant) was also on par with untreated control (0.47/ plant) at 7 days after spray. At 3 and 7 days after spray, no coccinellid population was observed in propargite treated plot. Similar was the trend with ethion at 3 days after spray. The information on the effect of dicofol and ethion on coccinellid predators is lacking. The safety of Buprofezin to the coccinellid predators in the present investigation is in line with the findings of Smith (1995). The safety of NSKE to coccinellid predators was reported by Chakroborti (2000), which confirms the present result. The report on safety of *C. inermae* leaf extract to coccinellid predators is lacking.

Safety to predatory mites

The predatory mites observed were *Amblyseius ovalis* and *Amblyseius longispinosus*. The pooled data recorded on predatory mite population are presented in Table 2. Before the initiation of the pesticide treatment, the mean population (ranged from 0.27 to 0.34 predatory mites/ leaf) did not differ significantly among the treatments. One day after the treatment, the population (ranged from 0.12 in dicofol and propargite to 0.24 in *V. negundo*) was reduced significantly in all the treatments except NSKE (0.31/ leaf), *C. inermae* leaf extract (0.29/leaf) and microbial pesticides (0.29 and 0.3 in *Verticillium lecanii* and *Paecilomyces fumosoroseus*, respectively), which were on par with untreated control. Except microbial pesticides (0.3/ leaf), all other treatments recorded significantly less population compared to untreated control (0.44/ leaf). Similar trend in population of predatory mites was observed among various treatments including untreated control at 7 days after spray.

Among the acaricides, fenpyroxymate recorded a population (0.19/ leaf) on par with that recorded in plots treated with plant extracts and

Table 2. Safety of treatments tested against *P. latus* to *Amblyseius* spp.

Sl. no.	Treatment	*Amblyseius* spp./leaf			
		Pre count	*1 DAS	3 DAS	7 DAS
1	Dicofol 18.5 EC @ 2.5 ml/l	0.34 (0.92)	0.12^{c} (0.79)	0.07^{c} (0.75)	0.11^{c} (0.78)
2	Propargite 57 EC @ 2.5ml/l	0.33 (0.91)	0.12^{c} (0.79)	0.08^{c} (0.76)	0.05^{c} (0.74)
3	Ethion 50EC @ 2ml/l	0.33 (0.91)	0.15^{c} (0.80)	0.08^{c} (0.76)	0.06^{c} (0.74)
4	Fenpyroximate 5 SC @ 1ml/l	0.27 (0.88)	0.17^{bc} (0.82)	0.19^{bc} (0.83)	0.17^{bc} (0.79)
5	Buprofezin 25 SC @ 0.5ml/l	0.32 (0.91)	0.20^{bc} (0.84)	0.18^{bc} (0.82)	0.18^{bc} (0.82)
6	Neem gold 0.15 EC @ 3ml/l	0.34 (0.92)	0.20^{bc} (0.84)	0.17^{bc} (0.82)	0.18^{bc} (0.83)
7	NSKE 5%	0.32 (0.91)	0.3^{ab} (0.90)	0.26^{b} (0.86)	0.24^{b} (0.85)
8	*Clerodendron inerme* leaf extract 5%	0.30(0.90)	0.29^{ab}(0.89)	0.25^{b}(0.86)	0.25^{b}(0.86)
9	*Vitex negundo* leaf extract 5%	0.28(0.88)	0.24$^{c\,b}$(0.85)	0.24^{b}(0.85)	0.20^{bc}(0.84)
10	*Verticilium lecanii* @ 5g/l	0.29(0.89)	0.29^{ab}(0.89)	0.30^{ab}(0.90)	0.30^{ab}(0.90)
11	*Paeciliomyces fumosoroseus* @ 5g/l	0.30(0.90)	0.30^{ab}(0.90)	0.30^{ab}(0.90)	0.29^{ab}(0.89)
12	Untreated control (No spray)	0.34(0.92)	0.37^{a}(0.93)	0.44^{a}(0.97)	0.42^{a}(0.96)
	SEM ±	-	0.02	0.03	0.03
	CD (0.05)	NS	0.06	0.09	0.08
	CV (%)	11.05	7.11	7.31	9.38

* DAS - Days after spray

NS - Non-significant

Figures in parentheses are $\sqrt{x} + 0.5$ values.

Means followed by same letter in a column do not differ significantly by DMRT (P=0.05).

microbial pesticides (ranged from 0.26 to 0.3/ leaf), which reflects the safety of this acaricide compared to dicofol, propargite and ethion. Buprofezin and Neemgold were also safe to predatory mites. The results indicate the safety of plant extracts and microbial formulations of *Verticillium lecanii* and *Paecilomyces fumosoroseus* to *Amblyseius* spp. The status of the NSKE (5%) on *Amblyseius* spp. in the present investigation is in line with the results of Chinniah and Mohanasundaram (1999), who reported the safety of NSKE to predatory mite, *Amblyseius* spp. Dicofol, propargite and ethion were highly toxic to predatory mites. The toxic effect of dicofol was reported earlier by Hegde and Patil (1994) on *Amblyseius longispinosus* and Somchoudhury *et al.* (2000) on *Amblyseius* spp. The toxic effect of propargite on *Amblyseius* spp. is in line with the findings of Hamstead (1970) who reported propargite as highly toxic to *T. fallacis* and Murthy (1982), who reported cent per cent mortality of *T. tetranychivorus* due to propargite (0.2%) under laboratory condition. Contrary to the above, the safety of propargite to *Amblyseius swirkii* has also been reported by Kilany *et al.* (1996), who found that propargite treated nymphs of *T. urticae* had least adverse effect on growth and fecundity of *A. swirskii*. Among the synthetic chemicals, fenpyroxymate, Buprofezin and Neemgold were intermediate in their safety. There is no report available in the literature on the effect of Buprofezin and fenpyroximate on predatory mites. *Clerodendron inermae* leaf extract was also moderate in its safety. However, *Vitex negundo* leaf extract was found less safe than *C. inermae* leaf extract. A low toxicity (3.75 per cent mortality) of *C. inermae* leaf extract to *Amblyseius tetranychivorus* was recorded earlier by Yathiraj and Jagadish (1999). There is no report available in the literature on the effect of Buprofezin and fenpyroxymate on predatory mites.

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