Side effects of a few botanicals on the aphidophagous coccinellids

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ABSTRACT

Side effects of botanicals *viz.*, neem (*Azadirachta indica* A. Juss) leaves (NL), neem seed kernel extract (NSKE), eucalyptus oil (EO), neem oil (NO) and a fern were evaluated against aphidophagous coccinellids. Aphid infested barley leaves were treated in the field with the different concentrations of the botanicals (1.25, 2.5, 5 and 10; 0.625, 1.25, 2.5 and 5 per cent for NL, NSKE and fern and NO and EO, respectively) and provided as food (prey) to the coccinellid, *Adonia variegata* (Goeze). The side effects of neem seed kernal botanicals on the coccinellid recorded the highest mortality (73.33%) due to NSKE (10%) followed by (65.0% mortality) for neem oil (5.0%); and the post treatment effect (one day after) evinced maximum reduction in feeding (72.0 %) for NSKE (10%) followed by that recorded as 68 per cent for *neem* oil (5%).

Keywords: Coccinellids, botanical pesticides, *Azadirachta indica*, *Eucalyptus*, *Adonia variegata*

INTRODUCTION

Coccinellids have been widely used in biological control for over a century, and the methods for using these predators have remained virtually unchanged. The causes for the relatively low rates of establishment of coccinellids in importation biological control have not been examined for most species. Augmentative releases of several coccinellid species are well documented and effective; however, ineffective species continue to be used because of ease of collection (Obrycki and Kring, 1998). About 90 per cent of approximately 4,200 coccinellid species are considered beneficial because of their predatory activity, mainly against homopterous insects and mites; however, members of the subfamily Epilachninae are foliage feeders.

The cultural practice that has the greatest effect on local populations of coccinellids is the application of insecticides. Accordingly, the greatest gains may be attained through reduction of toxic pesticides in coccinellid habitats. Insecticides and fungicides can reduce coccinellid populations. They may have direct or indirect toxic effects (DeBach and Rosen, 1991). Surviving coccinellids may also be directly affected, *e.g.* reductions in fecundity or longevity, or indirectly affected by decimation of their food source(s). Adults may disperse from treated areas in response to severe prey reductions or because of insecticide repellency (Newsom, 1974). Pesticides vary widely in their effect on coccinellids, and similarly, coccinellids vary greatly in their susceptibility to pesticides. Pesticides may interfere with the feeding behavior of the exposed insects in three general ways (Polonsky *et al.*, 1989; Decourtye and Pham-Delegue, 2002).

For pro-ovigenic natural enemies, reduced feeding may influence the overall predation rate because of reduced longevity. In contrast, reduced feeding by the adult of syn-ovigenic species may reduce egg production, leading to reduced fitness. Moreover, perturbation of host feeding behavior is exhibited by predators. Conforming to this ideology, the present investigation was undertaken to record the side effects of a few botanicals on the aphidiphagous coccinellids.

MATERIALS AND METHODS

In order to evaluate the side effects of some botanical pesticides *viz.*, *Azadirachta indica* A. Juss (neem) leaves, *Azadirachta* seed kernel extract (NSKE), eucalyptus oil, *Azadirachta* seed oil and a fern (unidentified) on the aphidiphagous coccinellids, aphid infested barley was treated with the different concentrations of the botanicals that were collected from the field one-hour after spray application and provided as food (prey) to the coccinellid, *A. variegata*, the test insect. The different concentrations of the plant products were prepared in distilled water as 10, 5, 2.5 and 1.25 per cent for *A. indica* leaves, *A. indica* seed kernel extract and the fern; while 5, 2.5, 1.25 and

0.625 per cent for the oil formulations of *A. indica* and eucalyptus.

To prepare *A. indica* seed kernel extract, mature kernels were collected and dried under shade. The kernels were crushed with the help of pastel and mortar (brass make). The ground powder was passed through 60 mesh sieve and mixed with distilled water @ 50g powder in 50 ml of distilled water. This extract was considered as a 100 percent stock solution from which the desired concentrations were made. In case of neem leaf extract, one kilogram of fresh, tender leaves were plucked, put in a glass container and one litre of distilled water added. The leaves were allowed to stand soaked in water for 12 hours and then macerated in a mixer grinder. The extract was filtered through a muslin cloth and collected in a glass jar. This extract was also considered as 100 per cent stock solution from which the desired concentrations were made. Similarly, one kilogram of the fern was dried and powdered, to which equal quantity of distilled water was added and the mixture filtered through a muslin cloth. The extract so obtained was considered as a 100 per cent stock solution from which desired concentrations were made. Aphid infested barley shoots were treated with each concentration using a hand atomizer. The treated barley shoots with aphids on them were dried at room temperature and provided as food to the adults of *Adonia variegata* (Goeze) in Petri-dishes (10 cm diameter) for 15-hours. Each treatment was replicated thrice. Thereafter, the test coccinellid, *A. variegata* was given untreated fresh barley shoots with aphid prey and maintained in fresh jars. Food was changed daily by providing fresh aphid infested barley shoots and care was taken to avoid any mortality due to starvation. Mortality of the adult coccinellids exposed to the different treatments (with a 15-hour exposure period) was recorded one day after treatment. The feeding behaviour was also noted and expressed as reduction in percent feeding; and the effect of treated food on the growth and development of the coccinellid, *A. variegata* was recorded.

RESULTS

From the table on effect of botanicals on the coccinellids, among the tested oils, *A. indica* seed oil (5.0%) recorded higher mortality (65.00%) than eucalyptus oil (33.33%); whereas, among the seed/ leaf extracts, *A. indica* seed kernel extract (10.0%) showed highest mortality (73.33%) (Table 1). The post treatment effect on the coccinellid's feeding ability had a varied response. The maximum reduction in feeding was (72 %) for *A. indica* seed kernel extract (10%) and the reduction was 68 per cent for *A. indica* seed oil (5%) (Table 1).

Table 1. Side effects of plant-origin insecticides on the adult coccinellid, *Adonia variegata* feeding the barley aphid

Treatments (%)	Mean Mortality(%)		Mean Feeding Reduction (%)
	Aphid	*A. variegata*	
A. indica seed oil			
5	38.00	65.00	68.00
2.5	30.67	40.00	64.00
1.25	26.00	Nil	56.00
0.625	16.67	Nil	52.00
Eucalyptus oil			
5	27.33	33.33	62.00
2.5	22.67	Nil	60.00
1.25	20.00	Nil	54.00
0.625	12.00	Nil	50.00
Fern			
10	26.67	33.33	50.00
5	22.67	Nil	46.00
2.5	20.00	Nil	42.00
1.25	16.67	Nil	46.00
A. indica leaf extract			
10	32.67	60.00	64.00
5	28.67	33.33	60.00
2.5	27.33	Nil	54.00
1.25	22.00	Nil	50.00
A. indica seed kernel extract (NSKE)			
10	44.00	73.33	72.00
5	34.67	60.00	62.00
2.5	26.67	30.33	56.00
1.25	26.00	Nil	52.00

DISCUSSION

In the present investigation, the side effects of botanicals on the coccinellids recorded the highest mortality due to *A. indica* seed oil (5.0%). The post treatment effect (coccinellids having been exposed for 24 hours to treated aphids) on the coccinellids' feeding ability showed maximum reduction in feeding of fresh untreated barley aphids provided 1 day after treatment for *A. indica* seed kernel extract (10%) followed by that for *A. indica* seed oil (5%).

Earlier studies on the use of bio-pesticides, a reduction in *Coleomegilla maculata* predation of Colorado potato beetle eggs was noted when eggs were treated with 10 times the field dosage of *Bacillus thuringiensis* var. *San Diego*, and the reduction was not from delta-endotoxin induced paralysis (Giroux *et al*., 1994). Use of the commercial product (M-One®) at the recommended dose did not reduce *C. sexmaculata* larval populations

(Grioux *et al*., 1994). Entomogenous fungi (*Metarhizium anisopliae, Paecilomyces fumosoroseus*, and two strains of *Beauveria bassiana*) caused significant mortality in young *Hippodamia convergens* larvae, although this predator is not susceptible to *Nomuraea rileyi* (James and Lighthart, 1994). Similarly, *C. maculata* and *Eriopis connexa* are highly susceptible to *B. bassiana* (Magalhaes *et al*., 1988). Conversely, no mycoses developed in *C. maculata* larvae or adults exposed to isolate ARSEF 3113 of *B. bassiana* in laboratory or field studies (Pingel and Lewis, 1996).

According to Ofuya (1997) the biologically active plant extracts evaluated were highly ovicidal to *Cheilomenes lunata* (Fabricius) and *Cheilomenes vicina* (Mulsant). None of the extracts caused mortality to either *C. lunata* or *C. vicina* fourth instar larvae after 24 hours. Larvae treated with extracts consumed fewer aphids in 24 hours than untreated larvae. Ability to pupate was also significantly reduced in larvae treated with the extracts. No morphological deformities were observed in adults emerging from treated larvae. Similarly, Simmonds *et al.* (2000) found that all the tested botanicals influenced the foraging behaviour of *Cryptolaemus montrouzieri* (Mulsant) at one or more concentration. Larval and adult foraging behaviour were influenced most by BTG 504 and neem also affected larval behaviour. The predators contacted fewer treated leaves and spent less time on treated than on untreated leaves; larvae also consumed fewer mealy bug treated with BTG 504 and BTG 505 as compared to untreated mealybugs. Regupathy and Ayyasamy (2005) reported that coccinellid species such as *Menochilus sexmaculatus* (*Cheilomenes sexmaculata*), *Coccinella transversalis* and *Alesia discolor* (*Micraspis discolor*) and the spider species such as, *Oxyopes* sp., *Argiope* sp., *Araneus* sp., *Neoscona* sp. and *Plexippus* sp. moved to the trap crops due to the application of *neem* on the main crops. Following the repellent action, the population and the occurrence ratio of coccinellids and spiders on the trap crops increased. Similarly, Duraimurugan and Regupathy (2005) observed that when neem kernel extract was applied to cotton, the coccinellid populations moved from cotton to trap crops (bhindi and red gram) and the occurrence ratio was altered towards trap crops. The increased occurrence ratio of coccinellids towards cotton: *bhindi* and cotton: red gram varied from 1:0.76 to 1:0.78 and 1:1.09 to 1:1.26, respectively. The occurrence ratio of spiders was altered to 1:0.86-1.33 and 1:1.10-1:1.98 on cotton: bhindi and cotton: red gram, respectively.

Contrary to our observations, Smitha and Giraddi (2006) found that botanical pesticides and formulations of bio-agents were quite safe to predatory coccinellids and mites at tested doses. Among the synthetic acaricides, fenpyroximate was quite safe to both predatory mite and coccinellid species and recorded similar results with the bio-agents and botanical pesticides. Buprofezin and Neem gold were intermediate in their safety to predators.

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