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Residual Effects of Some Conventional and Biorational Pesticides on Ladybird Beetle, *Adonia variegata* Goeze

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Abstract: A variety of pesticides is used in alfalfa field to control pests. Biological control agents are also used to control these pests, therefore it is important to understand the effects of such pesticides on these beneficial insects. The present study was carried out to examine the residual effects of Dursban and Fenvalerate as conventional pesticides as well as Bio-Fly and Bio-Neem as biorational pesticides on ladybird beetle, *Adonia variegata* Goeze using panel exposure technique. Dursban was highly toxic to ladybird beetles at ½, 1 and 2 folds of the recommended dosages, where mortality percentages ranging from 46.7-50, 50 and 55-55.33%, respectively during the period of 1-120 h. Fenvalerate produced moderate toxic effects on the coccinellids, where mortality percentages were 10-47.7, 20-50 and 13.33-50% following the residual exposure of ½, 1 and 2 folds of the recommended dosages. On the other hand, the biorational pesticides Bio-Neem and Bio-Fly showed slight toxicity of a maximum of 10% mortality, produced after 5-day exposure of their recommended and half the recommended dosages. When the dose was doubled the toxicity of Bio-Fly did not increase, however, that of Bio-Neem reached 26.7 after 5 days. It can be concluded that in IPM programs, the application of conventional pesticides must be considered carefully for use, whereas biorational pesticides can be used with natural enemies with minimum effects.

Key words: Ladybird beetle, conventional pesticides, bioratinal pesticides

INTRODUCTION

Biological control agents comprise an important elements of many integrated pest management (IPM) programs, but many synthetic pesticides affect them negatively (Morddue and Blackwell, 1993). Although biological control agents are available for many pests (Steiner and Elliot, 1987), managing the entire range of pests likely to be encountered in interior scape often requires integration of chemical and biological control (Stuffer and Rose, 1997). Beneficial arthropods can be exposed to pesticides by direct contact, by indirect contact with residues f plant surfaces, or by the ingestion of pesticide-contaminated prey or hosts (Jepson, 1989). The frequent use of pesticides to manage these pests may destroy natural enemies and encourage pest resurgence or a secondary pest outbreak. Yardim and Edwards (1998) reported that aphid populations were 125% greater in insects-treated plots than in control plots. Some of these organic compounds cause environmental pollution and are toxic to human (Osman and AL-Rehiayani, 2003). Nowadays there is public concern about the risk of synthetic pesticides to human and environment.

Al-Gaseem region is one of the largest agricultural areas in the Kingdom of Saudi Arabia where much of its arable and fertile land is put under wheat, alfalfa, vegetables, citrus and date palm orchards. Expansion in agricultural production has brought about increasing pest problems, which are confronted by reliance on heavy, injudicious and indiscriminate use of broad-spectrum pesticides. This resulted in unsatisfactory pest suppression due to removal of existing natural enemies and probably accelerated the development of pesticide resistance in some pest populations, in addition to poisoning the environment.

Moreover, pest population increased following the of broad-spectrum pesticides. The rapid increase in pest population in conjunction with repeated applications of broad-spectrum synthetic pesticides can and often does, results in serious disruption of host-parasite relationships (Bartlett, 1953).

Previous research in Gassim region indicated a remarkable presence of aphidophagous insects in wheat, alfalfa and vegetable fields and citrus orchards (Elhag *et al.*, 1996; Elhag, 1992; Elhag and Ahmed, 1992). These species belong to Coccinellidae, Chrysopidae, Syrphidae, Carabidae and parasitic hymenoptera.

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In field surveys to evaluate specific and seasonal abundance of aphidophagous insects, the coccinellids, *Adonia variegata* Goeze, *Coccinella undecimpunctata* L., *C. novemnotata* Herbst and *C. septempunctata* L. were the dominant natural enemies in wheat fields in the region and constituted 36.6, 31.8, 19.6 and 12.0% of the seven coccinellid species present, respectively (Elhag, 1992; Elhag *et al.*, 1996). Comparative laboratory studies were also carried out which evaluated biological parameters and consumption rates of the most abundant four coccinellids in the region (Al-Doghairi, 2003; Elhag and Zaitoon, 1996).

The conservation of rich entomophagous fauna requires careful management of alfalfa pests when application of pesticides becomes a necessity to treat these pests with conventional pesticides. These include some unpredictable pests such as the leafworms, *Spodoptera exigua* and *Agrotis* spp., the aphid *Aphis craccivora* and *Therioaphis trifolii* and the alfalfa weevil *Hypera brunniepennis.* Integration of chemical and biological controls is important whenever there are pesticides that are compatible with natural enemies and present minimal risks to humans and the environment.

Unfortunately, there are no or little information concerning the toxicity of either commercial or biorational pesticides to ladybird beetle, *Adonia variegata* Goeza. Therefore, the present study was undertaken to quantify the mortality of lady beetles induced by two commercial insecticides namely, Dursban and Fenvalerate compared with two biorational insecticides namely Bio-Neem and Bio-Fly.

MATERIALS AND METHODS

Predator rearing: Unsexed coccinellid adults, *Adonia variegata* Goeza used in this experiment were collected from the alfalfa field at College of Agriculture and Vet. Med. Research Center, King Saud University, Al-Gaseem Branch, where no pesticides were ever applied and transferred to a rearing cages. They kept on aphid-infested leaves in 50x50x50 cm metal cages. Also, they fed on 10% sucrose solution (w/v), which renewed every other day. Ladybird beetles were left for at least 2 weeks to be adapted to the laboratory conditions.

Pesticides tested: Formulated Pesticides Dursban* 4 (48%, EC), Fenvalerate (20%, EC), Bio-Fly (100%, *Beauveria bassiana*) and Bio-Neem (Azadirachtin, 0.09%, multipurpose concentrate) were purchased from DowElanco (England), Hockley (England), El-Nasar for Fertilizes and Biopesticides, Sadat City, Egypt and Safer, Inc., a wholly owned subsidiary of Verdant Brands, Inc., respectively.

All the tested pesticides were mixed with water at the ½, 1 and 2 fold of the labeled rates. The labeled rates were 1-1.5 L 1000 L^{-1}, 100 ml 1000 L^{-1}, 3 fl oz $gallon^{-1}$ and 100 ml 100 L^{-1} for Dursban, Fenvalerate, Bio-Neem and Bio-Fly, respectively. For comparison water was used as a control treatment.

Bioassay study: A group of 10 beetles were placed into petri dishes (90 x 15 mm) containing a piece of cotton wetted with sugar solution. There were 3 petri dishes in each treatment for a total of 30 beetles per treatment. Each dish was sprayed with 1 ml of the tested concentrations. The number of dead beetle was checked at 1, 3, 24, 48 and 120 h and percentages of mortality were calculated.

RESULTS AND DISCUSSION

Data presented in Tables 1-4 illustrate the effects of the tested conventional and biorational pesticides on coccinellids survival. Mortality percentages in Dursban treatment ranging from 46.7-50, 50 and 50-55.33 during the period of 1-120 h at ½, 1 and 2 folds of the labeled rates, respectively. Fenvalerate at ½, 1 and 2 folds of the labeled rates caused 10-47.7, 20-50 and 13.33-50% mortality, respectively. However, the recommended and half of the recommended dosages of the biorational insecticide, Bio-Neem had slight effect on coccinellids, but statistically increased coccinellids mortality with 2-folds of labeled rate where 26.7% mortality was obtained after 120 h of treatment. Moreover, the biorational insecticide Bio-Fly was found to be the less one to affect the coccinellids, where the mortality percentage not exceed 10 even when lady beetles were exposed to 2 folds of labeled rate. The maximum mortality was 10% after 120 h of treatment with all the tested dosages.

The present investigation revealed that all the tested biorational pesticides had less effects on survival of lady beetles than the conventional ones especially Dursban which resulted in 50% mortality after a short time. Coccinellid susceptibility to insecticides varies with species and the type of pesticide but the sensitivity of coccinellids to insecticides was often slightly lower than that of pests (Theiling and Croft, 1988). Various pesticides such as carbaryl, malathion, diazinon, deltamethrin, endosulfan, etofenprox and thiamethoxam affected predator populations significantly (Thomas *et al.*, 1990 Roger *et al.*, 1991; Yardim and Edwards, 1998; and Youn *et al.*, 2003). Smith and Krischick (2000) showed that Azatin, an extract from the Neem tree containing azadirachtin caused less mortality to lady beetles than carbaryl, whereas horticultural oil had no effect on beetle survivorship. However, the application of azadirachtin should be careful, especially in high concentration of its obvious insect growth regulator effects (Qi *et al.*, 2001).

Table 1: Mortality of lady beetle exposed to residue of dursban after the application of different labeled rates

	% of Mortality after		
Time interval	½ of Labeled rate	Labeled rate	2 folds of labeled rate
1 h	46.7±4.1a	50.0±0.0a	50.0±0.0a
3 h	50.0±0.0a	50.0±0.0a	50.0±0.0a
24 h	50.0±0.0a	50.0±0.0a	53.33±4.1a
48 h	50.0±0.0a	50.0±0.0a	53.33±4.1a
120 h	50.0±0.0a	50.0±0.0a	53.33±4.1a
LSD_{50}	4.7	0	8.14

Table 2: Mortality of lady beetle exposed to residue of fenvalerate after the application of different labeled rates

	% of Mortality after		
Time interval	½ of Labeled rate	Labeled rate	2 folds of labeled rate
1 h	10.00±0.0a	20.00±7.1a	13.33±4.03a
3 h	16.76±8.16a	26.70±8.1a	23.33±10.8a
24 h	16.76±8.15a	36.70±10.8ab	40.00±0.0b
48 h	30.00±14.1ab	36.70±10.8ab	40.00±0.0b
120 h	46.70±4.1b	50.00±0.0b	50.00±0.0b
LSD_{50}	21.53	21.52	13.29

Table 3: mortality of lady beetle exposed to residue of bio-neem after the application of different labeled rates

	% of Mortality after		
Time interval	½ of Labeled rate	Labeled rate	2 folds of labeled rate
1 h	0.00±0.0a	0.00±0.0a	0.00±0.0a
3 h	0.00±0.0a	0.00±0.0a	3.33±4.03a
24 h	3.33±4.03a	3.30±14.03a	6.70±4.03a
48 h	6.70±8.1a	6.70±18.1a	6.70±4.03a
120 h	10.00±7.1a	10.00±7.1a	26.70±4.03b
LSD_{50}	13.30	13.30	8.14

Table 4: Mortality of lady beetle exposed to residue of bio-fly after the application of different labeled rates

	% of Mortality after		
Time interval	½ of Labeled rate	Labeled rate	2 folds of labeled rate
1h	0.00±0.0a	0.00±0.0a	0.00±0.0a
3h	0.00±0.0a	0.00±0.0a	0.00±0.0a
24h	0.00±0.0a	3.30±14.03a	6.70±7.8a
48h	0.00±0.0a	3.30±4.03a	6.70±7.8a
120h	10.0±7.07b	10.00±7.07a	10.00±7.07a
LSD_{50}	8.14	21.52	15.80

Data are expressed as Mean±SE
Means within the same column followed common letters are not statistically different from each other, $p \leq 0.05$

Also, BotaniGard, the commercial formulation of the entomopathogenic fungus *Beauveria bassiana*, was found to reduce survival of coccinellids at 72 h after spraying to levels not statistically different from controls (Smith and Krischick, 2000). Biorational pesticides are usually compatible with natural enemies and minimal risk to the human and environment are preferred for pest management (Steiner and Elliott, 1987, Miller and Uetz, 1998). The toxicity of the conventional pesticides Dursban and fenvalerate for coccinellids indicate the application of the pesticides must be considered carefully for use in IPM programs. It can be concluded that biorational pesticides can be used with natural enemies in IPM programs.

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