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Toxicity of Some Biopesticides to the Fall Webworm, *Hyphantria cunea* Durry (Lepidoptera: Arctidae)

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ABSTRACT

Three biopesticides, NeemAzal T/S (1% Azadirachtin), Laser (480 g/l Spinosad) and Delphin (32000 IU/mg *Bacillus thuringiensis*) were studied on the 3rd larval instar of the fall webworm *Hyphantria cunea* Durry (Lepidoptera: Arctidae) under laboratory conditions. Different doses (NeemAzal: 600, 300, 150 and 75 ml, Laser: 60, 30, 15 and 7.5 g, Delphin: 200, 100, 50 and 25 g) were used in the study. Laboratory trials demonstrated that the three doses of NeemAzal T/S gave 69.4, 72.2 and 100% mortality, respectively and a mortality period ranged between 1-7 days. Similar results were obtained in the other biopesticides. Highest doses of all the tested biopesticides gave 100 % mortality after 7 days.

Key words: Biopesticide; *Hyphantria cunea*; mortality.

INTRODUCTION

The fall webworm *Hyphantria cunea* Durry (Lepidoptera: Arctidae) is a polyphagous pest causing serious damage to hazelnuts, mulberry, cherry, apple and poplar growing in Turkey (Tuncer 1995). Such polyphagous pest, with high reproductive potential and ability to spread easily, makes it difficult to be managed by chemicals that are being used for controlling it (Chlorpyriphos-ethyl, cypermethrin and methidathion). *H. cunea* has a large number of parasitoids, predators as well some of bird species that feed on its larvae.

Using biological formulations to keep the pest levels below the economic damage threshold without affecting the beneficial populations is one of the most important elements of an integrated pest management (IPM). Interest of using the selective biopesticides against phytophagous insects has increased in recent years, particularly in cropping systems that rely on natural enemies as a major component of IPM (Rausell *et al*., 2000).

NeemAzal T/S contains triterpenoids azadirachtin, as basic active compound and other neem ingredients (Mordue and Blackwell, 1993). This active component has a number of properties useful for insect control (repellency, feeding and oviposition deterrence, insect growth regulator) and is considered as safe for the environment (Schmutterer 1990 and Akca *et al*., 2009). The most widely used inundatively applied microbial control agent is the bacterium *Bacillus thuringiensis.* Today, a number of isolates of the bacterium are commercially produced with activity against Lepidoptera, Coleoptera, and Diptera (Shah and Goettel, 1999). *B. thuringiensis* insecticidal proteins are highly specific insect gut toxins with a superior safety record in regard to their effects on nontarget organisms (Melin and Cozzi 1990).

Spinosad is a commercial product containing a mixture of secondary metabolites (spinosyn A and spinosyn D) produced during fermentation of a soil actinomycete, *Saccharopolyspora spinosa* (Sparks *et al*., 1995). Spinosad has been registered in over 30 countries for the control of Lepidoptera, Coleoptera, Diptera, and Thysanoptera (Thompson *et al.*, 2000; Williams *et al*., 2004 and Aarthi and Murugan 2010). It is a favorable environmental profile with low persistence and low toxicity to a number of predatory insects (Willisms *et al*., 2003). As a result, the United States Environmental Protection Agency (EPA) has classified spinosad as a reduced risk material (Thompson *et al.*, 2000).

The objective of this study was to determine the toxicity of some biopesticides (NeemAzal T/S, Laser and Delphin) against fall webworm *H. cunea* under laboratory conditions.

MATERIALS AND METHODS

The experiment was carried out as a randomized complete block design (3 x 4 x 3) factorial treatment arrangement in four replicates. The Biopesticides; NeemAzal T/S (1% Azadirachtin), Laser (480 g/L Spinosad) and Delphin (32000 IU/mg *B. thuringiensis*), at their recommended doses, were tested against larvae of *H. cunea* under the laboratory conditions of 25±2 ^{0}C, 70±5% R.H. and 10 h light: dark (Table 1). The doses were prepared as formulation doses in 100 liter water. Samples of *H. cunea* were collected from hazelnut fields and reared in the laboratory to establish a stock culture of the pest. Third instar larvae of *H. cunea* were used in the experiments. Larvae were placed in plastic boxes (10 x 20 x 7 cm), having filter papers on their bottom. Before transferring the larvae to the boxes, maple leaves, equal in size and number were dipped for 30 seconds in the stock solutions prepared from each dose. Then the leaves were left to dry for 30 minutes and placed in the boxes. Ten larvae were transferred in to each box per treatment. For control boxes, the leaves were dipped only in distilled water. Mortality rate was estimated 1, 3 and 7 days after each application. Mortality rate was corrected by Schneider Orelli's Formula (Puntener, 1981). Additionally, all data were analyzed using SPSS 11.0 (Statistical package for social science) statistical software.

RESULTS AND DISCUSSION

Toxicity of different biopesticides (NeemAzal T/S, Laser and Delphin) tested on the 3rd instar larvae was presented in Table (2). All biopesticides were found effective against *H. cunea* larvae under the laboratory conditions. Mortality rate of larvae was dose dependant. Mortality rates increased as the dose and time increased ($p<0.05$). 100% mortality was recorded at all the high doses of the tested biopesticides after 7 days compared to only 10% mortality in the untreated controls after 7 days. There was also significant interaction among time, dose and type of biopesticides used ($p<0.05$) (Table 2). Least mortality rates for all biopesticides were found in the 1st day after treatment. Generally, mortality rates increased from day 3 to day 7 (Table 2). As the studied biopesticides caused effective mortality to *H. cunea* larvae at the laboratory, therefore, it is suggested that these biopesticides are likely to be effective larvicides against *H. cunea* in agricultural areas.

NeemAzal-T/S was tested in its emulsion stability. Its insecticidal effects towards the two different insect pests; the western flower thrips, *Frankliniella occidentalis* and the ware house moth, *Ephestia elutella* showed high efficacy of 95% mortality in both bioassays (Schroer *et al*., 2001). This finding was also confirmed by the results of some other studies (Jasinka 1984; Deseo *et al*., 1986; Ecevit *et al.*, 1994 and Brudea *et al.*, 2012) who found that Azadirachtin and *B. thuringiensis* had pronounced high toxicity to *H. cunea* larvae.

In a hazelnut IPM program, emphasis focuses on preventive biological, cultural and physical control, with minimal chemical use. When chemicals are the only option, they have to be used in a way to sustain their effectiveness as long as possible. Thus, it is important to apply the chemical only after an established economic threshold level of the pest has been reached.

According to the present results, Neemazal, Laser and Delphin were the most effective to control *H. cunea* larvae at the values of 150 ml, 30 ml and 100 g, respectively. Previous studies (Tuncer and Akca, 1996, Aliniazee *et al.*, 1997, Micik and Akca, 2011 and Brudea *et al.*, 2012) reported that these biopesticides had a high control effect on some hazelnut pests such as *H. cunea*, *Parthenolecanium coryli*, *Myzocallis coryli*, *Archips rosanus***.** Because of that, NeemAzal T/S, Laser and Delphin can be used to control *H. cunea* and as reliable biopesticides

Table (1): Biopesticides; compound, trade name and recommended dose used in the study

Compound	Trade name	Doses used
Azadirachtin 1%	Neem Azal T/S	75,150,300 and 600 ml/100 l water
Spinosad 480 g/L	Laser	7.5, 15, 30 and 60 ml/100 l water
32000IU/mg *Bacillus thuringiensis*	Delphin	25, 50, 100 and 200 g/100 l water

Table (2): Toxicity of some biopesticides to the fall webworm *Hyphantria cunea* under laboratory conditions

Biopesticides	Doses (100 l water)	Mortality (%) day 1	Mortality (%) day 3	Mortality (%) day 7	A
Neem Azal T/S	75 mL	0,0 ± 0,0 a	17,5 ± 2,5 ab	72,5 ± 4,8 b	69,4
	150 mL	2,5 ± 2,5 ab	27,5 ± 2,5 b	75,0 ± 6,4 b	72,2
	300 mL	7,5 ± 2,5 ab	57,5 ± 4,8 c	100,0 ± 0,0 c	100,0
	600 mL	10,0 ± 4,1 b	62,5 ± 3,1 c	100,0 ± 0,0 c	100,0
	control	0,0 ± 0,0 a	2,5 ± 2,5 a	10,0 ± 4,1 a	-
Laser	7,5 mL	12,5 ± 2,5 b	35,0 ± 2,9 b	65,0 ± 2,9 b	61,1
	15 mL	20,0 ± 4,1 bc	47,5 ± 4,8 c	72,5 ± 4,8 b	69,4
	30 mL	25,0 ± 2,9 c	92,5 ± 2,5 d	100,0 ± 0,0 d	100,0
	60 mL	27,5 ± 2,5 c	95,0 ± 2,9 d	100,0 ± 0,0 d	100,0
	control	0,0 ± 0,0 a	2,5 ± 2,5 a	10,0 ± 4,1 a	-
Delfin	25 g	0,0 ± 0,0 a	42,5 ± 4,8 b	62,5 ± 2,5 b	58,3
	50 g	0,0 ± 0,0 a	52,5 ± 4,8 b	77,5 ± 4,8 c	75,0
	100 g	30,0 ± 4,1 b	92,5 ± 2,5 c	100,0 ± 0,0 d	100,0
	200 g	37,5 ± 6,3 b	100,0 ± 0,0 c	100,0 ± 0,0 d	100,0
	control	0,0 ± 0,0 a	2,5 ± 2,5 a	10,0 ± 4,1 a	-

A = Mortality % corrected by Schneider Orelli's Formula (Puntener, 1981).

for hazelnut IPM. The addition of plant extract to *B. thuringiensis* can increase the larval mortality percentage due to biologically active compounds in these plant extracts and may enhance the *B. thuringiensis* activity (Nathan *et al.,* 2005). Additionally, use of these biopesticides instead of conventional insecticides can reduce environmental pollution, preserve non-target organisms, and avert insecticide-induced pest resurgence.

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