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Toxicological Responses of False Chinch Bug, *Nysius raphanus* (Howard), to Selected Insecticides

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Abstract: A two-year study was conducted to evaluate toxicological responses of false chinch bug (FCB), *Nysius raphanus* (Howard), to selected insecticides in the laboratory bioassays. A chlorpyrifos resulted in the lowest LC_{50} and highest mortality in both years. Diazinon showed the second lowest LC_{50} in first year, but not the following year. A cyfluthrin and lambda-cyhalothrin resulted in moderate effectively insecticides. However, a spinosad resulted in the highest LC_{50} and lowest mortality in the first year. Permethrin showed the lower LC_{50} and higher mortality than lambda-cyhalothrin and esfenvalerate in the following year. A diazinon and endosulfan also resulted in significant low LC_{50} and significant mortality on FCB. The highest LC_{50} and lowest mortality observed with imidacloprid.

Key words: False Chinch Bug (FCB), *Nysius raphanus* (Howard) (Hemiptera: Lygaeidae), insecticides, probit analysis

INTRODUCTION

The false chinch bug (FCB), *Nysius raphanus* (Howard) (Hemiptera: Lygaeidae), is one of the most serious pests among North American species of *Nysius* (Sweet, 2000). The bug is multivoltine (Burgess and Weegar, 1986) and overwinters as adults under protective debris or rubbish (Sweet, 2000). There are very few published insecticide trials have included false chinch bug. The earliest reported trials to control false chinch bug involved 5% malathion and 0.1% impregnated pyrethrum dust also provided control (Wene, 1958). Leigh (1961) conducted two different trials under field and laboratory conditions. In field experiments endrin and heptachlor resulted in satisfactory control, while Sevin (1-naphthyl methylcarbamate) was relatively ineffective. In laboratory trials, malathion was the most effective compound. Dieldrin and endrin were about equally effective against for false chinch bug, while toxaphene and DDT were relatively ineffective. The purpose of this study was to evaluate toxicological responses of false chinch bug, *Nysius raphanus* (Howard), to selected insecticides in the laboratory bioassays.

MATERIALS AND METHODS

Insecticide Bioassay

The study was conducted on 23 August in 1999 Fort Collins, Colorado (USA). Five concentrations of thiamethoxam, cyfluthrin, diazinon, chlorpyrifos and lambda- cyhalothrin were impregnated on filter paper, placed in Petri dishes (100×15 mm) following which adult FCB collected on canola plants using a sweep net placed at temperature 25°C. Similarly the toxicity of spinosad was assessed at three different concentrations. Mortality was assessed at 24 and 48 h and analyzed using the Probit Analysis ($p<0.05$) (SAS Institute Inc., 1998). In the following year, conducted on 27 June,

thiamethoxam, diazinon, chlorpyrifos, endosulfan, esfenvalerate, lambda-cyhalothrin, imidacloprid, permethrin and spinosad were assessed in similar bioassays, but evaluations were continued up to 72 h after treatment.

RESULTS AND DISCUSSION

Insecticide Bioassay

All insecticide treatments caused significant mortality on FCB during bioassay trial in both years (Table 1). In the first year, a 50% lethal concentrations (LC_{50}) were followed spinosad (0.46) < thiamethoxam (0.099) < cyfluthrin (0.050) < lambda-cyhalothrin (0.00205) < diazinon (0.0000059) < chlorpyrifos (0.00000378). In following year, a LC_{50} were followed imidacloprid (0.0449) < esfenvalerate (0.0133) < thiamethoxam (0.0056) < spinosad (0.00052) <lambda-cyhalothrin (0.00042) <endosulfan (0.00016) < diazinon (0.000123) < permethrin (0.000015) < chlorpyrifos (0.00000125). A chlorpyrifos resulted in the lowest LC_{50} and highest mortality in both years. Diazinon showed the second lowest LC_{50} in first year, but not second year. A cyfluthrin and lambda-cyhalothrin resulted in moderate effectively insecticides. However, a spinosad resulted in the highest LC_{50} and lowest mortality. Permethrin showed the lower LC_{50} and higher mortality than lambda-cyhalothrin and esfenvalerate in second year. A diazinon and endosulfan also resulted in significant low LC_{50} and responded significant mortality on FCB. The highest LC_{50} and lowest mortality observed with imidacloprid.

There are very few published insecticide trials for false chinch bug. Far more studies have been conducted on other lygaeids, notably chinch bugs (*Blissus* sp.), *Oxycarenus lavaterae* F. and *Geocoris punctipes* (Say). For example, post emergence application of chlorpyrifos spray to corn reduced *B. leucopterus leucopterus* (Say) over 90% in one experiment during the first week (Peters, 1983). However, carbofuran and carbaryl sprays were less effective in wheat. Bauernfeind (1987) also reported that treatments of fenvalerate and chlorpyrifos provided acceptable kill (at least 90% population reduction) within the first 24 h after their application. More recent studies done by Castro and Riley (1999) found effective control with cyfluthrin, deltamethrin, lambda cyhalothrin and chlorpyrifos. Sears *et al*. (1980) reported that a number of the insecticides were evaluated over a 5 year

Table 1: Toxicity of selected insecticides to *N. raphanus* at laboratory bioassay (1999 and 2000)

		Dose (μg mL^{-1}) mortality[x]			
Insecticides	n[y]	Slope (±SE)	χ^2	LC_{50}z	p<0.05
1999					
Cyfluthrin	951	0.37 (±0.05)	17.4	0.050	0.0001
Diazinon	1206	0.90 (±0.06)	253.8	0.0000059	0.0001
Chlorpyrifos	1362	0.62 (±0.05)	255.4	0.0000038	0.0001
Lambda-cyhalothrin	1339	0.59 (±0.05)	120.4	0.00205	0.0001
Thiamethoxam	1212	0.73 (±0.05)	44.4	0.099	0.0001
Spinosad	656	0.77 (±0.10)	9.6	0.460	0.0019
2000					
Diazinon	1508	1.04 (±0.06)	383.2	0.000123	0.0001
Chlorpyrifos	689	1.35 (±0.13)	127.6	0.0000013	0.0001
Endosulfan	1219	1.24 (±0.09)	223.1	0.00016	0.0001
Esfenvalerate	1378	1.51 (±0.07)	352.9	0.0133	0.0001
Lambda-cyhalothrin	704	0.77 (±0.05)	187.5	0.00042	0.0001
Imidacloprid	1425	1.18 (±0.06)	307.1	0.0449	0.0001
Permethrin	891	0.87 (±0.10)	151.0	0.000015	0.0001
Thiamethoxam	916	3.26 (±0.23)	187.3	0.0056	0.0001
Spinosad	417	0.37 (±0.14)	94.9	0.00052	0.0001

[x]Numbers within a column not followed by the same letter are significantly different (p<0.05) by Probit Analysis. [y]Number of *N. raphanus* tested. [z]LC_{50} Lethal concentrations of insecticides (in μg mL^{-1}) at the 50% (LC50) levels of probit mortality

period for control of hairy chinch bug, *Blissus leucopterus hirtus* Montandon. They concluded that diazinon at 2-4 kg AI ha^{-1} and chlorpyrifos provided the most consistent control. The southern chinch bug, *B. insularis*, also is an important pest of turfgrass in the southern United States (Sweet, 2000). Fenvalerate and permethrin provided good control of southern chinch bug populations on lawns (Reinert, 1982). The phytophagous bug, *O. lavaterae* F., may sometimes cause major public concern because of its breeding in large numbers near towns (Eritja *et al*., 1997). Different dilutions of beta-cyfluthrin, tralomethrin, deltamethrin, acephate, phoxim and malathion were evaluated by means of a direct-spray test. The tralomethrin at 22.7 mg L^{-1} yielded an LT50 of 30.6 min and considered to be the most appropriate product for field use (Eritja *et al*., 1997).

The big-eyed bug, *G. punctipes* (Say), was exposed to 10 insecticides in laboratory bioassay (Elzen, 2001). Toxicity of spinosad to *G. punctipes* was the lower comparing to endosulfan and cyfluthrin. Therefore, spinosad and imidacloprid should provide pest control while sparing beneficial species (Elzen, 2001). Tillman and Mulrooney (2000) evaluated the toxicity of lambda cyhalothrin and spinosad to the natural enemy of *G. punctipes* (Say). Lambda cyhalothrin exhibited the greatest toxicity to the natural enemies, while spinosad exhibited marginal to excellent selectivity (Tillman and Mulrooney, 2000). Moreover, in the laboratory assays, *G. punctipes* Say adults were continuously exposed for 48 h to filter papers treated with the individual insecticides (Myers *et al*., 2006). Survival was greatest following exposure to the untreated control and imidacloprid. In addition, mean survival following exposure to spinosad and thiamethoxam was significantly lower, whereas diazinon killed all adults within 12 h of exposure (Myers *et al*. 2006).

In summary, chlorpyrifos and diazion were more effective insecticides for causing mortality on FCB than cyfluthrin, lambda-cyhalothrin, permethrin, esfenvalerate, endosulfan, imidacloprid, thiamethoxam and spinosad. The spinosad was less effective insecticides to cause significant mortality on FCB.

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