ONTARIO TURFGRASS RESEARCH FOUNDATION FINAL REPORT 2011

FIELD EVALUATION OF BIOCONTROLS FOR LEATHERJACKETS

P. Purvis, Guelph Turfgrass Institute and **P. Charbonneau,** Ontario Ministry of Agriculture, Food and Rural Affairs

EXECUTIVE SUMMARY

This report outlines the results of two experiments conducted at the Guelph Turfgrass Institute involving European cranefly (*Tipula paludosa*) larvae (leatherjackets) found in a mixed stand of turf maintained as a home lawn.

The objective of the first study was to compare the accuracy and time required to sample early instars of leatherjackets larvae utilizing a mustard drench compared to destructive sampling. Insecticide efficacy trials involve applying insecticides to plots in the field and then counting the numbers of surviving insects compared with an untreated control. The standard method for determining how many insects have survived is destructive sampling, which involves taking a golf cup cutter soil plug and tearing it apart by hand searching for larvae. This method is extremely labour intensive, especially when searching for the very small early instar leatherjackets. There have been studies conducted on other soil dwelling insects that have developed methods of expelling insects from the soil utilizing irritants such as hot mustard.

Results of this first study showed that on average, a mustard drench (0.33%) detected 57.5% of the leatherjackets. The average time to recover the leatherjackets per mustard drench was nine minutes. The average time to determine the number of leatherjackets by destructive sampling was 10.6 minutes. Using the mustard drench did not prove to be a more reliable or more rapid method of counting European crane fly larvae since there was a loss of accuracy (only 57.7% of the crane fly larvae were detected using the mustard drench) and only a very slight reduction in the amount of time required to determine the number of leatherjackets.

The objective of the second study was to determine the efficacy of four bio-controls (*Bacillus thuringiensis kurstaki*; Neu1138I; Neu1161I; and entomopathogenic nematodes) and one reduced risk insecticide (Acelepryn) for the control of early instar leatherjackets larvae. Treatments were applied on Nov. 4, 2011 on areas known to have previous leatherjacket infestations. Larval densities were determined using destructive sampling at 3 and 6 weeks after treatment.

Results of this second study showed that at 3 week after treatment, *Bacillus thuringiensis kurstaki,* entomopathogenic nematodes and Neu1138I were effective in reducing the populations of first and second instar leatherjackets larvae compared to the untreated control. The level of control amongst those three treatments did not differ significantly from each other and ranged from ~ 55, 57.5 and 62% of the control respectively. At 6 weeks after treatment, only the entomopathogenic nematodes and Neu1161I were effective in reducing the populations of first and second instar leatherjackets larvae compared to the untreated control. The level of control amongst those two treatments did not differ significantly from each other and ranged from ~ 50-70% of the control respectively. None of the bio-controls or the reduced risk product resulted in phytotoxicity to the turf at 1 or 7 days after treatment.

EXPERIMENT 1: A COMPARISON OF MUSTARD DRENCH AND DESTRUCTIVE SAMPLING FOR THE QUANTIFICATION OF LEATHERJACKETS (*TIPULA PALUDOSA)* LARVAE IN TURF

INTRODUCTION

Leatherjackets (*Tipula paludosa*) are larvae of European cranefly that are destructive to turfgrass. When conducting field trials to control leatherjackets, the current method of assessing surviving populations is destructive sampling. This involves collecting golf course cup changer plugs of turf and soil then tearing the plugs apart by hand, examining the soil, thatch and leaf blades and extracting and counting the small larvae. A reliable, rapid, repeatable method to count the very small early stages (1st and 2nd instar) of leatherjackets to replace destructive sampling would make leatherjacket control trials less labour intensive and time consuming. Research was conducted to compare destructive sampling and immersion of turf samples in a mustard drench to determine the best method for quantifying very early stages of leatherjackets to facilitate field research trials. The time it took for each method of sampling was also determined.

OBJECTIVES

To compare the accuracy and the time required to sample early instar of leatherjackets larvae in cup cutter plugs of turf utilizing a mustard drench compared to destructive sampling.

EXPERIMENTAL DESIGN / METHODS

On November 30, 2010, forty-four golf course cup changer plugs (0.1 m diameter X 0.1 m depth) containing natural infestations of early instar leatherjackets were brought into the laboratory. Twenty-two plugs were destructively sampled to recover the leatherjackets within each plug. Twenty-two plugs were submerged turf side down in buckets of 0.33% mustard solution (commercially available Coleman's English Mustard) for 5 minutes. The turf plugs were removed and the water/soil slurry put through a 1 mm sieve, washed clean of soil and the leatherjackets counted. The mustard drench samples were then destructively sampled to determine the number of leatherjackets that were still remaining in the turf plug. The data was then analyzed and the percentage of leatherjackets recovered with the mustard drench was

calculated. In addition, the time required for each technique was recorded per cup changer plug for the destructive sampling and the mustard drench. The average time for each technique was determined.

RESULTS AND CONCLUSIONS

On average, the mustard drench detected 57.5% of the leatherjackets (Table 1). The average time to determine the number of leatherjackets per mustard drench was nine minutes. Destructive sampling detected 100% of the leatherjackets. The average time to determine the number of leatherjackets by destructive sampling the golf course cup changer plugs was 10.6 minutes.

The loss of accuracy (only 57.7% of the crane fly larvae were detected using the mustard drench) and the very slight reduction in the amount of time required to determine the number of leatherjackets (9 min for the mustard drench verse 10.6 min for destructive sampling) did not prove to be a more reliable or more rapid method of counting European crane fly larvae for the purpose of conducting insect control efficacy trials.

Table 1. Comparison of mustard drench and destructive sampling of leatherjackets

# of larvae/plug mustard drench	# of larvae/plug remaining after mustard drench	% of total larvae recovered with mustard drench	Time per mustard drench	Time per destructive sampling
4	0	100	9	9
9	2	81	8	10
4	1	80	9	9
3	6	33	10	11
11	0	100	9	10
4	0	100	9	12
4	1	80	10	12
5	11	31	8	10
5	3	62	8	9
1	3	25	9	10
3	4	75	10	11
0	3	0	10	11
9	8	53	9	13
1	2	33	8	11
3	2	60	8	10
1	3	25	9	9
2	1	66	9	10
2	1	66	10	12
0	0	0	10	11
2	1	66	9	12
4	3	57	9	11
5	2	71	8	10
Average 3.73	2.76	57.5	9	10.6

EXPERIMENT 2: EFFICACY OF BIOCONTROLS AND A REDUCED RISK INSECTICIDE FOR EUROPEAN CRANEFLY (*TIPULA PALUDOSA)* LARVAE IN TURF

INTRODUCTION

Since the passing of the Cosmetic Pesticides Ban Act in 2009 for the lawn care sector there has been interest in testing bio-controls and reduced risk pesticides to control insect pests, such as leatherjackets (*Tipula paludosa*). It is well documented that most bio-pesticides are efficacious on early instar insect larvae. These reduced risk pesticides have been used for the control of European chafer grubs and but there is limited data on their efficacy to control leatherjackets. Research was conducted to compare bio-controls and a reduced risk pesticide to control early instar leatherjackets.

OBJECTIVES

The objective of the project was to determine the efficacy of fall applied bio-controls (*Bacillus thuringiensis kurstaki*; Neu1138I; Neu1161I; and entomopathogenic nematodes (EPN's; which were a 50/50 mixture of *Steinernema feltiae*) and a reduced risk insecticide (Acelepryn) for the control of early instar leatherjackets on a mixed stand of turf maintained as a home lawn.

EXPERIMENTAL DESIGN / METHODS

This experiment was conducted on plots of a mixed stand of turf (Kentucky bluegrass, perennial ryegrass and creeping bentgrass maintained as a home lawn) on the native soil rootzone at the Guelph Turfgrass Institute. The turf was maintained at 7 cm mowing height and fertilized with 2 kg actual N 100 m^{-2} yr^{-1}.

Experimental Design and Plot size:
The experimental plots were arranged in a randomized complete block design with 6 replications of each treatment. Plots were 1 m x 2 m (2 m^2). Each block of plots was established separately on areas of turf with previously known infestations of leatherjackets. Treatments were as indicated in Table 1.

Table 1. Treatments

Treatment 1	Untreated Control
Treatment 2	Acelepryn at 0.58 g a.i. 100 m^{-2}
Treatment 3	*Bacillus thuringiensis kurstaki* at 2.85 g a.i. 100 m^{-2}
Treatment 4	Neu1138I (2.5% solution) 2.5 mL 100 m^{-2}
Treatment 5	Neu1161I (2% solution) 2.0 mL 100 m^{-2}
Treatment 6	Entomopathogenic nematodes (EPN's) (a 50/50 mixture of *Steinernema feltiae* and *Heterorhabditis bacteriophora*) at 2 million ij (infective juveniles) 100 m^{-2}

Application of the Treatments:
All treatments were applied on 1st and 2nd instar stages of leatherjackets (Nov. 4, 2011). Treatments 2, 3, 4 and 5 were applied using a compressed air sprayer (20 psi) with Teejet orange flat fan nozzles. Treatment 6 was applied using a 5 litre watering can. The total spray water volume for treatments 2, 3, 4 and 5 was 10 L per 100 m^2 (100 mL/m^2) and 200 L per 100 m^2 (2000 mL/m^2) for Treatment 6 to ensure delivery to the pest location. Treatments 2, 3 and 6 were watered in with 250L per 100 m^2 of water post-treatment. Treatments 4 and 5 were not watered in as recommended by the registrant (Neudorff Canada).

Efficacy Assessments:
Larvae were recovered from each plot by direct harvest from 4 cup-cutter cores (0.1 m diameter x 0.05 m depth) removed in a random pattern on Nov. 25, 2011 (3 weeks after treatment [3 WAT]) and on Dec. 16, 2011(6 WAT). Larval counts were determined from the untreated control of each of the six replications. Replicates 2, 5 and 6 had zero larvae per cup changer therefore those replicates were discarded from the experiment. Larval counts were done only on Replicates 1, 3 and 4 (3 WAT and 6 WAT). Leatherjackets population densities were reported as larvae per cup changer core and per m^2.

RESULTS

There was no insect damage to the turf detected at any time prior to or after treatment application.

Plots were assessed at 1 and 7 days after treatment (DAT) for phytotoxicity effects of the insecticide treatments on the turf. None were detected.

There were significant differences among the treatments for larvae counts. Results of the treatments at the 3 WAT and 6 WAT are shown in Table 2.

Table 2. Post-treatment larval counts taken on two dates in 2011

Treatment Number	Treatment	3 WAT (Nov. 25, 2011)		6 WAT (Dec. 16, 2011)	
		Larvae/core[1]	Larvae/m^2	Larvae/core	Larvae/m^2
1	Control	7.25[2]a	837.73a	5.25a	606.64a
2	Acelepryn	4.42ab	510.38ab	3.42ab	394.80ab
3	Neu1161I	4.42ab	510.38ab	1.58b	182.95b
4	*Bacillus thuringiensis kurstaki*	3.25b	375.54b	3.08ab	356.24ab
5	EPN's	3.08b	356.24b	2.58b	298.50b
6	Neu1138I	2.75b	317.76b	3.08ab	356.24ab

[1]Mean number of larvae per 4 cores. [2]Mean values from Fishers' protected LSD tests. Means with the same letters are not significantly different.

CONCLUSIONS

At 3 WAT, *Bacillus thuringiensis kurstaki,* EPN's and Neu1138I were effective in reducing the populations of first and second instar leatherjackets larvae compared to the untreated control. The level of control amongst those three treatments did not differ significantly from each other (ranging from ~ 55, 57.5 and 62% of the control respectively).

At 6 WAT, only the EPN's and Neu1161I were effective in reducing the populations of first and second instar leatherjackets larvae compared to the untreated control. The level of control between those two treatments did not differ significantly from each other (ranging from ~ 50 and 70% of the control respectively).

None of the experimental bio-control products resulted in phytotoxicity to the turf at 1 or 7 DAT.

ACKNOWLEDGEMENTS

The authors thank the Ontario Turfgrass Research Foundation for support for this study. They also thank Valent Canada for supplying the *Bacillus thuringiensis kurstaki* (DiPel2X), Neudorff Canada for supplying Neu1138I and Neu1161I and Natural Insect Control for supplying the EPN's (*Steinernema feltiae* and *Heterorhabditis bacteriophora*) for this experiment. The authors thank Shahram Sharififar from Natural Insect Control for assistance in applying the nematodes, Erica Gunn for assistance with direct harvesting leatherjackets from cores for post-treatment assessments and Dr. Ken Carey for assistance with the statistical analysis.