WIREWORM MANAGEMENT IN SUGARBEET USING PLANTING-TIME GRANULAR, LIQUID, AND SEED TREATMENT INSECTICIDES

Mark A. Boetel, Professor
Jacob J. Rikhus, Research Specialist
Allen J. Schroeder, Research Specialist

Department of Entomology, North Dakota State University, Fargo, ND

Introduction:

Wireworms occasionally cause significant plant stand and yield loss in Red River Valley (RRV) sugarbeet fields. They also can be problematic for producers in all other sugarbeet production areas of North America. Wireworms are the larval stage of insects commonly referred to as “click beetles”, and about three wireworm species are important pests of several North American field crops. Wireworm infestations are difficult to predict because the most common pest species of this group have between 3- and 5-year life cycles, and populations within an individual field can be at various stages within their life cycle.

For several decades, RRV sugarbeet producers mostly relied on prophylactic applications of planting-time granular insecticides to protect fields from a suite of soil-dwelling insects that threaten the profitability of sugarbeet production, including wireworms, the sugarbeet root maggot, springtails, and white grubs. More recently, growers have also had the option to use a seed-applied or sprayable liquid insecticide to protect crops from soil-inhabiting insect pests. Due to the aforementioned variability and unpredictability of wireworm infestations in North American field crop systems, the current body of literature lacks comprehensive data on the efficacy of insecticides against these pests. This experiment was carried out to compare at-plant granular, liquid, and seed-applied insecticides as tools to control wireworms in sugarbeet.

Materials & Methods:

The site chosen for this experiment was an established grower-owned sugarbeet field near Manvel, ND that had an infestation of about 1.2 wireworms per plant. Plots were planted on 20 June, 2017 by using a 6-row Monosem NG Plus 7x7 planter set to plant at a depth of 1¼ inch and a rate of one seed every 4½ inches of row length. Betaseed 89RR52, a glyphosate-tolerant seed variety, was used for all treatments. Individual treatment plots were two rows (22-inch spacing) wide and 25 feet long, and 20-ft wide tilled alleys were maintained between replicates throughout the growing season. The experiment was arranged in a randomized complete block design with four replications of the treatments. Two-row plots are the preferred experimental unit size in wireworm trials because infestations of these pests are often patchy within a field. As such, a smaller test area increases the likelihood of having a sufficiently uniform wireworm infestation among plots within each block.

Insecticidal seed treatment materials were applied to seed by Germain’s Technology Group (Fargo, ND). Granular insecticide treatments were applied by using band placement (Boetel et al. 2006), which consisted of 5-inch swaths that were delivered through Gandy^{TM} row banders. Output rates of the planting-time standard granular material used this experiment were regulated by using a planter-mounted SmartBox^{TM} computer-controlled insecticide delivery system that was calibrated on the planter immediately before all applications. Mustang Maxx was delivered in 3-inch T-bands over the open seed furrow by using a planter-mounted, CO_2-propelled spray system calibrated to deliver a finished spray volume output of 5 GPA through TeeJet^{TM} 400067E nozzles.

Treatment efficacy was compared for plant stand data and yield parameters because wireworm larval feeding injury causes stand losses that can lead to yield reductions. Stand counts involved counting all living plants within each 25-ft long row. Plant stand counts were taken on 30 June, and 7, 13, and 27 July, 2017, which were 10, 17, 23, and 37 days after planting (DAP), respectively. Raw stand counts were converted to plants per 100 linear row ft for the analysis. Plots were harvested on 9 October by using a 2-row mechanical harvester to collect all beets from both rows of each plot. Subsamples of 12-18 harvested beets were sent to the American Crystal Sugarbeet Quality Laboratory (East Grand Forks, MN) for quality analyses. Stand and yield data were subjected to analysis of variance (ANOVA) using the general linear models (GLM) procedure (SAS Institute, 2008), and treatment means were separated using Fisher’s protected least significant difference (LSD) test at a 0.05 level of significance.

Results and Discussion:

Results from plant stand counts for this trial are shown in Table 1. There were no significant differences among treatments at the initial stand count (10 DAP). However, at the second and third stand count dates (17 and 23 DAP), all insecticide-treated plots had significantly greater numbers of surviving plants than the untreated check plots, and there were no significant differences among insecticide-protected treatments.

Table 1. *Plant stand counts* from evaluation of planting-time granular, liquid, and seed treatment insecticides for wireworm control, Manvel, ND, 2017

Treatment/form.	Placement[a]	Rate (product/ac)	Rate (lb ai/ac)	Stand count[b] (plants / 100 ft)			
				10 DAP[c]	17 DAP[c]	23 DAP[c]	37 DAP[c]
Poncho Beta	Seed		68 g a.i./ unit seed	168 a	213 a	206 a	216 a
Counter 20G	B	5.9 lb	1.2	173 a	209 a	208 a	206 ab
Counter 20G	B	4.5 lb	0.9	173 a	209 a	203 a	196 ab
Mustang Maxx	3" T-band	4 fl oz	0.025	173 a	199 a	200 a	193 ab
NipsIt Inside	Seed	----	60 g a.i./ unit seed	170 a	205 a	200 a	190 b
Counter 20G	B	7.5 lb	1.5	159 a	192 a	199 a	194 ab
Cruiser 5FS	Seed	----	60 g a.i./ unit seed	148 a	190 a	198 a	193 ab
Check	---	----	---	126 a	151 b	148 b	134 c
LSD (0.05)				NS	24.6	25.1	24.2

Means within a column sharing a letter are not significantly (P = 0.05) different from each other (Fisher's Protected LSD test).
[a]B = banded at planting; T-band = 3" swath over open seed furrow at planting; Seed = insecticidal seed treatment
[b]Surviving plant stands were counted on June 30 and on July 7, 13, and 27, 2017 (10, 17, 23, and 37 days after planting, respectively).
[c]DAP = Days after planting

The effects of wireworm feeding on plant roots were more evident by the fourth stand count (37 DAP), when plots planted with Poncho Beta-treated seed had the highest average plant stands in the study. Poncho Beta plots had significantly greater plant stands than the untreated check plots and those planted with NipsIt Inside-treated seed, but they were not statistically different from any other insecticide-treated entry. All insecticide treatments, including NipsIt Inside seed treatment, had significantly greater plant densities per 100 row feet than the untreated check, irrespective of whether they were protected by a planting-time granular, sprayable liquid, or insecticidal seed treatment.

Yield results from this trial are presented in Table 2. All insecticide treatments provided significant increases in both recoverable sucrose yield and root tonnage when compared to yields recorded for the untreated check. There were no significant differences among any of the insecticide-protected treatments, however, plots treated with the lowest rate of Counter 20G (4.5 lb product/ac) generated numerically greater recoverable sucrose than any other insecticide-protected plots in the trial. Revenue benefits from Counter 20G, in comparison to revenue from the untreated check, ranged from $58/ac for the 5.9-lb/ac rate to $110/ac for the 4.5-lb rate. Seed treatment insecticides provided gross economic return increases that ranged from $89/ac in Poncho Beta plots to $111/ac for plots protected by NipsIt Inside. The gross economic return benefit from applying Mustang Maxx averaged $76/ac.

Table 2. *Yield parameters* from evaluation of planting-time granular, liquid, and seed treatment insecticides for wireworm control, Manvel, ND, 2017

Treatment/form.	Placement[a]	Rate (product/ac)	Rate (lb a.i./ac)	Sucrose yield (lb/ac)	Root yield (T/ac)	Sucrose (%)	Gross return ($/ac)
Counter 20G	B	4.5 lb	0.9	6,692 a	26.7 a	14.68 a	544
Counter 20G	B	5.9 lb	1.2	6,516 a	26.7 a	14.40 a	492
Poncho Beta	Seed	----	68 g a.i./ unit seed	6,438 a	25.7 ab	14.63 a	523
Cruiser 5FS	Seed	----	60 g a.i./ unit seed	6,430 a	25.3 bc	14.70 a	538
NipsIt Inside	Seed	----	60 g a.i./ unit seed	6,396 a	25.0 bc	14.83 a	545
Counter 20G	B	7.5 lb	1.5	6,268 a	24.9 bc	14.73 a	515
Mustang Maxx	3" T-band	4 fl oz	0.025	6,146 a	24.3 c	14.73 a	510
Check	---	----	---	5,415 b	21.7 d	14.55 a	434
LSD (0.05)				562.7	1.29	NS	

Means within a column sharing a letter are not significantly (P = 0.05) different from each other (Fisher's Protected LSD test).
[a]B = banded at planting; T-band = 3" swath over open seed furrow at planting; Seed = insecticidal seed treatment

It should be noted that this trial was planted atypically late in the growing season because the trial was initiated subsequent to the grower detecting a wireworm infestation in an established sugarbeet field. As is typical with sugarbeet research plots, this study was also harvested over two weeks earlier in the season than a typical grower field would be harvested. As such, the resulting sucrose yield, root tonnage, and percent sucrose content values are much lower than would be experienced by a commercial producer. However, these findings provide an excellent window into the significance of wireworms as serious sugarbeet pests and effective tools with which to control them.

Overall, the findings from this trial clearly indicate that wireworms can cause significant harm to sugarbeet seedlings, and the effects result in major yield and revenue losses. Effective wireworm management in this late-planted trial resulted in major increases in gross revenue that would have easily paid for the associated investments and provided significant net revenue benefits. As such, growers managing fields with known wireworm infestation histories should consider the use of one of these prophylactic tools to protect their crops.

References Cited:

Boetel, M. A., R. J. Dregseth, A. J. Schroeder, and C. D. Doetkott. 2006. Conventional and alternative placement of soil insecticides to control sugarbeet root maggot (Diptera: Ulidiidae) larvae. J. Sugar Beet Res. 43: 47–63.

SAS Institute. 2008. The SAS System for Windows. Version 9.2. SAS Institute Inc., 2002-2008. Cary, NC.