SEED TREATMENTS AND GRANULAR INSECTICIDES FOR SPRINGTAIL MANAGEMENT IN SUGARBEET

Mark A. Boetel, Associate Professor
Robert J. Dregseth and Allen J. Schroeder, Research Specialists
Ayanava Majumdar, Post-doctoral Research Associate

Department of Entomology
North Dakota State University
Fargo, ND

Introduction:
In recent years, springtails (Collembola) have caused early season stand losses for sugarbeet growers in the central and southern Red River Valley of Minnesota and North Dakota, and in western ND and eastern Montana. These tiny (almost microscopic), blind, and wingless insects usually spend their entire lives below the soil surface (Boetel et al. 2001). Optimal environmental conditions, such as heavy soils, cool and wet weather, and high levels of soil organic matter, can be conducive to buildups of springtail infestations that cause major plant stand reductions and yield losses in sugarbeet. Therefore, long periods of cool and rainy weather after planting can put fields at risk for springtail injury.

Currently, none of the soil insecticides used in sugarbeet are specifically labeled for springtail management in the crop. In 2006, we conducted two experiments to evaluate the performance of conventional granular insecticides and several recently developed insecticidal seed treatments for springtail control in sugarbeet.

Materials & Methods:

Methods common to both trials. These experiments were established on the NDSU experiment farm near Prosper, ND. Plots were planted May 26, 2006 using a 6-row John Deere 71 Flex planter; however, individual treatment plots were 2-rows each. Two-row plots are the preferred size of experimental unit in both springtail and wireworm trials because infestations of these insects are typically patchy and not uniform. Therefore, a smaller test area increases the likelihood of having a uniform infestation within blocks of the test.

Seeds were planted at a depth of 1¼ inches and seed spacing was every 4 3/4 inches. Each plot was 35 ft long, and 25-ft plant-free tilled alleys were maintained between replicates throughout the season. Experiments were arranged in a randomized complete block design with four replications. Granular insecticide treatments were either applied by band (B), modified in-furrow (M), or spoon (S) placement. Banded applications consisted of 5-inch swaths delivered through Gandy™ row banders. Modified in-furrow placement involved dropping granules down a tube over the row but directing the output back away from the seed drop zone and in front of the rear press wheel. This allowed some soil to cover the seed before granules entered the furrow so as to avoid direct insecticide/seed contact and the potential for phytotoxicity. Modified in-furrow placement resulted in delivery of a 2-inch band with the heaviest concentration of insecticide falling directly over the seed row. The spoon is a galvanized metal spoon-like apparatus with flanges on the outside edge to direct the granules in a miniature band over the row. A steel nut/bolt set (no. 10) was inserted in the center of the spoon near its tip with the two metal hex-shaped nuts designed to deflect the heaviest concentration of insecticide laterally to fall along the edge and outside of the furrow. Spoon placement results in a 2.5- to 3-inch miniature band over the row while avoiding the likelihood of granules entering the furrow. Output rates of the granular materials used in these experiments were controlled by using planter-mounted Noble metering units.

Treatment performance was compared using plant stand counts and yield parameters. Stand counts involved counting all living plants within each 35-ft long row. These counts, taken on June 13 and 15 in the granule and seed treatment experiments, respectively, were subsequently converted to plants per 100 linear row ft. Yield data were collected by harvesting both rows of each plot on September 28 using a 2-row mechanical harvester. Subsamples of harvested beets were sent to the American Crystal Sugarbeet Quality Laboratory (East Grand Forks, MN) for quality analyses. All stand count and yield data were subjected to analysis of variance (ANOVA) using the general linear models (GLM) procedure (SAS Institute, 1999), and treatment means were separated using Fisher's protected least significant difference (LSD) test at a 0.05 level of significance.

Methods specific to the respective experiments were as follows:

Study I – Granular Insecticides. Seed variety used in this trial was Van der Have 46519. The objective was to compare registered granular soil insecticides for springtail control using different rates and placement methods. Products evaluated included Counter 15G at low to moderate labeled application rates (5.9, 8, and 10 lb product/acre) and Lorsban 15G at the moderate (10 lb product/acre) rate. Lorsban was tested as a 5-inch band over the row and as a spoon application. Lorsban 15G is not used as a modified in-furrow application because of its high potential for phytotoxicity when applied via that placement method.

Study II – Experimental Seed Treatments. Beta 1305R seed variety, treated with Tachigaren fungicide at 20 g ai/unit (100,000 seeds) was used for all treatments in this experiment. Insecticidal seed treatments evaluated in this trial included the following: Poncho + Beta-Cyfluthrin (at 30:4 and 60:8 g ai/unit seed, respectively), Poncho 600 at 60 g, Cruiser 5FS at 60 g, V-10170 at 60 and 75 g, and V-10170 + Danitol (at 60:7.5 and 60:15 g ai/unit, respectively). Counter 15G, the industry standard in this trial, was applied at rates of 5.9, 8 and 10 lb product/ac, using modified in-furrow or band placement. Seed treatment insecticides were applied to seed by Germain's Technology Group (Fargo, ND).

Results and Discussion:

Study I – *Granular Insecticides.* Major differences in springtail-associated stand loss were observed among treatments in this study (Table 1). Counter 15G performed well in this study, especially when applied at 8 lb product/ac or higher. Impacts of placement method were not statistically significant, although trends suggested that banded and modified in-furrow were slightly more effective at managing springtails. The highest plant stand (i.e., least springtail injury) occurred in plots treated with 10 lb Counter per acre in a band. The plant density in this treatment was 41% higher than the untreated check. The only treatments that failed to provide significant levels of protection when compared with the untreated check were Counter applied via the spoon at the low (5.9 lb) labeled rate, and both Lorsban 15G treatments (banded and spoon applications of 10 lb product/ac). Inconsistencies in performance of the low rate of Counter 15G have been observed in previous testing. Growers planning on using Counter 15G for protection of sugarbeet from springtail injury should apply at least 8 lb/ac. Data from this experiment suggests that banded and modified in-furrow applications are effective placement methods with regard to springtail management; however, banded applications appear to be less likely to have phytotoxic impacts on the plant. Lorsban 15G is not a reliable control material for springtail management in sugarbeet.

Table 1. ***Plant stand counts*** **from evaluation of granular insecticides for springtail control, Prosper, ND, 2006**

Treatment/form	**Placement[a]**	**Rate (product/ac)**	**Rate (lb ai/ac)**	**Stand count (plants / 100 ft) July 13, 2006**
Counter 15G	B	10	1.5	120 a
Counter 15G	M	5.9	0.9	116 ab
Counter 15G	M	8	1.2	115 ab
Counter 15G	M	10	1.5	114 ab
Counter 15G	S	8	1.2	112 abc
Counter 15G	B	8	1.2	112 abc
Counter 15G	B	5.9	0.9	110 abc
Counter 15G	S	10	1.5	107 abc
Counter 15G	S	5.9	0.9	105 a-d
Lorsban 15G	B	10	1.5	98 bcd
Lorsban 15G	S	10	1.5	92 cd
Check	-	-	-	85 d
LSD (0.05)				20

Means within a column sharing a letter are not significantly (P = 0.05) different from each other (Fisher's Protected LSD).
[a]B = Band; M = Modified in-furrow; S = Spoon

Results from yield assessments in this study were reflective of plant stand data. In general, it was demonstrated that Counter is a very effective compound for protection of sugarbeet from economic losses associated with springtail injury. For example, all Counter-based treatments, except the low (5.9 lb) rate applied using the spoon, resulted in significant increases in recoverable sucrose yield and root yield when compared with the untreated check (Table 2). On average, band-treated plots produced about 2.9 tons of root yield more than those that were spoon-treated. The lowest yields in the experiment were observed in plots treated with Lorsban 15G. In fact, Lorsban-treated plots had significantly lower recoverable sucrose and root yield than all Counter treatments except the 5.9-lb spoon application. No statistical differences were observed between Counter 15G rates or placement methods. The top-yielding treatment was Counter 15G applied in a band at 8 lb product/ac. This treatment produced a recoverable sucrose yield of 9,674 and a root yield of 36 tons/ac. The gross economic return of this treatment, $933/ac, was $112 higher than the average return from the untreated check plots. These results are quite remarkable given that the experiment was not planted until May 26.

Table 2. *Yield* parameters from evaluation of granular insecticides for springtail control, Prosper, ND, 2006

Treatment /form	Placement[a]	Rate (product /ac)	Rate (lb ai/ac)	Re-coverable sucrose (lb/ac)	Root yield (T/ac)	Sucrose (%)	Gross return ($/ac)
Counter 15G	B	8	1.2	9674 a	36.0 a	15.38 a	933
Counter 15G	M	10	1.5	9467 a	33.3 ab	15.93 a	989
Counter 15G	S	8	1.2	9341 a	32.1 bc	16.25 a	1007
Counter 15G	B	10	1.5	9316 a	32.8 ab	15.95 a	971
Counter 15G	B	5.9	0.9	9208 a	33.9 ab	15.48 a	903
Counter 15G	M	5.9	0.9	9166 a	33.8 ab	15.45 a	896
Counter 15G	M	8	1.2	9156 a	32.3 ab	15.85 a	954
Counter 15G	S	10	1.5	8994 a	31.9 bc	15.78 a	928
Counter 15G	S	5.9	0.9	8784 ab	31.1bcd	15.85 a	908
Lorsban 15G	B	10	1.5	8089 bc	28.0 d	16.15 a	864
Lorsban 15G	S	10	1.5	8038 bc	28.4 cd	15.93 a	835
Check	-	-			27.6 d	15.93 a	821
LSD (0.05)				891	3.8	NS	

Means within a column sharing a letter are not significantly (*P* = 0.05) different from each other (Fisher's Protected LSD).
[a]B = Band; M = Modified in-furrow; S = Spoon

Study II – *Experimental Seed Treatments.* Similar to the results from the insecticide granule trial, Counter 15G performed well against springtails in this experiment. Banded applications of this material again tended to provide better protection than modified in-furrow applications. The highest plant stand survival, which was recorded in plots treated with Counter banded at 5.9 lb product/ac, was 250% of that in the untreated plots (Table 3). Seed treatments that provided good springtail control included the following: V-10170+Danitol at the high (60:15 g ai/unit) rate, V-10170 at 75 g, Poncho+Beta-cyfluthrin at the high (60:8 g ai/unit) rate, and Cruiser at 60 g. Rate responses were observed in using Poncho+Beta-cyfluthrin and V-10170+Danitol, with the high rates of each of these combination seed treatments resulting in statistically greater plant stand protection than their respective low rates. Similarly, the 75 g rate of V-10170 was superior to the lower (60 g) rate. Moderately poor levels of control were achieved with the following treatments (listed in decreasing order of performance): Poncho 600, V-10170 (60 g), and Poncho+Beta-cyfluthrin at the low (30:4 g ai, respectively) rate.

Table 3. ***Plant stand counts*** **from evaluation of experimental seed treatments for springtail control, Prosper, ND, 2006**

Treatment/form	Placement[a]	Rate (product /ac)	Rate (lb ai/ac)	Stand count (plants / 100 ft)
				June 15, 2006
Counter 15G	B	5.9 lb	0.9 lb	130 a
Counter 15G	B	8 lb	1.2 lb	110 b
V-10170+Danitol	Seed		60+15 g ai/ unit seed	109 bc
V-10170	Seed		75 g ai/ unit seed	100 bcd
Counter 15G	B	10 lb	1.5 lb	99 b-e
Poncho+Beta-cyfluthrin	Seed		60+8 g ai/ unit seed	93 b-f
Counter 15G	M	5.9 lb	0.9 lb	93 b-f
Cruiser	Seed		60 g ai/ unit seed	92 b-g
Counter 15G	M	8 lb	1.2 lb	91 c-g
V-10170+Danitol	Seed		60+7.5 g ai/ unit seed	86 d-g
Poncho 600	Seed		60 g ai/ unit seed	80 efg
V-10170	Seed		60 g ai/ unit seed	79 fg
Poncho+Beta-cyfluthrin	Seed		30+4 g ai/ unit seed	73 g
Check	---	----	---	52 h
LSD (0.05)				19

Means within a column sharing a letter are not significantly (P = 0.05) different from each other (Fisher's Protected LSD).
[a]B = Band; Seed = insecticidal seed treatment; M = Modified in-furrow

In terms of yield, all chemical treatments (i.e., seed and conventional granular) in this experiment resulted in significant improvements in recoverable sucrose yield and root tonnage compared to the untreated check (Table 4). Banded applications of Counter 15G produced outstanding yields, although there were no statistical differences among Counter treatments with respect to application rate or placement method. All Counter treatments produced over 9,100 lb of recoverable sucrose and more than 31 tons of beets per acre. Root yield benefits from Counter ranged between 11 and 13 tons per acre when compared with the untreated check plots in this study. The top-yielding seed treatment was V-10170+Danitol at 60:15 g ai/unit of seed. This treatment yielded over 3,200 lb more recoverable sucrose per acre than the check. The high (75 g) rate of V-10170 was statistically superior terms of root yield to the lower (60 g) rate, with the former producing a 3.5-ton improvement. Although there were no statistical differences in recoverable sucrose yield or root yield between other seed treatments, irrespective of rate, it should be noted that the high (60:8 g) rate of Poncho+Beta-cyfluthrin produced 2.7 tons more root yield than the low rate and 2 tons more per acre than Poncho 600. Major improvements in sucrose and root yield, in addition to gross economic return, were achieved with all seed treatments tested. Economic return benefits from seed treatments ranged from $246 to $375 per acre above the revenue gain in untreated check plots, and benefits from Counter were between $396 and $474 per acre more than from the check. These results underscore the economic significance of springtails as pests and also provide growers with information on effective options for managing these pests in sugarbeet.

Table 4. *Yield parameters* from evaluation of experimental seed treatments for springtail control, Prosper, ND, 2006

Treatment/form	Placement[a]	Rate (product/ ac)	Rate (lb ai/ac)	Re-coverable sucrose (lb/ac)	Root yield (T/ac)	Sucrose (%)	Gross return ($/ac)
Counter 15G	B	5.9 lb	0.9 lb	9810 a	33.6 a	16.35 a	1061
Counter 15G	B	8 lb	1.2 lb	9544 ab	33.2 ab	16.13 a	1010
Counter 15G	B	10 lb	1.5 lb	9364 abc	33.4 a	15.93 a	960
Counter 15G	M	8 lb	1.2 lb	9158 a-d	32.4 abc	15.88 a	949
Counter 15G	M	5.9 lb	0.9 lb	9108 a-d	31.3a-e	16.35 a	983
V-10170 +Danitol	Seed		60+15 g ai/ unit seed	8994 a-f	31.1a-e	16.28 a	962
V-10170	Seed		75 g ai/ unit seed	8877 a-f	31.6a-d	15.88 a	913
Poncho+Beta-cyfluthrin	Seed		60+8 g ai/ unit seed	8614 b-f	30.8a-e	15.85 a	881
V-10170 +Danitol	Seed		60+7.5 g ai/ unit seed	8488 c-f	29.6 cde	16.05 a	897
Cruiser	Seed		60 g ai/ unit seed	8365 c-f	29.9b-d	15.80 a	856
Poncho 600	Seed		60 g ai/ unit seed	8156 def	28.8 de	15.95 a	848

Poncho+Beta-cyfluthrin	Seed		30+4 g ai/ unit seed	8073 ef	28.1 e	16.15 a	855
V-10170	Seed		60 g ai/ unit seed	7977 f	28.1 e	16.05 a	833
Check	---	----	---	5741 g	20.5 f	15.85 a	587
LSD (0.05)				1050	3.4	NS	

Means within a column sharing a letter are not significantly (*P* = 0.05) different from each other (Fisher's Protected LSD).
[a]B = Band; Seed = insecticidal seed treatment; M = Modified in-furrow

References Cited:

Boetel, M. A., R. J. Dregseth, and M. F. R. Khan. 2001. Springtails in sugarbeet: identification, biology, and management. Extension Circular #E-1205, North Dakota State University Coop. Ext. Svc.

SAS Institute. 1999. SAS/STAT user's guide for personal computers, version 8.0. SAS Institute, Inc., Cary, NC.