SPRINGTAIL MANAGEMENT IN SUGARBEET USING GRANULAR, LIQUID, AND SEED TREATMENT INSECTICIDES

Mark A. Boetel, Assistant Professor
Robert J. Dregseth, Research Specialist
Allen J. Schroeder, Research Specialist
Ayanava Majumdar, Graduate Research Assistant

Department of Entomology
North Dakota State University
Fargo, ND

Introduction:

Springtails have caused early season stand losses in several sugarbeet fields in the central and southern Red River Valley of Minnesota and North Dakota, and in western ND and eastern Montana in recent years. These tiny (almost microscopic), blind, and wingless insects usually spend their entire lives below the soil surface. Optimal environmental conditions can be conducive to buildups of springtail infestations that cause major plant stand reductions and yield losses in sugarbeet. Seedlings are most vulnerable to attack by these insects. Problems are most prevalent in fine-textured soils (i.e., clays, clay loams, or silty clays) with high crop residue levels (Boetel et al. 2001). Damaging infestations have often developed in fields where small grain (barley or wheat) was grown in the previous year and post-harvest stubble was not removed from the field (M.A.B., *personal observation*). Moist soil conditions are conducive to springtail flare-ups, and the insects are not adversely impacted by cool weather. 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. Therefore, we conducted three trials to compare the performance of several granular, liquid, and seed treatment insecticides in protecting sugarbeet from springtail injury and associated yield losses.

Materials & Methods:

Methods common to all trials. All three experiments were established in the same commercial sugarbeet field near Kindred, ND. Plots were planted 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. A smaller test area allows for placement of plots over a slightly more uniform infestation than if the test were covering a large area. Seeds were planted at a depth of 1¼ inches and seed spacing was every 4 1/8 inches. The same variety (Crystal 822) was used for all experiments. 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. Springtail control assessments were done by taking plant stand counts at 3 post-planting dates (June 10, July 1, and at harvest on October 5). Treatment performance was also measured according to yields. To collect yield data, both rows of each plot were harvested on October 5 by 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 the Fisher protected least significant difference (LSD) test at a 0.05 level of significance.

Methods specific to the respective experiments were as follows:

Study 1 – Granular Insecticides. This experiment was planted on May 21, 2004 to compare registered granular soil insecticides for springtail control using different rates and placement methods. The 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 high label rate only (13.4 lb product/acre). Lorsban was tested as a 5-inch band over the row and as applied using the spoon placement method. Lorsban 15G is not used as a modified in-furrow application because of the high potential for phytotoxicity.

Study 2 – Experimental Liquid Insecticides. This experiment was also planted on May 21, 2004 at Kindred, ND. It was established to compare the efficacy of Counter 15G and two liquid insecticides, MustangMax and Regent (alone and tank-mixed with 10-34-0 starter fertilizer) for springtail control. Counter 15G was applied at the high (11.9 lb product/acre) labeled rate and at a moderate (10 lb) treatment rate. It was either banded or applied modified in-furrow. All granules were incorporated into the upper 1/8 inch of soil using drag chains attached to the rear of each row unit on the planter.

Output of all planting-time liquid insecticide treatments was regulated by using a planter-mounted Raven ™ spray system. Liquid insecticides evaluated were Regent 4SC (at 1.25, 2.08, 3.20 and 4.16 fl oz product/acre) in-furrow, MustangMAX 0.8EC at 4 fl oz product/acre (as an in-furrow or 3-inch T-band application), and Vydate C-LV 3.77SL at 34 fl oz product/acre in-furrow. Liquid insecticide treatments were applied in a finished spray volume of 5 GPA using TeeJet 6501E nozzles. In-furrow application of liquids was achieved by directing the nozzles such that the entire spray pattern was directed into the furrow over the seed.

Tank-mixes of 10-34-0 starter fertilizer with Mustang (4 fl oz product/acre) and Regent (2.08 and 4.16 fl oz rates) were also evaluated. To establish the starter fertilizer (10-34-0)/insecticide mixtures, the insecticides were initially pre-mixed with water at a ratio of 60:1 (water:insecticide) to minimize the likelihood of having incompatibility or nozzle clogging problems. These treatments were also applied in a spray volume of 5 GPA. A fertilizer control of 10-34-0 at the same ratio of fertilizer:water used in the insecticide treatments was established to monitor for possible yield impacts that could occur independent of the springtails, and an untreated check was also included for comparative purposes.

One entry in this test was a postemergence rescue treatment of MustangMAX 0.8EC at 4 fl oz product/acre to determine if additive treatment banded over the rows would provide measurable levels of control. This treatment followed MustangMax applied at planting as an in-furrow application. Both applications were made a rate of 4 fl oz product/acre. The postemergence application was delivered in a 7-inch band over the row at a finished spray volume of 10 GPA by using TeeJet 4001E nozzles. This treatment was applied on June 25.

Study 3 – Experimental Seed Treatments & Liquid Insecticides. This experiment was carried out to determine the effectiveness of several seed treatments and two liquid insecticides (F-58038, a 2 lb/gallon liquid formulation; and Lorsban 75WG at 0.89 and 1.33 lb product/acre) for springtail control. Planting date for the trial was May 20, 2004. The F-58038 was applied directly into the open seed furrow, and Lorsban 75W was applied in 3-inch T-bands, also over the open furrow. Seed treatments evaluated included Poncho+Cyfluthrin (30+8 and 60+16 grams ai/unit of seed), Poncho+Beta-cyfluthrin (60+8 grams ai/unit), Cruiser (at 60 and 90 g ai/unit), Cruiser+Tefluthrin (at 60+8 g ai/unit of seed), Icon 6.2TS (at 25 and 50 g ai/unit) and an untreated check. The same seed variety (Crystal 822) was used for all seed treatments, conventional insecticide plots, and untreated controls in the experiment. Seed treatments were applied to seed by personnel at ASTEC, Inc. (Sheridan, WY).

Results and Discussion:

Study 1 – Granular Insecticides. Stand count results from this trial are presented in Table 1. All insecticide treatments provided significant levels of plant stand protection when counts were compared with the untreated check. When Counter 15G was applied at 8 lb product/acre, stands were significantly greater in sugarbeet plots that received the modified in-furrow application than in those treated with the spoon application at the same rate. Regardless of application rate, trends indicated a slight advantage to applying Counter by modified in-furrow than banding the material. Applying Lorsban 15G by spoon placement rather than banding resulted in significantly greater plant stand during the first stand count; however, the difference was not significant in the two later plant stand assessments. Generally, Lorsban performed quite poorly at springtail control when banded in this trial

Table 1. *Plant stand counts* in plots treated with registered granular insecticides to control springtails, Kindred, ND, 2004.

Treatment/form.	Placement	Rate (lb product/ac)	Rate (lb ai/ac)	Stand count (plants/100 ft)		
				1st post-plant	2nd post-plant	Harvest
Counter 15G	M	8	1.2	112.1 a	107.0 a	95.4 a
Counter 15G	S	10	1.5	111.8 ab	106.3 a	92.5 ab
Counter 15G	M	5.9	0.9	108.2 abc	102.3 ab	95.0 a
Counter 15G	B	5.9	0.9	107.7 abc	101.4 ab	89.8 ab
Counter 15G	B	8	1.2	105.9 abc	101.4 ab	91.8 ab
Counter 15G	M	10	1.5	104.6 abc	97.3 ab	90.5 ab
Lorsban 15G	S	13.4	2.0	102.0 abc	97.1 abc	86.6 bc
Counter 15G	B	10	1.5	101.3 bc	94.6 bc	91.1 ab
Counter 15G	S	8	1.2	99.8 c	95.7 bc	88.2 ab
Counter 15G	S	5.9	0.9	99.3 c	95.0 bc	88.8 ab
Lorsban 15G	B	13.4	2.0	88.4 d	86.8 c	79.1 c
Check	---	---	---	64.6 e	64.8 d	59.3 d
LSD (0.05)				10.55	10.53	7.66

Yield data from the granular trial for springtail trial appear in Table 2. Two banded treatments (Lorsban 15G at 13.4 lb product/acre and Counter 15G at 5.9 lb) were the only entries in this experiment that failed to provide a significant increase in recoverable sucrose yield when compared with the untreated check. The banded Lorsban treatment also did not achieve a statistical increase in root yield tonnage over the check. Applying Lorsban 15G by using the spoon applicator resulted in 620 lb more recoverable sucrose, and 2.1 more tons of root yield per acre than when it was banded. Counter 15G performed most consistently when applied by using either modified in-furrow or spoon placement, and when used at 8 to 10 lb of product/acre.

Table 2. *Yield parameters* from comparison of registered granular insecticides to control springtails, Kindred, ND, 2004.

Treatment/form.	Placement	Rate (lb product/ac)	Rate (lb ai/ac)	Recoverable sucrose (lb/ac)	Root yield (T/ac)	Sucrose (%)	Gross return ($/ac)
Counter 15G	S	10	1.5	7257 a	23.6 ab	16.55 a	810
Counter 15G	M	8	1.2	7116 ab	24.1 a	16.00 a	764
Counter 15G	M	5.9	0.9	7047 ab	23.5 ab	16.20 a	768
Counter 15G	B	10	1.5	7011 ab	23.6 ab	16.08 a	756
Counter 15G	S	8	1.2	7001 ab	23.4 ab	16.18 a	761
Counter 15G	B	8	1.2	6938 ab	23.2 ab	16.18 a	754
Counter 15G	M	10	1.5	6788 abc	22.8 abc	16.15 a	733
Counter 15G	S	5.9	0.9	6735 abc	22.4 bc	16.25 a	736
Lorsban 15G	S	13.4	2.0	6676 bc	22.7 abc	15.95 a	711
Counter 15G	B	5.9	0.9	6337 cd	21.5 cd	15.98 a	677
Lorsban 15G	B	13.4	2.0	6056 d	20.6 de	15.93 a	646
Check	---	---	---	5864 d	19.8 e	16.08 a	630
LSD (0.05)				7.39	1.7	0.53	

Study 2 – Experimental Liquid Insecticides. Stand count results from this trial indicate that moderate stand protection was achieved with Regent 4SC when it was tank-mixed with 10-34-0 starter fertilizer (Table 3). As observed in the past 2 years of testing, MustangMax performed best when applied at the full (4 fl oz) labeled application rate, and when tank-mixed with 10-34-0 starter fertilizer. It performs inconsistently against springtails when applied as a 3-inch T-band.

Table 3. *Plant stand counts* in plots treated with Counter, Regent, Mustang, and Vydate insecticides at planting to control springtails in sugarbeet, Kindred, ND, 2004.

Treatment/form.	Placement	Rate (product/ac)	Rate (lb ai/ac)	Stand count (plants/100 ft)		
				1st post-plant	2nd post-plant	Harvest
Counter 15G	M	11.9 lb	1.8	114.8 a	110.0 a	105.0 a
Counter 15G	B	11.9 lb	1.8	112.5 ab	109.5 a	96.6 ab
Regent 4SC	IF	4.16 fl oz		111.1 abc	105.4 ab	92.9 ab
Counter 15G	M	10 lb	1.5	110.9 abc	103.9 ab	96.4 ab
Counter 15G	B	10 lb	1.5	110.5 abc	110.0 a	93.2 ab
Regent 4SC+ 10-34-0 Fert.	IF	2.08 fl oz		110.0 abc	106.3 ab	94.8 ab
MustangMAX 0.8EC + MustangMAX 0.8EC	IF 7” Band	4.0 fl oz 4.0 fl oz	0.025 0.025	109.1 abc	103.9 ab	95.7 ab
MustangMAX 0.8EC+ 10-34-0 Fert.	IF	4.0 fl oz	0.025	109.0 abc	106.3 ab	94.6 ab
Regent 4SC	IF	2.08 fl oz		105.5 a-d	103.0 ab	95.4 ab
MustangMAX 0.8EC	IF	4.0 fl oz	0.025	104.3 a-d	100.7 abc	93.8 ab
Counter 15G	M	5.9 lb	0.9	104.3 a-d	100.9 abc	89.3 bc
Regent 4SC	IF	3.2 fl oz		99.5 a-e	95.5 bc	86.4 bcd
MustangMAX 0.8EC	3” TB	4.0 fl oz	0.025	96.3 b-e	95.4 bc	89.3 bc
Regent 4SC	IF	1.25 fl oz		95.9 cde	89.8 cd	78.6 cde
Regent 4SC+ Fert. 10-34-0	IF	4.16 fl oz		92.3 def	107.1 ab	99.1 ab
Vydate 3.77SL	IF	34 fl oz	1.0	83.6 efg	82.0 de	75.9 de
10-34-0 Fert.	IF	---	---	78.2 fg	79.3 de	70.9 e
Untreated	---	---	---	73.0 g	76.4 e	67.0 e
LSD (0.05)				16.58	12.93	13.06

Yield data appear in Table 4. Plots treated with Regent at the high (4.16 fl oz) rate and tankmixed with 10-34-0 starter fertilizer yielded numerically more recoverable sucrose and tons per acre of root yield than any other liquid insecticide treatment in the study, although the differences were not always significant. Tank-mixing Regent with the fertilizer did, however, result in a major (947-lb) improvement in recoverable sucrose yield. The difference amounted to an increase of $120 per acre in gross economic return. A similar trend in increased yield was observed by mixing the reduced rate (2.08 fl oz/acre) with starter fertilizer; however, the difference was not significant.

Table 4. ***Yield parameters*** **from plots treated with Counter, Regent, Mustang, and Vydate insecticides at planting to control springtails in sugarbeet, Kindred, ND, 2004.**							
Treatment/form.	**Placement**	**Rate (product/ac)**	**Rate (lb ai/ac)**	**Recoverable sucrose (lb/ac)**	**Root yield (T/ac)**	**Sucrose (%)**	**Gross return ($/ac)**
Regent 4SC+ 10-34-0 Fert.	IF	4.16 fl oz		7478 a	25.0 a	16.23 a	813
Counter 15G	M	10 lb	1.5	6965 ab	23.6 ab	16.00 a	747
Counter 15G	B	11.9 lb	1.8	6942 ab	23.6 ab	15.95 a	739
Counter 15G	M	5.9 lb	0.9	6873 abc	23.4 ab	15.93 a	734
Counter 15G	B	10 lb	1.5	6863 abc	23.3 ab	15.98 a	734
10-34-0 Fert.	IF	---	---	6804 bc	23.1 b	16.05 a	728
MustangMAX 0.8EC+ 10-34-0 Fert.	IF	4.0 fl oz	0.025	6752 bc	23.1 b	15.90 a	716
Counter 15G	M	11.9 lb	1.8	6751 bc	22.6 bc	16.23 a	734
Regent 4SC	IF	3.2 fl oz		6678 bc	22.5 bc	16.08 a	719
MustangMAX 0.8EC	IF	4.0 fl oz	0.025	6668 bc	22.4 bc	16.05 a	719
Vydate 3.77SL	IF	34 fl oz	1.0	6626 bcd	21.8 bcd	16.40 a	732
Regent 4SC	IF	4.16 fl oz		6531 bcd	22.3 bc	15.88 a	693
MustangMAX 0.8EC	3” TB	4.0 fl oz	0.025	6513 bcd	22.3 bc	15.85 a	690
Regent 4SC+ 10-34-0 Fert.	IF	2.08 fl oz		6507 bcd	23.0 bc	15.50 a	666
MustangMAX 0.8EC+ MustangMAX 0.8EC	IF 7” Band	4.0 fl oz 4.0 fl oz	0.025 0.025	6480 bcd	22.3 bc	15.83 a	682
Regent 4SC	IF	2.08 fl oz		6266 cde	21.1 cde	16.08 a	676
Regent 4SC	IF	1.25 fl oz		5994 de	20.3 de	16.08 a	644
Untreated	---	---	---	5671 e	19.7 e	15.68 a	591
LSD (0.05)				652	1.9	0.68	

In considering both stand protection and yield variables, Counter 15G provided more consistent control than most of the liquid insecticide treatments; however, MustangMax was not outperformed in plant stand protection, sucrose yield, or root tonnage by any application of Counter in the entire study. Our findings suggest that MustangMax is can be an effective tool for managing springtails in Red River Valley sugarbeet if tank-mixed with 10-34-0 starter fertilizer and applied directly in-furrow. This is consistent with results from our previous trials. A few reports of unsatisfactory Mustang performance for springtail control have been received from growers during the 2003 and 2004 field seasons. It is possible that the reason for some of the discrepancy between those cases and our replicated trials is that MustangMax has usually been applied by using a pressurized nozzle/spray delivery system in the university trials rather than the microtube system that some growers use. It should also be pointed out that the spray output rate of Raven application systems should be confirmed on a daily basis to ensure that the proper volume is being dispensed.

Vydate did not appear to have sufficient activity against springtails in this trial. This was a consistent finding in considering both stand count comparisons and yield parameters.

Study 3 – Experimental Seed Treatments & Liquid Insecticides. All treatments except Cruiser at the high (90 g ai/unit of seed) resulted in significant levels of plant stand protection (Table 5). The experimental liquid insecticide F-58038 provided numerically the best stand protection in the entire test when applied at 19.2 fl oz/acre. Stands in plots treated with this experimental material were significantly higher than those treated with Counter 15G at 10 lb product/acre. The Cruiser (60 g), Cruiser+Tefluthrin, Icon, Poncho+Cyfluthrin and Poncho+Beta-cyfluthrin seed treatments also produced encouraging results with regard to plant stands. Icon, another experimental seed treatment, appeared to have good activity against springtails as well. Plots that received the 50 g (ai/unit) rate of Icon-treated seed had plant stands that were statistically greater than untreated check plots and those treated at planting with Counter 15G. Lorsban 75W provided moderate suppression from stand losses due to springtail feeding, but the difference did not cause a significant increase in root yield above that of the untreated check.

Table 5. *Plant stand counts* from comparison of seed treatments, liquid insecticides, and conventional treatments for control of springtails in sugarbeet, Kindred, ND, 2004

Treatment/form.	Placement	Rate (product/ac)	Rate (ai/ac)	Stand count (plants/100 ft)		
				1st post-plant	2nd post-plant	Harvest
F-58038 2 lb/gal liquid	IF	19.2 fl oz	0.30 lb	112.6 a	96.7 abc	91.2 a-d
Poncho+Beta-cyfluthrin	Seed		60+8 g ai/ unit	111.0 ab	96.4 abc	99.1 a
Icon 6.2 TS	Seed		50 g ai/ unit	110.2 ab	107.1 a	94.1 ab
Poncho+Cyfluthrin	Seed		30+8 g ai/ unit	109.1 ab	101.0 abc	93.3 abc
Icon 6.2 TS	Seed		25 g ai/ unit	105.0 abc	102.6 ab	88.3 a-d
Poncho+Cyfluthrin	Seed		60+16 g ai/ unit	102.9 abc	101.0 abc	93.3 abc
Cruiser+Tefluthrin	Seed		60+8 g ai/ unit	101.0 abc	96.2 abc	80.7 d
Cruiser	Seed		60 g ai/ unit	100.7 abc	93.1 abc	93.1 abc
Lorsban 75WG	3" TB	0.89 lb	---	99.5 abc	93.1 bc	82.9 bcd
Lorsban 75WG	3" TB	1.33 lb	---	97.9 bc	88.6 c	81.9 cd
Counter 15G	B	10 lb	1.5 lb	91.4 c	89.1 c	85.2 bcd
Untreated	---	---	---	58.8 d	68.6 d	59.8 e
Cruiser	Seed		90 g ai/ unit	47.4 d	52.9 e	53.1 e
LSD (0.05)				10.1	9.45	8.07

All Poncho-based seed treatments produced root yield benefits of 2 tons or more per acre when compared with untreated plots or even those treated with a planting-time application of Counter 15G (Table 6). Also, the Cruiser (60 g) and Poncho+Beta-cyfluthrin seed treatments, as well as F-58038, the experimental liquid, resulted in significant increases in root yield when compared with either Counter 15G or the untreated check. All experimental materials except the high (90 g) rate of Cruiser demonstrated good potential as springtail management tools. The 90-g rate of Cruiser may be phytotoxic to sugarbeet seedlings. Future research should examine the impacts of different seed coating and pelleting technologies on safening the seed treatments and possibly improving the potential treatment rates. It should be noted that the Counter treatment (10 lb product/acre) used in this study is a moderate rate and is included for comparative purposes; however, a higher rate (11.9 lb) is also labeled for use in sugarbeet.

Table 6. *Plant stand counts* from comparison of seed treatments, liquid insecticides, and conventional treatments for control of springtails in sugarbeet, Kindred, ND, 2004

Treatment/form.	Placement	Rate (product/ac)	Rate (ai/ac)	Recoverable sucrose (lb/ac)	Root yield (T/ac)	Sucrose (%)	Gross return ($/ac)
Cruiser	Seed		60 g ai/ unit	6738 a	23.6 ab	15.6 a	696
Lorsban 75WG	3" TB	0.89 lb		6267 a	22.3 abc	15.4 a	636
F-58038 2 lb/gal liquid	IF	19.2 fl oz	0.30 lb	6218 a	24.2 a	14.5 a	560
Poncho+Cyfluthrin	Seed		60+16 g ai/ unit	5998 a	22.7 abc	14.7 a	561
Poncho+Beta-cyfluthrin	Seed		60+8 g ai/ unit	5995 a	23.1 ab	14.6 a	546
Icon 6.2 TS	Seed		50 g ai/ unit	5917 a	22.4 abc	14.8 a	552
Icon 6.2 TS	Seed		25 g ai/ unit	5909 a	21.7 bc	15.1 a	575
Lorsban 75WG	3" TB	1.33 lb	---	5889 a	21.5 bc	15.2 a	579
Cruiser+Tefluthrin	Seed		60+8 g ai/ unit	5846 a	21.9 abc	14.9 a	554
Poncho+Cyfluthrin	Seed		30+8 g ai/ unit	5776 a	22.5 abc	14.5 a	518
Counter 15G	B	10 lb	1.5 lb	5556 a	20.3 cd	15.1 a	543
Untreated	---	---	---	5526 a	20.4 cd	15.2 a	536
Cruiser	Seed		90 g ai/ unit	5142 a	18.6 d	15.2 a	511
LSD (0.05)				NS	2.4	NS	

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.