CONTROL OF SUBTERRANEAN SPRINGTAILS IN SUGARBEET USING GRANULAR, LIQUID, AND SEED TREATMENT INSECTICIDES

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Introduction:

Springtails belong to the order Collembola, a group of organisms that is so unique that they are considered non-insects by many experts. Subterranean (soil-dwelling) springtails have been a regular pest of sugarbeet for many growers in the central and southern Red River Valley (RRV) of Minnesota and North Dakota for over a decade. Producers in western ND and eastern Montana also frequently have problems with springtails. These tiny, nearly microscopic, blind, and wingless insects spend their entire lives below the soil surface (Boetel et al. 2001).

Although subterranean springtails are present in many fields throughout the RRV, they only occasionally become a major pest problem. Subterranean springtails thrive in heavy soils with high levels of soil organic matter. Cool and wet weather can be conducive to buildups of springtail infestations because such conditions slow sugarbeet seed germination and seedling development, which renders plants extremely vulnerable to attack by springtails that are not negatively impacted by cool temperatures. Therefore, these pests can cause major stand and yield losses. We conducted two experiments to evaluate the performance of conventional granular insecticides, at-plant liquid materials, and several recently developed insecticidal seed treatments for springtail control in sugarbeet.

Materials & Methods:

These experiments were established on the NDSU experiment farm near Prosper, ND. Plots were planted 23 May, 2008 using a 6-row John Deere 71 Flex planter; however, individual treatment plots were 2-rows wide. Two-row plots are the preferred experimental unit size in both springtail and wireworm trials because infestations of these insects are typically patchy and not uniform. A smaller test area increases the likelihood of having a sufficiently uniform springtail infestation among plots within each block.

Van der Have 46519 seed was used for both experiments in this project. 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. Seed treatment insecticides were applied to seed by Germain's Technology Group (Fargo, ND). Granular insecticide treatments were either applied by using band (B), modified in-furrow (M), or spoon (S) placement (Boetel et al. 2006). Banded applications consisted of 5-inch swaths delivered through Gandy™ row banders. Modified in-furrow placement involved dropping granules down a conventional in-furrow tube over the row but directing the output back away from the seed drop zone and in front of the rear press wheel. This placement allowed some soil to cover the seed before granules entered the furrow, which helps avoid direct insecticide/seed contact and the potential for phytotoxicity. Modified in-furrow placement resulted in delivery of a 2-inch swath of granules over the row, with the heaviest concentration of insecticide falling directly over the seed furrow. The spoon device 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 bolt (no. 10 size) is inserted at the center of the spoon near its tip with two metal hexagonal nuts attached to the bolt to deflect most insecticide granules laterally so they fall immediately outside of the seed furrow. Output rates of the granular materials used in these experiments were regulated by using planter-mounted Noble™ metering units. Liquids were applied using a planter-mounted Raven spray system. Output volume was 5 GPA, which was delivered in 5-inch T-bands using TeeJet 8001EVS nozzles.

Efficacy of the treatments was compared by using plant stand counts and yield parameters because subterranean springtails cause stand losses that lead to yield reductions. Stand counts involved counting all living plants within each 35-ft long row. Counts were taken on 1 July and converted to plants per 100 linear row ft. Yield data were collected by harvesting both rows of each plot on 29 September using a 2-row mechanical harvester. Subsamples of 12-18 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.

Results and Discussion:

Study I: Stand count data for this experiment are presented in Table 1. All insecticidal treatments, irrespective of active ingredient, application rate, placement method, or formulation (i.e., granular versus seed treatment), provided significant reductions in springtail injury when compared to the untreated check. No statistical differences in stand counts were detected among seed treatment entries in this study. Similarly, there were no significant differences among rates or placement methods when Counter 15G was used. This finding is consistent with those from springtail control trials in previous years. F6551 2EC, an experimental liquid insecticide, provided stand protection from springtails that was not significantly different from that of any rate of Counter 15G or any of the seed treatment entries in the study. The banded application of Counter 15G, applied at 5.9 lb product/ac, resulted in the highest average stand counts in this experiment. Also, it outperformed the following entries in this study with regard to stand protection: Poncho+betacyfluthrin (30+4 g a.i./100,000 seeds), Poncho Beta (68 g), Cruiser (60 g), Lorsban 75WG (0.89 and 1.33 lb product/ac), and the experimental at-plant liquid, HGW86.

Table 1. ***Plant stand counts*** **from evaluation of insecticidal seed treatments and planting-time granular and liquid insecticides for springtail control, Study I, Prosper, ND, 2008**

Treatment/form.	Placement[a]	Rate (product/ac)	Rate (lb a.i./ac)	Stand count (plants / 100 ft.)
Counter 15G	B	5.9 lb	0.9	213 a
Counter 15G	B	10 lb	1.5	208 ab
Counter 15G	S	5.9 lb	0.9	208 ab
V-10170-29	Seed		60 a.i./unit	204 ab
Counter 15G	B	8 lb	1.2	203 ab
Counter 15G	S	8 lb	1.2	201 ab
F6551 2EC	5" TB	38.4 fl oz		201 ab
V-10170-13	Seed		60 a.i./unit	196 ab
Cruiser	Seed		30 a.i./unit	195 ab
Poncho Beta	Seed		68 g a.i./ unit seed	193 b
Poncho+betacyfluthrin	Seed		30+4 g a.i./ unit seed	191 bc
Cruiser	Seed		60 a.i./unit	190 bc
Lorsban 75WG	5" TB	1.33	1.0	174 cd
Lorsban 75WG	5" TB	0.89	0.67	170 de
HGW86	5" TB		0.13	155 e
Check	---	----	---	136 f
LSD (0.05)				18

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 = seed treatment; S = spoon; TB = T-band over open seed furrow

Yield data for Study I are presented in Table 2. The results from yield assessments corresponded well with the stand count data. The only insecticide treatments that did not provide significant benefits in recoverable sucrose yield when compared with the untreated check were Poncho+betacyfluthrin (30+4 g), Counter 15G (8 lb product/ac via spoon placement, HGW86 20SC, and the high (1.33 lb product/ac) rate of Lorsban 75WG. Banded applications of Counter 15G resulted in excellent sucrose and root yields, irrespective of rate, and tended to produce the highest sucrose and root yields. No differences were detected among the insecticidal seed treatments with respect to recoverable sucrose or sugarbeet root tonnage. The top-yielding treatment in this study, Counter 15G banded at 10 lb product/ac, also produced the greatest revenue ($779 per acre). The increase in revenue from this entry was $275 per acre above that of the untreated check. This finding clearly demonstrates the importance of subterranean springtails as sugarbeet pests.

Table 2. ***Yield parameters*** **from evaluation of insecticidal seed treatments and planting-time granular and liquid insecticides for springtail control, Study I, Prosper, ND, 2008**

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 15G	B	10 lb	1.5	7406 a	28.5 a	14.10 a-d	779
Counter 15G	B	5.9 lb	0.9	7071 ab	26.7 abc	14.28 abc	761
V-10170-1729	Seed		60 a.i./unit	7034 abc	27.2 ab	14.03 bcd	734
Counter 15G	B	8 lb	1.2	6969 abc	26.3 abc	14.33 abc	750
Poncho Beta	Seed		68 g a.i./ unit seed	6866 abc	26.0 abc	14.43 ab	752
Cruiser 5FS	Seed		30 a.i./unit	6805 abc	25.2 a-d	14.53 a	751
V-10170-1713	Seed		60 a.i./unit	6588 a-d	24.8 a-d	14.35 abc	713
Cruiser 5FS	Seed		60 a.i./unit	6586 a-d	25.4 abc	14.00 bcd	688
Lorsban 75WG	5” TB	0.89	0.67	6386 a-d	24.9 a-d	13.88 cd	657
F6551 2EC	5” TB	38.4 fl oz		6375 a-d	24.6 bcd	14.10 a-d	669
Counter 15G	S	5.9 lb	0.9	6187 bcd	24.0 bcd	14.05 a-d	643
Poncho+betacyfluthrin	Seed		30+4 g a.i./ unit seed	6080 b-e	23.8 b-e	13.90 cd	624
Counter 15G	S	8 lb	1.2	6059 b-e	24.0 bcd	13.78 d	613
HGW86 20SC	5” TB		0.13	5982 cde	23.2 cde	14.00 bcd	622
Lorsban 75WG	5” TB	1.33	1.0	5590 de	22.0 de	14.03 bcd	585
Check	---	----	---	5047 e	20.1 e	13.73 d	504
LSD (0.05)				1086	3.8	0.48	

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 = seed treatment; S = spoon; TB = T-band over open seed furrow

Study II: Stand count data for Study II are presented in Table 3. Differences in stand count means for this experiment were not as pronounced as those in Study I. The untreated check plots averaged only 20 plants per 100 ft less than plots treated with a modified in-furrow application of Counter 15G at 8 lb product/ac, which had the highest average stand counts in the study. Although this suggests that a somewhat low springtail infestation was present during this trial, all Counter 15G treatments, irrespective of rate or placement technique, resulted in significant reductions in stand losses associated with springtail feeding injury. There were no significant differences in plant stands among insecticide treatments in this study.

Yield data for Study II appear in Table 4. Significant improvements in recoverable sucrose yield and sugarbeet root yield occurred as a result of the following applications of Counter 15G: 1) 5.9 lb modified in-furrow; 2) 5.9 lb banded; and 3) 8 lb banded. Yield differences among Counter 15G rates and placement methods were rare. However, when modified in-furrow placement was used to apply Counter, plots treated with the low (5.9 lb product/ac) rate yielded significantly greater recoverable sucrose and root tonnage than those that received the high (10 lb) rate via modified in-furrow. The low rate of Counter also resulted in a higher root yield than the 8 lb application rate when the insecticide was applied modified in-furrow. The highest gross economic return was also achieved by applying the low rate of Counter using spoon placement. This treatment grossed $103 more revenue per acre than the untreated check. This demonstrates the impact that even moderately low springtail infestations can have on sugarbeet yield and revenue in the absence of adequate control. Trends toward reduced recoverable sucrose and sugarbeet root yields were most evident when Counter was applied at the highest rate in the study (10 lb product/ac) using either modified in-furrow or spoon placement. Root yield in plots treated with band applications of the low (5.9 lb) rate of Counter was statistically lower than when the same rate was applied modified in-furrow.

Table 3. *Plant stand counts* from evaluation of placement method and application rate effects on performance of Counter 15G for springtail control, Study II, Prosper, ND, 2008

Treatment/form.	Placement[a]	Rate (product/ac)	Rate (lb a.i./ac)	Stand count (plants / 100 ft.)
Counter 15G	M	8 lb	1.2	209 a
Counter 15G	M	5.9 lb	0.9	206 a
Counter 15G	S	8 lb	1.2	204 a
Counter 15G	S	10 lb	1.5	204 a
Counter 15G	S	5.9 lb	0.9	203 a
Counter 15G	B	8 lb	1.2	201 a
Counter 15G	B	10 lb	1.5	200 a
Counter 15G	B	5.9 lb	0.9	199 a
Counter 15G	M	10 lb	1.5	199 a
Check	---	----	----	179 b
LSD (0.05)				12

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 = Seed treatment; S = Spoon; TB = T-band over open seed furrow

Table 4. *Yield parameters* from evaluation of placement method and application rate effects on performance of Counter 15G, Study II, Prosper, ND, 2008

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 15G	M	5.9 lb	0.9	6431 a	25.5 a	13.73 a	647
Counter 15G	S	5.9 lb	0.9	6390 ab	24.8 ab	13.88 a	661
Counter 15G	B	8 lb	1.2	6268 ab	25.0 abc	13.83 a	642
Counter 15G	S	8 lb	1.2	6020 abc	23.3 a-d	14.03 a	628
Counter 15G	B	10 lb	1.5	5968 abc	22.6 bcd	14.20 a	639
Counter 15G	M	8 lb	1.2	5825 abc	22.8 bcd	13.90 a	597
Counter 15G	B	5.9 lb	0.9	5820 abc	22.5 bcd	14.03 a	608
Counter 15G	S	10 lb	1.5	5792 bc	23.4 a-d	13.58 a	566
Counter 15G	M	10 lb	1.5	5594 c	22.2 cd	13.78 a	564
Check	---	----	----	5439 c	21.3 d	13.90 a	558
LSD (0.05)				622	2.5	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

Conclusions:

The results from this year's two trials support our findings on chemical control of springtails in sugarbeet from previous years. Our research suggests that Counter 15G, V-10170, Poncho Beta, and Cruiser 5FS all appear to be capable of providing good protection from stand reductions and associated yield losses from subterranean springtail feeding injury. Occasionally, in the absence of insect damage or under low feeding pressure from soil insects such as springtails or sugarbeet root maggot, reduced yields have occurred as an apparent result of moderate crop injury from modified in-furrow applications of Counter 15G at higher rates (i.e., 10 lb product/ac and above). Modified in-furrow placement should not be used to apply this material at rates above 8 lb product/ac for control of subterranean springtails or other occasional soil pests such as wireworms and white grubs. Our research also suggests that no more than 8 lb product/ac of Counter 15G is needed for springtail management, irrespective of whether the product is applied using band, spoon, or modified in-furrow placement. Overall, the data from this research identifies effective tools for controlling subterranean springtails, underscores the significance of springtails as economic pests of sugarbeet, and demonstrates the value of good springtail management.

References Cited:

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