# SPRINGTAIL CONTROL IN SUGARBEET USING GRANULAR, SPRAYABLE LIQUID, AND SEED-APPLIED INSECTICIDES

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## Introduction:

Subterranean (soil-dwelling) springtails have been recognized as major pests of sugarbeet in the Red River Valley (RRV) of Minnesota and North Dakota since the late-1990s. They are capable of causing serious crop damage associated with early season plant injury and, occasionally, major plant stand losses. Springtails belong to the order Collembola, a group of organisms that resemble insects, but are so unique that they are not considered true insects. These tiny, nearly microscopic, blind, and wingless pests spend their entire lives below the soil surface (Boetel et al. 2001).

Although subterranean springtails are present in many fields throughout the sugarbeet production areas of North Dakota and Minnesota, the occurrence of damaging infestations tends to be spotty and is most commonly associated with heavy-textured, high organic matter soils. Persistently cold and wet spring weather conditions can be conducive to springtail infestation buildups, because those conditions slow sugarbeet seed germination and seedling development, rendering plants more vulnerable to attack by springtails. This research was conducted to evaluate the performance of a conventional granular insecticide, an at-plant liquid insecticide, and three neonicotinoid insecticidal seed treatments for springtail control in sugarbeet.

## Materials & Methods:

This field experiment was established on the NDSU Experiment Farm near Prosper, ND. Plots were planted on July 7, 2023 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 8018 CR+, a glyphosate- and Cercospora leaf spot-tolerant seed variety, was used for all treatments.

Individual treatment plots were two rows (22-inch spacing) wide and 25 feet long, and 25-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 springtail trials because infestations of these pests are typically patchy in distribution. Therefore, a smaller test area increases the likelihood of having a sufficiently uniform springtail infestation among plots within each test replicate.

Granular insecticide treatments were applied by using band placement (Boetel et al. 2006), which consisted of 5-inch swaths that were delivered through Gandy™ row banders. Output rates of the planting-time standard granular material used this experiment were regulated by using a planter-mounted SmartBox™ electronic insecticide delivery system that was calibrated on the planter immediately before all applications. Midac FC and Mustang Maxx were applied by using dribble in-furrow (DIF) placement through microtubes directed into the open seed furrow. Delivery of planting-time liquid insecticides was achieved by using a planter-mounted, $CO_2$-propelled spray system calibrated to deliver a finished spray volume output of 5 GPA. Teejet® No. 20 orifice plates were installed inline within check valves to achieve the correct spray output volume. The postemergence application of Movento HL was delivered in 10-inch bands by using a $CO_2$-propelled spray system that was mounted on a tractor-drawn four-row toolbar. The insecticide was lightly incorporated into the soil with two pairs of metal rotary tines straddling each row. One pair of tines was positioned ahead of each bander, and a second was mounted behind it. The spray system was calibrated to at a finished spray volume output of 10 GPA through Teejet® 8001E nozzles.

Treatments were compared according to surviving plant stands and yield parameters because subterranean springtails can cause stand reductions that lead to yield loss. Stand counts involved counting all live plants in both 25-ft long rows of each plot. Stands were counted July 28, and August 4 and 11, 2023 (i.e., 14, 21, and 28 days after planting [DAP], respectively). Raw stand counts were converted to plants per 100 linear row ft for the analysis.

Harvest operations, which were conducted on October 10, involved initially removing the foliage from all plots by using a commercial-grade mechanical defoliator immediately (i.e., between 10 and 60 minutes) beforehand. Plots were harvested by using a 2-row mechanical harvester to collect all beets from both rows of each plot.

Representative subsamples of 12-18 randomly selected beets were sent to the American Crystal Sugarbeet Quality Laboratory (East Grand Forks, MN) for quality analyses. All stand and yield data were subjected to analysis of variance (ANOVA) using the general linear models (GLM) procedure (SAS Institute, 2012), and treatment means were separated using Fisher's protected least significant difference (LSD) test at a 0.1 level of significance.

**Results and Discussion:**

Data from counts of surviving plant stands for this trial are presented in Table 1. Results from the first stand count date (14 DAP), indicated that the treatment combination of Poncho Beta insecticidal seed treatment plus a planting-time application of Mustang Maxx at 4 fl oz per acre resulted in the highest number of surviving plants in the trial. Similarly, plots treated with the high (8.9 lb product/ac) rate of Counter 20G had the second-highest stand counts, and those counts were not statistically different from those in plots protected by the Poncho Beta/Mustang Maxx combination. These same results for those two treatments also occurred during the 21- and 28-DAP counts. Additionally, at every stand count date, the plant densities in plots treated with Poncho Beta/Mustang Maxx combination were significantly greater than those in any other treatment, except those in plots treated with Counter 20G at the 8.9-lb rate.

It should be noted that, although plots treated with Counter at its high (8.9 lb product/ac) rate resulted in surviving plant stands that were not significantly different from the top-performing treatment in the experiment (i.e., Poncho Beta + Mustang Maxx), there were no statistically significant differences in plant stands between any of the Counter 20G treatments, irrespective of application rate.

One encouraging result from the stand count data involved the combination of Poncho Beta seed treatment plus a postemergence 10-inch band of Movento HL. Plots protected by this treatment had the 3rd-highest stands at all stand count dates, and it was the only other treatment (other than Poncho Beta + Mustang Maxx and the high rate of Counter 20G) that resulted in significantly greater plant densities than the untreated check at the 14 DAP count.

The 4th-ranked treatment in the trial, according to surviving plant stands, involved a combination of Poncho Beta plus a planting-time DIF application of Midac FC at 13.6 fl oz per acre. When assessments were made at 21 and 28 DAP, it was the only other treatment (in addition to the three above-mentioned treatments) that resulted in surviving plant stands that were statistically greater than those in the untreated check plots. Less-than-desired performance, with regard to plant stand protection, mostly involved single-component insecticide treatments, including Midac FC, Poncho Beta, and the two lower rates of Counter 20G (i.e., 4.5 and 5.9 lb product/ac).

**Table 1.** ***Plant stand counts*** **from an evaluation of planting-time granular, liquid, and seed treatment insecticides, and a postemergence sprayable liquid for springtail control, Prosper, ND, 2023**

| Treatment/form. | Placement$^{a}$ | Rate (product/ac) | Rate (lb a.i./ac) | Stand count$^{b}$ (plants / 100 ft) | | |
|---|---|---|---|---|---|---|
| | | | | 14 DAP$^{c}$ | 21 DAP$^{c}$ | 28 DAP$^{c}$ |
| Poncho Beta +<br>Mustang Maxx | Seed<br>DIF | 4 fl oz | 68 g a.i./ unit seed | 146.5 a | 152.0 a | 155.0 a |
| Counter 20G | B | 8.9 lb | 1.5 | 122.0 ab | 128.5 ab | 126.5 ab |
| Poncho Beta +<br>Movento HL | Seed<br>10" Post B | 2.5 fl oz | 68 g a.i./ unit seed | 96.5 bc | 100.5 bc | 102.0 bc |
| Poncho Beta +<br>Midac FC | Seed<br>DIF | 13.6 fl oz | 68 g a.i./ unit seed<br>0.18 | 92.5 bcd | 99.0 bc | 98.0 bc |
| Mustang Maxx | DIF | 4 fl oz | | 86.0 bcd | 94.5 bcd | 95.5 bcd |
| Counter 20G | B | 5.9 lb | 1.2 | 84.0 bcd | 93.0 bcd | 94.5 bcd |
| Counter 20G | B | 4.5 lb | 0.9 | 82.0 bcd | 79.5 cd | 82.0 bcd |
| Poncho Beta | Seed | | 68 g a.i./ unit seed | 66.5 cd | 68.0 cd | 76.5 bcd |
| Midac FC | DIF | 13.6 fl oz | 0.18 | 68.0 cd | 70.5 cd | 72.0 cd |
| Check | --- | --- | --- | 47.5 d | 46.5 d | 47.0 d |
| LSD (0.1) | | | | 48.0 | 48.4 | 50.13 |

Means within a column sharing a letter are not significantly ($P$ = 0.1) different from each other (Fisher's Protected LSD test).

[a] Seed = insecticidal seed treatment; B = 5-inch band at planting; DIF = dribble in-furrow at planting; Post B = postemergence band

[b] Surviving plant stands were counted on July 28 and August 4 and 11, 2023 (i.e., 14, 21, and 28 days after planting [DAP], respectively).

[c] DAP = Days after planting

Yield results from this experiment are presented in Table 2. NOTE: the springtail infestation at this site was detected in late-June. Subsequently, soil samples were collected and processed to confirm an adequate springtail infestation for screening trials. Upon that confirmation, the field was tilled and the trial was planted shortly thereafter on July 7, which was much later than a typical grower's field would be planted in the Red River Valley growing area. However, the treatment performance patterns associated with yield in these results should still reflect what can be expected in a more typically established grower's sugarbeet field where an economically significant springtail infestation is present.

The top-performing treatment in this trial, with regard to recoverable sucrose yield and root tonnage, was the combination involving Poncho Beta-treated seed plus Mustang Maxx applied via dribble-in-furrow placement. The planting-time application of Counter 20G, applied at the maximum labeled rate of 8.9 lb product per acre was the only other treatment in the experiment that produced recoverable sucrose and root yields that were not statistically different from the Poncho Beta/Mustang Maxx treatment combination. These performance patterns corresponded closely to those observed in the stand count results.

Other treatments that performed comparably to, and were not significantly outperformed by, the high rate of Counter 20G included Counter at the 5.9-lb rate, Poncho Beta plus a postemergence band of Movento HL, Counter at the 4.5-lb rate, Poncho Beta plus Midac FC, and the single-component treatment of Mustang Maxx. All of the above-mentioned treatments provided significant increases in recoverable sucrose yield and root yield when compared with the untreated check. The only treatments that did not result in statistically significant recoverable sucrose yield were Poncho Beta alone and Midac FC alone.

**Table 2.** ***Yield parameters*** **from an evaluation of planting-time granular, liquid, and seed treatment insecticides, and a postemergence sprayable liquid for springtail control, Prosper, ND, 2023**

| Treatment/ form. | Placement[a] | Rate (product/ac) | Rate (lb a.i./ac) | Sucrose yield (lb/ac) | Root yield (T/ac) | Sucrose (%) | Gross return ($/ac) |
|---|---|---|---|---|---|---|---|
| Poncho Beta +<br>Mustang Maxx | Seed<br>DIF | 4 fl oz | 68 g a.i./ unit seed | 6,586 a | 26.2 a | 13.77 ab | 937 |
| Counter 20G | B | 8.9 lb | 1.5 | 5,054 ab | 19.9 ab | 13.86 a | 733 |
| Counter 20G | B | 5.9 lb | 1.2 | 4,735 b | 19.5 b | 13.31 abc | 641 |
| Poncho Beta +<br>Movento HL | Seed<br>10" Post Band | 2.5 fl oz | 68 g a.i./ unit seed | 4,671 b | 18.9 b | 13.49 abc | 650 |
| Counter 20G | B | 4.5 lb | 0.9 | 4,523 b | 18.5 b | 13.39 abc | 615 |
| Poncho Beta +<br>Midac FC | Seed<br>DIF | 13.6 fl oz | 68 g a.i./ unit seed<br>0.18 | 4,447 b | 18.5 b | 13.14 bcd | 588 |
| Mustang Maxx | DIF[b] | 4 fl oz | | 4,354 b | 18.3 b | 13.09 cd | 564 |
| Midac FC | DIF | 13.6 fl oz | 0.18 | 4,093 bc | 17.1 b | 13.26 abc | 539 |
| Poncho Beta | Seed | | 68 g a.i./ unit seed | 3,552 bc | 15.4 bc | 12.54 d | 438 |
| Check | --- | --- | --- | 2,553 c | 10.5 c | 13.04 cd | 342 |
| LSD (0.1) | | | | 1,724.7 | 6.5 | 0.66 | |

Means within a column sharing a letter are not significantly ($P$ = 0.1) different from each other (Fisher's Protected LSD test).

[a] Seed = insecticidal seed treatment; B = 5-inch band at planting; DIF = dribble in-furrow at planting; Post B = postemergence band

Gross economic return results from this trial followed similar patterns to those observed in plant stand and yield results. The Poncho Beta plus Mustang Maxx treatment generated $937/ac in gross economic return, which was a revenue gain of $595/ac over that of the untreated check. Additionally, the Poncho Beta/Mustang Maxx treatment combination generated a $373/ac in increased revenue over the Mustang-only treatment and $499 more gross revenue than the Poncho Beta-only treatment.

All three rates of Counter resulted in relatively high levels of gross economic return, but the high rate (8.9 lb product/ac) was economically superior, generating $391/ac more revenue than the untreated check, as well as $92 and $118/ac over that generated by the moderate (5.9 lb) and low (4.5 lb) rates of Counter, respectively.

As was observed with stand count and yield assessments, the treatment combination of Poncho Beta plus a postemergence rescue application of Movento HL provided an encouraging revenue increase. This combination generated a gross economic benefit of $308/ac when compared to the untreated check and $212 in additional gross revenue when compared to that from the Poncho Beta-only treatment.

The increased plant survival, yield, and revenue provided by the better-performing insecticide treatments in this experiment demonstrate that effective, economically justified tools are available to producers for managing subterranean springtails in sugarbeet. These findings also illustrate the significance of subterranean springtails as sugarbeet pests and the economic benefits that can be achieved by effectively managing them, even under the late-planted scenario in which this experiment was conducted.

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