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SPRINGTAIL CONTROL IN SUGARBEET USING INSECTICIDE GRANULES, LIQUIDS, AND SEED TREATMENTS AT PLANTING

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Introduction:

Subterranean (below-ground) springtails have been sporadic pests of sugarbeet in the central and southern Red River Valley of Minnesota and North Dakota, as well as the sugarbeet-growing areas of western ND and eastern Montana in recent years. Although both surface-dwelling and subterranean springtails exist, those causing most problems in ND, MN, and MT sugarbeet are subterranean. These tiny (almost microscopic), blind, wingless insects usually spend their entire lives below the soil surface. They are usually regarded as either benign because of their relative non-preference for feeding on living crop plants or beneficial because they feed on and help break down soil organic matter. They have also been shown to feed on important soil-inhabiting fungi such as *Rhizoctonia solani* Kuhn. However, optimal environmental conditions can be conducive to buildups of springtail infestations that cause major plant stand reductions and yield losses in sugarbeet. Populations become most problematic in high organic matter, fine-textured soils (i.e., clays, clay loams, or silty clays), and damaging infestations have often developed in fields where smallgrain (barley or wheat) was grown in the previous year and the post-harvest stubble was left in the field rather than removed. Springtails are not adversely impacted by cool weather and they thrive in near-saturated conditions, so extended periods of cool and rainy weather after planting can also put fields at risk for springtail injury. Seedling plants are most vulnerable to attack from these insects.

Although historical information suggests that insecticides used for protection from other soil insect pests may offer some control, none of those products are specifically labeled for springtail management in sugarbeet. Therefore, we conducted two trials on planting-time insecticide treatments to achieve the following objectives: 1) to compare the performance of registered granular insecticides at variable rates using different placement techniques for control of springtail in sugarbeet; and 2) to determine if seed treatments liquid insecticides (registered and experimental) could provide protection from springtail injury and associated yield losses. The overriding goal of this work is to develop effective tools for growers to battle this newly recognized insect pest of sugarbeet.

Materials & Methods:

Commercial sugarbeet field sites near Colfax and Manvel, ND were selected for this research in 2003, and two trials were run at each location. Soil core samples (4-inch diameter x 6-inch depth) were collected in mid- to late-April from each site before planting. Samples were processed using standard floatation and sieving, and averages of 38 and 26.5 springtails were recovered per core from Colfax and Manvel, respectively. These figures translated to infestations of about 4.7 million springtails per acre at Colfax and 3.3 million per acre at Manvel.

Study 1 involved planting-time applications of Counter and Lorsban using different placement techniques, application rates, and formulations. Entries in Study 2 included registered and experimental seed treatments (Gaucho, Poncho, and Spinosad), planting-time liquid insecticides (Mustang 0.8EC and Regent 4SC with and without 10-34-0 starter fertilizer), and two commonly used registered materials (Counter 15G and Lorsban 15G). Both trials included untreated checks for comparative purposes and treatments were arranged in a randomized complete block design with four replications for both experiments. Individual plots were 25 ft long and 2 rows (22-inch spacing) wide. All insecticides in both studies were applied at planting time using delivery equipment mounted on a 6-row John Deere 71 Flex planter. Noble metering units were used to regulate delivery of granular insecticides. ***Banded*** (B) granules were delivered in 5-inch swaths over the row using Gandy™ banders. ***Modified in-furrow*** placement (MIF) consisted of dropping granules down a standard in-furrow tube over the row with output directed near the rear press wheel so some soil would cover the seed before the insecticide reached the row. This resulted in a 2- to 2.5-inch band with the heaviest insecticide concentrations landing immediately over the row (it is critical that Counter and Lorsban insecticides not come in contact with the seed when this application technique is used). Applications of water-based sprays of Mustang 0.8EC and Regent 4SC in Study 2 were made using a planter-mounted Raven™ liquid application system calibrated to deliver a finished spray volume of 5 GPA using Teejet™ 6501E nozzles. Fertilizer-based spray mixtures of these insecticides were applied using the same system and output volume, but the thicker, more viscous 10-34-0 liquid required use of Teejet™ 11101 nozzles to maintain the 3-inch bands. Banded liquids were delivered in 3-inch swaths over the open seed furrow (T-banded) in front of the planter's rear press wheels. ***In-furrow placement*** (IF) involved orienting nozzles lengthwise and directly into the open seed furrow. Seed treatments were applied to bare seed in the Gustafson Research &

Development Center (Gustafson, Inc., McKinney, TX) and the same variety (Beta 6600) was used for all treatments in both experiments.

Springtail control assessments were done by taking plant stand counts at 20 and 28 days after planting and by harvesting the inner 2 rows of each plot on 16 September 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.

Results & Discussion:

Study 1. Stand count results from the registered granular insecticide trial are presented in Table 1. Counter 15G provided the best overall protection of stand in this study. Although Counter 20CR also gave fairly good springtail control, the 15G formulation of Counter was often superior to 20CR when the same placement and rate of active ingredient were used. This is most likely due to the quicker release of active ingredient from the standard 15% granule than from the plastic polymer CR (controlled release) granules. Lorsban 15G performed quite poorly with respect to stand protection in this trial, even at the highest labeled application rate of 13.4 lb active ingredient/ac. No major rate impacts were observed with any of these granular products.

Table 1. *Plant stand counts* in plots treated with registered granular insecticides to control springtails, Colfax, ND, 2003.

Treatment/form.	Placement	Rate (lb product/ac)	Rate (lb ai/ac)	Stand count (plants / 100 ft)	
				20 days post-plant	28 days post-plant
Counter 15G	B	11.9	1.8	109.5	107.5
Counter 15G	B	10	1.5	107.0	107.5
Counter 15G	M	11.9	1.8	105.4	105.4
Counter 15G	M	5.9	0.9	104.6	103.0
Counter 20CR	M	9	1.8	104.6	104.1
Counter 15G	M	10	1.5	104.3	103.6
Counter 15G	B	7	1.05	101.8	105.2
Counter 15G	B	5.9	0.9	101.4	101.8
Counter 20CR	M	7.5	1.5	101.1	101.4
Counter 15G	M	7	1.05	100.4	101.6
Counter 20CR	B	9	1.8	100.4	98.9
Counter 20CR	B	7.5	1.5	98.4	100.7
Counter 20CR	M	4.5	0.9	98.0	98.0
Counter 20CR	B	4.5	0.9	95.4	93.4
Lorsban 15G	B	10	1.5	47.5	46.2
Lorsban 15G	B	13.4	2.0	42.7	40.4
Lorsban 15G	B	6.7	1.0	42.0	42.5
Check	--	---	---	21.1	20.0
LSD (0.05)				7.1	7.4

Yield comparisons corresponded well with stand count data, however, differences among treatments were not as striking (Table 2). Counter 15G-treated beets tended to yield numerically higher levels of recoverable sucrose and tonnage per acre than those treated with Counter 20CR, although those differences were not statistically significant. Overall, Counter performance in protecting sugarbeet was not impacted by formulation (15G vs. 20CR), placement method, or application rate when recoverable sucrose and sugarbeet root yield were considered, although gross return calculations suggested that Counter 15G could potentially give a grower as much as $70 more per acre in return on investment than 20CR. More importantly, the yield data demonstrate that Counter 15G and Counter 20CR are superior to Lorsban 15G in protecting sugarbeet from net recoverable sucrose and sugarbeet root yield losses due to springtail injury. Poor performance by Lorsban 15G is probably due to the fact that Lorsban is slower to release from its granular carrier and much less mobile in the soil than Counter and other soil insecticides. Gross economic return data from this study also show that growers opting to apply Counter for springtail management are likely to gross at least $154 more and up to $238 more in revenue per acre than if they were to use Lorsban 15G.

Table 2. *Yield parameters* from comparison of registered granular insecticides for control of springtails, Colfax, ND, 2003.

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	B	11.9	1.8	5026	18.3	16.0	502
Counter 15G	B	5.9	0.9	4901	18.2	15.6	480
Counter 15G	M	5.9	0.9	4894	18.1	15.7	479
Counter 20CR	M	7.5	1.5	4864	17.7	15.8	486
Counter 15G	M	7	1.05	4863	17.2	16.4	506
Counter 20CR	B	7.5	1.5	4844	17.5	15.9	488
Counter 15G	B	10	1.5	4840	17.6	16.0	486
Counter 15G	B	7	1.05	4832	18.0	15.6	469
Counter 15G	M	11.9	1.8	4827	17.3	16.1	492
Counter 20CR	M	4.5	0.9	4669	16.6	16.2	480
Counter 15G	M	10	1.5	4629	18.2	15.0	418
Counter 20CR	B	9	1.8	4627	17.3	15.6	449
Counter 20CR	M	9	1.8	4577	17.4	15.3	432
Counter 20CR	B	4.5	0.9	4473	16.2	16.0	451

Lorsban 15G	B	10	1.5	3440	14.3	14.1	284
Lorsban 15G	B	6.7	1.0	3412	13.5	14.5	306
Lorsban 15G	B	13.4	2.0	3220	13.4	14.0	264
Check	--	---	---	1828	7.3	13.5	160
LSD (0.05)				1011	3.2	1.4	

Study 2. Plant stand data from study 2 are presented in Table 3. As observed in Study 1, Counter 15G provides excellent protection from stand losses due to springtail feeding injury when applied at the standard (10 lb product/ac) rate. MustangMax performed best when applied directly in furrow, and performance was enhanced when it was delivered with 10-34-0 starter fertilizer. MustangMax provided very poor springtail control when applied in the 3-inch T-band. As observed in Study 1, Lorsban 15G did not provide sufficient protection from springtail injury in this study. **Regent 4SC is not registered in beets yet**, but looked promising as a future tool for managing springtails, and its performance at the low rate (2.08 oz) was enhanced slightly when applied with starter fertilizer. The improvement from liquid fertilizer was not observed when Regent was applied at the high (4.16 oz) rate. Encouraging results were also observed with some of the seed treatments. Plots planted with Gaucho-treated seed had stands that were not statistically different from those receiving the following registered treatments: Counter 15G at 10 lb modified in-furrow, Counter 15G banded at 5.9 lb, and MustangMax applied in-furrow either with or without 10-34-0 starter fertilizer. **Poncho is not currently registered for use in sugarbeet**; however, it also performed well at protecting plant stands. Although not significant, the 22.5 gram/unit of seed rate had slightly better plant stands than the higher (45 gram) rate. It is possible that the 45-gram rate may be harmful to seedling health, although further study is needed to make that determination. The **Spinosad seed treatment is also not registered for use in sugarbeet;** however, it performed very poorly and provided low stand protection levels that were similar to Lorsban 15G and the 3-inch T-banded applications of MustangMax. Thus, Spinosad does not appear to be worthy of pursuit as a seed treatment for springtail control.

The top-performing treatment with regard to net recoverable sucrose yield was Counter 15G applied at 10 lb of product/acre in a band (Table 4). In addition to the Counter treatment, plots treated with MustangMax + 10-34-0 fertilizer placed in-furrow also yielded significantly more recoverable sucrose than the untreated controls. Plots that received Poncho seed treatment at the low (22.5 grams/unit of seed) rate and Regent (4.16 oz/ac) also were among the highest in recoverable sucrose yield, and were not statistically outyielded by Counter 15G banded at 10 lb; however, recoverable sucrose from those treatments was not quite statistically different from the untreated check either. The treatment effect for root tonnage per acre from this study was only marginally a significant ($P = 0.0569$) so the LSD value is not included; however, trends in root yield corresponded with plant stand and recoverable sucrose yield data. These findings support the stand data, and suggest that Counter 15G is an effective tool for protecting sugarbeet from yield losses caused by springtail feeding injury. MustangMax also performs well if placed directly in-furrow and applied with 10-34-0 starter fertilizer. MustangMax effectiveness at controlling springtails is reduced without the 10-34-0 and this was evident from stand counts and recoverable sucrose yields. Also, gross return values suggest that it may be possible to have practical economic benefit from several other treatments in this experiment. For example, plots that received Poncho-treated seed (22.5 g), Regent 4SC (4.16 oz), Regent 4SC at 2.08 oz + 10-34-0, and Gaucho-treated seed averaged \$97, \$112, \$79, and \$76/ac more gross economic return than the untreated check plots.

Further study will be needed to test these materials in different conditions. Work is also needed to determine if the 45-gram rate of Poncho is injurious to sugarbeet seed, and to test intermediate rates (between 22.5 and 45 grams/unit of seed) for determination of the optimal concentration of this promising experimental material.

Table 3. ***Plant stand counts*** **in plots treated with registered and experimental insecticides as seed treatments, granules, or aqueous sprays at planting to control springtails in sugarbeet, Colfax, ND, 2003.**

Treatment/form.	Placement	Rate (lb product/ac)	Rate (lb ai/ac)	Stand count (plants / 100 ft)	
Counter 15G	B	10	1.5	107.0	104.3
MustangMAX 0.8EC + Fert. 10-34-0	IF	4 oz + 5 GPA	0.025	106.1	100.9
Counter 15G	B	5.9	0.9	103.4	102.9
Regent 4SC + Fert. 10-34-0	IF	2.08 oz + 5 GPA	0.065	102.3	100.2
Counter 15G	M	10	1.5	98.9	99.5
Gaucho	SEED	45 grams/unit	n/a	97.0	88.9
Poncho	SEED	22.5 grams/unit	n/a	94.8	92.0
Regent 4SC + Fert. 10-34-0	IF	4.16 oz + 5 GPA	0.13	93.8	90.2
Regent 4SC	IF	2.08 oz	0.065	91.4	86.2
Regent 4SC	IF	4.16 oz	0.13	91.1	83.6
MustangMAX 0.8EC	IF	4 oz	0.025	90.4	85.0
Poncho	Seed Treatment	45 grams/unit	n/a	90.2	83.6
MustangMAX 0.8EC + Fert. 10-34-0	3" TB	4 oz + 5 GPA	0.025	84.8	75.0
Lorsban 15G	B	10	1.5	79.6	79.1
MustangMAX 0.8EC	3" TB	4 oz	0.025	77.5	68.0
Spinosad	SEED	22.5 grams/unit	n/a	72.9	63.6
Spinosad	SEED	45 grams/unit	n/a	71.2	65.5
Check	--	---	---	58.6	52.5

LSD (0.05)				8.4	9.6

Table 4. *Yield parameters* from comparison of registered and experimental insecticides as seed treatments, granules, or liquid sprays at planting to control springtails in sugarbeet, Colfax, ND, 2003.

Treatment/form.	Placement	Rate (product/ac)	Rate (lb ai/ac)	Recoverable sucrose (lb/ac)	Root yield (T/ac)	Sucrose (%)	Gross return ($/ac)
Counter 15G	B	10 lb	1.5	5595	20.2	16.0	565
MustangMAX 0.8EC + Fert. 10-34-0	IF	4 oz + 5 GPA	0.025	5454	19.0	16.3	575
Poncho	Seed Treatment	22.5 grams/unit	n/a	4884	17.5	15.9	498
Regent 4SC	IF	4.16 oz	0.13	4850	16.9	16.3	513
Regent 4SC + Fert. 10-34-0	IF	2.08 oz + 5 GPA	0.065	4800	17.5	15.9	480
Regent 4SC	IF	2.08 oz	0.065	4734	17.6	15.6	462
Spinosad	SEED	45 grams/unit	n/a	4661	17.5	15.5	448
Counter 15G	B	5.9	0.9	4661	17.2	15.7	460
Regent 4SC + Fert. 10-34-0	IF	4.16 oz + 5 GPA	0.13	4623	16.9	15.7	460
Gaucho	SEED	45 grams/unit	n/a	4610	16.3	16.1	477
MustangMAX 0.8EC	IF	4 oz	0.025	4605	17.1	15.6	450
Counter 15G	M	10	1.5	4481	16.8	15.5	433
Poncho	SEED	45 grams/unit	n/a	4479	16.6	15.6	438
Lorsban 15G	B	10	1.5	4471	16.2	15.9	450
Check	--	---	---	4351	16.9	15.0	401
Spinosad	SEED	22.5 grams/unit	n/a	4277	15.6	15.8	427
MustangMAX 0.8EC + Fert. 10-34-0	3” TB	4 oz + 5 GPA	0.025	4248	15.5	15.8	424
MustangMAX 0.8EC	3” TB	4 oz	0.025	3716	14.0	15.3	355
LSD (0.05)				782	NS	NS	

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