MOVENTO HL® AS A POSTEMERGENCE RESCUE INSECTICIDE FOR SUGARBEET ROOT MAGGOT CONTROL

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Introduction:

The sugarbeet root maggot (SBRM), *Tetanops myopaeformis* (Röder) is a major insect pest of sugarbeet in the Red River Valley (RRV) growing area. Most RRV sugarbeet producers in high-risk areas for economic loss from this pest use a two-pronged approach to control it. This typically involves beginning the season with a prophylactic insecticide application, which involves either a planting-time granular insecticide or an insecticidal seed treatment. That initial measure of protection is usually followed by the application of a postemergence insecticide, in either a granular or sprayable liquid form. Organophosphate insecticides, which kill insects through acetylcholinesterase (ACHE) inhibition, have been the predominate choice of Red River Valley sugarbeet growers for both planting-time and postemergence insecticides in SBRM control programs for well over four decades. This means that a single mode of action has been widely used for SBRM control for an exceptionally long time. This long-term, repeated use of ACHE inhibitor insecticides suggests that it is only a matter of time before SBRM populations develop insecticide resistance to this insecticide class.

In July of 2017, the U.S. Environmental Protection Agency approved the registration of Movento HL insecticide for use in sugarbeet. The addition of this product is encouraging from an insect resistance management perspective because spirotetramat, the active ingredient in Movento, belongs to the lipid biosynthesis inhibitors (LBIs), a completely different insecticide mode of action from the ACHE inhibitors. This project was carried out to evaluate the efficacy of Movento HL as a postemergence insecticide for sugarbeet root maggot control. A secondary objective was to assess the performance of dual-insecticide programs for SBRM management that include Poncho Beta as the planting-time insecticide component and Movento HL as the postemergence rescue component.

Materials and Methods:

This experiment was conducted during the 2020 growing season on a commercial sugarbeet field site near St. Thomas in rural Pembina County, ND. Plots were planted on 18 May using Betaseed 8524 glyphosate-resistant seed. A 6-row Monosem NG Plus 4 7x7 planter set to deliver seed at a depth of 1¼ inch and a rate of one seed every 4½ inches of row length was used to plant the trial. Plots were six rows (22-inch spacing) wide with the four centermost rows treated. The outer "guard" row on each side of the plot served as an untreated buffer. Each plot was 35 feet long, and 35-foot tilled alleys were maintained between replicates throughout the growing season. The experiment was arranged in a randomized complete block design with four replications.

Planting-time insecticide applications. Planting-time applications of Counter 20G were applied by using band (B) placement (Boetel et al. 2006), which consisted of 5-inch swaths of granules delivered through Gandy™ row banders. Granular application rates were regulated by using planter-mounted SmartBox™ computer-controlled insecticide delivery system that had been calibrated on the planter before all applications.

Postemergence insecticide applications. Additive postemergence insecticides applied in this trial included Movento HL, Mustang Maxx, and Yuma 4E (a generic chlorpyrifos formulation, similar to Lorsban 4E). Treatment timings evaluated included the following: 1) Yuma 4E and Mustang Maxx were applied at two days before peak SBRM fly activity; and 2) Movento HL was applied at three days pre-peak. Liquid insecticide solutions were delivered with a tractor-mounted CO_2-propelled spray system equipped with TeeJet™ 110015VS AIXR nozzles, and the system was calibrated to deliver a finished output volume of 10 GPA. Both postemergence Movento spray treatments included methylated seed oil at the recommended rate of 0.25% v/v.

Root injury ratings: Sugarbeet root maggot feeding injury was assessed in this experiment on 28 July, 2020. Sampling consisted of randomly collecting ten beet roots per plot (five from each of the outer two treated rows), hand-washing them, and scoring them in accordance with the 0 to 9 root injury rating scale (0 = no scarring, and 9 = over ¾ of the root surface blackened by scarring or dead beet) of Campbell et al. (2000).

Harvest: Treatment performance was also compared on the basis of sugarbeet yield. Plots were harvested on 23 September. Foliage was removed from plots immediately before harvest by using a commercial-grade mechanical defoliator. All beets from the center two rows of each plot were extracted from soil using a mechanical harvester and weighed in the field using a digital scale. A representative subsample of 12-18 beets was collected from each plot and sent to the American Crystal Sugar Company Tare Laboratory (East Grand Forks, MN) for sucrose content and quality analysis.

Data analysis: All data from root injury ratings and harvest samples were subjected to analysis of variance (ANOVA) using the general linear models (GLM) procedure (SAS Institute, 2012). Treatment means were compared by using Fisher's protected least significant difference (LSD) test at a 0.05 level of significance.

Results and Discussion:

Sugarbeet root maggot feeding injury results from this trial are presented in Table 1. The feeding injury rating mean for the untreated check (5.24 on the 0 to 9 scale of Campbell et al. [2000]) indicated the presence of a moderately high SBRM infestation for the trial. All insecticide-treated entries in the trial provided significant reductions in SBRM feeding injury when compared to the untreated check. The lowest level of SBRM feeding injury (i.e., the highest level of protection) was observed in plots treated with the single planting-time application of Counter 20G at its moderate labeled rate (7.5 lb product/ac); however, that entry was not statistically superior to any of the dual (i.e., planting-time plus postemergence) insecticide entries in the trial that included Poncho Beta insecticidal seed treatment plus a postemergence foliar spray of either Movento HL, Mustang Maxx, or Yuma 4E. The planting-time treatment of Counter 20G at its moderate rate was the only insecticide treatment that provided significantly greater root protection than the Poncho Beta-only treatment. There were no significant differences in SBRM feeding injury sustained between any of the treatments that included both Poncho Beta and a postemergence rescue insecticide application, irrespective of which post-applied product was used, or at which rate it was applied.

Table 1. *Larval feeding injury* in a comparison of Movento HL with other commonly used postemergence rescue insecticides for sugarbeet root maggot control, St. Thomas, ND, 2020

Treatment/form.	Placement[a]	Rate (product/ac)	Rate (lb a.i./ac)	Root injury (0-9)
Counter 20G	B	7.5 lb	1.5	4.33 c
Poncho Beta + Mustang Maxx	Seed 2 d Pre-peak Broadcast	4 fl oz	68 g a.i./ unit seed 0.025	4.38 bc
Poncho Beta + Movento HL + MSO	Seed 3 d Pre-peak Broadcast	4.5 fl oz	68 g a.i./ unit seed 0.156	4.65 bc
Poncho Beta + Yuma 4E	Seed 2 d Pre-peak Broadcast	2.0 pts	68 g a.i./ unit seed 1.0	5.15 bc
Poncho Beta + Yuma 4E	Seed 2 d Pre-peak Broadcast	1.0 pts	68 g a.i./ unit seed 0.5	5.18 bc
Poncho Beta + Movento HL + MSO	Seed 3 d Pre-peak Broadcast	2.5 fl oz	68 g a.i./ unit seed 0.078	5.23 bc
Poncho Beta	Seed		68 g a.i./ unit seed	5.33 b
Check	-----	----	-----	6.35 a
LSD (0.05)				0.964

Means within a column sharing a letter are not significantly (P = 0.05) different from each other (Fisher's Protected LSD test).
[a]B = 5-inch at-plant band; Seed = insecticidal seed treatment

Yield data from this experiment are shown in Table 2. The top-performing treatment, with regard to recoverable sucrose and root yield was the combination of Poncho Beta seed treatment plus a postemergence application of Yuma 4E at its high labeled rate for a single application (2 pts product/ac). When compared to the untreated check, that entry produced 1,814 lb more recoverable sucrose and 7.6 additional tons per acre in root yield, and generated a revenue increase of $137/ac above that recorded for the check.

The only other treatment that was not significantly different from the top treatment, with regard to both recoverable sucrose yield and root tonnage, was the combination of Poncho Beta seed treatment plus Mustang Maxx. Interestingly, in plots initially protected with Poncho Beta-treated seed, applying a postemergence application of Movento HL at its highest labeled rate (4.5 fl oz/ac) produced significantly greater recoverable sucrose yield than when the Movento was applied at the lower rate of 2.5 fl oz/ac. Also, plots that received the higher rate of Movento HL generated $214/ac more revenue than similar plots treated with the lower (2.5-oz) rate of that product. Similarly, plots treated with the higher (2-pt) rate of Yuma generated $61/ac more revenue than those that received the 1-pt rate of Yuma.

Table 2. *Yield parameters* from a comparison of Movento HL with other commonly used postemergence rescue insecticides for sugarbeet root maggot control, St. Thomas, ND, 2020

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 + Yuma 4E	Seed 2 d Pre-peak Broadcast	2.0 pts	68 g a.i./ unit seed 1.0	10,259 a	33.8 a	16.33 a	1,297
Poncho Beta + Mustang Maxx	Seed 2 d Pre-peak Broadcast	4 fl oz	68 g a.i./ unit seed 0.025	9,758 ab	31.0 ab	16.95 a	1,300
Counter 20G	B	7.5 lb	1.5	9,577 ab	29.3 bcd	17.44 a	1,334
Poncho Beta + Movento HL + MSO	Seed 3 d Pre-peak Broadcast	4.5 fl oz	68 g a.i./ unit seed 0.156	9,514 ab	29.6 bc	17.19 a	1,334
Poncho Beta	Seed		68 g a.i./ unit seed	9,392 abc	29.6 bc	16.99 a	1,261
Poncho Beta + Yuma 4E	Seed 2 d Pre-peak Broadcast	1.0 pts	68 g a.i./ unit seed 0.5	9,225 bc	29.2 bcd	16.79 a	1,236
Poncho Beta + Movento HL + MSO	Seed 3 d Pre-peak Broadcast	2.5 fl oz	68 g a.i./ unit seed 0.078	8,511 c	27.3 cd	17.28 a	1,120
Check	-----	----	-----	8,445 c	26.2 d	15.10 a	1,160
LSD (0.10)				970.2	3.30	NS	

Means within a column sharing a letter are not significantly (P = 0.10) different from each other (Fisher's Protected LSD test).
[a]B = 5-inch at-plant band; Seed = insecticidal seed treatment

Overall, results from this study demonstrate that major yield and revenue benefits can be achieved by using insecticide-based control programs that combine a neonicotinoid seed treatment insecticide and a postemergence sprayable insecticide such as Yuma 4E or Mustang Maxx. Results also suggest that the higher rate (4.5 fl oz/ac) of Movento HL may be needed under moderately high to severe SBRM feeding pressure situations.

It should be pointed out that, due to equipment- and weather-related complications, the Movento HL applications could not be applied at the planned pre-peak interval. Movento is a systemic insecticide. As such, if the Movento treatments could have been applied at a more appropriate time (7 to 14 days ahead of peak SBRM fly activity), they would have likely resulted in higher concentrations of insecticide active ingredient in roots when SBRM larval feeding injury was occurring and, thus, would have been more likely to provide greater levels of control.

Further research is needed to evaluate Movento HL under higher SBRM infestation levels to determine its ability to effectively control this pest. Research should also focus on optimizing the application timing and use rate for this product. The EPA-approved label allows for applying Movento HL at 4.5 fl oz/ac; however, it is uncertain at this time as to whether that rate, if more effective, would be economically viable for sugarbeet producers.

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