MOVENTO HL®: TWO YEARS OF PERFORMANCE TRIALS ON A NEWLY REGISTERED INSECTICIDE FOR SUGARBEET ROOT MAGGOT CONTROL

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Introduction:

The sugarbeet root maggot (SBRM), *Tetanops myopaeformis* (Röder) is a serious economic pest of sugarbeet in the Red River Valley (RRV) growing area. Sugarbeet producers in the RRV typically manage this pest by prophylactically applying granular insecticides to at-risk fields during planting operations. In areas where severe SBRM infestations frequently develop, planting-time control efforts are often augmented by one to two postemergence applications. As far back as the mid-1970s, most of these applications have involved the use of insecticides in the organophosphate and carbamate classes to manage the sugarbeet root maggot. Both of these classes cause mortality in insects through the same mode of action, acetylcholinesterase (ACHE) inhibition.

Grower dependence on a single mode of action for SBRM control in the Red River Valley has been largely due to two factors. First, a limited number of insecticide products have been registered for use in the crop for much of this time. Second, despite frequent screening efforts on a variety of insecticides belonging to alternative modes of action, very few insecticidal products tested in screening programs have shown promise as viable options for SBRM control. As a result of this long-term, repeated use of ACHE inhibitor insecticides, the threat of insecticide resistance development in RRV sugarbeet root maggot populations has been a looming concern for pest management advisors and producers for several years.

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 the active ingredient in Movento (spirotetramat) belongs to the lipid biosynthesis inhibitors (LBIs), which will provide an alternative mode of action to the commonly used ACHE inhibitors. Thus far, after significant screening efforts have been conducted on insect species with known resistance to other insecticides, there is no evidence of cross resistance between the LBI insecticides and other classes.

This project was carried out to evaluate the efficacy of Movento HL as a postemergence tool 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 2016 and 2017 growing seasons on commercial sugarbeet field sites near St. Thomas in rural Pembina County, ND. Betaseed 89RR52 glyphosate-resistant seed was used for all treatments in both study years. Plots were planted on 11 May in 2016 and 10 May in 2017. All plots were planted using 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. 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. Treatments were replicated four times in 2016 and three times in 2017.

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, Movento 240SC, Lorsban Advanced, and Mustang Maxx. The original (i.e., 240SC) formulation of Movento was included in the trial for comparative purposes because it had been included in previous NDSU screening trials before the HL formulation was available for testing. Treatment timings evaluated included the following: 1) Lorsban Advanced and Mustang Maxx at two days before peak SBRM fly activity; 2) Movento 240SC and one Movento HL entry at seven days pre -peak; and 3) Movento HL on or within one day of peak fly activity. Liquid insecticide solutions were delivered with a tractor-mounted CO_2-propelled spray system equipped with TeeJet™ 110015VS nozzles calibrated to deliver applications in a finished output volume of 10 GPA. All postemergence Movento spray solutions 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 3 and 1 August in 2016 and 2017, respectively. 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 parameters. Plots were harvested on 20 September in 2016, and on 3 October in 2017. 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, 2008). Treatment means were compared by using Fisher's protected least significant difference (LSD) test at a 0.05 level of significance. Initial analyses indicated that there were no significant treatment × year interactions for root injury ratings ($P = 0.7445$), recoverable sucrose yield ($P = 0.2636$), root yield ($P = 0.1345$), or percent sucrose content data ($P = 0.4321$). As such, two-year combined analyses were performed on all data from this experiment.

Results and Discussion:

Sugarbeet root maggot feeding injury results from this two-year 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 moderate SBRM larval infestation across both years. However, feeding injury recorded in all insecticide-protected plots was significantly lower than that in the untreated check.

Table 1. *Larval feeding injury* in a comparison of Movento HL®, Lorsban Advanced, and Mustang Maxx for postemergence sugarbeet root maggot control, St. Thomas, ND, 2016 – 2017

Treatment/form.	Placement[a]	Rate (product/ac)	Rate (lb a.i./ac)	Root injury (0-9)
Counter 20G	B	7.5 lb	1.5	3.27 d
Poncho Beta + Mustang Maxx	Seed 2 d Pre-peak Broadcast	4 fl oz	68 g a.i./ unit seed 0.025	3.29 d
Poncho Beta + Movento 240SC + MSO	Seed 7 d Pre-peak Broadcast	5 fl oz	68 g a.i./ unit seed 0.078	3.51 cd
Poncho Beta + Lorsban Advanced	Seed 2 d Pre-peak Broadcast	2.0 pts	68 g a.i./ unit seed 1.0	3.59 bcd
Poncho Beta + Movento HL + MSO	Seed Peak fly	2.5 fl oz	68 g a.i./ unit seed 0.078	4.24 bc
Poncho Beta	Seed		68 g a.i./ unit seed	4.27 bc
Poncho Beta + Movento HL + MSO	Seed 7 d Pre-peak Broadcast	2.5 fl oz	68 g a.i./ unit seed 0.078	4.34 b
Check	-----	----	-----	5.24 a
LSD (0.05)				0.763

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

The lowest average root maggot feeding injury was observed in plots protected by the single at-plant application of Counter 20G at its moderate (7.5 lb product/ac) rate. Other entries that were not significantly outperformed by this treatment included the following: 1) Poncho Beta + a postemergence application of Mustang Maxx at 4 fl oz of product/ac; 2) Poncho Beta plus a postemergence application of Movento 240SC at 5 fl oz of product/ac (7 days pre-peak); and 3) Poncho Beta seed treatment plus a postemergence application of Lorsban Advanced at its high (2 pts product/ac) labeled rate. There was no significant difference in SBRM feeding injury between applications of Movento HL made at peak fly and seven days pre-peak.

Yield data from this experiment are shown in Table 2. Similar to the results from root ratings, all insecticide treatments provided significant increases in both recoverable sucrose yield and root tonnage. 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 Lorsban Advanced. When compared to the untreated check, that entry produced 2,416 lb more recoverable sucrose and 7.4 additional tons per acre in root yield, and generated a revenue benefit of $352/ac. Treatments that were not significantly different from the top treatment with regard to both recoverable sucrose yield and root tonnage included Poncho Beta plus Mustang Maxx and Poncho Beta plus Movento HL (applied at seven days ahead of peak SBRM fly activity).

Applying Movento HL at seven days ahead of peak fly to plots initially protected by Poncho Beta seed treatment generated an increase in revenue of $79/acre when compared to Poncho Beta plots that did not receive a postemergence spray. Although there were no significant differences in coverable sucrose yield or root tonnage between the two Movento HL postemergence spray timings, applying this insecticide earlier (seven days pre-peak) generated $69 more gross revenue than when it was applied at peak SBRM fly activity. Gross economic return increases from insecticide-based programs in this experiment ranged from $165/ac for Poncho Beta plus Movento 240SC at postemergence to the aforementioned $352/ac for the treatment that included Poncho Beta-treated seed plus a postemergence application of Lorsban Advanced.

Table 2. *Yield parameters* from a comparison of Movento HL®, Lorsban Advanced, and Mustang Maxx for postemergence sugarbeet root maggot control, St. Thomas, ND, 2016 – 2017

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 + Lorsban Advanced	Seed 2 d Pre-peak Broadcast	2.0 pts	68 g a.i./ unit seed 1.0	8,039 a	26.7 a	15.99 a	1,063
Poncho Beta + Mustang Maxx	Seed 2 d Pre-peak Broadcast	4 fl oz	68 g a.i./ unit seed 0.025	7,885 a	25.9 a	15.96 a	1,053
Poncho Beta + Movento HL + MSO	Seed 7 d Pre-peak Broadcast	2.5 fl oz	68 g a.i./ unit seed 0.078	7,409 ab	24.9 ab	15.69 a	961
Poncho Beta + Movento HL + MSO	Seed Peak fly Broadcast	2.5 fl oz	68 g a.i./ unit seed 0.078	6,923 b	23.4 b	15.43 a	892
Counter 20G	B	7.5 lb	1.5	6,877 b	23.1 b	15.66 a	894
Poncho Beta	Seed		68 g a.i./ unit seed	6,865 b	23.3 b	15.49 a	882
Poncho Beta + Movento 240SC + MSO	Seed 7 d Pre-peak Broadcast	5 fl oz	68 g a.i./ unit seed 0.078	6,841 b	23.3 b	15.49 a	876
Check	-----	----	-----	5,623 c	19.3 c	15.27 a	711
LSD (0.05)				755.5	2.22	NS	

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

There were no significant differences in percent sucrose content between any of the treatments in this trial, but the untreated check had the lowest sucrose concentration, and roots from the treatment that generated the highest root tonnage and sucrose yield (Poncho Beta + Lorsban Advanced) also had numerically higher percent sucrose content than any other treatment in the experiment.

Overall, results from this two-year experiment demonstrate that, even under moderate SBRM infestation, major yield and revenue benefits can be achieved in insecticide-based control programs combining a neonicotinoid seed treatment insecticide and a postemergence sprayable insecticide such as Lorsban Advanced. Results also suggest that yields and revenue are markedly increased by adding a postemergence spray. Major yield increases were also achieved by applying Mustang Maxx at 2 days before peak fly and Movento HL at seven days pre-peak.

Although there were no significant differences in regard to root protection from SBRM feeding activity or

resulting yield parameters between the two timings tested for Movento HL applications, results also suggest slight yield improvements by applying this product earlier. This pattern may have been associated with the fact that Movento is a systemic insecticide. As such, applying it earlier may have resulted in higher concentrations of insecticide active ingredient in roots when SBRM larval feeding injury was occurring.

Further research is needed to evaluate Movento HL under higher SBRM infestation levels to determine its ability to effectively control this pest. Additional research should focus on optimizing the effectiveness of application timing and use rate. The EPA-approved label allows for a much higher application rate of 4.5 fl oz/ac. However, at this time, it is uncertain as to whether applying this product at its maximum labeled rate, even if shown to be effective, would be economically viable.

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