SUGARBEET ROOT MAGGOT CONTROL USING SINGLE- DUAL- AND TRIPLE-COMPONENT INSECTICIDE PROGRAMS

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Introduction:

Severe infestations of the sugarbeet root maggot (SBRM), *Tetanops myopaeformis* (Röder), occur on a frequent basis in central and northern portions of the Red River Valley (RRV) of North Dakota and Minnesota. Published research has demonstrated that this pest is capable of causing more than 45% yield losses in the absence of effective control measures (Boetel et al. 2010). High population levels of this pest often require aggressive pest management programs to ensure adequate protection of the sugarbeet crop. Control programs in areas at high risk of damaging SBRM infestations usually consist of either a granular insecticide or an insecticidal seed treatment at planting, followed by an additive postemergence insecticide application when SBRM populations warrant it. Broadcast applications of sprayable liquid insecticides, applied on an as-needed, rescue basis, are the most commonly used postemergence tools for SBRM control in the RRV. However, the use of postemergence granular insecticide products has increased in recent years. An advantage of postemergence sprays is that growers can use a "wait and see" approach, and make informed decisions on whether rescue insecticide treatments are needed based on current fly activity levels in their fields. This research was carried out to determine the most effective combinations of planting-time and postemergence insecticides to optimize sugarbeet root maggot control.

This project involved two experiments. The objectives of Study I were to: 1) compare Counter 20G granular insecticide with Poncho Beta seed treatment for at-plant SBRM control; 2) assess the efficacy of combining Poncho Beta with Counter 20G at planting time for a one-pass SBRM control system; 3) determine the impacts of additive postemergence applications of Thimet 20G to plots initially treated with either Counter 20G or Poncho Beta seed treatment for SBRM control; 4) measure the performance of Counter 20G as a postemergence control option; and 5) determine if SBRM control can be maximized by employing a three-component (i.e., seed treatment insecticide + at-plant or postemergence granular insecticide + postemergence liquid spray) management program.

The objectives of Study II were to: 1) measure the impact of Lorsban Advanced liquid insecticide spray applications on plots initially treated at planting time with Poncho Beta seed treatment or Counter 20G for root maggot control; and 2) assess the effect of application rate on performance of Lorsban Advanced for postemergence root maggot control.

Materials and Methods:

Both experiments were established on a commercial sugarbeet field site near St. Thomas (Pembina County), ND. Betaseed 89RR52 glyphosate-resistant seed was used for all entries in both experiments, and a professional seed preparation company (Germains Seed Technology, Fargo, ND) applied Poncho Beta insecticide to seed for all seed treatment entries. Both experiments were planted on 10 May. All plots were planted using a 6-row Monosem NG Plus 4 7x7 planter set to plant 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" rows (i.e., rows one and six) on each side of the plot served as untreated buffers. Each plot was 35 feet long, and 35-foot alleys between replicates were maintained weed-free throughout the growing season through tillage operations. The experiment was arranged in a randomized complete block design with four replications of the treatments.

<u>Planting-time insecticide applications</u>. Counter 20G was 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 a planter-mounted SmartBox™ computer-controlled insecticide delivery system that was calibrated on the planter immediately before all applications.

Postemergence insecticide applications (Studies I and II). Postemergence insecticides in Study I consisted of two granular materials (i.e., Counter 20G and Thimet 20G) and one liquid spray product (i.e., Lorsban Advanced). Postemergence granules (Post B) were applied on 5 June, or about 6 days before peak SBRM fly activity. Band placement of postemergence granules was achieved by using Kinze™ row banders attached to a tractor-mounted tool bar and adjusted to a height needed to deliver the insecticides in 4-inch bands. Similar to at-plant insecticide applications, postemergence granular output rates were also regulated by using a SmartBox™ system mounted on a tractor-drawn four-row toolbar. Postemergence granules were delivered in 4-inch bands by using Kinze™ row banders. All postemergence granular applications were incorporated using two pairs of rotary tines that straddled each row on the tool bar. A paired set of tines was positioned ahead of each bander, and a second pair was mounted behind the granular drop zone. This system effectively stirred soil around the bases of sugarbeet seedlings and incorporated granules as the unit passed through each plot.

The postemergence spray applications of Lorsban Advanced were broadcast-applied on 8 June (i.e., about 3 days before peak SBRM fly activity). Sprays were applied from a tractor-mounted CO_2-propelled spray system equipped with an 11-ft boom that was calibrated to deliver a finished spray volume output of 10 GPA through TeeJet™ 110015VS nozzles.

In Study II, all postemergence insecticide treatments involved Lorsban Advanced spray applications that were applied in the same manner as described for Study I. Sprays were applied on 8 June (i.e., about 3 days before peak SBRM fly activity).

Root injury ratings: Sugarbeet root maggot feeding injury was assessed in both studies on 31 July by 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 for both studies were harvested on 10 October. 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), 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. Sugarbeet root maggot feeding injury rating results for Study I are presented in Table 1. The level of root injury that occurred in the untreated check plots (mean = 5.48 on the 0 to 9 scale of Campbell et al. [2000]) suggested that a moderate SBRM infestation was present for this study. This is due, in large part, to a hailstorm that occurred on 9 June (2 days before peak fly activity). It is estimated that the storm killed at least 40 to 60% of the SBRM fly population in the plot area and surrounding fields. Despite that reduction in the local population, there were several significant differences among treatments in this trial. All insecticide-protected plots had significantly lower levels of SBRM feeding injury than the untreated check, regardless of whether they involved a seed treatment, single at-plant granular application, dual-, or triple-application insecticide combination was used for SBRM control.

The lowest overall root injury rating mean (i.e., highest root protection level) in Study I occurred in plots that received the triple-insecticide application treatment comprised of Poncho Beta-treated seed, combined with an at-plant application of Counter 20G at its high (8.9 lb product/ac) rate, and followed by a postemergence application of Lorsban Advanced at 1 pt/ac. Root maggot feeding injury in those plots was significantly lower than that in all other treatments, except a similar treatment that included Poncho Beta plus the at-plant application of Counter 20G at 8.9 lb, but without the post application of Lorsban Advanced. Similarly, there was no significant difference in root protection between a triple-component program consisting of Poncho Beta-treated seed plus a postemergence application of Thimet 20G, followed by a postemergence spray of Lorsban, and similar plots that received Poncho Beta and Thimet, but were not treated with the additional application of Lorsban Advanced. These results suggest that there was no significant improvement in root protection from the postemergence spray of Lorsban Advanced.

In dual insecticide programs, adding a postemergence granular product consistently provided significant improvements in root protection from SBRM feeding injury, irrespective of whether plots were initially protected at planting by Poncho Beta or any rate of Counter 20G. The lowest average SBRM feeding injury for dual-insecticide treatments was observed in plots protected by Poncho Beta-treated seed plus a planting-time application of Counter 20G at its high (8.9 lb product/ac) rate. Root maggot feeding injury in plots treated with this combination was the second-lowest in the entire trial, and it was significantly lower than that observed in plots treated with the similar dual-insecticide program that included Poncho Beta plus Counter applied at its low (5.25 lb) rate at planting.

Table 1. *Larval feeding injury* in an evaluation of sugarbeet root maggot control by combining planting-time insecticide granules or seed treatments with postemergence insecticides, St. Thomas, ND, 2017

Treatment/form.	Placement[a]	Rate (product/ac)	Rate (lb a.i./ac)	Root injury (0-9)
Poncho Beta + Counter 20G + Lorsban Advanced	Seed B 3 d Pre-peak Broadcast	 8.9 lb 1 pt	68 g a.i./unit seed 1.8 0.5	0.88 g
Poncho Beta + Counter 20G	Seed B	 8.9 lb	68 g a.i./ unit seed 1.8	1.48 fg
Counter 20G + Thimet 20G	B 6 d Pre-peak Post B	8.9 lb 7 lb	1.8 1.4	1.55 f
Poncho Beta + Counter 20G	Seed 6 d Pre-peak Post B	 8.9 lb	68 g a.i./ unit seed 1.8	1.68 ef
Poncho Beta + Thimet 20G + Lorsban Advanced	Seed 6 d Pre-peak Post B 3 d Pre-peak Broadcast	 7 lb 1 pt	68 g a.i./ unit seed 1.4 0.5	1.73 ef
Poncho Beta + Counter 20G	Seed 6 d Pre-peak Post B	 5.25 lb	68 g a.i./ unit seed 1.05	1.75 ef
Counter 20G + Thimet 20G	B 6 d Pre-peak Post B	7.5 lb 7 lb	1.5 1.4	1.78 ef
Poncho Beta + Thimet 20G	Seed 6 d Pre-peak Post B	 7 lb	68 g a.i./ unit seed 1.4	1.98 def
Counter 20G	B	8.9 lb	1.8	2.23 cde
Poncho Beta + Counter 20G	Seed B	 5.25 lb	68 g a.i./ unit seed 1.05	2.30 cde
Counter 20G	B	7.5 lb	1.5	2.50 cd
Counter 20G	B	5.25 lb	1.05	2.85 c
Poncho Beta	Seed		68 g a.i./ unit seed	4.13 b
Check	---	----	---	5.48 a
LSD (0.05)				0.667

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; Post B = postemergence band; Seed = insecticidal seed treatment

Although trends suggested that higher rates of both at-plant and postemergence granular insecticides provided improved protection from SBRM feeding injury, there were no statistical differences among the three rates of Counter 20G when applied as single at-plant treatments. There also was no significant difference in root protection between at-plant and postemergence applications of when Counter 20G was applied at the low (5.25 lb/ac) rate to plots planted with Poncho Beta-treated seed.

Yield data from Study I are presented in Table 2. Most treatments in this experiment resulted in exceptionally high yields, and relative differences in treatment performance generally followed patterns observed in root maggot feeding injury data for this trial. There were very few significant differences among treatments in relation to recoverable sucrose and root tonnage yield, and there were no significant differences in percent sucrose content among treatments. The infrequent statistical differences in yields is probably due to two factors: 1) the unusually moderate SBRM feeding pressure; and 2) there was a considerable amount of variability within and between replications in this trial due to a couple of heavy rainfall during the growing season that resulted in standing water in the plots. The standing water would have added variability to root yields, but also could have precluded SBRM females from laying eggs in the affected plots.

As observed in the SBRM feeding injury data for this trial, trends suggested better performance with increasing rates of both at-plant and postemergence applications of Counter 20G, although significant rate-related differences were rare. The top-performing entries with regard to both recoverable sucrose and root tonnage included the following: 1) Poncho Beta + Counter 20G applied at planting time at 8.9 lb/ac; 2) the triple-component program consisting of Poncho Beta seed treatment, combined with an at-plant application of Counter 20G at its high (8.9 lb product/ac) rate and a postemergence spray application of Lorsban Advanced at its moderate rate of 1 pt/ac; 3) Poncho Beta + postemergence Thimet 20G at 7 lb/ac + Lorsban Advanced applied postemergence at 1 pt/ac; and 4) at-plant Counter 20G + postemergence Thimet 20G, both applied at their respective high labeled rates of 8.9 and 7 lb/ac. Yields from these treatments were not statistically different from the single planting-time application of Counter at 8.9 lb/ac or most of the dual-insecticide programs in this trial. However, these top-performing treatments generated between $97 and $159/ac more gross revenue than the at-plant application of Counter at 8.9 lb/ac, and between $201 and $263/ac more revenue than the untreated check plots. These economic benefits would have easily paid for the costs of their use, and provided significant amounts of additional revenue per acre.

The gross economic return generated by using stand-alone planting-time applications of Counter 20G ranged between $104 and $172/ac, which would have significantly exceeded the treatment cost and provided additional net revenue. The use of Poncho Beta as a stand-alone form of protection generated an increase of $57/ac in gross return, which also would have easily paid for the cost of the treatment.

Although these results demonstrate the economic benefits of at-plant protection against SBRM feeding injury and associated yield/revenue loss, they also clearly demonstrate the economic value of applying an additive insecticide, either in the form of a planting-time insecticide (if insecticide-treated seed is used), or a postemergence insecticide application (whether the initial at-plant protection consists of a seed treatment or a conventional insecticide).

Table 2. *Yield parameters* from an evaluation of sugarbeet root maggot control by combining planting-time insecticide granules or seed treatments with postemergence insecticides, St. Thomas, ND, 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 + Counter 20G	Seed B	 8.9 lb	68 g a.i./ unit seed 1.8	12,433 a	40.2 ab	16.70 a	1,477
Poncho Beta + Counter 20G + Lorsban Advanced	Seed B 3 d Pre-peak Broadcast	 8.9 lb 1 pt	68 g a.i./unit seed 1.8 0.5	12,400 a	41.0 a	16.48 a	1,427
Poncho Beta + Thimet 20G + Lorsban Advanced	Seed 6 d Pre-peak Post B 3 d Pre-peak Broadcast	 7 lb 1 pt	68 g a.i./ unit seed 1.4 0.5	12,388 a	41.0 a	16.35 a	1,423
Counter 20G + Thimet 20G	B 6 d Pre-peak Post B	8.9 lb 7 lb	1.8 1.4	12,173 ab	40.0 abc	16.40 a	1,415
Poncho Beta + Counter 20G	Seed 6 d Pre-peak Post B	 8.9 lb	68 g a.i./ unit seed 1.8	12,083 abc	39.3 a-d	16.60 a	1,425
Poncho Beta + Counter 20G	Seed B	 5.25 lb	68 g a.i./ unit seed 1.05	12,045 abc	40.1 ab	16.35 a	1,375
Counter 20G + Thimet 20G	B 6 d Pre-peak Post B	7.5 lb 7 lb	1.5 1.4	11,905 abc	39.8 abc	16.20 a	1,348
Counter 20G	B	7.5 lb	1.5	11,720 abc	38.0 cde	16.70 a	1,386
Poncho Beta + Thimet 20G	Seed 6 d Pre-peak Post B	 7 lb	68 g a.i./ unit seed 1.4	11,710 abc	40.2 ab	16.00 a	1,275
Counter 20G	B	8.9 lb	1.8	11,637 abc	38.9 b-e	16.20 a	1,318
Counter 20G	B	5.25 lb	1.05	11,468 bcd	37.5 de	16.55 a	1,343
Poncho Beta	Seed		68 g a.i./ unit seed	11,372 bcd	37.0 e	16.68 a	1,341
Poncho Beta + Counter 20G	Seed 6 d Pre-peak Post B	 5.25 lb	68 g a.i./ unit seed 1.05	11,192 cd	38.8 b-e	15.78 a	1,199
Check	---	----	---	10,560 d	35.0 f	16.38 a	1,214
LSD (0.05)				917.6	2.01	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; Post B = postemergence band; Seed = insecticidal seed treatment

The following treatments failed to provide statistically significant increases in recoverable sucrose yield when compared to the untreated check plots: 1) Counter 20G applied at planting at its low (5.25 lb/ac) rate; 2) Poncho Beta seed treatment; and 3) Poncho Beta + Counter 20G applied postemergence at 5.25 lb/ac.

It should be noted that Counter insecticide can only be applied once per year. Therefore, if Counter is applied at planting, it cannot be applied to the same field at postemergence. It also bears noting that the Counter 20G label has been revised to include a 90-day preharvest interval (i.e., PHI, the number of days that must elapse after application before a crop can be harvested) for sugarbeet. This makes Counter 20G a much more feasible product as a postemergence option for sugarbeet root maggot control than before, as it previously was labeled with a 110-day PHI.

The 90-day PHI should work well for Red River Valley growers choosing to use Counter 20G for SBRM management. Postemergence granule applications for SBRM control in the growing area are typically most effective if made in late-May to early-June. If this product were to be applied to a field on June 1, the 90-day PHI would expire before September 1, which is typically the earliest that preliminary sugarbeet harvest operations begin in the Valley.

Study II. Results from evaluations of sugarbeet root maggot larval feeding injury in Study II are shown in Table 3. Moderate larval feeding pressure developed in this trial, as was evidenced by the moderate root injury rating mean recorded for the untreated check plots (5.98 on the 0 to 9 scale). All insecticide-treated entries provided significant reductions in SBRM feeding injury when compared to the injury recorded in the untreated check plots.

Table 3. *Larval feeding injury* in an evaluation of sugarbeet root maggot control by combining planting-time insecticide granules or seed treatments with postemergence liquid sprays, St. Thomas, ND, 2017

Treatment/form.	Placement[a]	Rate (product/ac)	Rate (lb a.i./ac)	Root injury (0-9)
Counter 20G + Lorsban Advanced	B 3 d Pre-peak Broadcast	8.9 lb 1 pt	1.8 0.5	1.25 e
Counter 20G + Lorsban Advanced	B 3 d Pre-peak Broadcast	7.5 lb 2 pts	1.5 1.0	1.73 de
Counter 20G + Lorsban Advanced	B 3 d Pre-peak Broadcast	8.9 lb 2 pts	1.8 1.0	1.90 cde
Counter 20G + Lorsban Advanced	B 3 d Pre-peak Broadcast	7.5 lb 1 pt	1.5 0.5	2.23 cd
Counter 20G	B	8.9 lb	1.8	2.63 bc
Counter 20G	B	7.5 lb	1.5	2.65 bc
Poncho Beta + Lorsban Advanced	Seed 3 d Pre-peak Broadcast	 1 pt	68 g a.i./ unit seed 0.5	3.10 b
Poncho Beta + Lorsban Advanced	Seed 3 d Pre-peak Broadcast	 2 pts	68 g a.i./ unit seed 1.0	3.25 b
Poncho Beta	Seed		68 g a.i./ unit seed	3.38 b
Check	---	----	---	5.98 a
LSD (0.05)				0.837

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 following treatments provided the highest levels of root protection in Study II: 1) Counter banded at 8.9 lb product/ac + Lorsban Advanced postemergence at 1 pt/ac; 2) Counter banded at 7.5 lb product/ac + Lorsban Advanced at 2 pts/ac; and 3) Counter banded at 8.9 lb product/ac + Lorsban Advanced postemergence at 2 pts/ac. There were no significant differences in levels of SBRM feeding injury among these three treatments.

In plots initially treated with at-plant applications of Counter 20G at its high (8.9 lb) rate, the addition of a postemergence application of Lorsban Advanced at 1 pt/ac resulted in a significant improvement in root protection from SBRM feeding injury when compared to plots that only received the at-plant application of Counter. Similarly, applying Lorsban Advanced at 2 pts/ac to plots initially treated with Counter at its moderate (7.5 lb) rate resulted in a significant reduction in SBRM feeding injury when compared to plots that only received the moderate rate of Counter. In contrast, there were no significant improvements in protection from SBRM feeding injury by adding postemergence applications of Lorsban Advanced to plots initially protected with Poncho Beta-treated seed.

Yield results for Study II (Table 4) were somewhat supportive of the root maggot feeding injury rating results. As observed in Study I of this project, recoverable sucrose and root tonnage yields were exceptionally high for most treatments. This was partly due to the comparatively low root maggot infestation, but also a result of good growing conditions in the St. Thomas area during 2017.

The top-performing treatments with regard to recoverable sucrose yield in Study II included the following: 1) Counter banded at 8.9 lb product/ac + Lorsban Advanced postemergence at 1 pt/ac; 2) Counter banded at 7.5 lb product/ac + Lorsban Advanced at 1 pt/ac; 3) Counter banded at 8.9 lb product/ac + Lorsban Advanced postemergence at 2 pts/ac; and 4) Counter banded at 7.5 lb product/ac + Lorsban Advanced at 2 pts/ac. There were no significant differences among these treatments with respect to recoverable sucrose yield. The best treatment overall, regarding recoverable sucrose and root yield, and gross economic return, was Counter banded at 8.9 lb product/ac + Lorsban Advanced postemergence at 1 pt/ac. Plots protected by this treatment produced significantly more recoverable sucrose per acre than most other treatments, and significantly more root yield than all treatments, except the combination of Counter banded at 7.5 lb product/ac + Lorsban Advanced postemergence at 2 pts/ac.

Table 4. *Yield parameters* from an evaluation of sugarbeet root maggot control by combining planting-time insecticide granules or seed treatments with postemergence liquid sprays, St. Thomas, ND, 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)
Counter 20G + Lorsban Advanced	B 3 d Pre-peak Broadcast	8.9 lb 1 pt	1.8 0.5	12,357 a	38.9 a	16.98 a	1,519
Counter 20G + Lorsban Advanced	B 3 d Pre-peak Broadcast	7.5 lb 1 pt	1.5 0.5	11,595 ab	35.7 bcd	17.33 a	1,469
Counter 20G + Lorsban Advanced	B 3 d Pre-peak Broadcast	8.9 lb 2 pt	1.8 1.0	11,487 abc	35.8 bcd	17.20 a	1,432
Counter 20G + Lorsban Advanced	B 3 d Pre-peak Broadcast	7.5 lb 2 pts	1.5 1.0	11,425 abc	36.9 ab	16.70 a	1,358
Counter 20G	B	7.5 lb	1.5	11,300 bc	36.5 bc	16.75 a	1,346
Counter 20G	B	8.9 lb	1.8	11,233 bc	35.5 bcd	16.90 a	1,374
Poncho Beta + Lorsban Advanced	Seed 3 d Pre-peak Broadcast	2 pts	68 g a.i./ unit seed 1.0	10,642 bcd	34.6 cde	16.58 a	1,256
Poncho Beta + Lorsban Advanced	Seed 3 d Pre-peak Broadcast	1 pt	68 g a.i./ unit seed 0.5	10,572 cd	33.9 de	16.80 a	1,273
Poncho Beta	Seed		68 g a.i./ unit seed	10,133 d	32.4 ef	16.83 a	1,224
Check	---	----	---	9,768 d	31.1 f	16.85 a	1,187
LSD (0.05				972.8	2.24	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

Estimated gross revenue from treatment combinations that included Counter 20G at planting, followed by a postemergence application of Lorsban Advanced, ranged from $1,358 to $1,519/ac, which translated to revenue increases of between $171and $332/ac when compared to revenue from the untreated check plots. Plots protected by single, planting-time applications of Counter 20G generated revenue increases of between $159 and $187. Plots planted with Poncho Beta-treated seed (i.e., without an additive postemergence insecticide application) generated a revenue increase of $37/ac; however, applying a postemergence application of Lorsban Advanced to Poncho Beta plots resulted in additional revenue increases ranging from $69 to $86/ac.

In general, the results from Study II indicate that effective root maggot control, even under moderate infestation levels such as those that developed in this trial, can result in significant yield increases. These findings also demonstrate that single-component insecticide programs may not provide sufficient protection from yield losses associated with SBRM larval feeding injury, even under such moderate infestations. Although the returns generated by single control tool entries in this study would easily justify their use, these results demonstrate that more aggressive approaches, combining at-plant and postemergence rescue insecticide protection, can contribute substantially to maximizing economic returns from sugarbeet production in areas affected by this pest.

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