PERFORMANCE OF SINGLE- DUAL- AND TRIPLE-COMPONENT INSECTICIDE PROGRAMS TO MANAGE THE SUGARBEET ROOT MAGGOT

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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. Previous field research has shown that this pest is capable of causing more than 45% yield losses in the absence of effective control measures (Boetel et al. 2010). This pest is a perennial threat to the profitability of many sugarbeet producers in the northern RRV. In recent years, the root maggot has expanded its range southward and eastward, with damaging infestations occurring in Grand Forks and Traill counties in North Dakota, and Polk and Norman counties in Minnesota. Management of high SBRM infestations typically involves application of either a planting-time soil-applied insecticide or an insecticidal seed treatment. In areas affected by moderate- to high-SBRM infestations, additive protection with either a banded application of a granular insecticide a postemergence spray application is often necessary to prevent significant yield loss associated with SBRM feeding injury. The postemergence spray strategy provides growers with a "wait and see" option to make informed decisions on whether rescue insecticide treatments are needed. The need for a postemergence application is based on SBRM fly activity levels. 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 entailed 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) determine the efficacy of combining Poncho Beta with Counter 20G at planting time for a one-pass protection system; 3) assess 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 granular 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) determine the most effective rate of Lorsban Advanced applied as a postemergence treatment for providing additive 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 11 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 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. To avoid cross-contamination of seed between treatment applications, planter seed hoppers and seed dispensation equipment were completely disassembled, cleaned, and re-assembled after the application of each entry that involved a treatment insecticide.

<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 7 June, or about 2 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 1 day 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 in Study I. Sprays were applied on 7 June (i.e., about 2 days before peak SBRM fly activity).

Root injury ratings: Sugarbeet root maggot feeding injury was assessed in both studies on 2 August 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 19 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, 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 = 6.23 on the 0 to 9 scale of Campbell et al. [2000]) suggested that a moderately high SBRM infestation was present for this study. All insecticide-protected plots had significantly lower levels of root maggot feeding injury than the untreated check, irrespective of whether a seed treatment, single at-plant granular application, dual-, or triple-application insecticide combination was used for SBRM control. However, there were no statistical differences among the three rates of Counter 20G tested or between any single application of Counter and Poncho Beta.

There were very few statistically significant differences in SBRM feeding injury among insecticide-protected treatments in Study I. For example, there were no instances of significant impacts on root protection from any of the postemergence applications in this experiment when compared to the root protection provided by their single, at-plant counterparts. These are very atypical findings in comparison to those from several previous years of testing on these same materials. The lowest root injury ratings (i.e., highest root protection levels) in Study I were in plots that received a planting-time application of Counter 20G at its high labeled rate (8.9 lb product/ac) and a postemergence application of the high rate (7 lb/ac) of Thimet 20G. However, the only dual-insecticide treatment that this combination differed significantly from was the combination of Poncho Beta seed treatment plus a planting-time application of Counter at its low (5.25 lb/ac) labeled rate. The only major rate-related difference in root ratings in Study I was where the high (8.9-lb) rate of at-plant Counter 20G provided significantly greater additive root protection than the low (5.25-lb) rate of Counter in plots planted with Poncho Beta-treated seed.-

A trend toward better performance by higher rates of Counter 20G was evident with both at-plant and postemergence applications, however, there were no statistically significant rate responses with this insecticide. Another apparent trend was that dual- and triple-insecticide application treatments tended to provide slightly better root protection than single-application treatments, although none of the differences in paired comparisons were statistically significant. There also was no significant difference in additive root protection between at-plant and postemergence applications of Counter 20G when it was applied at the low (5.25 lb/ac) rate.

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, 2016

Treatment/form.	Placement[a]	Rate (product/ac)	Rate (lb a.i./ac)	Root injury (0-9)
Counter 20G + Thimet 20G	B 2 d Pre-peak Post B	8.9 lb 7 lb	1.8 1.4	3.20 d
Poncho Beta + Counter 20G	Seed 2 d Pre-peak Post B	 8.9 lb	68 g a.i./ unit seed 1.8	3.57 cd
Poncho Beta + Counter 20G	Seed B	 8.9 lb	68 g a.i./ unit seed 1.8	3.63 cd
Poncho Beta + Thimet 20G	Seed 2 d Pre-peak Post B	 7 lb	68 g a.i./ unit seed 1.4	3.67 cd
Counter 20G + Thimet 20G	B 2 d Pre-peak Post B	7.5 lb 7 lb	1.5 1.4	3.73 cd
Poncho Beta + Thimet 20G + Lorsban Advanced	Seed 2 d Pre-peak Post B 1 d Pre-peak Broadcast	 7 lb 1 pt	68 g a.i./ unit seed 1.4 0.5	3.87 bcd
Poncho Beta + Counter 20G + Lorsban Advanced	Seed B 1 d Pre-peak Broadcast	 8.9 lb 1 pt	68 g a.i./unit seed 1.8 0.5	3.93 bcd
Counter 20G	B	8.9 lb	1.8	4.20 bcd
Poncho Beta + Counter 20G	Seed 2 d Pre-peak Post B	 5.25 lb	68 g a.i./ unit seed 1.05	4.30 bcd
Poncho Beta	Seed		68 g a.i./ unit seed	4.50 bc
Counter 20G	B	7.5 lb	1.5	4.60 bc
Poncho Beta + Counter 20G	Seed B	 5.25 lb	68 g a.i./ unit seed 1.05	4.93 b
Counter 20G	B	5.25 lb	1.05	4.93 b
Check	---	----	---	6.23 a
LSD (0.05)				1.12

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

Yield data from Study I are presented in Table 2. Treatment performance in relation to yield mostly followed similar patterns to those observed in root maggot feeding injury data for this trial in that there were very few significant differences among treatments. In fact, despite large numerical differences in root tonnage among treatments, no statistically significant differences were detected for root yield. This was probably due to a considerable amount of variability within and between replications in this trial due to frequent and sometimes heavy rainfall during the growing season that resulted in frequent periods of standing water in the plots.

As observed in the SBRM feeding injury data, slight trends toward better performance were evident with increasing rates of both at-plant and postemergence applications of Counter 20G, although significant rate-related differences were rare. Additionally, a strong trend toward increased recoverable sucrose and root yields was evident in plots that received dual- or triple-component insecticide protection when compared to those treated with single-component insecticidal protection. One notable result was that, when Counter was used at its low (5.25 lb/ac) rate in combination with Poncho Beta-protected seed, the dual program that included Counter as a planting-time application resulted in significantly greater sucrose yield than when it was applied postemergence.

The top-performing entry in Study I with regard to recoverable sucrose yield, root tonnage, and percent sucrose content was 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. Plots protected by this program generated a minimum of over $104/acre in gross revenue over that of any other insecticide program in this trial, and they produced an average of

$447 more revenue than the untreated check plots. However, it should be noted that Lorsban Advanced applications failed to impart statistically significant impacts on recoverable sucrose, root yield, or percent sucrose in the triple-component insecticide programs when compared to dual-component (i.e., seed treatment + an at-plant or postemergence granule) treatments that excluded the Lorsban Advanced application.

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, 2016

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 + Lorsban Advanced	Seed B 1 d Pre-peak Broadcast	 8.9 lb 1 pt	68 g a.i./unit seed 1.8 0.5	8265 a	28.5 a	15.50 a	860
Poncho Beta + Counter 20G	Seed B	 8.9 lb	68 g a.i./ unit seed 1.8	7736 ab	28.3 a	14.80 a-e	728
Counter 20G + Thimet 20G	B 2 d Pre-peak Post B	8.9 lb 7 lb	1.8 1.4	7356 abc	25.6 a	15.43 ab	756
Poncho Beta + Counter 20G	Seed B	 5.25 lb	68 g a.i./ unit seed 1.05	6940 a-d	26.6 a	14.27 de	596
Poncho Beta + Counter 20G	Seed 2 d Pre-peak Post B	 8.9 lb	68 g a.i./ unit seed 1.8	6925 a-e	25.0 a	14.97 a-d	670
Poncho Beta	Seed		68 g a.i./ unit seed	6694 a-e	24.0 a	15.10 abc	653
Counter 20G + Thimet 20G	B 2 d Pre-peak Post B	7.5 lb 7 lb	1.5 1.4	6461 b-e	23.6 a	14.83 a-e	612
Poncho Beta + Thimet 20G + Lorsban Advanced	Seed 2 d Pre-peak Post B 1 d Pre-peak Broadcast	 7 lb 1 pt	68 g a.i./ unit seed 1.4 0.5	6459 b-e	23.3 a	15.07 abc	624
Counter 20G	B	8.9 lb	1.8	6147 b-f	23.9 a	14.40 cde	512
Counter 20G	B	7.5 lb	1.5	5934 c-f	21.9 a	14.70 b-e	547
Poncho Beta + Thimet 20G	Seed 2 d Pre-peak Post B	 7 lb	68 g a.i./ unit seed 1.4	5783 c-f	22.3 a	14.17 e	488
Counter 20G	B	5.25 lb	1.05	5437 def	20.8 a	14.50 cde	470
Poncho Beta + Counter 20G	Seed 2 d Pre-peak Post B	 5.25 lb	68 g a.i./ unit seed 1.05	5187 ef	20.0 a	14.17 e	441
Check	---	----	---	4565 f	17.1 a	14.50 cde	413
LSD (0.05)				1740.4	NS	0.777	

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

Entries that were not statistically different from the top-performing treatment with respect to recoverable sucrose yield and percent sucrose content included the following: 1) Poncho Beta + Counter 20G applied at planting time at 8.9 lb/ac; 2) Counter 20G applied at planting at 8.9 lb/ac + Thimet 20G applied at postemergence at 7 lb/ac; 3) Poncho Beta + at-plant Counter 20G at 5.25 lb/ac; 4) Poncho Beta + a postemergence application of Counter 20G at 8.9 lb/ac; and 5) Poncho Beta as a stand-alone treatment. One interesting result was that the aforementioned triple-component program, which included a planting-time banded application of Counter 20G, produced significantly more recoverable sucrose yield than the other triple-component entry in which the granular component was a postemergence application of Thimet.

The general lack of differences between single and multi-component treatments in this study could have been a product of two factors. One major influence could have been the repeated and often heavy rainfall events that occurred during the SBRM mating and egg-laying periods, which also coincided with our attempts to apply postemergence insecticides. A second factor, also related to rainfall, was that stormy weather and associated muddy field conditions delayed the timing of planned postemergence granule applications by nearly one week. These findings may suggest that applying these postemergence granules at or very close to peak SBRM fly activity may not provide effective protection from SBRM feeding injury in some years.

Overall, the findings from this trial demonstrate that triple-component insecticide programs for SBRM management generated gross revenue benefits of at least $211 per acre when compared to the untreated check, and dual (i.e., planting-time plus postemergence) insecticide programs produced gross revenue increases of $28 to $315 per acre above the control. The gross economic benefits from single at-plant insecticide programs (i.e., Counter or Poncho Beta) ranged from $57/ac in plots treated with the low (5.25 lb product/ac) rate of Counter 20G to $240 per acre in plots protected with Poncho Beta-treated seed. These findings clearly demonstrate the economic value of applying an additive insecticide, either in the form of a planting-time or postemergence application. The results of this trial also underscore the importance of the SBRM as a serious economic pest of sugarbeet.

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, as it previously was labeled with a 110-day PHI. The new, 90-day PHI should work well for SBRM management in the Red River Valley, because postemergence granule applications are typically most effective if made in late-May to early-June. However, growers must comply with this new PHI if choosing to use Counter 20G for postemergence SBRM control.

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 (5.45 on the 0 to 9 scale). All insecticide entries provided significant reductions in SBRM feeding injury when compared to the injury recorded in the untreated check plots.

The following treatments provided the greatest levels of root protection in Study II: 1) Counter banded at 8.9 lb product/ac + Lorsban Advanced postemergence at 2 pts/ac; 2) Counter banded at 8.9 lb product/ac + Lorsban Advanced at 1 pt/ac; 3) Counter banded at 7.5 lb product/ac + Lorsban Advanced postemergence at 2 pts/ac; 4) Counter banded at 7.5 lb product/ac + Lorsban Advanced at 1 pt/ac; and 5) Poncho Beta + Lorsban Advanced applied as a postemergence broadcast at 2 pts of product/ac. There were no statistically significant differences among these treatments.

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, 2016

Treatment/form.	Placement[a]	Rate (product/ac)	Rate (lb a.i./ac)	Root injury (0-9)
Counter 20G + Lorsban Advanced	B 2 d Pre-peak Broadcast	8.9 lb 2 pts	1.8 1.0	1.53 e
Counter 20G + Lorsban Advanced	B 2 d Pre-peak Broadcast	8.9 lb 1 pt	1.8 0.5	2.08 de
Counter 20G + Lorsban Advanced	B 2 d Pre-peak Broadcast	7.5 lb 2 pts	1.5 1.0	2.30 de
Counter 20G + Lorsban Advanced	B 2 d Pre-peak Broadcast	7.5 lb 1 pt	1.5 0.5	2.43 cde
Poncho Beta + Lorsban Advanced	Seed 2 d Pre-peak Broadcast	 2 pts	68 g a.i./ unit seed 1.0	2.70 cde
Poncho Beta + Lorsban Advanced	Seed 2 d Pre-peak Broadcast	 1 pt	68 g a.i./ unit seed 0.5	3.20 bcd
Counter 20G	B	8.9 lb	1.8	3.20 bcd
Counter 20G	B	7.5 lb	1.5	3.60 bc
Poncho Beta	Seed		68 g a.i./ unit seed	4.05 b
Check	---	----	---	5.45 a
LSD (0.05)				1.23

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

A general pattern observed in Study II was that postemergence broadcast applications of Lorsban Advanced, applied two days before peak SBRM fly activity, resulted in excellent control. This was especially true when the high (2 pts/ac) rate of Lorsban Advanced was used. For example, plots treated at planting with Counter 20G (i.e., either 7.5 lb/ac or 8.9 lb/ac) had significantly lower SBRM feeding injury when Lorsban Advanced was applied at postemergence at its high (2 pts product/ac) labeled rate. The same trend was evident with postemergence applications of Lorsban Advanced at the lower (1 pt per acre) rate; however, the differences were not significant between Counter-only plots (i.e., either 7.5 or 8.9 lb/ac) and those to which Lorsban Advanced was applied. Similarly, the high (2-pt) rate of Lorsban Advanced provided a significant reduction in SBRM feeding injury in plots planted with Poncho Beta-treated seed; however, applying Lorsban Advanced at the 1-pt rate did not significantly reduce the extent of SBRM feeding injury in plots initially protected by Poncho Beta seed treatment. A general trend in Study II was that the root protection provided by Counter 20G was generally better than that provided by Poncho Beta insecticidal seed treatment. Although this was not the case in Study I, it has been in most previous experiments that included these materials.

Yield results for Study II (Table 4) were somewhat supportive of the root maggot feeding injury rating results. All dual insecticide (i.e., planting-time plus postemergence) entries provided significant increases in recoverable sucrose yield and root yield when compared to the untreated check plots. None of the single-component programs resulted in statistically significant increases in recoverable sucrose yield when compared to the untreated check plots. There also were no significant differences in recoverable sucrose yield or root tonnage between Poncho Beta and Counter 20G, irrespective of which rate of Counter was applied. Poncho Beta was the only single-component entry in which plots produced significantly more root tonnage than the untreated check plots.

There were no significant differences in recoverable sucrose yield, root yield, or percent sucrose among the dual-insecticide (i.e., planting-time plus postemergence) treatments in Study II. The combination of Poncho Beta-treated seed with a postemergence application of Lorsban Advanced at its high (2 pts/ac) labeled rate was the top-performing entry in this study with regard to recoverable sucrose yield. Plots protected by this combination produced significantly greater recoverable sucrose and root yield than those protected with only Poncho Beta seed treatment. The Lorsban Advanced application in this dual program accounted for a $296 increase in revenue in comparison to the single Poncho Beta treatment. A similar program, comprised of Poncho Beta-treated seed plus a postemergence application of Lorsban Advanced at 1 pt per acre, also produced significantly greater sucrose yield and root tonnage. Although trends suggested that the high (2 pts/ac) rate of Lorsban Advanced performed slightly better than the 1-pt rate, there were no significant differences between rates of this material in relation to recoverable sucrose or root yield in Study II, irrespective of whether the initial protection involved Counter 20G or Poncho Beta.

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, 2016**

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 pts	68 g a.i./ unit seed 1.0	7057 a	24.3 a	15.53 ab	736
Counter 20G + Lorsban Advanced	B 2 d Pre-peak Broadcast	8.9 lb 2 pt	1.8 1.0	6876 a	24.0 a	15.30 abc	701
Poncho Beta + Lorsban Advanced	Seed 2 d Pre-peak Broadcast	 1 pt	68 g a.i./ unit seed 0.5	6746 a	23.0 ab	15.75 a	718
Counter 20G + Lorsban Advanced	B 2 d Pre-peak Broadcast	7.5 lb 2 pts	1.5 1.0	6623 a	22.9 ab	15.43 abc	689
Counter 20G + Lorsban Advanced	B 2 d Pre-peak Broadcast	8.9 lb 1 pt	1.8 0.5	6416 a	22.0 ab	15.50 abc	673
Counter 20G + Lorsban Advanced	B 2 d Pre-peak Broadcast	7.5 lb 1 pt	1.5 0.5	5831 ab	20.4 abc	15.35 abc	596
Poncho Beta	Seed		68 g a.i./ unit seed	5029 bc	19.1 bc	14.33 de	440
Counter 20G	B	7.5 lb	1.5	4880 bc	17.7 cd	14.75 cd	467
Counter 20G	B	8.9 lb	1.8	4779 bc	17.4 cd	14.78 bcd	455
Check	---	----	---	3702 c	14.5 d	13.90 e	303
LSD (0.05				1366.7	4.19	0.757	

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

Overall, the results from Study II indicate that effective root maggot management, under even 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 in moderate infestations. Postemergence sprays in dual-component insecticide regimes generated gross economic return increases ranging from between $129 and $278 per acre when Lorsban Advanced was applied at the low (1 pt/ac) rate to between $222 and $296 per acre when Lorsban Advanced was applied at 2 pts per acre. Dual programs also produced gross revenue benefits of between $293 and $433 per acre when compared to the revenue from untreated check plots; whereas, single-component regimes increased revenue by $137 to $164 per acre. Although the returns generated by single control tools 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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