OPTIMAL APPLICATION TIMING AND RATES OF POSTEMERGENCE GRANULAR INSECTICIDES FOR SUGARBEET ROOT MAGGOT CONTROL

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Introduction:

Sugarbeet root maggot (SBRM), *Tetanops myopaeformis* (Röder), populations in many areas of the Red River Valley production area have been at alarmingly high levels during the past decade. Concerns regarding these trends have increased the urgency for refinement of postemergence tools for more effective SBRM management. Other concerns surround the potential that chlorpyrifos, the most commonly used postemergence insecticide used by Valley sugarbeet producers, is facing a potential ban from federal registration in the U.S. Therefore, optimization of the existing control tools available to growers is critically needed. The key objective of this experiment was to assess the impacts of application timing and rate on the performance of Thimet 20G insecticide when applied as a postemergence rescue insecticide for SBRM control in the Red River Valley growing area. A secondary objective was to compare moderate and high rates of Counter 20G (i.e., 7.5 and 8.9 lb product/acre, respectively) as planting-time tools in dual-insecticide (i.e., planting-time + postemergence) regimes for root maggot control.

Materials and Methods:

This study was planted on 12 May at a commercial field site near St. Thomas (Pembina County), ND. Plots were planted using a 6-row Monosem NG Plus 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 two rows of each plot served as untreated buffers. Individual plots were 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. Counter 20G was used as a base planting-time insecticide for all plots that received insecticide protection, and it was applied at either the moderate (7.5 lb product/ac) or high (8.9 lb/ac) labeled rate. Granular output rates were regulated by using a planter-mounted SmartBox™ computer-controlled insecticide system that was calibrated on the planter before planting. Placement of granules in 5-inch bands over the rows during planting was achieved by using Gandy™ row banders.

Postemergence Thimet 20G granules were applied at either seven days before peak fly or on the day of peak fly activity (i.e., 2 or 9 June, respectively), and rates of Thimet 20G included 4.9 and 7 lb product/ac. As with at-plant applications, granular output rates were regulated by using a SmartBox™ system mounted on a tractor-drawn four-row toolbar, and placement of insecticide in 4-inch bands was achieved by using Kinze™ row banders. Granules were incorporated by using two pairs of metal rotary tines that straddled each row. A set of tines was positioned ahead of each bander, and a second pair was mounted behind the granular drop zone. Lorsban Advanced, applied in a broadcast at 1 pt product/ac using TeeJet™ 110015VS nozzles, was also included in this experiment for comparative purposes. This application was made on 7 June, which was two days before the initial peak in SBRM fly activity.

Root injury ratings: Root maggot feeding injury assessments were carried out 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: Performance was also compared using sugarbeet yield parameters derived by harvesting roots from all treatment plots. All foliage was removed from plots immediately before harvest on 20 September by using a commercial-grade mechanical defoliator. On the same day, all beets from the center two rows of each plot were extracted from soil by 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 yield/quality analyses were subjected to analysis of variance (ANOVA) using the general linear models (GLM) procedure (SAS Institute, 2008). Treatment means were separated using Fisher's protected least significant difference (LSD) test at a 0.05 level of significance.

Results and Discussion:

Root maggot feeding injury results from this trial are presented in Table 1. A high SBRM infestation was present in this experiment, as was evidenced by the high average feeding injury rating of 7.4 (0 to 9 scale of Campbell et al. 2000) in the untreated check plots. All insecticide entries in the experiment provided significant reductions in SBRM feeding injury when compared to the untreated check. Dual (i.e., planting-time plus postemergence) insecticide programs that included postemergence applications of Thimet 20G consistently provided significant improvements in root protection from SBRM feeding injury over those that involved a single, planting-time application of Counter 20G, irrespective of Counter or Thimet rate applied.

There was no significant difference between the 7.5- and 8.9-lb product/ac planting-time-only applications of Counter 20G with regard to protection from SBRM feeding injury, irrespective of whether the Counter was applied as a single, planting-time only treatment or combined with a postemergence application of Thimet. However, trends suggested that increased root protection may occur when using the high labeled rates of both Counter and Thimet. Another trend suggested that applying the Thimet applications later (i.e., at peak fly activity rather than seven days pre-peak) may have resulted in slight performance increases regarding root protection. However, that trend could have been related to frequent rainfall events that occurred shortly after the peak-fly applications. Rain totals of 0.21, 0.20, 0.44, and 1.46" occurred at one, three, five, and eight days, respectively, after the peak-fly Thimet applications. Regardless of what may have caused the trend in slightly lower root injury ratings in most peak-fly Thimet treatments, none of the root injury rating differences were statistically significant. The postemergence spray of Lorsban Advanced, applied at its moderate labeled rate (1 pt product/ac) did not provide a significant improvement in root protection when added to plots initially treated with the 7.5-lb rate of Counter 20G at planting. This also occurred during testing in 2015, and may have also resulted from frequent and sometimes heavy rainfall events shortly after Lorsban Advanced applications in 2016.

Table 1. *Larval feeding injury* in an evaluation of Thimet 20G application timing and rate on sugarbeet root maggot control, 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 Peak-fly Post B	8.9 lb 7 lb	1.8 1.4	3.38 f
Counter 20G + Thimet 20G	B 7 d Pre-peak Post B	8.9 lb 7 lb	1.8 1.4	3.53 ef
Counter 20G + Thimet 20G	B Peak-fly Post B	7.5 lb 7 lb	1.5 1.4	3.53 ef
Counter 20G + Thimet 20G	B Peak-fly Post B	7.5 lb 4.9 lb	1.5 1.0	3.73 def
Counter 20G + Thimet 20G	B 7 d Pre-peak Post B	7.5 lb 7 lb	1.5 1.4	4.35 cde
Counter 20G + Thimet 20G	B 7 d Pre-peak Post B	7.5 lb 4.9 lb	1.5 1.0	4.45 cd
Counter 20G + Lorsban Advanced	B 2 d Pre-peak Broadcast	7.5 lb 1 pt	1.5 0.5	4.65 bc
Counter 20G	B	8.9 lb	1.8	4.75 bc
Counter 20G	B	7.5 lb	1.5	5.38 b
Check	-----	----	-----	7.40 a
LSD (0.05)				0.85

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

Yield data from this experiment appear in Table 2. All insecticide-treated entries in this trial resulted in significant increases in recoverable sucrose and root yields when compared to the untreated check. Plots treated with the combination of Counter 20G at its moderate (7.5 lb product/ac) rate plus a postemergence broadcast spray of Lorsban Advanced at 1 pt /ac generated the most recoverable sucrose and root yield in the trial; however, those values were not statistically different from those of any other dual-insecticide application treatment.

The higher rate of Counter 20G (8.9 lb product/ac), when used as a planting-time-only treatment, was superior to the moderate (7.5 lb/ac) rate in regard to recoverable sucrose yield, root tonnage, and percent sucrose content, and the differences resulted in a gross economic return increase of $90/ac in plots treated with the higher rate of Counter. However, when postemergence applications of Thimet 20G were included in dual-insecticide programs, there were no significant yield or quality benefits from using the high rate of Counter at planting.

General yield trends suggested that applying postemergence Thimet at the higher (7 lb/ac) rate and at, or close to, peak fly activity may occasionally produce more recoverable sucrose yield; however, there were no significant differences in sucrose yield or root yield among dual-insecticide treatments with regard to rate or timing of the Thimet applications. These results have been observed in previous testing, and suggest that growers could potentially save input costs and achieve excellent SBRM control by using lower at-plant granular insecticide application rates in dual-insecticide programs that include postemergence Thimet applications.

Adding postemergence applications of Thimet 20G to plots initially treated with a planting-time application of Counter 20G at its high (8.9 lb/ac) labeled rate generated gross economic return increases that ranged from $79 to $133 per acre above the revenue from planting-time-only applications of Counter at 8.9 lb per acre. Plots initially treated at planting with Counter at the moderate (7.5 lb product/ac) rate produced revenue increases of between $125 and $233/ac when a postemergence application of Thimet was added. Similarly, when plots that received 7.5 lb of Counter at planting were treated with a postemergence rescue application of Lorsban Advanced within two days of peak fly, gross economic return was increased by $245/ac.

Table 2. Impacts of Thimet 20G application timing and rate on *yield parameters* in an evaluation of sugarbeet root maggot control, 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)
Counter 20G + Lorsban Advanced	B 2 d Pre-peak Broadcast	7.5 lb 1 pt	1.5 0.5	5848 a	21.7 a	14.65 ab	538
Counter 20G + Thimet 20G	B Peak-fly Post B	7.5 lb 7 lb	1.5 1.4	5576 a	20.8 a	14.53 abc	504
Counter 20G + Thimet 20G	B Peak-fly Post B	8.9 lb 7 lb	1.8 1.4	5410 ab	19.6 ab	14.83 a	516
Counter 20G + Thimet 20G	B Peak-fly Post B	7.5 lb 4.9 lb	1.5 1.0	5372 ab	20.4 a	14.30 a-d	469
Counter 20G + Thimet 20G	B 7 d Pre-peak Post B	8.9 lb 7 lb	1.8 1.4	5363 ab	20.5 a	14.20 bcd	462
Counter 20G + Thimet 20G	B 7 d Pre-peak Post B	7.5 lb 7 lb	1.5 1.4	5098 ab	19.2 ab	14.43 abc	455
Counter 20G + Thimet 20G	B 7 d Pre-peak Post B	7.5 lb 4.9 lb	1.5 1.0	5094 ab	19.9 ab	14.00 cd	418
Counter 20G	B	8.9 lb	1.8	4428 bc	16.9 bc	14.25 a-d	383
Counter 20G	B	7.5 lb	1.5	3735 c	14.9 c	13.75 d	293
Check	-----	----	-----	1913 d	8.4 d	12.83 e	114
LSD (0.05)				990.1	3.47	0.623	

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

The results of this experiment showed that combining at-plant Counter 20G with postemergence applications of Thimet 20G provides effective control of the sugarbeet root maggot, and that Thimet performance is not significantly impacted by application timing (i.e., seven days pre-peak vs. peak fly) or rate. This allows growers

a wide window of flexibility in relation to when the Thimet must be applied to achieve satisfactory SBRM control. Results also indicated that, in a dual-insecticide program that includes Counter 20G as the planting-time component, it is not necessary to maximize the application rate of Counter to achieve excellent root maggot control. As such, these findings further suggest that growers can optimize SBRM control and increase net revenue by applying the 7.5-lb rate of Counter at planting and following that with a postemergence application of either a broadcast application of Lorsban Advanced or a banded application of Thimet 20G at the 4.9- or 7-lb rate.

The additional economic returns from postemergence insecticide applications in this experiment provide ample justification for the use of these materials to provide additive control of the sugarbeet root maggot. The fact that insecticide protection, in the form of either a single at-plant insecticide or a dual-insecticide program, increased gross economic returns by between $179 and $424/ac above the untreated check clearly demonstrates the significance of the sugarbeet root maggot as a serious economic pest of sugarbeet. As such, effective SBRM management programs, such as the dual-insecticide programs tested in this experiment, are critical to the profitability of sugarbeet production in areas affected by moderate to high infestations of this pest.

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