APPLICATION TIMING AND RATE EFFECTS ON THIMET 20G FOR POSTEMERGENCE SUGARBEET ROOT MAGGOT CONTROL

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Introduction:

The severity and geographic distribution of sugarbeet root maggot (SBRM), *Tetanops myopaeformis* (Röder), populations in the Red River Valley growing area have increased sharply during the past nine years (Fig. 1). Concerns regarding these trends have increased the urgency for refinement of postemergence tools for more effective SBRM management. 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.

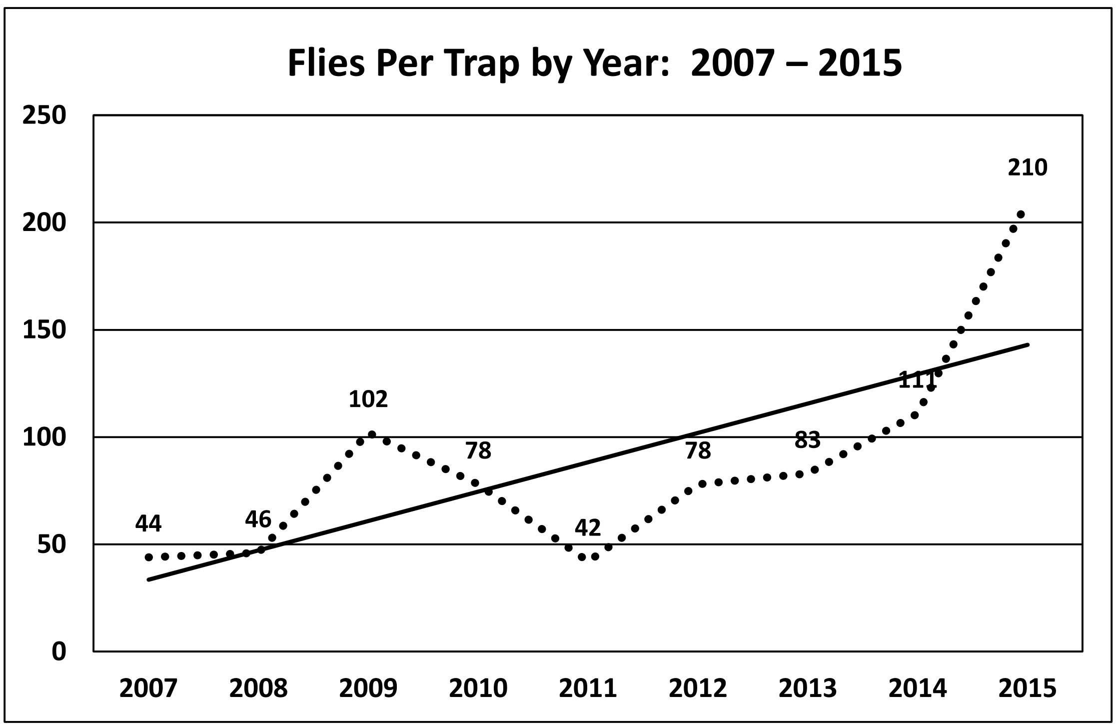

Figure 1. Yearly averages of sugarbeet root maggot flies captured on sticky-stake traps (Blickenstaff and Peckenpaugh, 1976) in the Red River Valley from 2007 to 2015.

Materials and Methods:

This study was planted on 27 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^{TM} 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^{TM} row banders.

Postemergence Thimet 20G granules were applied at either one or seven days before peak fly activity (i.e., 11 or 5 June, repsectively), 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^{TM} system mounted on a tractor-drawn four-row toolbar, and placement of insecticide in 4-inch bands was achieved by using Kinze^{TM} row banders. Granules were incorporated by using two pairs of 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^{TM} 110015VS nozzles, was also included in this experiment for comparative purposes. This application was made on 10 June, which was two days before the initial peak in SBRM fly activity. To avoid confounding effects from neighboring treatments that did not receive a treatment capable of killing SBRM flies, plots treated with Lorsban Advanced were three tractor passes wide rather than the standard single pass. However, only the inner six rows of the plot were sprayed, and all treatment assessments were made in the inner four rows of the sprayed zone of each plot.

<u>Root injury ratings</u>: Root maggot feeding injury assessments were carried out on 28 and 29 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).

<u>Harvest</u>: 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 30 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.

<u>Data analysis</u>: 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. Extremely high SBRM infestations were present in this experiment, as was evidenced by the high average rating of 7.83 (0 to 9 scale of Campbell et al. 2000) in the untreated check plots. Also, all insecticide entries in the experiment provided significant reductions in SBRM feeding injury when compared to the check. Dual (planting-time plus postemergence) insecticide programs that included postemergence applications of Thimet 20G provided significant improvements in root protection from SBRM feeding injury over those that involved a single, planting-time application of Counter 20G. Overall findings from root injury rating data indicated that there were no significant differences among entries that included Counter 20G at planting with postemergence Thimet 20G, irrespective of the rate of either insecticide or the timing of Thimet applications. 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. However, trends suggested that increased root protection may occur when using the high labeled rates of both Counter and Thimet. The postemergence spray of Lorsban Advanced at its moderate labeled rate (1 pt product/ac) failed to provide a significant improvement in root protection when added to plots initially treated with the 7.5-lb rate of Counter 20G at planting.

Table 1. ***Larval feeding injury*** **in an evaluation of Thimet 20G application timing and rate on sugarbeet root maggot control, St. Thomas, ND, 2015**				
Treatment/form.	**Placement[a]**	**Rate (product/ac)**	**Rate (lb a.i./ac)**	**Root injury (0-9)**
Counter 20G + Thimet 20G	B 7 d Pre-peak Post B	8.9 lb 7 lb	1.8 1.4	3.40 d
Counter 20G + Thimet 20G	B 1 d Pre-peak Post B	8.9 lb 7 lb	1.8 1.4	3.68 d
Counter 20G + Thimet 20G	B 1 d Pre-peak Post B	7.5 lb 7 lb	1.5 1.4	3.90 d
Counter 20G + Thimet 20G	B 7 d Pre-peak Post B	7.5 lb 4.9 lb	1.5 1.0	3.93 d
Counter 20G + Thimet 20G	B 7 d Pre-peak Post B	7.5 lb 7 lb	1.5 1.4	4.05 cd
Counter 20G + Thimet 20G	B 1 d Pre-peak Post B	7.5 lb 4.9 lb	1.5 1.0	4.15 cd
Counter 20G	B	8.9 lb	1.8	4.80 bc
Counter 20G + Lorsban Advanced	B 2 d Pre-peak Broadcast	7.5 lb 1 pt	1.5 0.5	5.35 b
Counter 20G	B	7.5 lb	1.5	5.45 b
Check	-----	----	-----	7.83 a
LSD (0.05)				0.76

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 are presented in Table 2. As observed in SBRM feeding injury data, all insecticide-treated entries in this trial resulted in significant increases in recoverable sucrose yield when compared to the untreated check. The top-performing treatment in relation to recoverable sucrose yield involved an at-plant application of Counter 20G at its high (8.9 lb product/ac) rate, combined with a postemergence application of Thimet 20G applied at high (7 lb product/ac) rate at one day before the main SBRM fly activity peak. This combination produced significantly more recoverable sucrose than when the lower rates of Counter and Thimet were applied earlier (i.e., seven days ahead of peak fly). No other differences were observed in sucrose yields between control programs that included Counter applied at planting and Thimet applied postemergence, irrespective of application rate of either insecticide. This suggests that growers could potentially save input costs and achieve good SBRM control by using lower application rates in dual-insecticide programs that include postemergence Thimet applications.

Although not significant, later Thimet applications produced slightly more sucrose yield than earlier applications. This could have been related to the fact that the plots were planted relatively late. Technical problems with planting equipment, followed by several days of wet soils, prevented planting until 27 May. Plants were in the cotyledon stage when the earlier (7-d pre-peak) Thimet applications were made. As such, the combination of planting-time and postemergence insecticide would have been at very high concentrations, and could have produced phytotoxic effects on young sugarbeet seedlings. This is supported by the observation that percent sucrose in two of these treatments was 0.45 to 0.5% lower than in their counterparts that received the later application of Thimet.

Dual-insecticide programs in this study generated revenue benefits that ranged from \$79 to \$94 per acre when compared to single at-plant programs. This additional economic return provides ample justification for the use of postemergence granular insecticides to control the sugarbeet root maggot. Additionally, insecticide protection in general, whether in the form of a single at-plant insecticide or a dual-insecticide program, increased gross economic returns of between \$194 and \$368/ac. This demonstrates the significance of the sugarbeet root maggot as an economic pest of sugarbeet, and underscores the importance of effective SBRM control.

Table 2. Impacts of Thimet 20G application timing and rate on *yield parameters* in an evaluation of sugarbeet root maggot control, St. Thomas, ND, 2015							
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 + Thimet 20G	B 1 d Pre-peak Post B	8.9 lb 7 lb	1.8 1.4	7610 a	29.3 abc	14.45 a	723
Counter 20G + Thimet 20G	B 1 d Pre-peak Post B	7.5 lb 7 lb	1.5 1.4	7521 ab	28.9 abc	14.48 a	715
Counter 20G + Thimet 20G	B 1 d Pre-peak Post B	7.5 lb 4.9 lb	1.5 1.0	7509 ab	29.7 ab	14.13 a	675
Counter 20G + Thimet 20G	B 7 d Pre-peak Post B	8.9 lb 7 lb	1.8 1.4	7415 ab	29.8 a	13.95 a	644
Counter 20G + Thimet 20G	B 7 d Pre-peak Post B	7.5 lb 7 lb	1.5 1.4	7386 ab	28.4 abcd	14.48 a	700
Counter 20G + Lorsban Advanced	B 2 d Pre-peak Broadcast	8.9 lb 1 pt	1.8 0.5	7104 ab	27.8 bcd	14.20 a	654
Counter 20G	B	8.9 lb	1.8	6982 ab	27.5 cd	14.15 a	633
Counter 20G	B	7.5 lb	1.5	6807 ab	26.7 d	14.25 a	621
Counter 20G + Thimet 20G	B 7 d Pre-peak Post B	7.5 lb 4.9 lb	1.5 1.0	6711 b	27.7 bcd	13.68 a	549
Check	-----	----	-----	4733 c	20.2 e	13.3 a	355
LSD (0.05)				889	2.0	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

References Cited:

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