OPTIMIZING POSTEMERGENCE SUGARBEET ROOT MAGGOT CONTROL USING REGISTERED AND EXPERIMENTAL INSECTICIDE SPRAYS

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Introduction:

Severe sugarbeet root maggot (SBRM), *Tetanops myopaeformis* (Röder), infestations occur on a frequent basis in central and northern portions of the Red River Valley growing area of North Dakota and Minnesota. This intense insect pressure typically requires aggressive pest management programs to ensure adequate protection of the sugarbeet crop. Crop protection programs in areas at high risk for damaging SBRM infestations usually consist of either a granular insecticide or an insecticidal seed treatment at planting, followed by an additive postemergence insecticide application. Broadcast applications of sprayable liquid insecticides, applied on an as-needed, rescue basis, are the most commonly used postemergence tools for root maggot control in the Red River Valley.

Effective for the 2010 growing season, federal label changes resulted in 10-day reapplication interval for all sprayable liquid chlorpyrifos insecticide products (e.g., Lorsban 4E, Lorsban Advanced, and all generic versions). The label revision lengthened the reapplication interval by three days and most likely compromised the ability of sugarbeet growers to effectively manage the SBRM because fly activity peaks typically persist for less than seven days. In an effort to address this challenging situation, research was undertaken to achieve the following objectives regarding postemergence SBRM management: 1) determine the most effective timing schemes for repeated applications of chlorpyrifos (i.e., Lorsban Advanced) sprays that adhere to the 10-day reapplication restriction; 2) assess the impact of application rate on chlorpyrifos spray performance; and 3) evaluate the performance of alternative sprayable liquid insecticide products (i.e., Asana XL, Mustang Maxx, and Onslaught) as single applications and rotated with chlorpyrifos applications for postemergence SBRM control.

Materials and Methods:

This experiment were established on a commercial sugarbeet field site near St. Thomas in rural Pembina County, ND. The same glyphosate-resistant seed variety (i.e., Betaseed 89RR83) was used for all entries in these experiments. Plots were planted on 27 May. 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 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 treatment.

<u>Planting-time insecticide applications</u>. 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.

<u>Postemergence insecticide applications.</u> Additive postemergence insecticide treatments involved Lorsban Advanced, Mustang Maxx, Asana, and Onslaught spray applications. Treatment timings included two, three, and eight days pre-peak-fly (i.e., 4, 10, and 11 June, respectively, and three and four days after peak SBRM fly activity (i.e., 15 and 16 June, resp.). Spray applications were delivered by using a tractor-mounted CO_2-propelled spray system equipped with TeeJet™ 110015VS nozzles. The system was calibrated to deliver a finished spray volume of 10 GPA as a broadcast application. Plots assigned to receive postemergence broadcasts of liquid insecticides were three tractor passes (i.e., 33 ft rather than the standard 11-ft width) wide to minimize the likelihood of flies exposed

to a foliar liquid insecticide treatment in one plot moving into and colonizing a neighboring plot. However, all root maggot feeding injury ratings and harvest samples were taken out of the inner 4 rows of each plot.

Root injury ratings: Sugarbeet root maggot feeding injury was assessed in this experiment on 28 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 30 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:

Sugarbeet root maggot feeding injury ratings in the untreated check plots of this trial averaged 7.45 on the 0 to 9 scale of Campbell et al. (2000), thus indicating that high SBRM pressure was present (Table 1). All insecticide treatments, whether involving single at-plant applications, or at-plant/postemergence combinations, provided significant reductions in feeding injury when compared to the untreated check. General patterns indicated that the best protection from root maggot feeding injury was provided by entries that involved combining planting-time

Table 1. *Larval feeding injury* in an evaluation of postemergence liquid insecticide rates, timing, and alternating products for 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 + Lorsban Advanced + Lorsban Advanced	B 8 d Pre-peak Broadcast 4 d Post-peak Broadcast	7.5 lb 2 pts 2 pts	1.5 1.0 1.0	4.65 g
Counter 20G + Lorsban Advanced	B 2 d Pre-peak Broadcast	7.5 lb 2 pts	1.5 1.0	5.05 fg
Counter 20G + Lorsban Advanced	B 2 d Pre-peak Broadcast	8.9 lb 2 pts	1.8 1.0	5.23 efg
Counter 20G + Lorsban Advanced + Mustang Maxx	B 2 d Pre-peak Broadcast 3 d Post-peak Broadcast	7.5 lb 1 pt 4 fl oz	1.5 0.5 0.025	5.43 def
Counter 20G + Mustang Maxx	B 2 d Pre-peak Broadcast	7.5 lb 4 fl oz	1.5 0.025	5.73 c-f
Counter 20G	B	8.9 lb	1.8	5.73 c-f
Counter 20G + Lorsban Advanced + Lorsban Advanced	B 8 d Pre-peak Broadcast 4 d Post-peak Broadcast	7.5 lb 1 pt 1 pt	1.5 0.5 0.5	5.78 c-f
Counter 20G + Lorsban Advanced	B 2 d Pre-peak Broadcast	7.5 lb 1 pt	1.5 0.5	5.85 b-e
Counter 20G + Onslaught	B 2 d Pre-peak Broadcast	7.5 lb 11.75 fl oz	1.5	5.88 b-e
Counter 20G	B	7.5 lb	1.5	6.05 bcd
Counter 20G + Lorsban Advanced + Asana 0.66EC	B 2 d Pre-peak Broadcast 3 d Post-peak Broadcast	7.5 lb 1 pt 9.6 fl oz	1.5 0.5 0.05	6.28 bc
Counter 20G + Asana 0.66EC	B 2 d Pre-peak Broadcast	7.5 lb 9.6 fl oz	1.5 0.05	6.58 b
Check	---	---	---	7.45 a
LSD (0.05)				0.77

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

and postemergence insecticide applications. The best overall root protection was provided by the combination of Counter 20G at its moderate (7.5 lb product/ac) rate at planting plus two applications (8 days pre- and 4 days post-peak fly) of Lorsban Advanced at the high label rate of 2 pts/ac. Although this combination had numerically less root injury than all other treatments in the trial, the following entries were not significantly different from it with respect to root protection from SBRM: 1) Counter at 7.5 lb/ac + Lorsban Advanced at 2 pts/ac at 2 days pre-peak; and 2) Counter at 8.9 lb/ac + Lorsban Advanced at 2 pts/ac at 2 days pre-peak. The top three entries provided significantly better root protection from SBRM feeding injury than the following treatments: 1) the planting-time application of Counter 20G at its lower (7.5 lb/ac) rate; 2) the combination of Counter at 7.5 lb + Lorsban Advanced at 1 pt/ac applied 2 days before peak + Asana XL 0.66EC at its high (9.6 fl oz/ac) rate applied 3 days post-peak; and 3) planting-time Counter at 7.5 lb + Asana applied at 9.6 oz at 2 days pre-peak.

Yield, percent sucrose content, and gross economic return results from this trial are presented in Table 2. Most insecticide regimes tested resulted in significant increases in recoverable sucrose yield and root tonnage. The following were the only treatments that failed to generate significant increases in yield over that of the untreated check plots: 1) the planting-time application of Counter 20G at the moderate (7.5 lb/ac) rate; and 2) Counter at planting time at 7.5 lb + Asana as a postemergence broadcast at its maximum labeled rate (9.6 oz/ac). Similar to observations from SBRM feeding injury data, applications of Asana and Onslaught were generally ineffective in providing yield benefits. It should be noted that Onslaught was viewed as an experimental insecticide in this trial because it is not currently registered for use in sugarbeet.

Table 2. *Yield parameters* from an evaluation of postemergence liquid insecticide rates, timing, and alternating products for 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 + Lorsban Advanced + Lorsban Advanced	B 8 d Pre-peak Broadcast 4 d Post-peak Broadcast	7.5 lb 2 pt 2 pt	1.5 1.0 1.0	7735 a	29.3 a	14.58 a	757
Counter 20G + Lorsban Advanced	B 2 d Pre-peak Broadcast	7.5 lb 2 pts	1.5 1.0	7371 ab	27.8 ab	14.58 a	727
Counter 20G + Mustang Maxx	B 2 d Pre-peak Broadcast	7.5 lb 4 fl oz	1.5 0.025	7121 abc	25.7 a-d	15.20 a	758
Counter 20G + Lorsban Advanced + Lorsban Advanced	B 8 d Pre-peak Broadcast 4 d Post-peak Broadcast	7.5 lb 1 pt 1 pt	1.5 0.5 0.5	7044 abc	25.6 bcd	14.95 a	741
Counter 20G + Lorsban Advanced	B 2 d Pre-peak Broadcast	8.9 lb 2 pts	1.8 1.0	6965 abc	27.3 abc	14.13 a	637
Counter 20G + Lorsban Advanced	B 2 d Pre-peak Broadcast	7.5 lb 1 pt	1.5 0.5	6712 abc	25.9 a-d	14.28 a	635
Counter 20G + Lorsban Advanced + Mustang Maxx	B 2 d Pre-peak Broadcast 3 d Post-peak Broadcast	7.5 lb 1 pt 4 fl oz	1.5 0.5 0.025	6651 a-d	26.7 a-d	13.90 a	579
Counter 20G + Onslaught	B 2 d Pre-peak Broadcast	7.5 lb 11.75 fl oz	1.5	6648 a-d	25.7 a-d	14.28 a	627
Counter 20G + Lorsban Advanced + Asana 0.66EC	B 2 d Pre-peak Broadcast 3 d Post-peak Broadcast	7.5 lb 1 pt 9.6 fl oz	1.5 0.5 0.05	6596 a-d	25.8 a-d	14.25 a	609
Counter 20G	B	8.9 lb	1.8	6440 bcd	24.9 bcd	14.20 a	604
Counter 20G	B	7.5 lb	1.5	6147 cde	23.8 cde	14.30 a	579
Counter 20G + Asana 0.66EC	B 2 d Pre-peak Broadcast	7.5 lb 9.6 fl oz	1.5 0.05	5486 de	23.1 de	13.50 a	428
Check	---	---	---	5017 e	20.8 e	13.63 a	407
LSD (0.05				1179	3.7	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

Despite the overall findings that many of the SBRM control programs evaluated in this experiment provided effective SBRM control, which translated to major yield benefits, there were no significant differences between the top-yielding nine treatments. Another general conclusion that can be drawn from this trial is that the root protection, yield, and revenue benefits from additive postemergence insecticides make them cost-effective tools to use in areas where damaging SBRM populations occur. In plots initially treated with the lower (7.5 lb/ac) rate of

Counter 20G at planting, the addition of a postemergence insecticide generated from $25 to $179/ac in additional revenue over those that did not receive a postemergence insecticide. Similarly, when the initial at-plant protection involved Counter at its high labeled rate (8.9 lb/ac), adding a postemergence insecticide spray of either Lorsban Advanced or Mustang Maxx, or a combination thereof, generated gross revenue benefits ranging from $23 to $154/ac. It also should be noted that the top-yielding entry (Counter 20G at 7.5 lb/ac at planting + two postemergence applications of Lorsban Advanced at 2 pts/ac each) increased sucrose yield by over 2,700 lb and improved gross revenue by $350/ac when compared to the untreated check. This clearly demonstrates the importance of effective SBRM management, because this pest is capable of severely impacting sugarbeet yield and revenue.

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