BIOLOGY AND CONTROL OF THE SUGARBEET ROOT MAGGOT IN THE RED RIVER VALLEY - 2000

Mark A. Boetel, Assistant Professor
Robert J. Dregseth, Research Specialist
Allen J. Schroeder, Research Specialist
Department of Entomology
North Dakota State University
Fargo, ND

Larry J. Smith, Superintendent
Northwest Research & Outreach Center
University of Minnesota
Crookston, MN

Acknowledgments:

A substantial portion of this research was funded by the Sugarbeet Research and Education Board of Minnesota and North Dakota. Their support is essential to this research program, and has played a major role in the successful development of strategies for monitoring, forecasting, and managing populations of the sugarbeet root maggot (SBRM). Support monies are utilized to defray labor, equipment, and travel expenses for conducting field and laboratory research. Additionally, this support assists us with carrying out field survey work.

We are very grateful for the willingness of many producers to provide us with portions of their sugarbeet fields for establishment of our experimental test plots. We therefore extend our gratitude to the following individuals:

Brent Baldwin
William Baldwin
Glen Hultin
Brad Narloch

Much appreciation is also due to the following producers for participating with us on strip trials, large-scale studies, and/or allowing us to carry out commercial field surveys of sugarbeet root maggot feeding injury on their farms:

Allen Albertson
Pete Carson
Robert Green
Harlow Grove
Jim Grove
Ross Monsebroten
Dave Mueller
Paul Mueller
Brad Narloch
Tom Schulz
Hal Sillers
Steve Sillers
Ray Steiger
Tim Thompson
Allen Tucker

Special thanks are also extended to the agricultural staff of the American Crystal and Minn-Dak Sugar cooperatives for cooperating on several aspects of SBRM population monitoring. We also wish to acknowledge the efforts of Charlie Hotvedt and his staff at the American Crystal sugarbeet quality laboratory in East Grand Forks for processing our beet samples for quality components.

We also thank the seed and crop protection chemical companies for providing us with sugarbeet seed and test materials to conduct our 2000 research trials.

Finally, sincere gratitude is extended to the following summer aides and work study students for their valuable assistance with plot maintenance, sticky stake monitoring, collection of maggot larvae, soil sample processing, and digging and washing efforts associated with sugarbeet root maggot damage rating operations:

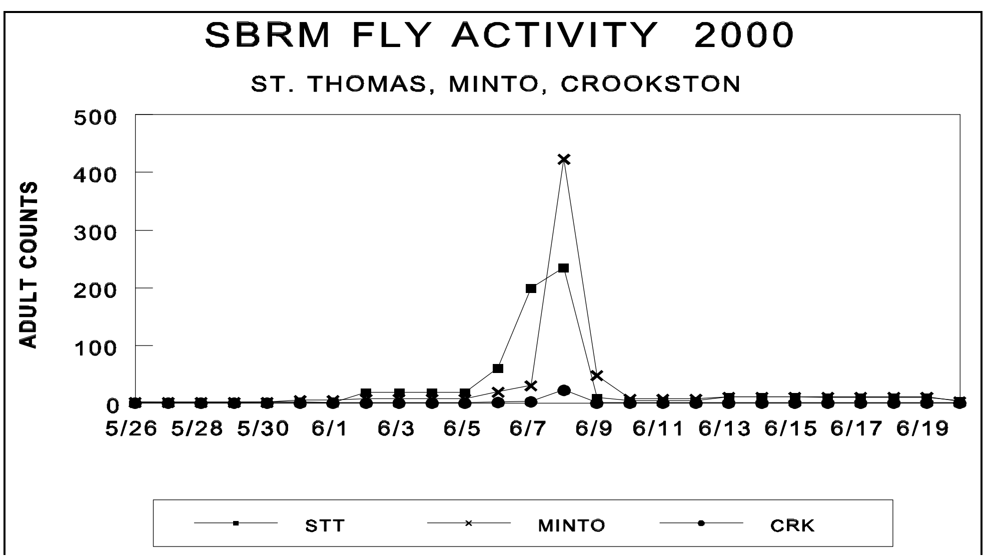
Meera Damle
Julie Dejong
Mahinda Ferdinando
Shawn Frieler
Kari Fuglesten
Brandon Miller
Christina Vick
Chad Zander

Weather Patterns, SBRM Populations, and other Sugarbeet Insect Pests:

Although many areas of the Red River Valley received favorable rainfall amounts during late summer and early fall of 1999, weather patterns throughout the winter of 1999-2000 were generally dry and unseasonably warm. Snowfall amounts in the northern end of the valley were especially light and, thus, soil moisture levels were poor for spring planting in many fields. The general lack of snow cover and mild temperatures across much of the northern valley permitted many producers to start the 2000 growing season with very early seedbed preparation and planting. However, many fields remained cool and dry, and seedling emergence was somewhat delayed in those sites. In scattered areas throughout central and southern portions of the region received adequate late-fall and winter precipitation resulted in favorable soil moisture conditions for a normal spring planting. Most planting was completed by the last week of April and into the first week of May.

The first measurable post-planting rainfall in the northern end of the valley came on May 12. The late-spring rain appeared to get beet seedling development off to a fairly good start for the season in that area. However, fields remained very dry farther south. Our plots in the Minto area failed to receive more than trace amounts of rain until June 13. A series of weather systems characterized by dry air and high winds passed through much of the area after a high percentage of fields had been planted. The dry and windy spring conditions were of concern for three reasons. First, with insecticide granules sitting on the surface of powdery dry soil that was being blown around a lot, how much insecticide was remaining at the site of application? In other words, were the applied granules being blown around and redistributed to a much thinner concentration immediately over the row than necessary for protection from sugarbeet root maggot feeding injury. Second, under the dry conditions that predominated several weeks after planting, it was not likely that insecticide active ingredients had yet been released from granules into the soil before the winds came. Third, the dry conditions resulted in soil temperatures remaining cool later into the spring than anticipated. Cooler soils generally have a delaying effect on activity of the overwintered mature larvae and also pupation timing. Therefore, it was difficult to predict a solid anticipated fly emergence date. However, 6.15 inches of rain fell at St. Thomas and 5.81 inches were recorded at Minto during the last two weeks of June. Rainwater percolated warmer temperatures into the subsoil zones where SBRM larvae and pupae were, and resumed or accelerated their development to result in relatively typical emergence timing. Adult SBRM were first detected at St. Thomas on May 18 which was one day later than in 1999.

Based on data from 1999 fly activity monitoring and commercial field damage surveys, severe sugarbeet root maggot infestations were expected for much of the northern end of the valley during 2000 production season. Fly activity was monitored again during 2000 by university personnel and American Crystal agricultural staff using sticky-stake traps. As forecasts had suggested, fly captures varied from very low in the southern and central areas of the Red River Valley to extremely high in the northern portion. Peak fly occurred on or near June 8 at Minto and St. Thomas, ND as well as at



Crookston, MN (Fig. 1). This corresponded closely with monitoring data from most other sites throughout the

Figure 1. Sugarbeet root maggot fly activity during the 2000 season at St. Thomas, Minto, and Crookston (counts represent flies captured on sticky stakes on a per-trap per-day basis).

valley. The highest fly counts were recorded near Cavalier, Minto, and St. Thomas in North Dakota. The highest fly capture counts recorded during the season were those from the Minto area near our research plots in which the stakes averaged over 400 flies per stake per day on June 8. Typically, maggot fly pressure was most severe in fields established adjacently to those that had been planted to beets during the preceding season. Fly activity fluctuated after peak for several days and moderate levels persisted throughout much of June as well into the first week of July. Counts from sticky stakes may have actually underestimated true population levels due to several rain showers and thunderstorms during the maggot fly emergence, mating, and egg-laying periods. Those weather systems were also accompanied by cool and windy conditions, which would have kept flies on the ground and generally less active during that time.

Rainfall received between mid-June and mid-July also resulted in very moist soil conditions during egg laying and subsequent maggot feeding periods. Extremely wet subsoils most likely caused larvae to remain high in the soil profile (i.e., away from beet tap roots and near/within insecticide-treated zones). Therefore, very few tap roots were severed, beet seedlings were able to outgrow most SBRM feeding injury, and insecticides performed adequately in most cases. Additionally, producer strip trials in heavily infested areas indicated that planting-time insecticide applications followed by postemergence treatments were beneficial in reducing SBRM injury.

Other insect pests reported infesting sugarbeet fields during the 2000 growing season included cutworms, wireworms, springtails, and lygus bugs. Cutworms are relatively easy to manage if soil moisture is adequate. Moist soil results in a preference by cutworms to feed at or above the soil surface and therefore, foliar-applied liquid insecticides can be very effective. Wireworms caused stand losses in fields that were not treated with a planting-time insecticide. Most of the affected fields were in the southern tip of the valley and into the southern Minnesota cooperative acres. Feeding injury from springtails resulted in some isolated stand losses just south of the Fargo/Moorhead area. Again, those losses were in fields that had not received a planting-time insecticide application. Also, injury was most prevalent in areas that had been at or near saturation for extended periods during the spring. Lygus bugs affected sugarbeet fields again during August of the 2000 season. However, the only significant infestations detected were in a few isolated sites near the Crookston, MN area, with rescue insecticide applications being made to a relatively small number of acres. As suggested in previous reports, the determination of an appropriate insecticide choice for this late-season insect needs to be based on the anticipated harvest date and in consideration of the preharvest interval appearing on the insecticide labels of the insecticide choices.

SBRM Population Forecast for the 2001 Growing Season

The erratic weather events that occurred during the 2000 season make it somewhat difficult to predict where SBRM problems may arise during 2001. In our population forecast for the 2001 production season (Fig. 2) we suggest that growers in the vicinity of Wahpeton and north to just beyond Grand Forks, ND as well as most of the Minnesota production area will likely experience generally low SBRM infestations with intermittent pockets of moderate pressure. Walsh County, ND growers farming south of ND Highway 17 and east of Highway 32 as well those in Pembina County east of US Highway 81 will most likely encounter moderate SBRM infestations. Populations in fields west of US Highway 81 and north of Highway

17 near Park River, ND all the way to north to the US/Canadian border are anticipated to vary from moderate to high during the 2001 season. These forecasts are general in nature, and will not always be precise on an individual field basis. Proximity of current year sugarbeets to fields that were planted to beets during the preceding season can be an important management consideration. Significant fly activity is likely for beets planted adjacently to previous-year beet fields that had moderate to high fly densities and/or substantial maggot feeding pressure. Certain environmental conditions could prevent this situation from resulting in significant maggot feeding injury. Growers are encouraged to continue using planting-time insecticides. Also, monitoring individual fields for adult fly population levels will be very important during the 2001 season. Fields should be carefully monitored from late May through June for significant increases in fly activity. High activity and/or an extended emergence period may warrant the need for additional control tactics such as the application of a postemergence insecticide. Growers are encouraged to review research findings in this report and previous volumes of "Sugarbeet Research Extension Reports," as well as the "Sugarbeet Production Guide" to determine management strategies that will best fit their operation. Extension personnel will continue to inform growers regarding SBRM activity each spring via radio reports, DTN, and selected issues of the NDSU "Crop & Pest Report."

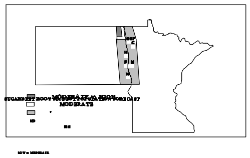


Fig. 2. Predicted sugarbeet root maggot population levels for the 2001 growing season in the Red River Valley of Minnesota and North Dakota.

Sugarbeet Root Maggot Control Trials:

Research trials were conducted at three sites (St. Thomas, Minto, and Hillsboro) in North Dakota and an additional location (Crookston) in Minnesota to evaluate the performance of various insecticidal strategies for control of the sugarbeet root maggot. High fly numbers were observed at the St. Thomas and Minto site throughout the month of June in 2000. As a result, extremely severe larval infestations of SBRM developed at those locations. Thus, excellent insect pressure levels existed for insecticide performance comparisons. At St. Thomas the soil remained very dry until May 12 when the site received a 0.42-inch rain that was sufficient to germinate the seed and move some of the insecticide into the soil. However, the Minto site did not receive measurable precipitation until the middle of June and the topsoil was powdery dry until then. Therefore, beet seed germination, as well as cover crop establishment, was adversely affected. Soil moisture at Hillsboro was favorable for good germination and for activation of the insecticides. The heavy rains that fell throughout much of the valley in June helped to keep SBRM feeding higher up in the soil profile and, thus, away from beet tap roots. Therefore, plant stands were not significantly affected by larval injury, and dead beets were not as apparent as what we observed in 1999. Fly activity and resulting larval infestations were very low at our Hillsboro site and resulting injury to beets was very light.

Damage Rating Scale:

The 0–9 damage rating scale has been implemented as our standard system for quantifying SBRM feeding injury. The major feature of this scale is that it broadens the 3 rating on the 0–5 scale that has been used in previous years. This refinement may allow us to achieve a closer association of feeding injury with yield. Criteria for the respective points on the 0–9 damage rating scale are as follows:

0 = no scars
1 = 1-4 small (pin head size) scars
2 = 5-10 small scars
3 = 3 large scars or scattered small scars
4 = few large scars and /of numerous small scars
5 = several large scars and/or heavy feeding on laterals
6 = up to 1/4 root scared
7 = 1/4 - ½ root blackened by scars
8 = ½ - 3/4 root blackened by scars
9 = more than 3/4 of root area blackened

Insecticide Application Methods used in Experiments:

Banded applications were applied in a 5-inch swath over the row using Gandy™ banders. The spoon application uses an in-furrow tube, however, a small galvanized steel device is attached to the terminal end of the tube. A #10 bolt with two nuts facing upward (inner face of spoon; near the tip) helps to laterally deflect the heavy central concentration of granules coming down the tube and., thus, reduces the likelihood of phytotoxicity to beet seedlings. The resulting application is a 3 to 4-inch swath with the heaviest concentration of granules being placed immediately adjacent to, but outside of, the seed furrow. Modified in-furrow placement consisted of dropping granules down a standard planter-equipped in-furrow tube over the row; however, granules were directed near the rear press wheel so some soil would cover the seed before the insecticide reached the row. This placement method results in a 2 to 3-inch band with the heaviest insecticide concentration being placed immediately over the row (it is critical that the insecticide does not come in contact with the seed when using this application technique). Postemergence granules were applied in 4-inch bands over the row and postemergence liquid treatments were applied in 5 or, 7.3-inch bands or broadcast using standard equipment.

Placement Method Experiment:

This experiment was carried out at two sites in eastern North Dakota (St. Thomas and Hillsboro) to evaluate the impact of placement method on the efficacy of registered soil insecticides applied at planting time. The St. Thomas site was planted on May 10 and the Hillsboro plots were planted on May 17. Placement methods evaluated included banded (B), modified in-furrow (M), and spoon (S) techniques.

The seedbed at St. Thomas was extremely dry when this trial was planted; however, the site received about 0.25 inches of rain shortly after planting, which helped with seed germination and should have assisted with incorporation and activation of the insecticide. Sugarbeet root maggot pressure for this experiment was fairly heavy at the St. Thomas site (Table 1) as evidenced by the damage rating of 7.2 on the 0–9 scale. This evaluation indicated that Temik 15G was significantly superior to the other two insecticides in protection of beet roots from SBRM injury, irrespective of placement method. Those findings were similar to our 1999 results, however, the spoon was statistically more effective than the modified in-furrow method during that year. Also similar to our 1999 trial was that spoon-applied treatments resulted in generally less SBRM feeding injury than those applied using other application methods. Temik applied using the spoon application produced the highest recoverable sucrose (5923 lb/ac) in this trial and the lowest damage rating (2.53), however, it should be noted that this value was not statistically different from the other Temik placement method treatments. Also, the other yield and quality factors were not significantly affected by Temik placement. Lorsban 15G was also most effective when applied using the spoon placement technique. This treatment was significantly better than the banded application when comparing damage ratings. This is also a repeat of our 1999 findings. Also, yield and gross economic return in spoon-applied Lorsban plots were numerically higher than modified-in-furrow and banded treatments, although those disparities were not statistically significant. In comparing Counter 15G placement methods, spoon-applied granules were significantly more effective in preventing SBRM feeding injury than those applied modified-in-furrow. However, this difference was not detected in yield, percent sucrose, or gross economic return comparisons. It should be noted that Lorsban 15G or Chlorfos 15G will likely cause major plant injury to sugarbeet plants if the spoon technique is used without the nut/bolt modification because too heavy of an insecticide concentration will be placed adjacent to (or in contact with) beet seedlings. Producers that choose to use the spoon method to apply one of these products at planting time are strongly advised to modify it properly with the #10 nut/bolt set to avoid these problems.

Table 1. Effect of insecticide placement method on control of sugarbeet root maggot larvae, St. Thomas, ND, 2000.

Treatment/ formulation	Rate lb (AI/ac)	Placement[a]	Recoverable sucrose (lb/ac)	Recoverable sucrose (lb/T)	Yield (T/ac)	Sucrose (%)	Damage rating (0-9)	Gross return ($/ac)
Temik 15G	2.1	S	5293 a	298 a	17.8 a	16.2 a	2.53 f	527 a
Temik 15G	2.1	M	5285 a	302 a	17.6 a	16.4 a	2.33 f	536 a
Temik 15G	2.1	B	5034 ab	306 a	16.6 ab	16.6 a	2.70 f	515 a
Lorsban 15G	2.0	S	4857 ab	305 a	15.9 abc	16.5 a	3.80 e	500 a
Lorsban 15G	2.0	M	4539 ab	310 a	14.7 bc	16.8 a	4.00 de	472 a
Counter 15G	1.8	M	4484 ab	298 a	15.2 bc	16.3 a	5.23 b	445 a
Counter 15G	1.8	S	4322 b	298 a	14.6 bc	16.2 a	4.35 cd	431 a
Counter 15G	1.8	B	4320 b	300 a	14.5 bc	16.3 a	4.63 c	432 a
Lorsban 15G	2.0	B	4295 b	299 a	14.5 c	16.3 a	4.45 cd	429 ab
Check	-	-	3378 c	283 a	12.0 d	15.7 a	7.20 a	315 b

Means within a column sharing the same letter are not significantly ($P > 0.05$) different (LSD).
[a]M = Modified-in-furrow; B = Band; S = Spoon

The SBRM infestation level at our Hillsboro site was much lower than at St. Thomas. This was demonstrated by a relatively light mean damage rating (3.25; 0–9 scale) in the untreated check plots (Table 2). Additionally, the only variable showing significance among treatments was damage rating. However, similar performance levels were observed among placement methods as those observed St. Thomas, as well as those recorded during the 1999 season. Spoon-applied Lorsban was significantly superior to modified in-furrow placement in preventing larval damage.

Table 2. Effect of insecticide placement method on control of sugarbeet root maggot larvae, Hillsboro, ND, 2000.

Treatment/ formulation	Rate lb (AI/ac)	Placement[a]	Recoverable sucrose (lb/ac)	Recoverable sucrose (lb/T)	Yield (T/ac)	Sucrose (%)	Damage rating (0-9)	Gross return ($/ac)
Lorsban 15G	2.0	B	7401 a	261 a	28.4 a	15.0 a	0.88 bc	613 a
Lorsban 15G	2.0	S	7373 a	256 a	28.8 a	14.8 a	0.53 c	593 a
Check	-	-	7231 a	264 a	27.4 a	15.0 a	3.25 a	611 a
Counter 15G	1.8	M	7172 a	257 a	27.9 a	14.8 a	0.80 bc	581 a
Temik 15G	2.1	S	7164 a	260 a	27.6 a	14.8 a	0.48 c	590 a
Counter 15G	1.8	B	7148 a	265 a	27.1 a	15.1 a	0.43 c	605 a
Lorsban 15G	2.0	M	7056 a	271 a	26.0 a	15.3 a	1.08 b	622 a
Counter 15G	1.8	S	7042 a	250 a	28.2 a	14.4 a	0.68 bc	543 a
Temik 15G	2.1	B	6979 a	262 a	26.8 a	15.0 a	0.43 c	580 a
Temik 15G	2.1	M	6841 a	249 a	27.5 a	14.4 a	0.93 bc	524 a

Means within a column sharing the same letter are not significantly ($P > 0.05$) different (LSD).
[a]M = Modified-in-furrow; B = Band; S = Spoon

Registered Insecticide Trial:

This experiment was established at three sites in eastern North Dakota (St. Thomas, Minto, and Hillsboro) and one site at the University of Minnesota Northwest Research & Outreach Center (near Crookston) to evaluate the efficacy of registered granular soil insecticides applied at planting-time for control of the sugarbeet root maggot. The trial was planted on May 9, 10, 16, and 17, 2000 at Crookston, St. Thomas, Minto, and Hillsboro, respectively. As in past years, the SBRM infestation level at St. Thomas was very high. This was demonstrated by the severe root damage (7.35 on 0–9 scale) observed in untreated plots (Table 3). In comparing damage ratings of the treatments at St. Thomas (Table 3), all insecticide treatments resulted in statistically lower SBRM injury than the untreated check. Temik applied at 1.5 lb (AI)/acre) using either banded or modified-in-furrow placement resulted significantly lower root damage rating means than all other treatments. Yield, quality, and gross economic return were also numerically better with the two Temik treatments, however, those values were not significantly better than all other treatments. No significant response in yield, percent sucrose, gross economic return, or damage rating, was observed between rates (1.5 vs. 1.8 lb) or formulations (15G vs. 20CR) of Counter. Similarly, our comparisons of Lorsban at 1.5 and 2.0 lb failed to show a rate response in yield, quality, or damage rating.

Table 3. Performance of registered insecticides in managing sugarbeet root maggot larvae, St. Thomas, ND, 2000.

Treatment/ formulation	Rate lb (AI/ac)	Placement[a]	Recoverable sucrose (lb/ac)	Recoverable sucrose (lb/T)	Yield (T/ac)	Sucrose (%)	Damage rating (0-9)	Gross return ($/ac)
Temik 15G	1.5	M	5180 a	305 a	17.1 a	16.5 a	4.18 e	530 a
Temik 15G	1.5	B	4972 ab	299 a	16.8 ab	16.2 a	4.13 e	496 ab
Lorsban 15G	2.0	B	4729 abc	295 a	16.1 abc	16.0 a	5.55 bc	465 abc
Lorsban 15G	1.5	B	4664 abc	294 a	16.0 abc	15.9 a	5.28 cd	455 abc
Counter 15G	1.5	M	4641 abc	299 a	15.6 abc	16.2 a	5.58 bc	464 abc
Counter 15G	1.8	B	4536 abc	293 a	15.5 abc	15.9 a	4.75 d	446 abc
Counter 20CR	1.5	M	4395 bc	281 a	15.6 abc	15.4 a	6.05 b	409 bcd
Counter 20CR	1.8	M	4356 bc	295 a	14.8 bcd	16.1 a	5.70 bc	429 bc
Counter 15G	1.5	B	4254 cd	296 a	14.5 cd	16.0 a	5.30 c	420 bcd
Counter 15G	1.8	M	4099 cd	287 a	14.3 cd	15.7 a	5.70 bc	390 cd
Check	-	-	3661 d	279 a	13.2 d	15.4 a	7.35 a	335 d

Means within a column sharing the same letter are not significantly ($P > 0.05$) different (LSD).
[a]M = Modified-in-furrow; B = Band

The SBRM population level at Minto was more moderate, with an average damage rating of 6.28 in the untreated control plots (Table 4). Similar to our St. Thomas results, all insecticide treatments resulted in significantly lower damage ratings than that observed in the untreated check. Also, plots treated with Temik 15G at 1.5 lb (AI/ac) had statistically lower damage ratings than all others that received an insecticide treatment. No other significant differences were observed between treatments with regard to yield, percent recoverable sucrose, gross economic return, or damage rating at this site.

Table 4. Performance of registered insecticides in managing sugarbeet root maggot larvae, Minto, ND, 2000.

Treatment/ formulation	Rate lb (AI/ac)	Placement[a]	Recoverable sucrose (lb/ac)	Recoverable sucrose (lb/T)	Yield (T/ac)	Sucrose (%)	Damage rating (0-9)	Gross return ($/ac)
Temik 15G	1.5	B	4602 a	275 a	16.7 a	15.4 a	3.43 c	415 a
Counter 15G	1.8	B	4320 a	290 a	14.9 a	16.0 a	4.68 b	418 a
Counter 15G	1.5	B	4297 a	276 a	15.5 a	15.4 a	4.60 b	391 a
Counter 20CR	1.5	B	4207 a	280 a	15.0 a	15.6 a	5.10 b	391 a
Lorsban 15G	1.5	B	3757 a	279 a	13.5 a	15.5 a	5.00 b	346 a
Lorsban 15G	2.0	B	3724 a	277 a	13.4 a	15.4 a	4.70 b	340 a
Counter 20CR	1.8	B	3678 a	278 a	13.3 a	15.5 a	5.28 b	336 a
Check	-	-	3556 a	271 a	13.1 a	15.1 a	6.28 a	313 a

Means within a column sharing the same letter are not significantly (*P* > 0.05) different (LSD).
[a]B = Band

The Hillsboro site, as in past years, had very light SBRM pressure. The mean damage rating in the untreated check plots at this site was only a 3.53 (Table 5). However, with lighter infestations expected, we selected lower labeled rates of the registered insecticides to determine their relative efficacy under such conditions. Despite the light infestation, all insecticide treatments resulted in lower damage ratings than that observed in the untreated check. Our 1999 findings from Hillsboro were repeated in 2000 when plots treated with Counter 15G again had significantly lower damage ratings than those treated with the 20CR formulation. This was observed at both 1.05 and 1.5 lb application rates. No significant differences in damage ratings were detected among application rates of Lorsban 15G, Counter 15G, or Counter 20CR at this site. Additionally, no statistical differences existed among any of the treatments with regard to yield, recoverable sucrose, or gross economic return. This is most likely a product of the light SBRM feeding pressure at this site.

Table 5. Performance of registered insecticides in managing sugarbeet root maggot larvae, Hillsboro, ND, 2000.

Treatment/ formulation	Rate lb (AI/ac)	Placement[a]	Recoverable sucrose (lb/ac)	Recoverable sucrose (lb/T)	Yield (T/ac)	Sucrose (%)	Damage rating (0-9)	Gross return ($/ac)
Temik 15G	1.05	B	6971 a	253 a	27.6 a	14.6 a	0.48 e	547 a
Counter 20CR	1.05	B	6713 a	260 a	25.8 a	14.9 a	2.10 b	556 a
Counter 15G	1.5	B	6566 a	253 a	26.0 a	14.6 a	0.48 e	516 a
Counter 20CR	1.5	B	6495 a	244 a	26.6 a	14.3 a	1.58 bc	479 a
Lorsban 15G	1.5	B	6354 a	241 a	26.3 a	14.1 a	0.70 de	458 a
Lorsban 15G	1.05	B	6350 a	239 a	26.6 a	14.1 a	1.25 cd	446 a
Counter 15G	1.05	B	6344 a	243 a	26.1 a	14.2 a	0.53 e	462 a
Check	-	-	6239 a	251 a	24.9 a	14.5 a	3.53 a	482 a

Means within a column sharing the same letter are not significantly (*P* > 0.05) different (LSD).
[a]B = Band

The Crookston location of this test had relatively light SBRM pressure with a mean damage rating of 3.53 on the 0–9 scale being recorded for beets collected from the untreated check plots (Table 6). It should be noted that, in addition to the standard registered materials, two rates of an experimental compound were evaluated at Crookston. Thiamethoxam 2G (referred to in previous reports as CGA-293343) was applied at 0.134 and 0.2 lb (AI/ac) rates in this trial. Damage ratings for all insecticide treatments at this site were significantly lower than that observed in the untreated check plots. In comparing application rates, no significant differences in recoverable sugar yield or average damage rating were detected between the 1.5 and 2.0 lb (AI/ac) rates of Lorsban 15G using banded placement. Similarly, the 1.5 and 1.8 lb rates of Counter 15G were not significantly different in comparing both yield and damage rating means. This was also true for the comparison of the 1.5 and 1.8 lb rates of Counter 20CR. Formulations were also compared in this experiment and, similar to our St. Thomas findings, there was no statistical difference in yield, beet quality, or damage rating between the 15G and the 20CR formulations of Counter. Additionally, in comparing placement technique with Counter 15G, no statistical differences in yield or SBRM feeding injury were observed between modified in-furrow and banded applications of Counter 15G. Thiamethoxam-treated beets sustained significantly more injury than some of the other registered treatments, however, these differences were not manifested in sucrose or beet tonnage yield. No rate response was observed between the 0.135 and 0.2 lb applications of Thiamethoxam. Temik 15G did not perform as well at this site as it did at St. Thomas, Minto, and Hillsboro this year or in the 1999 trials at St. Thomas and Crookston. We have not identified the reason for this disparity in Temik performance among sites, but more research is planned for the 2001 growing season.

Table 6. Performance of registered and experimental insecticides in managing sugarbeet root maggot larvae, Crookston, MN, 2000.

Treatment/ formulation	Rate lb (AI/ac)	Placement[a]	Recoverable sucrose (lb/ac)	Recoverable sucrose (lb/T)	Yield (T/ac)	Sucrose (%)	Damage rating (0-9)	Gross return ($/ac)
Counter 15G	1.8	B	7139 a	319 a	22.4 a	17.1 a	1.6 e	661
Lorsban 15G	1.5	B	6947 ab	314 a	22.2 a	17.0 a	2.0 de	633
Counter 15G	1.5	B	6712 abc	306 a	22.0 a	16.6 a	1.8 de	594
Temik 15G	1.5	M	6709 abc	306 a	22.0 a	16.5 a	2.7 bc	592
Lorsban 15G	2.0	B	6581 bcd	298 a	22.1 a	16.2 a	1.8 de	561
Temik 15G	1.5	B	6563 bcd	305 a	21.5ab	16.5 a	2.4 bcd	576
Counter 20CR	1.5	M	6517 bcd	306 a	21.3 abc	16.6 a	2.0 de	575
Counter 15G	1.5	M	6498 bcd	305 a	21.3 abc	16.5 a	2.2 cd	571
Thiamethoxam 2G	0.134	M	6429 bcd	321 a	20.0 d	17.3 a	2.7 bc	601
Thiamethoxam 2G	0.2	M	6321 cd	315 a	20.1 cd	16.9 a	2.9 b	537
Counter 15G	1.8	M	6288 cd	297 a	21.2 a-d	16.2 a	2.2 cde	534
Counter 20CR	1.8	M	6091 d	297 a	20.5 bcd	16.2 a	2.2 cd	516
Check	-	-	5405 e	304 a	17.8 e	16.5 a	3.6 a	473

Means within a column sharing the same letter are not significantly (*P* > 0.05) different (LSD).
[a]M = Modified-in-furrow; B = Band

Planting-time and Postemergence Granular and Liquid Insecticide Combinations:

This experiment was carried out at St. Thomas, ND to determine the relative efficacy of standard and low labeled application rates of registered insecticides at planting-time alone and followed by postemergence rescue treatments. Planting-time granules were applied using methods described previously and Kinze™ banders were used to apply postemergence granular treatments in 4-inch bands on June 7 (1 day before peak fly activity). Postemergence granules were regulated using Noble metering units on a tractor-mounted tool bar. Row-units on the tool bar were all equipped with an incorporation device similar to the "crust-buster." Each incorporation device was equipped with two sets of rotary tines: 1) a set placed ahead of the bander for breaking up the soil surface adjacent to beet seedlings immediately before granule drop; and 2) one set behind the bander for granule incorporation.

Light showers dropped a total of 0.15 inch of rain during the two days after planting and another 0.66 inch fell on June 12. These events should have been sufficient to move insecticides into the soil. However, due to a general lack of rain before our postemergence applications, the soil lacked a crust and the front set of tines tended to pick up clods and clog up. This resulted in some mechanical plant injury and even total extraction of seedlings from the soil. More work will be carried out with this device when more applicable conditions (i.e., a more crusted soil surface) exist.

Similar to other experiments at St. Thomas, this test had a severe SBRM infestation. This was demonstrated by the heavy injury (average of 7.48) in the untreated check plots (Table 7). The top treatments according to root damage ratings included the planting-time treatment of Counter 15G banded at 1.5 lb (AI/ac), Counter 15G at 1.05 lb at planting plus Lorsban 15G at 1.05 lb postemergence, Counter 15G at 1.05 lb at planting followed by 3 postemergence applications of Lorsban 4E at 0.5 lb ai each, and Temik 15G at 1.5 lb as a planting-time only application. These findings were reflected in yield and gross economic return as well, however, the differences were not always significant. Although the low (1.05 lb) rate of Counter 15G at planting time alone was not very effective in preventing SBRM injury, its efficacy was significantly improved by postemergence applications of the following: 1) Lorsban 15G at 1.05 lb; 2) three

Table 7. Comparison of granular and liquid insecticides applied at planting-time and postemergence for controlling sugarbeet root maggot larvae, St. Thomas, ND, 2000.

Treatment/ formulation	Rate lb (AI/ac)		Placement[c]	Recoverable sucrose		Yield (T/ac)	Sucrose (%)	Damage rating (0-9)	Gross return ($/ac)
	Planting-time	Postemergence[a,b]		(lb/ac)	(lb/T)				
Counter 15G	1.5	---	B	5092 a	301 a	17.0 a	16.4 a	4.20 hi	513 a
Counter 15G + Lorsban 15G	1.05 ---	--- 1.05 I	B B	5061 ab	281 a	18.0 a	15.5 a	4.45 gh	471 a-d
Counter 15G + Lorsban 4E	1.05 ---	--- 0.5 x 3	B B	4885 abc	294 a	16.7 a	16.0 a	3.80 i	479 abc
Counter 15G + Thimet 20G	1.8 ---	--- 1.4 I	B B	4876 abc	293 a	16.7 a	15.9 a	4.85 efg	477 a-d
Counter 20CR + Thimet 20G	1.5 ---	--- 1.4 I	M B	4795 a-d	309 a	15.7 a	16.7 a	5.23 cde	495 ab
Counter 15G + Lorsban 4E	1.05 ---	--- 0.5 I	B B	4733 a-d	283 a	16.7 a	15.5 a	4.98 def	446 a-e
Counter 20CR + Thimet 20G	1.05 ---	--- 1.05 I	B B	4678 a-d	287 a	16.3 a	15.7 a	5.55 bc	446 a-e
Counter 15G + Thimet 20G	1.05 ---	--- 1.05 I	B B	4604 a-e	292 a	15.9 a	15.9 a	4.93 efg	446 a-e
Temik 15G	1.5	---	B	4543 a-f	302 a	15.0 a	16.3 a	4.13 hi	464 a-d
Lorsban 15G	1.5	---	B	4482 a-f	303 a	14.9 a	16.3 a	5.63 bc	454 a-e
Counter 15G + Lorsban 15G	1.05 ---	--- 1.5 I	B B	4475 a-f	297 a	15.2 a	16.2 a	4.50 fgh	443 a-e
Counter 15G + Asana 0.66 EC	1.05 ---	--- 0.030 x 3	B B	4294 a-f	273 a	15.8 a	15.2 a	5.83 b	380 b-f
Counter 15G + Lorsban 4E	1.05 ---	--- 0.5 x 2	B B	4227 b-f	302 a	14.1 a	16.3 a	4.60 fgh	428 a-e
Counter 15G + Asana 0.66 EC	1.05 ---	--- 0.015 x 3	B B	4099 c-f	290 a	14.6 a	15.9 a	5.65 bc	381 b-f
Temik 15G + Lorsban 4E	1.05 ---	--- 0.5 I	B B	4067 c-f	272 a	15.2 a	15.0 a	4.78 efg	353 def
Counter 15G + Thimet 20G	1.5 ---	--- 1.4 I	M B	3972 def	276 a	14.4 a	15.4 a	5.45 bcd	360 c-f
Check	---	---	---	3798 ef	268 a	14.1 a	14.9 a	7.48 a	331 ef
Counter 15G	1.05	---	B	3734 f	254 a	14.8 a	14.2 a	5.83 b	294 f

Means within a column sharing the same letter are not significantly (*P* > 0.05) different (LSD).

[a]Postemergence granules were applied June 8 (peak fly activity); Asana 0.66 EC and Lorsban 4E were applied June 2, 8, and 22.

[b]I = incorporated

[c]M = Modified-in-furrow; B = Band

applications of Lorsban 4E at 0.5 lb; 3) two applications of Lorsban 4E at 0.5 lb each; 4) one application of Lorsban 4E at 0.5 lb; 5) Thimet 20G at 1.05 lb; and 6) Lorsban 15G at 1.5 lb. However, the only postemergence treatments to result in significant positive impacts on yield and economic return among these treatment comparisons were Lorsban 15G at 1.05 lb, three 0.5-lb applications of Lorsban 4E, one incorporated 0.5-lb application of Lorsban 4E, and Thimet 20G at 1.05 lb (AI/ac). The 0.015 and 0.03 lb postemergence applications of Asana that followed Counter 15G at planting failed to achieve a statistical improvement in efficacy against SBRM in this experiment. Plots may have been too small to fairly assess the efficacy of this treatment due to possible invasion by healthy mated flies from adjacent plots. Also, the 3rd application of Asana was not made at the regularly scheduled interval due to inclement mid-June weather. This delay in treatment may have come after the majority of females had already laid eggs in the plots.

Experimental Insecticide Trial:

This trial was conducted at St. Thomas to ensure an adequate SBRM infestation level. The chief objective of this investigation was to screen alternative materials and strategies for potential use as SBRM management tools in the Red River Valley. The experiment was established on May 11. The topsoil was extremely dry at the onset of planting, however, rain showers moved in quickly after liquid applications had been initiated. All treatments were successfully applied as light rain continued, and an additional 0.42 inch of rain fell overnight help incorporate and activate the insecticides. One of the non-labeled experimental treatments in this trial was a combination of Temik 15G applied pre-plant followed by a planting-time application of Counter 20CR. Both products in this treatment were applied at a labeled rate of 1.5 lb (AI/ac). Similarly, a second experimental treatment consisted of a blend of Temik 15G and Counter 15G in which the total active ingredient applied was 1.5 lb (i.e., each product at 0.75 lb AI per acre). Thiamethoxam 2G is an experimental compound that appeared in previously published reports as CGA-293343. It was evaluated because it is a member of a relatively new chemical class of insecticides that have demonstrated favorable activity against some soil insects. In addition, Actara 25W is a wettable formulation of thiamethoxam. Remaining experimental entries involved Mustang 1.5EW (a pyrethroid compound) and an application of Counter 15G followed by Thiamethoxam 2G postemergence. Also included in this trial was a tank-mixed application of Lorsban 4E plus Asana 0.66EC plus Peters 20-20-20 greenhouse fertilizer solution.

This study had a very severe SBRM infestation level. Damage ratings of sugarbeet samples collected from untreated control plots averaged 7.88 on the 0–9 scale (Table 8). The combination treatment of Temik applied pre-plant plus Counter 20CR at planting and the blended of treatment of these two products resulted in the highest levels of recoverable sucrose (4,035 and 3,854 lb/ac, respectively) and the lowest mean damage ratings. In fact, the damage ratings from these two treatments were significantly lower than all other treatments in this experiment. The fertilizer/liquid insecticide tank-mix (Lorsban 4E + Asana 0.66EC + Peters solution fertilizer) treatment resulted in a fairly high damage rating, however, it produced a very favorable yield response. Poor performance of this treatment in preventing SBRM feeding injury may have been related to its late (June 23) application timing, which was over two weeks beyond peak fly activity. It will be investigated further in 2001 to assess the potential for better control at an earlier application date. One interesting result in this experiment was that the treatment of Counter 15G applied at 1.5 lb (AI/ac) followed by a postemergence application of Thiamethoxam 2G provided significantly lower damage ratings than the planting-time only treatment of Counter. Relatively poor performance was demonstrated with both planting-time only rates of Thiamethoxam 2G as well as the postemergence application of Actara 25WG. Additionally, there was no rate response shown with Thiamethoxam 2G. Fairly high levels of SBRM feeding injury were also recorded in plots treated with Mustang 1.5EW. The high rate (0.05 lb) of this product resulted in significantly lower damage ratings than the low planting-time treatment as well as the low rate at postemergence. However, further study is needed to fully address the SBRM control potential of this compound. The planting-time only treatments of Counter 15G and Lorsban 15G resulted in significantly lower damage ratings than most other entries.

Although some of the experimental compounds evaluated in this trial did not perform adequately, further investigation will be necessary to determine the most effective treatment rate and timing. Most of them are alternative chemistries to the traditional organophosphate and carbamate insecticides. Thus, their potential incorporation into our current SBRM management practices could be useful in minimizing the risk of insecticide resistance development.

Table 8. Performance evaluation of experimental insecticide treatments for management of sugarbeet root maggot larvae, St. Thomas, ND, 2000.

Treatment/ formulation	Rate lb (AI/ac)		Placement[a]	Recoverable sucrose		Yield (T/ac)	Sucrose (%)	Damage rating (0-9)	Gross return ($/ac)
	Planting-time	Postemergence		(lb/ac)	(lb/T)				
Temik 15G +	1.5	---	M						
Counter 20CR	1.5	---	M	4035 a	289 a	14.0 a	15.6 a	2.13 h	388 a
Temik 15G +	Blend	---	-						
Counter 20CR	1.5	---	B	3854 ab	284 a	13.6 ab	15.4 a	4.03 g	362 ab
Lorsban 4E +	---	1.0	-						
Asana 0.66 EC +	---	0.03	-						
Peters 20-20-20	---	100 ppm	B	3684 abc	291 a	12.6 abc	15.8 a	7.85 ab	359 ab
Counter 15G +	1.5	-	B						
Thiamethoxam 2G	---	0.2	B	3510 a-d	287 a	12.2 a-d	15.5 a	4.83 f	335 abc
Asana 0.66 EC	---	0.015	B	3471 bcd	288 a	12.0 bcd	15.7 a	7.18 cd	333 abc
Check	---	---	-	3342 b-e	289 a	11.6 c-f	15.7 a	7.38 a-d	322 bcd
Asana 0.66 EC	---	0.03	B	3289 cde	280 a	11.7 cde	15.3 a	7.00 d	304 b-e
Lorsban 15G	1.5	---	B	3251 cde	283 a	11.5 c-f	15.4 a	6.00 e	305 b-e
Actara 25W	---	0.0625	B	3205 cde	286 a	11.2 c-f	15.6 a	7.50 a-d	305 b-e
Counter 15G	1.5	---	B	3200 cde	277 a	11.6 c-f	15.1 a	5.48 e	290 c-f
Thiamethoxam 2G	0.134	---	B	3155 c-f	283 a	11.1 c-f	15.4 a	7.95 a	296 c-f
Mustang 1.5 EW	---	0.028	B	3056 d-g	284 a	10.8 d-g	15.5 a	7.75 abc	287 c-f
Mustang 1.5 EW	0.044	---	B	3033 d-g	288 a	10.5 d-h	15.7 a	7.70 abc	291 c-f
Mustang 1.5 EW	0.05	---	B	2875 e-h	288 a	10.0 e-i	15.7 a	7.00 d	275 c-f
Mustang 1.5 EW	---	0.05	B	2817 e-h	284 a	9.9 f-i	15.5 a	7.43 a-d	265 d-g
Lorsban 4EC	---	1.0	B	2649 fgh	283 a	9.3 ghi	15.4 a	7.05 d	250 efg
Thiamethoxam 2G	0.2	---	B	2531 gh	282 a	9.0 hi	15.4 a	7.25 bcd	236 fg
Lorsban 4EC	---	0.5	B	2338 h	275 a	8.5 i	15.1a	7.88 a	210 g

Means within a column sharing the same letter are not significantly ($P > 0.05$) different (LSD).

[a]M = Modified-in-furrow; B = Band

[b]Applied June 8 (peak fly activity)

Cover Crop Experiment:

This experiment was conducted at St. Thomas, and Minto, ND to determine the impact of cereal cover crops on the incidence of sugarbeet root maggot feeding injury. The experiment was arranged in a randomized complete block design with treatments consisting of oat, barley, wheat and rye cover crops in combination with low and standard application rates of registered soil insecticides. Cereal grains were broadcast immediately before beet planting (May 9 and 16 at St. Thomas and Minto, respectively) using a standard lawn fertilizer spreader. The grain was then incorporated into the plots using a motorized walk-behind garden tiller. The first treatment of Poast herbicide at St. Thomas was applied at a rate of 0.1 lb (AI/ac) on June 8 to set back the cover. The grain was in the 3-leaf stage and about 6 inches tall at the time of this application. On June 15, Poast herbicide was applied at a rate of 0.4 lb to kill off the grasses in all cover crop treatments. However, frequent rainfall events during the 2000 growing season interfered with the success the herbicide applications. Also, this was the first year that we experience difficulty cultivating the cover crop plots. This was a result of wet conditions which caused clogging of the cultivator. Therefore, it needed to be cleaned often. Poast herbicide was applied at the Minto site on June 26 at a rate of 0.4 lb AI/ac and only one application was necessary to kill the grasses.

Soil conditions during planting were very dry at both locations, although about 0.42 inch of rain fell at the St. Thomas site three days after it was planted. The rainfall helped to germinate some of the grain; however, some germination was delayed and the plants failed to come up until late May. Soils remained dry at the Minto location until a June 13 rainfall occurred which helped initiate germination. Unfortunately, plant (both cereal and beet) stands at this location were very sparse during peak SBRM fly activity. Therefore, significant SBRM larval infestations were not expected. However, low levels of fly activity persisted as late as the first week of July. The size of beet plants in these plots was probably more attractive to egg-laying SBRM flies than the more mature plants in the adjacent commercial field, therefore, the SBRM larval infestation in the plot area was much higher than anticipated.

Although sufficient, the SBRM infestation level in this experiment was somewhat lower than those recorded in other studies at St. Thomas. This was demonstrated by damage ratings from the untreated control plots that averaged a 6.63 on the 0–9 rating scale (Table 9). Our results indicated that plots treated with Counter at 1.05 lb (AI/ac) and seeded with oats at 1.75 yielded numerically the highest total recoverable sucrose, beet tonnage, and gross economic return values at St. Thomas. Interestingly, Counter at the 1.05 lb rate in combination with the 1.75 bu oat cover crop was statistically superior in recoverable sucrose, beet tonnage, gross economic return, and SBRM damage rating to the same rate of Counter without a cover crop. A significant reduction in damage rating was also exhibited when either rye or barley cover crops were used (irrespective of seeding rate)in plots treated with Counter 15G at 1.5 lb (AI/ac) in comparison to non-cover plots treated with this same insecticide application. Additionally, plots seeded with barley and rye covers at the 1.75 bu rate had significantly less SBRM feeding injury than their 0.75 bu counterparts. This finding was not observed with Counter-treated wheat plots. Lorsban-treated plots had significantly lower damage ratings when a cover crop of oats was established. This occurred with 1.75 and 3 bu/ac oat seeding rates. Finally, our comparison of rye and barley covers indicated that beet roots collected from 1.75 bu rye plots treated with Counter 15G at the 1.5 lb (AI/ac) application rate had significantly less SBRM damage than those dug from 1.75 bu barley cover crop plots that had also been treated with the same application rate of Counter. Rye was also superior to barley using the 0.75 bu seeding rate in combination with Counter 15G at 1.5 lb.

Table 9. Impact of cereal cover crops and soil insecticides on management of sugarbeet root maggot larvae, St. Thomas, ND, 2000.

Treatment/ formulation	Rate lb (AI/ac)	Placement[a]	Cover Crop	Cover Rate (bu/ac)	Recoverable sucrose (lb/ac)	Recoverable sucrose (lb/T)	Yield (T/ac)	Sucrose (%)	Damage rating (0-9)	Gross return ($/ac)
Counter 15G	1.05	B	Oat	1.75	4343 a	292 a	14.9 a	15.8 a	5.00 f-i	425 a
Lorsban 15G	1.5	B	None	-	4088 ab	293 a	14.0 abc	15.9 a	6.30 bc	401 ab
Counter 15G	1.5	B	Wheat	1.75	4062 ab	281 a	14.4 ab	15.4 a	5.05 f-i	378 a-d
Counter 15G	1.5	B	Oat	1.75	3950 abc	301 a	13.2 a-f	16.2 a	4.73 ghi	399 ab
Lorsban 15G	1.5	B	Oat	1.75	3936 a-d	294 a	13.3 a-e	16.0 a	4.88 ghi	389 abc
Check	-	-	Oat	3	3902 a-d	290 a	13.5 a-d	15.8 a	5.93 cd	376 a-d
Counter 15G	1.5	B	Wheat	0.75	3845 a-e	291 a	13.2 a-f	15.7 a	5.18 e-h	372 a-e
Check	-	-	Rye	0.75	3834 a-e	289 a	13.3 a-e	15.7 a	5.58 def	368 a-e
Check	-	-	Wheat	1.75	3811 a-e	291 a	13.1 a-g	15.8 a	5.75 cde	370 a-e
Check	-	-	None	-	3787 a-e	287 a	13.2 a-f	15.7 a	6.63 ab	362 a-e
Lorsban 15G	1.5	B	Oat	3	3732 a-e	288 a	13.0 a-g	15.7 a	4.43 ij	356 a-f
Counter 15G	1.5	B	Rye	0.75	3711 b-e	293 a	12.7 b-h	15.9 a	4.53 i	364 a-e
Counter 15G	1.5	B	Oat	3	3694 b-f	289 a	12.8 b-g	15.7 a	5.25 efg	354 a-f
Check	-	-	Wheat	0.75	3632 b-g	281 a	12.9 a-g	15.4 a	5.63 def	338 b-g
Counter 15G	1.05	B	None	-	3614 b-g	288 a	12.6 b-h	15.6 a	7.00 a	346 b-g
Counter 15G	1.5	B	Barley	0.75	3513 b-g	285 a	12.4 c-h	15.5 a	5.35 d-g	332 b-g
Check	-	-	Rye	1.75	3475 b-g	289 a	12.1 c-h	15.7 a	4.58 hi	333 b-g
Check	-	-	Barley	1.75	3377 c-g	286 a	11.8 d-h	15.6 a	5.70 cde	321 c-g
Counter 15G	1.5	B	None	-	3312 d-g	279 a	11.9 d-h	15.2 a	6.88 ab	302 efg
Counter 15G	1.5	B	Rye	1.75	3248 efg	289 a	11.3 fgh	15.7 a	3.18 k	313 d-g
Check	-	-	Barley	0.75	3233 efg	282 a	11.5 e-h	15.4 a	5.78 cde	302 efg
Counter 15G	1.5	B	Barley	1.75	3078 fg	276 a	11.1 gh	15.2 a	3.83 j	280 g
Check	-	-	Oat	1.75	3037 g	285 a	10.7 h	15.5 a	5.58 def	287 fg

Means within a column sharing the same letter are not significantly ($P > 0.05$) different (LSD).
[a]B = Band

Our analysis of the Minto data could only detect treatment differences with regard to root maggot feeding injury (Table 10). The failure to detect differences in yield may have been related to the delayed and erratic plant emergence due to the general lack of pre- and post-planting soil moisture. In comparing damage ratings, Lorsban 15G used in combination with an oat cover crop sown at either 1.75 or 3 bu per acre resulted in significantly less damage than the same rate of Lorsban without a cover. Moreover, the average damage rating for plots receiving Lorsban plus 3 bu oat plots were significantly lower than the same Lorsban rate seeded with 1.75 bu of oats. Similar to our findings at St. Thomas, SBRM damage was significantly reduced by using a 1.75 bu oat seeding rate in combination with Counter 15G at the low application rate of 1.05 lb (AI/ac) when comparing the same Counter application without the oat cover. No further differences were detected in relation to cover crops and Counter 15G at Minto. Interestingly, SBRM injury sustained in the 3 bu oat plots without an insecticide was not significantly different from levels recorded in the 3 bu oat plots treated with 1.5 lb (AI/ac) of either Counter or Lorsban. The untreated check without a cover at this location had the highest damage rating although not significant from the Lorsban treatment with no cover crop and the wheat check.

The results from our cover crop evaluations are very encouraging; however, more work will be necessary before concrete recommendations can be made. **It should be noted that we did not have such remarkable success with the non-insecticide treated cover crop treatments during previous years of this investigation. Therefore, although a much of our data suggests additive effects in protection from sugarbeet root maggot injury when cereal cover crops are established, growers are strongly advised to continue using soil insecticides in areas where damaging populations are expected for the 2001 growing season. Do not use a cereal cover crop in lieu of a soil insecticide.**

Table 10. Impact of cereal cover crops and soil insecticides on management of sugarbeet root maggot larvae, Minto, ND, 2000.

Treatment/ formulation	Rate lb (AI/ac)	Placement[a]	Cover Crop	Cover Rate (bu/ac)	Recoverable sucrose (lb/ac)	Recoverable sucrose (lb/T)	Yield (T/ac)	Sucrose (%)	Damage rating (0-9)	Gross return ($/ac)
Counter 15G	1.05	B	None	-	4296 a	261 a	16.3 a	14.8 a	4.53 def	362 a
Counter 15G	1.5	B	Rye	1.75	4292 a	276 a	15.5 a	15.4 a	3.43 gh	390 a
Counter 15G	1.5	B	Barley	1.75	4180 a	271 a	15.3 a	15.2 a	3.75 fg	374 a
Counter 15G	1.5	B	None	-	4061 a	286 a	14.2 a	15.8 a	4.13 efg	386 a
Lorsban 15G	1.5	B	Oat	1.75	4053 a	275 a	14.7 a	15.3 a	3.85 fg	366 a
Counter 15G	1.5	B	Oat	3	3949 a	275 a	14.3 a	15.3 a	3.33 gh	357 a
Check	-	-	Wheat	1.75	3884 a	269 a	14.4 a	15.0 a	5.40 abc	341 a
Counter 15G	1.5	B	Oat	1.75	3760 a	268 a	13.9 a	15.1 a	3.70 g	329 a
Lorsban 15G	1.5	B	Oat	3	3657 a	270 a	13.5 a	15.1 a	2.85 h	323 a
Check	-	-	Oat	1.75	3624 a	264 a	13.6 a	14.9 a	4.80 cde	310 a
Check	-	-	Oat	3	3606 a	279 a	13.0 a	15.5 a	3.95 fg	330 a
Counter 15G	1.5	B	Wheat	1.75	3553 a	266 a	13.2 a	14.9 a	3.43 gh	311 a
Check	-	-	Rye	1.75	3186 a	275 a	11.5 a	15.3 a	5.05 bcd	289 a
Counter 15G	1.05	B	Oat	1.75	3177 a	263 a	12.1 a	14.7 a	3.43 gh	269 a
Check	-	-	Barley	1.75	3176 a	257 a	12.3 a	14.5 a	4.98 bcd	259 a
Lorsban 15G	1.5	B	None	-	3079 a	260 a	11.7 a	14.6 a	5.65 ab	260 a
Check	-	-	None	-	2819 a	260 a	10.7 a	14.6 a	5.93 a	237 a

Means within a column sharing the same letter are not significantly ($P > 0.05$) different (LSD).

[a]B = Band

Granular Incorporation and Postemergence Insecticides:

The purpose of this experiment was to compare registered preplant, planting-time, and postemergence insecticides for efficacy at controlling sugarbeet root maggot larvae and to assess the impact of incorporation on the performance of postemergence granular soil insecticide applications. The St. Thomas, ND site was also chosen for this trial, and the experiment was planted May 11. Postemergence treatments were applied on June 7 (1 day before peak fly activity) using the banding and incorporation methods previously described in the "Planting-time and Postemergence Granular and Liquid Insecticide Combinations" section of this report.

As was the case in other studies carried out at this site, the SBRM larval infestation was quite severe. The damage rating for the untreated control plots averaged 7.8 (Table 11). All insecticide treatments resulted in significant reductions in SBRM feeding injury. However, no differences were observed among treatments with regard to beet yield, sugar yield, quality, or gross economic return. The planting-time application of Counter 15G followed by an incorporated Lorsban 15G application was not significantly different from its Counter/non-incorporated Lorsban counterpart. Also, no difference in efficacy was observed between preplant Counter 15G applied modified-in-furrow and the planting-time banded treatment. However, the preplant Counter 15G plus planting-time banded Lorsban 15G treatment resulted in significantly less SBRM feeding injury than the preplant-only Counter treatment.

Small amounts of rain (total of 0.15 inch) were received at the site during the two days immediately after application of the postemergence granules and an additional 0.66 inch was recorded on June 12. This postapplication rainfall may have naturally incorporated some of the granules and, thus, obscured any otherwise detectable difference between incorporated and non-incorporated treatments.

Table 11. Effect of granule incorporation on performance of postemergence insecticides for controlling sugarbeet root maggot larvae, St. Thomas, ND, 2000.

Treatment/ formulation	Rate lb (AI/ac) Preplant	Planting-time[a]	Post-emergence[b,c]	Place-ment[c]	Recoverable sucrose (lb/ac)	Recoverable sucrose (lb/T)	Yield (T/ac)	Sucrose (%)	Damage rating (0-9)	Gross return ($/ac)
Counter 15G	1.5	-	-	M	4892 a	302 a	16.3 a	16.4 a	5.33 b	494 a
Counter 15G +	-	1.5	-	B						
Lorsban 15G	-	-	1.5 NC	B	4853 a	315 a	15.4 a	17.0 a	3.33 d	519 a
Counter 15G	-	1.5	-	B	4804 a	311 a	15.6 a	16.7 a	4.78 bc	499 a
Counter 15G +	-	1.5	-	B						
Lorsban 15G	-	-	1.5 IC	B	4719 a	300 a	15.8 a	16.3 a	3.23 d	472 a
Counter 15G +	1.5	-	-	M						
Lorsban 15G	-	1.5	-	B	4491 a	300 a	15.1 a	16.3 a	4.45 c	448 a
Check	-	-	-	-	3440 b	290 a	11.9 b	15.9 a	7.80 a	333 b

Means within a column sharing the same letter are not significantly (*P* > 0.05) different (LSD).

[a]Applied June 7 (1-d before peak fly)
[b]NC = Not incorporated; IC = Incorporated
[c]M = Modified-in-furrow; B = Band

FIELD PLOT SITE DATA

Location:	**St. Thomas, ND, Pembina County**	
Crop:	Sugarbeets	
Variety:	Van der Have 66140	
Plot Size:	Six 35-ft long rows, 4 Center rows treated	
Experimental Design:	Randomized complete block, 4 replicates	
Soil Name:	Sandy Loam	
% OM, pH:	3.3% OM, 8.0% pH	
Previous Crop:	Wheat - 1999	
Soil Preparation:	Kongskilde Triple K Field Cultivator worked once, Commercial Harrow, 2nd time, dry	
Herbicide:	4#/ac Ro-Neet applied May 8, 2000, incorporated twice Poast 0.1# (AI/ac), Dash 2 pt, June 8, 2000 - Cover Crop Experiment Poast 0.4# (AI/ac), Dash 2 pt, June 15, 2000 - Cover Crop Experiment Betamix 0.5 pt/ac, Stinger 1.3 oz/ac, Upbeet 1/8 oz/ac, Meth oil 1.5 %, June 15, 2000 - Cover Crop Betamix 0.5 pt/ac, Stinger 1.3 oz/ac, Upbeet 1/8 oz/ac, Meth oil 1.5 %, July 6, 2000 - Cover Crop and Experimentals	
Fungicide:	Eminent 13 oz/ac, July 21, 2000 Supertin 5 oz/ac, August 4, 2000	
Insecticide:	Noble applicators, granules banded (B) 5" band, modified in furrow (M), & spoon (S) Postemergence liquids in 5 & 7.3" bands or broadcast; post granules in 4" bands	
Planting Depth:	1 1/4"	
Planting Date:	May 09, 2000	Cover-crop Experiment
	May 10, 2000	Registered, Application, and Planting-time vs. Post Granule studies
	May 11, 2000	Experimentals, and Incorporation studies
Post Treatments:	June 02, 2000	Lorsban 4E & Asana; Planting-time vs. Post Granule
	June 07, 2000	Post Granules, Planting-time vs. Post Granule and Incorporation studies
	June 08, 2000	Lorsban 4E & Asana; Planting-time vs. Post Granule Lorsban 4E, Asana, Mustang, and Actara; Experimentals & Planting-time vs. Post Granule
	June 22, 2000	Lorsban 4E & Asana; Planting-time vs. Post Granule
	June 23, 2000	Lorsban 4E; Planting-time vs. Post Granule Lorsban 4E, Asana, & Fertilizer; Experimentals
Rainfall:	May 12, 2000	0.42"
	May 15, 2000	0.13"
	May 22, 2000	0.05"
	May 23, 2000	0.03"
	May 31, 2000	0.01"
	Total/May	**0.64"**
	June 01, 2000	0.07"
	June 05, 2000	0.04"
	June 08, 2000	0.07"
	June 09, 2000	0.08"
	June 12, 2000	0.66"
	June 13, 2000	1.23"
	June 15, 2000	1.33"
	June 19, 2000	0.51"
	June 21, 2000	1.03"
	June 22, 2000	1.02"
	June 26, 2000	0.16"

	June 30, 2000	0.21"
	Total/June	**6.41"**
	July 04, 2000	0.27"
	July 06, 2000	0.03"
	July 07, 2000	0.05"
	July 12, 2000	0.39"
	July 15, 2000	0.11"
	July 25, 2000	0.18"
	July 31, 2000	0.27"
	Total/July	**1.30"**
	Total/August	**5.90"**
	Total/September	**1.15"**

Damage Ratings: July 18, 19, 20, 25, 31, and August 1, 2, 2000
Harvest: September 27, 28, 2000
Harvest Sample: 2 center rows x 35' long - 70' total

Location:	**Minto, ND, Walsh County**	
Crop:	Sugarbeet	
Variety:	Van der Have 66140	
Plot Size:	Six 35-ft long rows, 4 Center rows treated	
Experimental Design:	Randomized complete block, 4 replicates	
Soil Name:	Sandy Loam	
% OM, pH:	4.1% OM, 7.8% pH	
Previous Crop:	Wheat - 1999	
Soil Preparation:	RTS Rau Tillage Tool Alloway Seedbedder worked once, dry	
Herbicide:	3#/ac Ro-Neet applied May 9, 2000, incorporated once, Poast 0.4# (AI/ac), Dash 2 pt, June 26, 2000 - Cover Crop Experiment Betamix 0.5 pt /ac, Stinger 1.3 oz /ac, Upbeet 1/8 oz /ac, Meth oil 1.5 %, June 29, 2000 - Cover Crop Betamix 0.5 pt /ac, Stinger 1.3 oz /ac, Upbeet 1/8 oz /ac, Meth oil 1.5 %, July 10, 2000 - Cover Crop Betamix 0.5 pt /ac, Stinger 1.3 oz /ac, Upbeet 1/8 oz /ac, Meth oil 1.5 %, July 17, 2000 - Cover Crop	
Fungicide:	Eminent 13 oz/ac, August 8, 2000	
Insecticide:	Noble applicators, granules banded (B) 5" band	
Planting Depth:	1 1/4"	
Planting Date:	May 16, 2000	Cover-Crop & Registered Experiments
Rainfall:	May 22, 2000	0.13"
	May 23, 2000	0.02"
	May 30, 2000	0.03
	Total/May	**0.18"**
	June 01, 2000	0.02"
	June 05, 2000	0.21"
	June 09, 2000	0.01"
	June 13, 2000	0.97"
	June 14, 2000	3.75"
	June 21, 2000	0.67"
	June 26, 2000	0.22"

	June 30, 2000	0.20"	
	Total/June	**6.05"**	
	July 04, 2000	1.00"	
	July 07, 2000	0.49"	
	July 25, 2000	0.17"	
	July 31, 2000	0.01"	
	Total/July	**1.67"**	
	Total/August	**2.58"**	
	Total/September	**2.06"**	
	Total/October	**0.23"**	
Damage Ratings:	August 3, 7, 2000		
Harvest:	October 4 , 2000		
Harvest Sample:	2 center rows x 35' long - 70' total		

Location:	**Hillsboro, ND, Traill County**		
Crop:	Sugarbeet		
Variety:	Van der Have 66140		
Plot Size:	Six 35-ft long rows, 4 Center rows treated		
Experimental Design:	Randomized complete block, 4 replicates		
% OM, pH:	4.2% OM, 7.9% pH		
Soil Name:	Loam		
Previous Crop:	Wheat - 1999		
Soil Preparation:	Kongskilde Triple K Field Cultivator worked twice, wet		
Herbicide:	4# Ro-Neet applied May 11, 2000 incorporated twice		
Insecticide:	Noble applicators, granules banded (B) 5" band, modified in-furrow (M), spoon (S)		
Planting Depth:	1 1/4"		
Planting Date:	May 17, 2000	Registered & Application Experiments	
Rainfall:	May 30, 2000	0.96"	
	Total/May	**0.96"**	
	June 01, 2000	0.20"	
	June 22, 2000	1.94"	
	June 30, 2000	0.32" **Total/June**	**2.46"**
	July 10, 2000	1.85"	
	July 15, 2000	0.56"	
	July 19, 2000	0.18"	
	Total/July	**2.59"**	
	Total/August	**3.50"**	
	Total/September	**1.85"**	
Damage Ratings:	July 25, 2000		
Harvest:	September 26, 2000		
Harvest Sample:	2 center rows x 35' long - 70' total		

Location:	**Crookston, MN, Polk County**			
Crop:	Sugarbeet			
Variety:	Beta 2276			
Plot Size:	Six 35-ft long rows, 4 Center rows treated			
Experimental Design:	Randomized complete block, 4 replicates			
Soil Name:	Wheatville Loam			
Previous Crop:	Wheat - 1999			
Soil Preparation:	Alloway Seedbedder			
Herbicide:	Betamix 0.5 pt/ac, Upbeet 1/8 oz/ac, Stinger 1.3 oz/ac, Poast 5.3 oz/ac, Meth oil 2.0 pt/ac, May 21 & 28, 2000			
	0.5 pt/ac Poast, June 26, 2000			
Fungicide:	Eminent 13 oz/ac, July 27, 2000			
	Supertin 5 oz/ac, August 10, 2000			
	Eminent 5oz/ac August 24, 2000			
Insecticide:	Noble applicators, granules banded (B) 5" band, modified in-furrow (M)			
Planting Depth:	1 1/2"			
Planting Date:	May 09, 2000	Registered Experiment		
Rainfall:	May 11 2000	0.02"		
	May 12, 2000	0.02"		
	May 20, 2000	0.11"		
	May 21, 2000	0.10"		
	May 27, 2000	0.02"		
	May 29, 2000	0.37"	**Total/May**	**0.64"**
	June 01, 2000	0.06"		
	June 03, 2000	0.01"		
	June 08, 2000	0.02"		
	June 10, 2000	0.01"		
	June 13, 2000	0.36"		
	June 14, 2000	2.25"		
	June 15, 2000	0.32"		
	June 16, 2000	0.02"		
	June 17, 2000	0.15"		
	June 18, 2000	0.18"		
	June 19, 2000	0.88"		
	June 20, 2000	0.50"		
	June 21, 2000	0.48"		
	June 25, 2000	0.04"		
	June 26, 2000	0.02"		
	June 28, 2000	0.40"		
	June 29, 2000	0.02"		
	Total/June	**5.72"**		
	July 02, 2000	0.03"		
	July 04, 2000	0.50"		
	July 05, 2000	0.82"		
	July 07, 2000	0.98"		
	July 08, 2000	0.02"		
	July 11, 2000	0.45"		
	July 15, 2000	0.04"		
	July 19, 2000	0.20"		
	July 25, 2000	0.17"		
	Total/July	**3.21"**		
	Total/August	**1.38"**		

	Total/September	**1.60"**

Damage Ratings:	July 31, 2000
Harvest:	September 25, 2000
Harvest Sample:	2 center rows x 35' long - 70' total