SUGARBEET ROOT MAGGOT FLY MONITORING IN THE RED RIVER VALLEY – 2011

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

Lesley Lubenow, NDSU Extension Agent, Pembina County, Cavalier, ND

Terry A. Lunde, Agriculturist, Minn-Dak Farmers Cooperative, Wahpeton, ND

Sugarbeet root maggot (SBRM), *Tetanops myopaeformis* (Röder), fly activity was monitored at 45 grower field sites throughout the Red River Valley during the 2011 growing season. This was a collaborative effort between the Entomology Department at North Dakota State University, Pembina County Extension, and the Minn-Dak Farmers Cooperative. The project was jointly funded by the Sugarbeet Research & Education Board of Minnesota and North Dakota and the American Crystal Sugar Company.

Similar to previous years, moderate to high levels of SBRM fly activity were observed in central and northern portions of the Red River Valley in 2011. Moderate levels of fly activity were also observed in near Ada, Climax, and Euclid, MN, as well as Reynolds, ND. Also similar to previous observations was that fly activity in most of the southern portion of the Valley was low. Figure 1 presents results from fly monitoring efforts at three representative sites (i.e., St. Thomas, Thompson, and Conway, ND) within the production area.

Root maggot fly activity typically begins in current-year beet fields in the Red River Valley around mid- to late-May and peaks near the second week of June. In 2011, fly activity began slightly later as a result of unseasonably cool temperatures and frequent rainfall events that persisted during much of May and early June. The first SBRM flies captured on sticky stakes were observed on May 25. Corresponding to the delayed onset of fly emergence in the region, activity peaks were also later than average. Fly activity initially peaked around June 20 at all three locations. Rainfall events and relatively high winds caused intermittent reductions in activity near the end of the third week of June, and again around July 1. This temporarily reduced fly activity and delayed many emerged flies from leaving their overwintering fields and moving into current-year beet fields, which resulted in secondary peaks being observed at St. Thomas (June 27) and Conway (June 24-26). Overall, fly activity persisted at relatively high levels for over two weeks after peaking at both St. Thomas and Conway.

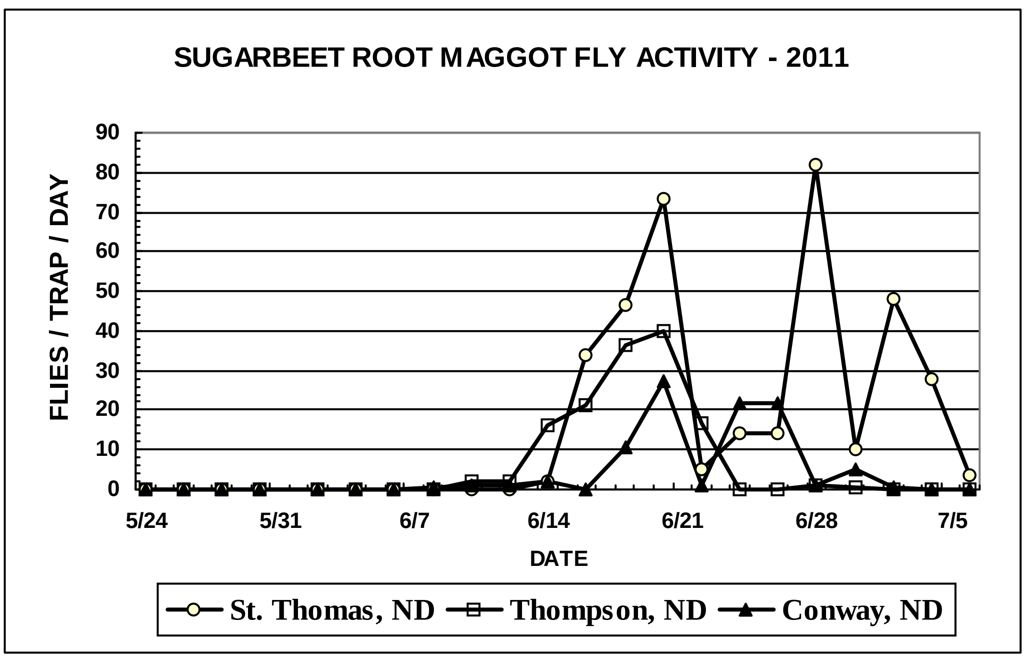

Fig. 1. Sugarbeet root maggot fly activity at selected sites in the Red River Valley, 2011 (counts represent flies captured on sticky stakes on a per-trap, per-day basis).

All 45 root maggot fly monitoring sites were also assessed for maggot feeding injury after the larval feeding period was completed. This is carried out on an annual basis as a means of determining whether fly outbreaks and resulting larval infestations were managed effectively. Moderate levels of feeding injury were observed in the traditional root maggot problem areas of Pembina and Walsh Counties in North Dakota. Although these specific fields did not incur as much larval feeding injury as could have potentially occurred, other fields surveyed for root injury in the same area were significantly damaged by SBRM larvae. The fact that some of the fly monitoring fields had low injury is encouraging, because it could suggest that control efforts made by producers in those areas were effective at managing SBRM infestations in 2011.

It should be noted, however, that although relatively low root injury levels were recorded for in some areas during 2011, root maggot feeding scars were still evident in most of those fields. Thus, careful monitoring will be critical in 2012 to detect unanticipated flare-ups of SBRM fly activity and to prevent economic loss. Vigilant monitoring and effective SBRM management on a field-by-field basis by sugarbeet producers may also help prevent significant population increases from one year to another because even moderate levels of root maggot survival in one year can be sufficient to result in economically damaging populations in the following growing season.

SUGARBEET ROOT MAGGOT POPULATION FORECAST FOR 2012

Mark A. Boetel, Associate Professor
Robert J. Dregseth and Allen J. Schroeder, Research Specialists

Department of Entomology, North Dakota State University, Fargo, ND

The 2012 forecast map for anticipated sugarbeet root maggot (SBRM) fly activity in the Red River Valley is shown in Figure 1. Areas at high risk of damaging SBRM infestations include rural Auburn, Cavalier, Conway, Glasston, Grafton, St. Thomas, and Thompson, ND. Moderate risk is expected near Forest River, Grand Forks, Minto, Nash, and Reynolds, ND, as well as near Ada, Borup, Climax, Crookston, and Euclid, MN. The remainder of the Valley will be at low risk of damaging infestations. Despite high fly activity occurring at many monitoring sites in 2011, several incurred low levels of SBRM feeding injury. This could indicate that SBRM control efforts were successful in the 2011 growing season. Also, as a result of excessive rainfall events that occurred in much of the Valley, root disease was prevalent in most SBRM fly monitoring sites. This made it difficult to positively confirm SBRM feeding injury in those sites. Fields in areas where high fly activity occurred in 2011 should be closely monitored in 2012. Populations can increase rapidly from year to year, especially if they are not effectively managed. Proximity to previous-year beet fields increases risk for damaging SBRM infestations, especially when beets are planted near fields in which SBRM control was unsatisfactory the previous year. Growers in areas at moderate to high risk of damaging infestations should continue using insecticides at planting time and pay close attention to fly activity levels during late May and the first few weeks of June to decide whether a postemergence insecticide is needed. NDSU Entomology will continue to inform growers regarding SBRM activity levels and hot spots each year through radio reports, the NDSU "Crop & Pest Report", and notification of sugar cooperative agricultural staff when appropriate. In-season SBRM fly count information and historical records from monitoring programs from previous years can be viewed at: http://www.ndsu.edu/entomology/people/faculty/boetel/flycounts/.

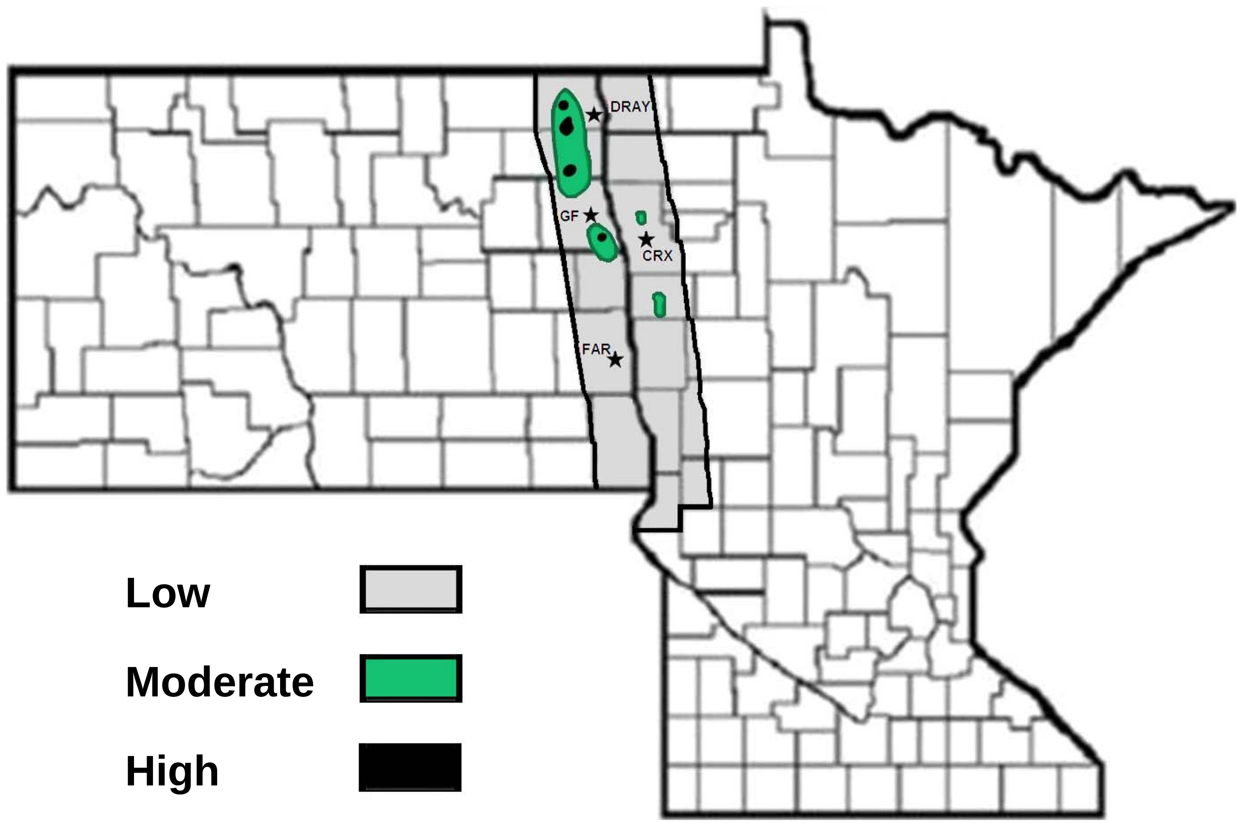

Fig. 1. Anticipated SBRM population levels for the Red River Valley.

COMBINING SEED TREATMENTS OR PLANTING-TIME INSECTICIDES WITH POSTEMERGENCE TOOLS FOR SUGARBEET ROOT MAGGOT CONTROL

Mark A. Boetel, Associate Professor
Robert J. Dregseth and Allen J. Schroeder, Research Specialists

Department of Entomology, North Dakota State University, Fargo, ND

Introduction:

The sugarbeet root maggot (SBRM), *Tetanops myopaeformis* (Röder) continues to be the key insect pest of sugarbeet in the Red River Valley growing area. Sugarbeet growers in the region have typically relied on planting-time granular insecticides to control this pest for several decades, and postemergence insecticide applications are commonly used for additive protection in the more heavily infested areas. In recent years, insecticidal seed treatments have been widely adopted by Valley growers for at-plant protection from sugarbeet insect pests. Seed treatment technology is attractive to growers as an insecticide option because no on-farm equipment calibration is required to achieve the desired application rate, no specialized application equipment is needed on the planter to apply protection, and insecticidal seed treatments allow for significant reductions in the amount of insecticide active ingredient applied to the environment for insect management. In addition to the relatively new seed treatment options for growers, the marketplace has also recently seen the introduction of a 20G (i.e., 20% granular) formulation of Counter (i.e., terbufos) insecticide, which is replacing the longstanding 15G formulation.

This investigation included two experiments that were carried out during the 2011 growing season. Study I was initiated with the following objectives: 1) determine whether there are differences in SBRM control efficacy between Counter 15G and 20G formulations; 2) compare conventional granular insecticides with Poncho Beta seed treatment for SBRM control; 3) assess the impacts of additive postemergence applications of Thimet 20G to plots initially treated with either Counter 20G or Poncho Beta seed treatment.

Study II was carried out to achieve the following objectives: 1) compare registered and experimental liquid insecticides (i.e., Mustang Max and HGW86 20SC [experimental]) with Poncho Beta seed treatment and Counter 20G for planting-time control of the SBRM; 2) assess the capability of postemergence liquid insecticides (i.e., Lorsban Advanced and HGW86 10OD [experimental]) for providing additive SBRM control.

Materials and Methods:

These experiments were established on a commercial sugarbeet field site near St. Thomas in rural Pembina County, ND. A professional seed preparation company (Germains Seed Technology, Fargo, ND) applied seed treatment insecticides to seed for all entries in both studies. Additionally, the same seed variety (SES VanderHave 36812RR [glyphosate-resistant]) was used for all entries in these experiments. Study I was planted on 26 May and Study II was planted on 6 June. All plots were planted using a six-row John Deere 71 Flex planter set to plant at a depth of 1¼ inch and a rate of one seed every 4½ inches of row. 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 25-foot tilled alleys were maintained between replicates. 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 seed treatment entry.

Planting-time insecticide applications. Counter 15G and 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 Noble™ metering units that had been calibrated on the planter before all applications. Planting-time applications of Mustang Max were applied in 3-inch T-bands over open seed furrows, whereas HGW86 was applied directly into seed furrows at planting. All planting-time liquid applications were delivered by using a tractor-mounted CO_2-propelled spray system that was calibrated to deliver a finished spray volume of 5 GPA using TeeJet™ 6501E nozzles.

Postemergence insecticide applications. Postemergence insecticides used in Study I consisted of two granular materials (i.e., Counter 20G and Thimet 20G. Postemergence granules (Post B) were applied on 17 June, or about 3 days before the initial peak in SBRM fly activity. However, the highest peak occurred on 27 June (10 d after the applications). Band placement of postemergence granules was achieved by using Kinze™ row banders attached to a tractor-mounted tool bar and adjusted to a height needed to deliver the insecticides in 4-inch bands. As with at-plant applications, postemergence granular application rates were controlled by using planter-mounted Noble™ metering units, and granules were incorporated using two pairs of rotary tines that straddled each row on the tool bar. A paired set of tines was positioned ahead of each bander, and a second pair of tines was mounted behind the granular drop zone. This system effectively stirred soil around the bases of sugarbeet seedlings and incorporated granules as the unit passed through each plot.

In Study II, all postemergence insecticides used were liquid materials (i.e., Lorsban Advanced HGW86 10 OD). Postemergence liquid applications were carried out on 17 June (i.e., about 3 days before the initial peak in SBRM fly activity) using a tractor-mounted CO_2-propelled spray system equipped with TeeJet™ 11002VS 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 reduce 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 and yield assessments were taken out of the center 4 rows of each plot.

Root injury ratings: Sugarbeet root maggot feeding injury was assessed in Studies I and II on 3 and 4 August, respectively, 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 27 September. Foliage was removed from plots immediately before harvest by using a commercial-grade mechanical defoliator. All beets from the center 2 rows of each plot were lifted 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 analyzed for sucrose content and quality.

Data analysis: All data from root injury ratings and harvest samples were subjected to analysis of variance (ANOVA) using the general linear models (GLM) procedure (SAS Institute, 2008), and treatment means were separated using Fisher's protected least significant difference (LSD) test at a 0.05 level of significance.

Results and Discussion:

Study I. Sugarbeet root maggot feeding injury rating results for Study I are presented in Table 1. Root injury ratings in the untreated check plots (mean = 8.3 on the 0 to 9 scale of Campbell et al. [2000]) indicated that a relatively high SBRM infestation was present for this study. All insecticide-protected plots had significantly lower levels of root maggot feeding injury than the untreated check, irrespective of whether a seed treatment, single at-plant granular application, or dual-treated combination was used for SBRM control.

As observed in previous years of testing, trends indicated that dual (planting-time + postemergence) insecticide programs tended to provide slightly better root protection than single, at-plant treatments. For example, the dual control program consisting of Counter 20G at its high (8.9 lb product/ac) labeled rate, combined with a postemergence application of Thimet 20G at its high (7 lb product/ac) rate, provided significantly greater root protection than any other treatment in this trial. The dual application treatment that included Poncho Beta seed treatment and a postemergence application of Counter 20G also provided good protection from SBRM feeding injury.

Root injury rating data also indicated that there were no significant differences in performance between the 15G and 20G formulations of Counter insecticide when the same rate (either 1.5 or 1.8 lb) of active ingredient was applied per acre. Both formulations, when applied at the highest labeled application rate of active ingredient per acre, provided good protection from SBRM feeding injury, even if they were applied as stand-alone (i.e., without a postemergence insecticide) treatments.

Table 1. ***Larval feeding injury*** **in evaluation of planting-time granules, seed treatments and postemergence granules for sugarbeet root maggot control, St. Thomas, ND, 2011 (Study I)**				
Treatment/form.	**Placement[a]**	**Rate (product/ac)**	**Rate (lb a.i./ac)**	**Root injury (0-9)**
Counter 20G + Thimet 20G	B 3 d pre-peak Post B	8.9 lb 7 lb	1.8 1.4	3.73 f
Counter 20G + Thimet 20G	B 3 d pre-peak Post B	7.5 lb 7 lb	1.5 1.4	5.00 e
Poncho Beta + Counter 20G	Seed B	 5.25 lb	68 g a.i./ unit seed 1.05	5.17 de
Counter 15G	B	11.9 lb	1.8	5.37 de
Counter 20G	B	8.9 lb	1.8	5.47 cde
Poncho Beta + Counter 20G	Seed 3 d pre-peak Post B	 5.25 lb	68 g a.i./ unit seed 1.05	5.87 b-e
Counter 20G	B	7.5 lb	1.5	5.97 b-e
Poncho Beta + Thimet 20G	Seed 3 d pre-peak Post B	 7 lb	68 g a.i./ unit seed 1.4	6.00 b-e
Counter 15G	B	10 lb	1.5	6.30 bcd
Counter 20G	B	5.25 lb	1.05	6.63 bc
Poncho Beta	Seed		68 g a.i./ unit seed	6.73 b
Check	---	----	---	8.30 a
LSD (0.05)				1.18

Means within a column sharing a letter are not significantly (P = 0.05) different from each other (Fisher's Protected LSD).
[a]B = at-plant band; Post B = postemergence band; Seed = insecticidal seed treatment

Yield data from Study I are shown in Table 2. There were no statistically significant differences among any of the treatments with regard to recoverable sucrose yield or root tonnage. However, patterns of performance with regard to yield parameters were somewhat similar to those observed in root maggot feeding injury assessments. Interestingly, the top-performing entry with regard to recoverable sucrose yield, root yield, and gross economic return was the stand-alone entry of Counter 15G, applied at its highest labeled rate (11.9 lb product/ac). Other entries that resulted in the highest average yields in Study I included the following: 1) Counter 20G banded at planting (7.5 lb product/ac) + Thimet 20G postemergence band (7 lb product/ac); 2) Poncho Beta + Counter 20G postemergence band (5.25 lb/ac); and 3) Poncho Beta + Counter 20G planting-time band (5.25 lb/ac).

Table 2. ***Yield parameters*** **from evaluation of planting-time granules, seed treatments & postemergence granules for sugarbeet root maggot control, St. Thomas, ND, 2011 (Study I)**							
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 15G	B	11.9 lb	1.8	6113 a	22.2 a	15.30 abc	855
Counter 20G + Thimet 20G	B 3 d pre-peak Post B	7.5 lb 7 lb	1.5 1.4	5563 a	20.2 a	15.23 abc	780
Poncho Beta + Counter 20G	Seed 3 d pre-peak Post B	 5.25 lb	68 g a.i./ unit seed 1.05	5456 a	18.9 a	15.80 a	811
Poncho Beta + Counter 20G	Seed B	 5.25 lb	68 g a.i./ unit seed 1.05	5380 a	18.6 a	15.80 a	804
Counter 20G + Thimet 20G	B 3 d pre-peak Post B	8.9 lb 7 lb	1.8 1.4	4958 a	18.4 a	15.00 abc	673
Counter 20G	B	5.25 lb	1.05	4763 a	17.3 a	15.20 abc	666
Counter 20G	B	8.9 lb	1.8	4604 a	16.1 a	15.33 ab	677
Poncho Beta + Thimet 20G	Seed 3 d pre-peak Post B	 7 lb	68 g a.i./ unit seed 1.4	4573 a	16.7 a	15.23 abc	633
Counter 20G	B	7.5 lb	1.5	4521 a	17.2 a	14.73 bcd	585
Poncho Beta	Seed		68 g a.i./ unit seed	4151 a	17.0 a	13.90 d	471
Counter 15G	B	10 lb	1.5	4128 a	15.4 a	14.93 abc	556
Check	---	----	---	4128 a	16.3 a	14.37 cd	501
LSD (0.05)				NS	NS	0.95	

Means within a column sharing a letter are not significantly (P = 0.05) different from each other (Fisher's Protected LSD).
[a]B = at-plant band; Post B = postemergence band; Seed = insecticidal seed treatment

Percent sucrose data indicated that most of the entries in this study produced favorable sugar concentrations; however, plots protected with the stand-alone treatment of Poncho Beta had a significantly lower sucrose concentration than most other entries. The untreated check plots also produced significantly lower sucrose concentrations per sample than most other treatments.

It should be noted that Counter insecticide (both 15G and 20G formulations) can only be applied once per year. Thus, if either of these products were applied at planting, they could not be applied to the same field at postemergence. Additionally, it bears noting that using a Counter product as a postemergence material will not always be a viable option for commercial sugarbeet production because both 15G and 20G formulations are labeled with a 110-day preharvest interval. Thus, if an application were made in early to mid-June for SBRM management, no treated portion of the field could be harvested until mid- to late-September at the earliest.

Study II. Results from root maggot larval feeding injury assessments for Study II appear in Table 3. The best root protection was provided by the following treatments: 1) Counter 20G banded at 8.9 lb product/ac; 2) Counter banded at 7.5 lb product/ac + Lorsban Advanced postemergence broadcast at 1 pt product/ac; 3) Counter banded at 7.5 lb; and 4) Counter banded at 7.5 lb + Lorsban Advanced postemergence broadcast at 2 pt/ac. Entries that failed to provide significant levels of root protection included Poncho Beta + Lorsban Advanced (2 pt/ac); Poncho Beta without a postemergence insecticide, Poncho Beta + Lorsban Advanced (1 pt), Mustang MAX 0.8EC at planting time, HGW86 20SC at planting, HGW86 20SC at planting + HGW86 10OD postemergence, and Mustang MAX 0.8EC + Lorsban Advanced at 2 pt product/ac. Overall, the trends in this study indicated that the protection provided by planting-time granular insecticide applications was generally better than the at-plant protection provided by Poncho Beta seed treatment and the liquid insecticides (i.e., Mustang Max, or HGW86 20SC). Additionally, no significant increases in root protection were observed when postemergence applications of Lorsban Advanced or the experimental insecticide (i.e., HGW86) were added to planting-time applications of Counter 20G, Poncho Beta seed treatment, or Mustang MAX. This was probably due to the unusually high and extended period of SBRM fly activity, which also resulted in a high SBRM larval infestation in these plots. The long period of fly activity also made it difficult to effectively time the postemergence insecticide applications for optimal SBRM control.

Table 3. *Larval feeding injury* in evaluation of planting-time granules, liquids, seed treatments, and postemergence liquid insecticides for sugarbeet root maggot control, St. Thomas, ND (Study II)

Treatment/form.	Placement[a]	Rate (product/ac)	Rate (lb a.i./ac)	Root injury (0-9)
Counter 20G	B	8.9 lb	1.8	3.90 e
Counter 20G + Lorsban Advanced	B 3 d post-peak Broadcast	7.5 lb 1 pt	1.5 0.5	4.70 de
Counter 20G	B	7.5 lb	1.5	4.88 d
Counter 20G + Lorsban Advanced	B 3 d post-peak Broadcast	7.5 lb 2 pt	1.5 1.0	5.28 cd
Poncho Beta + Lorsban Advanced	Seed 3 d post-peak Broadcast	 2 pt	68 g a.i./ unit seed 1.0	6.10 bc
Poncho Beta	Seed		68 g a.i./ unit seed	6.38 ab
Poncho Beta + Lorsban Advanced	Seed 3 d post-peak Broadcast	 1 pt	68 g a.i./ unit seed 0.5	6.43 ab
MustangMAX 0.8EC	3" TB	4 fl oz	0.025	6.65 ab
Check	---	----	---	6.83 ab
HGW86 20SC	IF		0.352	6.85 ab
HGW86 20SC + HGW86 10OD	IF 3 d post-peak Broadcast		0.352 0.176	7.05 a
MustangMAX 0.8EC + Lorsban Advanced	3" TB 3 d post-peak Broadcast	4 fl oz 2 pt	0.025 1.0	7.05 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).
[a]B = Band; Post B = postemergence band; Seed = insecticidal seed treatment; TB = T-band over open seed furrow; IF = direct in-furrow

Yield results for Study II (Table 4) corresponded closely to those from root maggot feeding injury ratings. For example, the top-performing entries in this study involved Counter 20G applied at planting time (either as stand-alone (no postemergence) treatments or when combined with Lorsban Advanced as a postemergence broadcast application. Adding Lorsban Advanced augmented recoverable sucrose yield by at least 600 lb/ac when compared to a stand-alone application of Counter, and this translated to increases in gross economic return of $165-167/ac. These observed revenue increases clearly demonstrate the economic value and thereby, justify the Lorsban Advanced applications under relatively high SBRM pressure such as that which was present for this study.

Control programs in Study II involving Poncho Beta as the planting-time insecticide provided significant sucrose yield increases when compared to the untreated check; however, dual programs consisting of Counter 20G and a postemergence broadcast application of Lorsban Advanced were superior to Poncho-based entries. Entries in this experiment that failed to provide significant increases in recoverable sucrose yields included the single at-plant application of Mustang Max, and both the single and dual applications of the experimental insecticide, HGW86.

The top-performing entries with regard to recoverable sucrose and root yield in Study II provided gross economic returns that were about twice as much as (i.e., increases of over $500/ac) those from the untreated check plots. This demonstrates the economic significance of the sugarbeet root maggot and underscores the importance of effectively managing it when moderately high infestations develop.

Table 4. ***Yield parameters*** **from evaluation of planting-time granules, liquids, seed treatments, and postemergence liquid insecticides for sugarbeet root maggot control, St. Thomas, ND, 2011 (Study II)**

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 3 d post-peak Broadcast	7.5 lb 1 pt	1.5 0.5	7452 a	24.9 a	16.30 ab	1162
Counter 20G + Lorsban Advanced	B 3 d post-peak Broadcast	7.5 lb 2 pt	1.5 1.0	7345 a	24.3 a	16.43 a	1160
Counter 20G	B	8.9 lb	1.8	6942 ab	23.6 ab	16.03 ab	1059
Counter 20G	B	7.5 lb	1.5	6742 ab	23.5 ab	15.70 ab	995
Poncho Beta + Lorsban Advanced	Seed 3 d post-peak Broadcast	2 pt	68 g a.i./ unit seed 1.0	6095 bc	20.6 bc	16.10 ab	939
Poncho Beta + Lorsban Advanced	Seed 3 d post-peak Broadcast	1 pt	68 g a.i./ unit seed 0.5	5560 cd	19.0 cd	15.90 ab	841
Poncho Beta	Seed		68 g a.i./ unit seed	5458 cd	18.7 cd	15.90 ab	826
MustangMAX 0.8EC + Lorsban Advanced	3” TB 3 d post-peak Broadcast	4 fl oz 2 pt	0.025 1.0	5409 cd	18.7 cd	15.90 ab	811
MustangMAX 0.8EC	3” TB	4 fl oz	0.025	5210 cde	17.8 cd	16.03 ab	790
HGW86 20SC + HGW86 10OD	IF 3 d post-peak Broadcast		0.352 0.176	5020 de	18.1 cd	15.45 bc	711
HGW86 20SC	IF		0.352	5008 de	17.8 cd	15.40 bc	721
Check	---	----	---	4335 e	16.7 d	14.65 c	551
LSD (0.05)				1071	3.5	0.90	

Means within a column sharing a letter are not significantly (P = 0.05) different from each other (Fisher's Protected LSD).
[a]B = band; Post B = postemergence band; Seed = insecticidal seed treatment; TB = T-band over open seed furrow; IF = direct in-furrow

References Cited:

Boetel, M. A., R. J. Dregseth, A. J. Schroeder, and C. D. Doetkott. 2006. Conventional and alternative placement of soil insecticides to control sugarbeet root maggot (Diptera: Ulidiidae) larvae. J. Sugar Beet Res. 43: 47–63.

Campbell, L. G., J. D. Eide, L. J. Smith, and G. A. Smith. 2000. Control of the sugarbeet root maggot with the fungus *Metarhizium anisopliae*. J. Sugar Beet Res. 37: 57–69.

SAS Institute. 2008. The SAS System for Windows. Version 9.2. SAS Institute Inc., 2002-2008. Cary, NC.

EVALUATION OF REGISTERED SEED TREATMENT INSECTICIDES FOR SUGARBEET ROOT MAGGOT CONTROL

Mark A. Boetel, Associate Professor
Allen J. Schroeder and Robert J. Dregseth, Research Specialists

Department of Entomology, North Dakota State University, Fargo, ND

Introduction:

Three insecticidal seed treatment materials have recently received Environmental Protection Agency registration for use in sugarbeet to manage insect pests. This experiment was conducted to compare the relative efficacy of Cruiser 5FS, NipsIt Inside, and Poncho Beta insecticidal seed treatments under low and high sugarbeet root maggot infestations. Other objectives included comparing seed treatment alternatives with Counter 20G granular insecticide, and evaluating the impact of application rate on the performance of Counter 20G.

Materials and Methods:

Two commercial grower fields near St. Thomas (Pembina County) and Forest River (Walsh County), ND were chosen as sites to conduct this experiment. Seed treatment insecticides were applied to seed by a custom seed-coating company (Germains Seed Technology, Fargo, ND). Respective planting dates for Forest River and St. Thomas were 19 and 26 May, 2011. Plots were established using a 6-row John Deere™ 71 Flex planter. The planter was adjusted to plant at a depth of 1¼ inch and a rate of one seed every 4¾ inches of row. SES VanderHave 36812RR, a glyphosate-resistant seed variety, was used for all treatment plots at both locations. Each plot was 6 rows (22-inch spacing) wide with the 4 centermost rows treated. The outer "guard" row to each side of the plot served as an untreated buffer. Each plot was 35 feet long, and 25-foot tilled alleys were maintained between replicates. 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 were completely disassembled, cleaned, and re-assembled after each seed treatment was applied.

Counter 20G served as a planting-time granular insecticide standard the seed treatments. Granules were applied by using band (B) placement. Banded applications consisted of 5-inch swaths of granules that were achieved by using Gandy™ row banders. Granular output rates used in these experiments were regulated by using planter-mounted Noble™ metering units.

Root injury ratings: Root maggot feeding injury was assessed on 2 and 3 August at Forest River and St. Thomas, respectively. Ratings consisted of 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 at Forest River and St. Thomas were harvested on 26 and 27 September, respectively. Immediately before harvest, the foliage was removed from all treatment plots by using a commercial-grade mechanical defoliator. After defoliation, all beets from the center 2 rows of each plot were lifted using a mechanical harvester and weighed in the field using a digital scale. A representative subsample of 12-16 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:

St. Thomas (high SBRM pressure). Sugarbeet root maggot feeding injury data for this trial are presented in Table 1. Root injury ratings from the untreated check plots averaged 7.45on the 0 to 9 scale of Campbell et al. (2000), suggesting that a relatively high SBRM infestation was present. Counter 20G, applied at either 7.5 or 8.9 lb product/ac, was the only crop protection material that provided significant reductions in SBRM feeding injury at this location. The levels of root protection provided by Cruiser and Poncho Beta seed treatments were intermediate because, although they were not significantly outperformed by Counter 20G at the 8.9-lb rate, they were not statistically better than the untreated check. As observed with Poncho Beta and Cruiser, NipsIt Inside also failed to provide significant reductions in root maggot feeding injury when compared to the untreated check at St. Thomas.

Table 1. *Larval feeding injury* in comparison of registered seed treatments for sugarbeet root maggot control, St. Thomas, ND, 2011

Treatment/form.	Placement[a]	Rate (product/ac)	Rate (lb a.i./ac)	Root injury (0-9)
Counter 20G	B	7.5 lb	1.5	5.63 c
Counter 20G	B	8.9 lb	1.8	5.83 bc
Poncho Beta	Seed		68 g a.i./ unit seed	7.08 ab
Cruiser 5FS	Seed		60 g a.i./ unit seed	7.10 ab
NipsIT Inside	Seed		60 g a.i./ unit seed	7.35 a
Check	---	----	---	7.45 a
LSD (0.05)				1.36

Means within a column sharing a letter are not significantly (P = 0.05) different from each other (Fisher's Protected LSD).
[a]B = band; Seed = insecticidal seed treatment

The highest recoverable sucrose yield in this trial at St. Thomas was achieved by using the moderate (7.5 lb product/ac) rate of Counter 20G; however, the sucrose yields from those plots were not significantly different from plots treated with the high (8.9 lb product/ac) rate of Counter or Cruiser seed treatment. Cruiser was the only seed treatment entry in this trial that provided a significant increase in sucrose yield in comparison to the untreated check at St. Thomas. There were no statistical differences among treatments with regard to sugarbeet root tonnage; however, applying planting-time protection by using Counter 20G provided increases in root yield of up to 4.2 tons/ac and gross revenue increases ranging from $182 to $197/ac. Although the seed treatment plots tended to provide lower yields than Counter-treated plots, Cruiser and Poncho Beta plots generated relatively high sucrose percentages. As a result of this increased in quality, Cruiser and Poncho Beta imparted gross revenue increases of $216 and $73/ac, respectively, over that of the untreated check. Also, NipsIt Inside seed treatment resulted in a revenue increase of $33/ac when compared to the check.

Table 2. *Yield parameters* in comparison of registered seed treatments for sugarbeet root maggot control, St. Thomas, ND, 2011

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	B	7.5 lb	1.5	5380 a	20.7 a	14.68 a	688
Counter 20G	B	8.9 lb	1.8	5215 ab	19.4 a	14.98 a	703
Cruiser 5FS	Seed		60 g a.i./ unit seed	5168 ab	18.8 a	15.28 a	722
Poncho Beta	Seed		68 g a.i./ unit seed	4395 bc	16.6 a	14.95 a	579
NipsIT Inside	Seed		60 g a.i./ unit seed	4197 c	16.1 a	14.63 a	539
Check	---	----	---	4173 c	16.5 a	14.33 a	506
LSD (0.05)				900	NS	NS	

Means within a column sharing a letter are not significantly (P = 0.05) different from each other (Fisher's Protected LSD).
[a]B = band; Seed = insecticidal seed treatment

Forest River (low SBRM pressure). Root injury ratings in the untreated check plots at Forest River averaged 3.53 on the 0 to 9 scale of Campbell et al. (2000), thus indicating a low root maggot infestation at this site (Table 3). All insecticide-protected plots provided significant reductions in SBRM feeding injury, irrespective of whether a planting-time granule or insecticidal seed treatment was used. Trends with regard to protection from root maggot feeding injury tended to follow the same general patterns as those observed at the St. Thomas site. For example, the best overall root protection was provided by Counter 20G at its moderate (7.5 lb product/ac) rate. This entry resulted in significantly lower SBRM feeding injury than any seed treatment at Forest River. There were no significant differences in root protection between seed treatments at this site.

Table 3. *Larval feeding injury* in comparison of registered seed treatments for sugarbeet root maggot control, Forest River, ND, 2011				
Treatment/form.	**Placement[a]**	**Rate (product/ac)**	**Rate (lb a.i./ac)**	**Root injury (0-9)**
Counter 20G	B	7.5 lb	1.5	2.10 c
Counter 20G	B	8.9 lb	1.8	2.45 bc
Cruiser 5FS	Seed		60 g a.i./ unit seed	2.85 b
Poncho Beta	Seed		68 g a.i./ unit seed	2.88 b
NipsIT Inside	Seed		60 g a.i./ unit seed	2.90 b
Check	---	----	---	3.53 a
LSD (0.05)				0.52

Means within a column sharing a letter are not significantly (*P* = 0.05) different from each other (Fisher's Protected LSD).
[a]B = band; Seed = insecticidal seed treatment

Yield results from Forest River are presented in Table 4. Yields at Forest River were much higher than those observed at St. Thomas. Performance patterns with regard to yield tended to be similar among the two locations, although there were no statistical differences between any of the treatments in regard to sucrose yield, root tonnage, or sucrose percentage. As observed at St. Thomas, plots treated with at-plant applications of Counter 20G tended to provide higher yields than those protected using insecticidal seed treatments. As a result of the low root maggot pressure at this location, gross economic returns from all treatments were negligible. Similar to the results at St. Thomas, the highest revenue occurred in plots treated with Counter 20G at the moderate (7.5 lb product/ac); however, the Counter application only increased revenue by $5/ac when compared to the revenue value generated by the untreated check. Obviously, this small increase would not have paid a positive return on investment for purchase of the insecticide.

Table 4. *Yield parameters* in comparison of registered seed treatments for sugarbeet root maggot control, Forest River, ND, 2011							
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	B	7.5 lb	1.5	7924 a	29.6 a	15.20 a	1063
Counter 20G	B	8.9 lb	1.8	7860 a	29.9 a	14.83 a	1024
NipsIT Inside	Seed		60 g a.i./ unit seed	7712 a	28.5 a	15.03 a	1049
Poncho Beta	Seed		68 g a.i./ unit seed	7618 a	28.7 a	14.83 a	1007
Cruiser 5FS	Seed		60 g a.i./ unit seed	7561 a	29.1 a	14.63 a	963
Check	---	----	---	7553 a	27.4 a	15.28 a	1058
LSD (0.05)				NS	NS	NS	

Means within a column sharing a letter are not significantly (*P* = 0.05) different from each other (Fisher's Protected LSD).
[a]B = band; Seed = insecticidal seed treatment

The results of this trial suggest that Counter 20G provides better root maggot control than all registered insecticidal seed treatments when high infestations of this pest are present. However, the seed treatment materials tend to allow for slightly higher sucrose percentages, and the increased quality provided by seed treatments can offset the impacts of lower root maggot control performance. Continued research involving these crop protection materials should focus on optimizing at-plant protection rather than maximizing it (to enhance yield quality), as well as determining the most efficacious means of augmenting root maggot control by using postemergence rescue insecticide applications.

References Cited:

Campbell, L. G., J. D. Eide, L. J. Smith, and G. A. Smith. 2000. Control of the sugarbeet root maggot with the fungus *Metarhizium anisopliae*. J. Sugar Beet Res. 37: 57–69.

SAS Institute. 2008. The SAS System for Windows. Version 9.2. SAS Institute Inc., 2002-2008. Cary, NC.

PRELIMINARY ASSESSMENT OF EXPERIMENTAL SEED TREATMENT COMBINATIONS FOR SUGARBEET ROOT MAGGOT CONTROL

Mark A. Boetel, Associate Professor
Robert J. Dregseth and Allen J. Schroeder, Research Specialists

Department of Entomology, North Dakota State University, Fargo, ND

Introduction:

The most important economic insect pest of sugarbeet in the Red River Valley (RRV) is the sugarbeet root maggot (SBRM), *Tetanops myopaeformis* (Röder). Growers in the RRV have achieved good control of the SBRM for several years by using conventional planting-time granular insecticides in combination with postemergence insecticide applications. However, because insecticides belonging to the same mode of action have been used to control this insect for several decades, with many fields requiring two to three applications within a season for adequate control, the threat of insecticide resistance in regional populations has long been an area of concern. To address this threat, research has been underway for the past several years to identify effective insecticides from alternative chemical classes for sustainable management of this important insect pest.

Recent interest on insect control in sugarbeet has been focused on the use of insecticidal seed treatments. Three seed treatment insecticides have recently received Environmental Protection Agency registration for use in sugarbeet, and this technology has been widely adopted by sugarbeet producers in the Red River Valley growing area. However, the currently registered seed treatment materials have thus far tended to provide lower levels of control than conventional planting-time insecticides. Thus, additional screening of experimental insecticides, including newly developed seed treatments, is considered a worthy pursuit of research efforts. The overriding objective of this experiment was to conduct preliminary screening on several experimental insecticidal seed treatment materials to determine their potential for future use as tools to manage the sugarbeet root maggot.

Materials and Methods:

This experiment was established at a commercial field site near St. Thomas (Pembina County) and at a second site near Forest River (Walsh County), ND. Seed treatment insecticides for the experiment were applied to seed by Syngenta, Inc., and Hilleshög HM100001 (glyphosate-resistant) seed was used for all treatments. Plots were planted on 19 May, 2011 at Forest River and on 3 June at St. Thomas.

Plots were planted using a six-row John Deere 71 Flex planter set to plant at a depth of 1¼ inch and a rate of one seed every 4½ inches of row. 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 25-foot tilled alleys were maintained between replicates. 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 were completely disassembled, cleaned, and re-assembled after the application of each seed treatment entry.

Counter 20G was used as the planting-time granular insecticide standard in both experiments, and it was applied at its highest (8.9 lb product/ac) rate by using band (B) placement (Boetel et al. 2006). This involved delivering granules in 5-inch swaths over rows through Gandy^{TM} row banders positioned behind the seed drop zone and ahead of the planter's rear packer wheels. Granular output was regulated by using planter-mounted Noble^{TM} metering units that were calibrated on the planter prior to planting. The experimental liquid insecticides (Force CS and Endigo ZC) were applied directly over the open seed furrow as 5-inch T-bands using a tractor-mounted CO_2 spray unit. The unit was calibrated to deliver a finished spray volume of 5 GPA using TeeJet^{TM} 8001E nozzles.

<u>Root injury ratings</u>: Assessments of root maggot feeding injury were carried out between 2 and 3 August for experiments and locations. Rating procedures consisted of first randomly collecting ten beet roots per plot (five from each of the outer two treated rows), then hand-washing the roots 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. All plots for these experiments were harvested between 26 and 27 September. Immediately before each experiment was harvested, the foliage from all treatment plots was removed by using a commercial-grade mechanical defoliator. After defoliation, all beets from the center 2 rows of each plot were collected from the soil using a mechanical harvester and weighed in the field using a digital scale. A representative subsample of 12-16 beets was collected from each plot and analyzed for sucrose concentration, tare soil weight, and quality/impurities.

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:

Root maggot feeding injury data from the St. Thomas location are presented in Table 1. The average root injury rating of 7.3 (0 to 9 scale of Campbell et al. [2000]) for the untreated check plots in this test indicated that a relatively high root maggot infestation was present at St. Thomas. Both Counter-based entries resulted in the lowest average root maggot feeding injury at St. Thomas, but adding the coded seed treatment insecticide A9765 did not appear to augment control. Results indicated that the combinations of A9765+Force CS liquid insecticide and A9765+Endigo liquid spray provided significant reductions in root maggot feeding injury over the untreated check. These combinations were also superior to the singular entry of A9765 seed treatment, suggesting that Force and Endigo provided the majority of SBRM control in the combination treatments. Poncho Beta and the coded entries of A13219 and A17960 did not appear to provide appreciable levels of protection from SBRM feeding injury.

Table 1. *Larval feeding injury* in evaluation of experimental seed treatment for sugarbeet root maggot control, St. Thomas, ND, 2011

Treatment/form.	Placement[a]	Rate (product/ac)	Rate (lb a.i./ac)	Root injury (0-9)
Counter 20G	B	8.9 lb	1.8	4.75 e
A9765 + Counter 20G	Seed B	 8.9 lb	60 g a.i./ unit seed 1.8	5.53 de
A9765 + Force CS	Seed 5" TB	 13.5 fl oz	60 g a.i./ unit seed 0.22	6.03 cd
A9765 + Endigo ZC	Seed 5" TB	 9.7 fl oz	60 g a.i./ unit seed 0.16	6.23 bcd
A9765 + A17960	Seed		60 g a.i./ unit seed 0.2 mg/ seed	6.48 a-d
A9765 + A13219	Seed		60 g a.i./ unit seed 8 g a.i./ unit	6.58 abc
Poncho Beta	Seed		68 g a.i./ unit seed	6.90 abc
A9765	Seed		60 g a.i./ unit seed	6.95 abc
Check	---	----	---	7.05 ab
A9765 + A17960	Seed		60 g a.i./ unit seed 0.1 mg/ seed	7.30 a
LSD (0.05)				0.99

Means within a column sharing a letter are not significantly (P = 0.05) different from each other (Fisher's Protected LSD).
[a]B = Band; Seed = insecticidal seed treatment; TB = T-band over open seed furrow

Yield assessments for Study I at St. Thomas (Table 2) corresponded with root injury data, and again showed that entries including Counter 20G performed well at managing the sugarbeet root maggot. The top-yielding entry in this experiment was A9765+Counter 20G (8.9 lb product/ac), and it resulted in a revenue increase of $313/ac when compared to the gross revenue recorded for the untreated check. Also reflective of the root rating data was that the seed treatment/at-plant liquid insecticide (i.e., Force CS and Endigo ZC) combinations resulted in significant increases in recoverable sucrose and root tonnage yields over that observed in the untreated check. Revenue increases over that of the untreated check from these combinations were $202/ac for A9765+Force 2.08CS and $92/ac for A9765+Endigo ZC. These combinations were not significantly outperformed by the Counter-based entries in this experiment at St. Thomas. The coded insecticide, A9765, also provided significant increases in recoverable sucrose and root tonnage; however, as observed with root maggot feeding injury ratings, Poncho Beta, A31219, and A17960 did not appear to positively impact yield parameters in this study.

Table 2. *Yield parameters* from evaluation of experimental seed treatment for sugarbeet root maggot control, St. Thomas, ND, 2011

Treatment/form.	Placement[a]	Rate (product/ac)	Rate (lb a.i./ac)	Sucrose yield (lb/ac)	Root yield (T/ac)	Sucrose (%)	Gross return ($/ac)
A9765 + Counter 20G	Seed B	8.9 lb	60 g a.i./ unit seed 1.8	7101 a	26.1 a	15.30 a	977
Counter 20G	B	8.9 lb	1.8	6564 ab	23.8 ab	15.55 a	920
A9765 + Force CS	Seed 5" TB	13.5 fl oz	60 g a.i./ unit seed 0.22	6446 ab	24.0 ab	15.18 a	866
A9765 + Endigo ZC	Seed 5" TB	9.4 fl oz	60 g a.i./ unit seed 0.16	5890 abc	22.6 bc	14.88 a	756
A9765	Seed		60 g a.i./ unit seed	5677 bcd	21.4 bcd	15.03 a	751
A9765 + A13219	Seed		60 g a.i./ unit seed 8 g a.i./ unit	5548 b-e	21.0 bcd	15.05 a	730
A9765 + A17960	Seed		60 g a.i./ unit seed 0.2 mg/ seed	5394 b-e	19.5 cde	15.50 a	759
A9765 + A17960	Seed		60 g a.i./ unit seed 0.1 mg/ seed	4940 cde	18.4 def	15.05 a	664
Poncho Beta	Seed		68 g a.i./ unit seed	4447 de	16.4 ef	15.15 a	610
Check	---	----	---	4435 e	15.3 f	16.18 a	664
LSD (0.05)				1235	3.3	NS	

Means within a column sharing a letter are not significantly (P = 0.05) different from each other (Fisher's Protected LSD).
[a]B = band; Seed = insecticidal seed treatment; TB = T-band over open seed furrow

A low infestation of sugarbeet root maggot larvae developed at the Forest River location for this experiment, as was evidenced by the average root feeding injury rating of 3.6 (0 to 9 scale of Campbell et al. [2000]) recorded for the untreated check plots (Table 3). Despite the lower SBRM infestation, the results from Forest River corresponded closely with those observed at St. Thomas. For example, the lowest average root maggot feeding injury was observed in plots protected with the combination treatment of A9765 insecticidal seed treatment plus an at-plant application of Counter 20G at its high (8.9 lb product/ac) rate, and similar levels of protection were observed with A9765+Endigo ZC and the stand-alone entry of Counter 20G applied at planting time. The only entries in this test at Forest River that failed to result in significant reductions in root maggot feeding injury when compared to the untreated check were the A9765 and Poncho Beta seed treatments.

Table 3. *Larval feeding injury* in evaluation of experimental seed treatment for sugarbeet root maggot control, Forest River, ND, 2011

Treatment/form.	Placement[a]	Rate (product/ac)	Rate (lb a.i./ac)	Root injury (0-9)
A9765 + Counter 20G	Seed B	8.9 lb	60 g a.i./ unit seed 1.8	2.15 c
A9765 + Endigo ZC	Seed 5" TB	9.41 fl oz	60 g a.i./ unit seed 0.16	2.18 c
Counter 20G	B	8.9 lb	1.8	2.18 c
A9765 + Force CS	Seed 5" TB	13.5 fl oz	60 g a.i./ unit seed 0.22	2.50 bc
A9765 + A17960	Seed		60 g a.i./ unit seed 0.1 mg/ seed	2.68 bc
A9765 + A13219	Seed		60 g a.i./ unit seed 8 g a.i./ unit	2.73 bc
A9765 + A17960	Seed		60 g a.i./ unit seed 0.2 mg/ seed	2.78 bc
A9765	Seed		60 g a.i./ unit seed	2.80 abc
Poncho Beta	Seed		68 g a.i./ unit seed	3.28 ab
Check	---	----	---	3.60 a
LSD (0.05)				0.82

Means within a column sharing a letter are not significantly (P = 0.05) different from each other (Fisher's Protected LSD).
[a]B = Band; Seed = insecticidal seed treatment; TB = T-band over open seed furrow

Yield results for the Forest River location of this experiment are presented in Table 4. Overall, yields at Forest River were much higher than those observed at St. Thomas. This was largely a result of the Forest River site being planted over two weeks earlier than St. Thomas. Unfortunately, due to excessive rainfall and some drainage problems at this location, plant vigor was highly variable across the plot area. The resulting high variability in yields between replicates prevented the detection of statistically significant differences for recoverable sucrose and root yield between treatments. These results should also be interpreted with discretion because of the low SBRM infestation that was present for the experiment.

Although there were no statistically significant differences between treatments for recoverable sucrose or root yield parameters at Forest River, some interesting performance patterns were evident. For example, most of the entries that involved the coded seed treatment insecticide (A9765) provided large, albeit nonsignificant, increases (1,196 to 2,772 lb/ac) in recoverable sucrose and root yield (3.4 to 4.8 tons/ac) when compared to the untreated check. Interestingly, the following seed treatment entries resulted in significantly higher percent sucrose concentrations than the untreated check: A9765+A17960 (0.1 and 0.2 mg/unit of seed), A9765 +A13219, and A9765 alone. This suggests that further testing should be carried out to determine the repeatability of the results.

Gross revenue from plots established with seed treatments involving A9765 were also excellent, with returns ranging from $218 to $680/ac over that from the untreated check. Yield benefits from Counter, Poncho Beta, Force CS, and Endigo ZC were as not apparent at this location as observed at St. Thomas; however, combining A9765 seed treatment with the planting-time application of Counter 20G resulted in a $60/ac increase in revenue over that in the Counter-only entry.

As mentioned above, results from the Forest River site of this study were the product of a light SBRM infestation, coupled with high variability in growing conditions among replicates. Further testing should be carried out on these materials under more normal growing conditions to determine their potential for managing the sugarbeet root maggot and other insect pests of economic significance in the Red River Valley.

Table 4. ***Yield parameters*** **from evaluation of experimental seed treatment for sugarbeet root maggot control, Forest River ND, 2011**

Treatment/form.	Placement[a]	Rate (product/ac)	Rate (lb a.i./ac)	Sucrose yield (lb/ac)	Root yield (T/ac)	Sucrose (%)	Gross return ($/ac)
A9765 + A17960	Seed		60 g a.i./ unit seed 0.1 mg/ seed	8411 a	28.3 a	16.48 abc	1300
A9765 + A13219	Seed		60 g a.i./ unit seed 8 g a.i./ unit	8364 a	27.4 a	16.73 a	1337
A9765 + A17960	Seed		60 g a.i./ unit seed 0.2 mg/ seed	7967 a	26.5 a	16.60 ab	1246
A9765	Seed		60 g a.i./ unit seed	7900 a	26.7 a	16.35 abc	1214
A9765 + Force CS	Seed 5” TB	13.5 fl oz	60 g a.i./ unit seed 0.22	7844 a	29.5 a	15.45 bcd	1042
A9765 + Counter 20G	Seed B	8.9 lb	60 g a.i./ unit seed 1.8	7437 a	29.5 a	14.93 d	899
A9765 + Endigo ZC	Seed 5” TB	9.4 fl oz	60 g a.i./ unit seed 0.16	6835 a	26.9 a	14.85 d	838
Counter 20G	B	8.9 lb	1.8	6834 a	26.9 a	14.85 d	839
Poncho Beta	Seed		68 g a.i./ unit seed	6615 a	24.5 a	15.40 cd	899
Check	---	----	---	5639 a	23.5 a	14.48 d	620
LSD (0.05)				NS	NS	1.16	

Means within a column sharing a letter are not significantly ($P = 0.05$) different from each other (Fisher’s Protected LSD).
[a]B = band; Seed = insecticidal seed treatment; TB = T-band over open seed furrow

References Cited:

Campbell, L. G., J. D. Eide, L. J. Smith, and G. A. Smith. 2000. Control of the sugarbeet root maggot with the fungus *Metarhizium anisopliae*. J. Sugar Beet Res. 37: 57–69.

SAS Institute. 2008. The SAS System for Windows. Version 9.2. SAS Institute Inc., 2002-2008. Cary, NC.

Entomology Appendix A. Agronomic and Rainfall Information for Research Sites

Location:	**St. Thomas (Pembina County), ND – Pete Carson Farm**
Sugarbeet Varieties:	SES VanderHave 36812RR, Hilleshög HM100001RR
Plot Size:	Six 35-ft long rows, 4 center rows treated
Design:	Randomized complete block, 4 replications
Soil Name:	Glyndon Silt Loam
Soil Test:	Organic Matter = 3.1%; pH = 7.9
Soil Texture:	40.0% sand 22.5% silt 37.5% clay
Previous Crop:	Potatoes - 2011
Soil Preparation:	Field cultivator
Herbicide:	Roundup PowerMAX (28 fl oz/ac), June 17 & July 12, 2011 Roundup PowerMAX (28 fl oz/ac) & Headline (9 fl oz/ac), August 05, 2011
Planting Depth:	1.25"

Rainfall:		
	May 21, 2011	1.50"
	May 22, 2011	0.16"
	May 27, 2011	0.44"
	May 28, 2011	0.05"
	May 30, 2011	0.72"
	May 31, 2011	0.10"
	Total/May	**2.97"**
	June 02, 2011	0.03"
	June 03, 2011	0.05"
	June 05, 2011	0.04"
	June 07, 2011	0.88"
	June 13, 2011	0.35"
	June 15, 2011	0.24"
	June 17, 2011	0.11"
	June 21, 2011	0.93"
	June 22, 2011	1.84"
	June 26, 2011	0.78"
	June 27, 2011	0.05"
	Total/June	**5.30"**
	July 08, 2011	0.13"
	July 09, 2011	0.60"
	July 16, 2011	0.39"
	July 17, 2011	0.22"
	July 20, 2011	0.88"
	July 23, 2011	0.73"
	July 26, 2011	0.21"
	Total/July	**3.16"**
	Total/August	**1.92"**
	Total/September	**3.05"**

Location:	**Forest River (Walsh County), ND – Rod Schanilec Farm**
Sugarbeet Varieties:	SES VanderHave 36812RR, Hilleshög HM100001RR
Plot Size:	Six rows 35-ft long, 4 center rows treated
Design:	Randomized complete block, 4 replications
Soil Name:	Glyndon Silt Loam
Soil Test:	Organic Matter = 4.0%; pH = 7.5
Soil Texture:	28.8% sand 37.5% silt 33.7% clay
Previous Crop:	Wheat - 2010
Soil Preparation:	Field cultivator
Herbicide:	Roundup PowerMAX (28 fl oz/ac), June 16, 2011 Roundup PowerMAX (28 fl oz/ac) & Headline (9 fl oz/ac), August 05, 2011
Planting Depth:	1.25"

Rainfall:

May 21, 2011	0.65"
May 27, 2011	0.30"
May 30, 2011	0.29"
Total/May	**1.24"**
June 03, 2011	0.14"
June 15, 2011	0.56"
June 21, 2011	0.90"
June 22, 2011	1.15"
June 25, 2011	0.68"
June 27, 2011	0.37"
Total/June	**3.80"**
July 08, 2011	0.50"
July 09, 2011	0.47"
July 15, 2011	0.35"
July 16, 2011	0.47"
July 20, 2011	0.95"
July 23, 2011	0.78"
July 26, 2011	0.32"
Total/July	**3.84"**
Total/August	**2.34"**
Total/September	**2.47"**

Entomology Appendix B. 0 to 9 Scale for Rating Sugarbeet Root Maggot Feeding Injury

Treatment performance in preventing sugarbeet root maggot feeding injury was quantified for all root maggot control trials by rating beets on the 0 to 9 root injury rating scale of Campbell et al. (2000). Criteria for respective points on the scale are as follows:

0 = no scars

1 = 1 to 4 small (pin head size) scars

2 = 5 to 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 scarred

7 = 1/4 to 1/2 of root blackened by scars

8 = 1/2 to 3/4 root blackened by scars

9 = more than 3/4 of root area blackened

Reference Cited:

Campbell, L. G., J. D. Eide, L. J. Smith, and G. A. Smith. 2000. Control of the sugarbeet root maggot with the fungus *Metarhizium anisopliae*. J. Sugar Beet Res. 37: 57–69.