SUGARBEET ROOT MAGGOT CONTROL USING SEED TREATMENTS, PLANTING-TIME GRANULES, AND POSTEMERGENCE GRANULAR INSECTICIDES

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Introduction:

The key insect pest of sugarbeet in the Red River Valley (RRV) is the sugarbeet root maggot (SBRM), *Tetanops myopaeformis* (Röder). For several decades, growers in the RRV have mainly relied on planting-time applications of granular insecticides for SBRM control, and those in the heavier infested areas have also regularly used additive applications of postemergence liquid sprays or banded insecticide granules on an as-needed basis to augment protection of their sugarbeet crop. In recent years, Poncho Beta (clothianidin+betacyfluthrin), NipsIt Inside (clothianidin), and Cruiser 5FS (thiamethoxam) insecticidal seed treatments have received federal registration for use in sugarbeet, and seed treatment technology has met with wide adoption by many growers. Conventional granular insecticides continue to provide good control of the SBRM and several other soil-dwelling insect pests of sugarbeet. However, seed treatment technology is an attractive insecticide option for insect management in sugarbeet because of the following benefits: 1) no on-farm calibration is needed to achieve the targeted application rate; 2) no tank mixing is required by grower (reduced likelihood of pesticide exposure); 3) no specialized application equipment is needed on planter; 4) it allows for significant reductions in insecticide active ingredient applied per acre; and 5) the applied material is unlikely to be blown off-target by wind.

This investigation was carried out during the 2010 growing season to accomplish the following objectives: 1) evaluate Counter 20G, Poncho Beta seed treatment, and WC077 experimental granular insecticide as planting-time materials for SBRM control; and 2) assess the potential additive SBRM control from postemergence applications of Thimet 20G when applied to plots initially treated with either Counter 20G or Poncho Beta.

Materials and Methods:

This experiment was established on a field site near St. Thomas in rural Pembina County, ND. Seed treatment insecticides were applied to seed by a custom seed-coating company (Germains Seed Technology, Fargo, ND). The same seed variety (Betaseed 87RR38; glyphosate-resistant) was used for all treatments in the experiment. Plots were planted on 14 May, 2010 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 the experiment, and it was applied by using band (B) placement (Boetel et al. 2006).

Postemergence insecticides used in this study consisted of two granular materials (i.e., Counter 20G and Thimet 20G. Applications of postemergence granules (Post B) were made on 3 June. Band placement of postemergence granules was achieved by using Kinze row banders, which were 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. Postemergence insecticide 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 the bander and a second pair 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.

Root injury ratings: Sugarbeet root maggot feeding injury was assessed in this experiment on 28 July by randomly collecting ten beet roots per plot (five from each of the outer two treated rows), hand-washing them, and scoring them in accordance with the 0 to 9 root injury rating scale (0 = no scarring, and 9 = over ¾ of the root surface blackened by scarring or dead beet) of Campbell et al. (2000).

Harvest: Treatment performance was also compared on the basis of sugarbeet yield parameters. Plots were harvested on 6 October. 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 sent to the American Crystal Sugar Company Quality 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:

Frequent and heavy rainfall events began shortly after planting, resulting in post-planting soil crusting and standing water for long periods of time in several experiments. These factors led to variable plant stands, non-uniform root maggot infestations, and highly variable yield results. Rainfall and wind events also prevented timely application of postemergence insecticides in these trials. Therefore, the results of these trials should be interpreted with discretion. Although the timing of postemergence insecticide applications in these trials was not typical, the results from such delayed applications may shed some light on whether growers can benefit from them.

Root maggot feeding injury rating data for Trial 1 are presented in Table 1. Root rating results from this experiment were somewhat inconclusive because there were no statistical differences in SBRM feeding injury among the treatments. However, trends indicated that dual (planting-time + postemergence) insecticide programs tended to provide slightly better root protection than single, at-plant treatments. The dual control program consisting of Counter 20G at its moderate (7.5 lb product/ac) rate, combined with a postemergence application of Thimet 20G at its high (7 lb product/ac) labeled rate, provided the best root protection in this trial. Dual application treatments that included Poncho Beta seed treatment and a postemergence granular insecticide (i.e., either Counter 20G or Thimet 20G) also provided good protection from SBRM feeding injury.

Table 1. *Larval feeding injury* in evaluation of planting-time insecticide granules, seed treatments, and postemergence granules for sugarbeet root maggot control, St. Thomas, ND, 2010

Treatment/form.	Placement[a]	Rate (product/ac)	Rate (lb a.i./ac)	Root injury (0-9)
Counter 20G + Thimet 20G	B 1 d pre-peak Post B	7.5 lb 7 lb	1.5 1.4	4.38 a
Poncho Beta + Counter 20G	Seed B	 5.25 lb	68 g a.i./ unit seed 1.05	4.58 a
Counter 15G	B	10 lb	1.5	4.63 a
Poncho Beta + Thimet 20G	Seed 1 d pre-peak Post B	 7 lb	68 g a.i./ unit seed 1.4	4.78 a
Poncho Beta + Counter 20G	Seed 1 d pre-peak Post B	 5.25 lb	68 g a.i./ unit seed 1.05	4.80 a
Counter 20G	B	7.5 lb	1.5	5.23 a
Counter 15G	B	11.9 lb	1.8	5.38 a
Poncho Beta	Seed		68 g a.i./ unit seed	5.45 a
Counter 20G	B	8.9 lb	1.8	5.50 a
WC077	B	10 lb		5.63 a
Counter 20G	B	5.25 lb	1.05	5.85 a
Check	---	----	---	6.15 a
LSD (0.05)				NS

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

Yield data from Trial 1, shown in Table 2, reflected the treatment performance patterns observed in data from root maggot feeding injury ratings. Specifically, the best-performing entries were usually those that involved combining a moderate level of at-plant insecticide protection, either as Poncho Beta seed treatment or Counter 20G, with a postemergence application of Thimet 20G. The top-performing treatment in relation to recoverable sucrose yield was Poncho Beta seed treatment, combined with Counter 20G that was applied postemergence at 1 day before peak SBRM fly activity. This entry yielded significantly more recoverable sucrose and root tonnage than a similar entry that combined Poncho Beta with an at-plant application of Counter 20G at the same rate (5.25 lb product/ac). Excellent yields and gross economic returns were also recorded for the following dual treatments: 1) Poncho Beta + postemergence Thimet 20G, applied postemergence at 7 lb product/ac 1 day before peak SBRM fly activity; and 2) Counter 20G at planting (7.5 lb product/ac) + Thimet 20G postemergence at 7 lb product/ac.

Table 2. *Yield parameters* from evaluation of planting-time insecticide granules, seed treatments, and postemergence granules for sugarbeet root maggot control, St. Thomas, ND, 2010

Treatment/ form.	Placement[a]	Rate (product/ac)	Rate (lb a.i./ac)	Sucrose yield (lb/ac)	Root yield (T/ac)	Sucrose (%)	Gross return ($/ac)
Poncho Beta + Counter 20G	Seed 1 d pre-peak Post B	 5.25 lb	68 g a.i./ unit seed 1.05	8612 a	29.8 a	16.23 a	1218
Poncho Beta + Thimet 20G	Seed 1 d pre-peak Post B	 7 lb	68 g a.i./ unit seed 1.4	8578 a	28.9 ab	16.67 a	1252
Counter 15G	B	11.9 lb	1.8	8550 a	28.6 abc	16.70 a	1258
Counter 20G + Thimet 20G	B 1 d pre-peak Post B	7.5 lb 7 lb	1.5 1.4	8061 ab	27.8 abc	16.43 a	1144
Counter 20G	B	8.9 lb	1.8	7856 ab	27.0 abc	16.43 a	1116
Counter 15G	B	10 lb	1.5	7788 abc	26.9 abc	16.30 a	1103
Poncho Beta + Counter 20G	Seed B	 5.25 lb	68 g a.i./ unit seed 1.05	7243 bcd	24.6 bcd	16.53 a	1045
WC077	B	10 lb		7117 bcd	24.1 cd	16.43 a	1032
Poncho Beta	Seed		68 g a.i./ unit seed	6934 bcd	24.5 bcd	15.97 a	953
Counter 20G	B	5.25 lb	1.05	6918 bcd	24.4 bcd	15.97 a	953
Counter 20G	B	7.5 lb	1.5	6609 cd	21.5 d	17.03 a	1001
Check	---	----	---	6338 d	22.3 d	16.23 a	878
LSD (0.05)				1227	4.6	NS	

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

Other entries that performed well in this trial were the single, at-plant applications of Counter 15G and Counter 20G at their respective high labeled rates of 11.9 and 8.9 lb product/ac. Neither of these planting-time-only entries of Counter, when applied at the highest labeled rates, were statistically outperformed by any of the dual (planting-time + postemergence insecticide) entries. Also, applying Counter 15G at 11.9 lb/ac resulted in the highest gross economic return in this trial.

Treatments in this trial that did not provide statistically significant yield improvements when compared with the untreated check included the following: 1) Poncho Beta + Counter 20G (at-plant band; 5.25 lb product/ac); 2) the experimental entry of WC077 at 10 lb product/ac; 3) Poncho Beta; 4) Counter 20G, 5.25 lb/ac at planting; and 5) Counter 20G, 7.5 lb/ac at planting. However, it should be noted that even these lower-performing entries provided gross revenue benefits of $75/ac or greater, which easily justifies the use of insecticide protection under the moderately high root maggot pressure that developed in this experiment.

One surprising and encouraging conclusion that can be drawn from this trial is that, despite the late timing (i.e., only 1 day before peak fly activity) of postemergence granule applications, major yield and economic returns were achieved by making these additive control efforts. For example, adding a postemergence application of Counter 20G at its low (5.25 lb product/ac) rate increased recoverable sucrose yield by 1,678 lb/ac and root yield by 5.3 tons/ac when compared with the single entry of Poncho Beta. Similarly, applying a postemergence treatment of Thimet 20G at 7 lb/ac resulted in 1,644 lb/ac more recoverable sucrose and a root yield increase of 4.4 tons/ac when compared with the single, stand-alone entry of Poncho Beta.

Although such late timing of postemergence granule applications is not recommended, weather-related factors may, on occasion present growers with the decision of whether to make postemergence granule applications at or very near peak SBRM fly activity. These findings support previous findings and suggest that, although earlier timing (i.e., 6 to 14 days before peak fly) is recommended for excellent SBRM control, it appears that additive control using granular insecticide products such as Thimet 20G will be beneficial, even if the application is made at or near peak SBRM fly activity. It also should be noted that Counter 20G, although labeled for either planting-time or postemergence control, its label includes a 110-day preharvest interval (PHI), meaning that sugarbeets treated with this material cannot be harvested until 110 days after the application. For example, if a field were treated on June 1st with a postemergence application of Counter 20G, September 19th would be the earliest it could be harvested. It also should be noted that Counter 20G can only be applied once per year. Thus, if this product were applied at planting, it could not be applied to the same field at postemergence.

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