INSECTICIDE, FUNGICIDE, AND STARTER FERTILIZER COMBINATIONS IN SUGARBEET: AN EVALUATION OF ROOT MAGGOT CONTROL EFFICACY AND PLANT SAFETY

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Introduction:

The integration of pesticide and fertilizer applications into a single implement pass through the field, either during planting operations or after emergence of the crop, can be a valuable, input cost saving strategy for producers. However, the impacts of such combinations on plant health or pest control efficacy should be thoroughly investigated before they are recommended for implementation on the farm.

Insect pests, including wireworms, springtails, white grubs, and the sugarbeet root maggot (SBRM), *Tetanops myopaeformis* (Röder) are annual threats to sugarbeet production in the Red River Valley (RRV) growing area. Producers typically manage these root-feeding pests by applying a prophylactic insecticide during sugarbeet planting. This at-plant protection usually involves a granular or sprayable liquid insecticide, insecticide-treated seed, or a combination of these tools. In situations where high SBRM fly activity and associated larval feeding pressure are expected, most producers also supplement the initial at-plant insecticide(s) with a postemergence granular or sprayable liquid insecticide application.

Fungicides are also often applied to manage soil-borne root diseases of sugarbeet such as Rhizoctonia damping off, as well as Rhizoctonia crown and root rot, which are all caused by the pathogen *Rhizoctonia solani* Kühn. Similar to the insecticides used to manage root-feeding insect pests, fungicides targeting Rhizoctonia management in sugarbeet also can be delivered as planting-time and/or early-season postemergence applications. Starter fertilizer, applied at planting time, is also commonly used by RRV sugarbeet producers. However, little is known about the crop safety of combining these applications or if they either complement or impair pesticide performance. If demonstrated as safe for the crop and at least neutral in impact on pest control performance, consolidating the delivery of these products into tank-mixed combinations or concurrent (i.e., single-pass) applications would provide major time savings and reduce application-associated input costs for sugarbeet growers.

This experiment was carried out to evaluate the impact of multicomponent application systems on sugarbeet root maggot control. A secondary objective was to monitor for any potential symptoms of phytotoxic effects of the treatment combinations, including impacts on plant emergence and survival. Several treatment combinations, based on the following application groupings, were evaluated:

1) Counter 20G insecticide, banded at planting with a concurrently applied (i.e., at same time through a separate delivery system) dribble-in-furrow application of 10-34-0 starter fertilizer, with and without AZteroid (i.e., azoxystrobin) fungicide;
2) Mustang Maxx insecticide applied as a postemergence band in a tank mixture with Quadris (i.e., azoxystrobin) fungicide; and
3) Thimet 20G insecticide applied as a postemergence band with a concurrent, banded application of Quadris fungicide.

Materials and Methods:

This experiment was conducted during the 2022 growing season in a commercial sugarbeet field site near St. Thomas in rural Pembina County, ND. Plots were planted on May 27, 2022. Betaseed 8961 glyphosate-tolerant seed was used for all treatments. A 6-row Monosem NG Plus 4 7x7 planter set to deliver seed at a depth of 1¼ inch and a rate of one seed every 4½ inches of row length was used to plant the trial. Plots were six rows (22-inch spacing) wide by 35 ft long with the four centermost rows treated. The outer "guard" row on each side of the plot served as an untreated buffer. Thirty-five-foot tilled, plant-free alleys were maintained between replicates throughout the growing season. The experiment was arranged in a randomized complete block design with four replications. AZteroid fungicide was used for all treatments that included an at-plant fungicide, and Quadris was used in all treatments that included a postemergence fungicide. These two products were chosen for the experiment because they are the most commonly used azoxystrobin-based fungicides used by RRV producers for at-plant and postemergence root diseases, respectively, in the Red River Valley growing area.

Planting-time insecticide applications. Planting-time applications of Counter 20G were applied by using band (B) placement (Boetel et al. 2006), which consisted of 5-inch swaths of granules delivered through Gandy™ row banders. Granular application rates were regulated by using planter-mounted SmartBox™ electronic insecticide delivery system that had been calibrated on the planter before all applications.

Planting-time liquid spray applications were delivered by using dribble in-furrow (DIF) placement. Dribble in-furrow treatments were applied in a 3:2 gallon ratio of three gallons 10-34-0 starter fertilizer to two gallons water spray solution, and the applications were made by orienting a microtube (1/4" outside diam.) directly into the open seed furrow. An electric ball valve system, equipped with inline Teejet™ No. 24 orifice plates was used to propel spray output from the microtubes at a finished volume of five gallons per acre (GPA).

Postemergence insecticide applications. Additive postemergence insecticides applied in this trial included Mustang Maxx (active ingredient: zeta-cypermethrin) and Thimet 20G (active ingredient: phorate). Treatment combinations that included postemergence applications of Thimet and/or Quadris fungicide were applied on June 13, which was about two days before peak SBRM fly activity (i.e., "pre-peak"). That timing is not recommended for applications of Thimet (recommended for 5-14 days pre-peak); however, the wet early-spring soil conditions that delayed planting operations in this experiment also led to unusually late plant emergence, thus delaying the postemergence fungicide/insecticide applications. Postemergence applications of Mustang Maxx insecticide and/or Quadris fungicide were made on June 17, which was about two days after peak SBRM fly activity (i.e., post-peak). Those applications were also carried out later than preferred, and for the same reasons. As such, and the timing of Mustang applications was also considered suboptimal for achieving good SBRM control.

Postemergence liquid treatments were delivered with a tractor-mounted CO_2-propelled spray system equipped with TeeJet™ XR 110015VS nozzles. The system was calibrated to deliver a finished output volume of 10 GPA. Postemergence granular insecticide output rates were regulated by using a SmartBox™ system mounted on a tractor-drawn four-row toolbar, and placement of insecticide in 4-inch bands was achieved by using Kinze™ row banders. Granules were incorporated into the soil by using two pairs of metal rotary tines that straddled each row. One pair of tines was positioned ahead of each bander, and a second pair was mounted behind it.

Plant Stand Counts: To determine treatment impacts on seedling emergence and survival throughout the growing season, surviving plant stands were counted on 8, 15, 24 June, and on 1 July, 2022 (i.e., 20, 27, 34, and 46 days after planting [DAP], respectively). Plant stand assessments involved counting all living plants within each 35-ft-long row. Raw stand counts were then converted to plants per 100 linear row feet for the analysis.

Root injury ratings: Sugarbeet root maggot feeding injury was assessed in this experiment on August 3, 2022. Sampling 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. All plots were harvested on October 5, 2022. Foliage was removed from plots immediately before harvest by using a commercial-grade mechanical defoliator. All beets from the center two rows of each plot were extracted from soil using a mechanical harvester and weighed in the field using a digital scale. A representative subsample of 12-18 beets was collected from each plot and sent to the American Crystal Sugar Company Tare Laboratory (East Grand Forks, MN) for sucrose content and quality analysis.

Data analysis: All data from plant stand counts, root injury ratings, and harvest samples were subjected to analysis of variance (ANOVA) using the general linear models (GLM) procedure (SAS Institute, 2012), and treatment means were separated using Fisher's protected least significant difference (LSD) test at a 0.05 level of significance.

Results and Discussion:

The results from a series of four counts of surviving plant stands are shown in Table 1. These data, as well as those involving SBRM larval feeding injury ratings and harvest results, should be interpreted with the aforementioned fact that unfavorable soil conditions prevented timely planting operations, which subsequently led to delayed applications of postemergence insecticides and fungicides. The most likely negative impact of those factors on these results was probably reduced efficacy of postemergence insecticides, because they could not be applied at an optimal interval ahead of peak SBRM fly activity to maximize control.

At the first stand count, which was carried out at 20 days after planting (20 DAP), most treatments, including the untreated check, had favorable plant stands that hovered around 200 plants per 100 linear row feet. However, significantly lower stands were recorded in entries comprised of concurrent applications of Counter 20G insecticide with the tank mixture of 10-34-0 starter fertilizer and AZteroid fungicide when compared to similar plots that did not receive the fertilizer/fungicide combination, irrespective of whether the Counter was applied at 7.5 or 8.9 lb product per acre.

Table 1. *Plant stand counts* from an evaluation of concurrently applied and tank-mixed combinations of azoxystrobin fungicide with sugarbeet root maggot-targeted insecticides, St. Thomas, ND, 2022

Treatment/form.[a]	Placement[b]	Rate (product/ ac)	Rate (lb a.i./ac)	Stand count[c] (plants / 100 ft)			
				20 DAP[c]	27 DAP[c]	34 DAP[c]	46 DAP[c]
Counter 20G	B	8.9 lb	1.8	215.7 a	226.0 a	226.7 a	213.6 a
Counter 20G + Mustang Maxx	B 10" Post B, 2 d Post-peak	8.9 lb 4 fl oz	1.8 0.025	206.9 ab	225.0 a	222.8 abc	211.9 a
Counter 20G	B	7.5 lb	1.5	214.3 a	226.0 a	225.5 ab	204.1 ab
Counter 20G + Thimet 20G	B 4" Post B, 2 d Pre-peak	8.9 lb 7 lb	1.8 1.4	195.5 bc	211.4 bcd	214.3 abc	203.8 ab
Counter 20G + Mustang Maxx + Quadris	B 10" Post B, 2 d Post-peak	8.9 lb 4 fl oz 10 fl oz	1.8 0.025 0.17	194.5 bc	210.7 bcd	209.5 bc	202.6 ab
Counter 20G + 10-34-0	B DIF	8.9 lb 5 GPA	1.8	203.1 ab	211.7 bc	208.3 c	201.9 ab
Counter 20G + Thimet 20G + Quadris	B 4" Post B, 2 d Pre-peak 10" Post B	8.9 lb 7 lb 10 fl oz	1.8 1.4 0.17	186.4 cd	202.9 cde	210.0 abc	200.2 ab
Counter 20G + 10-34-0	B DIF	7.5 lb 5 GPA	1.5	204.3 ab	217.9 ab	213.6 abc	194.1 ab
Counter 20G + AZteroid FC+ 10-34-0	B DIF	7.5 lb 5.7 fl oz 5 GPA	1.5 0.0625	176.9 d	193.1 ef	190.2 d	182.4 b
Counter 20G + AZteroid FC+ 10-34-0	B DIF	8.9 lb 5.7 fl oz 5 GPA	1.8 0.0625	182.1 cd	191.0 f	191.4 d	178.6 b
Check	-----	----	-----	203.8 ab	210.0 bcd	186.7 d	131.9 c
Fertilizer check	DIF	5 GPA		191.4 bcd	200.0 def	181.2 d	124.3 c
LSD (0.05)				15.92	11.64	16.72	27.57

Means within a column sharing a letter are not significantly (P = 0.05) different from each other (Fisher's Protected LSD test).

[a]At-plant sprays were delivered in a 10-34-0 starter fertilizer/water carrier (3:2 gal. H_2O to fertilizer) at an output volume of 5 GPA.

[b]B = 5-inch at-plant band; Post B = postemergence band (i.e., 4-inch width for granular products; 10-inch width for sprayable liquid formulations); DIF = dribble in-furrow

[c]Surviving plant stands were counted on 8, 15, 24 June, and on 1 July, 2022 (i.e., 20, 27, 34, and 46 days after planting [DAP], respectively).

In stand counts conducted at 27 DAP, plots treated at planting with Counter 20G at its high rate (8.9 lb product/ac) had significantly lower plant stands when a concurrent planting-time application of 10-34-0 starter fertilizer was included. A similar pattern was observed when the moderate (7.5 lb) rate of Counter was applied at planting with a concurrent application of 10-34-0, but the difference in plant stands between plots that received starter fertilizer and those that were not fertilized was not statistically significant.

As observed during the initial stand counts, there was a significant stand reduction at 27 DAP in plots treated with concurrent applications of Counter 20G insecticide and the tank mixture of 10-34-0 starter fertilizer and AZteroid fungicide in comparison to similar plots that did not receive the fertilizer/fungicide combination. That disparity in surviving plant stands was the case irrespective of whether Counter was applied at 7.5 or 8.9 lb product per acre. Additionally, in plots treated with the high (8.9 lb) rate of Counter 20G at planting, the addition of a concurrent application of 10-34-0 starter fertilizer resulted in a significant stand reduction when compared to similar that in plots that received the high rate of Counter without fertilizer.

At 34 DAP, which was slightly more than one week after peak SBRM fly activity and, presumably approaching peak SBRM larval feeding activity, the highest average plant stand counts were recorded in plots treated solely with a planting time application of Counter 20G at 8.9 lb product per acre. However, other entries in the study that also had high stand counts, which were not significantly different from that treatment, included the following (listed in descending order of mean surviving plant stand at 34 DAP):

1) Counter 20G (7.5 lb/ac, banded at planting);
2) Counter 20G (8.9 lb/ac, banded at planting) + Mustang Maxx (4 fl oz/ac, 2d after peak fly);
3) Counter 20G (8.9 lb/ac, banded at planting) + Thimet 20G (7 lb product/ac, banded, 2d pre-peak);
4) Counter 20G (7.5 lb/ac, banded at planting) + 10-34-0 (at-plant, DIF); and
5) Counter 20G (8.9 lb/ac, banded at planting) + Thimet 20G (7 lb product/ac, banded, 2d pre-peak) + Quadris (banded, 10 fl oz/ac, 2 d pre-peak).

Combining a planting-time application of Counter 20G at its moderate (7.5 lb product/ac) rate with DIF-applied 10-34-0 starter fertilizer did not appear to impact plant survival at 34 DAP. However, in plots treated with Counter 20G at planting time using its high (8.9 lb product/ac) rate, the inclusion of the starter fertilizer resulted in a significant reduction in surviving plant stands. Plant stands were also significantly reduced in treatment combinations that included Counter 20G and a tank mixture of starter fertilizer and AZteroid fungicide, irrespective of whether the Counter was applied at 7.5 or 8.9 lb product per acre. Similarly, in comparing Counter 20G/fertilizer combinations versus Counter20G/fertilizer/Azteroid combinations, the latter programs had significantly lower surviving stands than when the fungicide was excluded, and the rate of Counter 20G used was not a factor in plant survival with those comparisons.

In stand counts conducted on July 1 (46 DAP), the highest overall stand counts were recorded in plots that treated solely with a planting-time application of Counter 20G at its high (8.9 lb product/ac) rate. However excellent stands were also recorded for most other insecticide-treated plots. The following treatments in this trial had surviving plant stands that were not statistically different from the single, high rate of Counter 20G (listed in descending order of mean surviving plant stand):

1) Counter 20G (8.9 lb/ac, banded at planting) + Mustang Maxx (4 fl oz/ac, 2d after peak fly);
2) Counter 20G (7.5 lb/ac, banded at planting);
3) Counter 20G (8.9 lb/ac, banded at planting) + Thimet 20G (7 lb product/ac, banded, 2d post-peak);
4) Counter 20G (8.9 lb/ac, banded at planting) + Mustang Maxx (4 fl oz/ac, 2d post-peak fly) + Quadris (banded, 10 fl oz/ac, 2 d post-peak);
5) Counter 20G (8.9 lb/ac, banded at planting) + 10-34-0 (at-plant, DIF);
6) Counter 20G (8.9 lb/ac, banded at planting) + Thimet 20G (7 lb product/ac, banded, 2d post-peak) + Quadris (banded, 10 fl oz/ac, 2 d post-peak); and
7) Counter 20G (7.5 lb/ac, banded at planting) + 10-34-0 (at-plant, DIF).

The treatment combinations involving Counter 20G and a concurrent at-plant application of AZteroid, which was tank mixed with 10-34-0 starter fertilizer, were the only insecticide treatments in which stand counts at 46 DAP were significantly reduced when compared to that recorded in plots treated with the stand-alone planting-time application of Counter 20G (8.9 lb product/ac). This finding was consistent, regardless of whether the Counter 20G component was applied at the 7.5- or 8.9-lb rate, and the combinations that included the AZteroid/10-34-0 tank mixture appeared to exert a more pronounced negative effect on plant survival than when the fertilizer was excluded from the application. However, it bears noting that, at the 46 DAP stand count, all insecticide/fungicide and insecticide/fertilizer combinations resulted in significantly greater plant stands than the untreated check and the 10-34-0 fertilizer control.

Sugarbeet root maggot feeding injury results from this trial appear in Table 2. The average SBRM feeding injury sustained in the true untreated check and the fertilizer-only check plots (5.83 and 6.70, respectively, on the 0 to 9 scale of Campbell et al. [2000]) indicated the presence of a moderately high SBRM larval infestation for the experiment. All insecticide-treated entries in the trial provided significant reductions in SBRM feeding injury when compared to the untreated check and the fertilizer-only check. The lowest average SBRM feeding injury (i.e., the highest level of root protection) was observed in plots that received the combination of a planting-time application of Counter 20G at its high labeled rate (8.9 lb product/ac) plus a postemergence application of Thimet 20G, which was accompanied by a concurrent banded application of Quadris fungicide; however, that entry was not statistically superior in preventing SBRM feeding injury in comparison to any of the dual (i.e., planting-time plus postemergence) insecticide treatments in the experiment.

Protection of roots from SBRM feeding injury was not significantly impaired by including concurrent dribble-in-furrow applications of 10-34-0 starter fertilizer concurrently with banded applications of Counter 20G at planting time, irrespective of whether the insecticide was applied at 7.5 or 8.9 lb product per acre. There also were no significant reductions in SBRM control when Quadris was applied concurrently with Thimet 20G applications or when it was tank mixed with Mustang Maxx.

Table 2. *Larval feeding injury* from an evaluation of concurrently applied and tank-mixed combinations of azoxystrobin fungicide with sugarbeet root maggot-targeted insecticides, St. Thomas, ND, 2022

Treatment/form.[a]	Placement[b]	Rate (product/ac)	Rate (lb a.i./ac)	Root injury (0-9)
Counter 20G + Thimet 20G + Quadris	B 4” Post B, 2 d Pre-peak 10” Post B	8.9 lb 7 lb 10 fl oz	1.8 1.4 0.17	1.10 d
Counter 20G + Thimet 20G	B 4” Post B, 2 d Pre-peak	8.9 lb 7 lb	1.8 1.4	1.53 cd
Counter 20G + Mustang Maxx	B 10” Post B, 2 d Post-peak	8.9 lb 4 fl oz	1.8 0.025	2.50 bcd
Counter 20G + Mustang Maxx + Quadris	B 10” Post B, 2 d Post-peak	8.9 lb 4 fl oz 10 fl oz	1.8 0.025 0.17	2.50 bcd
Counter 20G	B	8.9 lb	1.8	2.60 bc
Counter 20G + 10-34-0	B DIF	8.9 lb 5 GPA	1.8	2.73 bc
Counter 20G	B	7.5 lb	1.5	3.10 b
Counter 20G + AZteroid FC+ 10-34-0	B DIF	7.5 lb 5.7 fl oz 5 GPA	1.5 0.0625	3.23 b
Counter 20G + AZteroid FC+ 10-34-0	B DIF	8.9 lb 5.7 fl oz 5 GPA	1.8 0.0625	3.70 b
Counter 20G + 10-34-0	B DIF	7.5 lb 5 GPA	1.5	3.90 b
Check	-----	----	-----	5.83 a
Fertilizer check	DIF	5 GPA		6.70 a
LSD (0.05)				1.409

Means within a column sharing a letter are not significantly (P = 0.05) different from each other (Fisher’s Protected LSD test).
[a]At-plant sprays were delivered in a 10-34-0 starter fertilizer/water carrier (3:2 gal. H_2O to fertilizer) at an output volume of 5 GPA.
[b]B = 5-inch at-plant band; Post B = postemergence band (i.e., 4-inch width for granular products; 10-inch width for sprayable liquid formulations); DIF = dribble in-furrow

Yield data from this experiment are presented in Table 3. All treatments in the experiment that included an insecticide provided significant increases in both recoverable sucrose yield and root yield when compared to the untreated check and the fertilizer check. Generally, the performance patterns observed in relation to recoverable sucrose yield and root tonnage indicated that postemergence applications of Thimet 20G performed slightly better than those involving a post-applied liquid spray application of Mustang Maxx. However, it is important to point out that, although all postemergence insecticide applications were made later than optimal, the timing of Mustang Maxx applications was likely more detrimental to its performance than were the Thimet applications. A timely 1.15-inch rainfall that occurred one day after the Thimet applications probably activated the insecticide from Thimet granules, which would have resulted in favorable conditions for control of SBRM larvae in the soil near the bases of sugarbeet plants. Conversely, Mustang Maxx applications, which are directed at killing adult SBRM flies, occurred two days after peak SBRM fly activity. As such, a substantial amount of egg laying likely occurred before the Mustang treatments could be applied.

Interestingly, although plant stand data suggested negative effects from concurrent applications of 10-34-0 starter fertilizer and Counter 20G, there were no statistically significant yield reductions, either negative or positive, from combining concurrent at-plant insecticide/fertilizer applications in this experiment. Similarly, despite the observations of significant plant stand reductions when tank-mixed combinations of AZteroid fungicide and 10-34-0 were applied at the same time as planting-time Counter 20G applications in this study, the differences did not translate to significantly negative yield impacts.

Although significant differences among treatments that included an insecticide were somewhat lacking, some patterns in the yield results of this experiment provide cause for concern. For example, applying a postemergence application of Quadris fungicide during the application of Thimet 20G resulted in numerical reductions in recoverable sucrose yield and root tonnage, which translated to a $50/ac reduction in gross revenue when compared with a similar treatment combination that excluded the Quadris application.

Table 3. ***Sugarbeet yield parameters and gross economic return*** **from an evaluation of concurrently applied and tank-mixed combinations of azoxystrobin fungicide with sugarbeet root maggot-targeted insecticides, St. Thomas, ND, 2022**

Treatment/form.[a]	Placement[b]	Rate (product/ac)	Rate (lb a.i./ac)	Sucrose yield (lb/ac)	Root yield (T/ac)	Sucrose (%)	Gross return ($/ac)
Counter 20G + 10-34-0	B DIF	8.9 lb 5 GPA	1.8	10,583 a	30.5 ab	18.14 a	2,150
Counter 20G + Thimet 20G	B 4” Post B, 2 d Pre-peak	8.9 lb 7 lb	1.8 1.4	10,517 a	31.1 a	17.81 a	2,092
Counter 20G + Thimet 20G + Quadris	B 4” Post B, 2 d Pre-peak 10” Post B	8.9 lb 7 lb 10 fl oz	1.8 1.4 0.17	10,263 ab	30.3 ab	17.76 a	2,042
Counter 20G + AZteroid FC+ 10-34-0	B DIF	7.5 lb 5.7 fl oz 5 GPA	1.5 0.0625	10,144 ab	30.4 ab	17.64 a	1,996
Counter 20G + 10-34-0	B DIF	7.5 lb 5 GPA	1.5	9,943 ab	29.5 ab	17.69 a	1,972
Counter 20G + Mustang Maxx	B 10” Post B, 2 d Post-peak	8.9 lb 4 fl oz	1.8 0.025	9,886 ab	29.4 ab	17.65 a	1,957
Counter 20G	B	7.5 lb	1.5	9,832 ab	30.1 ab	17.32 a	1,899
Counter 20G + AZteroid FC+ 10-34-0	B DIF	8.9 lb 5.7 fl oz 5 GPA	1.8 0.0625	9,671 ab	28.3 b	17.94 a	1,939
Counter 20G	B	8.9 lb	1.8	9,659 ab	28.8 ab	17.66 a	1,909
Counter 20G + Mustang Maxx + Quadris	B 10” Post B, 2 d Post-peak	8.9 lb 4 fl oz 10 fl oz	1.8 0.025 0.17	9,382 b	28.0 b	17.56 a	1,849
Fertilizer check	DIF	5 GPA		6,219 c	20.0 c	16.69 a	1,146
Check	-----	----	-----	6,089 c	19.2 c	16.77 a	1,143
LSD (0.05)				975.5	2.47	NS	

Means within a column sharing a letter are not significantly (P = 0.05) different from each other (Fisher’s Protected LSD test).
[a]At-plant sprays were delivered in a 10-34-0 starter fertilizer/water carrier (3:2 gal. H_2O to fertilizer) at an output volume of 5 GPA.
[b]B = 5-inch at-plant band; Post B = postemergence band (i.e., 4-inch width for granular products; 10-inch width for sprayable liquid formulations); DIF = dribble in-furrow

The overall findings of this experiment suggest that combining a dribble-in-furrow application of 10-34-0 starter fertilizer with a concurrently applied planting-time banded application of Counter 20G is a feasible approach to fertility and pest management that is unlikely to result in negative impacts on sugarbeet root maggot control or sugarbeet yield parameters, even when the insecticide is applied at its high labeled rate of 8.9 lb product per acre.

However, numerical (i.e., not statistically significant) trends observed in this research suggest that there could be some level of plant health or stand establishment risk associated with applying azoxystrobin fungicide/10-34-0 starter fertilizer tank mixtures concurrently with planting-time tank applications of Counter 20G in sugarbeet. Similarly, non-significant, but concerning numerical trends also suggested the possibility of deleterious impacts on yield and revenue occurring when applying azoxystrobin fungicide concurrently with postemergence banded applications of Thimet 20G or tank mixing the fungicide with Mustang Maxx. For example, although not statistically significant, plots treated with a tank mixture comprised of Mustang Maxx and Quadris produced numerically lower recoverable sucrose yield and root tonnage (i.e., reduced by 504 lb and 1.4 tons per acre, respectively), and generated $108/ac less gross revenue than plots that received a Mustang Maxx application without the Quadris component. Therefore, research on concurrent and tank-mixed applications of these treatment combinations should be further explored.

Finally, it bears noting that this trial was conducted in an environment that involved the presence of a moderately high sugarbeet root maggot infestation. The net impacts of the treatment combinations tested should also be evaluated under low SBRM pressure and probably in its absence to more fully understand the crop safety of these treatment combinations.

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