SUGARBEET YIELD AND QUALITY IMPACTS FROM LATE-SEASON TANK MIXTURES OF GLYPHOSATE HERBICIDE WITH FOLIAR FUNGICIDES AND INSECTICIDES

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Introduction:

Roundup-Ready™ (glyphosate-resistant) sugarbeet technology has seen wide adoption by growers throughout most sugarbeet production areas of the United States, including the Red River Valley of North Dakota and Minnesota. The addition of glyphosate-based herbicide products to sugarbeet production systems has provided opportunities for producers to achieve effective weed management on their farms.

In most crop production systems, including sugarbeet, it can be advantageous to combine two or more crop protection materials as a tank mixture for a single application. Tank-mixed pesticide combinations, in addition to facilitating management of more than one crop pest (e.g., weed, insect, and/ or pathogen), also save producers time and input costs associated with fuel, equipment wear and tear, and equipment depreciation.

This experiment was carried out to determine the impacts of tank mixtures comprised of Roundup PowerMAX™ herbicide with postemergence liquid foliar fungicides and insecticides on sugarbeet yield and quality. The tank mixtures tested in this preliminary trial were designed to reflect mid- to late-summer crop protection scenarios, such as Cercospora leaf spot, foliar insect pests (e.g., Lygus bugs, cutworms, webworms, or grasshoppers), in addition to a late application of glyphosate for weed management. IMPORTANT: It should be noted that the intent of this experiment was not to evaluate pesticide performance in managing any of the aforementioned pests. Rather, it was to assess the relative safety of pesticide tank mixtures with regard to plant health, and to determine whether any such combinations should not be used in sugarbeet production due to potential risks of phytotoxicity and associated yield loss.

Materials and Methods:

This study was conducted during the 2012 growing season at the NDSU Prosper Experiment Farm near Prosper (CassCounty), ND. Plots were planted on 15 May using a 6-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. SES VanderHave SV36917RR (glyphosate-resistant) seed was used for all plots. Individual treatment plots were 35 ft long by 6 rows (22-inch spacing) wide with the 4 centermost rows treated. The outer row on each side served as an untreated buffer. Plant-free, 25-foot alleys were established between replicates. The experiment was arranged in a randomized complete block design with four replications of the treatments. On 18 July, plots were thinned to a population of 127 plants per 100 row ft to establish consistent plant stands for subsequent treatment comparisons on the basis of yield and quality, and to eliminate unwanted confounding effects associated with uneven plant populations among plots.

To control for potential confounding effects from soil-dwelling pests (e.g., springtails, wireworms, etc.), Counter 20G was applied at planting time in 5-inch bands at the low labeled rate (4.5 lb product/ac) to all plots, including the checks. Delivery of Counter granules was regulated by using planter-mounted Noble™ metering units that had been calibrated on the planter before all applications.

All treatments in the experiment were postemergence sprays, which were applied on 19 July by using a tractor-mounted CO2-propelled spray system equipped with TeeJet™ AIXR 110015 nozzles. The system was calibrated to deliver a finished spray volume of 10 GPA as a broadcast application. The highest labeled rates of the insecticides (i.e., Lorsban Advanced and MustangMax), fungicides (i.e., Proline, Quadris, and Super Tin), and Roundup PowerMAX were used for all treatments to create worst-case scenarios for assessing potential risks of the pesticides and tank mixtures thereof. In addition to single, two-way, and three-way tank mixture combinations, a water-only (i.e., 10 GPA) check and a surfactant check (i.e., Veracity™ at a rate of 3 qt/100 gallons of spray solution) were included in the trial for comparative purposes.

Harvest: On 17 September, the foliage was removed from all plots immediately before harvest by using a commercial-grade mechanical defoliator. Shortly thereafter, all beets were extracted from the center 2 rows of each plot by using a mechanical harvester, and weighed in the field using a harvester-mounted 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 analysis of sugar content and quality.

Data analysis: All data from harvest samples were subjected to analysis of variance using the general linear models procedure (SAS Institute, 1999), and treatment means were compared by using Fisher's protected least significant difference (LSD) test at a 0.05 level of significance.

Results and Discussion:

Yield, quality, and revenue data from this trial are presented in Table 1. There were no significant differences between any treatments with regard to recoverable sucrose yield, root yield, or percent sucrose. This overall lack of statistical significance was probably due, in part, to the size of the experiment and excessive treatment variability between replicates. Despite the occurrence of large numerical differences between some treatments, the overall result of no statistical significance between treatments precludes us from determining whether any are safer or more hazardous to sugarbeet plant health than others. It is probably important, however, to at least consider some of these large numerical differences with a moderate degree of caution, because major reductions in yield and associated gross economic return could have serious consequences to individual growers if similar results occur on their farms.

The highest average yields in this study were from plots that received the following single-component treatments: 1) Lorsban Advanced; 2) Super Tin; 3) Quadris; 4) the water-only check; and 5) the Veracity-only check. Plots treated with the single-component application of Proline also produced relatively high yields compared to the remaining treatments in the experiment. This pattern could suggest that there is at least some risk of possible yield and revenue loss from some of the other, single-pesticide treatments tested and, potentially, even more risk from tank mixtures comprised of more than one pesticide.

The highest-yielding and, potentially, safest tank-mix combinations in the experiment included the following: 1) MustangMax + Quadris; 2) MustangMax+ Roundup PowerMAX + Quadris; 3) Lorsban Advanced + Roundup PowerMAX; 4) MustangMax + Roundup PowerMAX + Proline; and 5) Lorsban Advanced + Quadris. These results, although not statistically significant could suggest that MustangMax may be a relatively safe tank-mix insecticide partner with Proline and Quadris fungicides; however, the results suggested that yield loss is possible when Mustang is combined in a three-way mixture with Roundup PowerMAX and Super Tin.

One of the more consistent trends observed in this experiment was that plots treated with two- and three-way tank mixtures containing Super Tin fungicide mostly tended to produce much lower yields than those treated with the Super Tin-only spray. This was most evident when Lorsban Advanced and Super Tin were both included in tank-mixed spray applications, but also, as mentioned above, when MustangMax and Roundup were combined with Super Tin. Alternately, two- and three-way tank mixtures containing Quadris as the fungicide element tended to be safer and allow for higher recoverable sucrose and root yields than those containing Super Tin as the fungicide component. Results from entries that included Proline as the fungicide component were not as consistent as those for the other fungicides; however, it appeared that MustangMax was a safe tank-mix partner with Proline, either as a two-way mixture, or as a three-way combination that included Mustang, Proline, and Roundup PowerMAX.

Due to the overall absence of statistically significant differences in this study, it cannot be concluded that any of the treatments, either single or those involving tank-mixed combinations, pose a significant threat of phytotoxicity and associated yield and revenue loss in sugarbeet. However, the large (i.e., up to 2,200 lb recoverable sucrose) yield differences suggest that major losses are at least possible with some tank-mixed combinations.

It should be noted that weather conditions during spray applications for this experiment should have presented a somewhat worst-case scenario for the likelihood of crop injury and associated yield loss. The high temperature at the Prosper Experiment Farm on the day the plots were sprayed (19 July) was 93°F, and highs during the subsequent three days were 100, 89, and 99°F (NDAWN, 2012). The relative lack of strong trends, and the absence of significant yield losses from any treatment in this experiment could suggest that most of the tank mixtures tested are relatively safe for use in sugarbeet. However, it is equally important to note that these results reflect only one year of testing and that, as such, this experiment should be repeated.

Table 1. ***Yield parameters*** **from an evaluation of single applications and tank-mixed combinations of foliar insecticides, fungicides, and Roundup PowerMAX herbicide in sugarbeet, Prosper, ND, 2012**

Treatment/form.	Placement	Rate (product/ac)	Rate (lb a.i./ac)	Sucrose yield (lb/ac)	Root yield (T/ac)	Sucrose (%)	Gross return ($/ac)
Lorsban Advanced	Broadcast	2 pt	1.0	9204	28.4	17.6	1539
Super Tin 4L	Broadcast	8 fl oz	0.25	8769	27.0	17.7	1472
Quadris	Broadcast	15.4 fl oz	0.25	8639	26.6	17.7	1449
Check	---	---	---	8596	26.3	17.9	1451
Surfactant Check (Veracity)	Broadcast	3 qt/100 gal	---	8513	26.2	17.6	1428
MustangMax + Quadris	Broadcast	4 fl oz 15.4 fl oz	0.025 0.25	8436	25.7	17.9	1428
MustangMax + Roundup PowerMAX + Quadris	Broadcast	4 fl oz 32 fl oz 15.4 fl oz	0.025 1.13 ae[a] 0.25	8359	25.5	17.8	1413
Lorsban Advanced + Roundup PowerMAX	Broadcast	2 pt 32 fl oz	1.0 1.13 ae[a]	8320	26.3	17.3	1363
Proline 480SC	Broadcast	5 fl oz	0.16	8270	26.2	17.3	1345
MustangMax + Roundup PowerMAX + Proline 480SC	Broadcast	4 fl oz 32 fl oz 5 fl oz	0.025 1.13 ae[a] 0.16	8239	25.5	17.6	1374
Lorsban Advanced + Quadris	Broadcast	2 pt 15.4 fl oz	1.0 0.25	8217	25.0	18.0	1393
MustangMax + Super Tin 4L	Broadcast	4 fl oz 8 fl oz	0.025 0.25	8155	24.4	18.1	1404
MustangMax + Proline 480SC	Broadcast	4 fl oz 5 fl oz	0.025 0.16	7964	25.5	17.2	1285
Lorsban Advanced + Roundup PowerMAX + Quadris	Broadcast	2 pt 32 fl oz 15.4 fl oz	1.0 1.13 ae[a] 0.25	7907	25.3	17.1	1276
MustangMax	Broadcast	4 fl oz	0.025	7848	24.2	17.7	1315
Lorsban Advanced + Roundup PowerMAX + Proline 480SC	Broadcast	2 pt 32 fl oz 5 fl oz	1.0 1.13 ae[a] 0.16	7805	24.5	17.6	1285
MustangMax + Roundup PowerMAX + Super Tin 4L	Broadcast	4 fl oz 32 fl oz 8 fl oz	0.025 1.13 ae[a] 0.25	7768	24.0	17.6	1297
Lorsban Advanced + Super Tin 4L	Broadcast	2 pt 8 fl oz	1.0 0.25	7718	24.7	17.4	1246
Lorsban Advanced + Roundup PowerMAX + Super Tin 4L	Broadcast	2 pt 32 fl oz 8 fl oz	1.0 1.13 ae[a] 0.25	7703	24.0	17.5	1277
Roundup PowerMAX	Broadcast	32 fl oz	1.13 ae[a]	7528	22.4	18.3	1305
MustangMax + Roundup PowerMAX	Broadcast	4 fl oz 32 fl oz	0.025 1.13 ae[a]	7148	21.7	17.9	1212
Lorsban Advanced + Proline 480SC	Broadcast	2 pt 5 fl oz	1.0 0.16	6587	20.6	17.5	1087
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]Glyphosate acid equivalent per acre

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