2023
Research Report

Southern Minnesota Beet Sugar Cooperative

SMBSC

Southern Minnesota Agricultural Research

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SMBSC Research Vision Statement:

Conduct industry leading agronomic and sugar beet storage research that enables Shareholder's data driven decisions to increase productivity and profitability and empowers the Cooperative's sustainability into the future.

SMBSC Research Mission:

- Conduct industry leading research.
- Generate high quality data.
- Work to discover novel agronomic practices to solve the needs of SMBSC shareholders.
- Increase productivity and profitability of SMBSC shareholders.
- Utilize the Shareholder Innovation Committee to bridge small plot research to whole field situations.

SMBSC Official Variety Trial Procedures and Sugar Beet Seed Approval

Southern Minnesota Beet Sugar Cooperative Research

Southern Minnesota Beet Sugar Cooperative (SMBSC) growers face several challenges to producing a high-quality, high-yielding sugar beet crop. These challenges include managing sugar beet diseases such as Aphanomyces root rot, Rhizoctonia root rot, and Cercospora leaf spot. An important tool that SMBSC growers can utilize in managing these diseases is the varieties' genetic tolerance to those diseases. Genetic tolerance combined with a better understanding of genetic sugar content and yield potential allow for the accurate placement of varieties in fields. SMBSC has a Seed Policy that provides guidelines for approving varieties to be sold to SMBSC growers. This policy creates a competitive system where varieties compete against each other to be approved for sale, ensuring that the best varieties are available for growers to plant.

Research Objective

- Generate yield and disease tolerance data on new candidate varieties seed companies submit.
- Utilize this data to move candidate varieties through the SMBSC Seed Approval process and approve varieties for sale to SMBSC growers.

Methodology

The SMBSC Official Variety Trials (OVTs) utilize Yield Trials and Disease Nursery Trials.

Four OVT-Yield Trial locations were planted in 2023. These trials were located near Murdock, Renville, Lake Lillian, and Hector. Trials were planted with a modified 12 row John Deere 7300 vacuum planter. Plots were four 22”-rows wide by forty feet long. Each variety was replicated six times across each trial, for a total of 24 plots per variety when combining all locations (four locations * six replications per location). The experimental design of the trials was a partially balanced lattice. Five foot alleys were cut perpendicular to the rows. These are removed from the total 40’ plot length, so plot lengths were 35’ after the alleys were cut. Emergence counts were taken approximately 28 days after planting. After the emergence counts were taken, plots were thinned to a uniform spacing, and all doubles were removed. The final stand counts varied by trial location in 2023 due to differences in emergence between the trial locations. Excalia fungicide was banded over the row at approximately the four to six leaf stage to suppress Rhizoctonia root rot.

Weed control was accomplished by applying pre-emergence, post-emergence, and split lay-by herbicides at the appropriate rates and times. The weeds present at each site dictated the weed control products used at each location. All broadcast spraying operations were conducted by a tractor sprayer driving perpendicular to the rows down the tilled alleys. SMBSC Research Staff conducted all the spraying operations. The Renville and Lake Lillian sites received six CLS fungicide applications. The Murdock and Hector sites received seven CLS fungicide applications.

In late August, row lengths were taken on each harvest row. These row lengths were used to calculate the yield of each plot. All plots were defoliated using a 4-row defoliator. After defoliation, the beets within the two feet of row immediately adjacent to the soil alleys were marked using food-grade paint. This identified these “end-beets,” allowing them to be screened from the quality samples collected on the harvester. The end beets are not included in the quality samples to avoid the potential negative impact on quality, given their access to nutrients and moisture from the alley throughout the growing season. The center two rows of each plot were harvested using a 2-row research harvester. All beets harvested from the center two rows were weighed on a scale on the harvester, and a sample of beets was taken for quality analysis at the SMBSC tare lab.

SMBSC screens all varieties for Aphanomyces root rot, Rhizoctonia root rot, and Cercospora leaf spot. SMBSC operates an Aphanomyces nursery near Renville and submits all varieties to a second Aphanomyces nursery operated by KWS Seeds in Shakopee, MN. SMBSC operates a Rhizoctonia nursery near Renville and also submits all varieties to a second Rhizoctonia nursery operated by the Beet Sugar Development Foundation and the USDA/ARS in Michigan. SMBSC also conducts a Cercospora leaf spot nursery near Renville and submits all varieties to a KWS Seed Cercospora nursery near Randolph, MN. Each disease nursery is designed to utilize best management practices to mitigate all other diseases except for the disease of interest at that location.

Foliar disease ratings for the CLS nurseries occurred approximately two or three times per week between mid-July and mid-August. These ratings were taken on the KWS (1-9 scale) and adjusted using baseline varieties to remove year to year variation in disease levels. Root ratings for the APH and RHC nurseries occurred in late August and early September. For both the Aphanomyces nursery and Rhizoctonia nursery, the beets were defoliated and lifted out of the ground. The beets in each individual plot were cleaned and laid out down the plot for rating. Multiple raters conducted root ratings using the KWS (1-9 scale) for Aphanomyces. A (1-7) scale was utilized for Rhizoctonia root ratings. All disease nursery ratings were adjusted by the baseline varieties to remove year to year variation in disease levels.

During the 2023 season, the KWS CLS nursery was hit with a severe hail event in late July, which defoliated the beets. The disease had not fully developed in the nursery at the time of the hail. SMBSC elected not to use the ratings from the KWS nursery for 2023 due to the effects of the hail. CLS ratings for 2023 are only from the SMBSC CLS nursery. The BSDF Rhizoctonia nursery ratings did not provide sufficient separation of the susceptible and resistant varieties, and thus, SMBSC elected not to use these Rhizoctonia ratings for the 2023 season. Rhizoctonia root rot ratings for 2023 are only from the SMBSC Rhizoctonia nursery. The SMBSC and KWS Aphanomyces nurseries were utilized for Aphanomyces ratings in 2023.

Results and Discussion

Data from all four Yield Trials and the Disease Nurseries were utilized for CY24 Seed Approval. Data generated in CY23 was combined with the data generated from CY22 and CY21 trials for use in approving varieties for the 2024 crop.

In the following pages, you will find tables that share 2023 trial site specifications, one, two, and three-year combined OVT data, Disease Nursery data, Agriculturalist Variety Strip Trial results, and the data from each of the 2023 individual yield trial locations.

Conclusion

Data generated for the SMBSC Sugar Beet Seed Approval through the Official Variety Trials can be found in this report and other formats on the SMBSC website under the Agronomy section by selecting the Variety and Seed tab. This robust data set guides SMBSC producers to place varieties on their farms to optimize each field’s production potential.

2023 SMBSC Official Variety Trials

Yield Trials Specifications

Trial Type	Cooperator	Trial Location	Previous Crop	Starter Fertilizer	Planting Date	Thinning Date	Harvest Date	Disease
Yield	G.E. Johnson Inc	Hector	Soybean	No	5/10/2023	6/15/2023	10/3/2023	Med to light rot, no CLS
Yield	Steve and Nick Frank	Lake Lillian	Soybean	No	5/4/2023	6/12/2023	9/21/2023	Light rot, light CLS
Yield	Petersen Farms	Murdock	Soybean	No	5/8/2023	6/2/2023	10/20/2023	Med to light rot, no CLS
Yield	Watson Partners	Renville	Field Corn	No	5/24/2023	6/20/2023	10/10/2023	None to light rot, no CLS

Disease Nursery Trials Specifications

Trial Type	Investigator	Trial Location	Rating Performed by	Use of Ratings in 2023 Variety Approval System
Aphanomyces	SMBSC	Renville	SMBSC Staff	50% of 2023 APH Rating
Aphanomyces	KWS	Shakopee	KWS, M. Bloomquist, N. Olson	50% of 2023 APH Rating
Cercospora	SMBSC	Renville	SMBSC Staff	100% of 2023 CLS Rating
Cercospora	KWS	Randolph	KWS Staff	Not used in 2023 due to hail
Rhizoctonia	SMBSC	Renville	SMBSC Staff	100% of the 2023 RHC Rating
Rhizoctonia	BSDF - USDA/ARS	Michigan	Linda Hanson and USDA/ARS Staff	Not used in 2023 due to ns ratings

Table 1. Comparison of 2024 Fully Approved Varieties to Test Market and Specialty Approved Varieties - Three Years of Data (2021-2023)

		Rec/T (lbs)		Rec/A (lbs)		Sugar %		Purity (%)		Yield (T/A)		Aphanomyces Root Rating**		Cercospora Leaf Spot**		Rhizoctonia Root Rating**		Emerge-ence (%)		Revenue per Ton*	Revenue per Acre*	ESTESA ***	
	Specialty	3 yr avg	% of mean	3 yr avg	% of mean	3 yr avg	% of mean	3 yr avg	% of mean	3 yr avg	% of mean	3 yr avg	% of mean	3 yr avg	% of mean	3 yr avg	% of mean	3 yr avg	% of mean	% of mean	% of mean	3 yr avg	
2024 Fully Approved Varieties - Three Years of Data (% of Mean is of Fully Approved Mean)																							
Beta 9044		284.3	102.2	10556.0	97.1	16.9	101.9	90.2	100.1	37.4	95.1	4.6	101.2	4.1	141.0	3.8	93.2	66.4	97.3	104.2	99.1	754.9	9044
Beta 9098		272.2	97.9	10667.7	98.1	16.3	98.0	90.0	100.0	39.5	100.3	5.0	108.8	2.1	71.3	4.9	121.8	68.1	99.7	95.3	95.8	731.1	9098
Beta 9124		279.3	100.4	11071.3	101.8	16.7	100.2	90.2	100.1	39.9	101.3	5.1	111.1	2.3	78.3	4.4	108.9	69.4	101.6	101.4	102.9	780.1	9124
Beta 9131	RHC	275.6	99.1	11104.9	102.1	16.5	99.3	90.0	100.0	40.5	103.0	4.6	100.1	2.0	70.2	3.1	77.1	66.5	97.4	98.1	101.0	770.2	9131
Crystal M028		281.5	101.2	10651.0	97.9	16.8	101.2	90.0	100.0	38.0	96.6	4.3	95.3	3.8	132.2	4.1	101.5	69.3	101.5	102.2	98.7	754.1	M028
Crystal M106		278.5	100.2	11109.1	102.2	16.7	100.3	90.0	99.9	40.1	102.0	3.9	85.5	4.0	138.0	3.8	94.9	70.4	103.1	100.8	102.8	776.2	M106
Crystal M168		275.1	98.9	10958.1	100.8	16.5	99.1	90.0	99.9	40.0	101.6	4.5	98.0	2.0	69.1	4.1	102.5	67.9	99.4	98.1	99.7	759.3	M168
Mean of Fully Approved:		**278.1**	**100.0**	**10874.0**	**100.0**	**16.6**	**100.0**	**90.1**	**100.0**	**39.3**	**100.0**	**4.6**	**100.0**	**2.9**	**100.0**	**4.0**	**100.0**	**68.3**	**100.0**	**100.0**	**100.0**	**760.8**	**Mean**
2024 Test Market Varieties for Limited Sales - Three Years of Data (% of mean is of Fully Approved Mean)																							
Hilleshog 2395		266.1	95.7	10248.0	94.2	16.0	96.2	89.8	99.7	38.9	98.9	4.6	100.8	4.2	143.4	4.4	109.3	67.6	99.0	90.6	89.6	688.1	2395
Hilleshog 2398		270.3	97.2	10131.3	93.2	16.2	97.5	89.9	99.8	37.5	95.5	4.8	105.4	3.8	132.3	4.1	101.9	65.9	96.5	93.7	89.3	683.4	2398
2024 Specialty Approved Varieties - Three Years of Data (% of mean is of Fully Approved Mean)																							
Beta 9155	RHC	268.0	96.4	11114.1	102.2	16.1	96.8	89.9	99.8	41.7	106.0	4.3	93.6	2.4	83.2	3.3	82.9	68.1	99.8	92.3	97.9	748.8	9155
Crystal M089	RHC	264.9	95.3	10988.8	101.1	15.9	95.9	89.8	99.6	41.7	106.1	4.1	90.8	2.2	74.9	3.6	88.5	68.1	99.8	89.3	94.7	729.1	M089
Crystal M977	RHC+APH	268.4	96.5	11180.7	102.8	16.1	97.1	89.7	99.6	42.0	106.7	3.8	83.5	4.3	149.9	3.3	81.0	64.1	93.9	91.7	97.9	755.3	M977
SV RR863	RHC	270.0	97.1	10218.3	94.0	16.2	97.3	90.0	99.9	38.0	96.6	4.8	105.2	4.0	136.7	3.6	90.6	61.7	90.4	94.0	90.8	692.6	863
2024 Last Year Sales - Three Years of Data (% of mean is of Fully Approved Mean)																							
Hilleshog 2327		268.4	96.5	10251.5	94.3	16.1	97.0	89.7	99.6	38.3	97.5	4.4	97.6	4.0	137.1	3.8	94.4	60.1	88.1	91.7	89.3	687.7	2327
Hilleshog 2379		271.3	97.6	10165.0	93.5	16.3	97.8	89.9	99.8	37.5	95.5	4.6	101.1	4.0	138.4	4.1	101.9	64.0	93.8	95.0	90.6	693.6	2379

*__Revenue per Ton__ and __Revenue per Acre__ figures were produced using the payment calculation with factors released on Oct. 23, 2023 for the final 2022 crop payment.

** Lower numbers are better for all disease nursery ratings.

***ESTESA is a unitless SMBSC parameter that correlates to grower payment and revenue per acre. Higher is better.

Table 2. Comparison of 2024 Fully Approved Varieties to Test Market and Specialty Approved Varieties - Two Years of Data (2022-2023)

		Rec/T (lbs)		Rec/A (lbs)		Sugar %		Purity (%)		Yield (T/A)		Aphanomyces Root Rating**		Cercospora Leaf Spot**		Rhizoctonia Root Rating**		Emerge-ence (%)		Revenue per Ton*	Revenue per Acre*	ESTESA ***	
	Specialty	2 yr avg	% of mean	2 yr avg	% of mean	2 yr avg	% of mean	2 yr avg	% of mean	2 yr avg	% of mean	2 yr avg	% of mean	2 yr avg	% of mean	2 yr avg	% of mean	2 yr avg	% of mean	% of mean	% of mean	2 yr avg	
2024 Fully Approved Varieties - Two Years of Data (% of Mean is of Fully Approved Mean)																							
Beta 9044		290.9	102.2	10106.6	96.8	17.4	102.0	89.9	100.1	34.9	94.7	4.3	97.6	4.1	144.9	3.7	92.2	61.4	95.4	104.8	99.2	736.0	9044
Beta 9098		278.5	97.9	10163.3	97.3	16.7	97.9	89.9	100.0	36.8	99.8	5.0	111.4	1.9	68.4	5.0	124.9	66.0	102.7	95.7	95.6	712.3	9098
Beta 9124		285.0	100.1	10526.0	100.8	17.0	100.1	89.9	100.0	37.1	100.6	5.1	114.0	2.1	75.1	4.4	110.7	63.7	99.0	99.6	100.3	756.0	9124
Beta 9131	RHC	282.8	99.4	10741.3	102.9	16.9	99.3	89.9	100.1	38.2	103.5	4.4	97.8	1.9	68.2	2.9	73.2	61.3	95.4	98.3	101.9	761.6	9131
Crystal M028		289.1	101.6	10342.1	99.0	17.3	101.7	89.8	99.9	35.8	97.1	4.3	96.4	3.8	133.9	4.1	103.1	65.0	101.0	103.2	100.2	750.4	M028
Crystal M106		285.1	100.2	10652.6	102.0	17.1	100.1	89.9	100.0	37.6	101.9	3.7	84.1	4.0	142.8	3.7	94.1	67.1	104.3	100.9	102.9	766.5	M106
Crystal M168		280.6	98.6	10558.2	101.1	16.9	98.9	89.7	99.9	37.7	102.2	4.4	98.7	1.9	66.7	4.0	101.8	65.8	102.2	97.7	99.9	740.5	M168
Mean of Fully Approved:		**284.6**	**100.0**	**10441.4**	**100.0**	**17.0**	**100.0**	**89.9**	**100.0**	**36.9**	**100.0**	**4.5**	**100.0**	**2.8**	**100.0**	**4.0**	**100.0**	**64.3**	**100.0**	**100.0**	**100.0**	**746.2**	**Mean**
2024 Test Market Varieties for Limited Sales - Two Years of Data (% of mean is of Fully Approved Mean)																							
Beta 9284		290.2	102.0	10654.9	102.0	17.3	101.8	89.9	100.0	36.7	99.6	3.7	83.9	4.0	141.5	3.3	83.1	60.1	93.4	103.5	103.1	772.1	9284
Beta 9291	CLS	282.8	99.4	10310.8	98.7	17.0	99.6	89.8	99.9	36.3	98.5	4.3	96.2	1.6	55.0	4.0	101.1	59.3	92.1	99.3	97.8	723.7	9291
Hilleshog 2395		273.1	96.0	9805.1	93.9	16.4	96.4	89.7	99.8	36.1	98.1	4.8	107.5	4.1	145.6	4.5	112.2	65.1	101.2	91.2	89.3	675.3	2395
Hilleshog 2398		275.7	96.9	9762.3	93.5	16.6	97.4	89.6	99.7	35.3	95.9	4.9	109.8	3.9	136.5	4.2	105.7	62.4	97.0	93.5	89.5	671.5	2398
2024 Specialty Approved Varieties - Two Years of Data (% of mean is of Fully Approved Mean)																							
Beta 9155	RHC	273.9	96.2	10778.5	103.2	16.5	96.6	89.7	99.8	39.4	107.0	4.3	96.9	2.2	77.6	3.2	80.8	64.2	99.8	92.5	98.9	739.2	9155
Crystal M089	RHC	271.6	95.5	10734.5	102.8	16.3	95.9	89.7	99.8	39.7	107.7	4.1	92.1	2.0	71.8	3.6	89.9	63.7	99.1	89.9	96.8	733.2	M089
Crystal M977	RHC+APH	276.8	97.3	10799.5	103.4	16.6	97.3	89.9	100.0	39.2	106.4	3.6	80.9	4.4	155.4	3.1	77.9	61.2	95.1	94.4	100.4	748.7	M977
SV RR863	RHC	275.4	96.8	9737.1	93.3	16.5	97.1	89.8	99.9	35.4	96.2	5.3	118.4	3.9	138.2	3.6	91.1	56.7	88.2	92.8	89.1	672.7	863
2024 Last Year Sales - Two Years of Data (% of mean is of Fully Approved Mean)																							
Hilleshog 2327		275.5	96.8	9790.6	93.8	16.5	97.1	89.7	99.8	35.5	96.3	4.6	104.2	4.0	140.9	3.9	98.3	54.0	84.0	92.5	89.1	672.5	2327
Hilleshog 2379		278.2	97.8	9832.3	94.2	16.7	98.1	89.7	99.8	35.3	95.8	4.8	107.0	4.0	140.7	3.9	98.3	58.0	90.2	95.1	91.1	668.7	2379

*Revenue per Ton and Revenue per Acre figures were produced using the payment calculation with factors released on Oct. 23, 2023 for the final 2022 crop payment.

** Lower numbers are better for all disease nursery ratings.

***ESTESA is a unitless SMBSC parameter that correlates to grower payment and revenue per acre. Higher is better.

Table 3. Comparison of 2024 Fully Approved Varieties to Test Market and Specialty Approved Varieties - 1 Year Data (2023)

		Rec/T (lbs)		Rec/A (lbs)		Sugar %		Purity (%)		Yield (T/A)		Aphanomyces Root Rating**		Cercospora Leaf Spot**		Rhizoctonia Root Rating**		Emergence (%)		Revenue per Ton*	Revenue per Acre*	ESTESA ***	
	Specialty	1 yr avg	% of mean	1 yr avg	% of mean	1 yr avg	% of mean	1 yr avg	% of mean	1 yr avg	% of mean	1 yr avg	% of mean	1 yr avg	% of mean	1 yr avg	% of mean	1 yr avg	% of mean	% of mean	% of mean	1 yr avg	
2024 Fully Approved Varieties - One Year of Data (% of Mean is of Fully Approved Mean)																							
Beta 9044		287.8	101.6	10371.9	96.7	17.2	101.7	89.9	99.9	36.1	95.1	4.4	96.9	4.0	146.2	3.5	90.7	57.3	92.6	103.2	98.4	748.0	9044
Beta 9098		280.3	99.0	10530.5	98.2	16.7	98.7	90.4	100.3	37.5	98.9	5.2	114.0	1.9	69.4	5.5	141.8	65.4	105.6	98.2	97.2	735.8	9098
Beta 9124		284.1	100.3	10761.3	100.3	16.9	100.0	90.3	100.3	37.9	100.1	5.2	114.0	2.0	71.4	4.3	109.6	58.7	94.8	100.5	100.6	764.5	9124
Beta 9131	RHC	279.1	98.6	10966.9	102.2	16.7	98.5	90.1	100.0	39.4	104.0	4.1	90.4	1.9	67.8	2.3	60.2	62.0	100.2	97.3	101.2	769.8	9131
Crystal M028		286.3	101.1	10568.7	98.5	17.1	101.3	89.8	99.7	37.0	97.5	4.3	94.8	3.8	139.0	4.1	104.2	62.2	100.6	101.6	99.2	757.4	M028
Crystal M106		283.5	100.1	10775.2	100.5	17.0	100.4	89.9	99.8	38.0	100.3	3.9	84.9	3.9	141.7	3.8	96.7	64.8	104.7	100.6	100.9	764.9	M106
Crystal M168		281.3	99.3	11108.9	103.6	16.8	99.3	90.1	100.1	39.4	104.0	4.8	105.0	1.8	64.3	3.8	96.9	62.8	101.4	98.6	102.5	781.4	M168
Mean of Fully Approved:		**283.2**	**100.0**	**10726.2**	**100.0**	**16.9**	**100.0**	**90.1**	**100.0**	**37.9**	**100.0**	**4.6**	**100.0**	**2.8**	**100.0**	**3.9**	**100.0**	**61.9**	**100.0**	**100.0**	**100.0**	**760.2**	**Mean**
2024 Test Market Varieties - One Year of Data (% of mean is of Fully Approved Mean)																							
Beta 9284		281.6	99.4	10430.3	97.2	16.9	99.8	89.8	99.7	36.9	97.3	3.7	80.7	4.0	146.1	3.1	80.5	56.6	91.5	99.0	96.4	732.6	9284
Beta 9291	CLS	281.6	99.4	10411.6	97.1	16.8	99.6	90.0	99.9	36.8	97.1	4.3	94.6	1.5	55.9	3.8	97.1	53.3	86.2	98.3	95.5	730.6	9291
Hilleshog 2395		271.0	95.7	10072.5	93.9	16.2	95.9	90.0	100.0	37.4	98.7	4.6	100.7	3.9	139.3	4.9	125.8	64.8	104.7	90.4	89.2	689.2	2395
Hilleshog 2398		275.9	97.4	9806.3	91.4	16.5	97.7	89.9	99.8	35.5	93.7	5.3	116.1	3.9	141.9	4.3	110.4	60.3	97.4	94.0	88.1	675.8	2398
2024 Specialty Approved Varieties - One Year of Data (% of mean is of Fully Approved Mean)																							
Beta 9155	RHC	276.4	97.6	11135.7	103.8	16.6	98.1	89.8	99.8	40.3	106.4	4.5	99.5	2.0	72.1	3.2	81.5	59.2	95.7	95.0	101.1	768.6	9155
Crystal M089	RHC	272.8	96.3	10855.8	101.2	16.3	96.4	90.1	100.1	39.9	105.2	4.3	94.2	1.9	67.1	3.6	92.4	57.3	92.5	92.0	96.9	740.2	M089
Crystal M977	RHC+APH	273.7	96.6	10761.6	100.3	16.4	97.1	89.9	99.8	39.5	104.3	3.7	80.5	4.0	145.4	2.9	74.5	60.6	97.9	92.7	96.7	740.6	M977
SV RR863	RHC	276.5	97.6	9680.8	90.3	16.6	97.9	90.0	99.9	35.0	92.2	5.8	127.1	3.8	137.5	3.7	95.5	55.3	89.4	95.7	88.4	667.7	863
2024 Last Year Sales - One Year of Data (% of mean is of Fully Approved Mean)																							
Hilleshog 2327		274.9	97.1	9696.7	90.4	16.5	97.4	89.9	99.9	35.2	93.0	4.7	103.6	3.9	140.0	4.0	102.6	50.8	82.1	94.0	87.4	668.8	2327
Hilleshog 2379		277.1	97.8	9703.3	90.5	16.6	98.2	89.9	99.8	34.8	91.8	5.2	114.7	3.8	138.8	4.1	105.2	53.0	85.6	95.3	87.6	670.3	2379

*__Revenue per Ton__ and __Revenue per Acre__ figures were produced using the payment calculation with factors released on Oct. 23, 2023 for the final 2022 crop payment.

** Lower numbers are better for all disease nursery ratings.

***ESTESA is a unitless SMBSC parameter that correlates to grower payment and revenue per acre. Higher is better.

2021-2023 Disease Nursery Data for Aphanomyces, Cercospora, and Rhizoctonia

Variety Description	Aphanomyces Root Ratings					Cercospora Leafspot Ratings					Rhizoctonia Root Ratings				
	2023 Root Rating	2022 Root Rating	2021 Root Rating	**2022-2023 2 Year Mean** Root Rating	**2021-2023 3 Year Mean** Root Rating	2023 CLS Rating	2022 CLS Rating	2021 CLS Rating	**2022-2023 2 Year Mean** Foliar Rating	**2021-2023 3 Year Mean** Foliar Rating	2023 Root Rating	2022 Root Rating	2021 Root Rating	**2022-2023 2 Year Mean** Root Rating	**2021-2023 3 Year Mean** Root Rating
Fully Approved Varieties															
Beta 9044	4.4	4.3	5.1	4.3	4.6	4.0	4.1	4.1	4.1	4.1	3.5	3.8	3.9	3.7	3.8
Beta 9098	5.2	4.7	4.9	5.0	5.0	1.9	1.9	2.3	1.9	2.1	5.5	4.4	4.8	5.0	4.9
Beta 9124	5.2	5.0	5.0	5.1	5.1	2.0	2.3	2.6	2.1	2.3	4.3	4.5	4.4	4.4	4.4
Beta 9131	4.1	4.6	5.0	4.4	4.6	1.9	2.0	2.3	1.9	2.0	2.3	3.5	3.5	2.9	3.1
Crystal M028	4.3	4.3	4.4	4.3	4.3	3.8	3.7	3.9	3.8	3.8	4.1	4.1	4.1	4.1	4.1
Crystal M106	3.9	3.6	4.2	3.7	3.9	3.9	4.1	3.9	4.0	4.0	3.8	3.7	4.0	3.7	3.8
Crystal M168	4.8	4.0	4.6	4.4	4.5	1.8	2.0	2.2	1.9	2.0	3.8	4.3	4.3	4.0	4.1
Test Market Varieties															
Beta 9291	4.3	4.3	-	4.3	-	1.5	1.6	-	1.6	-	3.8	4.2	-	4.0	-
Beta 9284	3.7	3.8	-	3.7	-	4.0	3.9	-	4.0	-	3.1	3.5	-	3.3	-
Hilleshog 2395	4.6	5.0	4.2	4.8	4.6	3.9	4.4	4.3	4.1	4.2	4.9	4.0	4.4	4.5	4.4
Hilleshog 2398	5.3	4.5	4.6	4.9	4.8	3.9	3.8	3.8	3.9	3.8	4.3	4.1	3.9	4.2	4.1
APH Specialty Approved															
Crystal M977	3.7	3.5	4.2	3.6	3.8	4.0	4.7	4.3	4.4	4.3	2.9	3.3	3.6	3.1	3.3
RHC Specialty Approved															
Beta 9131	4.1	4.6	5.0	4.4	4.6	1.9	2.0	2.3	1.9	2.0	2.3	3.5	3.5	2.9	3.1
Beta 9155	4.5	4.1	4.2	4.3	4.3	2.0	2.4	2.9	2.2	2.4	3.2	3.2	3.6	3.2	3.3
Crystal M089	4.3	3.9	4.2	4.1	4.1	1.9	2.2	2.5	2.0	2.2	3.6	3.5	3.5	3.6	3.6
Crystal M977	3.7	3.5	4.2	3.6	3.8	4.0	4.7	4.3	4.4	4.3	2.9	3.3	3.6	3.1	3.3
SV RR863	5.8	4.8	3.8	5.3	4.8	3.8	4.0	4.1	3.9	4.0	3.7	3.5	3.7	3.6	3.6
CLS Specialty Approved															
Beta 9291	4.3	4.3	-	4.3	-	1.5	1.6	-	1.6	-	3.8	4.2	-	4.0	-
Last Year of Sales															
Hilleshog 2327	4.7	4.6	4.1	4.6	4.4	3.9	4.1	4.0	4.0	4.0	4.0	3.8	3.7	3.9	3.8
Hilleshog 2379	5.2	4.3	4.3	4.8	4.6	3.8	4.1	4.1	4.0	4.0	4.1	3.8	4.3	3.9	4.1
	Aphanomyces Ratings from SMBSC Nursery at Renville and KWS Nursery in Shakopee. **Ratings are on scale of 1 - 9.**					Cercospora Ratings from SMBSC Nursery in Renville and KWS Nursery near Randolph MN. **Ratings are on scale of 1-9.**					Rhizoctonia Ratings from SMBSC Nursery at Renville and BSDF Nursery in Michigan **Ratings are on scale of 1 - 7.**				

** Lower Ratings mean more resistant to disease and are shown in green font.
**Higher Ratings mean more susceptible to disease and are shown in red font.

SMBSC Agricultural Staff Variety Strip Trial - Summary

Strip Trial Means Table

Variety*	Stand Count 28 DAP Beets/100' row	Sugar %	Purity %	Tons / Acre	Extractable Sugar per Ton	Extractable Sugar per Acre	Percent of Mean Revenue per Acre**
Beta 9124	195	17.4	89.9	35.8	287.3	10326.7	101.6%
Beta 9131	204	17.2	89.6	36.3	282.5	10460.4	100.3%
Beta 9155	197	17.1	89.6	36.0	281.3	10202.0	97.8%
Crystal M106	200	17.5	89.5	34.8	285.5	10049.4	97.8%
Crystal M168	200	17.4	89.8	36.6	285.3	10703.1	104.2%
Hilleshog 2395	196	17.0	89.7	37.3	277.9	10414.2	98.2%
Hilleshog 2398	191	17.5	89.5	35.4	286.8	10208.3	100.0%
Mean	197.6	17.3	89.7	36.0	283.8	10337.7	100.0
%CV	6.3	1.5	0.4	7.0	1.3	6.3	6.2
PR>F	0.6787	0.0089	0.2380	0.7098	0.0006	0.6939	0.5240
LSD (0.05)	ns	0.3	ns	ns	4.2	ns	ns
Reps***	6	6	6	6	6	6	6

* Varieties are organized in alphabetical order. The top and bottom performers measured by 'Percent of Mean Revenue per Acre' vary by location, indicating an environmental effect.

** Revenue is calculated using the 2022 crop payment calculator, utilizing values released Oct. 23, 2023

*** Combined data from 6 locations with each location considered a replicate.

Locations: Renville, Redwood Falls, Raymond, Hector, Maynard, and Belgrade

SMBSC Variety Strip Trial - Redwood Falls

Variety	28 DAP Stand Beets/100' row	Sugar %	Purity %	Tons / Acre	Extractable Sugar per Ton	Extractable Sugar per Acre	Percent Rev/Acre	Variety
Beta 9124	189	17.6	89.4	28.9	291.7	8435	107%	Beta 9124
Beta 9131	195	16.9	89.4	26.9	280.8	7559	92%	Beta 9131
Beta 9155	168	17.5	88.7	28.2	287.1	8103	101%	Beta 9155
Crystal M106	208	17.3	88.9	26.4	284.7	7519	93%	Crystal M106
Crystal M168	214	17.4	89.4	28.3	289.5	8193	103%	Crystal M168
Hilleshog 2395	216	17.6	89.2	27.6	291.1	8038	102%	Hilleshog 2395
Hilleshog 2398	176	17.4	88.9	28.0	287.2	8031	101%	Hilleshog 2398
Average	**195**	**17.4**	**89.1**	**27.8**	**287.4**	**7982**	**100.0%**	**Average**

Planted: April 27, 2023
Harvested: September 7, 2023
Agriculturalist: Chris Dunsmore

SMBSC Variety Strip Trial - Olivia

Variety	28 DAP Stand Beets/100' row	Sugar %	Purity %	Tons / Acre	Extractable Sugar per Ton	Extractable Sugar per Acre	Percent Rev/Acre	Variety
Beta 9124		18.8	90.6	31.5	319.1	10051	99%	Beta 9124
Beta 9131		18.9	90.3	34.0	318.5	10839	107%	Beta 9131
Beta 9155		18.2	90.6	35.5	309.4	10972	105%	Beta 9155
Crystal M106		19.1	90.6	31.9	323.5	10324	103%	Crystal M106
Hilleshog 2395		18.2	90.8	30.2	308.5	9321	89%	Hilleshog 2395
Hilleshog 2398		18.5	90.8	32.9	315.5	10381	101%	Hilleshog 2398
Average		**18.6**	**90.6**	**32.7**	**315.7**	**10315**	**100.0%**	**Average**

Planted: May 3, 2023
Harvested: September 18, 2023
Agriculturalist: Chris Dunsmore

SMBSC Variety Strip Trial - Belgrade**

Variety	28 DAP Stand Beets/100' row	Sugar %	Purity %	Tons / Acre	Extractable Sugar per Ton	Extractable Sugar per Acre	Percent Rev/Acre	Variety
Beta 9124	204	16.6	90.3	40.2	279.1	11215	103%	Beta 9124
Beta 9131	216	16.4	90.3	42.4	275.7	11696	106%	Beta 9131
Beta 9155	214	16.2	89.8	37.2	270.1	10036	88%	Beta 9155
Crystal M106	200	16.5	90.3	39.4	277.6	10950	100%	Crystal M106
Crystal M168	213	16.8	90.0	39.5	281.2	11119	103%	Crystal M168
Hilleshog 2395	213	15.9	90.3	43.6	267.0	11647	101%	Hilleshog 2395
Hilleshog 2398	214	16.5	90.0	40.4	275.2	11110	100%	Hilleshog 2398
Beta 9044*	197	16.7	90.4	41.1	280.9	11547	106%	Beta 9044
Crystal M028*	203	16.3	90.3	37.6	273.7	10299	92%	Crystal M028
Average	**211**	**16.4**	**90.1**	**40.4**	**275.1**	**11111**	**100.0%**	**Average**

Planted: May 2, 2023
Harvested: October 23, 2023
Agriculturalist: Jared Kelm

* Denotes variety shown with final data but not included with average/statistical analysis
**Denotes an irrigated strip trial

SMBSC Variety Strip Trial - Raymond

Variety	28 DAP Stand Beets/100' row	Sugar %	Purity %	Tons / Acre	Extractable Sugar per Ton	Extractable Sugar per Acre	Percent Rev/Acre	Variety
Beta 9124	196	18.2	90.4	38.0	286.7	11350	102%	Beta 9124
Beta 9131	204	18.1	90.7	38.1	284.4	12128	108%	Beta 9131
Beta 9155	189	17.9	90.9	38.0	279.4	11381	99%	Beta 9155
Crystal M106	190	18.9	90.7	36.3	284.0	11051	98%	Crystal M106
Crystal M168	195	18.8	90.4	35.3	283.3	11761	104%	Crystal M168
Hilleshog 2395	180	18.3	90.7	34.9	274.7	10450	89%	Hilleshog 2395
Hilleshog 2398	188	18.6	90.3	37.0	286.4	11085	99%	Hilleshog 2398
Average	**192**	**18.4**	**90.6**	**36.8**	**282.7**	**11315**	**100.0%**	**Average**

Planted: May 5, 2023
Harvested: September 20, 2023
Agriculturalist: Jared Kelm

SMBSC Variety Strip Trial - Hector

Variety	28 DAP Stand Beets/100' row	Sugar %	Purity %	Tons / Acre	Extractable Sugar per Ton	Extractable Sugar per Acre	Percent Rev/Acre	Variety
Beta 9124	189	17.2	89.8	39.6	286.7	11350	102%	Beta 9124
Beta 9131	208	17.3	88.9	42.6	284.4	12128	108%	Beta 9131
Beta 9155	198	16.9	89.4	40.7	279.4	11381	99%	Beta 9155
Crystal M106	194	17.2	88.9	38.9	284.0	11051	98%	Crystal M106
Crystal M168	196	17.1	89.5	41.5	283.3	11761	104%	Crystal M168
Hilleshog 2395	204	16.7	89.0	38.0	274.7	10450	89%	Hilleshog 2395
Hilleshog 2398	186	17.3	89.4	38.7	286.4	11085	99%	Hilleshog 2398
Hilleshog 2023 B*	168	16.5	88.3	36.0	268.6	9661	80%	Hilleshog 2023 B
Hilleshog 2023 C*	193	16.3	88.9	40.8	268.2	10943	91%	Hilleshog 2023 C
Hilleshog 2023 H*	166	17.0	88.8	36.7	279.7	10255	90%	Hilleshog 2023 H
Average	**196**	**17.1**	**89.2**	**40.0**	**282.7**	**11315**	**100.0%**	**Average**

Planted: May 5, 2023
Harvested: October 20, 2023
Agriculturalist: Ryan Kuester

* Denotes variety shown with final data but not included with average/statistical analysis

SMBSC Variety Strip Trial - Renville

Variety	28 DAP Stand Beets/100' row	Sugar %	Purity %	Tons / Acre	Extractable Sugar per Ton	Extractable Sugar per Acre	Percent Rev/Acre	Variety
Beta 9124	183	16.6	89.3	35.6	274.4	9772	97%	Beta 9124
Beta 9131	188	16.3	89.0	34.3	267.4	9183	89%	Beta 9131
Beta 9155	207	16.2	88.5	40.3	265.0	10674	102%	Beta 9155
Crystal M106	192	16.6	88.3	33.7	271.1	9125	90%	Crystal M106
Crystal M168	166	16.4	89.0	41.9	270.6	11329	111%	Crystal M168
Hilleshog 2395	153	15.5	89.4	47.7	255.9	12195	111%	Hilleshog 2395
Hilleshog 2398	166	16.8	88.5	36.5	275.3	10036	100%	Hilleshog 2398
Average	**179**	**16.4**	**88.9**	**38.6**	**268.5**	**10331**	**100.0%**	**Average**

Planted: May 4, 2023
Harvested: October 20, 2023
Agriculturalist: Griffin Schaub

SMBSC Variety Strip Trial - Appleton**

Variety	28 DAP Stand Beets/100' row	Sugar %	Purity %	Tons / Acre	Extractable Sugar per Ton	Extractable Sugar per Acre	Percent Rev/Acre	Variety
Beta 9124	166	16.4	89.4	29.5	272.2	8018	93%	Beta 9124
Beta 9131	165	16.3	89.4	33.0	269.6	8891	102%	Beta 9131
Beta 9155	205	16.0	89.2	33.5	263.8	8824	98%	Beta 9155
Crystal M106	194	16.8	89.6	32.8	279.3	9148	109%	Crystal M106
Crystal M168	166	16.3	89.0	32.2	268.7	8640	99%	Crystal M168
Hilleshog 2395	173	15.6	89.3	33.8	257.4	8698	94%	Hilleshog 2395
Hilleshog 2398	188	16.2	89.4	34.4	268.8	9247	105%	Hilleshog 2398
Beta 9044*	150	16.7	89.4	33.0	276.1	9108	107%	Beta 9044
Crystal M028*	179	16.8	89.6	30.0	279.7	8391	100%	Crystal M028
Average	**179**	**16.2**	**89.3**	**32.7**	**268.5**	**8781**	**100.0%**	**Average**

Planted: May 2, 2023
Harvested: September 12, 2023
Agriculturalist: Scott Thaden

* Denotes variety shown with final data but not included with average/statistical analysis
**Denotes an irrigated strip trial

SMBSC Variety Strip Trial - Maynard

Variety	28 DAP Stand Beets/100' row	Sugar %	Purity %	Tons / Acre	Extractable Sugar per Ton	Extractable Sugar per Acre	Percent Rev/Acre	Variety
Beta 9124	208	18.1	90.4	32.2	305.3	9838	98%	Beta 9124
Beta 9131	214	18.1	89.7	33.3	302.2	10068	100%	Beta 9131
Beta 9155	205	18.1	90.7	31.4	307.0	9637	97%	Beta 9155
Crystal M106	214	18.6	89.7	34.0	311.5	10600	108%	Crystal M106
Crystal M168	219	18.0	90.4	33.1	303.6	10055	100%	Crystal M168
Hilleshog 2395	213	18.2	89.6	31.9	303.7	9704	97%	Hilleshog 2395
Hilleshog 2398	218	18.5	89.9	31.9	310.4	9903	101%	Hilleshog 2398
Crystal M089		17.8	90.2	38.8	299.5	11636	114%	Crystal M089
Average	**213**	**18.2**	**90.0**	**32.6**	**306.2**	**9972**	**100.0%**	**Average**

Planted: May 4, 2023
Harvested: September 28, 2023
Agriculturalist: Charles Tvedt

SMBSC Variety Strip Trial - Lake Lillian

Variety	28 DAP Stand Beets/100' row	Sugar %	Purity %	Tons / Acre	Extractable Sugar per Ton	Extractable Sugar per Acre	Percent Rev/Acre	Variety
Beta 9131	201	17.0	89.8	48.3	283.1	13675	101%	Beta 9131
Beta 9155	209	16.4	89.9	52.0	274.3	14274	101%	Beta 9155
Crystal M106	206	17.3	89.6	44.7	288.5	12902	97%	Crystal M106
Crystal M168	208	16.8	90.2	48.0	281.2	13490	99%	Crystal M168
Hilleshog 2395	198	16.9	89.7	49.6	281.5	13969	102%	Hilleshog 2395
Hilleshog 2398	193	16.8	90.1	49.0	281.1	13784	101%	Hilleshog 2398
Average	**205**	**16.9**	**89.9**	**48.6**	**281.6**	**13682**	**100.0%**	**Average**

Planted: May 5, 2023
Harvested: October 24, 2023
Agriculturalist: Dylan Swanson

Hector OVT

Entry	Name	Tons		Sugar		Percent ES		EST		ESA		Emergence		Purity	
		Mean	% Mean	Mean	% Mean	Mean	% Mean	Mean	% Mean	Mean	% Mean	Mean	% Mean	Mean	% Mean
1	Crystal M089	37.53	113.60	15.49	97.10	12.82	98.00	256.41	98.00	9,620.8	110.50	40.36	110.90	89.60	100.80
2	Hill 2327	29.03	87.90	15.38	96.40	12.59	96.20	251.75	96.20	7,308.4	83.90	25.42	69.80	88.89	100.00
3	Baseline 9 SV RR863	32.29	97.70	15.62	97.90	12.71	97.10	254.22	97.10	8,196.6	94.10	27.09	74.40	88.48	99.50
4	Filler #4	11.94	36.10	14.42	90.40	11.55	88.20	231	88.20	2,780.7	31.90	4.73	13.00	87.74	98.70
5	Crystal M106	38.4	116.20	16.38	102.70	13.5	103.10	269.93	103.10	10,417.5	119.60	49.1	134.90	89.08	100.20
6	Beta 9155	38.33	116.00	16.25	101.90	13.43	102.60	268.5	102.60	10,268.4	117.90	43.24	118.80	89.3	100.40
7	Beta 9325	35.44	107.30	16.26	101.90	13.37	102.20	267.48	102.20	9,530.2	109.40	40.92	112.40	88.99	100.10
8	Beta 9044	32.97	99.80	16.52	103.50	13.51	103.20	270.24	103.20	8,877.2	101.90	43.77	120.30	88.59	99.70
9	Hill 2484	28.93	87.60	15.44	96.80	12.57	96.00	251.32	96.00	7,568.0	86.90	9.75	26.80	88.51	99.60
10	Beta 9131	37.81	114.40	16.24	101.80	13.36	102.10	267.16	102.10	10,056.2	115.50	49.71	136.60	88.99	100.10
11	Filler #3	9.63	29.20	15.33	96.10	12.42	94.90	248.47	94.90	2,465.7	28.30	1.35	3.70	88.24	99.30
12	Beta 9124	36.5	110.50	16.27	102.00	13.47	103.00	269.5	103.00	9,823.8	112.80	41.14	113.00	89.49	100.70
13	SV 833	35.27	106.80	15.56	97.50	12.67	96.80	253.34	96.80	8,896.3	102.10	40.27	110.60	88.5	99.50
14	Crystal M028	35.53	107.60	16.37	102.60	13.45	102.80	269.06	102.80	9,611.8	110.40	44.02	120.90	88.88	100.00
15	Hill 2485	34.57	104.70	15.49	97.10	12.72	97.20	254.49	97.20	8,728.4	100.20	39.82	109.40	89.09	100.20
16	Baseline 10 Crystal M623	38.49	116.50	16.05	100.60	13.15	100.50	262.95	100.50	10,143.7	116.50	44.98	123.60	88.76	99.80
17	Beta 9098	35.52	107.50	15.94	99.90	13.16	100.60	263.22	100.60	9,385.6	107.80	45.5	125.00	89.35	100.50
18	Beta 9367	33.96	102.80	16.1	100.90	13.17	100.60	263.37	100.60	8,953.0	102.80	39.22	107.80	88.67	99.70
19	Filler #2	37.46	113.40	16.1	100.90	13.22	101.00	264.36	101.00	9,917.7	113.90	45.97	126.30	88.9	100.00
20	SV 863	32.73	99.10	15.73	98.60	12.91	98.60	258.14	98.60	8,459.1	97.10	35.45	97.40	88.96	100.10
21	Filler #1	38.5	116.50	15.89	99.60	13.15	100.50	263.05	100.50	10,109.5	116.10	44.55	122.40	89.49	100.70
22	Beta 9369	35.8	108.40	16.81	105.40	13.86	105.90	277.14	105.90	9,925.0	114.00	40.68	111.80	89.03	100.10
23	Crystal M343	36.21	109.60	16.45	103.10	13.62	104.10	272.44	104.10	9,911.2	113.80	47.3	130.00	89.38	100.50
24	Hill 2398	31.84	96.40	16	100.30	13.22	101.00	264.42	101.00	8,438.3	96.90	34.77	95.50	89.34	100.50
25	Baseline 12 Hilleshog 2327	33.45	101.30	15.65	98.10	12.78	97.60	255.5	97.60	8,581.0	98.50	34.65	95.20	88.65	99.70
26	Hill 2395	30.68	92.90	15.48	97.10	12.79	97.70	255.77	97.70	7,904.4	90.80	35.26	96.90	89.46	100.60
27	Hill 2483	23.95	72.50	15	94.00	12.14	92.70	242.72	92.70	5,773.1	66.30	12.07	33.20	88.27	99.30
28	Crystal M168	35.63	107.90	16.08	100.80	13.31	101.70	266.12	101.70	9,521.6	109.30	44.76	123.00	89.43	100.60
29	Beta 9284	34.82	105.40	16.15	101.20	13.18	100.70	263.57	100.70	9,223.0	105.90	33.13	91.00	88.5	99.50
30	Crystal M357	30.71	93.00	16.63	104.30	13.63	104.20	272.68	104.20	8,399.8	96.40	38.79	106.60	88.68	99.80
31	Hill 2379	28.75	87.00	15.84	99.30	12.94	98.90	258.79	98.90	7,564.3	86.80	24.28	66.70	88.67	99.70
32	Crystal M339	37.26	112.80	16.45	103.20	13.57	103.60	271.31	103.60	10,147.7	116.50	44.44	122.10	89.1	100.20
33	Beta 9291	32.89	99.60	16.19	101.50	13.27	101.40	265.31	101.40	8,690.0	99.80	32.61	89.60	88.77	99.80
34	Baseline 11 Beta 9780	35.47	107.40	16.43	103.00	13.52	103.30	270.47	103.30	9,580.5	110.00	52.39	143.90	89.01	100.10
35	Crystal M977	37.2	112.60	15.91	99.70	13.03	99.60	260.67	99.60	9,637.9	110.70	40.89	112.40	88.82	99.90
36	Crystal M322	33.72	102.10	16.36	102.60	13.42	102.60	268.46	102.60	9,133.2	104.90	37.82	103.90	88.79	99.90
	GRAND MEAN	33.03		15.95		13.09		261.76		8,709.7		36.39		88.9	
	Residual	6.24		0.18		0.15		61.68		490,008.19		57.08		0.2	
	%CV	8.01		2.76		3.11		3.11		8.51		21.57		0.52	
	LSD	3.02		0.5		0.46		9.28		846.62		8.96		0.53	

Lake Lillian OVT

Entry	Name	Tons		Sugar		Percent ES		EST		ESA		Emergence		Purity	
		Mean	% Mean	Mean	% Mean	Mean	% Mean	Mean	% Mean	Mean	% Mean	Mean	% Mean	Mean	% Mean
1	Crystal M089	40.22	102.40	16.78	97.60	14.16	97.90	283.23	97.90	11,273.5	99.10	62.25	96.60	90.57	100.40
2	Hill 2327	39.85	101.50	17.26	100.40	14.64	101.20	292.78	101.20	11,566.7	101.70	65.44	101.60	90.79	100.60
3	Baseline 9 SV RR863	40.37	102.80	17.32	100.70	14.57	100.70	291.36	100.70	11,662.9	102.50	68.15	105.80	90.27	100.00
4	Filler #4	21.79	55.50	16.16	93.90	13.45	93.00	269.09	93.00	5,867.3	51.60	13.17	20.50	89.75	99.40
5	Crystal M106	40.23	102.50	17.39	101.10	14.56	100.70	291.3	100.70	11,696.9	102.80	76.94	119.40	89.93	99.60
6	Beta 9155	43.65	111.20	16.81	97.70	13.96	96.50	279.21	96.50	12,235.5	107.50	69.67	108.10	89.58	99.30
7	Beta 9325	41.32	105.20	17.25	100.30	14.52	100.40	290.34	100.40	12,071.2	106.10	70.31	109.10	90.37	100.10
8	Beta 9044	39.04	99.50	18.03	104.80	15.21	105.20	304.23	105.20	11,935.5	104.90	64.03	99.40	90.33	100.10
9	Hill 2484	39.14	99.70	16.6	96.50	13.83	95.60	276.61	95.60	10,867.4	95.50	35.93	55.80	89.82	99.50
10	Beta 9131	43.11	109.80	17.22	100.10	14.54	100.50	290.8	100.50	12,457.6	109.50	66.76	103.60	90.5	100.30
11	Filler #3	19.5	49.70	15.94	92.70	13.17	91.10	263.34	91.10	5,145.9	45.20	8.32	12.90	89.21	98.80
12	Beta 9124	40.06	102.10	17.62	102.40	14.87	102.80	297.33	102.80	11,931.7	104.90	63.3	98.30	90.42	100.20
13	SV 833	39.51	100.60	17.27	100.40	14.46	100.00	289.26	100.00	11,425.9	100.40	65.8	102.10	90.02	99.80
14	Crystal M028	39.08	99.50	17.92	104.20	15.1	104.40	302.07	104.40	11,736.2	103.10	72.78	113.00	90.24	100.00
15	Hill 2485	41.81	106.50	16.59	96.40	14	96.80	280.09	96.80	11,727.8	103.10	73.78	114.50	90.74	100.50
16	Baseline 10 Crystal M623	39.73	101.20	16.89	98.20	14.12	97.60	282.34	97.60	11,261.0	99.00	68.69	106.60	89.98	99.70
17	Beta 9098	39.82	101.40	17.45	101.40	14.72	101.80	294.33	101.80	11,723.0	103.00	72.07	111.90	90.44	100.20
18	Beta 9367	40.02	101.90	17.6	102.30	14.84	102.60	296.78	102.60	11,971.8	105.20	77.81	120.80	90.45	100.20
19	Filler #2	38.8	98.80	17.23	100.20	14.55	100.60	291.04	100.60	11,324.7	99.50	59.14	91.80	90.49	100.30
20	SV 863	39.28	100.10	17.12	99.50	14.4	99.60	288.01	99.60	11,365.8	99.90	61.84	96.00	90.33	100.10
21	Filler #1	40.9	104.20	16.8	97.70	14.19	98.20	283.88	98.20	11,681.7	102.70	73.28	113.70	90.72	100.50
22	Beta 9369	41.2	104.90	17.62	102.40	14.94	103.30	298.89	103.30	12,333.2	108.40	75.04	116.50	90.77	100.60
23	Crystal M343	41.15	104.80	17.52	101.80	14.7	101.70	294.1	101.70	12,135.7	106.70	77.53	120.40	90.1	99.80
24	Hill 2398	39.82	101.40	17.04	99.10	14.34	99.20	286.81	99.20	11,418.6	100.40	69.19	107.40	90.31	100.10
25	Baseline 12 Hilleshog 2327	40.86	104.10	17.16	99.80	14.4	99.60	287.97	99.60	11,775.0	103.50	68.31	106.00	90.18	99.90
26	Hill 2395	41.85	106.60	16.93	98.40	14.23	98.40	284.69	98.40	11,840.8	104.10	74.44	115.50	90.32	100.10
27	Hill 2483	40.04	102.00	17.17	99.80	14.37	99.40	287.38	99.40	11,487.7	101.00	49.99	77.60	89.98	99.70
28	Crystal M168	41.15	104.80	17.25	100.30	14.47	100.00	289.35	100.00	11,980.6	105.30	70.79	109.90	90.15	99.90
29	Beta 9284	40.63	103.50	17.53	101.90	14.78	102.20	295.63	102.20	12,058.2	106.00	69.62	108.10	90.4	100.20
30	Crystal M357	39.3	100.10	17.81	103.60	15.07	104.20	301.41	104.20	11,891.6	104.50	66.95	103.90	90.58	100.40
31	Hill 2379	38.57	98.30	17.21	100.10	14.47	100.10	289.46	100.10	11,244.5	98.80	66.6	103.40	90.3	100.10
32	Crystal M339	40.2	102.40	17.45	101.50	14.67	101.50	293.49	101.50	11,762.6	103.40	77.28	120.00	90.19	99.90
33	Beta 9291	38.63	98.40	17.64	102.60	14.97	103.50	299.39	103.50	11,613.1	102.10	60.61	94.10	90.77	100.60
34	Baseline 11 Beta 9780	40.15	102.30	17.3	100.60	14.55	100.60	291	100.60	11,624.5	102.20	75.44	117.10	90.23	100.00
35	Crystal M977	43.52	110.90	16.74	97.30	14.03	97.00	280.57	97.00	12,074.2	106.10	69.6	108.00	90.07	99.80
36	Crystal M322	38.97	99.30	17.63	102.50	14.72	101.80	294.49	101.80	11,459.7	100.70	58.37	90.60	89.66	99.30
	GRAND MEAN	39.26		17.2		14.46		289.22		11,378.6		64.42		90.25	
	Residual	3.72		0.05		0.04		16.11		341,563.04		60.17		0.2	
	%CV	5.11		1.38		1.48		1.48		5.25		12.54		0.51	
	LSD	2.29		0.27		0.24		4.87		681.54		9.22		0.53	

Murdock OVT

Entry	Name	Tons Mean	Tons % Mean	Sugar Mean	Sugar % Mean	Percent ES Mean	Percent ES % Mean	EST Mean	EST % Mean	ESA Mean	ESA % Mean	Emergence Mean	Emergence % Mean	Purity Mean	Purity % Mean
1	Crystal M089	43.93	118.60	16.22	98.60	13.53	98.80	270.69	98.80	11,862.0	116.80	50.10	101.50	89.89	100.10
2	Hill 2327	36.17	97.60	16.31	99.20	13.56	99.00	271.29	99.00	9,705.8	95.60	46.41	94.00	89.69	99.80
3	Baseline 9 SV RR863	36.07	97.40	16.26	98.90	13.49	98.40	269.78	98.40	9,784.1	96.40	46.9	95.00	89.51	99.70
4	Filler #4	19.46	52.50	15.13	92.00	12.27	89.50	245.44	89.50	4,779.8	47.10	5.07	10.30	88.28	98.30
5	Crystal M106	38.71	104.50	16.97	103.20	14.18	103.50	283.67	103.50	10,949.9	107.90	58.86	119.20	89.9	100.10
6	Beta 9155	44.2	119.30	16.43	99.90	13.72	100.10	274.47	100.10	12,106.9	119.30	52.97	107.30	89.97	100.20
7	Beta 9325	35.9	96.90	16.8	102.20	14	102.20	280.04	102.20	10,137.9	99.90	48.11	97.50	89.77	99.90
8	Beta 9044	39.5	106.70	16.57	100.70	13.91	101.50	278.17	101.50	10,921.8	107.60	51.06	103.40	90.29	100.50
9	Hill 2484	30.38	82.00	16.14	98.20	13.24	96.60	264.85	96.60	8,017.7	79.00	29.03	58.80	88.88	99.00
10	Beta 9131	40.19	108.50	16.19	98.50	13.51	98.50	270.12	98.50	10,837.4	106.70	51.93	105.20	89.94	100.10
11	Filler #3	11.98	32.40	15.51	94.30	12.62	92.10	252.38	92.10	3,012.4	29.70	1.26	2.60	88.44	98.50
12	Beta 9124	38.01	102.60	16.75	101.90	14.14	103.10	282.73	103.10	10,678.3	105.20	56.41	114.30	90.59	100.80
13	SV 833	39.56	106.80	16.64	101.20	13.85	101.00	276.96	101.00	10,892.7	107.30	54.11	109.60	89.68	99.80
14	Crystal M028	37.79	102.00	16.97	103.20	14.16	103.30	283.23	103.30	10,686.7	105.30	57.11	115.70	89.83	100.00
15	Hill 2485	38.88	105.00	15.91	96.80	13.37	97.60	267.41	97.60	10,364.8	102.10	63.07	127.80	90.53	100.80
16	Baseline 10 Crystal M623	40.58	109.60	16.33	99.30	13.65	99.60	273.02	99.60	11,038.5	108.70	55.98	113.40	90.08	100.30
17	Beta 9098	38.17	103.10	16.24	98.80	13.72	100.10	274.43	100.10	10,463.4	103.10	65.09	131.80	90.85	101.10
18	Beta 9367	33.31	89.90	17.11	104.10	14.3	104.30	285.92	104.30	9,500.6	93.60	48.95	99.20	89.79	100.00
19	Filler #2	42.13	113.70	16.13	98.10	13.54	98.80	270.89	98.80	11,438.3	112.70	58.06	117.60	90.47	100.70
20	SV 863	33.22	89.70	16.42	99.80	13.74	100.20	274.72	100.20	9,013.8	88.80	50.44	102.20	90.16	100.40
21	Filler #1	43.94	118.60	16.35	99.40	13.74	100.30	274.81	100.30	12,221.0	120.40	54.74	110.90	90.45	100.70
22	Beta 9369	37.17	100.40	17.11	104.00	14.27	104.20	285.49	104.20	10,756.6	106.00	42.58	86.30	89.76	99.90
23	Crystal M343	40.45	109.20	16.56	100.70	13.8	100.70	276.02	100.70	11,063.3	109.00	51.16	103.60	89.83	100.00
24	Hill 2398	35.28	95.30	16.02	97.40	13.29	97.00	265.86	97.00	9,316.4	91.80	57.79	117.10	89.62	99.80
25	Baseline 12 Hilleshog 2327	39.86	107.60	16.12	98.00	13.31	97.10	266.21	97.10	10,539.5	103.80	59.1	119.70	89.29	99.40
26	Hill 2395	39.81	107.50	15.68	95.40	13.09	95.50	261.73	95.50	10,088.3	99.40	65.96	133.60	90.09	100.30
27	Hill 2483	30.97	83.60	16.84	102.40	13.93	101.60	278.52	101.60	8,714.9	85.80	28.04	56.80	89.22	99.30
28	Crystal M168	44.22	119.40	16.84	102.40	14.08	102.70	281.53	102.70	12,418.7	122.30	58.54	118.60	89.96	100.10
29	Beta 9284	37.4	101.00	16.66	101.30	13.91	101.50	278.19	101.50	10,428.7	102.70	57.4	116.30	89.89	100.10
30	Crystal M357	36.66	99.00	17.13	104.20	14.3	104.30	285.93	104.30	10,507.3	103.50	40.19	81.40	89.76	99.90
31	Hill 2379	36.62	98.90	16.43	99.90	13.71	100.00	274.12	100.00	9,842.9	97.00	48.29	97.80	89.88	100.10
32	Crystal M339	38.14	103.00	16.52	100.50	13.74	100.30	274.81	100.30	10,505.1	103.50	53.42	108.20	89.74	99.90
33	Beta 9291	39.13	105.70	16.75	101.80	14	102.10	279.92	102.10	11,004.9	108.40	52.23	105.80	90.01	100.20
34	Baseline 11 Beta 9780	38.61	104.20	16.86	102.50	14.05	102.50	281.07	102.50	10,841.0	106.80	55.03	111.50	89.71	99.90
35	Crystal M977	40.71	109.90	16.17	98.30	13.56	98.90	271.12	98.90	11,007.1	108.40	52.33	106.00	90.34	100.60
36	Crystal M322	36.27	97.90	16.95	103.10	14.12	103.00	282.32	103.00	10,031.9	98.80	49.38	100.00	89.69	99.80
	GRAND MEAN	37.04		16.45		13.71		274.11		10,152.2		49.36		89.83	
	Residual	5.95		0.2		0.15		58.99		673,474.23		101.4		0.26	
	%CV	7.01		2.78		2.91		2.91		8.58		21.35		0.6	
	LSD	2.96		0.52		0.46		9.11		994.36		12.02		0.62	

Renville OVT

Entry	Name	Tons		Sugar		Percent ES		EST		ESA		Emergence		Purity	
		Mean	% Mean	Mean	% Mean	Mean	% Mean	Mean	% Mean	Mean	% Mean	Mean	% Mean	Mean	% Mean
1	Crystal M089	37.88	110.60	16.7	98.40	14.03	98.30	280.70	98.30	10,666.7	109.00	76.29	110.80	90.40	100.00
2	Hill 2327	35.89	104.80	16.88	99.50	14.19	99.40	283.84	99.40	10,205.9	104.30	66.01	95.90	90.29	99.90
3	Baseline 9 SV RR863	35.2	102.80	17.15	101.10	14.44	101.10	288.82	101.10	10,232.8	104.60	71.66	104.10	90.52	100.20
4	Filler #4	10.43	30.50	16.19	95.40	13.34	93.50	266.88	93.50	2,865.1	29.30	6.32	9.20	89.17	98.70
5	Crystal M106	34.76	101.50	17.16	101.10	14.46	101.30	289.22	101.30	10,036.2	102.60	74.28	107.90	90.49	100.10
6	Beta 9155	35.06	102.40	16.81	99.10	14.17	99.30	283.47	99.30	9,932.2	101.50	71.05	103.20	90.45	100.10
7	Beta 9325	36.01	105.20	16.9	99.60	14.14	99.00	282.77	99.00	10,144.5	103.70	72.43	105.20	90.1	99.70
8	Beta 9044	32.67	95.40	17.67	104.10	14.94	104.60	298.73	104.60	9,753.2	99.70	70.25	102.00	90.51	100.20
9	Hill 2484	34.92	102.00	16.84	99.20	14.03	98.30	280.67	98.30	9,784.4	100.00	40.31	58.50	89.91	99.50
10	Beta 9131	36.6	106.90	16.99	100.20	14.42	101.00	288.42	101.00	10,516.4	107.50	79.69	115.70	90.78	100.40
11	Filler #3	12.6	36.80	16.37	96.50	13.53	94.80	270.58	94.80	3,505.8	35.80	9.04	13.10	89.34	98.90
12	Beta 9124	37.13	108.40	16.97	100.00	14.35	100.50	286.94	100.50	10,611.3	108.40	73.76	107.10	90.65	100.30
13	SV 833	36.25	105.90	16.82	99.10	14.17	99.20	283.36	99.20	10,219.0	104.40	79.76	115.80	90.47	100.10
14	Crystal M028	35.43	103.50	17.26	101.70	14.54	101.80	290.71	101.80	10,240.3	104.60	74.96	108.90	90.28	99.90
15	Hill 2485	37.17	108.50	16.58	97.70	13.98	97.90	279.63	97.90	10,312.8	105.40	76.64	111.30	90.72	100.40
16	Baseline 10 Crystal M623	32.95	96.20	16.65	98.20	14.15	99.10	283.01	99.10	9,174.1	93.70	75.27	109.30	91.25	101.00
17	Beta 9098	36.5	106.60	17.1	100.80	14.47	101.30	289.39	101.30	10,550.1	107.80	78.73	114.30	90.76	100.40
18	Beta 9367	36.43	106.40	17.17	101.20	14.49	101.50	289.77	101.50	10,556.8	107.90	75.84	110.10	90.54	100.20
19	Filler #2	35.95	105.00	17	100.20	14.36	100.60	287.29	100.60	10,273.1	105.00	73.09	106.10	90.65	100.30
20	SV 863	34.58	101.00	16.91	99.60	14.25	99.80	284.99	99.80	9,884.4	101.00	73.39	106.60	90.5	100.10
21	Filler #1	37.15	108.50	16.75	98.70	14.07	98.50	281.38	98.50	10,358.6	105.90	72.22	104.90	90.24	99.80
22	Beta 9369	37.42	109.30	17.23	101.60	14.59	102.20	291.85	102.20	10,916.2	111.60	75.69	109.90	90.7	100.40
23	Crystal M343	37.45	109.40	17.2	101.40	14.48	101.40	289.5	101.40	10,885.5	111.20	77.48	112.50	90.38	100.00
24	Hill 2398	35.13	102.60	17.02	100.30	14.32	100.30	286.36	100.30	10,052.0	102.70	79.27	115.10	90.28	99.90
25	Baseline 12 Hilleshog 2327	36.1	105.40	17.1	100.80	14.36	100.50	287.13	100.50	10,388.9	106.20	75.08	109.00	90.23	99.80
26	Hill 2395	37.3	108.90	16.76	98.80	14.08	98.60	281.63	98.60	10,456.4	106.90	83.44	121.20	90.23	99.80
27	Hill 2483	31.28	91.30	17.08	100.70	14.32	100.30	286.45	100.30	8,757.0	89.50	43.5	63.20	90.04	99.60
28	Crystal M168	36.68	107.10	17	100.20	14.4	100.90	288.07	100.90	10,514.9	107.50	76.96	111.80	90.85	100.50
29	Beta 9284	34.62	101.10	17.16	101.20	14.45	101.20	288.94	101.20	10,011.5	102.30	66.38	96.40	90.25	99.90
30	Crystal M357	33.55	98.00	17.31	102.00	14.63	102.40	292.53	102.40	9,767.5	99.80	71.99	104.50	90.51	100.20
31	Hill 2379	35.27	103.00	16.93	99.80	14.3	100.20	286	100.20	10,161.3	103.80	72.67	105.50	90.63	100.30
32	Crystal M339	35.47	103.60	17.01	100.20	14.33	100.40	286.6	100.40	10,143.0	103.70	79.22	115.00	90.45	100.10
33	Beta 9291	36.52	106.60	16.74	98.60	14.09	98.70	281.74	98.70	10,338.2	105.60	67.79	98.40	90.34	100.00
34	Baseline 11 Beta 9780	35.71	104.30	17.38	102.40	14.75	103.30	294.92	103.30	10,559.6	107.90	71.8	104.30	90.8	100.50
35	Crystal M977	36.63	107.00	16.81	99.10	14.13	98.90	282.5	98.90	10,327.2	105.50	79.38	115.30	90.26	99.90
36	Crystal M322	32.04	93.60	17.2	101.30	14.29	100.10	285.79	100.10	9,182.8	93.80	67.33	97.80	89.49	99.00
	GRAND MEAN	34.24		16.97		14.28		285.57		9,785.7		68.86		90.37	
	Residual	4.09		0.1		0.11		43.53		369,382.34		45.07		0.32	
	%CV	6.22		2		2.42		2.42		6.48		9.97		0.65	
	LSD	2.43		0.39		0.4		7.9		723.69		7.84		0.67	

Date of Harvest Trials

Southern Minnesota Beet Sugar Cooperative Research

Since 2011, SMBSC has been conducting trials from mid-August through mid-October to measure the growth rate and sugar content of sugar beets, which increase yield until harvest. This growth can vary with annual environmental conditions and foliage health.

Research Objective

- These trials provided rate of growth data for each season for sugar percent, root yield, purity, and extractable sugar per acre (ESA). The weekly harvest information could also be used to examine the SMBSC pre-pile premium and how effectively it compensates shareholders for early harvesting a portion of their sugar beet crop.

Methodology

These trials are replicated at 2-4 locations, often coinciding with the sites of the SMBSC Official Variety Trials. In 2023, the Date of Harvest Trials took place near Murdock, Lake Lillian, and Renville. These trials followed best management practices similar to the Official Variety Trials.

During the harvest season, approximately 180 feet of sugar beet row was harvested weekly from each location from mid-August to early October. Harvesting was performed using a tractor-mounted one-row defoliator and harvester. The harvested beets were placed in tare bags and sent to the SMBSC Tare Lab for weight and quality analysis, including tare, sugar content, and purity.

Each week, the length of the row harvested was measured, and these measurements were used to calculate the harvested area. This data was then utilized to determine the yield on a per-acre basis, providing valuable insights into the growth and sugar accumulation of the sugar beets during this period.

Results

The first harvest date for the trial was August 12, 2023. Harvest continued once per week until October 14, 2023. A total of nine harvest timings were completed in 2023. Trials sites had even stands, uniform canopy development, and minimal root rot at Renville, with Lake Lillian and Murdock having light to moderate root rot. All sites had minimal levels of CLS.

The 2023 regression analysis of extractable sugar per acre in Figure 1 reveals a daily increase of 87.34 lbs. This exceeds the eleven-year average of 81.73 lbs. (Table 1). Table 1 also contains the daily pounds of extractable sugar per acre increase for every year since 2012.

Figure 2 shows the sugar percent each week of the 2023 Date of Harvest Trial. The weekly sugar percent dropped in late September due to substantial rainfall. Table 2 shows that the daily increase in sugar percent for 2023 was 0.05%, slightly below the eleven-year average of 0.06%. Weekly increases in sugar percent followed a similar pattern, with the current year's gain at 0.37% compared to the long-term average of 0.39%.

The 2023 root yield data in Figure 3 shows the weekly change in tons per acre during the 2023 Date of Harvest Trial. Table 3 has the root yield rate of gain for 2012-2023. In 2023, the average daily rate of gain of 0.23 tons per acre was marginally above the 2012-2022 average of 0.22 tons. This upward trend was also reflected every week, with a gain of 1.59 tons per acre, which compares favorably against the 2012-2022 average of 1.55 tons per acre weekly gain.

A second purpose of the Date of Harvest Trials is to provide data on how well the pre-pile premium compensates SMBSC producers for their early-harvest deliveries. The pre-pile premium was instituted at SMBSC to pay an additional premium on early-harvested tons to compensate growers for the loss of the growing season and yield potential on early-harvested beets. For 2023, pre-pile began for SMBSC growers on 8/14/2023 and ended 47 days later on 9/29/2023, with the main harvest beginning on 10/01/2023.

Table 4 compares the weekly yield and revenue results for each Date of Harvest Trial week. The revenue values were calculated using a payment calculator with the November 29, 2023 payment estimate. The prepile premium was calculated using the December 2023 prepile premium estimate. The revenue values are shown as a percent of the main harvest. This is done by treating the harvest date 10/05/2023 (the nearest to main harvest that occurs at or after the main harvest) as the “mean” and comparing this value to other dates. The nearer a value is to 100.0, the closer the value is to the payment on day 1 of the main harvest; as a value grows larger than 100, that revenue is more than the first day of the main harvest. With the exception of the 8/16/2023 harvest date, all prepile dates saw higher revenues than the first day of main harvest. For data generated in the 2023 Date of Harvest Trial, revenue per acre averaged 5.4% greater for those acres where tons were delivered during pre-pile than at the beginning of main harvest.

It is important to point out that this trial compares "like for like" in that the harvested beets are designed to be as uniform as possible and represent the main part of a given sugar beet field. This can be different than the pre-pile harvest that many producers conduct. A common use of pre-pile allocation at SMBSC is harvesting headlands before the start of main harvest. These headlands may have yield and quality that differ from the main part of a field.

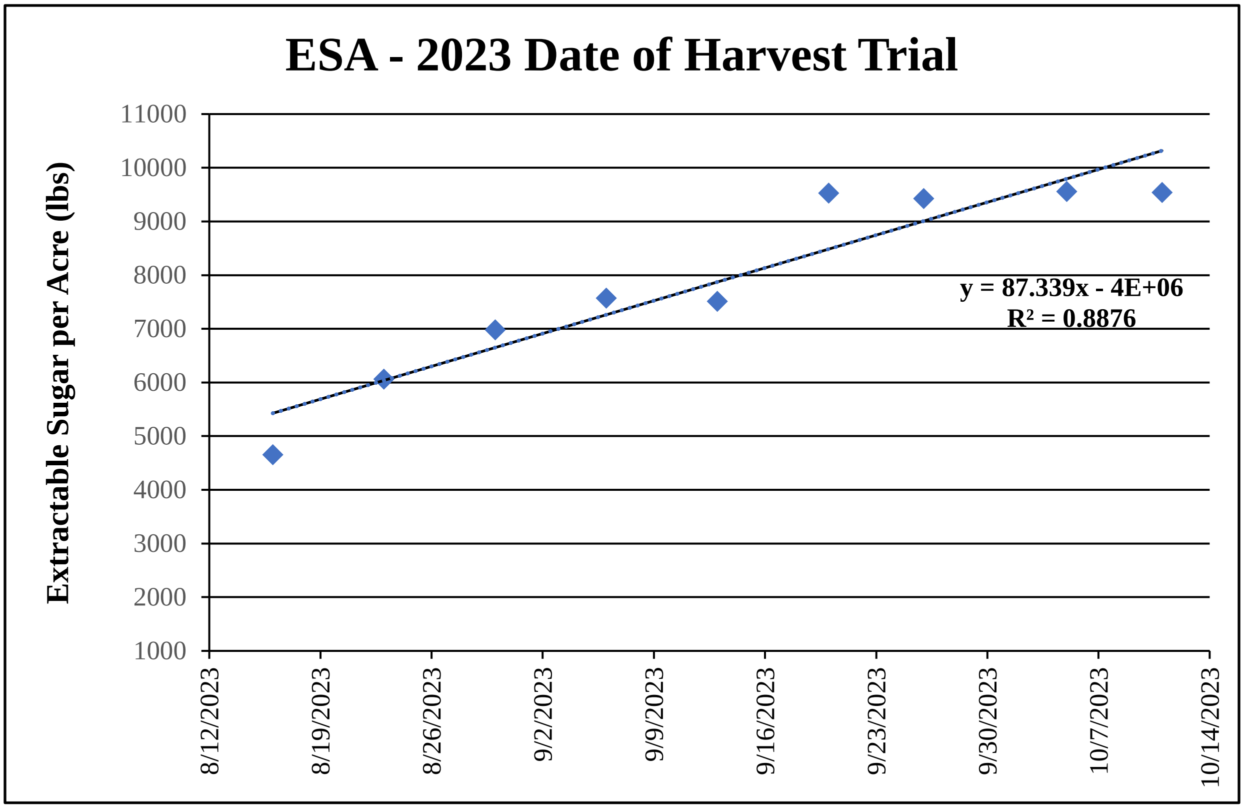

Figure 1. Extractable sugar per acre (ESA) data collected during the 2023 Date of Harvest Trials, plotted across the harvest period, depicting a positive trend

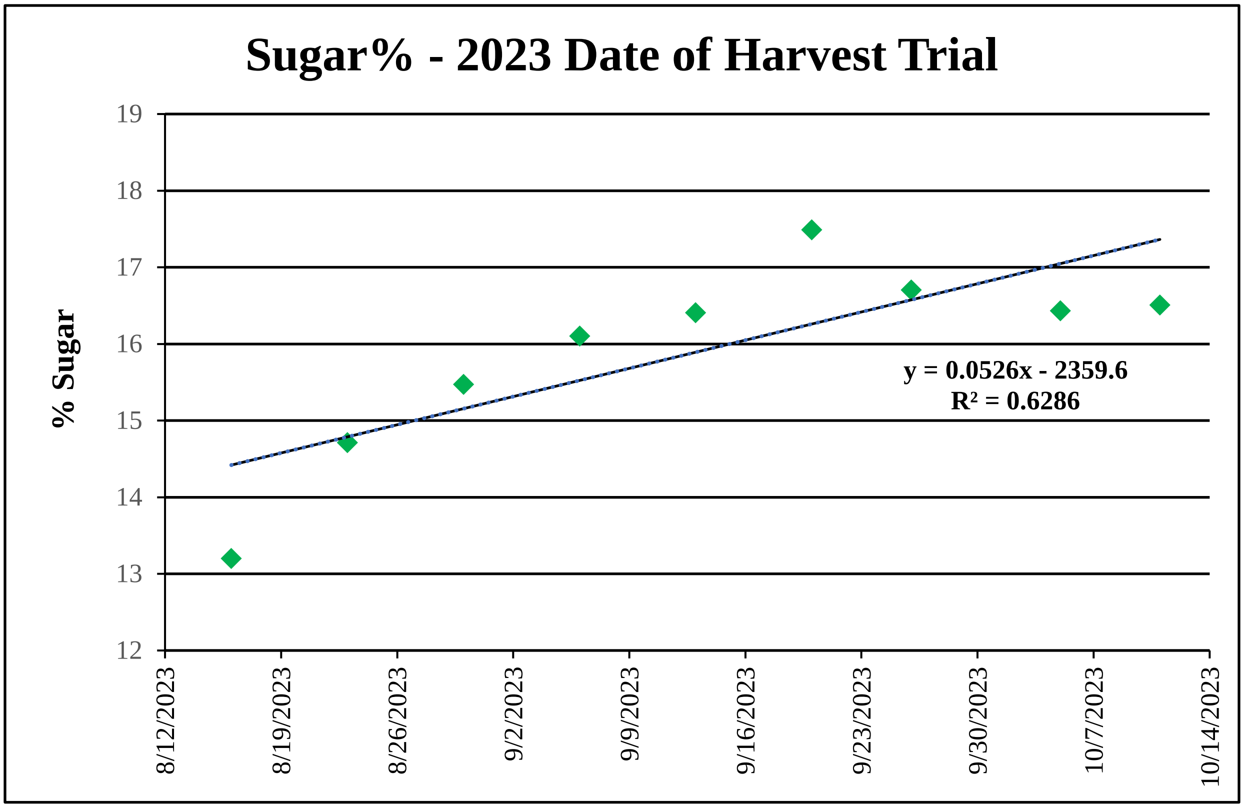

Figure 2. Sugar percent data collected during the 2023 Date of Harvest Trials, plotted across the harvest period, depicting a positive trend

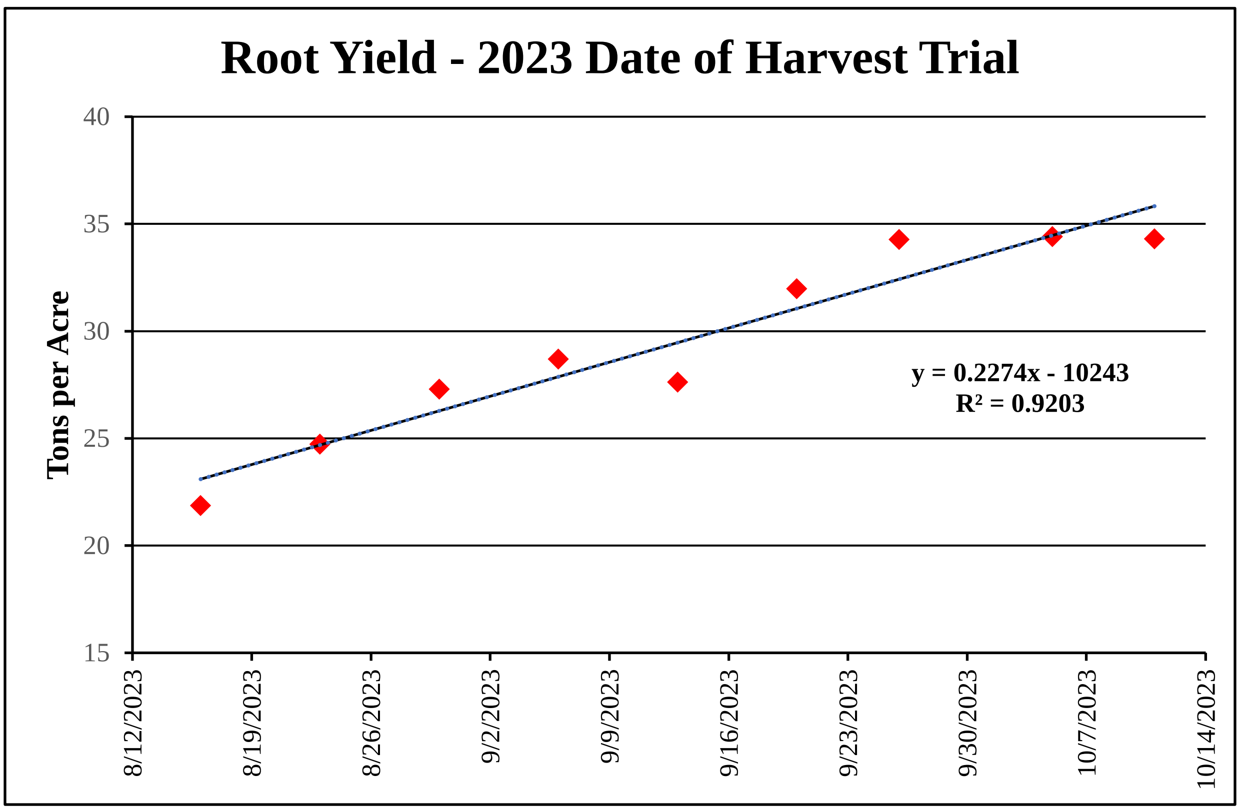

Figure 3. Root yield data collected during the 2023 Date of Harvest Trials, plotted across the harvest period, depicting a positive trend.

Table 1. 2012-2023 Regression Analysis of Extractable Sugar per Acre Increase per Day

Year	Extractable Sugar per Acre Increase per Day (lbs.)
2012	89.0
2013	91.6
2014	93.4
2015	99.8
2016	45.7
2017	60.0
2018	63.8
2019	78.6
2020	79.0
2021	106.8
2022	91.3
Average (2012-2022)	81.7
2023	87.3

Table 2. 2012-2023 Regression Analysis of Percent Sugar Increase per Day

Year	Percent Sugar Increase per Day (%)	Percent Sugar Increase per Week (%)
2012	0.09	0.63
2013	0.05	0.35
2014	0.09	0.63
2015	0.06	0.42
2016	0.03	0.21
2017	0.06	0.42
2018	0.01	0.04
2019	0.04	0.28
2020	0.07	0.49
2021	0.02	0.14
2022	0.09	0.65
Average (2012-2022)	0.06	0.39
2023	0.05	0.37

Table 3. 2012-2023 Regression Analysis Results of Root Yield Increase per Day

Year	Root Yield Increase per Day (tons/acre)	Root Yield Increase per Week (tons/acre)
2012	0.15	1.06
2013	0.29	2.01
2014	0.23	1.59
2015	0.24	1.67
2016	0.14	0.99
2017	0.12	0.82
2018	0.27	1.87
2019	0.24	1.66
2020	0.16	1.12
2021	0.37	2.61
2022	0.24	1.68
Average (2012-2022)	0.22	1.55
2023	0.23	1.59

Table 4. 2023 Date of Harvest Data with Pre-pile Percent of Main Harvest

Week	Date	Sugar (%)	Purity (%)	Root Yield (tons/acre)	ES (%)	EST (lbs)	ESA (lbs)	Revenue without Prepile Premium per Acre (Percent of Main Harvest)	Total Payment per Acre with Premium (Percent of Main Harvest)
1	8/16/2023	13.2	88.6	21.9	10.6	212.9	4657.2	36.7	86.2
2	8/23/2023	14.7	90.3	24.7	12.3	245.4	6066.8	56.7	104.0
3	8/30/2023	15.5	89.5	27.3	12.8	255.9	6983.3	68.0	110.6
4	9/6/2023	16.1	88.8	28.7	13.2	263.9	7573.3	75.8	110.5
5	9/13/2023	16.4	89.5	27.6	13.6	272.0	7512.7	77.2	100.9
6	9/20/2023	17.5	91.1	32.0	14.9	298.0	9528.7	105.1	121.3
7	9/26/2023	16.7	88.9	34.3	13.7	275.0	9426.8	97.8	104.8
Main Harvest	10/5/2023	16.4	90.8	34.4	13.9	277.9	9560.8	100.0	100.0
Main Harvest	10/11/2023	16.5	90.6	34.3	13.9	278.2	9541.8	100.0	100.0

Conclusion

The percent sugar peaked at 17.5% on 9/20/2023 and declined a full point by 10/11/2023. During this period ESA was stagnant. This was similar to the rest of the co-op as conditions became wetter just prior to and during the start of full harvest. The percent sugar and root yield growth rates were near the long-term averages. However, the ESA growth rate was slightly greater than the long-term average. All but the first week of the 2023 Date of Harvest Trial was greater than 100% of main harvest revenue per acre, and the 2023 Date of Harvest Data mirrors the Cooperative trend. Thus, the data generated in this trial supports that the pre-pile premium program worked as designed: to pay premiums on deliveries in the pre-pile period at, or above, the payments for deliveries on the first day of main harvest.

Cercospora Leaf Spot Fungicide Screening Trial

David Mettler[1] and **Mark Bloomquist**[2]
[1]Research Agronomist, [2]Research Director, SMBSC, Renville, MN

Cercospora leaf spot (CLS) is the most destructive foliar disease to impact sugar beet production in the SMBSC growing area. Without effective new fungicides, controlling the disease has become more difficult. Despite advancements in variety tolerance to CLS the key to control is still utilizing best management practices that include an appropriately timed fungicide program that incorporates multiple modes of action along with planting sugar beet varieties with higher levels of genetic tolerance to CLS.

Research Objective

- An effective fungicide program paired with genetic tolerance is necessary to grow a profitable crop. Trials need to be conducted to evaluate individual fungicides to determine if there is a benefit to using a particular fungicide in the recommended CLS program.

Methodology

In 2023 the Fungicide Screening Trial was conducted as randomized complete block with four replications and was located near Clara City, MN. This trial evaluated fungicides individually, and in combinations to look at possible synergies. The site was planted on May 24th using Crystal M977. Dual Magnum was applied preemergence and other standard practices were used post emergence to keep the site weed free. The site was inoculated with pulverized leaves from the previous year that were infected with CLS. The inoculum was spread evenly across the site with a Gandy Orbit-Air applicator on July 11th. Five fungicide applications were made in the Fungicide Screening Trial beginning July 13th and continuing on a ten to twelve-day spray interval.

Applications were made using a custom-made tractor mounted sprayer traveling 3.1mph with a spray volume of 20gpa and 60psi, utilizing XR11002 spray nozzles (Photo 1). Each plot consisted of six rows that were 35ft in length. The sprayer used CO^2 as a propellant and was designed to apply the treatment to the center four rows, leaving rows one and six untreated. Plots were rated for foliar damage using the (1-9) KWS (Kleinwanzlebener Saatzucht) scale with one being disease free and nine being completely necrotic. The center two rows of each six-row plot were harvested on September 19th using a six-row defoliator and a two-row research harvester. The beets harvested from the center two rows were weighed on the harvester and a sample of those beets were used for a quality analysis at the SMBSC tare lab. The data was analyzed for significance using SAS version 9.4.

Photo 1. Tractor mounted sprayer used for fungicide applications.

Results

In the Fungicide Screening Trial there were significant differences in overall yield and in foliar disease ratings. The unsprayed control had significantly lower yield than any of the other treatments. There was very little difference between the rest of the treatments (Table 1). The control had the highest foliar disease rating, followed by Proline alone and Manzate Prostick alone (Table 2). Most of the tank mixed treatments had similar foliar disease ratings with the Proline plus Manzate Prostick treatment having the lowest rating overall.

Table 1. Yield parameter results for the Fungicide Screening Trial. Values with different letters are significantly different. Table 3 contains a full description of each treatment.

Entry	Entry Description	Percent Sugar	Root Yield Tons/Acre	Percent Extractable Sugar	Extractable Sugar per Ton (lbs.)	Extractable Sugar per Acre (lbs.)	Percent Purity
1	Control	15.2 a	27.1 a	12.6 a	251.9 a	6809.6 a	89.8
2	Manzate Prostick	16.8 bc	33.3 bcd	14.3 bc	285.9 bcd	9511.3 bcd	91.1
3	Proline	17.1 bc	31.4 bc	14.4 bc	286.9 bcd	9003.0 b	90.4
4	Proline+Manzate Prostick	17.0 bc	33.9 de	14.4 bc	287.9 bcd	9765.3 cd	90.9
5	Minerva+Manzate Prostick	17.1 bc	32.6 bcd	14.4 bc	288.3 bcd	9380.9 bcd	90.6
6	Inspire XT+Manzate Prostick	17.3 c	32.7 bcd	14.8 c	294.9 d	9627.4 bcd	91.1
7	Enable+Manzate Prostick	17.1 bc	31.1 b	14.5 bc	288.7 bcd	8993.8 b	90.6
8	Provysol+Manzate Prostick	17.1 bc	31.6 bcd	14.5 bc	290.5 cd	9195.5 bc	91.0
9	Lucento+Manzate Prostick	16.9 bc	33.7 cd	14.2 b	284.5 bcd	9580.8 bcd	90.4
11	Topguard+Manzate Prostick	17.0 bc	32.0 bcd	14.3 bc	286.5 bcd	9144.2 bc	90.7
12	SuperTin+Manzate Prostick	16.9 bc	33.2 bcd	14.3 bc	286.1 bcd	9484.7 bcd	90.6
16	Luna Flex+Manzate Prostick	16.7 b	33.9 de	14.1 b	281.1 bc	9454.0 bcd	90.7
	Mean	16.8	32.5	14.2	284.2	9236.2	90.6
	CV%	2.3	5.2	2.7	2.6	4.9	0.6
	Pr>F	<.0001	0.0001	<.0001	<.0001	<.0001	0.2
	lsd (0.05)	0.55	2.4	0.54	10.7	644.9	ns

Table 2. Foliar ratings for the Fungicide Screening Trial using the KWS (1-9) rating system with 1 being disease free and 9 being completely necrotic. Ratings with different letters are significantly different. Table 3 contains a full description of each treatment.

Entry	Entry Description	21-Aug	31-Aug	7-Sep	15-Sep
1	Control	5.8 a	8.3 a	8.9 a	9.0 a
2	Manzate Prostick	1.2 c	2.4 c	3.8 c	4.1 c
3	Proline	1.7 b	3.7 b	4.9 b	5.1 b
4	Proline+Manzate Prostick	1.1 c	1.3 e	2.0 efg	2.0 g
5	Minerva+Manzate Prostick	1.1 c	1.3 e	2.0 efg	2.6 defg
6	Inspire XT+Manzate Prostick	1.1 c	1.5 de	2.1 defg	2.4 efg
7	Enable+Manzate Prostick	1.1 c	1.6 de	2.6 def	3.2 d
8	Provysol+Manzate Prostick	1.1 c	1.5 de	2.3 defg	2.8 def
9	Lucento+Manzate Prostick	1.2 c	1.4 e	1.9 g	2.5 efg
11	Topguard+Manzate Prostick	1.1 c	1.5 de	2.1 defg	2.5 efg
12	SuperTin+Manzate Prostick	1.2 c	1.5 de	2.1 defg	2.7 def
16	Luna Flex+Manzate Prostick	1.1 c	1.3 e	1.9 fg	2.2 fg
	Mean	1.5	2.2	3.1	3.4
	CV%	7.9	15.6	16.2	13.0
	Pr>F	<.0001	<.0001	<.0001	<.0001
	lsd (0.05)	0.2	0.5	0.7	0.6

Conclusions

Despite a low infection year, significant differences still occurred in yield and foliar disease ratings. Treatments that contained only one product had a lower yield and higher foliar disease rating highlighting the importance of tank-mix partners. As in previous years, the tank-mix of Manzate Prostick plus Proline continued to perform very well. In the Fungicide Screening trial most of the triazole products combined with Manzate Prostick had very similar foliar disease ratings. Rotation of these triazole products remains important for resistance management. The results of this trial indicate that all of the triazole products tested are viable options to use in a CLS fungicide program. However, these triazoles should never be applied alone but should be tank-mixed with another fungicide such as mancozeb or copper.

Table 3. Fungicide Screening Trial treatment list.

Entry	Entry Description	Rate/A
1	Control	n/a
2	Manzate Prostick	2 lbs
	Masterlock	6.4 oz
3	Proline	5.7 oz
	Masterlock	6.4 oz
4	Proline	5.7 oz
	Manzate Prostick	2 lbs
	Masterlock	6.4 oz
5	Minerva	13 oz
	Manzate Prostick	2 lbs
	Masterlock	6.4 oz
6	Inspire XT	7 oz
	Manzate Prostick	2 lbs
	Masterlock	6.4 oz
7	Enable	8 oz
	Manzate Prostick	2 lbs
	Masterlock	6.4 oz
8	Provysol	4 oz
	Manzate Prostick	2 lbs
	Masterlock	6.4 oz
9	Lucento	5.5 oz
	Manzate Prostick	2 lbs
	Masterlock	6.4 oz
11	Topguard	14 oz
	Manzate Prostick	2 lbs
	Masterlock	6.4 oz
12	SuperTin	8 oz
	Manzate Prostick	2 lbs
	Masterlock	6.4 oz
16	Luna Flex	13.6 oz
	Manzate Prostick	2 lbs
	Masterlock	6.4 oz

Cercospora Leaf Spot Program Trial

David Mettler[1] and **Mark Bloomquist**[2]
[1]Research Agronomist, [2]Research Director, SMBSC, Renville, MN

Cercospora leaf spot (CLS) is the most destructive foliar disease to impact sugar beet production in the SMBSC growing area. Without effective new fungicides, controlling the disease has become more difficult. Despite advancements in variety tolerance to CLS the key to control is still utilizing best management practices that include an appropriately timed fungicide program that incorporates multiple modes of action along with planting sugar beet varieties with higher levels of genetic tolerance to CLS.

Research Objective

- High levels of cercospora inoculum and a favorable environment for the development of CLS have been major contributors in causing losses to profitability of sugar beet production in the past. Trials need to be conducted to evaluate the efficacy of individual fungicides and season long fungicide programs.

Methodology

In 2023 the CLS Program Trial was conducted as a randomized complete block with four replications and located near Renville, MN. This trial evaluated fungicides in a program setting. The site was planted on May 4th using Crystal M977 for the traditional CLS tolerant variety and Crystal M089 for the high CLS tolerant (HCT) variety. Standard practices were used to keep the site weed free. The site was inoculated with pulverized leaves from the previous year that were infected with CLS. The inoculum was spread evenly across the site with a Gandy Orbit-Air applicator on July 7th. Six fungicide applications were made in the Program Trial beginning July 10th and continuing on a ten to twelve-day spray interval.

Applications were made using a custom-made tractor mounted sprayer traveling 3.1mph with a spray volume of 20gpa and 60psi, utilizing XR11002 spray nozzles (Photo 1). Each plot consisted of six rows that were 35ft in length. The sprayer used CO^2 as a propellant and was designed to apply the treatment to the center four rows, leaving rows one and six untreated. Plots were rated for foliar damage using the (1-9) KWS (Kleinwanzlebener Saatzucht) scale with one being disease free and nine being completely necrotic. The center two rows of each six-row plot were harvested on September 18th using a six-row defoliator and a two-row research harvester. The beets harvested from the center two rows were weighed on the harvester and a sample of those beets were used for a quality analysis at the SMBSC tare lab. The data was analyzed for significance using SAS version 9.4.

Photo 1. Tractor mounted sprayer applying a fungicide treatment on August 11th, 2022.

Results

Yield differences were minimal with significant differences occurring between the unsprayed controls compared to most other treatments (Table 1). The traditional variety unsprayed control had the lowest yield followed by the HCT unsprayed control. The foliar disease ratings in the Program Trial were highest in the unsprayed control treatments (Table 2). Differences in foliar disease ratings between all other treatments were minimal.

Table 1. Yield parameter results for the CLS Program Trial. Values with different letters are significantly different. Table 3 contains a full description of each treatment.

Entry	Variety	Entry Description	Percent Sugar	Root Yield Tons/Acre	Percent Extractable Sugar	Extractable Sugar per Ton (lbs.)	Extractable Sugar per Acre (lbs.)	Percent Purity
1	Trad	Control	15.6 a	28.9 a	12.9 a	258.3 a	7436.8 a	89.7
2	HCT	Control	17.0 b	32.3 b	14.1 b	282.2 b	9105.1 b	89.6
3	Trad	7 Spray Program	17.3 b	36.3 c	14.4 b	287.9 b	10339.6 cd	89.7
4	Trad	7 Spray Program (with sulfur, no tin or copper)	17.0 b	37.6 c	14.1 b	282.0 b	10443.5 cd	89.4
5	HCT	4 Spray Program	17.4 b	38.0 c	14.6 b	292.1 b	11054.0 d	90.1
6	HCT	4 Spray Program (Sulfur no copper)	17.0 b	34.9 bc	14.3 b	285.1 b	9945.6 bc	90.3
7	HCT	4 Spray Program (Priaxor no copper)	17.0 b	35.4 bc	14.2 b	284.7 b	10091.0 bcd	90.3
8	HCT	4 Spray Program	17.2 b	34.8 bc	14.6 b	291.1 b	10108.3 bcd	90.7
9	HCT	4 Spray Program (EBDC+Sulfur)	17.0 b	36.1 c	14.3 b	285.5 b	10322.3 cd	90.3
		Mean	16.9	34.7	14.2	283.2	9800.0	90.0
		CV%	2.4	6.6	3.0	2.9	7.7	0.7
		Pr>F	0.0001	0.0045	0.0005	0.0004	0.0005	0.115
		lsd (0.05)	0.6	3.4	0.6	12.2	1106.8	ns

Table 2. Foliar ratings for the Program Trial using the KWS (1-9) rating system with 1 being disease free and 9 being completely necrotic. Ratings with different letters are significantly different. Table 3 contains a full description of each treatment.

Entry	Variety	Entry Description	21-Aug	31-Aug	7-Sep	15-Sep
1	Trad	Control	4.5 a	7.7 a	8.6 a	8.7 a
2	HCT	Control	1.8 b	4.0 b	4.9 b	5.2 b
3	Trad	7 Spray Program	1.0 c	1.2 c	1.7 c	1.7 c
4	Trad	7 Spray Program (with sulfur, no tin or copper)	1.0 c	1.2 c	1.5 c	1.6 cd
5	HCT	4 Spray Program	1.0 c	1.2 c	1.3 c	1.3 d
6	HCT	4 Spray Program (Sulfur no copper)	1.0 c	1.2 c	1.4 c	1.5 cd
7	HCT	4 Spray Program (Priaxor no copper)	1.0 c	1.2 c	1.4 c	1.3 d
8	HCT	4 Spray Program	1.0 c	1.3 c	1.4 c	1.4 cd
9	HCT	4 Spray Program (EBDC+Sulfur)	1.0 c	1.2 c	1.5 c	1.6 cd
		Mean	1.5	2.2	2.6	2.7
		CV%	16.7	11.0	11.8	9.4
		Pr>F	<.0001	<.0001	<.0001	<.0001
		lsd (0.05)	0.4	0.4	0.5	0.4

Conclusions

The overall conditions for disease development were low in 2023. All treatments in the program trial, other than the unsprayed controls, provided good control of CLS. The data from this trial would indicate that our current fungicide program is able to adequately protect a traditional variety from yield losses due to CLS in a season when the environment does not highly favor disease development.

Table 3. Program Trial treatment list. The application code indicates when the product was applied in the six spray program.

Entry	Variety	Entry Description	Product	Rate/Acre		Application Code
1	Trad	Control	n/a	n/a		n/a
2	HCT	Control	n/a	n/a		n/a
3	Trad	7 Spray Program	SuperTin	8	oz	BD
			Masterlock	6.4	oz	0ABCDE
			Lucento	5.5	oz	C
			Manzate Prostick	2	lbs	0ABCDE
			Proline	5.7	oz	A
			Provysol	4	oz	E
4	Trad	7 Spray Program w/ Sulfur no tin no copper	Microthiol Disperss	1	lb	BDF
			Masterlock	6.4	oz	0ABCDE
			Lucento	5.5	oz	C
			Manzate Prostick	2	lbs	0ABCDE
			Proline	5.7	oz	A
			Provysol	4	oz	E
5	HCT	4 Spray Program	Proline	5.7	oz	A
			Masterlock	6.4	oz	0ACE
			Badge SC	32	oz	C
			Provysol	4	oz	E
			Manzate Prostick	2	lbs	0ACE
6	HCT	4 Spray Program Sulfur no copper	Proline	5.7	oz	A
			Masterlock	6.4	oz	0ACE
			Microthiol Disperss	1	lb	C
			Provysol	4	oz	E
			Manzate Prostick	2	lbs	0ACE
7	HCT	4 Spray Program Priaxor no copper	Proline	5.7	oz	A
			Masterlock	6.4	oz	0ACE
			Priaxor	6.7	oz	C
			Provysol	4	oz	E
			Manzate Prostick	2	lbs	0ACE
8	HCT	4 Spray Program	Proline	5.7	oz	A
			Masterlock	6.4	oz	0ACE
			Badge SC	32	oz	C
			Veltyma	8	oz	E
			Manzate Prostick	2	lbs	0ACE
9	HCT	4 Spray Program	Microthiol Disperss	1	lb	0ACE
			Masterlock	6.4	oz	0ACE
			Manzate Prostick	2	lbs	0ACE

Southern Minnesota Agricultural Research

Cercospora Leaf Spot Protectant Trial

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Cercospora leaf spot (CLS) is the most destructive foliar disease to impact sugar beet production in the SMBSC growing area. Without effective new fungicides, controlling the disease has become more difficult. Despite advancements in variety tolerance to CLS the key to control is still utilizing best management practices that include an appropriately timed fungicide program that incorporates multiple modes of action along with planting sugar beet varieties with higher levels of genetic tolerance to CLS.

Research Objective

- An effective fungicide program paired with genetic tolerance is necessary to grow a profitable crop. Trials need to be conducted to evaluate the efficacy of individual fungicides and possible synergies between fungicide products.

Methodology

In 2023 the CLS Protectant Trial was conducted as a randomized complete block with four replications and located near Renville, MN. This trial evaluated fungicides individually, and in combinations to look at possible synergies. The site was planted on May 4th using Crystal M977. Standard practices were used to keep the site weed free. The site was inoculated with pulverized leaves from the previous year that were infected with CLS. The inoculum was spread evenly across the site with a Gandy Orbit-Air applicator on July 7th. Five fungicide applications were made in the Protectant Trial beginning July 17th and continuing on a ten to twelve-day spray interval.

Applications were made using a custom-made tractor mounted sprayer traveling 3.1mph with a spray volume of 20gpa and 60psi, utilizing XR11002 spray nozzles. Each plot consisted of six rows that were 35ft in length. The sprayer used CO^2 as a propellant and was designed to apply the treatment to the center four rows, leaving rows one and six untreated. Plots were rated for foliar damage using the (1-9) KWS (Kleinwanzlebener Saatzucht) scale with one being disease free and nine being completely necrotic. The center two rows of each six-row plot were harvested on September 18th using a six-row defoliator and a two-row research harvester. The beets harvested from the center two rows were weighed on the harvester and a sample of those beets were used for a quality analysis at the SMBSC tare lab. The data was analyzed for significance using SAS version 9.4.

Results

There were significant differences in the Protectant Trial in quality and ESA (Table 1). The unsprayed control and the Microthiol Disperss alone had significantly lower percent sugar than all other treatments and had a lower ESA than most other treatments. There were also significant differences between the treatments for the foliar disease ratings (Table 2). Similar to the ESA, the unsprayed control had the highest foliar disease rating followed by the Microthiol Disperss alone. Other than the Microthiol Disperss alone, the other single-mode treatments were similar, with Manzate Prostick, Proline, and Cuprofix Ultra all having similar disease ratings. Additional treatment comparisons are outlined below:

- Adding Microthiol Disperss to Proline did not improve disease control.
- Adding Microthiol Disperss to Manzate Prostick slightly improved disease control.
- Adding Microthiol Disperss to Cuprofix Ultra did not improve disease control.
- The combination of Manzate Prostick and Cuprofix Ultra was better than either product alone.
- The combination of Proline and Cuprofix Ultra was better than either product alone.
- The combination of Proline and Manzate Prostick was better than either product alone and the best treatment overall.

Conclusions

The results of Cuprofix Ultra were very positive with similar disease ratings as Manzate Prostick and Proline. However, the results of Microthiol Disperss were not as positive. There is hope that copper products could benefit the CLS fungicide program but further testing needs to be done as data with copper products have been inconsistent in the past.

Table 1. Yield parameter results for the Protectant Trial. Values with different letters are significantly different. Table 3 contains a full description of each treatment.

Entry	Entry Description	Percent Sugar	Root Yield Tons/Acre	Percent Extractable Sugar	Extractable Sugar per Ton (lbs.)	Extractable Sugar per Acre (lbs.)	Percent Purity
1	Control	15.8 d	26.7	13.2 c	263.7 c	7044.8 de	90.2
2	Manzate Prostick (2lbs)	17.3 abc	30.9	14.6 a	291.3 ab	8978.4 a	90.4
3	Proline	17.3 abc	27.9	14.5 ab	289.5 ab	8080.9 abcd	90.0
4	Proline+Manzate Prostick (2lbs)	17.6 a	29.9	14.7 a	294.3 a	8802.8 ab	89.9
5	Proline+Microthiol Disperss (1lb)	17.1 bc	29.3	14.3 ab	285.9 ab	8352.9 abc	90.0
6	Proline+Microthiol Disperss (2lbs)	17.3 abc	28.1	14.5 ab	289.5 ab	8136.2 abc	89.9
7	Manzate Prostick (2lbs)+Microthiol Disperss (1lb)	17.2 abc	29.4	14.6 a	291.1 ab	8562.9 abc	90.5
8	Manzate Prostick (2lbs)+Microthiol Disperss (2lbs)	17.5 ab	28.5	14.6 ab	291.3 ab	8267.5 abc	89.8
9	Microthiol Disperss (2lbs)	16.1 d	24.9	13.4 c	267.9 c	6657.5 e	90.1
10	Cuprofix Ultra (2lbs)	17.2 abc	28.2	14.4 ab	287.3 ab	8088.3 abcd	90.1
11	Proline+Cuprofix Ultra (2lbs)	17.2 abc	27.6	14.4 ab	288.3 ab	7938.9 abcd	90.1
12	Manzate Prostick (2lbs)+Cuprofix Ultra (2lbs)	16.9 c	27.9	14.1 b	281.9 b	7873.1 bcd	89.9
13	Microthiol Disperss (2lbs)+Cuprofix Ultra (2lbs)	17.4 abc	26.0	14.6 a	292.7 a	7605.8 cde	90.1
	Mean	17.0	28.1	14.3	285.8	8030.0	90.1
	CV%	2.1	9.3	2.3	2.3	9.3	0.6
	Pr>F	<.0001	0.1617	<.0001	<.0001	0.0056	0.802
	lsd (0.05)	0.5	ns	0.5	9.5	1076.1	ns

Table 2. Foliar ratings for the Protectant Trial using the KWS (1-9) rating system with 1 being disease free and 9 being completely necrotic. Ratings with different letters are significantly different. Table 3 contains a full description of each treatment.

Entry	Entry Description	11-Aug	21-Aug	31-Aug	7-Sep	15-Sep
1	Control	2.9 a	4.6 a	8.1 a	9.0 a	9.0 a
2	Manzate Prostick	1.9 de	2.4 d	3.4 def	4.8 de	5.8 cd
3	Proline	1.3 f	2.2 def	3.7 cd	5.1 cd	6.1 bc
4	Proline+Manzate Prostick	1.1 f	1.6 g	1.9 h	2.7 h	2.9 h
5	Proline+Microthiol Disperss (1lb)	1.3 f	1.9 fg	3.3 ef	4.5 ef	5.6 cde
6	Proline+Microthiol Disperss (2lbs)	1.3 f	1.9 efg	3.5 de	5.0 cd	6.0 bc
7	Manzate Prostick+Microthiol Disperss (1lb)	1.8 de	2.4 d	3.2 ef	4.6 ef	5.3 def
8	Manzate Prostick+Microthiol Disperss (2lbs)	2.1 cd	2.3 de	3.1 f	4.4 f	5.2 ef
9	Microthiol Disperss (2lbs)	2.6 ab	4.0 b	7.3 b	8.6 b	9.0 a
10	Cuprofix Ultra (2lbs)	2.3 bc	3.0 c	4.0 c	5.1 cd	6.0 bc
11	Proline+Cuprofix Ultra (2lbs)	1.7 e	2.2 def	2.6 g	3.7 g	4.8 f
12	Manzate Prostick+Cuprofix Ultra (2lbs)	1.7 e	2.2 def	2.5 g	3.5 g	4.2 g
13	Microthiol Disperss (2lbs)+Cuprofix Ultra (2lbs)	2.0 cde	2.5 cd	4.1 c	5.4 c	6.3 b
	Mean	1.8	2.5	3.9	5.1	5.8
	CV%	12.9	12.8	7.0	5.4	5.8
	Pr>F	<.0001	<.0001	<.0001	<.0001	<.0001
	lsd (0.05)	0.34	0.47	0.39	0.40	0.49

Table 3: Protectant Trial treatment list.

Entry	Entry Description	Rate/A
1	Control	n/a
2	Manzate Prostick	2 lbs
	Masterlock	6.4 oz
3	Proline	5.7 oz
	Masterlock	6.4 oz
4	Proline	5.7 oz
	Manzate Prostick	2 lbs
	Masterlock	6.4 oz
5	Proline	5.7 oz
	Microthiol Disperss	1 lb
	Masterlock	6.4 oz
6	Proline	5.7 oz
	Microthiol Disperss	2 lbs
	Masterlock	6.4 oz
7	Manzate Prostick	2 lbs
	Microthiol Disperss	1 lb
	Masterlock	6.4 oz
8	Manzate Prostick	2 lbs
	Microthiol Disperss	2 lbs
	Masterlock	6.4 oz
9	Microthiol Disperss	2 lbs
	Masterlock	6.4 oz
10	Cuprofix Ultra	2 lbs
	Masterlock	6.4 oz
11	Proline	5.7 oz
	Cuprofix Ultra	2 lbs
	Masterlock	6.4 oz
12	Manzate Prostick	2 lbs
	Cuprofix Ultra	2 lbs
	Masterlock	6.4 oz
13	Microthiol Disperss	2 lbs
	Cuprofix Ultra	2 lbs
	Masterlock	6.4 oz

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Previous Crop Trial

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Nitrogen management is a priority for production of high-quality sugar beets. Previous crop can affect nitrogen availability and earlier harvested crops like sweet corn and spring wheat tend to have less residue potentially leading to better planting conditions for the following sugar beet crop.

Research Objective

- Provide previous crop and nitrogen fertilizer guidelines for sugar beet production in the Southern Minnesota Beet Sugar Cooperative growing area.

Methodology

A two-year trial was conducted near Bird Island (2021-2022) and near Hector (2022-2023) as a split block with four replications. In the first year of the trials four rotational crops were planted in randomized blocks: field corn, soybean, sweet corn, and spring wheat. Soil samples were taken in the spring prior to planting the four rotational crops and fertilizer applications were made using University of Minnesota recommendations for each crop. The fertilizer treatments were applied broadcast in the spring and incorporated using a small field cultivator. Standard practices were used to keep the four rotational crops weed and disease free. Important dates and average yields are reported in Table 1. The previous crops were machine harvested with small research combines except for the sweet corn (Photo 1). The sweet corn was hand harvested and then mowed to chop up the stalks. The 2021 crop year was abnormally dry, especially in the area where this trial was located as illustrated with the large soil cracks (Photo 2). As a result, the yields were somewhat suppressed, most notable the field corn.

For the second year of the trials, sugar beets were planted into each of the previous crops. The previous crop blocks were soil sampled to a depth of four feet in the fall prior to planting sugar beets. Prior to planting, the blocks were separated into 3 treatments for each crop. These treatments were residual nitrogen only, 110 lbs total N per acre, and 150 lbs total N per acre (Tables 2 and 3). Each of these plots were 6 rows wide. Nitrogen treatments were applied as urea and incorporated with a small field cultivator. The Bird Island site was planted on May 23, 2022 using Crystal M089 and the Hector site was planted on May 10, 2023 using Crystal M089. Standard grower practices were used to keep the site weed and disease free. The center two rows of each six-row plot were harvested on September 20, 2022 at Bird Island and October 5, 2023 at Hector using a six-row defoliator and a two-row research harvester. The sugar beet roots harvested from the center two rows were weighed on the harvester and two samples of those beets from each plot were used for a quality analysis at the SMBSC tare lab. The data were analyzed for significance using SAS GLM version 9.4.

Table 1. Planting date, harvest date, and yield for the four rotational crops in 2021 near Bird Island and in 2022 near Hector.

Previous Crop	Planting Date	Harvest Date	Yield per Acre
Bird Island, 2021			
Field Corn	May 6th	October 19th	140 bushels
Soybean	May 7th	October 6th	55 bushels
Sweet Corn	May 6th	August 10th	9 tons
Spring Wheat	April 22nd	August 2nd	51 bushels
Hector, 2022			
Field Corn	May 7th	October 14th	203 bushels
Soybean	May 7th	September 29th	59 bushels
Sweet Corn	May 7th	August 9th	8.8 tons per acre
Spring Wheat	May 6th	August 17th	50 bushels

Photos 1 & 2. Combine used to harvest the spring wheat. Sweet corn in the dry summer conditions during the 2021 season.

Table 2. The Bird Island previous crop trial had 12 treatments that were based upon previous crop and total N (Residual + Applied).

Treatment	1	2	3	4	5	6	7	8	9	10	11	12
Previous Crop	Field Corn	Field Corn	Field Corn	Soybean	Soybean	Soybean	Sweet Corn	Sweet Corn	Sweet Corn	Spring Wheat	Spring Wheat	Spring Wheat
Residual N (lbs/A)	42	42	42	47	47	47	76	76	76	11	11	11
Applied N (lbs/A)	0	68	108	0	63	103	0	34	74	0	99	139
Total N (lbs/A)	42	110	150	47	110	150	76	110	150	11	110	150

Table 3. The Hector previous crop trial had 12 treatments that were based upon previous crop and total N (Residual + Applied).

Treatment	1	2	3	4	5	6	7	8	9	10	11	12
Previous Crop	Field Corn	Field Corn	Field Corn	Soybean	Soybean	Soybean	Sweet Corn	Sweet Corn	Sweet Corn	Spring Wheat	Spring Wheat	Spring Wheat
Residual N (lbs/A)	39	39	39	39	39	39	90	90	90	24	24	24
Applied N (lbs/A)	0	71	111	0	71	111	0	20	60	0	86	126
Total N (lbs/A)	39	110	150	39	110	150	90	110	150	24	110	150

Results

The crop planted in the year prior to sugar beets had a significant impact on the sugar beet root yield (Figure 1). Sugar beet planted after sweet corn had higher root yield compared to those following the other three crops tested in this trial. The sugar beet planted after spring wheat had a greater root yield than field corn and soybean in 2023 but not in 2022. Nitrogen rate also had a significant impact on root yield (Figure 1) and quality (Table 4). In 2022 increasing the nitrogen rate to 110 lbs per acre of total N dramatically increased root yield following all previous crops, with only a slight increase following sweet corn. Root yields did not substantially increase when the nitrogen rate was increased to 150 lbs per acre of total N. In 2023 the response to N was mixed with a less dramatic increase in root yield with increasing N, however, the root yield still increased slightly with greater rates of N, with the exception of sugar beet following sweet corn. Increasing the rate of N had a consistent negative impact on quality in both 2022 and 2023 (Table 4).

Table 4. The effect of nitrogen rate on sugar beet quality across previous crops for 2022 and 2023.

	2022			2023		
Total N (lbs/A)	*Extractable Sugar %*	*Extractable Sugar Per Ton*	*Purity %*	*Extractable Sugar %*	*Extractable Sugar Per Ton*	*Purity %*
Residual N*	12.4c	247b	90.0b	13.9bc	277b	90.0b
110	12.1b	242b	89.6ab	13.8b	276b	89.8ab
150	11.8a	235a	89.3a	13.6a	272a	89.6a
LSD$_{(0.05)}$	0.21	3.9	0.50	0.16	3.2	0.23

*Residual N = residual N depends on the previous crop (Tables 2 and 3).

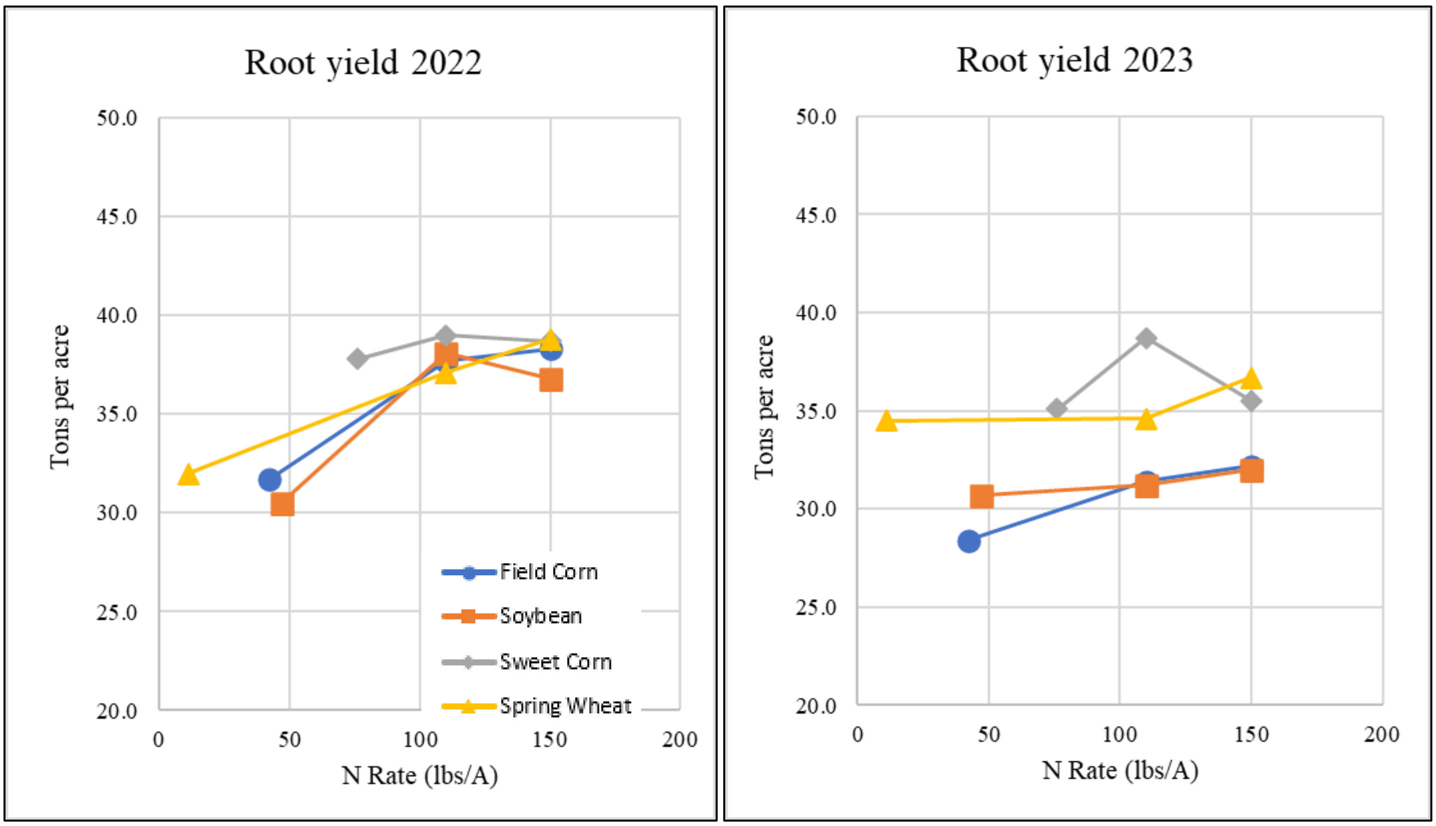

Figure 1. The effect of nitrogen and previous crop on root yield.

Conclusions

Root yields in the SMBSC Agronomic Practice Database have indicated that canning crops such as sweet corn and peas have a positive impact on the following sugar beet crop. This could be caused by the early harvest of the canning crops and lower crop residue levels. The early harvest of these crops gives the residue ample time to breakdown, which leads to less tie-up of nitrogen in the next year and potentially creates a better seed bed to plant sugar beets. Spring wheat also has the benefit of an early harvest, however, if the grain that is dropped during harvest is allowed to grow, like it was in this trial, then the volunteer wheat cover crop can also tie-up nitrogen and create a less ideal seed bed than if the volunteer wheat cover crop was terminated earlier.

Fertilizing each of the previous crops up to 110 and 150 lbs per acre of total N had a consistent negative impact on quality in 2022 and 2023. This negative impact was not drastic but something to consider when applying nitrogen, especially if it's not needed. The results from these trials would indicate that less nitrogen is needed following sweet corn to optimize root yield. These trials would also indicate that the benefit of increasing total N from residual levels to 110 is substantial, while the further increase to 150 lbs per acre of total N is less beneficial and often not significant.

Southern Minnesota Agricultural Research

Nitrogen Rate and Placement Trials

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Nitrogen management is a priority for production of high-quality sugar beets. The use of nitrogen placement could offset the input cost of nitrogen and lower the overall use rate through more efficient use and availability.

Research Objective

- Provide nitrogen fertilizer guidelines for sugar beet production in the Southern Minnesota Beet Sugar Cooperative growing area.

Methodology

Two trials were established in 2023 using randomized complete block design. One trial was located near the Murdock piling site following soybean and the other trial was located near Clara City following field corn. Both sites were soil sampled in the fall of 2022 to develop treatment rates for the trials in 2023 (Table 1). The treatments for each site were identical with treatments including broadcast urea rates, placement of liquid 32% N (UAN), and use of nitrogen fixing biological products (Tables 2 and 3). The Murdock site was planted on May 9th, and the Clara City site was planted on May 24th. Both sites were planted using Crystal M089. Prior to planting, the urea treatments were broadcast by hand and incorporated with a small field cultivator. The liquid 32% N treatments were applied at planting using a 360 Bandit system with CO_2 as a propellant for the fertilizer. The 360 Bandit dribbled the liquid three inches either side of the row at a depth from the soil surface of 0.75 to one inch (Photo 2). For the surface applied UAN dribble treatment, the hoses were removed from the disc and allowed to drag along the soil surface (Photo 3). The Biopath, Generate, and Alpha Complete treatments were applied through the infurrow system on the planter with a 6gpa application volume. The Utrisha N treatments were applied with the bicycle sprayer on June 9th at the Murdock trial and June 15th at the Clara City trial. The bicycle sprayer was equipped with XR11002 nozzles with a spray volume of 17gpa. Standard sugar beet production practices were used to keep the trial weed and disease free. Each plot was 35ft long and 6 rows wide. The center two rows of each six-row plot were harvested on September 19th at Clara City and October 11th at Murdock using a six-row defoliator and a two-row research harvester. The beets harvested from the center two rows were weighed on the harvester and two samples of those beets from each plot were used for quality analysis at the SMBSC tare lab. The data was analyzed for significance using SAS GLM version 9.4.

Table 1. Soil test results for the two trial locations from fall soil sample in 2022.

Soil test	Murdock	Clara City
Soil nitrate-N 0-4 ft. (lb N/A)	34	39
Olsen P 0-6 in. (ppm)	3	8
K 0-6 in. (ppm)	178	199
pH 0-6 in. (unitless)	8.1	7.9
Organic matter 0-6 in. (%)	5.5	5.8

Results

There were no significant differences between any of the treatments at the Murdock site (Table 3). The root yield data for this site had some variability caused by rhizoctonia root rot. There may be numerical differences, however, these differences are not statistically significant because of the variability caused by the rhizoctonia.

There was a significant increase in root yield at the Clara City site up to an additional 60lbs per acre of nitrogen (Table 2). Adding additional nitrogen over 60lbs did not result in greater root yield compared to the 60lbs N per acre (99lbs per acre Total N) nitrogen treatment. There were also some differences in quality parameters with the check (residual N only), and the highest two rates of additional N having lower quality than some of the other treatments with lower amounts of additional N applied.

Photos 2 & 3. The 360 Bandit system installed on the 6-row research planter. The dribble treatment visible on the soil surface after planting.

Conclusions

In the past decade of nitrogen research at SMBSC, many nitrogen trials have failed to generate a positive response to the addition of nitrogen over the residual nitrogen that's already present in the field. In the most recent years, trials following field corn have generally had a greater response to additional nitrogen compared to trials following soybean. Because of the lack of response to the addition of nitrogen following soybean, a comparison of the methods of application cannot be made at the site located north of the Murdock piling site. The Clara City site, which followed field corn, had a slight increase in root yield with the addition of nitrogen, however, there were no statistical differences between the application methods. These nitrogen placement trials will be conducted again in 2024 to complete a third year of evaluation into the methods of nitrogen application.

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Table 2. Root yield and quality data for the Clara City trial following field corn. Trial harvested on September 19th.

Entry	Treatment	Applied N	Total N	Percent Sugar	Root Yield Tons/Acre	Percent Extractable Sugar	Extractable Sugar per Ton (lbs.)	Extractable Sugar per Acre (lbs.)	Percent Purity
1	Check	0	39	16.9	27.1 d	14.4 cdef	286.6 cde	7749.8	91.0 abcd
2	Broadcast Urea	30	69	17.3	29.3 bcd	14.8 ab	295.5 ab	8650.1	91.3 a
3	Broadcast Urea	60	99	17.4	29.9 abcd	14.9 a	297.1 a	8871.9	91.3 ab
4	Broadcast Urea	90	129	17.0	30.8 abc	14.4 cdef	287.5 cde	8858.2	90.7 d
5	Broadcast Urea	120	159	16.9	31.3 ab	14.3 def	286.0 cde	8946.4	90.8 bcd
6	Broadcast Urea	150	189	16.7	31.6 ab	14.1 f	282.2 e	8922.6	90.7 cd
7	Broadcast Urea	180	219	16.8	33.1 a	14.2 ef	284.1 de	9384.5	90.7 cd
8	3x1 32%	30	69	17.0	30.6 abc	14.4 bcdef	288.6 bcde	8819.0	91.0 abcd
9	3x1 32%	60	99	17.1	31.3 ab	14.5 abcde	290.7 abcd	9096.0	90.9 abcd
10	3x0 32%	30	69	17.2	27.9 cd	14.6 abcd	292.7 abc	8175.6	91.3 a
11	3x0 32%	60	99	17.2	29.5 bcd	14.6 abcd	292.6 abc	8626.3	91.1 abcd
12	Utrisha N	30	69	17.2	29.3 bcd	14.7 abc	293.9 abc	8609.9	91.3 ab
13	BioPath	30	69	17.2	29.9 abcd	14.6 abcd	292.1 abc	8725.6	91.0 abcd
14	Generate	30	69	17.1	27.6 cd	14.4 bcdef	289.0 bcde	7971.5	90.8 cd
15	Alpha Complete	30	69	17.1	27.6 cd	14.6 abcde	291.8 abcd	8031.9	91.2 abc
			Mean	17.1	29.8	14.5	290.0	8629.3	91.0
			CV%	1.7	6.6	1.6	1.6	6.4	0.3
			Pr>F	0.2042	0.0275	0.0191	0.0239	0.0536	0.0492
			lsd (0.05)	ns	3.3	0.4	7.9	ns	0.5

Table 3. Root yield and quality data for the Murdock trial following soybean. Trial harvested on October 11th.

Entry	Treatment	Applied N	Total N	Percent Sugar	Root Yield Tons/Acre	Percent Extractable Sugar	Extractable Sugar per Ton (lbs.)	Extractable Sugar per Acre (lbs.)	Percent Purity
1	Check	0	34	16.5	36.5	13.9	276.8	10079.2	90.3
2	Broadcast Urea	30	64	16.8	34.9	14.1	281.7	9816.5	90.1
3	Broadcast Urea	60	94	16.7	35.1	14.0	280.4	9870.7	90.4
4	Broadcast Urea	90	124	16.6	36.1	14.0	278.9	10149.8	90.4
5	Broadcast Urea	120	154	16.7	36.1	14.0	279.9	10108.3	90.5
6	Broadcast Urea	150	184	16.5	40.6	13.8	276.2	11116.9	89.9
7	Broadcast Urea	180	214	16.5	35.2	13.8	275.4	9682.1	90.1
8	3x1 32%	30	64	16.6	35.9	13.9	278.2	9927.6	90.3
9	3x1 32%	60	94	16.6	40.4	13.9	278.2	11265.0	90.2
10	3x0 32%	30	64	16.8	35.4	14.1	280.8	9925.6	90.1
11	3x0 32%	60	94	16.5	35.0	13.8	276.6	9664.3	90.3
12	Utrisha N	30	64	16.4	35.0	13.7	274.2	9743.3	90.1
13	BioPath	30	64	16.5	33.7	13.9	276.6	9372.7	90.3
14	Generate	30	64	16.8	33.1	14.1	281.9	9380.0	90.5
15	Alpha Complete	30	64	16.8	34.4	14.1	281.5	9671.9	90.2
			Mean	16.6	35.8	13.9	278.5	9987.4	90.2
			CV%	1.9	12.7	2.0	2.0	11.9	0.4
			Pr>F	0.75	0.89	0.70	0.65	0.90	0.57
			lsd (0.05)	ns	ns	ns	ns	ns	ns

Phosphorus by Nitrogen Rate Trial

David Mettler[1], **Mark Bloomquist**[2], and **John A. Lamb**[3],
[1]Research Agronomist, [2]Research Director, SMBSC, Renville, MN
[3]Professor Emeritus University of Minnesota, St. Paul, MN

Nitrogen management is a priority for production of high-quality sugar beets. However, many other nutrients also play a role in plant growth. It is important to understand how the availability of other major nutrients may be impacted by varying levels of nitrogen.

Research Objective

- Provide phosphorus and nitrogen fertilizer guidelines for sugar beet production in the Southern Minnesota Beet Sugar Cooperative growing area.

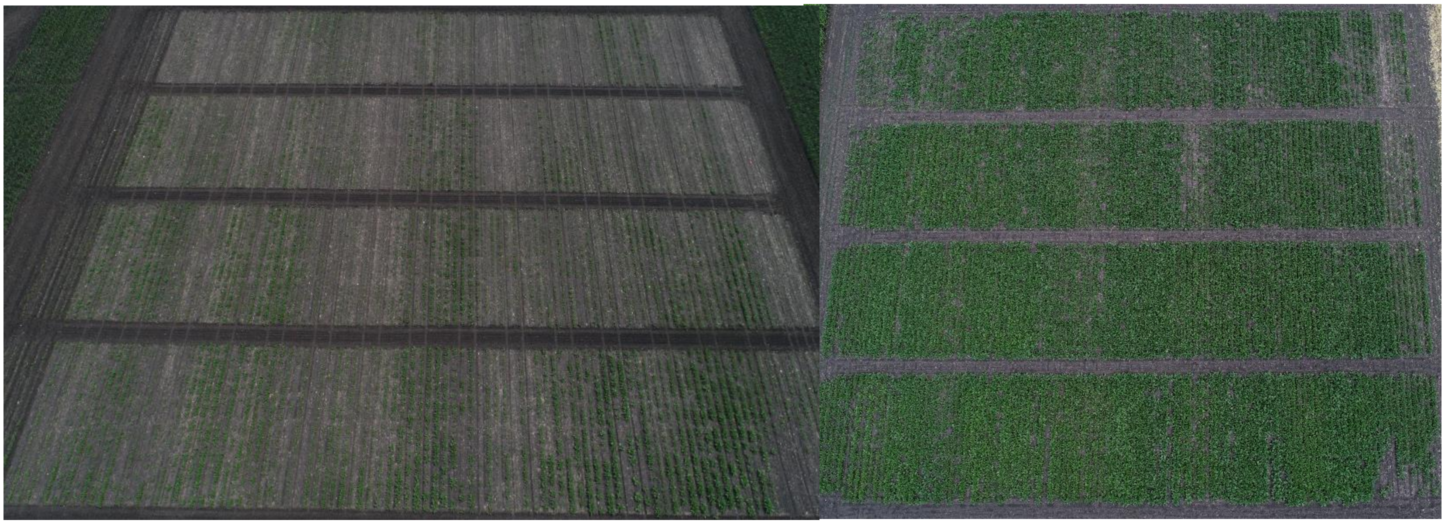
Methodology

This trial was conducted as a 3 x 5 factorial with four replications following soybean northeast of Renville, MN. Soil samples were taken in the fall prior to treatment application (Table 1). The applied nitrogen fertilizer rates were 0, 70, and 140 lb N/A. The phosphorus fertilizer rates were 0, 15, 30, 45, and 60 lb P_2O_5/A. The phosphorus and nitrogen treatments were applied broadcast in the spring and incorporated using a small field cultivator. The nitrogen source was urea (46-0-0), and the phosphorus source was triple super phosphate (0-46-0). The site was planted on May 4th using Crystal M089. Dual Magnum was applied preemergence and other standard practices were used post emergence to keep the site weed free. The center two rows of each six-row plot were harvested on September 18th using a six-row defoliator and a two-row research harvester. The beets harvested from the center two rows were weighed on the harvester and two samples of those beets were used for a quality analysis at the SMBSC tare lab. The data was analyzed for significance using SAS GLM version 9.4.

Table 1. Soil test results for Renville location from fall soil sample in 2022.

Soil test	Renville
Soil nitrate-N 0-4 ft. (lb N/A)	33
Olsen P 0-6 in. (ppm)	3
K 0-6 in. (ppm)	224
pH 0-6 in. (unitless)	8.0
Organic matter 0-6 in. (%)	5.3

Figure 1. Drone images from June 15th and July 20th showing reduced foliage in plots that were deficient in phosphorus, nitrogen, or both.



Results

The application of phosphorus and nitrogen had an interaction that significantly impacted root yield and ESA (Figure 2). The application of phosphorus did not impact any quality parameters. The application of nitrogen did however have an impact on quality with percent sugar, ES, and EST being negatively impacted by the highest rate of nitrogen (Table 2).

Figure 2. Impact on root yield of increasing nitrogen across P_2O_5 rates and increasing phosphorus across nitrogen rates.

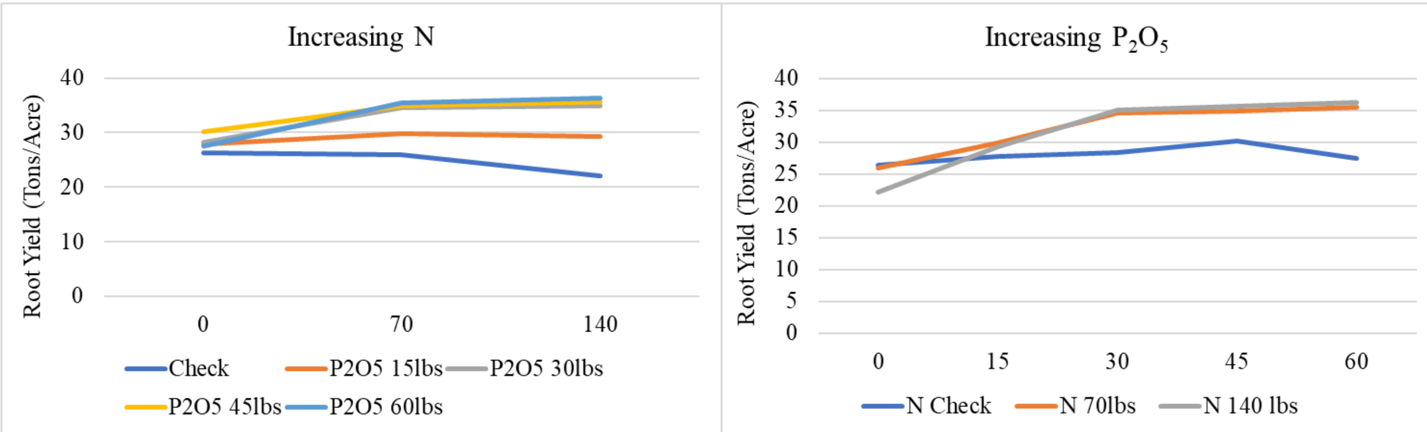


Table 2. The effect of fertilizer N on quality averaged across P_2O_5 rates.

Applied Nitrogen Rates	Total Nitrogen	Percent Sugar	Percent Extractable Sugar	Extractable Sugar per Ton (lbs.)	Percent Purity
0	33	17.2 a	14.4 a	288.8 a	90.1
70	103	17.2 a	14.4 a	288.1 a	89.9
140	173	16.9 b	14.1 b	283.0 b	90.0
Mean		17.1	14.3	286.6	90.0
CV%		1.7	1.7	1.7	0.4
Pr>F		0.0011	0.0008	0.0008	0.2451
lsd (0.05)		0.18	0.16	3.11	ns

Conclusions

Phosphorus having a significant impact on root yield was not surprising as the soil sample results indicated very low soil test levels of phosphorus (Table 1). The response to additional nitrogen over the control was expected and consistent with previous studies when conducted on a site with low residual nitrogen. There was a deficiency in both nutrients being tested. This resulted in an interaction between the two nutrients. Increasing the rate of nitrogen without increasing the rate of phosphorus did not result in a root yield increase (Figure 2). Similarly, increasing the rate of phosphorus without increasing the rate of nitrogen also did not result in a root yield increase. Increasing the rate of phosphorus improved root yield up to 30lbs of additional phosphate with no further increase in root yield after that rate. Root yield increased with the addition of 70lbs nitrogen per acre but did not increase any further with 140lbs per acre of additional nitrogen. After sufficiency levels were met there does not appear to be any benefit to increasing the rate of phosphorus if the rate of nitrogen is increased. Increasing the rate of nitrogen outside the recommended range did not improve the root yield in this study and had a negative impact on the quality.

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Southern Minnesota Agricultural Research

Potassium by Nitrogen Rate Trial

David Mettler[1], **Mark Bloomquist**[2], and **John A. Lamb**[3],

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[3]Professor Emeritus University of Minnesota, St. Paul, MN

Nitrogen management is a priority for production of high-quality sugar beets. However, many other nutrients also play a role in plant growth. It is important to understand how the availability of other major nutrients may be impacted by varying levels of nitrogen.

Research Objective

- Provide potassium and nitrogen fertilizer guidelines for sugar beet production in the Southern Minnesota Beet Sugar Cooperative growing area.

Methodology

This experiment was conducted over 3 years as a 3 x 5 factorial with four replications. Soil samples were taken in the fall prior to treatment application (Table 1). The nitrogen fertilizer rates were varied due to differences in residual nitrogen between the sites. However, for the combined analysis the rates will be presented as low, medium, and high. The low rate is the control with no additional nitrogen applied (52lbs average total N). The medium rate is the middle of the recommended range for total nitrogen (128lbs average total N). The high rate is on the high side or above the recommended nitrogen rate (198lbs average total N). The potassium fertilizer rates were 0, 30, 60, 90, and 120 lb K_2O/A. The potassium and nitrogen treatments were applied broadcast in the spring and incorporated using a small field cultivator. The nitrogen source was urea (46-0-0), and the potassium source was potash (0-0-60). The sites were planted with a good root disease variety to mitigate any impacts from disease. Dual Magnum was applied preemergence and other standard practices were used post emergence to keep the sites weed free. The center two rows of each six-row plot were harvested using a six-row defoliator and a two-row research harvester. The planting and harvest dates for each site can be found in Table 1. The beets harvested from the center two rows were weighed on the harvester and a sample of those beets were used for a quality analysis at the SMBSC tare lab. The data was analyzed for significance using SAS GLM version 9.4.

Table 1. Fall soil sample results and important dates for all three locations.

Soil test	Hector, 2021	Redwood Falls, 2022	Renville, 2023
Soil nitrate-N 0-4 ft. (lb N/A)	45	77	33
Olsen P 0-6 in. (ppm)	7	14	3
K 0-6 in. (ppm)	168	228	224
pH 0-6 in. (unitless)	7.7	7.7	8.0
Organic matter 0-6 in. (%)	4.7	5.6	5.3
Previous Crop	Field corn	Field corn	Soybean
Planting Date	April 30th	May 16th	May 4th
Harvest Date	September 29th	October 6th	September 18th

Results

Across all three years the application of potassium had no impact on the root yield or quality of sugar beets regardless of the amount of nitrogen applied (Table 2). The increased rate of nitrogen applied had a positive impact on tons per acre and extractable sugar per acre (Table 3). There was also an interaction between nitrogen and year for the quality parameters. This interaction occurred because the impact of nitrogen on the quality parameters varied between the 3 years that this study was conducted (Figure 1).

Conclusions

It was speculated that as nitrogen rates increase the rates of other nutrients, such as potassium, would also need to be increased. However, increasing potassium rates as nitrogen rates increase does not have any impact if there are already sufficient levels of potassium. The impact of nitrogen on root yield was expected with an increase from the control to the rate that was within the recommended range, but no increase in root yield occurred as the rate of nitrogen was increased beyond the recommended range. Increasing nitrogen rates beyond the recommended range had a negative impact on quality two out of three years. The environment plays a large role in nitrogen availability, and we do not always get the response we may expect. Most of the time applying a high rate of nitrogen will likely have a negative impact on quality, however, there are times when the opposite can happen, as was the case with this study in 2022. Nitrogen remains a very important nutrient for growing a profitable sugar beet crop. However, growers need to be aware of the risk and reward of applying too much or too little nitrogen.

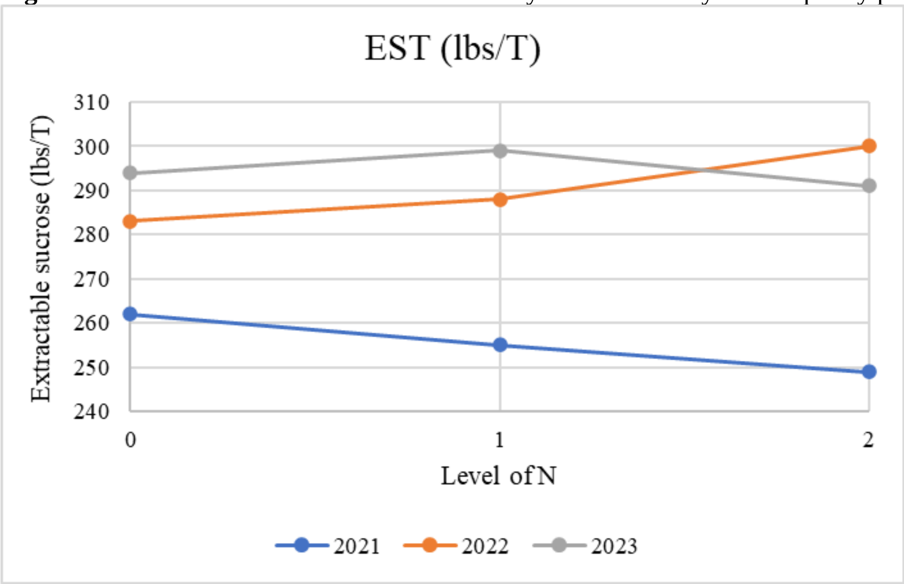
Table 2. The effect of fertilizer K_2O on root yield and quality averaged across N rates.

Level of K_2O (lbs)	Percent Sugar	Root Yield Tons/Acre	Percent Extractable Sugar	Extractable Sugar per Ton (lbs)	Extractable Sugar per Acre (lbs)	Percent Purity
0	16.8	34.2	13.9	279.0	9481.0	89.4
30	16.9	34.0	14.0	279.3	9431.1	89.2
60	16.9	34.4	14.0	280.4	9591.4	89.4
90	16.9	34.6	14.0	280.4	9677.5	89.4
120	17.0	34.7	14.1	281.6	9726.1	89.3
Mean	16.9	34.4	14.0	280.1	9591.4	89.3
CV%	3.0	7.8	3.8	3.8	8.1	0.8
Pr>F	0.4448	0.4225	0.5676	0.5636	0.2223	0.0862
lsd (0.05)	ns	ns	ns	ns	ns	ns

Table 3. The effect of fertilizer N on root yield averaged across K rates.

Level of N (lbs)	Root Yield Tons/Acre	Extractable Sugar per Acre (lbs)
Low (52)	30.6 a	8535.6 a
Med (128)	36.1 b	10049.1 b
High (198)	36.6 b	10159.7 b
Mean	34.4	9591.4
CV%	7.8	8.1
Pr>F	0.0011	0.0015
lsd (0.05)	2.9	854.8

Figure 1. The effect of fertilizer N on EST in all years of the study. Other quality parameters had similar results.



Rhizoctonia Management Trial

David Mettler[1] and **Mark Bloomquist**[2]
[1]Research Agronomist, [2]Research Director, SMBSC, Renville, MN

Rhizoctonia root rot can negatively impact plant stand by causing seedling damping off in the spring, but it can also cause a reduction in quality and yield from late season infections. This reduction in quality can having a negative impact on factory operations as well as the storage of the beets in piles.

Research Objective

- To screen new products for control of rhizoctonia root rot and develop recommendations for best management practices.

Methodology

A trial was conducted near Renville to screen products for control of rhizoctonia and to compare best management practices. The trial was planted on May 23rd using Beta 9098. Prior to planting, the site was broadcast with whole barley infected with rhizoctonia provided by Dr. Chanda. The barley was then incorporated with a small field cultivator. Normal agronomic practices were used to keep the trials weed free. These trials were designed as randomized complete blocks with four replications and 13 treatments (Table 1). Each plot consisted of six rows that were 35ft in length. Post applications were broadcast using a custom-made bike sprayer on June 14th when the beets were at the 4-6 leaf stage. The sprayer used CO2 as a propellant and was designed to apply the treatment to the center four rows, leaving rows one and six untreated. Stand counts were taken on the center two rows in the spring, before and after the post application, and again prior to harvest. The center two rows of each six-row plot were harvested for yield and quality analysis on September 14th using a six-row defoliator and a two-row research harvester. The beets harvested from the center two rows were weighed on the harvester and samples of those beets were used for a quality analysis at the SMBSC tare lab. The beets on the harvester were also rated for root rot using a 1-7 scale. 1 being free of disease and 7 being severely rotten beets. The data was analyzed for significance using SAS GLM version 9.4.

Photo 1. Post treatment being banded across a plot using a bike sprayer.

Table 1. Treatment list and rates.

Entry	Entry Description	Infurrow	Post
1	Control	n/a	n/a
2	4-6 leaf Quadris	n/a	14.3oz
3	Azteroid Infurrow	5.7oz	n/a
4	4-6 leaf Azterknot	n/a	16.5oz
5	Azteroid Infurrow fb 4-6 leaf Azterknot	5.7oz	16.5oz
6	4-6 leaf Howler EVO	n/a	1.25lbs
7	4-6 leaf Howler EVO	n/a	2.5lbs
8	Azteroid + Howler EVO Infurrow	5.7oz + 1lb	n/a
9	Azteroid Infurrow fb 4-6 leaf Proline	5.7oz	5.7oz
10	Azteroid+Minuet Infurrow fb 4-6 leaf Proline	5.7oz+12oz	5.7oz
11	Zironar Infurrow	9 oz	n/a
12	Zironar Infurrow	12 oz	n/a
13	Zironar Infurrow fb 4-6 leaf Quadris	12 oz	14.3oz

Table 2. Yield and harvester rot rating data.

Entry	Percent Sugar	Root Yield Tons/Acre	Percent Extractable Sugar	Extractable Sugar per Ton (lbs.)	Extractable Sugar per Acre (lbs.)	Percent Purity	Harvester Rot Rating
1	16.7	23.5 bcd	13.5	270.2	6352.5 de	87.9	3.4 abc
2	16.9	26.7 a	13.7	274.4	7320.7 abc	88.1	3.3 abc
3	16.7	23.5 bcd	13.6	271.2	6381.6 cde	87.9	2.9 bcd
4	17.3	26.1 ab	14.1	281.6	7343.0 ab	88.1	2.6 cd
5	17.4	26.6 a	14.1	282.4	7523.2 a	87.9	2.1 d
6	16.9	23.9 abcd	13.8	275.0	6582.8 bcde	88.1	4.0 a
7	16.8	23.5 bcd	13.7	273.4	6420.8 bcde	88.1	3.5 abc
8	17.3	24.4 abcd	14.1	282.6	6897.6 abcd	88.3	2.8 bcd
9	17.2	25.1 abc	14.0	279.4	7026.5 abcd	88.0	2.9 bcd
10	17.4	24.3 abcd	14.2	284.0	6892.8 abcd	88.2	2.3 d
11	17.1	22.4 cd	13.9	278.8	6239.5 de	88.2	3.6 ab
12	16.9	21.6 d	13.8	275.6	5940.5 e	88.3	3.5 abc
13	17.4	23.0 bcd	14.1	282.2	6482.4 bcde	87.7	3.0 bcd
Mean	17.1	24.2	13.9	277.7	6723.4	88.1	3.1
CV%	3.7	8.9	4.0	4.0	9.8	0.6	22.6
Pr>F	0.7113	0.0385	0.7206	0.7207	0.036	0.9246	0.0162
lsd (0.05)	ns	3.1	ns	ns	940.2	ns	1.0

Results

Significant differences were observed for root yield but not quality (Tables 2). Stand count data was nonsignificant (data not shown). The main significant difference was the harvester rot rating. Treatments using biological type products had similar rot ratings to the control. Treatments that used Azteroid infurrow had a lower rot rating, but the treatments that combined Azteroid infurrow with a post application had the lowest rot ratings.

Conclusions

While there were not any significant differences for the quality parameters tested, it is worthwhile to note the lower rot ratings of the treatments that utilized both infurrow and foliar applications. This was a later planting that occurred when the soil temperature and moisture conditions were ideal for rhizoctonia development. The infurrow+foliar worked well in this environment compared to a single application. None of the biological type products tested performed better than products currently being used as industry standards.

SMBSC Southern Minnesota Agricultural Research

A COMPENDIUM OF OUR ETHOFUMESATE KNOWLEDGE

Thomas J. Peters[1] and Alexa L. Lystad[2]

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Summary
1. Ethofumesate might be our most important sugarbeet herbicide; however, it is our least understood sugarbeet herbicide.
2. Ethofumesate applied at greater than 2 pt/A will reduce stands of nurse crops including spring barley.
3. Early season waterhemp control from ethofumesate is dependent on rainfall or mechanical tillage for activation. Rainfall provides the best quality activation but has been unreliable, especially in years with late sugarbeet planting.
4. Our research supports ethofumesate alone applied either at 4 or 6 pt/A or tank mixed with Dual Magnum for early season waterhemp control.

Introduction
We have designed and conducted many ethofumesate experiments. Our experiments consider many facets of ethofumesate including reduced rates combined with Dual Magnum for waterhemp control, potential to injure nurse crops, and amount of rainfall required for activation. More recently we have compared ethofumesate preplant and preemergence, especially since spring rainfall for activation has been inconsistent. This compilation completes a series of five experiments conducted from 2020 to 2023 comparing waterhemp control and spring barley injury from ethofumeste applied up to 12 pt/A preplant or preemergence.

Nurse crop safety. Growers frequently ask if ethofumesate can be used safely with a nurse crop. Nurse crops are used as companion crops to reduce effect of blowing soil on sugarbeet. Stated another way, growers want to know the trade-off between using a soil residual herbicide for waterhemp control versus a successful establishment of nurse crops. We learned nurse crops respond differently to ethofumesate and Dual Magnum, that spring wheat and barley are more sensitive than oat (Peters et al. 2015). Second, nurse crops tolerate Dual Magnum better than ethofumesate, although both Dual Magnum and ethofumesate inhibit the root and apical meristem in susceptible species. The difference is Dual Magnum is metabolized faster than ethofumesate by cereals. However, there are situations where Dual Magnum and ethofumesate cause minimal stand loss to cover crops; situations where rainfall fails to incorporate herbicides into the soil for uptake by emerging shoots or developing roots. We have received questions regarding winter rye as a cover crop (fall seeded) and winter rye as a nurse crop (spring seeded). To be clear, we have not evaluated rye tolerance to ethofumesate; however, I anticipate no injury from fall-seeded rye and less injury from spring-seeded rye as compared with oat, spring wheat, or barley.

Activation. Challenges with activating soil residual herbicides have been commonplace since 2021. Conditions were so poor that the experiment at Moorhead was abandoned due to erratic emergence of spring barley and we observed very poor overall control of waterhemp at the Fargo location in 2021. Waterhemp escapes were either small or big plants, depending on treatment, suggesting control of either early or late emerging waterhemp. Ethofumesate preplant provided no control of early emerging waterhemp, but 56% control of late emerging waterhemp. Conversely, ethofumesate preemergence provided 55% control of early emerging waterhemp, but only 28% control of late emerging waterhemp. We hypothesize that ethofumesate incorporated into the soil was bound to soil colloids and unavailable for waterhemp uptake early in the season due to sub-optimal soil moisture conditions (Figure 1). Ethofumesate moved into the soil solution following rain events in early June and was partially effective at controlling later emerging waterhemp. Ethofumesate PRE likely was bound to the soil surface and may have moved into the soil following these rainfall events in late May and early June, providing some early season control. However, degradation likely reduced control of late emerging waterhemp.

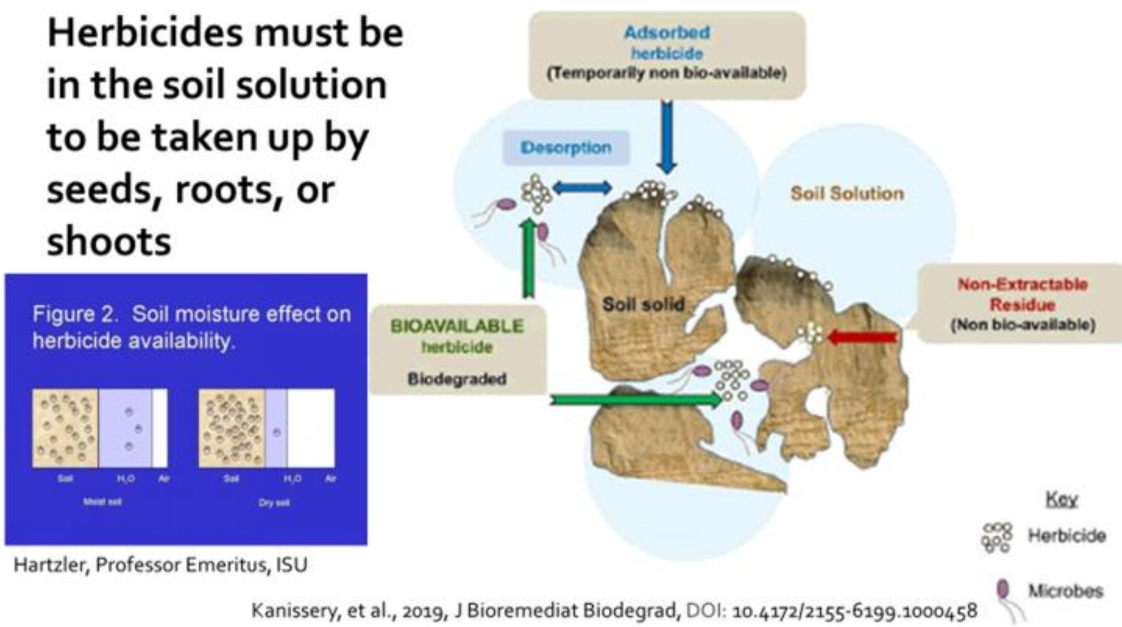

Figure 1. Illustration depicting ethofumesate bound to soil colloids when soil water content is low and in the soil solution when the soil water content is greater.

Our hypothesis is supported by the physical properties of ethofumesate compared with other herbicides (Table 1). KOC value of 350 for ethofumesate means that it has a high affinity for soil colloids and would rather be bound to soil than be in the soil solution as compared with other chloroacetamide herbicides. Second, water solubility value of 110 means ethofumesate is less water soluble than other chloroacetamide herbicides and requires more rainfall (quantity and intensity) to be incorporated into the soil. Further, we believe rainfall and soil moisture (above and below) are a predictor of waterhemp control from ethofumesate and at least partially explains the inconsistent results growers have experienced when ethofumesate has been applied preemergence in some fields in previous years. Finally, ethofumesate controls waterhemp best following timely, adequate, and penetrating rainfall events to move ethofumesate off the soil surface and into the water solution and/or spaces between colloids.

Table 1. Herbicide absorptivity (KOC) and water solubility (ppm).

Herbicide	Absorptivity	Water Solubility
	---K_{OC}^{a}---	---ppm---
Treflan	7,000	0.3
Dicamba	2	4,500
Acetochlor	200	233
Outlook	155	1,174
S-metolachlor	200	488
Ethofumesate	340	110

[a]The K value represents the ratio of herbicide bound to soil collides versus what is free in the water. Thus, the higher the K value, the greater the adsorption to soil colloids.

Waterhemp control. Ethofumesate has not provided season-long waterhemp control in our, or previous NDSU, sugarbeet research. Further, growers are reluctant to use full rates preplant or preemergence due to price, specter of carryover to grass crops planted in sequence with sugarbeet, and injury potential to nurse crops. Rather, growers have adopted an integrated strategy whereby chloroacetamide herbicides applied POST to sugarbeet and PRE to waterhemp in a single or split application at the V2 and/or V6 sugarbeet stage precede application PRE. Ethofumesate alone or ethofumesate mixed with Dual Magnum are applied PRE at less than full rates. We teach that PRE is not providing season long control, but rather is a layer to protect sugarbeet against early germinating waterhemp until the chloroacetamides are applied. However, we have wondered about waterhemp control from less than labeled rates. That is, are less than labeled rates providing full control for a short duration or are less than labeled rates providing substandard control for short duration?

Waterhemp control was dependent on ethofumesate PRE rate and evaluation timing (Figure 2). We believe our target must be 85% to 90% waterhemp control for 30 to 40 days or until chloroactamide herbicides can be applied and are activated by rainfall. The 85% waterhemp control threshold was accomplished when ethofumesate was applied at 4.5, 6.0, or 7.5 pt/A. The 90% waterhemp control threshold was accomplished when ethofumesate was applied at 6.0 or 7.5 pt/A. Ethofumsate PRE at 7.5 pt/A provided 85% waterhemp control, 54 days after application, indicating ethofumesate at the full rate does not provide season long waterhemp control. Sub-lethal rates or ethofumesate at 1.5 or 3.0 pt/A did not meet our 85% to 90% waterhemp control threshold. These data suggest sub-lethal rates are providing insufficient waterhemp control, even for a short duration.

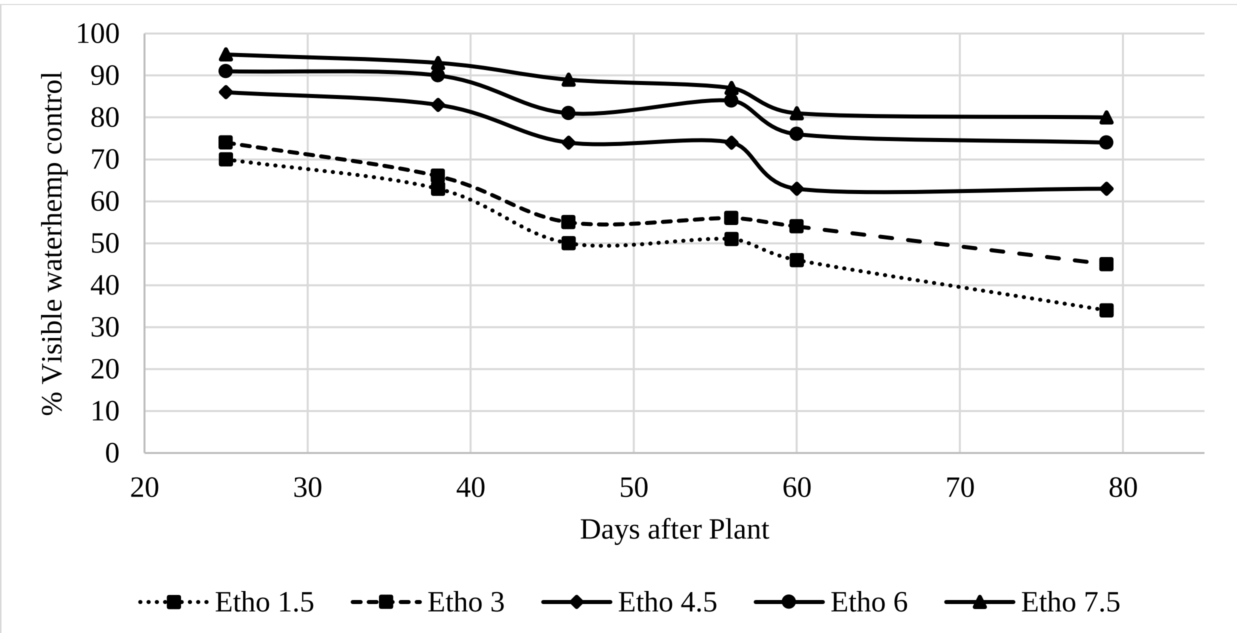

Figure 2. Waterhemp control from ethofumesate PRE across rates, Blomkest, MN, 2020.

We continued to evaluate the fate of ethofumesate on both nurse crops and waterhemp control (Peters et al. 2022). Our results suggest ethofumesate rate alone does not overcome environmental challenges when timely, adequate, and penetrating rainfall fails to occur. Thus, mixing Dual Magnum with ethofumesate is a strategy to reduce risk, as Dual Magnum adsorbs less to soil and is more water soluble, providing short duration control until sufficient rainfall occurs for ethofumesate activation. Incorporating ethofumesate is a risk-aversion strategy, provided ethofumesate is incorporated 0.5- or 1-inch (tillage at 1-inch or 2-inch) with tillage equipment that enables movement of ethofumesate into the soil, thereby maximizing pigweed control.

The objective of this 2023 experiment was to 1) demonstrate crop safety to nurse crop spring barley and 2) determine the duration of waterhemp control from ethofumesate.

Materials and Methods

An experiment was conducted near Moorhead, MN in 2023. The experimental area was prepared for planting by fertilizing and conducting tillage across the experimental area. Sugarbeet was planted on May 24 at Moorhead, MN in 2023. Sugarbeet was seeded in 22-inch rows at approximately 62,000 seeds per acre with 4.5 inch spacing between seeds. Herbicide treatments are found in Table 2.

Treatments were applied with a bicycle sprayer in 17 gpa spray solution through 8002 XR flat fan nozzles pressurized with CO_2 at 35 psi to the center four rows of six row plots 40 feet in length. Spring barley was seeded perpendicular to sugarbeet rows using a Land Pride grain drill (Great Plains Manufacturing, Salina, KS). Ethofumesate applied preplant and spring barley was incorporated into soil parallel to sugarbeet rows using a

Kongskilde s-tine field cultivator with rolling baskets set approximately 2-inch deep and operated at approximately 5 mph.

Table 2. Herbicide treatment, application timing, and rate, Moorhead, MN, 2023.

Herbicide Treatment	Application timing	Rate (pt/A)
Ethofumesate	Preplant	2
Ethofumesate	Preplant	4
Ethofumesate	Preplant	6
Ethofumesate	Preplant	8
Ethofumesate	Preplant	10
Ethofumesate	Preplant	12
Ethofumesate	Preemergence	2
Ethofumesate	Preemergence	4
Ethofumesate	Preemergence	6
Ethofumesate	Preemergence	8
Ethofumesate	Preemergence	10
Ethofumesate	Preemergence	12

Spring barley nurse crop ground coverage was evaluated using a numeric scale of 1 to 9 (1-3=poor ground coverage, 4-6=good ground coverage, and 7-9=excellent ground coverage). Visible waterhemp control (0 to 100% control, 0% indicating no control, and 100% indicating complete control) was collected 34, 42, 49, 54, and 67 days after treatment (DAT). Experimental design was randomized complete block design with four replications in a factorial arrangement, with factors being herbicide application method and herbicide rate. Data were analyzed with the ANOVA procedure of ARM, version 2023.6 software package.

Results and Discussion

Herbicide activation technique did not interact with ethofumesate rate (P-value=0.3202, 0.6570, 0.8676; 13, 19, 26 days after planting (DAP), respectively) so assessment of ground coverage was averaged across activation technique. However, we observed improved spring barley ground coverage across rates when ethofumesate was applied PRE as compared with ethofumesate machine incorporated into soil (data not shown). The site received 0.8-inch rainfall, 5 and 7 DAP, which should have been plenty of rainfall to both activate ethofumesate PRE into the soil and further distribute ethofumesate incorporated with tillage.

Spring barley stands decreased as ethofumesate rate increased (Figure 3). We observed what was considered ‘poor nurse crop ground cover’ following ethofumesate at 12 pt/A. We observed ‘good nurse crop ground coverage’ following ethofumesate rates of 4 to10 pt/A and ‘excellent nurse crop ground coverage’ following ethofumesate at 2 pt/A. These evaluations were consistent between 12 and 25 DAP; however, we observed numerically improved spring barley ground coverage over time. This could be due to continued growth and tillering as the spring barley established.

Ultimately, what is considered acceptable nurse crop ground cover is up to the producer. Our experiment indicates ethofumesate applied for waterhemp control at greater than 2 pt/A significantly reduced nurse crop ground coverage.

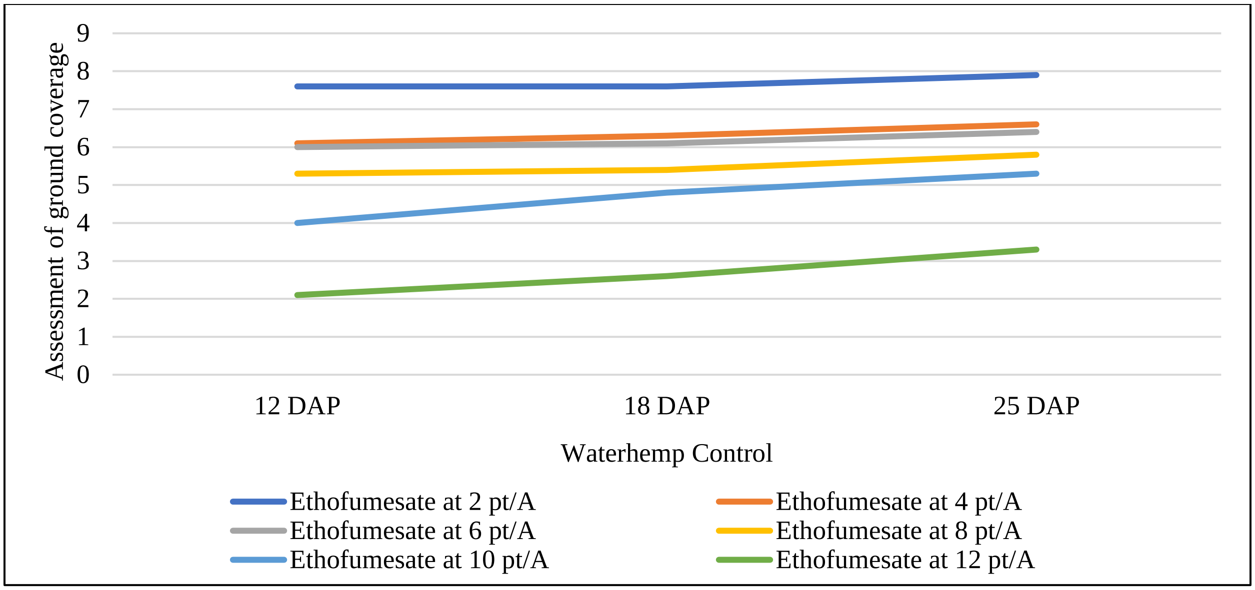

Figure 3. Spring barley ground coverage 12, 18, and 25 days after planting (DAP) in response to ethofumesate rate, Moorhead, MN, 2023.

Herbicide activation technique did not interact with ethofumesate rate (P-value >0.10) 34 to 67 DAP so assessment of waterhemp control was averaged across herbicide application method. Overall, waterhemp control was slightly greater when ethofumesate was rainfall activated as compared with tillage incorporation (Table 3). Improved waterhemp control PRE ranged from 14% to 20% across evaluation timing. Depth of incorporation for preplant incorporated (PPI) treatments may have contributed to decreased waterhemp control as compared with PRE treatments. We have often cautioned producers on pushing ethofumesate too deep into the soil with tillage since waterhemp germinates from the surface to 1-inch deep in soil. Ethofumesate PRE provided greater and longer lasting control as compared with ethofumesate PPI, which is likely due to the uniformity and consistency from rainfall activation.

Table 3. Waterhemp control in response to herbicide application method, averaged across ethofumesate rate, Moorhead, MN, 2023.[a]

	Waterhemp Control				
Herbicide Application Method	34 DAP[b]	42 DAP	49 DAP	54 DAP	67 DAP
	---------------------------------------%	-------------------------------------			
Preplant Incorporated	63 b	54 b	47 b	47 b	31 b
Preemergence	77 a	74 a	61 a	64 a	54 a
LSD (0.10)	6	6	7	6	8

[a]Means within a rating timing that do not share any letter are significantly different by the LSD at the 10% level of significance.
[b] DAP=days after planting.

Waterhemp control and length of waterhemp control was dependent on rate (Table 4). Ethofumesate at 10 and 12 pt/A provided the greatest waterhemp control across all evaluation timings. However, ethofumesate at 10 and 12 pt/A are not labeled rates in sugarbeet. Ethofumesate at 4 to 8 pt/A provided similar waterhemp control up to 34 days after planting. Waterhemp control from ethofumesate at 6 and 8 pt/A was the same up to 67 days after application (DAA). Ethofumesate at 4 pt/A provided greater waterhemp control across evaluation timings in this experiment.

Table 4. Waterhemp control in response to ethofumesate rate, averaged across activation technique, Moorhead, MN, 2023.[a]

		Waterhemp Control				
Herbicide Treatment	Rate	34 DAP[b]	42 DAP	49 DAP	54 DAP	67 DAP
	---pt/A---	-------------------------------------	------------	%-	------------	---------------------------------------
Ethofumesate	2	45 c	32 d	15 e	19 d	10 e
Ethofumesate	4	66 b	54 c	34 d	38 c	29 d
Ethofumesate	6	70 b	72 ab	64 bc	61 b	49 bc
Ethofumesate	8	74 ab	66 bc	58 c	62 b	41 cd
Ethofumesate	10	82 a	77 ab	75 ab	74 a	59 ab
Ethofumesate	12	84 a	83 a	78 a	77 a	66 a
LSD (0.10)		10	11	11	11	13

[a]Means within a rating timing that do not share any letter are significantly different by the LSD at the 10% level of significance.
[b] DAP=days after planting.

Conclusions

Spring barley ground cover decreased as ethofumesate rate increased from 2 to 12 pt/A and loss of ground cover was greater from ethofumesate PPI than ethofumesate PRE. Ethofumesate at 2 pt/A caused negligible loss of ground cover; however, ethofumesate rates between 4 and 6 pt/A may cause up to 50% loss of nurse crop ground cover. Ground cover from nurse crops is a grower preference. Ultimately, the effect of ethofumesate rate and application method on cover crop will be dependent on conditions after application method and once herbicide rate is selected. Waterhemp control from ethofumesate was greatest PRE, indicating ethofumesate dilution occurs with mechanical tillage incorporation. Loss of control from mechanical activation as compared with rainfall activation averaged 18% across evaluation timings at Moorhead, MN in 2023. This outcome was in a season when there was timely rainfall for activation after application. Ultimately, the decision is about waterhemp control and a compromise between nurse crop ground cover and expectations for early season waterhemp control. Ethofumesate at 2 pt/A alone PRE does not accomplish early season waterhemp control and is discouraged (Figure 4). We encourage ethofumesate alone at 4 to 6 pt/A PRE or ethofumesate at 2 to 3 pt/A tank mixed with Dual Magnum PRE at 0.5 to 0.75 pt/A, targeting a minimum of 85% waterhemp control for 30 to 40 days or until chloroacetamide POST application.

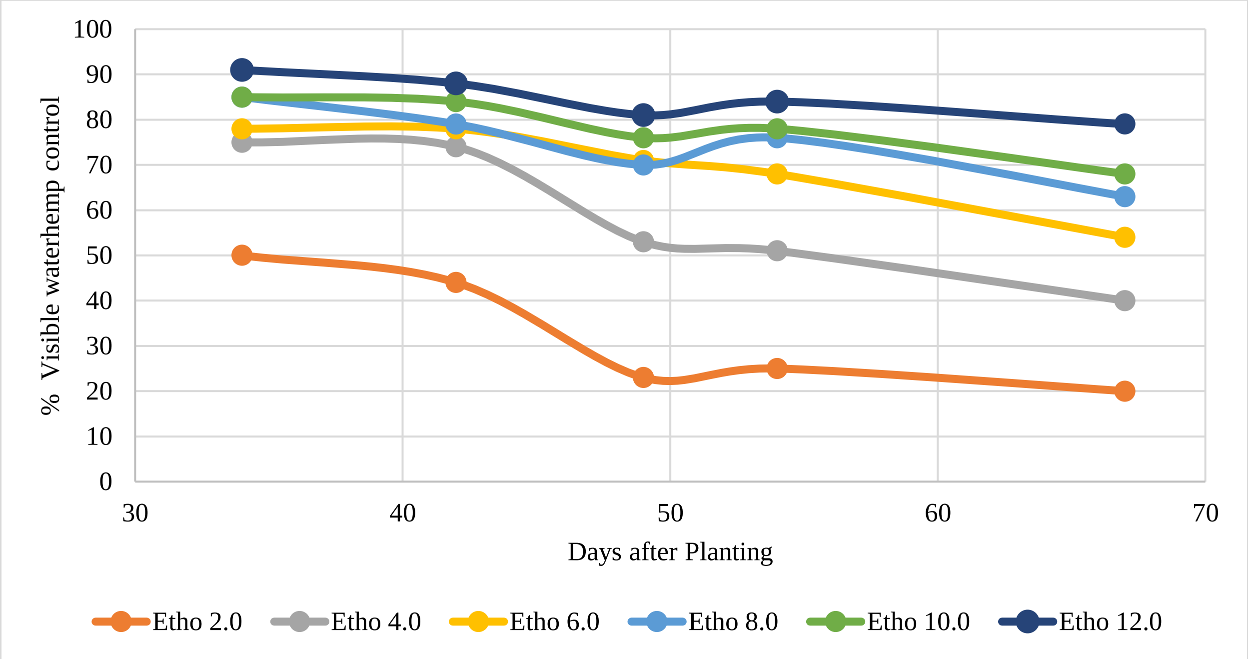

Figure 4. Waterhemp control from ethofumesate PRE across rates, Moorhead, MN, 2023.

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SUMMARY OF ULTRA BLAZER APPLIED IN SUGARBEET

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Summary

1. Environmental conditions at application and adjuvants influence sugarbeet tolerance and waterhemp control from Ultra Blazer.
2. Glyphosate (Roundup PowerMax/Roundup PowerMax3) mixed with Ultra Blazer consistently has improved waterhemp control from Ultra Blazer.
3. Roundup PowerMax3 mixed with Ultra Blazer increased necrosis and sugarbeet growth reduction injury and reduced root yield and recoverable sucrose as compared with Ultra Blazer alone.
4. Nozzle selection and 20 gpa spray volume improved waterhemp control, theoretically, by improving coverage.
5. Control escape waterhemp less than 4-inches tall with Ultra Blazer at 16 fl oz/A with NIS; control 'train-wreck' situations with Roundup PowerMax3 mixed with Ultra Blazer and AMS.

Introduction

I remember asking Dr. Dexter, Professor Emeritus and retired Extension Sugarbeet and Weed Control Specialist from 1969 to 2007, if he had any regrets; ideas he never got around to pursuing. Alan immediately replied that he wished he would have spent more time investigating Ultra Blazer in sugarbeet. I took that hint and invested seven years pursuing use of Ultra Blazer in sugarbeet. This will be our final report.

The first experiments were proof of concept; exploring sugarbeet injury from Ultra Blazer. We found that environment was important. Ultra Blazer was more active during hot and humid environments as compared with cooler or drier air. However, we learned that we could avoid the effects of environment by applying Ultra Blazer to sugarbeet greater than the 6-lf stage. Ms. Emma Burt's Master of Science thesis work focused on Ultra Blazer alone and with adjuvants and Ultra Blazer mixed with Roundup PowerMax and/or Stinger. We found that petroleum or vegetable oil-based adjuvants increased sugarbeet injury and waterhemp control. Sugarbeet injury was greater when Ultra Blazer was mixed with HSMOC (high surfactant methylated seed oil), MSO (methylated oil concentrate), or COC (crop oil concentrate) than with NIS (non-ionic surfactant). We also found sugarbeet injury from Ultra Blazer mixed with Roundup PowerMax was greater than from either Ultra Blazer or Roundup PowerMax alone. Sugarbeet injury was attributed to the formulated surfactant with glyphosate, not the salt of glyphosate. Further, adding Ultra Blazer with glyphosate and either *S*-metolachlor or Outlook, applied at the 6- to 8-lf sugarbeet stage in the layby program application, caused unacceptable injury. Finally, our original experiments were Ultra Blazer tank mixed with Roundup PowerMax. We believe Roundup PowerMax3 mixed with Ultra Blazer causes more sugarbeet injury than the Roundup PowerMax formulation mixed with Ultra Blazer.

Ultra Blazer was applied to approximately 80,000 acres in 2021 and 2022 to control escape waterhemp. The primary concern from producers was regrowth to waterhemp, especially when sugarbeet leaves partially covered waterhemp. Experiments in 2022 and 2023 were designed to improve waterhemp control by increasing either carrier volume or through nozzle selection to improve spray coverage. Second, in an effort to find the appropriate balance between efficacy and tolerance, we evaluated applying Ultra Blazer at 12 fl oz/A in a split application, Ultra Blazer at 16 fl oz/A with COC, or mixing Ultra Blazer plus Roundup PowerMax3 with Warrant as a safener. This report summarizes sugarbeet tolerance and waterhemp control experiments conducted in 2022 and 2023.

Materials and Methods

Sugarbeet tolerance experiments were conducted near Crookston, Hendrum, Kent, Lake Lillian, and Murdock, MN in 2023. Waterhemp efficacy experiments were conducted near Moorhead and Blomkest, MN. The experimental area was prepared for planting by applying the appropriate fertilizer and tillage. Sugarbeet was seeded in 22-inch rows at about 62,000 seeds per acre with 4.6 inch spacing between seeds. We had started the Moorhead experiment in a sugarbeet area; however, due to challenges with waterhemp emergence and sugarbeet size, we moved the Moorhead experiment into a bulk fill soybean area to be consistent with waterhemp size at application.

Treatments shown in Table 1 were applied with a bicycle sprayer in 17 gpa spray solution through 8002 XR flat fan nozzles pressurized with CO_2 at 35 psi to the center four rows of six row plots 40 feet in length. Environmental conditions at application are in Table 2 and 3.

Table 1. Herbicide treatment, herbicide rate, and application timing across locations in 2023.

Herbicide Treatment	Rate (fl oz/A)	Application timing (SGBT leaf stage)
Ultra Blazer + Prefer 90 NIS	16 + 0.25%	6-8 lf
Ultra Blazer + Prefer 90 NIS / Ultra Blazer + Prefer 90 NIS	12 + 0.125% / 12 + 0.125 %	6-8 lf / A + 3-days
Ultra Blazer + Crop Oil Concentrate	16 + 1.25%	6-8 lf
Roundup PowerMax3 + Ultra Blazer + Amsol Liquid AMS	25 + 16 + 2.5% v/v	6-8 lf
Roundup PowerMax3 + Ultra Blazer + Warrant + Amsol Liquid AMS	25 + 16 + 40 + 2.5% v/v	6-8 lf
Roundup PowerMax3 + Prefer 90 NIS + Amsol Liquid AMS / Roundup PowerMax3 + Prefer 90 NIS + Amsol Liquid AMS	25 + 0.25% + 2.5% v/v / 25 + 0.25% + 2.5% v/v	2 lf / 6 lf

Table 2. Application information for tolerance experiments.

	Crookston	Hendrum	Kent	Murdock	Lake Lillian
Plant Date	May 5	May 16	May 17	May 9	May 4
Application Date	June 8	June 15	June 21	June 9	June 6
Time of Day	10:30 AM	10:00 AM	6:00 PM	12:30 PM	8:00 AM
Air Temperature (F)	72	73	86	73	61
Relative Humidity (%)	56	62	43	57	83
Wind Velocity (mph)	8	3	8	7	6
Wind Direction	SSE	NE	NW	SW	E
Soil Temp. (F at 6”)	70	66	-	-	-
Soil Moisture	Good	Fair	-	-	-
Cloud Cover (%)	50	100	-	-	-

Table 3. Application information for efficacy experiments.

	Moorhead	Blomkest
Plant Date	May 24	May 22
Application Date	July 5	June 23
Time of Day	7:00 AM	7:00 AM
Air Temperature (F)	67	66
Relative Humidity (%)	43	94
Wind Velocity (mph)	2	2
Wind Direction	-	-
Soil Temp. (F at 6”)	70	70
Soil Moisture	Good	-
Cloud Cover (%)	90	20

Visible sugarbeet necrosis, malformation, and growth reduction were evaluated approximately 7 and 14 days after treatment (DAT) as sugarbeet injury using a 0 to 100% injury scale with 0% denoting no sugarbeet injury and 100% denoting complete loss of sugarbeet stature. Visible weed control was evaluated 7, 14, and 21 days after the 2-lf stage application using a 0 to 100 scale (0 is no control and 100 is complete control). All evaluations were a visual estimate of percent fresh weight reduction in the four treated rows compared with the adjacent untreated strip.

At harvest for tolerance experiments, sugarbeet was defoliated, harvested mechanically from the center two rows of each plot, and weighed. A root sample (about 20 lbs) was collected from each plot and analyzed for sucrose content and sugar loss to molasses by American Crystal Sugar Company (East Grand Forks, MN). Experimental design was randomized complete block with six replications. Data were analyzed in this report as a RCBD with the ANOVA procedure of ARM, version 2023.3 software package.

Results

Tolerance and Yield Components. Sugarbeet necrosis injury was evaluated as the percent of sugarbeet leaf area that was bronzed from Ultra Blazer application. All Ultra Blazer treatments caused necrosis injury; however, necrosis injury was greatest from Ultra Blazer at 16 fl oz/A plus crop oil concentrate (COC) at 1.25% v/v and was consistent across locations (Table 4). Similarly, an application of Roundup PowerMax3 mixed with Ultra Blazer plus AMS increased necrosis injury as compared with Ultra Blazer alone. Repeat Ultra Blazer applications of 12 fl oz/A followed by (fb) 12 fl oz/A gave slightly less necrosis injury than Ultra Blazer at 16 fl oz/A; however, the repeat Ultra Blazer application extended the duration of necrosis injury as compared with a single application.

Table 4. Sugarbeet visible injury from herbicide treatments, across locations, 2023.[a]

		Necrosis[b]	**Sugarbeet Growth Reduction**		
Herbicide Treatment	**Rate**	**3 DAAC[c]**	**3 DAAC**	**10 DAAC**	**20 DAAC**
	-----fl oz/A-----	--------------------	----------%	----------	----------
Ultra Blazer + Prefer 90 NIS	16 + 0.25%	26 bc	25 b	22 b	13 ab
Ultra Blazer + Prefer 90 NIS / Ultra Blazer + Prefer 90 NIS	12 + 0.125% / 12 + 0.125 %	21 b	22 b	33 bc	23 bc
Ultra Blazer + Crop Oil Concentrate	16 + 1.25%	49 d	43 c	46 d	34 c
Roundup PowerMax3 + Ultra Blazer + Amsol Liquid AMS	25 + 16 + 2.5% v/v	48 d	44 c	43 cd	32 c
Roundup PowerMax3 + Ultra Blazer + Warrant + Amsol Liquid AMS	25 + 16 + 40 + 2.5% v/v	35 c	29 b	28 b	18 b
Roundup PowerMax3 + Prefer 90 NIS + Amsol Liquid AMS / Roundup PowerMax3 + Prefer 90 NIS + Amsol Liquid AMS	25 + 0.25% + 2.5% v/v / 25 + 0.25% + 2.5% v/v	1 a	4 a	2 a	3 a
P-Value (0.05)		**<0.0001**	**<0.0001**	**<0.0001**	**<0.0001**

[a]Means within a rating timing that do not share any letter are significantly different by the LSD at the 5% level of significance.
[b] Nec. = Visual necrosis.
[c]DAAC = Days after application C.

Necrosis injury from Warrant mixed with Ultra Blazer, Roundup PowerMax3, and liquid AMS was less than injury from Ultra Blazer plus Roundup PowerMax3 and liquid AMS (Table 4). Sugarbeet necrosis and growth reduction injury from adding Warrant to Ultra Blazer and Roundup PowerMax3 was similar to the Ultra Blazer at 16 fl oz/A plus NIS standard treatment, across locations.

Sugarbeet growth reduction injury across treatments averaged 28%, 29%, and 21%, 3, 10, and 20 DAAC, respectively (Table 4). As with necrosis, growth reduction injury was greatest when COC or Roundup PowerMax3 with liquid AMS was mixed with Ultra Blazer. Sugarbeet growth reduction injury from Ultra Blazer at 16 fl oz/A with NIS was similar to sugarbeet injury from 2-times Roundup PowerMax3 applications with NIS and liquid AMS. Two-times Ultra Blazer application at 12 fl oz/A with NIS gave growth reduction injury similar to Ultra Blazer at 16 fl oz/A with NIS; however, injury was greater than injury from the Roundup PowerMax3 control.

Root yield, % sucrose, and recoverable sucrose from Ultra Blazer at 16 fl oz/A plus NIS were the same as two applications of glyphosate alone (Table 5). Root yield and % sucrose from two applications of Ultra Blazer at 12 fl oz/A with NIS were the same as Ultra Blazer at 16 fl oz/A. However, recoverable sucrose from two applications of Ultra Blazer applications at 12 fl oz/A was less than a single application of Ultra Blazer at 16 fl oz/A.

Warrant mixed with Ultra Blazer, Roundup PowerMax3, and liquid AMS appeared to reduce sugarbeet vegetative injury and yield components as compared with Ultra Blazer mixed with Roundup PowerMax3 and liquid AMS. This is consistent from results in Michigan (personal communication with Dr. Christy Sprague).

Table 5. Sugarbeet root yield, % sucrose, and recoverable sucrose in response to herbicide treatment across locations, 2023.[a]

Herbicide Treatment	Rate	Root Yield	Sucrose	Recoverable Sucrose
	-----fl oz/A-----	-Ton/A-	--%--	---lb/A---
Ultra Blazer + Prefer 90 NIS	16 + 0.25%	35.5 ab	17.7	11,180 ab
Ultra Blazer + Prefer 90 NIS / Ultra Blazer + Prefer 90 NIS	12 + 0.125% / 12 + 0.125 %	34.2 bc	17.7	10,611 c
Ultra Blazer + Crop Oil Concentrate	16 + 1.25%	33.3 c	17.7	10,417 c
Roundup PowerMax3 + Ultra Blazer + Amsol Liquid AMS	25 + 16 + 2.5% v/v	33.3 c	17.8	10,430 c
Roundup PowerMax3 + Ultra Blazer + Warrant + Amsol Liquid AMS	25 + 16 + 40 + 2.5% v/v	34.9 bc	17.5	10,737 bc
Roundup PowerMax3 + Prefer 90 NIS + Amsol Liquid AMS / Roundup PowerMax3 + Prefer 90 NIS + Amsol Liquid AMS	25 + 0.25% + 2.5% v/v / 25 + 0.25% + 2.5% v/v	37 a	17.8	11,639 a
P-Value (0.05)		**0.001**	**NS**	**0.001**

[a]Means within a rating timing that do not share any letter are significantly different by the LSD at the 5% level of significance.

Waterhemp Control. The waterhemp control experiment at Moorhead was terminated and reestablished in soybean. The efficacy experiment was in sugarbeet at Blomkest. Thus, we elected to consider each experiment singly due to the difference in crop species between the two experiments.

Waterhemp control ranged from 40 to 88% at Moorhead, MN and 68 to 93% at Blomkest, MN, 14 DAAC (Table 6). Waterhemp control was or tended to be best when Ultra Blazer was tank mixed with Roundup PowerMax3 plus AMS across locations and evaluations. These results are consistent with results from Ms. Emma Burt's Master of Science research and other results previously communicated. Ultra Blazer plus COC provided or tended to provide waterhemp control similar to Ultra Blazer mixed with Roundup PowerMax3 across locations and evaluations. Two applications of Ultra Blazer at 12 fl oz/A gave better waterhemp control at Blomkest than Moorhead. Conversely, Ultra Blazer plus Roundup PowerMax3 and Warrant plus AMS gave better control at Moorhead than Blomkest.

Table 6. Waterhemp control 7 and 14 days after herbicide treatments, two locations, 2023.[a]

		Waterhemp Control			
		Moorhead		Blomkest	
Herbicide Treatment	Rate	7 DAAC[b]	14 DAAC	7 DAAC	14 DAAC
	-----fl oz/A-----	---------------	---------------%	---------------	---------------
Ultra Blazer + Prefer 90 NIS	16 + 0.25%	71 b	61 c	79 abc	81 abc
Ultra Blazer + Prefer 90 NIS / Ultra Blazer + Prefer 90 NIS	12 + 0.125% / 12 + 0.125 %	74 b	71 c	84 ab	89 ab
Ultra Blazer + Crop Oil Concentrate	16 + 1.25%	83 ab	73 bc	88 ab	81 abc
Roundup PowerMax3 + Ultra Blazer + Amsol Liquid AMS	25 + 16 + 2.5% v/v	91 a	85 ab	93 a	93 a
Roundup PowerMax3 + Ultra Blazer + Warrant + Amsol Liquid AMS	25 + 16 + 40 + 2.5% v/v	89 a	88 a	75 bc	73 bc
Roundup PowerMax3 + Prefer 90 NIS + Amsol Liquid AMS / Roundup PowerMax3 + Prefer 90 NIS + Amsol Liquid AMS	25 + 0.25% + 2.5% v/v / 25 + 0.25% + 2.5% v/v	43 c	40 d	69 c	68 c
P-Value (0.05)		**<0.0001**	**<0.0001**	**0.0383**	**0.0472**

[a]Means within a rating timing that do not share any letter are significantly different by the LSD at the 5% level of significance.
[b]DAAC = Days after application C.

A repeat application of Ultra Blazer at 12 fl oz/A plus NIS gave waterhemp control similar to a single Ultra Blazer application at 16 fl oz/A plus NIS.

Roundup PowerMax3 provided excellent common lambsquarters control whereas Ultra Blazer provided little or no common lambsquarters control (Table 7). We did not observe any antagonism with common lambsquarters when Ultra Blazer and Warrant were tank mixed with glyphosate.

Table 7. Common lambsquarters control 7 and 14 days after herbicide treatments, Moorhead, MN, 2023.[a]

		Common Lambsquarters Control	
Herbicide Treatment	**Rate**	**7 DAAC[b]**	**14 DAAC**
	-----fl oz/A-----	------------------------%----------------------	
Ultra Blazer + Prefer 90 NIS	16 + 0.25%	3 d	0 e
Ultra Blazer + Prefer 90 NIS / Ultra Blazer + Prefer 90 NIS	12 + 0.125% / 12 + 0.125 %	35 b	10 d
Ultra Blazer + Crop Oil Concentrate	16 + 1.25%	23 c	23 c
Roundup PowerMax3 + Ultra Blazer + Amsol Liquid AMS	25 + 16 + 2.5% v/v	99 a	94 b
Roundup PowerMax3 + Ultra Blazer + Warrant + Amsol Liquid AMS	25 + 16 + 40 + 2.5% v/v	99 a	97 ab
Roundup PowerMax3 + Prefer 90 NIS + Amsol Liquid AMS / Roundup PowerMax3 + Prefer 90 NIS + Amsol Liquid AMS	25 + 0.25% + 2.5% v/v / 25 + 0.25% + 2.5% v/v	98 a	98 a
P-Value (0.05)		**<0.0001**	**<0.0001**

[a]Means within a rating timing that do not share any letter are significantly different by the LSD at the 5% level of significance.
[b]DAAC = Days after application C.

Conclusion
The 2023 (and 2022) Ultra Blazer experiments were designed to determine if sugarbeet injury in response to Ultra Blazer could be reduced, while maintaining or improving waterhemp control through improved water volume, spray nozzle selection, adjuvants or herbicide mixtures. Unfortunately, there is no 'silver bullet' with Ultra Blazer. COC mixed with Ultra Blazer increased vegetative sugarbeet injury and reduced root yield while providing only a modest improvement in waterehemp control. Repeat Ultra Blazer applications extended the length of time with visual necrosis with only a modest improvement in waterhemp control. Mixing Warrant with Ultra Blazer, Roundup PowerMax3, and AMS reduced sugarbeet injury but waterhemp control was inconsistent across locations. We have not investigated glyphosate formulations with adjuvants different from Roundup PowerMax3. Once again, improving sugarbeet safety likely results in less waterhemp control. At this time, I am hesitant to recommend Warrant mixtures with Ultra Blazer and Roundup PowerMax3. Warrant, a chloroacetamide herbicide, is a very important component to our waterhemp control strategy. Suggesting Warrant can be used to safen sugarbeet injury from Ultra Blazer and Roundup PowerMax3 seems to send a confusing message. Likewise, the weed control results from Warrant mixtures with Ultra Blazer and Roundup PowerMax3 were inconsistent.

We recommend applying single Ultra Blazer applications at 16 fl oz/A plus NIS for waterhemp control with XR TeeJet, Turbo TeeJet, or Turbo TwinJet nozzles in 20 gpa water carrier (Table 8). Waterhemp should be less than 4-inches tall to optimize control. Ultra Blazer mixtures with Roundup PowerMax3 may be used in situations with significant waterhemp control challenges. We recommend ammonium sulfate with Roundup PowerMax3 and Ultra Blazer but no additional surfactant. As with Ultra Blazer alone, optimize spray quality to deliver good spray coverage.

Table 8. Sugarbeet necrosis, growth reduction, and waterhemp control in response to spray nozzle and water carrier volume, Moorhead, MN, 2022.

Spray Nozzle[a]	Necrosis[b]		Growth Reduction[b]		Waterhemp Control[c]	
	15 GPA	20 GPA	15 GPA	20 GPA	15 GPA	20 GPA
XR TeeJet	33 abc	38 ab	19 a	20 a	60 c	80 a
AIXR	23 c	23 c	8 c	8 c	64 c	68 c
Turbo TeeJet	28 bc	30 bc	15 ab	13 bc	69 bc	78 ab
Turbo TwinJet	26 c	43 a	10 bc	19 a	83 a	81 a
P-Value (0.20)	0.1781		0.0324		0.0357	

[a]TeeJet.
[b]Necrosis and growth reduction, 13 DAT.
[c]Waterhemp control, 41 DAT.

SUGARBEET TOLERANCE AND WEED CONTROL FROM RO-NEET AND EPTAM IN 2023

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Summary

1. Ro-Neet, Eptam, or Ro-Neet mixed with Eptam at planting caused more sugarbeet injury than ethofumesate at planting.
2. Ro-Neet, Eptam, or Ro-Neet mixed with Eptam provided waterhemp control greater than ethofumesate, 15 and 23 days after planting (DAP).
3. Mixing ethofumesate with either Ro-Neet, Eptam, or Ro-Neet and Eptam might be a way to improve early season waterhemp control, especially when sugarbeet are planted in May or when rainfall is inconsistent.

Introduction

Waterhemp control is our most important weed management challenge in sugarbeet according to the annual growers' survey (Peters et al. 2022). The chloroacetamide herbicides applied at 2- and 6-lf sugarbeet stage are a critical component with our waterhemp control strategy; however, season-long waterhemp control ultimately is dependent on early season control from ethofumesate, Dual Magnum or ethofumesate mixed with Dual Magnum at planting. Some growers are incorporating ethofumesate mostly to ensure activation before waterhemp emergence and to prevent inconsistent waterhemp control (Peters et al. 2022). Ro-Neet, Pyramin, ethofumesate, and Eptam were applied preplant incorporated (PPI) or preemergence (PRE) for weed control in sugarbeet fields in the Red River Valley and Michigan from 1970 to the mid-1980s (Dale et al. 2006). However, use of soil-applied herbicides declined to less than 5% of sugarbeet acres in North Dakota and Minnesota in the mid-1980s because of reliance on POST herbicides and inter-row cultivation (Luecke and Dexter 2003). Stachler and Luecke (2011) reported Ro-Neet, ethofumesate, or Eptam, applied either PPI or PRE, controlled glyphosate-resistant waterhemp; however, they added, sugarbeet growers are reluctant to incorporate herbicides due to detrimental effects of tillage on seed bed moisture and sugarbeet stand.

Sugarbeet growers apply ethofumesate at 3 to 6 pt/A, Dual Magnum at 0.5 to 1 pt/A, or ethofumesate mixed with Dual Magnum at 2 to 3 pt plus 0.5 to 0.75 pt/A, respectively, PRE. These options have provided early season residual control but need to be rainfall activated. Sugarbeet planting was delayed in 2022 and 2023 due to environmental conditions and spring rains have been inconsistent for activating ethofumesate. Thus, growers have opted to incorporate ethofumesate before planting to lessen risk. Incorporating ethofumesate has shifted the mindset and growers are once again asking if Ro-Neet and/or Eptam incorporated might provide more consistent early season waterhemp control than ethofumesate.

Objective

The objective of this experiment was to evaluate weed control and sugarbeet tolerance from Ro-Neet and Eptam alone or in mixtures in comparison with ethofumesate.

Materials and Methods

Experiment was conducted on natural waterhemp populations near Blomkest, MN in 2023. The experimental area was prepared for planting by applying the appropriate fertilizer and tillage. Sugarbeet was planted on May 22, 2023, seeded in 22-inch rows at 60,271 seeds per acre with 4.8 inch spacing between seeds. Herbicide treatments containing Ro-Neet, Eptam, and Ro-Neet + Eptam were two pass incorporated to a 3-inch depth. The first pass was tillage parallel with sugarbeet rows immediately following herbicide application. The second pass was at a shallow angle across the whole trial. Herbicide treatments and rates are described (Table 1). For reasons unknown, Ro-Neet and Eptam rates historically were presented as lb/A rather than pt/A (Table 2).

All treatments were applied with a bicycle sprayer in 17 gpa spray solution through 11002 XR flat fan nozzles pressurized with CO_2 at 40 psi to the center four rows of six row plots 35 feet in length. Herbicides were immediately incorporated for each plot with the rows using a field cultivator set 3 inches deep. A second tillage pass was conducted across the entire trial at a 15-degree angle to the rows.

Table 1. Herbicide treatments, rates, and application timing, Blomkest, MN in 2023.

Herbicide treatment	Rate (pt/A)	Timing of Application
Ro-Neet / Roundup PowerMax3 + etho[a,b] /	4.5 / 25 + 6 /	PPI/EPOST/
Roundup PowerMax3 + etho	25 + 6	POST
Ro-Neet/ Roundup PowerMax3 + etho /	5.33 / 25 + 6 /	PPI/EPOST/
Roundup PowerMax3 + etho	25 + 6	POST
Eptam / Roundup PowerMax3 + etho /	2.29 / 25 + 6 /	PPI/EPOST/
Roundup PowerMax3 + etho	25 + 6	POST
Eptam / Roundup PowerMax3 + etho /	2.85 / 25 + 6 /	PPI/EPOST/
Roundup PowerMax3 + etho	25 + 6	POST
Ro-Neet+ Eptam / Roundup PowerMax3 + etho /	3.33 + 1.71 / 25 + 6 /	PPI/EPOST/
Roundup PowerMax3 + etho	25 + 6	POST
Ro-Neet+ Eptam / Roundup PowerMax3 + etho /	2.67 + 2.29 / 25 + 6 /	PPI/EPOST/
Roundup PowerMax3 + etho	25 + 6	POST
Ethofumesate / Roundup PowerMax3 + etho /	6 / 25 + 6 /	PRE/EPOST/
Roundup PowerMax3 + etho	25 + 6	POST
Etho + Dual Magnum[c] / Outlook + Roundup PowerMax3 + etho[c] /	2.5 + 0.75 / 12 + 25 + 6 /	PRE/EPOST/
Warrant + Roundup PowerMax3 + etho	3 + 25 + 6	POST
Ro-Neet+ Eptam + / Warrant + Roundup PowerMax3 + etho /	2.67 + 1.14 / 3 + 25 + 6 /	PPI/EPOST/
Warrant + Roundup PowerMax3 + etho	3 + 25 + 6	POST
Roundup PowerMax3 + etho /	25 + 6 /	EPOST/
Roundup PowerMax3 + Ultra Blazer + Warrant	25 + 16 + 3	POST

[a]Roundup PowerMax3 plus ethofumesate, Outlook, or Warrant POST applied with HSMOC at 1.5 pt/A and Amsol Liquid AMS at 2.5% v/v.
[b]etho = ethofumesate.
[c]Roundup PowerMax3, Ultra Blazer, and Warrant POST applied with non-ionic surfactant at 0.25% v/v and Amsol Liquid AMS at 2.5% v/v.

Visible sugarbeet growth reduction injury was evaluated using a 0 to 100% scale (0% representing no visible injury and 100% as complete loss of plant / stand) approximately 7 and 14 days (+/- 3 days) after sugarbeet emergence and 7 and 14 days (+/- 3 days) after early POST (EPOST) application. The combination of two-pass incorporation and dry soils created some gaps in stands. Estimates of stand were collected to separate effects from herbicides and lack of stand associated with dry soils. Visible waterhemp control was evaluated using a 0 to 100% scale (0% indicating no control and 100% indicating complete weed control) 14 and 21 days (+/- 3 days) after PPI/PRE (application A/B) and 7, 14, 21, and 40 days and after EPOST/POST (application C/D). Experimental design was randomized complete block with four replications. Data were analyzed with the ANOVA procedure of ARM, version 2023.5 software package.

Table 2. Eptam and Ro-Neet treatments expressed as pt/A and lb/A.

Treatment	Rate	
	---pt/A---	---lb/A---
Ro-Neet	4.50	3.4
Ro-Neet	5.33	4.0
Eptam	2.29	2.0
Eptam	2.85	2.5
Ro-Neet + Eptam	3.32 + 1.71	2.5 + 1.5
Ro-Neet + Eptam	2.67 + 2.29	2.0 + 2.0
Ro-Neet + Eptam	2.67 + 1.14	1.0 + 1.0
Ethofumesate	6	3.0

Results and Discussion

Sugarbeet growth reduction ranged from 13% to 50%, 16 days after application A (DAAA) and 3% to 20%, 32 DAAA (Table 3). We observed the greatest sugarbeet growth reduction from treatments with Eptam alone and Eptam mixed with Ro-Neet. Sugarbeet injury 24 or 32 DAAA was less than sugarbeet injury 16 DAAA. These results are consistent with Dr. Alan Dexter's observations that Eptam may reduce sugarbeet stands and cause reduced sugarbeet stands and temporary early season growth reduction, especially on coarse textured and low organic matter soils (personal communication).

We observed minor sugarbeet growth reduction with ethofumesate mixed with Dual Magnum, our standard lay-by program (Table 3). However, we attribute observed lack of uniformity in stand to lack of rainfall throughout the growing season. Weekly rainfall totals collected weekly after planting from on-site instrumentation are in Table 4.

Table 3. Sugarbeet growth reduction from herbicide treatments, Blomkest, MN in 2023.[a]

		Sugarbeet Growth Reduction		
Herbicide treatment	**Rate**	**16 DAAA[b]**	**24 DAAA**	**32 DAAA**
	-------pt/A-------	------------------------%------------------------		
Ro-Neet / RUPM3[c] / RUPM3	4.5 / 25 / 25	29 abc	8 abcd	3 a
Ro-Neet/ RUPM3 / RUPM3	5.33 / 25 / 25	25 ab	0 a	5 ab
Eptam / RUPM3 / RUPM3	2.29 / 25 / 25	50 d	10 bcd	14 bcd
Eptam / RUPM3 / RUPM3	2.85 / 25 / 25	48 d	14 cd	20 d
Ro-Neet + Eptam / RUPM3 / RUPM3	3.33 + 1.71 / 25 / 25	36 bcd	3 ab	13 bcd
Ro-Neet + Eptam / RUPM3 / RUPM3	2.67 + 2.29 / 25 / 25	40 bcd	15 d	13 bcd
Ethofumesate / RUPM3 / RUPM3	6 / 25 / 25	24 ab	0 a	5 ab
Ethofumesate + Dual Magnum / Outlook + RUPM3[d] / Warrant + RUPM3	2.5 + 0.75 / 12 + 25 / 3 + 25	13 a	10 bcd	10 abc
Ro-Neet + Eptam / Warrant + RUPM3 / Warrant + RUPM3	2.67 + 1.14 / 3 + 25 / 3 + 25	45 cd	13 cd	15 cd
RUPM3 + etho / RUPM3 + Ultra Blazer + Warrant[e]	25 / 25 + 16 + 3	18 a	6 abc	3 a
LSD (0.10)		**17**	**8**	**9**

[a]Means within a rating timing that do not share any letter are significantly different by the LSD at the 10% level of significance.
[b]DAAA = Days after application A.
[c]RUPM3=Roundup PowerMax3. POST Roundup PowerMax3 applied with ethofumesate at 6 fl oz/A.
[d]Roundup PowerMax3 plus ethofumesate, Outlook, or Warrant POST applied with HSMOC and Amsol Liquid AMS at 1.5 pt/A + 2.5% v/v.
[e]Roundup PowerMax3, Ultra Blazer, and Warrant POST applied with non-ionic surfactant at 0.25% v/v and Amsol Liquid AMS at 2.5% v/v.

We evaluated sugarbeet stand using a 1 to 9 scale; 1 representing little to no stand and 9 representing a complete stand and sugarbeet canopy on a percent ground cover basis using a 0% to 100% scale in our attempt to discern sugarbeet injury caused by herbicide from stand variation caused by dry moisture conditions. Overall, sugarbeet stands averaged roughly 7, which is classified as a good stand (Table 4). Sugarbeet canopy tended to be less from Eptam alone or Eptam mixtures (Figure 1).

Table 4. Weekly rainfall measurements beginning May 22, 2023, Blomkest, MN.[a]

Week	Herbicide Application	Rainfall (inch)
1: May 22	PPI and PRE	0.0
2: May 29		0.2
3: June 5	2-lf sugarbeet stage	1.0
4: June 12		0.3
5: June 19	8-lf sugarbeet stage	0.7
6: June 26		0.0
7: July 3		0.6
8: July 10		1.0
9: July 17		0.0
	Cumulative total:	**3.8**

[a]Blomkest precipitation data collected using weather station instrumentation by Campbell Scientific, Inc., Logan, UT.

Waterhemp control from herbicide treatments was observed weekly between June 7 and July 31, 2023, or 15 to 69 days following planting and 0 to 53 days following the first postemergence glyphosate application. This summary will focus on waterhemp and common lambsquarters control 23, 31, and 52 days after planting, or 7, 15, and 36 days after the first postemergence application, when waterhemp control across treatments averaged 81%, 82%, and 66%, respectively (Table 5). Our sugarbeet standard for waterhemp control, ethofumesate followed by (fb) Outlook+ RUPM3+etho fb Warrant+RUPM3+etho applied at planting and at the sugarbeet 2- and 6-lf stage fell below the experiment averages. We attribute this to the lack of activating rainfall after planting. In general, waterhemp control was best from treatments containing Ro-Neet, Eptam or Ro-Neet mixed with Eptam, 7 and 15 DAAC. Waterhemp control was similar across treatments 36 DAAC.

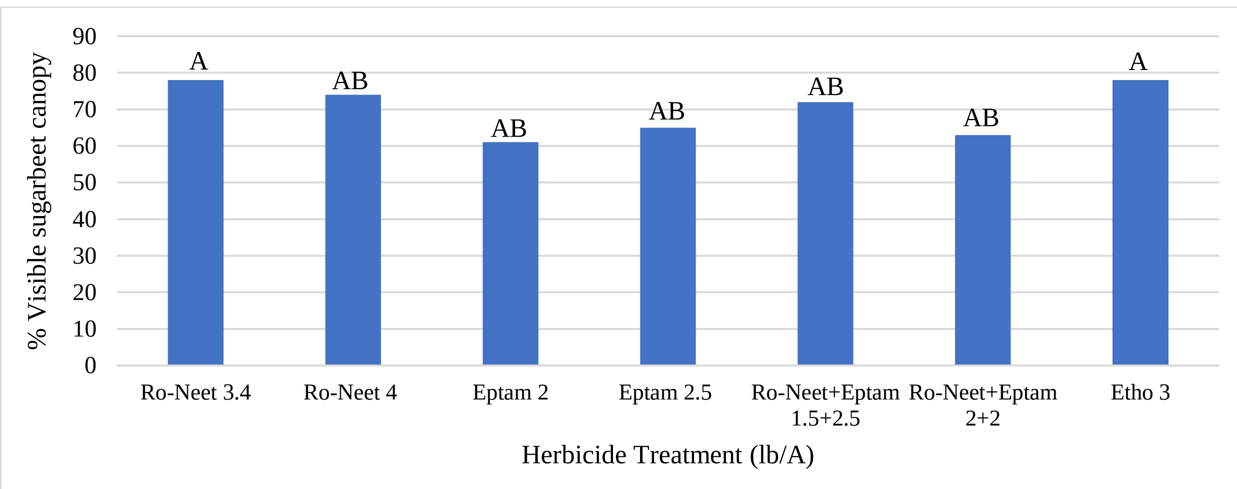

Figure 1. Sugarbeet canopy from selected treatments, 53 days after plant (DAP) or at canopy closure, Blomkest, 2023.

Treatment 9 was Ro-Neet + Eptam followed by Warrant at 3 pt/A applied at the 2-lf sugarbeet stage. Treatment 9 also contained glyphosate + ethofumesate applied at the 2- and 6-lf stage. Although it is difficult to observe benefits from the layby program in a dry year, we intend to continue to evaluate this concept in 2024.

We were able to evaluate common lambsquarters in the experiment; however, Roundup PowerMax3 provided complete control of all common lambsquarters in the POST applications.

Conclusions

We observed the greatest numeric waterhemp control from Eptam at 2.29 and 2.85 pt/A; however, these rates resulted in close to 50% growth reduction, 16 DAAA. Ethofumesate at planting followed by two times Roundup PowerMax3 and ethofumesate or ethofumesate followed by Outlook or Warrant with Roundup PowerMax3 and ethofumesate provided less waterhemp control compared with treatments containing Eptam, Ro-Neet, or both. We have stated ethofumesate probably did not provide at planting waterhemp control due to the dry conditions at and after planting. However, those are the conditions our growers planted into in 2023 and we need to develop reliable programs, regardless of environmental conditions. For the 2024 growing season, we intend to further evaluate Eptam and/or Ro-Neet mixed with ethofumesate to develop more consistent early season waterhemp control.

Table 5. Waterhemp control from herbicide treatments, Blomkest, MN in 2023.[a]

		Waterhemp Control		
Herbicide treatment	**Rate**	**7 DAAC[b]**	**15 DAAC**	**36 DAAC**
	----------pt/A----------	----------------------%----------------------		
Ro-Neet/ RUPM3[c] / RUPM3	4.5 / 25 / 25	89 a	88 a	68
Ro-Neet/ RUPM3 / RUPM3	5.33 / 25 / 25	79 bc	84 a	65
Eptam / RUPM3 / RUPM3	2.29 / 25 / 25	91 a	88 a	66
Eptam / RUPM3 / RUPM3	2.85 / 25 / 25	89 a	86 a	73
Ro-Neet+ Eptam / RUPM3 / RUPM3	3.33 + 1.71 / 25 / 25	90 a	89 a	68
Ro-Neet+ Eptam / RUPM3 / RUPM3	2.67 + 2.29 / 25 / 25	92 a	89 a	76
Ethofumesate / RUPM3 / RUPM3	6 / 25 / 25	63 d	63 b	49
Ethofumesate + Dual Magnum / Outlook + RUPM3[d] / Warrant + RUPM3	2.5 + 0.75 / 12 + 25 / 3 + 25	75 c	83 a	61
Ro-Neet+ Eptam / Warrant + RUPM3 / Warrant + RUPM3	2.67 + 1.14 / 3 + 25 / 3 + 25	85 ab	88 a	68
RUPM3 + etho / RUPM3 + Ultra Blazer + Warrant[e]	25 / 25 + 16 + 3	55 d	64 b	68
LSD (0.10)		**9**	**11**	**NS**

[a]Means within a rating timing that do not share any letter are significantly different by the LSD at the 10% level of significance.
[b]DAAC = Days after application C.
[c]RUPM3=Roundup PowerMax3. POST Roundup PowerMax3 applied with ethofumesate at 6 fl oz/A.
[d]Roundup PowerMax3 plus ethofumesate, Outlook, or Warrant POST applied with HSMOC and Amsol Liquid AMS at 1.5 pt/A + 2.5% v/v.
[e]Roundup PowerMax3, Ultra Blazer, and Warrant POST applied with non-ionic surfactant at 0.25% v/v and Amsol Liquid AMS at 2.5% v/v.

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Appendix. Trials conducted in the SMBSC growing area but not reported in the 2023 Research Reports.

Trial	**Location**	**Description**
Nitrogen Fall/Spring Comparison	Renville	These trials were designed to compare nitrogen products and rates in a fall/spring design. Data will be reported upon completion of the final year of trials in 2024. Cooperative project with Dan Kaiser from the University of Minnesota.
Proprietary Products Trials	Renville	Seven trials were conducted looking at a proprietary product that may have the ability to increase sugar content. This product is currently not labeled for use in sugar beets.
Liquid Separated Dairy Manure Trial	Murdock	2023 was the start of the second 3-year crop rotation for this trial. The data will be reported upon completion of the trial. Cooperative project with Melissa Wilson from the University of Minnesota and Minn-Dak Farmers Cooperative.
Rhizoctonia Management Trial	Renville	Data from this trial was not usable due to drought conditions that impacted the trial site unevenly.
Weed Efficacy or Tolerance Trials	Blomkest and Murdock	We conduct many weed control efficacy and tolerance trials with Dr. Tom Peters across the coop. Not all these trials are in this report as some may be proprietary or may be an incomplete data set.
Magno Prelim Trials	Renville, Murdock, Hector, and Lake Lillian	These variety trials were conducted on behalf of the breeding company. The data is the property of the seed company, and the seed company contracts the research work by SMBSC. As such, no data was published on these trials.
Minn-Dak Aph Nursery	Renville Aph Nursery	Trial conducted on behalf of Minn-Dak. Data is property of Minn-Dak and as such will not be reported.