2024 Research Report

Southern Minnesota Beet Sugar Cooperative

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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.

SMBSC Official Variety Trial Procedures and Sugar Beet Seed Approval

Lynsey Nass[1] and **Mark Bloomquist**[2]
[1]Production Agronomist, [2]Research Director, SMBSC, Renville, MN

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 submitted by seed companies.
- 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 2024. These trials were located near Cosmos, Hector, Murdock, and Wood Lake. Trials were planted with a modified twelve-row John Deere 7300 vacuum planter. The plots were four twenty-two inch-rows wide by forty feet long. Each variety was replicated six times across each trial, for a total of twenty-four 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 forty-foot plot length, so final plot lengths were approximately thirty-five feet after the alleys were cut. Emergence counts were taken approximately twenty-eight 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 2024 due to differences in emergence between the trial locations. AZteroid 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 and post-emergence split lay-by herbicides at the appropriate rates and times. The weeds present dictated the weed control products used at each location. Pre-emergence applications were made using a side by side sprayer going down the rows while all post-emergence 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 trials received CLS fungicide applications starting around row closure and continuing approximately every two weeks.

Between late August and early September, row lengths were taken on each harvest row. These row lengths were used to calculate the harvest area of each plot, which is then used to calculate the yield. All plots were defoliated using a four-row defoliator. After defoliation, the beets within the two feet of row immediately adjacent to the bare 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 two-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 Seed in Shakopee, MN. SMBSC also operates a Rhizoctonia nursery near Renville and 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 two or three times per week between mid-July and mid-August. These ratings were taken using the KWS (1-9) scale. Root ratings for the Aphanomyces and Rhizoctonia 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 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.

Results and Discussion

In 2024, the Hector site was abandoned due to poor stands and multiple heavy rainfall events in May and June. Data from the remaining three Yield Trials and all six Disease Nurseries was utilized for CY25 Seed Approval. To approve varieties to be planted in CY25, data produced in CY24 was combined with the data generated in CY23 and CY22.

In the following pages, you will find tables that share 2024 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 2024 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.

2024 SMBSC Official Variety Trials

Yield Trials Specifications

Trial Type	Cooperator	Trial Location	Previous Crop	Starter Fertilizer	Planting Date	Thinning Date	Harvest Date	Notes
Yield	Scott Buboltz	Hector	Soybeans		5/6/2024	-	-	Abandoned due to large rainfall events and poor stand.
Yield	Steve and Nick Frank	Cosmos	Soybeans		4/24/2024	6/7/2024	10/8/2024	Moderate Rhizoc and Aph
Yield	Petersen Farms	Murdock	Corn		4/25/2024	6/6/2024	9/24/2024	Low levels of Rhizoc and Aph
Yield	Schwerin Farms	Wood Lake	Soybeans		5/15/2024	6/26/2024	9/26/2024	Moderate Rhizoc and Aph. Lost reps 3-6 due to standing water.

Disease Nursery Trials Specifications

Trial Type	Investigator	Trial Location	Rating Performed by	Use of Ratings in 2024 Variety Approval System
Aphanomyces	SMBSC	Renville	SMBSC Staff	50% of the 2024 Aph Rating
Aphanomyces	KWS	Shakopee	KWS, M. Bloomquist, L. Nass, A. Chanda	50% of the 2024 Aph Rating
Cercospora	SMBSC	Renville	SMBSC Staff	50% of the 2024 CLS Rating
Cercospora	KWS	Randolph	KWS Staff	50% of the 2024 CLS Rating
Rhizoctonia	SMBSC	Renville	SMBSC Staff	50% of the 2024 RHC Rating
Rhizoctonia	BSDF - USDA/ARS	Michigan	Linda Hanson and USDA/ARS Staff	50% of the 2024 RHC Rating

Table 1. Comparison of 2025 Fully Approved Varieties to Test Market and Specialty Approved Varieties - Three Years of Data (2022-2024)

			Recoverable Sugar Per Ton		Recoverable Sugar Per Acre		Sugar Percent		Purity Percent		Yield Tons Per Acre		Aphanomyces Root Rating [1]		Cercospora Leaf Spot [1]		Rhizoctonia Root Rating [1]		Emergence (%)		Revenue per Ton [2]	Revenue per Acre [2]
	Variety	**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**
Fully Approved	Beta 9124		279.5	99.8	9830.8	98.6	16.7	99.9	89.8	100.0	35.2	98.8	4.8	116.1	2.4	83.7	4.6	118.9	67.4	100.9	99.1	98.0
	Beta 9131	RHC	279.1	99.7	10121.4	101.5	16.7	99.5	90.0	100.1	36.3	101.9	4.2	100.7	2.0	71.7	3.2	82.2	66.0	98.8	99.7	101.6
	Beta 9284	RHC	284.9	101.7	10121.4	101.5	17.0	101.5	89.9	100.0	35.4	99.4	3.6	86.7	3.8	133.6	3.6	92.0	64.3	96.3	102.9	102.3
	Crystal M106		279.7	99.9	9957.5	99.9	16.8	99.9	89.8	100.0	35.8	100.4	3.8	91.8	3.9	136.7	3.7	95.3	67.7	101.3	100.3	100.8
	Crystal M168		276.9	98.9	9803.9	98.4	16.6	99.1	89.8	99.9	35.4	99.4	4.3	104.7	2.1	74.4	4.3	111.7	68.6	102.8	98.0	97.3
	Mean of Fully Approved:		**280.0**	**100.0**	**9967.0**	**100.0**	**16.8**	**100.0**	**89.9**	**100.0**	**35.6**	**100.0**	**4.1**	**100.0**	**2.8**	**100.0**	**3.9**	**100.0**	**66.8**	**100.0**	**100.0**	**100.0**
Specialty	Beta 9155	RHC	269.6	96.3	10029.9	100.6	16.2	96.6	89.8	99.9	37.1	104.4	4.2	101.2	2.4	83.9	3.2	83.1	67.8	101.5	93.3	97.1
	Crystal M089	RHC	268.8	96.0	10194.2	102.3	16.1	96.3	89.8	99.9	38.0	106.6	4.1	99.5	2.2	79.1	3.5	91.0	69.9	104.7	92.1	98.2
	Crystal M977	RHC	272.1	97.2	10292.6	103.3	16.3	97.4	89.9	100.0	37.5	105.3	3.6	88.4	4.4	154.8	3.2	81.0	64.5	96.6	94.7	99.7
	SV 863	RHC	273.1	97.5	8906.2	89.4	16.4	97.8	89.8	99.9	32.7	91.8	5.2	126.2	3.8	135.7	3.6	93.6	50.9	76.1	95.6	87.8
Test Market	Hilleshog 2395		269.6	96.3	9384.2	94.2	16.2	96.7	89.7	99.8	34.8	97.9	4.8	116.1	4.1	145.9	4.5	114.5	64.7	96.9	93.0	90.8

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

2. **Revenue per Ton** and **Revenue per Acre** figures were produced using the payment calculation for the final 2023 crop payment.

Table 2. Comparison of 2025 Fully Approved Varieties to Test Market and Specialty Approved Varieties - Two Years of Data (2023-2024)

			Recoverable Sugar Per Ton		Recoverable Sugar Per Acre		Sugar Percent		Purity Percent		Yield Tons Per Acre		Aphanomyces Root Rating [1]		Cercospora Leaf Spot [1]		Rhizoctonia Root Rating [1]		Emergence (%)		Revenue per Ton [2]	Revenue per Acre [2]
	Variety	**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**
Fully Approved	Beta 9124		276.3	100.0	9600.9	98.7	16.5	100.0	90.0	100.1	34.6	98.6	4.7	115.0	2.4	86.1	4.7	120.2	66.7	99.4	99.7	98.2
	Beta 9131	RHC	275.4	99.7	9924.2	102.0	16.5	99.5	90.0	100.1	36.0	102.5	3.9	96.3	2.1	73.0	3.1	78.8	68.7	102.3	99.7	102.2
	Beta 9284	RHC	277.9	100.6	9742.4	100.1	16.6	100.7	89.9	99.9	34.8	99.2	3.5	84.7	3.7	131.5	3.6	93.5	64.6	96.4	100.6	99.7
	Crystal M106		276.2	100.0	9671.2	99.4	16.6	100.2	89.8	99.9	35.1	99.9	3.9	94.6	3.7	132.6	3.7	95.3	66.8	99.6	100.3	100.3
	Crystal M168		275.3	99.7	9702.0	99.7	16.5	99.7	90.0	100.1	35.1	99.9	4.5	109.4	2.2	76.9	4.4	112.2	68.6	102.2	99.7	99.6
	Mean of Fully Approved:		**276.2**	**100.0**	**9728.1**	**100.0**	**16.5**	**100.0**	**89.9**	**100.0**	**35.1**	**100.0**	**4.1**	**100.0**	**2.8**	**100.0**	**3.9**	**100.0**	**67.1**	**100.0**	**100.0**	**100.0**
Specialty	Beta 9155	RHC	268.8	97.3	9834.2	101.1	16.1	97.6	89.9	99.9	36.4	103.7	4.2	103.0	2.4	84.3	3.2	83.1	67.1	100.0	94.6	98.0
	Crystal M089	RHC	267.9	97.0	9984.8	102.6	16.0	97.0	90.1	100.1	37.2	105.9	4.2	102.7	2.3	80.3	3.5	91.0	69.8	104.1	93.9	99.5
	Crystal M977	RHC	268.3	97.1	10020.3	103.0	16.1	97.4	89.9	99.9	36.8	104.7	3.7	90.6	4.2	149.1	3.1	79.4	65.9	98.2	94.6	99.1
	SV 863	RHC	272.5	98.6	8462.6	87.0	16.3	98.8	89.9	99.9	31.0	88.4	5.4	132.8	3.8	133.6	3.7	95.3	47.2	70.3	97.0	85.6
Test Market	Beta 9369	CLS	283.2	102.5	10176.3	104.6	16.8	101.9	90.3	100.4	35.7	101.7	3.9	96.4	1.7	61.3	3.9	100.7	66.7	99.4	104.2	105.9
	Crystal M339	CLS	274.3	99.3	9896.9	101.7	16.5	99.7	89.8	99.8	35.9	102.3	3.9	96.1	2.0	70.6	3.4	88.5	71.2	106.2	99.1	101.3
	Hilleshog 2395		266.7	96.6	9307.4	95.7	16.0	96.8	89.9	99.9	34.8	99.1	4.7	114.6	4.0	142.5	4.7	120.3	64.4	96.0	93.4	92.5

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

2. **Revenue per Ton** and **Revenue per Acre** figures were produced using the payment calculation for the final 2023 crop payment.

Table 3. Comparison of 2025 Fully Approved Varieties to Test Market and Specialty Approved Varieties - 1 Year of Data (2024)

			Recoverable Sugar Per Ton		Recoverable Sugar Per Acre		Sugar Percent		Purity Percent		Yield Tons Per Acre		Aphanomyces Root Rating [1]		Cercospora Leaf Spot [1]		Rhizoctonia Root Rating [1]		Emergence (%)		Revenue per Ton [2]	Revenue per Acre [2]
	Variety	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
Fully Approved	Beta 9124		268.4	99.2	8440.5	97.6	16.2	99.6	89.7	99.8	31.4	98.2	4.2	109.5	2.9	98.6	5.1	117.7	74.8	102.1	99.2	97.5
	Beta 9131	RHC	271.6	100.4	8881.5	102.7	16.2	100.1	90.0	100.1	32.6	102.0	3.8	97.5	2.2	76.8	3.8	87.5	75.3	102.9	100.1	102.1
	Beta 9284	RHC	274.2	101.4	9054.4	104.7	16.4	101.1	90.0	100.1	32.8	102.7	3.3	84.4	3.4	115.4	4.1	95.8	72.7	99.3	102.6	105.3
	Crystal M106		268.8	99.4	8567.2	99.1	16.1	99.5	89.8	99.9	32.1	100.7	3.9	100.4	3.5	121.7	3.7	84.4	68.9	94.1	98.3	98.7
	Crystal M168		269.3	99.6	8295.1	95.9	16.2	99.6	89.9	100.0	30.8	96.4	4.2	108.2	2.5	87.5	5.0	114.6	74.4	101.6	99.8	96.2
	Mean of Fully Approved:		**270.5**	**100.0**	**8647.7**	**100.0**	**16.2**	**100.0**	**89.9**	**100.0**	**31.9**	**100.0**	**3.9**	**100.0**	**2.9**	**100.0**	**4.3**	**100.0**	**73.2**	**100.0**	**100.0**	**100.0**
Specialty	Beta 9155	RHC	261.1	96.5	8532.6	98.7	15.7	96.7	89.9	100.0	32.6	102.0	3.9	101.1	2.7	94.5	3.3	76.0	74.9	102.4	93.5	95.4
	Crystal M089	RHC	263.1	97.3	9113.8	105.4	15.8	97.3	90.0	100.1	34.5	108.1	4.1	106.6	2.7	91.6	3.5	80.6	82.3	112.5	95.1	102.7
	Crystal M977	RHC	262.9	97.2	9278.9	107.3	15.8	97.4	89.9	100.0	34.0	106.6	3.7	97.1	4.4	150.2	3.3	75.7	71.2	97.3	94.8	100.9
	SV 863	RHC	268.5	99.3	7244.5	83.8	16.1	99.4	89.8	99.9	27.1	85.0	5.1	131.7	3.7	127.7	3.7	85.5	39.1	53.4	98.3	83.4
Test Market	Beta 9369	CLS	278.0	102.8	9369.8	108.4	16.5	101.7	90.6	100.8	33.5	105.0	3.5	91.3	1.8	63.4	4.1	95.9	74.8	102.3	105.6	110.7
	Crystal M339	CLS	267.0	98.7	9154.3	105.9	16.1	99.2	89.7	99.8	34.1	106.8	3.6	92.7	2.1	73.7	3.9	90.4	78.9	107.8	98.0	104.6
	Hilleshog 2395		262.5	97.1	8542.4	98.8	15.8	97.4	89.7	99.9	32.2	100.9	4.8	124.2	4.2	143.2	4.5	103.1	64.0	87.5	94.2	95.0

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

2. **Revenue per Ton** and **Revenue per Acre** figures were produced using the payment calculation for the final 2023 crop payment.

2022-2024 Disease Nursery Data for Aphanomyces, Cercospora, and Rhizoctonia

			Aphanomyces Root Ratings					Cercospora Leafspot Ratings					Rhizoctonia Root Ratings				
	Variety	Specialty	2024 Root Rating	2023 Root Rating	2022 Root Rating	2023-2024 2 Year Mean Root Rating	2022-2024 3 Year Mean Root Rating	2024 CLS Rating	2023 CLS Rating	2022 CLS Rating	2023-2024 2 Year Mean Foliar Rating	2022-2024 3 Year Mean Foliar Rating	2024 Root Rating	2023 Root Rating	2022 Root Rating	2023-2024 2 Year Mean Root Rating	2022-2024 3 Year Mean Root Rating
Fully Approved	Beta 9124		4.2	5.2	5.0	4.7	4.8	2.9	2.0	2.3	2.4	2.4	5.1	4.3	4.5	4.7	4.6
	Beta 9131	RHC	3.8	4.1	4.6	3.9	4.2	2.2	1.9	2.0	2.1	2.0	3.8	2.3	3.5	3.1	3.2
	Beta 9284	RHC	3.3	3.7	3.8	3.5	3.6	3.4	4.0	3.9	3.7	3.8	4.1	3.1	3.5	3.6	3.6
	Crystal M106		3.9	3.9	3.6	3.9	3.8	3.5	3.9	4.1	3.7	3.9	3.7	3.8	3.7	3.7	3.7
	Crystal M168		4.2	4.8	4.0	4.5	4.3	2.5	1.8	2.0	2.2	2.1	5.0	3.8	4.3	4.4	4.3
Specialty	Beta 9155	RHC	3.9	4.5	4.1	4.2	4.2	2.7	2.0	2.4	2.4	2.4	3.3	3.2	3.2	3.2	3.2
	Crystal M089	RHC	4.1	4.3	3.9	4.2	4.1	2.7	1.9	2.2	2.3	2.2	3.5	3.6	3.5	3.5	3.5
	Crystal M977	RHC	3.7	3.7	3.5	3.7	3.6	4.4	4.0	4.7	4.2	4.4	3.3	2.9	3.3	3.1	3.2
	SV 863	RHC	5.1	5.8	4.8	5.4	5.2	3.7	3.8	4.0	3.8	3.8	3.7	3.7	3.5	3.7	3.6
Test Market	Beta 9369	CLS	3.5	4.4		3.9		1.8	1.6		1.7		4.1	3.7		3.9	
	Crystal M339	CLS	3.6	4.3		3.9		2.1	1.8		2.0		3.9	3.0		3.4	
	Hilleshog 2395		4.8	4.6	5.0	4.7	4.8	4.2	3.9	4.4	4.0	4.1	4.5	4.9	4.0	4.7	4.5
			Aphanomyces Ratings from SMBSC Nursery in Renville and KWS Nursery in Shakopee.					Cercospora Ratings from SMBSC Nursery in Renville and KWS Nursery near Randolph MN.					Rhizoctonia Ratings from SMBSC Nursery in Renville and BSDF Nursery in Michigan.				
			Ratings are on scale of 1 - 9.					**Ratings are on scale of 1-9.**					**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 9155	208	16.6	90.1	32.2	278.2	8942.2	100.6%
Beta 9284	196	17.1	90.0	30.8	286.7	8811.0	102.2%
Crystal M089	213	16.7	90.5	33.0	280.9	9256.8	105.4%
Crystal M168	196	17.0	90.1	31.4	285.0	8949.6	103.6%
Hilleshog 2395	188	16.5	90.1	32.2	276.3	8886.1	100.3%
Hilleshog 2449	175	16.5	89.7	28.6	274.7	7861.0	88.0%
Mean	195.9	16.7	90.1	31.4	280.3	8784.5	100.0
%CV	7.5	1.5	0.5	5.1	1.9	5.7	7.0
PR>F	<0.0001	<0.0001	0.0082	<0.0001	<0.0001	<0.0001	<0.0001
LSD (0.05)	13.1	0.2	0.4	1.4	4.8	452.7	6.3
Reps***	10	10	10	10	10	10	10

* 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 2023 crop payment calculator, utilizing values released Oct. 23, 2024
*** Combined data from 10 locations with each location considered a replicate.

Locations: Redwood Falls, Olivia, Raymond, Hector, Murdock, Appleton, De Graff, Lake Lillian, 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
Crystal M168	206	17.9	90.5	38.8	303.5	11792	102%	Crystal M168
Beta 9284	214	17.6	90.1	38.0	296.1	11237	96%	Beta 9284
Beta 9155	216	17.6	90.8	40.7	298.9	12169	104%	Beta 9155
Hilleshog 2395	206	17.7	90.7	39.7	299.7	11895	102%	Hilleshog 2395
Crystal M089	218	17.7	91.0	40.8	301.0	12279	106%	Crystal M089
Hilleshog 2449	206	17.7	89.8	35.7	295.6	10544	90%	Hilleshog 2449
Average	**211**	**17.7**	**90.5**	**38.9**	**299.2**	**11653**	**100.0%**	**Average**

Planted: April 15, 2024
Harvested: October 13, 2024
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
Crystal M168	204	16.8	89.4	33.4	278.1	9299	106%	Crystal M168
Beta 9284	194	16.9	89.1	34.6	279.8	9673	111%	Beta 9284
Beta 9155	239	15.9	89.2	32.9	261.6	8604	93%	Beta 9155
Hilleshog 2395	179	16.1	89.3	35.4	266.4	9430	104%	Hilleshog 2395
Crystal M089	238	16.2	89.3	36.5	268.3	9801	108%	Crystal M089
Hilleshog 2449	198	16.0	88.7	27.7	261.4	7232	78%	Hilleshog 2449
Beta 9131*	214	16.6	89.4	37.1	274.5	10192	115%	Beta 9131*
Crystal M339*	205	16.8	89.1	34.8	276.8	9635	110%	Crystal M339*
Average	**208**	**16.3**	**89.1**	**33.4**	**269.3**	**9006**	**100.0%**	**Average**

Planted: April 14, 2024
Harvested: September 30, 2024
Agriculturalist: Chris Dunsmore

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

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
Crystal M168	187	18.1	89.4	42.2	300.7	12674	104%	Crystal M168
Beta 9284	185	18.2	89.9	42.2	306.0	12896	107%	Beta 9284
Beta 9155	205	17.7	89.9	43.7	297.1	12987	105%	Beta 9155
Hilleshog 2395	175	17.1	89.8	40.5	285.4	11567	91%	Hilleshog 2395
Crystal M089	208	17.4	89.5	45.5	288.9	13149	104%	Crystal M089
Hilleshog 2449	162	17.6	89.7	37.5	293.2	10998	88%	Hilleshog 2449
Beta 9131*	200	17.6	90.3	39.3	297.0	12872	104%	Beta 9131*
Beta 9124*	205	18.2	89.7	39.2	304.7	12986	107%	Beta 9124*
Average	**187**	**17.7**	**89.7**	**37.5**	**295.2**	**11066**	**100.0%**	**Average**

Planted: April 25, 2024
Harvested: October 19, 2024
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
Crystal M168	193	16.9	90.2	23.6	284.1	6703	96%	Crystal M168
Beta 9284	213	17.2	89.9	25.7	287.3	7387	107%	Beta 9284
Beta 9155	195	16.6	90.1	27.7	278.5	7704	108%	Beta 9155
Hilleshog 2395	188	16.1	89.3	24.9	265.4	6603	89%	Hilleshog 2395
Crystal M089	210	16.9	91.0	28.2	287.3	8088	117%	Crystal M089
Hilleshog 2449	178	16.5	90.1	21.5	276.1	5922	83%	Hilleshog 2449
Average	**196**	**16.7**	**90.1**	**25.2**	**279.8**	**7068**	**100.0%**	**Average**

Planted: April 22, 2024
Harvested: October 1, 2024
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
Crystal M168	199	17.8	91.8	19.6	307.1	6023	116%	Crystal M168
Beta 9284	183	17.7	90.8	16.7	300.2	5017	95%	Beta 9284
Beta 9155	192	17.9	91.1	16.1	306.1	4938	95%	Beta 9155
Hilleshog 2395	184	17.6	90.7	18.4	299.1	5501	104%	Hilleshog 2395
Crystal M089	194	17.4	91.4	18.3	297.5	5442	102%	Crystal M089
Hilleshog 2449	162	16.9	90.1	17.0	283.9	4823	87%	Hilleshog 2449
SV 863*		18.1	90.6	15.8	307.4	4856	94%	SV 863*
Average	**186**	**17.6**	**91.0**	**17.7**	**299.0**	**5291**	**100.0%**	**Average**

Planted: April 14, 2024
Harvested: October 13, 2024
Agriculturalist: Ryan Kuester

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

SMBSC Variety Strip Trial - Murdock

Variety	28 DAP Stand Beets/100' row	Sugar %	Purity %	Tons / Acre	Extractable Sugar per Ton	Extractable Sugar per Acre	Percent Rev/Acre	Variety
Crystal M168	218	14.9	88.8	36.5	242.4	8852	94%	Crystal M168
Beta 9284	220	15.7	90.1	35.6	261.8	9315	107%	Beta 9284
Beta 9155	223	15.0	88.8	39.6	244.4	9685	104%	Beta 9155
Hilleshog 2395	203	15.1	90.0	38.3	250.7	9599	106%	Hilleshog 2395
Crystal M089	220	15.1	90.5	37.9	252.8	9577	107%	Crystal M089
Hilleshog 2449	198	14.5	88.1	34.6	233.5	8078	82%	Hilleshog 2449
Average	**213**	**15.0**	**89.4**	**37.1**	**247.6**	**9184**	**100.0%**	**Average**

Planted: April 23, 2024
Harvested: September 17, 2024
Agriculturalist: William Luepke

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
Crystal M168	161	15.2	91.2	27.1	256.8	6954	102%	Crystal M168
Beta 9284	163	15.2	91.1	28.4	256.9	7289	106%	Beta 9284
Beta 9155	179	15.0	91.2	27.0	253.9	6846	99%	Beta 9155
Hilleshog 2395	164	14.8	91.1	30.0	250.5	7517	107%	Hilleshog 2395
Crystal M089	170	14.9	91.0	25.3	250.7	6350	90%	Crystal M089
Hilleshog 2449	158	14.9	90.8	26.7	251.1	6716	96%	Hilleshog 2449
Beta 9131*	169	15.2	91.2	28.4	256.6	7283	106%	Beta 9131*
Beta 9124*	108	15.2	91.0	29.8	255.7	7628	111%	Beta 9124*
Average	**166**	**15.0**	**91.1**	**27.4**	**253.3**	**6945**	**100.0%**	**Average**

Planted: April 13, 2024
Harvested: September 9, 2024
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 - De Graff

Variety	28 DAP Stand Beets/100' row	Sugar %	Purity %	Tons / Acre	Extractable Sugar per Ton	Extractable Sugar per Acre	Percent Rev/Acre	Variety
Crystal M168	174	17.4	89.5	28.8	290.2	8364	109%	Crystal M168
Beta 9284	180	17.4	90.0	23.1	292.5	6743	89%	Beta 9284
Beta 9155	195	17.1	89.7	27.9	284.5	7947	102%	Beta 9155
Hilleshog 2395	144	16.8	89.8	27.1	280.2	7583	96%	Hilleshog 2395
Crystal M089	199	17.3	90.0	27.6	290.6	8034	105%	Crystal M089
Hilleshog 2449	159	17.3	89.9	25.9	289.3	7492	98%	Hilleshog 2449
Crystal M106*	193	17.5	90.1	30.5	293.9	8969	119%	Crystal M106*
Average	**175**	**17.2**	**89.8**	**26.7**	**287.9**	**7694**	**100.0%**	**Average**

Planted: April 24, 2024
Harvested: October 8, 2024
Agriculturalist: Scott Thaden

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

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
Crystal M168	239	17.5	89.3	32.7	289.7	9486	106%	Crystal M168
Beta 9284	226	17.6	89.3	32.8	292.7	9605	108%	Beta 9284
Beta 9155	244	16.4	89.7	32.9	272.3	8973	95%	Beta 9155
Hilleshog 2395	250	16.6	89.3	33.2	275.1	9137	98%	Hilleshog 2395
Crystal M089	254	16.8	90.2	33.8	282.1	9524	104%	Crystal M089
Hilleshog 2449	143	16.7	89.1	29.9	275.9	8256	89%	Hilleshog 2449
Beta 9124*		17.2	89.4	32.1	286.4	9203	102%	Beta 9124*
Average	**226**	**16.9**	**89.5**	**32.6**	**281.3**	**9163**	**100.0%**	**Average**

Planted: April 24, 2024
Harvested: October 8, 2024
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
Crystal M168	180	17.5	90.8	31.4	297.4	9349	101%	Crystal M168
Beta 9284	184	17.5	90.1	30.4	294.0	8948	96%	Beta 9284
Beta 9155	194	16.9	90.4	33.7	284.3	9570	99%	Beta 9155
Hilleshog 2395	182	17.2	90.6	34.6	290.1	10029	106%	Hilleshog 2395
Crystal M089	214	17.1	90.8	35.6	290.1	10324	109%	Crystal M089
Hilleshog 2449	182	17.0	90.6	29.8	286.7	8549	89%	Hilleshog 2449
Average	**189**	**17.2**	**90.6**	**32.6**	**290.4**	**9461**	**100.0%**	**Average**

Planted: April 25, 2024
Harvested: October 14, 2024
Agriculturalist: Dylan Swanson

		Cosmos OVT													
		Sugar		Tons		ES		EST		ESA		Purity		Emergence	
Entry	Variety	Mean	Mean %	Mean	Mean %	Mean	Mean %	Mean	Mean %	Mean	Mean %	Mean	Mean %	Mean	Mean %
901	Hilleshog 2395	16.8	98.5	26.8	92.6	14.2	98.4	284.3	98.4	7928.9	94.5	90.7	100.0	49.8	81.7
902	Baseline 11 Beta 9780	17.3	101.1	29.0	100.2	14.7	101.4	293.0	101.4	8505.5	101.4	90.9	100.2	57.1	93.7
903	Baseline 9 SV RR863	16.9	99.1	29.0	100.0	14.3	99.3	286.8	99.3	8300.4	99.0	90.9	100.2	53.0	86.9
904	SV 863	16.9	99.1	24.5	84.6	14.2	98.3	284.1	98.3	6927.7	82.6	90.2	99.4	30.4	49.8
905	SV 845	16.3	95.3	32.8	113.2	13.7	95.0	274.4	95.0	8726.8	104.0	90.7	100.0	62.0	101.6
906	Hilleshog 2500	16.4	96.0	22.2	76.7	13.7	94.8	273.8	94.8	6078.0	72.5	90.0	99.2	64.8	106.3
907	Beta 9497	17.7	103.4	31.8	109.8	15.1	104.4	301.6	104.4	9582.7	114.2	91.3	100.6	60.1	98.5
908	Crystal M452	17.5	102.7	31.8	109.6	14.9	103.0	297.8	103.0	9407.7	112.2	90.9	100.2	59.0	96.7
909	Beta 9369	17.6	102.9	32.1	110.9	15.1	104.3	301.5	104.3	9694.2	115.6	91.6	100.9	63.3	103.7
910	Beta 9124	16.8	98.6	26.2	90.5	14.2	98.3	284.1	98.3	7430.6	88.6	90.6	99.8	61.3	100.5
911	Crystal M481	16.9	98.7	29.3	101.1	14.2	98.4	284.3	98.4	8391.4	100.0	90.6	99.8	68.2	111.8
912	Beta 9284	17.7	103.5	31.3	108.1	15.1	104.2	301.2	104.2	9442.5	112.6	91.1	100.4	60.0	98.4
913	Crystal M089	17.0	99.4	31.2	107.8	14.4	99.8	288.3	99.8	9031.0	107.7	91.0	100.3	70.1	114.9
914	Crystal M168	17.0	99.5	27.0	93.0	14.3	99.2	286.7	99.2	7683.3	91.6	90.6	99.8	63.3	103.7
915	Baseline 10 Crystal M623	17.3	101.2	30.0	103.6	14.6	101.3	292.7	101.3	8785.0	104.7	90.8	100.0	67.7	111.0
916	Crystal M339	17.1	100.4	31.6	109.2	14.5	100.6	290.7	100.6	9235.6	110.1	90.9	100.2	70.4	115.4
917	Crystal M445	17.6	103.1	29.4	101.3	14.9	103.2	298.2	103.2	8742.9	104.2	90.7	99.9	57.3	94.0
918	Beta 9131	17.3	101.1	28.8	99.3	14.7	101.5	293.4	101.5	8423.6	100.4	91.0	100.3	62.9	103.2
919	Filler #1	17.2	100.5	33.8	116.7	14.5	100.4	290.0	100.4	9843.0	117.4	90.6	99.9	68.3	112.0
920	Baseline 12 Hilleshog 2327	16.8	98.5	29.2	100.6	14.2	98.5	284.6	98.5	8281.3	98.7	90.8	100.1	60.9	99.8
921	Beta 9476	17.6	103.0	28.8	99.4	15.1	104.7	302.5	104.7	8790.0	104.8	91.8	101.1	60.5	99.2
922	Hilleshog 2449	16.6	97.4	26.3	90.7	13.8	95.7	276.6	95.7	7293.4	87.0	89.7	98.8	59.9	98.1
923	SV 846	16.8	98.4	19.0	65.6	14.0	97.2	280.7	97.2	5396.9	64.3	89.9	99.1	65.1	106.7
924	Crystal M432	17.3	101.3	32.1	110.8	14.7	101.4	293.1	101.4	9363.0	111.6	90.8	100.1	61.4	100.6
925	Beta 9419	17.5	102.6	28.0	96.8	14.8	102.1	295.1	102.1	8267.2	98.6	90.3	99.5	62.3	102.2
926	Beta 9436	16.5	96.7	27.6	95.1	13.9	96.5	278.8	96.5	7666.7	91.4	90.7	100.0	66.8	109.5
927	Crystal M977	16.7	97.8	32.8	113.2	14.1	97.4	281.5	97.4	9254.0	110.3	90.6	99.8	61.2	100.4
928	Beta 9155	16.8	98.3	28.5	98.3	14.2	98.1	283.5	98.1	8092.8	96.5	90.7	99.9	64.7	106.1
929	Crystal M106	17.3	101.5	26.3	90.9	14.7	101.7	293.8	101.7	7722.8	92.1	90.8	100.0	53.7	88.1
930	Beta 9415	17.1	100.4	32.0	110.5	14.6	101.0	291.9	101.0	9340.5	111.4	91.2	100.5	64.2	105.2
	Grand Mean	17.07		28.97		14.45		288.96		8387.65		90.74		60.99	
	%CV	1.72		13.22		2.36		2.37		13.45		0.82		14.58	
	LSD	0.34		4.38		0.39		7.82		1291.43		0.85		10.17	

Murdock OVT

Entry	Variety	Sugar		Tons		ES		EST		ESA		Purity		Emergence	
		Mean	Mean %	Mean	Mean %	Mean	Mean %	Mean	Mean %	Mean	Mean %	Mean	Mean %	Mean	Mean %
901	Hilleshog 2395	15.8	98.6	42.4	103.7	13.2	98.3	264.2	98.3	11068.1	100.9	90.1	99.8	61.7	90.1
902	Baseline 11 Beta 9780	16.2	101.1	39.0	95.4	13.6	101.2	272.1	101.2	10602.8	96.6	90.3	100.0	74.4	108.7
903	Baseline 9 SV RR863	15.7	98.1	38.8	94.9	13.3	98.6	265.0	98.6	10018.1	91.3	90.7	100.4	57.7	84.4
904	SV 863	16.1	100.7	35.0	85.5	13.5	100.7	270.8	100.7	9348.4	85.2	90.3	100.0	24.9	36.4
905	SV 845	15.1	93.9	44.8	109.6	12.5	93.1	250.3	93.1	11211.6	102.2	90.1	99.7	72.2	105.5
906	Hilleshog 2500	15.1	94.1	40.1	98.0	12.6	93.5	251.5	93.5	10130.5	92.3	90.2	99.9	75.1	109.8
907	Beta 9497	16.5	102.8	42.2	103.2	13.9	103.6	278.7	103.6	11766.0	107.2	90.7	100.4	67.7	99.0
908	Crystal M452	16.1	100.1	43.4	106.1	13.5	100.6	270.6	100.6	11739.7	107.0	90.7	100.4	69.8	102.0
909	Beta 9369	16.3	101.4	40.8	99.7	13.7	102.0	274.3	102.0	11184.7	101.9	90.7	100.4	72.9	106.5
910	Beta 9124	16.4	102.4	40.5	99.1	13.8	102.3	275.1	102.3	11171.0	101.8	90.2	99.9	72.8	106.4
911	Crystal M481	16.6	103.4	41.4	101.2	14.0	103.8	279.1	103.8	11586.6	105.6	90.5	100.2	71.6	104.6
912	Beta 9284	16.2	100.9	41.2	100.6	13.5	100.5	270.2	100.5	11095.8	101.1	90.0	99.6	70.6	103.2
913	Crystal M089	15.7	98.1	42.9	104.9	13.2	98.0	263.5	98.0	11308.7	103.0	90.4	100.1	80.4	117.5
914	Crystal M168	16.3	101.4	40.4	98.7	13.7	101.8	273.8	101.8	10961.8	99.9	90.5	100.2	71.6	104.6
915	Baseline 10 Crystal M623	16.2	100.8	39.2	95.9	13.6	101.2	272.0	101.2	10665.2	97.2	90.6	100.3	71.8	105.0
916	Crystal M339	16.1	100.6	41.2	100.7	13.5	100.1	269.1	100.1	11090.1	101.1	90.0	99.7	73.8	107.9
917	Crystal M445	16.3	101.4	40.7	99.5	13.6	101.3	272.3	101.3	11101.9	101.2	90.3	99.9	58.6	85.6
918	Beta 9131	16.3	101.9	42.3	103.4	13.7	101.6	273.3	101.6	11538.7	105.1	90.1	99.7	73.7	107.7
919	Filler #1	16.0	99.8	42.3	103.4	13.4	99.9	268.7	99.9	11353.1	103.4	90.4	100.1	75.0	109.6
920	Baseline 12 Hilleshog 2327	15.8	98.4	40.5	99.0	13.3	98.6	265.1	98.6	10731.2	97.8	90.5	100.2	66.4	97.0
921	Beta 9476	16.1	100.5	41.3	100.9	13.7	101.6	273.2	101.6	11289.9	102.9	91.1	100.9	65.8	96.2
922	Hilleshog 2449	16.0	99.7	38.7	94.6	13.4	99.4	267.3	99.4	10342.6	94.2	90.1	99.7	59.1	86.3
923	SV 846	15.7	97.7	40.2	98.3	13.0	96.5	259.4	96.5	10412.5	94.9	89.5	99.1	74.6	109.1
924	Crystal M432	16.4	102.4	39.7	96.9	13.8	102.9	276.6	102.9	10961.7	99.9	90.5	100.2	72.6	106.2
925	Beta 9419	16.5	102.8	40.0	97.7	13.8	102.5	275.5	102.5	10990.0	100.1	90.0	99.6	64.4	94.2
926	Beta 9436	15.8	98.5	40.7	99.4	13.2	98.0	263.5	98.0	10690.9	97.4	90.0	99.6	75.7	110.6
927	Crystal M977	15.9	99.0	43.2	105.6	13.3	99.0	266.3	99.0	11507.5	104.9	90.3	100.0	65.6	95.9
928	Beta 9155	15.7	98.1	42.1	102.9	13.2	98.0	263.6	98.0	11092.5	101.1	90.3	100.0	73.1	106.8
929	Crystal M106	16.1	100.1	42.0	102.7	13.4	99.7	267.9	99.6	11228.8	102.3	90.1	99.7	68.6	100.3
930	Beta 9415	16.2	101.2	40.4	98.7	13.7	101.7	273.5	101.7	11045.4	100.6	90.7	100.4	70.3	102.8
	Grand Mean	16.0		40.9		13.4		268.9		10974.5		90.3		68.4	
	%CV	2.2		4.7		2.8		2.8		4.7		0.7		8.1	
	LSD	0.4		2.2		0.4		8.6		596.0		NS		6.3	

Wood Lake OVT

Entry	Variety	Sugar		Tons		ES		EST		ESA		Purity		Emergence	
		Mean	Mean %	Mean	Mean %	Mean	Mean %	Mean	Mean %	Mean	Mean %	Mean	Mean %	Mean	Mean %
901	Hilleshog 2395	14.7	98.0	27.6	101.4	11.9	97.0	237.6	97.1	6613.5	98.8	88.1	99.4	84.7	98.1
902	Baseline 11 Beta 9780	15.3	101.7	25.0	92.0	12.6	103.1	252.3	103.1	6341.4	94.7	89.5	101.0	86.8	100.6
903	Baseline 9 SV RR863	15.4	102.5	28.2	103.6	12.7	103.7	254.0	103.7	7141.2	106.7	89.3	100.8	84.0	97.3
904	SV 863	15.5	102.9	22.7	83.6	12.8	104.4	255.5	104.4	5802.0	86.7	89.5	101.0	74.3	86.1
905	SV 845	14.0	93.4	23.5	86.5	11.4	92.9	227.5	92.9	5409.4	80.8	88.6	100.0	83.3	96.5
906	Hilleshog 2500	14.2	94.7	22.8	83.8	11.4	93.4	228.8	93.4	5255.7	78.5	88.1	99.3	85.4	99.0
907	Beta 9497	15.6	104.0	32.3	118.9	12.9	105.4	258.0	105.4	8338.1	124.5	89.3	100.8	84.7	98.1
908	Crystal M452	15.6	104.0	27.6	101.7	12.8	104.9	256.8	104.9	7103.0	106.1	89.1	100.5	84.0	97.3
909	Beta 9369	15.8	104.9	27.9	102.8	13.1	106.7	261.2	106.7	7291.4	108.9	89.6	101.0	86.8	100.6
910	Beta 9124	15.2	101.3	28.6	105.2	12.3	100.5	246.0	100.5	7060.2	105.4	88.1	99.3	90.3	104.6
911	Crystal M481	15.0	100.1	33.0	121.6	12.3	100.3	245.6	100.3	8111.0	121.1	88.8	100.2	88.2	102.2
912	Beta 9284	15.3	101.7	24.2	89.2	12.5	102.3	250.4	102.3	6056.3	90.5	89.0	100.4	84.7	98.1
913	Crystal M089	14.5	96.3	29.2	107.5	11.7	95.6	234.0	95.6	6856.0	102.4	88.3	99.6	93.1	107.8
914	Crystal M168	15.3	101.6	25.1	92.5	12.4	101.3	248.0	101.3	6284.8	93.9	88.4	99.7	86.8	100.6
915	Baseline 10 Crystal M623	15.1	100.1	27.9	102.7	12.3	100.1	245.2	100.1	6954.4	103.9	88.7	100.0	88.2	102.2
916	Crystal M339	14.9	99.4	29.3	107.9	11.9	97.1	237.7	97.1	6967.4	104.1	87.2	98.4	89.6	103.8
917	Crystal M445	15.3	101.7	31.6	116.2	12.6	102.6	251.2	102.6	7928.1	118.4	89.2	100.6	77.1	89.3
918	Beta 9131	15.0	100.1	26.1	96.0	12.4	101.0	247.1	100.9	6440.3	96.2	89.2	100.7	88.9	103.0
919	Filler #1	15.2	101.3	29.8	109.6	12.3	100.5	246.0	100.5	7365.3	110.0	88.1	99.4	88.9	103.0
920	Baseline 12 Hilleshog 2327	15.0	99.5	23.8	87.6	12.3	100.3	245.6	100.3	5856.9	87.5	89.2	100.6	81.9	94.9
921	Beta 9476	15.8	105.3	29.6	109.0	13.1	107.0	262.0	107.0	7765.0	116.0	89.5	100.9	86.8	100.6
922	Hilleshog 2449	14.7	97.5	27.1	99.8	11.7	95.8	234.6	95.8	6375.3	95.2	87.7	98.9	82.0	94.9
923	SV 846	14.1	93.8	26.0	95.6	11.2	91.7	224.7	91.8	5863.3	87.6	87.5	98.7	89.6	103.8
924	Crystal M432	15.6	103.6	22.7	83.6	12.8	104.2	255.2	104.2	5824.3	87.0	88.9	100.3	93.8	108.6
925	Beta 9419	14.9	99.0	28.0	102.9	12.0	97.7	239.2	97.7	6703.8	100.1	87.9	99.1	88.9	103.0
926	Beta 9436	14.6	97.3	27.8	102.2	11.8	96.1	235.2	96.1	6527.6	97.5	88.0	99.3	87.5	101.4
927	Crystal M977	14.9	99.1	23.2	85.5	12.1	98.7	241.8	98.7	6150.2	91.9	88.5	99.8	89.6	103.8
928	Beta 9155	14.4	95.9	27.3	100.3	11.7	95.6	234.0	95.6	6419.3	95.9	88.6	99.9	86.8	100.6
929	Crystal M106	15.0	99.5	29.5	108.5	12.1	99.2	242.8	99.2	7172.6	107.1	88.4	99.8	86.1	99.8
930	Beta 9415	15.0	100.1	27.8	102.3	12.4	101.1	247.5	101.1	6888.3	102.9	89.3	100.8	86.8	100.6
	Grand Mean	15.0		27.2		12.2		244.8		6695.5		88.6		86.3	
	%CV	2.4		16.1		3.3		3.3		18.1		0.7		5.3	
	LSD	0.8		NS		0.8		16.5		NS		1.3		NS	

Date of Harvest Trials

Lynsey Nass[1] and **Mark Bloomquist**[2]
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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 2024, the Date of Harvest Trials took place near Murdock, Cosmos, and Wood Lake. 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 14, 2024. Harvest continued once per week until October 16, 2024. A total of ten harvest timings were completed in 2024. Trials sites had even stands, uniform canopy development, and minimal root rot at Murdock, with Cosmos and Wood Lake having light to moderate root rot. All sites had minimal levels of CLS.

The 2024 regression analysis of extractable sugar per acre in Figure 1 reveals a daily increase of 94.17 lbs. This exceeds the twelve-year average of 82.2 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 2024 Date of Harvest Trial. The weekly sugar percent steadily increased throughout the ten-week period. Table 2 shows that the daily increase in sugar percent for 2024 was 0.09%, which is well above the twelve-year average of 0.06%. Weekly increases in sugar percent followed a similar pattern, with the current year's gain at 0.66%, compared to the long-term average of 0.39%.

The 2024 root yield data in Figure 3 shows the weekly change in tons per acre during the 2024 Date of Harvest Trial. Table 3 has the root yield rate of gain for 2012-2024. In 2024, the average daily rate of gain of 0.21 tons per acre was slightly below the 2012-2023 average of 0.22 tons. This trend was also reflected every week, with a gain of 1.45 tons per acre, which is slightly less than the 2012-2023 average of 1.56 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 2024, pre-pile began for SMBSC growers on August 26, 2024 and ended 38 days later on October 3, 2024.

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 27, 2024 payment estimate. The first two weeks of the Date of Harvest Trial are not included in Table 4 as they occurred before the start of prepile. The prepile premium was calculated using the December 2024 prepile premium estimate. The revenue values are shown as a percent of the main harvest. This is done by treating the harvest date October 9, 2024 (the nearest to main harvest that occurs at or after the start of main harvest) as the “mean” and comparing this value to other dates. The nearer the value is to 100, the closer the value is to the payment on day 1 of the main harvest. As the value grows larger than 100, that revenue is greater than the first day of the main harvest. With the exception of the October 2, 2024 harvest date, all prepile dates saw higher revenues than the first day of main harvest. Higher levels of root disease present in the October 2, 2024, harvest area may have resulted in lower yields on this date. For data generated in the 2024 Date of Harvest Trial, revenue per acre averaged 12.8% 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.

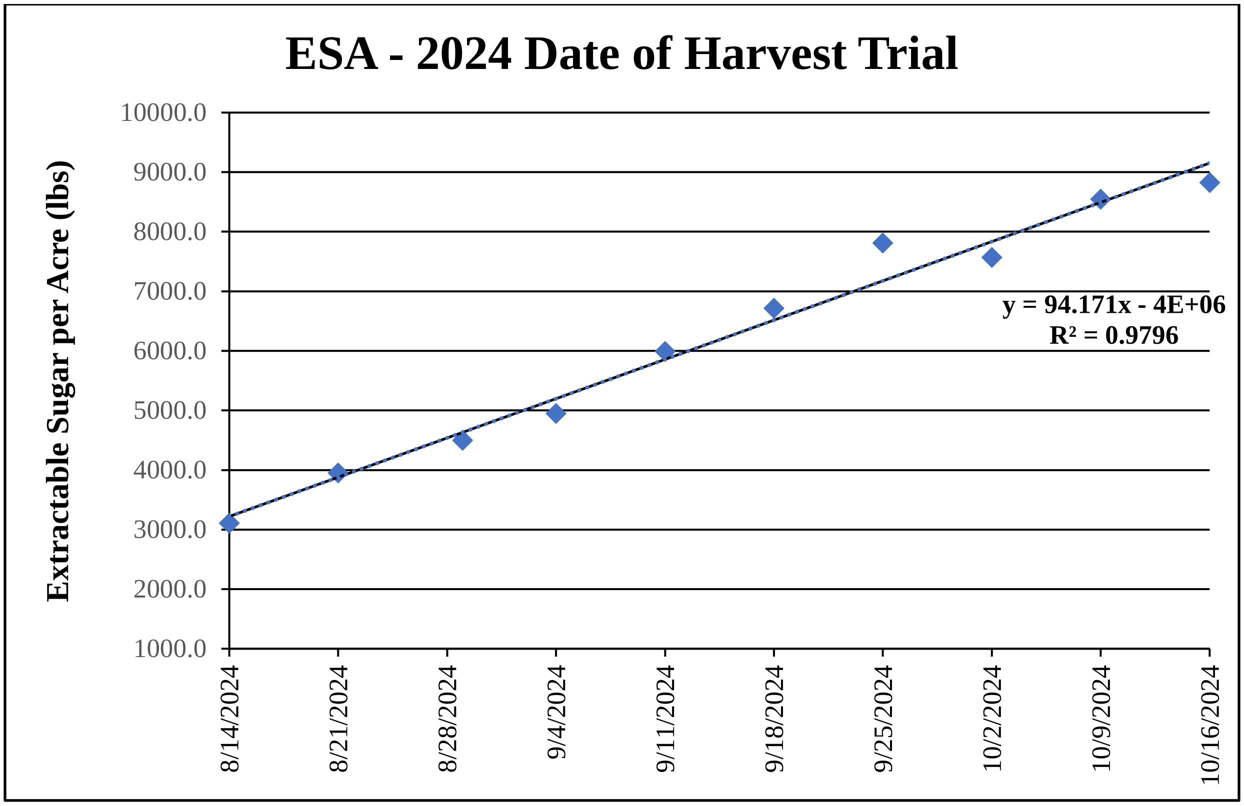

Figure 1. Extractable sugar per acre (ESA) data collected during the 2024 Date of Harvest Trials, plotted across the harvest period, depicting a positive linear trend.

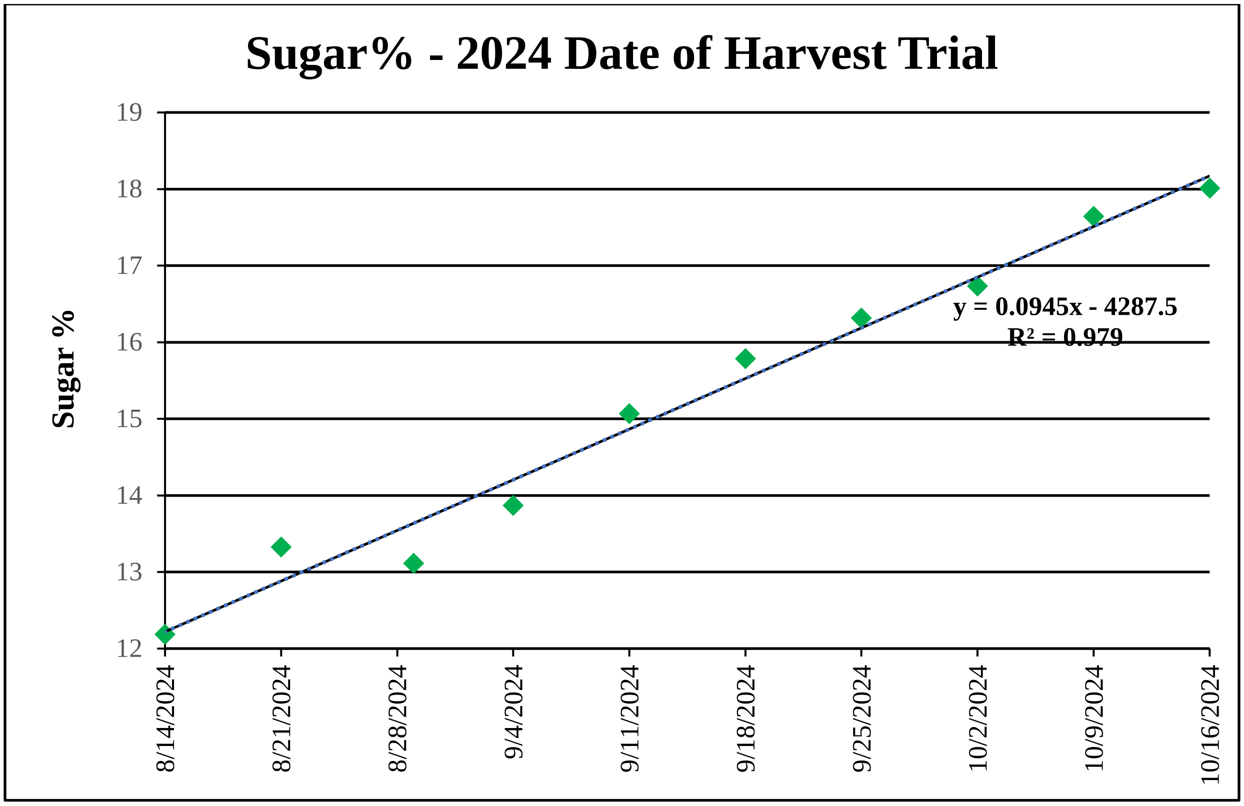

Figure 2. Sugar percent data collected during the 2024 Date of Harvest Trials, plotted across the harvest period, depicting a positive linear trend.

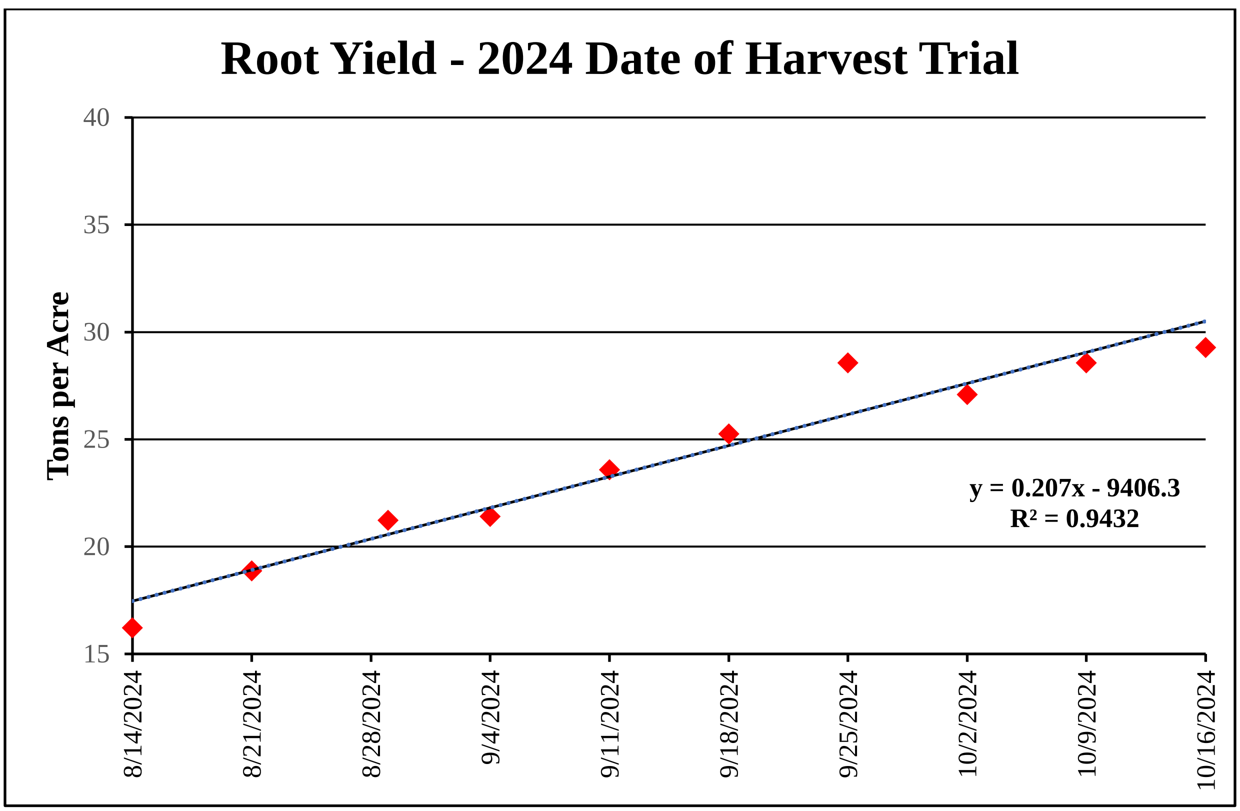

Figure 3. Root yield data collected during the 2024 Date of Harvest Trials, plotted across the harvest period, depicting a positive linear trend.

Table 1. 2012-2024 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
2023	87.3
Average (2012-2023)	82.2
2024	94.2

Table 2. 2012-2024 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
2023	0.05	0.37
Average (2012-2023)	0.06	0.39
2024	0.09	0.66

Table 3. 2012-2024 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
2023	0.23	1.59
Average (2012-2023)	0.22	1.56
2024	0.21	1.45

Table 4. 2024 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 (% of Main Harvest)	Total Payment per Acre with Premium (% of Main Harvest)
3	8/29/2024	13.1	88.7	21.2	10.6	211.9	4497.2	24.5%	120.2%
4	9/4/2024	13.9	90.5	21.4	11.6	231.0	4946.3	36.3%	116.8%
5	9/11/2024	15.1	91.0	23.6	12.7	253.9	5990.0	54.8%	122.8%
6	9/18/2024	15.8	90.7	25.2	13.3	266.0	6715.3	66.2%	116.8%
7	9/25/2024	16.3	90.2	28.6	13.7	273.5	7810.8	80.5%	112.8%
8	10/2/2024	16.7	89.9	27.1	14.0	279.5	7570.0	80.6%	87.4%
Main Harvest	10/9/2024	17.6	90.7	28.6	15.0	299.2	8546.1	100.0%	100.0%
Main Harvest	10/16/2024	18.0	89.8	29.3	15.1	301.4	8826.1	105.0%	105.0%

Conclusion

The percent sugar continued to gain throughout the entire sampling period ending with an average sugar of 18.0%. Tons and ESA also showed steady gains. All but the October 2nd week of the 2024 Date of Harvest Trial were greater than 100% of main harvest revenue per acre, and the 2024 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

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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 individual fungicides to determine if there is a benefit to using a particular fungicide in the recommended CLS program.

Methodology

In 2024 the Fungicide Screening Trial was conducted as randomized complete block with four replications and was located near Wood Lake, MN. This trial evaluated fungicides individually, and in combinations to look at possible synergies. The site was planted on May 15th 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 19th. Four fungicide applications were made in the Fungicide Screening Trial beginning July 25th and continuing on a fourteen-day spray interval. The treatment list containing the fungicide rates can be found in Table 3.

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 30th 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 untreated control had significantly lower yield than most of the other treatments. There were also some yield differences between single-mode treatments and tank-mixed treatments (Table 1). The untreated control had the highest foliar disease rating, followed by copper products and Manzate Max alone (Table 2). Most of the tank mixed treatments had similar foliar disease ratings with the Proline + Manzate Prostick treatment having the lowest rating overall, but not significantly different than Supertin + Manzate Prostick.

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	Tons per acre	Percent Extractable Sugar	Extractable Sugar per Ton (lbs.)	Extractable Sugar per Acre (lbs.)	Percent Purity
1	Untreated Control	15.5 e	21.7 f	12.7 d	253.4 e	5502.0 f	88.6
2	Manzate	16.6 ab	26.7 abcde	13.7 ab	272.8 ab	7282.5 abcde	89.1
3	Luna Flex+Manzate	16.5 abc	28.2 abc	13.6 abc	271.4 abcd	7654.5 abc	89.0
4	Luna Flex	16.2 abcd	24.2 ef	13.4 abc	266.4 abcd	6457.3 e	89.0
5	Proline+Manzate	16.2 abcd	29.2 a	13.3 abc	266.6 abcd	7783.6 a	88.9
6	Regev+Manzate	16.7 a	28.2 abc	13.8 a	275.6 a	7770.5 ab	89.2
7	InspireXT+Manzate	16.4 abcd	28.5 ab	13.6 ab	271.6 abc	7746.2 ab	89.4
9	Lucento+Manzate	16.3 abcd	29.3 a	13.3 bc	265.8 abcd	7790.3 a	88.7
11	Topguard+Manzate	16.5 abc	28.5 ab	13.7 ab	273.6 ab	7783.3 a	89.3
12	Supertin+Manzate	16.1 bcd	27.4 abcd	13.2 bc	263.8 bcd	7219.3 abcde	88.7
15	Proline	16.5 abc	28.9 ab	13.7 ab	272.8 ab	7873.7 a	89.1
18	Cuprofix	15.9 de	25.2 cde	13.1 cd	261.6 de	6594.7 de	89.0
19	Cuprofix+Proline	16.3 abcd	25.9 bcde	13.4 abc	267.8 abcd	6945.5 bcde	89.0
20	BadgeSC	16.4 abcd	26.5 abcde	13.6 ab	272.0 abc	7199.1 abcde	89.4
21	Kocide3000	16.3 abcd	24.2 ef	13.5 abc	268.6 abcd	6494.6 e	89.2
22	Manzate Max	16.5 abc	26.1 bcde	13.5 abc	270.4 abcd	7048.2 abcde	89.0
	Mean	16.3	26.9	13.4	268.6	7233.6	89.0
	CV%	2.2	7.9	2.6	2.6	8.1	0.6
	Pr>F	0.018	0.0001	0.0149	0.0165	<.0001	0.6273
	lsd (0.05)	0.5	3.0	0.5	9.9	830.1	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	Treatment	3-Sep	11-Sep	18-Sep	27-Sep
1	Untreated Control	4.5 a	5.5 a	7.0 a	8.1 a
2	Manzate Prostick	2.2 cd	2.6 de	3.4 d	4.5 de
3	Luna Flex+Manzate	2.0 cdef	2.2 defgh	2.6 ef	3.3 h
4	Luna Flex	2.6 c	3.3 c	4.2 c	5.2 cd
5	Proline+Manzate	1.3 g	1.3 i	1.6 g	1.9 j
6	Regev+Manzate	2.2 cde	2.5 def	3.1 de	4.0 efg
7	InspireXT+Manzate	1.7 defg	2.0 efgh	2.5 ef	3.4 gh
9	Lucento+Manzate	1.7 defg	1.8 ghi	2.3 f	3.1 hi
11	Topguard+Manzate	1.7 defg	1.9 fgh	2.2 fg	3.3 h
12	Supertin+Manzate	1.6 efg	1.6 hi	2.0 fg	2.6 ij
15	Proline	1.9 defg	2.3 defg	3.2 de	4.1 ef
18	Cuprofix	3.6 b	4.1 b	5.0 b	5.8 bc
19	Cuprofix+Proline	2.2 cde	2.5 def	3.0 de	4.2 ef
20	BadgeSC	4.0 ab	4.2 b	4.9 b	5.7 bc
21	Kocide3000	4.0 ab	4.5 b	5.2 b	6.0 b
22	Manzate Max	3.5 b	4.3 b	5.0 b	5.8 bc
	Mean	2.4	2.7	3.4	4.3
	CV%	19.1	15.9	13.9	10.9
	Pr>F	<.0001	<.0001	<.0001	<.0001
	lsd (0.05)	0.6376	0.612	0.6683	0.6583

Conclusions

Significant differences still occurred in yield and foliar disease ratings despite later planting and inoculation timing. 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 + 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. However, rotation of these triazole products remains important for resistance management. The three copper products with different formulations (Cuprofix – basic copper sulfate (71.1%), Badge SC – hydroxide (15.36%) + oxychloride (16.81%), and Kocide3000 – hydroxide (46.1%)) all performed similarly lowering the foliar disease ratings by > 2 points compared to the untreated control. While this is significantly better than the untreated control, copper fungicides continue to underperform compared to Manzate Prostick.

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. Copper fungicides are an effective option as a tank-mix partner to replace mancozeb for resistance management during the season and to have a lower PHI option at the end of the season.

Table 3. Fungicide Screening Trial treatment list.

Entry	Entry Description	Rate/A
1	Untreated Control	n/a
2	Manzate Prostick	2 lbs
	Masterlock	6.4 oz
3	Luna Flex	13.6 oz
	Manzate Prostick	2 lbs
	Masterlock	6.4 oz
4	Luna Flex	13.6 oz
	Masterlock	6.4 oz
5	Proline	5.7 oz
	Manzate Prostick	2 lbs
	Masterlock	6.4 oz
6	Regev	8.5 oz
	Manzate Prostick	2 lbs
	Masterlock	6.4 oz
7	Inspire XT	7 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
15	Proline	5.7 oz
	Masterlock	6.4 oz
18	Cuprofix	2 lbs
	Masterlock	6.4 oz
19	Cuprofix	2 lbs
	Proline	5.7 oz
	Masterlock	6.4 oz
20	Badge SC	40 oz
	Masterlock	6.4 oz
21	Kocide 3000	2 lbs
	Masterlock	6.4 oz
22	Manzate Max	51.2 oz
	Masterlock	6.4 oz

SMBSC Southern Minnesota Agricultural Research

Cercospora Leaf Spot Program Trial

David Mettler[1] and **Mark Bloomquist**[2]
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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

- 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 2024 the CLS Program Trial was conducted as a randomized complete block with four replications and located near Wood Lake, MN. This trial evaluated fungicides in a program setting. The site was planted on May 15th using Crystal M089. 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 11th. Four fungicide applications were made in the Program Trial beginning July 25th and continuing on a fourteen-day spray interval. The treatment list containing the fungicides used, rates, and timing of application can be found in Table 3.

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 30th 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.

Results

Yield differences were minimal with no significant differences (Table 1). The foliar disease ratings in the Program Trial were highest in the unsprayed check (Entry 1) followed by the Manzate or Copper treatment (Entry 3) (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	Percent Sugar	Tons per Acre	Percent Extractable Sugar	Extractable Sugar per Ton (lbs.)	Extractable Sugar per Acre (lbs.)	Percent Purity
1	16.2	25.7	13.2	264.2	6808.9	88.8
3	16.0	24.7	13.2	263.4	6523.1	89.2
4	16.4	28.6	13.7	273.0	7804.4	89.9
5	16.3	28.1	13.4	267.0	7482.8	88.9
7	16.5	26.2	13.6	272.6	7133.7	89.4
8	15.9	27.5	13.1	261.8	7236.4	88.9
10	16.2	30.0	13.3	265.8	7972.6	89.0
12	16.2	27.0	13.4	268.0	7219.3	89.4
13	16.1	27.9	13.3	265.8	7407.0	89.4
Mean	16.2	27.3	13.3	266.8	7285.6	89.2
CV%	2.8	9.7	3.5	3.4	9.0	0.7
Pr>F	0.9037	0.459	0.8671	0.8469	0.2667	0.4822
lsd (0.05)	ns	ns	ns	ns	ns	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 entry.

Entry	11-Sep	18-Sep	27-Sep
1	2.8 a	3.7 a	4.9 a
3	1.3 b	1.7 b	2.5 b
4	1.2 b	1.3 c	1.4 cd
5	1.2 b	1.3 bc	1.7 cd
7	1.1 b	1.3 c	1.3 d
8	1.2 b	1.4 bc	1.6 cd
10	1.2 b	1.4 bc	1.6 cd
12	1.2 b	1.5 bc	1.6 cd
13	1.3 b	1.5 bc	1.9 c
Mean	1.3	1.6	1.9
CV%	18.3	16.2	19.7
Pr>F	<.0001	<.0001	<.0001
lsd (0.05)	0.3494	0.3601	0.5334

Conclusions

The overall conditions for disease development were high in 2024, however with wet conditions at this location canopy development was slow, which led to a later inoculation and first fungicide application dates. All treatments in the program trial, other than the untreated control, provided good control of CLS. The only other significant difference was the slightly higher foliar disease rating of the Manzate or Copper treatment. The data from this trial would indicate that our current fungicide program is able to adequately protect a variety that is tolerant to CLS and that tank-mixing remains important compared to the use of single product applications.

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

Entry	Product	Rate/Acre	Application Code
1	CR+ Untreated Control	n/a	abcd
3	Manzate Prostick	2 lbs	abd
	Masterlock	6.4 fl oz	abcd
	Cuprofix Ultra	2 lbs	c
4	Manzate Prostick	2 lbs	abcd
	Masterlock	6.4 fl oz	abcd
	Vacciplant	16 fl oz	ab
	Proline	5.7 fl oz	b
	Super Tin	8 fl oz	c
	Provysol	5 fl oz	d
5	Manzate Prostick	2 lbs	abcd
	Masterlock	6.4 fl oz	abcd
	Cuprofix Ultra	2 lbs	abcd
7	Manzate Prostick	2 lbs	abcd
	Masterlock	6.4 fl oz	abcd
	Priaxor	6.7 fl oz	b
	Proline	5.7 fl oz	b
	SuperTin	8 fl oz	c
	Provysol	5 fl oz	d
8	Manzate Prostick	2 lbs	abcd
	Masterlock	6.4 fl oz	abcd
	Proline	5.7 fl oz	b
	SuperTin	8 fl oz	c
	Veltyma	10 fl oz	d
10	Manzate Prostick	2 lbs	abcd
	Masterlock	6.4 fl oz	abcd
	Proline	5.7 fl oz	b
	Super Tin	8 fl oz	c
	Provysol	5 fl oz	d
12	Manzate Prostick	2 lbs	abcd
	Masterlock	6.4 fl oz	abcd
	Provysol	5 fl oz	b
	Super Tin	8 fl oz	c
	Proline	5.7 fl oz	d
13	Manzate Prostick	2 lbs	abcd
	Masterlock	6.4 fl oz	abcd
	Lucento	5.5 fl oz	b
	Super Tin	8 fl oz	c
	Provysol	5 fl oz	d

SMBSC® Southern Minnesota Agricultural Research

SMBSC – Early Season Cercospora Leaf Sampling Program

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Cercospora leaf spot (CLS) is a foliar disease that occurs in Southern Minnesota Beet Sugar Cooperative (SMBSC) fields each season. Managing CLS requires the timely application of fungicides to reduce infection and delay disease progression. The proper time to begin a CLS fungicide program is a very important decision to maintain adequate control of this disease throughout the growing season. Dr. Nathan Wyatt at the USDA-ARS in Fargo, ND, has developed a system to analyze sugar beet leaves to detect Cercospora infection prior to symptom development. SMBSC collaborated with Dr. Wyatt in 2024 to monitor for Cercospora infection in sugar beet fields on a weekly basis during June.

Research Objective

- Detect CLS infection in sugar beet fields before visual symptom development.
- Provide an early warning of disease presence for timely fungicide application.

Methodology

SMBSC Agriculturists each collected leaf samples from seven fields beginning the week of June 6, 2024, and continuing weekly until the week of June 27, 2024. Fields on a common line to 2023 sugar beet fields or fields with areas likely to develop disease early in the season were targeted for the sampling. A total of 56 fields were sampled each week during the project. Of the 56 fields sampled, 39 were planted to CR+ varieties, and 17 were planted to traditional CLS tolerant varieties. The protocol required each Agriculturist to collect 3-5 leaves per sampled field. The leaves from each field were not to be sampled from the same plant but from plants located at least 10 steps apart. Each field's leaf samples were placed in a manilla envelope, identified numerically on the envelope, and stored in a refrigerator until shipment. The Agriculturists sampled leaves from the same area of each field each week. The samples were collected on Monday and Tuesday of each week and shipped to Dr. Wyatt via UPS Next-Day Delivery on Wednesday. Dr. Wyatt's lab received the samples, prepared them for analysis, analyzed them using digital drop PCR (ddPCR) technology, and reported the weekly results to SMBSC. The ddPCR analysis of each sample can detect the presence of Cercospora within the sugar beet leaf before symptom development can be visually seen on the leaf. The results provided a yes or no answer for the presence of Cercospora in each leaf sample every week.

Results and Discussion

Table 1 contains the results of the 2024 weekly early season Cercospora leaf sampling. Two of the 56 samples were positive for Cercospora during the week of June 3. One of these fields was planted to a CR+ variety, and the other was planted to a traditional variety. During the second week of sampling, seven fields tested positive for Cercospora. Two of these fields were CR+ varieties. This increased to 100% of the samples being positive for Cercospora by the third week of June. The 2024 SMBSC crop was planted earlier than average, and June was very wet. This combination provided an environment conducive to the occurrence of Cercospora infection. The results of the early leaf sampling show the disease began infecting the crop during June. Wet field conditions during this time made ground application of fungicides difficult to combat the disease.

Table 1. Results of 2024 early season leaf sampling for Cercospora infection.

Week	Total Samples	# of Positive	% Positive
June 3-7	56	2	3.6
June 10-14	56	7	12.5
June 17-21	56	56	100.0
June 24-28	56	56	100.0

Conclusion

The 2024 early leaf sampling project results showed that Cercospora was present in many SMBSC fields by the third week of June. The infection was occurring regardless of whether the variety was CR+ or traditional. This information can provide growers with an early warning and a reason to begin their CLS fungicide programs for the season. Delaying fungicide programs until visual symptoms are present in the field or the growing area provides an opportunity for Cercospora to become established, making managing this disease more difficult later in the growing season.

Acknowledgment

SMBSC would like to acknowledge and thank Dr. Nathan Wyatt and his team for analyzing the leaf samples and collaborating with SMBSC on this project for the past two growing seasons. The SMBSC Agricultural Research Staff would also like to acknowledge the assistance of the SMBSC Agriculturists in collecting the samples weekly through June.

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Nitrogen Rate and Placement Trials

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Nitrogen management is a priority for the 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 2024 using randomized complete block design. One trial was located near Sacred Heart following soybean and the other trial was located near Roseland following field corn. Both sites were soil sampled in the fall of 2023 to develop treatment rates for the trials and sampled again in the spring of 2024 to identify any changes in soil nitrate (Table 1). The treatments for each site were identical with treatments including broadcast urea rates, placement of liquid 32% N (UAN), and use of additional nutrient management products (Tables 2 and 3). The Sacred Heart site was planted on April 23rd using Beta 9284 and the Roseland site was planted on April 25th using Beta 9131. 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 1). For the surface applied UAN dribble treatment, the hoses were removed from the disc and allowed to drag along the soil surface (Photo 2). The Receptor treatment was applied through the infurrow system on the planter with a 6gpa application volume. The Envita SC, Transit Foliar, and Lalstim Osmo treatments were applied with the bicycle sprayer on June 11th at both trial sites when the beets were at the 10 leaf stage. Description of products used in this trial can be found in the appendix. The bicycle sprayer was equipped with XR11002 nozzles with a spray volume of 17gpa. Percent canopy cover ratings were taken in late June and mid-July (Figures 1 and 2). 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 17th at Roseland and October 3rd at Sacred Heart 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 2023.

Soil test	Sacred Heart	Roseland
Fall Soil nitrate-N 0-4 ft. (lb N/A)	36	12.5
Spring Soil nitrate-N 0-4 ft. (lb N/A)	80	26
Olsen P 0-6 in. (ppm)	10	5
K 0-6 in. (ppm)	181	178
pH 0-6 in. (unitless)	7.8	7.9
Organic matter 0-6 in. (%)	5.2	6.5

Results

Both sites had a significant yield response to additional nitrogen (Tables 2 and 3). The Roseland site following field corn had more of a response to higher nitrogen rates than the Sacred Heart site following soybean but neither had a linear response (Figure 1).
The differences in root yield between equivalent rates in the nitrogen placement treatments were minimal. The only significant difference in those comparisons was the 30lb surface dribble had less root yield than the 30lb broadcast urea treatment at the Roseland site. This is similar to results in other years. There have generally been no differences in nitrogen placement treatments unless the surface dribble had less root yield. The commercial products tested in furrow or foliar had no impact on yield. The correlation between percent canopy cover ratings and extractable sugar per acre were high with R values of 0.8967 on June 25th and 0.9831 on July 18th at the Sacred Heart site and R values of 0.9903 on June 24th and 0.9914 on July 17th at the Roseland site (Figures 2 and 3).

Photos 1 & 2. The 360 Bandit system installed on the 6-row research planter. The dribble treatment visible on the soil surface after planting.

Conclusions

Both sites had very low fall soil nitrate tests in 2023, however the Sacred Heart site following soybean increased significantly in soil nitrate over the warm fall and spring months leading up to planting (Table 1). With the increase in soil nitrate, it is not surprising that the site following soybean had less of a response to additional nitrogen compared to the field corn site with the high amount of corn residue tying up soil nitrate. Based on the spring soil sample the soybean site maxed out yield with 130lbs of total nitrogen and the field corn site maxed out with 160lbs of total nitrogen. However, based on the fall soil sample the soybean site would have maxed out at 100lbs and the field corn site 130lbs of total nitrogen. This stresses the importance of an accurate soil test so that we do not under or overapply nitrogen. A soil test will be more accurate the later it is taken in the fall (lower soil temps), but even better if taken in the spring as mineralization can be significant in some years. The potential increased efficiency of placing nitrogen closer to the row with a 3x1 system over broadcast urea was not realized over the last 3 years of testing and is possibly detrimental to root yield if UAN is applied as a surface dribble. None of the commercial infurrow or foliar applied products proved beneficial this year or in previous years of testing. The high correlation between percent canopy cover and extractable sugar per acre will continue to be investigated to determine if it could be a useful tool in the future to compare treatments when root yields are not able to be collected. Overall, the testing from this year agreed with the current recommendation of 110 to 150lbs of total nitrogen based on a fall soil test.

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Table 2. Root yield and quality data for the Roseland trial following field corn. Trial harvested on September 17th.

Entry	Treatment	Applied N	Total N	Percent Sugar	Tons per Acre	Percent Extractable Sugar	Extractable Sugar per Ton (lbs.)	Extractable Sugar per Acre (lbs.)	Percent Purity
1	Check	0	13	16.1 bcd	12.4 g	13.7 abc	273.3 abc	3401.6 g	91.1
2	Broadcast Urea	30	43	16.3 abc	19.8 de	13.8 abc	276.5 abc	5480.5 de	90.9
3	Broadcast Urea	60	73	16.4 abc	23.6 c	14.0 a	280.6 a	6659.7 c	91.7
4	Broadcast Urea	90	103	16.5 abc	27.6 b	13.9 ab	278.4 ab	7703.1 b	90.8
5	Broadcast Urea	120	133	16.5 ab	29.4 ab	14.0 a	280.4 a	8237.2 ab	91.1
6	Broadcast Urea	150	163	16.6 a	29.3 ab	14.2 a	284.7 a	8348.4 ab	91.6
7	Broadcast Urea	180	193	16.5 abc	30.8 ab	14.1 a	281.8 a	8657.6 a	91.7
16	Broadcast Urea	210	223	16.4 abc	32.0 a	13.9 a	279.0 a	8932.3 a	91.2
8	3x1 32%	30	43	16.4 abc	17.6 ef	14.0 a	279.1 a	4914.5 def	91.2
9	3x1 32%	60	73	16.3 abc	21.2 cd	13.8 abc	275.7 abc	5860.9 cd	90.7
10	3x0 32%	30	43	15.8 de	15.5 fg	13.2 cd	264.9 cd	4084.1 fg	90.4
11	3x0 32%	60	73	16.1 cd	21.4 cd	13.3 bcd	266.7 bcd	5697.2 de	89.7
12	Receptor	30	43	15.6 e	18.7 de	13.0 d	259.9 d	4842.6 ef	90.0
13	Envita SC	30	43	16.4 abc	20.8 cde	13.9 ab	278.2 ab	5784.7 cde	91.1
14	Transit Foliar	30	43	16.1 cd	17.8 ef	13.7 abc	274.9 abc	4915.0 def	91.7
15	Lalstim Osmo	30	43	16.4 abc	20.6 cde	13.9 ab	278.1 ab	5721.5 cde	91.1
			Mean	16.3	22.4	13.8	275.8	6202.6	91.0
			CV%	1.8	10.0	3.0	3.0	10.7	1.1
			Pr>F	0.0008	<.0001	0.0085	0.0085	<.0001	0.2651
			lsd (0.05)	0.43	3.18	0.59	11.88	948.52	ns

Table 3. Root yield and quality data for the Sacred Heart trial following soybean. Trial harvested on October 3rd.

Entry	Treatment	Applied N	Total N	Percent Sugar	Tons per Acre	Percent Extractable Sugar	Extractable Sugar per Ton (lbs.)	Extractable Sugar per Acre (lbs.)	Percent Purity
1	Check	0	36	17.3	32.8 g	14.7 bcd	293.3 bcde	9615.2 f	90.8 abc
2	Broadcast Urea	30	66	17.2	34.7 fg	14.6 cd	291.0 de	10088.6 ef	90.6 bc
3	Broadcast Urea	60	96	17.7	39.6 abcd	15.1 a	302.6 a	11984.1 ab	91.3 ab
4	Broadcast Urea	90	126	17.3	40.9 ab	14.6 cd	291.8 de	11931.3 abc	90.3 bc
5	Broadcast Urea	120	156	17.3	41.2 a	14.6 cd	292.2 cde	12043.7 a	90.5 bc
6	Broadcast Urea	150	186	17.1	40.3 abc	14.4 d	287.0 e	11571.3 abcd	90.1 c
7	Broadcast Urea	180	216	17.3	39.7 abcd	14.5 cd	289.6 de	11494.2 abcd	90.1 c
8	3x1 32%	30	66	17.4	36.0 efg	14.7 abcd	294.6 abcde	10619.4 de	90.9 abc
9	3x1 32%	60	96	17.4	37.4 cdef	14.8 abc	295.4 abcde	11011.7 bcde	91.0 abc
10	3x0 32%	30	66	17.5	36.5 def	15.1 ab	301.2 abc	10989.1 cde	91.8 a
11	3x0 32%	60	96	17.4	38.5 abcde	14.7 bcd	293.1 bcde	11292.2 abcd	90.6 bc
12	Receptor	30	66	17.4	35.9 efg	14.8 abc	296.9 abcd	10642.0 de	91.2 ab
13	Envita SC	30	66	17.4	37.5 bcdef	14.9 abc	296.5 abcd	11092.2 abcd	91.2 ab
14	Transit Foliar	30	66	17.5	36.3 defg	15.1 ab	301.0 abc	10896.5 de	91.7 a
15	Lalstim Osmo	30	66	17.6	35.2 efg	15.1 ab	301.6 ab	10611.1 de	91.7 a
			Mean	17.4	37.5	14.8	295.2	11058.8	90.9
			CV%	1.4	6.5	2.1	2.1	6.3	0.8
			Pr>F	0.1235	0.0002	0.0191	0.0210	0.0002	0.0120
			lsd (0.05)	ns	3.5	0.4	9.0	986.3	1.0

Figure 1. Comparison of nitrogen response between sites following soybean or field corn based on the 2023 fall soil sample.

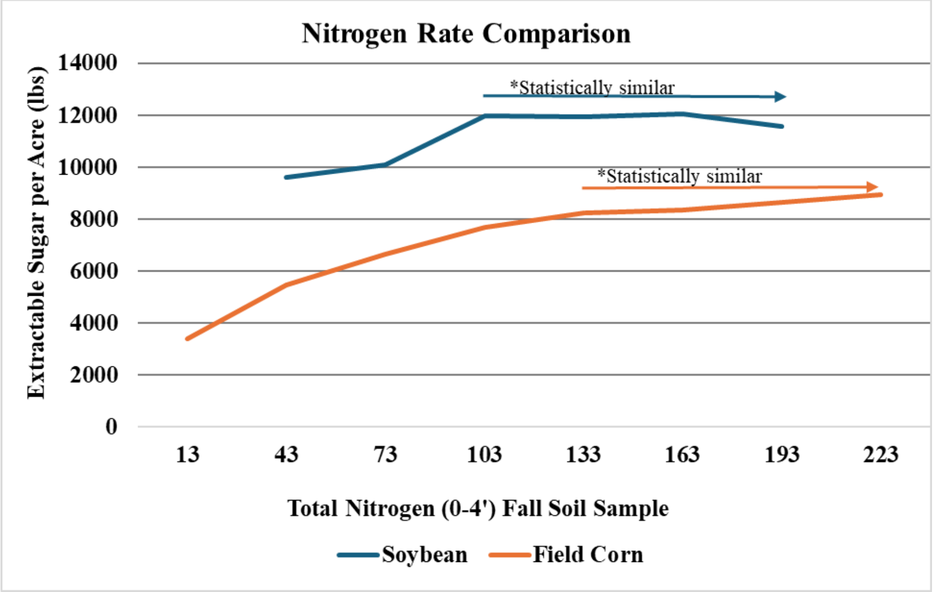


Figure 2. Percent canopy cover ratings taken on June 24th and July 17th at Roseland correlated with Extractable Sugar per Acre.

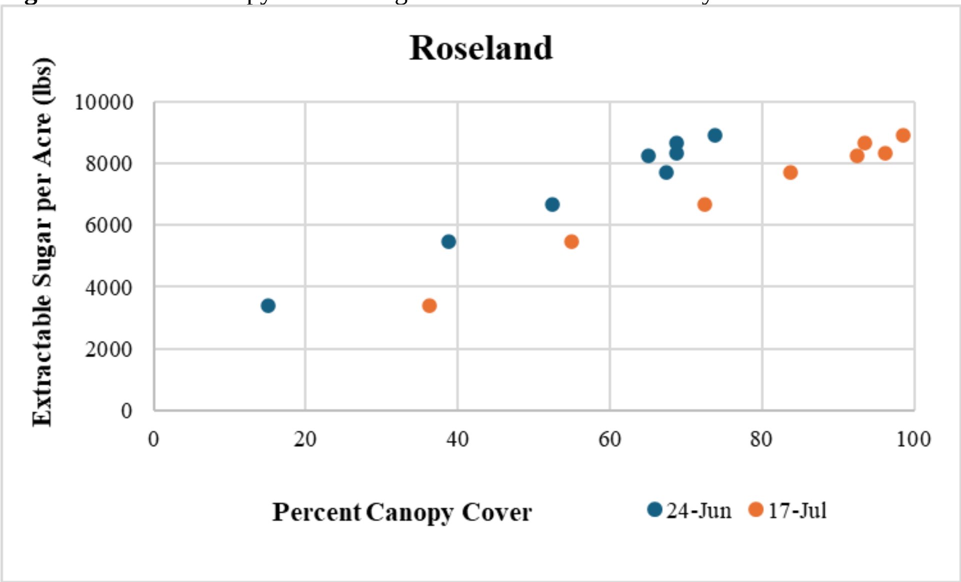
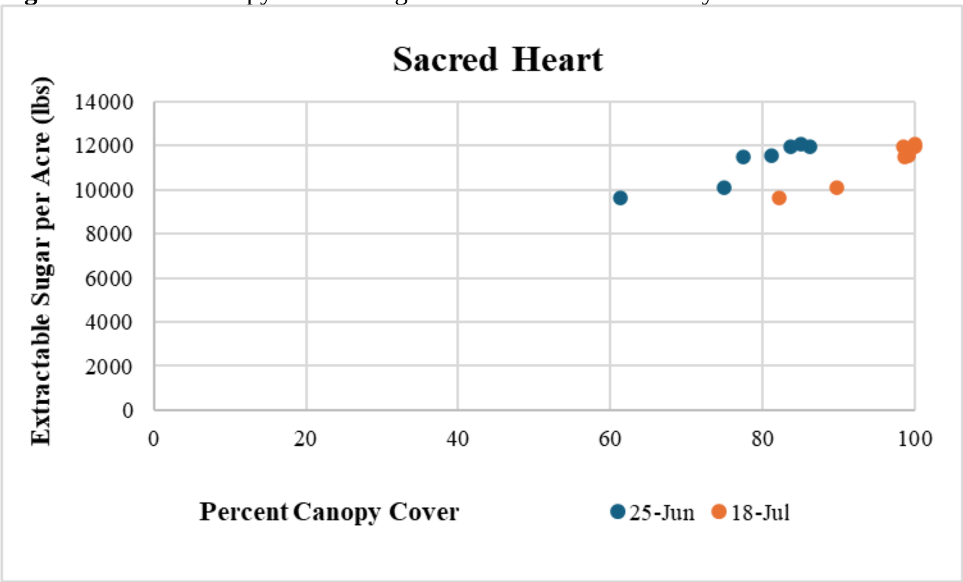


Figure 3. Percent canopy cover ratings taken on June 25th and July 18th at Sacred Heart correlated with Extractable Sugar per Acre.



Phosphorus by Nitrogen Rate Trial

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Nitrogen management is a priority for the 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 southeast of Sacred Heart, MN. Soil samples were taken in the fall prior to treatment application (Table 1). The applied nitrogen fertilizer rates were 0, 45, and 115lbs N/A. The phosphorus fertilizer rates were 0, 15, 30, 45, and 60lbs 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 April 23rd using Beta 9284. Percent canopy cover ratings were taken in late June and mid-July. Standard practices were used to keep the site weed and disease free. The center two rows of each six-row plot were harvested on October 3rd 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 2023.

Soil test	Sacred Heart
Fall Soil nitrate-N 0-4 ft. (lb N/A)	55
Spring Soil nitrate-N 0-4 ft. (lb N/A)	67
Olsen P 0-6 in. (ppm)	4
K 0-6 in. (ppm)	136
pH 0-6 in. (unitless)	8.1
Organic matter 0-6 in. (%)	5.8

Results

The application of phosphorus and nitrogen did not have an interaction on yield or quality. The application of phosphorus did not impact any quality parameters and only increased yield with the first rate of additional P_2O_5 (Table 2). The use of starter (3 gal of 6-24-6) alone had similar root yield to all other phosphorus treatments at the same nitrogen rate (Table 4). The application of nitrogen also did not have any impact on quality; however, yield had a linear respond to increasing nitrogen rates (Table 3). The percent canopy ratings taken in late June and mid-July were highly correlated with final root yield for nitrogen rates (0.982 and 0.999) but less so for phosphorus rates (0.890 and 0.842).

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). What was surprising was that increasing the rate of phosphorus only improved root yield up to 15lbs of additional phosphate with no further increase in root yield after that rate (Table 2). The response to additional nitrogen over the control was expected and consistent with previous studies when conducted on a site with low residual 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. However, if the phosphorus needs are not met, root yield will be reduced even with high levels of nitrogen. These trials stress the importance of soil sampling and understanding the underlying nutrient levels of a field prior to planting. This trial will be conducted again in 2025 and a combined report will be published with data from multiple years.

Figure 1. Drone image from June 13th showing reduced foliage in plots that were deficient in phosphorus, nitrogen, or both.

Table 2. The effect of increasing P_2O_5 rates on yield and quality averaged across nitrogen rates.

P Rate	Percent Sugar	Tons per Acre	Percent Extractable Sugar	Extractable Sugar per Ton (lbs.)	Extractable Sugar per Acre (lbs.)	Percent Purity
0	17.5	32.7 b	14.8	296.7	9675.6 b	90.6
15	17.6	35.3 a	14.9	298.8	10543.2 a	90.7
30	17.4	35.4 a	14.8	295.1	10444.9 a	90.7
45	17.4	35.1 a	14.8	295.8	10375.2 a	90.8
60	17.4	35.6 a	14.8	295.7	10532.5 a	90.9
Mean	17.5	34.8	14.8	296.4	10314.3	90.8
CV%	1.5	6.8	1.8	1.8	6.1	0.6
Pr>F	0.1945	0.021	14.82	0.4977	0.0081	0.4811
lsd (0.05)	ns	1.9	ns	ns	521.3	ns

Table 3. The effect of fertilizer N on yield and quality averaged across P_2O_5 rates.

N Rate (lbs per acre)	Total N (lbs per acre)	Sugar	Tons per Acre	Percent Extractable Sugar	Extractable Sugar per Ton (lbs.)	Extractable Sugar per Acre (lbs.)	Percent Purity
0	55	17.5	31.4 c	14.9	298.0	9343.3 c	90.9
45	100	17.5	35.5 b	14.8	296.3	10518.1 b	90.8
115	170	17.4	37.6 a	14.8	295.0	11081.5 a	90.6
	Mean	17.5	34.8	14.8	296.4	10314.3	90.8
	CV%	1.5	6.8	1.8	1.8	6.1	0.6
	Pr>F	0.5429	<.0001	0.2402	0.2216	<.0001	0.121
	lsd (0.05)	ns	1.5	ns	ns	403.8	ns

Table 4. The effect of increasing rates of phosphorus and nitrogen analyzed as an RCBD with the addition of a starter fertilizer treatment of 3 gal 6-24-6 mixed with 3 gal of water.

Entry	N Rate	P Rate	Sugar	Tons per Acre	Percent Extractable Sugar	Extractable Sugar per Ton (lbs.)	Extractable Sugar per Acre (lbs.)	Percent Purity
1	0	0	17.7	28.9 i	15.0	299.3	8641.8 h	90.7
2	0	15	17.7	33.0 efgh	15.0	300.8	9930.0 efg	90.8
3	0	30	17.5	32.7 fgh	14.9	297.9	9729.9 fg	91.0
4	0	45	17.5	30.8 hi	14.9	298.6	9195.1 gh	91.1
5	0	60	17.3	31.5 ghi	14.7	293.3	9219.6 gh	91.1
6	45	0	17.5	35.0 cdef	14.8	295.4	10332.7 cdef	90.7
7	45	15	17.6	34.1 defg	15.0	299.5	10210.1 cdef	90.9
8	45	30	17.4	35.7 bcdef	14.8	295.0	10535.9 bcdef	90.7
9	45	45	17.3	36.6 abcd	14.6	292.6	10687.3 abcde	90.7
10	45	60	17.6	36.2 abcde	15.0	298.8	10824.6 abcd	90.9
11	115	0	17.5	34.1 defgh	14.8	295.3	10052.3 defg	90.5
12	115	15	17.5	38.9 ab	14.8	296.0	11489.5 a	90.5
13	115	30	17.4	37.9 abc	14.7	292.4	11069.0 abc	90.4
14	115	45	17.5	38.0 abc	14.8	296.3	11243.2 ab	90.7
15	115	60	17.4	39.2 a	14.8	294.9	11553.4 a	90.9
16	45	Starter	17.8	35.7 bcdef	15.1	301.9	10779.1 abcde	90.7
Mean			17.5	34.9	14.8	296.8	10343.3	90.8
CV%			1.4	6.6	1.7	1.8	6.0	0.5
Pr>F			0.1581	<.0001	0.2722	0.285	<.0001	0.7932
lsd (0.05)			ns	3.3	ns	ns	883.6	ns

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Variety x Nitrogen Rate Trial

David Mettler[1], **Mark Bloomquist**[2], and **John A. Lamb**[3],
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Nitrogen management is a priority for the production of high-quality sugar beets. Differences in nitrogen use efficiency between varieties would be beneficial information for growers to optimize yield potential.

Research Objective

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

Methodology

The trial was established near Sacred Heart following soybean in 2024 using randomized complete block design. The site was soil sampled in the fall of 2023 to develop treatment rates and sampled again in the spring of 2024 to identify any changes in soil nitrate over the winter (Table 1). The Sacred Heart site was planted on April 22nd using Beta 9284 and Beta 9131. Prior to planting, the urea treatments were broadcast by hand and incorporated with a small field cultivator. Percent canopy cover ratings were taken in late June and mid-July. Standard sugar beet production practices were used to keep the trial weed and disease free. Each plot was 35ft long and six rows wide. The center two rows of each six-row plot were harvested on October 3rd 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 from the fall soil sample in 2023.

Soil test	Sacred Heart
Fall Soil nitrate-N 0-4 ft. (lb N/A)	60
Spring Soil nitrate-N 0-4 ft. (lb N/A)	136
Olsen P 0-6 in. (ppm)	5
K 0-6 in. (ppm)	142
pH 0-6 in. (unitless)	8.0
Organic matter 0-6 in. (%)	6.1

Results

A significant amount of nitrogen mineralization occurred between the fall soil sample and planting (Table 1). This mineralization resulted in less differences occurring between nitrogen rates than would have been expected given the fall soil sample results (Table 2). Differences in root yield and ESA were generally lower for the zero nitrogen applied treatment for both varieties with no differences between plots that had any rate of nitrogen applied.

Conclusions

No significant differences were observed between the two varieties tested and their response to increasing nitrogen rates. The response to increasing nitrogen rates was minimal with the high nitrogen residual present after mineralization.

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Table 2. Root yield and quality data.

Entry	Variety	Applied N	Total N	Percent Sugar	Tons per Acre	Percent Extractable Sugar	Extractable Sugar per Ton (lbs.)	Extractable Sugar per Acre (lbs.)	Percent Purity
1	9284	0	60	17.1	39.3 bc	14.5	290.0	11395.0 bc	90.9 ab
2	9284	50	110	17.3	39.7 abc	14.6	292.1	11596.5 abc	90.6 bc
3	9284	100	160	17.1	41.5 ab	14.5	289.0	11968.3 a	90.5 bc
4	9284	150	210	17.1	41.3 ab	14.4	288.3	11902.7 ab	90.5 bc
5	9131	0	60	17.2	37.8 c	14.7	293.1	11081.4 c	91.3 a
6	9131	50	110	17.0	41.8 a	14.6	290.7	12131.9 a	91.3 a
7	9131	100	160	17.1	41.5 ab	14.5	290.2	12022.1 a	91.0 ab
8	9131	150	210	16.8	41.5 ab	14.2	282.9	11731.5 ab	90.3 c
			Mean	17.1	40.5	14.5	289.5	11728.7	90.8
			CV%	1.7	4.0	1.8	1.8	3.2	0.4
			Pr>F	0.5902	0.0217	0.2395	0.2516	0.0095	0.0042
			lsd (0.05)	ns	2.4	ns	ns	544.8	0.6

Sugar Enhancement Trial

David Mettler[1] and **Mark Bloomquist**[2]
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The sugar content and purity of a beet crop is a factor in how efficiently the factory can operate and ultimately how profitable the sugar beet crop will be to the shareholders. The SMBSC growing area has struggled to increase the sugar content of the beet crop in recent years. The impact of finding a product that could substantially increase the sugar content of the beet crop would be a monumental achievement.

Research Objective

- Products currently available were tested in these trials to evaluate their ability to improve the sugar content of the crop.

Methodology

Trials were conducted near Wood Lake and Murdock to screen products that may have the ability to improve sugar content. The trials were planted on May 15th at Wood Lake and May 10th at Murdock using Beta 9131. Normal agronomic practices were used to keep the trial weed and disease free. These trials were designed as randomized complete block (Table 1). Early applications were made using a bike sprayer traveling 3.2mph with a spray volume of 17gpa and 40psi, utilizing XR11002 nozzles. Applications made after canopy closure were done with 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 sprayers used CO2 as a propellant and were designed to apply the treatment to the center four rows, leaving rows one and six untreated. The center two rows of each six-row plot were harvested for yield and quality analysis on September 23rd at Murdock and September 26th at Wood Lake 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 data was analyzed for significance using SAS GLM version 9.4.

Results

None of the entries tested made a significant impact of root yield or quality at either location (Tables 3 and 4).

Conclusions

Many foliar nutrient products have been tested in the past to improve the sugar content of sugar beets here at SMBSC and in other sugar beet production areas. None of these foliar nutrient products have been able to meaningfully increase sugar content with any consistency.

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Table 1. Description of treatments in the Murdock Sugar Enhancement Trial.

Entry	Entry Description	Product Rate	Application Timing	Date
1	Untreated Control	-	-	-
2	ZMB+	32oz/ac	Mid Aug (at least 30 days before harvest)	8/19/2024
3	Yield-On	24oz/ac	Mid - Late July fb 2 weeks later	7/19/2024 fb 7/29/24
4	LPI6612	32oz/ac	Mid July fb Mid Aug	7/19/2024
5	LPI6612	32oz/ac	Mid July fb Mid Aug	7/19/2024
	LPI6860	16oz/ac	Mid July	7/19/2024
6	LPI6612	32oz/ac	Mid July fb Mid Aug	7/19/2024
	LPI6860	16oz/ac	Mid July	7/19/2024
	LPI6728	4oz/ac	Mid Aug	8/19/2024

Table 2. Description of treatments in the Wood Lake Sugar Enhancement Trial.

Entry	Entry Description	Product Rate	Application Timing	Date
1	Untreated Control	-	-	-
2	Sugar Mover Premier	32oz/ac	~30 days before harvest	8/26/2024
	Sugar Power	128oz/ac	~12 days before harvest	9/9/2024
3	Energy Power	8oz/ac	At Plant	5/15/2024
	Fortified Stimulate Yield Enhancer Plus	4oz/ac	At Plant	5/15/2024
	Energy Power	8oz/ac	8-10 leaf	6/26/2024
	Keylate CoMo Classic	4oz/ac	8-10 leaf	6/26/2024
	Sugar Mover Premier	32oz/ac	Beginning of July fb 3-4 weeks later	7/12/2024 fb 8/12/24
4	Energy Power	8oz/ac	At Plant	5/15/2024
	Fortified Stimulate Yield Enhancer Plus	4oz/ac	At Plant	5/15/2024
	Energy Power	8oz/ac	8-10 leaf	6/26/2024
	Keylate CoMo Classic	4oz/ac	8-10 leaf	6/26/2024
	Sugar Mover Premier	32oz/ac	Beginning of July	7/12/2024
	Sugar Mover Premier	32oz/ac	~30 days before harvest	8/26/2024
	Sugar Power	128oz/ac	~12 days before harvest	9/9/2024
5	ZMB+	32oz/ac	8-10 leaf	6/26/2024
	ZMB+	32oz/ac	Mid Aug (at least 30 days b4 harvest)	8/26/2024
6	Ascend2	5.3oz/ac	At Plant	5/15/2024
	Ascend2	5.3oz/ac	8-10 leaf	6/26/2024
7	Yield-On	24oz/ac	Mid-late July fb 2 weeks later	7/29/2024 fb 8/12/24
8	6-24-6	3gal/ac	At Plant	5/15/2024
9	6-24-6	3gal/ac	At Plant	5/15/2024
	Lalrise Start SC	1oz/ac	At Plant	5/15/2024
10	6-24-6	3gal/ac	At Plant	5/15/2024
	Lalrise Start SC	1oz/ac	At Plant	5/15/2024
	Ascend2	5.3oz/ac	At Plant	5/15/2024

Table 3. Yield parameter results for the Murdock Sugar Enhancement Trial.

Entry	Percent Sugar	Tons per acre	Percent Extractable Sugar	Extractable Sugar per Ton (lbs.)	Extractable Sugar per Acre (lbs.)	Percent Purity
1	16.2	42.2	13.4	268.0	11312.0	89.5
2	16.2	40.6	13.5	270.1	10960.4	89.9
3	16.0	39.6	13.4	267.1	10583.8	89.9
4	16.4	38.8	13.7	273.3	10599.8	89.7
5	16.3	41.3	13.7	273.7	11286.8	90.3
6	16.3	41.9	13.6	271.4	11384.9	90.0
Mean	16.2	40.7	13.5	270.6	11021.3	89.9
CV%	2.0	4.3	2.1	2.2	4.8	0.4
Pr>F	0.756	0.212	0.625	0.680	0.307	0.152
lsd (0.05)	ns	ns	ns	ns	ns	ns

Table 4. Yield parameter results for the Wood Lake Sugar Enhancement Trial.

Entry	Percent Sugar	Tons per Acre	Percent Extractable Sugar	Extractable Sugar per Ton (lbs.)	Extractable Sugar per Acre (lbs.)	Percent Purity
1	16.5	30.4	13.6	272.0	8278.1	89.0
2	16.2	31.3	13.4	267.6	8376.0	89.2
3	16.1	29.8	13.2	263.7	7858.4	88.8
4	16.5	31.4	13.5	270.5	8480.8	88.9
5	16.6	31.1	13.7	274.5	8539.5	89.2
6	16.5	31.2	13.7	274.8	8675.3	89.7
7	16.4	30.3	13.6	271.5	8242.5	89.4
8	16.3	32.3	13.5	269.6	8694.5	89.2
9	16.4	31.8	13.6	271.4	8727.4	89.1
10	16.2	30.4	13.3	266.1	8080.4	89.1
Mean	16.4	31.1	13.5	270.1	8422.2	89.2
CV%	1.7	5.1	2.0	1.9	4.8	0.4
Pr>F	0.1882	0.859	0.1609	0.1627	0.3518	0.2775
lsd (0.05)	ns	ns	ns	ns	ns	ns

Seed Treatment Trial

David Mettler[1] and **Mark Bloomquist**[2]
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Any planter box seed treatment that may increase root yield or quality of the sugar beet crop would be of benefit to SMBSC growers. Planter box products are generally easy to apply and would be a convenient option for growers.

Research Objective

- Products currently available were tested in this trial to evaluate their ability to improve the overall yield of the crop.

Methodology

This trial was conducted near Wood Lake to screen products that may have the ability to improve sugar beet yield. The trial was planted on May 15th using Crystal 089 with two different products and an untreated control. HomeLAND Sugarbeet contains a talc 80/20 graphite blend enhanced with micronutrients to promote early vigor and uniform germination. Lalrise Shine DS contains a *Bacillus velezensis* bacteria that is supposed to colonize the rhizosphere and make nutrients more available to the plant. Normal agronomic practices were used to keep the trial weed and disease free. The trial was designed as randomized complete block with eight replications. The center two rows of each four-row plot were harvested for yield and quality analysis on September 26th using a four-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 data was analyzed for significance using SAS GLM version 9.4.

Results

None of the entries tested made a significant impact on stand count or root yield (Table 1). The Lalrise Shine DS treatment had a slightly better purity.

Conclusions

Neither of the products tested made a meaningful impact on overall yield. However, this is only one year of testing and conclusions should not be drawn on one year of data.

Table 1. Stand counts and yield parameter results for the Wood Lake Seed Treatment Trial.

Entry	May 23rd Stand Count 100' of row	June 4th Stand Count 100' of row	Percent Sugar	Tons per Acre	Percent Extractable Sugar	Extractable Sugar per Ton (lbs.)	Extractable Sugar per Acre (lbs.)	Percent Purity
Untreated Control	220	256	15.7	29.4	12.9	258.4	7598.2	89.0 b
HomeLAND Sugarbeet	235	258	15.6	29.5	12.8	256.0	7554.5	88.9 b
Lalrise Shine DS	226	259	15.7	29.1	13.0	259.2	7559.6	89.4 a
Mean	227.1	257.7	15.7	29.4	12.9	257.9	7570.7	89.1
CV%	8.8	4.2	1.1	5.5	1.5	1.4	5.8	0.4
Pr>F	0.3517	0.8895	0.2834	0.8877	0.1926	0.2240	0.9766	0.0175
lsd (0.05)	ns	ns	ns	ns	ns	ns	ns	0.34

Rhizoctonia Management Trial

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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 have 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

Two trials were conducted near Renville to screen fungicide products for control of rhizoctonia and to compare best management practices. The trials were planted on May 20th using Beta 9098. Prior to planting, the site was inoculated by broadcasting with whole barley kernels 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. The treatment list for Trial A can be found in Table 1 and the treatment list for Trial B is in Table 2. Each plot consisted of six rows that were 35ft in length. The post applications took place on June 19th at the 6-8 leaf stage except for entry 10, which was applied five days earlier on June 14th. These applications were broadcast or banded using a custom-made bike sprayer. 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 12th 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; one being free of disease and 7 being severely rotten beets. The data was analyzed for significance using SAS GLM version 9.4.

Table 1. Treatment list and rates for Trial A.

Entry	Entry Description	Infurrow	Broadcast Post
1	Untreated Control	-	-
2	AZteroid FC 3.3	5.7 oz	-
3	Excalia	-	2 oz
4	AZterknot	-	18.4 oz
5	Aframe	-	15.5 oz
6	AZteroid FC 3.3	5.7	-
	AZterknot	-	18.4 oz

Photo 1. Post treatment application using a bike sprayer.

Results

Significant differences were observed for root yield in Trial A (Table 3) but not Trial B (4). Stand count data was nonsignificant (data not shown). The main difference observed was the harvester rot rating (Tables 3 and 4). Entries that combined two application timings generally had a lower rot rating, but some single application entries also had low rot ratings such as Elatus and Excalia. The vast majority of the entries had lower rot ratings than the untreated control. None of the adjuvants tested improved the efficacy of Quadris.

Table 2. Treatment list and rates for Trial B.

Entry	Entry Description	Infurrow	Post
1	Untreated Control	-	-
2	Elatus 45 WG + NIS	7oz + 0.25% v/v	-
3	AZteroid FC 3.3	5.7oz	-
4	Elatus 45 WG Banded + NIS	-	7.2oz + 0.25% v/v
5	Quadris Broadcast	-	15.5 oz
6	AZteroid FC 3.3	5.7 oz	-
7	Quadris Banded	-	15.5oz
8	AZteroid FC 3.3	5.7 oz	-
	Quadris Broadcast	-	15.5 oz
9	Quadris Broadcast	-	15.5 oz
	Reduced Volume (10gpa)	-	-
10	Quadris - 4 leaf	-	15.5 oz
	Excalia - 8 leaf	-	2 oz
11	Quadris + Silkin	-	15.5 oz + 0.5% v/v
12	Quadris + Prefer NIS	-	15.5 oz + 0.25% v/v

Table 3. Yield and harvester rot rating data for Trial A.

Entry	Entry Description	Percent Sugar	Tons per Acre	Percent Extractable Sugar	Extractable Sugar per Ton (lbs.)	Extractable Sugar per Acre (lbs.)	Percent Purity	Harvester Rot Rating
1	Untreated Control	14.6	21.2 b	12.0	239.9	5069.0 c	89.5	3.6 a
2	AZteroid IF	15.0	21.5 b	12.4	247.7	5321.1 bc	89.7	2.5 bc
3	Excalia Broadcast	14.5	21.8 b	11.9	237.3	5184.2 c	89.4	1.8 c
4	Azterknot Broadcast	15.0	21.8 b	12.4	248.3	5407.4 bc	89.8	2.8 ab
5	Aframe Broadcast	15.0	23.8 a	12.5	249.9	5929.5 a	90.1	2.0 bc
6	AZteroid IF fb AZterknot	15.0	23.2 a	12.5	248.9	5770.0 ab	90.0	1.6 c
Mean		14.8	22.2	12.3	245.3	5446.8	89.7	2.4
CV%		2.7	4.1	3.6	3.5	5.8	0.7	27.6
Pr>F		0.2331	0.0100	0.2167	0.2479	0.0152	0.5416	0.0050
lsd (0.05)		ns	1.4	ns	ns	470.8	ns	1.0

Conclusions

While there were not any significant differences for the quality parameters tested, it is worthwhile to note the lower rot ratings of the entries compared to the untreated control. Rhizoctonia root rot can continue to have a negative impact in pile storage due to the compromised beets and secondary infections. It appears that Excalia and Elatus, which contain Group 7 or SDHI products, are a good treatment option for Rhizoctonia to alternate with azoxystrobin products. It is a good management practice to use a fungicide to reduce the negative impacts of Rhizoctonia.

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Table 4. Yield and harvester rot rating data for Trial B.

Entry	Entry Description	Percent Sugar	Tons per Acre	Percent Extractable Sugar	Extractable Sugar per Ton (lbs.)	Extractable Sugar per Acre (lbs.)	Percent Purity	Harvester Rot Rating
1	Untreated Control	14.6	20.2	12.0	238.9	4844.0	89.2	3.9 a
2	Elatus IF	15.0	23.4	12.4	248.3	5815.6	89.8	2.3 cd
3	Azteroid IF	14.7	21.1	12.1	240.7	5073.8	89.4	3.5 ab
4	Elatus Band	15.0	23.1	12.5	249.1	5696.4	89.8	2.3 cd
5	Quadris Broadcast	14.6	22.3	12.0	239.9	5355.8	89.5	2.6 bcd
6	Azteroid IF	14.5	21.4	11.9	237.5	5068.3	89.3	3.4 ab
7	Quadris Band	14.8	23.4	12.3	245.1	5729.5	89.7	2.8 bcd
8	Azteroid IF fb Quadris	14.6	23.0	12.0	240.5	5530.8	89.7	2.3 cd
9	Quadris (reduced volume)	14.6	24.5	12.0	239.7	6032.3	89.4	2.6 bcd
10	Quadris fb Excalia	15.0	23.0	12.5	248.3	5711.1	89.7	2.0 d
11	Quadris + Silkin	15.0	23.5	12.5	249.1	5855.9	90.0	2.8 bcd
12	Quadris + NIS	14.8	23.1	12.2	244.5	5632.4	89.9	3.1 abc
	Mean	14.7	22.4	12.2	242.8	5442.8	89.5	2.9
	CV%	2.7	7.9	3.4	3.5	9.1	0.7	22.6
	Pr>F	0.4188	0.1478	0.3710	0.4058	0.0734	0.4116	0.0027
	lsd (0.05)	ns	ns	ns	ns	ns	ns	0.9

INTEGRATING RO-NEET AND EPTAM BACK INTO THE WATERHEMP CONTROL PROGRAM IN SUGARBEET

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Summary

1. Ro-Neet plus Eptam and Eptam applied pre-plant incorporated (PPI) followed by ethofumesate applied preemergence (PRE) followed by Outlook and Warrant POST caused early season sugarbeet growth reduction, however, Ro-Neet plus Eptam and ethofumesate PRE following Eptam applied PPI followed by Outlook and Warrant POST did not reduce root yield or % sucrose.
2. Ro-Neet plus Eptam or Eptam integrated into the waterhemp control strategy that includes ethofumesate or *S*-metolachlor products, Outlook, and Warrant potentially may improve waterhemp control, especially in dry environments.

Introduction

Researchers and agriculturalists favor ethofumesate over Eptam (EPTC) and Ro-Neet (cycloate) for at planting waterhemp control since Eptam and Ro-Neet must be incorporated immediately and uniformly into the soil after application to prevent herbicide loss due to volatility and optimize weed control. Historically, sugarbeet growers have utilized multiple options to incorporate EPTC and/or cycloate into the soil. The first included two tillage operations, either with a disk or field cultivator. The first pass ran in one direction and the second pass in a different direction. Another option was a single pass with a roto-tiller. In both examples, this aggressive use of tillage prior to planting compromised the seedbed and reduced the uniformity of sugarbeet stand establishment. Aggressive tillage to incorporate herbicides can also break soils into fine particles which are susceptible to movement and loss from wind and water erosion.

Ethofumesate preemergence (PRE) provides acceptable weed control when applied at 'full' rates or when mixed with *S*-metolachlor followed by split layby applications of chloroacetamide herbicides. However, waterhemp control from ethofumesate is dependent on rainfall after application for incorporation into the soil. Erratic rainfall patterns have compelled some growers to shallow incorporate ethofumesate before planting. Survey of production practices at the 2024 Willmar Growers' Seminar indicated approximately 30% of ethofumesate applied in 2023 was preplant incorporated (PPI) (Figure 1). Further, ethofumesate incorporated or ethofumesate applied at rates ranging from 3 to

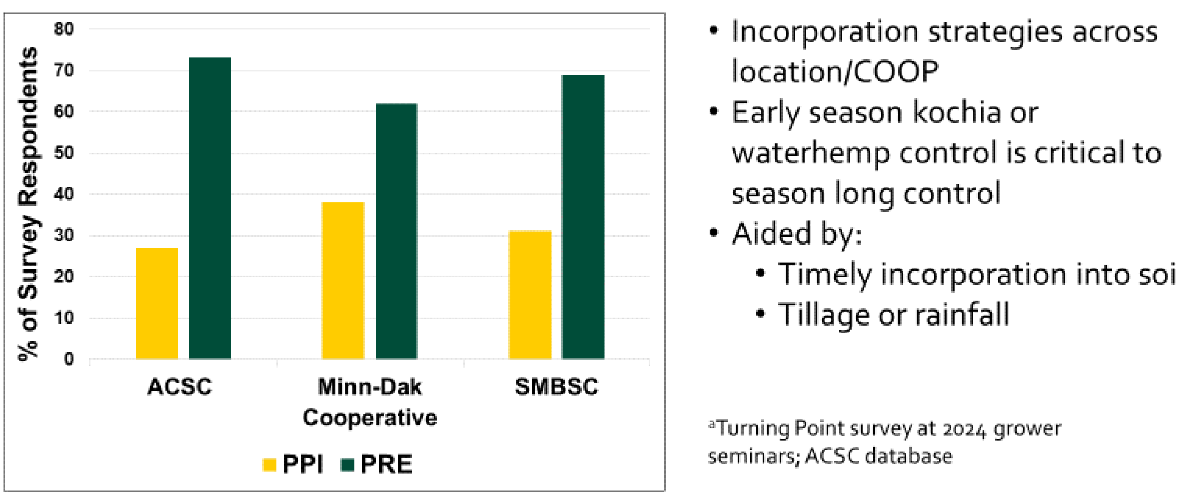

Figure 1. Ethofumesate incorporation technique across cooperatives in 2023 as determined by survey at the 2024 Growers seminars at Willmar, MN and Wahpeton, ND, 2024; ACSC grower production practices database.

7.5 pt/A adversely affected oat, barley, or wheat seeded as a nurse crop to protect sugarbeet from wind or blowing soil damage. The question is: if our production practices are once again requiring PPI techniques, are growers incorporating the best herbicide for waterhemp control?

Integrating Ro-Neet and Eptam into the current waterhemp control program might be an effective way to improve overall waterhemp control in sugarbeet. That is, Ro-Neet, Eptam, and/or ethofumesate at planting and chloroacetamide herbicides with Roundup PowerMax3 and ethofumesate early postemergence (EPOST) and postemergence (POST). The objective of these experiments was to evaluate waterhemp control and sugarbeet tolerance from Ro-Neet and Eptam integrated with the layby program.

Materials and Methods
Sugarbeet tolerance and waterhemp control experiments were conducted at multiple locations in 2024.

Sugarbeet Tolerance. Experiment was conducted at Crookston, Hendrum, and Murdock, MN and Prosper, ND in 2024. The experimental area was prepared for planting by applying the appropriate fertilizer and conducting tillage across the experimental area at each location. Herbicide treatments were applied PPI, PRE, and POST (Table 1). All treatments were applied with a bicycle sprayer in 17 gpa spray solution through 8002XR nozzles (XR TeeJet® Flat Fan Spray Tips; TeeJet® Technologies, Glendale Heights, IL) pressurized with CO2 at 40 psi to the center four rows of six row plots 40 feet in length. Ro-Neet and Eptam were incorporated into the soil as soon as possible following application using a field cultivator operated parallel to sugarbeet rows and at a slight angle with a 2-inch preset (tillage equipment set 4-inch deep).

Table 1. Herbicide treatments, herbicide rate, and sugarbeet stage at application.

PPI/PRE Herbicide	POST Herbicide[a]	Rate (pt or fl oz/A)	Sugarbeet stage (lvs)
Ro-Neet + Eptam		2.67 + 1.14	PPI
Eptam / Nortron		1.14 / 4	PPI / PRE
	Outlook / Warrant	0.75 / 3	2 / 6
Ro-Neet + Eptam	Outlook / Warrant	2.67 + 1.14 / 0.75 / 3	PPI / 2 / 6
Eptam / Nortron	Outlook / Warrant	1.14 / 4 / 0.75 / 3	PPI / PRE / 2 / 6
	RUPM3 + etho / RUPM3 + etho	25 + 6 / 25 + 6	2 / 6

[a]Roundup PowerMax3 + ethofumesate applied at 25 + 6 fl oz/A with NIS and Amsol liquid AMS at 0.25% and 2.5% v/v.

Sugarbeet was planted on April 24, June 10, and May 10 at Crookston, Hendrum, and Murdock, MN, respectively, and May 29 at Prosper, ND. Sugarbeet was seeded in 22-inch rows at approximately 63,500 seeds per acre with 4.6 inch spacing between seeds.

Sugarbeet stand was collected by counting the number of sugarbeet in 10-ft row in rows 3 and 4 of the plot when sugarbeet were at the 2- to 4-lf stage. Visible sugarbeet necrosis, malformation, and growth reduction were evaluated as 'sugarbeet injury' approximately 7 and 14 days after treatment (DAT) using a 0 to 100% injury scale (0% denoting no sugarbeet injury and 100% denoting complete loss of sugarbeet stature). All evaluations were a visual estimate of injury in the four treated rows compared with the adjacent, two-row, untreated strip. At harvest, 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) and the Quality Lab at Southern Minnesota Beet Sugar Cooperative (Renville, MN). Experiments were a randomized complete block design with six replications. Data were combined across Crookston and Murdock, MN and Prosper, ND experiments and compared with Hendrum, MN since the Hendum experiment was planted later than the other experiments. Data was analyzed using the GLIMMIX procedure in Statistical Analysis Software (SAS 9.4) (Cary, NC).

Waterhemp Control. Experiments were conducted at Blomkest and Moorhead, MN in 2024. The experimental area was prepared for planting by applying the appropriate fertilizer and conducting tillage across the experimental area at each location. Herbicide treatments were applied PPI, PRE, and POST (Table 2). All treatments were applied with a bicycle sprayer in 17 gpa spray solution through 8002XR nozzles (XR TeeJet® Flat Fan Spray Tips; TeeJet® Technologies, Glendale Heights, IL) pressurized with CO2 at 40 psi to the center four rows of six row plots 40 feet in length. Ro-Neet and Eptam were incorporated into the soil as soon as possible following application using a field

Table 2. Herbicide treatments, herbicide rate, and sugarbeet stage at application.

Herbicide treatment[a]	Rate (pt or fl oz/A)	Sugarbeet stage (lvs)
Ro-Neet / RUPM3 + etho[b] / RUPM3 + etho	2.67 / 25 + 6 / 25 + 6	PPI/EPOST/POST
Eptam / RUPM3 + etho / RUPM3 + etho	1.14 / 25 + 6 / 25 + 6	PPI/EPOST/POST
Ro-Neet + Eptam / RUPM3 + etho / RUPM3 + etho	2.67 + 1.14 / 25 + 6 / 25 + 6	PPI/EPOST/POST
Ethofumesate / RUPM3 + etho / RUPM3 + etho	7.5 / 25 + 6 / 25 + 6	PRE/EPOST/POST
Etho + *S*-meto / Outlook + RUPM3 + etho[c] / Warrant + RUPM3 + etho	2.5 + 0.75 / 12 + 25 + 6 / 3 + 25 + 6	PRE/EPOST/ POST
Ro-Neet / ethofumesate / Outlook + RUPM3 + etho / Warrant + RUPM3 + etho	2.67 / 4 /12 + 25 + 6 / 3 + 25 + 6	PPI/PRE/EPOST/ POST
Eptam / ethofumesate / Outlook + RUPM3 + etho / Warrant + RUPM3 + etho	1.14 / 4 /12 + 25 + 6 / 3 + 25 + 6	PPI/PRE/EPOST/ POST
Ro-Neet + Eptam + / Outlook + RUPM3 + etho / Warrant + RUPM3 + etho	2.67 + 1.14 /12 + 25 + 6 / 3 + 25 + 6	PPI/EPOST/ POST

[a]RUPM3 = Roundup PowerMax3. S-meto = *S*-metolachlor.
[b]Roundup PowerMax3 + ethofumesate applied at 25 + 6 fl oz/A, respectively, mixed with high surfactant methylated oil concentrate (HSMOC) at 1.5 pt/A and Liquid AMS at 2.5 % v/v.
[c]Outlook + Roundup PowerMax3 + ethofumesate applied at 12 + 25 + 6 fl oz/A, respectively, mixed with high surfactant methylated oil concentrate (HSMOC) at 1.5 pt/A and Liquid AMS at 2.5 % v/v.

cultivator operated parallel to sugarbeet rows and at a slight angle with a 2-inch preset (tillage equipment set 4-inches deep). Sugarbeet was planted on May 11 and May 14 at Moorhead and Blomkest MN, respectively. Sugarbeet was seeded in 22-inch rows at approximately 63,500 seeds per acre with 4.6 inch spacing between seeds.

The experimental area at Moorhead received tremendous rainfall. Accumulated rainfall was 1.9-inches, 4.7-inches, 5.4-inches, and 7.2-inches at 7, 14, 21, and 28 days, respectively, after PRE applications. Unfortunately, the Moorhead site could not take this rainfall and standing water prevailed the week of May 19. The experimental area was broadcast sprayed with Gramoxone to kill emerged vegetation, including sugarbeet, that survived the excessive rainfall conditions and was replanted June 17.

Visible sugarbeet growth reduction injury was evaluated using a 0 to 100% scale (0 is no visible injury and 100 is complete loss of plant / stand). Visible waterhemp control was evaluated using a 0 to 100% scale (0 is no control and 100 is complete control). Visible sugarbeet growth reduction was collected approximately 7 and 14 days (+/- 3 days) after sugarbeet emergence and 7 and 14 days (+/- 3 days) after early EPOST application. Visible waterhemp control from at planting and POST applications were collected 7, 14, 28, 42, and 56 days (+/- 3 days) after sugarbeet emergence. Sugarbeet tolerance and waterhemp control are reported as days after planting (DAP). Experiment was a randomized complete block design and four replications. The experiments were analyzed individually using Agricultural Research Manager (ARM) Revision 2024.4.

Results

Sugarbeet Tolerance. At planting or POST herbicides did not affect early season or preharvest sugarbeet stands (Table 3); however, caused significant sugarbeet growth reduction (Table 4). Sugarbeet growth reduction injury was

Table 3. Sugarbeet stand in response to at planting and postemergence treatments, data averaged across four environments, 2024.

Herbicide treatment PPI/PRE	Herbicide treatment POST	Rate	Early Season Stand	Pre-Harvest Stand
		------pt or fl oz/A------	-----------100 ft row--------	
Ro-Neet + Eptam		2.67 + 1.14	225	228
Eptam / ethofumesate		1.14 / 4	215	232
	Outlook / Warrant	0.75 / 3	230	240
Ro-Neet + Eptam	Outlook / Warrant	2.67 + 1.14 / 0.75 / 3	210	230
Eptam / ethofumesate	Outlook / Warrant	1.14 / 4 / 0.75 / 3	220	227
	RUPM3 + etho / RUPM3 + etho	25 fl oz + 6 fl oz / 25 fl oz + 6 fl oz	230	232
P-value (0.05)			0.2521	0.4276

Table 4. Visible sugarbeet growth reduction in response to at planting and postemergence treatments, data averaged across four environments, 2024.[a]

Herbicide treatment PPI/PRE	Herbicide treatment POST	Rate	Days after Planting 40-45	47-51	60-63	75-89
		------pt or fl oz/A------	-------------------------%-------------------------			
Ro-Neet + Eptam		2.67 + 1.14	8 b	9 b	9 bc	5
Eptam / ethofumesate		1.14 / 4	10 b	9 b	6 c	7
	Outlook / Warrant	0.75 / 3	6 b	4 b	4 c	3
Ro-Neet + Eptam	Outlook / Warrant	2.67 + 1.14 / 0.75 / 3	20 a	18 a	4 c	8
Eptam / ethofumesate	Outlook / Warrant	1.14 / 4 / 0.75 / 3	21 a	18 a	15 a	7
	RUPM3 + etho / RUPM3 + etho	25 fl oz + 6 fl oz / 25 fl oz + 6 fl oz	8 b	5 c	5 c	4
P-value (0.05)			0.0013	0.0076	0.0010	0.1599

[a]Means within a main effect not sharing any letter are significantly different by the LSD at the 5% level of significance.

greatest 40 to 45 DAP and decreased with subsequent evaluations. Ro-Neet mixed with Eptam or Eptam followed by ethofumesate at planting or Outlook followed by Warrant postemergence caused negligible injury across evaluations. However, Ro-Neet mixed with Eptam or Eptam followed by ethofumesate at planting followed by Outlook EPOST and Warrant POST injured sugarbeet at both 40-45 and 47-51 DAP. Injury from Eptam PPI and ethofumesate PRE followed by Outlook EPOST and Warrant POST was significant from other treatments up to 60-63 DAP evaluations. Sugarbeet canopy was uniform across treatments with no evidence of growth reduction injury 75-89 DAP. Two applications of Roundup PowerMax3 plus ethofumesate POST remains the industry standard for safety and caused less than 10% growth reduction injury across evaluations. There was no evidence of chlorosis, malformation, or greater susceptibility to Cercospora leaf spot from herbicide treatments.

Sugarbeet yield data from Crookston and Murduck, MN and Prosper, ND experiments were combined across environments (Table 5). Sugarbeet yield data from Hendrum, MN is presented separate from the combined analysis due to the differences in root yield weights, which is credited to late planting. We did not observe differences in root yield or % sucrose credited to herbicide treatment in either data set. We also observed similar root yield trends across treatments with both experiments.

Table 5. Root yield and % sucrose in response to herbicide treatment, averaged across Crookston, Prosper, and Murdock, and Hendrum, 2024.

			Crookston/Prosper/ Murdock		Hendrum	
Herbicide treatment PPI/PRE	Herbicide treatment POST	Rate	Root Yield	Sucrose	Root Yield	Sucrose
		------pt /A------	---TPA[a]---	---%---	---TPA---	---%---
Ro-Neet + Eptam		2.67 + 1.14	38.0	16.77	23.3	18.79
Eptam / etho		1.14 / 4	36.3	16.63	23.5	18.92
	Outlook / Warrant	0.75 / 3	36.7	16.82	24.5	18.52
Ro-Neet + Eptam	Outlook / Warrant	2.67 + 1.14 / 0.75 / 3	36.9	16.70	24.1	18.84
Eptam / etho	Outlook / Warrant	1.14 / 4 / 0.75 / 3	36.6	16.72	24.1	18.41
	RUPM3 + etho / RUPM3 + etho	25 fl oz + 6 fl oz / 25 fl oz + 6 fl oz	37.3	16.45	25.8	18.16
P-value (0.05)			0.4925	0.3141	0.2177	0.1715

[a]TPA=Tons per acre.

Root yield was greatest with two applications of Roundup PowerMax3 plus ethofumesate POST. We did not observe any differences from Ro-Neet plus Eptam or Eptam followed by ethofumesate at planting, Outlook EPOST followed by Warrant POST or Ro-Neet plus Eptam or Eptam followed by ethofumesate at planting followed by Outlook EPOST and Warrant POST. Interestingly, we observed slightly less sucrose from two applications of Roundup PowerMax3 POST as compared with treatments including PPI and POST soil residual herbicides.

Waterhemp Control. Data for each location were analyzed separately since standing water compromised the Moorhead experiment, forcing replant. We did not observe differences with treatment groupings at Moorhead. We attribute this to terminating the experiment with paraquat due to standing water and replanting in June. Paraquat application may have eliminated waterhemp germinating in treatments before excessive rainfall. This summary will focus on results from the Blomkest experiment.

Ethofumesate PRE followed by two applications of Roundup PowerMax3 plus ethofumesate POST provided greater than 95% control, 28 DAP, but control decreased as the number of days increased after application (Figure 1). These data indicate Ro-Neet plus Eptam followed by two applications of Roundup PowerMax3 plus ethofumesate POST might last longer than initially thought, although Ro-Neet and Eptam did not provide full season weed control. Further, the Ro-Neet plus Eptam treatment had the same rates as the treatments where Ro-Neet and Eptam were applied singly.

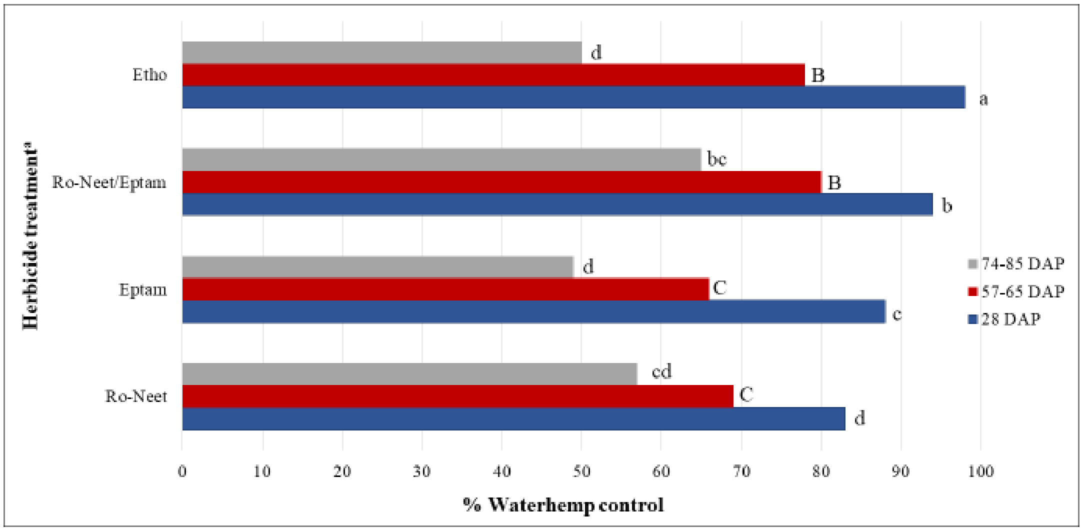

Figure 1. Waterhemp control from soil residual herbicides applied at planting, Blomkest MN, 2024. Means within a main effect not sharing any letter are significantly different by the LSD at the 5% level of significance. Each treatment includes two applications of Roundup PowerMax3 plus ethofumesate POST and HSMOC plus liquid AMS.

Soil residual treatments applied at planting were followed by Outlook mixed with Roundup PowerMax3 plus ethofumesate at the 2-lf sugarbeet stage and Warrant mixed with Roundup PowerMax3 plus ethofumesate at the 6-lf sugabeet stage (Figure 2). The current waterhemp control standard, ethofumesate plus Dual Magnum followed by Outlook mixed with Roundup PowerMax3 plus ethofumesate at the 2-lf sugabeet stage and Warrant mixed with Roundup PowerMax3 plus ethofumesate at the 6-lf sugabeet stage provided very good control in this experiment.

The experiment received timely and sufficient rainfall to incorporate the at planting and POST residual herbicide treatments into the soil (rainfall data not presented). We would likely see more of a benefit to Eptam, Ro-Neet or Eptam mixed with Ro-Neet in a season with less timely and less cumulative rainfall. This further emphasizes the challenge sugarbeet growers face. Ethofumesate alone or ethofumesate mixed with Dual Magnum provide good (80 to 90%) to excellent (90 to 99%) control when rainfall is timely and at an intensity to be incorporated into the soil. However, these same treatments may provide poor control (40 to 65%) or fair control (65 to 80%) when rainfall fails to occur or is less timely (Peters and Lystad 2024).

The chloroacetamide herbicides applied postemergence following Ro-Neet, Eptam or Ro-Neet plus Eptam provided good waterhemp control, suggesting these herbicides integrated into the weed management plan for waterhemp control have promise (Figure 2). Ideally, we would prefer to apply ethofumesate in mixtures with Ro-Neet or Eptam in this experiment; however, differences in incorporation requirements present a challenge. For example, Ro-Neet and Eptam should be incorporated to a depth of 2-inches (equipment set to a depth of 4-inches to incorporate them

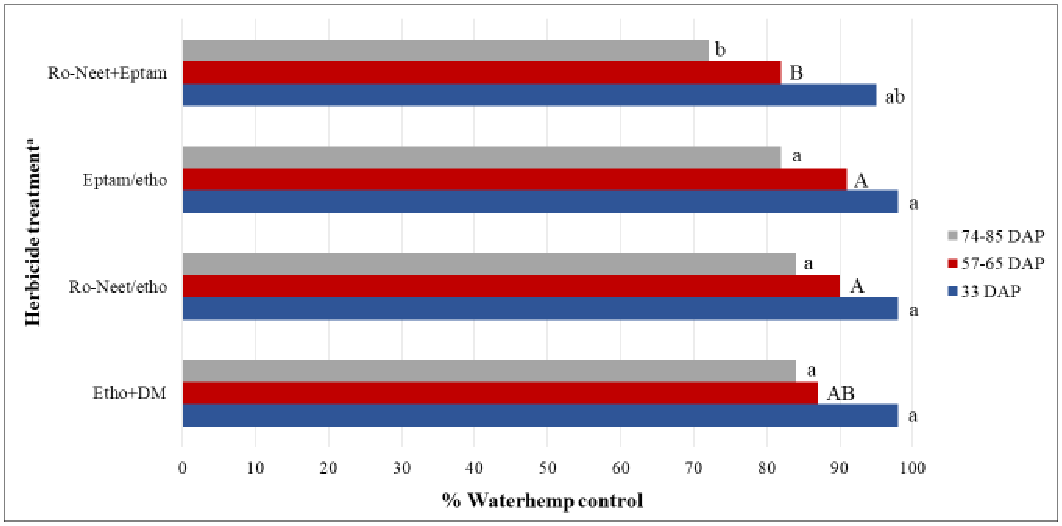

Figure 2. Waterhemp control from soil residual herbicides applied at planting, Blomkest MN, 2024. Means within a main effect not sharing any letter are significantly different by the LSD at the 5% level of significance. Treatment fb Outlook mixed with Roundup PowerMax3 plus ethofumesate and HSMOC plus liquid AMS at the 2-lf sugabeet stage and Warrant mixed with Roundup PowerMax3 plus ethofumesate and HSMOC plus liquid AMS at the 6-lf sugabeet stage.

and to reduce the likelihood of volatility loses); however, 2-inches is too deep to incorporate ethofumesate. Thus, ethofumesate was applied PRE, immediately following Ro-Neet or Eptam PPI application.

Conclusions

Ro-Neet, Eptam or Ro-Neet plus Eptam integrated into the weed management plan for waterhemp control has merit. However, we struggled to find a place for ethofumesate in this system since waterhemp control is most effective with ethofumesate when applied PRE or shallow incorporated. Ro-Neet and Eptam should be incorporated to a depth of 2-inches (equipment set to 4-inches) to eliminate volatility losses. Ro-Neet and Eptam were two-pass incorporated in this experiment. However, recent communication with Gowan Company, the manufacturer of Eptam, indicates one pass incorporation to a depth of 2-inches is sufficient.

Ethofumesate, Eptam, and Dual Magnum were fall applied in experiments initiated at multiple locations in 2024. Fall herbicide application is a waterhemp control strategy that growers have inquired about. Based on our results, fall application may remedy some of the spring application challenges with incorporating Ro-Neet and Eptam into the waterhemp control strategies that currently include ethofumesate, Dual Magnum, Outlook, and Warrant.

Literature Cited

Peters TJ and Lystad AL (2024) A compendium of our ethofumesate knowledge. Sugarbeet Res Ext Rep 54:16-23

WATERHEMP CONTROL WITH ETHOFUMESATE BRANDS IN SUGARBEET

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Summary

1. Preemergence (PRE) waterhemp control from Maxtron 4SC, Ethotron, and Ethofumesate 4SC was the same as Nortron at Moorhead, MN. Waterhemp control was less with Ethofumesate 4SC at Renville, MN.
2. All ethofumesate brands evaluated were safe to sugarbeet.
3. We conclude ethofumesate across brands provide similar waterhemp control and sugarbeet safety.

Introduction

Ethofumesate is one of the most valuable and flexible herbicides for sugarbeet weed control in the Red River Valley. Ethofumesate provides control of small seeded broadleaves, including waterhemp, at PRE rates ranging from 4 to 7.5 pint per acre and contributes to a 'layered residual' program for sugarbeet weed control (Peters et al. 2022). Recently, Albaugh, LLC received approval for their ethofumesate product called Maxtron 4SC for use in sugarbeet. The approval of Maxtron 4SC provides five ethofumesate options on the market in sugarbeet. Additional options include Ethofumesate 4SC from Farm Business Network, Ethotron from UPL NA, Inc., Nortron from Bayer CropScience, and Nektron from Atticus, LLC.

Sugarbeet growers utilize a strategic criteria specific to their operational needs to select products. Some criteria examples include relationships with ag retailers, product formulation, and price per gallon. The objective of this experiment was to evaluate sugarbeet tolerance and waterhemp control with Maxtron 4SC compared with other ethofumesate products on the market to determine if brand should be a consideration in selection criterion.

Materials and Methods

Experiments were conducted on indigenous populations of waterhemp in fields near Moorhead and Renville, MN in 2024. The experimental area was prepared for planting by applying the appropriate fertilizer and conducting tillage across the experimental area at each location. Sugarbeet was planted on May 11 and May 14, 2024 at Moorhead and Renville, respectively. Sugarbeet was seeded in 22-inch rows at approximately 63,500 seeds per acre with 4.6 inch spacing between seeds.

Herbicide treatments were applied PRE and POST. All treatments were applied with a bicycle sprayer in 17 gpa spray solution through 8002XR nozzles (TeeJet® Technologies, Glendale Heights, IL) pressurized with CO_2 at 40 psi to the center four rows of six row plots 40 feet in length. The treatment list can be found in Table 1.

Table 1. Herbicide treatments and rates in trials at Renville and Moorhead, MN in 2024.

Herbicide Treatment	Rate (fl oz/A)[1]	Sugarbeet Stage (lvs)
Control - Weedy Check / RUPM3[2] / RUPM3	0 / 25/ 25	PRE / 2-4 / 6-8
Maxtron 4SC / RUPM3 / RUPM3	101.6 / 25/ 25	PRE / 2-4 / 6-8
Nortron SC / RUPM3 / RUPM3	96 / 25/ 25	PRE / 2-4 / 6-8
Ethotron / RUPM3 / RUPM3	96 / 25/ 25	PRE / 2-4 / 6-8
Ethofumesate 4SC / RUPM3 / RUPM3	96 / 25/ 25	PRE / 2-4 / 6-8

[1]Active ingredient applied was consistent across products. Maxtron has a different product formulation, resulting in an increased application rate.
[2]Roundup PowerMax3 plus ethofumesate applied with Destiny HC HSMOC at 1.5 pt/A plus Amsol Liquid AMS at 2.5% v/v.

The experimental area at Moorhead received tremendous rainfall. Accumulated rainfall was 1.9-inch, 4.7-inch, 5.4-inch and 7.2-inch at 7, 14, 21 and 28 days, respectively, after PRE application. Unfortunately, the site could not absorb the rainfall amount over such a short time period, resulting in standing water the week of May 19. The experimental area was broadcast sprayed with Gramoxone to kill emerged vegetation, including sugarbeet, that survived the excessive rainfall conditions and was replanted June 17.

Visible sugarbeet growth reduction injury was evaluated using a 0 to 100% scale (0 is no visible injury and 100 is complete loss of plant / stand) and visible waterhemp control using a 0 to 100% scale (0 is no injury and 100 is complete control). Visible sugarbeet growth reduction was collected approximately 7 and 14 days (+/- 3 days) after sugarbeet emergence and 7 and 14 days (+/- 3 days) after the early POST (EPOST) application. Visible waterhemp control from at planting and POST application was collected 7, 14, 28, 42, and 56 days (+/- 3 days) after sugarbeet emergence. Sugarbeet tolerance and waterhemp control are reported as days after planting (DAP). Experiment was a randomized complete block design and four replications. The experiment was analyzed using Agricultural Research Manager (ARM) Revision 2024.4.

Results

Waterhemp control was influenced by herbicide treatments (P < 0.10) at Renville and Moorhead (Table 2 Figure 1, Figure 2). At Renville, no growth reduction was observed in any of the ethofumesate treatments, 28 DAP. At Moorhead, PRE treatments were applied on May 14. However, evaluations were not collected until July 20; 33 days after sugarbeet replanting or 68 days after the PRE application. We observed similar waterhemp control from ethofumesate brands 68, 76, and 83 DAP at Moorhead. No growth reduction data were collected due to replanting.

Table 2. Waterhemp control and sugarbeet growth reduction in response to herbicide treatment at Renville and Moorhead, MN, 2024.[1]

	Sugarbeet Injury	Waterhemp Control				
Herbicide Treatments	**Renv 28 DAP**	**Renv 28 DAP**	**Renv 57 DAP**	**Moor 68 DAP**	**Moor 76 DAP**	**Moor 83 DAP**
	%	-----------------------------	------	--%--	------	-----------------------------
RUPM3[2] / RUPM3	0	5 c	5 d	10 b	8 b	3 b
Maxtron 4SC / RUPM3 / RUPM3	0	90 a	70 b	74 a	74 a	63 a
Nortron SC / RUPM3 / RUPM3	0	94 a	85 a	75 a	65 a	60 a
Ethotron / RUPM3 / RUPM3	0	89 a	74 ab	76 a	65 a	59 a
Ethofumesate 4SC / RUPM3 / RUPM3	0	78 b	48 c	75 a	64 a	60a
P-value 0.10	-	0.0001	0.0001	0.0001	0.0001	0.0001

[1]Means within a main effect not sharing any letter are significantly different by the LSD at the 5% level of significance.
[2]Roundup PowerMax3 plus ethofumesate applied with Destiny HC HSMOC at 1.5 pt/A plus Amsol Liquid AMS at 2.5% v/v.

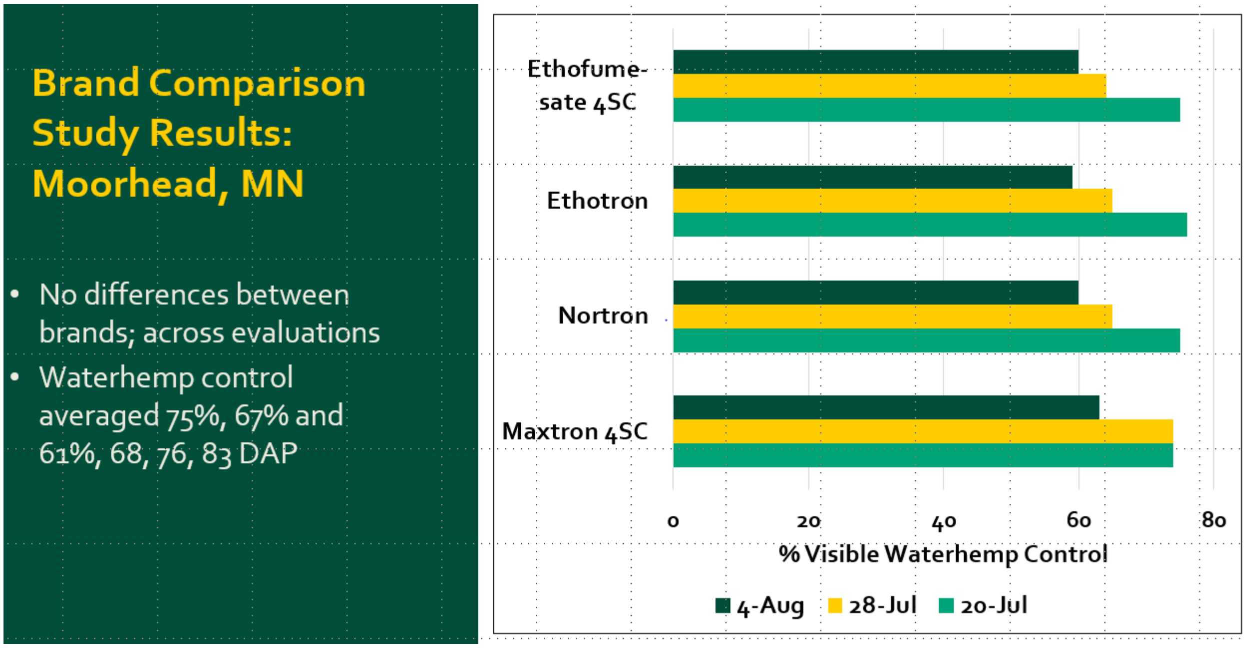

Figure 1. Waterhemp control from Ethofumesate 4SC, Ethotron, Nortron, and Maxtron on July 20, July 28, and August 4, or 68, 76, and 83 DAP, respectively, at Moorhead MN, 2024.

Ethofumesate 4SC provided less waterhemp control, 28 and 57 DAP, at Renville (Table 2, Figure 2). We attribute this difference to position affect in the field rather than herbicide treatment. The waterhemp infestation tended to be more severe in the southwest side of the experiment area, requiring increased product performance compared with other areas with lower weed populations. Our experiments are evaluated against a running control that borders each treatment. However, waterhemp ground cover may have caused bias that was reflected in the evaluations. Further, flooding from Beaver Creek compromised the Renville experiment, and adversely affected waterhemp control after 28 DAP by saturating the soil and potentially bringing in more weed seed to control.

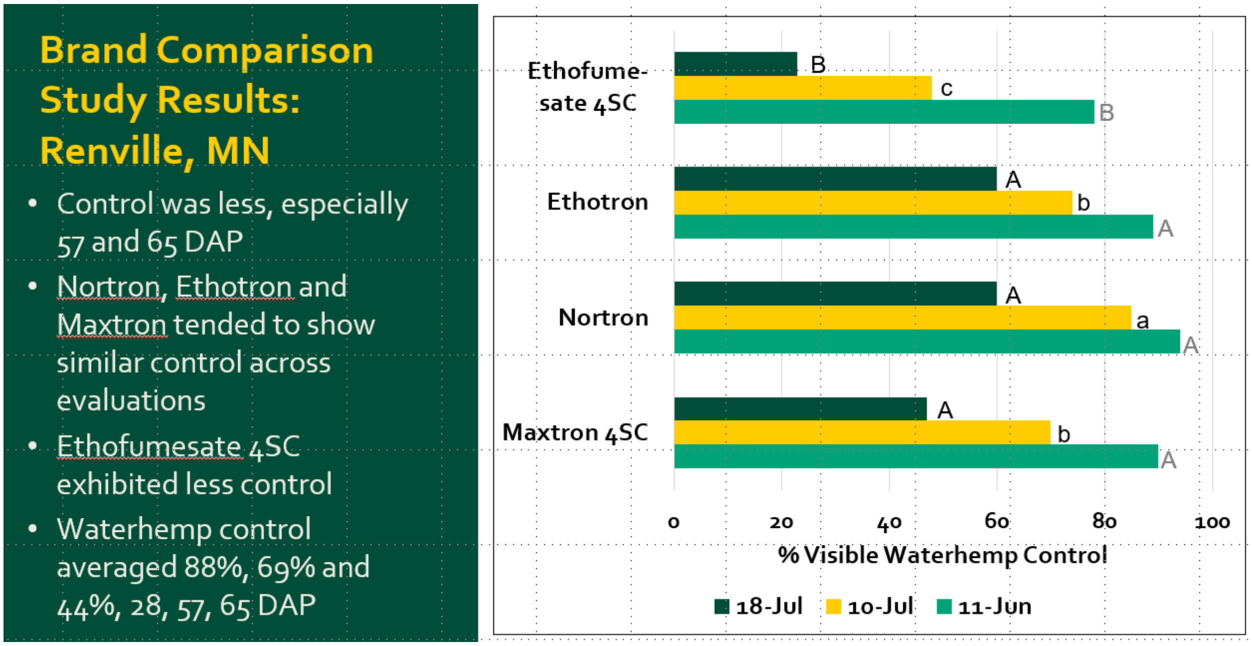

Figure 2. Waterhemp control from Ethofumesate 4SC, Ethotron, Nortron, and Maxtron on July 20, July 28 and August 4, or 68, 76, and 83 DAP, respectively, at Renville MN, 2024.

Ethofumesate has a relatively high soil adsorption coefficient (KOC) value compared with chloroacetamide herbicides to which sugarbeet growers are familiar. KOC is the ratio of herbicide bound to soil collides versus what is free in the water. The higher the KOC value, the greater the adsorption to soil colloids. Likewise, ethofumesate is relatively less water soluble compared with other sugarbeet soil residual herbicides. The combination of a high KOC value and low water solubility means rainfall is required to incorporate the ethofumesate products into the soil. While all ethofumesate brands used in this study were suspension concentrates (SC) types, variations in their specific formulations, such as particle size, stabilizers, or adjuvant systems, could influence their performance. Our field experiments received abundant rainfall in 2024, removing any potential separation from formulation and ease of incorporation into soil.

Conclusions

These experiments indicate that all ethofumesate brands available on the market provide similar waterhemp control. The sugarbeet grower will elect to purchase one brand over another based on his/her established criterion; however, waterhemp control or sugarbeet tolerance should not be a criterion for purchase decision.

References

Peters TP, Lystad AL, Mettler D (2022) Waterhemp control from soil residual preemergence and postemergence herbicides in 2022. Sugarbeet Res Ext Rep 53:12-17.

PALMER AMARANTH CONTROL IN SUGARBEET

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Summary

1. Soil residual herbicides applied postemergence (POST) was more important than preemergence (PRE) herbicides for Palmer amaranth control.
2. Three-times soil residual herbicides applied POST was more efficacious for Palmer amaranth control than two-times soil residual herbicides applied POST.
3. Preliminary data suggests integrating Ultra Blazer into the program would improve overall Palmer amaranth control.
4. Cultural control practices, specifically sugarbeet planting date and stand establishment, will delay Palmer amaranth population since weed emergence was late June or 45 to 75 days after when sugarbeet typically are planted.
5. The best herbicide treatments in sugarbeet provided *only* fair to good (65% to 80%) Palmer amaranth control.

Introduction

The anticipation of Palmer amaranth has created a mystic about weeds we seldom see in agriculture. By now, growers have read the press clippings indicating 2- to 3-inch of growth a day in June, a base so large that it can damage the sickle bar on a combine, and Palmer amaranth's ability to produce a million seed per plant. Department of Agriculture and Extension in Minnesota and North Dakota have created awareness and have assisted in eradicating Palmer amaranth before it has a chance to establish. To our knowledge, there are no incidences of Palmer amaranth in sugarbeet in Minnesota or North Dakota.

Successful organizations create contingency plans in the event something happens. It seems that weed management in sugarbeet should operate similarly. We need to know how our current weed management programs perform in sugarbeet and what programs would be implemented in the event Palmer amaranth establishes in fields to be planted to sugarbeet. A greenhouse experiment was conducted in 2016 to evaluate Betamix mixtures with ethofumesate and UpBeet for Palmer amaranth control. Betamix, ethofumesate and UpBeet were applied at 3 pt/A + 12 fl oz/A + 1 oz/A when Palmer amaranth was 2-, 4- and 8-inches tall. We found control was best when Palmer amaranth was 2-inches tall (Figure 1). However, control was not consistent across experiments and decreased significantly when Palmer amaranth was 4- or 8-inches at application.

Herbicide treatment	Height (inch)	Control 5 DAT	Control 24 DAT
		---------(%)---------	
Betamix+ethofumesate+UpBeet (3 pt + 12 fl oz + 1 oz)	2	99 a	99 a
Betamix+ethofumesate+UpBeet (3 pt + 12 fl oz + 1 oz)	4	56 b	57 b
Betamix+ethofumesate+UpBeet (3 pt + 12 fl oz + 1 oz)	8	34 c	24 c

Herbicide treatment	Height (inch)	Control 20 DAT	Control 28 DAT
		---------(%)---------	
Betamix+ethofumesate+UpBeet (3 pt + 12 fl oz + 1 oz)	2	70 a	23
Betamix+ethofumesate+UpBeet (3 pt + 12 fl oz + 1 oz)	4	43 b	17
Betamix+ethofumesate+UpBeet (3 pt + 12 fl oz + 1 oz)	8	38 b	13

Figure 1. Palmer amaranth control in response to herbicide treatment applied on 2-, 4- and 8-inch Palmer amaranth, two greenhouse runs, 2016.

The Sugarbeet Research and Education Board funded a field experiment at the University of Nebraska-Lincoln and Scotts Bluff Research Stations in collaboration with Dr. Nevin Lawrence in 2018. The objective of the experiment was to determine Palmer amaranth control in response to ethofumesate preemergence (PRE) followed by soil residual herbicides applied at the 2-lf, 6-lf, and 2- followed by 6-lf sugarbeet stage. The experiment considered three soil residual herbicide treatments: a) Warrant at 3 pt/A; b) ethofumesate at 2 pt/A; and c) Warrant + ethofumesate at 1.5 + 2 pt/A. We learned that Warrant, a site of action (SOA) 15 chloroacetamide herbicide, was effective for Palmer amaranth control (Figure 2). However, soil types in Nebraska are unique from soil types in the Red River Valley so reproducing similar results was difficult in Minnesota and North Dakota.

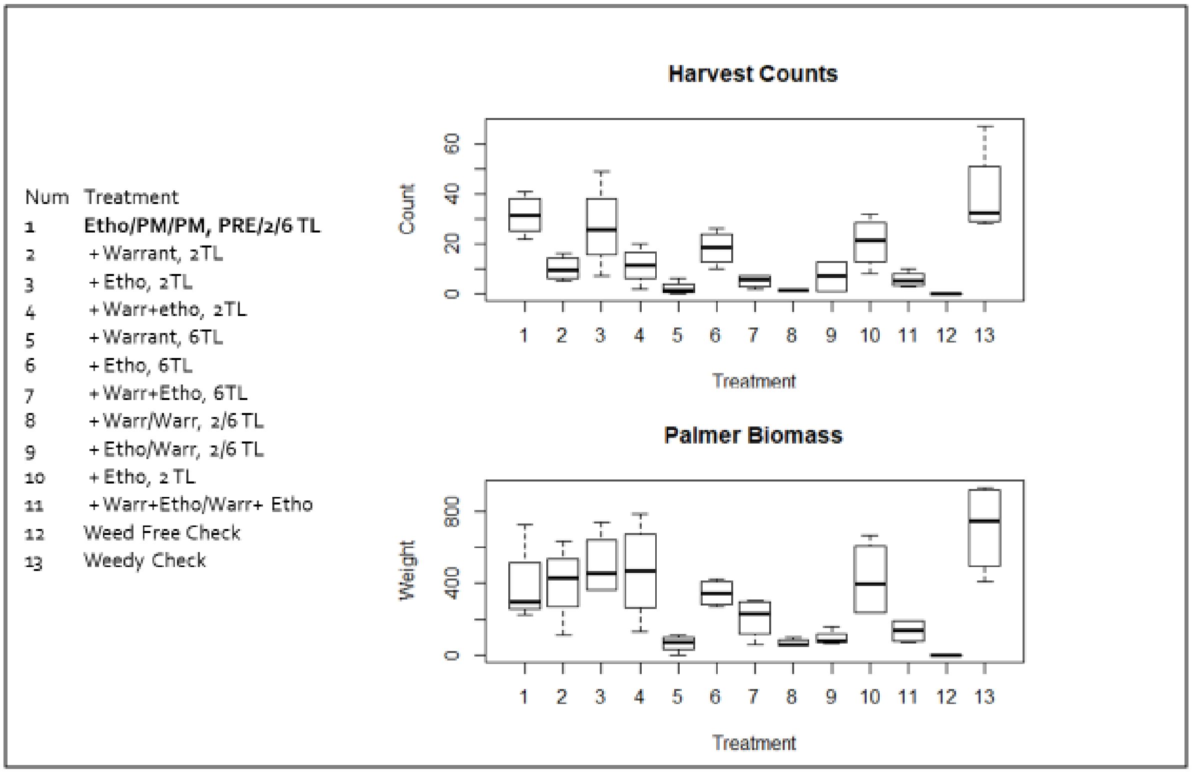

Figure 2. Palmer amaranth plant biomass and harvest counts in response to herbicide treatments, University of Nebraska, Scottsbluff, NE, 2018.

Palmer amaranth was first identified in Minnesota in 2016 and identified in North Dakota in 2018. We identified a field location inhabited with Palmer amaranth and suitable for a sugarbeet experiment near Eckelson, ND in Barnes County for the 2024 field season. The objectives of the experiment were to a) to evaluate soil residual herbicides in soils indicative of those where sugarbeet are produced in Minnesota and North Dakota and: b) to evaluate Palmer amaranth control with layered soil residual herbicides applied preemergence and postemergence (POST) in sugarbeet.

Materials and Methods

The experimental area was prepared for planting with spring tillage. Sugarbeet was planted on June 1, 2024. Sugarbeet was seeded in 30-inch rows at approximately 51,500 seeds per acre with 4-inch spacing between seeds.

Herbicide treatments were applied PRE and POST. All treatments were applied with a bicycle sprayer in 17 gpa spray solution through 8002XR nozzles (TeeJet® Technologies, Glendale Heights, IL) pressurized with CO_2 at 40 psi to the center four rows of six row plots 40 feet in length. The treatment list can be found in Table 1.

Table 1. Herbicide treatment, treatment rates and sugarbeet stage at application, Eckelson ND, 2024.

Herbicide Treatment	Rate (pt or fl oz/A)	Sugarbeet Stage (lvs)
RUPM3[a] + etho[b] / RUPM3 + etho /	25 + 4 / 25 + 4 /	2 / 6 /
RUPM3 + etho	20 + 4	10
Etho + Dual Magnum / RUPM3 + etho /	3p + 12 / 25 + 4 /	PRE / 2 /
RUPM3 + etho / RUPM3 + etho	25 + 4 / 20 + 4	6 / 10
Etho + Torero / RUPM3 + etho /	8 + 8p / 25 + 4 /	PRE / 2 /
RUPM3 + etho / RUPM3 + etho	25 + 4 / 20 + 4	6 / 10
Etho / RUPM3 + etho / RUPM3 + etho /	7.5p / 25 + 4 / 25 + 4 /	PRE / 2 / 6 /
RUPM3 + etho	20 + 4	10
Outlook + RUPM3 + etho /	18 + 25 + 4 /	2 /
Warrant + RUPM3 + etho / RUPM3 + etho	4p + 25 + 4 / 20 + 4	6 / 10
Etho + Dual Magnum / Outlook + RUPM3 + etho /	3p + 12 / 18 + 25 + 4 /	PRE / 2 / 6 /
Warrant + RUPM3 + etho / RUPM3 + etho	4p + 25 + 4 / 20 + 4	10
Etho / Outlook + RUPM3 + etho / Warrant + RUPM3 +	7.5p / 18 + 25 + 4 /	PRE / 2 /
etho / RUPM3 + etho	4p + 25 + 4 / 20 + 4	6 / 10
Etho + Torero / Outlook + RUPM3 + etho /	8 + 8p / 18 + 25 + 4 /	PRE 2 /
Warrant + RUPM3 + etho / RUPM3 + etho	4p + 25 + 4 / 20 + 4	6 / 10
Outlook + RUPM3 + etho / Warrant + RUPM3 + etho /	18 + 25 + 4 / 4p + 25 + 4 / 1.25p	2 /
Dual Magnum + RUPM3 + etho	20 + 4	6 / 10
Etho + Dual Magnum / Outlook + RUPM3 + etho /	3 p + 12 / 18 + 25 + 4 /	PRE / 2 /
Warrant + RUPM3 + etho /	4p + 25 + 4 /	6 /
Dual Magnum + RUPM3 + etho	1.25p + 20 + 4	10
Etho + Torero / Outlook + RUPM3 + etho /	8 + 8p / 18 + 25 + 4 /	PRE / 2 /
Warrant + RUPM3 + etho /	4p + 25 + 4 /	6 /
Dual Magnum + RUPM3 + etho	1.25p + 20 + 4	10
Etho / Outlook + RUPM3 + etho /	7.5p / 18 + 25 + 4 /	PRE / 2 /
Warrant + RUPM3 + etho /	4p + 25 + 4 /	6 /
Dual Magnum + RUPM3 + etho	1.25p + 20 + 4	10

[a]RUPM3 = Roundup PowerMax3; etho = ethofumesate.
[b]Roundup PowerMax3 and ethofumesate applied with high surfactant methylated oil concentrate at 1.5 pt/A plus liquid AMS at 2.5% v/v.

Sugarbeet injury and Palmer amaranth control was collected subjectively and objectively. Visible percent sugarbeet injury (0 to 100%, 0%, no injury and 100% complete loss of sugarbeet stand) and visible percent Palmer amaranth control (0 to 100%, 0% is no control and 100% complete control) was assessed 14, 21, 28, 56, and 70 (+/- 3) days after planting (DAP). Palmer amaranth infestation was classified into three groups: ‘1’ or heavy Palmer amaranth infestation; ‘2’ or moderate Palmer amaranth infestation and ‘3’ or light Palmer amaranth infestation. The number of Palmer amaranth plants between rows 2 and 3 in the length of the plot was collected 70 DAP.

Experiment design was a randomized complete block design with four replications. Treatment arrangement was a two-factor factorial experiment with four replications. Main affects were PRE herbicide(s) and POST herbicide treatment. The experiment was analyzed using Agricultural Research Manager (ARM) revision 2024.4.

Results

The experiment was analyzed as a factorial treatment arrangement. ANOVA indicated Factor A, PRE herbicide was not significant; however, Factor B, POST herbicide treatment, was significant. The interaction of both A and B factors was not significant. Factor A considered PRE herbicide treatment. There were four treatments: 1) no herbicide treatment; 2) Nortron+Dual Magnum; 3) Nortron+Torero; and 4) Nortron alone. To be clear, treatment one is the average of the three Factor B treatments not receiving a PRE herbicide.

Sugarbeet growth reduction was evaluated but will not be discussed in this report. Growth reduction tended to be random across treatments and was compromised by Palmer amaranth infestation.

PRE treatment did not influence Palmer amaranth control (Table 2). Palmer amaranth control collected 58-69 DAP was marginally significant, indicating PRE herbicide application tended to improve control. Palmer amaranth control collected 43-52 DAP, both visible score or Palmer amaranth count, were not influenced by PRE treatment.

Table 2. Palmer amaranth control, population score, and stand count in response to herbicide treatment applied PRE averaged over POST treatments, Eckelson ND, 2024.

		Palmer Amaranth Control			
Herbicide treatment	**Rate**	**43-52 DAP**	**58-69 DAP**	**Score[b]**	**Stand Count[c]**
	---pt/A---	----------------%---------------		---------Number--------	
Untreated		67	49 b	2.6	23
Nortron + Dual Magnum	3 + 0.75	74	64 a	2.3	14
Nortron +Torero	0.5 + 8	80	63 a	2.2	14
Nortron	7.5	78	70 a	2.2	14
P-value (0.10)		0.1319	0.1020	0.4756	0.2276

[a]Palmer amaranth population density score: 1= heavy, 2= moderate, 3 = light.
[b]Palmer amaranth control group by plot: 1 = heavy, poor control; 2 = moderate infestation and control; 3= light infestation, good control.
[c]Number of Palmer amaranth between rows 2 and 3, length of plot.

POST application at the 2-lf sugarbeet stage was sprayed on June 17. On the same day, glyphosate was broadcast applied across the experimental area to control redroot pigweed, grasses, velvetleaf, and other weeds. The experimental area was void of weeds, including Palmer amaranth, when we returned for visit on June 25. However, Palmer amaranth emerged shortly there after and grew vigorously in July and August (Figure 3).

Figure 3. A wire flag measured Palmer amaranth height on July 24, 2024. Images collected on July 29, or 5 days after flagging, and on August 8, or 15 days after flagging, to demonstrate rapid Palmer amaranth growth.

POST treatment influenced Palmer amaranth control both 43-52 DAP and 58-69 DAP. Likewise, herbicides applied POST improved Palmer amaranth control. Further, a 3-times POST program tended to improve control as compared with a 2-times POST program, and number of Palmer amaranth between rows 2 and 3 measured the length of the plot (Table 3). In general, a 3-times soil residual program improved Palmer amaranth control as compared with a 2-times soil residual program.

Table 3. Palmer amaranth control, population score, and stand count in response to herbicide treatment applied POST averaged over PRE treatments, Eckelson ND, 2024.[a]

Herbicide treatment	Rate	Palmer Amaranth Control 43-52 DAP	Palmer Amaranth Control 58-69 DAP	Score[b]	Stand Count[c]
	---pt/A---	---------------%-------------		------Number------	
RUPM3 + etho[d] (3x)	1.6 + 0.25	68 b	52 b	2.4	23 b
Outlook/Warrant (3x)	1.1 / 4	76 ab	60 b	2.3	16 ab
Outlook/Warrant/Dual Magnum (3x)	1.1 / 4/ 1.3	82 a	72 a	2.3	10 a
P-value (0.10)		0.0257	0.0255	0.7119	0.0153

[a]Means within a main effect not sharing any letter are significantly different by the LSD at the 10% level of significance.
[b]Palmer amaranth control group by plot: 1 = heavy, poor control; 2 = moderate infestation and control; 3= light infestation, good control.
[c]Number of Palmer amaranth between rows 2 and 3, length of plot.
[d]RUMP3 = Roundup PowerMax3; etho = ethofumesate.

Interaction of factor A (PRE treatment) and factor B (POST treatment) was not significant (Table 4). Each individual PRE herbicide with its respective POST herbicide are listed to inform the reader of rank order. Palmer amaranth control tended to be best when ethofumesate was applied at full rates and when Outlook, Warrant, and Dual Magnum were applied with a 3-times application with Roundup PowerMax3 and ethofumesate (Figure 4). By accident, Roundup PowerMax3 was mixed with Ultra Blazer and applied at the V6 stage (Table 4). Roundup PowerMax3 mixed with Ultra Blazer provided 88% Palmer amaranth control or numerically, the greatest control 43-53 DAP. Control was less 58-69 DAP and the number of Palmer amaranth plants tended to be greater than the ethofumesate PRE or 3-times Roundup PowerMax3 and ethofumesate with Outlook, Warrant, and Dual Magnum.

Table 4. Palmer amaranth control, population score, and stand count in response to herbicide treatment, Eckelson ND, 2024.

Herbicide Treatment: Preemergence	Rate	Postemergence[a,b]	Rate	Palmer Amaranth Control 43-52 DAP	Palmer Amaranth Control 58-69 DAP	Score[c]	Stand Count[d]
	-pt/A-		--pt/A--	-------------%-----------		---Number---	
-		-		53	35	2.8	27
-		Outlook/Warrant	1.1/4	75	55	2.3	23
-		Outlook/Warrant/Dual Magnum	1.1/4.0/1.3	75	59	2.8	18
Etho + D Mag	2 + 0.5	-		64	48	2.3	24
Etho + D Mag	2 + 0.5	Outlook/Warrant	1.1/4	75	65	2	12
Etho + D Mag	2 + 0.5	Outlook/Warrant/Dual Magnum	1.1/4.0/1.3	83	79	2.8	6
Etho + Torero[b]	0.5 + 8	-		***88***	***75***	***2.3***	***14***
Etho + Torero	0.5 + 8	Outlook/Warrant	1.1/4	68	42	2.5	22
Etho + Torero	0.5 + 8	Outlook/Warrant/Dual Magnum	1.1/4.0/1.3	83	73	1.8	6
Ethofumesate	7.5	-		66	52	2.5	27
Ethofumesate	7.5	Outlook/Warrant	1.1/4	84	80	2.3	7
Ethofumesate	7.5	Outlook/Warrant/Dual Magnum	1.1/4.0/1.3	85	78	1.8	10
P-value				0.0912	0.0931	0.4404	0.4234

[a]All plots received Roundup PowerMax3 and Nortron with HSMOC and liquid AMS alone or mixed with soil residual herbicides POST. Application applied at 2-4-, 6-8- and 10-12-lf stage.
[b]Application applied at 6-8-lf stage contained Ultra Blazer by accident.
[c]Palmer amaranth control group by plot: 1 = heavy, poor control; 2 = moderate infestation and control; 3= light infestation, good control.
[d]Number of Palmer amaranth between rows 2 and 3, length of plot.

Figure 4. Palmer amaranth control assessed July 22, 2024 or 6 days after application D (DAAD). Images were A: 3-times Roundup PowerMax3 plus ethofumesate, POST; B) ethofumesate PRE followed by 3-times Roundup PowerMax3 plus ethofumesate; B) ethofumesate PRE followed by 2-times Roundup PowerMax3 plus ethofumesate, first application with Outlook and second application with Warrant; and D) ethofumesate PRE followed by 3-times Roundup PowerMax3 plus ethofumesate, first application with Outlook and second application with Warrant and third application with Dual Magnum, Eckelson, ND, 2024.

Conclusion

The Palmer amaranth biotype at Eckelson, ND germinated and emerged in late June. It is likely each incidence of Palmer amaranth in Minnesota or North Dakota will be a population that may respond uniquely to local environmental conditions. These data demonstrate the importance of the POST treatment. The experiment was planted on wide rows due to equipment availability. Sugarbeet planted in mid-April or early May, in 22-inch rows and with stand densities averaging 175 plants per 100 ft of row, will be the best defense against Palmer amaranth.

This experiment provided positive outcomes but demonstrated the growth potential of Palmer amaranth and the need to aggressively manage throughout the growing season. Overall, the experiment provided fair (65% to 80%) to good (80% to 90%) control and provides a base-line for Palmer amaranth control in sugarbeet. Commercial fields will demand greater than 90% control, indicating the challenges and importance of developing robust future programs.

Appendix

Appendix. Trials conducted in the SMBSC growing area but not reported in the 2024 Research Reports.

Trial	Location	Description
Nitrogen Fall/Spring Comparison	Raymond	These trials were designed to compare nitrogen products and rates in a fall/spring design. This is a cooperative project with Dan Kaiser from the University of Minnesota.
Proprietary Products Trials	Renville, Murdock, Roseland, Sacred Heart, Raymond, and Clara City	Nine trials were conducted looking at proprietary products that may have the ability to increase sugar content. These products are currently not labeled for use in sugar beets.
Liquid Separated Dairy Manure Trial	Murdock	2024 was the 5th year of 6 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.
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.
UBS Proprietary Trials	Wood Lake, Murdock, Hector, and Cosmos	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 and Amalgamated Aph Nurseries	Renville Aph Nursery	Trials conducted on behalf of Minn-Dak and Amalgamated. Data is property of Minn-Dak and Amalgamated.
Storage Trials	Renville Receiving Station and Cold Storage	Sugar beet storage trials monitoring sugar beet pile temperatures, sugar loss, regrowth, and respiration rates.

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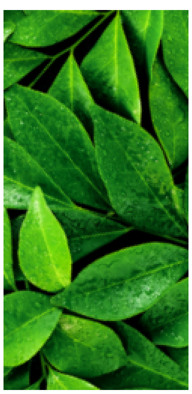

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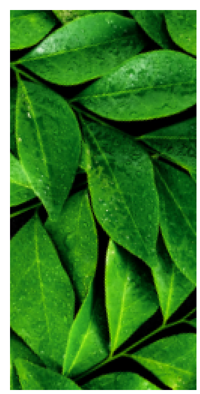

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