2014
RESEARCH REPORT

Southern Minnesota Beet Sugar Cooperative

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Failure to acknowledge any form of assistance whether cooperative or technical is purely unintentional.

2014 SMBSC Official Variety Trial Procedures

Mark Bloomquist
Gary Lindahl

Four Official Variety Trial locations were planted in 2014. These trials were located near Murdock, Renville, Lake Lillian, and Hector. Trials were planted with a modified 12 row John Deere 7300 vacuum planter. Plots were four rows wide by forty feet long. Each variety was replicated six times across the trial. Emergence counts were taken approximately 28 days after planting, and alleys were cut perpendicular to the rows. After the emergence counts were taken, plots were thinned to a uniform spacing of approximately 190-200 sugar beets per 100 foot of row, and all doubles were removed. Quadris was banded over the row at approximately the four to six leaf stage to suppress rhizoctonia root and crown rot.

Weed control was accomplished by applying Roundup Weathermax, Sequence, Stinger, Betamix, and Selectmax at the appropriate rates and times. The weeds present at each site dictated the actual weed control products used at each site. All spraying operations were conducted by a tractor sprayer driving perpendicular to the rows down the tilled alleys. All spraying operations were conducted by SMBSC Research Staff. Three cercospora leafspot fungicide applications were made on all Official Variety Trial plots.

In early September, approximately 2.5 feet is tilled under on each end of every plot to eliminate the border effect that develops on the outside of the plots near the tilled alleys. Row lengths are taken on each harvest row to calculate yield at harvest. All plots were defoliated using a 4-row defoliator. The center two rows of each plot were harvested using a 2-row research harvester. All beets harvested from the center two rows were weighed on a scale on the harvester and a sample of beets was taken for quality analysis.

Varieties were entered into various disease nurseries to evaluate the disease tolerance of the varieties. Cercospora leafspot nurseries were conducted in cooperation with the Beet Sugar Development Foundation at a location in Michigan and at a Betaseed location near Rosemount, MN. Aphanomyces root rot nurseries were conducted at Betaseed's facility in Shakopee, MN and in the SMBSC Aphanomyces nursery near Renville. Rhizoctonia tolerance was tested at a SMBSC location near Clara City as well as the BSDF rhizoctonia nursery in Michigan.

All the data is summarized and merged with the 2012 and 2013 data to evaluate the varieties for approval. SMBSC Seed Policy sets out guidelines for minimum performance standards of the varieties. Varieties that meet all the approval criteria are approved for shareholders to plant their 2015 sugar beet crop.

2014 SMBSC Official Variety Trials Specifications

Trial Location	Cooperator	Entry Designation	Previous Crop	Starter Fertilizer	Planting Date	Disease	Harvest Date
Hector	G.E. Johnson Inc	Official Trial	Sweet corn	Yes	5/24/14	Moderate aphanomyces Light rhizomania	10/10/14
Lake Lillian	Mike, Brad, and Jeff Schmoll	Official Trial	Sweet Corn	No	5/22/14	Light rhizomania	10/7/14
Renville	C&P Farms	Official Trial	Field Corn	No	5/21/14	Light aphanomyces and rhizoctonia	9/23/14
Murdock	Kyle Petersen	Official Trial	Field Corn	Yes	5/24/14	Light - Moderate Fusarium in first rep.	9/29/14

All trials were sprayed with two applications of Sequence (glyphosate + Dual Magnum) and hand weeded for any escapes
Quadris was band applied to all trials at approximately the 4-8 leaf beet stage for rhizoctonia suppression.
Three CLS fungicide applications were applied to all trial locations.

2014 Disease Nursery Trial Specifications

Disease	Cooperator	Location	Ratings Performed By	Use of Ratings in 2014 Variety Approval
Cercospora	Betaseed	Rosemount	Betaseed	50% of 2014 CLS Rating
Cercospora	BSDF - USDA/ARS Linda Hanson Mitch McGrath	Michigan	USDA/ARS Personnel	50% of 2014 CLS Rating
Aphanomyces	Betaseed	Shakopee	Betaseed, Jason Brantner, Mark Bloomquist	50% of 2014 Aphanomyces Rating
Aphanomyces	SMBSC	Renville	SMBSC Research Staff	50% of 2014 Aphanomyces Rating
Rhizoctonia	BSDF - USDA/ARS Linda Hanson	Michigan	USDA/ARS	Rhizoctonia Specialty Approval Status
Rhizcotonia	SMBSC Bob Condon	Clara City	SMBSC Research Staff	Rhizoctonia Specialty Approval Status

SMBSC APPROVED VARIETIES
2015

FULLY APPROVED
UNLIMITED SALES VARIETIES

Beta 90RR54 (Rhizoctonia)
Beta 92RR30 (Aphanomyces)
Beta 92RR60
Crystal RR018
Crystal RR270
Crystal RR459

TEST MARKET VARIETIES - All have 2 years testing.
(Sales shall not exceed 10% of total seed sales for each variety).

Beta 93RN
Crystal M375
Crystal M380
Hilleshog 9528RR
Hilleshog 9517RR

APHANOMYCES
SPECIALTY
APPROVED VARIETIES

Beta 91RR01
Crystal RR850

RHIZOCTONIA
SPECIALTY
APPROVED VARIETIES

Beta 91RR01
Hilleshog 9093RR
Hilleshog 4302RR
Maribo MA109RR

Table 1. Comparison of 2015 SMBSC Fully Approved Varieties and Specialty Varieties - 3 Year Data (2012 - 2014)

	Rec/T (lbs)		*Rec/A (lbs)*		*Yield (T/A)*		*Sugar %*		*Cercospora Leaf Spot*		*Emerg-ence (%)*		*Aphano-myces*		*Purity (%)*		*Revenue/ * Ton*	*Revenue/ * Acre*
Entry	**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**
2015 APPROVED VARIETIES																		
Beta 90RR54	284.1	97.2	8680.4	100.6	30.4	103.5	16.6	97.4	4.3	95.3	71.2	100.0	4.1	93.0	91.4	99.9	94.9	98.3
Beta 92RR30	294.0	100.6	8535.6	98.9	28.8	98.1	17.1	100.4	4.2	93.1	71.6	100.5	3.7	84.2	91.6	100.2	101.1	99.2
Beta 92RR60	297.7	101.8	9129.8	105.8	30.6	104.2	17.4	101.6	4.9	108.9	72.2	101.4	4.7	106.1	91.6	100.2	103.5	107.9
Crystal RR018	286.9	98.1	8575.3	99.4	29.9	101.9	16.8	98.6	4.5	100.9	69.8	98.0	4.3	97.7	91.1	99.6	96.5	98.4
Crystal RR270	296.0	101.3	8661.8	100.4	29.0	98.8	17.3	101.3	5.1	114.3	72.7	102.0	4.6	102.9	91.4	99.9	102.2	101.1
Crystal RR459	295.1	101.0	8184.0	94.9	27.4	93.4	17.2	100.7	3.9	87.4	70.0	98.2	5.1	116.1	91.7	100.2	101.8	95.1
	292.3	**100.0**	**8627.8**	**100.0**	**29.3**	**100.0**	**17.1**	**100.0**	**4.5**	**100.0**	**71.3**	**100.0**	**4.4**	**100.0**	**91.5**	**100.0**	**100.0**	**100.0**
RHIZOCTONIA AND APHANOMYCES SPECIALTY APPROVED VARIETIES WITH THREE YEARS OF DATA																		
Beta 91RR01	279.8	95.7	8497.3	98.5	30.3	103.1	16.5	96.7	4.1	91.9	70.6	99.1	3.7	84.7	90.9	99.3	92.4	95.4
Crystal RR850	275.1	94.1	8688.3	100.7	31.4	107.2	16.2	95.1	5.0	112.7	68.5	96.2	3.9	88.8	90.9	99.3	89.4	95.9
Hilleshog 4302RR	282.7	96.7	8004.0	92.8	28.0	95.4	16.5	96.6	4.3	95.3	64.7	90.7	5.4	121.5	91.7	100.2	94.0	89.8
Hilleshog 9093RR	272.8	93.3	7894.6	91.5	28.9	98.4	16.1	94.5	4.3	97.0	70.4	98.8	5.1	115.0	90.8	99.2	88.1	86.7
Maribo MA109RR	290.0	99.2	7953.1	92.2	27.3	92.9	16.9	99.1	4.0	89.5	70.1	98.3	4.9	110.6	91.6	100.1	98.6	91.7

* Revenue per Ton and Revenue per Acre figures were produced using the SMBSC payment formula for the 2013 crop.

Table 2. Comparison of 2015 Approved Varieties to Test Market Varieties and Specialty Varieties Based on 2 Year Data, 2013 - 2014

2015 APPROVED VARIETIES

Entry		*Rec/T (lbs)* 2 yr avg	% of mean	*Rec/A (lbs)* 2 yr avg	% of mean	*Yield (T/A)* 2 yr avg	% of mean	*Sugar %* 2 yr avg	% of mean	*Cercospora Leaf Spot* 2 yr avg	% of mean	*Emerg-ence (%)* 2 yr avg	% of mean	*Aphano-myces* 2 yr avg	% of mean	*Purity (%)* 2 yr avg	% of mean	*Revenue/ * Ton* % of mean	*Revenue/ * Acre* % of mean
Beta 90RR54		267.0	97.2	7918.9	101.0	29.6	104.2	15.7	97.5	4.1	92.9	73.0	100.8	3.9	90.0	91.2	99.9	94.6	98.6
Beta 92RR30		278.1	101.2	7884.1	100.5	28.1	99.1	16.3	100.8	4.1	94.2	74.7	103.1	3.4	80.1	91.5	100.3	102.2	101.3
Beta 92RR60		281.2	102.3	8380.1	106.8	29.7	104.8	16.5	102.1	4.8	108.9	72.4	99.9	4.8	111.5	91.4	100.1	104.5	109.5
Crystal RR018		269.6	98.1	7643.1	97.4	28.5	100.3	15.9	98.6	4.3	98.9	70.4	97.2	4.4	102.0	91.0	99.6	96.4	96.6
Crystal RR270		279.6	101.7	7982.6	101.8	28.2	99.4	16.4	101.6	5.3	119.7	73.8	101.9	4.5	104.2	91.3	100.0	103.2	102.6
Crystal RR459		273.5	99.5	7250.1	92.4	26.2	92.2	16.0	99.3	3.8	85.4	70.4	97.1	4.8	112.3	91.5	100.2	99.1	91.3
		274.8	100.0	7843.1	100.0	28.4	100.0	16.2	100.0	4.4	100.0	72.4	100.0	4.3	100.0	91.3	100.0	100.0	100.0

2015 TEST MARKET VARIETIES FOR LIMITED SALES WITH 2 YEARS OF DATA (% OF MEAN IS OF APPROVED MEAN)

Entry		*Rec/T (lbs)* 2 yr avg	% of mean	*Rec/A (lbs)* 2 yr avg	% of mean	*Yield (T/A)* 2 yr avg	% of mean	*Sugar %* 2 yr avg	% of mean	*Cercospora Leaf Spot* 2 yr avg	% of mean	*Emerg-ence (%)* 2 yr avg	% of mean	*Aphano-myces* 2 yr avg	% of mean	*Purity (%)* 2 yr avg	% of mean	*Revenue/ * Ton* % of mean	*Revenue/ * Acre* % of mean
Beta 93RN		258.1	93.9	7887.0	100.6	30.3	106.7	15.2	94.4	4.4	100.0	72.0	99.4	4.1	94.4	91.2	99.9	88.5	94.5
Crystal M375		283.5	103.1	8538.5	108.9	29.9	105.5	16.6	102.9	4.9	111.0	65.9	90.9	5.2	121.7	91.4	100.1	106.0	111.8
Crystal M380		279.3	101.6	8062.2	102.8	28.6	100.8	16.3	101.2	4.8	109.3	71.6	98.8	3.5	82.4	91.6	100.3	103.1	103.9
Hilleshog 9517RR		266.9	97.1	6999.9	89.2	25.9	91.3	15.8	97.8	3.8	86.4	60.4	83.4	4.7	110.4	90.9	99.6	94.5	86.2
Hilleshog 9528RR		265.8	96.7	7703.2	98.2	28.7	101.1	15.6	96.5	4.8	109.6	72.4	99.9	4.7	110.2	91.7	100.4	94.0	95.0

2015 RHIZOCTONIA AND APHANOMYCES SPECIALTY APPROVED VARIETIES (% OF MEAN IS OF APPROVED MEAN)

Entry		*Rec/T (lbs)* 2 yr avg	% of mean	*Rec/A (lbs)* 2 yr avg	% of mean	*Yield (T/A)* 2 yr avg	% of mean	*Sugar %* 2 yr avg	% of mean	*Cercospora Leaf Spot* 2 yr avg	% of mean	*Emerg-ence (%)* 2 yr avg	% of mean	*Aphano-myces* 2 yr avg	% of mean	*Purity (%)* 2 yr avg	% of mean	*Revenue/ * Ton* % of mean	*Revenue/ * Acre* % of mean
Beta 91RR01	Spec	264.8	96.3	7852.4	100.1	29.6	104.2	15.7	97.1	3.9	88.5	74.0	102.1	3.7	86.5	90.9	99.5	93.2	97.1
Crystal RR850	Spec	257.2	93.6	8022.7	102.3	30.9	108.9	15.3	94.8	4.9	110.9	70.3	97.1	3.8	88.8	90.7	99.3	88.0	95.9
Hilleshog 4302RR	Spec	263.5	95.9	7191.6	91.7	26.9	94.9	15.5	95.9	4.2	96.0	66.9	92.4	5.4	124.9	91.4	100.1	92.2	87.5
Hilleshog 9093RR	Spec	254.3	92.5	7159.6	91.3	28.0	98.8	15.2	93.8	4.4	100.0	70.7	97.5	5.2	121.8	90.6	99.2	85.9	84.9
Maribo MA109RR	Spec	273.2	99.4	7371.9	94.0	26.8	94.6	16.0	99.1	4.1	94.1	72.6	100.2	4.8	110.6	91.6	100.3	98.9	93.5

* Revenue per Ton and Revenue per Acre figures were produced using the SMBSC payment forumla for the 2013 crop.

Table 3. Comparison of 2015 Fully Approved Varieties to Test Market and Specialty Approved Varieties Based on 1 Year Data, 2014

Entry	*Rec/T (lbs)* 1 yr avg	% of mean	*Rec/A (lbs)* 1 yr avg	% of mean	*Yield (T/A)* 1 yr avg	% of mean	*Sugar %* 1 yr avg	% of mean	*Cercospora Leaf Spot* 1 yr avg	% of mean	*Emerg-ence (%)* 1 yr avg	% of mean	*Aphano-myces* 1 yr avg	% of mean	*Purity (%)* 1 yr avg	% of mean	*Revenue/ Ton* % of mean	*Revenue/ Acre* % of mean
2015 APPROVED VARIETIES																		
Beta 90RR54	262.4	97.8	6888.4	101.2	26.3	103.8	15.6	98.2	4.2	96.8	70.7	101.7	3.8	86.9	90.7	99.7	95.7	99.3
Beta 92RR30	268.7	100.1	6732.2	98.9	24.9	98.3	15.9	100.0	3.9	89.2	72.1	103.8	3.6	82.4	91.0	100.1	100.2	98.4
Beta 92RR60	275.1	102.5	7436.3	109.2	27.1	107.1	16.2	102.1	5.1	116.8	68.4	98.4	4.8	111.3	91.2	100.3	105.0	112.4
Crystal RR018	265.5	98.9	6642.7	97.6	25.4	100.6	15.8	99.4	4.3	98.1	69.3	99.7	4.4	102.7	90.6	99.6	97.8	98.3
Crystal RR270	272.3	101.5	7061.3	103.7	25.6	101.4	16.1	101.3	4.9	113.6	67.6	97.3	4.4	102.0	91.0	100.1	102.7	104.1
Crystal RR459	266.4	99.3	6079.7	89.3	22.5	88.9	15.7	99.1	3.7	85.5	68.9	99.2	5.0	114.7	91.1	100.2	98.5	87.5
	268.4	100.0	6806.7	100.0	25.3	100.0	15.9	100.0	4.3	100.0	69.5	100.0	4.3	100.0	90.9	100.0	100.0	100.0
2015 TEST MARKET VARIETIES WITH 1 YEAR DATA (% OF MEAN IS OF APPROVED MEAN)																		
Beta 93RN	248.8	92.7	6601.2	97.0	26.4	104.5	14.8	93.4	4.4	100.6	66.1	95.1	4.5	103.2	90.7	99.7	85.9	89.7
Crystal M375	277.7	103.5	7636.3	112.2	27.3	108.1	16.4	103.1	4.9	113.2	64.2	92.3	5.5	127.9	91.1	100.2	106.7	115.3
Crystal M380	271.8	101.2	6991.7	102.7	25.6	101.3	16.0	100.6	4.7	107.9	69.1	99.4	3.6	84.2	91.3	100.4	102.3	103.5
Hilleshog 9517RR	258.4	96.3	5656.5	83.1	21.7	85.7	15.4	97.0	4.1	94.1	48.5	69.7	5.8	134.2	90.5	99.6	92.9	79.6
Hilleshog 9528RR	258.2	96.2	6527.4	95.9	25.0	99.0	15.2	96.0	5.3	122.8	69.7	100.2	5.0	116.5	91.3	100.4	92.9	91.9
2015 RHIZOCTONIA AND APHANOMYCES SPECIALTY APPROVED VARIETIES (% OF MEAN IS OF APPROVED MEAN)																		
Beta 91RR01	261.0	97.2	7004.5	102.9	26.8	106.0	15.5	97.7	3.7	84.8	71.6	103.0	3.5	82.0	90.7	99.7	94.7	100.3
Crystal RR850	249.4	92.9	6846.5	100.6	27.4	108.2	14.9	94.0	4.7	107.9	68.5	98.5	4.2	96.1	90.4	99.4	86.6	93.6
Hilleshog 4302RR	254.7	94.9	6072.1	89.2	23.5	92.9	15.1	95.1	4.3	98.9	65.5	94.2	5.6	129.0	91.0	100.1	90.3	83.8
Hilleshog 9093RR	246.6	91.9	6213.0	91.3	25.2	99.7	14.8	93.4	4.5	102.6	69.6	100.1	5.3	123.4	90.1	99.0	84.4	84.1
Maribo MA109RR	266.5	99.3	6286.7	92.4	23.5	93.1	15.7	98.9	4.5	104.6	66.6	95.8	4.8	111.0	91.2	100.3	98.6	91.7

* Revenue per Ton and Revenue per Acre figures were produced using the SMBSC payment forumla for the 2013 crop.

2014 SMBSC Variety Strip Trial - Combined 8 Locations

Variety	28 DAP Stand Counts Beets/100' Row	Tons/Acre	Sugar	Purity	ESA	Percent of Mean Rev / Acre
Beta 92RR30 + ZOC	174	25.7	16.0	90.6	6895	105.3
Crystal RR018	154	26.0	15.8	90.1	6857	103.7
Crystal RR018 + ZOC	161	26.2	15.7	90.0	6867	102.3
Crysal RR270 + ZOC	166	26.2	16.1	90.5	7071	108.8
Hilleshog 4302RR + ZOC	168	23.8	15.1	90.2	6062	85.9
Maribo MA109RR + ZOC	156	24.0	15.8	90.5	6375	95.6
Average	163	25.3	15.7	90.3	6688	100
lsd (.05)	NS	1.44	0.35	NS	416	8.73
Pr>F	0.131	0.002	<.0001	0.0628	0.0001	<.0001
CV%	9.7	5.6	2.2	0.5	6.1	8.6
Reps (Locations)	8	8	8	8	8	8

Revenue calculated using 2013 Final Payment Factors

Combined Data of 8 locations. Excludes Hector due to missing treatment and Gluek due to water issues.

2014 SMBSC Variety Strip Trial - Lake Lillian Early Harvest Strip

Variety	28 Day Stand Counts Beets/100' row	Tons/acre	Sugar	Purity	ESA	Percent of Mean Rev/Acre
Beta 92RR30 + ZOC	160	25.9	14.0	91.2	6,104	99.7
Crystal RR018	128	27.1	14.2	89.9	6,339	102.5
Crystal RR018 + ZOC	150	28.7	13.8	89.8	6,513	101.4
Crystal RR270 + ZOC	143	27.3	14.4	90.5	6,533	108.5
Hilleshog 4302RR + ZOC	175	25.0	14.0	90.5	5,838	94.1
Maribo MA109RR + ZOC	138	23.3	14.4	90.8	5,617	93.8
Average	149	26.2	14.1	90.5	6,157	100

Les Plumley - Agriculturist
Planted: May 16
Harvested: September 16
Revenue calculated using 2013 Final Payment Factors

2014 SMBSC Variety Strip Trial - Lake Lillian Late Harvest Strip

Variety	28 Day Stand Counts Beets/100' row	Tons/acre	Sugar	Purity	ESA	Percent of Mean Rev/Acre
Beta 92RR30 + ZOC	160	30.3	17.0	89.0	8,475	102.8
Crystal RR018	128	29.1	17.0	88.6	8,085	97.4
Crystal RR018 + ZOC	150	29.7	17.1	89.1	8,392	102.4
Crystal RR270 + ZOC	143	30.4	17.6	89.6	8,912	112.0
Hilleshog 4302RR + ZOC	175	29.4	16.7	88.9	8,053	95.9
Maribo MA109RR + ZOC	138	25.7	17.1	89.4	7,300	89.6
Average	149	29.1	17.1	89.1	8,203	100

Les Plumley - Agriculturist
Planted: May 16
Harvested: October 14
Revenue calculated using 2013 Final Payment Factors

2014 SMBSC Variety Strip Trial - Renville

Variety	28 DAP Stand Counts Beets/100' row	Tons/Acre	Sugar	Purity	ESA	Percent Rev / Acre
Crystal RR018	161	21.5	16.4	90.8	5937	113.2
Crystal RR018 + ZOC	151	22.4	16.5	90.6	6222	119.3
Crystal RR270 + ZOC	158	21.3	15.4	89.4	5417	95.7
Beta 92RR30 + ZOC	155	23.5	15.7	90.3	6164	112.2
Hilleshog 4302RR + ZOC	172	18.6	14.9	90.0	4586	78.5
Maribo 109RR + ZOC	186	18.6	16.1	91.4	5079	96.0
Average	164	20.7	15.7	90.4	5461	100

Mike Schjenken - Agriculturist

Planted: May 21

Harvested: September 25

Revenue calculated using 2013 Final Payment Factors

2014 SMBSC Variety Strip Trial - Danube

Variety	28 DAP Stand Counts Beets/100' row	Tons / Acre	Sugar %	Purity %	ESA	Percent of Mean Rev / Acre
Beta 92RR30 + ZOC	175	28.5	14.6	89.8	6871	99.6
Crystal RR018	170	29.5	14.6	89.6	7109	103.1
Crystal RR018 + ZOC	173	29.5	14.8	89.9	7205	105.9
Crystal RR270 + ZOC	145	29.1	14.9	89.6	7145	105.6
Hilleshog 4302RR + ZOC	133	26.7	14.2	90.0	6280	88.2
Maribo MA109RR + ZOC	143	26.5	14.8	90.5	6553	97.5
Average	157	28.3	14.6	89.9	6861	100

Chris Dunsmore - Agriculturist

Planted: May 18

Harvested: September 18

Revenue calculated using 2013 Final Payment Factors

2014 SMBSC Variety Strip Trial - Belgrade

Variety	28 DAP Stand Counts Beets/100' Row	Tons/Acre	Sugar	Purity	ESA	Percent of Mean Rev / Ace
Beta 92RR30 + ZOC	220	29.9	18.0	90.9	9125	105.4
Crystal RR018	185	30.5	17.5	90.0	8936	100.0
Crystal RR018 + ZOC	193	30.7	17.7	90.1	9124	103.2
Crysal RR270 + ZOC	190	28.5	18.0	91.5	8779	102.0
Hilleshog 4302RR + ZOC	185	30.2	17.1	90.4	8675	95.6
Maribo MA109RR + ZOC	170	30.2	17.5	90.5	8927	100.6
Beta 90RR54 + ZOC	198	29.1	17.4	90.7	8569	96.3
Beta 91RR01 +ZOC	208	29.1	17.5	90.5	8607	96.9
Average	194	29.8	17.6	90.6	8843	100

Jared Kelm - Agriculturist

Planted: May 6

Harvested: October 16

Revenue calculated using 2013 Final Payment Factors

2014 SMBSC Variety Strip Trial - Benson

Variety	28 DAP Stand Counts Beets / 100' row	Ton/Acre	Sugar	Purity	ESA	Percent of Mean Rev / Acre
Beta 92RR30 + ZOC	135	24.3	16.3	91.6	6776	103.5
Crystal RR018	118	22.2	16.2	91.2	6106	92.2
Crystal RR018 + ZOC	153	22.0	16.1	90.8	5983	89.5
Crystal RR270 + ZOC	180	23.8	16.3	91.7	6632	101.3
Hilleshog 4302RR + ZOC	155	22.9	15.9	91.9	6263	94.1
Maribo 109RR +ZOC	130	25.8	16.3	91.5	7202	110.2
Beta 90RR54 + ZOC	154	27.2	15.5	90.5	7075	101.5
Hilleshog 9528RR	185	25.8	16.1	91.8	7109	107.6
Average	151	24.3	16.1	91.4	6643	100

Scott Thaden - Agriculturist

Planted: May 16

Harvested: September 18

Revenue calculated using 2013 Final Payment Factors

10 - 10' samples taken per variety for quality and yield.

For yield, all samples were 10' of row which was averaged and calculated to tons per acre.

2014 SMBSC Variety Strip Trial - Murdock

Variety	28 DAP Stand Counts Beets/100' row	Ton/Acre	Sugar	Purity	ESA	Percent of Mean Rev / Acre
Beta 92RR30 + ZOC	205	26.6	15.2	89.9	6725	113.2
Crystal RR018	200	26.5	14.8	90.7	6558	108.1
Crystal RR018 + ZOC	183	27.0	14.7	89.3	6496	103.8
Crystal RR270 + ZOC	213	28.0	15.2	89.6	7016	117.1
Hilleshog 4302RR + ZOC	203	22.0	13.8	89.9	5022	75.2
Maribo RR109 + ZOC	185	24.2	14.0	88.9	5516	82.6
Average	198	25.7	14.6	89.7	6222	100

Jeff Keltgen - Agriculturist
Planted: May 22
Harvested: September 23
Revenue calculated using 2013 Final Payment Factors

2014 SMBSC Variety Strip Trial - Montevideo

Variety	28 DAP Stand Counts Beets/100' row	Tons / Acre	Sugar %	Purity %	ESA	Percent of Mean Rev / Acre
Beta 92RR30 + ZOC	175	18.4	16.4	91.4	5,145	104.9
Crystal RR018	153	20.8	15.8	90.3	5,503	106.6
Crystal RR018 + ZOC	128	21.1	16.1	91.3	5,806	116.4
Crystal RR270 + ZOC	158	18.9	16.8	91.2	5,387	111.7
Hilleshog 4302RR + ZOC	148	15.8	14.4	90.3	3,779	65.9
Maribo 109RR + ZOC	158	17.8	15.8	91.4	4,802	94.5
Average	153	18.8	15.9	91.0	5070	100

Scott Thaden - Agriculturist
Planted: May 20
Harvested: September 25
Revenue calculated using 2013 Final Payment Factors

2014 SMBSC Variety Strip Trial - Hector

Variety	28 DAP Stand Counts Beets/100' row	Tons / Acre	Sugar %	Purity %	ESA	Percent of Mean Rev / Acre
Beta 92RR30 + ZOC	211	22.8	17.0	91.1	6590	110.4
Crystal RR1018 + ZOC	189	22.8	17.0	90.3	6534	108.7
Crystal RR270 + ZOC	225	25.4	17.5	90.7	7544	129.1
Hilleshog 4302RR + ZOC	191	18.8	15.6	89.8	4856	73.8
Maribo 109RR + ZOC	189	20.7	15.9	89.5	5441	84.2
Hilleshog 9528RR	200	21.3	16.3	90.5	5844	93.7
Average	201	22.0	16.5	90.3	6135	100

Pete Caspers - Agriculturist
Planted: May 24
Harvested: October 8
Revenue calculated using 2013 Final Payment Factors

2012 - 2014 Disease Nursery Data for Rhizoctonia, Aphanomyces, and Cercospora

** Lower Ratings mean more resistant to disease, and higher ratings mean more susceptible to the disease
This applies to all three disease nurseries

Variety Description	Rhizoctonia Root Ratings					Aphanomyces Root Ratings					Cercospora Leafspot Ratings				
				2013-2014	2012-2014				2013-2014	2012-2014				2013-2014	2012-2014
	2014 Root Rating	2013 Root Rating	2012 Root Rating	2 Year Mean Baseline Adjusted Root Rating	3 Year Mean Baseline Adjusted Root Rating	2014 Root Rating	2013 Root Rating	2012 Root Rating	2 Year Mean Baseline Adjusted Root Rating	3 Year Mean Baseline Adjusted Root Rating	2014 CLS Rating	2013 CLS Rating	2012 CLS Rating	2 Year Mean Baseline Adjusted Root Rating	3 Year Mean Baseline Adjusted Root Rating
Fully Approved Varieties															
Beta 90RR54	3.3	3.9	3.8	3.6	3.7	3.8	4.0	4.6	3.9	4.1	4.2	4.0	4.6	4.1	4.3
Beta 92RR30	4.3	5.0	4.4	4.7	4.6	3.6	3.3	4.3	3.4	3.7	3.9	4.4	4.2	4.1	4.2
Beta 92RR60	4.3	4.3	4.4	4.3	4.3	4.8	4.8	4.5	4.8	4.7	5.1	4.5	5.0	4.8	4.9
Crystal RR270	4.3	5.5	5.2	4.9	5.0	4.4	4.6	4.7	4.5	4.6	4.9	5.6	4.8	5.3	5.1
Crystal RR018	3.7	4.1	3.3	3.9	3.7	4.4	4.3	4.2	4.4	4.3	4.3	4.4	4.8	4.4	4.5
Crystal RR459	4.4	4.4	4.3	4.4	4.3	5.0	4.7	5.8	4.8	5.1	3.7	3.8	4.2	3.8	3.9
Test Market Varieties															
Betaseed 93RN	3.8	3.6		3.7		4.5	3.7		4.1		4.4	4.4		4.4	
Crystal M375	4.3	4.6		4.5		5.5	4.9		5.2		4.9	4.9		4.9	
Crystal M380	3.9	5.3		4.6		3.6	3.5		3.5		4.7	4.9		4.8	
Hilleshog 9528RR	3.9	4.7		4.3		5.0	4.4		4.7		5.3	4.3		4.8	
Hilleshog 9517RR	3.8	4.0		3.9		5.8	3.7		4.7		4.1	3.5		3.8	
Specialty Approved															
Beta 91RR01 (RHC and Aph)	3.9	3.9	3.5	3.9	3.8	3.5	3.9	3.8	3.7	3.7	3.7	4.1	4.5	3.9	4.1
Crystal RR850 (Aph)	4.4	4.1	3.7	4.3	4.1	4.2	3.5	4.2	3.8	3.9	4.7	5.1	5.3	4.9	5.0
Hilleshog 9093RR (RHC)	3.3	3.4	3.8	3.3	3.5	5.3	5.1	4.8	5.2	5.1	4.5	4.3	4.1	4.4	4.3
Hilleshog 4302RR (RHC)	3.3	3.6	3.8	3.4	3.6	5.6	5.2	5.4	5.4	5.4	4.3	4.2	4.3	4.2	4.3
Maribo MA109RR (RHC)	2.8	3.2	3.1	3.0	3.1	4.8	4.7	5.2	4.8	4.9	4.5	3.7	3.7	4.1	4.0

Rhizotonia Ratings from SMBSC Nursery at Clara City and BSDF Nursery in Michigan
Ratings are on scale of 1 - 7. (1 = Healthy, 7 = Dead)

Aphanomyces Ratings from SMBSC Nursery at Renville and Betaseed Nusery in Shakopee.
Ratings are on scale of 1 - 9. (1 = Healthy, 9 = Dead)

Cercospora Ratings from BSDF Nursery in Michigan and Betaseed Nursery near Rosemount.
Ratings are on scale of 1-9. 1 = Clean leaves, 9 = Dead Leaves.

2014 Agronomy Trials Procedures

David Kee
James Radermacher
Nicole VanOs

Management of the crop (pesticide application, hand weeding, fertilizer application, etc.) was uniform for all plots in a study unless treatment requirements dictated differently. On most sites all agronomic inputs (seed, fertilizer, fungicides, etc.) were provided by SMBSC research staff. However on farmer planted and managed sites, SMBSC staff applied treatments, rated the plots and harvested the middle row(s) as appropriate. Traffic was limited to the alley area unless required for data collection or weeding. Soil samples were collected on sites managed by SMBSC staff. The number and method of soil sampling was conducted based on experimental protocol. Unless dictated by experimental protocol, nutrients rates were based on the SMBSC recommendations as modified by soil organic matter level. In non-weed control studies, 96 ounces per acre of Ethofumesate and 1-3 applications of glyphosate, often mixed other compounds to enhance control of glyphosate resistant weeds (Sequence {s-Metolachlor}, Stinger {Clopyralid} etc.) were applied to the site, over all plots, as needed. Insects were controlled with proper IPM techniques, with insecticide applications made only on an as needed basis across all plots within each study. Disease control utilized methods recommended by SMBSC standard practices unless dictated by the experimental protocol. These practices can be found in the notes section of each chapter

Unless otherwise noted, individual plot sizes were six rows wide by 30 foot long at planting. Alley width varied from 5 to 35 feet wide depending on the space needed to position equipment for application of treatment. Plot length was reduced prior to harvest by tilling in the end of row beets to modify the "edge" effect due to reduced competition for light and space commonly seen with "end" beets.

Data management and analysis was performed using Microsoft Excel, CropStat v7.2.3 and/or SAS v9.2, Data was entered into excel spreadsheet pages, proofed for errors, then calculated variables created. After the complete data set, entered numbers and variable calculations, were proofed, the data saved on a common network drive. Data was then analyzed using either CropStat (data sets with limited missing individual points using standard ANOVA procedures) or SAS. Error terms were selected based by experiment design and the situation of fixed (location, year, etc.) or randomized (block, treatment, etc.) independent variables within a study. Unless otherwise indicated experiments utilized a randomized complete block design, usually with 4 blocks, or replicates, unless anticipated variation dictated greater replication. Blocks ran perpendicular to the slope to divide, or block, out anticipated variation due to soil differences. Blocks were also used to 'block out' introduced management variation (weeding, petiole sampling, etc.) as needed.

NITROGEN MANAGEMENT STRATEGIES FOR FIELD CORN BEFORE SUGARBEET

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Justification: Nitrogen management for quality sugar beet production has been a focus of nutrient management research for a number of years. A key factor in being able to manage N for sugar beet production is to have a smaller amount of residual soil nitrate-N before planting sugar beet. Close to 70 % of the sugar beet grown in the Southern Minnesota Beet Sugar Cooperative is preceded by corn. Corn needs proper N application to optimize grain yield. Corn grain yield is not hurt by over application of nitrogen, however it is detrimental to sugar beet quality.

The use of corn stalks for bedding and a possible biofuel has increased in the last few years. The removal of the corn stalks could affect the soil mineralization processes of nitrogen. This mineralization change could affect the nitrogen management for sugar beet production following corn.

Research is needed to optimize nitrogen management throughout the whole crop rotation with or without removal of corn stalks for the greatest profit. To answer questions about nitrogen management in a corn/sugar beet production system a study with the objectives of 1. determine the effect on residual soil nitrate-N by different nitrogen and residue management systems for corn production, and 2. determine the effect of different nitrogen and residue management systems for corn grown previous to sugar beet production on sugar beet yield and quality.

Materials and Methods: This study started in 2011 and ended in 2014. Two sites were established in 2011, 2012, and 2013 with corn grown as the first crop in the two year sequence. Nitrogen treatments applied before the corn crop included a check, 120 lb N/acre, 160 lb N/acre, 200 lb N/acre, and 300 lb N/acre. The 120 lb N/acre is the University of Minnesota guideline for corn following soybean. The 160 lb N/acre treatment is based on SMBSC corn guideline when using a nitrate-N soil test (soil test nitrate-N to 2 ft. plus fertilizer = 160). The 200 and 300 lb N/acre are aggressive and excessive N applications for corn production. The nitrogen fertilizer was applied as urea or as a mix of ¼ urea and ¾ ESN. ESN is a polymer coated urea that is designed as a slow release nitrogen product. All plots received 3 gal/acre of 10-34-0 in-furrow at planting. There were 4 replications of the treatments. Corn was hand harvested in the fall and on half of the plots the corn residue was removed by raking and baling with farm sized equipment. Soil samples were taken after harvest to a depth of four feet. Nitrate-N was determined and the results determined the amount of fertilizer N applied for sugar beet production in following year. The total nitrogen applied was soil test nitrate-N (0 to 4 ft.) + fertilizer (urea) equaled 100 lb N/A at sites 1110 and 1111 and 110 lb N/A at sites 1210, 1211, 1310, and 1311. A summary of the treatments applied before corn can be found in Table 1.

Table 1. Summary of the fertilizer and residue treatments. The residue treatments were only applied to the sugar beet year of the study.

Product	N rate	Residue removed
Check	0	Yes/No
Urea	120	Yes/No
Urea/ESN	120	Yes/No
Urea	160 (SMBSC)	Yes/No
Urea/ESN	160 (SMBSC)	Yes/No
Urea	200	Yes/No
Urea/ESN	200	Yes/No
Urea	300	Yes/No
Urea/ESN	300	Yes/No

Results:

Initial soil test results: The initial soil test results are reported in Table 2. The pH ranged from 7.1 to 8.0 at the six sites while the organic matter ranged from 3.5 to 5.9%. Phosphorus and potassium were applied at recommended rates at sites with lower soil tests. The soil nitrate-N values were used to calculate the amount of N fertilizer to apply for the 160 (SMBSC) treatments. The amounts were 88 lb N/A for site 1110, 142 lb N/A for site 1111, 88 lb N/A for site 1210, 140 lb N/A for site 1211, 151 lb N/A for site 1310, and 139 lb N/A for site 1311.

Table 2. Initial soil test values for all sites.

Soil test	1110 (T)	1111 (S)	1210 (MC)	1211 (MI)	1310 (L)	1311 (MII)
pH	7.9	7.2	7.8	7.6	8.0	7.1
Organic matter (%)	3.5	4.8	5.9	4.9	5.2	5.4
Nitrate-N (0-2 ft.) lb/A	72	18	72	20	9	21
Olsen-P (ppm)	19	14	22	26	4	9
K (ppm)	175	164	300	259	193	127
Zinc (ppm)	1.33	1.37	4.12	1.31	0.78	1.12

Corn grain yields: Corn grain yields were increased at five of the six sites, Table 3 and Table 4. There was no grain yield response from the addition of N at the 1110 site. While the soil nitrate-N test would indicate a need for N, it was not needed at site 1110. None of the treatments, N source or N rates, affected corn grain yield at site 1110.

In 2011, there was a significant corn grain yield response to N fertilization at site 1111. The grain response was from the addition of N and not the source of the N. Corn grain yield was the best at the 200 lb N/A rate. This is 15 bushels per acre more than the corn grain yield with the 120 lb N/A application. The addition of an extra 100 lb N/A did not increase grain yield.

At the 1210 and 1311 sites, there was an increase in corn grain yields caused by the addition of N fertilizers. The rate of N applied did not affect the grain yield, only the N source. At the 1210 site the Urea/ESN mix treatments had corn grain yields that were 11 bushels per acre greater than the grain yields treated with urea while at 1311 the difference was 5 bushels per acre.

The 1211 site had an increase in corn grain yield for the addition of N fertilizer but the different N rates and N sources did affect grain yield.

At the sixth site, 1310, corn grain yield was increased with the use of N fertilizer. At all N rates, urea produced greater grain yields compared to the urea/ESN mix. The differences in grain yield between urea and urea/ESN N sources were different at each N rate.

Table 3. Corn grain yields as affected by nitrogen rate and source.

		Corn grain yield					
Treatment		1110	1111	1210	1211	1310	1311
N source	N rate (lb/A)	--------------------------------- Bushels/acre ---------------------------------					
Check	0	214	95	159	121	115	162
Urea	120	211	194	207	189	177	207
Urea/ESN	120	211	188	224	176	170	213
Urea	160 (SMBSC)*	210	203	202	188	172	207
Urea/ESN	160 (SMBSC)*	203	194	203	177	165	210
Urea	200	202	205	204	188	173	206
Urea/ESN	200	203	206	227	169	177	220
Urea	300	207	199	212	177	188	206
Urea/ESN	300	205	208	216	196	165	204

* N application rates for this treatment were 88 lb N/A for site 1110, 142 lb N/A for site 1111, 88 lb N/A for site 1210, 140 lb N/A for site 1211, 151 lb N/A for site 1310, and 139 lb N/A for site 1311.

Table 4. Statistical analysis for corn grain yield.

	1110 (T)	1111 (S)	1210 (MC)	1211 (MI)	1310 (L)	1311 (MII)
Source of variation	------------------------- Pr > F -------------------------					
Treatment	0.70	0.0001	0.0006	0.0001	0.0001	0.0001
Check vs rest	0.42	0.0001	0.0001	0.0001	0.0001	0.0001
N source	0.62	0.72	0.03	0.92	0.02	0.06
N rate	0.39	0.009	0.22	0.33	0.32	0.19
N source X Nrate	0.87	0.22	0.33	0.20	0.04	0.22
C.V.%	6.6	6.4	9.1	13.0	7.5	5.0

Corn basal stalk nitrate-N concentrations: The nitrate-N concentrations of the basal portion of the corn stalk were measured at each site each fall, Table 5 and Table 6. The basal corn stalk nitrate-N concentration can be used to evaluate if the corn plant had enough N for growth in the season. IT IS NOT TO BE USED AS A TOOL TO DETERMINE HOW MUCH N NEEDS TO PUT APPLIED FOR THE FOLLOWING CROP! The basal stalk nitrate-N concentration increased with increasing N application at all sites. At sites 1110 and 1310, N source, urea or urea/ESN mix affected the basal stalk nitrate-N concentrations. At site 1110, the use of urea/ESN mix produced greater basal stalk nitrate-N concentration, 5479 vs 5959 ppm. At site 1310, the use of urea/ESN produced less basal stalk nitrate-N concentrations than urea, 824 vs 1084 ppm. This was opposite of the 1110 site. The differences although of some statistical significance are not large.

Table 5. Corn basal stalk nitrate-N concentrations as affected by nitrogen rate and source.

		Corn basal stalk nitrate-N concentration					
Treatment		1110	1111	1210	1211	1310	1311
N source	N rate (lb/A)	--------------------------------- ppm ---------------------------------					
Check	0	3246	10	14	9	7	68
Urea	120	5660	304	1069	1412	342	525
Urea/ESN	120	5263	792	1471	1616	197	314
Urea	160 (SMBSC)	4585	1053	1086	1330	680	892
Urea/ESN	160 (SMBSC)	5043	441	1110	1381	540	285
Urea	200	5316	2681	3424	4294	960	1134
Urea/ESN	200	6009	2692	2589	4251	1101	1551
Urea	300	6357	4630	4100	4768	2354	2594
Urea/ESN	300	7424	5935	4040	5649	1462	2871

Table 6. Statistical analysis for corn basal stalk nitrate-N concentrations.

	1110 (T)	1111 (S)	1210 (MC)	1211 (MI)	1310 (L)	1311 (MII)
Source of variation	------------------------- Pr > F -------------------------					
Treatment	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
Check vs rest	0.0001	0.005	0.0001	0.0001	0.0004	0.0002
N source	0.09	0.46	0.70	0.49	0.13	0.88
N rate	0.0001	0.0001	0.0001	0.0001	0.001	0.0001
N source X Nrate	0.40	0.37	0.55	0.76	0.17	0.31
C.V.%	18.1	66.4	51.9	45.6	70.0	66.2

Residual soil nitrate-N: Each plot was soil sampled to a depth of 4 feet in the fall after corn harvest. The information from the soil samples was used to determine the amount of N that was left after corn production and also to determine how much N to apply to the following year's sugar beet crop. Except for sites 1110 and 1311, as the N rate increased, the residual soil nitrate-N increased, Table 7. This residue soil nitrate-N increase is not consistently affected by the N source. Site 1110 had elevated residual soil nitrates for all treatments while the residual soil nitrate-N at 1311 had some unexplainable results. The increases in residue nitrate-N at the other four sites are reflected in the amounts of fertilizer applied for the following year's sugar beet crop, Table 8. The greater the amount of N fertilizer applied for the previous corn crop, the less N fertilizer is needed for the upcoming sugar beet crop.

Table 7. Residual nitrate-N to 4 ft. following corn.

		Soil nitrate-N to a depth of 4 feet					
Treatment		1110	1111	1210	1211	1310	1311
N source	N rate (lb/A)	---------------------------------- lb/acre ----------------------------------					
Check	0	60	13	22	25	21	49
Urea	120	184	21	34	32	42	38
Urea/ESN	120	141	17	33	52	44	45
Urea	160 (SMBSC)	92	34	48	44	71	47
Urea/ESN	160 (SMBSC)	135	20	38	44	77	99
Urea	200	180	53	91	72	93	92
Urea/ESN	200	174	54	68	75	158	46
Urea	300	207	83	193	109	157	70
Urea/ESN	300	271	90	214	235	126	54

Table 8. Nitrogen fertilizer rate applied before sugar beet production.

		N application					
Treatment		1110	1111	1210	1211	1310	1311
N source	N rate (lb/A)	---------------------------------- lb/acre ----------------------------------					
Check	0	40	87	88	85	89	61
Urea	120	0	80	77	78	68	72
Urea/ESN	120	0	84	77	59	66	65
Urea	160 (SMBSC)	8	67	62	66	39	64
Urea/ESN	160 (SMBSC)	0	80	72	66	33	11
Urea	200	0	47	19	38	17	18
Urea/ESN	200	0	46	42	36	0	64
Urea	300	0	18	0	2	0	40
Urea/ESN	300	0	10	0	0	0	56

Sugar beet root yield: The effects of the N fertilization practices for corn production on sugar beet root yield are presented in Table 9. The sugar beet root yields at site 1210 were below 10 ton per acre and did not reflect the treatments applied in this study. For this reason, the data was discarded.

The residual N treatments and the removal of residue did significantly affect the sugar beet root yield, Table 9. These differences were different at each site. The check was compared to rest of the treatments because in the previous year it did not have any N fertilizer applied to it. In two of the five sites, the check root yield was different than the other previous treatments. At the 1111 and 1310 sites the root yield for the previous year's check was 2.5 and 7 tons per acre less than the mean root yields for the other residual N fertilizer treatments, Table 10. In most cases, the check treatments from the previous years had the most N applied before the sugar beet production year. At three of the five sites, root yields were not different from the check treatment, sites 1110, 1211, and 1311. At four of the five sites, there was a significant interaction between the N source and N rate from the previous year for root yield, Table 9. For site 1110, the interaction indicates that root yield was affect by N rate differently if urea was the N source as opposed to a urea/ESN mix, Table 11. The differences are small and not consistent. At site 1211, as N rate increased, the root yield increased up to the 200 lb N per acre application in the previous. The interaction occurred because the root yield at 120 lb N/A was greater for the urea/ESN N source compared to root yield for the urea N source treatments. The root yield increased with increasing N rate when urea was used while the root yield decreased with increasing N rates when urea/ESN was the N source at site 1310. At site 1311, the root yield was not affected by N rate when urea was the N source while the root yield decreased with increasing N rate when urea/ESN was the N source. At site 1111, there was no effect of any of the previous N treatments on root yield. Overall, the use of urea/ESN in the previous corn crop did not have a large or consistent effect on the root yield the following year.

At site 1211, root yield was also affected by the removal of residue. Overall, the removal increased root yields at the 120 and 200 lb N/A previous year treatments by 2.5 to 3.0 tons per acre, while at the 160 and 300 lb N per acre treatments, the root yield was greater with the residue left and incorporated with tillage 0.6 to 2.2 tons per acre. At site 1310, the removal of residue did not affect root yield when urea was the N source while the removal decreased root yield when urea/ESN was the N source.

Table 9. Statistical analysis of sugar beet root yield.

	1110 (T)	1111 (S)	1211 (MI)	1310 (L)	1311 (MII)
Source of variation	------------------------ Pr > F ------------------------				
Treatment	0.02	0.07	0.0001	0.0001	0.01
Check vs rest	0.15	0.05	0.14	0.0001	0.70
Residue	0.90	0.81	0.16	0.11	0.17
N source	0.07	0.94	0.52	0.002	0.41
N rate	0.03	0.53	0.0001	0.91	0.58
N source X N rate	0.02	0.85	0.04	0.003	0.08
N rate X Residue	0.97	0.30	0.002	0.50	0.11
N source X Residue	0.55	0.47	0.36	0.01	0.24
N source X N rate X Residue	0.27	0.65	0.54	0.83	0.32
C.V. (%)	11.9	7.3	5.3	15.1	13.4

Table 10. Root yield of the previous year's check vs the rest of the previous N treatments.

	1110	1111	1211	1310	1311
Previous year's treatments	Root yield (ton/acre)				
Check	26.2	30.8	32.0	14.8	18.2
Rest	27.2	33.3	32.7	21.8	21.5

Table 11. The effect of N source and N rate from the previous production year on sugar beet root yield.

	1110		1211		1310		1311	
N rate	Urea	Urea/ESN	Urea	Urea/ESN	Urea	Urea/ESN	Urea	Urea/ESN
lb/A	Root yield (tons/acre)							
120	28.5	27.0	30.8	33.5	21.5	22.6	20.7	24.2
160	31.2	23.9	32.1	32.0	22.1	20.6	22.5	18.9
200	24.0	23.8	35.2	34.6	24.3	19.0	21.0	21.2
300	28.6	29.7	32.0	31.3	26.2	17.3	23.0	20.1

Extractable sucrose per ton: The residual treatments affected extractable sucrose per ton (quality) at only two of the five sites, 1110 and 1111. The extractable sucrose per ton from the check treatment from the corn year of production was different for the rest of N treatments at only site 1110. The difference was a reduction in extractable sucrose per ton, 278 lb sucrose per ton for the check treatment versus 269 lb per ton of sugar beet processed. At both sites, 1110 and 1111, there was a N source by N rate interaction for extractable sucrose per ton. At both sites, as N rate application increased, the extractable sucrose per acre decreased. The rate of decrease was different for each N source at each site.

Table 12. Statistical analysis of sugar beet extractable sucrose per ton.

	1110 (T)	1111 (S)	1211 (MI)	1310 (L)	1311 (MII)
Source of variation	------------------------ Pr > F ------------------------				
Treatment	0.0003	0.08	0.16	0.66	0.43
Check vs rest	0.0007	0.16	0.89	0.91	0.35
Residue	0.75	0.15	0.11	0.98	0.85
N source	0.05	0.25	0.14	0.46	0.34
N rate	0.0001	0.33	0.31	0.37	0.37
N source X N rate	0.007	0.002	0.41	0.32	0.69
N rate X Residue	0.06	0.94	0.10	0.39	0.45
N source X Residue	0.42	0.21	0.43	0.96	0.13
N source X N rate X Residue	0.53	0.64	0.58	0.96	0.75
C.V. (%)	3.0	3.9	3.4	4.5	3.4

Extractable sucrose per acre: Extractable sucrose per acre is affected mainly by root yield and tempered by the extractable sucrose per ton (quality). The N management treatments and residue removal did not affect extractable sucrose per acre at the 1110 site. At sites 1111 and 1211, the residual N from the N rate application to corn the previous year increased extractable sucrose per acre up to the 200 lb N per acre treatment and was reduced at the 300 lb N per acre. At site 1211, the removal of corn residue did decrease the amount of extractable sucrose per acre. At each N rate it was different in the amount but the trend was the same with increasing N rate. There were significant N rate by N source and N rate by residue removal interactions at sites 1310 and 1311. Generally, at both sites, as N rate increases when urea was the N source in the previous year, the extractable sucrose per acre increased, when the N source was the urea/ESN mix then the extractable sucrose per acre decreased, Table 14. The effect of residue removal is mixed at the two sites. At site 1310, when urea was the N source the previous year, the extractable sucrose per acre was not affected by the residue removal but if urea/ESN was the N source, the removal of residue did increase extractable sucrose per acre. The opposite is true at site 1311. When the N source was urea, extractable sucrose per acre was increase with the removal of residue while when urea/ESN was the N source, the removal of residue did not affect the extractable sucrose per acre.

Table 13. Statistical analysis of sugar beet extractable sucrose per acre.

	1110 (T)	1111 (S)	1211 (MI)	1310 (L)	1311 (MII)
Source of variation	------------------------ Pr > F ------------------------				
Treatment	0.15	0.002	0.0001	0.0001	0.002
Check vs rest	0.70	0.20	0.13	0.0001	0.75
Residue	0.74	0.75	0.61	0.11	0.31
N source	0.22	0.91	0.20	0.005	0.23
N rate	0.04	0.10	0.0001	0.76	0.56
N source X N rate	0.08	0.20	0.20	0.009	0.03
N rate X Residue	0.93	0.15	0.004	0.66	0.17
N source X Residue	0.64	0.68	0.65	0.02	0.09
N source X N rate X Residue	0.48	0.24	0.72	0.88	0.23
C.V. (%)	12.9	7.0	6.3	14.8	14.2

Table 14. The extractable sucrose per acre as effected by the N rate X N source and N source by N rate interactions at sites 1310 and 1311.

	1310		1311	
N rate previous year	Urea	Urea/ESN	Urea	Urea/ESN
lb N/A	Extractable sucrose per acre (lb/A)			
120	5258	5778	5731	6799
160	5478	5033	6323	5210
200	5886	4636	5897	5949
300	6225	4354	6494	5433
Residue removal				
No	5739	4426	5770	5864
Yes	5643	5474	6440	5839

Conclusions: This study was designed to investigate the effect on sugar beet production of N rate and N source used for a previous corn crop, and also the effect of corn residue removal. The N rate ranged from University based guideline of 120 lb N/A to 300 lb N/A. The N sources for the corn crop, were urea or a ¾ urea and ¼ ESN mix. The urea/ESN mix has been suggested for corn production as a slower release N product that would increase the efficiency of N fertilizer use by the corn plant. In general the following was learned from this study:

1. Additional N applied to corn has no negative effect on corn grain yield. The down side is the economic loss from buying more N fertilizer than you need to get optimal corn grain yield.
2. In this study and several other studies conducted in Minnesota, the use of ESN with urea did not consistently increase corn grain yields.
3. Basal stalk nitrate-N concentrations are affected by the amount of N applied. The N source does not generally affect the concentrations. THE BASAL STALK NITRATE-N TEST IT IS NOT TO BE USED AS A TOOL TO DETERMINE HOW MUCH N NEEDS TO PUT APPLIED FOR THE FOLLOWING CROP!

4. At most of the sites, the over application of N to corn will result in increased residual soil nitrate-N at a depth to 4 feet. At times this increase puts soil test N above the recommended guideline for N application for sugar beets.
5. Sugar beet production after corn can be affected by extreme application rates of N.
6. The use of slow release products in the previous production year will not consistently affect the root yield, extractable sucrose per ton, or extractable sucrose per acre.
7. The removal of corn crop residue one time, does consistently affect sugar beet production in the proceeding year.

The authors would like to thank the Sugar Beet Research and Education Board for the continued funding of this project.

Sweet Corn Fertility

Hector MN, - 2014

Trial Quality: Fair

Soil Info: Fine Texture/Non-Irrigated

Previous Crop: Soybeans

Plot size: 4 Reps

Planted: 05/28/2014

Variety: 124

Harvested: 9/14/2014

Introduction:
Sweet corn is becoming a more commonly utilized rotation crop with sugar beets in the SMBSC production area. Little information is available from the SMBSC production area on the effect of N rate in a sweet corn/sugar beet rotation program. This demonstration illuminated some issues regarding this program.

Methods:
Sweet corn was planted at one location in 2014, to be followed by sugar beets in 2015, to test nutrient application and the influence on sweet corn and sugar beet production. The study utilized a block demonstration design with no true replicates; however, plants from four 10 foot long sample regions in each block were taken and used as replicates. Individual treatment blocks (plots) were 150 ft. wide and 200 feet long.

Soil samples were collected from each treatment strip on October 25, 2013. Soil nitrogen levels (Table 1) were used to adjust the total available nitrogen for the crop. Phosphorus levels were adjusted using University of Minnesota guidelines for sweet corn. Nutrients were applied with a variable rate, high flotation applicator. Application maps were generated by SMBSC Research and used to control the rate of application.

Strip	pH	OM	N1	N2	N1+N2	N3	N1+N2+N3	P	K	Zn
		%	----------------- lbs N/ac -------------------					Parts per million		
1	7.6	5	7	11	18	8	26	10	193	1.32
3	7.9	5	7	15	22	14	36	4	216	1.03
5	8.0	4	8	11	18	14	32	5	195	0.96
7	6.9	4	6	20	25	34	59	11	176	0.71
9	7.5	5	10	15	25	34	59	10	197	0.86
11	8.0	5	22	143	164	94	258	4	183	0.68

Sweet corn was planted by the grower with a vacuum style planter in 22 inch wide rows with a seeding rate of 24,300 seeds per acre. Ten (10) feet of row was hand harvested for each sample. Sweet corn was collected by hand from the individual 10’ long sample rows and weighed using a portable scale.

Sugar beets will be planted in the plot area in 2015. Each treatment will be adjusted to a maximum 110 lbs N/ac for the sugar beet crop. Sugar beets will be harvested and a whole rotation benefit will be examined.

Results and Discussion:

In this strip study, the treatments were not truly replicated. However, the four samples were used as reps to enhance data analysis. This method allows for more complete understanding of the results. Table 2 shows nitrogen and phosphorous soil test results, applied product and yield in tons /acre. Although the treatments showed a stastical difference, nitrogen or phosphorous application did not influence yield as predicted. Yield was greatest at total nitrogen level s of 110 and 190 lbs. N/ac., and lowest at 90 and 170. The growing season was dry which may have allowed some nitrogen to convert to nitrite, affecting uptake. It is interesting to note, the highest sweet corn yield occurred in strips with the greatest soil K level, and lowest in the strip with the lowest soil K levels. This would indicate soil potassium levels were inadequate to support additional corn yield from increased levels of nitrogen (Soil K may have been the true limiting factor for sweet corn in this demonstration).

The intent of the test is to identify if sugar beet yield and quality is affected by previous sweet corn crop nutrient application and what recommendation would maximize the revenue over the two year rotation. Obviously, sweet corn response to soil K level in the SMBSC production area needs to be re-examined. Under current U of M soil test guidelines, sites with soil K levels of this magnitude, no additional broadcast K would have been recommended for sweet corn. Soil potassium levels have not been a problem with sugar beet production in this area. Adjustments may or may not have to be for the following sugar beet crop.

Table 2. Sweet corn yield response to total nitrogen level, as adjusted using soil test values, or affected by soil test nutrient level.

Demo Strip	Soil test level and nutrient application rate						Sweet Corn TPA
	N1+N2	lbs N App	Total N	P ppm	lbs P app	K ppm	
1	18	73	90	10	40	193	8.31
3	22	89	110	4	60	216	10.69
5	18	112	130	5	60	195	9.80
7	25	125	150	11	25	176	8.02
9	25	146	170	10	35	197	9.50
11	164	26	190	4	60	183	10.09
C.V							12.30
$LSD_{0.05}$							1.75

Phosphorus In furrow use in Sugar beet

Introduction: Approximately 80% of the SMBSC growers used 3 gallons/acre of an in-furrow or "Pop up" fertilizer at planting for the last 3-5 years. Three gallons of 10-34-0, diluted to 6 gallons of solution, per acre is the most common in-furrow program. This program has repeatedly shown an increase in beet yield when seeds are planted early in cold soil with low to medium phosphorus levels. Research has shown limited effect of 10-34-0 on beet quality. Increasing efficiency of the product selection and product rate may increase both sugar beet yield and quality. The use of a chelating agent may increase nutrient availability, however little research is available to support or contradict, this theory. A study was implemented at two sites to investigate the effect of fertilizer rate, nutrient source and inclusion of a chelate in-furrow at planting in 2014.

Methods: Sugar beets were planted at two locations in 2014 to test the Influence of High P in-furrow on sugar beet production. One site was on coarse textured soil and the second site was on fine textured soil. Soil test results are available in Tables 1 and 2. The plots were 11 ft. (6 rows) wide by 35 feet long. Sugar beets were planted by SMBSC research staff using a 6 row planter at both locations. All experimental treatments were applied at planting. Plots were not thinned. Other management practices were applied to all plots as per Notes 1 and 2. Rainfall was heavy in May and June at both sites (Note 3). The center rows (3 & 4) of the 6 row plot were harvested using a 2 row research harvester at both sites. Belgrade was harvested on 15 September, 2014, Renville on 15 October, 2014. The weights were collected and weighed on the harvester for yield calculation and a sub-sample was analyzed in the SMBSC quality lab. Data was entered into excel spreadsheet, proofed then combined for analysis using CropStat v7.2.1

Table 1. Soil test results for Renville. Fine, high OM level soil, rain fed.

			Soil depth (inches)				Soil nutrient levels			
Block	pH	OM	0-6	12-24	24-48	total	P_2O_5	K_2O	Mg	Ca
		%	--------------- lbs. N/ac ---------------				--------------- ppm ---------------			
1	7.9	6.9	14	42	48	104	6	118	460	6164
2	7.9	8.1	14	60	188	262	15	217	501	5948
3	7.9	7.0	22	36	108	166	14	206	523	5977
4	7.9	6.8	14	30	36	80	14	184	396	5922
Avg.	**7.9**	**7.2**	**16**	**42**	**95**	**153**	**12.3**	**181**	**470**	**6003**

Table 2. Soil tests results from Belgrade. Coarse, moderate OM level soil, irrigated

			Soil Depth (inches)				Soil Nutrient Levels				
Block	pH	OM	0-6	12-24	24-48	total	P_2O_5	K_2O	Zn	Mg	Ca
		%	lbs. N/acre				ppm				
1	7.4	4.8	14	39	80	133	18	111	1.70	497	2752
2	7.1	4.2	9	39	32	80	17	115	1.43	380	2027
3	7.2	4.4	7	9	8	24	29	120	2.42	372	1825
4	5.9	4.5	11	45	68	124	30	125	2.48	309	1910
Avg.	**6.9**	**4.5**	**10.3**	**33**	**47**	**90.3**	**23.5**	**118**	**2.01**	**390**	**2129**

Note 1: Whole study management practices implemented at the Belgrade site

Date		
5/5/14	Fertilizer Spread	*50 lbs. of N*
5/6/14	Planted 99RR01/Kabina	*57,000 POP, 1-1.25 inch depth*
5/14/14	Sprayed Ethofumesate 91 oz./A	51^{o}F-NW-14 Partly Cloudy
5/30/14	28% applied, 50lbs N,16.2 gpa	
6/11/14	Sprayed Roundup 32 oz./A, 4oz/A Stinger	66^{o}F-62% Humidity, SW-7 Partly Cloudy and finished at 9:15 a.m.
7/2/14	Sprayed Roundup 32oz./A	69 ^{o}F -39% Humidity, NW-10 Sunny and finished at 2:00 p.m.
7/16/14	Sprayed Select Max 9oz./A	68 ^{o}F -51% Humidity, N-5 Sunny and finished at 10)) a.m.
8/6/14	Sprayed Eminent 13oz./A	72 ^{o}F -62% Humidity, SE-5 Partly Cloudy and finished at 7:45 a.m.
8/20/14	Sprayed Supertin 8oz./A	62 ^{o}F -94% Humidity, SE-5, Partly Cloudy and finished at 8:23 a.m.

Note2. Whole study management practices implemented at the Renville site

Date		
5/29/14	Planted RR850/Metlock	*57,000 POP, 1-1.25 inch depth*
5/30/14	Sprayed Ethofumesate 91oz./A	82^{o}F -S-7, Sunny, finished at 11:45 a.m.
6/25/14	Sprayed Sequence 48oz./A	72^{o}F-ESE-15,Partly Cloudy, finished at 11:15 a.m.
8/7/14	Sprayed Eminent 13oz./A	76^{o}F-57% Humidity, SE-9, Partly Sunny, finished at 12:15 p.m.

Note 3. Rainfall (inches) during the growing season for both sites

Month	Belgrade	Renville
May	7.73	3.75
June	7.92	7.66
July	1.32	1.91
August	4.19	3.64
September	1.20	1.89
October	Harvested	0.97
TOTAL	**22.36**	**19.82**

Results

At Renville, neither beet yield (tons beet/ac) nor stand count was affected by treatment (Table 3). Sugar content was greatest from the 3 gallons 6-24-6/acre treatment and least from the WC101 and 3 gallons O-Phos/acre treatments. Revenue (%) was greatest from the 3 gallons 6-24-6 treatment and least from treatment 15, the 10-34-0 + O-Phos + WC101 combination.

Table 3. Sugar beet response to in-furrow phosphorus source and uptake enhancement product. Results from Renville MN, - 2014								
Soil Info: Fine Texture				Variety: RR850				
Planted: 5/29/14, Harvested: 10/15/14				Replicates: 4				
Previous Crop: Corn				Other: Heavy Rains in the spring				
No.	Treatment	Rate	Stand	Yield	Sugar	Purity	Extractable Sucrose	Revenue
		gpa	#/100 row ft.	t/ac	%	%	-lbs/ac-	%
1	Check (water)	6	162	32.4	14.2	86.4	7215	94.33
2	WC101	0.1875	148	33.4	13.9	85.1	7148	86.31
3	O-Phos	3	156	34.3	13.9	85.5	7389	90.68
4	O-Phos	4	141	33.7	14.2	85.6	7408	94.52
5	O-Phos + WC101	3 0.1875	138	36.1	14.5	86.7	8250	112.98
6	6-24-6	3	162	34.5	15.1	87.5	8378	125.77
7	6-24-6	4	112	30.6	14.1	86.4	6769	87.32
8	6-24-6 + WC101	3 0.1875	168	33.2	14.7	87.3	7826	112.39
9	6-24-6 + O-Phos	2 2	126	35.5	14.2	86.3	7951	104.75
10	6-24-6 + O-Phos + WC101	2 2 0.1875	135	32.9	14.8	87.4	7830	113.98
11	10-34-0	3	136	34.9	14.5	86.8	8016	110.39
12	10-34-0	4	128	31.2	14.3	86.2	6984	91.90
13	10-34-0 + WC101	3 0.1875	132	33.0	14.3	86.2	7394	97.63
14	10-34-0 + O-Phos	2 2	131	30.5	14.4	86.2	6891	92.05
15	10-34-0 + O-Phos + WC101	2 2 0.1875	140	32.6	13.8	85.6	6995	84.95
Coefficient of Variability			17	7.4	3.3	1.0	8	15.10
Fisher's Protected $LDS_{0.05}$			NSD	NSD	0.6	1.2	925	21.48

At Belgrade, stand count was greatest from 3 gallons 10-34-0/acre and lowest with 4 gallon O-Phos/acre treatment (Table 4). Generally, with the exception of 4 gallons 10-34-0/acre, 4 gallons of fertilizer per acre reduced stand count compared to the standard of 3 gallons 10-34-0/acre treatment. Treatment did not significantly affect any yield or quality variables measured at Belgrade.

Table 4. Sugar beet response to in-furrow phosphorus source and uptake enhancement product. Results from Belgrade, MN, - 2014								
Variety: 91RR01/Kabina					Soil Info: Course Texture			
Planted: 5/06/14, Harvested: 9/16/14					Previous Crop: Corn			
Replicates: 4								
No.	Treatment	Rate	Stand	Yield	Sugar	Purity	Extractable Sucrose	Revenue
		gpa	#/100' row	t/ac	%	%	-lbs/ac-	%
1	Check (water)	6	190	24.0	14.5	89.7	5860	102.37
2	WC101	0.1875	162	26.0	14.5	89.8	6261	108.63
3	O-Phos	3	191	21.8	14.8	90.6	5408	97.89
4	O-Phos	4	145	22.4	14.6	90.3	5504	97.85
5	O-Phos + WC101	3 0.1875	185	24.6	14.4	90.0	5899	101.74
6	6-24-6	3	195	20.6	14.5	90.5	5046	89.53
7	6-24-6	4	170	23.5	14.5	90.4	5722	100.41
8	6-24-6 + WC101	3 0.1875	203	20.8	14.5	89.9	5029	87.30
9	6-24-6 + O-Phos	2 2	195	23.6	14.6	89.7	5760	101.45
10	6-24-6 + O-Phos + WC101	2 2 0.8175	195	21.5	14.8	90.4	5339	96.71
11	10-34-0	3	205	21.8	14.2	89.8	5111	85.21
12	10-34-0	4	201	25.9	15.0	90.1	6693	122.94
13	10-34-0 + WC101	3 0.1875	181	22.3	14.5	89.9	5411	94.70
14	10-34-0 + O-Phos	2 2	163	23.5	14.8	90.6	5864	106.85
15	10-34-0 + O-Phos + WC101	2 2 0.1875	152	25.3	14.6	90.3	6226	111.23
Coefficient of Variability			10	16.1	2.0	0.6	16	18.10
Fisher's Protected $LDS_{0.05}$			27	NSD	NSD	NSD	NSD	NSD

The study is somewhat complex and the analyzed results somewhat confusing. The results can be simplified by breaking the initial study by forming two separate balanced experiments; a P source by chelate study (Table 5), and a P source by P rate study (Table 6)

Table 5. P Source by Chelate Treatment designations.

No.	P Source	P Source Rate Gallons/ac	Chelate
1	None	6	No
2	None	6	Yes
3	O-Phos	3	No
5	O-Phos	3	Yes
6	6-24-6	3	No
8	6-24-6	3	Yes
9	6-24-6 + O-Phos	2 + 2	No
10	6-24-6 + O-Phos	2 + 2	Yes
11	10-34-0	3	No
13	10-34-0	3	Yes
14	10-34-0 + O-Phos	2 + 2	No
15	10-34-0 + O-Phos	2 + 2	Yes

Table 6. P Source by Rate Designations

No.	Treatment	Rate gpa	Timing
3	O-Phos	3	In furrow
4	O-Phos	4	In furrow
6	6-24-6	3	In furrow
7	6-24-6	4	In furrow
11	10-34-0	3	In furrow
12	10-34-0	4	In furrow

P Source by chelate study: Statistical analysis of this data indicates the use of a chelate provided neither benefit nor harm to any of the variables measured. Location significantly affected beet stand counts, beet yield, purity, nitrate, and extractable sucrose per acre. Phosphorus source affected stand count, sugar level, purity, extractable sucrose and extractable sucrose per ton. However, a significant location by phosphorus source interaction existed for stand count, beet yield, sugar content, purity, nitrate, extractable sucrose, extractable sucrose per ton, extractable sucrose per acre, revenue and percent revenue. This interaction indicates if a grower changes location, the beet crop responds differently to phosphorus source. In the interest of brevity, our discussion will focus on yield, extractable sucrose per ton and percent revenue.

Beet yield at Renville was greater than that at Belgrade (Table 7). At Renville, beet yield from the O-Phos only treatment was significantly greater than that from combination of 10-34-0 with O-Phos, but statistically similar to all other treatments at Renville. At Belgrade, yield from the 6-24-6 treatment was significantly less than that from either the control or the 10-34-0 + O-Phos combination.

Table 7. Sugar Beet Yield (tons per acre) response to Phosphorus source selection at Renville and Belgrade.

	None	O-Phos	6-24-6	6-24-6 + O-Phos	10-34-0	10-34-0 + O-Phos	Average
Location	Sugar Beet Yield (tons per acre)						
Renville	32.95	35.22	33.92	34.29	34.01	31.64	33.7
Belgrade	25.12	23.21	20.77	22.61	22.08	24.44	23.0
Fisher's Protected $LSD_{0.05}$	3.11						0.9

Extractable sucrose per ton (EST) for each location was statistically similar. At Renville, the 6-24-6 treatment had statistically more EST than all other treatments except the 6-24-6 + O-Phos treatment. EST from this treatment (6-24-6 + O-Phos) was statistically similar to all other treatments, except the control (None) and the 10-34-0 + O-Phos combination. At Belgrade, EST from all treatments was statistically similar.

Table 8. Extractable Sucrose per ton (lbs. sucrose/ton of beets) response to Phosphorus source selection at Renville and Belgrade.

	None	O-Phos	6-24-6	6-24-6 + O-Phos	10-34-0	10-34-0 + O-Phos	Average
Location	Extractable Sucrose per ton (lbs sucrose/ton of beets)						
Renville	218.62	222.48	238.81	230.63	227.01	219.97	226.26
Belgrade	240.82	244.15	242.42	245.67	238.45	247.11	243.07
Fisher's Protected $LSD_{0.05}$	9.38						NSD

Revenue, as measured by percent revenue (PR), combines all factors, cost of product, yield and extractable sucrose. Across locations, PR was statistically similar. At Renville, PR from the 6-24-6 treatment was significantly greater than from the control, 10-34-0 + O-Phos, and the O-Phos treatments. At Belgrade, the lowest PR was from the 6-24-6 treatment, which was statistically different from that in the 10-34-0 + O-Phos combination. PR from the other treatments was statistically similar.

Table 9. Percent revenue response to Phosphorus source selection at Renville and Belgrade.							
	None	O-Phos	6-24-6	6-24-6 + O-Phos	10-34-0	10-34-0 + O-Phos	Average
Location	Revenue (%)						
Renville	90.32	101.83	119.08	109.37	104.01	88.51	102.19
Belgrade	105.50	99.82	88.42	99.09	89.96	109.05	98.64
Fisher's Protected $LSD_{0.05}$	17.34						NSD

Discussion: Beet Yield was either not statistically affected by starter fertilizer treatment (Renville) or reduced (Belgrade) by starter fertilizer selection. Extractable sucrose per ton (EST) at Renville was greatest from the 6-24-6 (alone) treatment and least from the control (no starter). At Belgrade, starter fertilizer selection did not affect EST compared to the control. Revenue was greatest from the 6-24-6 treatment, and significantly greater than the control, but similar to the standard (3 gallons of 10-34-0). Revenue was statistically similar to the control across all treatments at Belgrade.

Belgrade beets, were planted earlier than Renville (5/6 vs 5/29), might have had colder soils, and should have been more responsive to the use of starter fertilizer. However this site also had greater soil P levels and less soil nitrogen. Renville beets, planted later, were responsive to starter fertilizer. Starter selection did not significantly increase beet yield over the control, however did see an increase in sucrose content and revenue. These results are not in agreement with current recommendations. Additional investigation is required.

Phosphorus source by rate study

This study is structured in a manner that presumes the crop manager, like most of our growers, will use a starter fertilizer. Thus the control, or check, treatment is the local standard, 3 gallons 10-34-0/acre, not a no starter treatment. Location impacted stand count, beet yield, purity, nitrate extractable sucrose, extractable sucrose per ton, and extractable sucrose per acre. Phosphorus source impacted purity. Phosphorus source rate significantly affected stand count.

Multiple interactions were found during data analysis. A location by phosphorus source interaction affected Stand count, purity, Extractable sucrose and extractable sucrose per ton. A location by P source rate interaction affected yield, sugar content, extractable sucrose, extractable sucrose per ton and per acre, as well as revenue and percent revenue. To make things even more confusing, a significant location by Phosphorus Source by Phosphorus Source rate interaction existed for sugar content, extractable sugar, extractable sugar per ton, revenue and percent revenue. Results, and following discussion, will focus on beet yield, sucrose per ton and percent revenue responses from this study.

In Renville, beet yield was statistically greater from the 3 gallon rates than the 4 gallon rate. At Belgrade, the inverse happened, but yield was not significantly different (Table 10).

Table 10. Sugar beet yield (tons per acre) response to P source rate and location.		
Phosphorus Source Rate	Location	
Gallons/acre	Renville	Belgrade
3	34.6	21.4
4	31.9	24.0
Fisher's Protected $LSD_{0.05}$	2.6	

At Renville, EST was greatest from the 6-24-6 at 3 gallons per acre than all other product/product rate combination (Table 11). Three gallons of O-Phos produced the least sucrose of all treatments and was significantly lower than that from 3 gallons of 10-34-0 and 6-24-6. At Belgrade, 3 gallons of 10-34-0 produced less sucrose per ton of beet than 3 gallons of O-Phos per acre or 4 gallons of 10-34-0 per acre. The other product/product rate combinations were statistically similar to each other and the 3 gallons of 6-24-6 at Renville.

Table 11. Extractable Sucrose per ton of beets response to phosphorus source and source rate at Renville and Belgrade, MN in 2014				
Phosphorus Source	Location			
	Renville		Belgrade	
	Phosphorus Source rate (gallons/acre)			
	3	4	3	4
	Extractable Sucrose per ton of beets			
O-Phos	215.5	219.8	248.2	245.0
6-24-6	242.3	221.4	244.0	243.5
10-34-0	230.3	224.2	234.9	249.4
Fisher's Protected $LSD_{0.05}$	12.8			

Percent revenue at Renville was greatest from 3 gallons of 6-24-6, however it was not significantly different from the recommended rate of 3 gallons of 10-34-0 (Table 12). At Belgrade, 4 gallons of 10-34-0 produced the greatest revenue; however it was only significantly greater than 3 gallons per acre rates of 10-34-0 or 6-24-6.

Table 12. Percent revenue response to phosphorus source and source rate at Renville and Belgrade				
	Location			
	Renville		Belgrade	
	Phosphorus Source rate (gallons/acre)			
Phosphorus Source	3	4	3	4
	Revenue (%)			
O-Phos	90.7	94.5	97.9	97.9
6-24-6	125.8	87.3	89.5	100.4
10-34-0	110.4	91.9	85.2	118.1
Fisher's Protected $LSD_{0.05}$	20.4			

Discussion:

Interpretation of these results can be confusing. Soil nutrient levels were adequate at both locations, however, soil P levels at Renville were about half those of Belgrade, and soil N levels at Belgrade were lower than those at Renville, especially from 2 feet or lower samples. We would have anticipated lower sugar content at Renville than Belgrade due to the large supply of N below 2 feet. We would have also anticipated a larger response to starter fertilizer with the reduced P levels at Renville, however, the later planting date (5/29) should have resulted in warmer soils and a corresponding decrease in response to starter fertilizer.

Use of 10-34-0 as an in-furrow starter fertilizer is fairly common in southern Minnesota. It has been shown to increase beet yield fairly consistently, and the 3 gallons per acre produces adequate beet yield response with limited damage to seed at germination. However, sugar beet quality (sugar content, EST, etc.) response is usually small, if present at all.

These results indicate sugar levels may be affected by starter fertilizer choice. They also indicate the standard 3 gallons 10-34-0/acre recommendation may not be correct for all sites. As these results come from a single year study, and that year being a very short growing season, more investigation into this subject is warranted.

Growth Enhancement Products for Sugarbeet

Introduction: Previous research conducted by SMBSC has demonstrated use of a "pop-up" fertilizer can greatly enhance sugar beet yield, especially when used in lower than optimum temperature soil associated with early planting. There are numerous products available for use as in-furrow products. This study examines a variety of these products and their performance in 2014.

Materials and methods: Two sites, near Belgrade and Renville, were selected, prepared and planted in May 2014. Plot sizes at both sites were 6 rows (11 feet) by 40 foot long. Each site was planted using a 6 row planter, with seed spacing of five inches, or a seeding rate of approximately 57,000 seed per acre. Nitrogen and other nutrients were applied according to soil test recommendations, other management inputs were applied uniformly across all plots as needed (Tables 1 and 2).

Treatments are listed in Tables 3-5. The experiments utilized a randomized complete block design with 4 blocks (replicates). Stand counts were conducted at an over-all growth stage near 8 leaf. Plots were not thinned as the sugar beet stands did not warrant thinning.

The middle two rows of each plot were harvested with a two row research harvester. One sub-sample was collected from each plot and analyzed for quality at the SMBSC Tare lab. Data were entered into a spreadsheet on a timely basis and were analyzed using Crop Stat v7.2.

Results and Discussion: There were no significant responses to treatment for sugar beet yield, sugar content, purity, extractable sugar, or revenue at either location or from the combined data set. While there was a treatment difference in stand count at Belgrade, and in the combined data set, these differences did not translate into a significant economic response.

The short, wet year experienced in 2014 may have limited the ability for the sugar beet to express a difference due to treatment; also, soil temperatures may have been sufficiently high at planting to limit the differences due to treatment. This study will not be continued in 2015.

Tables and Figures

Table 1. Notes for the Renville site		
Date	Activity	Conditions
5/29/14	Fertilizer Spread	
5/29/14	Planted 99RR01/Kabina	
5/30/14	Sprayed Ethofumesate 96 oz./A	51 degrees-NW-14 Partly Cloudy
6/25/14	Sprayed Trt 17 and 18	73 degrees-67% humidity, Calm, Sunny finished at 2:00 p.m.
7/10/14	Sprayed Trt 18	82 degrees-54% humidity, SE-10, Sunny finished at 2:00 p.m.
8/6/14	Sprayed Eminent 13oz/A	76 degrees-57% humidity, SE-9 Sunny and finished at 12:15 p.m.

Table 2. Notes for the Belgrade site		
Date		
5/5/14	Fertilizer Spread	
5/6/14	Planted 99RR01/Kabina	
5/14/14	Sprayed Ethofumesate 96 oz./A	51 degrees-NW-14 Partly Cloudy
5/30/14	28% applied, 50lbs N,16.2 gpa	
6/9/14	Sprayed Trt 17 and 18	60 degrees-67% humidity,SSW-5 Cloudy finished at 10:30 a.m.
6/11/14	Sprayed Roundup 32 oz./A, 4oz/A Stinger	66 degrees-62% humidity, SW-7 Partly Cloudy and finished at 9:15 a.m.
6/23/14	Sprayed Trt 18	75 degrees-54% humidity, NW-9 Sunny finished at 10:00 a.m.
7/2/14	Sprayed Roundup 24oz/A	69 degrees-39% humidity, NW-10 Sunny and finished at 2:00 p.m.
7/16/14	Sprayed Select Max 9oz/A	68 degrees-51% humidity, N-5 Sunny and finished at 10 a.m.
8/6/14	Sprayed Eminent 13oz/A	72 degrees-62% humidity, SE-5 Partly Cloudy and finished at 8:45 a.m.
8/20/14	Sprayed Supertin 8oz/A	62 degrees-94% humidity, SE-5, Partly Cloudy and finished at 8:23 a.m.

Table 3. Sugar beet response to growth enhancement product selection at Renville MN, - 2014									
Soil Info: Fine Texture				Variety: RR850/Metlock					
Planted: 5/29/14				Harvested: 10/15/14					
Replicates: 4				Previous crop: Corn					
No.	Treatment	Rate/A	Timing	Stand	Yield	Sugar	Purity	Extractible Sucrose	Revenue
				#/100 row ft.	t/ac	%	%	-lbs/ac-	%
1	Untreated (water)	6 gal	N/A	146	30.4	16.2	89.7	8232	106.78
2	10-34-0	3 gal	In-furrow	142	29.7	18.8	88.1	7661	93.90
3	Nachurs 6-24-6	3 gal	In-furrow	151	31.1	16.0	88.4	8166	102.19
4	CHS 7-23-5	3 gal	In-furrow	150	29.0	16.1	88.8	7687	97.35
5	Zinc	10 lbs.	Broadcast, soil incorporated	172	29.8	16.1	88.9	7938	101.28
6	Redline	3 gal	In-furrow	125	33.2	15.5	88.0	8348	98.98
7	Redline + EB Mix	3 gal + 1qt.	In-furrow	156	30.8	15.9	88.5	8027	99.58
8	Clean Field EEHA Iron	1.33 qt.	In-furrow	150	28.9	16.0	88.9	7629	96.11
9	Budmate	32 oz.	In-furrow	151	31.7	16.3	89.2	8543	110.53
10	Blue Tsunami	1qt.	In-furrow	126	31.6	15.9	88.4	8219	101.77
11	Redline + Blue Tsunami	3 gal + 1qt.	In-furrow	141	33.9	15.6	88.7	8713	106.39
12	Redline + AMS	3 gal + 10 lbs.	In-furrow	138	27.9	16.3	88.9	7535	97.57
13	Redline + AMS + Blue Tsunami	3 gal + 10 lbs. + 1qt.	In-furrow	133	29.6	16.1	88.0	7885	98.66
14	WC101 + Amino MN	24 oz. + 1qt.	In-furrow	166	31.1	15.8	88.8	8077	100.04
15	Ascend	5 oz.	In-furrow	162	32.1	15.4	87.8	8176	95.69
16	Generate	1qt.	In-furrow	143	33.3	15.0	87.4	8042	90.26
17	Generate	1qt. + 1qt.	In-furrow + Foliar 4-6 Lf	156	33.7	15.6	88.1	8560	102.89
18	Generate	1qt. + 1qt.	Foliar 4-6 Lf + 10-15 days	168	32.5	15.8	88.2	8380	102.78
19	Agzyme + 6-24-6	19.2 oz. + 1qt.	In-furrow	135	30.2	15.4	87.9	7559	89.14
20	Micro Az + NutriHume	2qt. + 1qt.	In-furrow	166	32.9	16.1	89.1	8588	109.12
21	Iron up	2 lbs.	In-furrow	175	29.1	16.3	89.3	7857	101.82
22	Iper Fer Marathon + 6-24-6	1/2 lbs. + 3gal	In-furrow	151	31.8	16.0	89.0	8408	106.19
23	Iper Zinc Marathon + 6-24-6	1 lbs. + 3 gal	In-furrow	133	31.8	15.9	88.1	8253	101.97
24	Pro-Germinator 9-24-3	3 gal	In-furrow	145	32.2	15.9	88.3	8298	102.31
25	Micro 500	2qt.	In-furrow	146	30.2	15.4	89.1	7765	94.88
C.V				16	8.6	4.6	1.1	9	14.80
LSD 5%				NSD	NSD	NSD	NSD	NSD	NSD

Table 4. Sugar beet response to growth enhancement product: Belgrade MN, - 2014									
Soil Info: Course Texture				Variety: 91RR01/Kabina					
Planted: 5/06/14				Harvested: 9/16/14					
Replicates: 4				Previous Crop: Corn					
No.	Treatment	Rate/A	Timing	Stand	Yield	Sugar	Purity	Extractable Sucrose	Revenue
				#/100 row ft.	t/ac	%	%	-lbs/ac-	%
1	Untreated (water)	6 gal	N/A	186	24.5	14.0	90.5	5792	101.03
2	10-34-0	3 gal	In-furrow	167	28.9	14.5	90.4	7087	130.54
3	Nachurs 6-24-6	3 gal	In-furrow	193	25.3	14.4	90.7	6150	112.16
4	CHS 7-23-5	3 gal	In-furrow	217	28.3	14.5	90.6	6928	127.66
5	Zinc	10 lbs.	Broadcast, soil incorp.	197	25.1	14.2	90.1	5968	105.43
6	Redline	3 gal	In-furrow	203	24.0	14.4	90.6	5804	104.98
7	Redline + EB Mix	3 gal + 1qt.	In-furrow	192	22.2	14.5	90.9	5428	100.01
8	Clean Field EEHA Iron	1.33 qt.	In-furrow	152	21.9	14.5	91.0	5392	99.75
9	Budmate	32 oz.	In-furrow	198	18.0	14.5	90.9	4405	81.02
10	Blue Tsunami	1qt.	In-furrow	146	22.0	14.3	90.8	5294	94.71
11	Redline + Blue Tsunami	3 gal + 1qt.	In-furrow	162	19.8	13.9	91.1	4675	81.20
12	Redline + AMS	3 gal + 10 lbs.	In-furrow	181	23.8	14.5	90.5	5844	107.88
13	Redline + AMS + Blue Tsunami	3 gal + 10 lbs. + 1qt.	In-furrow	196	20.6	14.1	91.0	4957	89.15
14	WC101 + Amino MN	24 oz. + 1qt.	In-furrow	175	23.1	14.3	90.7	5616	102.23
15	Ascend	5 oz.	In-furrow	196	19.0	13.8	90.4	4412	75.20
16	Generate	1qt.	In-furrow	188	21.2	14.3	90.5	5127	92.56
17	Generate	1qt. + 1qt.	In-furrow + Foliar 4-6 Lf	208	17.6	14.3	91.0	4283	78.01
18	Generate	1qt. + 1qt.	Foliar 4-6 Lf + 10-15 days	201	27.8	14.3	90.7	6750	122.97
19	Agzyme + 6-24-6	19.2 oz. + 1qt.	In-furrow	167	20.9	14.4	90.3	5037	90.53
20	Micro Az + NutriHume	2qt. + 1qt.	In-furrow	165	23.4	14.5	89.8	5720	105.19
21	Iron up	2 lbs.	In-furrow	171	24.9	14.4	90.4	6095	111.98
22	Iper Fer Marathon + 6-24-6	1/2 lbs. + 3gal	In-furrow	198	23.9	14.5	90.6	5811	105.70
23	Iper Zinc Marathon + 6-24-6	1 lbs. + 3 gal	In-furrow	180	20.7	14.2	90.6	4945	87.76
24	Pro-Germinator 9-24-3	3 gal	In-furrow	153	23.8	14.3	90.8	5754	103.80
25	Micro 500	2qt.	In-furrow	156	20.2	14.4	90.6	4891	88.44
C.V				12	24.0	3.8	0.8	25.9	29.3
LSD 5%				33	NSD	NSD	NSD	NSD	NSD

Table 5. Sugar beet response to growth enhancement product selection averaged over two locations in 2014									
No.	Treatment	Rate/A	Timing	Stand	Yield	Sugar	Purity	Extractable Sucrose	Revenue
				#/100 row ft.	t/ac	%	%	-lbs/ac-	%
1	Untreated (water)	6 gal	N/A	166	27.5	15.1	90.1	7012	103.89
2	10-34-0	3 gal	In-furrow	155	29.3	15.2	89.3	7374	112.22
3	Nachurs 6-24-6	3 gal	In-furrow	172	28.2	15.2	89.6	7158	107.18
4	CHS 7-23-5	3 gal	In-furrow	183	28.7	15.3	89.7	7308	112.51
5	Zinc	10 lbs.	Broadcast soil incorp.	185	27.4	15.2	89.5	6953	103.36
6	Redline	3 gal	In-furrow	164	28.6	15.0	89.3	7076	101.98
7	Redline + EB Mix	3 gal + 1qt.	In-furrow	174	26.5	15.2	89.7	6728	99.80
8	Clean Field EEHA Iron	1.33 qt.	In-furrow	151	25.4	15.3	90.0	6511	97.93
9	Budmate	32 oz.	In-furrow	175	24.8	15.4	90.0	6474	95.77
10	Blue Tsunami	1qt.	In-furrow	136	26.8	15.1	89.6	6756	98.24
11	Redline + Blue Tsunami	3 gal + 1qt.	In-furrow	151	26.9	14.8	89.9	6694	93.80
12	Redline + AMS	3 gal + 10 lbs.	In-furrow	160	25.9	15.4	89.7	6690	102.72
13	Redline + AMS + Blue Tsunami	3 gal + 10 lbs. + 1qt.	In-furrow	165	25.1	15.1	89.5	6421	93.89
14	WC101 + Amino MN	24 oz. + 1qt.	In-furrow	170	27.1	15.1	89.8	6846	101.14
15	Ascend	5 oz.	In-furrow	179	25.5	14.6	89.1	6294	85.44
16	Generate	1qt.	In-furrow	166	27.2	14.6	89.0	6585	91.41
17	Generate	1qt. + 1qt.	In-furrow + Foliar 4-6 Lf	182	25.7	14.9	89.5	6422	90.45
18	Generate	1qt. + 1qt.	Foliar 4-6 Lf + 10-15 days	185	30.1	15.0	89.4	7565	112.87
19	Agzyme + 6-24-6	19.2 oz. + 1qt.	In-furrow	151	25.5	14.9	89.1	6298	89.83
20	Micro Az + NutriHume	2qt. + 1qt.	In-furrow	165	28.2	15.3	89.4	7154	107.14
21	Iron up	2 lbs.	In-furrow	173	27.0	15.3	89.9	6976	106.90
22	Iper Fer Marathon + 6-24-6	1/2 lbs. + 3gal	In-furrow	175	27.9	15.2	89.8	7109	105.95
23	Iper Zinc Marathon + 6-24-6	1 lbs. + 3 gal	In-furrow	156	26.2	15.1	89.4	6599	94.86
24	Pro-Germinator 9-24-3	3 gal	In-furrow	149	28.0	15.1	89.6	7025	103.06
25	Micro 500	2qt.	In-furrow	151	25.2	14.9	89.8	6328	91.66
C.V				14	16.0	4.3	0.9	17.2	23.5
LSD 5%				23	NSD	NSD	NSD	NSD	NSD

Foliar Micronutrients for Sugarbeets

Introduction: Previous research at SMBSC has shown a positive response to micronutrient applications when tank mixed with a foliar applied fungicide. Many questions remain unanswered. Which micronutrient, or multi-pack micronutrient package, will provide the desired response? Which application timing, or which fungicide application period, will provide a superior response? In addition, can the use of an uptake enhancer, such as a non-ionic surfactant (NIS) provide enhanced or decreased sugar beet response to foliar micronutrient application? A study was conducted at two sites in 2014 to explore these questions.

Methods: The study was conducted at two sites, near Belgrade and near Renville, in 2014. Soil test results (Table 1), indicate both sites had adequate soil P and K levels for sugar beet production. Soil nitrogen levels, to a depth of 4 feet, at Renville was sufficient for beet production, thus no additional nitrogen was applied. The Belgrade site received 50 lbs. N/ac applied as 28% UAN about 3 weeks post planting.

Both sites were planted to sugar beets in May. Belgrade was planted to 91RR01 with Kabina on 5/06/14, while the Renville site was planted on 5/29/2014 using RR850 with Metlock. Corners and alleys were laid out prior to planting. Individual 11 ft. (6 rows) wide by 35 feet long plots were then planted with a seeding spacing of 5 inches, or a seeding rate of 57,000 seeds per acre, then staked and prepared to receive treatments as scheduled (Table 2). Plots were not thinned.

All treatments were applied foliar using an ATV sprayer. Spray volume was 14 gpa and pressure was 40 lbs. psi. Where Non-ionic Surfactant (NIS) was added to the micronutrient, Preference was used. Rows 3 and 4 of each 6 row plot, at both sites, were harvested using a 2 row research harvester. The samples were collected and weighed on the harvester for yield calculation, and a sub-sample was analyzed in the SMBSC quality lab.

Results and Discussion: A significant location by treatment interaction was not found; consequently the data set was combined and analyzed together, and the results are presented in Table 2. Only treatment 6 (1 qt/ac 5-6% Mn applied with WC101) had a significantly greater yield and sugar per acre than the control (Treatment 1); However, this treatment, nor any other, was significantly different from the control in percent revenue.

Two treatments, EB Mix early (July 10) and Zinc late (July 24), significantly reduced beet yield compared to the control treatment. Also, the treatments with SRN, and Max-in Manganese, had significantly lower yields. The application of Zinc (treatments 8, 9, 10, 21 or 22) as well as the use of Ascend (treatments 12 or 25) resulted in lower percent sugar compared to the control.

Sugar per acre was significantly less than the control for Zinc with N-Tense (treatments 10 and 22), Ascend (treatments 12 and 25) and EB Mix applied early with WC101 or N-Tense (treatments 3 and 4).

Table 1. Soil analysis (2014) results from AgVise.

Location	Rep	Soil Texture	Soil pH	Soil OM	Total Nitrogen (0”-48”)	Plant Available Phosphorus	Plant Available Potassium	Plant Available Zinc
	#			%	lbs N/ac	ppm	ppm	ppm
Belgrade	1	Loam (Coarse)	7.5	4.6	95	19	98	1.80
	2		7.6	4.3	47	13	101	1.04
	3		6.5	3.6	105	4	76	0.90
	4		6.1	5.6	81	6	95	1.61
	Mean		***6.9***	***4.5***	***82***	***11***	***93***	***1.34***
Renville	1	Clay (Fine)	7.9		86	12	177	1.49
	2		7.8		124	14	220	1.60
	3		7.9		163	18	148	4.14
	4		8.0		132	13	166	1.62
	Mean		***7.9***		***126***	***14***	***178***	***2.21***

Table 2. Sugar beet yield, quality and economic response to Nutrient source, use of uptake enhancer, and application timing averaged across two locations (Belgrade and Renville) in 2014.									
#	Treatment	Uptake Enhancer	Rate/A	Timing	Stand	Yield	Sugar	Extractable sucrose	Revenue
					#/100'	t/ac	%	lbs/ac	%
1	Untreated	None	N/A	N/A	177	25.7	15.7	6746	107.20
2	EBMix	NIS	1qt + 0.25%	July 10th	171	23.7	15.9	6338	102.20
3	EBMix	WC101	1qt + 24oz	July 10th	175	23.5	15.3	6201	91.40
4	EBMix	N-Tense	1qt + 0.50%	July 10th	169	23.7	15.5	6197	94.18
5	5-6% Mn	NIS	1qt + 0.25%	July 10th	173	25.5	15.7	6674	106.39
6	5-6% Mn	WC101	1qt + 24oz	July 10th	177	26.9	15.9	7262	118.04
7	5-6% Mn	N-Tense	1qt + 0.50%	July 10th	175	26.4	15.5	6942	107.03
8	9-10% Zn	NIS	1qt + 0.25%	July 10th	167	25.3	15.3	6518	100.18
9	9-10% Zn	WC101	1qt + 24oz	July 10th	161	25.3	15.1	6474	97.27
10	9-10% Zn	N-Tense	1qt + 0.50%	July 10th	158	23.4	15.1	6023	87.79
11	SRN	None	3 gal	July 10th	176	26.2	15.1	6672	96.95
12	Ascend	None	3.2oz	July 10th	171	23.9	14.9	5974	85.10
13	Max-in Manganese	None	1qt	July 10th	166	26.1	15.4	6774	102.34
14	EBMix	NIS	1qt + 0.25%	July 24th	186	24.4	15.4	6388	97.12
15	EBMix	WC101	1qt + 24oz	July 24th	163	25.0	15.5	6513	99.97
16	EBMix	N-Tense	1qt + 0.50%	July 24th	175	25.7	15.4	6645	101.92
17	5-6% Mn	NIS	1qt + 0.25%	July 24th	184	25.6	16.1	7005	114.33
18	5-6% Mn	WC101	1qt + 24oz	July 24th	183	25.1	15.9	6715	108.82
19	5-6% Mn	N-Tense	1qt + 0.50%	July 24th	171	25.2	15.5	6589	103.54
20	9-10% Zn	NIS	1qt + 0.25%	July 24th	171	24.3	15.7	6473	102.97
21	9-10% Zn	WC101	1qt + 24oz	July 24th	175	24.7	15.1	6320	92.49
22	9-10% Zn	N-Tense	1qt + 0.50%	July 24th	172	22.4	15.2	5774	85.97
23	SRN	None	3 gal	July 24th	188	25.7	15.6	6788	106.76
24	Max-in Manganese	None	1qt	July 24th	172	24.5	15.6	6527	102.84
25	Ascend	None	3.2oz	July 24th	161	23.7	15.0	5976	87.12
C.V					13.1	15.2	5.0	15.9	23.4
Fischer's Protected LSD 5%					10.3	0.7	0.4	329	NSD

Interpretation of the initial experiment is a bit confusing. If one eliminates treatment 1 (control), 11/23 (SRN), 12/25 (Ascend) and 13/24 (Max-in Manganese), a 3 (micronutrient source) x 3 (uptake enhancer) x 2 (application time) x 2 (location) factorial study was nestled within this study. Use of a full factorial study will often enhance precision, and allow for increased replication of main factors, such as uptake enhancer in this case, is found not to be significant.

The following analysis of this full factorial study produced some interesting interpretations. Location affected yield, percent sugar, extractable sucrose per ton, extractable sugar per acre, but not percent revenue (Table 3). Micronutrient source affected percent sugar, extractable sucrose (percent, per ton and per acre), and percent revenue (Table 4). A location by micronutrient source interaction affected yield (Table 5). Neither time of application, nor the use of an uptake enhancer, significantly affected any of the factors measured.

It becomes evident manganese was somewhat limiting in these studies, however, soil zinc level was adequate to meet crop needs, to the point that additional applied zinc decreased beet sugar production compared to the control or those plots receiving the 5-6% Mn product. The micronutrient source and uptake enhancer study will be conducted again in 2015. The use of SRN, Max-in manganese and Ascend treatments will be dropped.

Table 3. Sugar beet yield, sugar and sucrose levels response to location.

	Sugar Beet Yield	Sugar	Extractable Sucrose	
Location	Tons/acre	- % -	-lbs/ton -	- lbs/acre -
Belgrade	20.4	14.4	242	4925
Renville	29.3	16.7	275	8044
Fisher's protected $LSD_{a=0.05}$	1.5	0.3	5	421

Table 4. Sugar beet quality response to micronutrient source averaged across two locations (Belgrade and Renville) and two times of application (10 July and 24 July).

Micronutrient Program	Rate	Sugar	----------Extractable Sucrose----------			Revenue
	qt/ac	%	%	lbs /ton	lbs /acre	%
EB Micro Mix	1	15.6	12.9	258	6381	100.5
5%-6% Mn	1	15.8	13.2	263	6808	111.6
9% - 10% Zn	1	15.3	12.7	254	6264	97.0
Fisher's Protected $LSD_{a=0.05}$		0.3	0.3	6	137	9.2

Table 5. Sugar beet yield response to a location by micronutrient source interaction averages over two times of application (10 July and 24 July) in 2014

Micronutrient Programs	Location	
	Belgrade	Renville
	short tons sugar beet/acre	
EB Micro Mix	19.2	29.6
5%-6% Mn	22.6	29.1
9% - 10% Zn	19.5	29.1
Fisher's Protected $LSD_{a=0.05}$	--------- 2.0 ----------	

Table 6. Field notes from Belgrade and Renville sites.

Belgrade site:

Trial Quality: Fair
Variety: 91RR01/Kabina
Planted: 5/06/14
Harvested: 9/16/14

Soil Info: Coarse Texture/Irrigation
Previous Crop: Corn
Plot size: 4 Reps
Rain Total-18.32 inch

Date	Activity	Conditions
5/5/14	Fertilizer Spread	
5/6/14	Planted 99RR01/Kabina	
5/14/14	Sprayed Ethofumesate 91 oz./A	51 degrees-NW-14 Partly Cloudy
5/30/14	28% applied, 50lbs N,16.2 gpa	
6/11/14	Sprayed Roundup 32 oz./A, 4oz/A Stinger	66 degrees-62% humidity, SW-7 Partly Cloudy. Finished at 9:15 a.m.
7/10/14	Sprayed July 10th application-Treatment 9 did not mix well	82 degrees-54% humidity, SE-10 Sunny
7/2/14	Sprayed Roundup 24oz/A	69 degrees-39% humidity, NW-10 Sunny and finished at 2:00 p.m.
7/16/14	Sprayed Select Max 9oz/A	68 degrees-51% humidity, N-5 Sunny. Finished at 10 a.m.
8/1/14	Sprayed July 24th application-Treatment 21 did not mix well. Sprayed late due to rain and irrigation	82 degrees-39% humidity, WNW-4 Sunny, finished at 1:00 p.m.
8/6/14	Sprayed Eminent 13oz/A	72 degrees-62% humidity, SE-5 Partly Cloudy. Finished at 7:45 a.m.
8/20/14	Sprayed Supertin 8oz/A	62 degrees-94% humidity, SE-5, Partly Cloudy. Finished at 8:23 a.m.

Renville site

Trial Quality: Good
Variety: RR850/Metlock
Planted: 5/29/14
Harvested: 10/15/14

Soil Info: Fine Texture
Previous Crop: Corn
Plot size: 4 Reps

Date	Activity	Conditions
5/29/14	Planted RR850/Metlock	
5/30/14	Sprayed Ethofumesate 91oz/A	82 degrees-S-7, Sunny, finished at 11:45 a.m.
6/25/14	Sprayed Sequence 48oz/A	72 degrees-ESE-15,Partly Cloudy, finished at 11:15 a.m.
7/10/14	Sprayed July 10th application –Treatment 9 did not mix well	82 degrees-54% humidity,SE-10, Sunny finished at 2:00 p.m.
7/28/14	Sprayed July 24th application-Treatment 21 did not mix well	72 degrees-55% humidity, Calm, finished at 1:30 p.m.
8/7/14	Sprayed Eminent 13oz/A	76 degrees-57% Humidity, SE-9, Partly Sunny, finished at 12:15 p.m.

Evaluation of Fungicide for Control of Cercospora Leaf Spot Using a Single Mode of Action

Danube, MN - 2014

Introduction: Concern for the potential development of resistance to any of our limited fungicide options has enhanced the need to consider the efficacy of single fungicidal modes of action within a Cercospora leaf spot control program. The testing described in this report is an evaluation of single mode of action fungicides for control of Cercospora leaf spot in 2014. The experiment discussed in this report is an evaluation of individual fungicides, to determine efficacy of the individual chemistry, and the influence on sugar beet production. Testing fungicides in this manner is only to determine the efficacy of the individual product. This is not a recommended practice. ***Multiple applications of a single fungicide should never be used as a control program for Cercospora leaf spot within a production season.***

Objectives: The objective of this test was to evaluate fungicide for control of Cercospora leaf spot using fungicide programs with a single mode of action. The test measures both the efficacy and the influence on sugar beet production.

Methods: Treatments are found in Table 1. The site was located close to Danube, MN (fine textured soil) in 2014. Corn was the previous crop planted and harvested in 2013. The study was planted on 29 May 2014 to variety 91RR01. Individual plots were 11 feet (6 rows with a 22 inch row width) wide and 35 feet long. The treatments were replicated 4 times. Sugar beets were not thinned since the test did not require thinning. Normal production practices were conducted on the sugar beets within the testing area. The site received one application of Roundup (24 oz. /acre) and Select Max (9 oz. /acre) to control weeds and volunteer corn on 17 July. On the following day, the site was inoculated with CLS using the Gandy Air Unit. Initial fungicide treatments were applied on 4 August with additional treatment applications occurring on 14 day intervals (8/19 or 9/2). Two checks, a no treatment and a water only treatment, were included in the study (Table 1). Treatments were applied using the CLS sprayer, a 4 nozzle (22" apart) boom sprayer with flat fan tips, at 14 gallons solution per acre using a tractor speed of 4.5 mph.

Sugar beets were weighed on the harvester for calculation of yield. A subsample was collected from each plot and analyzed in the SMBSC quality lab for sugar percent, purity and brie nitrate. The Cercospora leaf spot control, sugar beet production data, and sugar beet evaluations are included in Table 1.

Results and discussion: While the disease ratings were significantly affected by treatments (Table 1), most of the critical factors {yield, extractable sucrose per acre and revenue (%)} were not. As noted by the coefficient of variability (CV), variance was high (CV>15) with most of the factors measured. Sugar and purity were affected by treatment. The two checks, no treatment and the water check, had significantly lower sugar content than all of the fungicide treatments except Topguard and Gem 500 SC with EBDC. However none of the fungicides had significantly different sugar content compared to fungicides.

The climatic conditions may have been a larger factor than disease. The late planting (29 May) may have limited sugar beet growth. Field conditions and the natural soil variation found across the site may have introduced a large amount of variability in the data. In addition, the rather moderate humidity level observed in August and September may have limited the spread of CLS across the field.

Table 1. Sugar beet response to single mode fungicide disease control program.

Treatment		Disease Rating		Beet Yield	Sugar	Purity	Extractable Sucrose	Revenue
		10/01	10/13					
#	Description	rating		ton/ac	%		lbs/ac	%
1	No treatment check	6.4	7.1	14.0	16.6	90.4	3923	85.10
2	Headline	1.8	3.1	16.1	17.7	91.3	4903	115.05
3	Priaxor	2.1	3.3	16.2	17.6	91.1	4898	114.23
4	Proline + NIS	1.5	2.3	18.0	17.8	91.2	5490	128.96
5	Gem 500 SC	2.2	3.2	17.5	17.4	91.1	5219	120.02
6	Inspire-ST	1.6	2.6	13.4	17.8	91.0	4104	96.52
7	Eminent	1.8	2.8	15.9	17.5	91.1	4787	110.98
8	Water Check	6.8	7.5	14.2	16.6	90.3	3991	86.51
9	Topguard	1.7	2.9	13.1	17.2	90.5	3830	86.58
10	Quadris	2.2	3.5	14.7	17.5	90.7	4388	101.37
11	Topsin M4.5F	1.9	2.9	12.4	17.5	91.3	3751	87.85
12	Manzate Flowable	3.1	3.9	15.1	17.4	91.2	4522	104.50
13	Super-Tin 4L	2.9	3.5	10.9	17.6	90.8	3352	79.03
14	Agri-tin 4L	3.3	4.1	14.0	17.7	91.2	4261	99.75
15	Ballard Plus	3.4	4.6	10.6	17.4	90.8	3137	71.84
16	Badge Plus	4.4	5.7	12.2	17.3	90.8	3595	81.96
17	Topsin + Agri-Tin 4L	2.8	3.9	15.6	17.7	90.8	4715	110.01
18	Topsin + Super-Tin 4L	1.8	2.7	16.1	17.3	90.8	4777	109.38
19	Proline + EBDC + NIS	1.5	2.5	13.0	17.5	91.2	3937	92.00
20	Eminent + EBDC	2.1	3.1	15.1	17.3	91.2	4508	104.14
21	Headline + EBDC	1.7	3.0	16.8	17.4	91.1	5032	116.13
22	Gem + EBDC	1.6	2.9	14.8	17.1	90.9	4328	97.65
C.V		18.0	11.4	32.9	2.2	0.5	33.4	34.0
Fisher's protected LSD 5%		0.6	0.6	NSD	0.5	0.6	NSD	NSD

Evaluation of Fungicides Program for Control of Cercospora Leaf Spot.

Danube, MN - 2014

Introduction: Optimizing fungicide programs for control of Cercospora leaf spot in sugar beets is an ongoing research program. Concern for the potential development of resistance to any of our limited fungicide options has enhanced the need to consider the efficacy of multiple fungicidal modes of action within a Cercospora leaf spot control program.

Past research has been the basis for fungicide recommendations for Cercospora leaf spot control. The past recommendations have emphasized the rotation of alternate modes of action, 3 applications or more per season and more recently the inclusion of multiple modes of action to manage resistance.

Objectives: The objective of this test was to evaluate fungicides for control of Cercospora leaf spot using fungicide programs with multiple modes of action. The test measures both the efficacy and the influence on sugar beet production.

Methods: Table 1 lists the treatments evaluated at the Danube (fine textured soil) test site in 2014. Corn was the previous crop planted and harvested in 2013. The study was planted on 29 May 2014 to variety 91RR01. The individual 6 row plots were 11 feet (6 rows with 22 inch row spacing) wide and 35 feet long. The study used a randomized complete block design with 4 replicates. Sugar beets were not thinned.

Normal production practices were conducted on the sugar beets within the testing area. Sugar beets stands were not thinned. The site received one application of Roundup (24 oz. /acre) and Select Max (9 oz. /acre) to control weeds and volunteer corn on 17 July. The following day, the site was inoculated with CLS using a Gandy Air Unit. Initial fungicide treatments were applied on 5 August with additional treatment applications occurring on 14 day intervals (8/19, 9/2 or 9/15) as dictated by the experimental design (Table 1). Treatments were applied using a 4 nozzle (22” spacing) with flat fan tips, at 14 gallons solution per acre using a tractor speed of 4.5 mph.

Sugar beets were weighed on the harvester for calculation of yield and a subsample was collected and analyzed in the SMBSC quality lab for sugar percent, purity, and brie nitrate. The Cercospora leaf spot control, sugar beet production data, and sugar beet evaluations are included in Table 1.

Results and discussion: While the disease ratings collected in October were significantly affected by treatment selection (Table 1), the critical factors {yield, percent sugar, revenue (%)} were not. As evident from the coefficient of variability (CV), variance was high (CV>15) with most of the factors measured. The disease ratings indicated a difference between a 3 versus 4 application spray program. Ratings for the 4 applications treatments fell between the control (no treatment application) and applications 2 and 3.

The climatic conditions may have limited disease pressure. The late planting (29 May) would have limited sugar beet growth in a normal year. Field conditions and the natural variation found across the site may have introduced a large amount of variability in the data. In addition, the rather moderate relative humidity present in August and September may have limited the spread of CLS in the field.

Table 1. Sugar beet quantity and quality response to fungicide program.									
			Rating					Extractible	
No.	Treatment (first, fb 2nd, fb 3rd, etc.)	Timing	10/01	10/13	Yield t/ac	Sugar %	Purity %	Sucrose -lbs/ac-	Revenue %
1	Check	N/A	5.6	6.7	12.2	16.4	90.5	3419	71.04
2	Proline SC + Preference, Super-Tin 4L, Headline	First Appl. 14, 14	2.4	3.4	17.1	16.9	90.6	4928	105.36
3	Inspire XT, Super-Tin 4L, Headline	First Appl. 14, 14	1.9	3.0	20.3	17.0	90.7	5848	125.37
4	Proline + Ballard Plus, Super-Tin 4L, Headline	First Appl. 14, 14	2.1	3.1	19.6	17.2	90.7	5755	125.16
5	Topguard, Super-Tin 4L, Headline	First Appl. 14, 14	2.4	3.4	13.9	17.1	90.5	4092	89.07
6	Proline + NIS, Super-Tin 4L, Gem 500 SC	First Appl. 14, 14	2.5	3.5	17.5	17.2	90.9	5162	112.71
7	Inspire XT, Super-Tin 4L, Gem 500 SC	First Appl. 14, 14	2.3	3.9	12.3	17.1	91.5	3629	79.19
8	Eminent, Super-Tin 4,L Gem 500 SC	First Appl. 14, 14	2.6	3.4	16.8	17.1	91.2	4924	106.91
9	Topguard, Super-Tin 4L, Gem 500 SC	First Appl. 14, 14	2.5	3.9	16.6	16.1	86.3	4517	90.68
10	Proline + NIS, Super-Tin 4L, Priaxor	First Appl. 14, 14	2.2	2.9	17.5	17.1	90.8	5096	110.28
11	Inspire XT, Super-Tin 4L, Priaxor	First Appl. 14, 14	2.6	3.2	18.1	16.8	90.9	5200	110.61
12	Eminent, Super-Tin 4L, Priaxor	First Appl. 14, 14	2.6	3.6	19.2	17.3	90.8	5633	122.86
13	Eminent, Super-Tin 4L, Headline	First Appl. 14, 14	2.2	5.4	12.5	17.3	91.1	3706	81.41
14	Eminent + Badge SC, Super-Tin 4L, Headline	First Appl. 14, 14	2.1	3.2	14.3	17.2	91.0	4238	92.87
15	Affiance, Super-Tin 4L, Headline	First Appl. 14, 14	4.5	5.6	15.6	16.7	90.3	442 4	93.36
16	Eminent, Super-Tin 4L, Headline, Super-Tin 4L	First Appl. 14, 14, 14	4.0	4.8	12.7	17.0	91.0	3670	78.86
17	Eminent, Super-Tin 4L, Gem 500 SC, Super-Tin 4L	First Appl. 14, 14, 14	4.3	5.5	11.3	17.1	90.9	3292	70.90
18	Proline + NIS, Super-Tin 4L, Headline, Super-Tin 4L	First Appl. 14, 14 14	4.0	5.2	15.7	17.2	91.1	4567	98.61
19	Proline + NIS, Super-Tin 4L, Gem 500 SC, Super-Tin 4L	First Appl. 14, 14, 14	3.8	5.0	11.4	17.0	91.1	3320	71.72
20	Inspire XT + EBDC Super-Tin 4L, Headline	First Appl. 14, 14	2.3	3.4	16.1	17.1	90.7	4692	101.16
21	Inspire XT, Super-Tin 4L Headline + EBDC	First Appl. 14, 14	1.9	2.9	14.6	17.0	90.9	4243	91.24
22	Inspire XT , Super-Tin 4L Headline + EBDC	First Appl. 14, 14	2.1	3.0	19.9	17.3	90.8	5886	129.44
23	Inspire XT, Super-Tin 4L + Topsin, Headline + EBDC	First Appl. 14, 14	1.8	3.0	18.2	17.2	91.4	5381	117.84
24	Super-Tin 4L, Inspire XT Headline	First Appl. 14, 14	2.1	3.3	15.1	17.5	92.8	4747	110.01
25	Super-Tin 4L, Inspire XT Gem 500 SC	First Appl. 14, 14	2.0	3.2	20.9	17.1	90.7	6069	130.74
26	Proline + NIS/Powermax Super-Tin 4L, Headline	First Appl. 14, 14	1.8	2.7	9.7	12.7	68.0	333 0	82.51
27	Proline + NIS	First Appl.	1.6	3.4	15.8	17.2	90.7	4610	99.94
C.V			17.3	25.3	36.3	10.4	9.9	36.3	37.3
Fisher's Protected $LSD_{0.05}$			0.6	1.3	NSD	NSD	NSD	NSD	NSD