2016
RESEARCH REPORT

Southern Minnesota Beet Sugar Cooperative

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2016 SMBSC Official Variety Trial Procedures

Four Official Variety Trial locations were planted in 2016. These trials were located near Murdock, Renville, Lake Lillian, and Hector. Trials were planted with a modified 12 row John Deere 7300 vacuum planter. Plots were four 22” rows wide by forty feet long. Each variety was replicated six times across the trial. The experimental design of the trials was a partially balanced lattice design. 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, Dual Magnum, Stinger, Betamix, and Select Max 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. SMBSC Research Staff conducted all the spraying operations. Six or seven Cercospora leafspot fungicide applications were made at each Official Variety Trial sites.

In early September, approximately 2.5 feet was 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.

All varieties were entered into various disease nurseries to evaluate the disease tolerance of the varieties. Cercospora leafspot nurseries were conducted by SMBSC at a location near Renville 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 Renville as well as the BSDF Rhizoctonia nursery in Michigan.

All the data is summarized and merged with the 2014 and 2015 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 2017 sugar beet crop.

2016 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	Soybeans	No	5/2/16	Moderate-severe Aph. Moderate Rhizoc Heavy CLS	10/20/16
Lake Lillian	Mike, Brad, and Jeff Schmoll	Official Trial	Soybeans	No	5/3/16	Moderate Aph. Moderate CLS	10/2/2016 & 10/3/2016
Renville	C&P Farms	Official Trial	Soybeans	Yes	4/22/16	Light Rhizoc, Moderate CLS Rhizomania present	10/10/2016 & 10/11/2016
Murdock	Kyle Petersen	Official Trial	Sweet Corn	Yes	5/5/16	Moderate CLS	10/14/16

All trials were sprayed with 2-3 applications of glyphosate and a layby application Dual Magnum. Trials were hand weeded for any escapes
Quadris was band applied to all trials at approximately the 4-8 leaf beet stage for rhizoctonia suppression.
Six CLS fungicide applications were applied to Renville, Lake Lillian, and Hector. Seven CLS fungicides were applied to Murdock.

2016 Disease Nursery Trial Specifications

Disease	Cooperator	Location	Ratings Performed By	Use of Ratings in 2016 Variety Approval
Cercospora	Betaseed	Randolph	Betaseed	50% of 2016 CLS Rating
Cercospora	SMBSC	Renville	SMBSC Research Staff	50% of 2016 CLS Rating
Aphanomyces	Betaseed	Shakopee	Betaseed, Jason Brantner, Ashok Chanda, Mark Bloomquist	50% of 2016 Aphanomyces Rating
Aphanomyces	SMBSC	Renville	SMBSC Research Staff	50% of 2016 Aphanomyces Rating
Rhizoctonia	BSDF - USDA/ARS Linda Hanson	Michigan	USDA/ARS	2016 Rhizoctonia Specialty Approval Status
Rhizcotonia	SMBSC	Renville	SMBSC Research Staff	2016 Rhizoctonia Specialty Approval Status

Table 1. 2017 SMBSC Varieties Approved for Unlimited Sales

2017 Approved Varieties	Specialty	Rec/T (lbs) 3 yr avg	Rec/T (lbs) % of mean	Rec/A (lbs) 3 yr avg	Rec/A (lbs) % of mean	Sugar % 3 yr avg	Sugar % % of mean	Purity (%) 3 yr avg	Purity (%) % of mean	Yield (T/A) 3 yr avg	Yield (T/A) % of mean	Cercospora Leaf Spot** 3 yr avg	Cercospora Leaf Spot** % of mean	Rhizoctonia Root Rating** 3 yr avg	Rhizoctonia Root Rating** % of mean	Aphanomyces Root Rating** 3 yr avg	Aphanomyces Root Rating** % of mean	Emerge-ence (%) 3 yr avg	Emerge-ence (%) % of mean	Revenue per Ton* % of mean	Revenue per Acre* % of mean
Beta 92RR30	APH	277.8	100.1	8445.9	98.8	16.2	99.9	91.8	100.2	30.1	98.3	4.0	87.6	4.6	100.0	3.4	77.9	70.7	103.8	100.2	98.6
Beta 92RR60		279.9	100.9	8682.0	101.5	16.4	101.4	91.3	99.6	30.8	100.7	4.9	107.6	4.5	97.8	4.7	108.7	67.4	98.9	101.4	102.0
Beta 9475	CLS	277.6	100.1	9102.5	106.4	16.2	99.6	92.0	100.4	32.6	106.6	4.0	87.5	4.5	97.8	4.9	114.1	66.9	98.3	100.8	107.3
Crystal M375		280.3	101.1	8830.7	103.3	16.4	101.1	91.6	99.9	31.3	102.3	4.8	105.1	4.6	100.0	5.0	114.7	67.3	98.7	102.2	104.5
Crystal M380	APH	277.1	99.9	8432.1	98.6	16.1	99.5	91.9	100.3	30.2	98.7	4.6	100.1	4.2	91.3	3.5	79.8	67.9	99.7	99.2	97.9
Crystal RR270		273.5	98.6	8172.9	95.6	16.1	99.2	91.2	99.6	29.6	96.6	5.3	116.2	4.6	100.0	4.4	101.4	69.2	101.6	97.4	94.2
Maribo MA109RR	RHC	275.6	99.4	8198.1	95.9	16.1	99.3	91.7	100.1	29.6	96.8	4.4	95.8	3.2	69.6	4.5	103.4	67.5	99.1	98.7	95.4
Mean		**277.4**	**100.0**	**8552.0**	**100.0**	**16.2**	**100.0**	**91.6**	**100.0**	**30.6**	**100.0**	**4.6**	**100.0**	**4.3**	**100.0**	**4.3**	**100.0**	**68.1**	**100.0**	**100.0**	**100.0**
Specialty Approved Varieties with 3 Years of Data (% of mean is of Approved Mean)																					
Crystal RR018	RHC	270.2	97.4	8307.0	97.1	15.9	98.2	91.1	99.4	30.7	100.4	4.3	93.1	3.8	82.6	4.4	101.8	71.1	104.3	94.6	94.9
Hilleshog 9093RR	RHC	254.9	91.9	7883.6	92.2	15.2	93.4	90.7	99.0	30.8	100.6	4.4	95.8	3.3	71.7	5.0	115.0	68.6	100.8	84.8	85.3
Last Year of Sales (Variety did not make Approval Criteria in 2016)																					
Beta 90RR54		266.7	96.1	8596.0	100.5	15.7	96.6	91.4	99.8	32.1	104.8	4.2	90.8	4.0	87.0	4.1	94.5	70.9	104.1	92.9	97.4

*Revenue per ton and Revenue per Acre figures were produced using the payment calculation for the 2016 crop.

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

Table 2. 2017 Test Market and Specialty Varieties Compared with SMBSC Fully Approved Varieties - Two Years of Data

		Rec/T (lbs)		Rec/A (lbs)		Sugar %		Purity (%)		Yield (T/A)		Cercospora Leaf Spot		Rhizoctonia Root Rating		Aphanomyces Root Rating		Emerge-ence (%)		Revenue per Ton*	Revenue per Acre*
2017 Approved Varieties	**Specialty**	**2 yr avg**	**% of mean**	**2 yr avg**	**% of mean**	**2 yr avg**	**% of mean**	**2 yr avg**	**% of mean**	**2 yr avg**	**% of mean**	**2 yr avg**	**% of mean**	**2 yr avg**	**% of mean**	**2 yr avg**	**% of mean**	**2 yr avg**	**% of mean**	**% of mean**	**% of mean**
Beta 92RR30	APH	282.4	100.8	9302.7	100.1	16.4	100.4	92.1	100.3	32.7	99.1	4.1	89.2	4.7	106.8	3.3	77.9	70.0	102.3	101.7	100.9
Beta 92RR60		282.3	100.8	9304.8	100.1	16.6	101.5	91.3	99.4	32.7	99.0	4.8	106.1	4.6	104.5	4.7	110.5	66.8	97.7	102.1	101.2
Beta 9475	CLS	279.9	100.0	10011.4	107.7	16.2	99.4	92.3	100.5	35.6	108.0	4.0	86.8	4.5	102.3	4.8	114.1	68.0	99.4	99.7	107.7
Crystal M375		281.6	100.6	9428.0	101.4	16.4	100.6	91.8	100.0	33.2	100.8	4.8	104.1	4.8	109.1	4.7	111.3	68.8	100.6	100.9	101.6
Crystal M380	APH	279.7	99.9	9152.3	98.4	16.2	99.5	92.2	100.3	32.5	98.5	4.5	99.0	4.4	100.0	3.4	79.8	67.3	98.3	99.5	98.0
Crystal RR270		274.1	97.9	8728.8	93.9	16.1	98.6	91.3	99.4	31.5	95.6	5.5	120.6	4.7	106.8	4.4	103.9	70.0	102.3	95.9	91.6
Maribo MA109RR	RHC	280.2	100.1	9153.8	98.5	16.3	99.9	92.0	100.1	32.6	99.0	4.3	94.2	3.3	75.0	4.3	102.4	68.0	99.4	100.2	99.1
Mean		**280.0**	**100.0**	**9297.4**	**100.0**	**16.3**	**100.0**	**91.9**	**100.0**	**33.0**	**100.0**	**4.6**	**100.0**	**4.4**	**100.0**	**4.2**	**100.0**	**68.4**	**100.0**	**100.0**	**100.0**
2016 Test Market Varieties for Limited Sales with 2 Years Data (% of mean is of Approved Mean)																					
Beta 9545		279.0	99.6	9398.5	101.1	16.4	100.6	91.1	99.2	33.5	101.6	4.8	104.4	4.3	97.7	4.8	113.1	69.2	101.2	99.0	100.6
Beta 9565		274.3	98.0	9858.8	106.0	16.0	98.3	91.7	99.9	35.6	107.9	4.4	96.4	4.2	95.5	4.5	105.9	69.8	102.0	95.7	103.3
Crystal M579		288.6	103.1	9924.9	106.7	16.8	103.0	91.8	99.9	34.3	104.1	4.6	100.2	4.8	109.1	4.4	103.3	72.4	105.8	105.9	110.2
Hilleshog 9739		270.2	96.5	8671.8	93.3	15.7	96.5	92.1	100.2	31.8	96.6	4.1	88.8	3.6	81.8	4.8	113.7	64.6	94.5	93.0	89.6
SV RR958		269.2	96.1	9357.0	100.6	15.7	96.2	92.0	100.1	34.6	105.0	4.4	96.7	4.3	97.7	5.0	118.1	69.1	101.1	92.7	97.3
2016 Specialty Approved Varieties with 2 Years Data (% of mean is of Approved Mean)																					
Beta 9505	CLS	269.3	96.2	9513.4	102.3	15.7	96.2	92.0	100.2	35.2	106.7	3.8	83.0	4.3	97.7	3.8	89.7	69.6	101.7	92.7	98.9
Crystal M509	CLS	265.4	94.8	10709.0	115.2	15.5	95.0	92.0	100.1	40.2	121.8	3.7	81.8	4.4	100.0	3.8	89.6	71.6	104.7	90.2	110.0
Crystal RR018	RHC	272.6	97.3	9139.2	98.3	16.0	98.2	91.3	99.4	33.4	101.2	4.3	93.2	3.8	86.4	4.4	104.3	72.0	105.2	94.6	95.8
Hilleshog 9093RR	RHC	259.1	92.5	8718.9	93.8	15.3	93.9	91.1	99.1	33.5	101.7	4.3	95.1	3.3	75.0	4.8	114.1	68.2	99.7	85.5	86.8
Last Year of Sales (Variety did not make Approval Criteria in 2016) % of mean is of Approved Mean																					
Beta 90RR54		268.8	96.0	9449.7	101.6	15.7	96.3	91.8	99.9	35.0	106.0	4.1	90.3	4.3	97.7	4.3	101.1	71.1	103.9	92.2	97.8

*Revenue per ton and Revenue per Acre figures were produced using the payment calculation for the 2016 crop.

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

Table 3. Comparison of 2017 Fully Approved Varieties to Test Market and Specialty Approved Varieties Based on 1 Year Data, 2016

		Rec/T (lbs)		Rec/A (lbs)		Sugar %		Purity (%)		Yield (T/A)		Cercospora Leaf Spot**		Rhizoctonia Root Rating**		Aphanomyces Root Rating**		Emerge-ence (%)		Revenue per Ton*	Revenue per Acre*
2017 Approved Varieties	**Specialty**	**1 yr avg**	**% of mean**	**1 yr avg**	**% of mean**	**1 yr avg**	**% of mean**	**1 yr avg**	**% of mean**	**1 yr avg**	**% of mean**	**1 yr avg**	**% of mean**	**1 yr avg**	**% of mean**	**1 yr avg**	**% of mean**	**1 yr avg**	**% of mean**	**% of mean**	**% of mean**
Beta 92RR30	APH	263.4	100.8	7956.0	99.1	15.5	100.5	91.7	100.2	30.0	98.3	4.2	92.3	4.6	102.2	3.4	80.6	64.6	102.2	102.0	100.1
Beta 92RR60		266.1	101.9	8004.0	99.7	15.8	102.6	90.8	99.3	29.9	97.8	4.6	101.2	4.6	102.2	4.6	108.7	60.3	95.3	103.6	101.3
Beta 9475	CLS	266.3	101.9	9022.6	112.4	15.5	100.9	92.2	100.8	33.7	110.4	4.1	89.3	4.5	100.0	5.1	119.4	66.6	105.4	103.4	114.0
Crystal M375		263.0	100.7	8323.6	103.7	15.5	100.5	91.6	100.1	31.4	102.9	4.9	106.7	4.7	104.4	4.5	104.3	64.5	102.0	101.7	104.4
Crystal M380	APH	258.7	99.0	7689.2	95.8	15.2	98.6	91.9	100.4	29.6	97.0	4.6	101.8	4.7	104.4	3.4	79.9	59.3	93.8	98.3	95.1
Crystal RR270		247.4	94.7	7084.1	88.3	14.8	96.1	90.6	99.0	28.4	93.0	5.4	118.5	4.7	104.4	4.2	97.8	65.8	104.1	89.0	82.7
Maribo MA109RR	RHC	264.1	101.1	8089.9	100.8	15.5	100.7	91.7	100.2	30.7	100.5	4.1	90.2	3.8	84.4	4.7	109.4	61.4	97.1	102.0	102.4
Mean		**261.3**	**100.0**	**8024.2**	**100.0**	**15.4**	**100.0**	**91.5**	**100.0**	**30.5**	**100.0**	**4.6**	**100.0**	**4.5**	**100.0**	**4.3**	**100.0**	**63.2**	**100.0**	**100.0**	**100.0**
2017 Test Market Varieties with 1 Year Data (% of mean is of Approved Mean)																					
Beta 9545		260.5	99.7	8157.1	101.7	15.5	100.7	90.8	99.2	31.1	101.9	4.6	101.8	4.3	95.6	4.5	104.4	62.6	99.0	99.4	101.1
Beta 9565		259.5	99.3	8693.1	108.3	15.3	99.3	91.6	100.1	33.2	108.9	4.5	97.6	4.2	93.3	4.4	102.4	64.6	102.2	98.9	107.3
Crystal M579		271.9	104.0	8844.6	110.2	16.0	103.9	91.4	99.9	32.6	106.6	4.5	98.2	5.0	111.1	4.3	101.1	66.8	105.6	108.2	115.4
Hilleshog 9739		252.5	96.6	7402.8	92.3	14.9	96.8	91.6	100.1	29.2	95.7	4.1	89.6	3.8	84.4	4.6	107.2	56.6	89.6	93.2	89.0
SV RR958		253.2	96.9	8235.8	102.6	14.9	96.8	91.7	100.2	32.5	106.3	4.6	101.1	4.4	97.8	5.5	128.4	61.3	97.0	93.5	99.3
2017 Specialty Approved Varieties with 1 Year Data (% of mean is of Approved Mean)																					
Beta 9505	CLS	254.1	97.2	8381.5	104.5	14.9	97.0	91.8	100.3	32.9	107.9	4.1	88.7	4.5	100.0	4.1	95.1	64.3	101.8	93.8	100.9
Crystal M509	CLS	251.7	96.3	9458.1	117.9	14.8	96.4	91.7	100.2	37.4	122.6	3.9	85.4	4.5	100.0	4.0	93.8	65.2	103.1	92.1	112.6
Crystal RR018	RHC	255.2	97.7	7869.8	98.1	15.1	98.4	91.1	99.5	30.7	100.4	4.4	96.4	3.8	84.4	4.7	109.8	66.1	104.6	94.6	95.0
Hilleshog 9093RR	RHC	242.0	92.6	7502.6	93.5	14.4	94.0	90.8	99.2	31.1	101.8	4.3	95.1	3.3	73.3	4.8	112.3	61.8	97.8	84.0	85.4
Last Year of Sales (Variety did not make Approval Criteria in 2016) % of mean is of Approved Mean																					
Beta 90RR54		251.7	96.3	8115.6	101.1	14.9	96.7	91.4	99.9	32.2	105.4	4.2	92.0	4.4	97.8	4.4	102.5	65.5	103.6	92.7	97.6

*Revenue per ton and Revenue per Acre figures were produced using the payment calculation for the 2016 crop.

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

2014 - 2016 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 2016 Root Rating	2015 Root Rating	2014 Root Rating	2015-2016 2 Year Mean Baseline Adjusted Root Rating	2014-2016 3 Year Mean Baseline Adjusted Root Rating	Aphanomyces Root Ratings 2016 Root Rating	2015 Root Rating	2014 Root Rating	2015-2016 2 Year Mean Baseline Adjusted Root Rating	2014-2016 3 Year Mean Baseline Adjusted Root Rating	Cercospora Leafspot Ratings 2016 CLS Rating	2015 CLS Rating	2014 CLS Rating	2015-2016 2 Year Mean Baseline Adjusted Root Rating	2014-2016 3 Year Mean Baseline Adjusted Root Rating
Fully Approved Varieties															
Beta 92RR30 (Aph)	4.6	4.8	4.3	4.7	4.6	3.4	3.1	3.6	3.3	3.4	4.2	3.9	3.9	4.1	4.0
Beta 92RR60	4.6	4.6	4.3	4.6	4.5	4.6	4.7	4.8	4.7	4.7	4.6	5.1	5.1	4.8	4.9
Beta 9475 (CLS)	4.5	4.6	4.4	4.5	4.5	5.1	4.5	5.2	4.8	4.9	4.1	3.9	4.1	4.0	4.0
Crystal M375	4.7	4.8	4.3	4.8	4.6	4.5	4.9	5.5	4.7	5.0	4.9	4.7	4.9	4.8	4.8
Crystal M380 (Aph)	4.7	4.1	3.9	4.4	4.2	3.4	3.3	3.6	3.4	3.5	4.6	4.4	4.7	4.5	4.6
Crystal RR270	4.7	4.7	4.3	4.7	4.6	4.2	4.6	4.4	4.4	4.4	5.4	5.6	4.9	5.5	5.3
Maribo MA109RR (RHC)	3.8	2.9	2.8	3.3	3.2	4.7	4.0	4.8	4.3	4.5	4.1	4.5	4.5	4.3	4.4
Test Market Varieties															
Beta 9545	4.3	4.3		4.3		4.5	5.1		4.8		4.6	4.9		4.8	
Beta 9565	4.2	4.2		4.2		4.4	4.6		4.5		4.5	4.4		4.4	
Crystal M579	5.0	4.6		4.8		4.3	4.4		4.4		4.5	4.7		4.6	
Hilleshog 9739	3.8	3.5		3.6		4.6	5.0		4.8		4.1	4.0		4.1	
SV RR958	4.4	4.3		4.3		5.5	4.5		5.0		4.6	4.2		4.4	
Specialty Approved															
Crystal RR018 (RHC)	3.8	3.9	3.7	3.8	3.8	4.7	4.1	4.4	4.4	4.4	4.4	4.1	4.3	4.3	4.3
Hilleshog 9093RR (RHC)	3.3	3.3	3.3	3.3	3.3	4.8	4.8	5.3	4.8	5.0	4.3	4.4	4.5	4.3	4.4
Beta 9505 (CLS)	4.5	4.1		4.3		4.1	3.5		3.8		4.1	3.5		3.8	
Crystal M509 (CLS)	4.5	4.3		4.4		4.0	3.5		3.8		3.9	3.6		3.7	
Last Year of Sales															
Beta 90RR54	4.4	4.1	3.3	4.3	4.0	4.4	4.1	3.8	4.3	4.1	4.2	4.1	4.2	4.2	4.2

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

Cercospora Ratings from SMBSC Nursery in Renville and Betaseed Nursery near Randolph MN.
Ratings are on scale of 1-9. 1 = Clean leaves, 9 = Dead Leaves.

SMBSC Variety Strip Trial - Summary of Eight Locations

Variety	Stand Count 28 DAP Beets/100' row	Sugar %	Purity %	Tons / Acre	Extractable Sugar per Acre	Percent of Mean Revenue per Acre
Beta 9475	207.6	15.1	92.0	31.1	8016.6	114.2
Crystal M380	177.4	14.9	91.3	27.1	6822.1	94.7
Crystal RR018	216.9	15.2	91.7	28.3	7306.3	104.2
Hilleshog 9528RR	185.8	14.3	91.9	30.4	7397.0	99.3
SV RR865	159.3	14.0	90.9	27.0	6328.7	81.1
SV RR958	205.8	14.6	92.0	31.1	7739.4	106.5
Mean	192.1	14.7	91.6	29.2	7268.3	100.0
%CV	5.2	2.0	0.6	8.9	9.3	10.9
PR>F	<0.0001	<0.0001	0.0005	0.0029	0.0002	<0.0001
LSD (0.05)	10.1	0.3	0.5	2.6	684.4	11.0
Reps	8	8	8	8	8	8

Combined data of 8 locations. Each location is considered a replicate.

Locations included are: Maynard, Danube, Raymond, Belgrade, Lake Lillian, Montevideo, and Renville.

Revenue calculated using the October 15, 2015 payment with the new payment formula for 2016

2016 SMBSC Variety Strip Trial - Maynard

Variety	Stand Count 28 DAP Beets/100' row	Sugar %	Purity %	Tons / Acre	Extractable Sugar per Acre	Percent of Mean Revenue per Acre
Beta 9475	208	15.6	92.7	30.8	8299.4	107.3
Crystal M380	190	15.1	91.7	29.5	7592.9	94.1
Crystal RR018	220	14.9	91.5	30.0	7582.9	92.3
Hilleshog 9528RR	208	14.5	92.3	34.9	8674.8	103.7
SV RR865	180	14.5	92.1	33.0	8144.9	96.8
SV RR958	233	14.9	92.3	33.8	8628.2	105.9
Beta 90RR54		15.2	92.6	33.0	8674.6	109.6
Mean	207	14.9	92.1	32.0	8153.9	100.0

Planted: April 14
Harvested: September 20
Agriculturist - Cody Bakker

2016 SMBSC Variety Strip Trial - Danube

Variety	Stand Count 28 DAP Beets/100' row	Sugar %	Purity %	Tons / Acre	Extractable Sugar per Acre	Percent of Mean Revenue per Acre
Beta 9475	210	13.8	93.2	33.1	7913.0	117.3
Crystal M380	179	13.8	92.2	26.1	6142.8	89.4
Crystal RR018	213	13.5	92.4	29.6	6814.1	96.8
Hilleshog 9528RR	191	13.4	93.5	35.8	8320.9	119.3
SV RR865	159	13.1	92.7	29.0	6505.1	89.4
SV RR958	204	13.5	93.5	32.2	7547.3	109.1
Crystal M375	210	12.4	93.8	28.3	6085.8	78.7
Mean	195	13.4	93.0	30.6	7047.0	100.0

Planted: April 14
Harvested: September 30
Agriculturist - Chris Dunsmore

2016 SMBSC Variety Strip Trial - Belgrade

Variety	Stand Count 28 DAP Beets/100' row	Sugar %	Purity %	Tons / Acre	Extractable Sugar per Acre	Percent of Mean Revenue per Acre
Beta 9475	225	15.2	91.4	29.9	7701.7	108.9
Crystal M380	183	15.3	91.6	28.1	7330.9	104.9
Crystal RR018	245	16.1	91.1	31.5	8570.9	127.3
Hilleshog 9528RR	230	14.5	91.0	19.9	4837.8	64.6
SV RR865	163	14.1	89.9	20.5	4761.9	60.3
SV RR958	230	14.7	91.5	31.5	7838.5	107.1
Beta 9054	198	15.6	91.4	31.9	8439.9	122.3
Crystal M375	228	15.5	91.2	27.7	7276.1	104.5
Mean	213	15.1	91.1	27.6	7094.7	100.0

Planted: April 16
Harvested: October 16
Agriculturist - Jared Kelm

2016 SMBSC Variety Strip Trial - Raymond

Variety	Stand Count 28 DAP Beets/100' row	Sugar %	Purity %	Tons / Acre	Extractable Sugar per Acre	Percent of Mean Revenue per Acre
Beta 9475	180	16.7	92.6	28.8	8381.9	115.2
Crystal M380	153	16.0	91.2	26.8	7296.7	95.0
Crystal RR018	188	16.6	91.7	27.5	7826.4	105.9
Hilleshog 9528RR	138	15.8	91.6	28.4	7633.3	98.4
SV RR865	133	15.3	91.2	26.2	6779.1	84.5
SV RR958	160	15.6	91.9	29.5	7875.1	101.0
Mean	159	16.0	91.7	27.9	7632.1	100.0

Planted: April 22
Harvested: October 19
Agriculturist - Jared Kelm

2016 SMBSC Variety Strip Trial - Lake Lillian - Early Harvested Strip

Variety	Stand Count 28 DAP Beets/100' row	Sugar %	Purity %	Tons / Acre	Extractable Sugar per Acre	Percent of Mean Revenue per Acre
Beta 9475	205	14.7	92.0	28.3	7122.7	111.1
Crystal M380	170	14.7	91.8	22.6	5662.4	87.9
Crystal RR018	205	15.2	92.2	25.4	6642.1	107.5
Hilleshog 9528RR	168	14.2	91.1	29.1	6944.6	102.2
SV RR865	150	14.5	91.7	21.4	5279.1	80.6
SV RR958	200	14.9	92.2	27.4	6991.4	110.6
Mean	183	14.7	91.8	25.7	6440.4	100.0

Planted: April 16
Harvested: September 14
Agriculturist - Les Plumley

SMBSC Variety Strip Trial - Lake Lillian - Late Harvested Strip

Variety	Stand Count 28 DAP Beets/100' row	Sugar %	Purity %	Tons / Acre	Extractable Sugar per Acre	Percent of Mean Revenue per Acre
Beta 9475	205	15.5	93.2	31.0	8373.2	125.0
Crystal M380	170	15.2	92.3	26.4	6866.1	99.1
Crystal RR018	205	15.5	92.1	25.8	6856.1	100.9
Hilleshog 9528RR	168	14.2	92.6	31.1	7601.9	102.9
SV RR865	150	13.9	91.1	23.9	5583.7	71.8
SV RR958	200	14.7	92.4	28.5	7175.5	100.4
Mean	183	14.8	92.3	27.8	7076.1	100.0

Planted: April 16
Harvested: October 21
Agriculturist - Les Plumley

2016 SMBSC Variety Strip Trial - Renville

Variety	Stand Count 28 DAP Beets/100' row	Sugar %	Purity %	Tons / Acre	Extractable Sugar per Acre	Percent of Mean Revenue per Acre
Beta 9475	220	14.3	89.9	38.1	8979.1	111.7
Crystal M380	194	14.1	88.9	33.1	7584.7	91.1
Crystal RR018	216	14.7	90.9	33.7	8344.1	109.5
Hilleshog 9528RR	198	14.1	90.9	35.2	8351.0	104.5
SV RR865	176	13.0	88.1	35.3	7344.7	77.2
SV RR958	204	14.1	90.8	35.9	8487.4	105.9
Mean	201	14.0	89.7	35.1	8120.7	100.0

Planted: April 15
Harvested: October 18
Agriculturist - Mike Schjenken

SMBSC Variety Strip Trial - Montevideo

Variety	Stand Count 28 DAP Beets/100' row	Sugar %	Purity %	Tons / Acre	Extractable Sugar per Acre	Percent of Mean Revenue per Acre
Beta 9475	208	15.0	91.3	28.9	7361.7	116.0
Crystal M380	180	14.9	90.8	24.4	6100.0	94.2
Crystal RR018	243	15.0	91.3	23.0	5813.4	91.0
Hilleshog 9528RR	185	14.0	91.9	28.6	6811.7	99.8
SV RR865	163	13.9	90.7	26.9	6230.8	88.6
SV RR958	215	14.3	91.6	30.4	7372.3	110.4
Mean	199	14.5	91.2	26.4	6463.5	100.0

Planted: May 5
Harvested: October 14
Agriculturist - Scott Thaden

SMBSC Variety Strip Trial - Appleton

Variety	Stand Count 28 DAP Beets/100' row	Sugar %	Purity %	Tons / Acre	Extractable Sugar per Acre	Percent of Mean Revenue per Acre
Beta 9475	238	15.4	92.2	33.5	8877.1	104.1
Crystal M380	215	16.1	92.7	32.0	8919.6	109.4
Crystal RR018	208	16.1	91.6	27.9	7640.7	92.3
Hilleshog 9528RR	220	15.2	92.7	33.7	8853.7	102.9
SV RR865	178	14.3	90.6	35.3	8471.9	89.8
SV RR958	215	15.4	92.3	31.3	8268.9	96.7
Crystal M375	215	16.5	92.9	30.7	8805.7	110.5
Beta 90RR54	205	15.5	92.2	30.0	7981.7	93.9
Beta 92RR60		16.7	92.3	30.5	8766.1	110.2
Mean	212.33	15.4	92.0	32.3	8505.3	100.0

Planted:	4/14/2016
Harvested:	9/19/2016
Agriculturist:	Scott Thaden

* Strip Trial was not machine harvested. Ten foot of row was harvested from 10 points across the strip trial for each variety and yields calculated.

ENTRY	LABEL	Entry Name	% SUGAR MEAN	% SUGAR PCT	ESP MEAN	ESP PCT	RECOV. SUG/TON MEAN	RECOV. SUG/TON PCT	TONS/ACRE MEAN	TONS/ACRE PCT	ESA MEAN	ESA PCT	% PURITY MEAN	% PURITY PCT	NITRATE MEAN	NITRATE PCT	EMERGENCE MEAN	EMERGENCE PCT
16	P	Beta 90RR54	14.37	99.4	12.25	100.5	245.05	100.4	25.47	105.4	6231.9	105.7	92.03	100.9	24.19	101.7	65.28	100.9
24	X	Beta 92RR30	14.82	102.4	12.68	104.0	253.64	104.0	26.86	111.2	6809.5	115.4	92.16	101.1	15.18	63.8	69.98	108.1
38	AL	Beta 92RR60	14.75	102.0	12.31	100.9	246.13	100.9	23.21	96.1	5700.3	96.6	90.35	99.1	24.92	104.8	65.89	101.8
39	AM	Beta 9475	14.98	103.5	12.86	105.4	257.19	105.4	25.83	106.9	6683.3	113.3	92.33	101.2	12.99	54.6	69.36	107.2
32	AF	Beta 9505	14.39	99.4	12.18	99.8	243.57	99.8	27.92	115.6	6807.8	115.4	91.46	100.3	21.59	90.8	65.83	101.7
20	T	Beta 9545	14.86	102.7	12.45	102.0	248.95	102.0	24.89	103.0	6226.6	105.6	90.59	99.3	24.92	104.8	67.08	103.6
26	Z	Beta 9565	14.68	101.5	12.51	102.5	250.16	102.5	27.23	112.7	6936.7	117.6	91.87	100.7	19.74	83.0	66.41	102.6
19	S	Beta 9606	14.50	100.3	12.41	101.8	248.27	101.8	26.68	110.5	6605.9	112.0	92.26	101.2	24.69	103.8	64.22	99.2
22	V	Beta 9661	14.14	97.7	12.08	99.0	241.61	99.0	28.50	118.0	6889.4	116.8	92.26	101.2	22.21	93.4	67.98	105.0
36	AJ	Beta 9666	15.12	104.5	12.85	105.3	257.02	105.3	27.33	113.1	6854.2	116.2	91.59	100.4	19.77	83.1	68.45	105.8
4	D	Beta 9677	14.86	102.7	12.48	102.3	249.62	102.3	26.49	109.6	6598.0	111.9	90.82	99.6	19.21	80.8	64.26	99.3
40	AN	Beta 9688	14.75	102.0	12.22	100.2	244.42	100.2	23.32	96.5	5683.2	96.4	89.89	98.6	22.94	96.5	69.30	107.1
15	O	Crystal RR018	14.60	100.9	12.28	100.7	245.56	100.7	22.93	94.9	5611.4	95.1	90.98	99.8	30.40	127.8	70.23	108.5
46	AT	Crystal RR270	13.89	96.0	11.51	94.3	230.13	94.3	21.52	89.1	5016.2	85.0	90.11	98.8	45.73	192.3	64.57	99.8
49	AW	Crystal M375	14.55	100.6	12.31	100.9	246.26	100.9	25.13	104.0	6204.5	105.2	91.41	100.2	20.25	85.1	64.64	99.9
13	M	Crystal M380	14.07	97.3	11.92	97.7	238.34	97.7	26.10	108.0	6231.0	105.6	91.65	100.5	30.80	129.5	62.55	96.6
21	U	Crystal M509	14.27	98.6	12.12	99.4	242.44	99.4	31.28	129.5	7569.3	128.3	91.78	100.6	20.50	86.2	67.67	104.5
25	Y	Crystal M579	15.01	103.8	12.67	103.8	253.32	103.8	26.51	109.7	6708.4	113.7	91.05	99.8	19.36	81.4	67.25	103.9
43	AQ	Crystal M623	14.32	99.0	12.18	99.9	243.65	99.9	25.40	105.1	6180.6	104.8	91.85	100.7	23.89	100.5	67.54	104.3
34	AH	Crystal M635	14.83	102.5	12.41	101.7	248.22	101.7	27.12	112.2	6720.4	113.9	90.57	99.3	19.67	82.7	72.21	111.6
9	I	Crystal M640	14.08	97.3	11.90	97.5	237.99	97.5	26.84	111.1	6317.9	107.1	91.50	100.3	24.10	101.3	65.77	101.6
5	E	Crystal M657	15.05	104.0	12.59	103.2	251.71	103.2	26.78	110.8	6757.8	114.6	90.43	99.2	21.08	88.6	64.48	99.6
33	AG	Crystal M671	15.12	104.5	12.71	104.2	254.26	104.2	22.72	94.0	5788.7	98.1	90.83	99.6	23.84	100.2	66.94	103.4
1	A	Crystal M697	13.57	93.8	11.39	93.3	227.72	93.3	26.45	109.5	6054.9	102.7	91.13	99.9	29.92	125.8	66.99	103.5
12	L	Hilleshog 9093RR	14.45	99.9	12.02	98.6	240.45	98.6	21.75	90.0	5214.6	88.4	90.26	99.0	22.80	95.9	66.54	102.8
11	K	Hilleshog 9528RR	14.45	99.9	12.26	100.5	245.12	100.5	22.83	94.5	5590.5	94.8	91.59	100.4	26.36	110.8	60.93	94.1
8	H	Hilleshog 9739	14.68	101.5	12.37	101.4	247.33	101.4	21.93	90.8	5441.6	92.3	91.01	99.8	15.17	63.8	55.77	86.2
31	AE	Hilleshog 9874	14.14	97.8	11.77	96.5	235.51	96.5	20.69	85.6	4903.7	83.1	90.37	99.1	21.71	91.3	63.11	97.5
48	AV	Hilleshog 9875	14.64	101.2	12.42	101.9	248.49	101.9	21.75	90.0	5350.0	90.7	91.60	100.5	21.38	89.9	60.47	93.4
14	N	Hilleshog 9876	14.63	101.1	12.23	100.3	244.62	100.3	17.18	71.1	4185.5	71.0	90.54	99.3	31.55	132.7	70.82	109.4
45	AS	Hilleshog 9877	13.70	94.7	11.39	93.3	227.70	93.3	19.22	79.6	4380.8	74.3	90.44	99.2	33.87	142.4	60.88	94.1
27	AA	Maribo MA109RR	15.33	105.9	13.05	107.0	261.04	107.0	22.54	93.3	5851.5	99.2	91.62	100.5	17.55	73.8	65.95	101.9
44	AR	Maribo MA523	14.52	100.4	12.37	101.4	247.40	101.4	20.36	84.3	5017.8	85.1	91.93	100.8	17.79	74.8	62.52	96.6
10	J	Maribo MA600	14.20	98.2	11.89	97.5	237.73	97.4	20.83	86.2	4991.8	84.6	90.75	99.5	17.86	75.1	53.23	82.2
41	AO	Maribo MA601	14.52	100.4	12.12	99.4	242.46	99.4	17.89	74.1	4368.2	74.1	90.44	99.2	28.92	121.6	65.90	101.8
18	R	Maribo MA602	13.79	95.3	11.45	93.9	228.99	93.9	20.89	86.5	4759.5	80.7	90.36	99.1	22.53	94.7	58.87	91.0
23	W	Maribo MA603	14.02	96.9	11.66	95.6	233.16	95.6	21.86	90.5	5075.5	86.1	90.33	99.1	40.08	168.5	48.93	75.6
30	AD	SV RR861	14.11	97.6	11.97	98.2	239.52	98.2	23.91	99.0	5721.1	97.0	91.76	100.6	30.09	126.5	65.05	100.5
7	G	SV RR862	14.58	100.8	12.39	101.6	247.78	101.6	25.61	106.0	6347.9	107.6	91.70	100.6	13.24	55.7	55.00	85.0
3	C	SV RR863	14.98	103.6	12.78	104.8	255.62	104.8	25.77	106.7	6552.8	111.1	91.87	100.7	13.98	58.8	66.21	102.3
37	AK	SV RR864	14.41	99.6	12.19	99.9	243.73	99.9	23.50	97.3	5720.6	97.0	91.41	100.2	26.99	113.5	65.02	100.5
29	AC	SV RR865	14.30	98.9	12.06	98.9	241.21	98.9	23.33	96.6	5631.0	95.5	91.24	100.1	21.23	89.3	62.88	97.1
28	AB	SV RR958	14.60	100.9	12.40	101.6	248.03	101.7	25.88	107.1	6421.6	108.9	91.64	100.5	23.61	99.3	61.21	94.6
35	AI	Filler 1 Beta 70RR99	14.48	100.1	12.28	100.7	245.72	100.7	26.52	109.8	6536.8	110.8	91.67	100.5	23.46	98.6	73.47	113.5
17	Q	Filler 2 Crystal RR830	13.61	94.1	11.50	94.3	229.96	94.3	24.85	102.9	5686.8	96.4	91.61	100.5	20.20	84.9	70.44	108.8
42	AP	Baseline 5 Beta 95RR03	13.96	96.5	11.78	96.6	235.54	96.5	26.37	109.2	6240.7	105.8	91.38	100.2	17.13	72.0	62.71	96.9
47	AU	Baseline 6 Crystal RR265	14.24	98.4	11.96	98.1	239.28	98.1	27.82	115.1	6657.1	112.9	91.03	99.8	33.00	138.8	59.96	92.6
2	B	Baseline 7 Hilleshog 4017RR	14.42	99.7	12.02	98.5	240.37	98.5	16.38	67.8	3914.4	66.4	90.40	99.1	41.76	175.6	65.12	100.6
6	F	Baseline 8 Hilleshog 9093RR	14.51	100.3	12.13	99.5	242.67	99.5	21.64	89.6	5267.2	89.3	90.55	99.3	21.19	89.1	65.53	101.3
		GRAND MEAN	14.47		12.20		243.97		24.16		5898.30		91.19		23.78		64.72	
		CV	2.05		2.54		2.54		7.68		8.0		0.63		27.86		9.07	
		LSD	0.29		0.31		6.14		1.89		483.1		0.57		6.54		5.80	
		MSE	0.09		0.10		41.35		3.92		256297.2		0.36		47.05		36.97	
		SED	0.18		0.19		3.71		1.14		292.3		0.34		3.96		3.51	
		ALPH	0.05		0.05		0.05		0.05		0.1		0.05		0.05		0.05	
		REPS	6.00		6.00		6.00		6.00		6.0		6.00		6.00		6.00	

			% SUGAR		ESP		RECOV. SUG/TON		TONS/ACRE		ESA		% PURITY		NITRATE		EMERGENCE	
ENTRY	LABEL	Entry Name	MEAN	PCT	MEAN	PCT	MEAN	PCT	MEAN	PCT	MEAN	PCT	MEAN	PCT	MEAN	PCT	MEAN	PCT
16	P	Beta 90RR54	14.63	99.5	12.35	99.1	247.08	99.1	32.39	100.2	7991.46	99.2	91.26	99.7	37.00	110.8	71.18	111.6
24	X	Beta 92RR30	15.17	103.1	13.00	104.3	259.96	104.2	29.37	90.9	7660.92	95.1	92.15	100.7	30.41	91.0	63.62	99.8
38	AL	Beta 92RR60	15.61	106.2	13.25	106.3	264.98	106.3	29.69	91.9	7878.97	97.8	91.32	99.8	30.94	92.6	62.14	97.5
39	AM	Beta 9475	15.19	103.3	13.04	104.6	260.79	104.6	34.19	105.8	8918.48	110.7	92.26	100.8	20.99	62.8	71.94	112.8
32	AF	Beta 9505	14.68	99.9	12.55	100.6	250.94	100.6	33.13	102.5	8309.69	103.2	92.06	100.6	28.43	85.1	67.18	105.4
20	T	Beta 9545	15.54	105.7	13.20	105.8	263.93	105.8	30.46	94.3	8026.08	99.6	91.37	99.9	28.39	85.0	60.84	95.4
26	Z	Beta 9565	14.90	101.3	12.62	101.2	252.34	101.2	33.51	103.7	8473.19	105.2	91.35	99.8	28.58	85.6	67.36	105.6
19	S	Beta 9606	14.87	101.1	12.59	101.0	251.82	101.0	32.44	100.4	8185.93	101.6	91.35	99.8	42.42	127.0	65.80	103.2
22	V	Beta 9661	14.85	101.0	12.62	101.2	252.52	101.3	33.80	104.6	8525.89	105.8	91.67	100.2	25.26	75.6	67.29	105.5
36	AJ	Beta 9666	15.29	104.0	12.92	103.6	258.32	103.6	32.74	101.3	8473.68	105.2	90.99	99.4	38.00	113.8	61.80	96.9
4	D	Beta 9677	15.40	104.7	13.15	105.5	263.05	105.5	33.06	102.3	8696.65	108.0	91.80	100.3	25.66	76.8	69.69	109.3
40	AN	Beta 9688	15.37	104.5	12.94	103.8	258.78	103.8	31.51	97.5	8164.92	101.4	90.77	99.2	26.47	79.2	67.44	105.8
15	O	Crystal RR018	15.03	102.2	12.84	103.0	256.79	103.0	30.58	94.6	7836.17	97.3	91.97	100.5	43.47	130.1	67.01	105.1
46	AT	Crystal RR270	14.55	99.0	12.27	98.4	245.43	98.4	30.34	93.9	7464.62	92.7	91.15	99.6	37.18	111.3	68.93	108.1
49	AW	Crystal M375	15.48	105.2	13.26	106.3	265.13	106.3	31.10	96.2	8243.53	102.3	92.01	100.6	22.92	68.6	67.75	106.3
13	M	Crystal M380	14.94	101.6	12.80	102.6	255.97	102.6	29.00	89.7	7422.63	92.1	92.23	100.8	39.11	117.1	57.92	90.8
21	U	Crystal M509	14.54	98.9	12.34	99.0	246.80	99.0	38.39	118.8	9462.07	117.5	91.64	100.2	38.96	116.6	67.87	106.5
25	Y	Crystal M579	15.54	105.7	13.21	105.9	264.19	105.9	32.69	101.1	8380.14	104.0	91.46	100.0	24.70	73.9	64.93	101.8
43	AQ	Crystal M623	15.08	102.6	12.88	103.3	257.53	103.3	31.22	96.6	8038.87	99.8	91.91	100.4	35.93	107.6	66.51	104.3
34	AH	Crystal M635	15.24	103.6	12.97	104.0	259.46	104.0	35.04	108.4	9162.50	113.7	91.63	100.1	34.39	102.9	63.51	99.6
9	I	Crystal M640	15.03	102.2	13.05	104.7	261.04	104.7	32.35	100.1	8619.66	107.0	93.19	101.8	17.43	52.2	67.42	105.8
5	E	Crystal M657	15.11	102.7	12.78	102.5	255.61	102.5	32.61	100.9	8342.23	103.6	91.18	99.6	31.44	94.1	67.18	105.4
33	AG	Crystal M671	15.53	105.6	13.09	104.9	261.68	104.9	30.90	95.6	8088.53	100.4	90.79	99.2	26.60	79.6	68.49	107.4
1	A	Crystal M697	14.10	95.9	11.98	96.1	239.61	96.1	32.76	101.4	7873.08	97.7	91.80	100.3	31.29	93.7	68.94	108.1
12	L	Hilleshog 9093RR	14.23	96.7	11.92	95.6	238.33	95.6	35.01	108.3	8326.17	103.4	90.83	99.3	36.62	109.6	67.18	105.4
11	K	Hilleshog 9528RR	14.43	98.1	12.16	97.5	243.17	97.5	35.78	110.7	8782.56	109.0	91.10	99.6	38.78	116.1	67.29	105.5
8	H	Hilleshog 9739	14.73	100.1	12.48	100.1	249.56	100.1	31.62	97.8	7846.07	97.4	91.48	100.0	32.40	97.0	58.95	92.5
31	AE	Hilleshog 9874	13.85	94.2	11.67	93.6	233.38	93.6	32.26	99.8	7472.27	92.8	91.29	99.8	35.87	107.4	51.59	80.9
48	AV	Hilleshog 9875	14.27	97.0	12.15	97.4	242.91	97.4	31.86	98.6	7816.64	97.0	91.91	100.5	27.84	83.3	62.26	97.6
14	N	Hilleshog 9876	14.40	97.9	12.19	97.8	243.83	97.8	35.38	109.5	8649.18	107.4	91.52	100.0	46.66	139.7	67.70	106.2
45	AS	Hilleshog 9877	13.63	92.7	11.33	90.9	226.56	90.9	30.74	95.1	6989.39	86.8	90.57	99.0	34.68	103.8	59.29	93.0
27	AA	Maribo MA109RR	15.31	104.1	13.05	104.7	261.09	104.7	31.92	98.8	8343.60	103.6	91.62	100.1	28.40	85.0	57.86	90.8
44	AR	Maribo MA523	14.54	98.8	12.28	98.5	245.55	98.5	34.15	105.7	8382.05	104.1	91.32	99.8	31.10	93.1	66.20	103.8
10	J	Maribo MA600	14.61	99.4	12.44	99.8	248.75	99.7	31.08	96.2	7741.24	96.1	91.81	100.3	21.75	65.1	52.63	82.5
41	AO	Maribo MA601	14.76	100.4	12.36	99.1	247.16	99.1	29.85	92.4	7386.47	91.7	90.57	99.0	44.29	132.6	64.41	101.0
18	R	Maribo MA602	13.46	91.5	11.27	90.4	225.32	90.4	27.67	85.6	6189.37	76.8	90.98	99.4	38.41	115.0	55.02	86.3
23	W	Maribo MA603	13.55	92.1	11.33	90.9	226.61	90.9	34.02	105.3	7567.66	93.9	90.93	99.4	45.82	137.2	53.78	84.3
30	AD	SV RR861	14.31	97.3	12.02	96.4	240.29	96.4	32.71	101.2	7863.89	97.6	90.90	99.3	33.04	98.9	62.88	98.6
7	G	SV RR862	14.82	100.8	12.64	101.4	252.89	101.4	33.39	103.3	8463.19	105.1	91.87	100.4	30.13	90.2	62.59	98.2
3	C	SV RR863	15.39	104.6	13.24	106.2	264.72	106.2	34.08	105.4	9015.19	111.9	92.37	101.0	19.76	59.2	57.01	89.4
37	AK	SV RR864	14.65	99.6	12.46	99.9	249.10	99.9	32.71	101.2	8137.18	101.0	91.74	100.3	41.18	123.3	60.74	95.3
29	AC	SV RR865	14.66	99.7	12.51	100.4	250.30	100.4	30.25	93.6	7534.37	93.5	91.99	100.5	23.06	69.0	54.39	85.3
28	AB	SV RR958	14.76	100.4	12.52	100.4	250.44	100.4	32.22	99.7	8090.72	100.4	91.50	100.0	32.84	98.3	59.21	92.9
35	AI	Filler 1 Beta 70RR99	14.62	99.4	12.53	100.5	250.67	100.5	32.38	100.2	8106.42	100.6	92.40	101.0	36.32	108.7	71.75	112.5
17	Q	Filler 2 Crystal RR830	13.43	91.4	11.39	91.4	227.91	91.4	34.38	106.4	7771.18	96.5	92.00	100.5	25.76	77.1	70.77	111.0
42	AP	Baseline 5 Beta 95RR03	13.90	94.5	11.61	93.1	232.10	93.1	30.44	94.2	7059.10	87.6	90.70	99.1	33.16	99.3	64.28	100.8
47	AU	Baseline 6 Crystal RR265	14.25	96.9	11.93	95.6	238.54	95.7	31.85	98.5	7535.10	93.5	90.73	99.2	61.99	185.6	55.51	87.1
2	B	Baseline 7 Hilleshog 4017RR	14.02	95.3	11.82	94.8	236.43	94.8	32.39	100.2	7669.11	95.2	91.31	99.8	61.66	184.6	67.12	105.3
6	F	Baseline 8 Hilleshog 9093RR	14.33	97.5	12.01	96.3	240.09	96.3	32.18	99.6	7742.98	96.1	90.78	99.2	29.36	87.9	60.96	95.6
		GRAND MEAN	14.71		12.47		249.38		32.32		8055.53		91.50		33.41		63.76	
		CV	2.57		3.18		3.18		5.84		6.51		0.78		35.16		11.25	
		LSD	0.37		0.39		7.83		1.88		523.74		0.71		11.62		7.05	
		MSE	0.15		0.17		67.34		3.90		301178.57		0.56		148.33		54.59	
		SED	0.22		0.24		4.74		1.14		316.85		0.43		7.03		4.27	
		ALPHA	0.05		0.05		0.05		0.05		0.05		0.05		0.05		0.05	
		REP-MS	0.17		0.25		98.67		19.84		1987788.96		1.23		529.64		294.83	
		REPS	6.00		6.00		6.00		6.00		6.00		6.00		6.00		6.00	

ENTRY	LABEL	Entry Name	% SUGAR MEAN	% SUGAR PCT	ESP MEAN	ESP PCT	RECOV. SUG/TON MEAN	RECOV. SUG/TON PCT	TONS/ACRE MEAN	TONS/ACRE PCT	ESA MEAN	ESA PCT	% PURITY MEAN	% PURITY PCT	NITRATE MEAN	NITRATE PCT	EMERGENCE MEAN	EMERGENCE PCT
16	P	Beta 90RR54	15.23	99.3	13.09	99.3	261.66	99.3	37.16	101.8	9707.6	100.9	92.27	100.0	29.49	112.4	54.92	106.5
24	X	Beta 92RR30	16.03	104.5	13.92	105.6	278.36	105.6	33.62	92.1	9401.7	97.7	92.90	100.7	18.89	72.0	54.77	106.2
38	AL	Beta 92RR60	16.54	107.8	14.15	107.4	283.11	107.4	36.06	98.8	10239.3	106.4	91.69	99.4	18.62	71.0	42.98	83.3
39	AM	Beta 9475	16.04	104.6	14.05	106.6	280.98	106.6	40.07	109.8	11228.8	116.7	93.51	101.3	14.88	56.7	55.64	107.9
32	AF	Beta 9505	15.21	99.2	13.11	99.5	262.27	99.5	36.95	101.3	9684.5	100.6	92.57	100.3	26.81	102.2	55.22	107.1
20	T	Beta 9545	15.98	104.2	13.60	103.2	271.96	103.2	37.64	103.2	10272.1	106.7	91.41	99.1	24.19	92.2	52.12	101.1
26	Z	Beta 9565	15.68	102.2	13.56	102.9	271.20	102.9	38.06	104.3	10328.8	107.3	92.73	100.5	27.16	103.6	55.65	107.9
19	S	Beta 9606	15.55	101.4	13.38	101.5	267.51	101.5	36.06	98.8	9635.8	100.1	92.30	100.0	34.64	132.1	54.15	105.0
22	V	Beta 9661	15.75	102.7	13.69	103.9	273.82	103.9	37.76	103.5	10319.3	107.2	92.96	100.7	17.82	67.9	54.36	105.4
36	AJ	Beta 9666	16.30	106.3	13.98	106.1	279.66	106.1	39.87	109.3	11137.2	115.7	91.86	99.6	19.12	72.9	56.43	109.4
4	D	Beta 9677	15.84	103.3	13.64	103.5	272.79	103.5	41.29	113.2	11298.2	117.4	92.32	100.1	23.17	88.3	53.45	103.6
40	AN	Beta 9688	16.26	106.0	13.94	105.8	278.86	105.8	34.20	93.7	9552.3	99.3	91.89	99.6	20.84	79.5	54.85	106.3
15	O	Crystal RR018	15.77	102.8	13.55	102.8	271.01	102.8	37.19	101.9	10098.1	104.9	92.20	99.9	27.57	105.1	55.38	107.4
46	AT	Crystal RR270	15.44	100.7	13.17	100.0	263.47	100.0	33.40	91.5	8825.0	91.7	91.66	99.3	28.65	109.2	54.30	105.3
49	AW	Crystal M375	16.25	105.9	14.03	106.5	280.63	106.5	38.51	105.5	10789.6	112.1	92.38	100.1	19.99	76.2	54.80	106.2
13	M	Crystal M380	15.96	104.0	13.87	105.2	277.35	105.2	33.16	90.9	9179.7	95.4	92.96	100.7	28.60	109.0	49.11	95.2
21	U	Crystal M509	15.17	98.9	13.10	99.4	261.95	99.4	42.03	115.2	11027.7	114.6	92.70	100.5	29.74	113.4	52.59	102.0
25	Y	Crystal M579	16.63	108.4	14.35	108.9	287.02	108.9	38.67	106.0	11091.4	115.3	92.27	100.0	15.78	60.2	58.58	113.6
43	AQ	Crystal M623	15.49	101.0	13.29	100.8	265.70	100.8	37.53	102.8	9987.0	103.8	92.15	99.9	30.83	117.5	50.97	98.8
34	AH	Crystal M635	16.25	106.0	13.98	106.1	279.68	106.1	40.49	111.0	11357.1	118.0	92.14	99.9	20.40	77.8	54.87	106.4
9	I	Crystal M640	15.28	99.6	13.17	99.9	263.38	99.9	37.27	102.1	9825.1	102.1	92.52	100.3	20.21	77.1	55.00	106.6
5	E	Crystal M657	16.16	105.4	13.83	105.0	276.69	105.0	36.01	98.7	9974.6	103.6	91.80	99.5	17.03	64.9	55.88	108.3
33	AG	Crystal M671	16.62	108.3	14.33	108.8	286.73	108.8	34.71	95.1	10024.5	104.2	92.27	100.0	19.29	73.5	55.80	108.2
1	A	Crystal M697	14.68	95.7	12.61	95.7	252.32	95.7	35.33	96.8	8920.3	92.7	92.45	100.2	24.71	94.2	53.46	103.6
12	L	Hilleshog 9093RR	14.53	94.7	12.38	93.9	247.63	93.9	35.27	96.7	8683.8	90.2	91.93	99.6	25.08	95.6	43.37	84.1
11	K	Hilleshog 9528RR	14.37	93.7	12.35	93.7	247.08	93.7	35.79	98.1	8813.2	91.6	92.62	100.4	28.35	108.1	53.69	104.1
8	H	Hilleshog 9739	14.90	97.1	12.82	97.3	256.33	97.3	31.76	87.0	8156.9	84.8	92.55	100.3	15.68	59.8	46.53	90.2
31	AE	Hilleshog 9874	14.83	96.7	12.71	96.4	254.13	96.4	36.66	100.5	9257.7	96.2	92.10	99.8	31.51	120.1	44.45	86.2
48	AV	Hilleshog 9875	14.71	95.9	12.66	96.0	253.14	96.0	33.77	92.6	8567.1	89.0	92.59	100.3	23.76	90.6	51.60	100.0
14	N	Hilleshog 9876	15.23	99.3	13.02	98.8	260.47	98.8	34.78	95.3	9089.1	94.4	91.99	99.7	22.08	84.2	56.75	110.0
45	AS	Hilleshog 9877	14.23	92.8	12.08	91.7	241.63	91.7	36.11	99.0	8550.8	88.9	91.67	99.4	43.27	165.0	39.14	75.9
27	AA	Maribo MA109RR	15.77	102.8	13.67	103.7	273.37	103.7	34.59	94.8	9430.6	98.0	92.81	100.6	23.24	88.6	50.88	98.6
44	AR	Maribo MA523	14.65	95.5	12.60	95.6	252.01	95.6	31.56	86.5	7955.8	82.7	92.62	100.4	23.52	89.7	54.47	105.6
10	J	Maribo MA600	14.97	97.6	12.88	97.7	257.54	97.7	35.50	97.3	8964.7	93.2	92.40	100.1	18.29	69.7	51.47	99.8
41	AO	Maribo MA601	15.10	98.5	12.84	97.4	256.74	97.4	36.92	101.2	9445.6	98.2	91.61	99.3	36.24	138.2	50.07	97.1
18	R	Maribo MA602	13.38	87.2	11.19	84.9	223.73	84.9	34.13	93.5	7707.8	80.1	91.01	98.6	65.57	250.0	38.06	73.8
23	W	Maribo MA603	13.90	90.6	11.73	89.0	234.65	89.0	35.61	97.6	8471.8	88.0	91.41	99.1	28.34	108.1	44.04	85.4
30	AD	SV RR861	15.46	100.8	13.29	100.8	265.75	100.8	39.00	106.9	10382.1	107.9	92.21	99.9	21.65	82.5	53.38	103.5
7	G	SV RR862	15.60	101.7	13.52	102.6	270.26	102.5	36.80	100.9	9970.3	103.6	92.88	100.7	17.07	65.1	51.81	100.4
3	C	SV RR863	15.48	100.9	13.45	102.1	268.97	102.0	37.71	103.3	10122.3	105.2	93.04	100.8	19.98	76.2	50.32	97.5
37	AK	SV RR864	15.08	98.3	12.98	98.5	259.56	98.5	36.93	101.2	9651.2	100.3	92.58	100.3	22.05	84.1	52.12	101.0
29	AC	SV RR865	15.13	98.6	12.99	98.5	259.78	98.6	34.62	94.9	8990.5	93.4	92.29	100.0	20.58	78.5	44.42	86.1
28	AB	SV RR958	15.15	98.7	13.06	99.1	261.22	99.1	38.92	106.7	10152.0	105.5	92.59	100.3	25.22	96.2	55.41	107.4
35	AI	Filler 1 Beta 70RR99	15.36	100.1	13.27	100.7	265.31	100.7	39.11	107.2	10341.6	107.5	92.65	100.4	27.29	104.0	55.60	107.8
17	Q	Filler 2 Crystal RR830	14.44	94.2	12.43	94.3	248.56	94.3	37.44	102.6	9271.5	96.3	92.62	100.4	21.27	81.1	52.71	102.2
42	AP	Baseline 5 Beta 95RR03	14.74	96.1	12.51	94.9	250.19	94.9	35.61	97.6	8883.3	92.3	91.54	99.2	33.97	129.5	48.11	93.3
47	AU	Baseline 6 Crystal RR265	15.48	100.9	13.23	100.4	264.60	100.4	37.66	103.2	9834.0	102.2	91.77	99.5	44.54	169.8	41.98	81.4
2	B	Baseline 7 Hilleshog 4017RR	14.40	93.9	12.22	92.8	244.53	92.8	34.01	93.2	8311.9	86.4	91.74	99.4	62.26	237.4	50.12	97.2
6	F	Baseline 8 Hilleshog 9093RR	14.62	95.3	12.50	94.8	249.98	94.8	34.60	94.8	8645.5	89.8	92.12	99.8	25.94	98.9	51.58	100.0
		GRAND MEAN	15.34		13.18		263.58		36.49		9623.6		92.27		26.23		51.58	
		CV	2.85		3.42		3.42		4.50		5.6		0.78		54.43		12.28	
		LSD	0.43		0.45		8.99		1.60		534.2		0.72		14.10		6.20	
		MSE	0.21		0.22		88.83		2.80		313444.8		0.57		218.48		42.17	
		SED	0.26		0.27		5.44		0.97		323.2		0.44		8.53		3.75	
		ALPHA	0.05		0.05		0.05		0.05		0.05		0.05		0.05		0.05	
		REP-MS	0.29		0.18		72.94		8.53		362406.1		6.85		1039.47		92.00	
		REPS	6.00		6.00		6.00		6.00		6.0		6.00		6.00		6.00	

ENTRY	LABEL	Entry Name	% SUGAR MEAN	% SUGAR PCT	ESP MEAN	ESP PCT	RECOV. SUG/TON MEAN	RECOV. SUG/TON PCT	TONS/ACRE MEAN	TONS/ACRE PCT	ESA MEAN	ESA PCT	% PURITY MEAN	% PURITY PCT	NITRATE MEAN	NITRATE PCT	EMERGENCE MEAN	EMERGENCE PCT
16	P	Beta 90RR54	15.15	99.7	12.59	99.3	251.89	99.3	33.26	104.2	8373.02	103.5	90.07	99.9	72.56	118.7	70.00	102.9
24	X	Beta 92RR30	15.80	103.9	13.13	103.5	262.55	103.5	30.65	96.1	8066.53	99.7	89.76	99.5	62.01	101.5	69.98	102.9
38	AL	Beta 92RR60	16.19	106.5	13.53	106.7	270.68	106.7	29.97	93.9	8105.23	100.2	89.97	99.7	37.52	61.4	68.54	100.7
39	AM	Beta 9475	15.79	103.8	13.31	105.0	266.26	105.0	34.80	109.1	9273.13	114.6	90.82	100.7	35.20	57.6	69.61	102.3
32	AF	Beta 9505	15.37	101.1	13.00	102.5	259.95	102.5	33.24	104.2	8599.67	106.3	91.11	101.0	67.66	110.7	69.99	102.9
20	T	Beta 9545	15.50	101.9	12.84	101.2	256.77	101.2	31.59	99.0	8092.47	100.0	89.65	99.4	58.47	95.7	70.14	103.1
26	Z	Beta 9565	15.75	103.6	13.20	104.1	264.00	104.1	33.39	104.7	8861.14	109.5	90.44	100.3	43.79	71.7	68.19	100.2
19	S	Beta 9606	15.41	101.3	12.84	101.2	256.79	101.2	31.68	99.3	8108.11	100.2	90.09	99.9	95.83	156.8	67.03	98.5
22	V	Beta 9661	15.47	101.8	12.99	102.4	259.77	102.4	32.23	101.0	8378.23	103.5	90.58	100.4	47.83	78.3	71.10	104.5
36	AJ	Beta 9666	16.03	105.4	13.17	103.8	263.37	103.8	34.09	106.9	8935.23	110.4	88.95	98.6	43.91	71.9	68.79	101.1
4	D	Beta 9677	16.21	106.6	13.36	105.4	267.26	105.4	34.82	109.1	9291.45	114.8	89.15	98.8	43.10	70.5	68.54	100.7
40	AN	Beta 9688	15.94	104.8	13.29	104.8	265.74	104.8	30.21	94.7	8007.28	98.9	89.87	99.6	48.00	78.5	70.09	103.0
15	O	Crystal RR018	15.09	99.3	12.36	97.5	247.18	97.4	31.81	99.7	7887.18	97.5	89.01	98.7	88.46	144.8	71.59	105.2
46	AT	Crystal RR270	15.19	99.9	12.54	98.8	250.72	98.8	28.47	89.2	7085.06	87.6	89.46	99.2	68.44	112.0	75.18	110.5
49	AW	Crystal M375	15.51	102.0	12.98	102.3	259.63	102.4	30.77	96.4	8006.54	98.9	90.36	100.2	58.09	95.1	70.97	104.3
13	M	Crystal M380	15.61	102.7	13.16	103.8	263.32	103.8	30.10	94.4	7927.10	98.0	90.88	100.8	47.07	77.0	68.12	100.1
21	U	Crystal M509	15.27	100.4	12.79	100.8	255.77	100.8	37.63	118.0	9688.76	119.7	90.69	100.5	45.84	75.0	72.13	106.0
25	Y	Crystal M579	16.71	109.9	14.16	111.7	283.33	111.7	32.06	100.5	9078.36	112.2	90.90	100.8	36.40	59.6	75.71	111.3
43	AQ	Crystal M623	15.23	100.2	12.77	100.7	255.31	100.7	32.91	103.2	8443.69	104.3	90.58	100.4	63.04	103.2	71.41	105.0
34	AH	Crystal M635	15.99	105.2	13.35	105.3	267.04	105.3	34.07	106.8	9069.91	112.1	90.09	99.9	44.22	72.4	72.54	106.6
9	I	Crystal M640	15.56	102.3	13.16	103.7	263.11	103.7	30.56	95.8	8038.24	99.3	91.03	100.9	35.38	57.9	69.59	102.3
5	E	Crystal M657	15.54	102.2	12.85	101.3	256.94	101.3	34.38	107.8	8793.00	108.7	89.41	99.1	53.21	87.1	72.88	107.1
33	AG	Crystal M671	16.17	106.4	13.45	106.0	268.93	106.0	29.04	91.0	7846.14	97.0	89.75	99.5	44.48	72.8	70.62	103.8
1	A	Crystal M697	14.79	97.2	12.40	97.8	247.96	97.8	33.63	105.4	8425.74	104.1	90.71	100.6	36.69	60.0	69.65	102.4
12	L	Hilleshog 9093RR	14.50	95.4	12.02	94.8	240.41	94.8	32.57	102.1	7793.96	96.3	89.90	99.7	63.65	104.2	70.36	103.4
11	K	Hilleshog 9528RR	15.13	99.5	12.75	100.5	254.94	100.5	34.41	107.9	8764.12	108.3	90.98	100.9	42.64	69.8	67.67	99.5
8	H	Hilleshog 9739	15.12	99.4	12.76	100.6	255.17	100.6	31.28	98.0	8018.60	99.1	91.15	101.0	46.28	75.7	65.02	95.6
31	AE	Hilleshog 9874	14.09	92.7	11.45	90.3	228.90	90.2	32.02	100.4	7100.10	87.7	88.78	98.4	93.91	153.7	63.56	93.4
48	AV	Hilleshog 9875	14.85	97.7	12.57	99.1	251.41	99.1	30.21	94.7	7627.81	94.3	91.28	101.2	55.72	91.2	61.78	90.8
14	N	Hilleshog 9876	15.17	99.8	12.50	98.6	250.01	98.6	31.02	97.2	7757.95	95.9	89.18	98.9	66.84	109.4	65.16	95.8
45	AS	Hilleshog 9877	14.36	94.5	11.90	93.9	238.08	93.9	29.14	91.3	6815.48	84.2	90.01	99.8	79.13	129.5	59.10	86.9
27	AA	Maribo MA109RR	15.52	102.1	13.10	103.3	262.09	103.3	33.80	106.0	8821.38	109.0	90.85	100.7	45.99	75.3	69.80	102.6
44	AR	Maribo MA523	14.49	95.3	12.06	95.1	241.16	95.1	31.61	99.1	7651.90	94.6	90.34	100.1	56.53	92.5	70.78	104.0
10	J	Maribo MA600	14.96	98.4	12.55	98.9	250.97	98.9	28.62	89.7	7180.31	88.7	90.59	100.4	53.17	87.0	64.03	94.1
41	AO	Maribo MA601	14.94	98.2	12.27	96.8	245.51	96.8	31.39	98.4	7694.58	95.1	89.26	99.0	113.58	185.9	69.16	101.7
18	R	Maribo MA602	14.00	92.1	11.60	91.4	231.97	91.4	28.72	90.0	6638.68	82.0	90.12	99.9	99.18	162.3	58.90	86.6
23	W	Maribo MA603	13.91	91.5	11.49	90.6	229.77	90.6	34.19	107.2	7825.02	96.7	89.96	99.7	86.81	142.1	55.88	82.1
30	AD	SV RR861	15.01	98.7	12.45	98.2	248.99	98.2	32.45	101.7	8058.05	99.6	89.92	99.7	49.94	81.7	70.07	103.0
7	G	SV RR862	15.21	100.0	12.82	101.1	256.45	101.1	31.75	99.5	8166.91	100.9	91.00	100.9	52.89	86.6	61.79	90.8
3	C	SV RR863	15.41	101.4	12.95	102.1	258.95	102.1	31.88	99.9	8285.02	102.4	90.76	100.6	41.73	68.3	66.95	98.4
37	AK	SV RR864	15.08	99.2	12.62	99.5	252.37	99.5	31.49	98.7	7900.74	97.6	90.38	100.2	49.97	81.8	67.53	99.3
29	AC	SV RR865	15.54	102.2	13.09	103.2	261.93	103.3	31.80	99.7	8284.79	102.4	90.70	100.6	42.37	69.3	60.67	89.2
28	AB	SV RR958	14.98	98.5	12.66	99.8	253.28	99.8	32.75	102.6	8302.79	102.6	91.14	101.0	47.75	78.1	69.32	101.9
35	AI	Filler 1 Beta 70RR99	15.18	99.8	12.74	100.5	254.84	100.5	32.14	100.8	8189.77	101.2	90.59	100.4	69.87	114.3	71.88	105.7
17	Q	Filler 2 Crystal RR830	14.53	95.6	12.20	96.2	243.89	96.1	32.59	102.1	8062.70	99.6	90.87	100.7	62.17	101.7	71.96	105.8
42	AP	Baseline 5 Beta 95RR03	14.65	96.3	12.09	95.3	241.73	95.3	30.13	94.4	7283.20	90.0	89.62	99.4	66.41	108.7	61.69	90.7
47	AU	Baseline 6 Crystal RR265	14.35	94.4	11.72	92.4	234.36	92.4	31.88	99.9	7462.68	92.2	89.05	98.7	93.73	153.4	60.83	89.4
2	B	Baseline 7 Hilleshog 4017RR	14.21	93.4	11.73	92.5	234.60	92.5	27.37	85.8	6462.51	79.9	89.72	99.5	173.46	283.9	67.39	99.1
6	F	Baseline 8 Hilleshog 9093RR	14.58	95.9	12.17	95.9	243.32	95.9	32.69	102.5	7999.05	98.8	90.40	100.2	63.41	103.8	69.92	102.8
		GRAND MEANS	15.20		12.68		253.66		31.90		8092.43		90.20		61.11		68.03	
		CV	3.21		4.15		4.15		4.27		5.58		1.22		45.36		7.90	
		LSD	0.49		0.53		10.65		1.35		455.13		1.10		27.62		5.29	
		MSE	0.27		0.31		124.54		2.01		227479.07		1.33		838.20		30.77	
		SED	0.30		0.32		6.44		0.82		275.37		0.67		16.72		3.20	
		ALPHA	0.05		0.05		0.05		0.05		0.05		0.05		0.05		0.05	
		REP-MS	1.19		1.39		559.77		2.59		745257.88		2.06		1976.90		16.71	
		REPS	6.00		6.00		6.00		6.00		6.00		6.00		6.00		6.00	

Evaluation of Fungicide Programs for Control of Cercospora Leaf Spot, Clara City, MN - 2016

Introduction: Cercospora Leaf Spot is a disease that affects the SMBSC growing area every season. A well timed fungicide program is an important part of managing this disease. The past two seasons have produced large infections of Cercospora across the growing area. Fungicide resistance development has increased the importance of including multiple modes of action in a Cercospora fungicide program.

Objectives: The objective of this trial was to evaluate several fungicide programs for control of Cercospora leaf spot. Each of these fungicide programs contained treatments that rotated the fungicide modes of action through the course of the program. Foliar ratings were conducted to measure treatment efficacy against CLS. The trial was harvested for yield and quality results.

Methods: The trial was set up in a randomized complete block design with four replications. Each individual plot was six (22") rows wide by 35' long. The trial was planted on May 4, 2016 with the variety Betaseed 92RR60. One application of Sequence and one application of Roundup Powermax were made for weed control. Quadris was banded over the trial on June 10 to suppress Rhizoctonia root rot.

On July 15, the trial was inoculated with pulverized Cercospora leaf inoculum. The inoculation was conducted with a Gandy Air Unit. The first fungicide applications were made on July 22. The fungicide treatments were applied to the center four rows of each six row plot. In every plot, row one and six remained untreated. Additional fungicide treatments were applied on August 5, August 17, and selected treatments had a fourth application on September 1. Treatments were applied with a tractor sprayer at 4 mph using 11002 flat fan spray nozzles at 22 gallons per acre and a spray pressure of 90 psi.
Sugar beets were defoliated with a six row defoliator and harvested with a two row research harvester. The center two rows of each plot were harvested and weighed for yield determination. A sample was taken from every plot for analysis of sugar content and purity. The yield and rating data was compiled and an analysis of the data performed using SAS version 9.3. Table 1 lists the treatments as well as the Cercospora Leafspot ratings and yield information from the 2016 trial.

Results and discussion: The 2016 season was exceptionally favorable for Cercospora development. Foliar ratings were taken using the KWS 1-9 scale with 1 being disease free and 9 being completely brown. The untreated check plots had a CLS rating of 6.8 at the first rating period on August 17. There was a high level of Cercospora present throughout the trial and the fungicide treated plots were also affected by the disease. At the second rating period, all treatments had CLS ratings greater than 4.6 and the untreated check had a rating of 9.0. These high ratings indicate some economic loss occurred in all treatments included in the trial by the second rating period. All the treatments resulted in CLS ratings statistically better than the untreated check for the first two rating periods. By the third rating period on September 12, the disease had overwhelmed several of the treatments. The rapid progression of the disease across the trial once treatments ended limited yield differences between treatments and thus all yield parameters were not statistically significant.

2016 SMBSC Cercospora Leaf Spot Fungicide Trial

Treatment	Application 1 Date: July 22, 2016	Application 2 Date: August 5, 2016	Application 3 Date: August 17, 2016	Application 4 Date: September 1, 2016	Percent Sugar	Extractable Sugar/Ton (lbs.)	Tons/Acre	Extractable Sugar/Acre (lbs.)	Percent Purity	Brei Nitrate (ppm)	17-Aug Ave Rating	29-Aug Ave Rating	12-Sep Ave Rating
1	Untreated	Untreated	Untreated	Untreated	14.1	240.7	26.2	6297.8	92.2	92.3	6.8	9.0	9.0
2	AgriTin 4L (8 oz./Acre)	Priaxor (6.7 oz./A)	Proline SC (5 oz./Acre)		14.6	249.4	30.5	7594.7	92.3	69.0	3.8	5.8	8.8
	Topsin M 4.5L (10 oz./Acre)												
3	AgriTin 4L (8 oz./Acre)	Priaxor (6.7 oz./Acre)	Proline SC (5 oz./Acre)		14.4	237.5	30.0	7139.2	90.0	55.3	3.1	5.0	8.6
	Topsin M 4.5L (10 oz./Acre)	Dithane F45 (1.6 Quart./Acre)	Dithane F45 (1.6 Quart./Acre)										
4	AgriTin 4L (8 oz./Acre)	Priaxor (6.7 oz./Acre)	Proline SC (5 oz./Acre)		14.9	253.2	27.7	7004.7	91.5	60.0	2.8	5.3	7.4
	Topsin M 4.5L (10 oz./Acre)	Badge SC (2 pint/Acre)	Badge SC (2 pint/Acre)										
5	AgriTin 4L (8 oz./Acre)	Priaxor (6.7 oz./Acre)	Proline SC (5 oz./Acre)	AgriTin 4L (8 oz./Acre)	15.1	254.8	26.7	6798.8	91.2	72.5	2.8	4.9	8.3
	Topsin M 4.5L (10 oz./Acre)												
6	Proline SC (5 oz./Acre)	AgriTin 4L (8 oz./Acre)	Priaxor (6.7 oz./Acre)		14.3	239.5	28.2	6766.3	91.0	84.8	5.1	7.0	8.9
7	Proline SC (5 oz./Acre)	AgriTin 4L (8 oz./Acre)	Priaxor (6.7 oz./Acre)		15.1	259.1	27.8	7183.8	92.3	56.8	2.9	4.6	7.3
	Badge SC (2 pint/Acre)	Topsin M 4.5L (10 oz./Acre)	Badge SC (2 pint/Acre)										
8	AgriTin 4L (8 oz./Acre)	Priaxor (6.7 oz./Acre)	Minerva Duo (16 oz./Acre)		15.2	258.3	28.9	7435.6	91.6	80.5	2.8	5.2	8.3
	Topsin M 4.5L (10 oz./Acre)												
9	AgriTin 4L (8 oz./Acre)	Priaxor (6.7 oz./Acre)	Eminent VP (13 oz./Acre)		14.1	239.2	28.0	6705.0	91.5	103.3	3.3	5.1	8.8
	Topsin M 4.5L (10 oz./Acre)												
10	AgriTin 4L (8 oz./Acre)	Gem (3.5 oz./Acre)	Proline SC (5 oz./Acre)		14.4	240.2	29.1	6989.4	90.6	57.0	3.8	6.2	8.8
	Topsin M 4.5L (10 oz./Acre)												
11	Priaxor (6.7 oz./Acre)	AgriTin 4L (8 oz./Acre)	Proline SC (5 oz./Acre)		14.2	236.1	27.8	6645.9	90.3	108.0	5.1	5.8	8.9
		Topsin M 4.5L (10 oz./Acre)											
12	Priaxor (6.7 oz./Acre)	AgriTin 4L (8 oz./Acre)	Proline SC (5 oz./Acre)		15.1	254.0	28.9	7336.6	91.1	58.5	4.0	5.4	7.8
	Badge SC (2 pint/Acre)	Topsin M 4.5L (10 oz./Acre)	Badge SC (2 pint/Acre)										
13	AgriTin 4L (8 oz./Acre)	Priaxor (6.7 oz./Acre)	Inspire XT (7 oz./Acre)		15.2	258.7	27.6	7117.1	91.9	64.0	3.1	5.7	8.8
	Topsin M 4.5L (10 oz./Acre)												
14	AgriTin 4L (8 oz./Acre)	Priaxor (6.7 oz./Acre)	Proline SC (5 oz./Acre)	AgriTin 4L (8 oz./Acre)	14.9	254.1	28.4	7102.9	92.1	69.0	4.4	7.3	9.0
15	Minerva (13 oz. /Acre)	AgriTin 4L (8 oz./Acre)	Headline SC (9 oz./Acre)		14.7	250.6	27.6	6906.2	91.9	80.3	4.8	6.8	8.9
		Dithane F45 (1.6 Quart./Acre)											
16	Minerva Duo (16 oz. /Acre)	Dithane F45 (1.6 Quart./Acre)	Headline SC (9 oz./Acre)		14.7	246.9	27.9	6880.4	91.0	92.5	4.4	7.2	9.0

		Percent Sugar	Extractable Sugar/Ton (lbs.)	Tons/Acre	Extractable Sugar/Acre (lbs.)	Percent Purity	Brei Nitrate (ppm)	17-Aug Ave Rating	29-Aug Ave Rating	12-Sep Ave Rating
Location: Clara City	Mean	14.7	248.4	28.2	6997.9	91.4	75.2	3.9	6	8.5
Planted: May 4, 2016	CV%	4.1	5.6	7	8.8	1.4	35.7	15.3	9.2	3.3
Harvested: October 13, 2016	lsd (0.05)	N/S	N/S	N/S	N/S	N/S	N/S	0.86	0.78	0.39
Inoculated: July 15, 2016	Pr >F	0.1023	0.2128	0.2787	0.4015	0.3756	0.1053	<0.0001	<0.0001	<0.0001
	reps	4	4	4	4	4	4	4	4	4
	alpha	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05

Date of Harvest Trials
Clara City and Murdock, MN - 2016

Introduction: Sugar beets are a biennial crop and will continue to increase in yield and sugar content during the first year of growth until the beets are harvested. This rate of growth and sugar accumulation can vary based on the environmental conditions present in any given year and the health of the sugar beet foliage.

Objectives: In 2011, SMBSC began to perform trials to measure the rate of growth of the sugar beets during the period from mid-August through early-October. These trials provided rate of growth data for each season for sugar content, tons per acre, purity, and extractable sugar per acre. The weekly harvest information could also be used to look at the SMBSC prepile premium and how effectively it compensates shareholders for early harvesting of a portion of their sugar beet crop.

Methods: Trials were established at 2-4 locations across the Cooperative each season since 2011. These trials were often conducted on the same locations as the SMBSC Official Variety Trials. In 2016, the Date of Harvest Trials were conducted at a location near Murdock and at a location near Clara City. Trial maintenance was performed similar to the nearby Official Variety Trial. Each week during the mid-August to early-October time frame approximately 180' of row was harvested from each trial location. Harvest was accomplished with a tractor mounted one row defoliator and one row sugar beet harvester. The beets harvested each week were placed in tare bags and brought to the SMBSC tare lab for weights and quality analysis. Sample analysis included tare, sugar content, purity, and brie nitrate. Row lengths were measured each week prior to harvest and these lengths were used to accurately calculate the area harvested. The calculated harvested area for each week was used to determine yield on a per acre basis.

Results and discussion: The first harvest date for the trial was August 17, 2016. Harvesting continued on a weekly basis until October 13, 2016. We were not able to harvest during the week of September 4-10 due to rain and very wet field conditions at the two trial locations. The first 5-6 weeks were difficult harvest conditions due to the frequent rains and wet soils. Cercospora leaf spot levels were extremely high across the Cooperative growing area in 2016. The Cercospora infection destroyed the canopy in many fields causing regrowth of the leaves. This regrowth of the leaves comes at the expense of yield and sugar accumulation in the beets. The regrowth diverts the storage of sugars in the root and utilizes these sugars as energy sources for new leaf development. The effects of this can be seen in the 2016 growth rates of the sugar beet crop. Figure 1 shows rate of gain for extractable sugar per acre for the 2015 crop year. The 2015 data is typical of the pattern that is seen most seasons for extractable sugar per acre increases over this time period. The pattern is nearly linear over the time period. In 2016 the data does not follow the same pattern. The 2016 extractable sugar per acre data can be seen in Figure 2. The 2016 season begins with an upward linear trend, but it flattens out in early September and remains flat for the remainder of the season. The flat line in the growth pattern in 2016 is likely a result of the Cercospora leaf spot infection.

In Table 1, the average extractable sugar per acre increase per day is shown for the past six years for the period from mid-August to early-October. Using the years 2011 – 2015, on average there is an increase in extractable sugar per acre per day of 94.9 pounds of sugar. This is the amount of sugar produced by the leaves and stored in the roots every day on a per acre basis. The increase in extractable sugar per acre for the 2016 season was 45.7 pounds of extractable sugar per acre per day. This is less the 50% of the average from the previous five years.

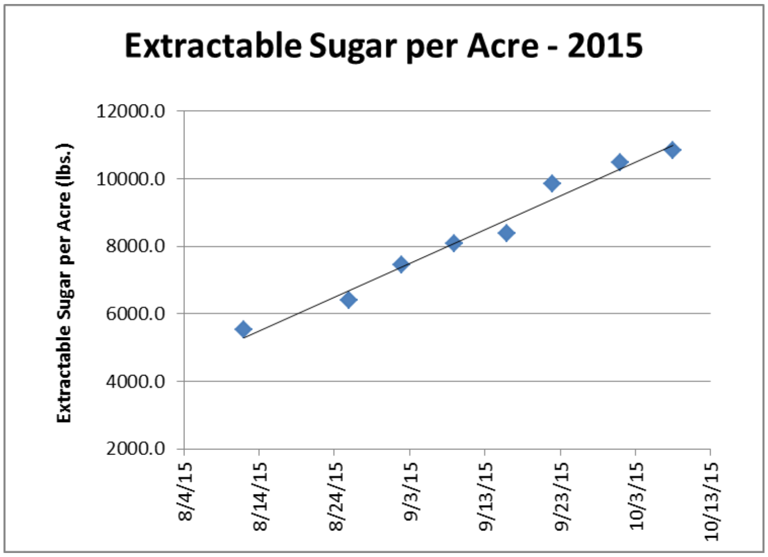

Figure 1

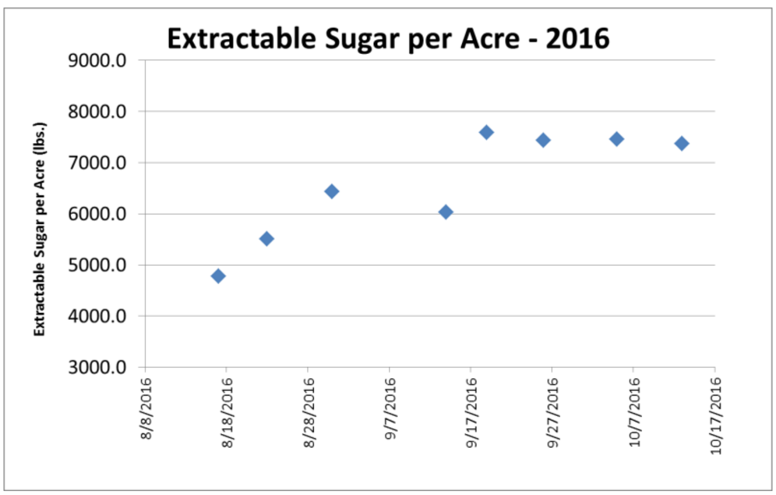

Figure 2

2011-2016 Regression Analysis of Extractable Sugar per Acre Increase per Day

Year	Extractable Sugar per Acre Increase per Day (lbs.)
2011	100.7
2012	89.0
2013	91.6
2014	93.4
2015	99.8
Average (2011-2015)	94.9
2016	45.7

Table 1

Prepile Premium Evaluation Using Date of Harvest Trials at Clara City and Murdock, MN - 2016

Introduction: Sugar beets are a biennial crop and will continue to increase in yield and sugar content during the first year of growth until the beets are harvested. SMBSC normally begins factory operations in late-August or early-September to maximize factory efficiency. This requires sugar beets to be harvested early and creates a loss in yield due to a shorter growing season. The loss of growing season on early harvested beets meant that a prepile premium system needed to be developed to compensate shareholders for lower yields and decreased revenue on early harvested acres. To help measure the effectiveness of the prepile premium, trials were established to obtain data on yield and sugar content on a weekly basis over the harvest period.

Objectives: In 2011, SMBSC initiated trials to measure the rate of growth of the sugar beets during the period from mid-August through early-October. These trials provided rate of growth data for each season for sugar content, tons per acre, purity, and extractable sugar per acre. The weekly harvest information could also be used to look at the SMBSC prepile premium and how effectively it compensates shareholders for early harvesting of a portion of their sugar beet crop.

Methods: Trials were established at 2-4 locations across the Cooperative growing area each season since 2011. These trials were often conducted on the same locations as the SMBSC Official Variety Trials. In 2016, the Date of Harvest Trials were conducted at a location near Murdock and at a location near Clara City. Trial maintenance was performed similar to the nearby Official Variety Trial. Each week during the mid-August to early-October time frame approximately 180' of row was harvested from each trial location. Harvest was accomplished with a tractor mounted one row defoliator and one row sugar beet harvester. The beets harvested each week were placed in tare bags and brought to the SMBSC tare lab for weights and quality analysis. Sample analysis included tare, sugar content, purity, and brie nitrate. Row lengths were measured each week prior to harvest and these lengths were used to accurately calculate the area harvested. The calculated harvested area for each week was used to determine yield on a per acre basis. The revenue per acre for each harvest period can be calculated using the yield components and the estimated payment for the 2016 crop. The prepile premium was added to each harvest date in the study, and this provided the revenue estimates.

Results and discussion: The first harvest date for the trial was August 17, 2016. Harvesting continued on a weekly basis until October 13, 2016. We were unable to harvest during the week of September 4-10 due to rain and very wet field conditions at the two trial locations. The data from the 2016 season is summarized in Table 1. There were two trial locations in 2016, and the data presented in the table is an average of the two locations. Actual yield information was utilized to calculate estimated revenue per acre. This revenue per acre is reported as a percent of the October 5 harvest date. The October 5 date was chosen because the prepile premium is designed to make a shareholder whole based on the revenue potential of the field on the first days of full harvest. The far right column in Table 1 shows the percent revenue per acre of the October 5 harvest date with the prepile premium dollars included. Figure 1 is a graphic representation of the revenue percent with the prepile premium included. In the 2016 trial, 4 of the 6 prepile harvest dates had revenue per acre higher than the October 5 harvest date. This trial will be repeated again in 2017.

2016 Date of Harvest Data with Prepile Premium (Average of Two Locations)								
Date	Percent Sugar	Percent Purity	Tons /Acre	Extractable Sugar per Ton (lbs.)	Extractable Sugar per Acre (lbs.)	Actual Revenue per acre as a percent of Oct. 5	Prepile Premium/Ton	Percent of Oct. 5 Revenue per Acre Including Prepile Premium
8/17/2016	13.0	91.2	22.0	216.9	4772.3	52.9	$17.51	93.4
8/23/2016	13.6	92.4	23.8	231.5	5504.8	67.2	$15.18	105.2
8/31/2016	14.6	91.7	25.8	248.9	6429.9	86.1	$12.06	118.9
9/14/2016	14.8	92.0	24.0	251.8	6032.8	81.9	$6.62	98.6
9/19/2016	14.8	92.3	29.9	254.2	7589.3	104.1	$4.67	118.8
9/26/2016	14.5	91.8	30.2	246.2	7437.8	98.3	$1.95	104.5
10/5/2016	14.8	90.7	30.0	249.1	7460.7	100.0	$0.00	100.0
10/13/2016	14.7	92.1	29.4	250.7	7369.6	99.5	$0.00	99.5

Table 1

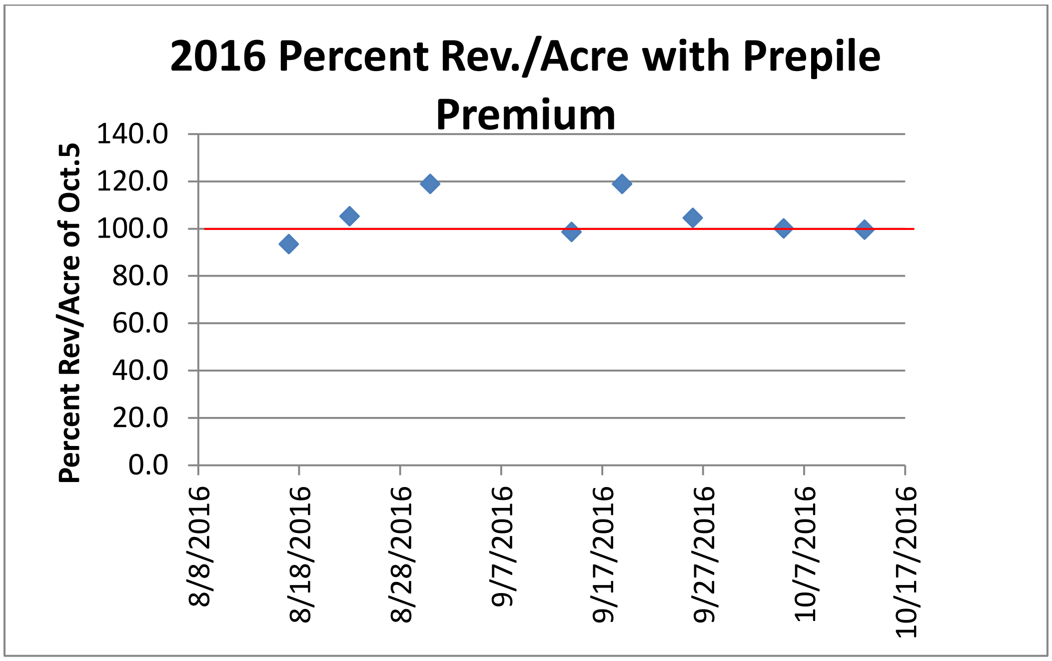

Figure 1

INTEGRATED MANAGEMENT OF RHIZOCTONIA ON SUGARBEET WITH VARIETAL RESISTANCE, AT-PLANTING TREATMENTS, AND POSTEMERGENCE FUNGICIDES

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Rhizoctonia damping-off and crown and root rot (RCRR) caused by *Rhizoctonia solani* AG 2-2 have been the most common root diseases on sugarbeet in Minnesota and North Dakota for several years (1, 4-5,7). Disease can occur throughout the growing season and reduces plant stand, root yield, and quality. Warm and wet soil conditions favor infection. Disease management options include rotating with non-host crops (cereals), planting partially resistant varieties, planting early when soil temperatures are cool, improving soil drainage, and applying fungicides as seed treatments, in-furrow (IF), or postemergence. An integrated management strategy should take advantage of multiple control options to reduce Rhizoctonia crown and root rot.

OBJECTIVES

A field trial was established to evaluate an integrated management strategy consisting of a resistant (R) and a moderately susceptible (MS) variety with new available seed treatments alone and in combination with two postemergence azoxystrobin application timings for 1) control of early-season damping-off and RCRR and 2) effect on yield and quality of sugarbeet.

MATERIALS AND METHODS

The trial was established at three locations, one at the University of Minnesota, Northwest Research and Outreach Center, Crookston, one at Wahpeton (MDFC), ND and one at Renville (SMBSC), MN. All locations were fertilized for optimal yield and quality. At each location, a combination of a R and MS variety treated with penthiopyrad (Kabina ST), fluxapyroxad (Systiva), sedaxane (Vibrance), or untreated was planted in four replicate plots. Plots were set up in a split-split plot design at the Crookston and Renville sites. Main plots were varieties, the first split was seed treatments, and the last split was postemergence azoxystrobin timings. At the Wahpeton location, the same combination of treatments was set up in a randomized complete block design. Seed treatments and rates are summarized in Table 1 and were applied by Germains Seed Technology, Fargo, ND. Each variety by seed treatment combination was planted in triplicate, so that at the 4- or 8-leaf stage, one plot of each variety by seed treatment combination received a postemergence 7-inch band application of azoxystrobin (14.3 fl oz product A^{-1}) while one was left as a stand-alone treatment. Controls for each variety included no seed treatment at planting with each postemergence azoxystrobin timing and without postemergence azoxystrobin. Two-year average Rhizoctonia ratings in American Crystal Sugar Company tests for the R and MS varieties were 3.8 and 4.7, respectively (8).

NWROC site. Prior to planting, soil was infested with *R. solani* AG 2-2-infested whole barley (35 kg ha^{-1}). The trial was sown in six-row plots (22-inch row spacing, 30-ft rows) on May 03 at 4.5-inch seed spacing. Counter 20G (8 lb A^{-1}) was applied at planting for control of sugarbeet root maggot. Glyphosate (4.5 lb product ae/gallon) was applied on May 11, 17, and 24, and June 2 and 13 (22 oz A^{-1}) for control of weeds. Postemergence azoxystrobin timings were applied in a 7-inch band in 10 gallon/A using 4002 nozzles and 39 psi on June 8 and 23 (5 and 7 weeks after planting). Cercospora leaf spot was controlled by Supertin + Topsin M (6 + 7.5 oz product in 19 gallons of water/A) applied with 8002 flat fan nozzles at 100 psi on August 8.

MDFC site. Prior to planting, soil was infested with *R. solani* AG 2-2-infested whole barley (35 kg ha^{-1}). The trial was sown in six-row plots (22-inch row spacing, 30-ft rows) on May 24 at 4.5-inch seed spacing. Glyphosate (4.5 lb product ae/gallon) tank-mixed with AMS (8.5 lbs A^{-1}) and Fusilade DX (12 oz A^{-1}) was applied on June 7. This weed control application was repeated again on June 22nd (less the graminicide). Postemergence azoxystrobin was applied in a 7-inch band on June 21 (4-leaf stage, 4 weeks after planting) or June 28 (8-leaf stage, 5 weeks after planting). Cercospora leafspot was controlled by separate applications of TPTH/Topsin (5 & 7.6 oz A^{-1}, respectively) on July 19, Inspire (7 oz A^{-1}) on August 2nd, Priaxor (6.7 oz A^{-1}) on August 15th and TPTH/Copper (5 oz A^{-1} & 2 pt oz A^{-1}, respectively) as last application. All fungicides for CLS control were applied utilizing a 3pt-mounted sprayer dispersing the products in broadcast pattern at a water volume of 15 GPA with TeeJet 8002 flat fan nozzles at 80 psi.

Table 1. Application type, product names, active ingredients, and rates of fungicides used at planting in a field trial for control of *Rhizoctonia solani* AG 2-2 on sugarbeet. Each at-plant treatment was used in combination with a Rhizoctonia resistant (2-year average rating = 3.8) and moderately susceptible (2-year average rating = 4.7) variety, and all treatment combinations in triplicate, with one set receiving a postemergence 7-inch band application of azoxystrobin (14.3 fl oz A^{-1}) at 4- or 8-leaf stage. Standard rates of Apron + Thiram and 45 g/unit Tachigaren were on all seed.

Application	Product	Active ingredient	Rate
None	-	-	-
Seed	Kabina ST	Penthiopyrad	14 g a.i./unit seed
Seed	Systiva	Fluxapyroxad	5 g a.i./unit seed
Seed	Vibrance	Sedaxane	1.5 g a.i./unit seed

Table 2. Monthly precipitation in inches at three sites during 2016 crop season based on weather stations.

	Precipitation in inches		
Month	NWROC	MDFC	SMBSC
May	6.68	1.46	3.93
June	1.78	0.93	4.16
July	3.50	4.85	5.54
August	3.34	3.88	8.77
September	1.58	3.74	4.84
Total	**16.88**	**14.86**	**27.24**

SMBSC site. Prior to planting, soil was infested with *R. solani* AG 2-2-infested whole barley (35 kg ha^{-1}). The trial was sown in six-row plots (22-inch row spacing, 30-ft rows) on May 18 at 4.5-inch seed spacing. Weeds were controlled by application of Sequence (2.5 pint A^{-1}) + Powermax (9 oz A^{-1}) + Selectmax (12 oz A^{-1}) on June 7 and Powermax (22 oz A^{-1}) + Selectmax (12 oz A^{-1}) on June 28. Postemergence azoxystrobin timings were applied on June 16 and 23 (4 and 5 weeks after planting, respectively). Fungicides were applied for controlling Cercospora leaf spot on July 14 (3.5 oz A^{-1} Gem), July 26 (13 oz A^{-1} Eminent), Aug 08 (8 oz A^{-1} Agritin), and Aug 23 (13 oz A^{-1} Eminent).

At NWROC stand counts were done beginning 2 weeks after planting through 8 weeks after planting. At Wahpeton stand counts were done 2 through 6 weeks after planting. At Renville stand counts were done 3, 5, and 8 weeks after planting. The trial was harvested September 20 at the NWROC and Renville and September 21 at Wahpeton. Data were collected for number of harvested roots (NWROC only), yield, and quality. Twenty roots per plot also were arbitrarily selected and rated for severity of RCRR using a 0 to 7 scale (0 = healthy root, 7 = root completely rotted and foliage dead).

Data were subjected to analysis of variance using SAS Proc GLM (SAS Institute, Cary, NC) for main effects of variety, at-plant treatment, postemergence azoxystrobin application, and all possible interactions.

RESULTS

NWROC site: There were no significant (P = 0.05) two way or three way interactions for stand or harvest data. R and MS varieties had similar stands until 3 weeks after planting (WAP), and from 4 to 7 weeks R variety had higher stands compared to MS variety and by 8 weeks both varieties had similar stands (Fig. 1A). At-planting (seed) treatments and untreated control had similar stands until 4 WAP and all the three seed treatments had higher stands compared to untreated control from 5 to 8 WAP (Fig. 1B). Harvest data is based on 3 replications only. MS variety had higher yield and also higher sugar loss to molasses (SLM) compared to the R variety. Root rot rating, yield, and other harvest parameters are not significantly different for the seed treatments and untreated control. Root rot severity and percent incidence (percent of roots with a disease rating of > 2.0) was significantly higher in the treatments without postemergence Quadris application, intermediate in 4-leaf Quadris, and lowest in the 8-leaf Quadris application (Table 3). Yield and Recoverable sugar A^{-1} (RSA) was higher for 8-leaf Quadris application compared to no Quadris. Percent sucrose and recoverable sucrose T^{-1} (RST) were not significantly different between Quadris and no Quadris application (Table 3).

MDFC site: There were no significant (*P* = 0.05) two way or three way interactions for stand or harvest data. From 2 to 6 weeks after planting (WAP) R variety had higher stands compared to MS variety (Fig. 2A). At 2 WAP Systiva and Kabina had higher stands compared to Vibrance and untreated control. By 5 and 6 WAP Systiva and Kabina had highest stands, intermediate for Vibrance and lowest for untreated control (Fig. 2B). Higher yield and recoverable sugar A^{-1} (RSA) and lower purity was observed for the MS variety compared to the R variety. Root rot rating, yield, and other harvest parameters were not significantly different for the seed treatments and untreated control (Table 4). Quadris application (4- and 8-leaf) had lower root rot severity and percent disease incidence and higher percent sugar, recoverable sucrose T^{-1} (RST) and RSA compared to no Quadris (Table 4).

SMBSC site: There were no significant (*P* = 0.05) two way or three way interactions for stand data. There was no significant difference between R and MS varieties for early season stands (Fig. 3B). At 3 and 5 weeks after planting (WAP) Vibrance and Systiva had highest stands, intermediate for Kabina and lowest for untreated control (Fig. 3B). By 8 WAP a similar trend was observed with Vibrance and Systiva with highest stands, Systiva and Kabina intermediate, and lowest for untreated control. Heavy rainfall in Renville caused extensive water damage to sugarbeet plants eventually compromising three replicates and thus harvest data is not reported.

DISCUSSION

NWROC site: At the NWROC site, early planting (May 03) into cool and dry soils resulted in uneven emergence. However, a 4.45 in. rainfall on May 31 resulted in better and uniform emergence later on. The month of June received much less rainfall and moderate rainfall in July and August resulted in low to moderate late season disease pressure. Four inch soil temperatures reached 65 °F by May 23, followed by 61-65 °F until June 07, and > 65 °F from June 08. The yield was higher for MS variety compared to R variety and it could be because of the difference in yield potential among the two varieties. With low early season disease pressure there was no significant benefit from any seed treatments compared to untreated control. The benefit from postemergence Quadris application was not evident in 2014 and 2015 because of relatively dry late season in both years (2,6). However, with moderate rainfall in July and August, Rhizoctonia was active during late season resulting in significant differences between no Quadris and 4- or 8-leaf Quadris application. Postemergence Quadris application increased the number of harvested roots, decreased root rot severity and incidence, increased yield and RSA.

MDFC site: The planting was done into warm soils resulting in some early season disease pressure at this site. Overall, the best sugar yield was obtained with MS variety compared to R variety which also resulted in higher RSA. Among at-planting seed treatments, Kabina and Systiva performed better followed by Vibrance and lowest stands were observed for untreated control. Even though some stands were lost early in the season the stand loss was not significant enough to see yield differences between seed treatments and untreated controls. Moderate rainfall in June-Aug resulted in some late season disease pressure which was clearly observed in the plots with no Quadris and 4- or 8-leaf Quadris application. Four or 8-leaf Quadris application resulted in lower root rot severity and incidence, higher % sucrose, RST and RSA compared to no Quadris application.

SMBSC site: Both R and MS varieties lost some stands until 6 weeks after planting and there was slight early season disease pressure at this site. Among at-planting seed treatments, Vibrance and Systiva performed better followed by Kabina and lowest stands were observed for untreated control. As this site received excellent rainfall throughout the growing season, we would have expected to see some nice differences among seed treatments and postemergence Quadris applications if the plots were not compromised because of excess rainfall in August.

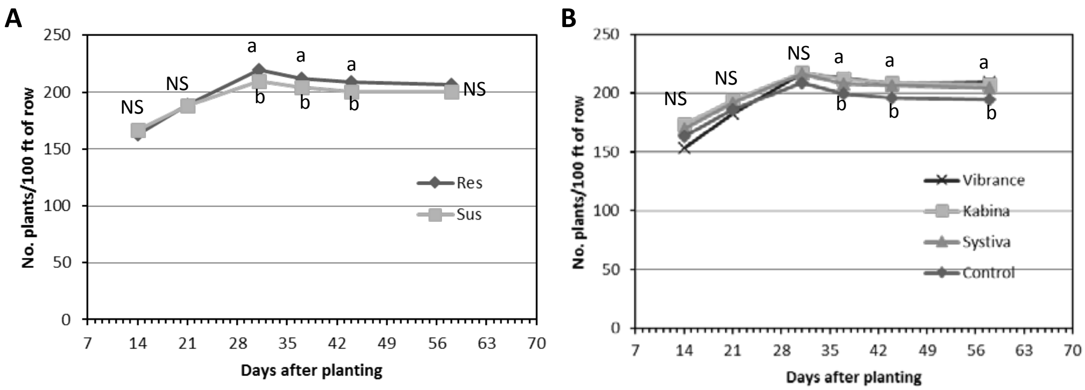

Fig. 1. NWROC site: Emergence and stand establishment for **A**) resistant and moderately susceptible sugarbeet varieties and **B**) fungicide treatments on seed or untreated control. For each stand count date, values sharing the same letter are not significantly different (*P* = 0.05); NS = not significantly different. Data shown in **A** represent mean of 48 plots averaged across at-planting and postemergence treatments and in **B** represent mean of 24 plots averaged across varieties and postemergence treatments.

Table 3. **NWROC site:** Main effects of variety, at-planting (seed or in-furrow), and postemergence fungicide treatments on Rhizoctonia crown and root rot and sugarbeet yield and quality in a field trial sown May 3, 2016.

Main effect (Apron + Maxim on all seed)	No. harv. roots/100 ft[T]	RCRR (0-7)[TU]	RCRR % incidence[TV]	Yield ton A^{-1}[T]	Sucrose[T] %	Sucrose[T] lb ton^{-1}	Sucrose[T] lb A^{-1}
Variety[W]							
Resistant	160	1.2	13	28.6	15.4	296	8302
Moderately Susceptible	163	1.4	18	32.1	15.2	282	9036
ANOVA p-value	0.2918	0.1148	0.1604	0.0336	0.4882	0.1896	0.0976
LSD (*P* = 0.05)	NS	NS	NS	2.9	NS	NS	NS
At-planting treatments[X]							
Untreated control	156	1.3	13	29.7	15.2	284	8407
Kabina ST @14 g a.i./unit	170	1.0	14	31.1	15.4	287	8899
Systiva @ 5 g a.i /unit	157	1.4	14	30.1	15.5	290	8710
Vibrance @ 1.5 g a.i./unit	164	1.4	20	30.5	15.2	284	8659
ANOVA p-value	0.154	0.2511	0.0913	0.6904	0.6924	0.798	0.5569
LSD (*P* = 0.05)	NS	NS	NS	NS	NS	NS	NS
Postemergence fungicide[Y]							
None	155 b	1.8 a	24 a	29.5 b	15.3	286	8408 b
4-leaf Quadris @ 14.3 fl. oz./A	164 a	1.2 b	15 b	30.4 ab	15.3	284	8635 ab
8-leaf Quadris @ 14.3 fl. oz./A	166 a	0.8 c	8 c	31.2 a	15.4	288	8964 a
ANOVA p-value	0.0174	<0.0001	<0.0001	0.0178	0.6788	0.6921	0.0171
LSD (*P* = 0.05)	7.3	0.35	5.1	1.1	NS	NS	373

[T] Numbers followed by the same letter are not significantly different; LSD = Least Significant Difference, *P* = 0.05

[U] RCRR = Rhizoctonia crown and root rot; 0-7 scale (adjusted rating), 0 = root clean, no disease, 7 = root completely rotted and plant dead

[V] RCRR = Rhizoctonia crown and root rot; percent of roots with rating greater than two

[W] Values represent mean of 36 plots (3 replicate plots across 4 at-planting treatments and 3 postemergence treatments)

[X] Values represent mean of 18 plots (3 replicate plots across 2 varieties and 3 postemergence treatments)

[Y] Values represent mean of 24 plots (3 replicate plots across 2 varieties and 4 at-planting treatments)

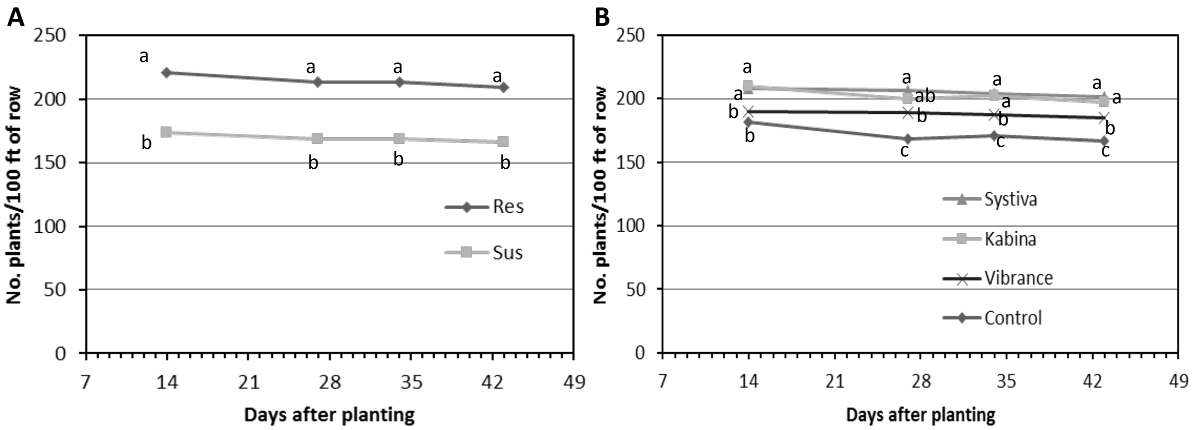

Fig. 2. MDFC site: Emergence and stand establishment for **A**) resistant and moderately susceptible sugarbeet varieties and **B**) fungicide treatments on seed or untreated control. For each stand count date, values sharing the same letter are not significantly different (*P* = 0.05); NS = not significantly different. Data shown in **A** represent mean of 48 plots averaged across at-planting and postemergence treatments and in **B** represent mean of 24 plots averaged across varieties and postemergence treatments.

Table 4. **MDFC site:** Main effects of variety, at-planting (seed or in-furrow), and postemergence fungicide treatments on Rhizoctonia crown and root rot and sugarbeet yield and quality in a field trial sown May 24, 2016.

Main effect (Apron + Maxim on all seed)	RCRR (0-7)[TU]	RCRR % incidence[TV]	Yield ton A^{-1}[T]	Sucrose[T] %	Sucrose[T] lb ton^{-1}	Sucrose[T] lb A^{-1}
Variety[W]						
Resistant	0.3	5	22.7	14.2	225	5106
Moderately Susceptible	0.4	7	25.0	14.2	221	5526
ANOVA p-value	0.0686	0.2308	0.0003	0.6790	0.193	0.0062
LSD (*P* = 0.05)	NS	NS	1.2	NS	NS	297
At-planting treatments[X]						
Untreated control	0.4	7	22.8	14.3	227	5173
Kabina ST @14 g a.i./unit	0.3	6	24.2	14.1	219	5320
Systiva @ 5 g a.i /unit	0.3	5	24.4	14.3	225	5481
Vibrance @ 1.5 g a.i./unit	0.3	6	23.8	14.2	222	5289
ANOVA p-value	0.6489	0.843	0.2522	0.4411	0.2497	0.5366
LSD (*P* = 0.05)	NS	NS	NS	NS	NS	NS
Postemergence fungicide[Y]						
None	0.6 a	12 a	23.0	13.9 b	217 b	5013 b
4-leaf Quadris @ 14.3 fl. oz./A	0.2 b	4 b	24.1	14.4 a	227 a	5471 a
8-leaf Quadris @ 14.3 fl. oz./A	0.2 b	3 b	24.3	14.4 a	225 a	5463 a
ANOVA p-value	0.0005	0.0009	0.2036	0.0072	0.0142	0.0199
LSD (*P* = 0.05)	0.2	4.8	NS	0.29	6.8	363

[T] Numbers followed by the same letter are not significantly different; LSD = Least Significant Difference, *P* = 0.05

[U] RCRR = Rhizoctonia crown and root rot; 0-7 scale (adjusted rating), 0 = root clean, no disease, 7 = root completely rotted and plant dead

[V] RCRR = Rhizoctonia crown and root rot; percent of roots with rating greater than two

[W] Values represent mean of 48 plots (4 replicate plots across 4 at-planting treatments and 3 postemergence treatments)

[X] Values represent mean of 24 plots (4 replicate plots across 2 varieties and 3 postemergence treatments)

[Y] Values represent mean of 32 plots (4 replicate plots across 2 varieties and 4 at-planting treatments)

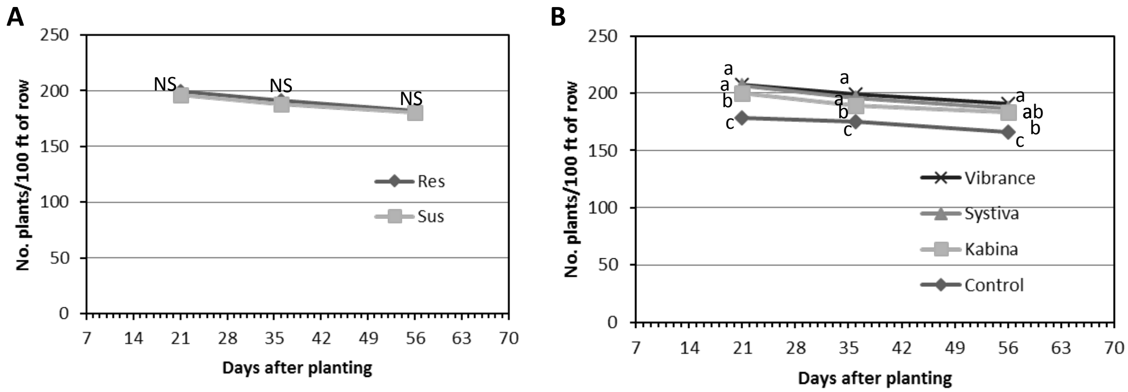

Fig. 3. SMBSC site: Emergence and stand establishment for **A**) resistant and moderately susceptible sugarbeet varieties and **B**) fungicide treatments on seed or untreated control. For each stand count date, values sharing the same letter are not significantly different (P = 0.05); NS = not significantly different. Data shown in **A** represent mean of 48 plots averaged across at-planting and postemergence treatments and in **B** represent mean of 24 plots averaged across varieties and postemergence treatments.

ACKNOWLEDGEMENTS

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LITERATURE CITED

1. Brantner, J.R. 2015. Plant pathology laboratory: summary of 2013-2014 field samples. 2014 Sugarbeet Res. Ext. Rept. 44:138-139.
2. Brantner, J.R. and A.K. Chanda. 2015. Integrated management of Rhizoctonia on sugarbeet with varietal resistance, seed treatment, and postemergence fungicides. 2014 Sugarbeet Res. Ext. Rept. 44: 142-146
3. Brantner, J.R., H.R. Mickelson, and E.A. Crane. 2014. Effect of *Rhizoctonia solani* inoculum density and sugarbeet variety susceptibility on disease onset and development. 2013 Sugarbeet Res. Ext. Rept. 44:203-208.
4. Brantner, J.R. and C.E. Windels. 2011. Plant pathology laboratory: summary of 2009-2010 field samples. 2010 Sugarbeet Res. Ext. Rept. 41:260-261.
5. Brantner, J.R. and C.E. Windels. 2009. Plant pathology laboratory: summary of 2007-2008 field samples. 2008 Sugarbeet Res. Ext. Rept. 39:250-251.
6. Chanda, A. K., Brantner, J. R., Metzger, M., and Radermacher, J. 2016. Integrated Management of Rhizoctonia on Sugarbeet with Varietal Resistance, At-Planting Treatments and Postemergence Fungicides. 2015 Sugarbeet Res. Ext. Rept. 46:154-159
7. Crane, E., Brantner, J.R., and Windels, C.E. 2013. Plant pathology laboratory: summary of 2011-2012 field samples. 2012 Sugarbeet Res. Ext. Rept. 43:169-170.
8. Niehaus, W.S. 2016. Results of American Crystal's 2015 Official Coded Variety Trials. 2015 Sugarbeet Res. Ext. Rept. 46:184-228.

DISEASE PROGRESS OF RHIZOCTONIA CROWN AND ROOT ROT ON SUGARBEET AT SELECT SITES IN NORTH DAKOTA AND MINNESOTA

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Seedling damping-off and crown and root rot caused by *Rhizoctonia solani* AG 2-2 continue to be among the most common diseases on sugarbeet in the Red River Valley (RRV) and southern Minnesota. Control options include rotating with non-host crops (small grains), planting varieties with partial resistance, planting early to avoid favorably warm soil temperatures when young seedlings are highly susceptible, and the use of seed treatment, in-furrow, and postemergence fungicides.

Fungicides are effective in controlling Rhizoctonia in sugarbeet when applied in advance of infection, but are ineffective when applied after infections occur (11). Disease onset is therefore critical in proper timing of fungicide applications. The disease is favored by warm and wet soil conditions. Studies under controlled conditions (1) have shown the importance of soil temperature and moisture to disease development. Under field conditions, application of azoxystrobin (Quadris) at soil temperatures of 62-67 °F tended to give best results (8,9), but results varied for different years and locations (6,7,8,9,10). We have observed disease onset in our trials to vary depending on inoculum density and trial location (2,3). Soil temperature, inoculum density, and other environmental factors affected by location are all likely to influence the onset of disease and efficacy of fungicide application timings.

Sentinel plots planted to a susceptible variety can be used to detect disease, track movements of diseases, and follow progress of disease. They have been used extensively to track soybean rust (12) and have been used in sugarbeet for Cercospora fungicide resistance tracking (4) and disease management (5).

OBJECTIVES

Field trials were established using a Rhizoctonia-susceptible variety with and without seed treatment for Rhizoctonia in multiple locations on different crop residues to determine onset and progress of Rhizoctonia crown and root rot.

MATERIALS AND METHODS

The trial was established at two sites in each of three locations: northern RRV (near Cavalier, ND), central RRV (near Halstad and Ada, MN), and southern Minnesota (near Clara City and Lake Lillian, MN). The two sites at each location allowed placement of the trial on two different crop residues: wheat and corn in the northern RRV, wheat and soybean in the central RRV and corn and soybean in southern Minnesota. In the RRV, three-row by 30-ft plots were sown (4.5 inch seed spacing) in 4 replicates to a Rhizoctonia-susceptible variety (4.7 RCRR 2-year rating in American Crystal Sugar Company variety trials) treated with Apron + Thiram + Tachigaren (45g). The same Rhizoctonia-susceptible variety was sown in two-row by 30-ft plots with 6 replicates in southern Minnesota. Treatments included seed not treated with a fungicide for Rhizoctonia control (referred to as untreated in figures) and seed treated with Vibrance at 1.5 g/unit (northern RRV) or Kabina at 14g/unit (central RRV and southern Minnesota). Two sets of each treatment were included so that one set could be used for destructive sampling to follow progress of root symptoms while the other set could be kept intact for stand counts and harvest data. Stand data was collected from two weeks after planting through mid-August. Root rot ratings (0-7 scale) were collected at various intervals beginning in late June through harvest. Roots with a rating of 3 or higher (>5% of root surface rotted) were considered positive in calculating percent disease incidence. Root weights and Rhizoctonia ratings were taken at harvest. Ten roots from each plot were also randomly selected and analyzed for quality by American Crystal Sugar Company quality lab, East Grand Forks, MN (RRV sites) or Southern Minnesota Beet Sugar Cooperative, Renville, MN (southern Minnesota sites). Table 1 summarizes the dates for planting and harvest for each site.

Table 1. Location, planting and harvest dates for Rhizoctonia disease progress trial sites.

Site	Location	Planting date	Harvest date
North RRV wheat residue	North of Cavalier, ND	May 12	September 14
North RRV corn residue	East of Cavalier, ND	May 12	September 14
Central RRV wheat residue	South of Halstad, MN	May 4	September 13
Central RRV soybean residue	Northeast of Ada, MN	May 4	September 29
Southern Minnesota corn residue	Northeast of Clara City, MN	May 6	October 13
Southern Minnesota soybean residue	Southeast of Lake Lillian, MN	May 3	October 1

RESULTS AND DISCUSSION

North RRV. Soil temperatures favorable for *Rhizoctonia* infection (daily mean 4-inch bare soil temperatures ≥ 60°F) were present by May 19 (within one week after planting) at the Cavalier North Dakota Agricultural Weather Network (NDAWN) station. Emergence was excellent at both wheat and corn residue sites, with stand of at least 200 plants per 100 ft of row by June 7 (3 ½ weeks after planting). At the wheat residue site, there was a slight drop in stand for seed with and without Vibrance between June 14 and 21 (4 ½ to 5 ½ weeks after planting), but both *Aphanomyces* and *Rhizoctonia* were recovered in equal amounts from sampled seedlings (data not shown). Stands remained fairly steady until a slight decline by the middle of August (Fig. 1A) when Rhizoctonia ratings and incidence began to rise (Fig. 2A). At the corn residue site, stands declined between June 7 and 21 (3 ½ to 5 ½ weeks after planting) regardless of seed treatment, remained steady through the month of July, and declined slightly in August (Fig. 1B). Both *Pythium* and *Rhizoctonia* were recovered from seedlings collected June 21, but only *Rhizoctonia* was isolated from samples collected after that date (data not shown). Rhizoctonia root rot ratings began a slow, steady incline beginning July 26 through the middle of September (Fig. 2B). Rhizoctonia incidence jumped up for seed not treated with Vibrance on July 26, but by September 14, incidence was around 20% for both seed treatments (Fig. 2B). Due to water damage from excessive rainfall and the moderate Rhizoctonia disease pressure, root yield and quality was low at both sites. Root yields averaged 18.4 and 16.1 ton/A and recoverable sucrose per ton averaged 269 and 241 at the wheat and corn residue sites, respectively. There were no significant (P = 0.05) differences between seed with and without Rhizoctonia seed treatment at either site.

Central RRV. Soil temperatures at the Ada, MN NDAWN station were briefly above 60°F from May 5 to 9, dipped, and then returned to greater than 60°F by May 18 (2 weeks after planting). Emergence was excellent at both wheat and soybean residue sites (Fig. 1C and 1D). At the wheat residue site, stands declined for both untreated and Kabina-treated seed from June 7 to 21 (4 ½ to 6 ½ weeks after planting) (Fig. 1C). Rhizoctonia was isolated from dying seedlings collected during this time. After June 21, stand remained steady until a slight decline from July 29 to August 15 (Fig. 1C). Root rot ratings and disease incidence were very low throughout the season (Fig. 2C). At the soybean residue site, there was a slight dip in stand for both seed treatments from June 7 to 14 (Fig. 1D). No pathogens could be isolated during this time so the small stand loss may have been from wind damage. Stands remained high (over 200 plants per 100 ft of row) and steady throughout the growing season (Fig. 1D). Similarly, Rhizoctonia root rot ratings and disease incidence showed no presence of Rhizoctonia throughout the season (Fig. 1D). Root yields were high at both sites while quality was low at the wheat site and moderate at the soybean site. Root yields averaged 33.3 and 34.2 ton/A and recoverable sucrose per ton averaged 229 and 298 at the wheat and soybean residue sites, respectively. There were no significant (P = 0.05) differences between seed with and without Rhizoctonia seed treatment at either site.

Southern Minnesota. Soil temperature data collected at the University of Minnesota, Southwest Research and Outreach Center in Lamberton, MN indicated daily mean 4-inch soil temperatures ≥ 60°F from May 7 to 9 and again from May 18 (2 weeks after planting) through the rest of the growing season. Emergence was lower at both sites in southern Minnesota than in the RRV with stands reaching 170 to 180 plants per 100 ft of row (Fig. 1E and 1F). Stands at both corn and soybean residue sites remained steady throughout the growing season with no evidence of damping-off (Fig. 1E and 1F). Rhizoctonia root rot was found at very low frequency and average root rot ratings and disease incidence remained low throughout the season at both corn and soybean residue sites (Fig. 2E and 2F). Root yields were moderate at the corn residue site (mean = 27.5 ton/A) and high at the soybean residue site (mean =

33.3 ton/A) while quality was low at both sites (means = 233 and 238 lb recoverable sucrose/A at corn and soybean residue sites, respectively). There were no significant (P = 0.05) differences between seed with and without Rhizoctonia seed treatment at either site.

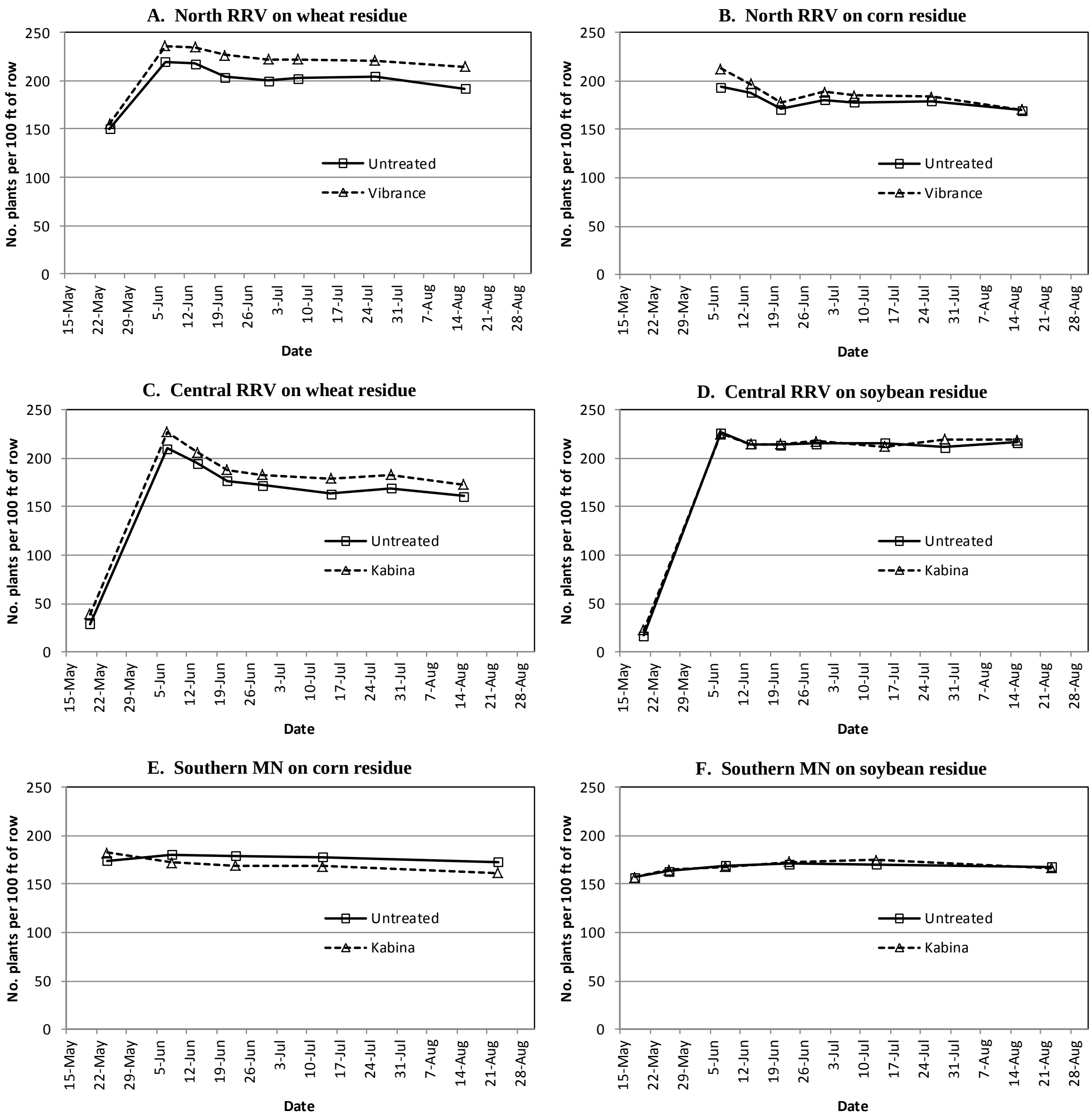

Fig. 1. Emergence and stand establishment for a Rhizoctonia-susceptible sugarbeet variety with and without Rhizoctonia seed treatment (Vibrance or Kabina) at locations across the Red River Valley (RRV) and in southern Minnesota.

Although soil temperatures were plenty high to favor infection by *Rhizoctonia* within two weeks after planting at all sites, Rhizoctonia damping-off occurred at only 3 of 6 sites, while Rhizoctonia crown and root rot occurred at a moderate level in just 2 of 6 sites. In the three sites with damping-off, timing and amount of stand loss due to Rhizoctonia damping-off was similar for both seed treatments suggesting that seed treatment efficacy had already declined prior to the onset of damping-off. In our inoculated field trials, we have seen greater efficacy of Rhizoctonia seed treatments when disease occurs very early, typically from higher pathogen populations. Onset and progress of Rhizoctonia damping-off and crown and root rot is most likely related to a combination of pathogen population and favorable environmental conditions (soil temperatures ≥ 60°F along with ample soil moisture). Significant benefits from newer seed treatments with activity against Rhizoctonia may only be realized when high pathogen populations and favorable environmental conditions conspire to cause damping-off when seedlings are young and very susceptible.

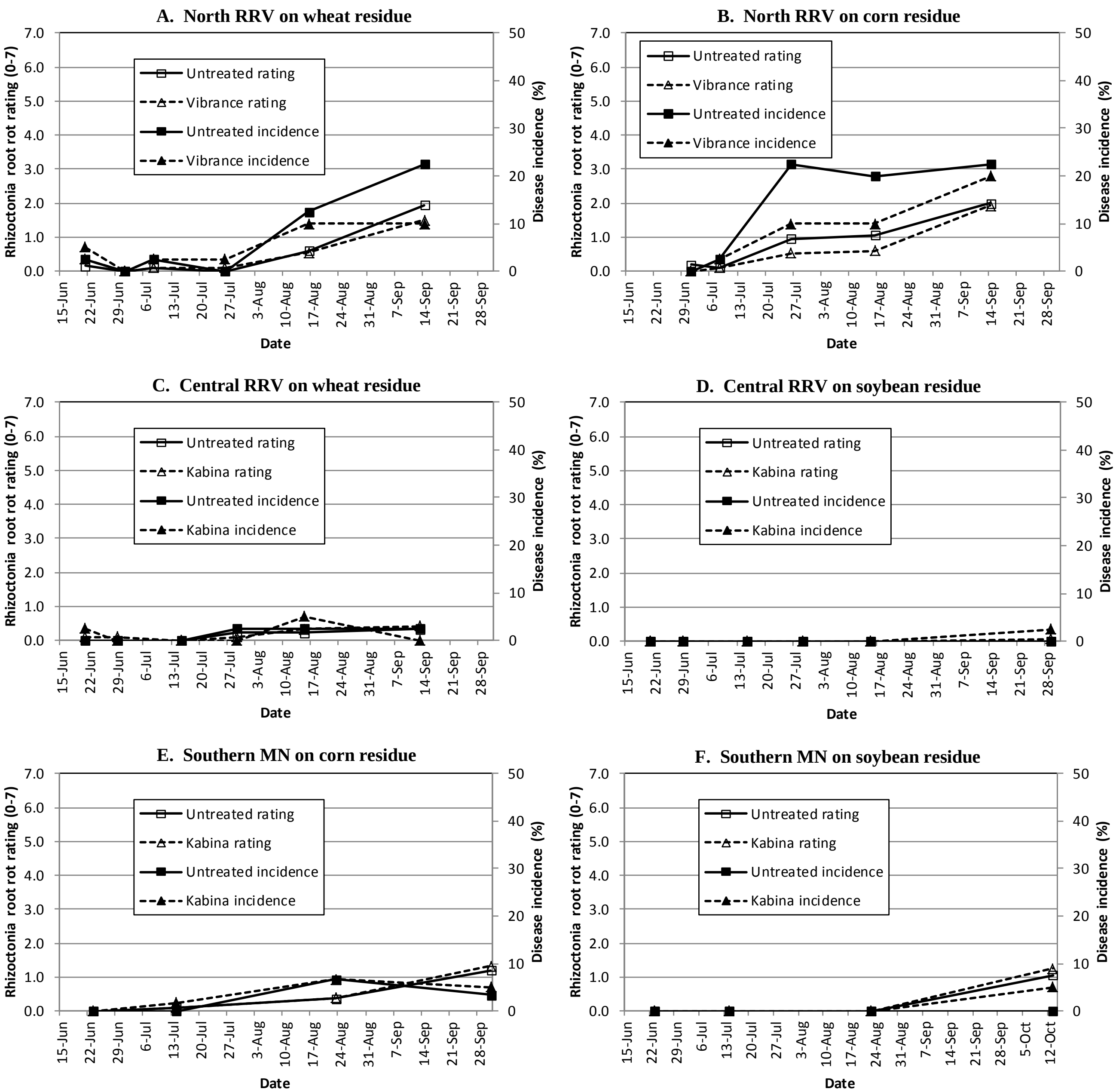

Fig. 2. Disease progress (root rot ratings on left axis and disease incidence on right axis) for a Rhizoctonia-susceptible sugarbeet variety with and without Rhizoctonia seed treatment (Vibrance or Kabina) at locations across the Red River Valley (RRV) and in southern Minnesota.

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LITERATURE CITED

1. Bolton, M.D., Panella, L., Campbell, L., and M.F.R. Khan. 2010. Temperature, moisture, and fungicide effects in managing Rhizoctonia root and crown rot of sugarbeet. Phytopathology 100:689-697.

2. Brantner, J.R. and Windels, C.E. 2013. Seed and in-furrow fungicides with and without postemergence Quadris for control of Rhizoctonia on sugarbeet. 2012 Sugarbeet Res. Ext. Rept. 43:202-207.

3. Brantner, J.R. and Windels, C.E. 2012. Seed and in-furrow fungicides with and without postemergence Quadris for control of Rhizoctonia on sugarbeet. 2011 Sugarbeet Res. Ext. Rept. 42:212-217.

4. Clark, G. 2012. Managing Cercospora resistance: an outline of the issue – and recommendations – in Michigan sugarbeets. Sugarbeet Grower 51(4):10-12.

5. Franc, G.D., Stump, W.L., Obuya, J.O., Cecil, J.T., and Moore, M.D. 2009. Pro-active crop surveys and strategic sentinel plot placement for pre-emptive cooperative extension programming efforts in Wyoming. In Abstracts, 2009 Second National Meeting, National Plant Diagnostic Network, Miami, FL. 6-10 Dec. 2009.

6. Jacobsen, B.J., Zidack, N.K., Johnston, M., Dyer, A.T., Kephart, K., and Ansley, J. 2006. Studies on optimal timing of azoxystrobin applications for Rhizoctonia crown and root rot control. 2005 Sugarbeet Res. Ext. Rept. 36:291-294.

7. Khan, M.F.R., Nelson, R., Bradley, C.A., and Khan, J. 2006. Developing a management strategy for controlling Rhizoctonia root and crown rot in sugarbeet. 2005 Sugarbeet Res. Ext. Rept. 36:295-296.

8. Khan, M.F.R., Bradley, C.A., Nelson, R. and Khan, J. 2005. Developing a management strategy for controlling Rhizoctonia root and crown rot in sugarbeet. 2004b Sugarbeet Res. Ext. Rept. 35:232-234.

9. Khan, M.F.R. and Nelson, R. 2004. Efficacy of Quadris on control of Rhizoctonia root and crown rot in 2003. 2004 Sugarbeet Res. Ext. Rept. 34:250-251.

10. Kirk, W.W., Wharton, P.S., Schafer, R.L., Tumbalam, P., Poindexter, S., Guza, C., Fogg, R., Schlatter, T., Stewart, J., Hubbell, L., and Ruppal, D. 2008. Optimizing fungicide timing for the control of Rhizoctonia crown and root rot of sugar beet using soil temperature and plant growth stages. Plant Dis. 92:1091-1098.

11. Windels, C.E. and Brantner, J.R. 2005. Early-season application of azoxystrobin to sugarbeet for control of *Rhizoctonia solani* AG 4 and AG 2-2. J. Sugar Beet Res. 42:1-17.

12. Young, H.M., Marois, J.J., Wright, D.L., Narvaez, D.F., and O'Brien, G.K. 2011. Epidemiology of soybean rust in soybean sentinel plots in Florida. Plant Dis. 95:744-750.

CONTINUED EVALUATION OF THE STRATEGY FOR MANAGING WATERHEMP IN SUGARBEET

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Summary

1. Chloroacetamide herbicides (S-metolachlor, Warrant, Outlook) applied early postemergence (lay-by) are the most effective waterhemp control strategy in sugarbeet
2. Dual Magnum at 0.5 to 0.75 pt/A, ethofumesate at 1 to 2 pt/A) or Dual Magnum + ethofumesate at 0.5+ 2 pt/A) applied preemergence and followed by split application of S-metolachlor, Warrant or Outlook early postemergence provides the most consistent waterhemp control in sugarbeet.
3. Sugarbeet injury is least when chloroacetamide herbicides are split applied early postemergence and postemergence.

Introduction

Sugarbeet growers across all sugarbeet producing regions in Minnesota and eastern North Dakota should be scouting for waterhemp. Waterhemp is a summer annual weed in the pigweed family that can germinate in mid to late May, June, and July in North Dakota and Minnesota. Waterhemp germinates and emerges from the soil surface to one-half inch deep in the soil and remains viable in soils from four to six years. Waterhemp plants have male and female flowers on separate plants thus increasing the genetic diversity in populations and results in plants that are biologically and morphologically unique. It also has contributed to development of biotypes that are resistant to several herbicide families including ALS inhibitor (SOA2), triazine (SOA5), PPO inhibitor (SOA14), and glyphosate (SOA9) in Minnesota and North Dakota.

Waterhemp germination and emergence is tracked using a growing degree day (GDD) model (base temperature 45F) that calculates GDD accumulation during calendar year. Three hundred fifty units correspondence with waterhemp emergence and generally occurs in mid to late May. However, improved awareness and recognition of waterhemp has challenged the accuracy and utility of the model. Extension personnel will continue to use the model but recognize that local weather conditions and field specific environments ultimate will determine waterhemp emergence date.

Field research conducted at multiple field locations in 2014 and 2015 has concluded the chloroacetamide herbicides (S-metolachlor, Outlook, and Warrant) applied early postemergence (lay-by) with glyphosate and ethofumesate provide the most consistent waterhemp control. Growers enjoyed very favorable conditions for timely sugarbeet planting in 2016. However, several variables including stand uniformity, crop stage of nurse crops, waterhemp germination and emergence, and lack of timely precipitation in May created challenges for execution of the lay-by waterhemp control strategy.

S-metolachlor applied PRE followed by lay-by application improved the consistency and overall waterhemp control in an experiment at Moorhead in 2015. Additional research needs to be conducted to evaluate the PRE fb EPOST concept. Outlook usually is applied split lay-by or 12 fl oz/A fb 12 fl oz/A compared to 18 or 21 fl oz/A. Additional research needs to be conducted to determine if S-metolachlor or Warrant should be split applied. The objectives of 2016 experiments were to evaluate sugarbeet safety and waterhemp control at multiple locations from: a) S-metolachlor applied PRE followed by S-metolachlor, Warrant, or Outlook lay-by in single or multiple application; b) S-metolachlor, Warrant, or Outlook lay-by in a single or multiple application and; c) S-metolachlor, Outlook and Warrant rates lay-by in single or multiple applications. The purpose of this report is to summarize the sugarbeet safety experiment conducted at Roseland, MN and the waterhemp control experiment conducted at Moorhead, MN in 2016.

Materials and Methods

Experiments were conducted on natural populations of waterhemp near Moorhead and Roseland, Minnesota in 2016. Plot area was prepared with a Kongskilde s-tine field cultivator on May 7, 2016 at Moorhead, MN and with a field cultivator with rolling baskets on May 4, 2016 at Roseland, MN. Hilleshog 'HM4302RR' sugarbeet treated with Tachigaren, at 45 grams product, Cruiser Maxx (contains Cruiser 5FS at 60 gram active ingredient (g a.i.), Apron XL at 15 g a.i., and Maxim 4FS at 2.5 g a.i.) and Vibrance at 2g a.i. per 100,000 seeds was seeded 1.25 inches deep in 22 inch rows at 60,825 seeds per acre on May 12, 2016 at Moorhead. Crystal 'M380' sugarbeet treated with Tachigaren and Kabina at 45 g product and 14 g a.i. per 100,000 seeds, respectfully, was seeded 1.25 inches deep in 22 inch rows at 61,000 seeds per acre on May 5, 2016 at Roseland, MN

Herbicide treatments were applied at Moorhead May 16, June 6, and June 20, 2016 and May 5, June 2, and June 17, 2016 at Roseland. All treatments were applied with a bicycle sprayer in 17 gpa spray solution through 8002 XR flat fan nozzles pressurized with CO_2 at 40 psi to the center four rows of six row plots 30 feet in length in fields with moderate to heavy infestations of glyphosate-resistant waterhemp. Ammonium sulfate (AMS) in all treatments was 'N-Pak' AMS, a liquid formulation from Winfield Solutions. Non-ionic surfactant (NIS) was 'Prefer 90', a product from West Central, Inc.

Sugarbeet injury was evaluated June 24 and July 22, 2016 at Moorhead, MN and June 10, June 23, and July 5, 2016 at Roseland, MN. Waterhemp control was evaluated June 24, June 28, July 22, and August 24, 2016 at Moorhead and June 10, June 23, and July 5, 2016 at Roseland. Common lambsquarters and redroot pigweed control also was evaluated at each location but not included in this report since glyphosate provided complete or near complete control. All evaluations were a visual estimate of percent fresh weight reduction in the four treated rows compared to the adjacent untreated strip. Experimental design was randomized complete block with 4 replications. Data were analyzed with the ANOVA procedure of ARM, version 2016.4 software package.

Table 1. Application information for sugarbeet trials near Roseland, MN in 2016.

Application code	A	B	C
Date	May 5	June 2	June 17
Time of Day			
Air Temperature (F)	61	74	70
Relative Humidity (%)	36	40	40
Wind Velocity (mph)	7	4	10
Wind Direction	SW	W	SE
Soil Temp. (F at 6")	-	-	-
Soil Moisture	Good	Fair	Very Wet
Cloud Cover (%)	40	-	-
Sugarbeet stage (avg)	PRE	2-4	8-10
Waterhemp	-	-	-

Table 2. Application information for sugarbeet trial near Moorhead, MN in 2016.

Application code	A	B	C
Date	May 16	June 6	June 20
Time of Day	9:00 AM	2:00 PM	2:30 PM
Air Temperature (F)	51	67	73
Relative Humidity (%)	56	56	37
Wind Velocity (mph)	7	12	10
Wind Direction	N	NW	NW
Soil Temp. (F at 6")	48	62	70
Soil Moisture	Poor	Good	Good
Cloud Cover (%)	80	90	10
Sugarbeet stage (avg)	PRE	4-6 lf	10 lf
Waterhemp	-	0.5"	1-3"

Results and Discussion

2014 and 2015. Lay-by is use of soil residual herbicides after crop emergence but before weed emergence. In sugarbeet, S-metolachlor, Warrant, and Outlook can be applied POST to sugarbeet after sugarbeet have reached the two-leaf stage. Timely precipitation is required for activation since neither S-metolachlor, Warrant, nor Outlook control emerged weeds.

S-metolachlor, Warrant, and Outlook were applied lay-by at multiple locations in 2014 and 2015. Locations represented experiments with early sugarbeet planting (Moorhead, 2015) late sugarbeet planting (Herman, 2014 and Herman, 2015), and an open sugarbeet canopy (Herman, 2015). Glyphosate at 28 fl oz/A + ethofumesate at 4 fl oz/A was applied in combination with lay-by herbicides to control emerged weeds. Waterhemp control tended to be more consistent across locations and years from herbicides applied lay-by (Figure 1) compared to waterhemp control from herbicides applied PRE followed by POST or POST only tank-mixtures (1, 2). Outlook tended to provide more consistent waterhemp control than S-metolachlor or Warrant.

Waterhemp control may be related to herbicide solubility and resultant herbicide activation. Outlook is more water soluble than S-metolachlor or Warrant and thus, more easily activated (3). Warrant is the least water soluble of the chloroacetamide herbicides and thus, most dependent on timely and significant precipitation for activation. Significant precipitation occurred four days after lay-by application and precipitation totals were 1.7 inches, two weeks after lay-by application at Moorhead, 2015. Similar precipitation totals occurred during the two week interval following lay-by application at Herman, 2015 but precipitation was more events and less total precipitation per event. Thus, activation of S-metolachlor and Warrant may not have occurred as quickly or as completely.

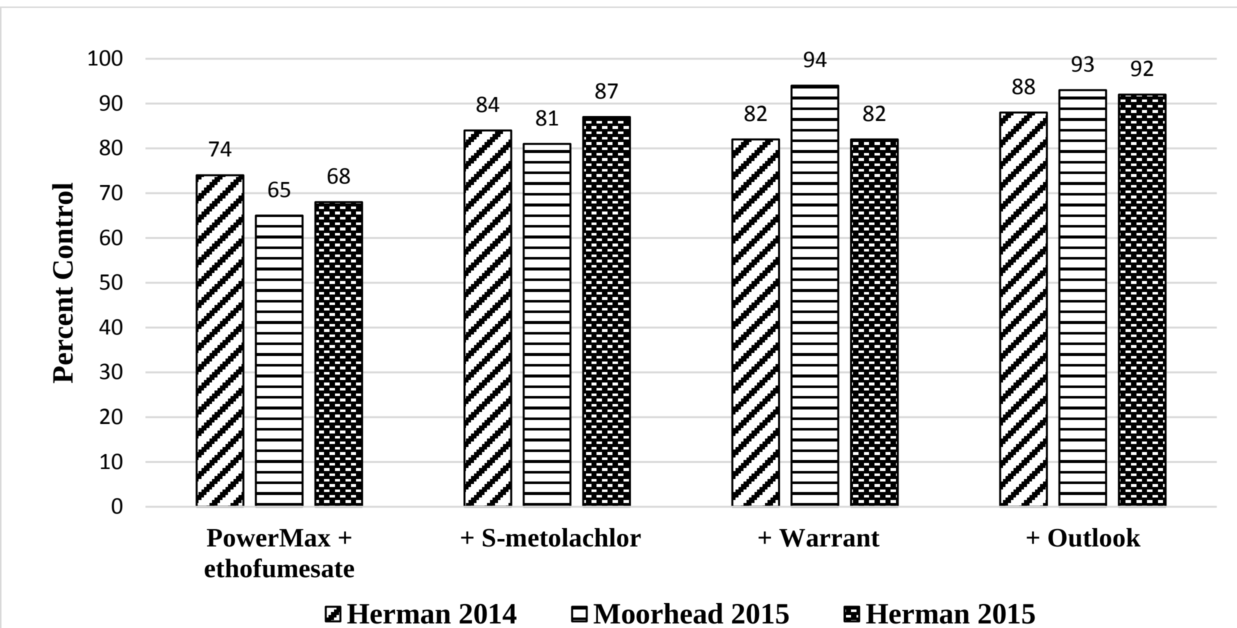

Figure 1. Waterhemp control from glyphosate plus ethofumesate and soil residual herbicides lay-by, across locations in 2014 and 2015.

There is a risk in relying on lay-by applications, that timely precipitation may not occur and thus, not activate herbicide. Preemergence herbicides followed by chloracetamide herbicides lay-by is a systems approach that may provide early-season broadleaf control including lambsquarters and redroot pigweed and available herbicide for waterhemp control until lay-by application is activated by precipitation. PRE fb lay-by may improve consistency of season-long control of waterhemp across environments.

S-metolachlor at 0.5 pt/A applied PRE followed by S-metolachlor, Outlook or Warrant improved the consistency of waterhemp control at Herman and Moorhead in 2015 (Figure 2). Waterhemp control tended to be greater when S-metolachlor was applied PRE fb lay-by, compared to lay-by alone.

Sugarbeet stands at Herman were compromised by a severe rhizoctonia root rot infestation that compromised sugarbeet stand and confounded sugarbeet injury evaluation from herbicide treatments. Sugarbeet safety from glyphosate, lay-by or PRE fb lay-by was negligible at Moorhead.

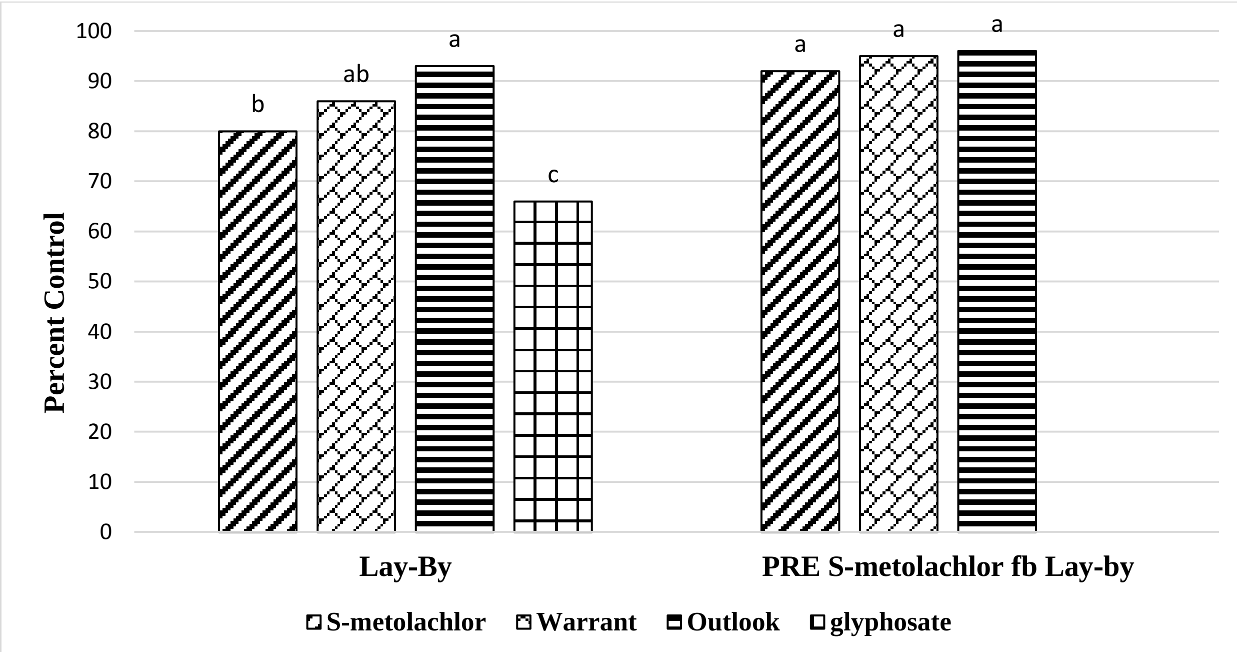

Figure 3. Waterhemp control from soil residual herbicides lay-by or S-metolachlor at 0.5 pt/A PRE followed by lay-by, averaged across Herman, MN and Moorhead, MN in 2015.

2016. Herbicides applied lay-by in single or multiple applications (split-lay-by) or PRE fb lay-by or split lay-by did not injure sugarbeets at Moorhead in 2016 (Table 2). This continues a trend of negligible sugarbeet injury from use of chloroacetamide herbicides alone or tank-mixed with glyphosate + ethofumesate. Lay-by applications were applied later than usual and at a higher growth stage (up to 6-lf sugarbeet) to achieve full stands since germination and emergence was confounded by dry soil conditions.

Waterhemp control was influenced by herbicide and application timing but generally was not influenced by herbicide rate (Table 2, Figure 4). Waterhemp control was best when S-metolachlor was applied PRE and followed by lay-by or split lay-by application. Timing of lay-by application may have impacted these results as the delay in application to achieve desired sugarbeet stage before application provided greater time for waterhemp to germinate and emerge, even though glyphosate + ethofumesate was in the tank-mix for burndown control. Previous experience and data from this experiment indicates glyphosate + ethofumesate alone do not provide sufficient waterhemp control, especially once waterhemp is greater than 1-inch. Splitting the lay-by application tended to improve waterhemp control as compared to a single application. Improvement in waterhemp control tended to occur across chloroacetamide herbicide. Outlook split lay-by at 12+12 fl oz/A is the common application approach by Growers, generally favoring this approach to a single application of 15 to 21 fl oz/A.

Common lambsquarters control was outstanding at Moorhead (data not presented). Control ranged from 95 to 100% across treatments. A uniform infestation of lambsquarters was 2 inches tall at application. Lambsquarters control was evaluated only on June 24 due to magnitude of control and competition from sugarbeet and waterhemp.

There was significant sugarbeet injury at Roseland (Table 3). Sugarbeet injury was characterized as growth reduction injury, sugarbeet a pale green color compared to untreated sugarbeet, and lack of sugarbeet uniformity within the row. Injury across treatments ranged from 14 to 51% on June 10, from 6 to 30% on June 23, and from 5 to 21% on July 5, 8, 28, and 33 days, respectfully, after the first lay-by application. Average sugarbeet injury across treatments was 29%, 25%, and 14% on June 10, June 23 and July 5, respectfully.

Table 2. Sugarbeet injury and waterhemp control from residual herbicides applied PRE and/or lay-by at Moorhead, MN in 2016.

Treatment[1]	Rate	App. Code[2]	Sugarbeet Jun 24	Sugarbeet Jul 22	Waterhemp Jun 24	Waterhemp Jul 22	Waterhemp Aug 24
	fl oz or pt (p)/A		---% injury---		------% control------		
PMax[3]+Etho / PMax+Etho	**28+4 / 28+4**	B / C	0	1	0	45	33
PMax+Etho+Dual / PMax+Etho	**28+4+1.25p / 28+4**	B / C	0	0	71	68	60
PMax+Etho+Dual / PMax+Etho	**28+4+1.67p / 28+4**	B / C	0	0	74	60	55
PMax+Etho+War / PMax+Etho	**28+4+3.25p / 28+4**	B / C	0	0	88	78	75
PMax+Etho+War / PMax+Etho	**28+4+4p / 28+4**	B / C	0	0	90	79	74
PMax+Etho+Out / PMax+Etho	**28+4+18 / 28+4**	B / C	0	0	78	64	55
PMax+Etho+Out / PMax+Etho	**28+4+21 / 28+4**	B / C	0	4	81	73	64
PMax+Etho+Dual / PMax+Etho+Dual	**28+4+1p / 28+4+1p**	B / C	5	0	84	80	71
PMax+Etho+Dual / PMax+Etho+Dual	**28+4+1.25p / 28+4+1.25p**	B / C	0	3	90	89	85
PMax+Etho+War / PMax+Etho+War	**28+4+2.25p / 28+4+2.25p**	B / C	0	3	93	88	86
PMax+Etho+War / PMax+Etho+War	**28+4+3p / 28+4+3p**	B / C	0	3	86	86	85
PMax+Etho+Out / PMax+Etho+Out	**28+4+12 / 28+4+12**	B / C	0	0	88	86	78
PMax+Etho+Out / PMax+Etho+Out	**28+4+15 / 28+4+9**	B / C	0	0	83	81	70
Dual / PMax+Etho+Dual / PMax+Etho	**0.5p / 28+4+1.25p / 28+4**	A / B / C	0	0	90	84	84
Dual / PMax+Etho+War / PMax+Etho	**0.5p / 28+4+3.25p / 28+4**	A / B / C	0	0	99	93	91
Dual / PMax+Etho+Out / PMax+Etho	**0.5p / 28+4+18 / 28+4**	A / B / C	0	5	100	98	100
Dual / PMax+Etho+Dual / PMax+Etho+Dual	**0.5p / 28+4+1p / 28+4+1p**	A / B / C	0	0	91	91	88
Dual / PMax+Etho+War / PMax+Etho+Dual	**0.5p / 28+4+2.25p / 28+4+2.25p**	A / B / C	0	0	94	95	94
Dual / PMax+Etho+Out / PMax+Etho+Dual	**0.5p / 28+4+9 / 28+4+9**	A / B / C	0	0	96	94	95
LSD (0.05)			**3**	**4**	**10**	**13**	**13**
CV			**879**	**341**	**8**	**12**	**12**

[1]Treatments of Roundup PowerMax contained Destiny HC at 1.5 pt/A + N-Pak AMS at 2.5% v/v
[2]Application codes refer to the information in Table 1
[3]PMax=Roundup PowerMax; Dual=Dual Magnum; War=Warrant; Out=Outlook; Etho=Ethofumesate 4SC

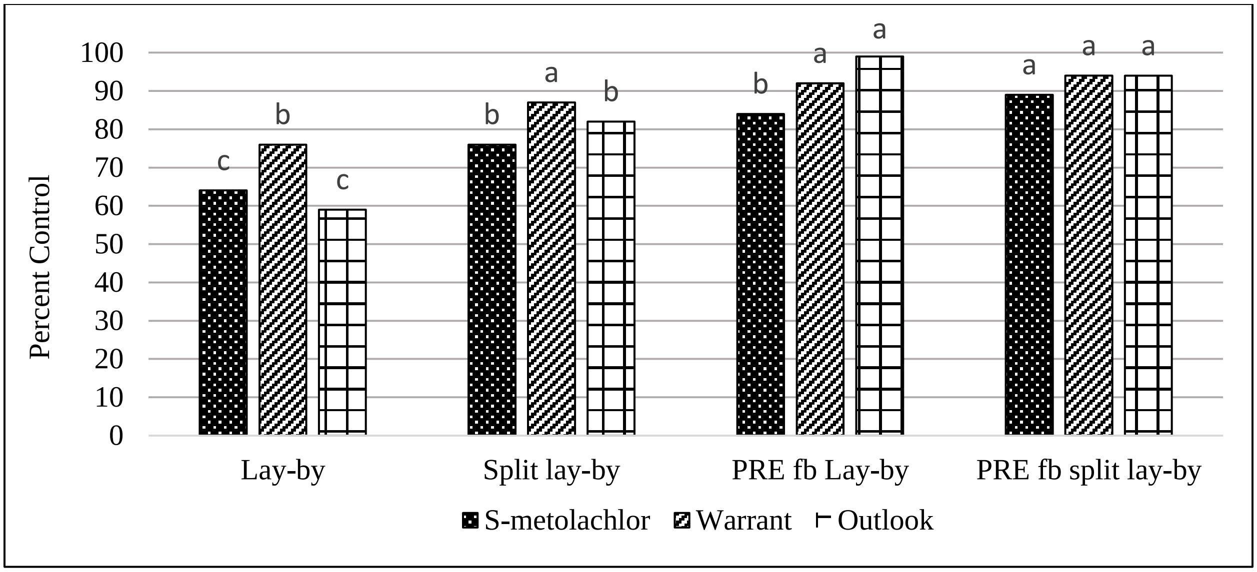

Figure 4. Waterhemp control from single (lay-by) or multiple applications of herbicides applied lay-by (split-lay-by) or S-metolachlor PRE followed by a lay-by or split lay-by, Moorhead, MN in 2016, average of July 22 and August 24 evaluation.

Sugarbeet injury was influenced by herbicide treatment, herbicide rate, timing of treatment application, and evaluation timing. Injury was greatest at the first evaluation timing or 8 days after PRE application. Injury tended to decrease in time from June 10 to July 5, the final evaluation. Injury was most severe from S-metolachlor PRE fb S-metolachlor, Outlook or Warrant lay-by (Figure 5). Splitting the lay-by application or a single lay-by application decreased or tended to decrease sugarbeet injury. Sugarbeet injury from S-metolachlor or Warrant was the same and was less or tended to be less than sugarbeet injury from Outlook. Greater injury from Outlook might be related to the amount and timeliness of precipitation and the solubility of Outook. These data provide good evidence for splitting Outlook lay-by compared to an 18 or 21 fl oz Outlook in a single application lay-by.

Experiment was very unique due to the amount and timeliness of precipitation. It is likely that chloroacetamide herbicide was leached into the seedling zone of actively growing plants. The outcome were plants that were not actively growing; plants that were standing still; plants that were drunk. The experiment received 10.6 inches of precipitation in May and June, the first eight weeks following planting. Over one-inch precipitation occurred in a single rainfall event five days following PRE, 11 days following lay-by and the day following split lay-by application. The experiment was planted into corn stalks residue.

Experiment does not suggest that chloroacetamide herbicides applied PRE and/or lay-by will always cause sugarbeet injury. Rather, the experiment informs its audience that when conditions are appropriate for sugarbeet injury, S-metolachlor PRE fb S-metolachlor, Outlook or Warrant lay-by will cause the greatest sugarbeet injury. It teaches that Outlook has the potential to cause more injury than Dual Magnum or Warrant.

Experiment reinforces our herbicide rate structure. Dual Magnum should be applied at 1.25 pt/a lay-by or 1 pt/a fb 1 pt/a split lay-by; Warrant 3.25 pt/a or 2.25 pt/a fb 2.25 pt/a; and Outlook 18 oz or 12 oz/a fb 12 oz/a split lay-by.

Waterhemp control ranged from 85 to 100% during the June 23 and July 5 evaluations (Table 3). Waterhemp control from lay-by herbicide application was slightly better than split-lay-by herbicide application but was herbicide treatment dependent. S-metolachlor applied PRE tended to improve control provided from lay-by treatments. However, control tended to be greater from lay-by herbicide application than split-lay-by application.

In general, there were no differences across herbicides, herbicide rates or application timing. Lambsquarters control was near perfect there were no observations of treatment differences (data not presented). There was a light infestation of redroot pigweed in the experimental area (data not presented). In general, all entries provided greater than 95% pigweed control. Lay-by tended to provide slightly better control than split-lay-by. PRE fb lay-by or PRE fb split lay-by gave perfect pigweed control.

Table 3. Sugarbeet injury and waterhemp control from residual herbicides applied PRE and/or lay-by at Roseland, MN in 2016.

Treatment[1]	Rate	App. Code[2]	Sugarbeet Jun 10	Sugarbeet Jun 23	Sugarbeet Jul 5	Waterhemp Jun 23	Waterhemp Jul 5
	fl oz or pt (p)/A		-------% injury-------			--% control--	
PMax[3]+Etho / PMax+Etho	**28+4 / 28+4**	B / C	0	0	9	70	64
PMax+Etho+Dual / PMax+Etho	**28+4+1.25p / 28+4**	B / C	25	5	11	90	65
PMax+Etho+Dual / PMax+Etho	**28+4+1.67p / 28+4**	B / C	38	20	6	96	93
PMax+Etho+War / PMax+Etho	**28+4+3.25p / 28+4**	B / C	16	15	5	99	95
PMax+Etho+War / PMax+Etho	**28+4+4p / 28+4**	B / C	41	14	11	98	95
PMax+Etho+Out / PMax+Etho	**28+4+18 / 28+4**	B / C	38	8	11	95	93
PMax+Etho+Out / PMax+Etho	**28+4+21 / 28+4**	B / C	39	23	19	98	96
PMax+Etho+Dual / PMax+Etho+Dual	**28+4+1p / 28+4+1p**	B / C	18	13	11	88	85
PMax+Etho+Dual / PMax+Etho+Dual	**28+4+1.25p / 28+4+1.25p**	B / C	21	10	14	95	91
PMax+Etho+War / PMax+Etho+War	**28+4+2.25p / 28+4+2.25p**	B / C	14	10	11	85	89
PMax+Etho+War / PMax+Etho+War	**28+4+3p / 28+4+3p**	B / C	35	19	13	98	96
PMax+Etho+Out / PMax+Etho+Out	**28+4+12 / 28+4+12**	B / C	34	18	18	96	95
PMax+Etho+Out / PMax+Etho+Out	**28+4+15 / 28+4+9**	B / C	26	6	6	100	100
Dual / PMax+Etho+Dual / PMax+Etho	**0.5p / 28+4+1.25p / 28+4**	A / B / C	36	15	18	100	100
Dual / PMax+Etho+War / PMax+Etho	**0.5p / 28+4+3.25p / 28+4**	A / B / C	39	16	18	99	99
Dual / PMax+Etho+Out / PMax+Etho	**0.5p / 28+4+18 / 28+4**	A / B / C	51	30	21	100	100
Dual / PMax+Etho+Dual / PMax+Etho+Dual	**0.5p / 28+4+1p / 28+4+1p**	A / B / C	20	19	19	99	93
Dual / PMax+Etho+War / PMax+Etho+Dual	**0.5p / 28+4+2.25p / 28+4+2.25p**	A / B / C	23	13	15	100	96
Dual / PMax+Etho+Out / PMax+Etho+Dual	**0.5p / 28+4+9 / 28+4+9**	A / B / C	15	9	13	98	98
LSD (0.05)			**16**	**14**	**9**	**8**	**11**
CV			**40**	**72**	**48**	**6**	**9**

[1]Treatments of Roundup PowerMax contained Destiny HC at 1.5 pt/A + N-Pak AMS at 2.5% v/v
[2]Application codes refer to the information in Table 1
[3]PMax=Roundup PowerMax; Dual=Dual II Magnum; War=Warrant; Out=Outlook; Etho=Ethofumesate 4SC

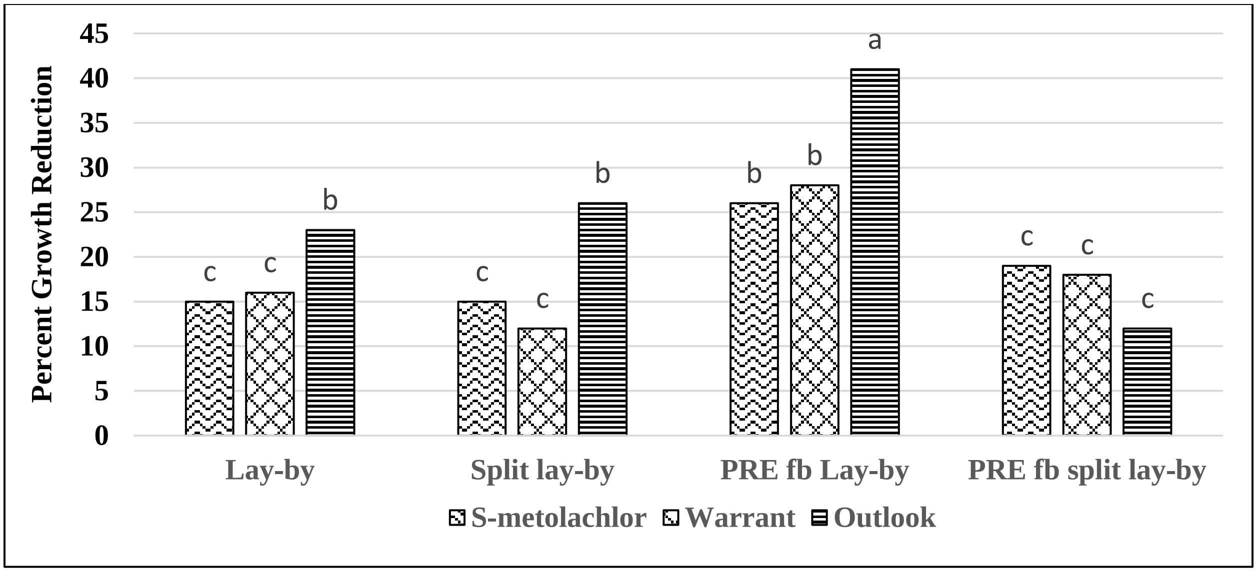

Figure 5. Sugarbeet injury from single (lay-by) or multiple applications of herbicides applied lay-by (split-lay-by) or PRE S-metolachlor followed by a lay-by or split lay-by, Moorhead, MN in 2016, average of June 10 and June 23 evaluation.

Conclusions

Sugarbeet planting date is the first consideration for waterhemp control recommendation (Table 9). Lay-by or split lay-by application of chloroacetamide herbicides is the preferred approach for waterhemp control for early planted sugarbeet. Use PRE followed by a split lay-by application for fields with early germinating weeds or to manage the risk of uncertainty with activation of lay-by herbicide.

Late planted sugarbeet may not reach the sugarbeet 2-lf stage by May 15 or the approximate date for waterhemp germination and emergence and lay-by application of chloroacetamide herbicides. Thus, Dual Magnum or ethofumesate should be applied PRE followed by split lay-by. Timing of lay-by will be dependent on sugarbeet planting date, precipitation to activate PRE, and waterhemp pressure in the field.

Continue to scout sugarbeet fields for waterhemp in July and August. Tank-mixes of Betamix or UpBeet with Roundup plus ethofumesate are recommended for POST waterhemp control. Apply in combination with HSMOC at 1.5 pt/A and AMS at 8.5 to 17 lb/100 gallon water carrier.

Table 4. Recommendation for waterhemp control in sugarbeet, by planting date.

Planting Date	**Recommendation**
Plant Sugarbeet in April	Split lay-by application (early postemergence / postemergence) of chloroacetamide herbicides applied at 2-lf sugarbeet fb 4 to 6-lf sugarbeet
	Single lay-by application when sugarbeet is at the 2-lf stage or greater
	Dual Magnum and/or ethofumesate PRE followed by a split lay-by application at 2 to 4-lf stage fb 4 to 6-lf stage
Plant Sugarbeet in May	Dual Magnum and/or ethofumesate PRE followed by a split lay-by
Mid Season	Continue to scout fields for late germinating waterhemp
	Be prepared to rescue with Betamix + ethofumesate, UpBeet+ ethofumesate or Betamix + UpBeet

Future Research

Sugarbeet growers have asked about cultivation as an integrated management strategy to achieve the zero tolerance for weed escapes strategy. We need to investigate if cultivation will disrupt the herbicide boundary, allowing new flushes of waterhemp to germination and emerge, thus potentially doing more harm than good. We need to investigate if cultivation is a method to activate lay-by herbicides when precipitation is not timely. We need to evaluate if Treflan is an effective option for lay-by control of waterhemp in sugarbeet.

We need to continue to evaluate the preemergence component of the systems strategy for waterhemp control. We need to determine if ethofumesate should be utilized in tank-mixtures with Dual Magnum to extend waterhemp control. We need to continue to evaluate formulation technology that may permit preemergence use of Ro-Neet SB in sugarbeet.

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Literature Cited

1. Peters, TJ Carlson AL (2015) Controlling Waterhemp in Fields Planted to Sugarbeet. Sugarbeet Res. Ext. Rept. 45: 29-35.
2. Peters, TJ Lueck AB Radermacher J (2016) A Strategy for Managing Waterhemp in Sugarbeet. Sugarbeet Res. Ext. Rept. 46: 22-30.
3. Weed Science Society of America (2014) Herbicide Handbook. 5th ed. Shaner DL. ed. Lawrence, KS: Weed Science Society of America. 513 p.