2007
Southern MN Beet Sugar Cooperative
Research Report

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SMBSC APPROVED VARIETIES – 2008

UNLIMITED VARIETIES

- Beta 1591R
- Beta 95RR03 (Roundup Ready)

- Hilleshog 2467Rz
- Hilleshog 3028Rz
- Hilleshog 3035Rz
- Hilleshog 3036Rz

- Holly Hybrid 255

SPECIALTY VARIETIES

Beta 4811R	(APH)
Beta 1322R	(APH)

UNLIMITED – Last year of sales

- Beta 4901R

TEST MARKET VARIETIES
(Sales shall not exceed 10% of total seed sales)

- Beta 1604R

TEST MARKET VARIETIES – Roundup Ready
(Combined sales shall not exceed 5% of total seed usage)

- BTS 95RR01 (Roundup Ready)
- Crystal RR201 (Roundup Ready)
- Hilleshog 4017RR (Roundup Ready)

2007 SMBSC Official Variety Trials Specifications

Trial #	Trial Location	Cooperator	Entry Designation	Previous Crop	Total Nitrogen	Planting Date	Stand Counts	Disease	Harvest Date
0756-05	Gluek	Luschen/Noble	Comm./SemiComm	Field Corn	113	5/14/07	6/13/07	Moderate to Severe Viral	9/15/07
0756-35	Gluek	Luschen/Noble	Transgenic	Field Corn	113	5/14/07	6/13/07		9/17/07
0756-04	Clara City	B&L Schwitters	Comm./SemiComm	Soybeans	96	5/3/07	5/31/07	Moderate Viral Disease	9/14/07
0756-34	Clara City	B&L Schwitters	Transgenic	Soybeans	96	5/3/07	5/31/07	Moderate Aph	9/13/07
0756-03	Renville	C&P Haen	Comm./SemiComm	Field Corn	91	5/1/07	5/29/07	Slight Rzm	9/21/07
0756-33	Renville	C&P Haen	Transgenic	Field Corn	91	5/1/07	5/29/07	Intermittant Rhizoc and Aph	9/21/07
0756-02	Lake Lillian	Schmoll Bros.	Comm./SemiComm	Sw Corn	86	5/11/07	6/10/07	Slight Rzm (88%)	9/22/07
0756-32	Lake Lillian	Schmoll Bros.	Transgenic	Sw Corn	86	5/11/07	6/10/07		9/23/07
0756-01	Hector	Rich Wehking	Comm./SemiComm	Field Corn	138	4/30/07	5/29/07	Intermittant Aph and Rzc	9/28/07
0756-31	Hector	Rich Wehking	Transgenic	Field Corn	138	4/30/07	5/29/07	Very little Rhizomania	9/27/07

Table 1. Mean of the Three Year 2008 SMBSC Varieties Approved for Unlimited Sales - Based Upon Approval Criteria

CONVERTED

Entry - Converted			*Rec/T (lbs)* 3 yr avg	% of mean	*Rec/A (lbs)* 3 yr avg	% of mean	*%ES* 3 yr avg	% of mean	*Yield (T/A)* 3 yr avg	% of mean	*Sugar %* 3 yr avg	% of mean	*Cercospora Leaf Spot* 3 yr avg	% of mean	*Emerg-ence (%)* 3 yr avg	% of mean	*Aphano-myces* 3 yr avg	% of mean	*Purity (%)* 3 yr avg	% of mean
2008 APPROVED VARIETIES																				
Beta 1591R		203.80	250.89	99.19	7257.50	104.61	12.54	99.17	29.03	106.06	15.11	99.54	4.78	98.38			5.02	100.00	89.81	99.68
BTS 95RR03		204.12	255.05	100.83	7165.40	103.29	12.74	100.78	28.12	102.75	15.09	99.43	5.06	104.09	62.09	96.00	4.72	94.09	91.13	101.15
Hilleshog 2467Rz	RZM	195.94	252.01	99.63	6681.57	96.31	12.60	99.61	26.35	96.27	15.28	100.68	5.04	103.66	66.30	102.50	5.38	107.12	89.41	99.23
Hilleshog 3028Rz		200.32	250.06	98.86	7038.45	101.46	12.49	98.80	28.02	102.37	15.09	99.43	5.09	104.72			5.16	102.81	89.71	99.57
Hilleshog 3035Rz	RZC	199.97	253.77	100.33	6912.45	99.64	12.69	100.38	27.10	99.01	15.22	100.27	4.63	95.24			5.19	103.35	90.13	100.03
Hilleshog 3036Rz		201.38	258.90	102.36	6869.87	99.03	12.95	102.38	26.40	96.45	15.46	101.89	5.09	104.77			4.81	95.84	90.34	100.27
HOLLY 255	APH & RZM	194.47	249.91	98.80	6637.00	95.67	12.50	98.88	26.58	97.11	14.99	98.75	4.33	89.12	65.66	101.50	4.86	96.78	90.15	100.06
			252.94	**100.00**	**6937.46**	**100.00**	**12.65**	**100.00**	**27.37**	**100.00**	**15.18**	**100.00**	**4.86**	**100.00**	**64.68**	**100.00**	**5.02**	**100.00**	**90.10**	**100.00**

2008 SPECIALTY VARIETIES (% of Mean is of Approved Mean)

Entry	Specialty	RST+ RSA	Rec/T 3 yr avg	% of mean	Rec/A 3 yr avg	% of mean	%ES 3 yr avg	% of mean	Yield 3 yr avg	% of mean	Sugar % 3 yr avg	% of mean	Cercospora 3 yr avg	% of mean	Emergence 3 yr avg	% of mean	Aphanomyces 3 yr avg	% of mean	Purity 3 yr avg	% of mean
Beta 1322R		206.76	252.29	99.74	7424.01	107.01	12.61	99.75	29.33	107.18	15.24	100.42	5.32	109.49	71.39	110.36	4.23	84.36	89.60	99.45
Beta 4811R	APH & RZM	192.96	245.10	96.90	6664.45	96.06	12.26	96.95	27.24	99.54	14.82	97.63	4.45	91.52	66.03	102.09	4.22	84.11	89.63	99.49

2008 PREVIOUSLY APPROVED VARIETIES NOT MEETING CRITERIA - FINAL YEAR OF SALES (% of Mean is of Approved Mean)

Candidate Varieties	Specialty	RST+ RSA	Rec/T 3 yr avg	% of mean	Rec/A 3 yr avg	% of mean	%ES 3 yr avg	% of mean	Yield 3 yr avg	% of mean	Sugar % 3 yr avg	% of mean	Cercospora 3 yr avg	% of mean	Emergence 3 yr avg	% of mean	Aphanomyces 3 yr avg	% of mean	Purity 3 yr avg	% of mean
Beta 4901R	RZM	191.40	254.06	96.66	7052.42	94.74	12.71	96.74	27.67	97.60	15.34	97.94	4.82	99.93	60.75	99.28	4.93	95.55	89.71	99.16

TEST MARKET VARIETIES FOR LIMITED SALES WITH 3 YEARS OF DATA (% of Mean is of Approved Mean)

Entry	Specialty	RST+ RSA	Rec/T 3 yr avg	% of mean	Rec/A 3 yr avg	% of mean	%ES 3 yr avg	% of mean	Yield 3 yr avg	% of mean	Sugar % 3 yr avg	% of mean	Cercospora 3 yr avg	% of mean	Emergence 3 yr avg	% of mean	Aphanomyces 3 yr avg	% of mean	Purity 3 yr avg	% of mean
BTS 95RR01		180.24	241.76	95.58	5873.16	84.66	12.09	95.61	23.90	87.34	14.56	95.95	5.01	103.11	57.34	88.65	5.98	119.07	90.03	99.92

Table 2. Comparison of 2008 Approved Varieties to Candidate Test Market Varieties Based on 2 Year Data, 2006 - 2007

CONVERTED

Entry - Converted	Specialty	RST+ RSA	*Rec/T (lbs)* 2 yr avg	% of mean	*Rec/A (lbs)* 2 yr avg	% of mean	*%ES* 2 yr avg	% of mean	*Yield (T/A)* 2 yr avg	% of mean	*Sugar %* 2 yr avg	% of mean	*Cercospora Leaf Spot* 2 yr avg	% of mean	*Emergence (%)* 2 yr avg	% of mean	*Aphanomyces* 2 yr avg	% of mean	*Purity (%)* 2 yr avg	% of mean
2008 APPROVED VARIETIES																				
Beta 1591R		206.50	262.44	99.85	7939.75	106.66	13.12	99.82	30.52	107.67	15.66	99.98	4.75	98.52			5.22	101.11	90.33	99.85
BTS 95RR03		201.05	258.85	98.48	7635.44	102.57	12.93	98.39	29.74	104.92	15.35	98.01	4.87	101.13	59.46	97.19	4.81	93.17	90.84	100.42
Hilleshog 2467Rz	RZM	196.81	262.69	99.94	7211.25	96.87	13.13	99.93	27.31	96.34	15.80	100.87	5.01	103.91	62.97	102.91	5.58	108.10	89.86	99.33
Hilleshog 3028Rz		202.16	261.46	99.48	7644.18	102.69	13.06	99.40	29.16	102.87	15.65	99.88	5.11	106.03			5.45	105.50	90.24	99.74
Hilleshog 3035Rz	RZC	198.56	264.99	100.82	7276.47	97.75	13.26	100.88	27.28	96.22	15.73	100.43	4.66	96.78			5.52	106.86	90.74	100.30
Hilleshog 3036Rz		200.91	269.08	102.37	7335.61	98.54	13.46	102.41	27.17	95.85	15.95	101.83	5.12	106.21			4.90	94.94	90.75	100.31
HOLLY 255	APH & RZM	193.99	260.38	99.06	7066.71	94.93	13.03	99.17	27.25	96.13	15.51	98.99	4.21	87.43	61.12	99.90	4.66	90.31	90.51	100.05
			262.84	**100.00**	**7444.20**	**100.00**	**13.14**	**100.00**	**28.35**	**100.00**	**15.66**	**100.00**	**4.82**	**100.00**	**61.18**	**100.00**	**5.16**	**100.00**	**90.47**	**100.00**
2008 SPECIALTY VARIETIES (% of Mean is of Approved Mean)																				
Beta 1322R		207.88	263.18	100.13	8021.11	107.75	13.16	100.12	30.47	107.47	15.75	100.52	5.26	109.18	69.94	114.31	4.65	90.02	90.16	99.66
Beta 4811R	APH & RZM	195.60	258.52	98.36	7239.18	97.25	12.94	98.45	28.17	99.36	15.46	98.67	4.48	92.91	63.90	104.44	4.59	88.87	90.26	99.77
2008 PREVIOUSLY APPROVED VARIETIES NOT MEETING CRITERIA - FINAL YEAR OF SALES (% of Mean is of Approved Mean)																				
Candidate Varieties																				
Beta 4901R	RZM	191.40	254.06	96.66	7052.42	94.74	12.71	96.74	27.67	97.60	15.34	97.94	4.82	99.93	60.75	99.28	4.93	95.55	89.71	99.16
TEST MARKET VARIETIES FOR LIMITED SALES WITH 2 YEARS OF DATA (% of Mean is of Approved Mean)																				
Beta 1604R		197.67	263.69	100.32	7246.64	97.35	13.19	100.39	27.62	97.42	15.85	101.19	4.92	102.11			4.86	94.11	89.71	99.16
BTS 95RR01		173.13	244.52	93.03	5962.81	80.10	12.22	93.03	23.94	84.45	14.74	94.09	4.93	102.24	51.62	84.36	6.81	131.93	89.92	99.39
Crystal RR201		196.64	272.88	103.82	6909.84	92.82	13.63	103.75	25.35	89.44	15.94	101.75	5.08	105.47	52.43	85.69	5.78	111.98	91.81	101.49
Hilleshog 4017RR		204.91	266.26	101.30	7712.53	103.60	13.31	101.28	29.02	102.36	15.66	100.00	5.31	110.15	53.09	86.78	6.18	119.81	91.37	100.99

Table 3. Comparison of 2008 Approved Varieties to Candidate Test Market Varieties Based on 1 Year Data, 2007

CONVERTED

Entry - Converted	Specialty	RST+ RSA	*Rec/T (lbs)* 1 yr avg	% of mean	*Rec/A (lbs)* 1 yr avg	% of mean	*%ES* 1 yr avg	% of mean	*Yield (T/A)* 1 yr avg	% of mean	*Sugar %* 1 yr avg	% of mean	*Cercospora Leaf Spot* 1 yr avg	% of mean	*Emergence (%)* 1 yr avg	% of mean	*Aphanomyces* 1 yr avg	% of mean	*Purity (%)* 1 yr avg	% of mean
2008 APPROVED VARIETIES																				
Beta 1591R		205.35	258.30	98.98	8021.20	106.37	12.90	98.90	31.50	108.41	15.50	98.99	4.66	96.92	65.50	101.74	5.96	108.55	89.90	99.88
BTS 95RR03		202.77	260.27	99.73	7769.23	103.03	13.01	99.71	30.49	104.93	15.61	99.68	4.74	98.52	65.67	102.00	4.52	82.32	90.06	100.06
Hilleshog 2467Rz	RZM	194.68	258.20	98.94	7219.60	95.74	12.90	98.90	28.00	96.37	15.70	100.27	5.18	107.71	59.60	92.57	5.73	104.28	89.20	99.10
Hilleshog 3028Rz		199.26	258.60	99.09	7553.50	100.17	12.90	98.90	29.10	100.15	15.60	99.63	5.18	107.71	60.70	94.28	6.43	117.10	89.80	99.77
Hilleshog 3035Rz	RZC	198.02	267.80	102.62	7193.70	95.40	13.40	102.73	26.90	92.58	15.90	101.54	4.56	94.85	66.70	103.60	5.87	106.84	90.70	100.77
Hilleshog 3036Rz		200.73	266.00	101.93	7450.00	98.80	13.30	101.97	28.00	96.37	15.90	101.54	5.01	104.04	69.00	107.17	5.02	91.46	90.20	100.21
HOLLY 255	APH & RZM	199.19	257.60	98.71	7576.60	100.48	12.90	98.90	29.40	101.19	15.40	98.35	4.34	90.26	63.50	98.63	4.91	89.46	90.20	100.21
			260.97	**100.00**	**7540.55**	**100.00**	**13.04**	**100.00**	**29.06**	**100.00**	**15.66**	**100.00**	**4.81**	**100.00**	**64.38**	**100.00**	**5.49**	**100.00**	**90.01**	**100.00**
2008 SPECIALTY VARIETIES (% of Mean is of Approved Mean)																				
Beta 1322R		207.33	260.10	99.67	8118.00	107.66	13.00	99.67	31.30	107.72	15.70	100.27	5.37	111.62	71.00	110.28	4.63	84.33	89.50	99.43
Beta 4811R	APH & RZM	195.94	255.60	97.94	7389.80	98.00	12.80	98.13	29.00	99.81	15.40	98.35	4.70	97.61	64.90	100.81	4.65	84.62	89.70	99.66
2008 PREVIOUSLY APPROVED VARIETIES NOT MEETING CRITERIA - FINAL YEAR OF SALES (% of Mean is of Approved Mean)																				
Candidate Varieties																				
Beta 4901R	RZM	186.99	249.90	95.76	6879.10	91.23	12.50	95.83	27.60	94.99	15.30	97.71	4.98	103.58	55.90	86.83	5.08	92.60	88.90	98.77
TEST MARKET VARIETIES FOR LIMITED SALES WITH 1 YEAR OF DATA (% of Mean is of Approved Mean)																				
Beta 1604R		195.78	261.70	100.28	7201.10	95.50	13.10	100.43	27.90	96.02	15.90	101.54	4.71	97.84			5.29	96.30	88.90	98.77
BTS 95RR01		206.00	264.40	101.31	7893.89	104.69	13.21	101.26	30.27	104.17	15.75	100.58	5.09	105.79	67.61	105.01	6.76	123.11	90.43	100.47
Crystal RR201		198.01	269.44	103.25	7145.33	94.76	13.46	103.20	26.82	92.31	16.02	102.32	5.08	105.58	47.40	73.63	6.21	113.10	90.50	100.55
Hilleshog 4017RR		207.39	265.15	101.60	7977.26	105.79	13.25	101.57	30.37	104.51	15.78	100.77	5.24	108.91	52.96	82.25	6.18	112.55	90.51	100.56

Table 8. Comparison of 2008 Approved Varieties to Candidate Transgenic Varieties Based on 3 Year Data, 2005 - 2007

Entry - Converted			Rec/T (lbs) 3 yr Avg	Rec/T (lbs) % of mean	Rec/A (lbs) 3 yr avg	Rec/A (lbs) % of mean	%ES 3 yr avg	%ES % of mean	Yield (T/A) 3 yr avg	Yield (T/A) % of mean	Sugar % 3 yr avg	Sugar % % of mean	Cercospora Leaf Spot 3 yr avg	Cercospora Leaf Spot % of mean	Emerg-ence (%) 3 yr avg	Emerg-ence (%) % of mean	Aphano-myces 3 yr avg	Aphano-myces % of mean	Purity (%) 3 yr avg	Purity (%) % of mean
Beta 1322R		206.77	252.29	100.12	7424.01	106.65	12.61	100.11	29.33	106.38	15.24	100.64	5.32	109.37	71.39	107.68	4.23	87.43	89.60	99.56
Beta 1591R		203.82	250.89	99.56	7257.50	104.26	12.54	99.53	29.03	105.27	15.11	99.76	4.78	98.27			5.02	103.63	89.81	99.80
Beta 4811R	APH & RZM	193.00	245.10	97.26	6664.45	95.74	12.26	97.31	27.24	98.80	14.82	97.84	4.45	91.41	66.03	99.61	4.22	87.16	89.63	99.60
BTS 95RR03		204.14	255.05	101.21	7165.40	102.93	12.74	101.15	28.12	101.99	15.09	99.64	5.06	103.98	62.09	93.66	4.72	97.51	91.13	101.27
Hilleshog 2467Rz	RZM	195.99	252.01	100.00	6681.57	95.98	12.60	99.98	26.35	95.55	15.28	100.90	5.04	103.55	66.30	100.01	5.38	111.01	89.41	99.35
Hilleshog 3028Rz		200.34	250.06	99.23	7038.45	101.11	12.49	99.16	28.02	101.61	15.09	99.65	5.09	104.60			5.16	106.54	89.71	99.69
Hilleshog 3035Rz	RZC	200.00	253.77	100.70	6912.45	99.30	12.69	100.75	27.10	98.27	15.22	100.48	4.63	95.14			5.19	107.10	90.13	100.15
Hilleshog 3036Rz		201.43	258.90	102.74	6869.87	98.69	12.95	102.76	26.40	95.73	15.46	102.11	5.09	104.66			4.81	99.32	90.34	100.39
HOLLY 255	APH & RZM	194.51	249.91	99.17	6637.00	95.34	12.50	99.24	26.58	96.39	14.99	98.97	4.33	89.02	65.66	99.04	4.86	100.30	90.15	100.18
			252.00	**100.00**	**6961.19**	**100.00**	**12.60**	**100.00**	**27.57**	**100.00**	**15.14**	**100.00**	**4.86**	**100.00**	**66.29**	**100.00**	**4.84**	**100.00**	**89.99**	**100.00**

TRANSGENIC VARIETIES - 3 YEAR DATA

BTS 95RR01		180.31	241.76	95.94	5873.16	84.37	12.09	95.96	23.90	86.69	14.56	96.15	5.01	102.99	57.34	86.50	5.98	123.39	90.03	100.04

Table 9. Comparison of 2007 Approved to Transgenic Varieties Based on 2 Year Data, 2007 - 2008

CONVERTED

Entry - Converted			Rec/T (lbs) 2 yr Avg	Rec/T (lbs) % of mean	Rec/A (lbs) 2 yr avg	Rec/A (lbs) % of mean	%ES 2 yr avg	%ES % of mean	Yield (T/A) 2 yr avg	Yield (T/A) % of mean	Sugar % 2 yr avg	Sugar % % of mean	Cercospora Leaf Spot 2 yr avg	Cercospora Leaf Spot % of mean	Emerg-ence (%) 2 yr avg	Emerg-ence (%) % of mean	Aphano-myces 2 yr avg	Aphano-myces % of mean	Purity (%) 2 yr avg	Purity (%) % of mean
Beta 1322R		207.45	263.18	100.30	8021.11	107.15	13.16	100.28	30.47	106.66	15.75	100.61	5.26	108.93	69.94	110.18	4.65	92.18	90.16	99.72
Beta 1591R		206.08	262.44	100.01	7939.75	106.07	13.12	99.98	30.52	106.86	15.66	100.07	4.75	98.29			5.22	103.54	90.33	99.91
Beta 4811R	APH & RZM	195.23	258.52	98.52	7239.18	96.71	12.94	98.61	28.17	98.61	15.46	98.76	4.48	92.69	63.90	100.66	4.59	91.01	90.26	99.83
BTS 95RR03		200.65	258.85	98.65	7635.44	102.00	12.93	98.54	29.74	104.13	15.35	98.10	4.87	100.90	59.46	93.68	4.81	95.41	90.84	100.48
Hilleshog 2467Rz	RZM	196.45	262.69	100.11	7211.25	96.34	13.13	100.09	27.31	95.62	15.80	100.96	5.01	103.67	62.97	99.19	5.58	110.70	89.86	99.39
Hilleshog 3028Rz		201.76	261.46	99.64	7644.18	102.12	13.06	99.56	29.16	102.09	15.65	99.97	5.11	105.78			5.45	108.03	90.24	99.81
Hilleshog 3035Rz	RZC	198.19	264.99	100.99	7276.47	97.21	13.26	101.04	27.28	95.49	15.73	100.52	4.66	96.56			5.52	109.43	90.74	100.37
Hilleshog 3036Rz		200.54	269.08	102.54	7335.61	98.00	13.46	102.57	27.17	95.13	15.95	101.92	5.12	105.96			4.90	97.23	90.75	100.38
HOLLY 255	APH & RZM	193.64	260.38	99.23	7066.71	94.40	13.03	99.33	27.25	95.41	15.51	99.08	4.21	87.22	61.12	96.29	4.66	92.48	90.51	100.11
			262.40	100.00	7485.52	100.00	13.12	100.00	28.56	100.00	15.65	100.00	4.83	100.00	63.48	100.00	5.04	100.00	90.41	100.00

TRANSGENIC VARIETIES - 2 YEAR DATA

BTS 95RR01		172.84	244.52	93.19	5962.81	79.66	12.22	93.18	23.94	83.81	14.74	94.18	4.93	102.00	51.62	81.31	6.81	135.10	89.92	99.45
Crystal RR201		196.31	272.88	104.00	6909.84	92.31	13.63	103.92	25.35	88.77	15.94	101.84	5.08	105.22	52.43	82.60	5.78	114.67	91.81	101.55
Hilleshog 4017RR		204.51	266.26	101.47	7712.53	103.03	13.31	101.44	29.02	101.59	15.66	100.09	5.31	109.90	53.09	83.64	6.18	122.69	91.37	101.06

2007 Southern Minnesota Beet Sugar Cooperative Variety Strip Trial Research

There were ten variety strip trials conducted in the SMBSC growing area in 2007. Eight variety strip trials were established in shareholders fields within the area of the cooperative that were heavily populated with beet production. Two additional variety strip trials were conducted in the north and northwest areas. The objective of the eight strip trials located in the core of the cooperative area was to provide an opportunity to observe variety performance in actual field conditions. The purpose of the strip trials in the northern region was the same but an additional purpose was to provide insight into variety performance in the soil types and cropping systems that predominate in this area in the absence of nearby official variety trials.

Six varieties were common at all locations. However, the Belgrade and Hancock strip trials included two additional entries. All variety strip trials were planted with shareholder planters. The eight trials placed in the core growing region of the cooperative were harvested with shareholder harvesters. Harvest of these sites consisted of delivery of harvested loads from a measured strip of land. Each variety had five samples taken for quality analysis. Data from the eight core growing area strip trials can be found on pages 9 - 12.

The harvest of the two northern locations consisted of hand harvesting fifteen to twenty samples per variety at each location. Each sample contained 10 feet of row that was used for quality analysis. Yield was estimated by using the sample weight over the 10 feet of harvested row for each sample and converting to tons per acre. The northern strip trials are hand harvested due to the distance of the field from sugar beet receiving stations and the likelihood of needing to haul partial loads a long distance if harvested in strips. Data from the two northern area strip trials can be found on page 9.

Final Campaign 2006-2007 Revenue Calculator

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Bloomquist (Belgrade) - Variety Strip Trial

Variety, Trtmt, or Payment Scenario	Sugar	Purity	Tons/Acre	ES	EST	ESA	Net $/Ton	Net $/Acre
Hilleshog 3036	16.15	92.58	32.64	13.98	279.52	9123.41	$38.51	$1,257.06
Hilleshog 3035	16.38	92.53	31.83	14.18	283.54	9025.05	$39.46	$1,256.13
Hilleshog 3028	16.05	91.37	32.97	13.66	273.13	9005.11	$37.00	$1,220.00
Beta 4901	15.87	91.84	33.13	13.58	271.65	8999.75	$36.65	$1,214.32
Beta 4811UP	15.95	92.30	31.78	13.74	274.82	8733.67	$37.40	$1,188.63
Beta 1591	15.75	92.36	30.93	13.57	271.39	8393.98	$36.59	$1,131.76
Hilleshog 2467	16.39	91.65	29.23	14.02	280.34	8194.47	$38.71	$1,131.45
Beta 4811	15.71	91.93	30.72	13.45	269.08	8266.13	$36.05	$1,107.33

Buss (Hancock) - Variety Strip Trial

Variety, Trtmt, or Payment Scenario	Sugar	Purity	Tons/Acre	ES	EST	ESA	Net $/Ton	Net $/Acre
Beta 1591	16.62	89.91	33.79	13.88	277.53	9377.71	$38.04	$1,285.48
Hilleshog 3036	16.83	89.79	32.94	14.04	280.74	9247.47	$38.80	$1,278.12
Beta 4811UP	16.54	89.57	30.99	13.74	274.73	8513.89	$37.38	$1,158.45
Hilleshog 3035	17.16	90.26	26.14	14.43	288.53	7542.18	$40.64	$1,062.42
Hilleshog 3028	16.59	88.69	28.74	13.60	271.96	7816.01	$36.73	$1,055.50
Beta 4901	16.69	88.94	27.68	13.74	274.74	7604.79	$37.38	$1,034.78
Hilleshog 2467	17.05	88.85	25.69	14.03	280.61	7208.95	$38.77	$996.05
Beta 4811	16.42	89.06	26.97	13.53	270.54	7296.43	$36.39	$981.46

Plumley Area - Variety Strip Trial - No. 1

Variety, Trtmt, or Payment Scenario	Sugar	Purity	Tons/Acre	ES	EST	ESA	Net $/Ton	Net $/Acre
Hilleshog 3036	14.94	91.48	24.54	12.68	253.52	6221.39	$32.37	$794.31
Hilleshog 3035	14.89	90.84	25.05	12.52	250.35	6271.37	$31.62	$792.07
Beta 4811	14.53	90.68	22.77	12.17	243.36	5541.31	$29.97	$682.33
Beta 1591	13.97	89.82	25.15	11.52	230.47	5796.28	$26.92	$677.01
Hilleshog 2467	14.83	89.99	21.99	12.31	246.24	5414.76	$30.65	$673.91
Hilleshog 3028	13.36	88.65	21.60	10.79	215.87	4662.84	$23.47	$506.92

Final Campaign 2006-2007 Revenue Calculator

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Wallert Area - Variety Strip Trial - No. 2

Variety, Trtmt, or Payment Scenario	Sugar	Purity	Tons/Acre	ES	EST	ESA	Net $/Ton	Net $/Acre
Hilleshog 3035	16.56	91.40	31.03	14.12	282.44	8764.03	$39.20	$1,216.48
Hilleshog 3036	16.12	90.68	31.23	13.59	271.73	8486.07	$36.67	$1,145.26
Beta 1591	16.42	91.13	29.73	13.94	278.86	8290.41	$38.36	$1,140.35
Hilleshog 3028	15.68	90.85	27.56	13.23	264.52	7290.14	$34.97	$963.71
Hilleshog 2467	16.58	90.28	25.16	13.92	278.33	7002.67	$38.23	$961.90
Beta 4811	15.95	90.40	25.13	13.38	267.61	6725.16	$35.70	$897.13

Hansen Area - Variety Strip Trial

Variety, Trtmt, or Payment Scenario	Sugar	Purity	Tons/Acre	ES	EST	ESA	Net $/Ton	Net $/Acre
Hilleshog 3035	17.58	92.70	26.20	15.31	306.20	8022.42	$44.82	$1,174.29
Beta 1591	16.43	89.17	24.71	13.56	271.16	6700.48	$36.54	$902.87
Hilleshog 3036	16.90	89.72	22.24	14.08	281.68	6264.51	$39.02	$867.89
Hilleshog 2467	17.35	90.09	20.72	14.56	291.18	6033.19	$41.27	$855.10
Hilleshog 3028	16.15	89.43	23.88	13.37	267.32	6383.69	$35.63	$850.86
Beta 4811	16.11	89.33	22.86	13.31	266.22	6085.86	$35.37	$808.57

Schjenken Area - Variety Strip Trial

Variety, Trtmt, or Payment Scenario	Sugar	Purity	Tons/Acre	ES	EST	ESA	Net $/Ton	Net $/Acre
Hilleshog 3035	16.26	90.52	31.18	13.68	273.60	8530.75	$37.11	$1,157.20
Hilleshog 3036	16.60	90.53	28.56	13.98	279.69	7987.93	$38.55	$1,101.09
Beta 1591	16.26	91.01	28.61	13.78	275.52	7882.53	$37.57	$1,074.80
Hilleshog 2467	16.62	89.84	26.74	13.86	277.24	7413.48	$37.98	$1,015.46
Hilleshog 3028	15.74	89.76	26.69	13.07	261.42	6977.39	$34.24	$913.76
Beta 4811	14.93	88.93	27.23	12.20	244.10	6646.80	$30.14	$820.73

Final Campaign 2006-2007 Revenue Calculator

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Variety, Trtmt, or Payment Scenario	Sugar	Purity	Tons/Acre	ES	EST	ESA	Net $/Ton	Net $/Acre
Buss Area - Variety Strip Trial								
Hilleshog 3035	16.30	89.61	28.86	13.53	270.68	7811.78	$36.42	$1,051.19
Hilleshog 2467	16.82	88.96	25.25	13.85	277.08	6996.39	$37.94	$957.93
Hilleshog 3036	15.60	88.75	28.79	12.75	255.04	7342.67	$32.73	$942.23
Beta 1591	16.20	88.78	25.97	13.28	265.57	6896.79	$35.22	$914.55
Hilleshog 3028	15.78	88.05	26.62	12.77	255.36	6797.74	$32.80	$873.22
Beta 4811	14.93	87.14	22.36	11.86	237.29	5305.76	$28.53	$637.95
Johnson Area - Variety Strip Trial								
Beta 1591	14.91	91.21	32.07	12.60	252.03	8082.49	$32.01	$1,026.71
Hilleshog 3035	14.55	91.24	31.42	12.28	245.66	7718.59	$30.51	$958.61
Hilleshog 2467	14.63	89.83	29.34	12.11	242.13	7104.19	$29.68	$870.70
Beta 4811	14.15	90.10	30.35	11.73	234.60	7120.21	$27.90	$846.65
Hilleshog 3036	14.04	90.00	30.48	11.62	232.32	7081.01	$27.36	$833.81
Hilleshog 3028	14.16	89.55	29.12	11.64	232.88	6781.49	$27.49	$800.48
Bloomquist Area - Variety Strip Trial								
Hilleshog 3035Rz	16.44	91.08	32.96	13.95	279.02	9196.47	$38.40	$1,265.51
Beta 1591R	16.19	90.40	30.15	13.59	271.88	8197.17	$36.71	$1,106.74
Hilleshog 3036Rz	16.05	90.41	30.41	13.47	269.43	8193.39	$36.13	$1,098.68
Hilleshog 3028 Rz	16.05	89.27	27.76	13.25	264.93	7354.57	$35.07	$973.43
Beta 4811R	16.27	89.98	26.31	13.58	271.63	7146.68	$36.65	$964.25
Hilleshog 2467Rz	16.13	89.56	24.83	13.37	267.49	6641.85	$35.67	$885.70

Final Campaign 2006-2007 Revenue Calculator

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Plumley Area - Variety Strip Trial - No. 2

Variety, Trtmt, or Payment Scenario	Sugar	Purity	Tons/Acre	ES	EST	ESA	Net $/Ton	Net $/Acre
Hilleshog 3035	15.38	89.90	27.27	12.78	255.61	6970.59	$32.86	$896.17
Beta 4811	15.09	88.63	20.99	12.29	245.75	5158.19	$30.53	$640.82
Hilleshog 2467	15.36	88.57	19.84	12.51	250.19	4963.68	$31.58	$626.54
Hilleshog 3036	15.51	85.82	20.35	12.08	241.67	4918.01	$29.57	$601.69
Hilleshog 3028	15.53	88.82	17.14	12.71	254.10	4355.30	$32.51	$557.14
Beta 1591	14.92	88.98	17.38	12.21	244.11	4242.64	$30.14	$523.90

Sugarbeet Response to Nitrogen Fertilizer Applied by Zone

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Introduction:

Technology has advanced to where nitrogen (N) placement for agricultural crops can be prescribed based on soil characteristics rather than using an average of soil samples collected within a given field. The current recommendation is 110 pounds total N per acre using soil nitrate-N in the surface- 4 foot of soil plus applied N. Technology advances in agriculture based software and application hardware make it possible to identify variables in soils and potential yield within a given field. Variable rate fertilizer application has become commonplace. The concern is whether growers should vary the N applied to adjust for N mineralized from organic matter (OM) and variability in soil characteristics.

Information about using variable rate fertilizer application on fertility zones in the Southern Minnesota Beet Sugar Cooperative (SMBSC) growing area is limited. Crop Consultants in the area have varying theories on how to develop zones in sugarbeet fields and how to correctly manage the fertility in those fields. No information exists at SMBSC regarding how to correctly identify zones. Current SMBSC OM research suggests adjustments in fertility should be made to compensate for OM mineralization throughout the growing season. Past research has proven soil N levels impact sugar and purity levels in sugarbeets. A study has been established to determine if zone fertility management is cost effective and what information should be used to correctly determine zones.

Methods:

In 2006, a field near Raymond, MN was established to collect information for the objective. Each zone was fertilized based on data acquired by SMBSC and the University of Minnesota from current OM mineralization and N research.

Deep soil samples were taken for a broad range of soil characteristics based on a two acre grid. Sample points were geo-referenced at the time of sampling. Using software designed to create fertility zones OM was solely used to create zones for the field. Nitrate-N was adjusted in each of the zones to varying levels. The formula is as follows:

Where OM was 3% or below N was adjusted to 120 lbs.
Where OM was 3-3.9% N was adjusted to 110 lbs.
Where OM was 4-4.9% N was adjusted to 100 lbs.
Where OM was greater than 5% N was adjusted to 90 lbs.

Phosphorus and Potash were adjusted based on current University guidelines. Sugarbeets were hand sampled in the fall at each of the geo-referenced sample points and analyzed by the SMBSC tare lab for quality. Soil test and sugarbeet data were compared at each point and statistically analyzed.

Results and discussion:

1: Table 1 shows a high correlation in zones to sugarbeet quality and revenue.

2: Table 2 compares zone to conventional soil testing procedures.

3: The zone data shown are actual numbers from the experimental field. As OM increases and total N is decreased, tons, sugar, purity and revenue trend upwards.

4: The conventional application data is assumed based upon information taken from the SMBSC database for 2007. As OM increases total N increases while tons; sugar, purity and revenue remain stagnant.

5: Rhizomania was present in the field and possibly affected yield and quality.

Table 1

	TPA	Sugar	Purity	Nitrate	Revenue
CV	8.25	2.86	0.98	71.2	9.1
LSD	2.59	0.46	0.9	20.66	95.89
	N/S	0.018	0.006	N/S	0.021

Table 2:

	Zone					**Conventional**				
	Total N	**Tons**	**Sugar**	**Purity**	**Revenue**	**Total N**	**Tons**	**Sugar**	**Purity**	**Revenue**
OM <3	120	29.0	15.9	90.6	915.32	107	24.8	16.8	90.3	857.97
OM 3-3.9	110	28.2	15.7	89.4	762.14	97	26.0	16.6	89.9	874.38
OM 4-4.9	100	32.3	16.2	91.0	1077.36	116	24.5	16.6	90.1	830.14
OM >5	90	31.6	16.3	91.4	1057.06	129	25.2	16.7	89.7	850.58
Avg total N per acre	**105**	**30.3**	**16.1**	**90.6**	**952.97**	**112**	**25.1**	**16.7**	**90.0**	**853.27**
Avg N added per acre	50					74				
N cost per acre	$15.51					$22.95				
Revenue minus N cost					$937.47					$830.32

Future Considerations:

Based on findings in 2007 it is suggested zone research continue. In 2008 there will be two or more fields zoned and planted to sugarbeets using the same criteria as the 2007 project. Changes include adding conventional test strips in each field to more accurately compare zones and conventional fertility management practices. Four other fields have been zoned with test strips. There are two each of soybeans and corn as the previous crop. The intent is to follow the rotations allowing growers to apply zone technology anytime within the sugarbeet rotation. In addition bare soil imagery will be added to the dataset to test the correlation between OM and imagery. The goal at SMBSC is to find a blueprint to determine zones that is common among all growers.

SMBSC infurrow application of popup fertilizers and amendment products for enhancement of sugarbeet growth-2007

Sugarbeets were planted at two locations to test the influence of pop-up fertilizer and amendment products on sugarbeet production. One location was north of Clara City, MN and the second location was located south of Buffalo Lake, MN. The data for the Clara City location is presented in this report. The data from the Buffalo Lake location will not be presented due to the high variability in the data due to the stunted growth observed in the testing area.

Methods:
Table 1 shows the specifics of activities conducted at each site. Plots were 11 ft. (6 rows) wide and 35 ft long. Pop up fertilizers and amendments were applied at planting time with a 6 row planter. Plots were maintained at the Clara City site by the grower/cooperator using normal production practices. Stand count, light reflectance and harvest data were collected from rows 3 and 4 of a 6 row plot. Plots were thinned following taking stand counts. Research trials were harvested on 9-17-07 with a 2 row research harvester. One quality sub-sample was collected from each plot.

Table 1. Site specifics for Clara City soil ammendment ***study***

Location - Clara City

Exp: 0729

Task	**Location**		**Date**	**Notes**	**Harvest date**
plant	Clara City		5/10/2007	Beta 1322	9/17/2007
spray	Clara City		5/11/2007	Nortron 7.5pt	
	Fertility				*Soil test*
	Soil test				*levels*
		Nitrogen			75.5
		Phosphorus			8.66
		Potassium			179
		pH			7.75
		O.M.			4.66
					Applied
	Applied				*Amounts*
		Nitrogen			20
		Phosphorus			50
		Potassium			0

Results and Discussion:

1. Table 2 shows the Light reflectance data for the sugarbeets grown at the Clara City site.

2. Light reflectance data is expressed as Normalized Differential Vegetative Index (NDVI) and Near Infra Red (NIR). There were no difference between treatments influence on light reflectance and stand count data at Clara City.

3. Table 3 shows production data of sugarbeets treated with various popup fertilizers and amendments applied in furrow or with seed.

4. Soygreen applied at 2 lbs per acre and Nutriplant (4-15-12) applied at 4 oz. per acre gave significantly higher tons per acre.

5. All treatments influenced sugar percent similarly except pop-up 10-34-0 which was significantly higher than Soygreen applied at 2 and 3 lbs. per acre and Soygreen at 2 lbs. plus pop-up 10-34-0.

6. Purity was influenced similarly, regardless of treatment.

7. Extractable sugar per acre and revenue per acre were significantly influenced by treatments with Soygreen applied at 2 lbs. per acre, pop-up 10-34-0 and Nutriplant (4-15-12) compared to the untreated treatment.

Table 2. Soil amendment for enhanced sugarbeet growth

Exp: 0729

Location - Clara City

Treatment	*Rate*	*Timing*	*4 LEAF Stand count (100ft)*	*NDVI avg 9/14/07*	*NIR av 9/14/07*
Soygreen	2 lbs.	at planting in furrow	**249**	**0.791**	**0.122**
Soygreen	3 lbs.	at planting in furrow	**251**	**0.795**	**0.118**
Soygreen/Pop-up (10-34-0)	2 lbs. 3 gal	at planting in furrow at planting in furrow	**251**	**0.806**	**0.110**
Soygreen/Pop-up (10-34-0)	3 lbs 3 gal	at planting in furrow at planting in furrow	**239**	**0.803**	**0.113**
Pop-up (10-34-0)	3 gal	at planting in furrow	**263**	**0.803**	**0.112**
Untreated	N/A	N/A	**215**	**0.771**	**0.135**
Nutriplant(4-15-12)	4 oz	at planting in furrow	**226**	**0.799**	**0.117**
Jump Start		at planting	**250**	**0.768**	**0.138**
Monty's plant(8-16-8) Monty's plant(8-16-8)	24 oz. 24 oz.	at planting in furrow 4 leaf	**250**	**0.799**	**0.117**
Nachurs	3 gal	at planting in furrow	**238**	**0.783**	**0.128**
		LSD (0.05)	NS	NS	NS
		CV %	15.67	4.2	19.52

Table 3. Soil ammendment for enhanced sugarbeet growth
Exp: 0729
Location - Clara City

Treatment	Rate	Timing	tons/acre	Sugar percent	Purity	Ext. sucrose per acre	Revenue per acre
Soygreen	2 lbs.	at planting in furrow	25.69	16.54	90.31	7137	$ 867.29
Soygreen	3 lbs.	at planting in furrow	17.79	15.65	89.25	4605	$ 527.00
Soygreen/Pop-up (10-34-0)	2 lbs. 3 gal	at planting in furrow	21.30	15.70	88.51	5484	$ 624.47
Soygreen/Pop-up (10-34-0)	3 lbs 3 gal	at planting in furrow	18.49	16.60	90.20	5146	$ 626.20
Pop-up (10-34-0)	3 gal	at planting in furrow	22.76	16.98	90.38	6478	$ 802.18
Untreated	N/A	N/A	19.97	16.11	89.31	5299	$ 619.84
Nutriplant(4-15-12)	4 oz	at planting in furrow	24.61	16.44	90.45	6812	$ 825.31
Jump Start		at planting	22.26	16.40	90.50	6142	$ 742.42
Monty's plant(8-16-8)	24 oz. 24 oz.	at planting in furrow 4 leaf	19.82	16.39	90.07	5427	$ 652.01
Nachurs	3 gal	at planting in furrow	21.50	16.23	89.61	5798	$ 687.49
		LSD (0.05)	3.05	1.09	1.57	1089	167.01
		CV %	9.82	4.63	1.21	12.91	16.59

Previous Crop Effects on Sugarbeet Response to Nitrogen Fertilizer

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Nitrogen guidelines for increased sugar beet root quality were revised in 2000. The current recommendation is 130 pounds N per acre as soil nitrate-N in the surface 4 feet of soil plus fertilizer N. The research used for development of the guidelines for the SMBSC area came from locations where the previous crop in the rotation was corn. Since then many growers have adopted corn varieties that have been genetically modified for insect and herbicide protection. Growers have commented that these modified corn varieties do not break down as fast as the non-genetically alter varieties. The concern is whether growers change the N applied to make up for slower N mineralized from the plant material.

Information about the effect of other previous crops grown in the SMBSC is also limited. In the past is has proposed to use spring wheat as a previous crop to improve sugar beet yield and quality. No information exists from the Southern Minnesota growing area about how spring wheat as a previous crop affects N rate. Sweet corn is a crop grown in the eastern growing area before sugar beet. It is general knowledge that sweet corn is over fertilized and prediction of N contribution for the sugar beet is difficult because of early harvest date of an immature plant. Finally soybean is the previous crop in about 15 % of the acres that sugar beet is grown in the SMBSC area. When the sugar beet crop is not greatly affected by diseases, sugar beet root yield and quality tend to be decreased when soybean is a previous crop. Little information exists on the effect of soybean as a previous crop on the N mineralization during the following sugar beet growing season. A study was established to determine the effect of previous crops on N required for optimum sugar beet yield and quality.

Methods and Materials

Six sites have been established to achieve the objective of the study. These sites are located and established near Hector and Gluek in 2005, Buffalo Lake and Clara City in 2006, and New Auburn and Clara City in 2007. Each site was established a year before they were cropped to sugar beet. The site established near Gluek in 2005 was lost in 2006, the sugar beet year, to drought while the site near Clara City established in 2006 was lost in 2007, the sugar beet year, to disease. The Clara City and New Auburn sites established in 2007 will be cropped to sugar beet in 2008. In the initial set up year, four large replicated blocks (35 X 66 ft.) of corn, genetically modified corn (round up ready and Bt or BtRR corn), sweet corn, soybean, and spring wheat were grown. Each crop was fertilized according to U of MN guidelines. Deep soil samples for nitrate-N were taken late fall of the initial year to characterize the sites before being cropped to sugar beet. The large crop blocks were subdivided into 11 X 35 ft. subplots to accommodate six N rates (0, 30, 60, 90, 120, and 150 lb N per acre) that were applied late fall before the sugar beet crop was grown. In the second year, sugar beet was grown with root yield and quality measured.

During the sugar beet production at the Hector (2006) and Buffalo Lake (2007) sites, three replications of the previous crop treatments of the genetically modified corn and sweet corn and N rates of 0 and 90 pounds N per acre applied before sugar beet production were established to measure nitrogen mineralization during the season. This measurement involved the placement of 24 soil cores per plot that were encased in poly carbonate tube with a resin bag at a depth of 10 inches in the soil. The resin has the ability to trap soil ammonium and nitrate-N before it moves out of the soil core. The cores are placed in the sugar beet crop exposed to the same temperatures and moisture as the sugar beet crop. A four times during the growing season, initial, two times during the growing season, and at harvest, six cores are removed and analyzed for ammonium and nitrate-N. This gives an estimate of soil mineralization.

Results

In 2006, there was no previous crop by nitrogen rate interaction for any reported parameter, Table 1. The lack of an interaction means that nitrogen rate guidelines are not affected by the previous crop at this location. Root yield and extractable sucrose per acre were significantly affected by previous crop and nitrogen application rate, Table 2. Sugar beet grown after BtRR corn had the lowest root yield extractable sucrose per acre, followed by corn. Sugar beet grown after soybean and sweet corn had similar root yield and extractable sucrose per acre while sugar beet grown after spring wheat had to largest. At this site the optimum root yield and extractable sucrose per acre were obtained at the 90 lb per acre nitrogen application, Table 3.

Purity was not affected by previous crop or nitrogen application. Extractable sucrose per ton was reduced by a previous crop of genetically modified corn for Bt and RR. The other previous crops had similar extractable sucrose per ton.

In 2006, there was no evidence to adjust nitrogen application rates for sugar beet because of previous crop.

Table 1. Statistical analysis for root yield, purity, extractable sucrose per ton, and extractable sucrose per acre in 2006.

	Root yield	Purity	Extractable sucrose per ton	Extractable sucrose per acre
Previous crop	0.007	NS	0.07	0.02
N rate	0.002	NS	NS	0.004
Previous crop X Nrate	NS	NS	NS	NS
C.V. (%)	11.5	1.9	7.8	13.4

Table 2. The means for the effect of previous crop on root yield, purity, extractable sucrose per ton, and extractable sucrose per acre in 2006.

	Root yield	Purity	Extractable sucrose	
Previous crop	ton/A	%	lb/ton	lb/acre
BTRR corn	28.9	89.4	255	7386
Corn	29.3	90.3	273	8001
Soybean	31.6	90.1	267	8463
Sweet corn	31.9	90.2	272	8668
Spring wheat	33.1	90.1	271	8976

Table 3. The means for the effect of nitrogen fertilizer application on root yield, purity, extractable sucrose per ton, and extractable sucrose per acre in 2006.

N rate	Root yield	Purity	Extractable sucrose	
lb/A	ton/A	%	lb/ton	lb/acre
0	28.0	89.9	267	7478
30	30.8	89.6	266	8196
60	30.4	90.4	271	8257
90	31.8	89.6	265	8484
120	31.7	90.4	265	8405
150	32.8	90.1	272	8973

In 2007, there was only one parameter with a N rate by previous crop interaction, extractable sucrose per acre, Table 4. Root yield was significantly affected by the previous crop and N rate. Root yields were affected with the least yield from the greatest root yield as follows: BtRR corn similar to corn < soybean < sweet corn < spring wheat, Table 5. Increasing N rate increased root yield up to 120 pounds N per acre, Table 6. The residual nitrate-N in 2007 was between 20 and 35 pounds nitrate-N per acre in the surface four feet.

Purity was decreased on the average by the application of nitrogen fertilizer, Tables 4 and 5. Previous crop did not affect purity in 2007, Tables 4 and 6. Extractable sucrose per ton of sugar beet refined integrates the sucrose concentration and the impurities in the sugar beet. Extractable sucrose per ton was not significantly affected by previous crop and N rate application, Table 4, 5, and 6.

Extractable sucrose per acre was affected by previous crop and N rate, Table 4. There was also an interaction between previous crop and N rate. The interaction is graphed in Figure 1. The main reason for the interaction is because of the response of extractable sucrose per acre to N rate application when soybean is the previous crop. In general, the extractable sucrose per acre increased with increasing N application in 2007. Extractable sucrose per acre was the least for sugar beet grown after BtRR corn and corn. Soybean was greater than the corn except at the 150 pound N per acre application. Sweet corn and spring wheat were the best.

Table 4. Statistical analysis for root yield, purity, extractable sucrose per ton, and extractable sucrose per acre in 2007.

	Root yield	Purity	Extractable sucrose per ton	Extractable sucrose per acre
Previous crop	0.0011	NS	NS	0.02
N rate	0.0001	0.06	NS	0.0001
Previous crop X Nrate	NS	NS	NS	0.06
C.V. (%)	6.6	1.4	3.9	6.9

Table 5. The means for the effect of previous crop on root yield, purity, extractable sucrose per ton, and extractable sucrose per acre in 2007.

	Root yield	Purity	Extractable sucrose	
Previous crop	ton/A	%	lb/ton	lb/acre
BTRR corn	30.6	90.9	259	7927
Corn	30.7	90.5	256	7887
Soybean	33.7	89.7	254	8512
Sweet corn	34.6	89.8	252	8739
Spring wheat	35.2	90.4	259	9087

Table 6. The means for the effect of nitrogen fertilizer application on root yield, purity, extractable sucrose per ton, and extractable sucrose per acre in 2007.

N rate	Root yield	Purity	Extractable sucrose	
lb/A	ton/A	%	lb/ton	lb/acre
0	30.8	90.9	259	7967
30	31.3	89.9	254	7975
60	33.3	90.4	255	8431
90	33.0	89.8	255	8414
120	34.2	90.4	258	8833
150	34.5	90.2	255	8797

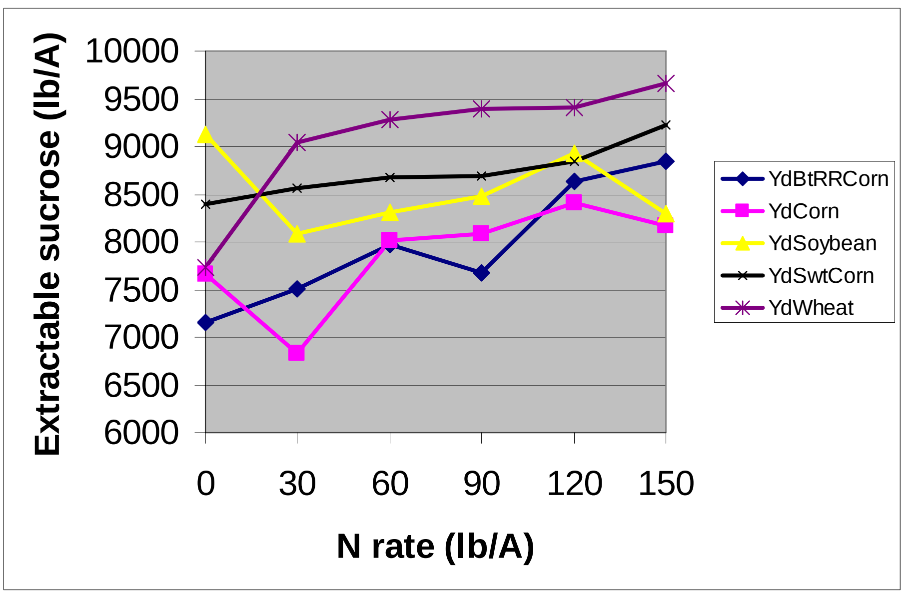

Figure 1. Extractable sucrose as affected by previous crop and N rate application in 2007.

In-season nitrogen mineralization during sugar beet production was measured in 2006 and 2007 for the treatments with BtRR corn and sweet corn as previous corn at the 0 and 90 pounds N per acre applications. The results for 2007 are not ready for presentation at the time of this report. The results for 2006 are presented in Figure 2.

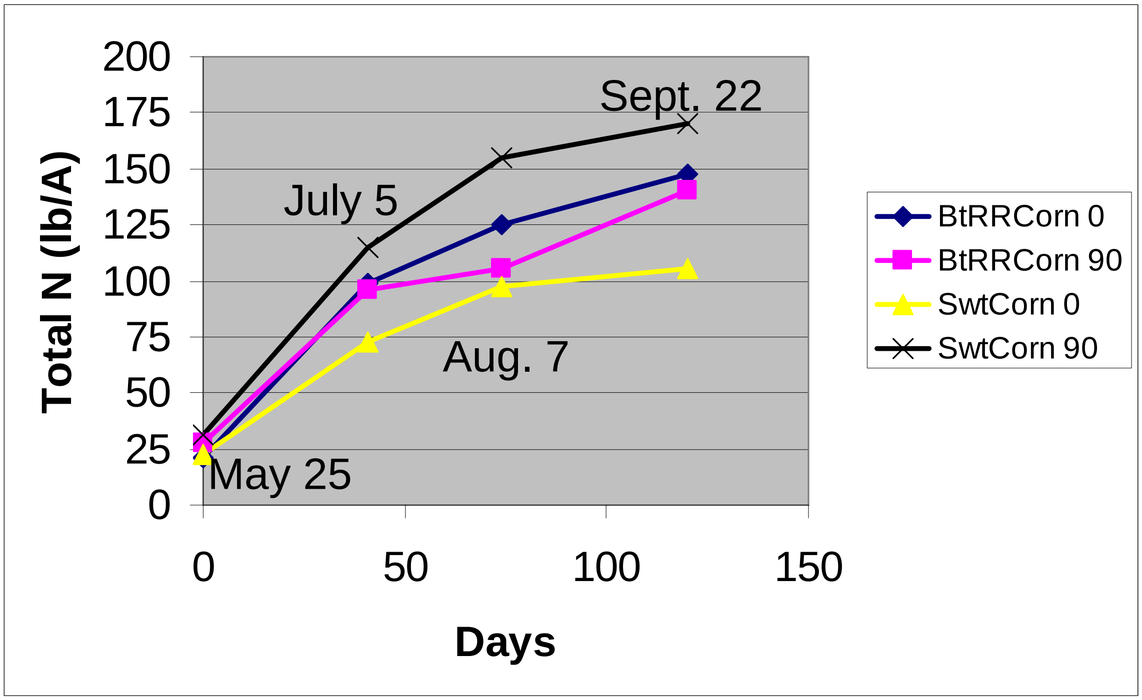

Figure 2. Total N in the surface 10 inches in a sugar beet crop in 2006 with a previous crop of BtRR corn and sweet corn with 0 and 90 pounds N applied.

In 2006, the addition of 90 pounds N per acre to sugar beet with a previous crop of BtRR corn did not affect the amount of N mineralization or the amount of mineral N measured. The addition of 90 pounds N per acre to sugar beet with a previous crop of sweet corn increased the amount of mineral N. The amount of mineral N during the growing season for BtRR corn was between the amounts found for the 0 and 90 pound N per acre with sweet corn as previous crop. The difference in mineralized N at the end of the season between sweet corn 0 pounds N per acre and sweet corn and 90 pounds N per acre was 56 pounds per acre, Table 7. This difference is because of the slower mineralization by the soil where sweet corn was a previous crop and 0 pounds of N per acre was applied. The differences in mineralized N between the other treatments are not large. These are results from one growing season and should not be used to make decisions alone.

Table 7. Mineralization rates during 2006 for soil with sugar beet grown after BtRR corn and sweet corn with 0 and 90 pounds N per acre.

		Mineralized N			
	N rate	Between May 25 and July 5	Between July 5 and August 7	Between August 7 and September 22	Between May 25 and September 22
Previous crop	lb N/A	------------------- pounds mineral N per acre -------------------			
BtRR corn	0	77	26	23	126
BtRR corn	90	69	9	35	114
Sweet corn	0	50	25	8	83
Sweet corn	90	84	40	15	139

Summary

In general, root yield and extractable sucrose per acre is affected by the previous crop and nitrogen application. Corn and genetically modified corn have least root yield and extractable sucrose. Spring wheat had the greatest root yield and extractable sucrose per acre in each year. The previous crop did not affect nitrogen application rate. Mineralization of nitrogen from organic matter was affected by the amount of N fertilizer applied when sweet corn was the previous corn but the N rate did not affect N mineralization when BtRR corn was the previous crop.

Turkey Litter Effects on Sugar beet Production

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Livestock operations, mainly poultry and swine, are increasing in size and impact in the Southern Minnesota sugar beet growing area. Many sugar beet producers own or have interest in these operations; thus have manure available to use on their fields. Manure research data concludes that manure has a positive effect on crop production from its effects on soil nutrient availability and soil physical properties. A concern has been raised about the effect of late season nitrogen mineralized from the manure on sugar beet quality. Grower observations indicate better growth in fields that have had manure applied. With the large amount of manure available, the question has changed from whether to use manure but when in the sugar beet crop rotation should manure be applied to minimize quality concerns and realize benefits? Turkey manure has a considerable amount of litter in it, thus slowing initial release of poultry manure-N. The implication of the manure-N release is critical, especially to sugar beet growers. Therefore, recommendations need to be evaluated with sugar beets. This research project has been designed to: 1) determine when in a three-year rotation, should turkey litter be applied and 2) determine nitrogen fertilizer equivalent of turkey litter applied two and three years in advance of sugar beet production.

Materials and Methods

To meet the objectives of this experiment the first of three sites was established near Raymond, Minnesota in the fall of 2006. This report is for the first year of this study. The site was cropped to soybean, turkey manure was applied fall 2006 and soybean grain yields were harvested by a plot combine in the fall of 2007. The treatments for the second year were applied to the first site near Raymond while a second site was established near Olivia, Minnesota in the fall of 2007. Below is a complete description of this project.

Each site of this study will have five replications of the treatments list in Table 1. Turkey litter treatments of 3 and 6 tons per acres are applied 2 and 3 years ahead in the three year rotation of soybean/corn/sugar beet. This rotation is the most common rotation is this growing area. Treatment 5 is the check treatment for the whole experiment while treatments 8 and 15 are checks for different parts of the rotation. Treatments 6 through 14 are the N fertilizer rates plus the two turkey litter rate applied the fall before the sugar beet production year. During the corn production year, 120 lb N per acre will be applied for treatments 6 through 14. This is the current U of MN N guideline for corn following soybeans. In the soybean production year, grain yield will be measured. Soil samples to and depth of 4 feet will be analyzed for nitrate-N while soil samples to a 6 inch depth will be analyzed for phosphorous, potassium, organic matter, and pH. The soil test phosphorus, potassium, and pH will be additional information to assess the effect of turkey litter on other soil chemical properties besides nitrogen. The year 2 manure and fertilizer treatments will be applied in the late fall. During the corn production year, biomass will be measured using a hand held sensor to assess early growth. Basal stalk samples will be taken at a week after grain black layer and analyzed for nitrate. This is a good tool to determine the effect of the nitrogen management treatments. Grain will be harvested and similar to year 1 soil samples will be taken. The year 3 treatments will be applied late fall of year 2. Sugar beet late season leaf growth will be assessed with a sensor. Root yield and quality will be determined in the fall. Final soil samples for nitrate-N, phosphorus, potassium, and pH will be taken after harvest. In each of the production years, optimum production practices for pests control and nutrient management besides nitrogen will be used.

Table 1. Treatment List

Treatment Number	Year 1 (soybean)	Year 2 (corn)	Year 3 (sugar beet)
1	3 ton litter	0 N	0 N
2	6 ton litter	0 N	0 N
3	0 N	3 ton litter	0 N
4	0 N	6 ton litter	0 N
5	0 N	0N	0 N
6	0 N	120 N	3 ton litter
7	0 N	120 N	6 ton litter
8	0 N	120 N	0 N
9	0 N	120 N	30 N
10	0 N	120 N	60 N
11	0 N	120 N	90 N
12	0 N	120 N	120 N
13	0 N	120 N	150 N
14	0 N	120 N	180 N
15	0 N	0 N	90 N

Table 2. Timeline for crops at each of three locations.

2007-08	2008-09	2009-10	2010-2011	2011-2012
Location 1 - soybean	Location 1 - corn	Location 1 – sugar beet		
	Location 2 - soybean	Location 2 - corn	Location 2 – sugar beet	
		Location 3 - soybean	Location 3 - corn	Location 3 - sugarbeet

Results

Soybean grain yields were significantly increased by the application of manure, Table 3. This increase was small. There was no difference in grain yield between 3 and 6 tons of turkey litter application.

Table 3. Soybean grain yields as affected by the application of 3 and 6 tons of turkey litter in fall 2006 at Raymond, Minnesota in 2007.

Treatment	Soybean grain yield (bushels per acre)
Zero (check)	50.0
3 tons turkey litter	51.8
6 tons turkey litter	53.5
Statistics	P>F
Zero vs turkey litter application	0.005
Manure (3 vs 6 tons turkey litter)	NS
C.V. (%)	5.3

Estimation of Sugarbeet Field Sucrose Concentration from Satellite Derived Canopy Data – Research Report 2007

Abstract Research linking sugarbeet canopy characteristics and other measures of field status to harvest sucrose levels continued during 2007. Data for the 2006 crop year were processed to quantify the strength of the linkage between canopy reflectance measures and sucrose concentration in that year. Rather than testing models for many varieties, sugarbeet fields were aggregated into three variety classes, with those being Beta varieties, Hilleshog varieties, and mixed plantings. Canopy status was quantified for each field in the form of a Green NDVI index calculated from a September 5, 2006 image. Harvested sucrose concentration for each field was discounted from the harvest date in the SMBSC database to the date of October 1. The canopy index was tested for correlation to the October 1 sucrose level through simple linear regression. Correlations in this year were low with R^2 values for these single variable models below 0.15, indicating that the canopy index alone only accounted for 15% or less of the variation in the harvested sucrose concentrations. Data from the 2007 crop year were processed in early September in an attempt to identify fields with higher sucrose prior to the general harvest. Canopy Index values were determined for each field from an August 30, 2007 image. Neural Network models trained with the data from crop years 2003, 2004, and 2005 were used in this attempt. Following the harvest, both conventional statistical approaches and neural network models were used on the 07 data. Conventional statistics results are shown graphically below for data from 2006 and 2007. The neural network results looking back at 2007 data are still under analysis.

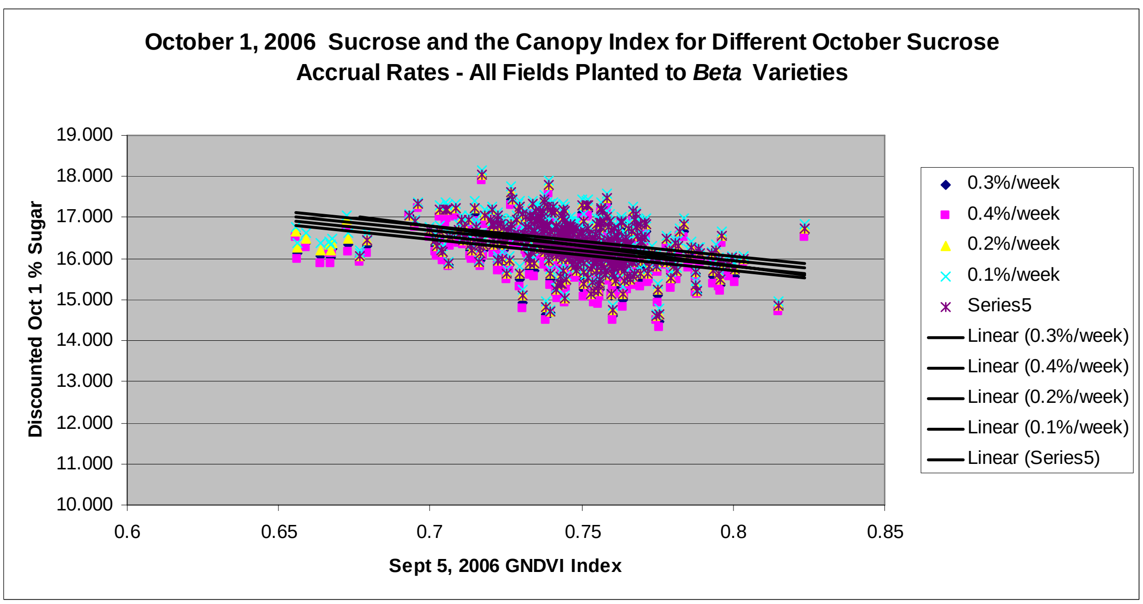

Figure 1. A graph of October 1 sucrose concentration and the Sept 5, 2006 canopy index, GNDVI, for all fields in the SMBSC database planted to one or more Beta seed varieties. Data and regression lines represent different sucrose accrual rates in October, and are used to identify the most likely accrual rate to be used in the estimate of the October 1 sucrose concentration from each field's harvested concentration.

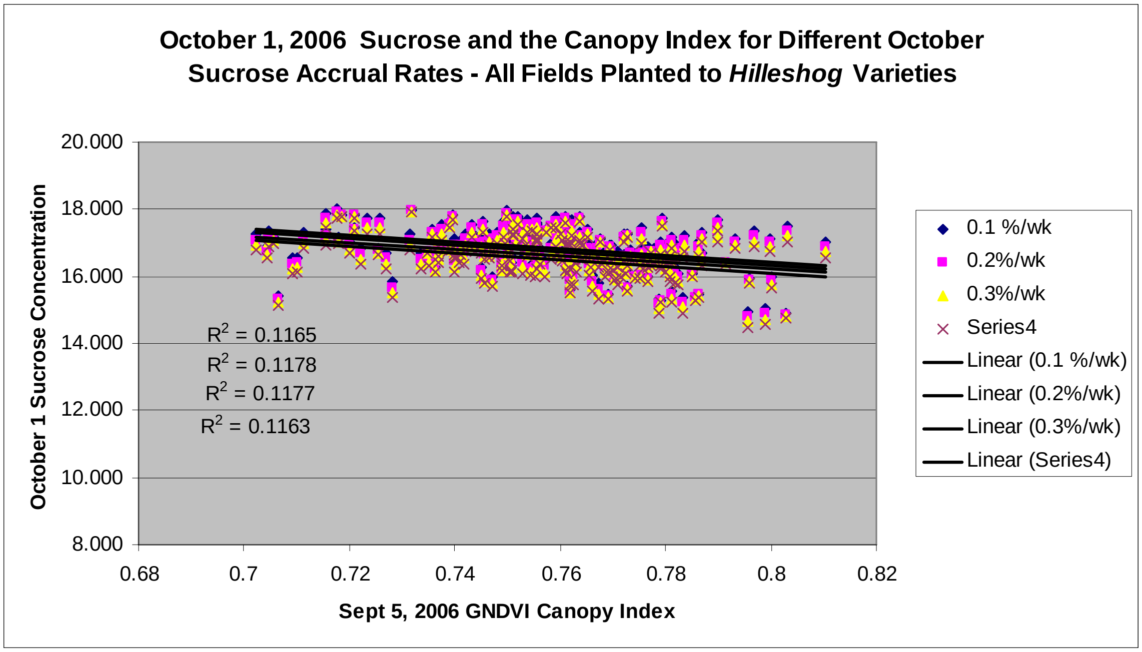

Figure 2. A graph of October 1 sucrose concentration and the Sept 5, 2006 canopy index, GNDVI, for all fields in the SMBSC database planted to one or more Hilleshog seed varieties. Data and regression lines represent different sucrose accrual rates in October, and are used to identify the most likely accrual rate to be used in the estimate of the October 1 sucrose concentration from each field's harvested concentration.

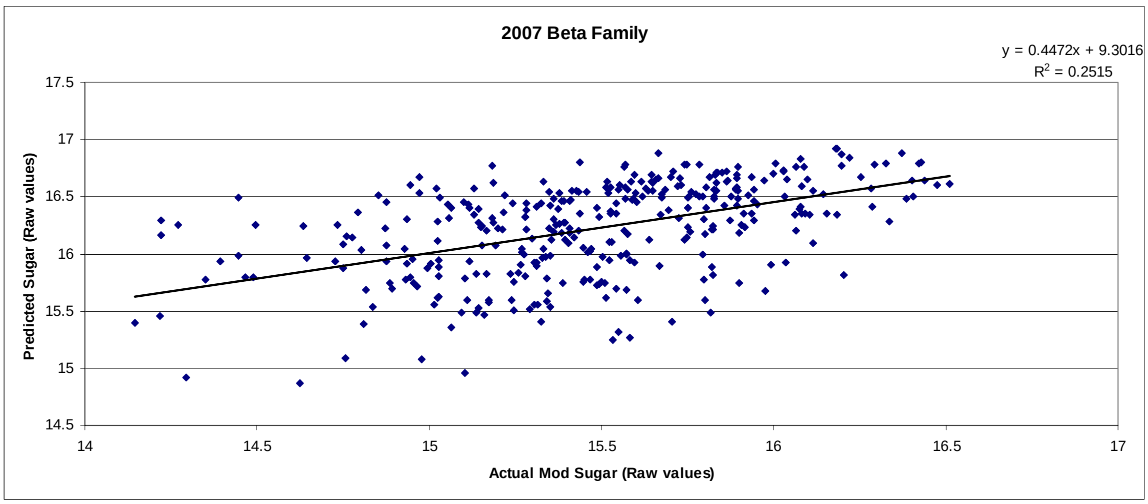

Figure 3. Results from 2007 predictions using a neural network model. Training data were from early September images in the years 2003, 2004 and 2005, utilizing bands 1, 2, 3, 4 and 5 and the field Range values. The learning method was adaptive gradient using a neural net to pick explanatory variable datasets. The network architecture forced all variables to be a part of the model. Actual sugar % was modified to a common date of October 1.

Observations:

- Canopy indices have shown statistical correlation to October 1 sucrose concentration in each year studied
- The strength of the relationship varies substantially from year to year if only canopy index is used to model sucrose

- The data include a great deal of scatter as many variables affect sucrose concentration, outside of canopy index from a single late season image
- Field status variables, such as disease levels, weed control, and population uniformity, maintained by the cooperative, may help to identify outlier fields that will not conform well to a modeling process based upon canopy
- Additional spatial variables, such as moisture status and timing, and soil types can be added to the existing analysis and may account for some of the scatter in the data

Conclusions: Satellite-based images of the SMBSC growing area can be used to develop a measure of sugarbeet canopy that is correlated to harvest sucrose concentration. The strength of the relationship appears to vary substantially between years, with some years producing only weak correlations to harvest sucrose. Other years have indicated that as much as 50% of the variability among fields may be correlated to a canopy index taken from a single image in late August or early September. Other data in the SMBSC database, such as disease, weed pressure ratings, and geographic Range have not by themselves greatly improved the ability to predict sucrose concentration. However, some of these variables provide a means of identifying fields under extreme pressures that tend to be outliers in any study and skew results. Scatter in the data is also occurring from other sources that have not yet been accounted for. The inclusion of additional variables that affect sucrose concentration, such as moisture status of the crop, and timing of rainfall events late in the season, may account for variability not apparent in a canopy index alone. It may be possible to extract weather and climate data, archived over the last several years, and combine this into the research databases already developed for the same years to test this hypothesis.

While accurate predictions of field quality prior to harvest may not be available yet, the research experiment process and the prediction process overlap effort to a great extent. Estimates of relative field quality, and continued study to refine usable models, can be a part of the same effort. Both are dependent upon the availability of quality and timely images, and timely development of the GIS database maintained by SMBSC.

SENSITIVITY OF *CERCOSPORA BETICOLA* TO FOLIAR FUNGICIDES IN 2007.

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Leaf spot, caused by the fungus *Cercospora beticola*, is an endemic disease of sugarbeets produced in the Northern Great Plains area of North Dakota and Minnesota. It causes a reduction in photosynthetic area thereby reducing both yield and sucrose content of the beets. The disease is controlled by crop rotation, resistant varieties and timely fungicide applications. *Cercospora* leaf spot usually appears in the last half of the growing season, and two to four fungicide applications are made during this time for disease control. Fungicides are alternated and the most frequently used fungicides are Tin (triphenyl tin hydroxide), Topsin (thiophanate methyl), Eminent (tetraconazole), Gem (trifloxystrobin) and, Headline (pyraclostrobin). Tin is usually applied alone, but Topsin is usually applied as a tank mix with Tin.

Like many other fungi, *C. beticola* has the ability to adapt and become less sensitive to the fungicides used to control them, especially if they are applied frequently over a period of time. It is important to monitor the *C. beticola* population for changes in sensitivity to these fungicides in order to achieve maximum disease control. We began testing *C. beticola* populations for sensitivity to tin in 1996, and expanded sensitivity testing to additional fungicides in subsequent years. From 1997-2000 we evaluated sensitivity to tin and thiophanate methyl. We utilized our extensive culture collection of *C. beticola* isolates from 1997-2000 to establish baseline sensitivities to Eminent, Headline and Gem and to evaluate shifts in sensitivity to tin and Topsin. Fungicide sensitivity testing of field isolates of *C. beticola* to these five commonly used fungicides in our area has been conducted in the years 2003 - 2006. In 2007 sensitivity testing was done for tin, Topsin, four triazole (DMI) and two strobilurin (QoI) fungicides.

OBJECTIVES

The 2007 objectives were:

1) Continue to evaluate sensitivity of *Cercospora beticola* isolates collected from fields representing the sugarbeet production area of the Red River Valley region to Tin (triphenyl tin hydroxide), Topsin (thiophanate methyl) and Eminent (tetraconazole).

2) Evaluate sensitivity of *Cercospora beticola* isolates collected from fields representing the sugarbeet production area of the Red River Valley region to pyraclostrobin (Headline) and trifloxystrobin (Gem) fungicides and compare sensitivity to previously established baselines.

3) Determine sensitivity of *Cercospora beticola* isolates from fields representing the sugarbeet production areas of ND and MN to three additional triazole (DMI) fungicides: fenbuconazole (Enable), difenaconazole (Inspire), and prothioiconazole (Proline).

4) Distribute results of sensitivity testing in a timely manner in order to make disease management decisions based on test results.

METHODS AND MATERIALS

In 2007, with financial support of the Sugarbeet Research and Extension Board of ND and MN, Sipcam Agro, BASF Corporation, Dow AgroSciences, Syngenta Crop Protection and Bayer Crop Science, we conducted extensive testing of *C. beticola* isolates collected from throughout the sugarbeet production regions of ND/MN for sensitivity to Tin, Topsin, Eminent, Enable, Inspire, Proline, Headline and Gem.

Sugar beet leaves with Cercospora leaf spot (CLS) were collected from commercial fields by agronomists from all factory districts. Leaves were delivered to our lab, and processed immediately to insure viability of spores. From each field sample *C. beticola*, spores were collected from a minimum of five spots/leaf from five leaves. The spores were mixed, and composite of 200 µl of spores transferred to each of two Petri plates containing water agar amended with Tin at 1 ug/ml or non-amended (water agar alone). For every third sample received, a composite of spores was also transferred to a Petri dish containing water agar amended with 5 ug/ml of thiophanate methyl.

For Tin and Topsin sensitivity, a bulk spore germination procedure was used. Germination of 100 random spores on the Tin amended water agar was counted 16 hrs after plating and percent germination calculated. Germination on non-amended media was calculated and this plate was used as a source of single spore sub cultures for subsequent Eminent and other triazoles, Headline and Gem sensitivity testing.

For Eminent and other triazole fungicide sensitivity testing, a standard radial growth procedure developed in our lab for *C. beticola* was used. A single spore subculture from the original non-amended media was grown on water agar medium amended with serial ten-fold dilutions of technical grade triazole fungicide from 0.001 – 1.0 ppm. After 15 days, inhibition of radial growth was measured, and compared to the growth on non-amended water agar medium. This data was used to calculate an EC_{50} value for each isolate (EC_{50} is the concentration of fungicide that reduces growth of *C. beticola* by 50% compared to the growth on non-amended media).

For the strobilurin fungicides Headline and Gem, the radial growth procedure does not work. Instead, we must use a procedure that measures inhibition of spore germination.. A subculture from the original non-amended medium was grown on modified V-8 medium and induced to sporulate abundantly using a procedure developed in our lab for efficient spore production and sensitivity testing The spores were collected and transferred to water agar amended with serial ten fold dilutions of technical grade pyraclostrobin or trifloxystrobin from 0.001 – 1.0 ppm. Previous studies demonstrated that *C. beticola* spores reach >80% germination in about 16 hours with some variability depending on isolate. Consequently, germination of 100 spores viewed at random was done 16 hrs after plating and percent germination calculated. An EC_{50} was calculated for each isolate (EC_{50} is the concentration of fungicide that inhibits the germination of *C. beticola* by 50% compared to germination on non-amended media). Fresh preparations of Gem (used the day as prepared) were used throughout the study, as some loss of potency with time has been observed in previous testing.

RESULTS AND DISCUSSION

Cercospora disease again developed late in the 2007 season and the majority (86%) of the CLS samples were delivered to our lab in September. A total of 1438 Cb isolates were tested for sensitivity to eight fungicides in 2007. Due to the diligent collection efforts of the grower cooperative agronomists, 1026 field samples representing all production areas and factory districts were received and tested. An additional 412 samples from fungicide trial plots of Dr. Mohamed Khan (Foxhome) and Mark Bredehoeft (Renville), were also tested for sensitivity to these fungicides. For this report, only results from the field samples are included; the fungicide trial results are not included. A few samples that were submitted were not done, because the spores did not germinate despite repeated attempts. We postulate that the fields from which these samples were collected had recently been treated with a fungicide that interfered with spore germination in the lab, or that the lesions may have been bacterial leaf spot and not Cercospora leaf spot.

Tolerance to Tin was first reported in 1994, with tolerance levels between 1-2 ppm. The incidence of Tin tolerance increased between 1997 and 1999, but incidence of isolates tolerant to Tin at 1.0 ppm has been declining since the introduction of Eminent for resistance management in 1999, Gem in 2002 and Headline in 2003. In 1998, the percentage of isolates with tolerance to Tin at 1.0 ppm was 64.6%, in 1999 it was 54.3%, in 2000 it was 17.7%, in 2001 was 14.9%, in 2002 was 9.0%, in 2003 was 1.1%, in 2004 was 1.1%, in 2005 was 0.97%, in 2006 was 0.0%, and in 2007 increased to 5.1%. (Fig.1). Percent tin sensitivity by factory district was Crookston 0, Drayton 5.1, EGF 3.6, Hillsboro 3.1, Moorhead 6.7, MinnDak 13.4 and SMBSC (Fig. 2). WE NEED TO ADD THIS FIGURE

Resistance to the benzimidazole fungicide Topsin became widespread in *C. beticola* in the 1980's in many sugar beet production areas of the US, including the Northern Great Plains. In 1998, 70.8% of the samples were resistant to Topsin at >5.0 ppm when tested using a bulk spore germination procedure; in 1999, 71.3% of the samples were resistant; in 2001, 56.4% of the samples were resistant; in 2003, 69.3% of the samples were resistant; and in 2004, 78.3% of the isolates were resistant. Due to the widespread resistance to Topsin sensitivity to Topsin was not tested in 2005 or 2006, but was tested in 2007. Overall, 42.0 percent of the samples were resistant to Topsin at 5 ug/ml. Sensitivity to Tospin declined in most factory districts; the percent isolates resistant to Topsin by factory district was: Crookston 0, Drayton 35.4, EGF 39.3, Hillsboro 67.6, Moorhead 77.8, MinDak 48.1, SMBSC 25.0 (Fig 3). WE NEED THIS FIGURE It appears that resistance to Topsin continues to be present in most of the sugarbeet production area of North Dakota and Minnesota and but is declining in most factory districts.Topsin is only recommended as a tank mix partner with Tin.

A baseline sensitivity curve was developed for Eminent using *C. beticola* isolates from 1997-1999 that had not been previously exposed to Eminent and the year 2000 from our culture collection. Compared to the baseline values there appears to be a slow increase in the average EC50 value of *C. beticola* isolates from 1998 to 2005. The average EC_{50} values of these *C. beticola* isolates from our culture collection are 0.13 (1997), 0.09 (1998), 0.12 (1999), and 0.23 (2000). The average EC_{50} value of field-collected isolates from 2002 was 0.21 ppm, from 2003 was 0.12 ppm, from 2004 was 0.24, and from 2005 was 0.29 (Fig. 4). There was a decline in the EC50 value in 2006 to 0.14, and an increase in 2007 to 0.21 (Fig.4). These values include isolates with an EC_{50} value of >1.0 ug/ml.

In 2002, 1.2 % of the isolates tested had an EC_{50} value of >1 to tetraconazole compared to 6.0% of the isolates in 2003, 10.8% of the isolates in 2004, 12.4% in 2005, and in 2006 was 7.3% (Fig 5). The trend from 2003 - 2005 was for increased resistance to tetraconazole as indicated by an increase in both average EC_{50} values (Fig. 6) and the incidence of isolates with EC_{50} values >1 ppm (Fig. 5), but in 2006 there was a decrease in resistance to Eminent (Figs. 5 and 6).This reduction along with the reduction in Tin resistance, may indicate that our collective resistance management program and recommendations may be working. In 2007 there was an increase in resistance to Eminent across all factory districts except for MinDak which showed a three-fold reduction in resistance. (Fig. 6).

Sensitivity to three additional DMI (triazole) fungicides; fenbuconazole (Enable), difenaconazole (Inspire), and prothioiconazole (Proline). The average EC50 values of these three triazoles was Proline ( ), Enable ( ), Inspire ( ) NEED NUMBERS compared to Eminent at 0.21 (Fig 7). The percent isolates highly resistant (>1.0 ug/ml) of the three triazoles was Proline (37.5), Enable (9.7), Inspire (5.4) compared to Eminent at 9.5 (Fig. 8). FIGURES 7 AND 8 ARE FROM THE PRESENTATION AND NEED TO BE ADDED TO THIS PAPER

Baseline sensitivity to the QoI (strobulurin) fungicides Headline and Gem was calculated using *C. beticola* isolates from our culture collection that were not previously exposed to Headline and Gem. This baseline will be used to monitor shifts in sensitivity to these fungicides. Sensitivity of C. *beticola* to both of these fungicides has remained relatively stable from 2003-2007 with only an 8-10 fold decrease in sensitivity compared to the baseline (Figs. 9) since these fungicides have been used commercially (Headline since 2003, Gem since 2004). However, substantial variability exists among the isolates tested, with a thousand-fold difference in EC_{50} values among the isolates to pyraclostrobin and trifloxystrobin, indicating the potential for reduced sensitivity is present in the population (Figs. 10 and 11). It should be emphasized that we have found isolates in the population that have an EC_{50} value >1.0 ppm for both Headline and Gem. It is important to know that there are numerous examples in many crops where resistance has developed to strobilurin (QOI) fungicides due to overapplication and misapplication of these fungicides. Because Gem and Headline are strobilurin/QOI fungicides, it is important to continue to monitor sensitivity of *C. beticola* to these two fungicides.

Because *C. beticola* has a history of developing resistance to fungicides, and has a high degree of variablility in culture, the potential for resistance development to fungicides is always there. This is especially true since we found both mating types of C. beticola naturally occurring in the population in ND and MN. We must continue to monitor C. beticola populations in our area for fungicide sensitivity/resistance and develop disease management strategies with this goal as a priority.

SUMMARY

1. Tin tolerance at 1.0 ppm has almost disappeared in our region, probably due to the use of alternate fungicides that has resulted in the reduction in the number of tin applications from 2.14 in 1998 to less than one each year since 2001. However in 2007 a slight increase was noted in most factory districts.

2. Resistance to Topsin at 5.0 ppm is present in most production areas in 2007, but appears to be declining in some areas.

3. Sensitivity to Eminent is relatively stable, but there has been a slow increase in the number of isolates with an EC_{50} > 1.0 ppm which may indicate the potential for reduced sensitivity to develop. In 2006 for the first time since testing began, there was a decrease in both the number of isolates with an EC_{50} value >1.0 ppm and the overall EC_{50} value across all isolates tested. However in 2007, there was an increase in resistance to Eminent in all factory districts except MinDak.

4. Sensitivity to Headline and Gem remains relatively stable, but there are rare isolates identified with a thousand-fold decrease in sensitivity. There has been a slight change in sensitivity to Gem and Headline compared to the baseline since use and testing of these compounds began three and four years ago respectively. This change is not a cause for concern.

5. It appears that the fungicide resistance management plan that we are following is working.

6. There have been not fungicide failures in our area due to resistance to fungicides.

7. Disease pressure has been low, and higher disease pressure may change fungicide sensitivity patterns.

6. A combination of alternation and combinations of fungicides with different modes of actions will continue to be necessary to prevent reduced sensitivity of *C. beticola* to currently registered fungicides.

7. Continue to use disease control recommendations currently in place including:

- Fungicide rotation
- Only one triazole per season
- Only one strobilurin per season
- A good three spray program is triazole, tin, strobilurin
- Scout at end of the season to decide the necessity of a late application; CLS developed late in recent years
- NDAWN daily infection values, row closure, first appearance of disease and the calendar are all used to determine first fungicide application
- Use fungicide resistance maps for fungicide selection
- Use a variety with resistance to CLS; KWS rating of 5. 0 or less
- Spray intervals of 14 days
- Use 15-20 gpa at 100-125 psi for ground application of fungicides and 5 gpa for air application

Fig 1. Sensitivity to TPTH of *C. beticola* isolates collected in ND and MN from 1998 to 2007 at 1.0 ppm as measured by bulk spore germination

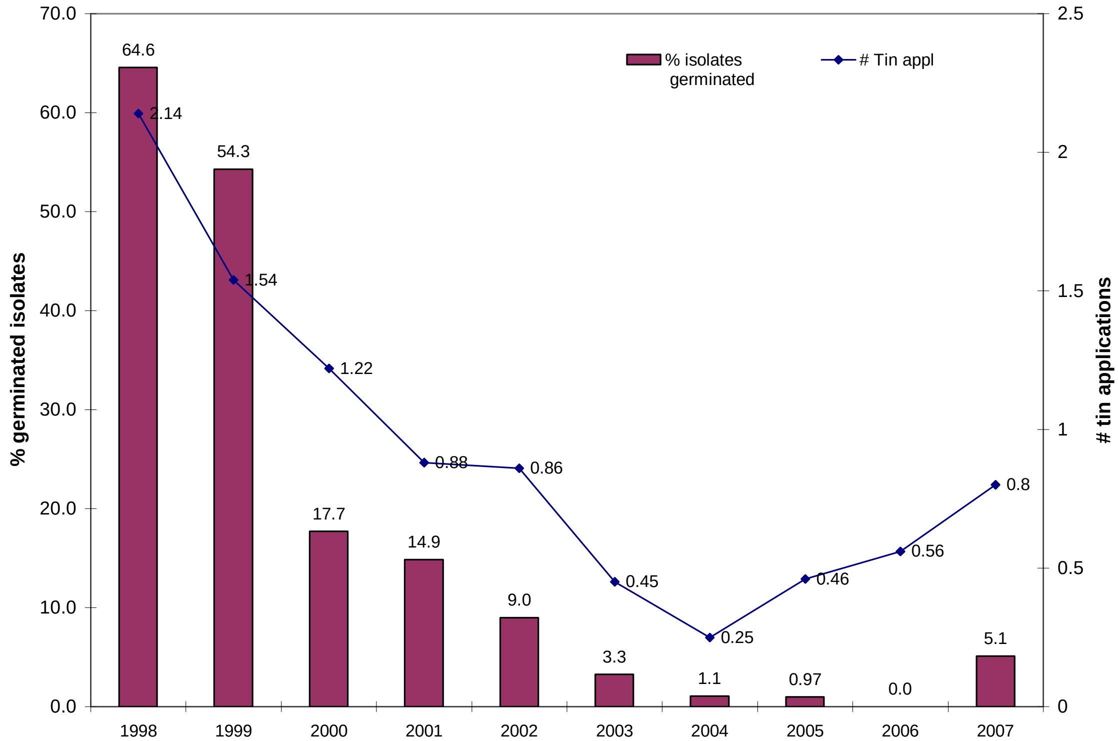


Fig. 2 Percent of *C. beticola* isolates collected in 2007 resistant to triphenytin hydroxide by factory district

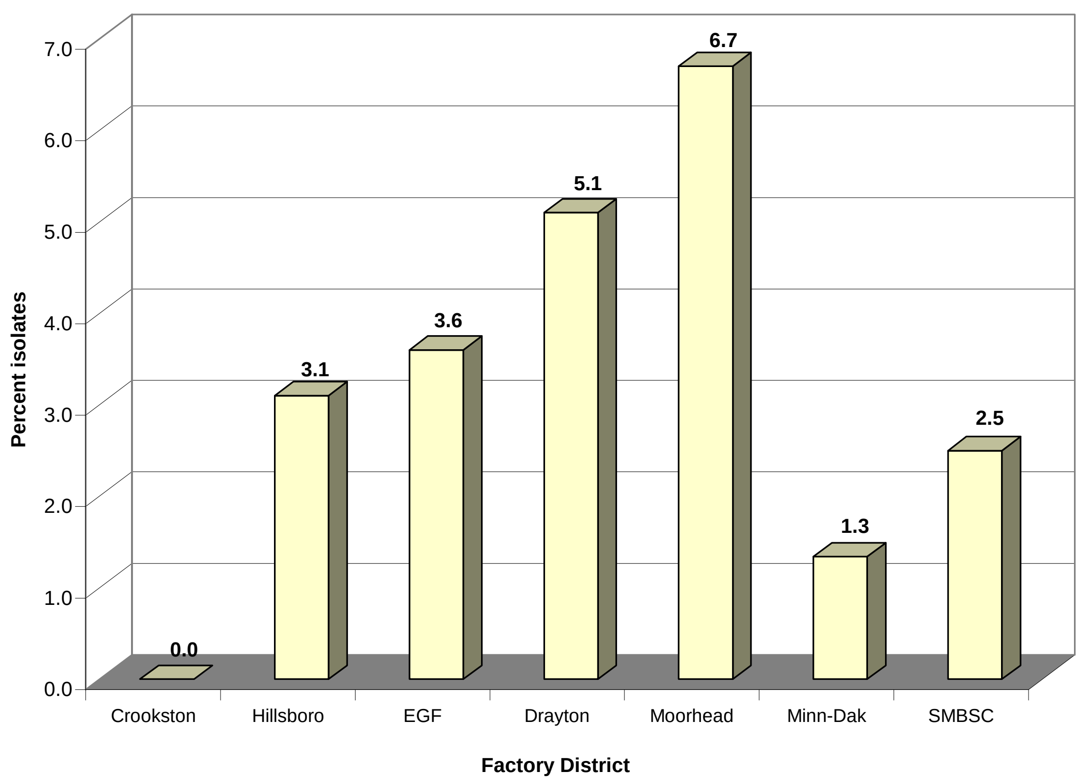


Fig. 3. Percent of *C. beticola* isolates resistant to Topsin (5 µg/ml) by factory district in 2007

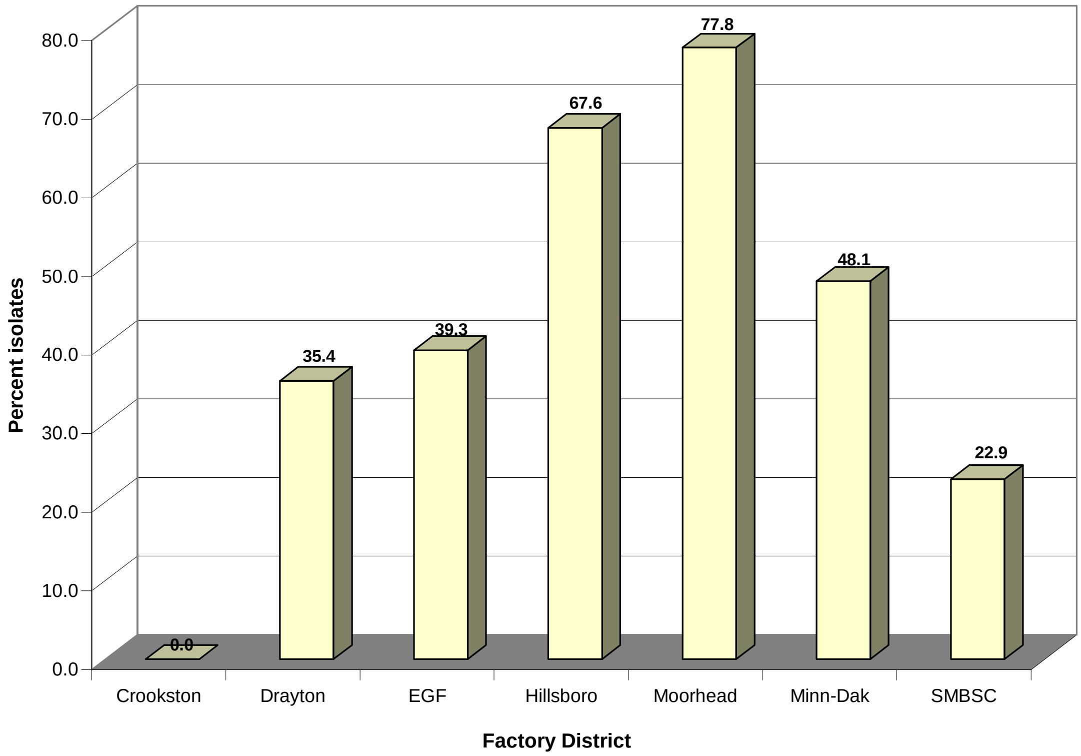


Fig 4. Average EC-50 value of *Cercospora beticola* isolates collected from 1997-2007 to tetraconazole.

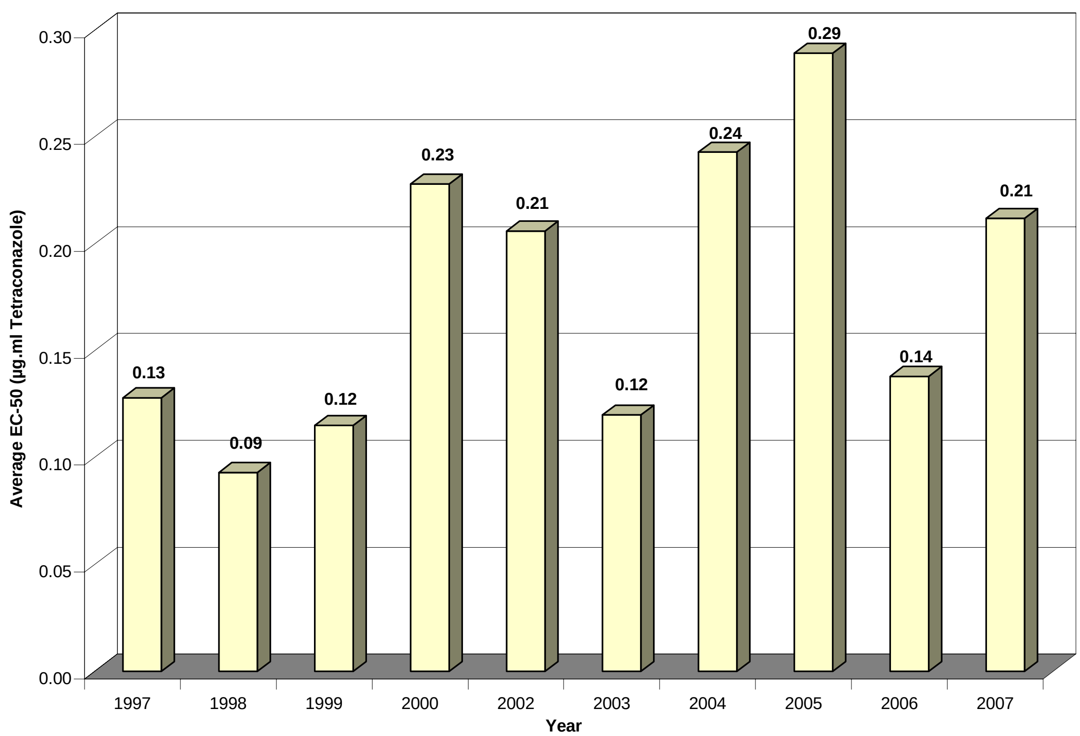


Fig. 5 Sensitivity of *C. beticola* isolates collected in ND and MN from 1997-2008 to tetraconazole

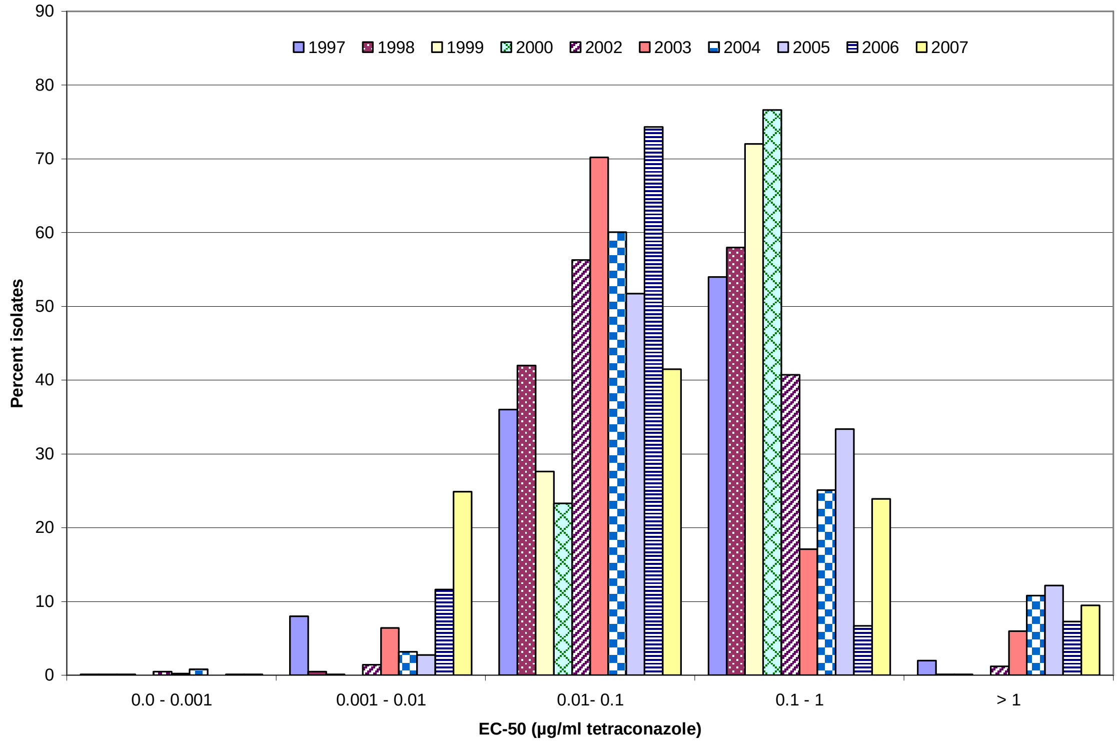


Fig 6. Sensitivity of *C. beticola* to tetraconazole by factory district 2005-2007

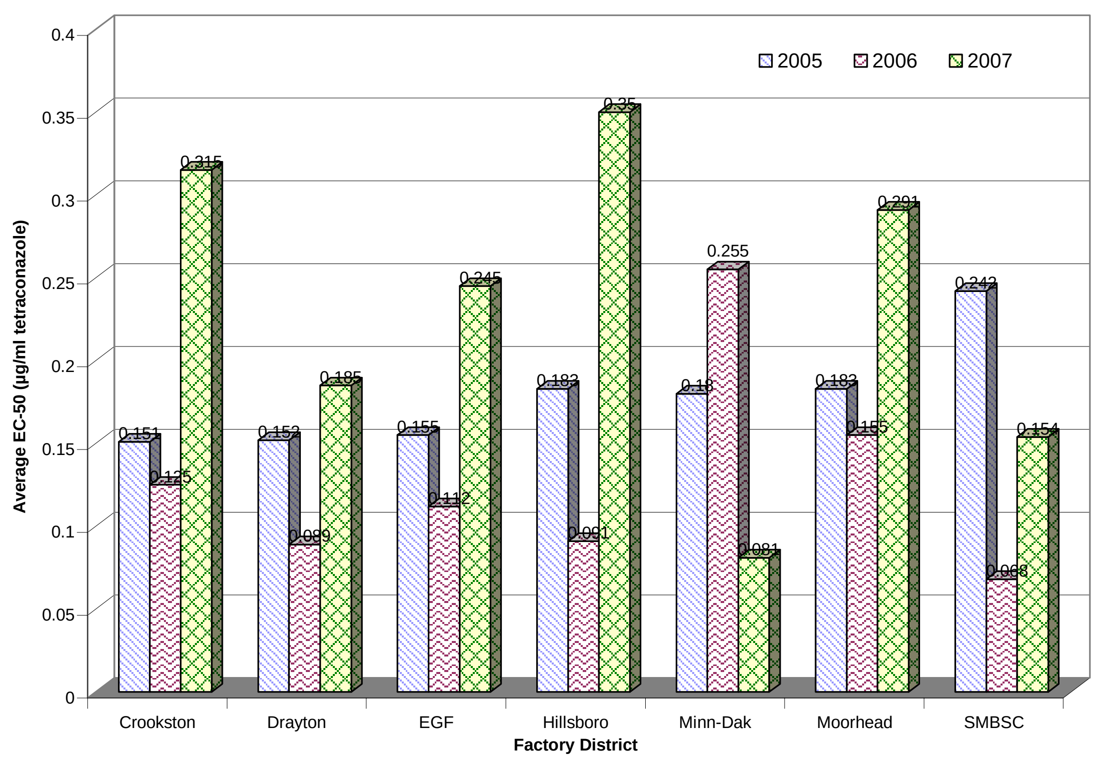


Fig 7. EC-50 values of C. beticola isolates collected in 2007 to four triazole fungides

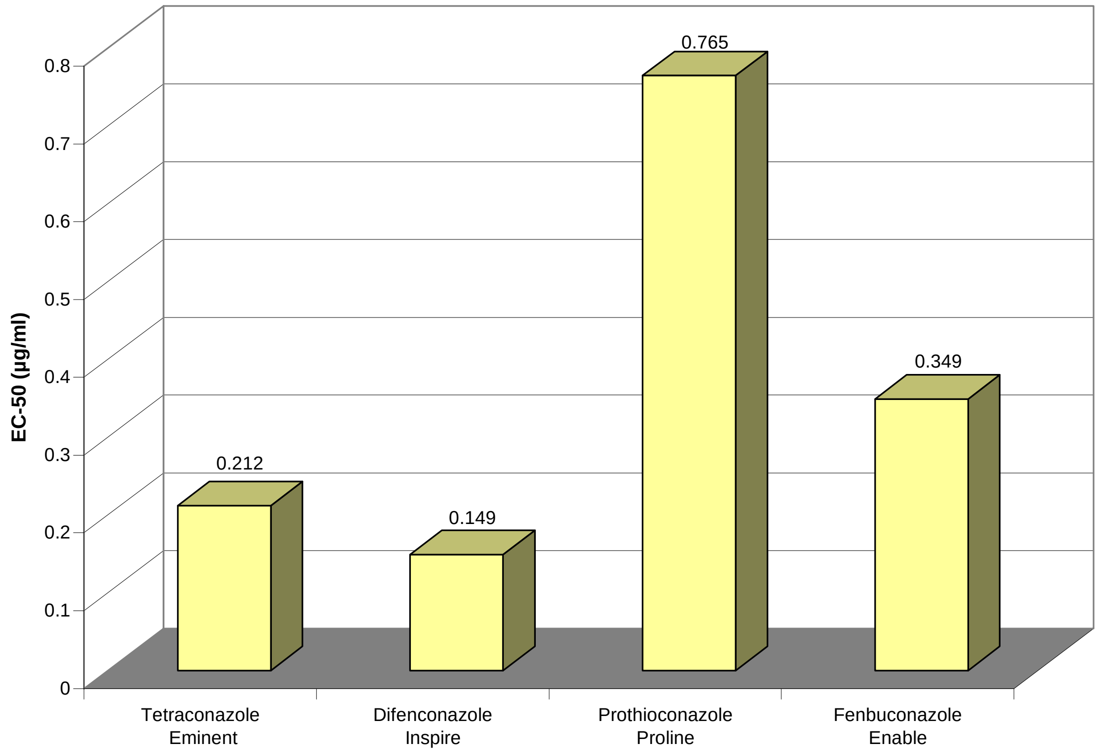


Fig 8. Percent *C. beticola* isolates with a EC-50 > 1 µg/ml for four triazole collected in 2007

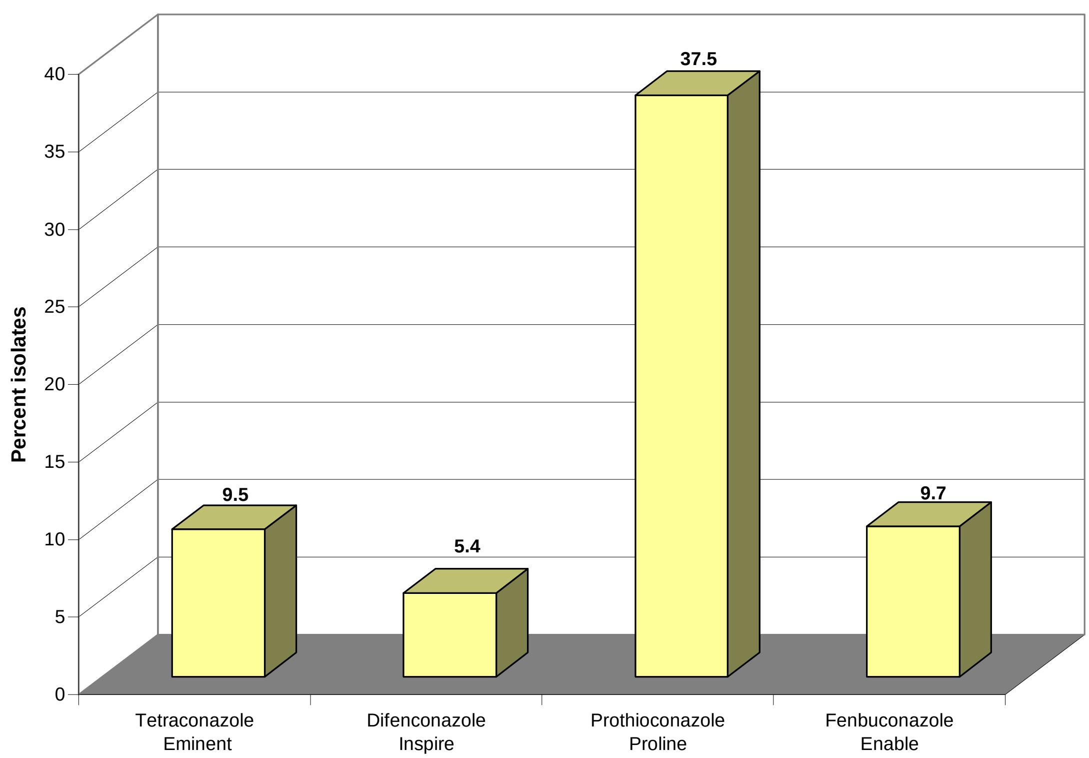


Fig. 9. Average EC-50 (µg/ml) values of *C. beticola* isolates collected in ND and NM to pyraclostrobin (Headline) and trifloxystrobin (Gem) from 2003 to 2007

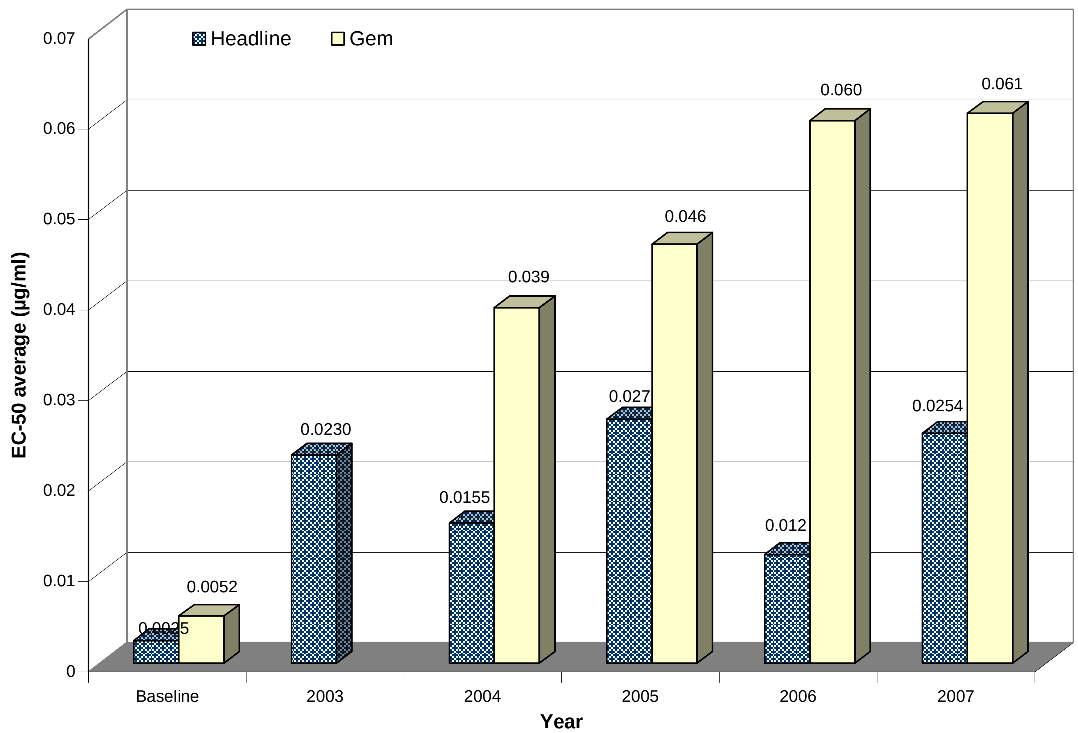


Fig. 10 Sensitivity of *C. beticola* isolatescollected in ND and MN from 2003 to 2007 to pyraclostrobin (Headline)

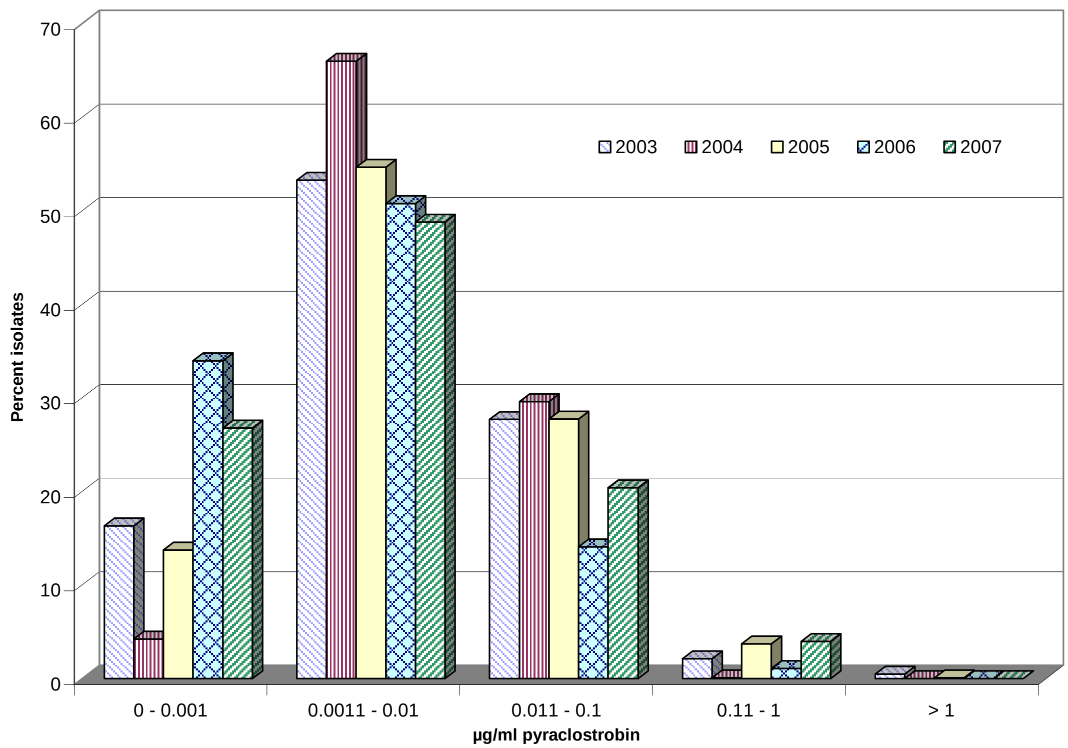
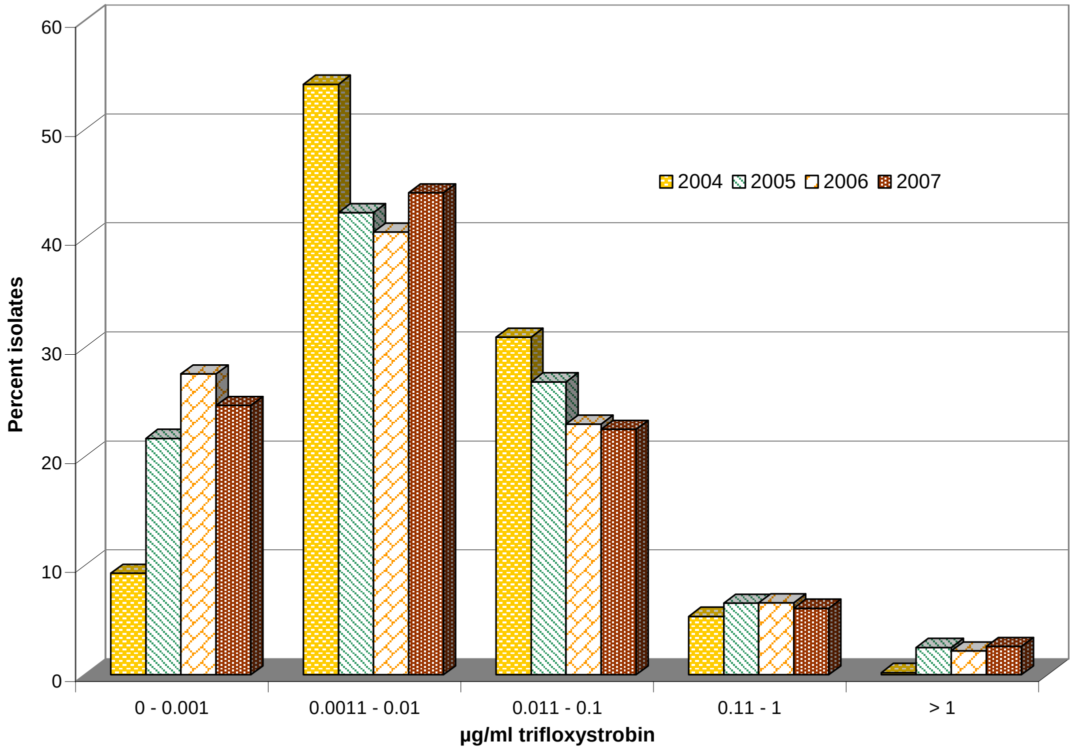


Fig 11. Sensitivity of Cercospora beticola isolates collected in 2004 to 2007 to trifloxystrobin (Gem)



SMBSC Evaluation of Fungicides for Control of Cercospora Leaf Spot Control with conventional varieties

Methods:

Sugarbeets were planted at two locations. One location was 3 miles south and the second location was located 4 miles north of Renville, MN. The site south of Renville was taken to harvest but the cercospora leaf disease level was very low. The site north of Renville had medium to high cercospora leaf spot disease pressure and was taken to harvest. The data for each site is presented separately due to the difference in disease pressure.

Table 1 and 2 show the specifics of activities conducted at each site. Applications were made every 14 days or as close to 14 days as the weather would allow. Plots were harvested on 10-11 and 10-13-07 with a 2 row research harvester. One quality sub-sample was collected from each plot.

Table 1. Site Specifics for SMBSC Renville North Site, 2007

Task	Date	Notes	Harvest date
plant	*5/3/2007*	*993RR/ Beta 1322*	
spray	*5/3/2007*	*Nortron-7.51pt*	*10/11-12/07*
spray	*5/23/2007*	*micro rate*	
spray	*5/31/2007*	*micro rate*	*Evaluation dates*
thin	*6/4/2007*		*9/5/2007*
spray	*6/21/2007*	*Select*	*9/26/2007*
spray	*6/28/2007*	*Roundup*	*10/10/2007*
inoculate	*7/5/2007*		
spray	*7/26/2007*	*CLS program*	
spray	*8/9/2007*	*CLS program*	
spray	*8/28/2007*	*CLS program*	

Table 2. Site Specifics for SMBSC Renville South Site, 2007

Task	Date	Notes	Harvest date
plant	*5/3/2007*	*993RR/ Beta 1322*	*10/13/2007*
spray	*5/3/2007*	*Nortron-7.51pt*	
spray	*5/23/2007*	*microrate*	
dig ends	*5/30/2007*		
spray	*5/31/2007*	*microrate*	
thin	*6/1/2007*		
spray	*6/21/2007*	*select*	*Evaluation dates*
dig ends	*6/25/2007*		*10/13/2007*
spray	*6/28/2007*	*Roundup*	
inoculate	*7/12/2007*		
spray	*7/25/2007*	*cls program*	
spray	*8/8/2007*	*cls program*	
spray	*8/28/2007*	*cls program*	
green seek	*10/12/2007*	*Conventional test only*	

Fungicide chemistry class

Triazole – Eminent, Inspire, Proline, Enable
Triphenyl Tin Hydroxide – Supertin, Agritin
Strobilurin – Headline, Gem

Results and discussion

The results will be discussed in bullet points by location.

Renville North location:

1. The Renville North location had medium to heavy cercospora leaf spot pressure.
2. Cercospora leaf spot control was relatively low regardless of the evaluation date.
3. The untreated check gave significantly higher cercospora leaf spot disease and significantly lower sugarbeet production and revenue compared to treatments with fungicide applied.
4. Table 3. Extractable sugar per acre was statistically similar regardless of the Triazole fungicide applied in the first application.
5. Sugar percent and tons per acre were influenced similarly by Eminent, Inspire and Proline applied in the first application of a three spray program
6. Revenue per acre was influenced similarly by Eminent, and Proline applied in the first application of a three spray program.
7. Eminent gave significantly higher revenue per acre than Enable and Inspire applied in the first application of a three spray program.

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8. Table 4. Shows a comparison of strobilurins in the last application of a three spray program. The baseline treatment is Eminent (1st application, triazole), Supertin (second application, tryphenyl tin hydroxide) and Headline (third application, strobilurin). This treatment sets a baseline for the other treatments presented with a strobilurn applied in the third application along with an adjuvant. There were no differences between treatments with and without adjuvants having the same fungicide scenario. Thus all treatments with and without adjuvants will be considered the same.
9. There were no statistical differences of the variables measured regardless of the strobilurin applied in the last application.

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10. Table 5. Shows the influence of Dithane (EBDC chemistry class) alone and mixed with other fungicides.
11. Dithane applied alone at 24 oz. per acre compared to 32 oz. per acre gave statistically similar cercospora leaf spot control, sugar percent and tons per acre.
12. Extractable sugar per acre and revenue per acre was statistically higher with 32 oz. per acre compared to 24 oz. per acre when Dithane was applied alone.
13. Enable applied in the first application with or without Dithane have given lower revenue per acre compared to other treatments with Enable or Gem applied with Dithane in the last application.

Renville South location

1. The Renville south location had very low cercospora leaf spot infection thus the following discussion will concentrate on fungicide benefit in absence of the disease.
2. Table 6. Sugar percent, tons per acre, recoverable sugar per acre and revenue per acre tended to be higher with Inspire, Enable and Proline applied in the first application compared to Eminent applied in the first application or untreated check.
3. Table 7. Strobilurins applied in the last application did not influence the factors measured.
4. Table 8. In absence of disease Dithane applied at 24 oz. per acre gave significantly less revenue per acre than all other treatments including the untreated check.
5. Revenue per acre tended to be higher when Dithane was applied with Enable in the first and last fungicide application of a three spray program.

Table 3. 2007 SMBSC Renville north location CLS fungicide testing-conventional variety

Triazole fungiceds applied in 1st app.

Exp:0741

Treatment Description	Application rate per acre	CLS ratings (1-9 scale) Date 1	Date 2	Date 3	Sugar percent	Tons per acre	Ex. Sug. per acre	Revenue $
EMINENT (3X) SUPER TIN 80 WP HEADLINE	13 oz. 5 oz. 9 oz.	1.19	1.35	2.06	16.26	36.72	10334	1267.22
PROLINE SC+INDUCE SUPER-TIN 80 WP HEADLINE	5 oz.+ 0.125 % v/v 5 oz. 9 oz.	1.10	1.25	1.44	15.89	38.07	10394	1247.78
INSPIRE SUPER-TIN 80 WP HEADLINE	7 oz. 5 oz. 9 oz.	2.00	2.25	2.81	15.61	36.36	9729	1147.93
ENABLE SUPER-TIN 80 WP HEADLINE	8 oz. 5 oz. 9 oz.	1.69	1.88	2.00	15.02	41.77	10592	1185.86
Check	N/A	3.00	4.00	7.13	14.36	31.40	7601	809.69
	C.V. %	27.04	23.82	30.13	2.88	9.34	9.47	10.75
	LSD (0.05)	0.53	0.56	0.92	0.06	4.79	926	80.39

Table 4. 2007 SMBSC Renville north location CLS fungicide testing- conventional variety

Strobilurins comparison in CLS programs

Exp:0741

Treatment Description	Application rate per acre	CLS ratings Date 1 (1-9 scale)	Date 2	Date 3	Sugar percent	Tons per acre	Ex. Sug. per acre	Revenue $
EMINENT	13 oz.	1.19	1.35	2.06	16.26	36.72	10334	1267.22
SUPER TIN 80 WP	5 oz.							
HEADLINE	9 oz.							
EMINENT+TROPHY GOLD	13 oz. + 0.25%	1.63	1.69	2.13	15.61	38.93	10401	1223.30
SUPER-TIN 80 WP	5 oz.							
HEADLINE+TROPHY GOLD	9 oz. + .25%							
EMINENT+TROPHY GOLD	5 oz.+0.25%	1.19	1.25	1.50	16.08	36.13	9976	1214.98
SUPER-TIN 80 WP	5 oz.							
GEM+TROPHY GOLD	3.5 oz.+.25%							
	C.V. %	*27.04*	*23.82*	*30.13*	*2.88*	*9.34*	*9.47*	10.75
	LSD (0.05)	*0.53*	*0.56*	*0.92*	*0.64*	*4.79*	*926*	80.39

Table 5. 2007 SMBSC Renville north location CLS fungicide testing- conventional variety

Dithane comparison in CLS programs

Exp:0741

Treatment Description	Application rate per acre	CLS ratings Date 1 (1-9 scale)	Date 2	Date 3	Sugar percent	Tons per acre	Ex. Sug. per acre	Revenue $
DITHANE (3X)	32 oz.	1.19	1.88	2.75	16.13	36.49	10188	1241.50
DITHANE (3X)	24 oz.	1.38	2.00	2.38	16.24	33.72	9438	1156.31
SUPER-TIN 80 WP	5 oz.	1.19	1.56	2.56	16.18	36.05	10118	1239.11
PROLINE +INDUCE	5 oz.+ 0.125 % v/v							
GEM 500 SC + DITHANE	3.5 OZ. + 32 OZ.							
ENABLE + DITHANE	8 oz. + 32 oz.	1.79	2.00	2.75	16.48	33.06	9199	1131.95
SUPER-TIN 80 WP	5 oz.							
HEADLINE	9 oz.							
SUPER-TIN 80 WP	5 oz.	1.44	1.88	2.31	15.69	38.39	10304	1219.95
HEADLINE	9 oz.							
ENABLE +DITHANE	8 oz. + 32 oz.							
ENABLE	8 oz.	1.69	1.88	2.00	15.02	41.77	10592	1185.86
SUPER-TIN 80 WP	5 oz.							
HEADLINE	9 oz.							
Check	N/A	3.00	4.00	7.13	14.36	31.40	7601	809.69
	C.V. %	*27.04*	*23.82*	*30.13*	*2.88*	*9.34*	*9.47*	10.75
	LSD (0.05)	*0.53*	*0.56*	*0.92*	*0.64*	*4.79*	*926*	80.39

Table 6. 2007 SMBSC Renville South location CLS fungicide testing-conventional variety

Triazole fungiceds applied in 1st app.

Exp:0742

Treatment Description	Application rate per acre	CLS rating *(1-9 scale)*	Sugar percent	Tons /acre	Ex. Sug. per acre	Revenue $
EMINENT	13 oz.	1.60	13.87	26.60	6180	633.82
SUPER TIN	5 oz.					
HEADLINE	9 oz.					
PROLINE SC+INDUCE	5 oz.+ 0.125 % v/v	1.20	14.09	30.49	7225	757.24
SUPER-TIN	3.75 oz.					
HEADLINE	9 oz.					
INSPIRE	7 oz.	1.18	14.15	32.04	7560	788.98
SUPER TIN	2.5 oz.					
HEADLINE	9 oz.					
ENABLE	8 oz.	1.20	14.20	30.69	7362	781.87
SUPER TIN	5 oz.					
HEADLINE	9 oz.					
Check	N/A	1.43	13.92	28.98	6736	691.27
	C.V. %	*29.43*	*3.81*	*15.62*	*17.49*	*20.98*
	LSD (0.05)	*0.55*	*0.75*	*6.36*	*1084.00*	*111.25*

Table 7. 2007 SMBSC Renville north location CLS fungicide testing-conventional variety

Strobilurin comparison in CLS programs

Exp:0741

Treatment Description	Application rate per acre	CLS rating *(1-9 scale)*	Sugar percent	Tons /acre	Ex. Sug. per acre	Revenue $
EMINENT	13 oz.	1.60	13.87	26.60	6180	633.82
SUPER TIN	5 oz.					
HEADLINE	9 oz.					
EMINENT+TROPHY GOLD	13 oz.+0.25% v/v	1.43	13.95	29.02	6722	687.11
SUPERTIN	5 oz.					
HEADLINE+TROPHY GOLD	9 oz.+ 0.25% v/v					
EMINENT+TROPHY GOLD	13 oz.+0.25%	1.23	13.90	27.80	6450	660.56
SUPERTIN	5					
GEM+TROPHY GOLD	3.5+0.25%					
Check	N/A	1.43	13.92	28.98	6736	691.27
	C.V. %	*29.43*	*3.81*	*15.62*	*17.49*	*20.98*
	LSD (0.05)	*0.55*	*0.75*	*6.36*	*1084.00*	*111.25*

Table 8. 2007 SMBSC Renville north location CLS fungicide testing-conventional variety

Dithane comparison in CLS programs

Exp:0741

Treatment Description	Application rate per acre	CLS rating *(1-9 scale)*	Sugar percent	Tons /acre	Ex. Sug. per acre	Revenue $
DITHANE (3X)	32 oz.	1.55	14.14	29.81	7134	755.73
DITHANE (3X)	24 oz.	1.25	14.02	25.02	5846	603.53
SUPER-TIN PROLINE SC+INDUCE GEM 500 SC + DITHANE	5 oz. 5 oz.+ 0.125 % v/v 3.5 oz.+ 32 oz.	1.38	13.59	25.71	5862	588.48
ENABLE + DITHANE SUPER TIN HEADLINE	8 oz.+ 32 oz. 5 oz. 9 oz.	1.75	14.52	30.73	7581	828.79
SUPERTIN HEADLINE ENABLE +DITHANE	5 oz. 9 oz. 8 oz.+ 32 oz.	1.30	14.57	31.29	7733	846.84
ENABLE SUPER TIN HEADLINE	8 oz. 5 oz. 9 oz.	1.20	14.20	30.69	7362	781.87
Check	N/A	1.43	13.92	28.98	6736	691.27
	C.V. %	*29.43*	*3.81*	*15.62*	*17.49*	*20.98*
	LSD (0.05)	*0.55*	*0.75*	*6.36*	*1084.00*	*111.25*

SMBSC Evaluation of Fungicides for Control of Cercospora Leaf Spot Control with Roundup Ready variety

Methods:
Sugarbeets were planted at two locations. One location was 3 miles south and the second location was located 4 miles north of Renville, MN. The site south of Renville was taken to harvest but the cercospora leaf disease level was very low. The site north of Renville had medium to high cercospora leaf spot disease pressure and was taken to harvest. The data will only be presented in this report on the north site.

Roundup Weathermax was applied at 32 oz. per acre plus ammonium sulfate at 17 lbs. per 100 gallon water. Roundup Weathermax was applied with the first application of fungicide as indicated by treatment in the tables presented. The experiment was setup as a randomized complete block design factorial, where each fungicide was applied with and without Roundup Weathermax in the first application. The same fungicide was used throughout the application timings in order to eliminate variability due to fungicide type. The fungicides were applied three times in a 14 day spray interval.

Table 1 shows the specifics of activities conducted at the north site. Applications were made every 14 days or as close to 14 days as the weather would allow. Plots were harvested on 10/11/08 with a 2 row research harvester. One quality sub-sample was collected from each plot.

Table 1. Site Specifics for SMBSC Renville North Site, 2007

Task	Date	Notes	Harvest date
plant	*5/3/2007*	*993RR/ Beta 1322*	
spray	*5/3/2007*	*Nortron-7.51pt*	*10/11-12/07*
spray	*5/23/2007*	*micro rate*	
spray	*5/31/2007*	*micro rate*	*Evaluation dates*
spray	*6/21/2007*	*Select*	*9/26/2007*
spray	*6/28/2007*	*Roundup*	*10/10/2007*
inoculate	*7/5/2007*		
spray	*7/26/2007*	*CLS program*	
spray	*8/9/2007*	*CLS program*	
spray	*8/28/2007*	*CLS program*	

Fungicide chemistry class

Triazole – Eminent, Inspire, Proline, Enable
Triphenyl Tin Hydroxide – Supertin, Agritin
Strobilurin – Headline, Gem

Results and discussion
The results will be discussed in bullet points by location.

Renville north location:

1. The Renville North location had medium to heavy cercospora leaf spot pressure.
2. Cercospora leaf spot ratings were relatively low regardless of the evaluation date or fungicide treatment.
3. The untreated check gave significantly higher cercospora leaf spot disease and significantly lower sugarbeet production and revenue per acre compared to treatments with fungicide applied.
4. Table 2. Shows fungicide treatments applied without Roundup Weathermax.
5. All fungicide treatments controlled cercospora leaf spot statistically similar.
6. All fungicide treatments gave a significantly higher sugar percent and extractable sugar per acre than the untreated check.
7. In the absence of Roundup Weathermax, revenue per acre was significantly higher when Headline fungicide was applied compared to all other fungicide applications.

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8. Table 3. Shows fungicide treatments applied with Roundup Weathermax.
9. Cercospora leaf spot control at cls rating date 1 was not significantly different from the untreated check regardless of fungicide applied, but cercospora leaf spot control at cls rating date 2 was significantly better with fungicides applied compared to the untreated check.
10. Tons per acre were increased with fungicides Gem, Inspire, Proline and Supertin when Roundup Weathermax was applied in the first fungicide application (table 3) compared to when Roundup Weathermax was not applied with the first fungicide application (table 3).
11. Fungicides with Roundup Weathermax influenced tons per acre similarly.
12. Fungicides applied with Roundup Weathermax in the first application had similar influence on sugar percent and treatments either were significantly greater or tended to be significantly greater than the untreated check with Roundup Weathermax applied.
13. Extractable sugar per was similar for all treatments except Supertin with Roundup Weathermax due to the increase in tons per acre achieved with the Supertin with Roundup Weathermax treatment.
14. Revenue per acre was significantly greater with all fungicides applied with Roundup Weathermax in the first application compared to the untreated check with Roundup Weathermax.
15. The higher revenue per acre with fungicide treatment was due to the increase sugar percent with fungicide applications as a result of Cercospora leaf spot control.

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16. Table 4. Shows the difference of sugarbeets applied with or without Roundup without fungicides.
17. The application of Roundup significantly increased sugar percent, tons per acre, extractable sugar per acre and revenue per acre.

18. Table 5. Shows the change in similar fungicide application with and without Roundup Weathermax. The change presented is Fungicide applied with Roundup minus the same fungicide treatment applied without Roundup.
19. The data presented shows that the application of Roundup Weathermax increased sugar percent, tons per acre, extractable sugar per acre and revenue per acre.
20. Roundup Weathermax did not increase Cercospora leaf spot control.

21. Table 6. Shows the benefit of the number of fungicide applications.
22. This research is consistent with data collected from conventional varieties where three applications of fungicides were better than two fungicides applications and similar to four applications of fungicides.

Table 2. 2007 SMBSC Renville North Biotech Cercospora leaf spot fungicide screening test.

Product comparisons

Exp. 0747

Treatment Description	Application rate/acre	cls rating Date 1 (1-9 scale)	cls rating Date 2 (1-9 scale)	Sugar percent (%)	Tons /acre	Ext. Sug. per acre (lb)	Revenue per acre ($)
Check w/o ROUNDUP WEATHER MAX	N/A	1.78	5.38	13.67	29.82	6760	673.73
HEADLINE (3X)	9 oz.	1.44	1.50	15.43	36.76	9631	1114.10
EMINENT (3X)	13 oz.	1.19	1.50	15.24	35.91	9204	1043.71
GEM (3X)	3.6 oz.	1.13	1.75	15.96	31.84	8611	1023.73
INSPIRE (3X)	7 oz.	1.00	1.31	15.32	32.03	8287	947.84
SUPERTIN (3X)	5 oz.	1.39	1.63	15.09	34.17	8579	954.13
PROLINE + INDUCE (3X)	5 oz. + 0.125% v/v	2.06	2.44	15.80	30.78	8088	937.96
	C.V. %	*18.1*	*19.9*	*3.65*	*6.04*	*7.12*	*10.04*
	LSD (0.05)	*0.81*	*1.05*	*0.79*	*2.95*	*692*	*52.87*

Table 3. 2007 SMBSC Renville North Biotech Cercospora leaf spot fungicide screening test.

Product with Roundup comparisons

Exp. 0747

Treatment Description	Application rate/acre	cls rating Date 1 (1-9 scale)	cls rating Date 2 (1-9 scale)	Sugar percent (%)	Tons /acre	Ext. Sug. per acre (lb)	Revenue per acre ($)
Check w/ROUNDUP WEATHERMAX (1X)	32 oz.	2.06	5.25	14.82	35.66	8815	965.52
ROUNDUP WEATHERMAX (1X) + HEADLINE (3X)	32 oz. + 9 oz.	1.31	1.81	15.49	34.86	9099	1049.21
ROUNDUP WEATHERMAX (1X) + EMINENT (3X)	32 oz. + 13 oz.	2.75	2.69	15.61	34.26	9020	1048.00
ROUNDUP WEAHTERMAX (1X)+ GEM (3X)	32 oz + 3.6 oz	1.25	1.38	15.54	36.05	9482	1100.63
ROUNDUP WEATHERMAX (1X) + INSPIRE (3X)	32 oz. + 7 oz.	1.25	1.56	15.66	35.81	9469	1104.35
ROUNDUP WEATHERMAX (1X)+ PROLINE + INDUCE (3X)	32 oz.+ 5 oz. +0.125% v/v	1.25	2.19	15.69	33.99	9033	1058.05
ROUNDUP WEATHERMAX (1X)+ SUPERTIN (3X)	32 oz. + 5 oz.	1.50	2.38	15.49	38.18	10033	1163.74
	C.V. %	*18.1*	*19.9*	*3.65*	*6.04*	*7.12*	*10.04*
	LSD (0.05)	*0.81*	*1.05*	*0.79*	*2.95*	*692*	*52.87*

Table 4. 2007 SMBSC Renville North Biotech Cercospora leaf spot fungicide screening test.

Untreated check comparison

Exp. 0747

Treatment Description	Application rate/acre	cls rating Date 1 (1-9 scale)	cls rating Date 2 (1-9 scale)	Sugar percent (%)	Tons / acre	Ext. Sug. per acre (lb)	Revenue per acre ($)
Check w/Roundup	32 oz.	2.06	5.25	14.82	35.66	8815	965.52
Check w/o Roundup	N/A	1.78	5.38	13.67	29.82	6760	673.73
	C.V. %	*18.1*	*19.9*	*3.65*	*6.04*	*7.12*	*10.04*
	LSD (0.05)	*0.81*	*1.05*	*0.79*	*2.95*	*692*	*52.87*

Table 5. 2007 SMBSC Renville North Biotech Cercospora leaf spot fungicide screening test.

Comparisons subtracting treatment with Roundup minus the same treatment without Roundup

Exp. 0747

Treatment Description	CLS rating	Sugar percent (%)	Tons per acre	Ext. Sug. per acre (lb)	Revenue per acre ($)
CHECK	-0.13	1.14	5.83	2054.80	291.79
HEADLINE (3X)	0.01	0.06	-1.90	-531.51	-64.88
EMINENT (3X)	0.02	0.37	-1.65	-184.05	4.29
GEM (3X)	-0.01	-0.43	4.21	870.48	76.90
INSPIRE (3X)	0.01	0.34	3.78	1182.55	156.51
PROLINE + INDUCE (3X)	-0.01	-0.11	3.21	945.52	120.10
SUPERTIN (3X)	0.00	0.40	4.02	1454.52	209.61

Table 6. 2007 SMBSC Renville North Biotech Cercospora leaf spot fungicide screening test.

Comparison of number of applications

Exp. 0747

Treatment Description	Application rate/acre	cls rating Date 1 (1-9 scale)	cls rating Date 2 (1-9 scale)	Sugar percent (%)	Tons per acre	Ext. Sug. per acre (lb)	Revenue per acre ($)
Check	N/A	1.63	5.00	13.99	26.91	6249	640.49
SUPERTIN PROLINE + INDUCE SUPERTIN HEADLINE	5 5 +0.125% 5 9	1.31	1.81	15.79	36.16	9617	1127.26
PROLINE + INDUCE SUPERTIN HEADLINE	5 oz.+ 0.125% v/v 5 oz. 9 oz.	1.13	1.63	15.67	36.34	9587	1115.72
SUPERTIN HEADLINE	5 oz. 9 oz.	1.44	2.06	14.15	37.64	8891	928.67
	C.V. %	*18.1*	*19.9*	*3.65*	*6.04*	*7.12*	*10.04*
	LSD (0.05)	*0.81*	*1.05*	*0.79*	*2.95*	*692*	*52.87*

MANAGING CERCOSPORA LEAF SPOT ON SUGARBEET AT MILAN, SOUTHERN MINNESOTA BEET SUGAR COOPERATIVE

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Cercospora leaf spot, caused by the fungus *Cercospora beticola* Sacc., is the most economically damaging foliar disease of sugarbeet in Minnesota and North Dakota. Severe disease reduces root and sucrose concentration, and generally increases the sugar lost to molasses resulting in significant reductions in recoverable sucrose (Shane and Teng, 1992; Khan and Smith, 2005). Cercospora leaf spot is managed by planting disease tolerant varieties, reducing inoculum by crop rotation and tillage, and fungicide applications (Miller et al., 1994; Khan et al; 2007). Khan et al. (2007) have demonstrated that fungicide application at initial symptoms and subsequent applications based on disease severity and favorable environmental conditions are effective and economical for growers in the northern and southern part of the Red River Valley (RRV) of North Dakota and Minnesota. In the RRV, growers typically apply the first fungicide at first symptoms and subsequent applications based on the presence of symptoms and favorable environmental conditions. In 2006, growers successfully controlled leaf spot using an average of 1.9 fungicide applications. In southern Minnesota, growers typically apply the first fungicide at or just after row closure followed by two and sometimes three applications at about 14 day intervals. In 2006, growers in southern Minnesota successfully controlled leaf spot using an average of 3.18 fungicide applications (Carlson et al., 2007).

The objective of this research was to determine the timing of fungicide application that would result in effective and economical control of Cercospora leaf spot on sugarbeet at Milan, MN.

MATERIALS AND METHODS

Field trial was conducted at Milan, MN in 2007 where the previous crop was soybean. The experimental design was a randomized complete block with four replicates. Field plots comprised of six 30-feet long rows spaced 22 inches apart. Plots were planted on 27 April with Betaseed variety RZ02RR07, that was glyphosate tolerant and resistant to Rhizomania. Terbufos (Counter 15G) was applied modified in-furrow at 12 lbs/A during planting to control sugarbeet root maggot (*Tetanops myopaeformis* von Röder; Diptera: Ulidiidae). Plots were thinned manually at the 6-leaf stage to 41,580 plants per acre. Weeds were controlled with glyphosate (Roundup Original Max, 64 oz/A + a non-ionic surfactant [premier 90] at 0.25%v/v + AMS at 10 lb/100 gal) applied on 15 May and 11 June. Plots were inoculated naturally.

Fungicide spray treatments were applied with a hand-held 4-nozzle (8002) sprayer calibrated to deliver 20 gpa of solution at 40 p.s.i pressure to the middle four rows of plots. Treatments were as follows: untreated check; 1st fungicide application at row closure followed by three applications at 14 d interval; 1st fungicide application at row closure followed by four applications at 14 d interval; 1st fungicide application at row closure with subsequent applications based on disease severity and favorable environmental conditions; 1st fungicide application at first symptoms with subsequent applications based on disease severity and favorable environmental conditions. Rows were considered closed when leaves of adjacent plants were touching or overlapping. Row closure was around 6 July and first fungicide application was made on 10 July. Disease severity of one lesion per lower leaf early in the season (July), or 10 lesions per lower leaf in late August were not attained. Fungicides were applied on 10 and 24 July, 8 17, and 29 August. The fungicide alternation program for treatments was Eminent (9 fl oz/A), SuperTin (5 oz/A), Headline (9 fl oz/A), SuperTin (5 oz/A), Eminent (9 fl oz/A).

Cercospora leaf spot severity was rated on the KWS scale of 1 to 9. A rating of 1 indicated no disease, a rating of 3 indicated that all outer leaves displayed typical symptoms and was the early stages of economic loss level, and a rating of 9 indicated that the plants had only new leaf growth, all earlier leaves being dead. Except for a few plants with a few lesions in late August, plants were free of Cercospora leaf spot throughout the season.

The middle two rows of plots were hand harvested on 20 September and weighed for root yield. Twelve to 15 random roots from each plot, not including roots on the ends of the plot, were analyzed for quality at the American Crystal Sugar Company Quality Tare Laboratory, Moorhead, MN. The data analysis was performed with the ANOVA procedure of the Agriculture Research Manager, version 6.0 software package (Gylling Data Management Inc., Brookings, South Dakota, 1999). The least significant difference (LSD) test was used to compare treatments when the F-test for treatments was significant (P=0.05).

RESULTS AND DISCUSSIONS

In late August, a few lesions were observed on a few plants; the conservative threshold of 10 lesions per lower leaf was not attained. As such, plots were not treated where fungicides were to be applied at first symptoms, or in the presence of symptoms and favorable environmental conditions. At harvest, all plots had a KWS Cercospora leaf spot rating of one (Table 1). Conditions were favorable for disease development in late August when a few lesions were observed; however, there was no significant outbreak of CLS, probably because of low inoculum levels as a result of crop rotation and the use of fungicides to control any leaf spot in sugarbeet fields. It may also be possible that a windbreak of trees on one side and corn that surrounded the research site prevented wind blown *C. beticola* inoculum from entering the plots.

Treatments with one, four, or five fungicide applications resulted in similar recoverable sucrose, root yield, sucrose concentration, and sugar loss to molasses as treatments with no fungicide application. The data suggest that in the absence of disease, there was no advantage, in terms of sugarbeet yield or quality at harvest, in using fungicides.

This research indicates that fungicide application should commence at first symptoms. However, some scouting will be necessary to determine the presence and severity of disease. At Milan, fungicide application starting at canopy closure with subsequent applications on a calendar basis was unnecessary and increased production cost since the disease did not develop.

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Table 1. Number of fungicide applications and yield measures using different management programs at Milan, MN in 2007

Treatment and rate/A	Sprays	CLS[z]	Recoverable Sucrose (lb/A)	Recoverable Sucrose (lb/T)	Root yield (t/A)	Sucrose concen-tration (%)	LTM[y] (%)	Net Return[x] ($/A)
Untreated Check	0	1	6591	258	25.9	14.48	1.55	857
Eminent 125SL 9 fl oz / SuperTin 80WP 5 oz/ Headline 2.09 EC 9 fl oz / SuperTin 80WP 5 oz[w]	4	1	6072	253	24.1	14.30	1.65	719
Eminent 125SL 9 fl oz / SuperTin 80WP 5 oz/ Headline 2.09 EC 9 fl oz / SuperTin 80WP 5 oz / Eminent 125SL 9 fl oz[v]	5	1	6737	261	26.1	14.63	1.60	784
Eminent 125SL 9 fl oz[u]	1	1	5967	252	24.0	14.22	1.63	754
1st Symptoms[t]	0	1	6374	263	24.5	14.73	1.60	829
LSD (P= 0.05)		NS	NS	NS	NS	NS	NS	NS

[z]Cercospora leaf spot measured on KWS scale 1-9 (1 = no leaf spot; 9 = dead outer leaves, inner leaves severely damaged, regrowth of new leaves).
[y]LTM: Sugar loss to molasses.
[x]Net Return was calculated as follows: [Recoverable sucrose/A x 13 cents/lb recoverable sucrose] – [Fungicide cost + application cost]. Fungicide cost/A were as follows: Eminent - $16.50/A; SuperTin - $9.42/A; Headline - $15.00/A; and fungicide application cost - $5.00/A.
[w]1st fungicide application at row closure followed by three applications at 14 d interval.
[v]1st fungicide application at row closure followed by four applications at 14 d interval.
[u]1st fungicide application at row closure with subsequent applications based on disease severity and favorable environmental conditions.
[t]1st fungicide application at first symptoms with subsequent applications based on disease severity and favorable environmental conditions.

COMPARING AIR-ASSIST AND CONVENTIONAL SPRAYERS FOR CERCOSPORA LEAF SPOT CONTROL IN SUGARBEET

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Cercospora leaf spot, caused by the fungus *Cercospora beticola* Sacc., is the most damaging foliar disease of sugarbeet (*Beta vulgaris* L.) in Minnesota and North Dakota. The disease reduces root yield and sucrose concentration resulting in reduced recoverable sucrose (Smith and Ruppel, 1973; Lamey et al., 1987; Shane and Teng, 1992; Lamey et al., 1996; Khan and Smith, 2005). Profitability is further reduced since roots of diseased plants do not store well in storage piles (Smith and Ruppel, 1973). Cercospora leaf spot is managed by planting disease tolerant varieties, reducing inoculum through crop rotation and tillage, and fungicide applications (Miller et al., 1994; Khan et al; 2007). It is difficult to develop sugarbeet varieties with high levels of Cercospora leaf spot tolerance and high yield (Smith and Campbell, 1996). Consequently, commercial varieties generally have moderate levels of tolerance and require fungicide applications to obtain acceptable levels of protection against Cercospora leaf spot (Miller et al., 1994).

The objective of this research was to compare Cercospora leaf spot control on sugarbeet with fungicides using air-assist and conventional sprayers.

MATERIALS AND METHODS

Field trials were conducted at Foxhome, MN in 2005, 2006, and 2007. The experimental design was a randomized complete block with four replicates. Field plots comprised of six 30-feet long rows spaced 22 inches apart. Plots were planted in late April or early May with a Betaseed variety resistant to Rhizomania but susceptible to Cercospora leaf spot. Terbufos (Counter 15G) was applied modified in-furrow at 12 lbs/A during planting to control sugarbeet root maggot (*Tetanops myopaeformis* von Röder; Diptera: Ulidiidae). Plots were thinned manually at the 6-leaf stage to 41,580 plants per acre. Weeds were controlled with recommended herbicides (Khan, 2005), and hand weeding. Plots were inoculated with inoculum provided by Margaret Rekoske (Betaseed, Shakopee, MN) in the first week of July.

Treatments included fungicides applied with conventional nozzles, Spray Air™ sprayer, and an untreated check. The fungicides applied in an alternation program were tetraconazole (Eminent 125SL, Sipcam Inc., USA) at 13 fl oz/A, triphenyltin hydroxide (SuperTin 80WP, Du Pont,) at 5 oz/A, and pyraclostrobin (Headline 2.09 EC, BASF, Raleigh, NC) at 9 fl oz/A. Fungicides were applied in 10 and 15 gpa of solution. The conventional boom sprayer was operated at 47 psi with 8002 nozzles at 4 and 6 mph to deliver 15 and 10 gpa of solution, respectively. The air assist treatments were applied by a Spray Air™ sprayer using an air pressure of 20 inches of water. A speed of 3 mph and 60 psi liquid pressure was used to deliver 15 gpa of solution, and 4 mph and 40 psi was used to deliver 10 gpa of solution. Fungicides were applied to the middle four rows of plots. Fungicide applications commenced at first symptoms and were applied at about 14 day intervals.

Cercospora leaf spot severity was rated on the KWS scale of 1 to 9. A rating of 1 indicated no disease, a rating of 3 indicated that all outer leaves displayed typical symptoms and was at the early stages of economic loss level, and a rating of 9 indicated that the plants had only new leaf growth, all earlier leaves being dead. Cercospora leaf spot severity was assessed throughout the season. However, the rating done three days prior to harvest is reported.

Plots were defoliated mechanically and harvested using a mechanical harvester in late September. The middle two rows of each plot were harvested and weighed for root yield. Twelve to 15 random roots from each plot, not including roots on the ends of the plot, were analyzed for quality at the American Crystal Sugar Company Quality Tare Laboratory, East Grand Forks, MN. The data analysis was performed with the ANOVA procedure of the Agriculture Research Manager, version 6.0 software package (Gylling Data Management Inc., Brookings, South

Dakota, 1999). The least significant difference (LSD) test was used to compare treatments when the F-test for treatments was significant (P=0.05).

RESULTS AND DISCUSSIONS

Cercospora leaf spot symptoms were observed in mid July. Fungicide treatments commenced on July 23 when disease incidence was uniform in all plots. CLS progressed slowly in July and August then rapidly in September in the untreated check and at harvest had a KWS Cercospora leaf spot rating of 8.0 which was significantly higher than the fungicide treatments (Table 1). Fungicide treatments resulted in higher root yield, sucrose concentration, and recoverable sucrose compared to the untreated check. There was no significant advantage in terms of disease control and thus recoverable sucrose in using the air assist sprayer compared to the conventional sprayer. Fungicides applied at the higher water volume resulted in slightly better disease control compared to when applied at the lower water volume.

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Table 1. Cercospora leaf spot control at Foxhome in 2007 with labeled fungicides.

Treatment and rate/A	App. interval (days)	CLS*	Recoverable (lb/A)	Sucrose (lb/T)	Root yield (t/A)	Sucrose concentration (%)	LTM** (%)	Return ($/A)***
15 gpa Conventional application	14	3.3	7655	334	23.1	18.1	1.42	1018
15 gpa Air-assist application	14	3.3	7514	329	23.1	17.9	1.43	999
10 gpa Conventional application	14	3.8	7515	331	23.0	18.0	1.45	999
10 gpa Air-assist application	14	3.5	7831	324	24.3	17.7	1.50	1042
Untreated Check		8.0	6706	307	22.1	16.8	1.48	892
LSD (*P*=0.05)		0.8	644	21	1.7	1.1	NS	86

*Cercospora leaf spot rating
**Loss to Molasses
***Gross return in dollars per acre based on Minn-Dak payment system

SURVIVAL OF *RHIZOCTONIA SOLANI* AG 2-2 ON CORN ROOTS

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Rhizoctonia root and crown rot (RRCR) of sugarbeet is caused by the soilborne fungus *Rhizoctonia solani*. The fungus is composed of genetically isolated populations called anastomosis groups or AGs (2). The AG population causing RRCR of sugarbeet is *R. solani* AG 2-2, which is further divided into the intraspecific groups (ISGs) AG 2-2 IIIB and AG 2-2 IV (2,4). Both ISGs cause RRCR on sugarbeet (4), but AG 2-2 IIIB is the more aggressive population (3).

Reports from Europe (1) indicate *R. solani* AG 2-2 IIIB is an aggressive root rot pathogen in rotations of corn and sugarbeet. In the southeastern U.S.A., *R. solani* AG 2-2 IIIB causes a crown root and brace root rot on corn. In recent field trials in the Red River Valley (RRV), we found that *R. solani* AG 2-2 IIIB caused lesions on roots of a conventional corn variety that displayed no aboveground symptoms or effects on yield, while *R. solani* AG 2-2 IV rarely infected roots (7,8,9). Consequently, these reports have raise concerns about the presence and role of *R. solani* AG 2-2 IIIB and AG 2-2 IV in corn and sugarbeet rotations in the RRV and southern Minnesota.

A wide range of commercial corn varieties are sold in the RRV and southern Minnesota including conventional as well as transgenic (Roundup Ready and insect resistance - with traits for feed or ethanol production). Availability of short-season varieties in the RRV has resulted in increased corn acreage in recent years. In southern Minnesota, however, sugarbeet frequently follows field corn (72% acres), sweet corn (11%), soybean (9%), and other crops (8%). Producers in the RRV and southern Minnesota are reporting increases in RRCR of sugarbeet. The relationship of this disease to corn varieties grown the previous season is unknown.

OBJECTIVES

We established field trials in the RRV and southern Minnesota to determine 1.) pathogenicity and survival of *R. solani* AG 2-2 IIIB and AG 2-2 IV on varieties of corn with different genetic traits, and 2.) effects on a subsequent sugarbeet crop. This report summarizes results for the first year of a two-year experiment.

MATERIALS AND METHODS

Field trials were established in the spring of 2007 at the University of Minnesota, Northwest Research and Outreach Center, Crookston and by the Southern Minnesota Beet Sugar Cooperative in a field near Gluek, Minnesota. Main plots consisted of a non-inoculated control, inoculation with *R. solani* AG 2-2 IV, and inoculation with *R. solani* AG 2-2 IIIB (inoculum of *R. solani* was grown for 3 weeks on sterilized barley and air-dried in the greenhouse for 48 hours). Transgenic corn varieties (Roundup Ready with resistance to corn borer and/or root worm) with traits for feed or ethanol production were sown as subplots in each main plot (Table 1). Trials were arranged in a split-plot design with four replicates.

Red River Valley. At Crookston, main plots were 77 feet wide by 30 feet long. Plots were fertilized to 130 lb N A^{-1}acre; 30 lb P_2O_5 A^{-1} also was added. On May 17, 2007 main plots were inoculated with 26.4 oz of barley infested with *R. solani* AG 2-2 IV or *R. solani* AG 2-2 IIIB. *Rhizoctonia*-infested grains were sprinkled on the soil surface and incorporated with a Melroe multiweeder; control plots were not inoculated. Then, main plots were divided into seven, 11-ft wide subplots (6 rows, 22 inches apart), which were sown with six transgenic and one conventional corn variety (sown in previous experiments, 7,8,9) (Table 1). The herbicide Volley (2.25 pints A^{-1}) was applied pre-emergence on May 25. Plots were cultivated June 21 and hand-weeded on June 28.

To determine disease indices and isolate *R. solani* AG 2-2 from corn roots, 20 plants were dug within two rows of each corn variety on September 12 and 13, 2007. Roots were washed with a pressure washer and rated for rot using

Table 1. Corn varieties planted at the University of Minnesota, Northwest Research and Outreach Center (NWROC), Crookston on May 17, 2007 and by the Southern Minnesota Beet Sugar Cooperative in a field near Gluek on May 15, 2007. Plots previously had been inoculated with *Rhizoctonia solani* AG 2-2 IV, *R. solani* AG 2-2 III, or were not inoculated (control).

NWROC (Red River Valley)		Southern Minnesota			
Variety	Maturity (days)	Variety	Maturity (days)	Genetics[Y]	End use[Z]
Proseed GVRP80	80	DKC 38-92	88	RR	Feed
DKC 35-51	85	DKC 41-64	91	RR + Bt	Feed
DKC 41-57	91	DKC 41-57	91	RR + Bt + CRW	Feed
DKC 35-18	85	DKC 48-52	98	RR	Ethanol
DKC 33-11	83	DKC 42-95	92	RR + Bt	Ethanol
DKC 42-91	92	DKC 42-91	92	RR + Bt + CRW	Ethanol
Pioneer 39D81	81			Conventional	

[Y] RR = Roundup Ready, Bt = Bt gene for corn borer resistance, CRW = gene for corn root worm resistance

[Z] Feed varieties have no special processing characteristics; Ethanol varieties are high fermentable corn for ethanol processing.

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a 1-5 scale (1 = less than 2% of roots were discolored or decayed, 5 = rot system rotted and plant dead or dying [6]). Three, 1-inch length segments of root from each plant were surface-treated in 0.5% NaOCl for 15 sec, rinsed twice in sterile deionized water, and placed on a semi-selective medium (modified tannic acid) for isolation of *R. solani*. Cultures of *R. solani* were transferred to potato dextrose agar for further identification.

Corn yield estimates were made by hand-harvesting all ears within 10 feet of each of two center rows per plot on October 12. Ears were placed in a bin dryer. Yield was adjusted to 15.5% moisture and calculated based on 56 pounds per bushel.

Southern Minnesota. At Gluek, main plots (inoculated with *R. solani* AG 2-2 IV or AG 2-2 IIIB and the non-inoculated control) were 66 feet wide by 35 feet long. Plots were fertilized, as recommended for the region. After plots were inoculated, six transgenic corn varieties were sown per plot (Table 1) on May 15, 2007, as described above. Plots were treated with Roundup to control weeds. Corn roots were sampled and ears harvested on October 3, as described above.

RESULTS

For both locations, there were no significant interactions between soil inoculum and corn variety, so these main treatments will be presented separately.

Red River Valley. At Crookston, root rot ratings of corn were low and similar among plots inoculated with *R. solani* AG 2-2 IV, AG 2-2 IIIB, and the non-inoculated control (Table 2). Isolation of *R. solani* from roots was unaffected by soil inoculation with either population of *R. solani* or in the non-inoculated control, although frequency of isolation tended to be highest in plots inoculated with *R. solani* AG 2-2 IIIB (Table 2). Corn yields were unaffected by inoculation of soil with *R. solani* compared to non-inoculated soil (Table 2).

Corn variety had no significant effect on root rot rating or percent isolation of *R. solani* from roots (Table 2). Yields were significantly higher for DKC 42-91 compared to Proseed GVRP80, DKC 33-11, and DKC 35-51 and the other varieties were intermediate (Table 2).

Southern Minnesota. At Gluek, root rot ratings were slightly higher (Table 3) than at Crookston (Table 2) but overall, were low and similar among plots inoculated with either population of *R. solani* and the non-inoculated control. Rating was difficult because a killing frost occurred about 4 weeks before plots were assessed for disease, so roots were discolored and senesced earlier than expected. Despite this problem, isolation of *R. solani* from roots was significantly higher in plots inoculated with *R. solani* AG 2-2 IIIB (19%) compared to plots inoculated with AG 2-2 IV and the non-inoculated control, which were equally low (4 and 6%, respectively) (Table 3).

Root rot ratings were significantly different among varieties (Table 3). Isolation of *R. solani* from roots varied from 4 to 18%, but was statistically the same among varieties (Table 3). Corn yields were somewhat lower than average and varied from 129 to 161 bushel A^{-1}, but were statistically the same among varieties (Table 3).

Table 2. Disease ratings, isolation of *Rhizoctonia solani* from roots, and yields of corn planted on May 17, 2007 in plots previously inoculated (same day) with *R. solani* AG 2-2 IV, *R. solani* AG 2-2 IIIB, or not inoculated at the University of Minnesota, Northwest Research and Outreach Center, Crookston.

Main treatment	Root rot rating[U]	% Plants with *R. solani* [V]	Yield (bu/A)[W]
Inoculum[X]			
Non-inoculated (control)	1.5	11	173
R. solani AG 2-2 IV	1.8	17	170
R. solani AG 2-2 IIIB	2.1	20	166
LSD (P = 0.05)[Y]	NS	NS	NS
Corn Variety[Z]			
Proseed GVRP80	1.8	25	159
DKC 35-51	1.7	12	169
DKC 41-57	1.8	15	170
DKC 35-18	1.9	17	172
DKC 33-11	1.8	15	164
DKC 42-91	1.6	12	183
Pioneer 39D81	1.9	19	171
LSD (P = 0.05)[Y]	NS	NS	13.5

[U] Corn plants were dug from plots on September 12 and 13, 2007; roots were washed and rated with a 1-5 scale where 1 = less than 2% root surface with lesions and 5 = roots completely rotted and plant dead (6). Each value for effect of inoculum is an average of 560 plants (20/corn variety/replicate). Each value for corn variety is an average of 240 plants (20/soil inoculum treatment/replicate).

[V] Segments of roots (three, ~1-inch long) per plant were excised after disease assessment, surface-sterilized with bleach, and cultured on a semi-selective medium (modified tannic acid medium) for isolation of *R. solani*.

[W] Plots were harvested October 12, 2007; yields were adjusted to 15.5% moisture and calculated based on 56 pounds per bushel.

[X] *R. solani* AG 2-2 IV and *R. solani* AG 2-2 IIIB were grown on sterile barley grains for 3 weeks and air-dried. Plots were inoculated on May 17, 2007 by sprinkling infested barley grains onto the soil surface (26.4 oz per 2,310 ft^2, the control was not inoculated) and incorporated with a Melroe multiweeder. Plots were arranged in a randomized block design with four replicates.

[Y] Corn varieties were sown May 17, 2007 as subplots (6 rows, 22 inches apart and 30 feet long) within each soil inoculum main plot.

[Z] LSD = Least significant difference, P = 0.05; for each column, values followed by the same letter are not significantly different; NS = not significantly different.

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Table 3. Disease ratings, isolation of *Rhizoctonia solani* from roots, and yields of corn planted on May 15, 2007 in plots previously inoculated (same day) with *R. solani* AG 2-2 IV, *R. solani* AG 2-2 IIIB, or not inoculated at Gluek in southern Minnesota.

Main treatment	Root rot rating[U]	% Plants with *R. solani* [V]	Yield (bu/A)[W]
Inoculum[X]			
Non-inoculated (control)	2.2	6	145
R. solani AG 2-2 IV	2.3	4	152
R. solani AG 2-2 IIIB	2.4	19	138
LSD (P = 0.05)[Z]	NS	4.8	NS
Corn Variety[Y]			
DKC 38-92	2.6	10	139
DKC 41-64	2.4	14	129
DKC 41-57	2.2	18	142
DKC 48-52	2.4	8	161
DKC 42-95	2.2	4	151
DKC 42-91	2.1	4	148
LSD (P = 0.05)[Z]	0.17	NS	NS

[U] Corn plants were dug from plots on October 3, 2007; roots were washed and rated with a 1-5 scale where 1 = less than 2% root surface with lesions and 5 = roots completely rotted and plant dead (6). Each value for effect of inoculum is an average of 480 plants (20/corn variety/replicate). Each value for corn variety is an average of 240 plants (20/soil inoculum treatment/replicate).

[V] Segments of roots (three, ~1-inch long) per plant were excised after disease assessment, surface-sterilized with bleach, and cultured on a semi-selective medium (modified tannic acid medium) for isolation of *R. solani*.

[W] Plots were harvested October 3, 2007; yields were adjusted to 15.5% moisture and calculated based on 56 pounds per bushel.

[X] *R. solani* AG 2-2 IV and *R. solani* AG 2-2 IIIB were grown on sterile barley grains for 3 weeks and air-dried. Plots were inoculated on May 15, 2007 by sprinkling infested barley grains onto the soil surface (26.4 oz per 2,310 ft^2, the control was not inoculated) and incorporated. Plots were arranged in a randomized block design with four replicates.

[Y] Corn varieties were sown May 15, 2007 as subplots (6 rows, 22 inches apart and 30 feet long) within each soil inoculum main plot.

[Z] LSD = Least significant difference, P = 0.05; for each column, values followed by the same letter are not significantly different; NS = not significantly different.

DISCUSSION

Populations of *R. solani* AG 2-2 IV and AG 2-2 IIIB had no affect on aboveground symptoms or yields compared to a non-inoculated control in trials at both locations, which confirms results of previous trials in the RRV (7,8,9). The significantly higher isolation of *R. solani* from roots in plots inoculated with *R. solani* AG 2-2 IIIB than in plots inoculated with AG 2-2 IV and the non-inoculated control also confirms results of previous trials at Crookston (8,9), but there were no differences in isolation of *R. solani* among soil treatments in the 2007 trials at Crookston.

The effect of corn variety on root rot ratings, percent recovery of *R. solani*, and yields were variable among both locations and showed no conclusive trends. In southern Minnesota, soil moisture was very low at silking, so yields were lower than expected. Overall, 2007 results followed previous reports where no aboveground symptoms or yield losses in *Rhizoctonia*-inoculated plots occurred on corn compare to the non-inoculated control. In contrast, Sumner (5) reported that all varieties of dent corn evaluated in the southeastern USA were susceptible to *R. solani* AG 2-2 IIIB.

In 2008, these trials will be sown with sugarbeet and evaluated for damping-off and root and crown rot caused by *R. solani* AG 2-2. This will be a more direct method to assess the impact of corn variety on build-up and survival of *R. solani* AG 2-2 IV and AG 2-2 IIIB on roots.

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CHANGES IN THE GENETIC STRUCTURE OF *BEET NECROTIC YELLOW VEIN VIRUS* POPULATIONS ASSOCIATED WITH PLANT RESISTANCE BREAKDOWN

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The genome of BNYVV consists of 4 to 5 single-stranded, RNA particles. RNA 1 and 2 encode the essential elements for virus replication, protein encapsidation, and cellular translocation, whereas RNA 3, 4, and 5 are involved in disease expression and vector transmission. Despite its multi-partite genome, and the potential of mixed infections with BSBMV, high genetic stability seems to be the norm. These observations suggest the existence of strong selective constraints on virus diversification, and effective isolation mechanisms operating among populations of BNYVV.

When a plant is infected by BNYVV, it is actually infected by a large collection of virus particles that are closely related, but not identical to each other. The specific molecular composition of these particles is referred to as virus population structure. Usually, when a virus is isolated from an infected plant, the virus is defined by the "average" genetic structure of all the infecting particles, and genetic variability of the virus population is not considered. However, when an infecting viral population whose specific genetic structure, rather than its average or dominant genotype, is discussed, it is referred to as a quasispecies. Few studies have investigated the quasispecies structure of plant viruses, even though it is likely that the quasispecies structure is the most important descriptive attribute of any specific virus isolate. In general, most infecting viral populations are composed of an arrangement of genotypes that are distinguished from each other by at least one mutation. Nonetheless, when the average genotypes of isolates from different infected plants are compared, the majority are almost identical. This suggests that in nature there is a strong selection pressure on infecting virus populations to maintain a state of equilibrium.

We believe that the genetic structure (quasispecies) of viral populations influences their biological properties, such as host range, pathogenicity, and transmissibility, but few efforts have been made in plant virology to test this idea. It has been found that the number of different genotypes in an infecting virus population can be altered by the host environment, including host genotype, but this variability has not been correlated to any other characteristic of the host or biological property of the infecting viral population. Our working premise is that widespread planting of *Rz1* resistant cultivars exerted selection pressure on BNYVV population structure which eventually led to emergence of resistance breaking isolates. The objective of this study was to identify and quantify the molecular changes that occur to an infecting BNYVV population when exposed to different host genotypes. Results of this study help explain how resistance breaking isolates evolve.

METHODS

BNYVV rarely infects foliar tissue, but root-infected plants often develop generalized yellowing that aids in the identification of plants with rhizomania. In this way, apparently healthy and diseased sugar beets were identified and then asymptomatic or symptomatic lateral roots were collected from 3-5 plants of the same condition. Isolates included in this study were from the Imperial Valley of California, Minnesota, and Texas.

RNA was extracted from root tissue using the RNAqueous®-Mini kit (Ambion Inc. Austin, TX) following manufacturer's instructions. Next, first strand cDNA was synthesized using the Omniscript® reverse transcriptase kit (Qiagen Inc., Valencia, CA). PCR was performed separately using Platinum® *Taq* high fidelity polymerase (Invitrogen, Inc., Carlsbad, CA) and 5.0 µl of the reverse transcription products. The amplified DNA fragment, composed of 974 or 1367 incorporated base pairs, was cleaned using the QIAquick kit (Qiagen Inc., Valencia, CA), quantified by spectrophotometry, and recombined with pCR®-Blunt (Invitrogen, Inc., Carlsbad, CA) vector. Plasmid DNA was extracted from individual clones using the QIAprep Spin Miniprep Kit (Qiagen, Inc.) and sequenced in both directions by a commercial company to analyze the genetic composition of the infecting populations. BNYVV titers in infected tissue were estimated by realtime RT-PCR quantification. The realtime reactions were performed by an ABI Prism 7000 system (Applied Biosystems, Inc., Foster City, CA).

The basic processing of sequences were performed with the DNAStar package v4.0 (Dnastar Inc., Madison, WI), and the chromatograms were inspected with Sequence Scanner v1.0 (Applied Biosystems, Inc.) to verify the presence of mutations. Out of 133 sequenced clones, 61 different genotypes were found. The specific type of variability in each of these genotypes was then determined.

RESULTS

The isolates included in this study were collected from 3-5 plants naturally infected in the field and clustered within a localized sampling area. These composite samples were grouped during the analyses according to plant response and host genotype. Thus, the compatible *Rz1*/RB group was composed of resistant breaking isolates of BNYVV which were taken from *Rz1* resistant cultivars showing severe rhizomania. The incompatible *Rz1*/AV group consisted of avirulent isolates that were collected from asymptomatic *Rz1*-resistant cultivars. Finally, the compatible *rz1*/WT group was comprised of wild type isolates of BNYVV obtained from diseased susceptible cultivars.

The use of realtime RT-PCR quantification revealed considerable variation in virus content among isolates. In compatible interactions, the amounts of amplifiable particles were 100 to 10,000 times higher than in the incompatible *Rz1*/AV interaction. In general, disease expression was associated with a virus content of at least 300,000 virus particles per nanogram of total RNA extracted from mature plants grown in the field. In some plant roots, the amount of virus was as high as 2.5 million particles per nanogram of total RNA.

Differences between isolates in this study focused on variability in RNA 3, which is responsible for disease severity. Sixty-one different genotypes were identified out of 133 samples. Phylogenetic analyses revealed that genotypes were clearly clustered based on their plant-virus interaction group. However, there were some cases where a genotype of one isolate was more closely related to genotypes of another isolate instead of its own. This genotype overlapping was common in the *rz1*/WT group despite the fact that these isolates were the most geographically separated (Minnesota and California isolates from 2005 and a Texas isolate from 1991). This finding supports the notion that they belong to a single North American BNYVV macro-population. The lineage that comprised isolates of the incompatible *Rz1*/AV group contained two genotypes from the *Rz1*/RB group. The genetic similarity between these overlapping genotypes supports the idea that RB variants evolved from existing avirulent populations from the same region rather than from an isolate that was externally introduced.

Analysis of molecular variance (AMOVA) indicated that each interaction group represented a separate genetic population of sequences. However, sequences derived from separate isolates did not always form populations that were significantly different from each other. For instance, within the *rz1*/WT group, none of the isolates were significantly different from each other. Similarly, within the *Rz1*/AV group, no significant difference existed between most of the isolates. In contrast, all *Rz1*/RB isolates represented distinct populations. Thus, resistance breaking isolates recovered from *Rz1* plants may not be derived from a single mutant strain or they have evolved separately to such an extent that any evidence of common ancestry was obscured. This finding helps explain our inability to identify a specific marker for RB isolates from Minnesota.

The greatest genetic diversity among isolates within a given group was found with the compatible *Rz1*/RB group. However, the degree of genetic diversity within individual isolates was 2-3 times higher in populations recovered from the incompatible *Rz1*/AV group than from either of the compatible interaction groups. The highest diversity was found in avirulent BNYVV and the lowest in wild type BNYVV. When the overall nucleotide diversities of the sequences included in each plant-virus interaction group were compared, only the less diverse *rz1*/WT group was significantly different from the others. However, when the overall diversity was broken down by diversity within and among isolates, the intraisolate diversity was highest in the incompatible *Rz1*/AV interactions, whereas the differences among isolates were greatest in the *Rz1*/RB group.

DISCUSSION

BNYVV isolates derived from susceptible (*rz1*) sugar beets were characterized by the same dominant wild type (WT) genotype surrounded by a few mutant genotypes. However, in resistant *Rz1*-cultivars, the scenario was completely different: each isolate contained a different dominant genotype that was surrounded by a broad collection of mutant genotypes. Moreover, in the incompatible interaction between *Rz1*-plants and avirulent isolates (*Rz1*/AV), the infecting populations were 2-3 times more heterogeneous than in the compatible interactions *rz1*/WT and *Rz1*/resistant breaking (RB) isolates. *Collectively, these data suggest that sugar beet cultivars carrying the Rz1 allele altered the genetic structure of BNYVV in a way that promoted the generation and selection of RB variants. Furthermore, if high genetic diversity is the norm for avirulent isolates recovered from Rz1 cultivars, several different mechanisms for overcoming Rz1 resistance could emerge independently. In conclusion, we propose that resistance breaking isolates that evolve in different sugar beet production regions need be analyzed separately, instead of assuming that there is a unique cause of Rz1-mediated resistance breakdown*.

SMBSC – Weed control program with conventional products and Roundup

The following weed control research is a screening of herbicide applied alone and in combinations for the control of various weeds present in sugarbeet fields.

Methods

Weed control trials were established at two locations; Sacred Heart and Lake Lillian. Experiments were established in a randomized complete block design with 4 replications. A Roundup Ready sugarbeet variety was planted at both locations. Treatments were applied to the middle four rows of six row, 35 foot long plots. Herbicide treatments at Sacred Heart were evaluated for weed control efficacy and harvested to determine the treatment and weed control effect on sugarbeet production. The Lake Lillian location had very low weed pressure and was harvested in order to evaluate the herbicide treatments effect on yield. Herbicide treatments were applied at 14 gal/acre and 40 psi with a bicycle wheel sprayer. Table 1 and 2 show the specifics of tasks conducted at each site. Production practices, other than those specified in table, were conducted by the cooperator at the Lake Lillian location. All production practices at the Sacred Heart location were performed by SMBSC.

Table 1. Site specifics for Lake Lillian weed *control study*

Location - Lake Lillian

Exp: 0733

Task	Date	Notes	Harvest date
spray	5/2/2007	Preplant application	
plant	5/3/2007	RR variety BTS RZ01RR07	9/17/2007
spray	5/19/2007	2 lf post application	
spray	5/26/2007	4 lf post application	
spray	6/1/2007	6 lf post application	
spray	6/15/2007	10 lf post application	

Fungicides for cercospora leaf spot applied by cooperator

Table 2. Site specifics for Sacred Heart weed control ***study***

Location - Sacred Heart

Exp: 0732

Task	Date	Notes	Harvest date
spray	4/28/2007	Preplant application	
fert	4/26/2007		
plant	4/30/2007	RR variety BTS RZ01RR07	9/11/2007
spray	5/17/2007	2 lf post application	
spray	5/23/2007	4 lf post application	
spray	5/30/2007	6 lf post application	
spray	6/15/2007	10 lf post application	
spray	8/1/2007	Eminent	
spray	8/15/2007	Super tin	

Results and Discussion

1. Tables 3-5 show the data from the Lake Lillian location. The Lake Lillian location had a very low weed population. The discussion of the data for the Lake Lillian location will emphasize the influence of herbicides in the absence of weeds.

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2. Table 3 shows conventional herbicide treatment with no preemergence herbicides.
    a. There was a tendency for tons per acre to be lower with herbicides applied compared to where there were no herbicides applied (check).
    b. Sugar percent was generally significantly less in the check compared to where postemergence herbicides were applied.
    c. Extractable sucrose percent, revenue per acre and sugarbeet injury were similarly influenced by all treatments.

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3. Table 4 shows conventional herbicide treatment with preemergence herbicides.
    a. There was a tendency for tons per acre to be lower with herbicides applied compared to where there were no herbicides applied (check), except when no preplant herbicide was applied and Progress at 16oz.per acre was applied with Nortron at 4oz. per acre on 2 leaf sugarbeets and Progress was applied on 4lf. Sugarbeets at 22 oz. per acre with Nortron at 4 oz.per acre and Outlook at 21 oz. per acre.
    b. Extractable sugar per acre was influenced similarly by all treatments.
    c. Revenue per acre either was significantly greater or tended to be significantly greater than the other treatments when no preplant herbicide was applied and Progress at 16oz.per acre was applied with Nortron at 4oz. per acre on 2 leaf sugarbeets and Progress was applied on 4lf. sugarbeets at 22 oz. per acre with Nortron at 4 oz.per acre and Outlook at 21 oz. per acre or when Nortron was applied preplant at 120 oz (7.5 pt.) per acre with the mid-microrate applied at the 2 leaf and 4 leaf stage of sugarbeets..
    (mid-microrate = Progress @ 8.5oz. (2lf) 11.5oz. (4lf&6lf) + Upbeet @ 1/8oz + Stinger @ 1.3oz . + MSO @ 1.5%)

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4. Table 5 shows treatments with Roundup and other conventional herbicides.
   a. All treatments had Roundup and ammonium sulfate applied at 22 oz. per acre and 2% solution in three consecutive applications (4 leaf, 10 leaf, and canopy sugarbeet stage).
   b. The untreated check tended to give higher tons per acre than all other treatments except when Nortron was applied preplant.
   c. No true trend was noticed relative to sugar content.
   d. Norton applied preplant plus Roundup was the only treatment that gave significantly greater extractable sugar per acre and revenue per acre than the untreated check.

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5. Table 6-8 show data from the Sacred Heart location. The Sacred Heart had high lambsquarter and amaranthus species (Redroot pigweed, tall water hemp and palmer amaranth) pressure.
   a. Sugarbeet yield was significantly increased by all herbicide treatments.

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6. Table 6 shows herbicide treatment with no preemergence herbicides.
   a. All treatments gave significantly higher tons per acre (data shown), extractable sugar per acre and revenue per acre (data not shown).
   b. Lambsquarter control was significantly increased when the micro rate was applied at the midrate microrate compared to the regular rate microrate.
   c. Across all treatments, the higher the rate of Progress the higher the control of lambsquarter.
   d. Higher rates of Progress gave better control of amaranth weed species compared to lower rates with similar treatments.
   e. Adding Nortron in the postemergence spray mix tended to increase amaranth weed species control.
   f. Adding Nortron with Methylated Seed Oil (MSO) in the postemergence spray mix with the midrate microrate gave the best control of amaranth.
   g. Treatments with midrate microrate gave significantly higher grass (yellow and giant foxtail) control compared to all other treatments.

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7. Table 7 shows conventional herbicide treatment with preemergence herbicides.
   a. In general, weed control with Nortron applied preplant at 120 oz. per acre (7.5 pt. per acre) with the regular microrate applied postemergence was similar to midrate microrate applied postemergence following Nortron applied preemergence.
   b. Nortron applied preemergence tended to give higher weed control with regular or midrate microrate compared to conventional rates of postemergence herbicides.

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8. Table 5 shows treatments with Roundup and other conventional herbicides.
   a. Sugarbeets treated with Roundup gave similar yields compared to sugarbeets treated with conventional rates (Table 6, 7 and 8).
   b. Weed control was similar regardless of the conventional herbicide applied with Roundup.

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9. Table 9 shows the comparison of the best treatment from the three systems presented in this report. The three systems were conventional postemegence herbicide without preemergence herbicides, conventional postemegence herbicide with preemergence herbicides, and Roundup herbicide with and without conventional herbicides.

a. The data shows a trend for the sugarbeets treated with Roundup to yield 1-2 tons better than the sugarbeets treated with conventional herbicides.
b. The trend observed for a 1-2 ton increase with Roundup treated compared to conventional herbicide treated sugarbeets has been the norm in most tests conducted.
c. Weed control is similar for the treatments presented in table 9. One would assume that whether additional weed control, such as labor, would be needed should be similar for all treatments since the weed control was similar.

Table 3. SMBSC sugarbeet weed control program evaluation - Lake Lillian location
Exp # 0733

Application	Herbicide	Rate	Tons per acre	Sugar percent	Ext. Suc.per acre	Revenue per acre	Sugar beet injury	*Treatment cost*
	No ppi/pre							
2 leaf	Progress+Upbeet+Stinger+MSO	5.7+0.125+1.3+1.5%:	**29.23**	**15.16**	**7205**	**786.96**	**8**	**$39.63**
4 leaf	Progress+Upbeet+Stinger+MSO	5.7+0.125+1.3+1.5%:						
6 leaf	Progress+Upbeet+Stinger+MSO	5.7+0.125+1.3+1.5%:						
	No ppi/pre							
2 leaf	Progress+Upbeet+Stinger+MSO	8.5+0.125+1.3+1.5%:	**29.02**	**15.38**	**7285**	**810.06**	**8**	**$46.76**
4 leaf	Progress+Upbeet+Stinger+MSO	11.5+0.125+1.3+1.5%:						
6 leaf	Progress+Upbeet+Stinger+MSO	11.5+0.125+1.3+1.5%:						
	No ppi/pre							
2 leaf	Progress	16	**27.80**	**15.21**	**6809**	**739.11**	**11**	**$29.84**
4 leaf	Progress	22						
6 leaf	Progress	24						
	No ppi/pre							
2 leaf	Progress+Upbeet+Stinger+Nortron+MSO	5.7+0.125+1.3+4+1.5%:	**27.14**	**15.32**	**6759**	**745.73**	**13**	**$45.98**
4 leaf	Progress+Upbeet+Stinger+Nortron+MSO	5.7+0.125+1.3+4+1.5%:						
6 leaf	Progress+Upbeet+Stinger+Nortron+MSO	5.7+0.125+1.3+4+1.5%:						
	No ppi/pre							
2 leaf	Progress+Upbeet+Stinger+Nortron+MSO	8.5+0.125+1.3+4+1.5%:	**27.06**	**15.34**	**6856**	**769.07**	**13**	**$52.91**
4 leaf	Progress+Upbeet+Stinger+Nortron+MSO	11.5+0.125+1.3+4+1.5%:						
6 leaf	Progress+Upbeet+Stinger+Nortron+MSO	11.5+0.125+1.3+4+1.5%:						
	No ppi/pre							
2 leaf	Progress+Nortron	16+4	**26.77**	**15.60**	**6804**	**765.60**	**13**	**$35.99**
4 leaf	Progress+Nortron	22+4						
6 leaf	Progress+Nortron	24+4						
	Check		**30.24**	**14.73**	**7057**	**727.52**	**1**	**N/A**
		C.V.%	15.28	2.99	15.72	17.38	91.53	
		LSD (0.05)	4.38	0.45	1101	131.83	5	

Table 4. SMBSC sugarbeet weed control program evaluation - Lake Lillian location
Exp # 0733

Application	Herbicide	Rate	Tons per acre	Sugar percent	Ext. Suc.per acre	Revenue per acre	Sugar beet injury	*Treatment cost*
pre	Nortron (pre)	120	**25.29**	**15.55**	**6428**	**723.48**	**8**	**$88.05**
2 leaf	Progress+Upbeet+Stinger+MSO	5.7+0.125+1.3+1.5%:						
4 leaf	Progress+Upbeet+Stinger+MSO	5.7+0.125+1.3+1.5%:						
pre	Nortron (pre)	120	**29.07**	**15.37**	**7250**	**801.19**	**13**	**$94.31**
2 leaf	Progress+Upbeet+Stinger+MSO	8.5+0.125+1.3+1.5%:						
4 leaf	Progress+Upbeet+Stinger+MSO	11.5+0.125+1.3+1.5%:						
pre	Nortron (pre)	120	**29.51**	**15.03**	**7163**	**770.35**	**10**	**$79.79**
2 leaf	Progress	16						
4 leaf	Progress	22						
pre	Nortron (pre)	120	**28.75**	**15.26**	**7178**	**793.90**	**5**	**$118.46**
2 leaf	Progress+Upbeet+Stinger+Nortron+MSO	5.7+0.125+1.3+4+1.5%:						
4 leaf	Progress+Upbeet+Stinger+Nortron+MSO	5.7+0.125+1.3+4+1.5%:						
pre	Nortron (pre)	120	**28.19**	**14.45**	**6430**	**645.53**	**8**	**$96.29**
2 leaf	Progress+Upbeet+Stinger+Nortron+MSO	8.5+0.125+1.3+4+1.5%:						
4 leaf	Progress+Upbeet+Stinger+Nortron+MSO	11.5+0.125+1.3+4+1.5%:						
pre	Nortron (pre)	120	**28.03**	**15.11**	**6813**	**733.67**	**13**	**$83.89**
2 leaf	Progress+Nortron	16+4						
4 leaf	Progress+Nortron	22+4						
pre	Nortron (pre)	120	**29.31**	**14.77**	**6939**	**726.61**	**6**	**$97.89**
2 leaf	Progress+Nortron	16+4						
4 leaf	Progress+Nortron+Outlook	22+4+21						
	No ppi/pre		**31.45**	**14.95**	**7528**	**797.52**	**9**	**$36.39**
2 leaf	Progress+Nortron	16+4						
4 leaf	Progress+Nortron+Outlook	22+4+21						
	Check		**30.24**	**14.73**	**7057**	**727.52**	**1**	**N/A**
		C.V.%	15.28	2.99	15.72	17.38	91.53	
		LSD (0.05)	4.38	0.45	1101	131.83	5	

Table 5. SMBSC sugarbeet weed control program evaluation - Lake Lillian location
Exp # 0733

Application	Herbicide	Rate	Tons per acre	Sugar percent	Ext. Suc.per acre	Revenue per acre	Sugar beet injury	*Treatment cost*
	No ppi/pre		**28.89**	**15.38**	**7212**	**797.65**	**0**	**$80.35**
4 leaf	Roundup Original Max+AMS	22+2%						
10 leaf	Roundup Original Max+AMS	22+2%						
canopy	Roundup Original Max+AMS	22+2%						
	No ppi/pre		**27.59**	**15.14**	**6833**	**749.86**	**5**	**$81.35**
4 leaf	Roundup Original Max+AMS+NIS	22+2%+.25%						
10 leaf	Roundup Original Max+AMS+NIS	22+2%+.25%						
canopy	Roundup Original Max+AMS+NIS	22+2%+.25%						
	No ppi/pre		**28.64**	**14.95**	**6868**	**729.27**	**3**	**$92.35**
4 leaf	Roundup Original Max+AMS	22+2%						
10 leaf	Roundup Original Max+AMS+Outlook	22+2%+18						
canopy	Roundup Original Max+AMS	22+2%						
	No ppi/pre		**29.76**	**15.12**	**7220**	**775.92**	**0**	**$90.79**
4 leaf	Roundup Original Max+AMS+Stinger	22+2%+4						
10 leaf	Roundup Original Max+AMS	22+2%						
canopy	Roundup Original Max+AMS	22+2%						
	No ppi/pre		**29.42**	**15.03**	**7115**	**762.06**	**1**	**$92.35**
4 leaf	Roundup Original Max+AMS+Outlook	22+2%+18						
10 leaf	Roundup Original Max+AMS	22+2%						
canopy	Roundup Original Max+AMS	22+2%						
	No ppi/pre		**29.42**	**15.05**	**7193**	**779.11**	**3**	**$83.45**
4 leaf	Roundup Original Max+AMS+SelectMt	22+2%+						
10 leaf	Roundup Original Max+AMS	22+2%						
canopy	Roundup Original Max+AMS	22+2%						
pre	Nortron (pre)	120	**33.99**	**14.95**	**8166**	**868.44**	**1**	**$141.85**
4 leaf	Roundup Original Max+AMS	22+2%						
10 leaf	Roundup Original Max+AMS	22+2%						
canopy	Roundup Original Max+AMS	22+2%						
	No ppi/pre		**29.33**	**15.53**	**7451**	**838.08**	**1**	**$71.98**
4 leaf	Roundup Original Max+AMS	22+2%						
10 leaf	Roundup Original Max+AMS+Upbeet	22+2%+.25						
canopy	Roundup Original Max+AMS	22+2%						
pre	Nortron (pre)	96	**28.14**	**15.36**	**7064**	**785.33**	**1**	**$70.50**
4 leaf	Roundup Original Max+AMS	22+2%						
10 leaf	Roundup Original Max+AMS+Nortron	22+2%+32						
canopy	Roundup Original Max+AMS	22+2%						
	Check		**30.24**	**14.73**	**7057**	**727.52**	**1**	**N/A**
		C.V.%	15.28	2.99	15.72	17.38	91.53	
		LSD (0.05)	4.38	0.45	1101	131.83	5	

Table 6. SMBSC sugarbeet weed control program evaluation-Sacred Heart location
Exp. 0732

Application	Herbicide	Rate oz/acre	Tons /acre	Sug.beet injury	Lambs Quarter weed control	Amaranth weed control	Grass weed control	*Treatment cost*
2 leaf	Progress+Upbeet+Stinger+MSO	5.7+0.125+1.3+1.5%:	**16.03**	**9**	**75**	**82**	**83**	**$39.63**
4 leaf	Progress+Upbeet+Stinger+MSO	5.7+0.125+1.3+1.5%:						
6 leaf	Progress+Upbeet+Stinger+MSO	5.7+0.125+1.3+1.5%:						
	No ppi/pre							
2 leaf	Progress+Upbeet+Stinger+MSO	8.5+0.125+1.3+1.5%:	**16.08**	**8**	**86**	**86**	**92**	**$46.76**
4 leaf	Progress+Upbeet+Stinger+MSO	11.5+0.125+1.3+1.5%:						
6 leaf	Progress+Upbeet+Stinger+MSO	11.5+0.125+1.3+1.5%:						
	No ppi/pre							
2 leaf	Progress	16	**17.30**	**3**	**84**	**74**	**77**	**$29.84**
4 leaf	Progress	22						
6 leaf	Progress	24						
	No ppi/pre							
2 leaf	Progress+Upbeet+Stinger+Nortron+MSO	5.7+0.125+1.3+4+1.5%:	**15.11**	**5**	**67**	**65**	**67**	**$45.98**
4 leaf	Progress+Upbeet+Stinger+Nortron+MSO	5.7+0.125+1.3+4+1.5%:						
6 leaf	Progress+Upbeet+Stinger+Nortron+MSO	5.7+0.125+1.3+4+1.5%:						
	No ppi/pre							
2 leaf	Progress+Upbeet+Stinger+Nortron+MSO	8.5+0.125+1.3+4+1.5%:	**16.45**	**9**	**92**	**95**	**96**	**$52.91**
4 leaf	Progress+Upbeet+Stinger+Nortron+MSO	11.5+0.125+1.3+4+1.5%:						
6 leaf	Progress+Upbeet+Stinger+Nortron+MSO	11.5+0.125+1.3+4+1.5%:						
	No ppi/pre							
2 leaf	Progress+Nortron	16+4	**17.13**	**6**	**88**	**71**	**76**	**$35.99**
4 leaf	Progress+Nortron	22+4						
6 leaf	Progress+Nortron	24+4						
	Check		**4.29**	**0**	**0**	**0**	**0**	**N/A**
		CV%	5.27	124	7.67	10.02	10	
		LSD (0.05)	1.20	5	9	12	13	

Table 7. SMBSC sugarbeet weed control program evaluation-Sacred Heart location
Exp. 0732

Application	Herbicide	Rate oz/acre	Tons /acre	Sug.beet injury	Lambs Quarter weed control	Amaranth weed control	Gass weed control	*Treatment cost*
2 leaf	Nortron (pre)	120	**16.79**	**9**	**86**	**90**	**76**	**$88.05**
4 leaf	Progress+Upbeet+Stinger+MSO	5.7+0.125+1.3+1.5%:						
6 leaf	Progress+Upbeet+Stinger+MSO	5.7+0.125+1.3+1.5%:						
pre	Nortron (pre)	120	**15.60**	**5**	**83**	**91**	**87**	**$94.31**
2 leaf	Progress+Upbeet+Stinger+MSO	8.5+0.125+1.3+1.5%:						
4 leaf	Progress+Upbeet+Stinger+MSO	11.5+0.125+1.3+1.5%:						
pre	Nortron (pre)	120	**17.35**	**4**	**75**	**71**	**68**	**$79.79**
2 leaf	Progress	16						
4 leaf	Progress	22						
pre	Nortron (pre)	120	**15.97**	**4**	**85**	**96**	**94**	**$118.46**
2 leaf	Progress+Upbeet+Stinger+Nortron+MSO	5.7+0.125+1.3+4+1.5%:						
4 leaf	Progress+Upbeet+Stinger+Nortron+MSO	5.7+0.125+1.3+4+1.5%:						
pre	Nortron (pre)	120	**15.40**	**6**	**83**	**95**	**91**	**$96.29**
2 leaf	Progress+Upbeet+Stinger+Nortron+MSO	8.5+0.125+1.3+4+1.5%:						
4 leaf	Progress+Upbeet+Stinger+Nortron+MSO	11.5+0.125+1.3+4+1.5%:						
pre	Nortron (pre)	120	**15.42**	**5**	**83**	**93**	**85**	**$83.89**
2 leaf	Progress+Nortron	16+4						
4 leaf	Progress+Nortron	22+4						
pre	Nortron (pre)	120	**16.23**	**6**	**87**	**94**	**92**	**$97.89**
2 leaf	Progress+Nortron	16+4						
4 leaf	Progress+Nortron+Outlook	22+4+21						
	No ppi/pre							
2 leaf	Progress+Nortron	16+4	**15.78**	**4**	**80**	**78**	**76**	**$36.39**
4 leaf	Progress+Nortron+Outlook	22+4+21						
	Check		**4.29**	**0**	**0**	**0**	**0**	**N/A**
		CV%	5.27	124	7.67	10.02	10	
		LSD (0.05)	1.20	5	9	12	13	

Table 8. SMBSC sugarbeet weed control program evaluation-Sacred Heart location
Exp. 0732

Application	Herbicide	Rate oz/acre	Tons /acre	Sug.beet injury	Lambs Quarter weed control	Amaranth weed control	Grass weed control	*Treatment cost*
	No ppi/pre							
4 leaf	Roundup Original Max+AMS	22+2%	16.16	1	94	96	99	$80.35
10 leaf	Roundup Original Max+AMS	22+2%						
canopy	Roundup Original Max+AMS	22+2%						
	No ppi/pre							
4 leaf	Roundup Original Max+AMS+NIS	22+2%+.25%	17.11	0	96	94	99	$81.35
10 leaf	Roundup Original Max+AMS+NIS	22+2%+.25%						
canopy	Roundup Original Max+AMS+NIS	22+2%+.25%						
	No ppi/pre							
4 leaf	Roundup Original Max+AMS	22+2%	17.46	0	99	99	99	$92.35
10 leaf	Roundup Original Max+AMS+Outlook	22+2%+18						
canopy	Roundup Original Max+AMS	22+2%						
	No ppi/pre							
4 leaf	Roundup Original Max+AMS+Stinger	22+2%+4	16.92	0	97	98	99	$90.79
10 leaf	Roundup Original Max+AMS	22+2%						
canopy	Roundup Original Max+AMS	22+2%						
	No ppi/pre							
4 leaf	Roundup Original Max+AMS+Outlook	22+2%+18	16.81	0	97	99	99	$92.35
10 leaf	Roundup Original Max+AMS	22+2%						
canopy	Roundup Original Max+AMS	22+2%						
	No ppi/pre							
4 leaf	Roundup Original Max+AMS+SelectMt	22+2%+	16.64	0	92	94	99	$83.45
10 leaf	Roundup Original Max+AMS	22+2%						
canopy	Roundup Original Max+AMS	22+2%						
pre	Nortron (pre)	120						
4 leaf	Roundup Original Max+AMS	22+2%	16.80	0	97	99	99	$141.85
10 leaf	Roundup Original Max+AMS	22+2%						
canopy	Roundup Original Max+AMS	22+2%						
	No ppi/pre							
4 leaf	Roundup Original Max+AMS	22+2%	17.55	1	88	92	99	$71.98
10 leaf	Roundup Original Max+AMS+Upbeet	22+2%+.25						
canopy	Roundup Original Max+AMS	22+2%						
pre	Nortron (pre)	96	17.46	1	94	97	99	$70.50
4 leaf	Roundup Original Max+AMS	22+2%						
10 leaf	Roundup Original Max+AMS+Nortron	22+2%+32						
canopy	Roundup Original Max+AMS	22+2%						
	Check		4.29	0	0	0	0	N/A
		CV%	5.27	124	7.67	10.02	10	
		LSD (0.05)	1.20	5	9	12	13	

Table 9. SMBSC sugarbeet weed control system comparison-Sacred Heart location
Exp. 0732

Application	Herbicide	Rate oz/acre	Tons /acre	Sug.beet injury	Lambs Quarter weed control	Amaranth weed control	Grass weed control	*Treatment cost*
	No ppi/pre							
2 leaf	Progress+Upbeet+Stinger+Nortron+MSO	8.5+0.125+1.3+4+1.5%:	**16.45**	**9**	**92**	**95**	**96**	**$52.91**
4 leaf	Progress+Upbeet+Stinger+Nortron+MSO	11.5+0.125+1.3+4+1.5%:						
6 leaf	Progress+Upbeet+Stinger+Nortron+MSO	11.5+0.125+1.3+4+1.5%:						
pre	Nortron (pre)	120	**15.40**	**6**	**83**	**95**	**91**	**$96.29**
2 leaf	Progress+Upbeet+Stinger+Nortron+MSO	8.5+0.125+1.3+4+1.5%:						
4 leaf	Progress+Upbeet+Stinger+Nortron+MSO	11.5+0.125+1.3+4+1.5%:						
	No ppi/pre							
4 leaf	Roundup Original Max+AMS	22+2%	**17.46**	**0**	**99**	**99**	**99**	**$92.35**
10 leaf	Roundup Original Max+AMS+Outlook	22+2%+18						
canopy	Roundup Original Max+AMS	22+2%						
	Check		**4.29**	**0**	**0**	**0**	**0**	**N/A**
		CV%	5.27	124	7.67	10.02	10	
		LSD (0.05)	1.20	5	9	12	13	

Sugarbeet herbicides, Milan, 2007.

Aaron Carlson, NDSU

(Dexter) 'Beta RZ02RR07' sugarbeet was seeded 1.25 inches deep in 22-inch rows April 27. Counter 15G insecticide at 12 pounds product per acre was applied modified in-furrow at planting. Preemerge ethofumesate was applied April 27 after planting. Postemergence treatments were applied May 8, May 15, May 29, and June 1. All treatments were applied in 17 gpa water at 40 psi through 8002 nozzles to the center four rows of six-row by 30-foot long plots. Sugarbeet injury and tear-thumb, velvet leaf, and waterhemp control were evaluated June 11 and June 19. Tear-thumb (Teth) is a smartweed with thorns on the stems.

Date of Application	April 27	May 8	May 15	May 22	June 1
Time of Day	1:00 PM	11:30 AM	12:15 PM	10:30 AM	1:30 PM
Air Temperature (^{o}F)	71	67	60	74	63
Relative Humidity (%)	32	46	29	47	60
Soil Temp. (^{o}F at 6")	54	57	63	66	62
Wind Velocity (mph)	13	4	13	20	5
Cloud Cover (%)	10	10	50	100	100
Soil Moisture	Good	Good	Good	Good	Good
Sugarbeet	preemerge	Cot	Cot-V1.5	V2.1-4.1	V4.8-5.8
Velvetleaf	---	Cot	Cot-2 lf	1-3 lf	2-4lf(1-4")
Tear-thumb (Smartweed)	---	Cot	2-4 lf	3-6 lf	2-5"
Redroot Pigweed	---	Cot	Cot-2 lf	2-4 lf	2-8lf(1/2-4")

Treatment*	Date of Application	Rate	June 11 Sgbt inj	June 11 Velf cntl	June 11 Teth cntl	June 11 Wahe cntl	June 19 Sgbt inj	June 19 Velf cntl	June 19 Teth cntl	June 19 Wahe cntl
		(lb/A)	%	%	%	%	%	%	%	%
De&Ph&Et+Tfsu+Clpy+CletM+MSO	(May 8, 15, 22, June 1)	0.08+0.004+0.03+0.03+1.5%	18	92	91	83	10	89	86	64
De&Ph&Et+Tfsu+Clpy+CletM+MSO	(May 8,15)	0.12+0.004+0.03+0.03+1.5%								
De&Ph&Et+Tfsu+Clpy+CletM+MSO	(May 22)	0.16+0.004+0.03+0.03+1.5%								
De&Ph&Et+Tfsu+Clpy+CletM+MSO	(June 1)	0.22+0.004+0.03+0.03+1.5%	23	92	92	91	14	89	89	76
De&Ph&Et+Tfsu+Clpy+CletM	(May 8)	0.25+0.008+0.06+0.03								
De&Ph&Et+Tfsu+Clpy+CletM	(May 15, 22)	0.33+0.008+0.06+0.03								
De&Ph&Et+Tfsu+Clpy+CletM	(June 1)	0.5+0.008+0.06+0.03	29	87	95	99	23	81	92	99
De&Ph&Et+Tfsu+Clpy+CletM+MSO+Etho	(May 8, 15, 22, June 1)	0.08+.004+.03+.03+1.5%+.094	13	94	93	88	9	90	90	73
Ethofumesate(Pre)	(April 27)	3.75								
Desm&Phen&Etho	(May 8)	0.25								
Desm&Phen&Etho	(May 15, 22)	0.33								
Desm&Phen&Etho	(June 1)	0.5	11	48	94	99	0	46	97	99
Glyt+Premier90+AMS	(May 15, June 1)	1+0.25%+1.7	0	94	94	98	0	90	94	94
Glyt+Premier90+AMS	(May 8,15,22, June 1)	1+0.25%+1.7	0	97	98	98	0	93	96	94
Glyt+Premier90+AMS	(May 8)	1+0.25%+1.7	0	5	5	0	0	0	0	0
Glyt+Premier90+AMS	(May 15)	1+0.25%+1.7	0	69	74	95	0	60	54	85
Glyt+Premier90+AMS	(May 22)	1+0.25%+1.7	0	93	92	97	0	90	89	89

Glyt+Premier90+AMS	(June 1)	1+0.25%+1.7	0	64	35	91	0	81	64	94

Table continued on next page.

Sugarbeet Herbicides, Milan, 2007. (continued)

Treatment*	Date of Application	Rate	June 11 Sgbt inj	June 11 Velf cntl	June 11 Teth cntl	June 11 Wahe cntl	June 19 Sgbt inj	June 19 Velf cntl	June 19 Teth cntl	June 19 Wahe cntl
		(lb/A)	%	%	%	%	%	%	%	%
Glyt+Premier90+AMS+Tfsu	(May 15,June 1)	1+0.25%+1.7+0.008	1	97	95	99	0	95	95	97
Glyt+P90+AMS+Tfsu	(May 15, June 1)	1+0.25%+1.7+0.032	3	97	95	99	3	96	96	99
Glyt+Premier90+AMS+Flumiclorac	(May 15)	1+0.25%+1.7+0.015								
Glyt+Premier90+AMS	(June 1)	1+0.25%+1.7	91	94	93	97	79	92	90	94
Glyt+Premier90+AMS+Clpy	(May 22)	1+0.25%+1.7+0.03								
Glyt+Premier90+AMS	(June 1)	1+0.25%+1.7	4	94	95	98	0	92	96	93
Glyt+Premier90+AMS+Clpy	(May 22)	1+0.25%+1.7+0.06								
Glyt+Premier90+AMS	(June 1)	1+0.25%+1.7	4	95	93	98	0	93	98	95
Glyt+Premier90+AMS+CletM	(May 15)	1+0.25%+1.7+0.09								
Glyt+Premier90+AMS	(June 1)	1+0.25%+1.7	0	91	89	97	0	88	76	91
Glyt+Premier90+AMS+Etho	(May 8)	1+0.25%+1.7+3.75								
Glyt+Premier90+AMS	(June 1)	1+0.25%+1.7	4	83	80	74	0	83	70	51
Ethofumesate (Pre)	(April 27)	3.75								
Glyt+Premier90+AMS	(May 15, June 1)	1+0.25%+1.7	1	89	93	99	0	88	92	99
EXP MEAN			11	83	84	89	7	81	82	83
C.V. %			30	7	7	4	62	8	11	8
LSD 5%			5	9	9	4	6	9	13	9
LSD 1%			6	12	11	6	8	12	18	12
# OF REPS			4	4	4	4	4	4	4	4

* Premier 90=non-ionic surfactant from West Central; MSO=methylated seed oil from Loveland; AMS=Am-Stik liquid ammonium sulfate from West Central.

Combined Evaluations

Treatment*	Date of Application	Rate	Sgbt inj	Velf cntl	Teth cntl	Wahe cntl
		(lb/A)	%	%	%	%
De&Ph&Et+Tfsu+Clpy+CletM+MSO	(May 8, 15, 22, June 1)	0.08+0.004+0.03+0.03+1.5%	14	91	89	73
De&Ph&Et+Tfsu+Clpy+CletM+MSO	(May 8,15)	0.12+0.004+0.03+0.03+1.5%				
De&Ph&Et+Tfsu+Clpy+CletM+MSO	(May 22)	0.16+0.004+0.03+0.03+1.5%				
De&Ph&Et+Tfsu+Clpy+CletM+MSO	(June 1)					

		0.22+0.004+0.03+0.03+1.5%	18	91	90	83

Table continued on next page.

Sugarbeet Herbicides, Milan, 2007. (continued)

Combined Evaluations (continued)

Treatment*	Date of Application	Rate	Sgbt inj	Velf cntl	Teth cntl	Wahe cntl
		(lb/A)				
De&Ph&Et+Tfsu+Clpy+CletM	(May 8)	0.25+0.008+0.06+0.03				
De&Ph&Et+Tfsu+Clpy+CletM	(May 15, 22)	0.33+0.008+0.06+0.03				
De&Ph&Et+Tfsu+Clpy+CletM	(June 1)	0.5+0.008+0.06+0.03	26	84	94	99
De&Ph&Et+Tfsu+Clpy+CletM+MSO+Etho	(May 8, 15, 22, June 1)	0.08+.004+.03+.03+1.5%+.094	11	92	92	80
Ethofumesate(Pre)	(April 27)	3.75				
Desm&Phen&Etho	(May 8)	0.25				
Desm&Phen&Etho	(May 15, 22)	0.33				
Desm&Phen&Etho	(June 1)	0.5	6	47	96	99
Glyt+Premier90+AMS	(May 15, June 1)	1+0.25%+1.7	0	92	94	96
Glyt+Premier90+AMS	(May 8,15,22, June 1)	1+0.25%+1.7	0	95	97	96
Glyt+Premier90+AMS	(May 8)	1+0.25%+1.7	0	3	3	0
Glyt+Premier90+AMS	(May 15)	1+0.25%+1.7	0	64	64	90
Glyt+Premier90+AMS	(May 22)	1+0.25%+1.7	0	91	91	93
Glyt+Premier90+AMS	(June 1)	1+0.25%+1.7	0	72	50	92
Glyt+Premier90+AMS+Tfsu	(May 15,June 1)	1+0.25%+1.7+0.008	1	96	95	98
Glyt+P90+AMS+Tfsu	(May 15, June 1)	1+0.25%+1.7+0.032	3	96	96	99
Glyt+Premier90+AMS+Flumiclorac	(May 15)	1+0.25%+1.7+0.015				
Glyt+Premier90+AMS	(June 1)	1+0.25%+1.7	85	93	91	95
Glyt+Premier90+AMS+Clpy	(May 22)	1+0.25%+1.7+0.03				
Glyt+Premier90+AMS	(June 1)	1+0.25%+1.7	2	93	95	95
Glyt+Premier90+AMS+Clpy	(May 22)	1+0.25%+1.7+0.06				
Glyt+Premier90+AMS	(June 1)	1+0.25%+1.7	2	94	95	96
Glyt+Premier90+AMS+CletM	(May 15)	1+0.25%+1.7+0.09				
Glyt+Premier90+AMS	(June 1)	1+0.25%+1.7	0	89	83	94
Glyt+Premier90+AMS+Etho	(May 8)	1+0.25%+1.7+3.75				
Glyt+Premier90+AMS	(June 1)	1+0.25%+1.7	2	83	75	63
Ethofumesate (Pre)	(April 27)	3.75				
Glyt+Premier90+AMS	(May 15, June 1)	1+0.25%+1.7	1	88	92	99
EXP MEAN			9	82	83	86
C.V. %			48	6	11	7
LSD 5%			4	6	9	6
LSD 1%			6	8	12	8
# OF REPS			8	8	8	8

* Premier 90=non-ionic surfactant from West Central; MSO=methylated seed oil from Loveland; AMS=Am-Stik liquid ammonium sulfate from West Central.

SUMMARY: Weed control with glyphosate was generally less at Milan than at other locations. Triflusulfuron added to glyphosate tended to improve weed control compared to glyphosate used alone. Weed control with glyphosate applied once on June 1 was poor compared to glyphosate applied once on May 22. Rainfall started during the last few treatments on June 1, and rain shortly after application probably washed off some of the glyphosate. Velvetleaf and tear-thumb control was affected more than waterhemp control. Glyphosate caused less sugarbeet injury than conventional treatments. Flumiclorac caused severe sugarbeet injury. The micro-rate and mid-rate treatments which included MSO gave better velvetleaf control than the conventional rate without MSO. The conventional rate gave better control of waterhemp than the micro-rate or mid-rate. PRE ethofumesate followed by POST desm&phen&etho gave poor velvetleaf control but good control of tear-thumb and waterhemp.