# Effective and Economic Management of Cercospora Leaf Spot and Targeting 35 Tons/Acre

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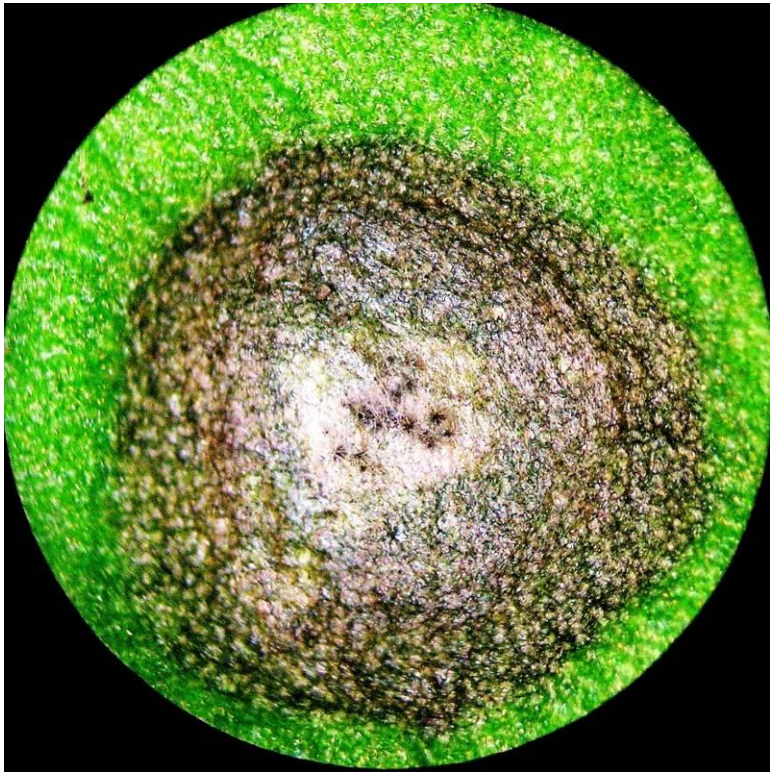
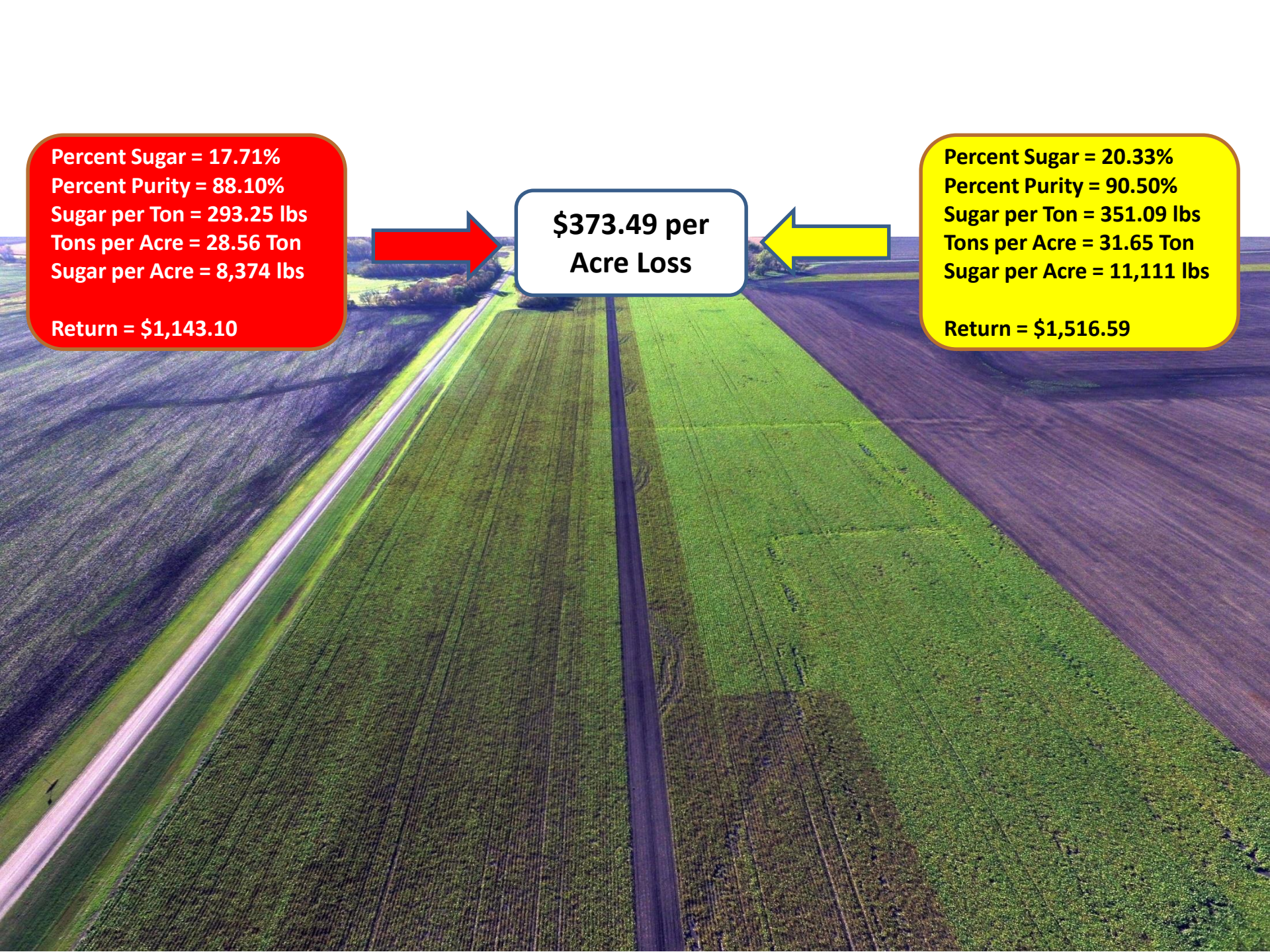
# Congratulations NDSU!

# Cercospora Leaf Spot - Symptoms

- **Fungus – *Cercospora beticola***
- **Circular spots on leaves – 1/8 to 3/16” diameter on largest, most productive leaves first**



# Death of Leaves Reduce Photosynthetic Capacity of Plants – Reduced Tonnage and Sucrose Concentration


Percent Sugar = 17.71%
Percent Purity = 88.10%
Sugar per Ton = 293.25 lbs
Tons per Acre = 28.56 Ton
Sugar per Acre = 8,374 lbs
Return = $1,143.10
$373.49 per Acre Loss
Percent Sugar = 20.33%
Percent Purity = 90.50%
Sugar per Ton = 351.09 lbs
Tons per Acre = 31.65 Ton
Sugar per Acre = 11,111 lbs
Return = $1,516.59

# Grower's Field in 2016 – 5 Fungicide Applications

# Fields With Fungicide Failures

Real time PCR was used for detection of G143A mutation in *Cytb* gene, which is found in the QoI-resistant *Cercospora beticola* isolates, but not in the QoI-sensitive isolates. Two specific probes were used (Sensitive-specific probe 6FAM-TGAG[G]TGCAACTGTTATTACTAA-BHQ-1 and G143A-specific probe HEX-TGAG[C]TGCAACTGTTATTACTAA-BHQ-1).

| | Ct value | |
|---|---|---|
| Isolate | Sensitive (FAM) | Resistant (HEX) |
| 38-1 | N/A | 15.2 |
| 38-2 | N/A | 15.7 |
| 38-3 | N/A | 13.9 |
| 38-4 | N/A | 17.5 |
| 39 | N/A | 37.8 |
| 42 | N/A | 14.8 |
| 43 | N/A | 17 |
| 194 (Resistant control) | N/A | 14.1 |
| 351 (Sensitive control) | 15.2 | N/A |
| Water control | N/A | N/A |


# Foxhome, MN
# Plot Tour
# August 29, 2017

# Foxhome, MN 2017 – Planted 5/5; Inoculated 6/29; Fungicides – 7/19, 31; 8/7, 21, 9/6

# Effect of Individual Fungicides and Mixtures at Controlling CLS in 2017

**Non-Treated Check August 29 and September 15**

**QoI A + SDHI**
**Priaxor**

**QoI B - Gem**

**QoI C - Pyrac**

**QoI A + SDHI**
**Priaxor**

**QoI B - Gem**

**QoI C - Pyrac**

# Headline 9 fl oz / Inspire XT 7 fl oz / Headline 9 fl oz/ Proline 5 fl oz + NIS

**Minerva 4x**

**Inspire XT 4x**

**Topguard 4x**

# Efficacy of Fungicides at Controlling *Cercospora beticola* Resistant to QoI Fungicides

| *Treatments @ 14 d* | *CLS* | *ton/Ac* | *S%* | *RSA (lb/Ac)* |
|---|---|---|---|---|
| **Nontreated Check** | **10.0** | **26** | **15.6** | **8,099** |
| **TPTH (Tin)** | **5.0** | **33** | **17.0** | **10,417** |
| **Proline + NIS** | **5.8** | **34** | **17.0** | **10,628** |
| ***Proline + NIS + TPTH*** | ***4.5*** | ***35*** | ***17.9*** | ***11,837*** |
| **Inspire XT** | **8.3** | **34** | **16.9** | **10,377** |
| ***Inspire XT + TPTH*** | ***4.8*** | ***35*** | ***17.4*** | ***11,348*** |
| **Minerva** | **9.3** | **31** | **16.2** | **9,3047** |
| ***Minerva Duo*** | ***4.8*** | ***35*** | ***17.6*** | ***11,809*** |
| **LSD (0.05)** | **0.6** | **3.1** | **1.0** | **1,203** |

**CLS 1-10 scale (1=No CLS; 10=regrowth)**

**S%= sugar concentration**

# [TPTH (Triphenyltin hydroxide –Tin) 8 fl oz] 4x

**(Proline 5 fl oz + NIS) 4x**

**(Proline 3.8 oz + TPTH 6 oz) 4x**

**Proline 4x**

**(Proline + TPTH) 4x**

← Inspire XT 7 fl oz 4x

(Inspire XT + TPTH) 4x ↓

← **Minerva 13 fl oz - 4x**

**Minerva Duo - 4x**

↓

# Badge SC – Copper (2016 [3x] vs 2017 [4x])

2016 3x

2017 4x

# Badge SC 3 pt + Inspire XT 5.3  fl oz

# Manzate 2.4 pt + Proline 3.8 fl oz + 0.125 % NIS

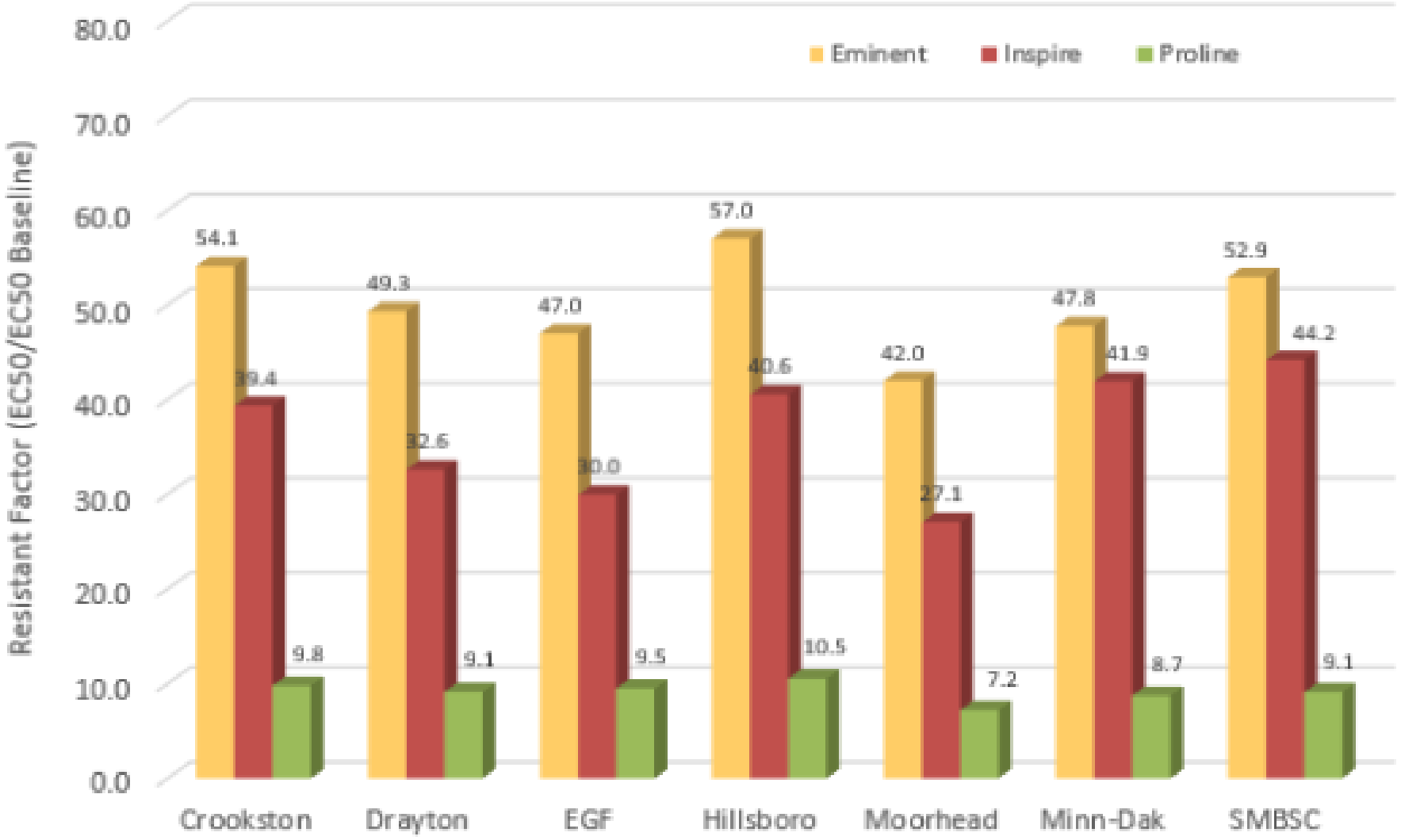
**(Minerva Duo 16 fl oz + <u>Badge</u> SC 4 pt) 4x**

**(Minerva Duo 16 fl oz + <u>Manzate</u> 1.6 qt) 4x**

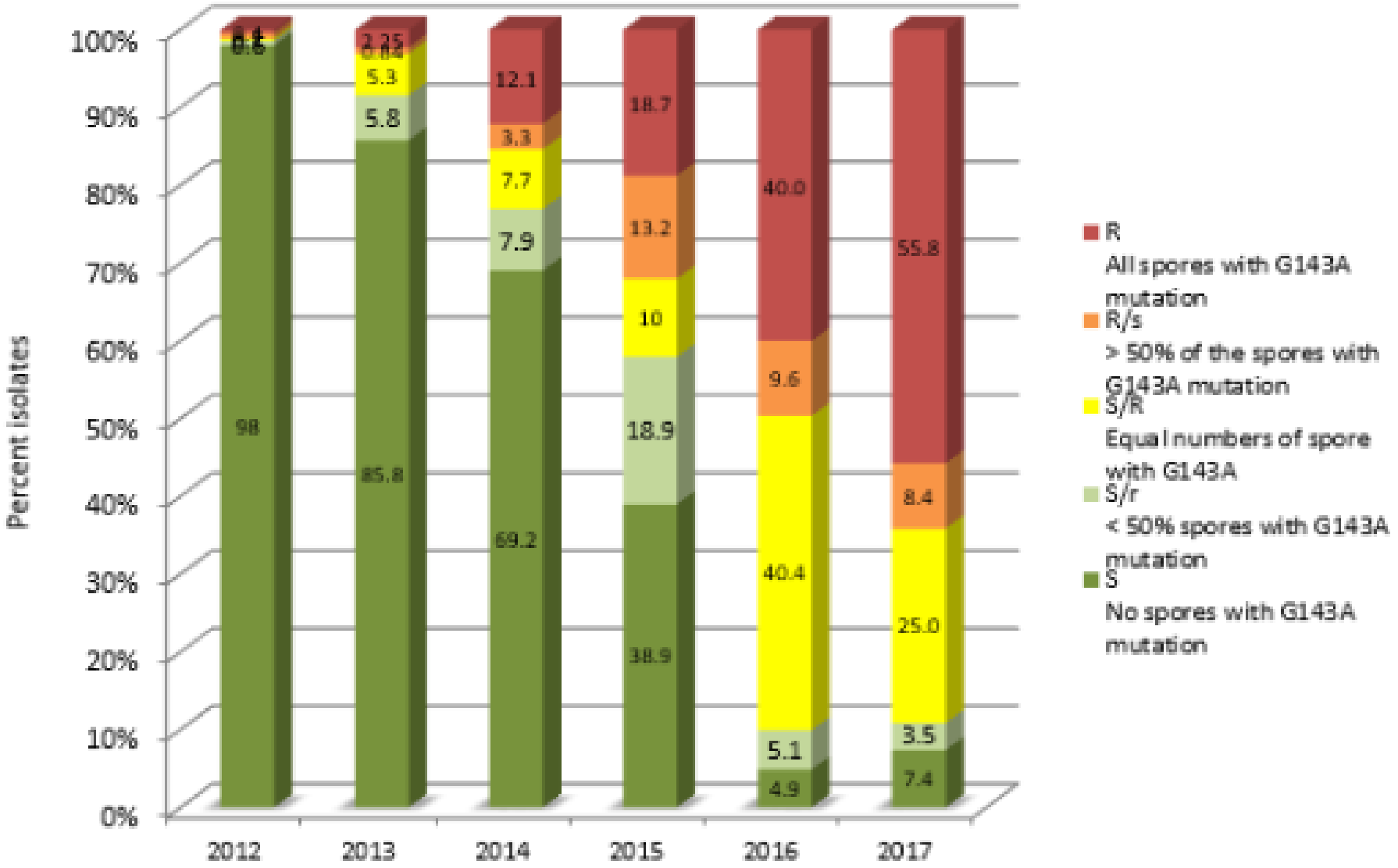
← ManKocide 4.3 lb/Ac 4x

(TPTH 6 oz + Topsin 10 oz) 4x

# Sensitivity of *C. beticola* isolates collected in 2017 to Eminent, Inspire and Proline by factory district as expressed by Resistance Factor Values – Secor et al.



# Sensitivity of *C. beticola* isolates collected in ND and MN to Headline from 2012 to 2017 as expressed by the percentage of spores with G143A mutation



# Summary – Fungicides Used Alone and in mixtures

- **Cercopora population is still resistant to QoI (or strobilurin) fungicides (Priaxor, Gem, Headline).**
- **Cercospora population is developing resistance to other fungicides (triazoles, TPTH, Topsin).**
- **It is best to use mixtures of fungicides for each application.**
- **Always mix triazoles (and strobilurins) with a broad spectrum fungicide (Mancozeb, Copper, TPTH, Mankocide).**

# Use of Fungicides in a Rotation Program for Controlling CLS in 2017

# Non-Treated Check – August 29, 2017

**1. Inspire XT + Topsin / 2. TPTH + Manzate / 3. Minerva Duo/ 4.TPTH + Manzate /5. (Proline + Manzate)**

**No Application 5.**

**Minerva Duo/ TPTH + Manzate / Priaxor + Manzate / Inspire XT + Manzate**

**Inspire XT + Manzate / TPTH + Manzate/ Minerva Duo/ TPTH + Manzate**

# Fungicide Mixtures in Alternation Provided Effective Control of *Cercospora beticola* in 2017

| *Treatments @ 14 d* | *CLS* | *RS (lb/ac)* |
|---|---|---|
| Nontreated Check | 10.0 | 8,289 |
| Inspire XT + Topsin / TPTH + Manzate / Minerva Duo / TPTH + Manzate / Proline + Manzate (10-12 d) | 4.3 | 12,085 |
| Inspire XT + Topsin / TPTH+ Manzate / Minerva Duo / TPTH + Manzate | 4.8 | 11,309 |
| TPTH + Topsin / Inspire XT + Badge / TPTH + Manzate / Minerva Duo + Badge SC | 5.3 | 11,218 |
| LSD *P*=0.05 | 0.6 | 1,156 |

# It was Economical to Use Fungicide For CLS Control in 2017

| *Treatments @ 14 d* | *RS* | *Net $* |
|---|---|---|
| **Nontreated Check** | **8,289** | **831** |
| **Inspire XT + Topsin / TPTH + Manzate / Minerva Duo / TPTH + Manzate / Proline + Manzate (10-12 d)** | **12,085** | **1,449** |
| **Inspire XT + Topsin / TPTH + Manzate / Minerva Duo / TPTH + Manzate** | **11,309** | **1,349** |
| **TPTH + Topsin / Inspire XT + Badge / TPTH + Manzate / Minerva Duo + Badge SC** | **11,218** | **1,278** |
| **LSD *P*=0.05** | **1,156** | **225** |

**$447 to $618 more/acre after paying for fungicides**

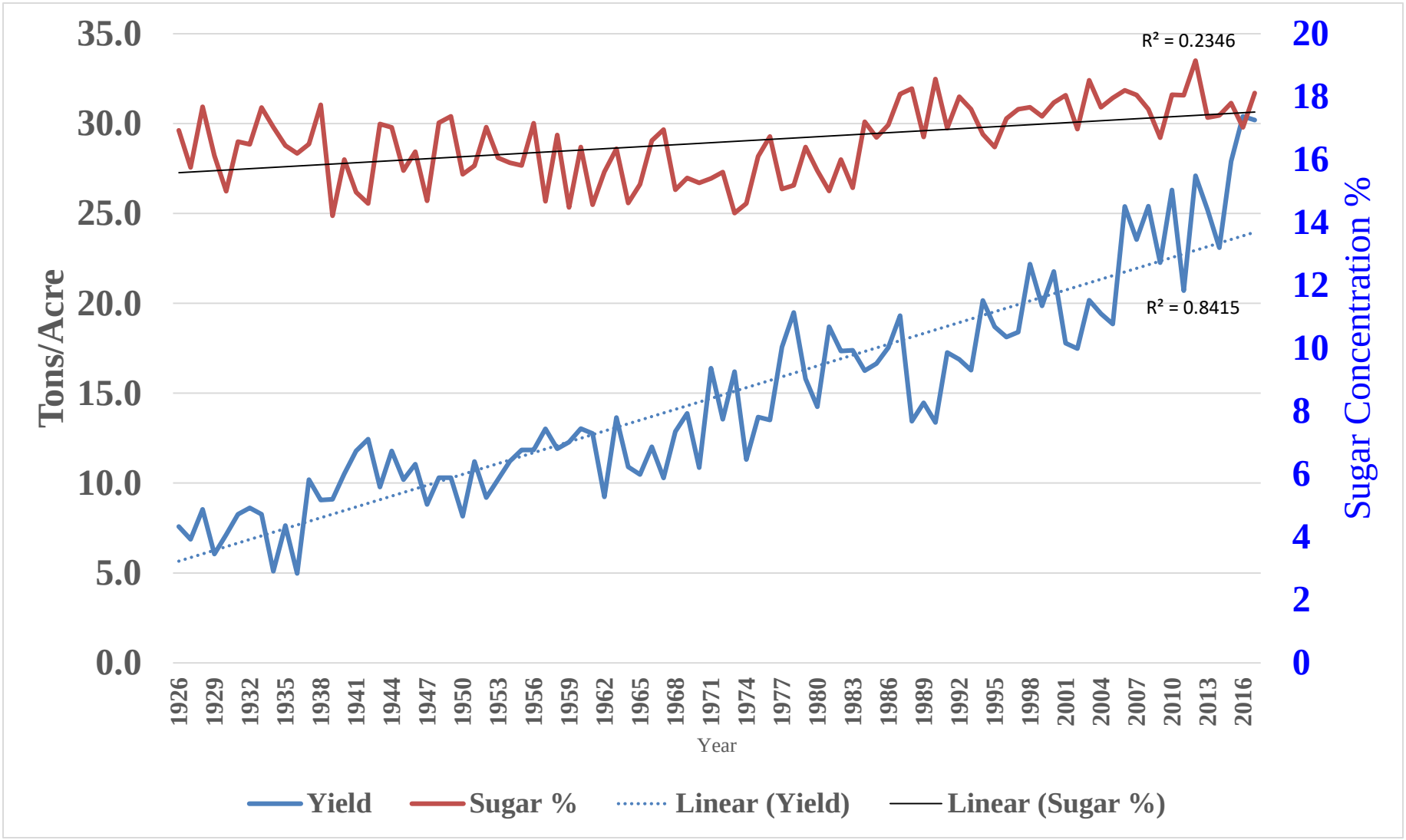
# Grower's Field in 2016 – 5 Fungicide Applications

# 2017 - Sweet Success!

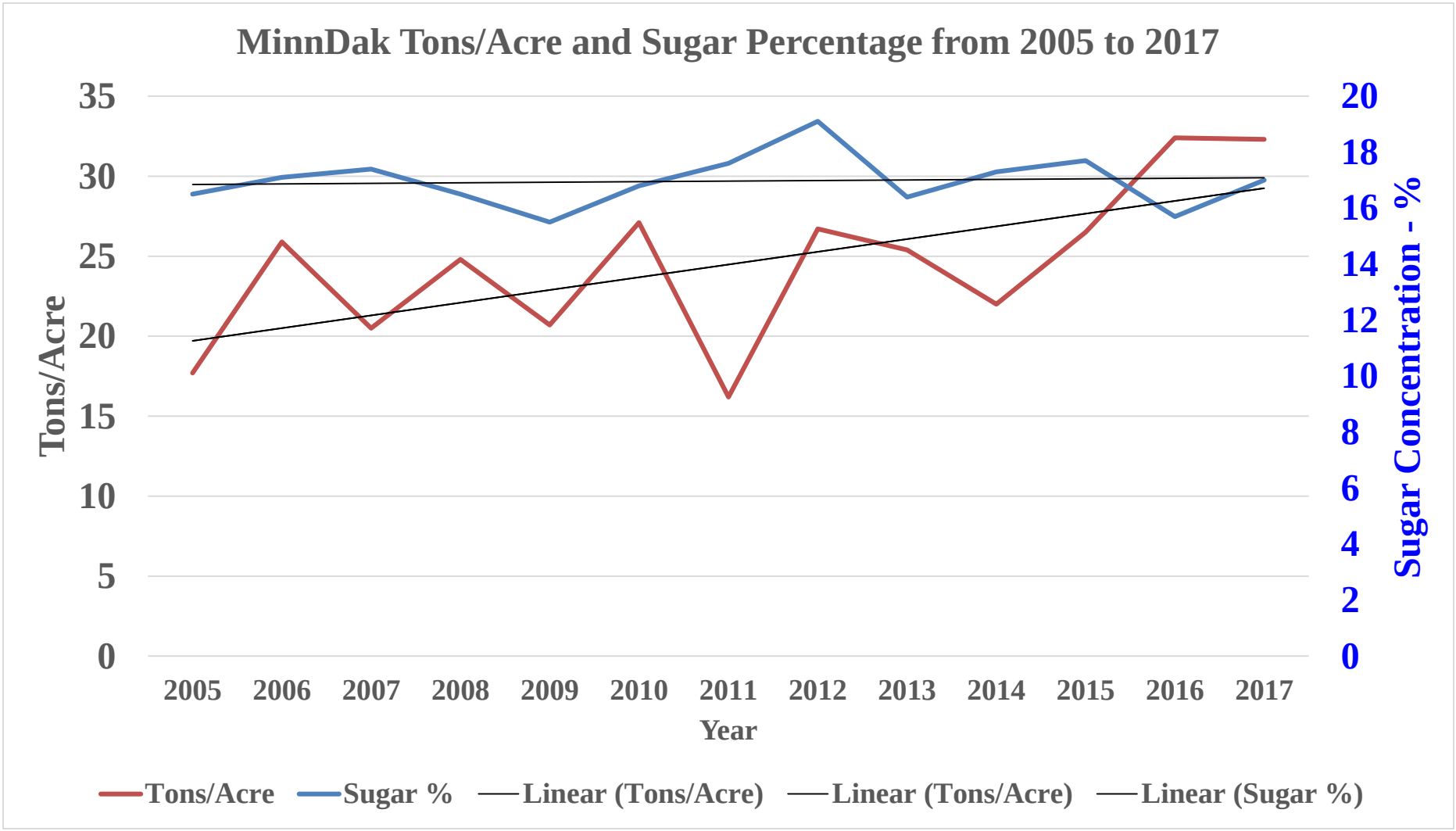
# Summary

- CLS was severe because of high Cercospora inoculum pressure and favorable environmental conditions; especially in central and southern Minnesota.
- Use of fungicide mixtures with effective and different modes of action resulted in effective and economical control of CLS.
- The practice of crop rotation, use of CLS tolerant varieties, and using recommended fungicide mixtures starting at first symptoms and continuing at intervals based on weather conditions (14 d in dry and 10-12 in wet), and using aerial application when necessary to keep the crop protected, will result in effective control of CLS, and over time, reduction of inoculum pressure.

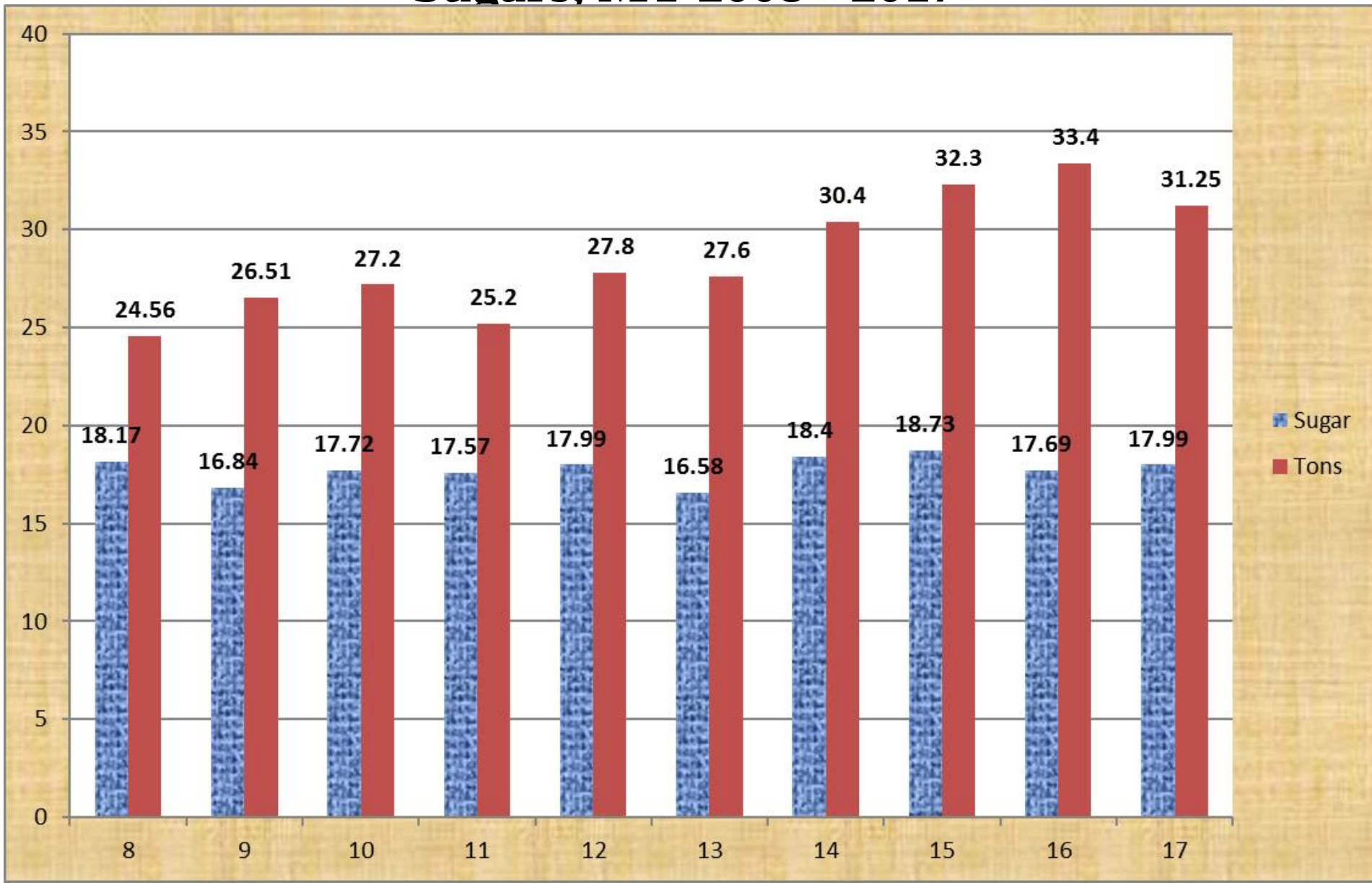
# American Crystal Sugar Tons/Acre and Sugar Concentration (%) from 1926 to 2017



# Minn-Dak: Tonnage and Sucrose Concentration 2005 - 2017



# Tonnage and Sucrose Concentration at Sidney Sugars, MT 2008 - 2017



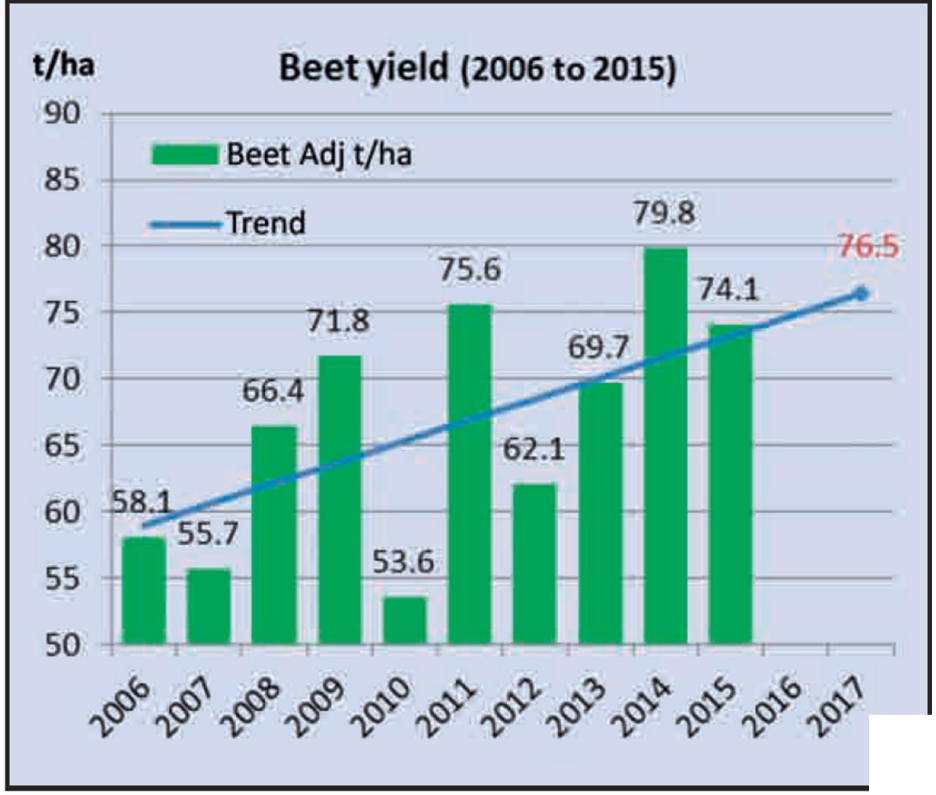
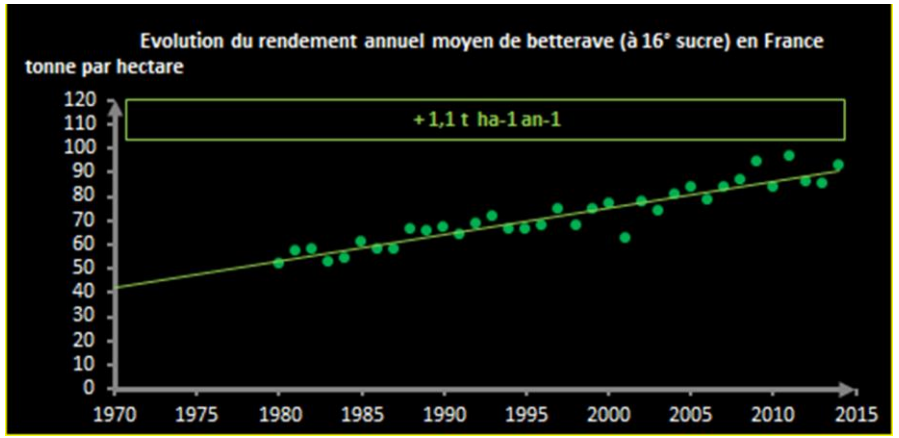
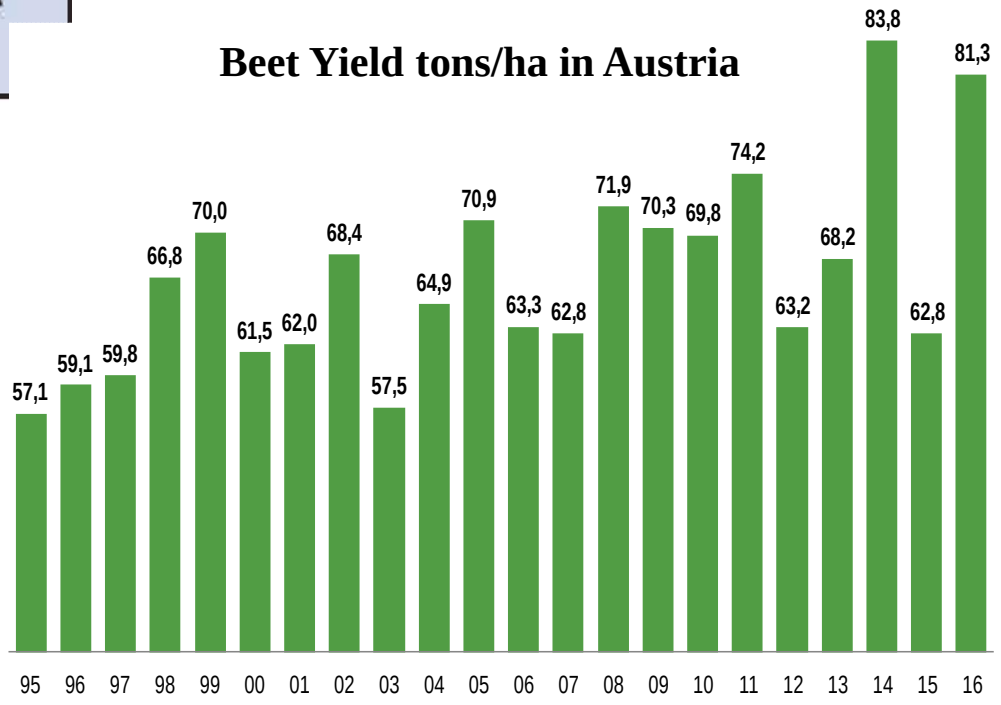


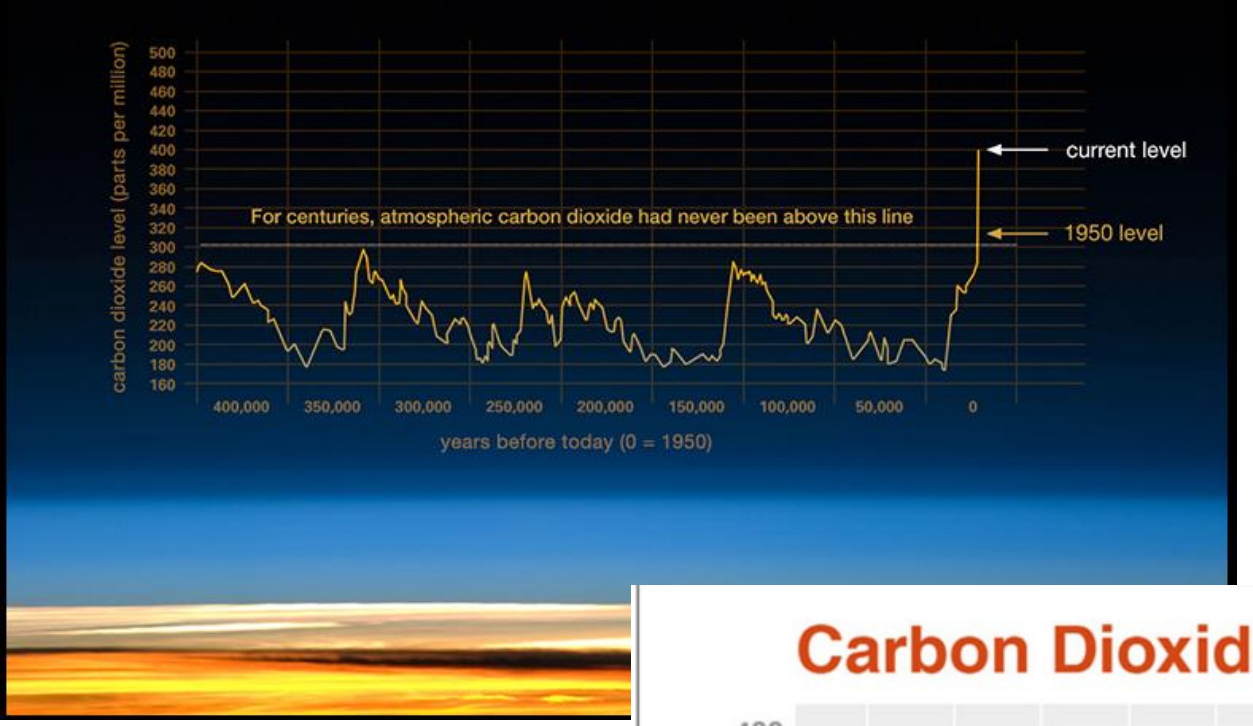

Fig. 3 – Historic paid beet yield in adjusted t/ha.

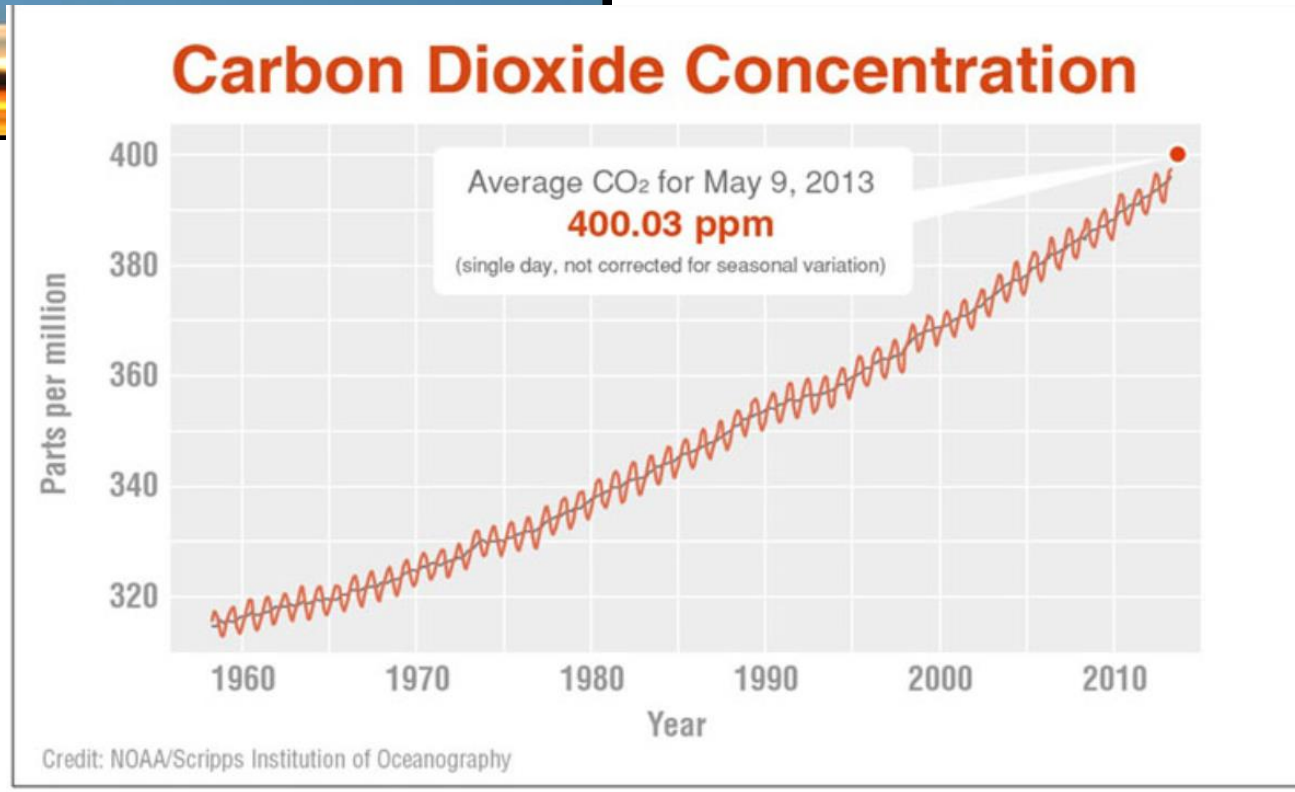
## UK




## France






This graph shows the monthly mean atmospheric carbon dioxide at Mauna Loa Observatory, Hawaii, measured since 1958. A single data point has been added for the concentration recorded on May 9. The black curve represents the seasonally corrected data. **(high resolution graphic)**

# North Dakota & Minnesota
# 2017 Crop

- **ACSC 30.2 tons/Ac** **18.11% Sugar**
- **Minn-Dak 32.3 tons/Ac** **17.0% Sugar**
- **SMBSC 30.29 tons/Ac** **16.37 % Sugar**

| *Tons/Ac* | *% S* | *SLM* | *RSA* |
|---|---|---|---|
| ***47.10*** | **18.27** | **1.0052** | **17,209** |
| ***51.02*** | **16.18** | **1.4060** | **16,510** |
| ***45.07*** | ***16.90 Spreckels – Irrigated (Aug-June)*** | | |

# Nitrogen Rates Impact on Sugarbeet Yield and Quality 2010, 2011

| *N rates:lb/A* | *Varieties* |
|---|---|
| *70* | *A - Prostrate* |
| *100* | *B – Erect* |
| *130* | |
| *160* | |

# Variety A – June, 2010

# Variety B – June, 2010

**70 lb/A N, Variety A**

**100 lb/A N, Variety A**

**130 lb/A N, Variety A**

**160 lb/A N, Variety A**

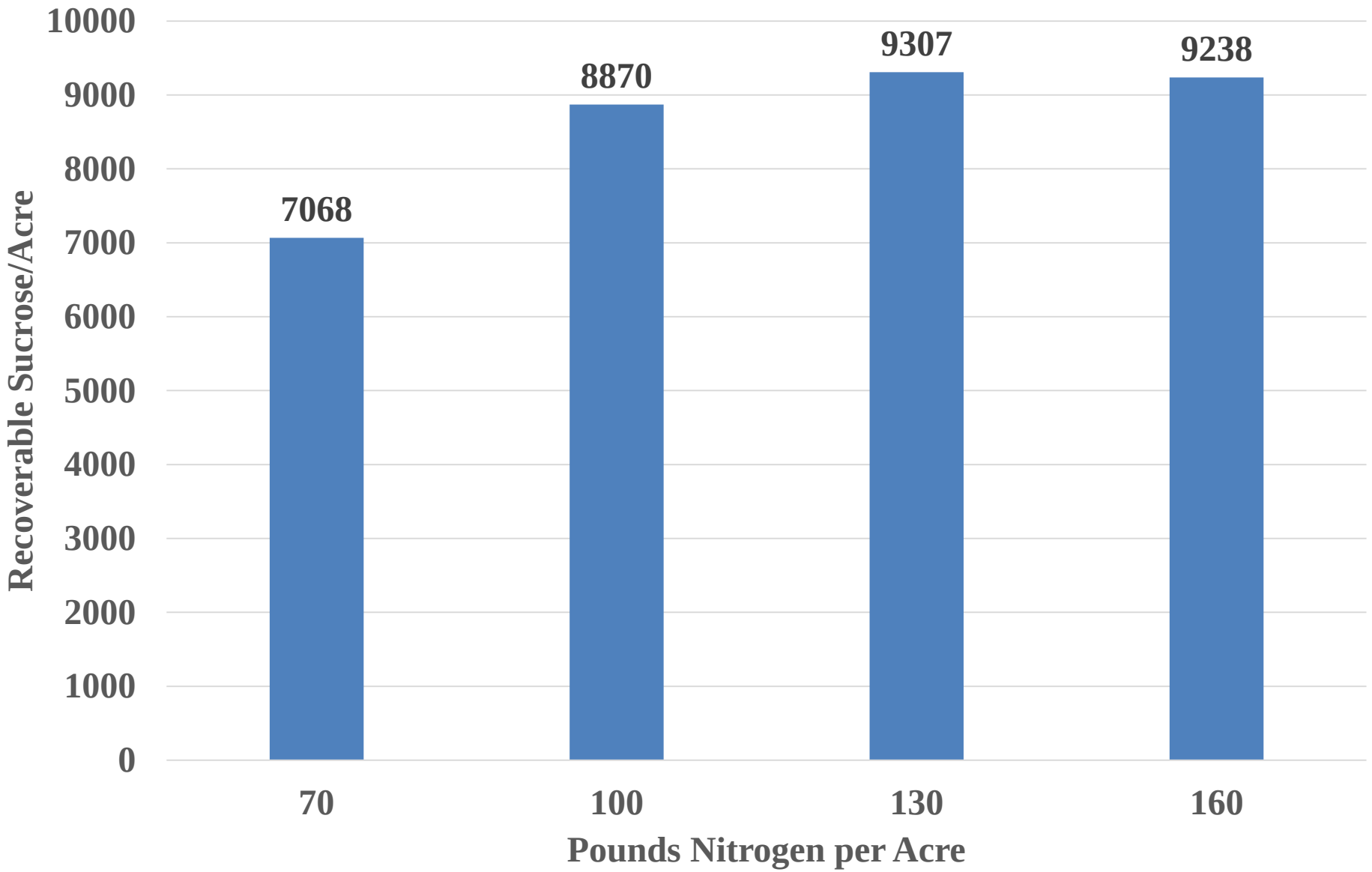
**70 lb/A N, Variety B**

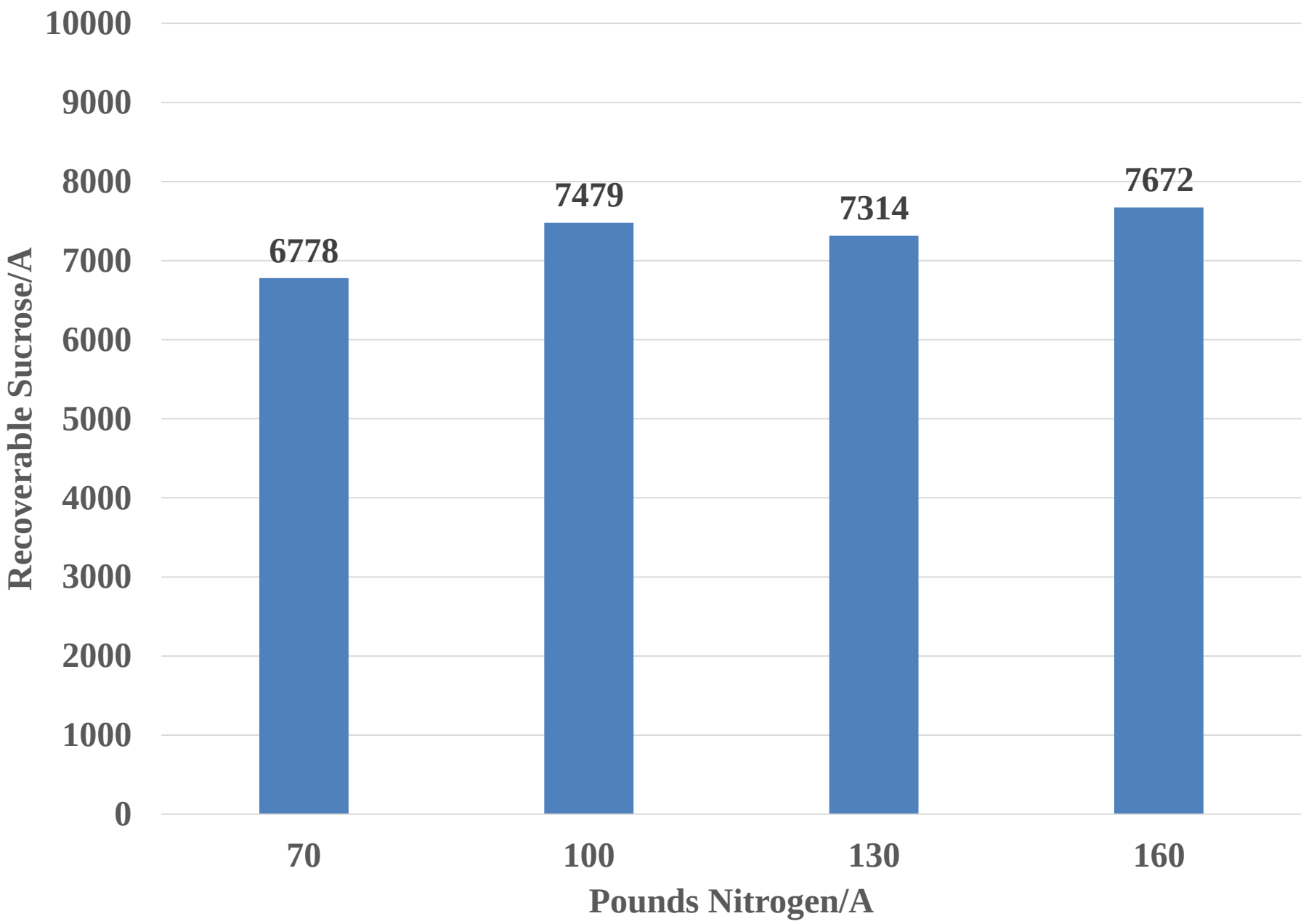
**100 lb/A N, Variety B**

**130 lb/A N, Variety B**

**160 lb/A N, Variety B**

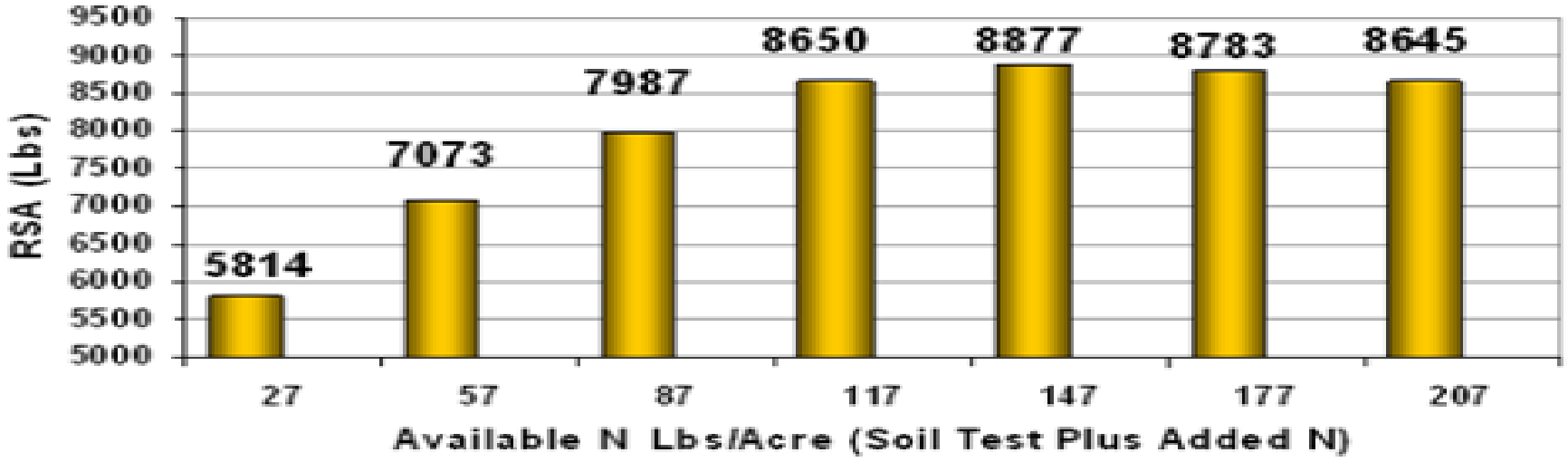
# Impact of Nitrogen Rates on Recoverable Sucrose - 2010




Impact of Nitrogen Rates on Recoverable Sucrose - 2011
Recoverable Sucrose/A
10000
9000
8000
7000
6000
5000
4000
3000
2000
1000
0
6778
7479
7314
7672
70
100
130
160
Pounds Nitrogen/A

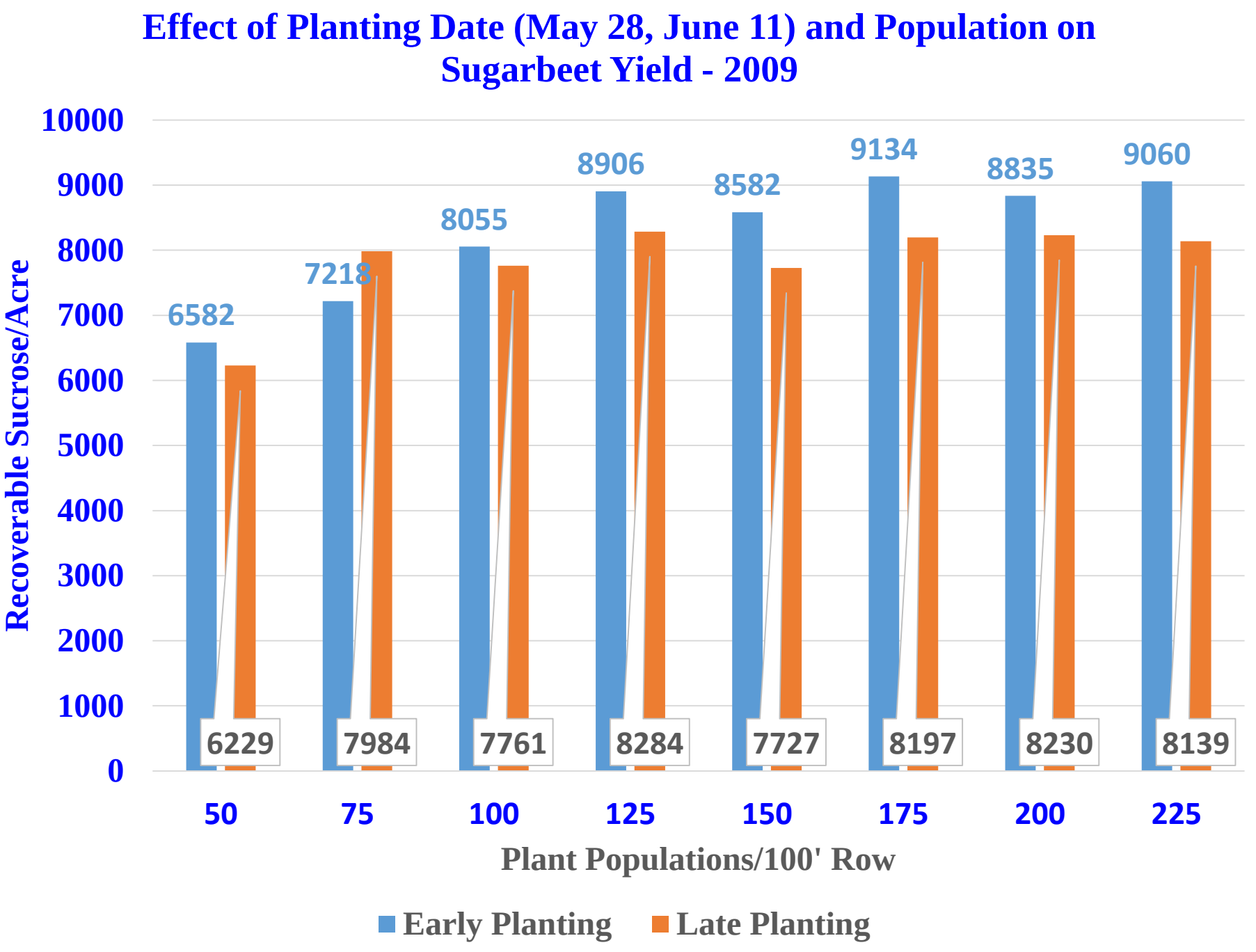
# Ag Notes: 535 - N Fertility for Roundup Ready Varieties, 3-9-10

Figure 1. Effect of N Fertilizer Rate On RR Variety Yield and Quality, UM, NWROC, Smith, 2009




## Conclusions:

- Maximum yields were at 117-147 lbs/A, close to recommended rates
- The Roundup Ready® varieties peaked at about the same rate of available N as conventional varieties
- Planted on May 14, 2009
- Data is an average from 4 Roundup Ready® varieties C-658, C-765, H-4012, B-87RR38
- N fertilization rate may vary based on soil type (See agriculturist for data)


Effect of Planting Date (May 28, June 11) and Population on Sugarbeet Yield - 2009
Recoverable Sucrose/Acre
10000
9000
8000
7000
6000
5000
4000
3000
2000
1000
0
6582
7218
8055
8906
8582
9134
8835
9060
6229
7984
7761
8284
7727
8197
8230
8139
50
75
100
125
150
175
200
225
Plant Populations/100' Row
Early Planting
Late Planting

# Effect of Planting Date (May 20, June 21) and Population on Sugarbeet Yield - 2010

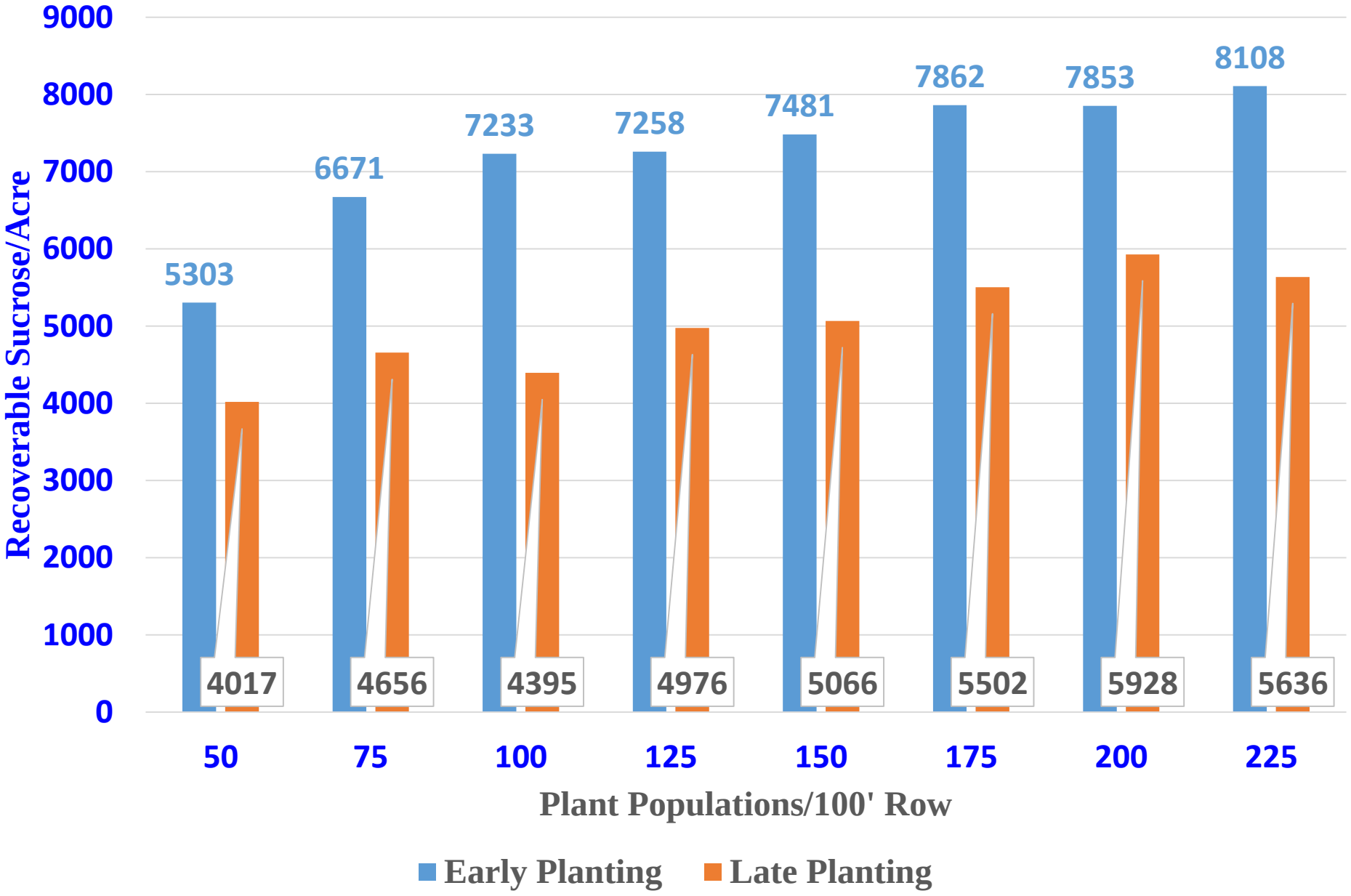
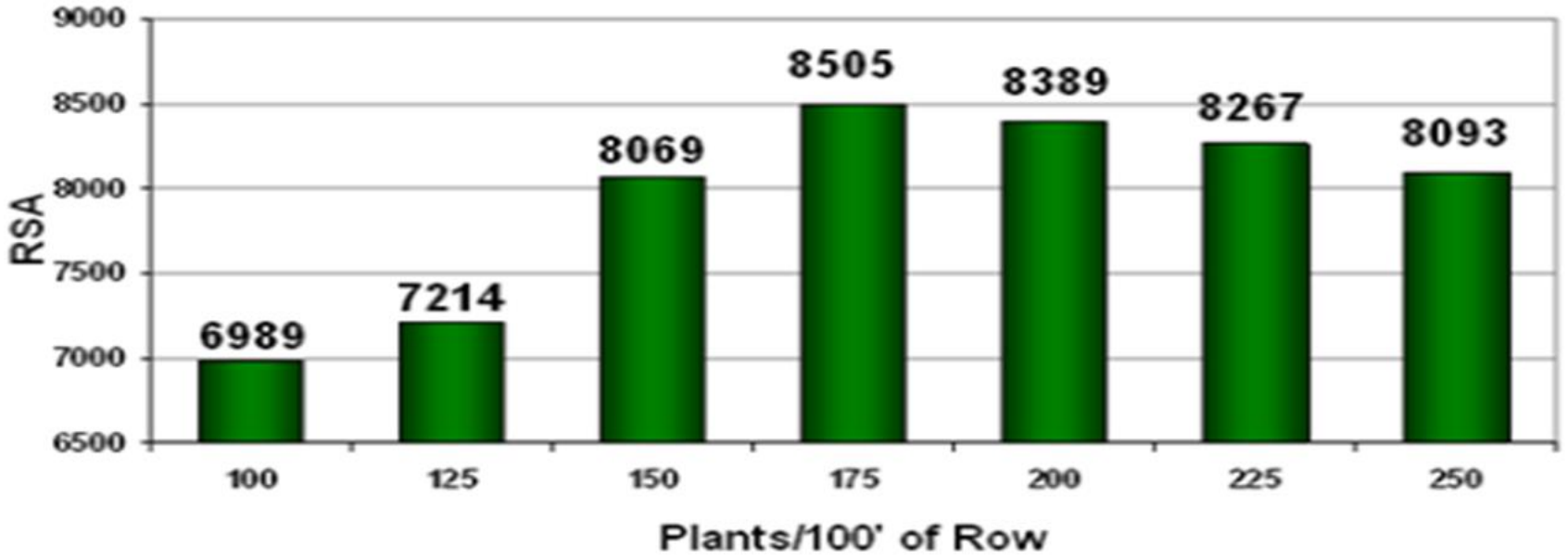


**Figure 2. Effect of Plant Population On Roundup Ready Variety Yield and Quality, UM, NWROC, Smith, 2009**




# Conclusions:

- Maximum RSA and Rev/A was achieved at 175 beets/100' row
- 200 beets/100' of row had only a slight detrimental effect
- Data shown is an average of two Roundup Ready® varieties C-658 and H-4010
- Grower practices database also shows maximum RSA at 175-200 beets/100'
- Planted May 18, 2009
- It may be necessary to thin very high plant populations

# Targeting 35 to 40 tons/acre and 18.5% Sugar

- **Select high yielding varieties with *disease resistance package matched to the field*; use recommended 130 lb N/Ac.**
- ***Plant as early as possible* aiming for *175 to 225* plants per 100 foot of 22" row.**
- **Use appropriate insecticide/fungicide seed treatments; target Rhizoctonia and Aphanomyces (and insect pests - sugarbeet root maggot, springtails, wireworm, etc: *Dr. Boetel*).**
- **Apply Quadris/Generics/Priaxor/Proline for Rhizoctonia; Tach 45 gm and Precipitated calcium carbonate (Waste lime) for Aphanomyces (*Dr. Chanda*).**
- **Manage weeds – use R/up, post-emergence, lay-by etc (*Dr. Peters*).**
- **Control Cercospora using fungicide mixtures.**
- **Start pre-pile in August to increase processing period.**
- **Have a bountiful harvest, good storage and processing, and high sugar prices.**
- **Thank You!**

# Acknowledgements –Thank You!


- **Growers through SBREB for funding research and educational programs.**
- **Seed, chemical and allied industries, and agriculturists and consultants for assistance.**
- **Kevin Etzler, Vince Ulstad, and Kevin Nelson for research conducted on their farms.**
- **Personnel at ACSC tare laboratory, East Grand Forks.**
- **Colleagues at NDSU for assistance in harvesting.**
- **Peter Hakk and summer interns for conducting field research.**