

Holistic Management of Cercospora Leaf Spot in Sugarbeet

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Integrated CLS Management

- ✓ **Crop rotation (wheat as preceding crop).**
- ✓ **Incorporation of infected crop residue.**
- ✓ **Healthy plants – use recommended nutrients (N).**
- ✓ **Improved CLS tolerant varieties.**
- ✓ **Timely application of fungicide mixtures.**

Copper Chemicals

Commercial Name	Active Ingredient	Notes
Badge SC	17.6% Copper Oxychloride + 16.4% Copper Hydroxide	Registered to control CLS
Badge X2	22.82% Copper Oxychloride + 21.49% Copper Hydroxide	Registered
Champion	46.1% Copper Hydroxide	Registered
Champion Formula 2	37.5% Copper Hydroxide	Registered
Cuprofix	71% Basic Copper sulfate	Registered
COCS	73.49% Copper Oxychloride + 13.39% Basic Copper Sulfate	Registered
Mastercop	21.46% Copper sulfate pentahydrate	Registered
Ridomil Gold Copper	60% Copper Hydroxide + 5% Mefenoxam	Not Registered
Microthiol Dispress	80% Sulfur	Registered to control powdery mildew
Fertileader	11.9% Soluble Copper	Fertilizer

Badge[®] SC

Badge[®] X₂
Fungicide/Bactericide

Champ[®] ION⁺⁺™

CHAMP[®] FORMULA 2
FLOWABLE

CUPROFIX[®] ULTRA
40 DISPERSS

C-O-C-S[®] WDG

Mastercop[®]

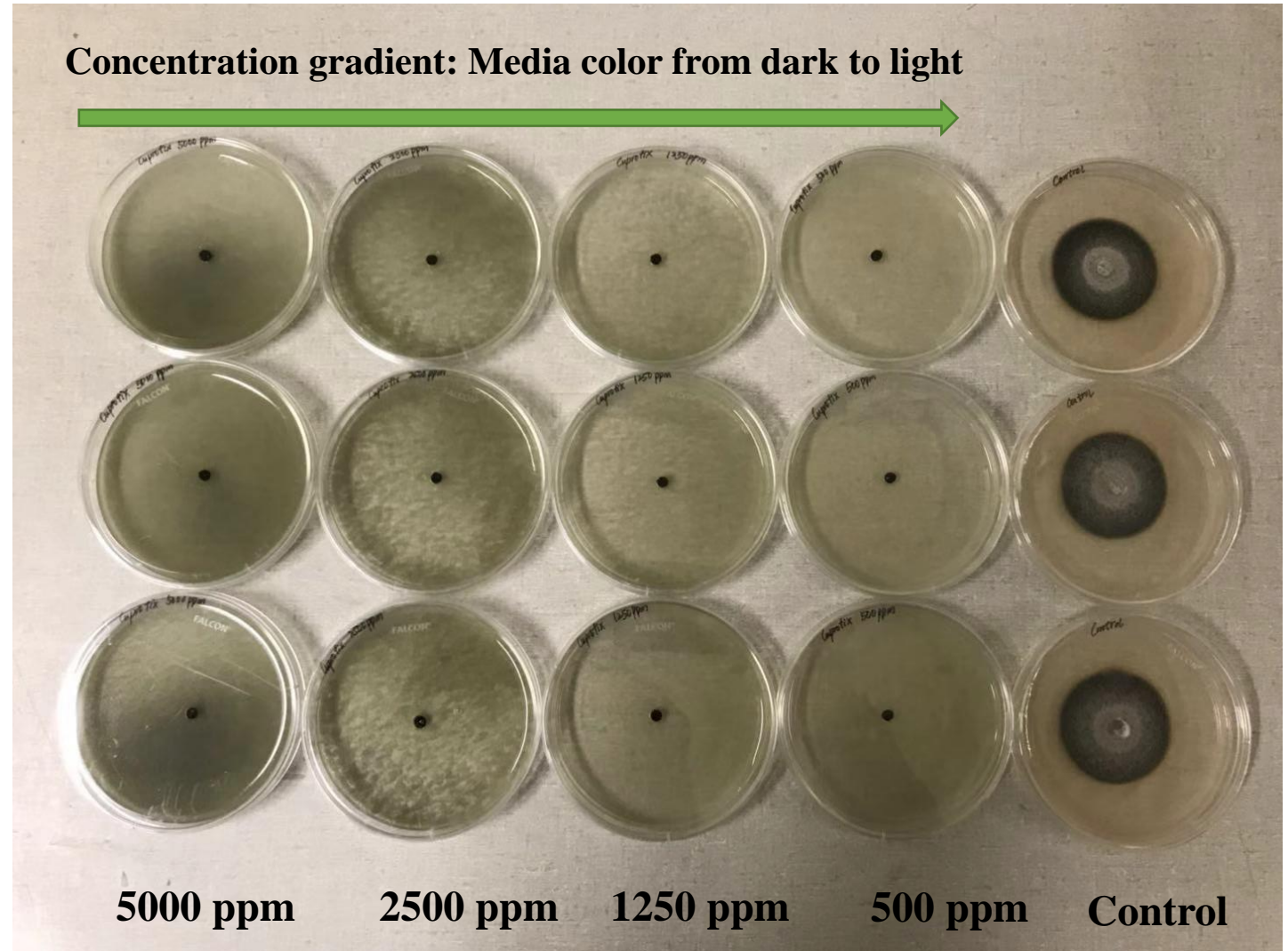
Ridomil[®] Gold[®]
GROUP 1 M1 FUNGICIDES

MICROTHIOL[®]
DISPERSS[®]
MICRONIZED WETTABLE SULFUR

FERTILEADER[®]

Sensitivity of *C. beticola* isolates to Copper – radial growth and germination

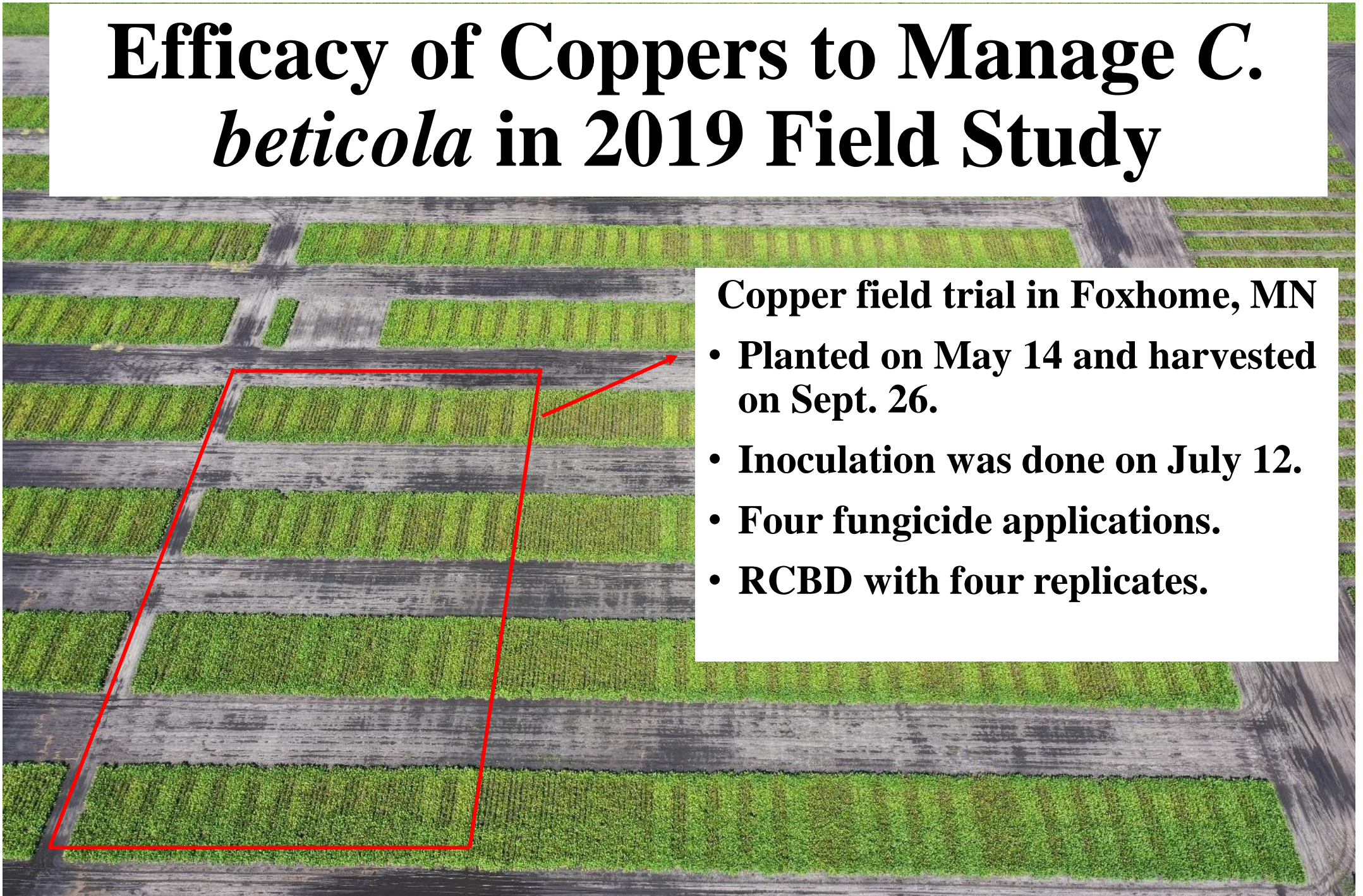
The label rate for Cuprofix (2 lb/A) in 20 gal/A water is 12,093 ppm.



Efficacy of Coppers to Manage *C. beticola* in 2019 Field Study

Copper field trial in Foxhome, MN

- **Planted on May 14 and harvested on Sept. 26.**
- **Inoculation was done on July 12.**
- **Four fungicide applications.**
- **RCBD with four replicates.**





Non-treated Check

5460 lb/A

Ridomil Gold Copper**

7414 lb/A

Cuprofix

6870 lb/A

Microthiol

6080 lb/A

Cuprofix+ Microthiol

7504 lb/A

**** Not labeled for sugarbeet**

Results

Coppers	CLS Ratings	Yield (Ton/A)	Sucrose (Lb/A)	
Untreated	9.0 a	22.8 e	5466 e	
Badge SC	6.3 de	28.6 a	7271 ab	→ Good yield
Badge X2	5.5 fgh	27.9 ab	7387 ab	→ Good yield
COCS	5.3 gh	27.2 abc	7396 ab	→ Good yield
Champion	5.8 efg	26.2 bcd	7080 abc	→ Good yield
Champ F2	6.0 ef	26.3 bcd	7053 abc	→ Good yield
Cuprofix + Microthiol	5.3 gh	27.0 abc	7505 a	→ Good yield
Ridomil Gold Copper	5.0 h	28.5 a	7414 ab	→ Good yield
Cuprofix	5.5 fgh	25.9 cd	6870 bc	→ Fair
Microthiol	8.3 b	25.1 d	6081 d	
Mastercop	7.3 c	24.7 d	6067 d	
Fertileader	6.8 cd	24.8 d	6536 cd	
LSD (P=0.05)	0.7	1.0	595	

Summary

- ✓ Copper products inhibited radial growth and spore germination of *C. beticola*.
- ✓ The fungicides evaluated provided better disease control and significantly higher recoverable sucrose than the check.
- ✓ There was some phytotoxicity by one product in the greenhouse conditions, but not in the field conditions.
- ✓ The labeled products evaluated will be useful in a mixture for use in a rotation program with different fungicide chemistries to control *Cercospora* leaf spot and manage fungicide resistance in sugar beet.

Do Adjuvants Help to Improve Efficacy of Fungicides for Controlling Cercospora Leaf Spot of Sugar beet?



Untreated
Check –
7,420 lb/A
2015



Headline
3x – 9,891
lb/A

Headline
+
Adjuvant
3x –
9,939
lb/A





**Non-
treated
check -
2016**



**(Inspire
XT) 4x**



**(Inspire
XT +
Adjuvant
A) 4x**



**(Inspire
XT +
Adjuvant
B) 4x**

Recoverable Sucrose (Yield in pounds sugar/Acre) of Fungicides With and Without Adjuvants at Controlling *Cercospora beticola*

<u>Treatments @ 14 d</u>	<u>None</u>	<u>Preference</u>	<u>Complex</u>	<u>Transfix</u>
Nontreated Check	5454e	5454e	5454e	5454e
Penncozeb (EBDC)	7365ab	7754a	7493abc	6983bcd
Badge (Copper)	6657cd	7184abc	7490ab	6292d
Inspire XT	7240abc	7684a	7796a	7657ab
F/cides Rotation	7774a	7857a	7715a	7606ab

Field Trial at Foxhome, MN - 2019

Non-treated Check
5454 lb/A



Inspire XT 4x
7240 lb/A



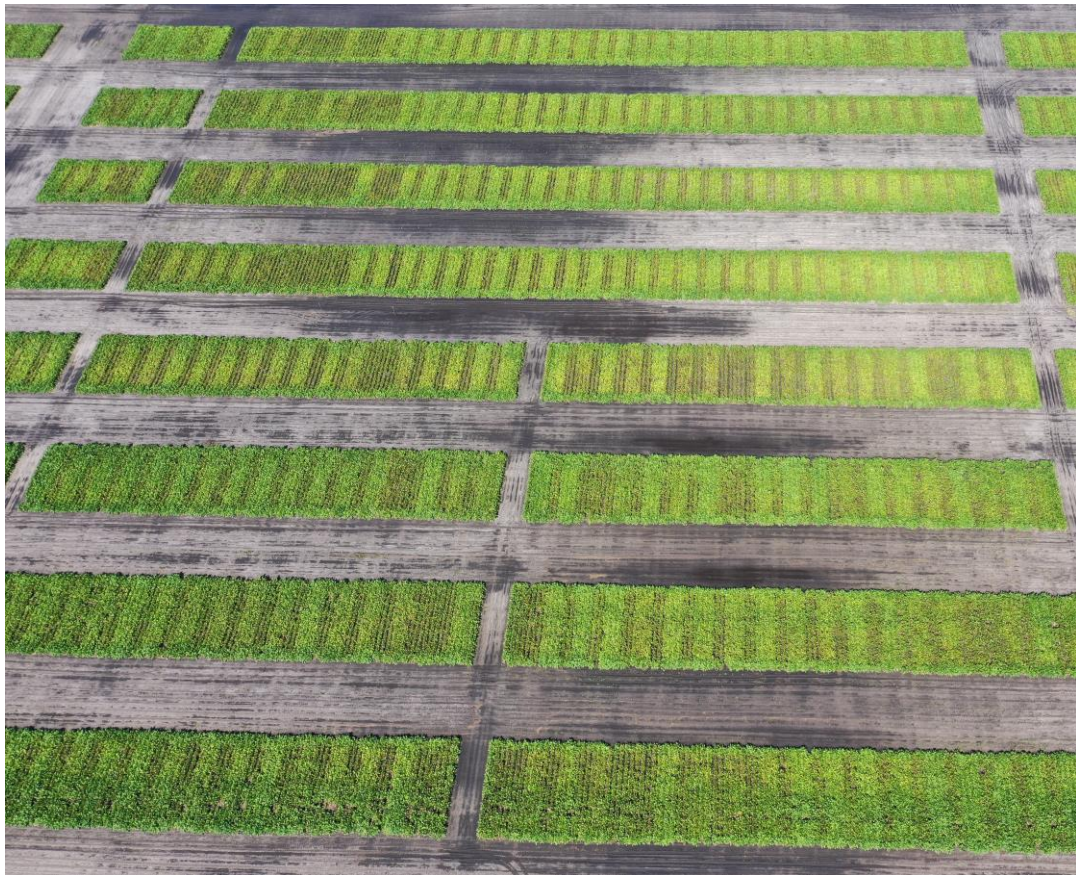
(Inspire XT + Adjuvant)4x
7796 lb/A



Summary

- ✓ Preliminary data suggest some adjuvant types may improve efficacy of copper.
- ✓ Please note adjuvant type may compromise disease control and reduce recoverable sucrose.
- ✓ Data suggest that using fungicide in mixtures in a rotation program does not need an adjuvant to provide effective control of CLS.

Effect of Individual Fungicides or Mixtures on *C. beticola*
Foxhome, MN; Planted May 14 & Inoculated 7/12.
Fungicides – July 22; Aug 1, 14 and 28; Harvested Sep 25.



Non-Treated Check





QoI + SDHI (Priaxor)



QoI - Quadris

QoI - Gem



QoI - Pyrac





Minerva 4x



Minerva Duo 4x



Inspire XT 4x



Proline 4x



TPTH

Inspire XT + TPTH (4x)



Minerva + TPTH (4x)

Proline + TPTH (4x)



Efficacy of DMI + TPTH Fungicides at Controlling *Cercospora beticola* Resistant to QoI Fungicides

<u>Treatments @ 14 d</u>	<u>CLS</u>	<u>RSA (lb/Ac)</u>
Nontreated Check	9.8	5,467
<i>TPTH</i>	4.3	8,207
Proline + NIS	4.3	8,436
<i>Proline + NIS + TPTH</i>	4.0	8,731
Inspire XT	5.0	8,028
<i>Inspire XT + TPTH</i>	4.0	9,285
Minerva	5.8	7,264
<i>Minerva + TPTH</i>	4.8	9,031
<i>Minerva Duo</i>	5.0	8,171
LSD (0.05)	1.1	733

Efficacy of Broad Spectrum Fungicides at Controlling *Cercospora beticola* Resistant to QoI Fungicides

<u>Treatments @ 14 d</u>	<u>CLS</u>	<u>RSA (lb/Ac)</u>
Nontreated Check	9.8	5,467
Manzate Max 1.6 qt	5.0	7,812
Dithane F45	5.0	7,937
<i>Badge SC 4 pt</i>	<i>4.8</i>	<i>8,474</i>
Mankocide 2.2 lb	5.0	7,527
<i>Mankocide 4.3 lb</i>	<i>5.5</i>	<i>7,907</i>
LSD (0.05)	1.1	733

Efficacy of Broad Spectrum and DMI Fungicides at Controlling *Cercospora beticola* Resistant to QoI Fungicides

<u>Treatments @ 14 d</u>	<u>CLS</u>	<u>RSA (lb/Ac)</u>
Nontreated Check	9.8	5,467
Manzate Max 1.6 qt	5.0	7,812
Inspire XT	5.0	8,028
<i>Inspire XT + Manzate</i>	<i>4.8</i>	<i>7,782</i>
<i>Inspire XT + Mankocide</i>	<i>5.3</i>	<i>8,021</i>
LSD (0.05)	1.1	733

Efficacy of DMI + Broad Spectrum Fungicide (Copper) at Controlling *Cercospora beticola* Resistant to QoI Fungicides

<u>Treatments @ 14 d</u>	<u>CLS</u>	<u>RSA (lb/Ac)</u>
Nontreated Check	9.8	5,467
Badge SC 2 pt	4.8	8,473
Inspire XT	5.0	8,028
<i>Inspire XT + Badge SC 2 pt</i>	<i>4.8</i>	<i>8,401</i>
Proline + NIS	4.3	8,435
<i>Proline + Badge 2 pt</i>	<i>5.0</i>	<i>7,689</i>
LSD (0.05)	1.1	733



**Non-Treated
Check**

***Bacillus mycoides* isolate J**



Bacillus amyloliquefaciens



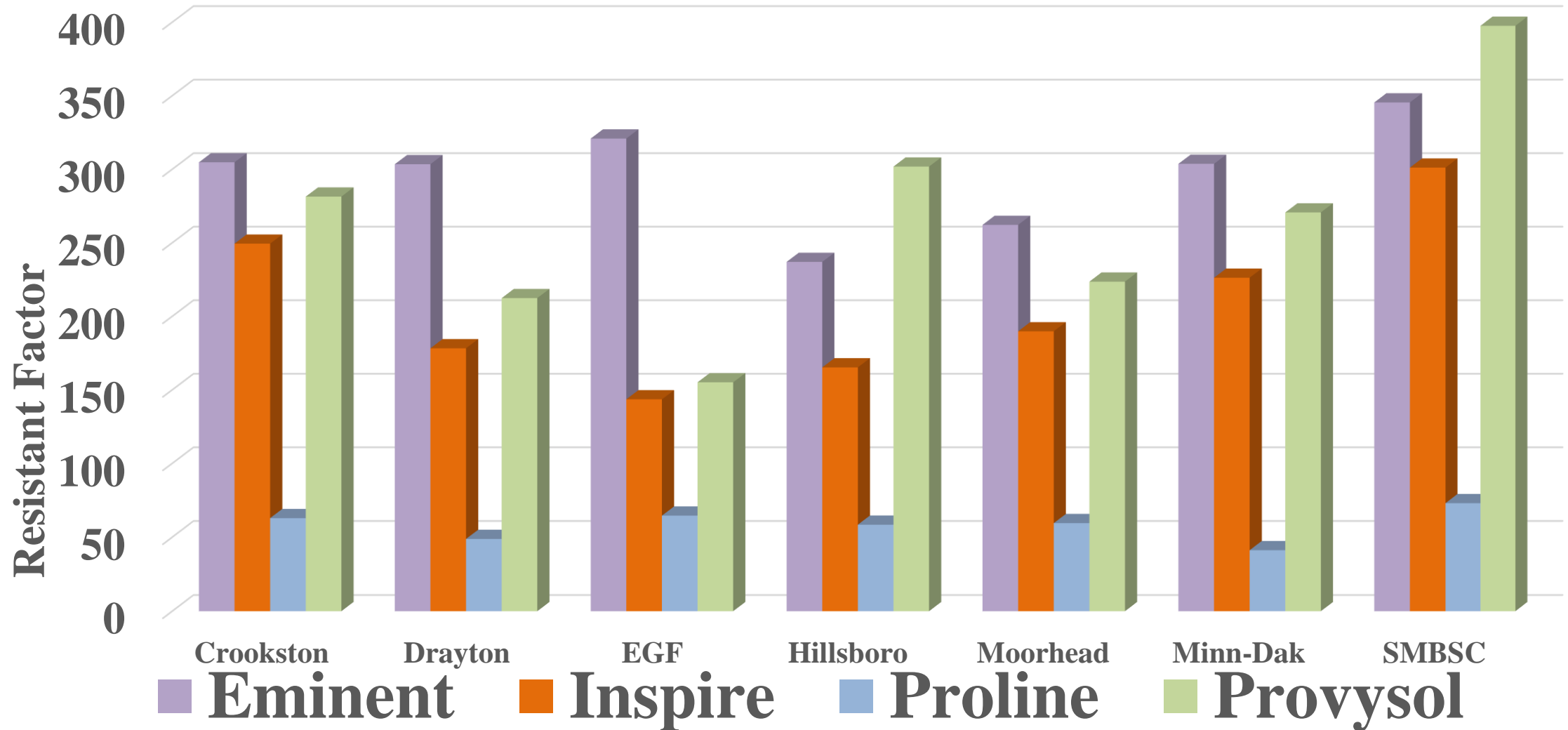


Topguard

Triazoles – Eminent, Minerva, Proline, Topguard, Enable, Provysol, Caramba,
Mixtures – Minerva Duo, Delaro, Priaxor, Protocol, Propulse, Inspire XT, Brixen, Dexter Max
TPTH – Super Tin, Agri Tin
Thiophanate methyl - Incognito
Mancozeb – Dithane, Koverall, Manzate, Penncozeb
Copper – Champ, ChampION, Kocide, Badge, Cuprofix, MasterCop, Basicop
QoI/Strobilurin – Flint, Quadris, Approach
Provysol



Sensitivity of *C. beticola* isolates collected in 2019 to Eminent, Inspire, Proline* and Provysol by factory district in ND and MNas expressed by RF values: Dr. Secor



Fungicide Mixtures in a Rotation Program Effectively and Economically Controlled CLS

*Inspire XT + Manzate/ Topsin + TPTH /
Proline + Manzate / Mankocide / TPTH + Priaxor*



*Inspire XT + TPTH / TPTH + Topsin /
Proline + Manzate / Mankocide*



Was it Economical to Use Fungicide Mixtures in Alternation Provided Effective Control of *Cercospora beticola* in 2019?

<i>Treatments @ 14 d</i>	<i>RS</i>	<i>Net \$/A</i>
Nontreated Check	5,687	547
Inspire XT + Manzate / Supertin + Topsin / Proline + Manzate / Supertin + Manzate**	8,774	883
<i>Inspire XT + Supertin / Supertin + Topsin /</i> <i>Proline + Manzate / Mankocide</i>	8,443	881
Supertin + Badge / Mankocide / Supertin + Badge / Mankocide	8,398	848
LSD $P=0.05$	887	164
<i>\$301 to \$336 more per acre after paying for fungicides and applications cost</i>		

Broad Spectrum Fungicides in Mixtures and in Rotation Program (with NO DMIs) Controlled CLS in 2018 and 2019

*TPTH + EBDC / Mankocide /
TPTH + Badge / Mankocide - 2018*

*TPTH + EBDC / Mankocide /
TPTH + EBDC / Mankocide - 2019*



Fungicide Mixtures in Alternation Provided Effective Control of *Cercospora beticola* in 2019

<u>Treatments @ 14 d</u>	<u>CLS</u>	<u>RS (lb/ac)</u>
Nontreated Check	9.5	5,687
Supertin + Badge / Mankocide /		
Supertin + Badge / Mankocide	5.0	8,398
Supertin + Manzate / Mankocide /		
Supertin + Manzate / Mankocide	5.0	8,165
LSD $P=0.05$	0.6	887

CLS Disease Severity at Foxhome, September 4 and 5th, 2019

Grower's Field



Research Site



More Severe CLS at SMBSC – September 4, 2019

**Southern Minnesota Beet Sugar Coop -
Research**



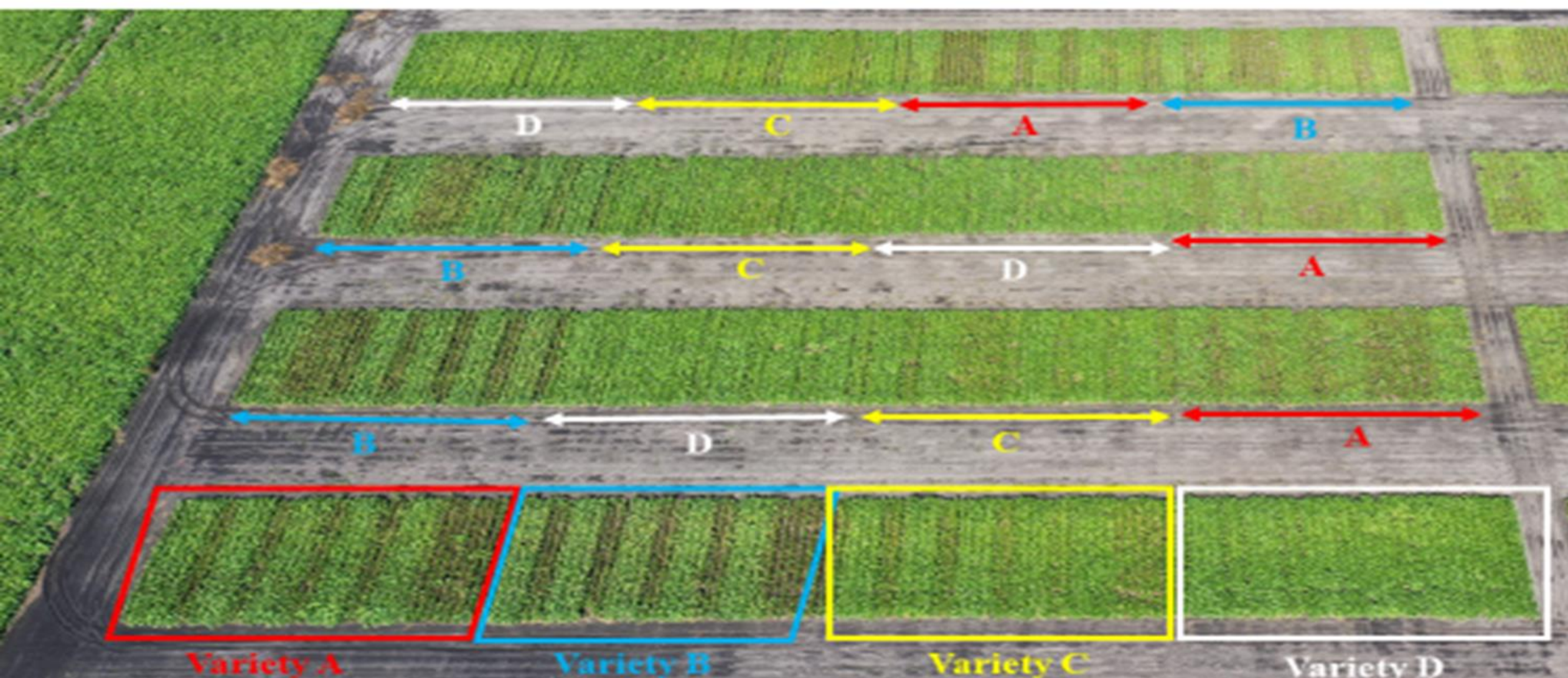
**Southern Minnesota Beet Sugar Coop –
Grower's Field**



Cercospora leaf spot started in Italy – still a problem; use of CLS resistant varieties.



Varieties A, B (Commercial), C and D (Improved CLS Tolerant) Response to Fungicides in Minnesota, USA



Take Home Message

- Use crop rotation (wheat before sugarbeet if possible); incorporate infected debris; use more CLS tolerant varieties (newer ones in 2021).
- Cercospora population is still resistant to QoI (or strobilurin) fungicides (Priaxor, Gem, Pyrac).
- Cercospora population is less sensitive to several other modes of action fungicides (DMIs, Topsin).
- It is best to use recommended mixtures of fungicides for each application.
- Always mix site specific fungicides (such as triazoles) with a non-specific fungicide (Mancozeb, Copper, TPTH, Mankocide), or mix different multi-site fungicides in a rotation program for effective and economical CLS control; start at first symptoms and be timely at 14 day intervals (or shorten to 10 to 12 days if there is regular rainfall).

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