Fighting our Foliar Foes with Fungicides

Dr. Jeff Miller

Early blight
Alternaria solani

Brown Spot
Alternaria alternata

White Mold

Sclerotinia sclerotiorum

Black Dot

Colletotrichum coccodes

Gray Mold

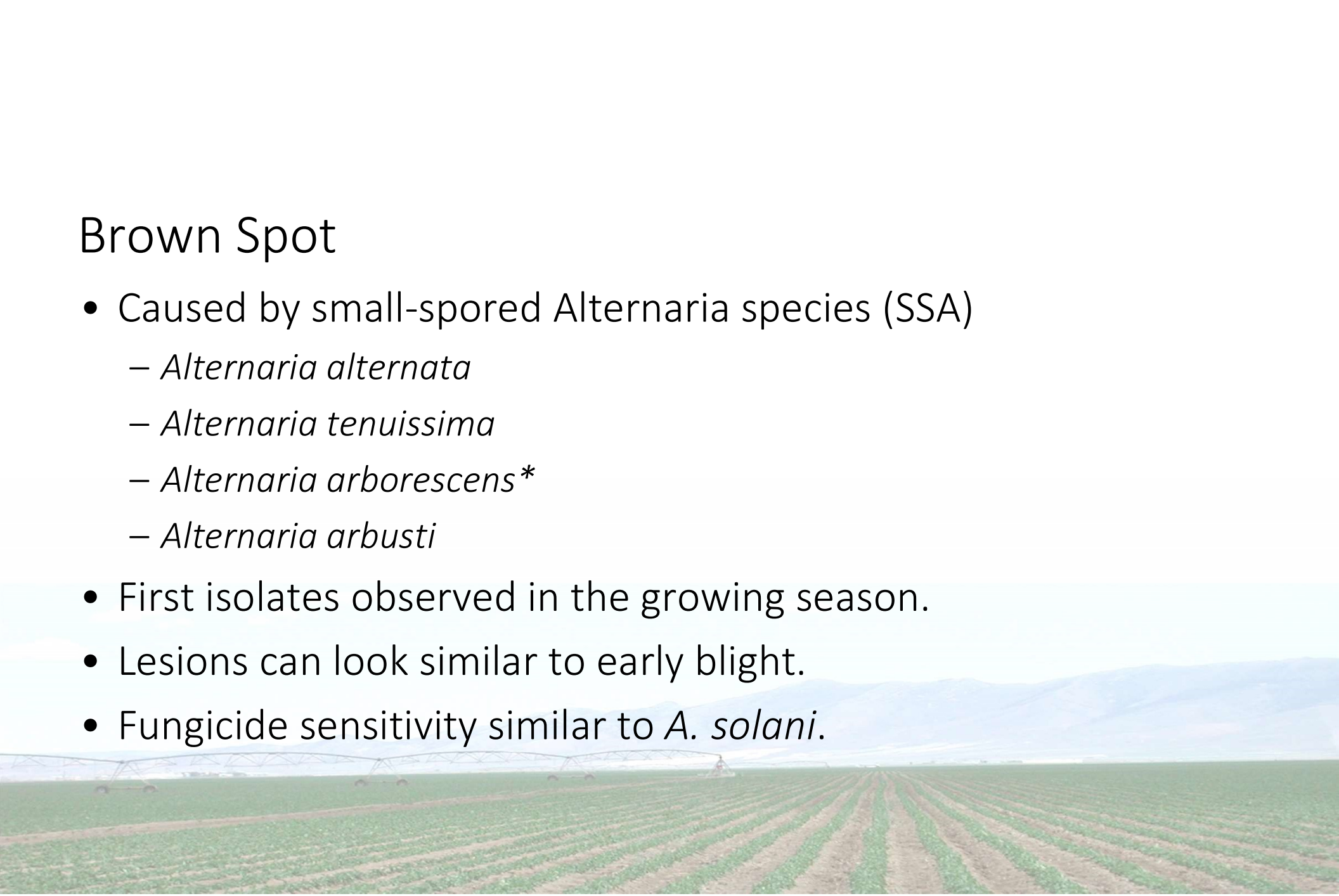
Late Blight

Early Blight/Brown Spot Management

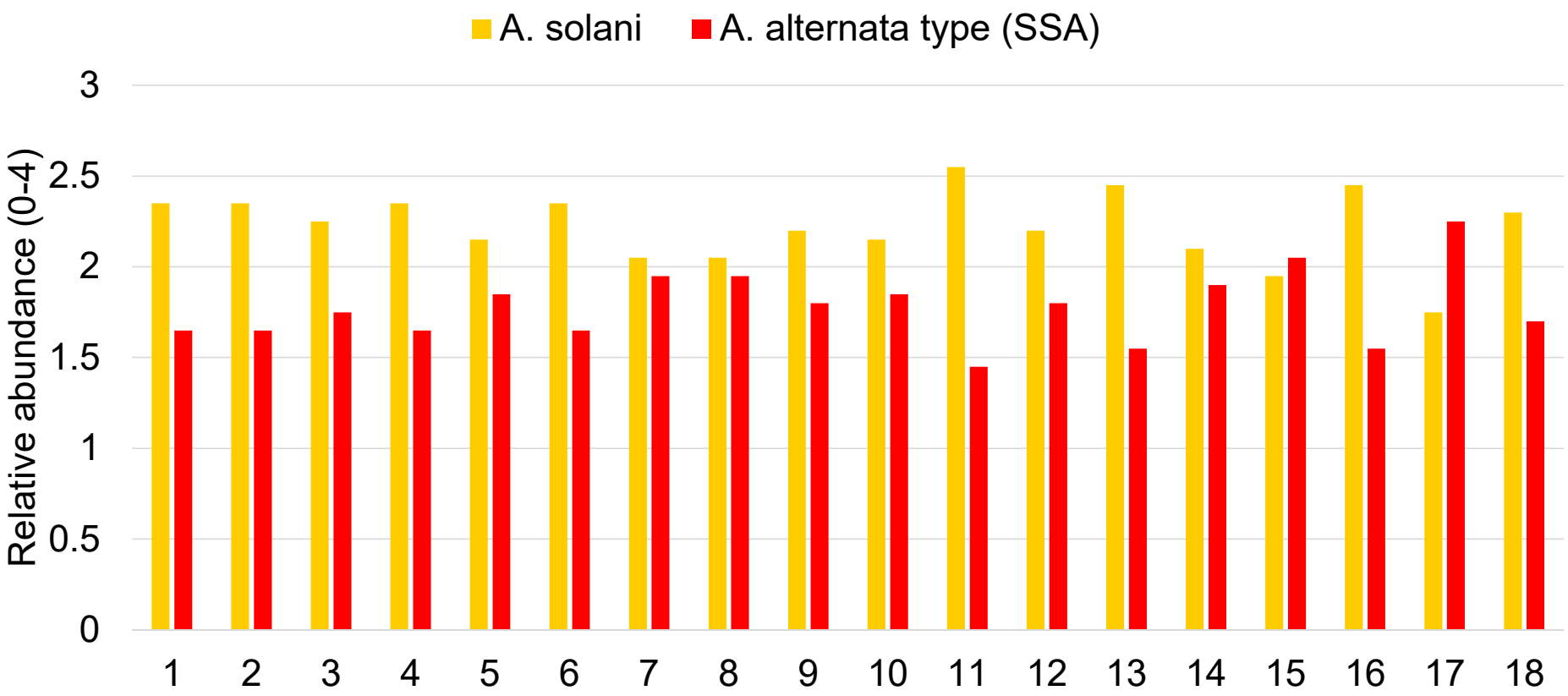
- Maintain adequate fertility.
- Effect of variety
- Use fungicides preventatively.
  - Use premium products early in the season.
  - Rotate products with different modes of action.
  - A back to back application of one mode of action may be most effective.
  - Then rotate to another chemistry.
  - No more than 2 of one group in southern Idaho!
- Tank mix premium products with a protectant or another mode of action.
- Allow tuber skins to mature prior to harvest.

Brown Spot

- Caused by small-spored Alternaria species (SSA)
  - *Alternaria alternata*
  - *Alternaria tenuissima*
  - *Alternaria arborescens**
  - *Alternaria arbusti*
- First isolates observed in the growing season.
- Lesions can look similar to early blight.
- Fungicide sensitivity similar to *A. solani*.

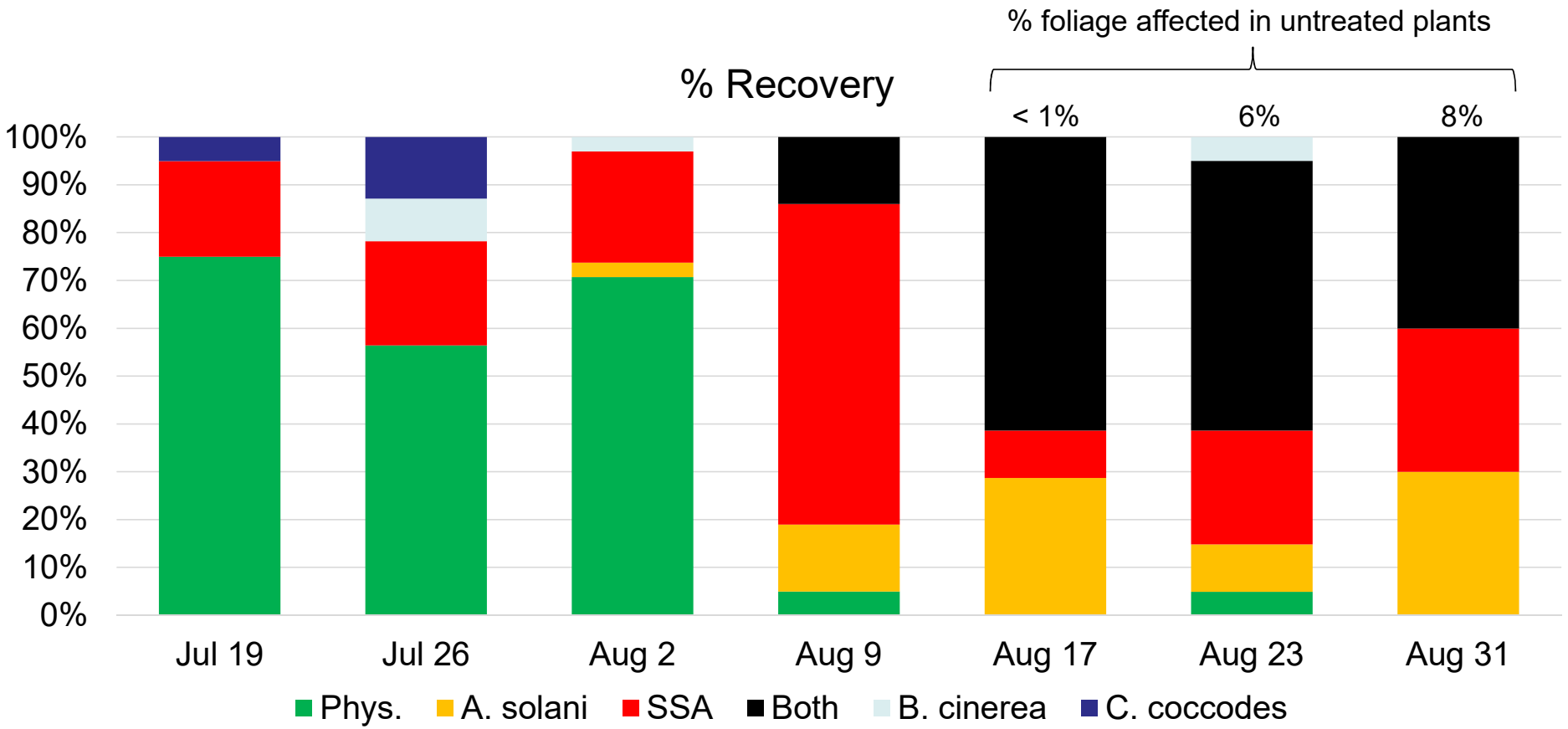


Effect of fungicide program on species presence, 2021



What was causing lesions in 2022?

Rupert, ID; Miller Research – Ranger Russet



Chemical Management

- Pesticides = Crop Medicines
- Protectant
  - Protects where it is applied
  - Interfere with infection
  - Apply preventatively
  - Low risk of resistance development
- Systemic
  - Absorbed and moved in plant
  - May cure infections
  - Best applied preventatively
  - Risk of resistance development

Effect of fungicides on late blight; Bonners Ferry, ID

- Dangers of tank-mixing
- Application method

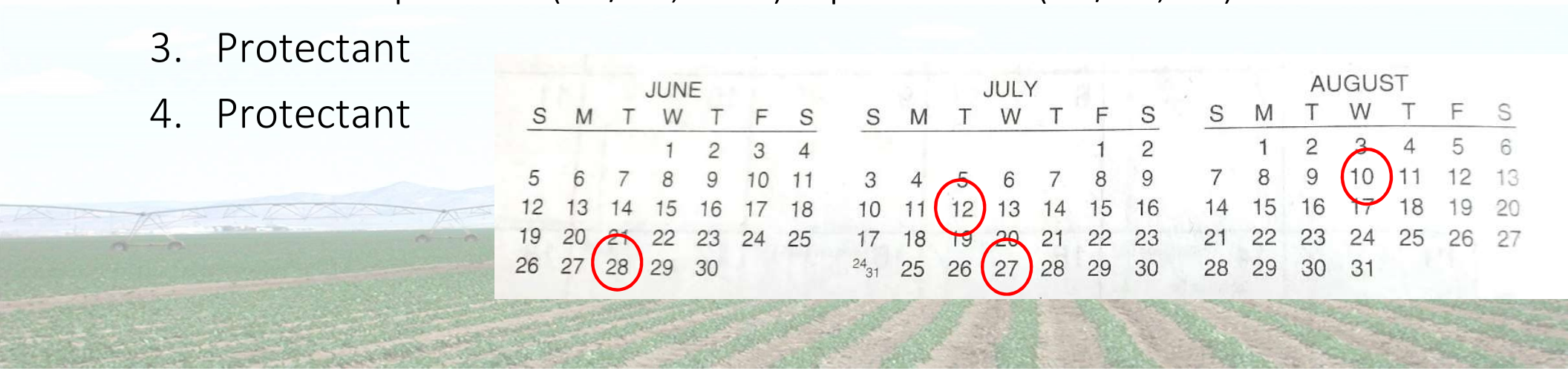
Two Analogies

Timing

Dose

How should I use my fungicides?

- Start at or just before row closure
  - Applications before that are not cost effective
- Apply every 10-14 days
  1. Premium product (EB/BS, WM) + protectant (EB/BS, LB)
  2. Premium product (EB/BS, WM) + protectant (EB/BS, LB)
  3. Protectant
  4. Protectant



JUNE

S	M	T	W	T	F	S
			1	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30		

JULY

S	M	T	W	T	F	S
					1	2
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24 31	25	26	27	28	29	30

AUGUST

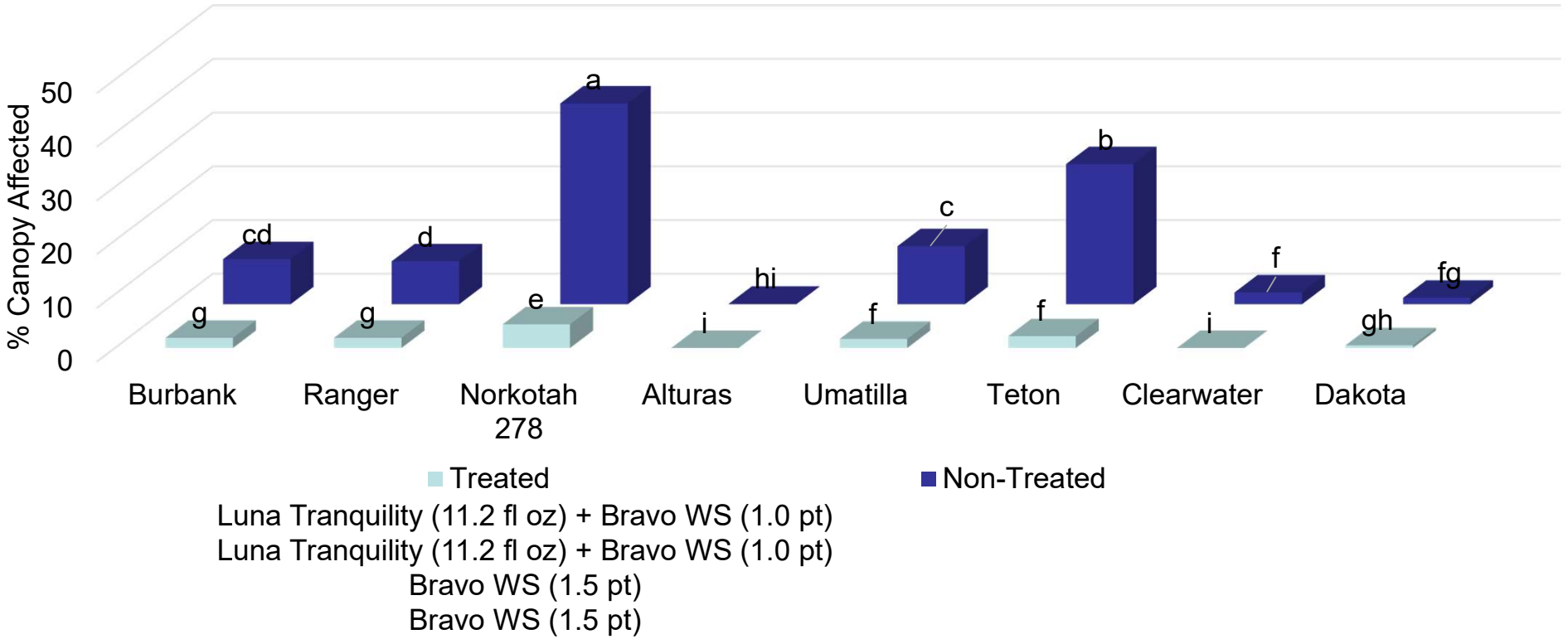
S	M	T	W	T	F	S
	1	2	3	4	5	6
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29	30	31			

Other Considerations

- More applications may be needed
  - Variety susceptibility
  - Length of season
- In-furrow fluopyram (Velum Prime) can replace one of the foliar premium product applications
- You don’t need total control
  - Some disease at the end of the season will not hurt
  - Not cost-effective

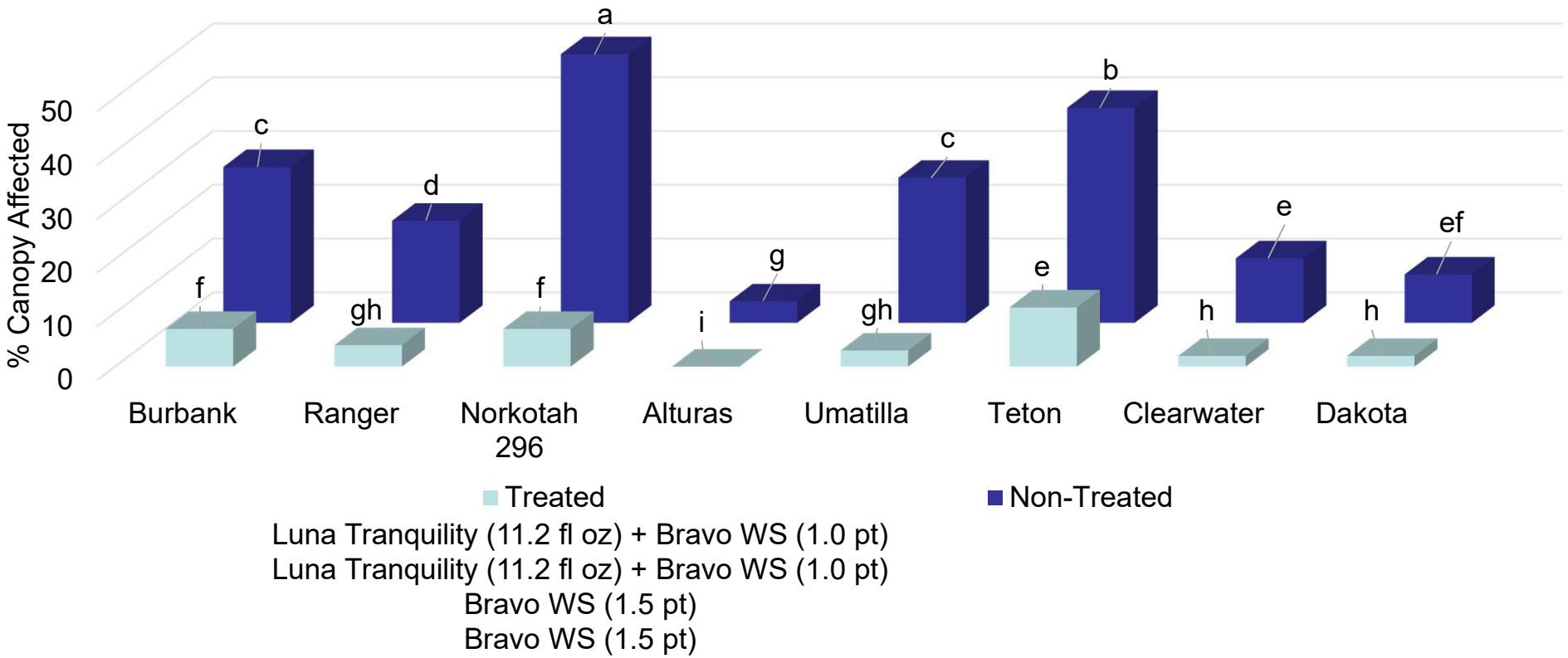
Early Blight/Brown Spot – Variety

% Disease Severity – August 14, 2019



Early Blight/Brown Spot – Variety

% Disease Severity – August 18, 2020



Russet Burbank

August 19

Ranger Russet

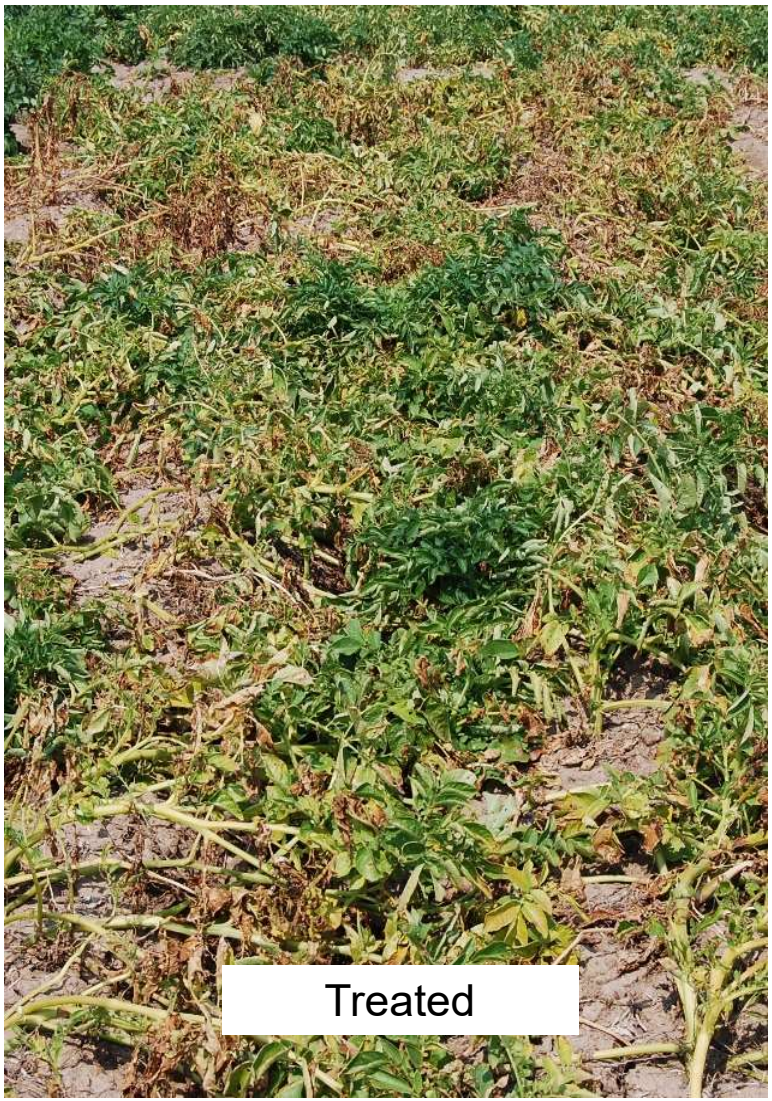
August 19

Russet Norkotah (TX-296)

August 19

Russet Norkotah (TX-296)

August 19

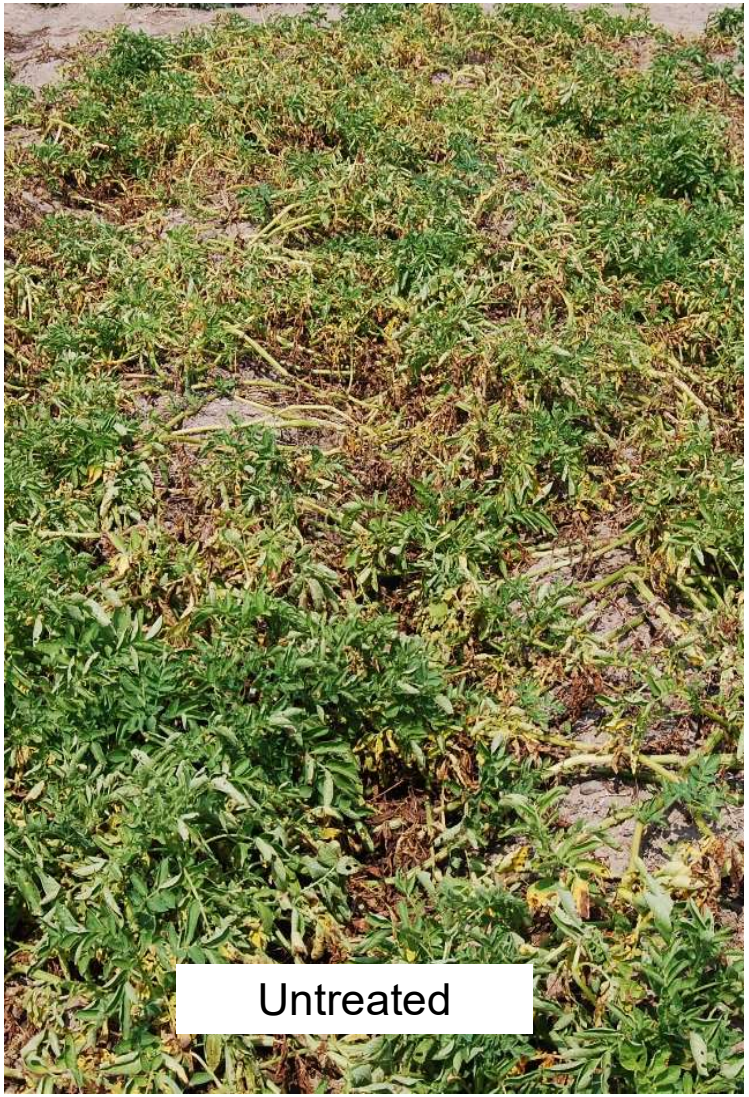


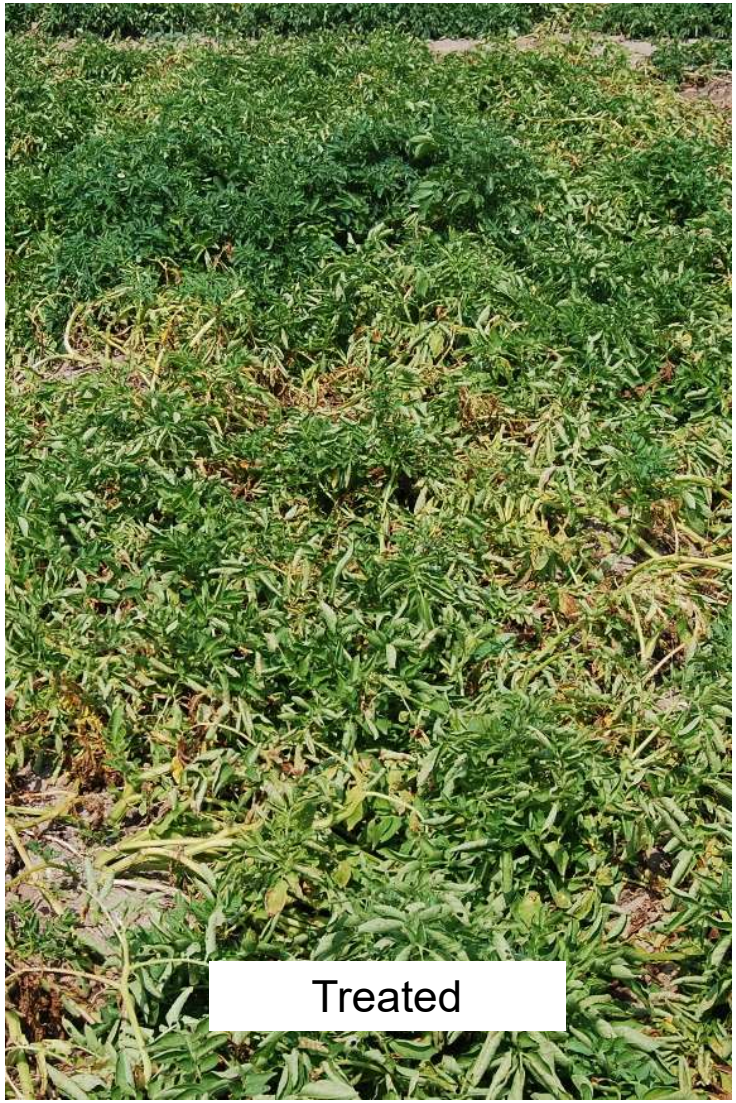
Umatilla Russet

August 19

Umatilla Russet

August 19





Teton Russet

August 19

Alturas

August 19

Dakota Russet

August 19

Clearwater Russet

August 19

Effect of Fungicide Program on Clearwater Yield

	2019		2020	
	Total	Marketable	Total	Marketable
Treated	682	632	672	596
Untreated	652	607	649	582
Difference	+30	+25	+23	+14

It’s important to use the tools properly

Take the comma, for example.

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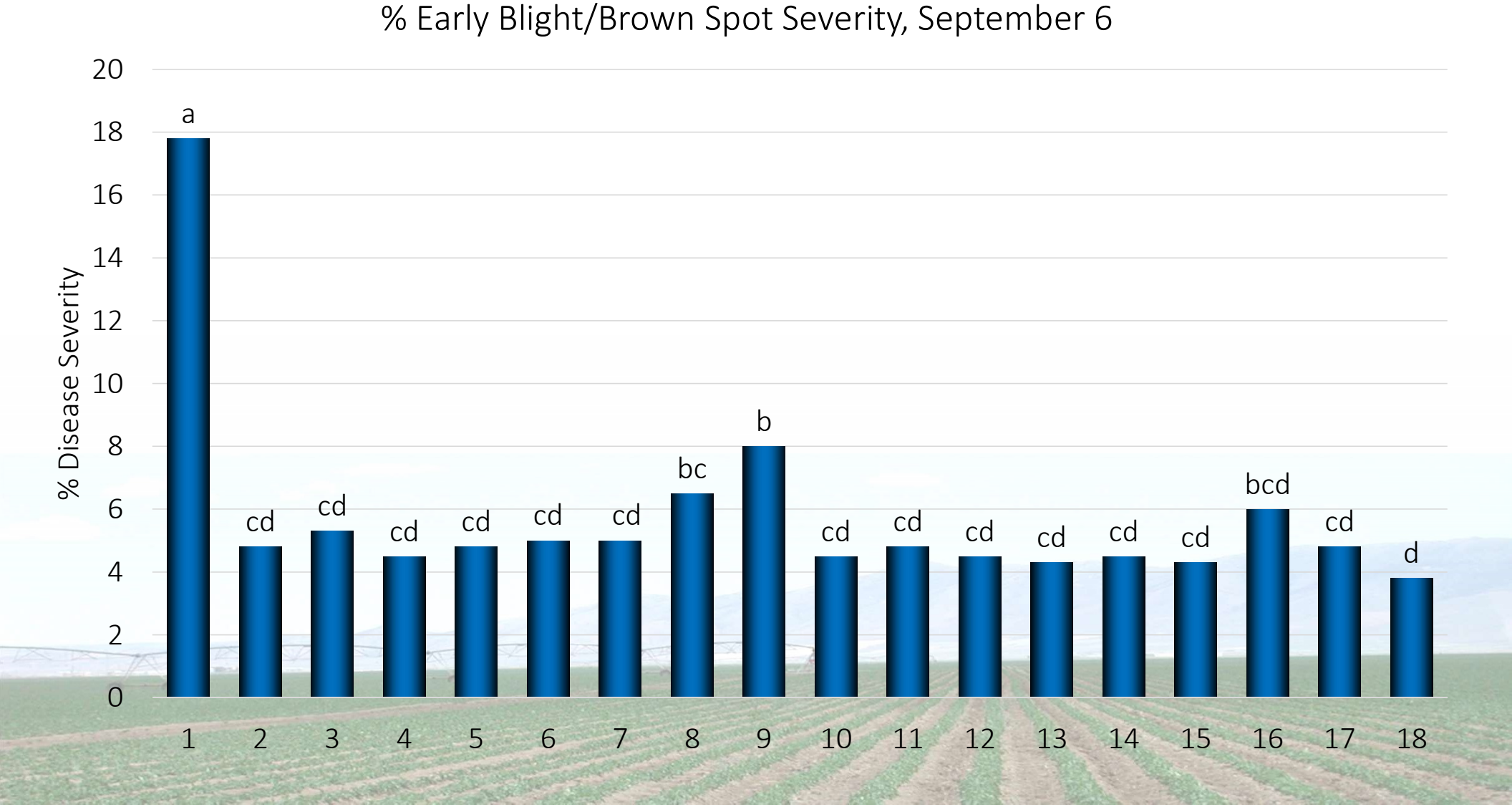
“Premium” Early Blight Fungicides (Selected)

- QoI Fungicides – Group 11*
  - Quadris
  - Headline
  - AZteroid FC
  - Evito
  - Tanos
  - Reason
  - Amistar Top (also group 3)
- Pyrimethanil – Group 9
  - Scala
  - Luna Tranquility (also group 7)
- Organotin – Group 30
  - Super Tin

- Triazoles (DMI) – Group 3
  - Provysol
  - Quadris Top (also group 11)
  - Quash
  - Revus Top (also group 40)
  - Luna Pro (also group 7)
- Carboxamides (SDHI) – Group 7
  - Endura*
  - Luna Tranquility (also group 9)
  - Luna Pro (also group 3)
  - Miravis Prime (also group 12)
  - Vertisan*
  - Priaxor*

* Fungicide Resistance


% Early Blight/Brown Spot Severity, September 6
% Disease Severity
20
18
16
14
12
10
8
6
4
2
0
a
cd
cd
cd
cd
cd
cd
bc
b
cd
cd
cd
cd
cd
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bcd
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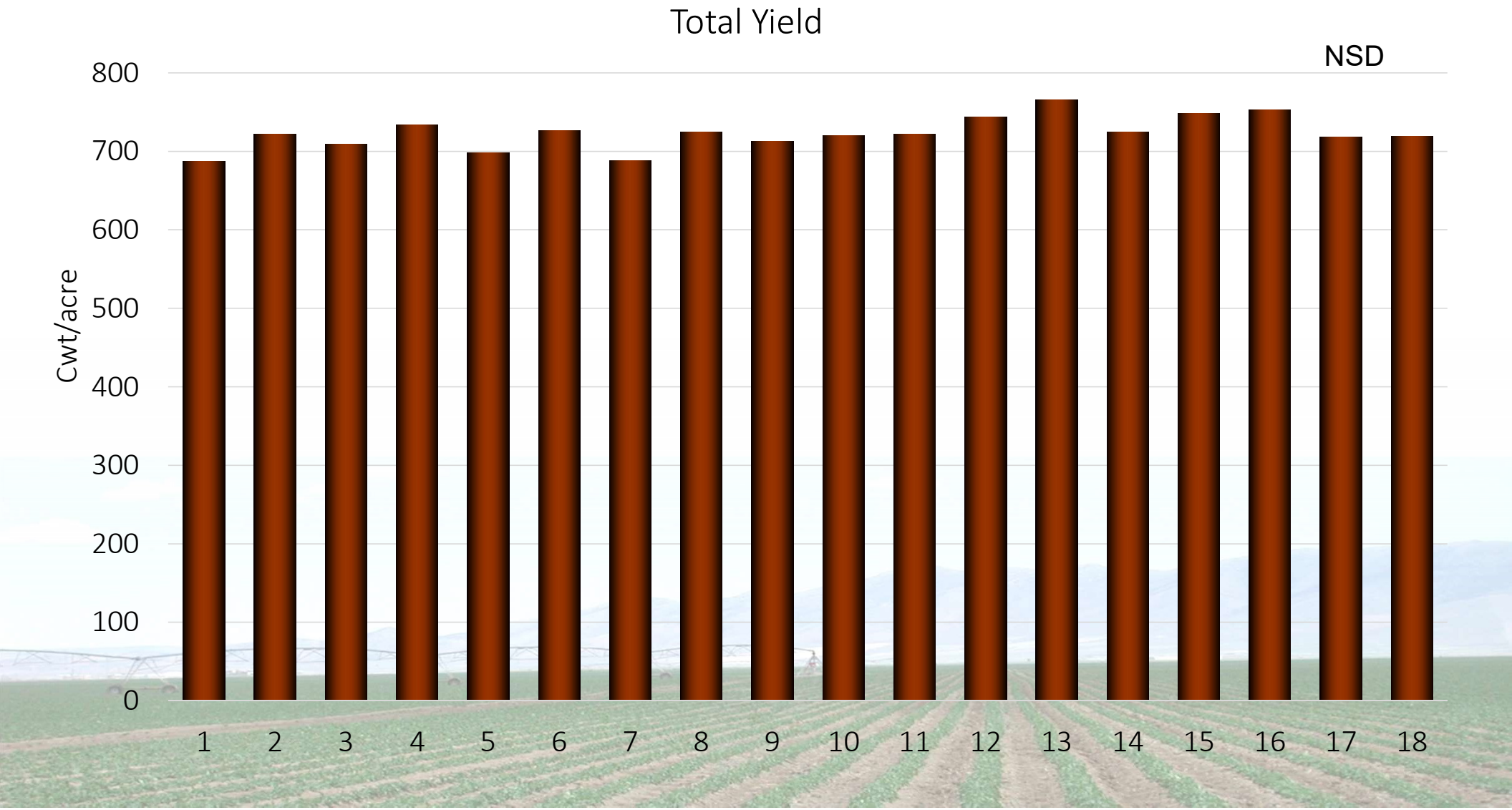
Total Yield
NSD
Cwt/acre
800
700
600
500
400
300
200
100
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18

C. respiration	7 C2 complex II: succinate-dehydro-genase	SDHI (Succinate-dehydrogenase inhibitors)	phenyl-benzamides	benodanil flutolanil mepronil	Resistance known for several fungal species in field populations and lab mutants. Target site mutations in sdh gene, e.g. H/Y (or H/L) at 257, 267, 272 or P225L, dependent on fungal species. Resistance management required. **Medium to high risk** **See FRAC SDHI Guidelines for resistance management.**	7
			phenyl-oxo-ethyl thiophene amide	isofetamid		
			pyridinyl-ethyl-benzamides	fluopyram		
			furan- carboxamides	fenfuram		
			oxathiin-carboxamides	carboxin oxycarboxin		
			thiazole-carboxamides	thifluzamide		
			pyrazole-4-carboxamides	benzovindiflupyr bixafen fluindapyr fluxapyroxad furametpyr inpyrfluxam isopyrazam penflufen penthiopyrad sedaxane		
			N-cyclopropyl-N-benzyl-pyrazole-carboxamides	isoflucypram		
			N-methoxy-(phenyl-ethyl)-pyrazole-carboxamides	pydiflumetofen		
			pyridine-carboxamides	boscalid		
			pyrazine-carboxamides	pyraziflumid		

MONCUT FUNGICIDE

Luna TRANQUILITY

VELUM PRIME

Vitavax

Elatus

Priaxor

EMESTO SILVER

VERTISAN®

Vibrance®

Miravis® Prime

Endura®

MOA	TARGET SITE AND CODE	GROUP NAME	CHEMICAL OR BIOLOGICAL GROUP	COMMON NAME	COMMENTS	FRAC CODE
sterol biosynthesis in membranes	3 G1 C14- demethylase in sterol biosynthesis *(erg11/cyp51)*	**DMI**-fungicides (**De**Methylation Inhibitors) (SBI: Class I)	piperazines	triforine	There are big differences in the activity spectra of DMI fungicides. Resistance is known in various fungal species. Several resistance mechanisms are known incl. target site mutations in cyp51 (erg 11) gene, e.g. V136A, Y137F, A379G, I381V; cyp51 promotor; ABC transporters and others. Generally wise to accept that cross resistance is present between DMI fungicides active against the same fungus. DMI fungicides are Sterol Biosynthesis Inhibitors (SBIs), but show no cross resistance to other SBI classes. **Medium risk.** **See FRAC SBI Guidelines for resistance management.**	3
			pyridines	pyrifenox pyrisoxazole		
			pyrimidines	fenarimol nuarimol		
			imidazoles	imazalil oxpoconazole pefurazoate prochloraz triflumizole		
			triazoles	azaconazole bitertanol bromuconazole cyproconazole difenoconazole diniconazole epoxiconazole etaconazole fenbuconazole fluquinconazole flusilazole flutriafol hexaconazole imibenconazole ipconazole mefentrifluconazole metconazole myclobutanil penconazole propiconazole simeconazole tebuconazole tetraconazole triadimefon triadimenol triticonazole		
			triazolinthiones	prothioconazole		

CruiserMaxx® Vibrance® Potato

CruiserMaxx® Potato Extreme

Vibrance® Ultra Potato

RevusTop®

Quadris Top®

Stadium®

Provysol

QUASH® FUNGICIDE

EMESTO™ SILVER

Luna® PRO

Relative Efficacy of Selected Early Blight Products

	Product	Other Targets
1	Luna Tranquility	White mold, gray mold
	Miravis Prime	White mold, gray mold
	Provysol	(White mold, gray mold)
2	Amistar Top	Black dot, powdery mildew
	Revus Top	Late blight
	Quash (commonly increases yield)	White mold (?)
	Priaxor*	Black dot
3	Endura*	White mold, gray mold
	Quadris*, Headline*	Black dot, powdery mildew
	Rovral	White mold
	Protectants (chlorothalonil, EBDC)	Late blight
	Scala	Gray mold

*Fungicide resistance issues

Relative Efficacy of Selected White Mold Products

	Product	Other Targets
1	Endura	Early blight
	Luna Pro	Early blight
	Luna Tranquility	Early blight, gray mold
	Miravis Prime	Early blight, gray mold
	Omega	Late blight
2	Quash	Early blight
	Rovral	Early blight
	Topsin	

No known resistance issues for white mold.

Some Challenges and Constraints

- Availability of products and MRL issues
- Pressure to reduce certain active ingredients
- Piling on products in a single application
- Industry/personal attitudes
  - Some sales driven by profit margin or relationships, not data
  - “Good Insurance Program” approach
  - “Better than the neighbor”
  - “Sunk Cost” issues