Practical Applications of Westbridge Biocontrol Products

Dr. Larry Parker
Director of Research and Development
Westbridge

Westbridge

SUPPRESS®

EPA Approved
Organic Herbicide

Lawrence Parker, Ph.D.
Director of Research and Development
Westbridge Agricultural Products

SUPPRESS® Herbicide EC
Approved for Organic Production

- **SUPPRESS® Herbicide EC** is EPA Approved
- Registered as an organic broad spectrum contact herbicide for post-emergent, non-selective weed control.
- The formulation is a proprietary low-foaming emulsifiable concentrate that has been approved by the Organic Materials Review Institute (OMRI) and Washington State Department of Agriculture (WSDA) and the US-EPA for use in organic crop production.
- For use in and around all agricultural food and non-food crops, as well as non-agricultural and industrial sites.

OMRI LISTED For Organic Use

REGISTERED MATERIAL For Use In Organic Agriculture Washington State Dept. of Agriculture

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SUPPRESS® Herbicide EC
Mode of Action

- Disrupts cuticle and epidermal layers causing plant desiccation.
- Its activity is against both monocotyledons and dicotyledons.
- Non-specific, so it will burn any plant it comes in contact with.
- Spray drift should be minimized.

SUPPRESS® Herbicide EC
Mode of Action

Sprayed

Not Sprayed

Disrupts cuticle and epidermal layers causing plant desiccation

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SUPPRESS® Herbicide EC
Application and Mixing Instructions

MIXING INSTRUCTIONS:

- Fill tank sprayer with half of the recommended water, then add the appropriate amount of SUPPRESS Herbicide EC. Fill tank with the remaining amount of water.
- The spray solution should have a dilute milky appearance.
- When spraying the solution, **use continuous agitation until all spray solution has been applied.**

Non Agitated

Agitated

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SUPPRESS® Herbicide EC Application and Mixing Instructions

- Use spray solution within 4 hours of mixing.
- Use adequate spray volume to ensure thorough weed coverage
- SPRAY WATER: Adjust pH to 6 or below using BioLink Acidifier prior to adding SUPPRESS Herbicide EC.
- SURFACTANTS:
  - Do not tank mix with silicon-based surfactants.
  - Do not tank mix with surfactants containing calcium.

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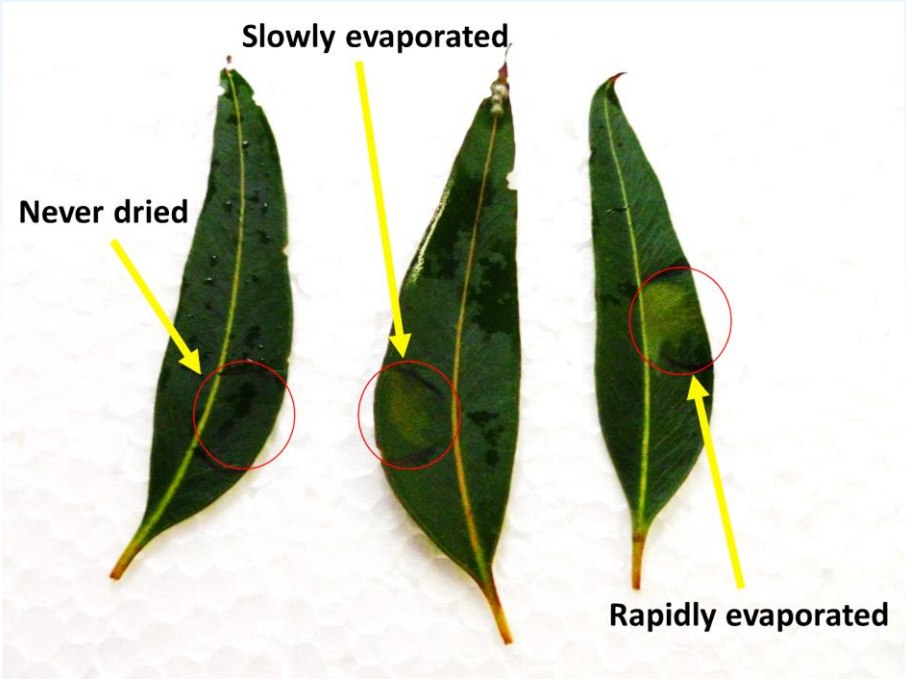
SUPPRESS® Herbicide EC
Effect of Moisture

- Do not apply to weeds when wet from dew, rain or water.



- Do not water within 4 hours after application.
- Do not apply if rainfall is expected within 4 hours of spray.

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Effect of Air Temperature on the Efficacy of SUPPRESS®

Nebraska, 2017

Temperature	
<55	SUPPRESS does not work very well.
55 to 60	SUPPRESS worked but slower.
>60 to <95	SUPPRESS worked very well.
>95	SUPPRESS Did not work.

SUPPRESS was applied at 4.5% in 42 gallons of water per acre using a shielded sprayer

Westbridge

Effect of Weed Age on the Efficacy of SUPPRESS®

- Don’t wait until there is a problem.
- Works best on young actively growing weeds. Try to treat before weeds are 6 inches tall.
- Once the weeds have a significant root system, it will require multiple applications to control regrowth of the weeds
- Poor efficacy on weeds under drought conditions.
- Once weeds are going to seed it is too late. The plant is shutting down and not actively growing.

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SUPPRESS® Herbicide EC
Weed Control in Young Apricot Orchard

Patterson, CA, 2014

Post-treatment

Pre-treatment

Applied at 6% solution and 25 gallons of water per treated acre.

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SUPPRESS® Herbicide EC
Lettuce Thinning and Weed Control Trial

Control

Treated

Westbridge

SUPPRESS® Herbicide EC
Nutsedge Control in Organic Table Grapes

Coachella, CA, 2014

Control

SUPPRESS Herbicide EC - 6% solution

SUPPRESS® Herbicide EC
Weed Control in Pome Fruit

Sonoma County, CA, 2015

Before

SUPPRESS EC Herbicide

24hr After Application

SUPPRESS Herbicide was applied in a 6% solution in 25 gallons of water per acre.

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SUPPRESS® Herbicide EC
Cheeseweed and Filaree Control in Wine Grapes

Sonoma County, CA, 2015

SUPPRESS applied in a 6% solution at 25 GPA.

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SUPPRESS® Herbicide EC
Weed Control in Strawberry

University Trial, CA, 2015

Control

Treated

- High rate used because of large sow thistle weeds
- “Very good burndown [of sow thistle]…of course [small weeds] were controlled close to 100%”

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SUPPRESS® Herbicide EC
Weed Control in Strawberry

University Trial, CA, 2015

Control

Treated

- High rate used because of large sow thistle weeds
- “Very good burndown [of sow thistle]…of course [small weeds] were controlled close to 100%”

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SUPPRESS® Herbicide EC
Weed Control in Organic Raspberries

Field Trial, Watsonville, CA, 2015

SUPPRESS EC Herbicide

SUPPRESS Herbicide was applied in a 6% solution in 25 gallons of water per acre.

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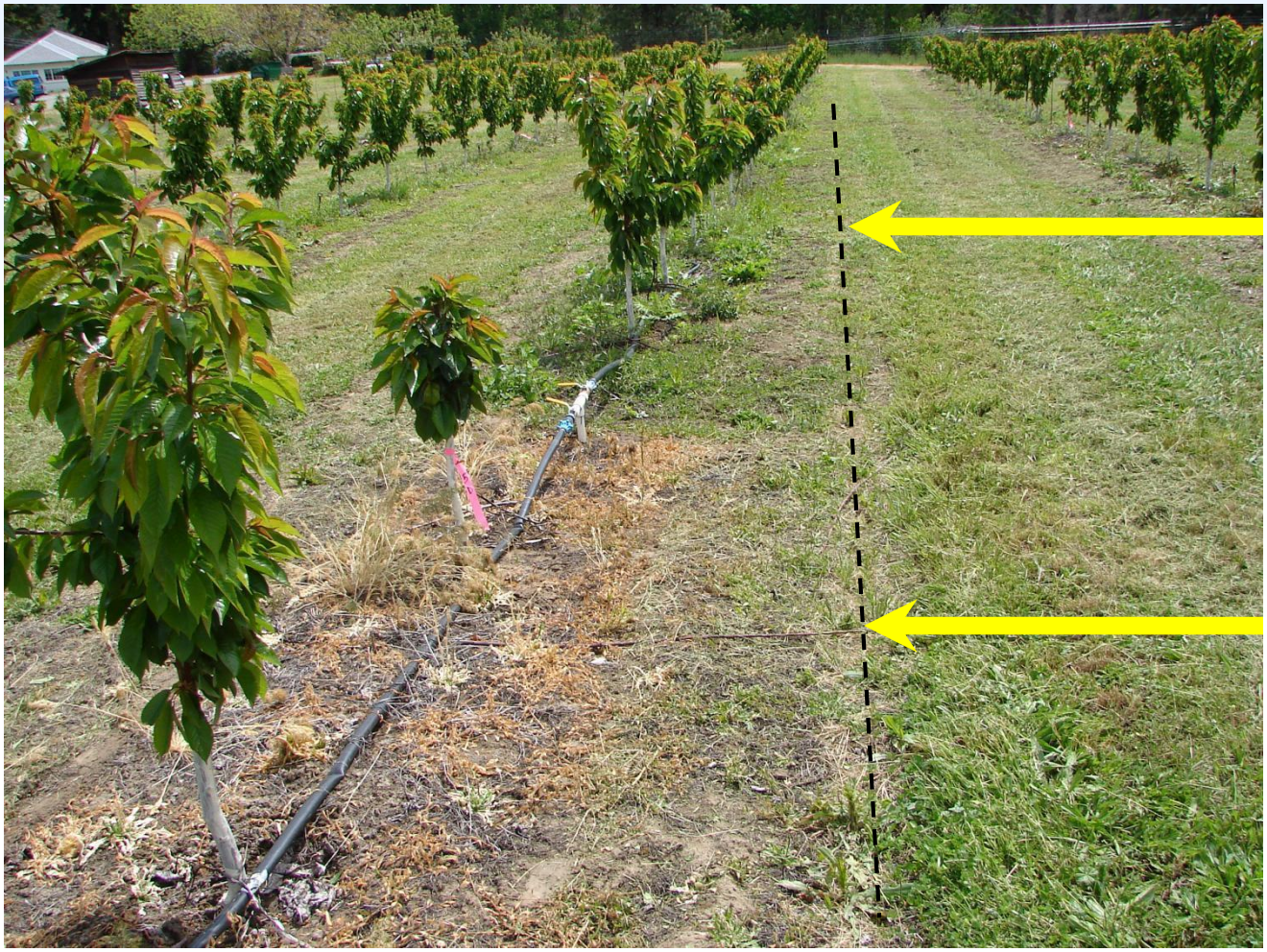
SUPPRESS® Herbicide EC
Trial on Cherries

Washington State University, 2010



Control

4 days post-treatment

SUPPRESS® Herbicide EC
Weed Control in Organic Pears

Field Trial, Courtland, CA, 2015

SUPPRESS EC Herbicide

SUPPRESS Herbicide was applied in a 6% solution in 25 gallons of water per acre.

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SUPPRESS® Herbicide EC
Weed Control in Organic Pistachios

Field Trial, Capay, CA, 2015

Control

SUPPRESS EC Herbicide
24hr After Application

SUPPRESS Herbicide was applied in a 6% solution by hand using an ATV mounted sprayer.

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SUPPRESS® Herbicide EC
Weed Control in Organic Figs

Field Trial, Capay, CA, 2015

SUPPRESS EC Herbicide

SUPPRESS Herbicide was applied in a 6% solution by Backpack sprayer.

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SUPPRESS® Herbicide EC
Weed Control in Blueberries

Oregon, 2016

Check

SUPPRESS

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SUPPRESS® Herbicide EC
Woolly Distaff Thistle Control in Rangeland

University Trial, Marin County, CA, 2015

Control **SUPPRESS Herbicide EC**

SUPPRESS Herbicide was applied in a 9% solution in 100 gallons of water per acre.

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SUPPRESS® Herbicide EC
Weed Control in Onions

2017

SUPPRESS Herbicide EC

Control

SUPPRESS was applied at 3% in 32 gallons of water per acre between late Whip Stage and the 3rd leaf Stage.

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SUPPRESS® Herbicide EC
Weed Control in Onions

2017

SUPPRESS was applied at 3% in 32 gallons of water per acre between late Whip Stage and the 3rd leaf Stage.

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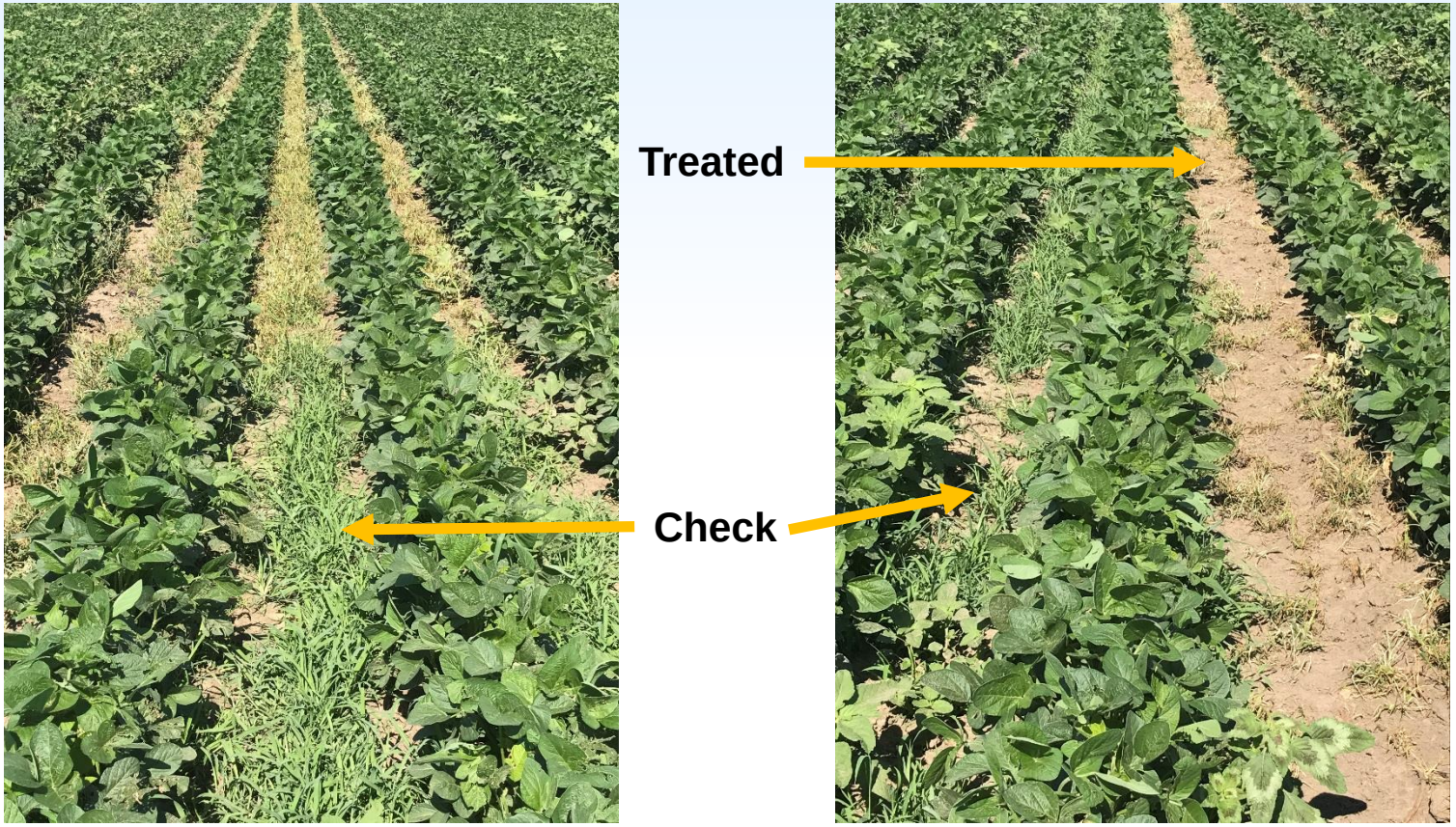
SUPPRESS® Herbicide EC
Weed Control in Soybeans

Nebraska, 2017



SUPPRESS was applied at 4.5 in 42 gallons of water per acre using a shielded sprayer

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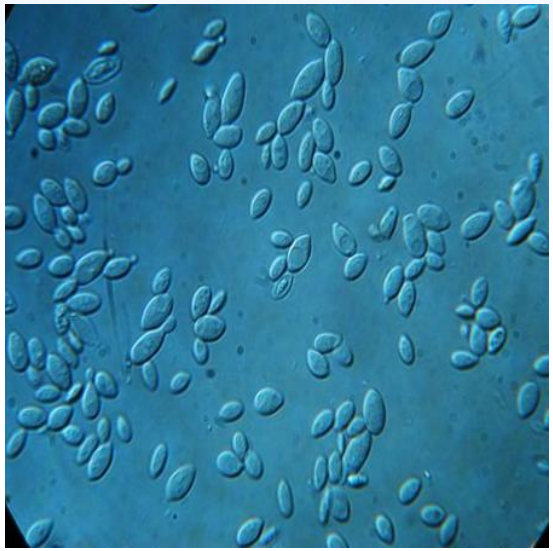
Blossom Protect™
Fire Blight Control

Larry Parker, Ph.D.
Westbridge Agricultural Products
Vista, CA

What is Blossom Protect™?

- Blossom Protect (51.6% active ingredients)
  - Contains two strains of the yeast-like microorganism *Aureobasidium pullulans*
  - Activity is against bacteria
- Labeled for control of fire blight on pome fruit and blight on walnuts
- Blossom Protect MUST be tank-mixed with Buffer Protect
  - Creates favorable microclimate for yeast to flourish
- Multiple applications to build up populations
- Mode of Action is competitive exclusion
  - Uses population dynamics to facilitate control
  - **No direct toxicity**



Microscopic view of

Aureobasidium pullulans

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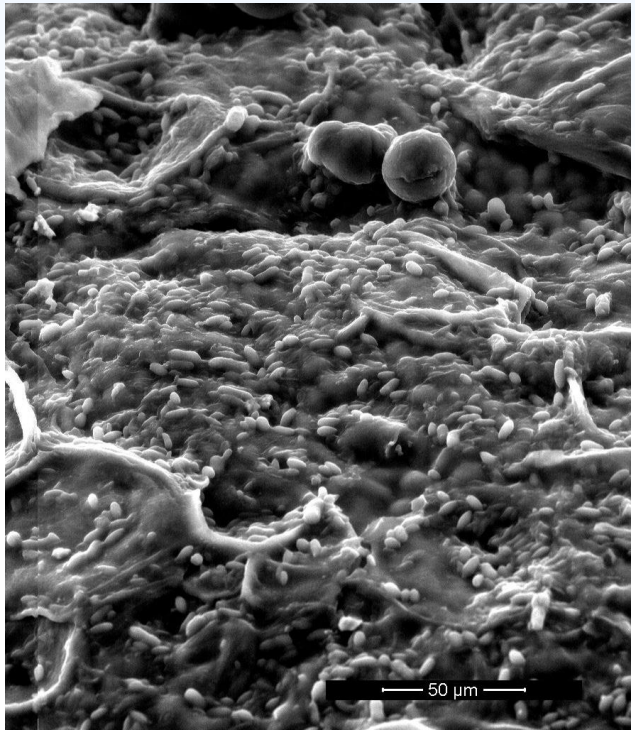
What is Competitive Exclusion?

Flower Colonization by *Aureobasidium pullulans*



- It is competition for space and nutrients
- One organism (biopesticide) is more aggressive than the other (pathogen)
  - Faster growing
  - More aggressive in nutrient uptake
  - May have a broader tolerance to temperature or moisture
- It is preventative and must be applied prior to infection by the pathogen
- It is not a curative

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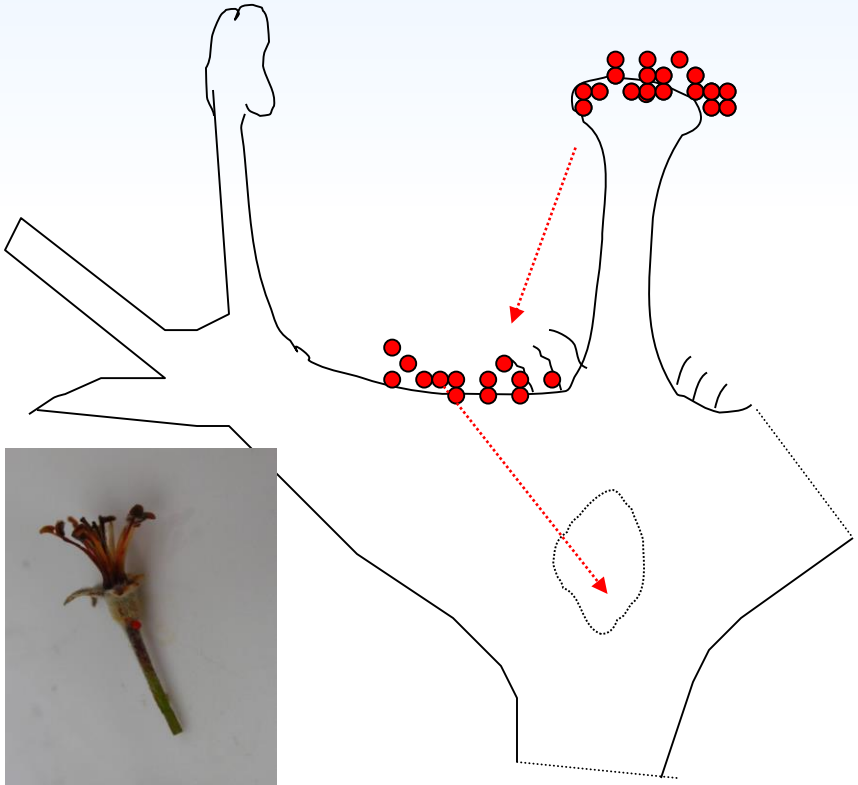
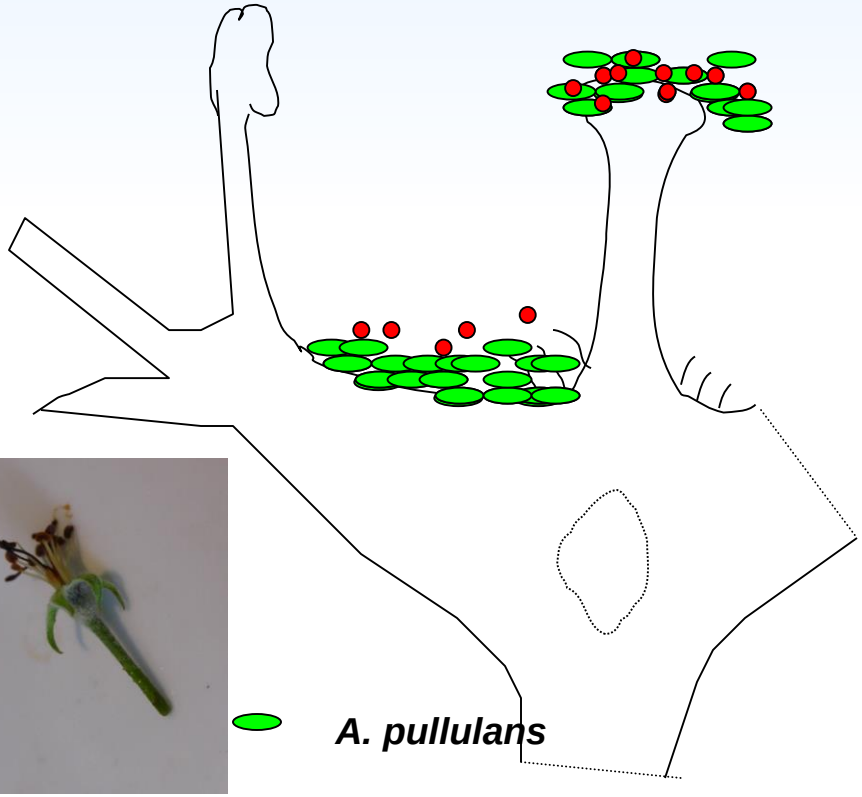
Blossom Protect™ Works to Prevent Fire Blight

Untreated



● *E. amylovora*

Blossom Protect™



⬭ *A. pullulans*

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Blossom Protect™ Application Instructions

- Must be used within 8 hours of mixing
- Can be applied with all conventional spray equipment
- ***Cannot*** be tank-mixed with copper or sulfur
- Applying copper under acidic conditions will cause russeting. Buffer Protect is strongly acidic. Allow a minimum of 2 days after copper applications for Blossom Protect application, especially in cool, wet conditions

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Forecast Models for Predicting the Potential for Fire Blight

Cougarblight Forecast Model

- Major Parameters
  - The presence of flowers
  - The level of disease pressure in the orchard
  - The temperatures that have occurred over the last four days (96 hours)
  - The documentation of a two hour or more blossom wetting event

Maryblight Forecast Model

- **When at least 3 of the following conditions are met**
  - Open and healthy blossom (pistil and anther present)
  - > 110 hours @ 65F (18.3^0C)
    - Builds the epiphytic population level of the pathogen
  - Free moisture (rain or dew) the same day or the day before
  - Daily average temperature over 60F (15.6^0C)

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When to Apply Blossom Protect™

Regular treatment when…

10% Bloom

40% Bloom

70% Bloom

90% Bloom

...blossoms are open

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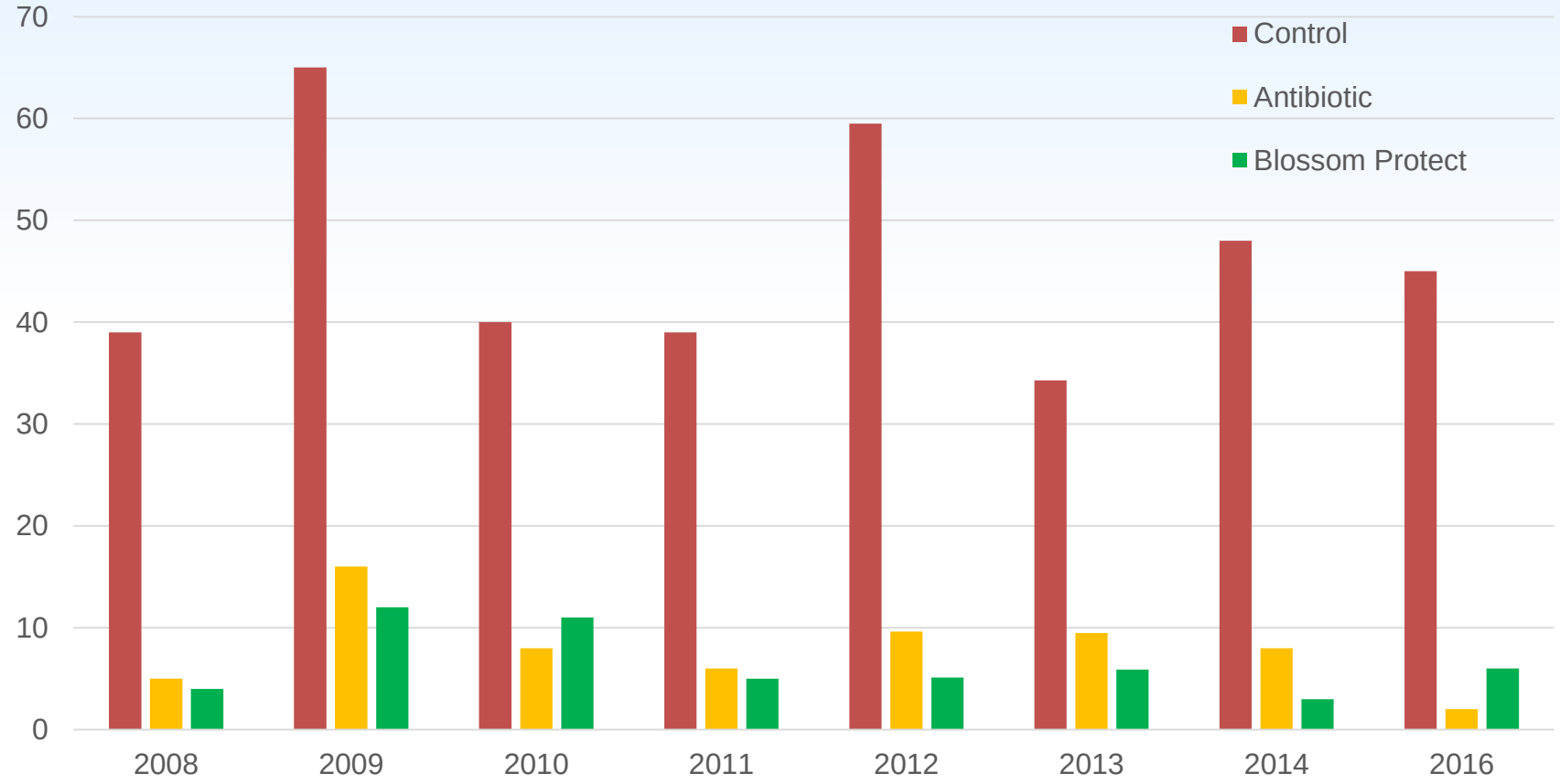
Effect of Blossom Protect™
Control of Fire Blight on Red Delicious Apples

University Trials, Washington, 2008-2016



All treatments were inoculated with a streptomycin sensitive strain of *Erwinia amylovora*

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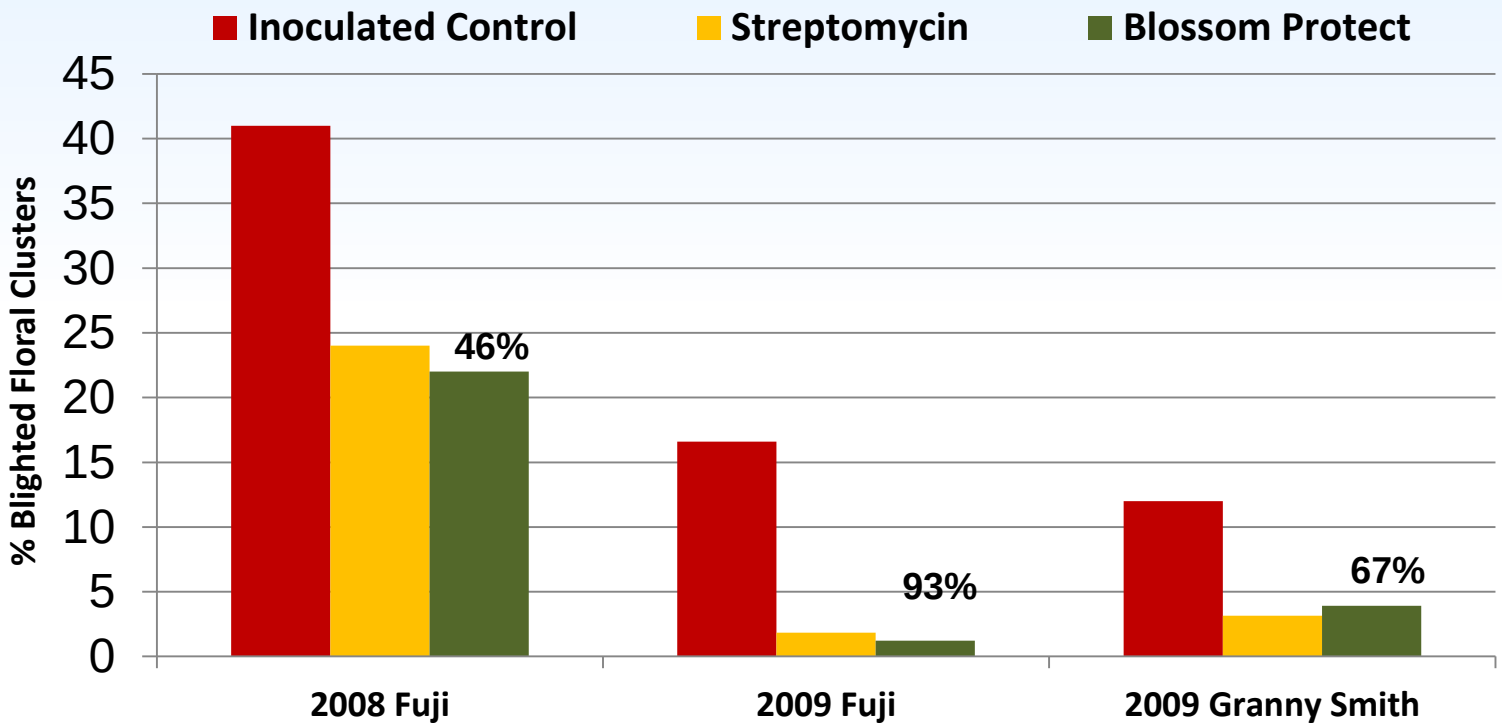
Effect of Blossom Protect™
Control of Fire Blight on Fuji and Granny Smith Apples

University Trials, California, 2008-2009



All treatments were inoculated with a streptomycin sensitive strain of *Erwinia amylovora*

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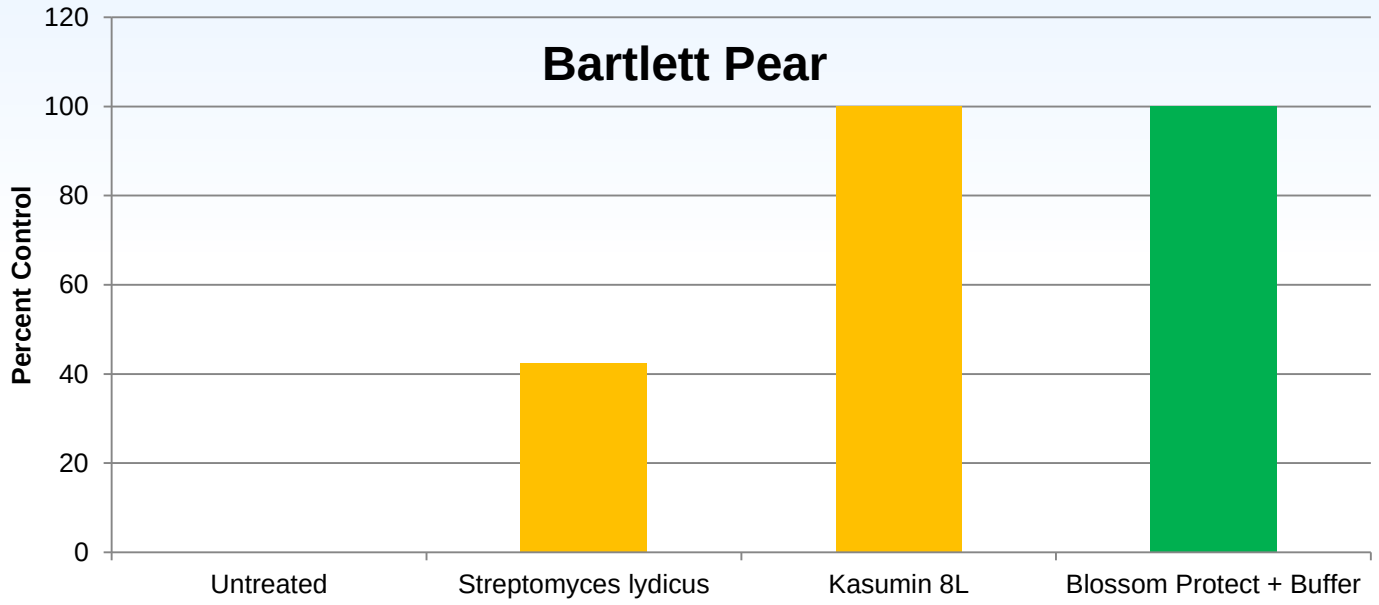
Effect of Blossom Protect™
Control of Fire Blight on Bartlett Pears

University Trial, CA, 2012



Treatments were applied on 3-26 (70% bloom), 4-2 (full bloom), 4-9 (petal fall), 4-14 (begin rattail), and on 4-24-12 (rattail) using an airblast sprayer at 100 gal/A.

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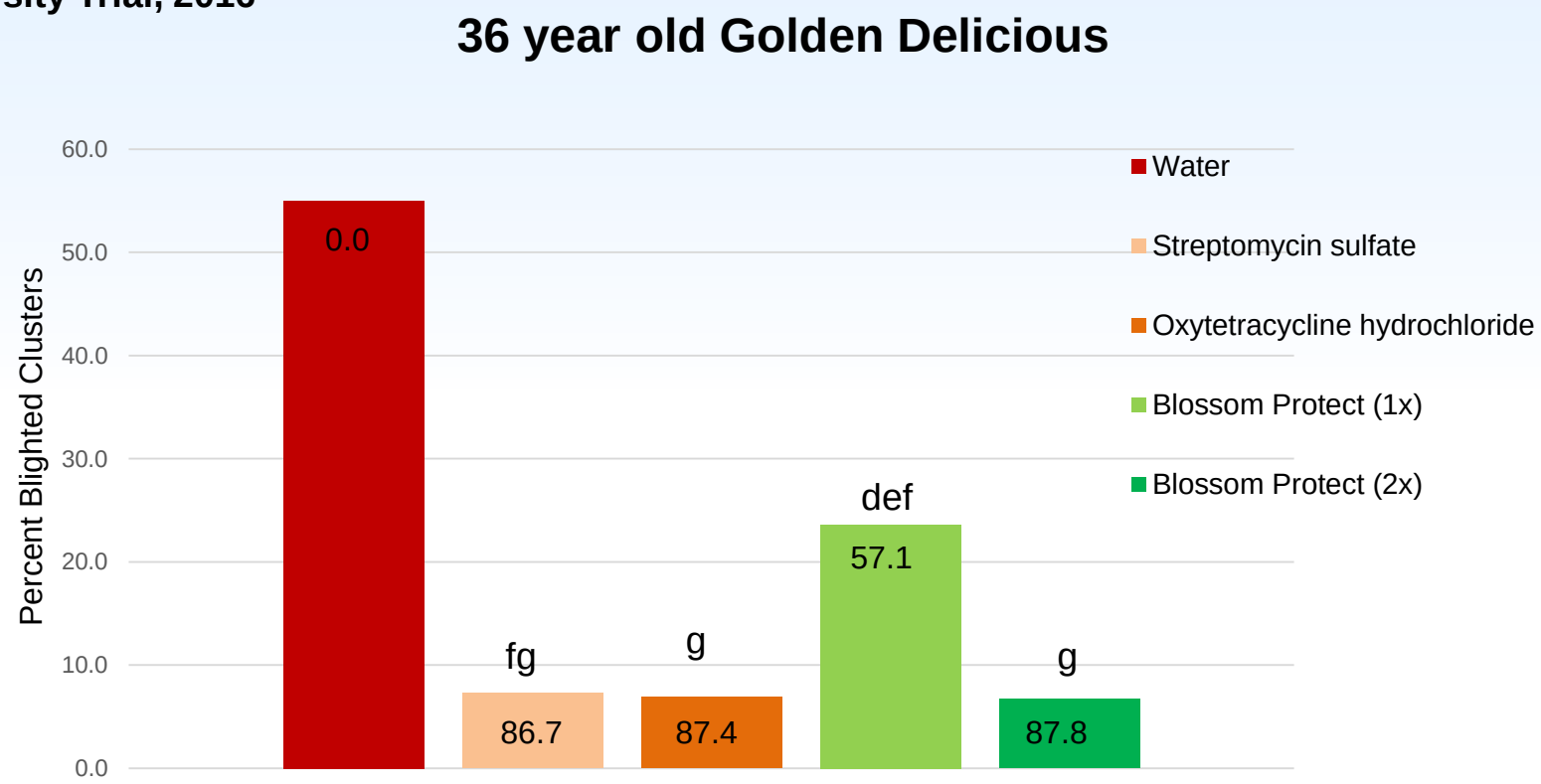
Blossom Protect™ for Fire Blight Control
Effect of a Second Application

University Trial, 2016



-Treatment dates: 4/6/19 (60% bloom), 4/9/16 (full bloom), and 4/12/16 (petal fall)
-Blossom Protect applied on 4/6 and 4/9
-Streptomycin applied on 4/9 and Oxytetracycline applied on 4/9 and 4/12

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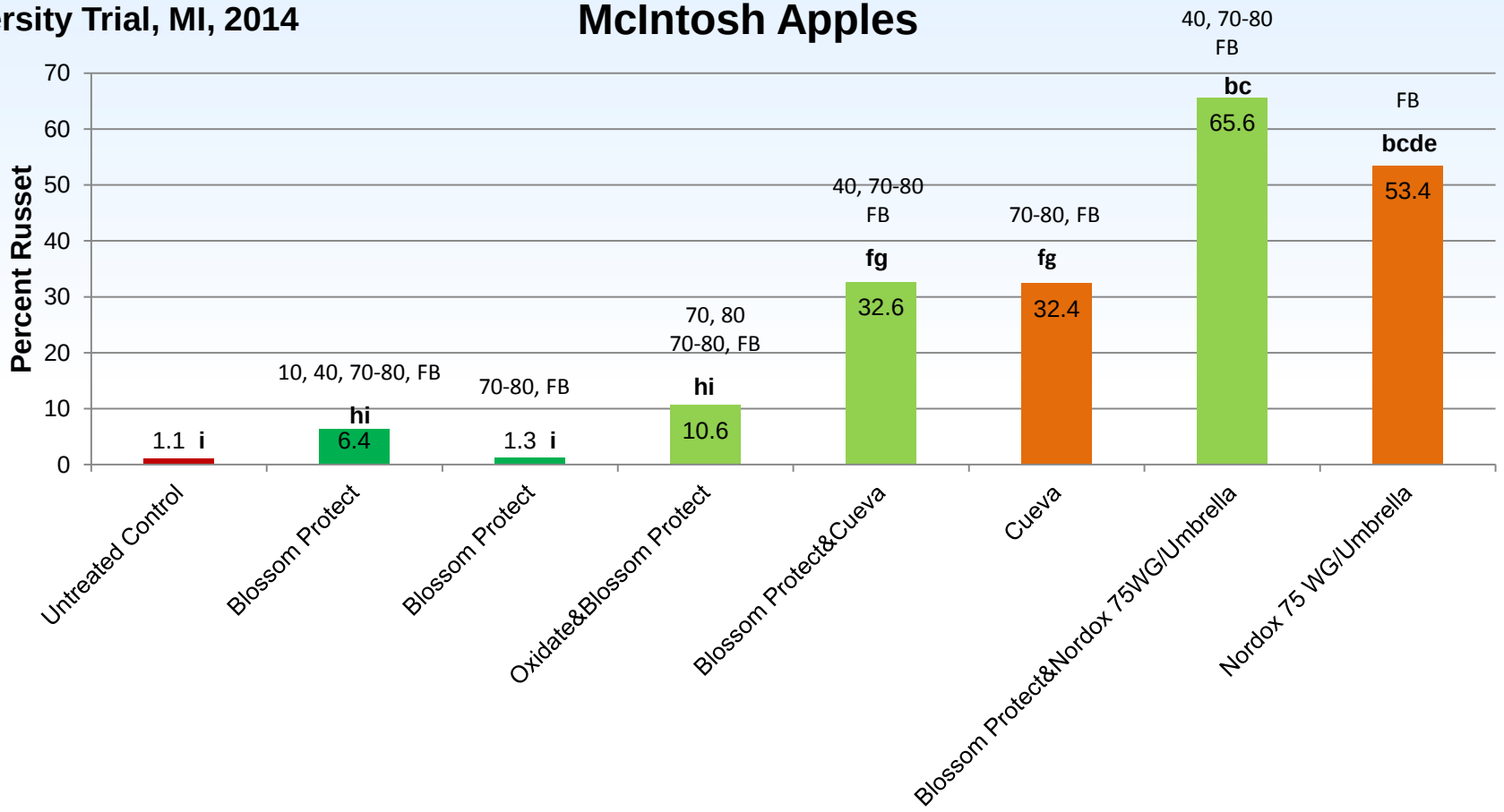
Blossom Protect™ for Control of Fire Blight Russet Tendencies

University Trial, MI, 2014

McIntosh Apples



- **Schedule:** 5/12 (10% bloom), 5/13 (40% bloom), 5/14 (70-80% bloom), 5/17 (full bloom), 5/29 (petal fall), 5/29 (1st cover)
- All Blossom Protect treatments with Buffer Protect at a 7:1 ratio (Buffer Protect:Blossom Protect)
- Blossom Protect at 1.34 lb, Cueva@0.5 %, Nordox 75 WG at 1.25 lb, and Umbrella at 0.125%
- All treatments with copper resulted in unacceptable levels of russet in this trial

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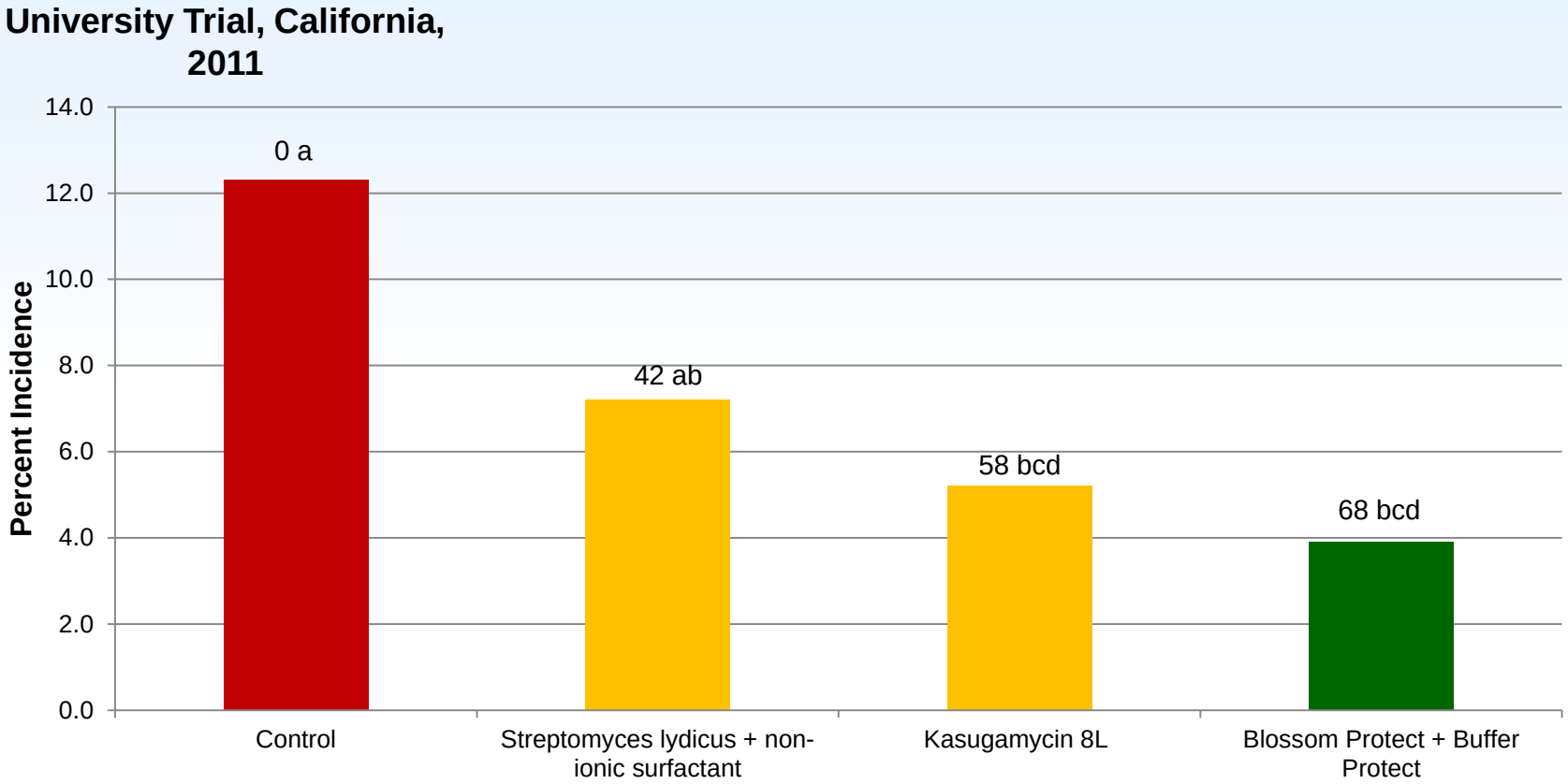
Blossom Protect™ for Control of Walnut Blight



Pathogen: *Xanthomonas arbicola* pv. *juglandis*

Application Dates (6): 4/14, 4/21, 4/27, 5/10, 5/16, and 5/26

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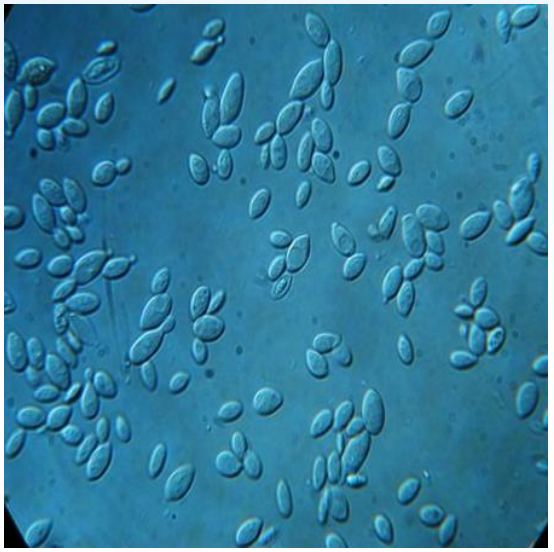
Effect of Botector® on Fruit Diseases

Lawrence Parker, Ph.D.
Director of Research and Development
Westbridge Agricultural Products

Botector®

EPA Registered for use in Certified Organic Production

- 80% active ingredient *(Aureobasidium pullulans)*
  - Labeled for control of:
    - Botrytis in grapes, berries and tomatoes
    - Anthracnose, phomopsis and rhizopus rots in berries
    - Blossom blight and brown rot in almonds and stone fruit
  - Activity is mostly against fungi
  - Mode of Action (MoA) is competitive exclusion



Microscopic view of *Aureobasidium pullulans*

REGISTERED MATERIAL For Use In Organic Agriculture Washington State Dept. of Agriculture

FOR ORGANIC PRODUCTION

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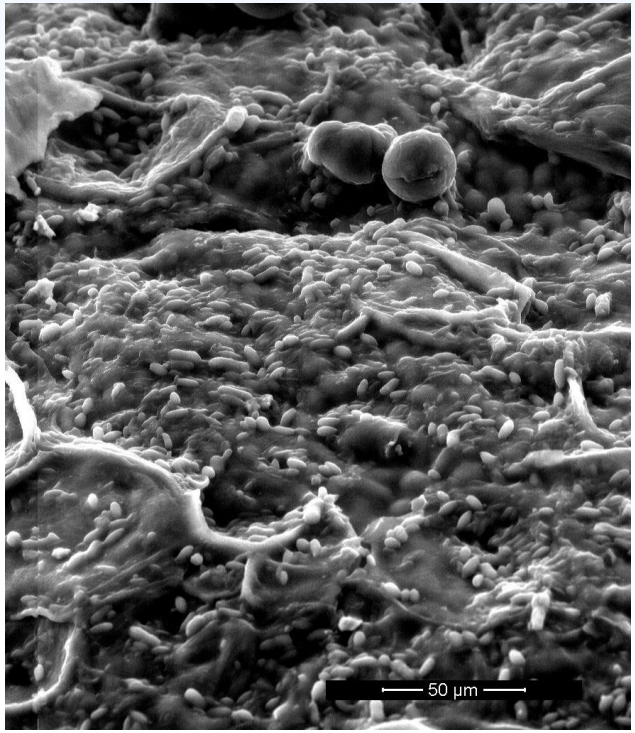
What is Competitive Exclusion?

Flower Colonization by *Aureobasidium pullulans*



- It is competition for space and nutrients
- One organism (biopesticide) is more aggressive than the other (pathogen)
  - Faster growing
  - More aggressive in nutrient uptake
  - May have a broader tolerance to temperature or moisture
- It is preventative and must be applied prior to infection by the pathogen
- It is not a curative

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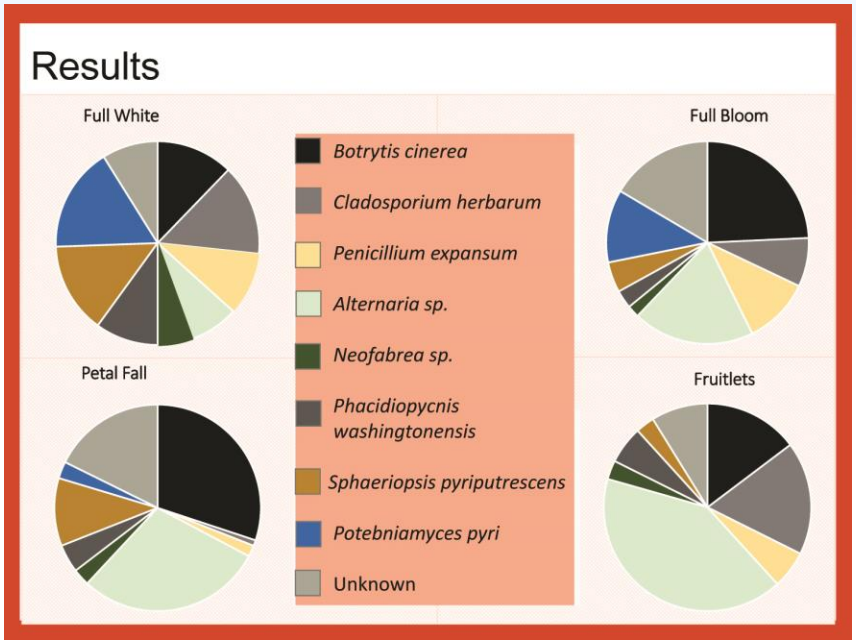
When Should You Start Botector® Applications?

Pathogen counts



Achala Nepal KC

achala.kc@oregonstate.edu

- Numerous pathogen spores are present on flowers during bloom
- As fruitlets develop the pathogens move onto the fruit
- Botector is very aggressive at colonizing flower surfaces
  - Occupying space
  - Utilizing nutrients
- Effectively blocking establishment of various pathogens
- When should you start Botector applications?

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Rates vs. Number of Applications

- For biopesticides with living active ingredients, it is an epidemiological approach to disease control
- Rate responses are not as pronounced as they are with active ingredients that are directly toxic to the pathogen
- Better coverage, and therefore control, can be achieved with multiple applications at low to intermediate rates than single applications at high rate

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Advantages of Using Botector®

- Shown to be safe for use around bees and beneficial insects.
- Excellent IPM and resistance management partner for both organic and conventional programs.
- Unique mode of action eliminates chance of resistance development.
- Naturally occurring ubiquitous microorganisms exempt from MRL's, making it an ideal product to use when pesticide residues are a concern.
- No visible residues left from the compound after application.
- Does not affect fermentation or wine quality.
- Zero (0) Day Pre-Harvest Interval

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Product Storage and Disposal

Botector® is biologically active and is perishable:

- **KEEP REFRIGERATED FOR MAXIMUM SHELF LIFE. DO NOT FREEZE.**

Temperature (degrees F)	Storage Time (months)
<46	30
<68	18
>100	<1

- Must be stored out of direct sunlight in a cool dry place.
- Always keep out of reach of children.
- Wastes resulting from the use of this product may be disposed of on-site or at an approved waste disposal facility.

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Botector®
Biological Compatibilities

Active Compound	Compatibility
Bacillus amyloliquefaciens strain D747	Yes
Ampelomyces quisqualis	Yes
Gliocladium catenulatum	Yes
Bacillus subtilis IAB/BS03	Yes
Saccharomyces cerevisiae LAS117	Yes
Bacillus ameliloquefaciens Serenade ASO	Yes
Bacillus pumilus QST2808	Yes
Bacillus thuringiensis spp	Yes
Codling moth granulose virus	Yes
Bacillus subtillus Serenade Max (WP)	no

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Botector®

Other Allowed Organic Pesticide Compatibilities

Active Compound	Compatibility
Reynoutria sacchalinensis	Yes
Clarified hydrophobic extract of Neem Oil	Yes
Laminarin and seaweed products	Yes
Neem	No
Orange oil	No
Spinosad	Yes
Potassium salts of fatty acids	No
Potassium hydrogen carbonate	Yes
Sodium hydrogen carbonate	Yes

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Botector®
Copper and Summer Oil Compatibilities

Active Compound	Compatibility
Copper hydroxide	Yes
Copper sulfate	Yes
Bordeaux mix	Sometimes (a function of composition)
Copper oxychloride	Yes
Copper chloride	Yes
Copper Octanoate	No
Trilogy	Yes
Sunspray 6E Summer Oil	Yes

- It would be prudent to apply Botector after these materials, if possible
- Bordeaux mix has lime at variable levels, therefore inconsistent compatibility results
- These are not compatible with Blossom Protect due to pH interactions, not viability issues

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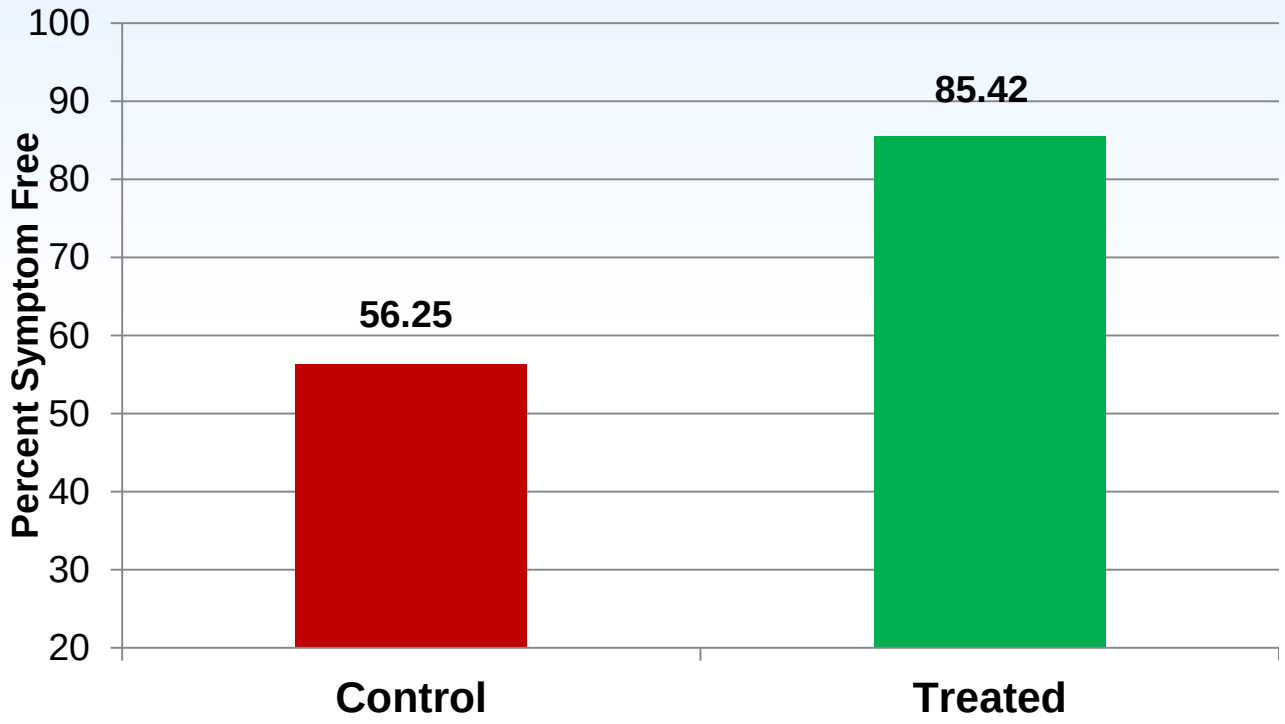
Botector® for the Control of Botrytis and Rhizopus in Strawberries var. Camarosa

Trial at Commercial Organic Farm, San Diego County, CA, 2013



- Applications of 6 oz/Acre at 2/28, 3/7, 3/14, 3/22, and 3/28
- Harvested on 4/11 and held at >70 F and 100% RH for 3 days

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Botector® on Camarosa Strawberries Post 3 Days @ 70º F and 100% RH

Commercial Organic Farm, CA, 2013

Control (Untreated)

Botector® Treated

- Botector® applications of 6 oz/Acre at 2/28, 3/7, 3/14, 3/22, and 3/28
- Harvested on 4/11 and held at >70 F and 100% RH for 3 days

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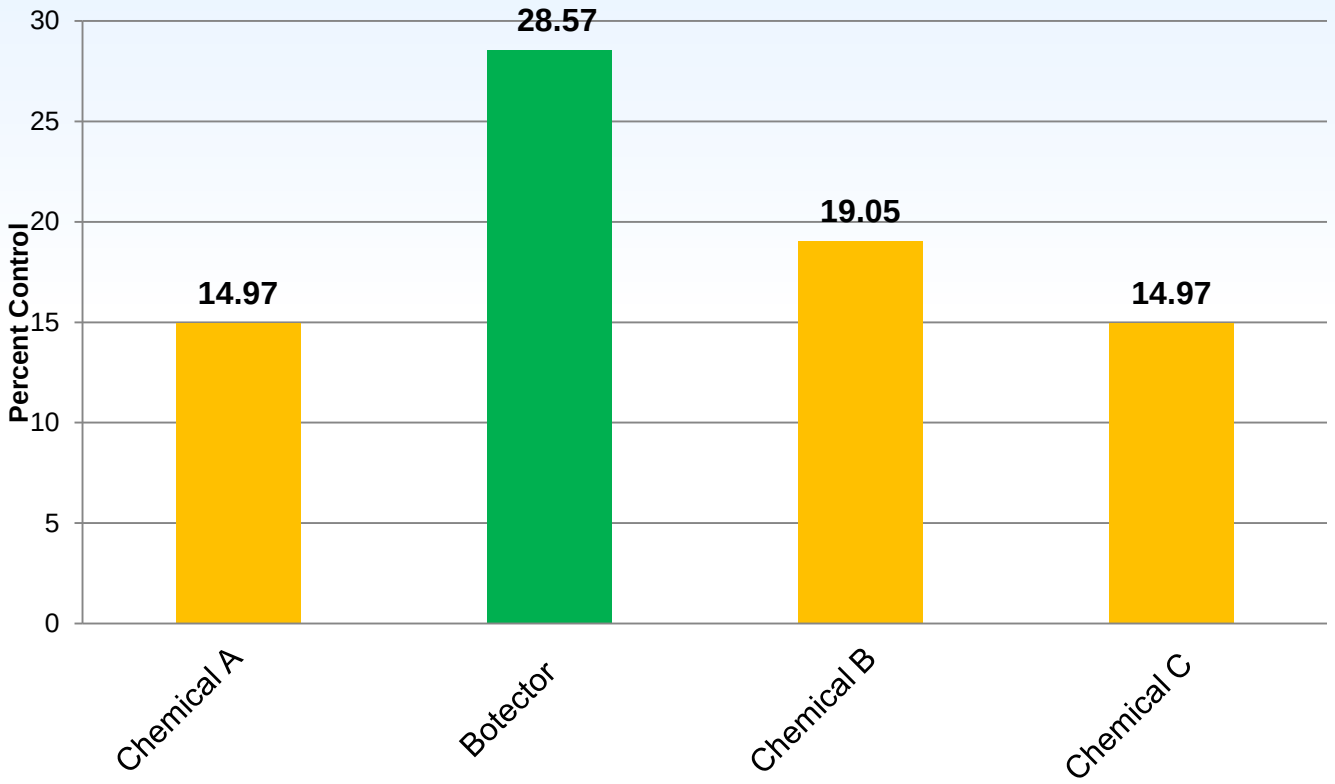
Botector® Increases Botrytis Control on Strawberries

University Trial, CA 2012



-Spray Schedule: 6/8, 6/22, 7/6, and 7/20. GPA: 150. PSI: 120.
-Pristine, Merivon, and Actinovate were respective chemical treatments

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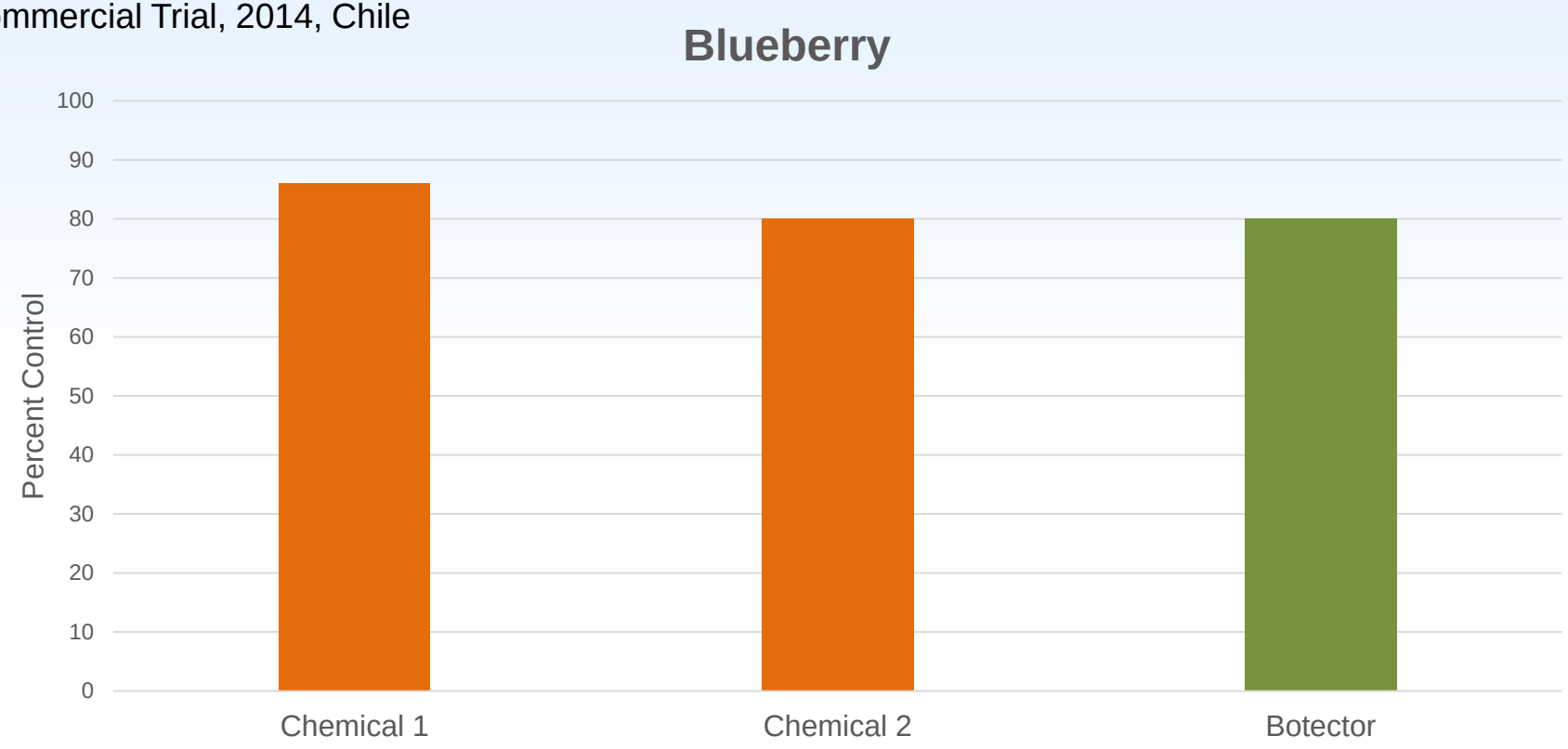
Botector® for Botrytis Control

Commercial Trial, 2014, Chile



-Application Timings **1**: full bloom, **2**: green fruit, **3**: blue fruit, **4**: post harvest
-Chemical 1: Cyprodinil/Fludioxinil **1-4**
-Chemical 2: Pyrimethanil **1-4**
-Botector: **1-4**
-Untreated infection level was 44%

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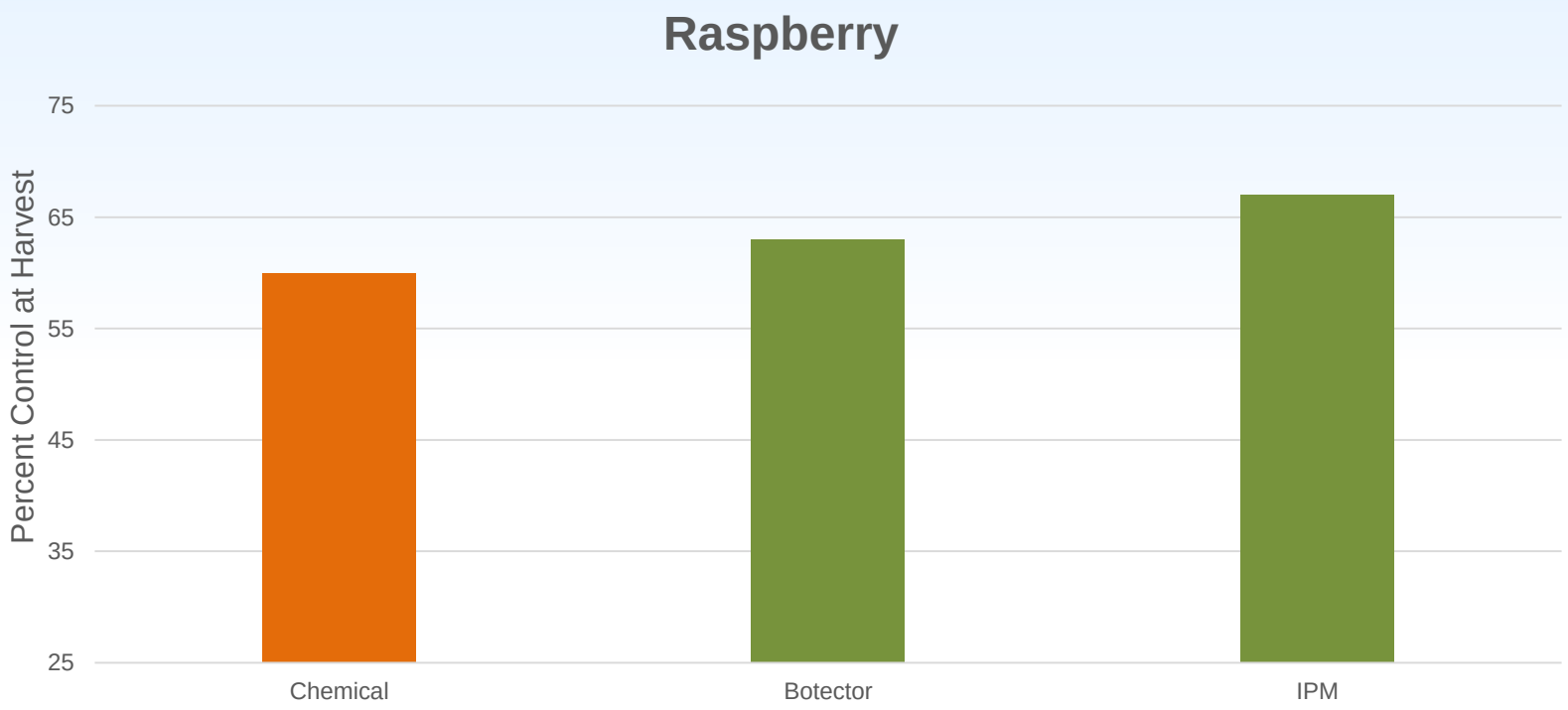
Botector® for Botrytis Control

Commercial Trial, 2014, Canada



-Application Timings **1**: BBCH 62, **2**: BBCH 65, **3**: BBCH 69, **4**: BBCH 74, **5**: BBCH 79, **6** BBCH 81
(BBCH 60-69 flowering, BBCH 70-79 fruit maturation, BBCH 80-89 fruit ripening)
-Chemical: Cyprodinil/Fludioxinil **1,3;** Pyrimethanil **2,4**
-Botector: **1-6**
-IPM: Cyprodinil/Fludioxinil **1;** Pyrimethanil **2**; Botector **3,4,5,6**
-Untreated infection level was 50%

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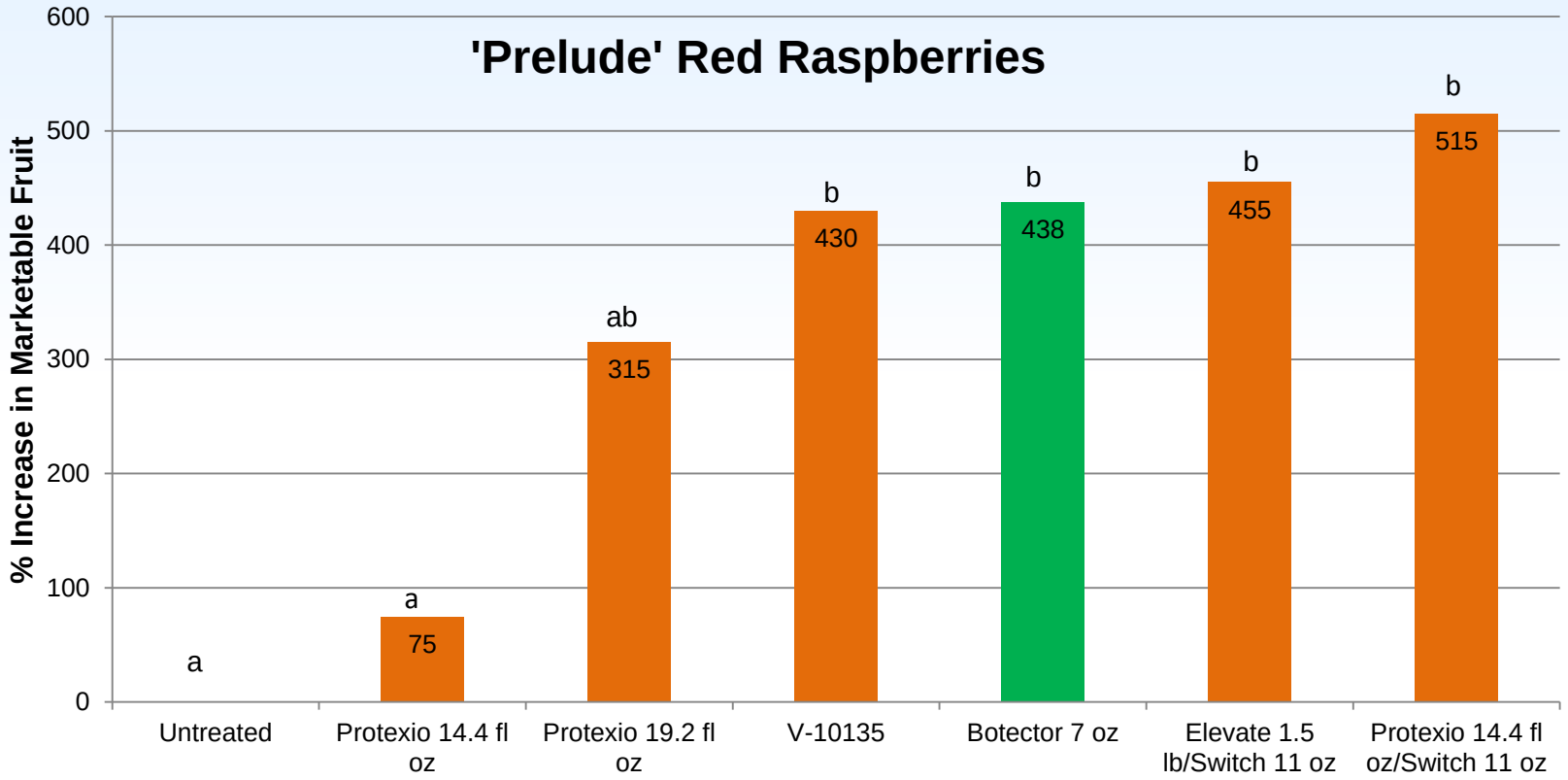
Botector® for Gray Mold Control

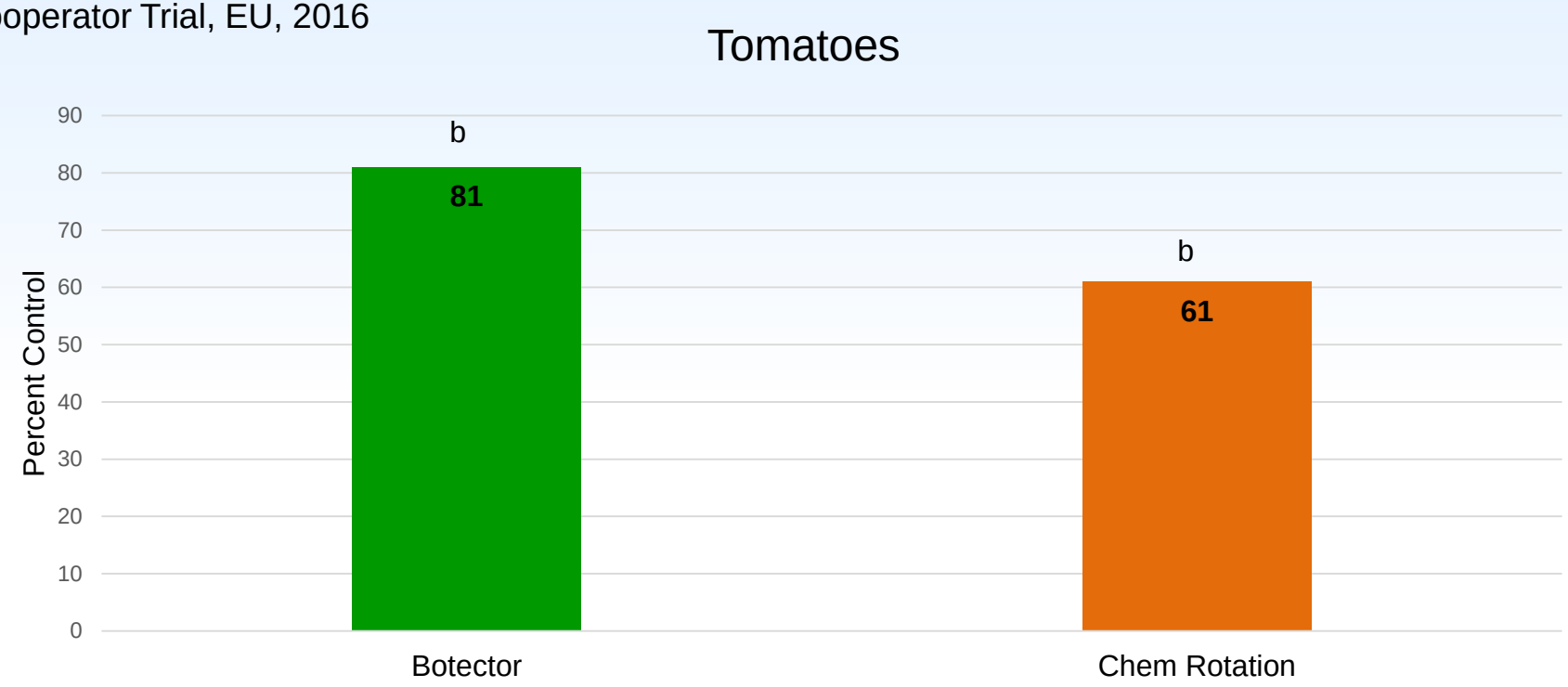
University Trial, MI, 2014



- Schedule: **1** = 5/23 green up; **2** = 6/3 bloom; **3** = 6/13 bloom and green fruit; **4** = 6/20 bloom and green fruit; **5** = 6/25 green & red fruit; **6** = 7/9 red fruit . Combo treatments alternated spray dates.
- 50 fruit were harvested on July 11 and placed at 100% RH for three days and evaluated for disease.

Botector® for the Control of Botrytis

Cooperator Trial, EU, 2016



- Control was 44% incidence, statistically an “a”
- Five applications made, approximately 7-10 days apart
- All Botector was at 1 kg/ha
- Chem Rotation: (1) Switch 0.8 kg/ha, (2) Elevate 1.5 L/ha, (3) Rovral 2.2 L/ha, (4) Elevate 1.5 L/ha, (5) Rovral 2.2 L/ha

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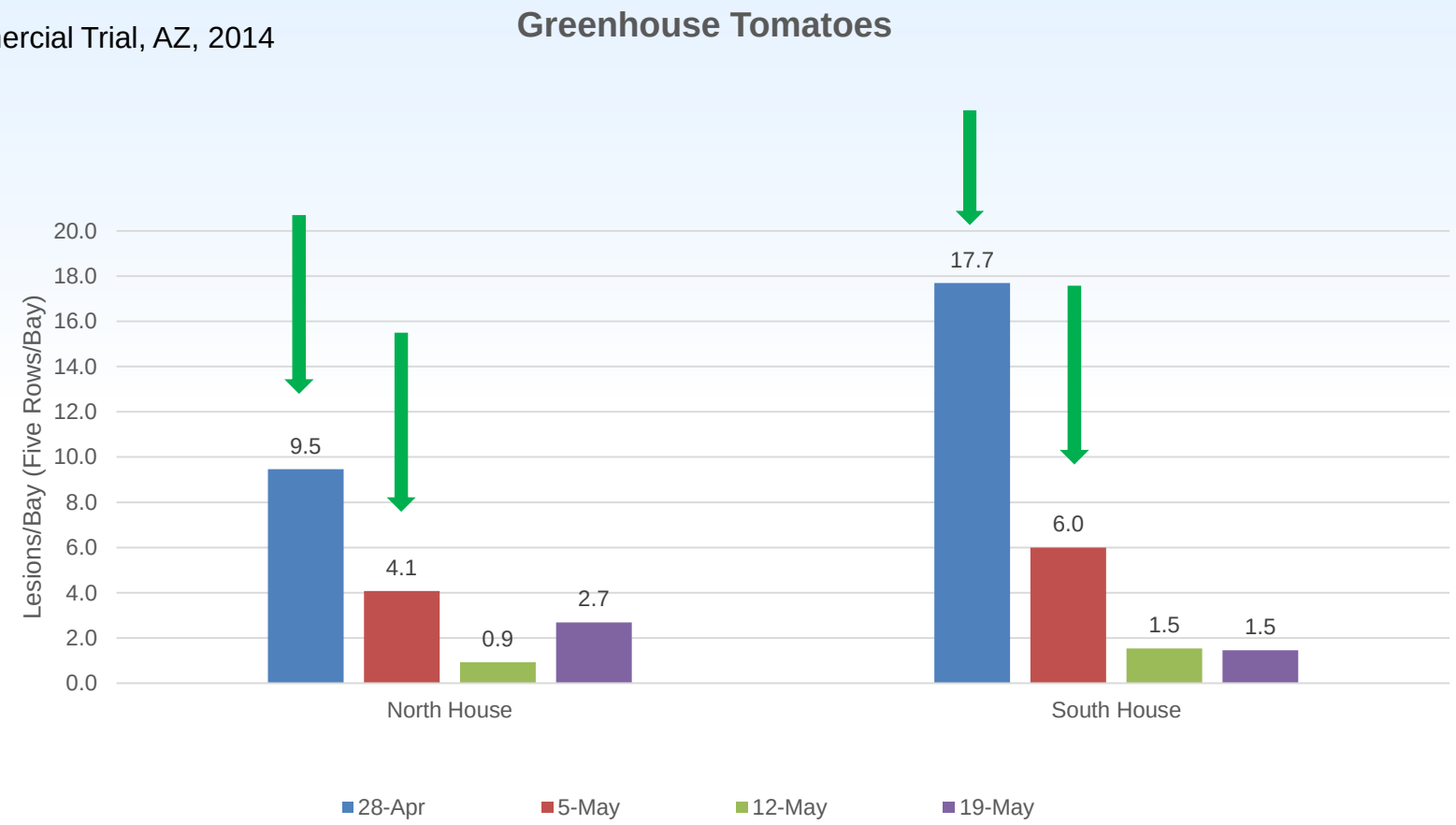
Botector® Greenhouse Trial
Botrytis on Tomato

Commercial Trial, AZ, 2014



Botector applied 4/28 and 5/5 (indicated by ↓)
May 5 and May 12 disease incidence significantly reduced at 95% confidence level

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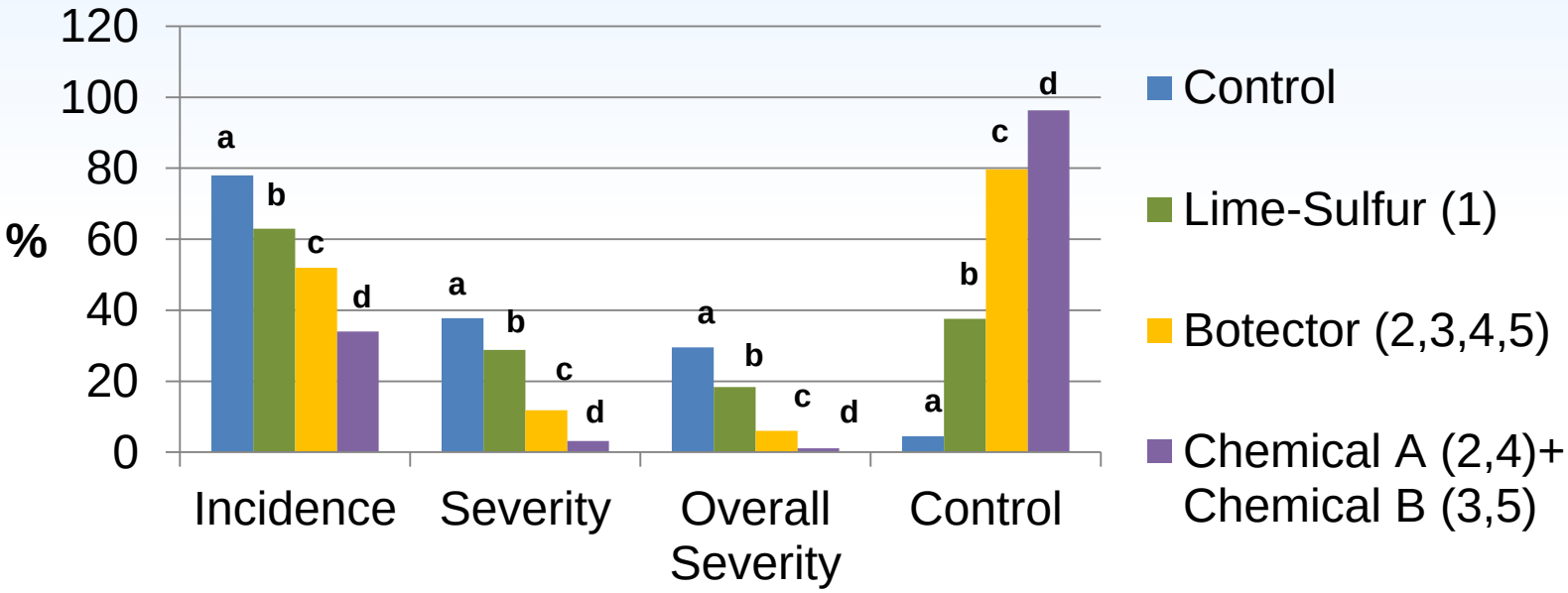
Effect of Botector® on Botrytis Cluster Rot in Wine Grapes

Michigan State University, 2011



Spray dates: 1 = 9 May (dormant), 2 = 14 Jun (bloom), 3 = 29 Jun (pea-sized clusters), 4 = 18 Jul (bunch closure), 5 = 8 Aug (veraison).

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Botector® Control of Botrytis on Raisin Grapes var. Fiesta

Fresno, CA 2013

Control **Treated**

Botector® was applied three times: 10 oz/Acre – at 50% bloom, 100% bloom and pre-closure

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Botector® Control of Botrytis on Raisin Grapes var. Fiesta

Fresno, CA 2013

Control

Treated

Botector® was applied three times: 10 oz/Acre – at 50% bloom, 100% bloom and pre-closure

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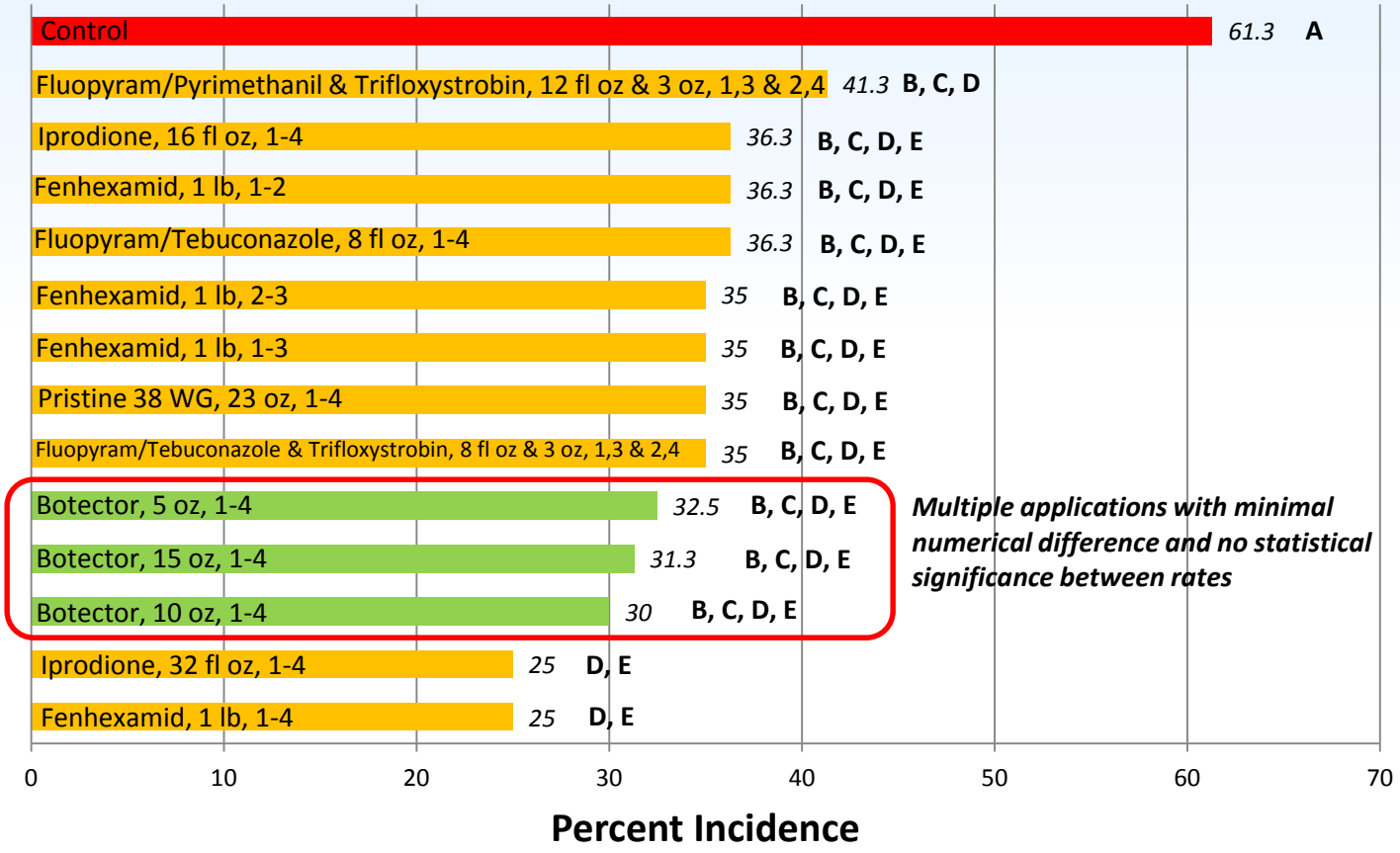
Botector® for Control of Botrytis on Vignoles Wine Grapes

University Trial, New York, 2012



Timing 1: Late Bloom; 2: Bunch Closure; 3: Veraison; 4: + 2 Weeks

App 1 @ 50 GPA, Apps 2-4 @ 100 GPA

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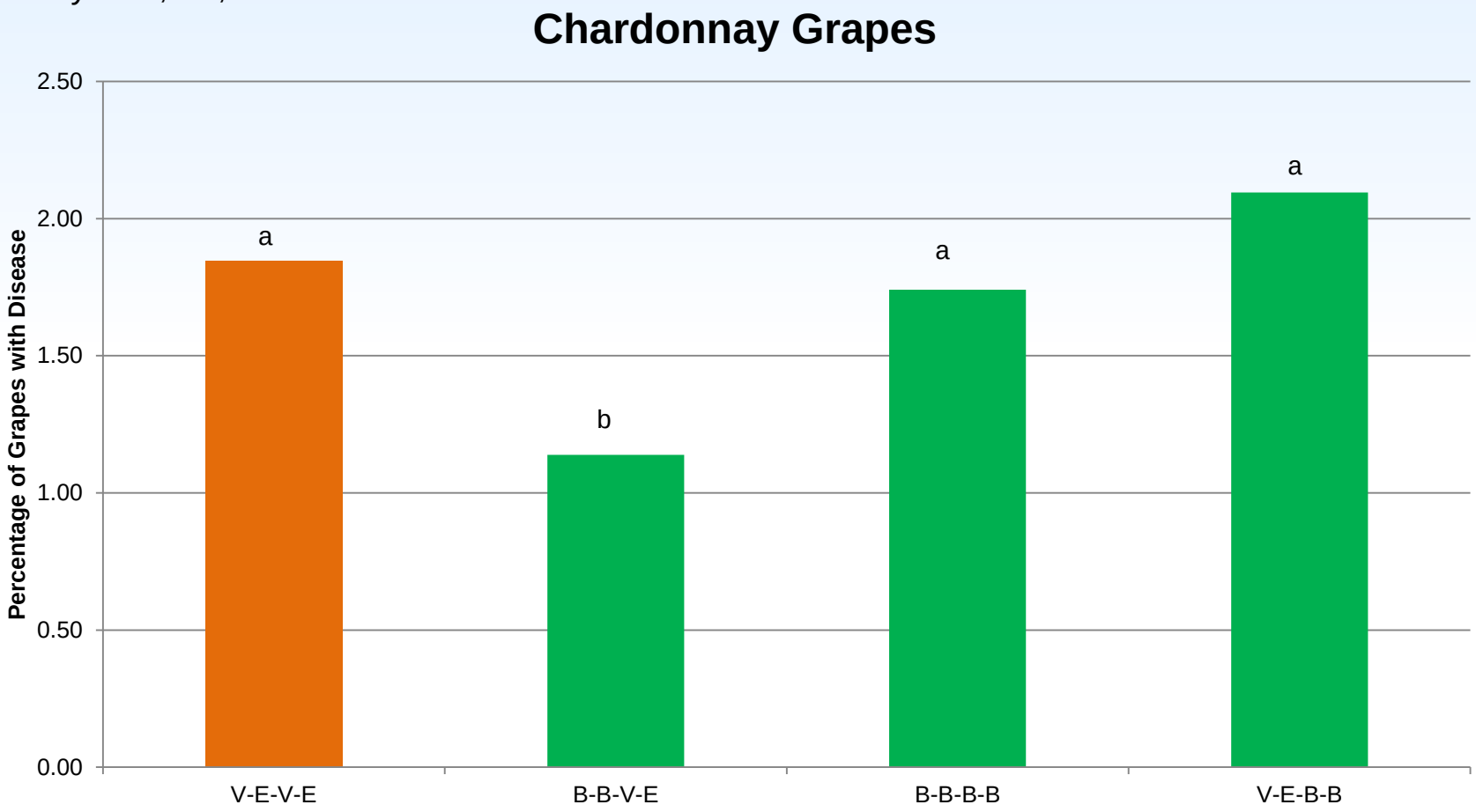
Botector® in an IPM Program for Wine Grape Botrytis Control

University Trial, NY, 2014



- Applications at 80% capfall (6/14), pre-bunch closure (7/11), veraison (8/14) and post-veraison (8/36)
- B: Botector, V: Vangard, E: Elevate

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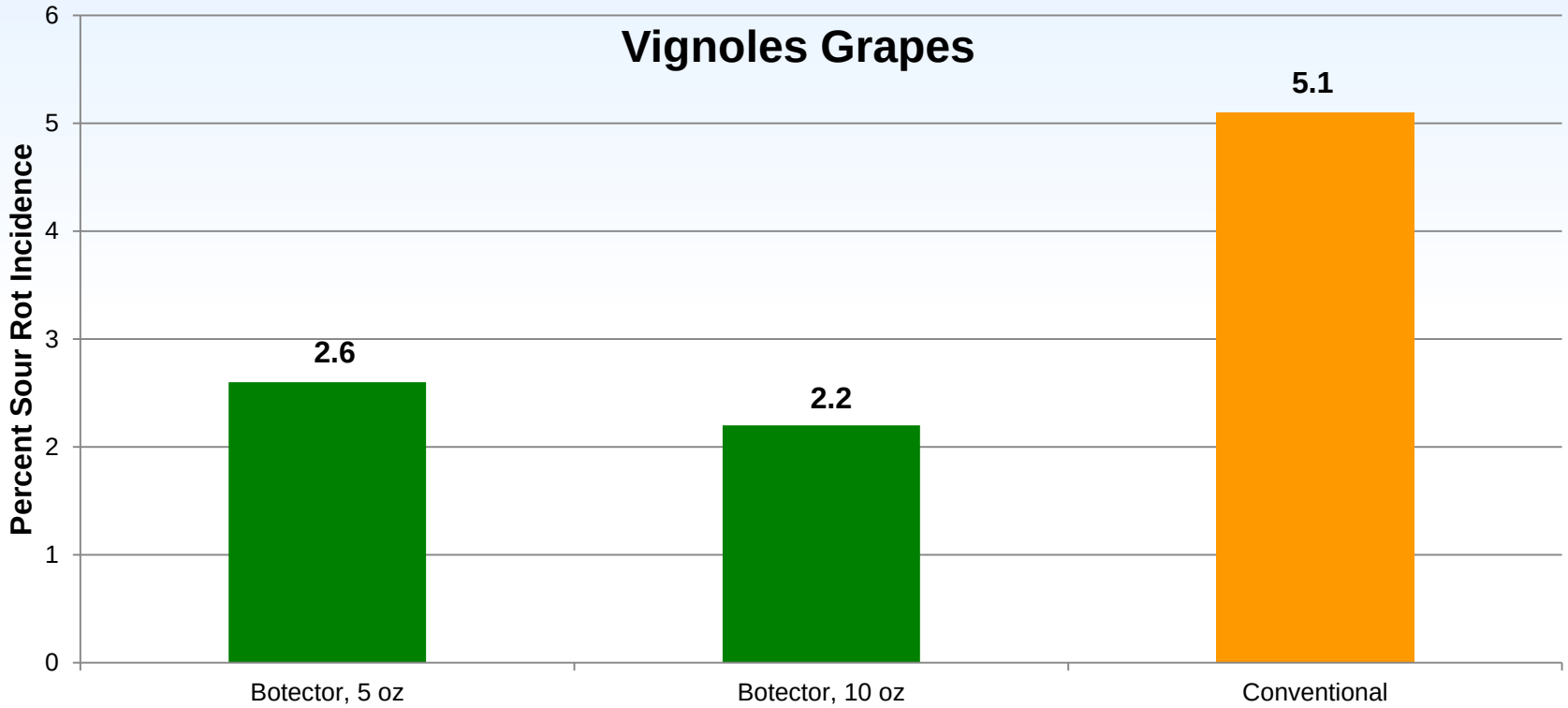
Botector® for Sour Rot Control

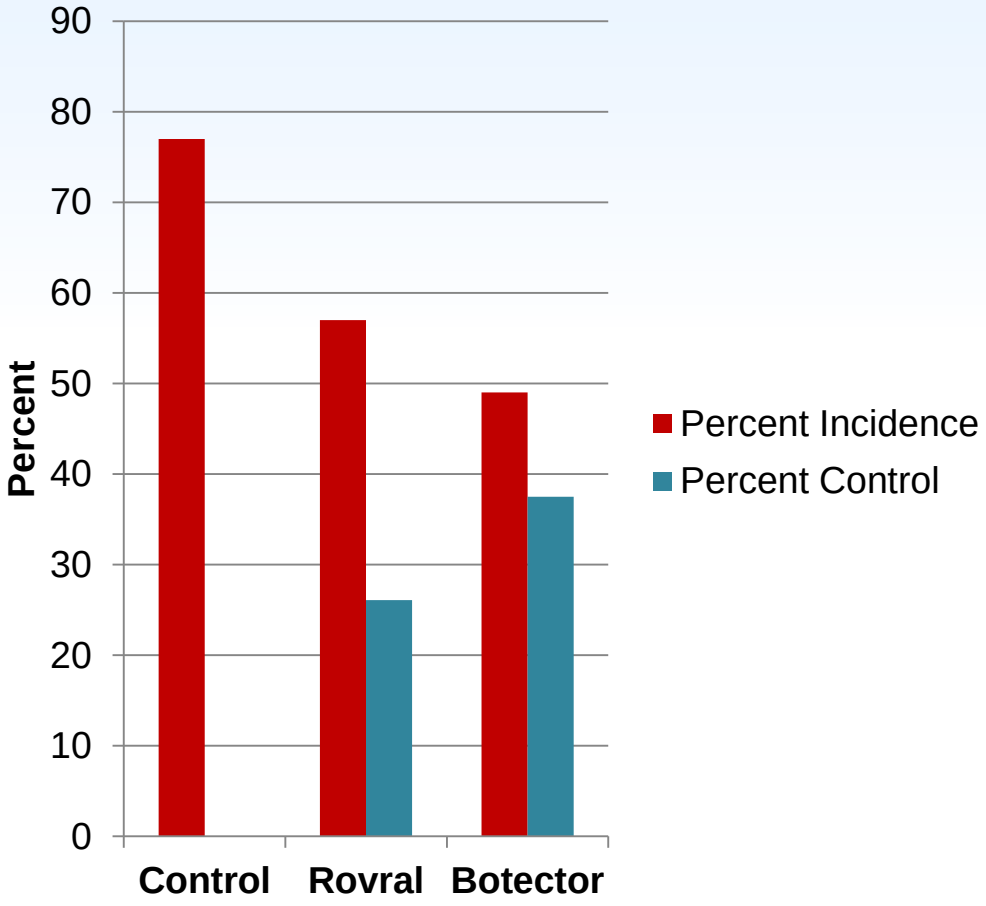
Commercial Trial, Hector, NY, 2013
Evaluated by University Researcher



Botector: Applied on 7/15, 8/12, and 9/9
Conventional: Pristine (20 oz.), Vangard (10 oz.), and Elevate (1.05 oz.), sequential applications
Botector statistically better and researcher noticed differences

Botector® for Monilinia Control ‘Santa Rosa’ Plums

Commercial Research Trial, CA, 2013



- Rovral at 48 fl oz/Acre
- Rovral applied at 70% bloom and 50% petal fall
- Botector at10 oz/Acre
- Botector applied at 70% and 100% bloom and 50% and >60% petal fall
- +98% confidence Botector has significantly less disease than the control

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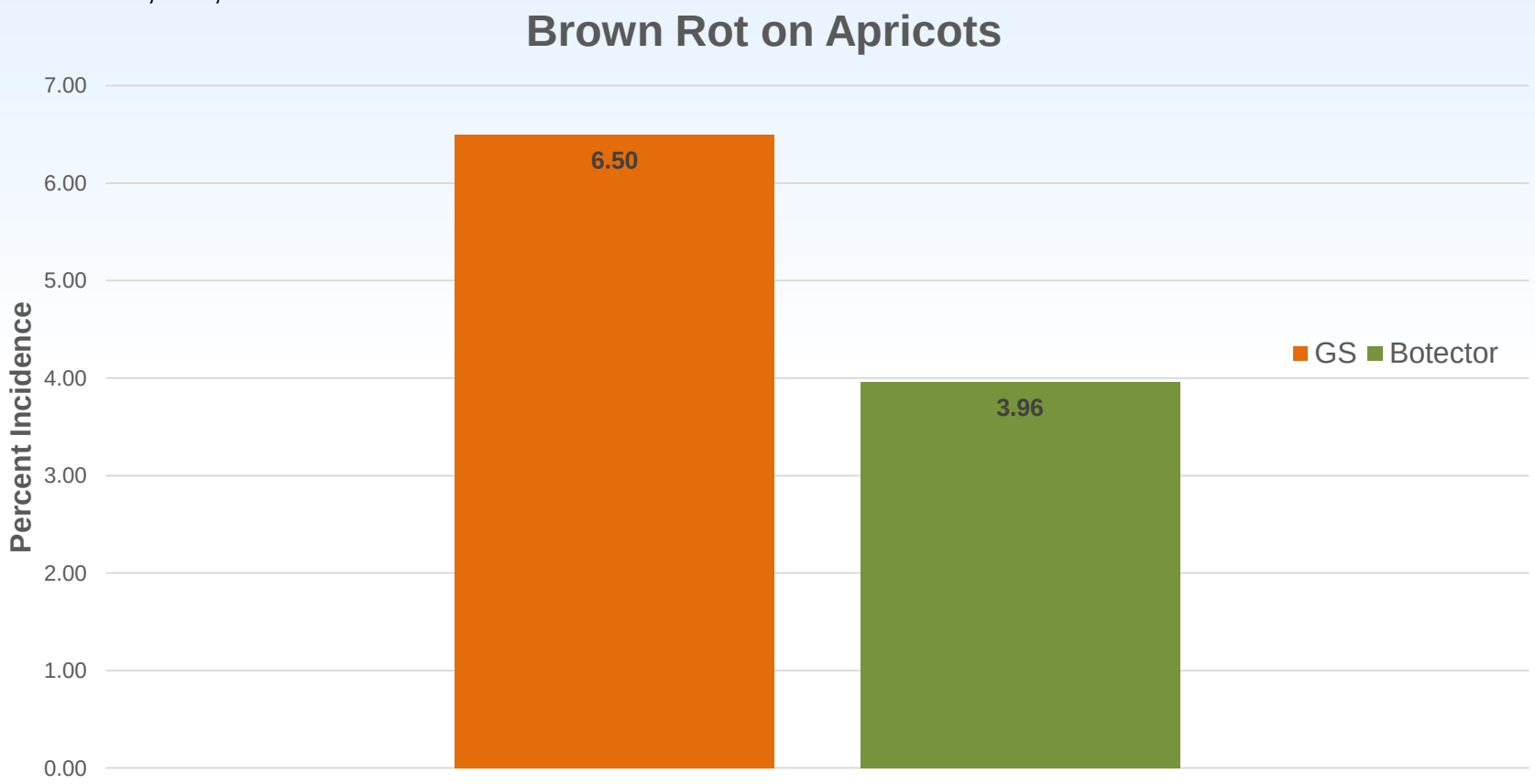
Botector® for Brown Rot Control

Grower Trial, CA, 2015



Significant at 92% confidence level

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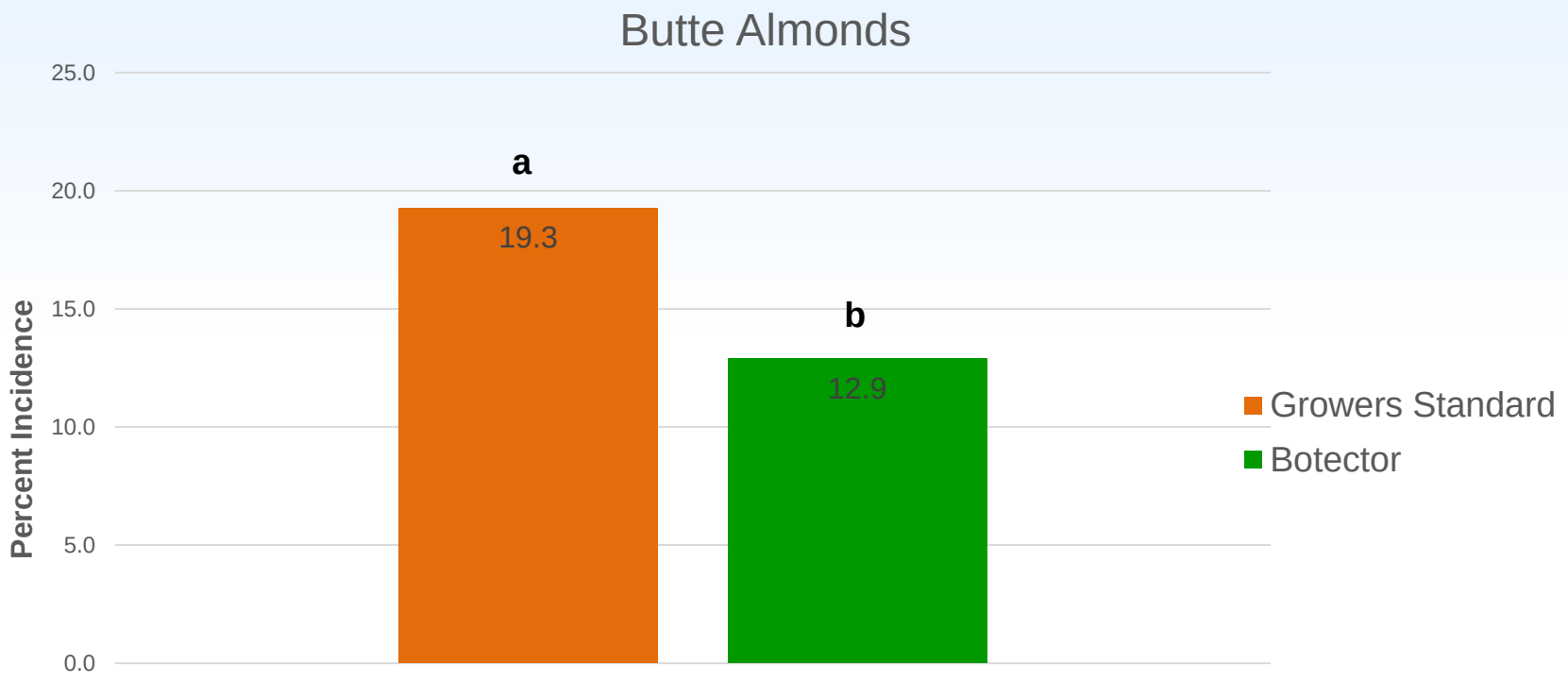
Botector® for Control of Brown Rot in Almonds

Grower Trial, CA, 2015



-Botector (8 oz./A) applications made at 90% and 100% bloom, GS applications made at 80% and 90% bloom
-Significant at 98% Confidence Level (CI = 1.67)
-Growers Standard was Giant Knotweed Extract

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Botector® Label

	Crops Treated	Disease Controlled
BERRIES	Strawberry, Red and Black Raspberry, Blueberry (highbush and lowbush), Blackberry, Huckleberry, Red and Black Currant, Loganberry, Cranberry**, Elderberry**, Gooseberry**, Jostaberry** (greenhouse and field production)	Gray mold (*Botrytis cinerea*) Anthracnose (*Colletotrichum* spp.) *Phomopsis* spp., *Rhizopus* spp. Fruit Rot
GRAPE	American Bunch Grapes (Table Grapes, Wine Grapes and Raisin Grapes), Muscadine Grape and Vinifera Grape	Gray mold (*Botrytis cinerea*)
POME FRUIT**	Apple, Crabapple, Loquat, Mayhaw, Pear, Oriental Pear, Quince	Storage diseases: *Botrytis cinerea, Penicillium* spp., *Monilinia* spp., *Nectria galligena* and *Pezicula* spp.
STONE FRUIT	Apricot, Cherry (including Sweet and Tart), Nectarine, Peach, Plum (including Chickasaw, Damson and Japanese), Plumcot, Prune (fresh)	Brown Rot Blossom Blight (*Monilinia laxa*) Fruit Brown Rot (*Monilinia fructicola*) Gray Mold (*Botrytis cinerea)* Anthracnose (*Colletotrichum* spp.)
ALMOND	Almond	Anthracnose (*Colletotrichum spp.*) Blossom blight and Brown rot (*Monilinia* spp.)
HAZELNUT**	Hazelnut (Filbert)	Eastern filbert blight (*Anisogramma anomala*)
FRUITING VEGETABLES	Fresh and processing tomatoes; eggplant**, nonbell-, chili- and bell-pepper**, cucumber**, zucchini** (greenhouse and field production)	Anthracnose (*Colletotrichum* spp.) Gray mold (*Botrytis cinerea*)

**** Not Registered for Use in California**

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Botector® Label

LEAFY VEGETABLES**	Head and leaf lettuce, Endive, Radicchio (red chicory), celery, spinach, parsley and other leafy vegetables (including those grown for seed production) (greenhouse and field production)	Anthracnose (*Colletotrichum spp.*) Gray mold (*Botrytis cinerea*)
ORNAMENTALS**	African violet, Asters, Begonia, Chrysanthemum, Cyclamen, Cymbidium, Dahlia, Fuchsia, Gerbera, Geranium, Gladiolus, Hydrangea, Marigolds, Orchids, Pansy, Pelargonium, Petunia, Poinsettia, Primrose, Primula, Ranunculus, Rose, Snapdragon, Zinnia (greenhouse and field production)	Anthracnose (*Colletotrichum* spp.) Gray mold (*Botrytis cinerea*)
OTHER AGRONOMIC CROPS**	Hops, Industrial Hemp	Anthracnose (*Colletotrichum* spp.) Gray mold (*Botrytis cinerea*)

**** Not Registered for Use in California**

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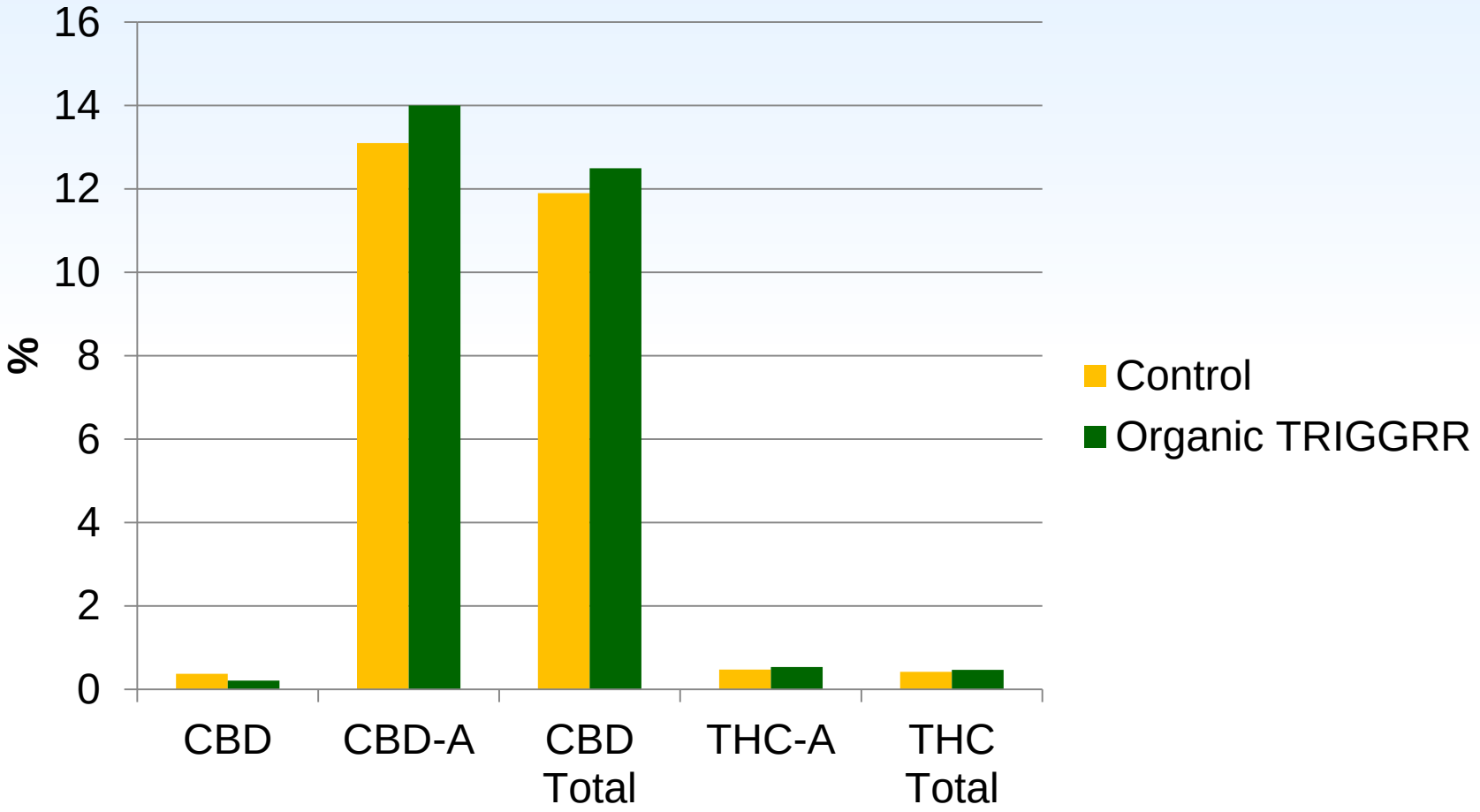
Effect of Organic TRIGGRR on the Chemical Properties of Hemp



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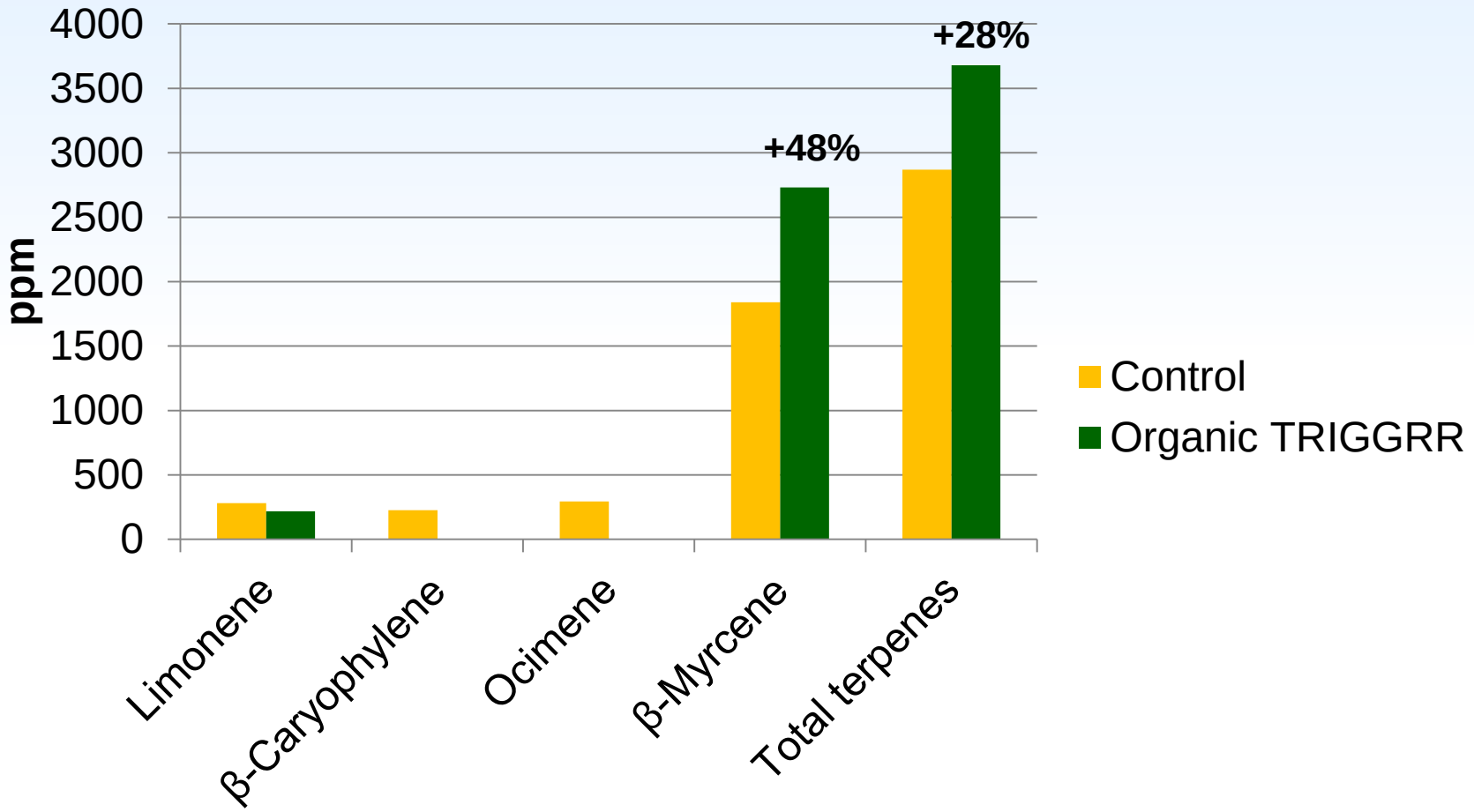
Effect of Organic TRIGGRR on the Chemical Properties of Hemp



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Myrcene’s Effects and Benefits

- Anti-inflammatory
- Analgesic (pain relief)
- Antibiotic
- Sedative
- Antimutagenic

Questions?

Thank you!

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