
Management and epidemiology of pre- and postharvest diseases of sweet cherry

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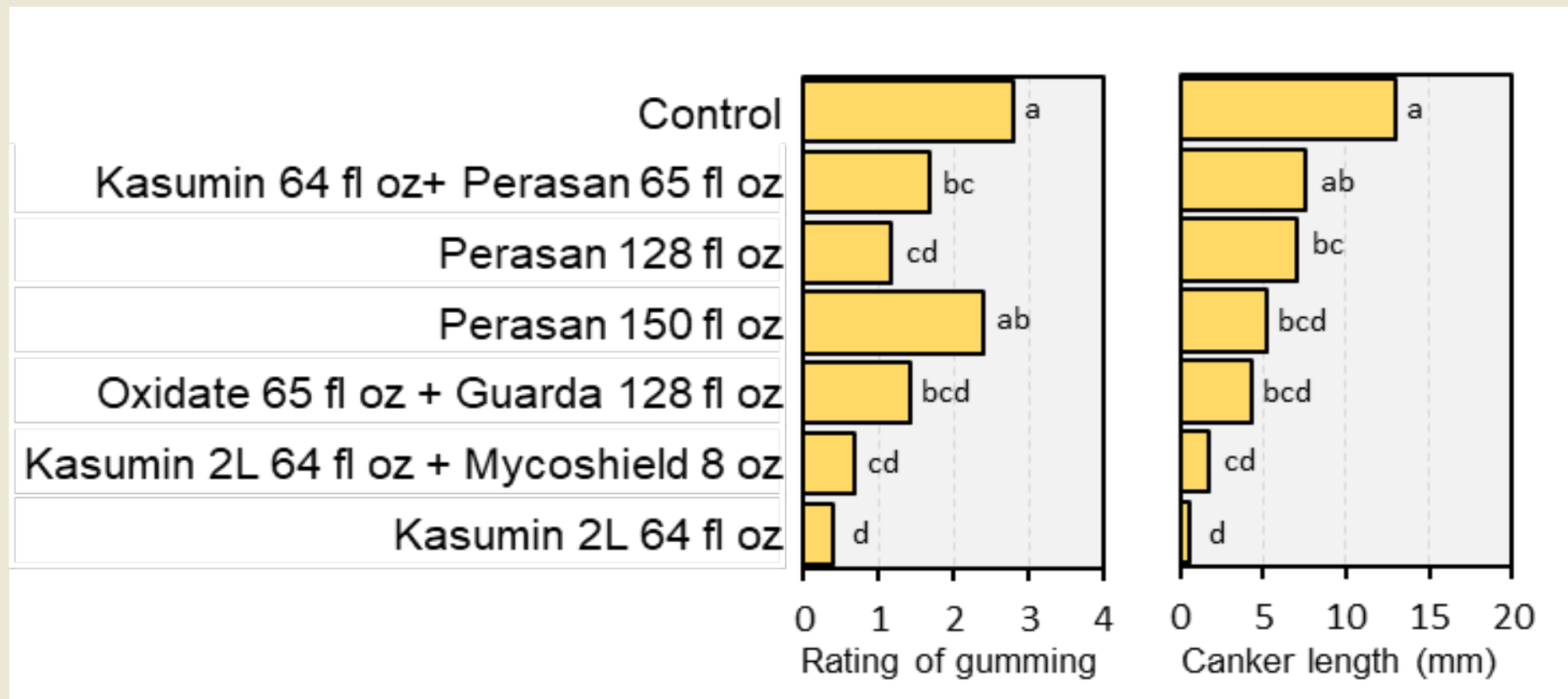
Cooperating:

H. Forster, D. Thompson, L. Wade

Diseases of sweet cherry currently being studied with the goal of developing new management practices

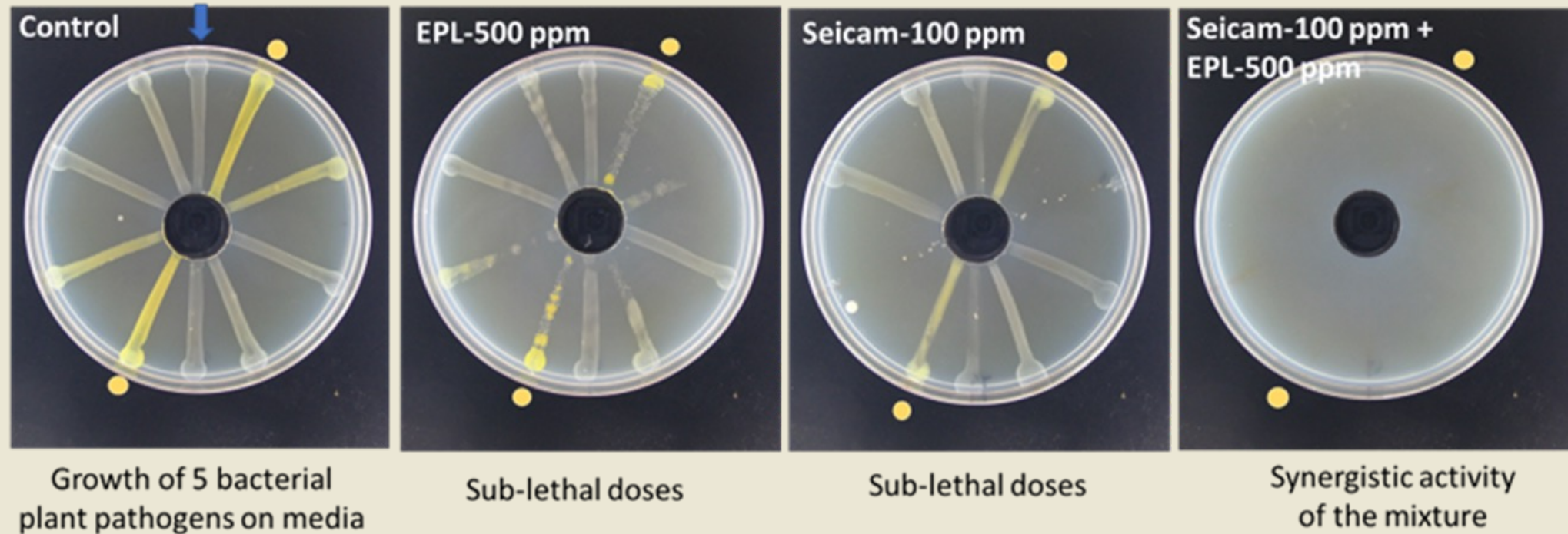
- Bacterial blast/canker
- Powdery mildew
- Brown rot and Botrytis blossom blight
- Preharvest and postharvest fruit decays
- Phytophthora root and crown rot

Evaluation of antibacterial treatments for protection of cv. Coral branches from bacterial canker - 2022



On 12-15-21, 1- to 2-year-old branches were wounded (3 wounds/branch; 2 mm deep, 2 mm in diameter) on the tree, sprayed with selected treatments using a hand sprayer, and spray-inoculated with *Pseudomonas syringae* (4×10^7 cfu/ml) after air-drying (TI). For the treatment using Perasan at 128 ppm, wounds were first inoculated and then treated (IT) after air-drying. Disease was evaluated on 4-26-22. Gumming of wounds was rated using a scale from 0 = no gum to 4 = extensive gumming. Canker length was measured after removing the bark.

Identification of potentially OMRI-approved bactericides active against *Pseudomonas syringae* and other bacterial plant pathogens in laboratory amended agar tests



Clockwise from arrow: *Erwinia amylovora*, *Xanthomonas arboricola* pv. *juglandis*, *X. arboricola* pv. *pruni*, *Pseudomonas savastanoi*, and *Pseudomonas syringae* (●).

Concept: Mixtures of OMRI-approved natural products similar to mixtures of conventional bactericides may be a new direction in developing agricultural bactericides.

Management of bacterial canker and blast

- **Copper:** inconsistently suppressive – resistance widespread
 - **Kasumin:** highly and consistently effective. Registered in 2018
 - **Mycoshield:** Pending registration at EPA (March 2023)
 - **Biocontrols** (Actinovate, Botector)/**PAA:** inconsistent.
 - **New products identified** (nisin, ϵ -poly-L-lysine, cinnamaldehyde)
 - **Timing:**
 - *Canker* – Cold wet (windy) conditions favoring disease and immediately after frost injury (1-day).
 - *Blast* - A bloom treatment with Kasumin or Mycoshield in combination with fungicides for blossom blight for trees treated with rest-breaking compounds
-

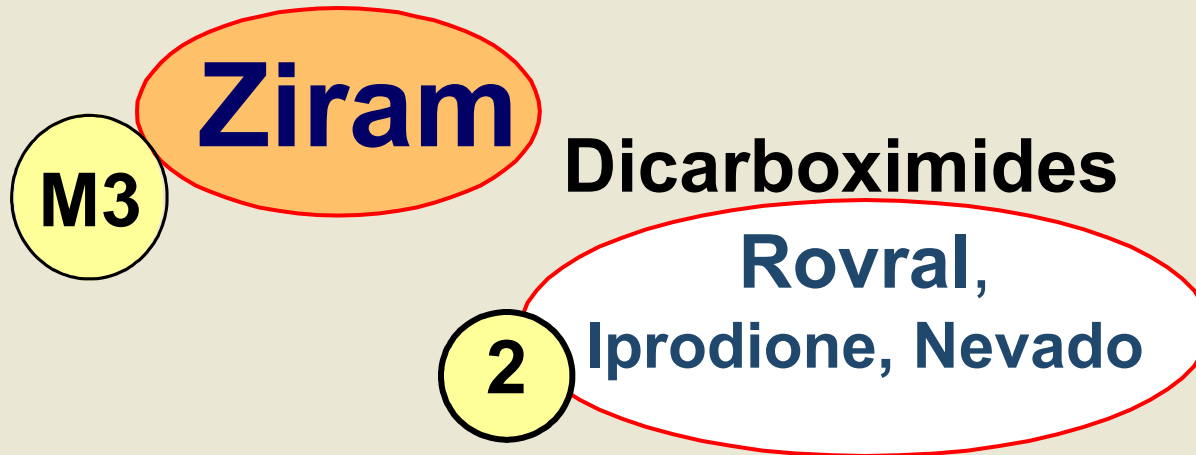
Evaluate, under field conditions, bloom and preharvest applications of new compounds, premixtures, and biologicals

- Powdery mildew
- Brown rot and Botrytis blossom blight
 - Brown rot fruit rot
 - Gray mold decay

Regulatory Challenges

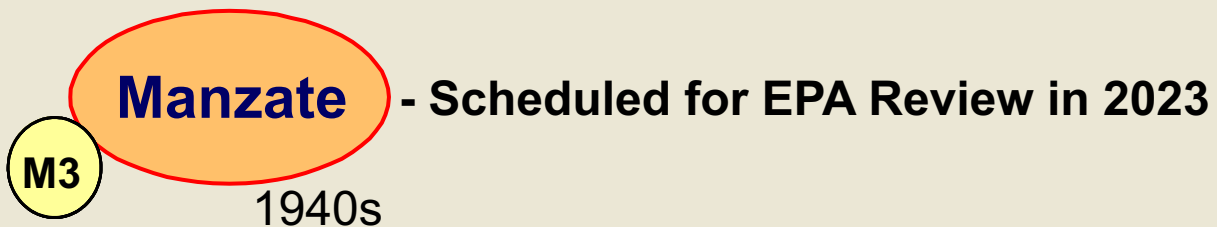
I . EPA Proposed Cancellation of Ziram and Iprodione in 2022

Dithiocarbamates



New dermal toxicity assays replace previous mammalian tests and now use human dermal skin cultures to determine toxicity to humans. EPA ignores 70 years of use data with no documented cases of poisoning and the agronomic importance to major crops across the United States. More cancellations planned that will remove most multi-site compounds.

Dithiocarbamates

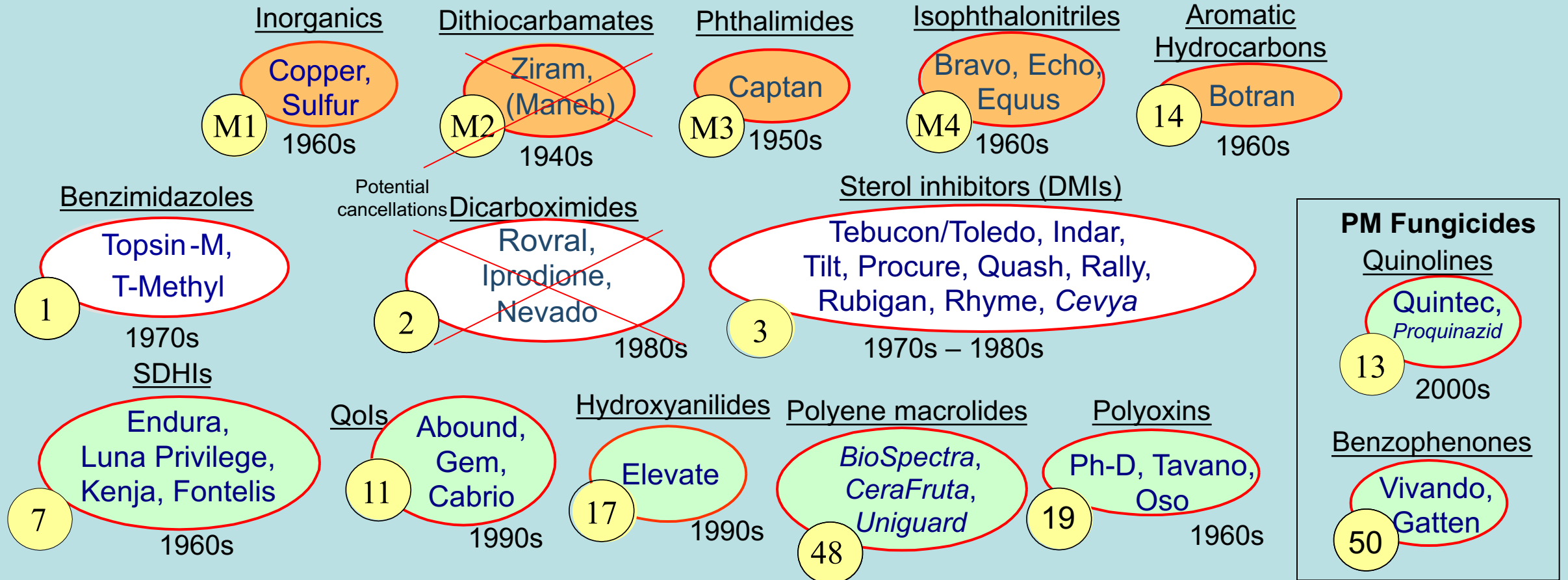


Inorganics



Fungicides for Sweet Cherry

Single-fungicides - Inorganics and Conventional Synthetics



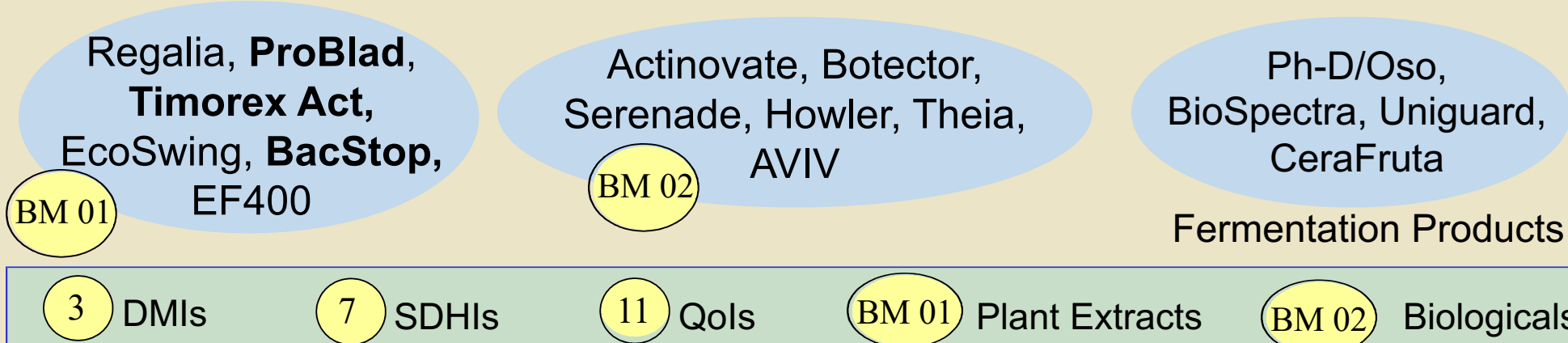
New in 2021/22: **Cevya, Miravis Duo, Natamycin** (postharvest). **Pending:** Parade, Miravis Prime, Mibelya, Regev

Premixture Fungicides and Natural Alternatives for Managing Cherry Diseases

Conventional Synthetic Fungicides – Pre-mixtures



Natural Products, Biocontrols, Fermentation Extracts



Natural products and biocontrols that already are or potentially will be OMRI approved are being continuously evaluated for organic farming of stone fruits.

**EFFICACY AND TIMING OF FUNGICIDES,
BACTERICIDES, AND BIOLOGICALS
FOR
DECIDUOUS TREE FRUIT AND NUT,
CITRUS, STRAWBERRY, AND VINE CROPS
2022**



**ALMOND
APPLE AND PEAR
APRICOT
CHERRY
CITRUS
GRAPE**

WALNUT

**KIWIFRUIT
PEACH
PISTACHIO
PLUM
PRUNE
STRAWBERRY**

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University of California, Davis

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his review of grape fungicides and Gerald Holmes, Director of the
Strawberry Center, for his review of strawberry fungicides*

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www.plpnem.ucdavis.edu

UC Kearney Agricultural Center

www.uckac.edu/plantpath

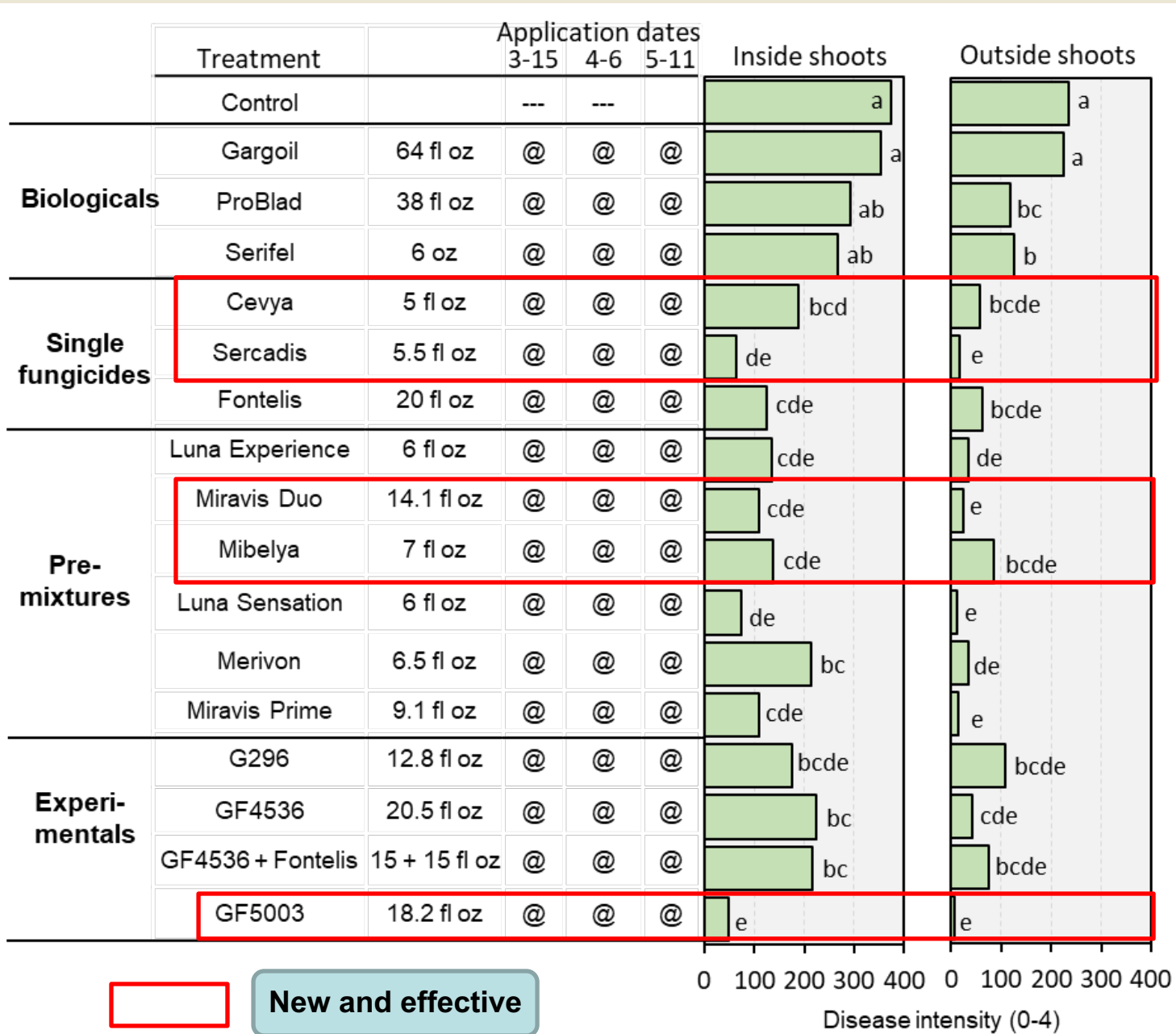
Statewide IPM Program

www.ipm.ucdavis.edu

Efficacy tables will be updated again for 2023!

Powdery mildew of sweet cherry





Evaluation of preharvest fungicide treatments for management of powdery mildew of Bing cherries in San Joaquin Co. 2022

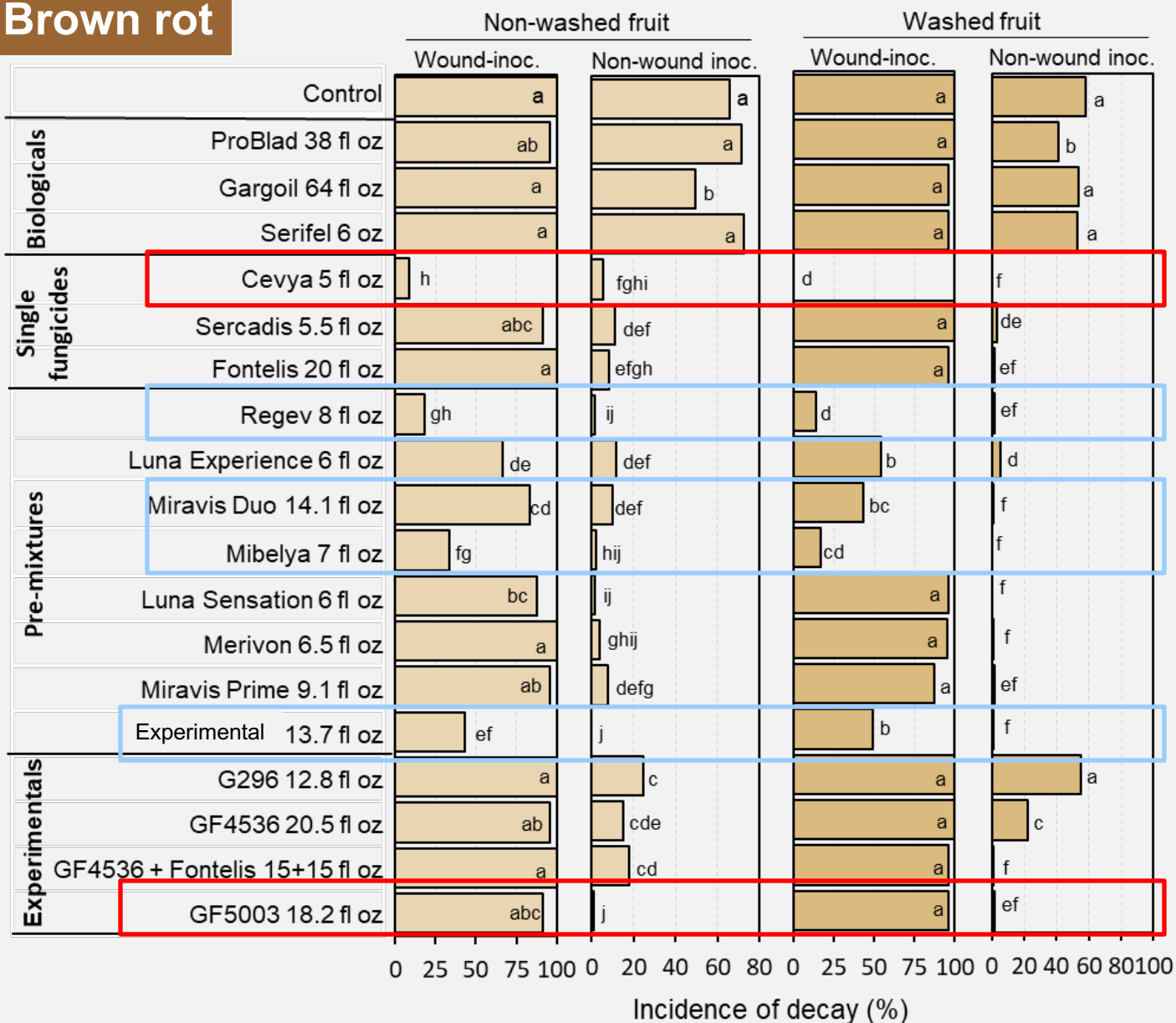
New: proquinazid (Tolendo) submitted to IR-4)

Applications were done using an airblast sprayer at 100 gal/A starting at 50% bloom. DyneAmic (6 fl oz /A) was added to treatments in the second and third applications. Disease was rated using a scale from 0=healthy to 4 = >50% of leaf area diseased. Disease intensity is the multiplication product of disease incidence and severity.

Brown Rot and Botrytis Rot of Sweet Cherry



Brown rot



New and effective

Efficacy of 6-day preharvest fungicide treatments for management of postharvest brown rot of Bing cherries - San Joaquin Co. - 2022



Treatments were applied on 5-11-22 using an air-blast sprayer at a rate of 100 gal/A, and all except Regev were done in combination with DynAmic at 8 fl oz/A. Treatments were also applied on 3-15 and 4-6-22 as part of a powdery mildew program, except for Regev and Miravis NXT that were only applied on 5-11-22. Harvested fruit were washed by gently agitating in water for 2 min. Fruit were wound-inoculated with *M. fructicola* (50,000 spores/ml) or non-wound drop-inoculated (50,000 spores/ml). Fruit were then incubated for 5-10 days at 22C.

Preharvest treatments for management of brown rot and gray mold

Fruit brown rot

**DMIs –
high efficacy with
wounded fruit**

Treatment	Excellent	Good
Non-washed, Wounded and Non- wounded	Elevate/Tebucon, Bumper/Tilt, Tebucon, Indar, Procure, Quash, Cevya , Miravis Duo, Mibelya	Quadris Top, Luna Experience, Elevate, Ph-D
Non-wounded fruit	Luna Sensation, Merivon, Quadris Top, Luna Experience, Cevya , Miravis Duo, Mibelya , (Regev pending)	Rhyme, Fontelis, Kenja

Gray mold

- Washed, non-wound inoculation studies: **Ph-D/Elevate or /Procure**, Elevate/ Tebucon, Luna Experience, Miravis Prime, Mibelya, Miravis Duo - *good efficacy*
- Natural incidence: Elevate + Ph-D, + Procure, or + Tebucon, Luna Experience, Luna Sensation, Merivon, Mibelya, Miravis Duo, Miravis Prime – *very good efficacy*

Powdery mildew

New: **Cevya** (mefentrifluconazole), **Gatten** (flutianil), **Ph-D** (polyoxin-D), **Sercadis** (fluxapyroxad), and premixtures (e.g., **Miravis Duo, Miravis Prime, Mibelya, Regev**). Pending - Tolendo

Initiate laboratory and field studies on new *Phytophthora* root rot fungicides

Fungicides for managing *Phytophthora* root and crown rot diseases

	Common Name	Trade Name	Class	FRAC
Currently registered	metalaxyl, mefenoxam	Ridomil Gold	phenylamides	4
	fosetyl-Al, phosphorous acid	Various	phosphonates	P07 (33)
In development for cherry	mandipropamid	Revus	CAAs	40
	fluopicolide	Presidio	benzamides	43
	ethaboxam	Intego	thiazole carboxamide	22
	oxathiapiprolin	Orondis	piperidinyl thiazole isoxazolines	49

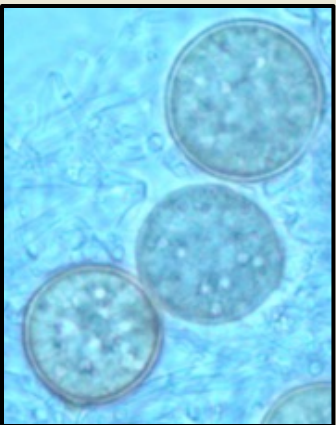
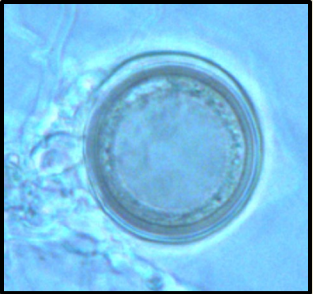
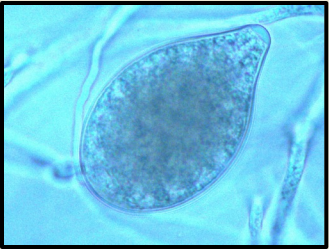
The new fungicides were shown to have high in vitro activity against all *Phytophthora* species from cherry with EC₅₀ values mostly of less than 0.1 ppm. Oxathiapiprolin was most toxic at extremely low concentrations (EC₅₀ values ≤0.001 ppm or ≤1ppb).

Crown rot with associated cankers and gumming followed by tree death are the most common symptoms of *Phytophthora* sp. infection on sweet cherry



Infected trees decline and may die.

Oomycota organisms recovered from soil and roots from California cherry orchards 2020-22



Orchard	Species isolated	Number of isolates	Year, Survey No.	Isolation Method
1	<i>Phytophthora cactorum</i>	1	2021-1	Pear baiting
2	<i>Phytophthora cryptogea</i>	2	2021-1	Pear baiting
	<i>Phytophthora cambivora</i>	3	2021-2	Pear baiting
	<i>Phytophthora</i> sp. (pending ID)	1	2021-2	Pear baiting
	<i>Phytophythium vexans</i>	1	2021-2	Pear baiting
3	<i>Phytophthora cambivora</i>	3	2021-2	Pear baiting
	<i>Phytophthora</i> sp. (pending ID)	4	2021-1	Root plating, pear baiting
	<i>Phytophythium vexans</i>	3	2021-1,2	Pear baiting
4	<i>Phytophythium vexans</i>	2	2021-1	Pear baiting
	<i>Phytophthora syringae</i>	1	2020	Pear baiting
5 species of <i>Phytophthora</i> and <i>Phytophythium vexans</i> recovered				

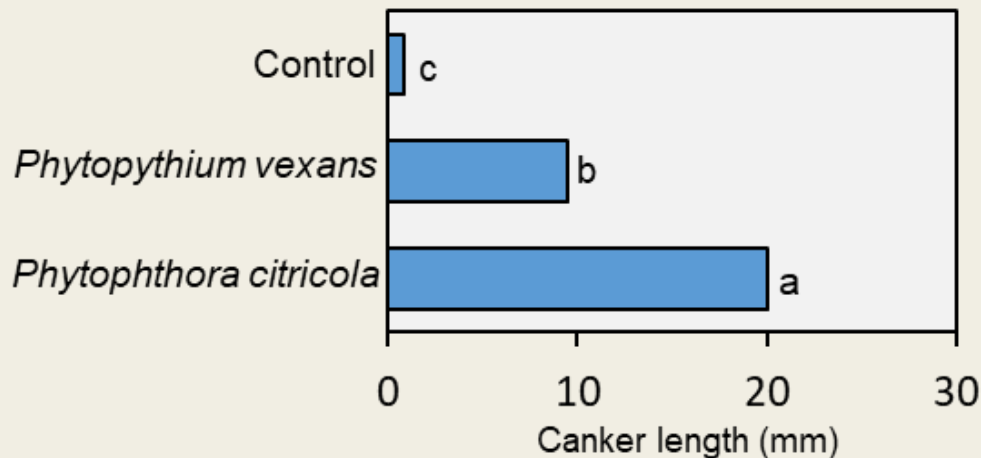
Surveys in California cherry orchards 2022

Or-chard	Species isolated	No. isolates	Isolation methods
1	<i>Phytophthium vexans</i>	9	Pear baiting, root plating
2	<i>Phytophthium vexans</i>	8	Pear baiting, root plating

In vitro sensitivity of *Phytophthora* spp. and *Ph. vexans* against 5 Oomycota-specific fungicides

Species	Fluopicolide	Ethaboxam	Mefenoxam	Oxathiapiprolin	Mandiprop.
<i>P. cactorum</i> (7)	0.10 - 0.23	0.03 - 0.09	0.01 - 0.02	0.0005 - 0.0010	0.007 - 0.009
<i>P. citricola</i> /complex (14)	0.03 - 0.05	0.08 - 0.26	0.08 - 0.16	0.0003 - 0.0006	0.002 - 0.004
<i>P. megasperma</i> (4)	0.08 - 0.24	0.04 - 0.08	0.01 - 0.01	0.0003 - 0.0005	0.002 - 0.005
<i>P. syringae</i> (16)	0.02 - 0.32	0.02 - 0.13	0.002 - 0.04	0.0002 - 0.0004	0.001 - 0.004
<i>Phytophthium vexans</i> (4)	0.02 - 0.05	0.02 - 0.07	0.01 - 0.03	0.0012 - 0.0028	>40

Comparative virulence of *Ph. vexans* and *P. citricola* in causing stem cankers of potted Mahaleb plants



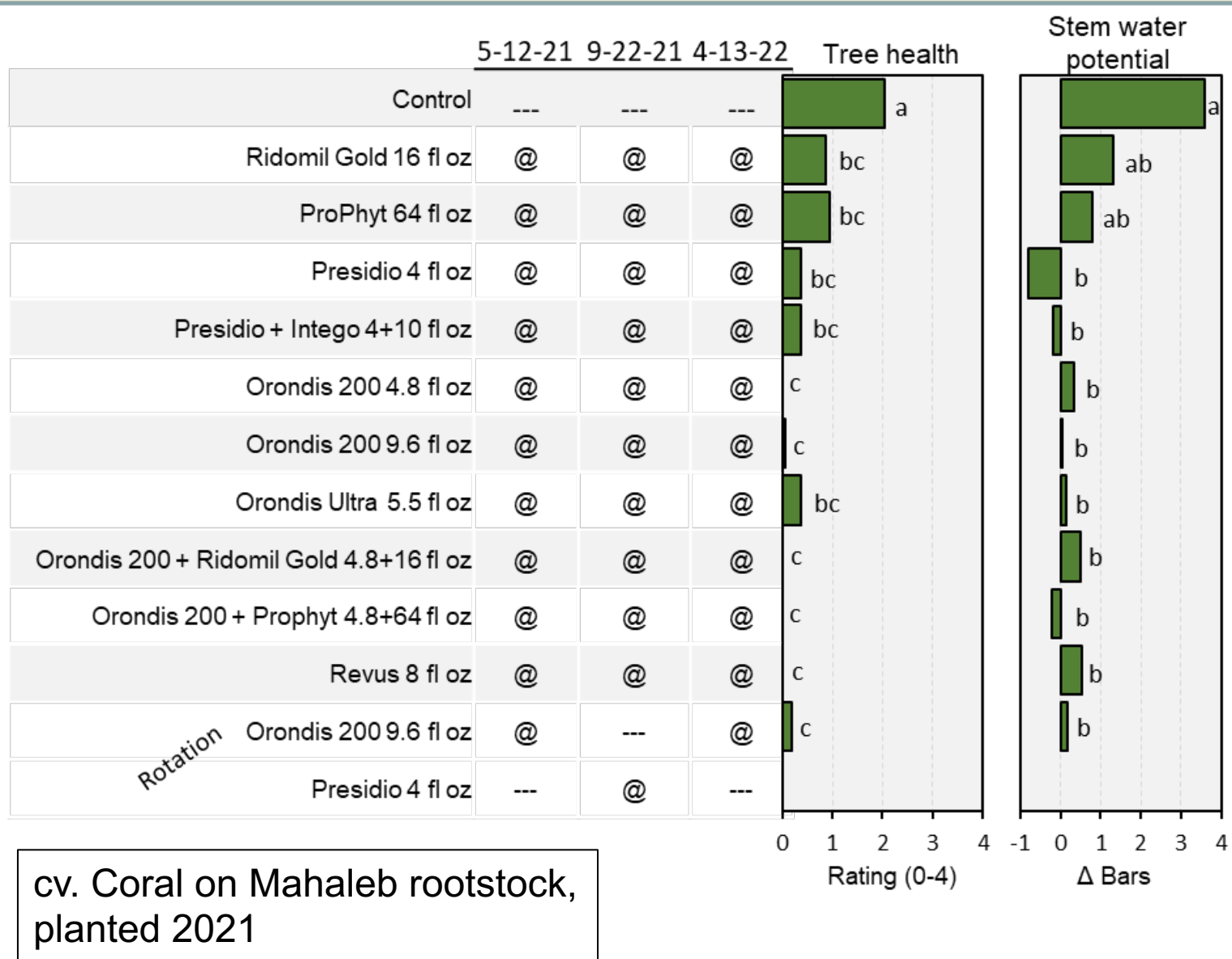
Trunks of potted Mahaleb trees were wound-inoculated with isolates of *P. vexans* or *P. citricola*. Canker lengths were measured after 3 weeks after removing the bark.

- *Phytophthium vexans* was commonly recovered from most cherry orchards with declining trees.
- *Ph. vexans* caused stem cankers in greenhouse inoculation studies
- *Ph. vexans* has been reported as a pathogen of several other fruit and ornamental tree species in recent years
- Ranges of sensitivities for *Ph. vexans* to 4 fungicides were similar to those for several *Phytophthora* species. *Ph. vexans*, however, was not inhibited by mandipropamid at 40 mg/ml.

Efficacy of soil-applied fungicide treatments for management of *Phytophthora* crown and trunk cankers in a field study at UC Davis 2022



- Treatments were applied to wet soil around trunks. Inoculum of a mixture of *P. citricola*, *P. cactorum*, and *P. cambivora* was buried next to the injured crown.
- Tree health evaluation and leaf stem water potential measurements were done in July. Higher values indicate that the trees were water-stressed, whereas low values indicate that trees maintained their water activity.
- No phytotoxicity was observed.**



Fungicide mobility after soil application in greenhouse and growth chamber studies

Mahaleb inoculated with *P. citricola*



Control



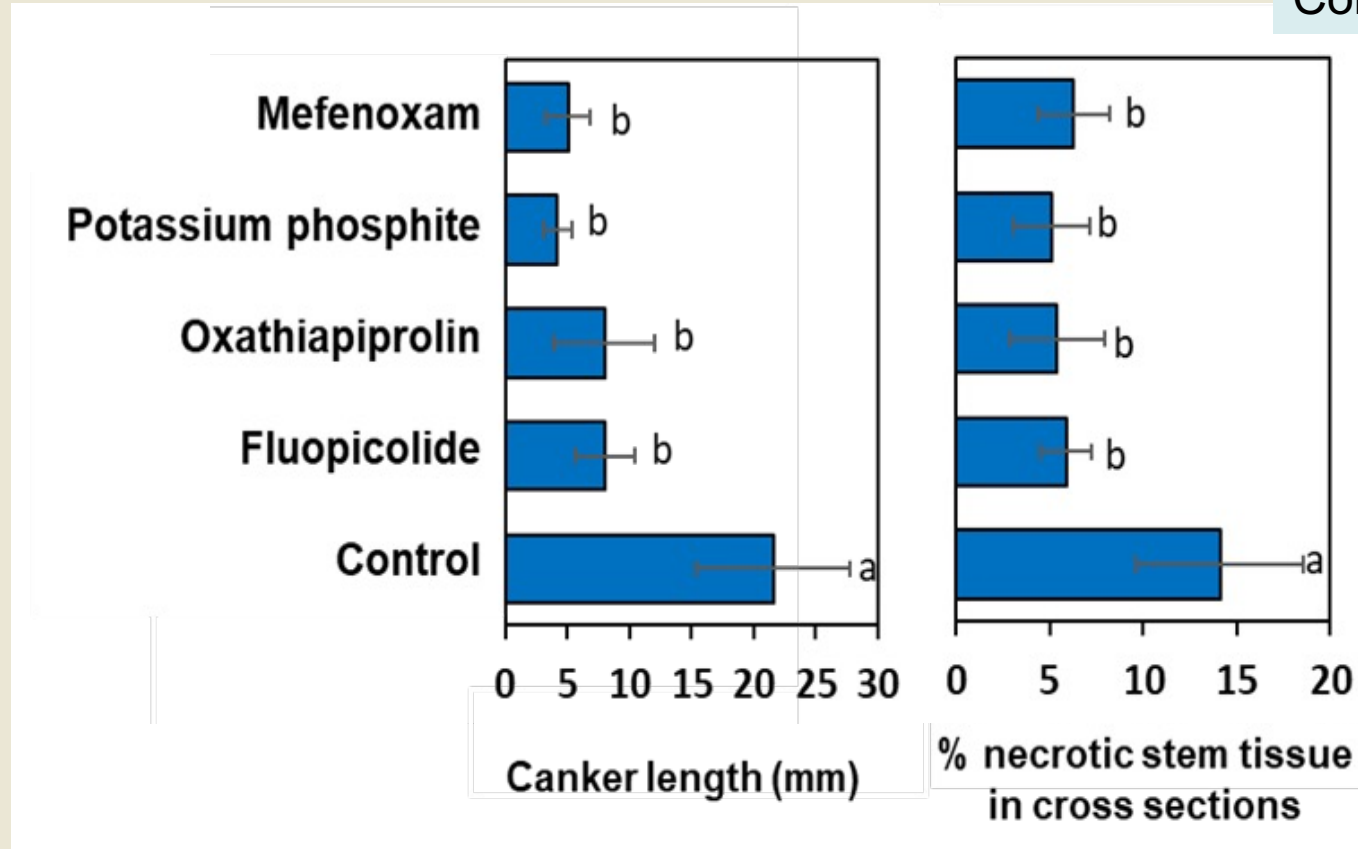
Fluopicolide



Control



Fluopicolide



Similar results for Mazzard and Krymsk.

New Oomycota fungicides show systemic movement in cherry plants.

Postharvest treatments with registered and new fungicides for decay control of sweet cherry fruit in laboratory studies

M. fructicola



B. cinerea



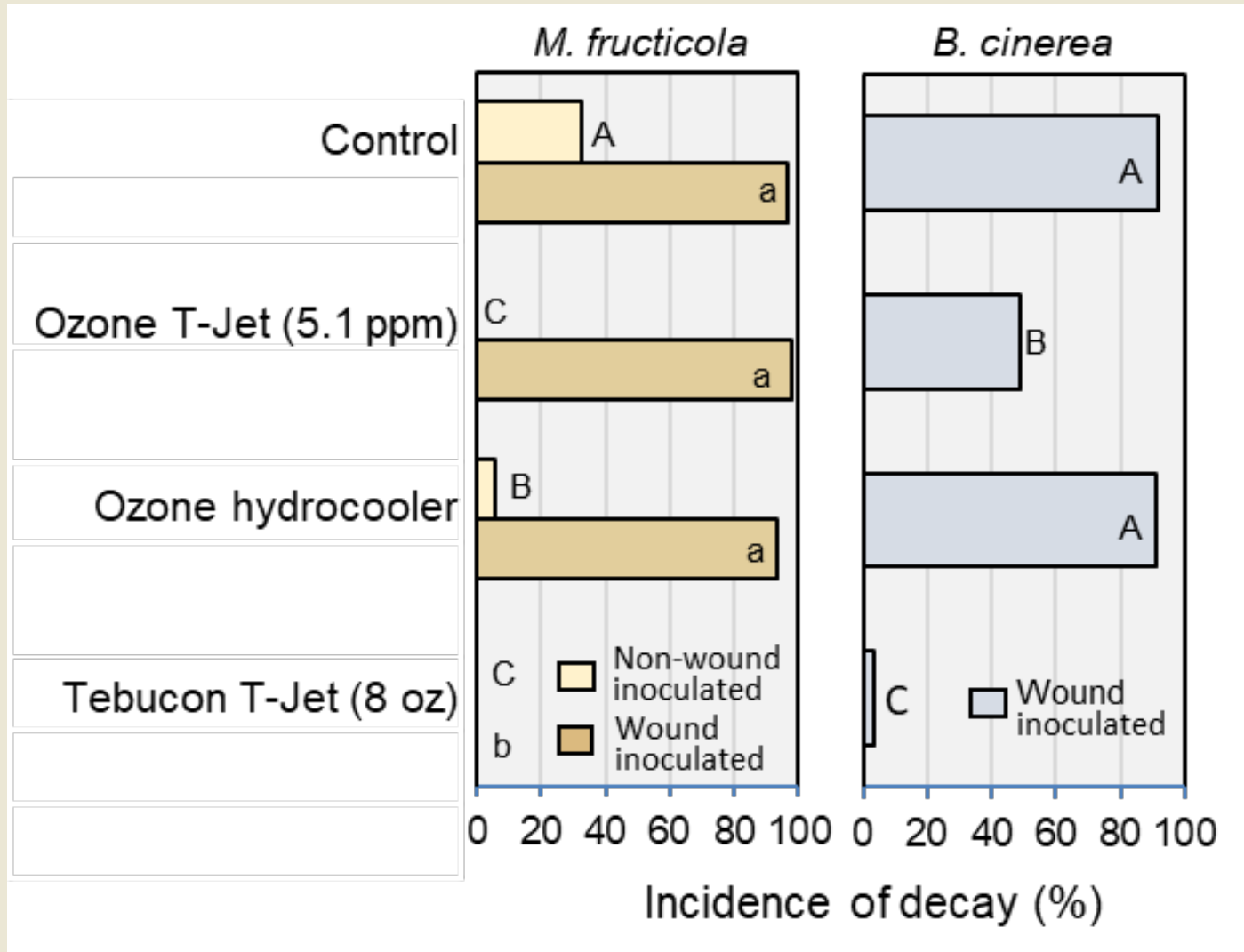
R. stolonifer



- 1 Control
- 2 Oso (polyoxin-D)
- 3 Experimental (mixture of 3 fungicides)
- 4 GF 5003 (exp. mixture with new ai)
- 5 BioSpectra (natamycin)
- 6 Chairman (fludioxonil/propiconazole)

Several new effective fungicides were identified that may be developed for postharvest use

Evaluation of commercial postharvest ozone sanitation treatments for managing postharvest decays of Bing cherry - 2022



Organic Packinghouse Study

Fruit were inoculated and incubated at 20 C for 14 -16 h prior to packinghouse treatments:

a) T-Jet - 15 sec

b) Hydrocooler – 3 min

Note: Ozone T-Jet treatment was heavily contaminated with *Rhizopus stolonifer*. Fruit were incubated at 20C for 7-10 days.

BioSpectra 100 SC and CeraFruta are now listed by the Organic Materials Review Institute (OMRI) for organic use in the U.S.

Organic Fruit Decay Control

BioSPECTRA[®] 100 SC | **ORGANIC**

Now OMRI Certified



Natural Organic Decay Control

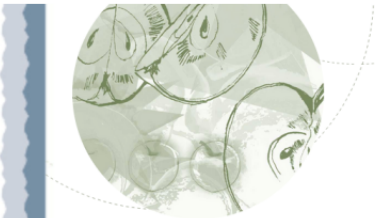
BioSpectra is the latest biorational fungicide to be organically certified for postharvest applications. It provides a broad-spectrum decay control against several major fungal postharvest diseases across various crops and has shown better disease control compared to other organic alternatives.

BioSpectra is a novel postharvest fungicide of natural origin with a unique mode of action against decay, including resistant strains to conventional fungicides, making it an ideal rotation or mixture partner.



Working on a postharvest label for Oso with the registrant Certis for 2023-24

CERADIS GRANTED OMRI LISTED STATUS FOR CERAFRUTA[®] BIOLOGICAL FUNGICIDE



OMRI Listed[®]

The following product is OMRI Listed. It may be used in certified organic production or food processing and handling according to the USDA National Organic Program regulations.

CeraFruta ORGANIC

Ceradis Granted OMRI Listed Status for CeraFruta[®] Biological Fungicide

Thank you!

- Questions?