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

J. E. Adaskaveg
Professor

Department of Microbiology and Plant Pathology
University of California, Riverside

Cooperating:
H. Forster, D. Thompson

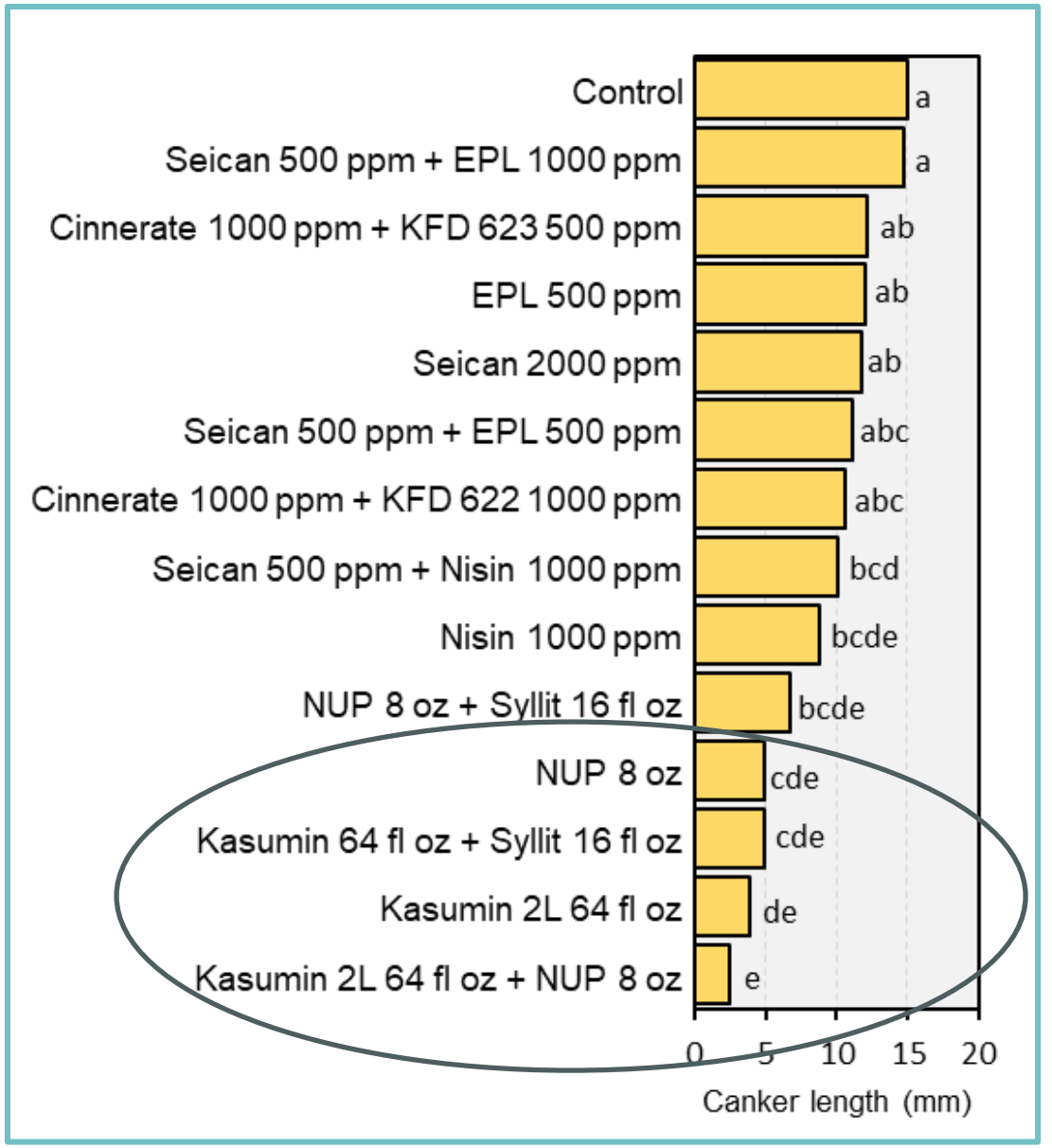
Evaluate, under field conditions, bloom and preharvest applications of new compounds, premixtures, and biologicals

- Bacterial canker/blast
- Powdery mildew
- Brown rot and Botrytis blossom blight
- Brown rot fruit rot
- Gray mold decay

Evaluation of antibacterial treatments for protection of cv. Coral branches from bacterial canker - 2023

Bacterial blast and canker of sweet cherry

- Associated with any injury (cold or mechanical) or stress during cool, wet conditions
- Symptoms: Cankers with progressive dieback



On 12-22-22, 1- to 2-year-old branches were wounded, spray-treated, and spray-inoculated with *Pseudomonas syringae.* Disease was evaluated in June 2023, and canker length was measured.

Management of bacterial canker and blast

- **Copper**: inconsistently suppressive – resistance widespread
- **Kasumin:** highly and consistently effective. Registered in 2018
- **Mycoshield:** Pending registration at EPA (2024?) - postponed
- **Biocontrols** (Actinovate, Botector)
- **Oxidizers:** Oxidate, Perasan (non-persistent)

} inconsistent

- **New products identified** (nisin, Ɛ-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 (pending) in combination with fungicides for blossom blight for trees treated with rest-breaking compounds

Preharvest fungicide treatments for management of powdery mildew of Bing cherries 2023

	Treatment	FRAC	Applications 3-23	Applications 4-12	Inside shoots	Outside shoots
	Control		---	---	a	a
Biological	ProBlad 40 fl oz	BM-01	@	@	ab	abc
Single fungicides	Cevya 5 fl oz	3	@	@	ab	abc
	Tesaris 5.5 fl oz	7	@	@	abcd	bc
	Fontelis 20 fl oz	7	@	@	abc	c
	Talendo 3.4 fl oz	13	@	@	cde	c
	Talendo 5.1 fl oz	13	@	@	de	abc
Pre-mixtures	Regev 6.4 fl oz	3/BM-01	@	@	bcde	c
	Luna Experience 6 fl oz	3/7	@	@	abcd	ab
	Miravis Duo 13.6 fl oz	3/7	@	@	ab	abc
	Elysis (Mibelya) 7 fl oz	3/7	@	@	bcde	abc
	Luna Sensation 6 fl oz	7/11	@	@	e	bc
	Merivon 6.5 fl oz	7/11	@	@	a	ab
	Miravis Prime 9.1 fl oz	7/12	@	@	de	c
Experi-mentals	GF5003 18.2 fl oz	---	@	@	cde	bc
	GF5249 20 fl oz	---	@	@	de	bc

0 1 2 3 4 0 1 2 3 4

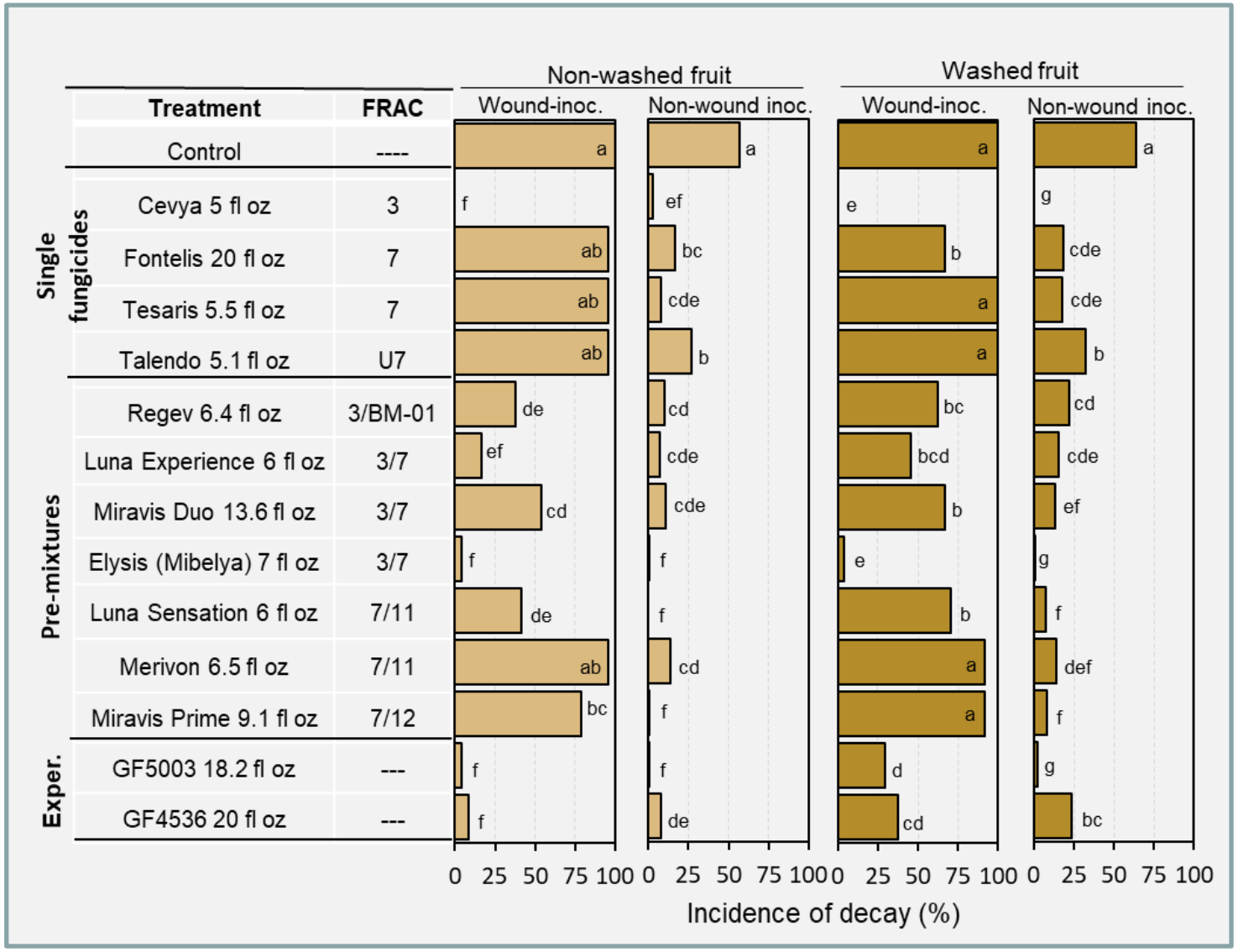
Disease rating (0-4)

New and effective

New: Talendo (proquinazid) is in the IR-4 program.
Pending: Miravis Prime, Elysis, Regev

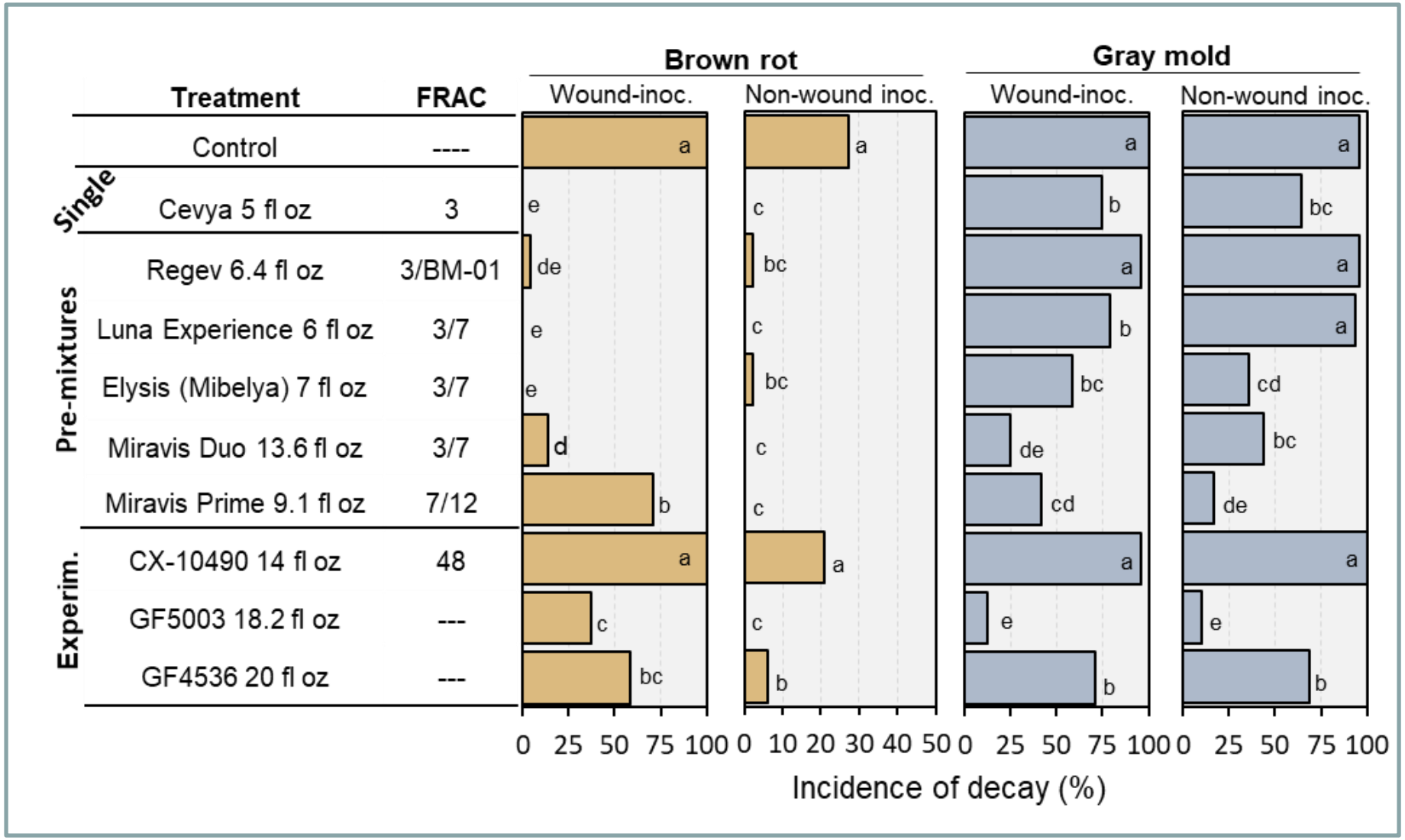
Applications starting at 50% bloom. Evaluation on 6-1-23. Terminal shoots from inside or outside of the tree were rated for the severity of disease: 0=healthy to 4=>50% of leaf area diseased.

Efficacy of 7-day preharvest fungicide treatments for management of postharvest brown rot of Bing cherries - San Joaquin Co. - 2023



Treatments were applied on 6-1-23 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 3-23 and 4-12-23 as part of a powdery mildew program. 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.

Evaluation of new pre-harvest fungicides for managing brown rot and gray mold decays of Bing cherry - 2023



Treatments were applied on 5-25-23 using an air-blast sprayer at a rate of 100 gal/A. Fruit were wound-inoculated with *M. fructicola* or *B. cinerea* (40,000 spores/ml) or non-wound drop-inoculated with *M. fructicola* (500,000 spores/ml) or *B. cinerea* (300,000 spores/ml 25% cherry juice). Fruit were then incubated for 5-10 days at 22C.

Fungicides for Sweet Cherry

Single-fungicides - Inorganics and Conventional Synthetics

Inorganics
M1 — Copper, Sulfur — 1960s

Dithiocarbamates
M2 — Ziram, (Maneb) — 1940s

Phthalimides
M3 — Captan — 1950s

Isophthalonitriles
M4 — Bravo, Echo, Equus — 1960s

Aromatic Hydrocarbons
14 — Botran — 1960s

Benzimidazoles
1 — Topsin-M, T-Methyl — 1970s

Dicarboximides
2 — Rovral, Iprodione, Nevado — 1980s

Sterol inhibitors (DMIs)
3 — Tebucon/Toledo, Indar, Tilt, Procure, Quash, Rally, Rubigan, Rhyme, Cevya — 1970s – 1980s

SDHIs
7 — Endura, Luna Privilege, Kenja, Fontelis — 1960s

QoIs
11 — Abound, Gem, Cabrio — 1990s

Hydroxyanilides
17 — Elevate — 1990s

Polyene macrolides
48 — BioSpectra, CeraFruta, Uniguard

Polyoxins
19 — Ph-D, Tavano, Oso — 1960s

PM Fungicides

Quinolines
13 — Quintec, *Talendo* — 2000s

Benzophenones
50 — Vivando, Gatten

New 2023: Cevya, Miravis Duo, BioSpectra/Cerafruta (postharvest). *Pending*: Parade, Miravis Prime, Mibelya (Elysis), Regev

Statewide IPM Program - *www.ipm.ucdavis.edu*

Multi-site MOA | Single-site MOA | Reduced risk fungicides

Premixture Fungicides and Natural Alternatives for Managing Cherry Diseases

Conventional Synthetic Fungicides – Pre-mixtures

- Quadris Top, Quilt Xcel — 3+11
- Pristine, Luna Sensation, Merivon — 7+11
- Luna Experience, Miravis Duo **Mibelya (Elysis)** — 3+7
- **New** **Miravis Prime** — 7+12
- **New** **Regev** — 3+BM01
- **New** Experimentals – for PM, BR and GM — X+Y

Natural Products, Biocontrols, Fermentation Extracts

- Regalia, **ProBlad**, **Timorex Act,** EcoSwing, **BacStop,** EF400 — BM 01
- Actinovate, Botector, Serenade, Howler, Theia, AVIV — BM 02
- Ph-D/Oso, BioSpectra, Uniguard, CeraFruta — Fermentation Products

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

3 DMIs | 7 SDHIs | 11 QoIs | BM 01 Plant Extracts | BM 02 Biocontrols

Statewide IPM Program - *www.ipm.ucdavis.edu*

Bold = not registered

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.

Five species of *Phytophthora* (*P. cactorum, P. cambivora, P. cryptogea, P. syringae,* and an unidentified species) and *Phytopythium vexans* were recovered.

Laboratory and field studies on new Phytophthora root rot fungicides

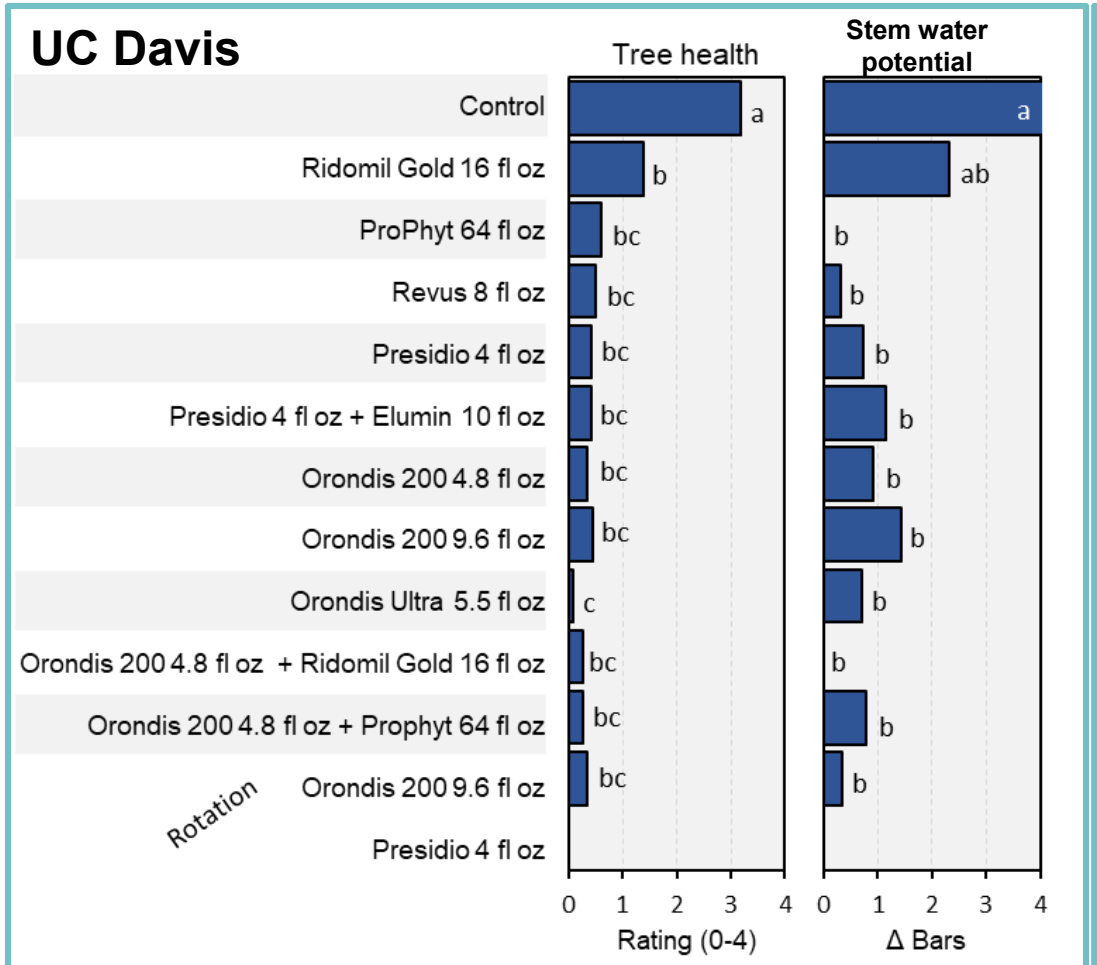
Fungicides for managing Phytophthora root and crown rot diseases

	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	Elumin	thiazole carboxamide	22
	oxathiapiprolin	Orondis	piperidinyl thiazole isoxazolines	49

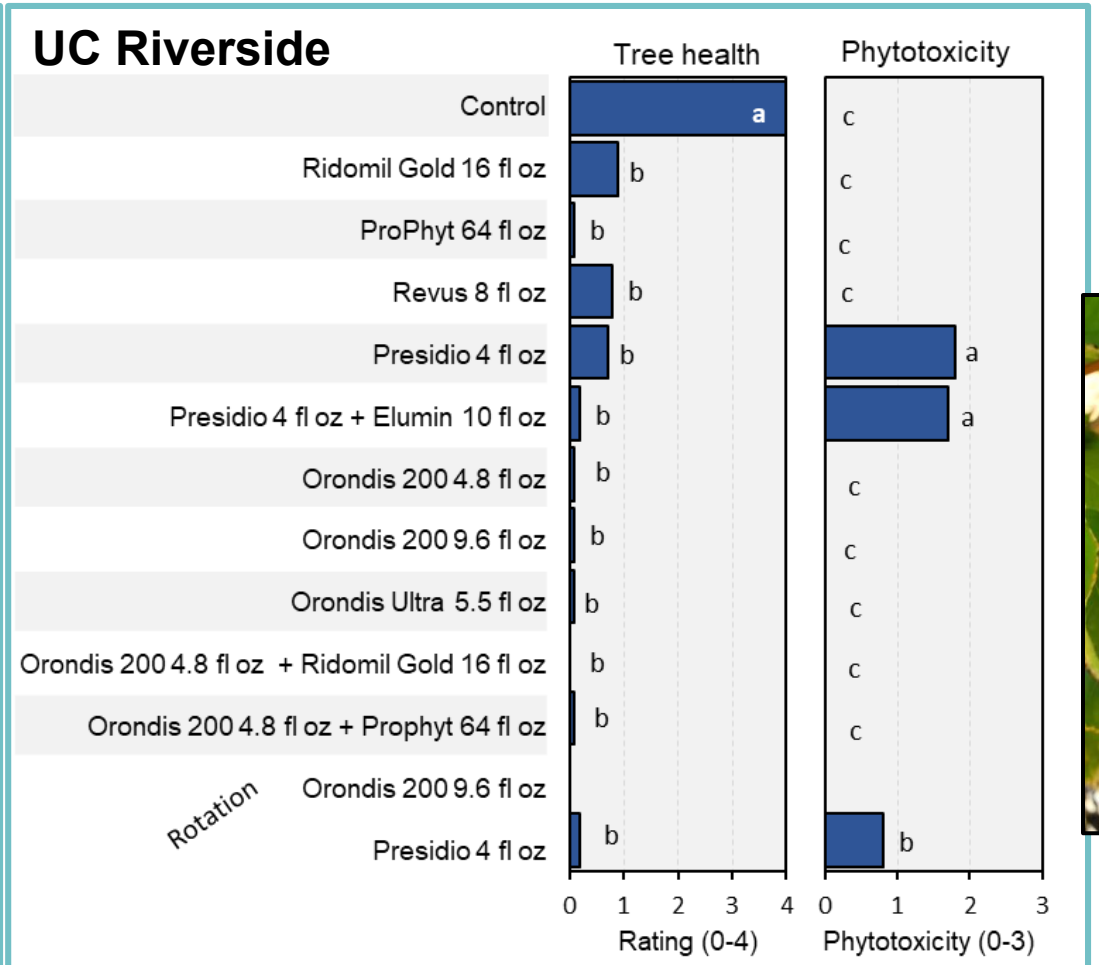
The new fungicides were shown to have high in vitro activity against all *Phytophthora* species from cherry with EC_{50} values mostly of less than 0.1 ppm. Oxathiapiprolin was most toxic at extremely low concentrations (EC_{50} values $\leq$0.001 ppm or $\leq$1ppb).

Efficacy of soil-applied fungicide treatments for management of Phytophthora crown and trunk cankers in field studies - 2023

UC Davis



UC Riverside

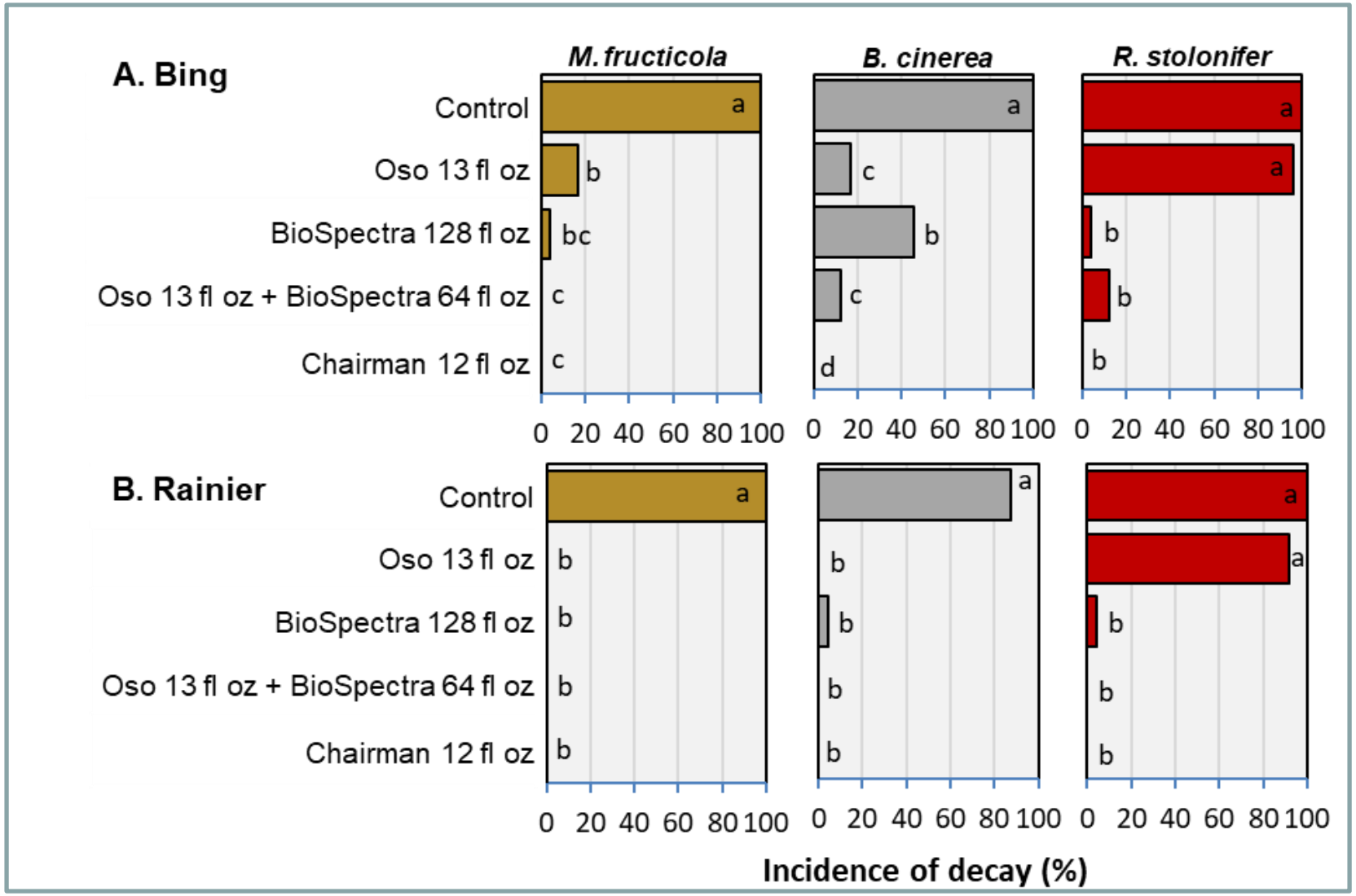


cv. Coral on Mahaleb rootstock, planted 2021

Treatments done to wet soil in May and Oct. 2021 and 2022. Soil inoculation with a mixture of *P. cactorum*, *P. cambivora*, and *P. citricola* in 2021. In 2023, tree health and phytotoxicity were rated.

- New Oomycota fungicides significantly improved tree health.
- *P. cactorum* and *P. cambivora* were recovered from trunk cankers.
- Fluopicolide (Presidio) showed some phytotoxic in sandy soils

Evaluation of new fungicides for managing postharvest decays of Bing cherry in laboratory studies 2023



Fruit were wound-inoculated with spores of *M. fructicola*, *B. cinerea*, or *R. stolonifer*. Aqueous treatments were applied after 13 h. Fruit were incubated at 20C for 4-7 days.

Natamycin and Polyoxin-D are Organic Materials Review Institute (OMRI) listed for organic postharvest use in the U.S.

Natamycin

CERADIS GRANTED OMRI LISTED STATUS FOR CERAFRUTA® BIOLOGICAL FUNGICIDE

Natamycin

CeraFruta ORGANIC

Ceradis Granted OMRI Listed Status for CeraFruta® Biological Fungicide

GROUP 19 FUNGICIDE

Polyoxin D Zinc Salt 5SC Post-Harvest Fungicide

For post-harvest use on listed fruits

Polyoxin D Zinc Salt 5SC Post-Harvest Fungicide is a suspension concentrate fungicide of polyoxin D zinc salt for control of certain post-harvest diseases of fruits in storage

STONE FRUIT

Application Method	Disease	Rate (fl. oz.)	Remarks
In-line Dip, Drench or aqueous Spray	Gray Mold (*Botrytis cinerea*) Brown Rot (*Monilinia fructicola*) Suppression of Rhizopus Rot (*Rhizopus stolonifer*) and Sour Rot (*Geotrichum candidum*)	3.5-16 fl. oz./100 gal	• Mix 3.5-16 fl. oz. of product in 100 gallons of water carrier. • Treat for approximately 15-30 seconds and allow fruit to drain. • For Rhizopus Rot and/or Sour Rot use highest rate. • Make no more than one application. • Make an application either before storage or after storage prior to shipping.
Stone Fruit Includes - Apricot (*Prunus armeniaca*); Apricot, Japanese (*Prunus mume*); Capulin (*Prunus serotina*); Cherry, black (*Prunus serotina*); Cherry, Nanking (*Prunus tomentosa*); Cherry, sweet (*Prunus avium*); Cherry, tart (*Prunus cerasus*); Jujube, Chinese (*Ziziphus jujuba*); Nectarine (*Prunus persica*); Peach (*Prunus persica*); Plum (*Prunus domestica*); Plum, American (*Prunus americana*); Plum, Beach (*Prunus maritima*); Plum, Canada (*Prunus nigra*); Plum, cherry (*Prunus cerasifera*); Plum, Chickasaw (*Prunus angustifolia*); Plum, Damson (*Prunus domestica*); Plum, Japanese (*Prunus salicina*); Plum, Klamath (*Prunus subcordata*); Plum, prune (*Prunus domestica*); Plumcot (*Prunus* hybr.); Sloe (*Prunus spinosa*); Cultivars, varieties, and/or hybrids of these.			

Polyoxin D pending CA approval

Includes **sweet cherry**

Summary

1. New products against **bacterial blast and canker** - Biologicals/natural products, antibiotics
2. New fungicides for control of **brown rot and Botrytis blossom blight, powdery mildew**, and **preharvest brown rot and gray mold fruit decay**: Cevya, proquinazid, pyraziflumid, new premixtures (Miravis Top, Miravis Prime, Mibelya), and biologicals.
3. New **postharvest treatments**: fungicides (Chairman), 'exempt from tolerance-OMRI approved biofungicides (natamycin) and potentially others (Oso: OMRI-approved preharvest), and biologicals

   - Support Scholar-natamycin mixtures for food additive tolerance (FAT) in Japan

   - Support IR-4 registration of Miravis Prime for preharvest use to remove postharvest labeling in Japan

4. New fungicides for managing **Phytophthora root and crown rot**

   - In vitro baseline sensitivities to oxathiapiprolin, mandipropamid, fluopicolide, and ethaboxam
   - Complete studies in experimental orchards at UC Davis and UC Riverside, demonstrating efficacy that are needed for CA registration.
   - Conduct field studies with selected cherry rootstocks to characterize fungicide mobility
   - Support registration of mandipropamid for use in container greenhouse trees during propagation.

Thank you!

- Questions?