Prune disease management
- Brown rot and rust -

Dr. J.E. Adaskaveg

Department of Plant Pathology
University of California, Riverside

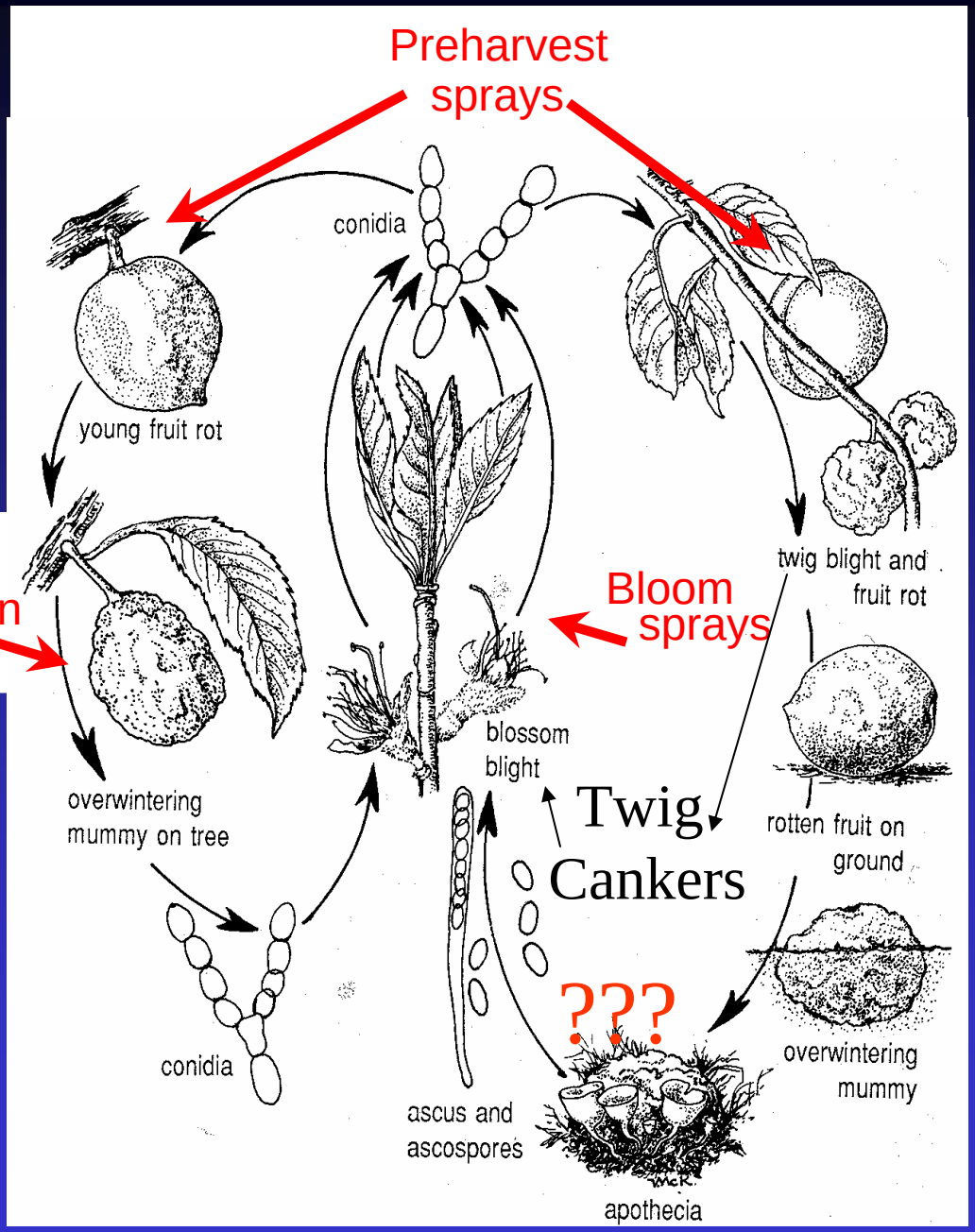
Brown rot of Prune

Monilinia laxa* & *M. fructicola

Preharvest fruit decay

Blossom blight

Disease cycle of *Monilinia fructicola* on prune and preharvest control measures



Orchard sanitation
Removal of overwintering fruit mummies

Mummies and cankers as primary inoculum sources in the spring.

Management of Brown Rot Blossom Blight

- Fungicide Maintenance Programs -

Dried Plum (prune) blossoms are susceptible at white tip through full bloom because all blossom tissues (green scales, petals, stamens, pistils) are susceptible and infection may lead to blossom blight, but the stamen and pistil tissues are the most susceptible.

Classes of preharvest fungicides for management of prune diseases in the US

Sterol biosynthesis inhibitors (Triazoles)

Elite*
Orbit, Rally,
Indar (new in '07)

3

Anilinopyrimidines (AP)

Vangard
(cyprodinil)
Scala
(pyrimethanil)

9

Old Fungicides:
Topsin-M, Botran, Rovral, Bravo, Captan, Sulfur

Strobilurins (QoI)

Abound
(azoxystrobin)
Flint/Gem
(trifloxystrobin)

11

Carboxamide + strobilurin (QoI)

Pristine
(boscalid + pyraclostrobin)

7+11

Hydroxyanilides

Elevate
(fenhexamid)

17

AP+QoI

Distinguish
(pyrimethanil+ trifloxystrobin)

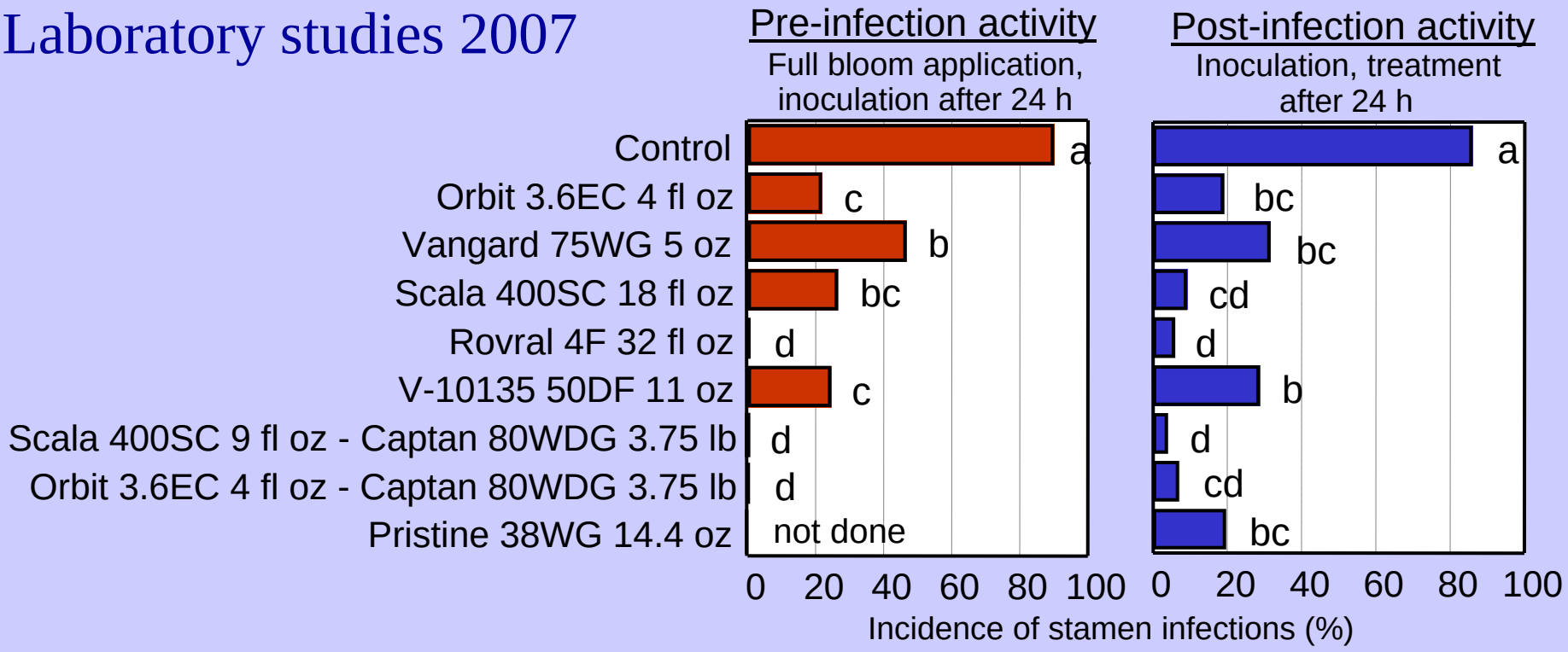
9+11

(New in '08)

Reduced risk fungicides
*** - Not registered on prune**

Efficacy of pre- and post-infection treatments with selected fungicides for management of blossom blight of French prune

Laboratory studies 2007



Pre-infection activity: blossoms were collected in the field, treated in the laboratory, and inoculated with a spore suspension of *M. laxa* (10K/ml) after 24 h.

Post-infection activity: blossoms were collected, inoculated, and treated after 24 h.

Summary: Fungicides for blossom blight control

- Highly effective fungicides for blossom blight control, pre- and post-infection activity:
  - SBIs (Orbit)
  - Dicarboximides (Rovral-oil)
  - Anilinopyrimidines (AP) (Vangard, Scala)
  - Pre-mix of a strobilurin and a carboxamide (Pristine)
  - Mixture of SBI or AP with captan

Blossom blight control with fungicides

UC guidelines

2 applications during bloom

Use when environmental conditions are highly conducive (rain)

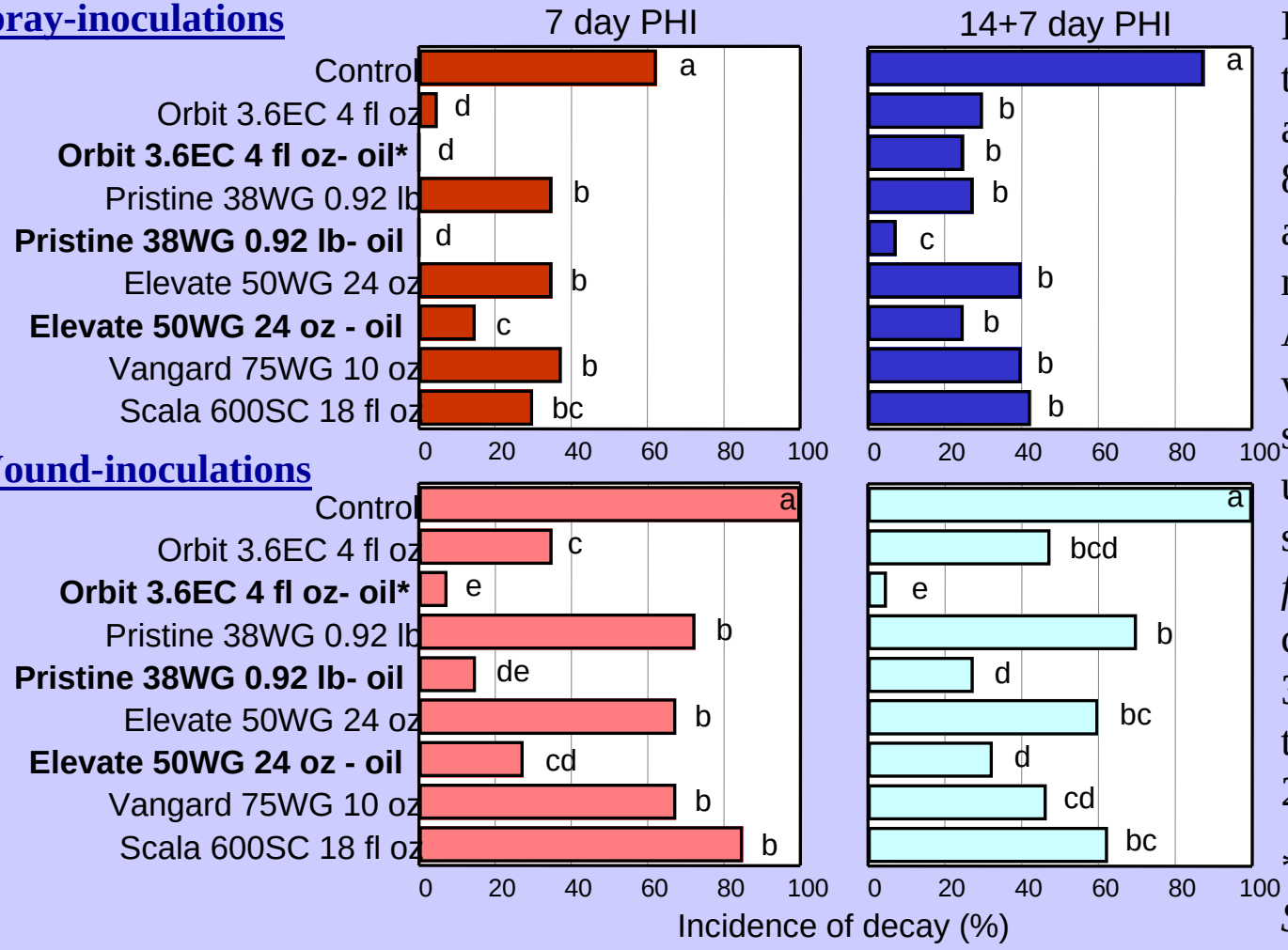
Delayed bloom application

1 application at 30-50% bloom

Use when environmental conditions are less favorable

Management of brown rot fruit decay with preharvest fungicide treatments

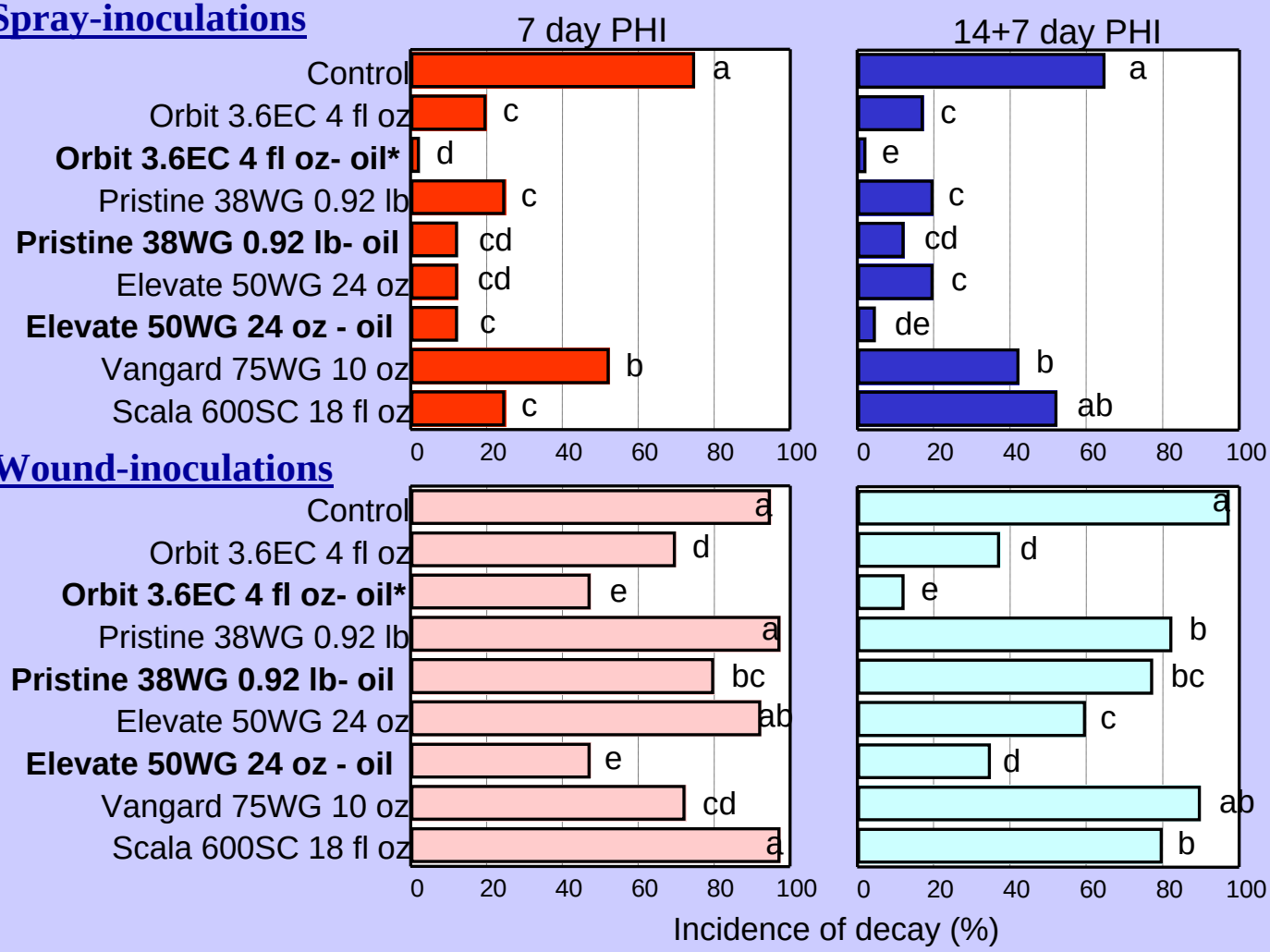
Efficacy of preharvest fungicide treatments for management of brown rot decay of French prune – UC Davis 2007



Preharvest treatments were applied on 8-14 and 8-20-07 using an air-blast sprayer at a rate of 100 gal/A. After harvest, fruit were wound- or spray-inoculated using a spore suspension of *M. fructicola* at a concentration of 30K/ml. Fruit were then incubated at 20C for 7 days.

**Superior 415 Spray oil was used.*

Efficacy of preharvest fungicide treatments for management of brown rot decay of French prune – Colusa Co. 2007



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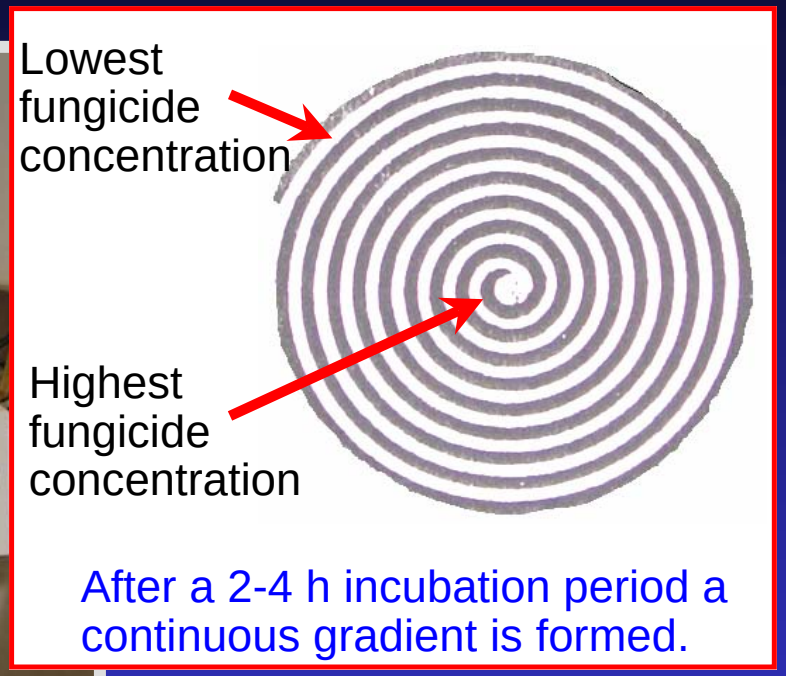
Summary: Fungicides for fruit brown rot control

- All fungicides significantly reduced the incidence of brown rot decay on harvested fruit after spray inoculations with *M. fructicola*.
- The addition of a spray oil to Orbit, Pristine, or Elevate in most cases significantly increased the efficacy of the fungicides.
- When fruit were wound-inoculated after treatment and harvest, the efficacy of most treatments was reduced as compared to the spray inoculations (fungicides are contact materials).
- Again when Orbit, Pristine, and Elevate were used in combination with a spray oil, in most cases a significant increase in efficacy was observed.

Evaluation of the in vitro toxicity of fungicides against *M. fructicola*

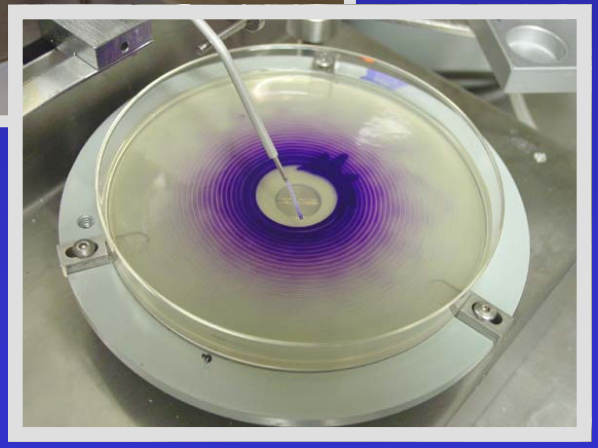
- Reported treatment failures after treatments with anilinopyrimidine (AP) fungicides.
- Resistance in pathogens of other crops has been reported for APs.
- Resistance against SBI fungicides has developed in other stone fruit growing areas of the country.
- Reason for treatment failures?

Quantification of fungicide sensitivity: The spiral gradient dilution method



After a 2-4 h incubation period a continuous gradient is formed.

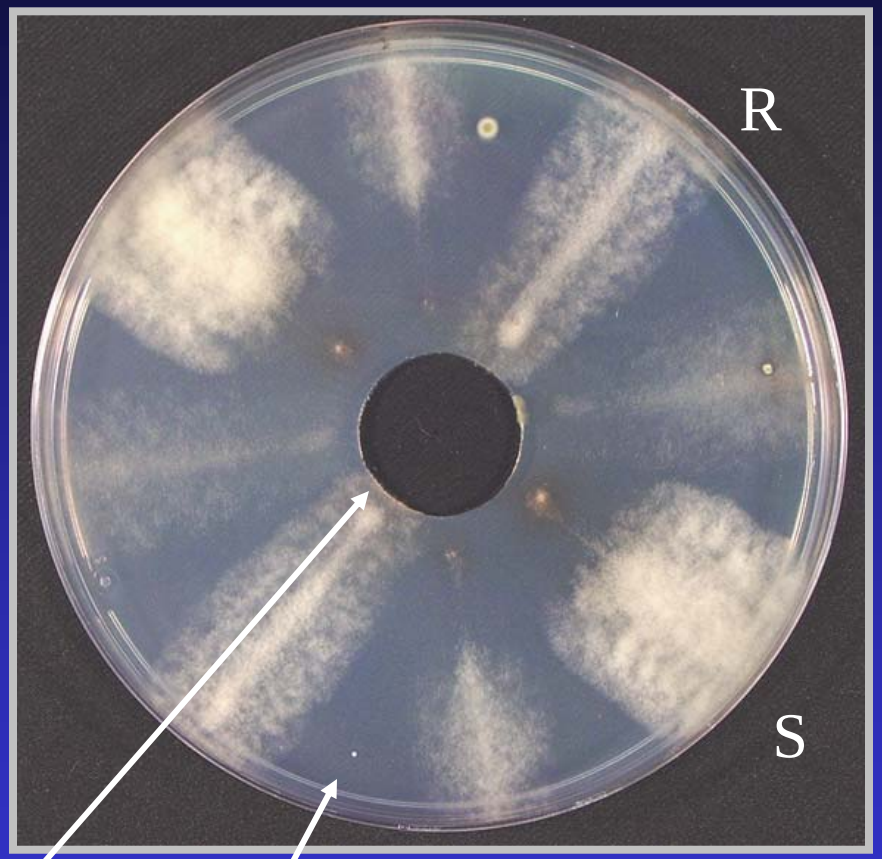
Creating a radial, exponential gradient of a fungicide using a spiral plater



Forster *et al.*, Phytopathology 94:163-170, 2004.

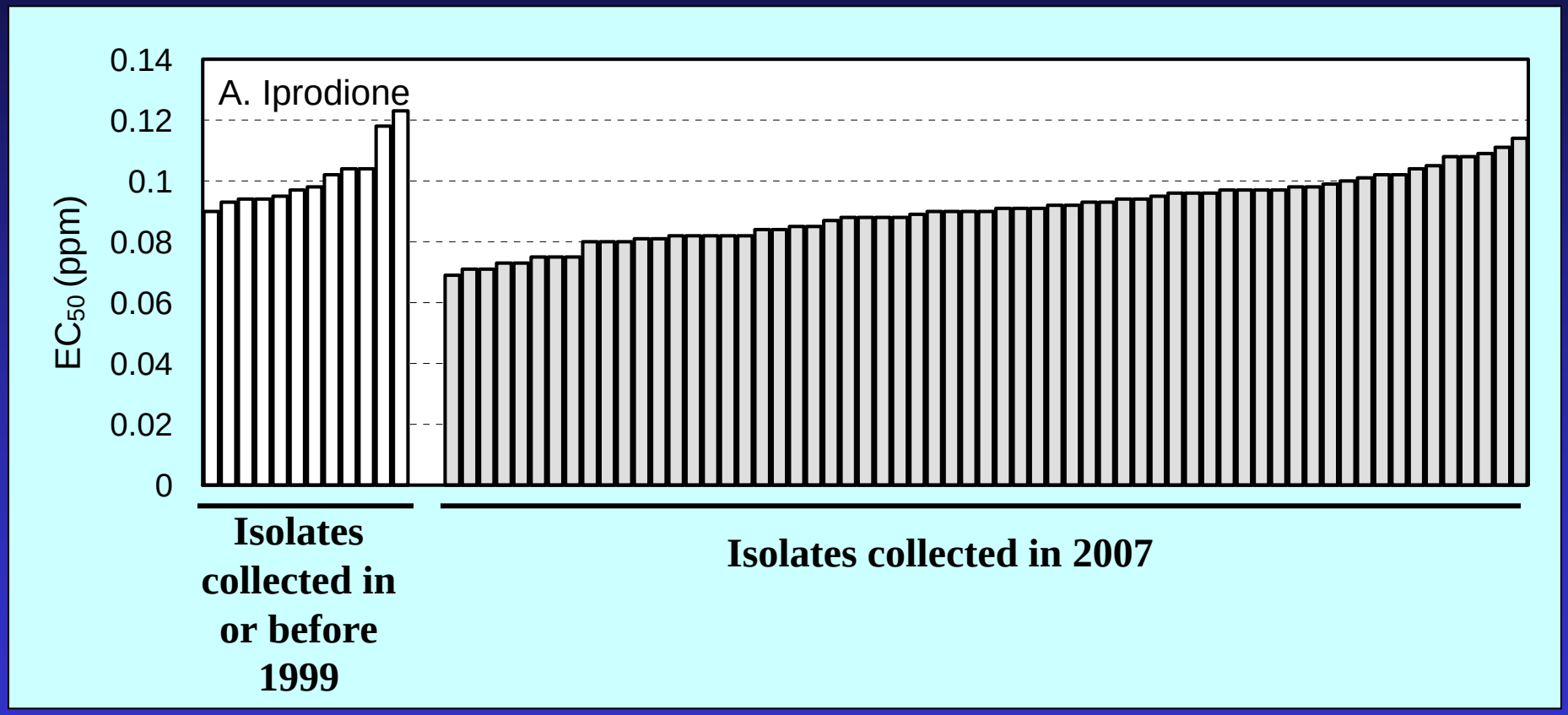
Brown rot resistance to AP fungicides in a California stone fruit orchard in 2007

- Cyprodinil resistance in the brown rot pathogen *M. fructicola* was detected for the first time in 2007 in an orchard in Northern California.
- This emphasizes the need of anti-resistance strategies in using single-site mode of action fungicides.



In vitro toxicity of fungicides against *M. fructicola*

Limited sampling in 2007 due to low incidence of brown rot
51 isolates – 12 orchards



All isolates sensitive to iprodione.

In vitro toxicity of fungicides against *M. fructicola*

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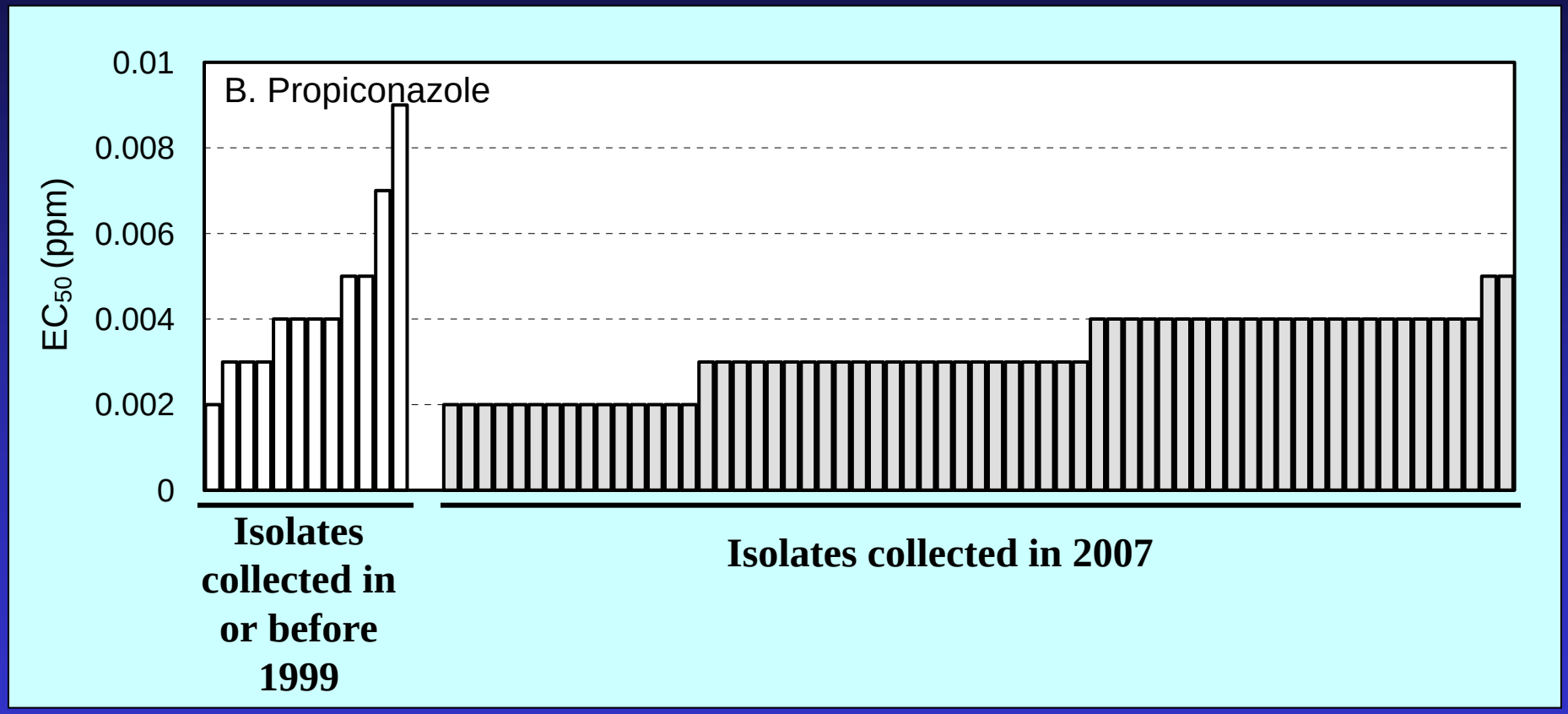

All isolates sensitive to propiconazole.

In vitro toxicity of fungicides against *M. fructicola*

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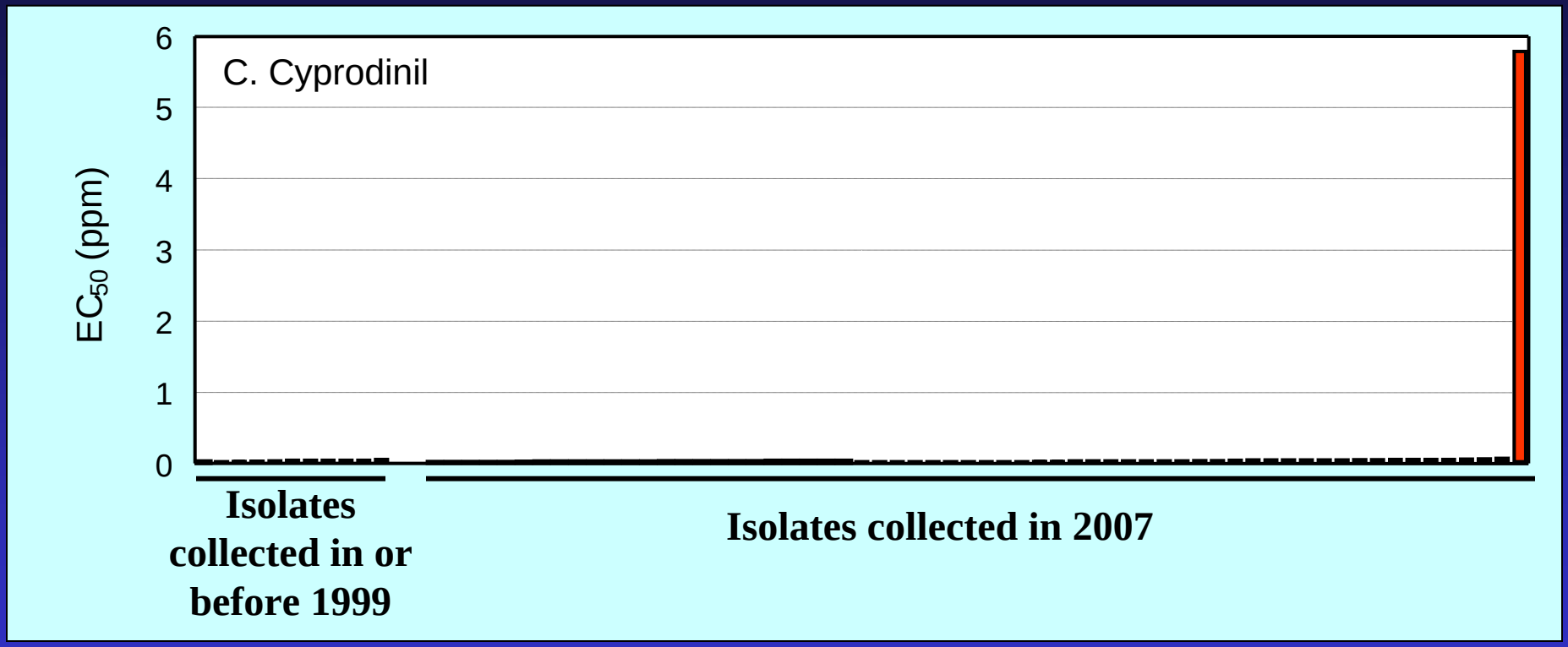
51 isolates – 12 orchards



- One isolate resistant to cyprodinil.
- EC_{50}: 5.8 ppm (as compared to 0.027-0.095 ppm for sensitive isolates).

Summary: In vitro toxicity of M. fructicola against selected fungicides

- One isolate resistant to cyprodinil was found in our limited 2007 survey.
- Thus, resistance development is occurring. If not managed with appropriate anti-resistance strategies, resistant isolates will likely continued to be selected for. This may ultimately result in field resistance.

Anti-resistance strategies for fungicides

- Fungicides within the same chemical class have the same mode of action. Thus, knowledge on the class of a particular fungicide being used is important.

Unlike insecticide-resistance, with fungicides cross-resistance patterns generally follow modes-of-action, presumably reflecting target site alterations rather than uptake and detoxification changes.

Kendall and Hollomon, 1998

Chemical disease control in stone fruit production

- There is an increasing arsenal of fungicides being introduced.
- Using the proper material is becoming more difficult and requires an increasing knowledge on the modes of action (fungicide classes), spectrum of activity, efficacy, and best usage strategies.
- **Goal: Use each class only once per season**

Anti-resistance strategies for fungicide use on almonds

- Application of “Following the Rules” in Fungicide Stewardship -

- **R**otate or mix fungicides of different mode of actions –
- **U**se labeled rates – For strobilurins, use upper label rates.
- **L**imit total number of applications – limit any single-site mode of action fungicide class to 1 (or 2) per orchard per season (strobilurins perhaps to 1/season for scab and Alternaria).
- **E**ducate yourself about fungicide activity, mode of action, and class - as well as resistance management practices.
- **S**tart a fungicide program with multi-site mode of action materials (e.g., Captan, Bravo/Echo, Ziram, Rovral, Sulfur)
  - -Reduce pathogen population size that is exposed to subsequent treatments. Probability of selecting for resistance is reduced.

Anti-resistance strategies

"Minimize disease and pathogen survivors"
Do not compromise control by minimizing rates or coverage

EFFICACY AND TIMING OF FUNGICIDES, BACTERICIDES, AND BIOLOGICALS FOR DECIDUOUS TREE FRUIT, NUT, STRAWBERRY, AND VINE CROPS 2008

ALMOND
APPLE AND PEAR
APRICOT
CHERRY
GRAPE
KIWIFRUIT
PEACH
PISTACHIO
PLUM
PRUNE
STRAWBERRY
WALNUT

Jim Adaskaveg
Professor
University of California, Riverside

Doug Gubler
Extension Plant Pathologist
University of California Davis

Themis Michailides
Plant Pathologist
University of California, Davis/Kearney Agricultural Center

Brent Holtz
Farm Advisor
University of California Cooperative Extension, Madera County

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UC Davis, Dept. of Plant Pathology
www.plpnem.ucdavis.edu

UC Kearney Agricultural Center
www.uckac.edu/plantpath

Statewide IPM Program
www.ipm.ucdavis.edu

2008 Prune (Dried Plum) – Fungicide Efficacy

http://www.ipm.ucdavis.edu

Fungicide	Resistance Risk	FRAC* Class	Blossom brown rot	Fruit brown rot	Russet scab	Rust
Benlate[1] + oil[2]	**HIGH**	1	++++	++++	---	---
Distinguish*	**medium**	9/11	++++	++	---	++
Orbit/Bumper	**HIGH**	3	++++	++++	---	+++
Indar	**HIGH**	3	++++	++++	---	+++
Pristine	**medium**	7 + 11	++++	++++	ND	ND
Rovral/Iprodione[3] + oil[2]	**low**	2	++++	NR	---	NR
Topsin-M/T-Methyl[1] + oil[2]	**HIGH**	1	++++	++++	---	---
Scala[6]	**HIGH**	9	++++	+++	---	ND
Vangard[6]	**HIGH**	9	++++	+++	---	ND
Elevate	**HIGH**	17	+++	+++	ND	---
Rovral/Iprodione[3]	**low**	2	+++	NR	---	NR
Topsin/T-Methyl[1]	**HIGH**	1	+++	+/-	---	---
Abound	**HIGH**	11	++	+	---	+++
Botran	**medium**	14	++	++	---	ND
Bravo/Echo/Chlorothalonil[4,5]	**low**	M5	++	++	++	---
Captan[4]	**low**	M4	++	++	+++	---
Gem	**HIGH**	11	++	+	---	+++
Rally	**HIGH**	3	++	++	---	---
Sulfur	**low**	M2	+/-	+/-	---	++

Rating: ++++ = excellent and consistent, +++ = good and reliable, ++ = moderate and variable, + = limited and erratic, +/- = minimal and often ineffective, --- = ineffective, and ? = insufficient data or unknown. NR = not registered after bloom, ND = no data.

1. Benlate label withdrawn. Strains of *Monalinia fructicola* and *M. laxa* resistant to Benlate and Topsin-M have been reported in some California prune orchards. No more than two applications of Benlate and Topsin should be made each year.
2. The oil is "light" summer oil, 1-2% volume/volume. If applied in summer cause fruit to lose bloom and look red. They dry to normal color.
3. Blossom blight only; not registered for use after petal fall.
4. Do not use in combination with or shortly before or after oil treatment
5. Do not use after jacket (shuck) split.
6. High summer temperatures and relative humidity reduce efficacy.

Generic registration. New registration.

* - Pending registration.

Fungicide treatment timing in prune (dried plum)

http://www.ipm.ucdavis.edu

Disease	Green bud	White bud	Full bloom	May	June	July
Brown rot[a]	+++	+++	++++	—	+	++
Russet scab[b]	—	—	+++	—	—	—
Rust[c]	—	—	—	+	++	+++
Rating: +++ = most effective, ++ = moderately effective, + = least effective, and — = ineffective.						
Timings used will depend upon orchard history of disease, length of bloom, and weather conditions each year.						
a. Flowers are susceptible beginning with the emergence of the sepals (green bud) until the petals fall, but are most susceptible when open.						
b. A physiological disorder, no pathogens involved.						
c. More severe when late spring rains occur.						

Components of an integrated disease management program for brown rot of stone fruit

- Early disease detection
- Planting
  - Variety selection (host resistance)
  - Plant spacing (greater air movement, shorter drying times)
- Cultural practices
  - Avoid high-angle sprinkler irrigation
  - Provide a balanced nutrition
  - Pruning practices (improved microclimate, removal of diseased tissue)
- Sanitation
  - At harvest remove all fruit from trees
  - Remove overwintering mummies from trees and cultivate mummies into soil
- Chemical control

Prune rust caused by *Tranzschelia discolor*

Early symptoms of disease will start in late April/early May. Defoliation may occur in July and August in severe years.

The incidence of rust was very low at most locations in 2007 and our studies on this disease were postponed.

Dried Plum Board Prune Day Presentation 2-29-08.ppt