Management of Walnut Blight in a Wet Spring?

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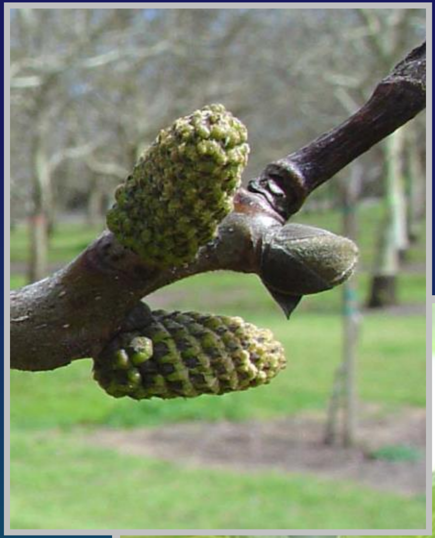
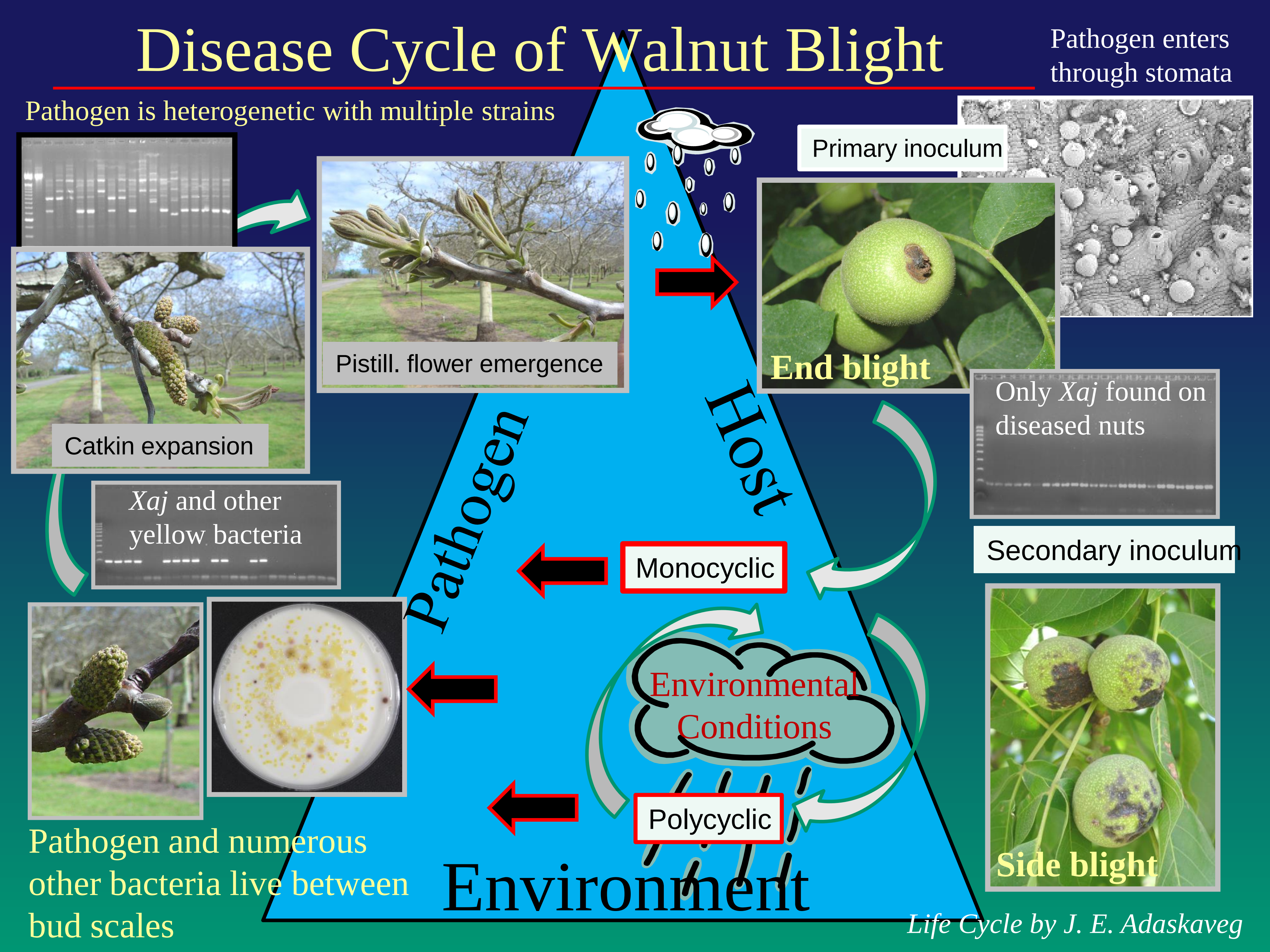
Walnut blight is a bacterial disease

- *Xanthomonas arboricola* pv. *juglandis*
- The pathogen lives between scales of living flower buds and in dead buds
  - Male catkins
  - Female pistillate
- Buds, flowers, fruit are susceptible to disease (cankers in wood on some varieties)
- Fruit infections –
  - Black irregular lesions with living bacteria inside
  - Infections develop and affect kernel
  - Direct crop loss




Disease Cycle of Walnut Blight
Pathogen enters through stomata
Pathogen is heterogenetic with multiple strains
Primary inoculum
Pistill. flower emergence
Catkin expansion
End blight
Only *Xaj* found on diseased nuts
Xaj and other yellow bacteria
Pathogen
Host
Monocyclic
Secondary inoculum
Environmental Conditions
Polycyclic
Side blight
Environment
Pathogen and numerous other bacteria live between bud scales
Life Cycle by J. E. Adaskaveg

Development of mancozeb insensitivity in California *Xaj* isolates?

- Growers are reporting reduced efficacy of copper-mancozeb applications.
- In vitro sensitivity studies with collections of *Xaj* were conducted - shift to reduced sensitivity to copper-mancozeb?

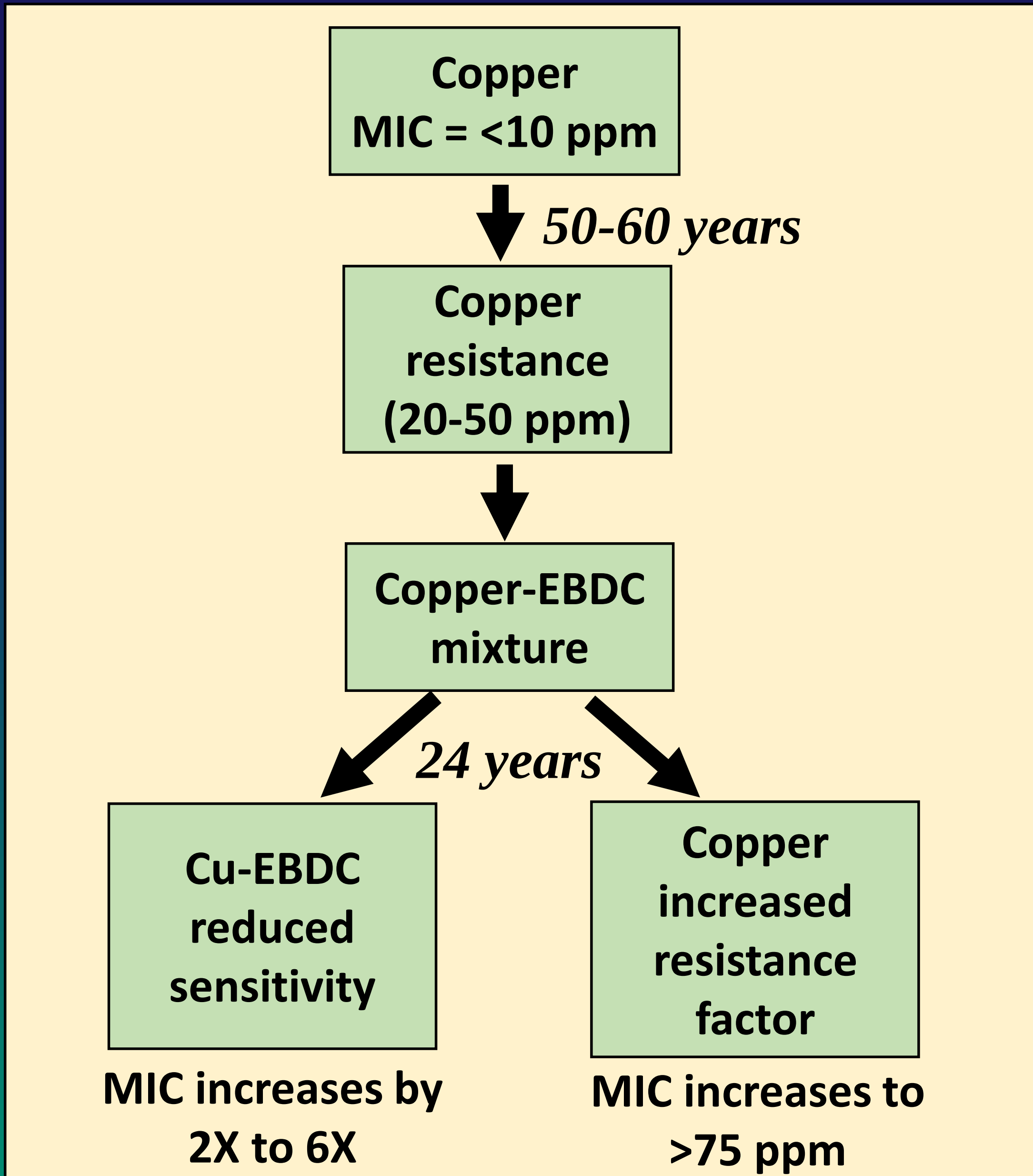
Sensitivity of Xaj from 17 walnut orchards to copper and copper-mancozeb

Orchard No.	Growing region*	No. strains copper-sensitive	No. strains with growth at 50 ppm Cu	Growth at 75 ppm Cu	No. strains less sensitive to Cu-mancozeb	Total Isolates tested
1	SV	2	10	N	0	12
2	SV	8	1	N	1	9
3	SV	2	5	N	3	7
4	SV	4	1	N	0	5
5	SV	3	0	N	0	3
6	SV	0	10	N	0	10
7	SV	4	4	N	0	8
8	SJV	7	0	N	0	7
9	SJV	0	10	N	8	10
10	SJV	6	2	N	2	8
11	SV	0	9	Y	6	9
12	SV	8	2	Y	2	10
13	SV	2	5	Y	4	7
14	SV	0	7	Y	5	7
15	SJV	0	10	Y	10	10
16	SJV	0	9	Y^	9	9
17	SJV	0	8	Y	8	8
	Total	46	93	7/17	58	139
	%	33.1	66.9	41.2	41.7	

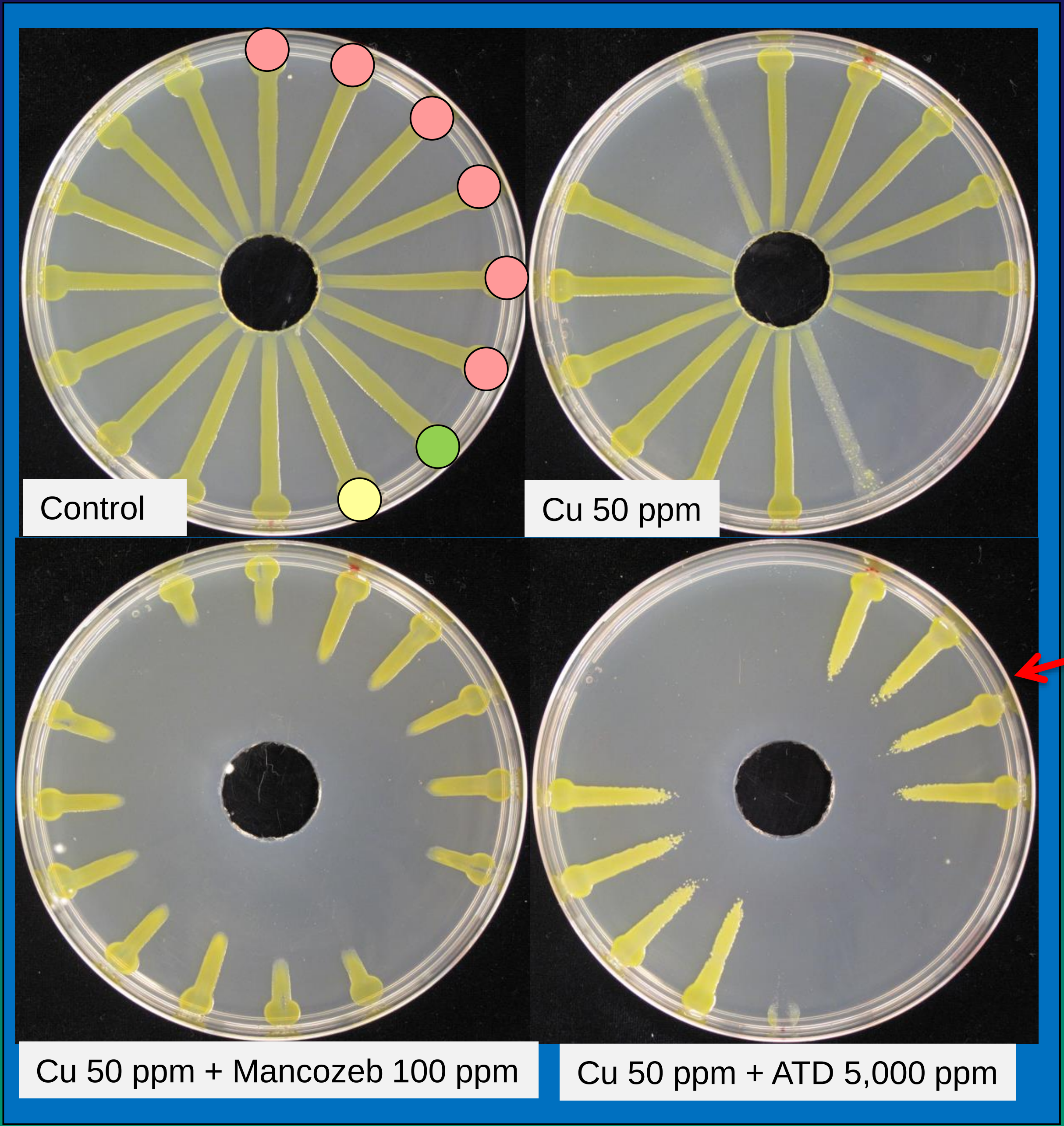
- Copper insensitivity is increasing to 75-100 ppm.
- Less sensitive strains mostly also less sensitive to Cu-mancozeb (a 2- to 6-fold shift)

SJV=San Joaquin Valley
SV= Sacramento Valley

Copper use in walnut blight management and continued selection pressure on pathogen populations



Sensitivity tests with Cu and mancozeb alternatives



Cultures of *Xaj* plated onto amended agar media. Order of isolates is the same for the four plates.

- Cu-sensitive
- Cu-resistant
- Cu moderate-resistant

The experimental ATD increased copper activity similar mancozeb.

Higher rates of copper in combination with mancozeb will be effective against high copper-resistant strains.

Blight management

- Effective treatments
- New bactericides
- Mancozeb alternatives

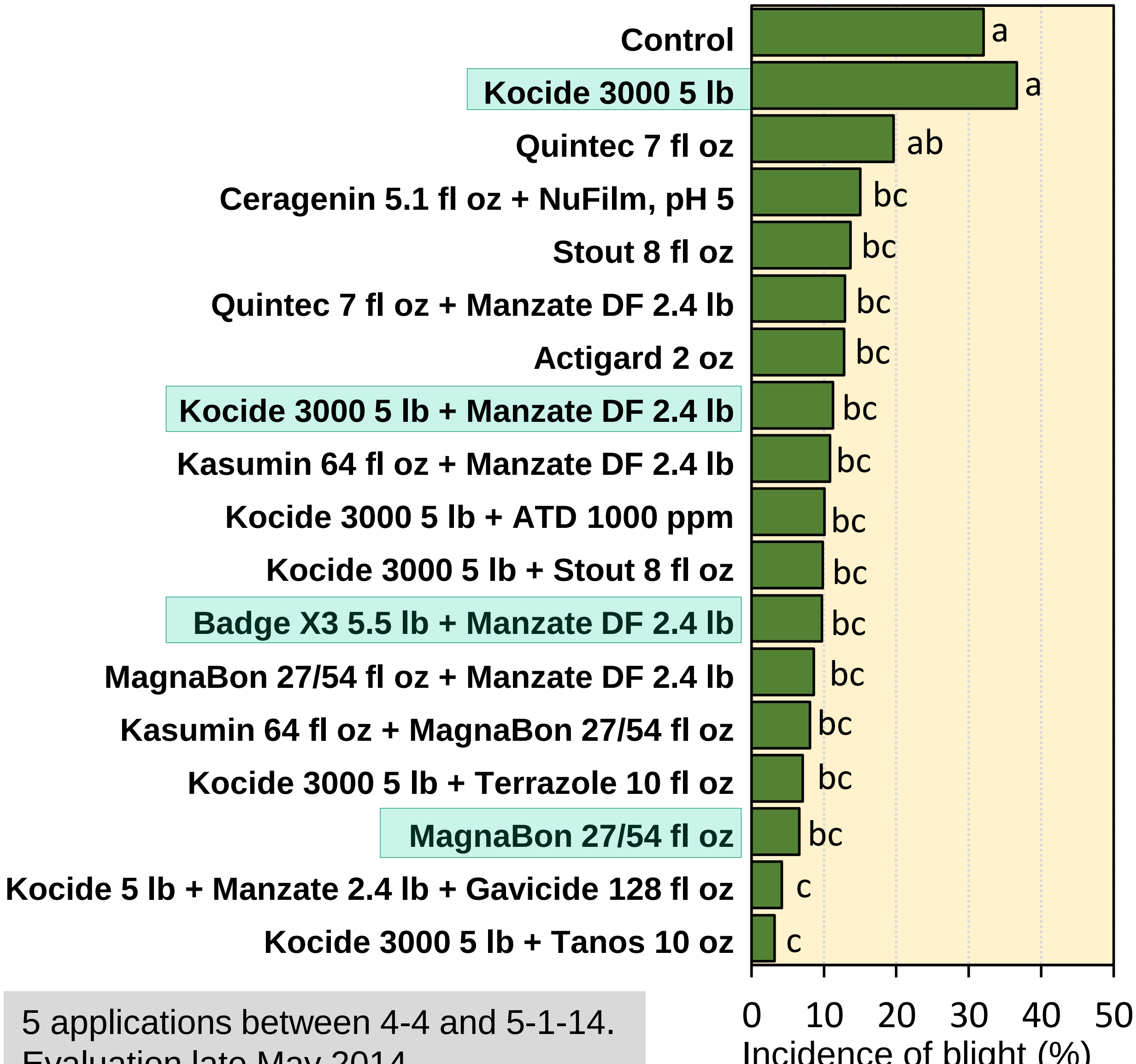
Walnut blight management trials 2015

Type of treatment	Treatment	Efficacy
Coppers, EBDCs	Kocide 3000, Badge X2 + EBDC ChampION++ + EBDC Cuprofix Ultra Disperss + EBDC MagnaBon SC-2005 + EBDC	++++ ++++ ++++ ++++
Antibiotics	Kasugamycin Kasugamycin + Cu Kasugamycin + EBDC Fireline/Mycoshield	++ ++++ ++++ +++
EBDC alternatives	ATD, Terrazole Tanos, Quintec	++++ +/+++
Biocontrols/ natural products	Actinovate + growth enhancer Botector + growth enhancer	++ ++
SARs	Actigard, Stout, USF-2018	+/++

Kasugamycin was registered on pome fruits in 2014, the first new antibiotic in US agriculture in more than 40 years. Currently in the 18-month review period as a new AI. New biologicals include Nacillus Pro, Pro-tect, etc.

Walnut blight management trials - Trial 1

cv. Tulare, Solano Co., Moderate resistance to copper, moderate disease pressure



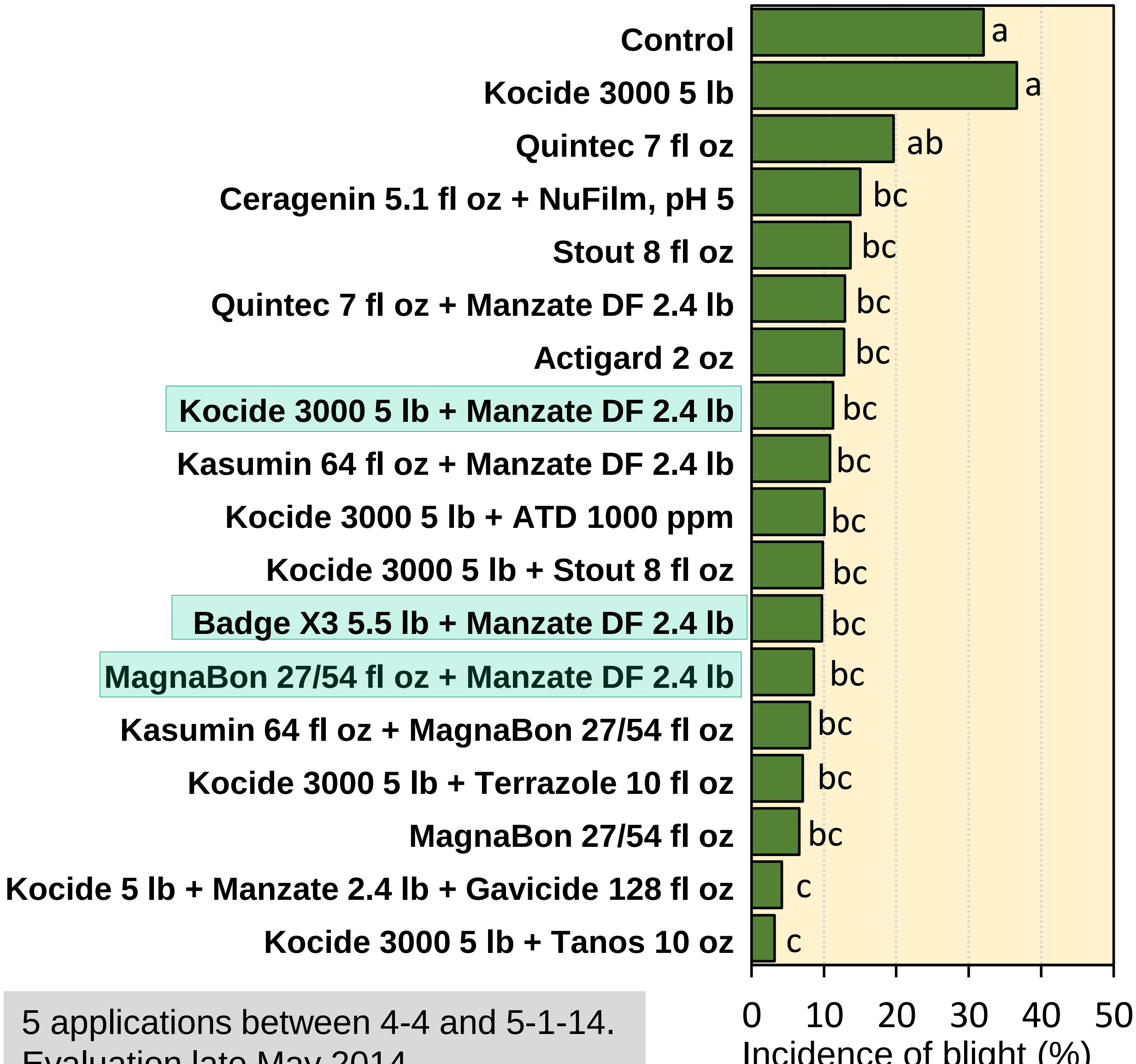
5 applications between 4-4 and 5-1-14.
Evaluation late May 2014.

1.

- Kocide 3000 not effective in the presence of moderate copper resistance
- CS-2500 - MagnaBon effective (but some phytotoxicity observed)
- Copper-Manzate effective
- Manzate was registered in 2013, Dithane in 2014.

Walnut blight management trials - Trial 1

cv. Tulare, Solano Co., Moderate resistance to copper, moderate disease pressure



5 applications between 4-4 and 5-1-14.
Evaluation late May 2014.

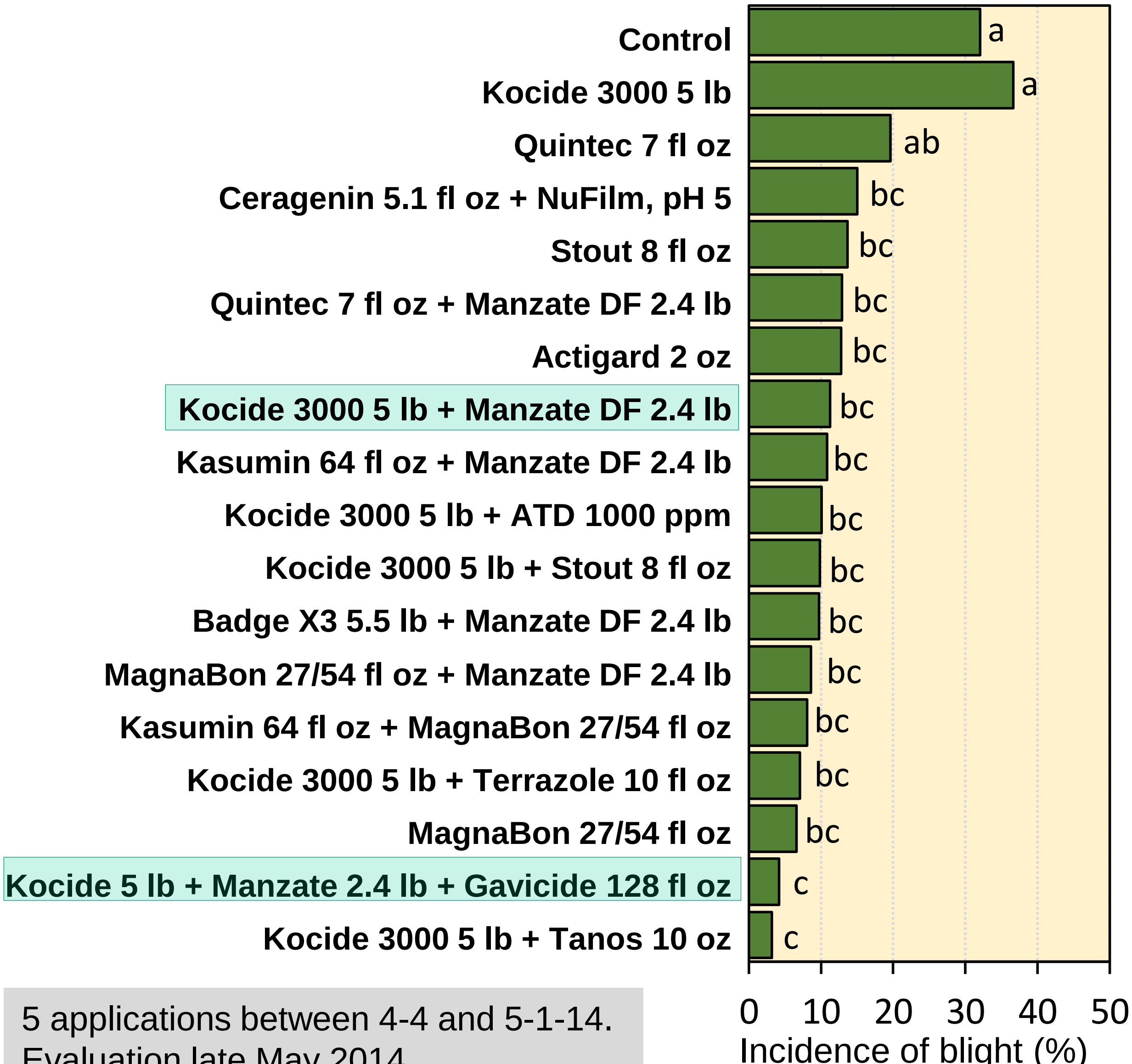
2.

Comparison of copper products in combination with Manzate:

- Kocide-Manzate, Badge-Manzate, MagnaBon-Manzate all had similar efficacy.
- In another trial, ChampION++ and Cuprofix were also similarly effective to Kocide 3000 and Magnabon.

Walnut blight management trials - Trial 1

cv. Tulare, Solano Co., Moderate resistance to copper, moderate disease pressure



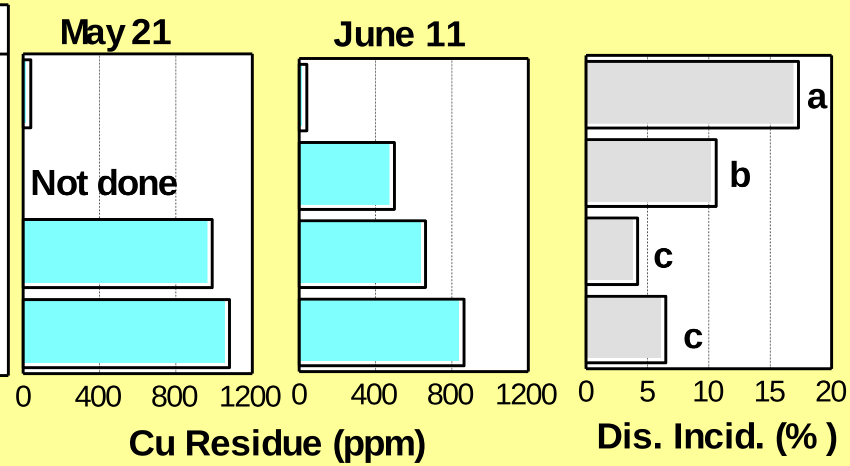
5 applications between 4-4 and 5-1-14.
Evaluation late May 2014.

3.

- Gavicide improved efficacy of copper-Manzate

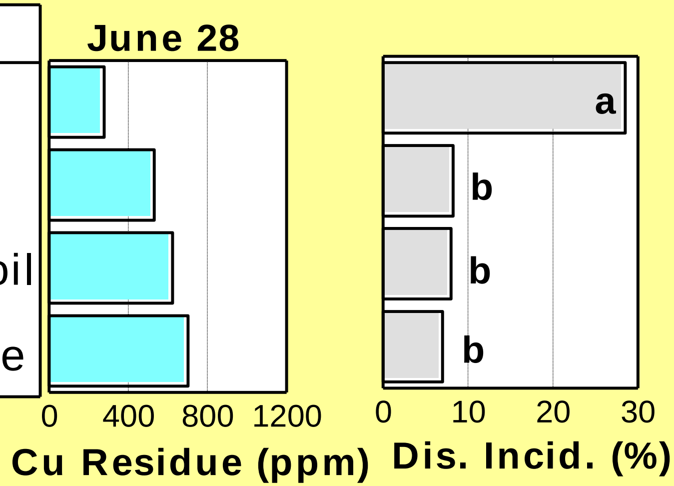
Persistence of copper residues on walnut leaves

Treatment
Untreated control
Badge X2 5 lb
Badge X2 5 lb + Manzate 2.4 lb
Badge X2 5 lb + Manzate 2.4 lb + Lime 4 lb



Treatments on 3-28, 4-2, 4-11, 4-17, and 5-7-2013.
5 lb * 0.27 = 1.35 lb MCE (1620 ppm)

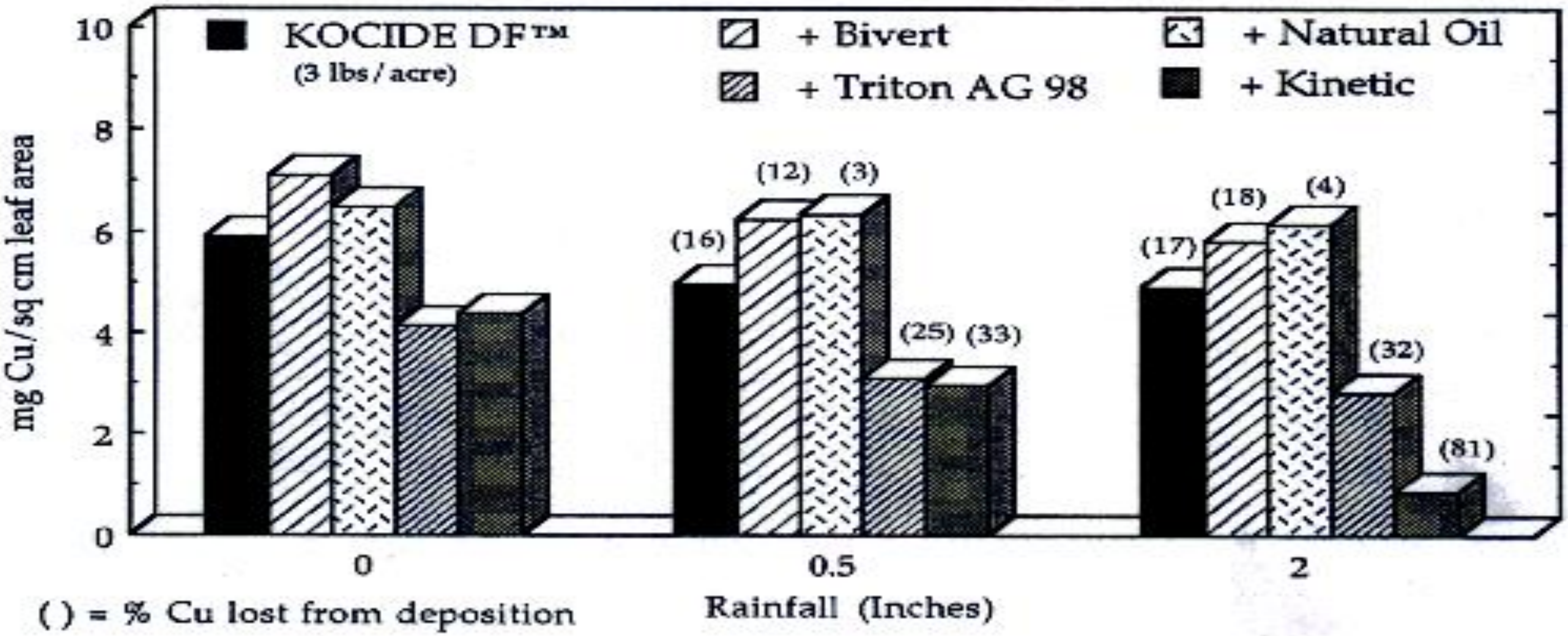
Treatment
Kocide 3000 5.25 lb
Kocide 3000 5.25 lb-Manzate 2.4 lb
Kocide 3000 5.25 lb-Manzate 2.4 lb + natural oil
Kocide 3000 5.25 lb-Manzate 2.4 lb + Zn - Lime



Treatments on 3-28, 4-2, 4-11, 4-17, and 5-7-2013.
5.25 lb * 0.30 = 1.58 lb MCE (1890 ppm)

Conclusion: Greater residues with lime or oil added to Cu-mancozeb (acting as a sticker) but no difference in disease control under low rainfall conditions of California.

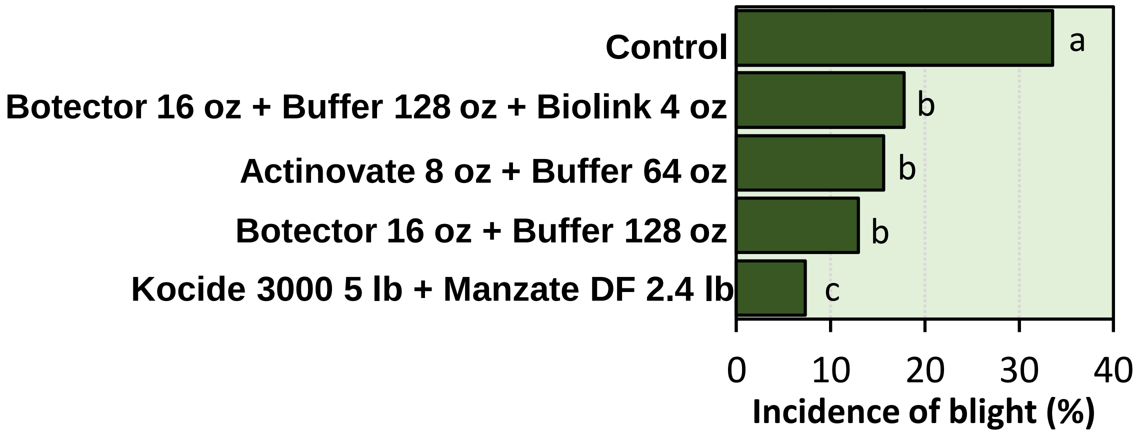
Effect of adjuvants on Kocide DF™ deposition and rainfastness after 0.5 and 2.0 inches of simulated rainfall.



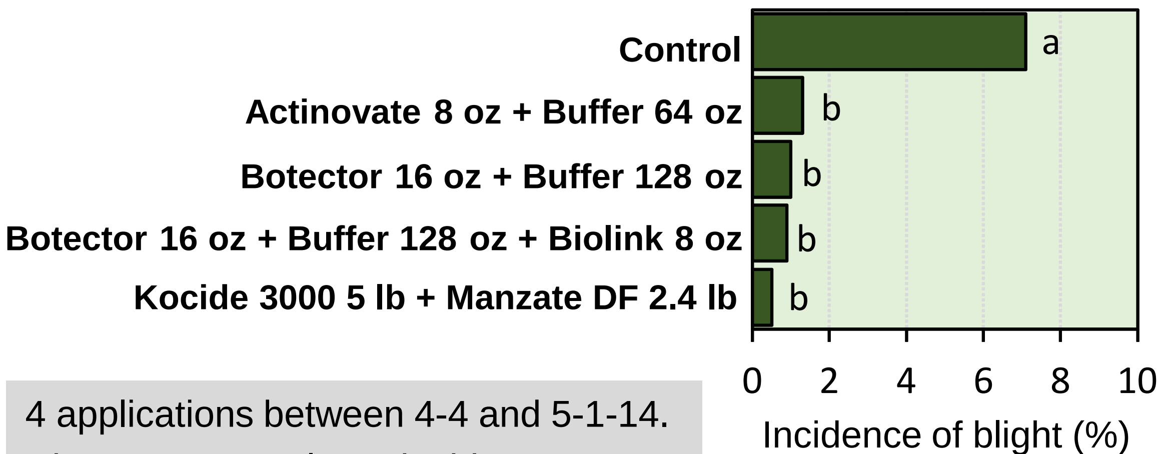
Courtesy of DuPont.

Walnut blight management trials - Biologicals

cv. Tulare, Solano Co., moderate disease pressure



cv. Hartley, Solano Co., low disease pressure



4 applications between 4-4 and 5-1-14.
Disease was evaluated mid-May 2014.

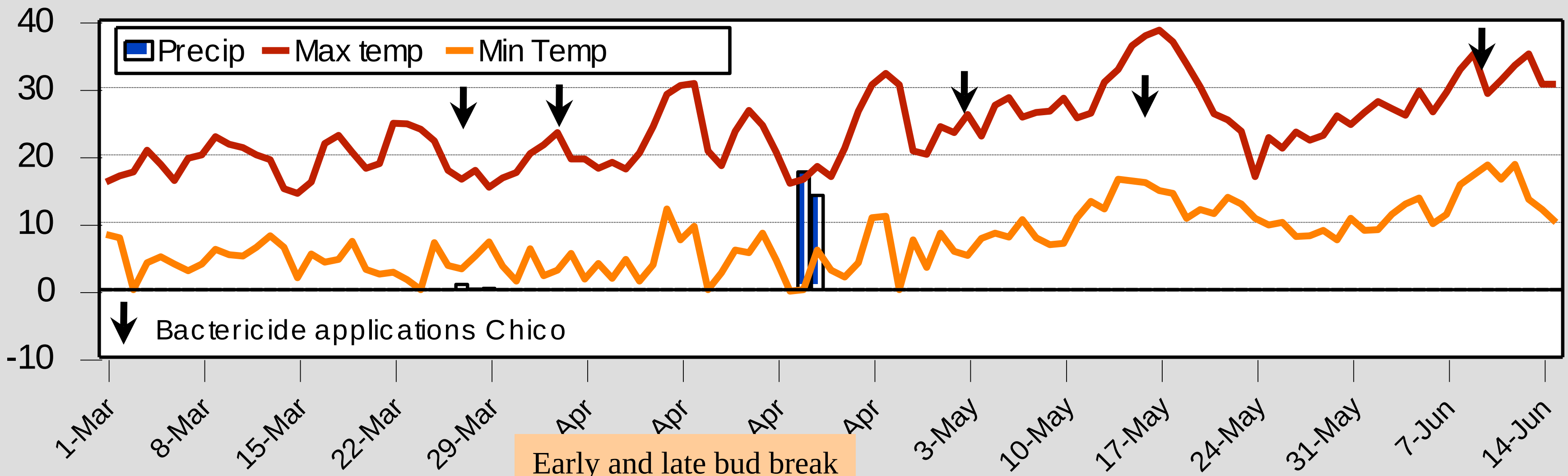
- The biocontrols Botector and Actinovate were effective under moderate disease pressure, very effective under low disease pressure.
- Experiments are underway to improve the efficacy of biocontrols with growth enhancers.

Evaluation of minimal spray programs based on host phenology, calendar dates, and XanthoCast

Environments and bloom stages determine start of spray programs.

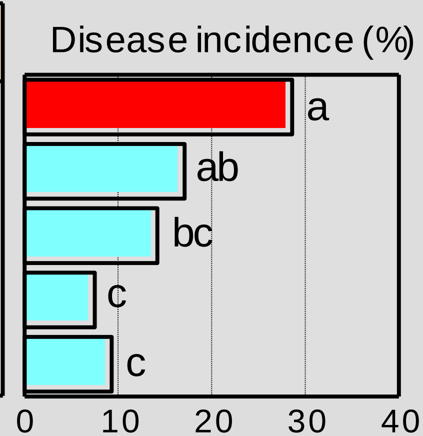
Terminal bud break 40-60% or pistillate flower emergence

Evaluation of minimal spray programs in a cv. Chico orchard under natural rain conditions - Solano Co.



Early and late bud break

No.	Treatment	Catkin 3-26	Pistillate Emergence 4-2	X'Cast 5-2	X'Cast 5-15	X'Cast 6-9
1	Control	–	–	–	–	–
2	Kocide 3000/Manzate Prostick	@	–	–	–	–
3	Kocide 3000/Manzate Prostick	–	@	–	–	–
4	Kocide 3000/Manzate Prostick	@	–	@	@	@
5	Kocide 3000/Manzate Prostick	–	@	@	@	@



Kocide 3000 was applied at a rate of 3.5 lb and Manzate at a rate of 2.4 lb/100/A. Simulated rain was applied for 6-7 h one day after each treatment.

Bactericide programs for management of walnut blight

Initiation of program

- **Flower phenology** (male & female flower emergence)
- **Environmental conditions**

→

- Reduction of primary inoculum residing in buds

The main assumption –
Orchard has a disease history

Subsequent applications

- **Environmental conditions**
  XanthoCast

Reduction of:

- Disease on current crop
- Secondary inoculum
- Contamination of developing buds, as well as shoots and leaves

Two methods for disease prediction evaluated

Bud population size of *Xaj* in the fall or late dormant season*

vs.

Actual disease level in the current season

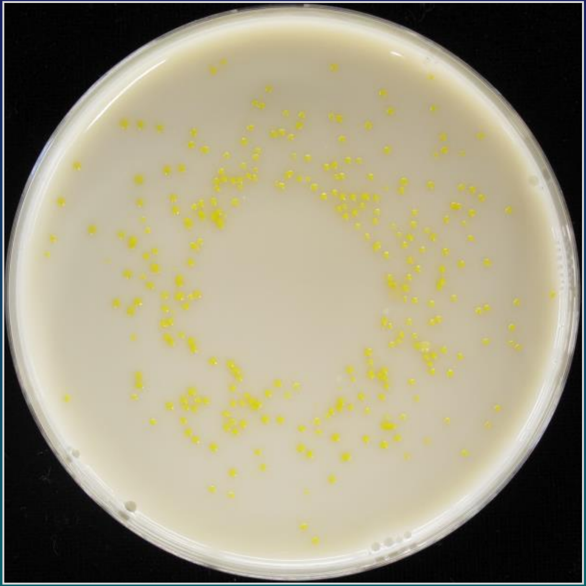
Prediction of next season's disease risk

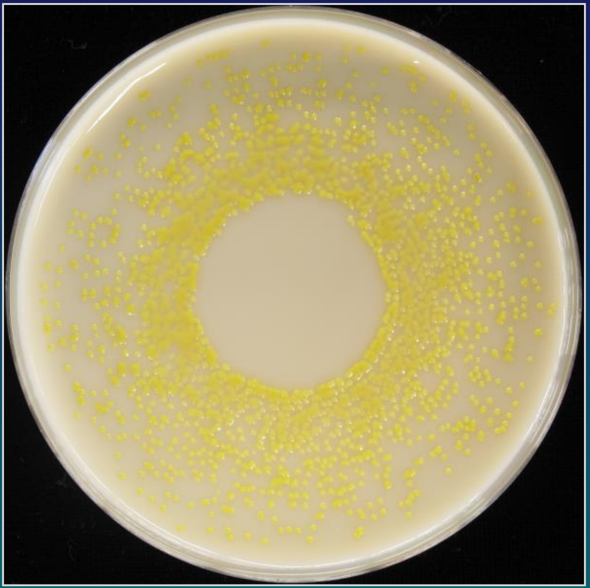
*** - Based on 50 bud samples per block.**

Walnut bud population study: Estimating Xaj population sizes in dormant walnut buds

Examples of:

Low population | Intermediate population | High population





Rating: 1 2 3

Walnut buds were macerated in sterile water and the suspensions were spiral-plated onto selective agar. Identity of selected colonies was verified by PCR.

Two methods for disease prediction - Results

Bud population size of *Xaj* in the fall

vs.

Disease level in the current season

Sampling of 35 walnut orchards

15 of 35 orchards had Low or Medium size bud populations in the fall of the previous season, but higher disease levels in current season = **21.4% error**.

6 of 35 orchards had Low or Medium disease levels the previous seasons, but higher disease levels in current season **= 8.6% error.**

Methods for disease prediction - Conclusion

- Neither method is advised as a sole method for predicting disease levels in the current season and for designing management practices.

- **Best management strategy:**
- Identify high-risk orchards based on disease levels in the previous season.
- Use weather forecasts (i.e., XanthoCast) in the current season (after the catkin expansion or pistillate-flower-emergence application of a bactericide).

Walnut blight management in a wet spring

- Identify high risk orchards based on disease levels in the previous season.
- Registered copper bactericides are effective but must use copper ***≥ 1.5 to 2 lb MCE/A*** in mixtures with mancozeb.
- Mancozeb (Manzate) obtained full registration on walnut in 2013, ***Dithane*** in 2014.
- Consider adding ***1% oil*** or ***a sticker*** to increase persistence of copper-mancozeb under forecasted wet conditions
- Start early at ***catkin expansion*** or ***pistillate flower emergence*** and continue applications in a 7-10 interval based on ***rainfall (wetness)*** using ***weather forecasts and/or XanthoCast***.
- Research on alternatives with different modes of action is imperative. Section 3 for ***Kasumin*** submitted.

Thank you