



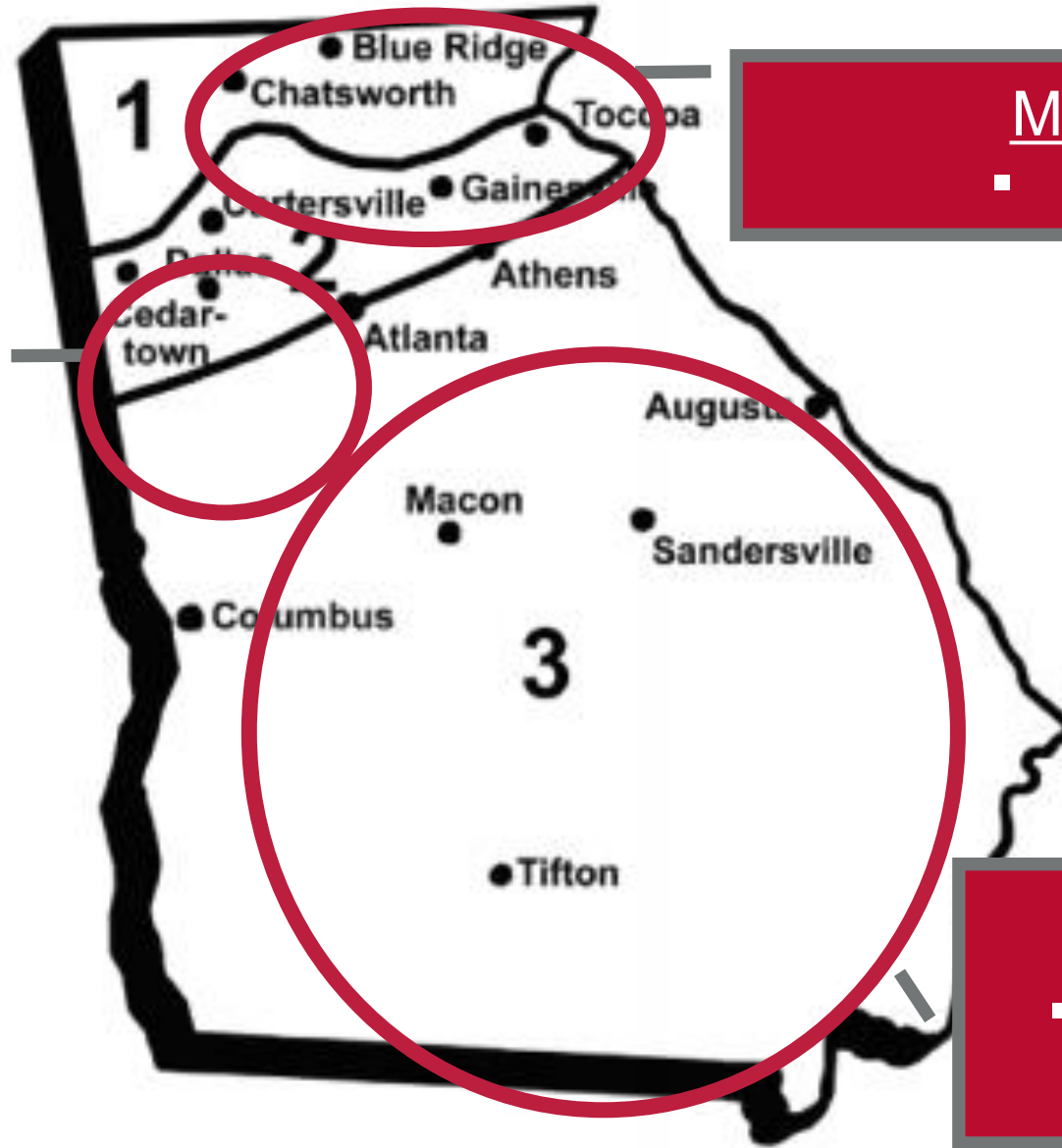
College of Agricultural &
Environmental Sciences
UNIVERSITY OF GEORGIA

EPA Removal of Resources in the Fungicide Toolbox

Phil Brannen
Department of Plant Pathology
University of Georgia



~ 2000 acres



Mountain Region

- Mostly *Vitis vinifera*

West Georgia

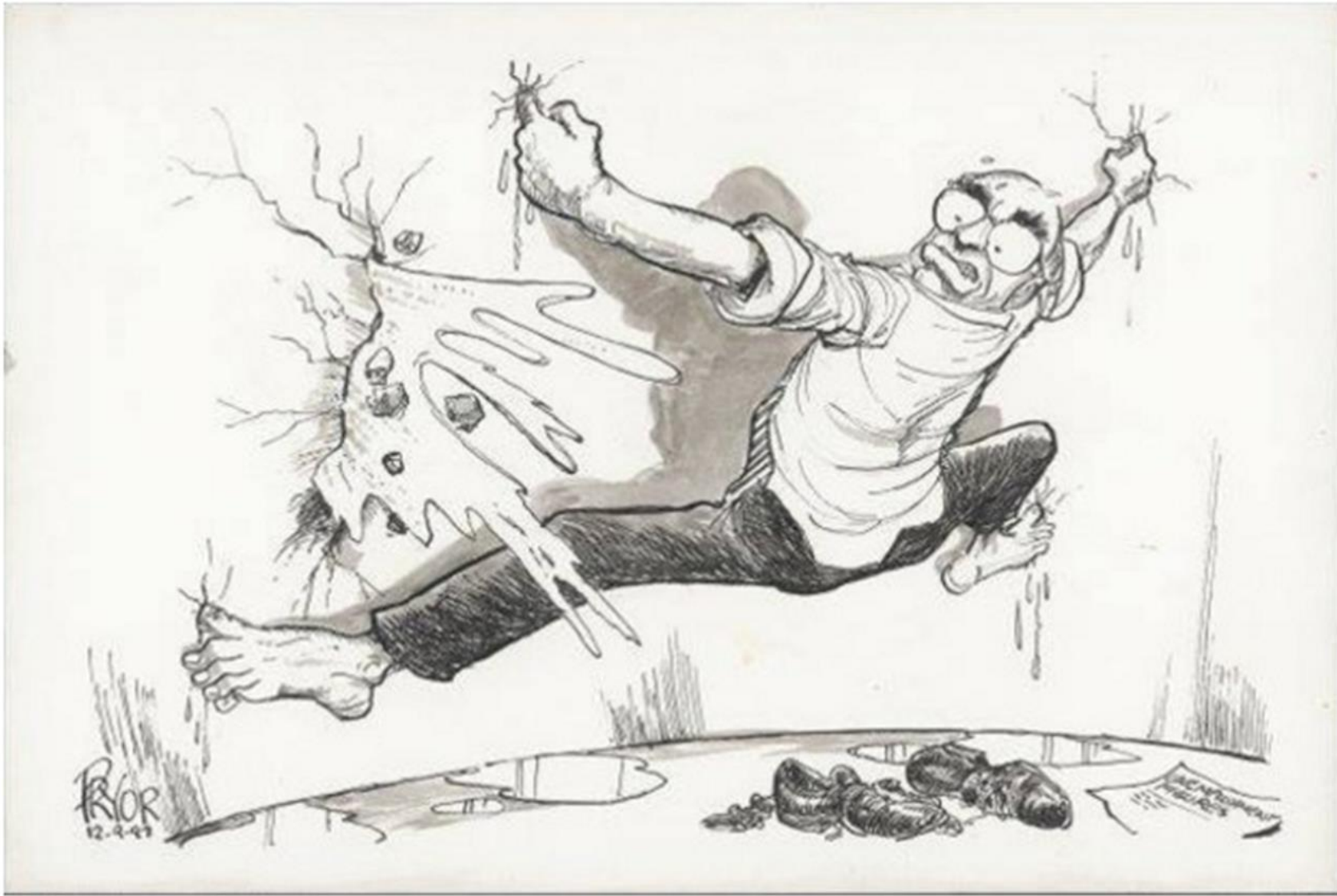
- Mostly hybrids

South Georgia

- Mostly muscadines and hybrids



The Environmental Protection Agency (EPA) is now heavily involved in either potentially removing critical fungicides (e.g., mancozeb) or modifying their use under the Endangered Species Act. This session will provide an overview of EPA activities that will impact grape production over the next few years. In addition to the overview, mitigation efforts and potential changes to fungicide programs will be discussed.





Why is the Environmental Protection Agency “suddenly” removing fungicides from the market?

What is the Endangered Species Act, and how does this act now “suddenly” interact with EPA regulations and registrations?





Any fungicides that are found to impact any aspect of the endocrine system will be advanced to Tier 2 Screening, which may result in further limitations of use or even cancellations of registrations.

'Endocrine disruptor' fungicide withdrawn in France

Charles O'Donnell | May 29, 2019, 2:36pm



Fungicide products based on the substance epoxiconazole have been withdrawn from the French market, allegedly because the substance disrupts the human endocrine system.



FRANCE: Withdrawal of propiconazole-based products

16 July 2019 / in Regulation Lynxee / by Émilie Vianay

As a result of the entry into force of Regulation (EU) 2018/1865 of 28th November 2018 concerning the non-renewal of propiconazole approval, ANSES has withdrawn 23 authorisations and 9 parallel trade permits for plant protection products containing this active substance.

The end of sales and distribution is set on 19.09.2019.

The end of use of the stocks of products is set on 19.12.2019.

EU poised to ban crop protection products on human health grounds

News 05 Jul 2017 | [Abi Kay](#)

A range of crop protection products used by farmers are set to be withdrawn from sale because of new EU rules on endocrine disruptors.



Propiconazole withdrawal: what does it mean?

17 DECEMBER 2018 | FEATURE ARTICLE



Dead patches of turf caused by Fusarium

The active ingredient found in products such as Syngenta's Banner Maxx, Headway and Instrata will be withdrawn from sale over the coming months.

The EU Commission announced its decision not to renew the approval for the fungicide active ingredient, propiconazole, in a move that was supported by the UK Government.

Endocrine disruptor bans in Europe

Fungicide	ED Effects
Captan	Inhibits the action of estrogen.
Propiconazole	Weak estrogen inhibitor. Inhibits the enzyme aromatase, decreasing the production of estrogens and increasing the available androgens.
Tebuconazole	Inhibits the enzyme aromatase, decreasing the production of estrogens and increasing the available androgens.

- Many of the fungicides that are currently included in the Endocrine Disruptor Program are critical to disease management programs, especially as related to IPM and resistance management.
- Tier 2 screening can be predicted for several of these fungicides, as there is documented association with endocrine disruption.
- Cancellation or use limits will increase resistance-development pressure for remaining fungicides.

EPA Mancozeb Update

- **Action:** EPA proposes to cancel mancozeb use for all grape production.
- **Reasoning:** High risk of **post-application worker exposure** during routine vineyard tasks.
- **Target Diseases:** Currently used to manage Phomopsis, downy mildew, black rot, and ripe rot, among others.
- **Regulatory Context:** Part of a broader FIFRA review to comply with the **Endangered Species Act**.



EPA Mancozeb Update

- **High-Risk Activities:** Tying, training, leaf-pulling, and hand-harvesting.
- **The REI Problem:** To ensure safety, a Restricted-Entry Interval (REI) of **45 to 72 days** would be required.
- **Feasibility:** EPA deems long REIs "unfeasible" as they would prevent growers from managing their crops.
- **Comparison:** Other fruit crops (orchards) can retain use because they don't require the same high-contact hand labor.



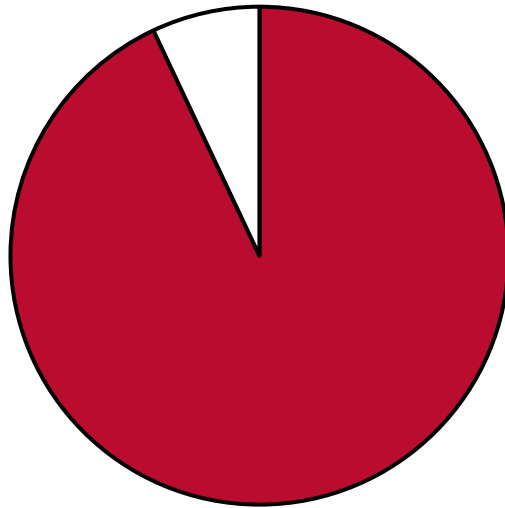
EPA Mancozeb Update

- **Increased Costs:** Shift toward more expensive single-site fungicides.
- **Resistance Risks:** Losing a multi-site tool forces reliance on **Captan** and single-site products (e.g., myclobutanil).
- **Geographic Sensitivity:** Highest impact expected for growers **East of the Rocky Mountains** due to disease pressure.



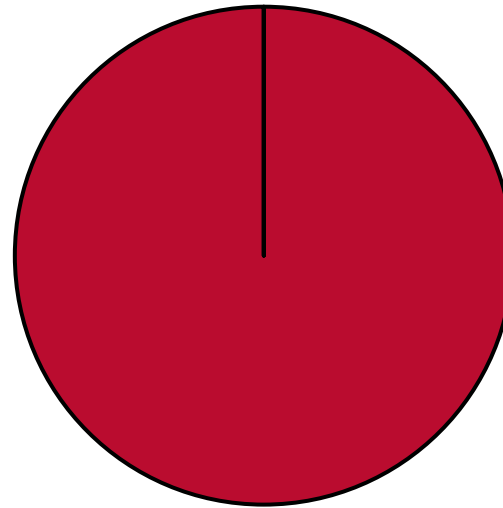
Georgia Mancozeb Survey

Mancozeb Use



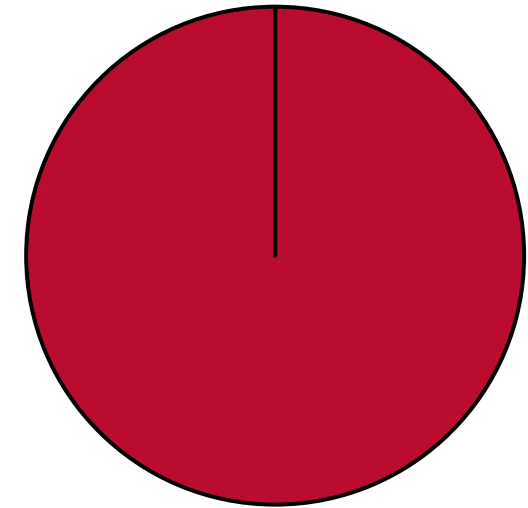
■ Yes □ No

Mancozeb Initiation



■ Budbreak

Mancozeb Termination



■ Pre-harvest Interval

- Manzate Pro-Stick most often utilized
- Maximum number of applications per season is 6 at the highest use rate; 16 at the lowest use rate
- Preharvest Interval (PHI): 66 days
- Utilized 7.3 times per year on average



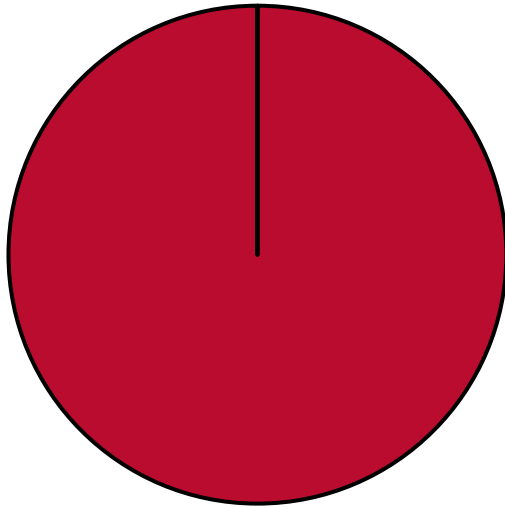
In-season Hand Operations for Grapes

Viticultural Practice	Hand	Mechanization Possible
Shoot thinning/tying	Yes	???
Skirting vines	Yes	Yes
Sucker removal	Yes	Yes
Weeding	Yes	Yes
Hedging	Yes	Yes
Leaf pulling	Yes	Yes
Bird netting	Yes	Yes (still touch vines); alternatives exist



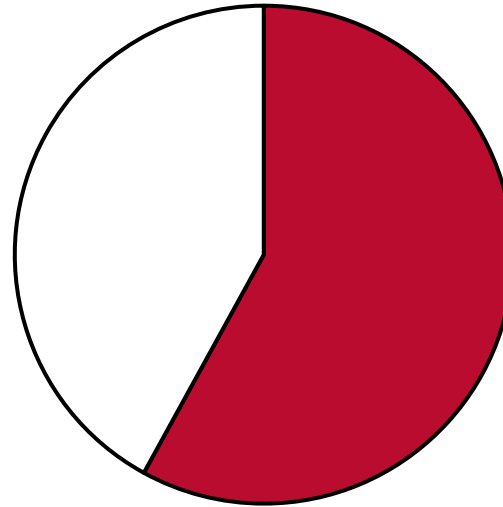
Georgia Mancozeb Survey

Vine Touch Avoidance Possible



■ No

Mancozeb Label Change



■ Would Adjust

□ Would Discontinue Use

- Mancozeb avoidance would be difficult for most wine grape systems.
- Avoiding vine touch for training operations would be largely impractical.
- Training systems could possibly be modified for some grapes.
- Not all grapes require in-season training operations (e.g. muscadines).



Efficacy of selected fungicides against diseases of bunch grapes

Chemical name (Fungicide product name)	FRAC	Anthraco-nose	Black rot	Bitter rot	Botrytis rot	Downy mildew	Phomopsis cane and leaf spot	Powdery mildew
Azoxystrobin (Abound)	11		E ^a	E	G ^b	E ^b	G	E ^b
Benzovindiflupyr (Aprovia), Isofedamid (Kenja)	7	G ^c	VG		E ^b			VG ^c
Benzovindiflupyr <i>plus</i> Difenoconazole (Aprovia Top)	3 plus 7	VG ^c	VG		E ^b			VG ^c
Boscalid (Endura)	7				E ^b			VG ^c
Boscalid <i>plus</i> Pyraclostrobin (Pristine)	7 plus 11	VG	E	E	E ^b	E ^b	E	E
Captan (Captan, Captec, etc.)	M4	G	G	E	F	VG	VG	
Fixed coppers and Bordeaux mixture (various)	M1		G	F	G	G	F	F
Cyazofamid (Ranman)	21					VG		
Cyflufenamid (Torino)	U8							VG
Cyprodinil (Vanguard)	9				E ^b			F
Cyprodinil <i>plus</i> Fludioxonil (Switch)	9 plus 12				VG ^b			
Cyprodinil <i>plus</i> Difenoconazole (Inspire Super)	3 plus 9	G ^c	VG		VG ^b			VG
Famoxadone <i>plus</i> cymoxanil (Tanos)	11 plus 29					G ^b		
Fenhexamid (Elevate)	17				E ^b			
Ferbam (Ferbam)	M3		VG	G		F	F	
Fenarimol (Rubigan)	3		F					E ^b
Fluopyram <i>plus</i> tebuconazole (Luna Experience)	3 plus 7		E		E ^b			E
Iprodione (Rovral, Meteor)	2				G ^b			
Kresoxim-methyl (Sovran)	M3		E	E	F ^b	G ^b	G	E ^b
Lime Sulfur (dormant application)	M2	G					G	F
Mancozeb (various: Penncozeb, Dithane, etc)	M3		E	E		E	E	

Fungicide	PHI (days)	FRAC MOA	Bitter rot	Powdery mildew	Ripe rot	Macro-phoma rot	Black rot	Sooty blotch	Dead arm	Angular leaf spot
Thiophanate-methyl (Topsin- M)	7 days	1	G	G	F	G	G	G	F	G
Myclobutanil (Rally)	14 days	3	VG	VG	NA	G	VG	G	UN	VG
Triflumizole (Procure)	7 days	3	VG	VG	UN	VG	VG	UN	UN	VG
Fluopyram + tebuconazole (Luna Experience)	14 days	3+7	VG	VG	UN	G	VG	UN	UN	E
Benzovendiflupyr (Aprovia)	21 days	7	VG	UN	F	VG	VG	UN	UN	VG
Isofetamid (Kenja)	14 days	7	VG	VG	F-G	E	VG	UN	UN	VG
Azoxystrobin + flutriafol (Topguard EQ)	14 days	3+11	E	VG	G	VG	VG	UN	UN	E
Fluxapyroxad + pyraclostrobin (Mervion)	14 days	7+11	E	VG	VG	VG	VG	UN	UN	E
Pyraclostrobin + boscalid (Pristine)	14 days	7+11	G	VG	VG	E	VG	E	F	VG
Kresoxim-methyl (Sovran)	14 days	11	G	G	G	G	G	G	F	G
Azoxystrobin (Abound)	14 days	11	G	VG	VG	VG	VG	VG	F	VG
Trifloxystrobin (Flint Extra)	14 days	11	G	VG	VG	E	VG	E	F	G
cyprodinil + fludioxonil (Switch)	7 days	9+12	E	VG	VG	E	VG	UN	UN	G
pydiflumetofen + fludioxonil (Miravis Prime)	14 days	7+12	E	VG	VG	E	VG	UN	UN	VG
Copper oxychloride + Copper hydroxide (Badge)	0 day (48 hrs re-entry)	M 1	NA	G	NA	NA	G	UN	UN	VG
Wettable Sulfur (Microthiol and other trade names)	0 day (24 hrs re-entry)	M 2	NA	VG	NA	NA	NA	F	NA	NA
Mancozeb + Zoxamide (Gavel)	66 days	22+M3	G	NA	NA	G	G	UN	UN	G
Ziram (Ziram)	21 days	M 3	G	NA	G	G	G	G	UN	G
Captan (Captan, Captec)	0 days (72 hrs re-entry)	M 4	G	NA	VG	G	G	G	UN	G
EBDCs (includes Maneb, Manex, Penncozeb, Manzate, Dithane M-45)	66 days	M 3	G	NA	G	G	G	G	UN	G

We have traditionally used mancozeb and then captan as the backbone of a fungicide program.

The loss of mancozeb will not impact powdery mildew management.

Loss of DMI fungicides will.

Powdery mildew



The loss of mancozeb will impact Phomopsis management.

Albeit lime sulfur is a helpful option.

Phomopsis



The loss of mancozeb will impact anthracnose management.

Albeit lime sulfur is a critical option.

Anthracnose



Use of lime sulfur and similar products will be essential for management of Phomopsis and anthracnose in *V. vinifera* and hybrids.

Lime sulfur



The loss of mancozeb will dramatically impact downy mildew management.

Downy mildew



The loss of mancozeb will dramatically impact black rot and bitter rot management.

Black rot



Loss of mancozeb will affect ripe-rot management, mainly because the QoI fungicides are no longer effective due to resistance.

Ripe rot



Can we replace mancozeb
with captan, copper, or
biologicals?

GROUP M FUNGICIDE

Drexel

Captan 4L

A fungicide for listed plant disease control.

ACTIVE INGREDIENT:

Captan 38.5%

OTHER INGREDIENTS: 61.5%

TOTAL: 100.0%

This product contains 4 pounds of active ingredient per gallon.

KEEP OUT OF REACH OF CHILDREN

DANGER / PELIGRO

Si usted no entiende la etiqueta, busque a alguien para que se la explique a usted en detalle. (If you do not understand the label, find someone to explain it to you in detail.)

PRECAUTIONARY STATEMENTS

Hazards to Humans and Domestic Animals

DANGER: Corrosive. Causes irreversible eye damage. Harmful if swallowed or absorbed through skin or inhaled. Do not get in eyes or on clothing. Avoid contact with skin. Avoid breathing spray mist. Prolonged or frequently repeated skin contact may cause allergic reactions in some individuals.

PERSONAL PROTECTIVE EQUIPMENT (PPE)

Some materials that are chemical-resistant to this product are listed below. If you want more options, follow the instructions for category A on an EPA chemical-resistance category selection chart.

All mixers, loaders, applicators and other handlers (including handlers participating in seeding and transplanting as part of seedling treatment) must wear: long-sleeved shirt and long



Sixteen applications are allowed at the low rate of 0.75 quarts per acre.

Will this rate provide good disease control?

Wet weather will require the high rate (six applications per season).

Supplementary Table S1: Evaluation of mancozeb, captan, copper, and a *Pseudomonas chlororaphis* for management of black rot and downy mildew of grape.

Treatment and amount/A	Application timing ^x	Fruit black rot severity (%) ^y	Downy mildew		
			Leaf incidence (%) ^z	Leaf severity (%) ^z	Whole plant severity (%) ^z
Microthiol Disperss 3 lb	ABCDE	58.7 a	99.0 a	16.6 a	68.8 a
Microthiol Disperss 3lb + Manzate Prostick 3 lb	ABCDE	13.3 c	65.0 c	4.6 b	10.2 b
Microthiol Disperss 3lb + Captan 4L 0.75 qt	ABCDE	23.8 bc	77.7 bc	5.0 b	16.7 b
Microthiol Disperss 3lb + Kocide 3000 1.75 lb	ABCDE	33.0 b	85.7 ab	5.3 b	25.8 b
Microthiol Disperss 3lb + Howler Evo 7.5 lb	ABCDE	57.5 a	97.3 a	17.4 a	72.3 a
LSD ($\alpha = 0.05$)		17.7	14.4	4.6	18.1

^xTreatment dates: A = 13 Apr, B = 26 Apr, C = 8 May, D = 19 May, E = 31 May.

^yFruit black rot severity (% of cluster area covered by black rot) was calculated from 10 representative grape clusters per plant. Means followed by the same letter are not significantly different when comparing each pair using a Fisher's protected LSD test of significance ($P \leq 0.05$).

^zDowny mildew incidence (% of leaves with downy mildew) and severity (% of leaf area covered by downy mildew) was calculated from 50 leaves per plant. Whole plant severity is a subjective visual rating that incorporates total plant damage from downy mildew, to include defoliation. Means followed by the same letter are not significantly different when comparing each pair using a Fisher's protected LSD test of significance ($P \leq 0.05$).

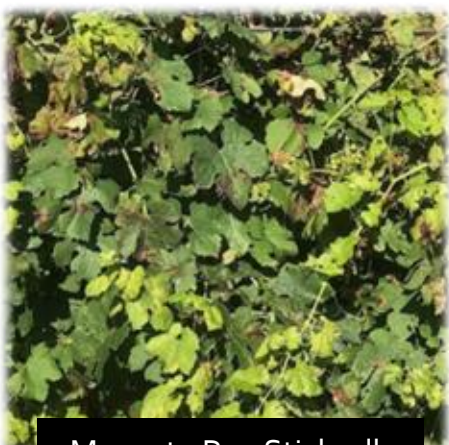
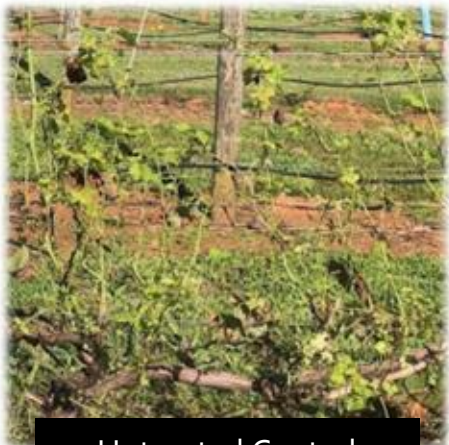
6



5



4



Untreated Control

Manzate Pro-Stick 3 lb

Captan 4L 0.75 qt

Kocide 3000 1.75 lb

Howler Evo 7.5 lb

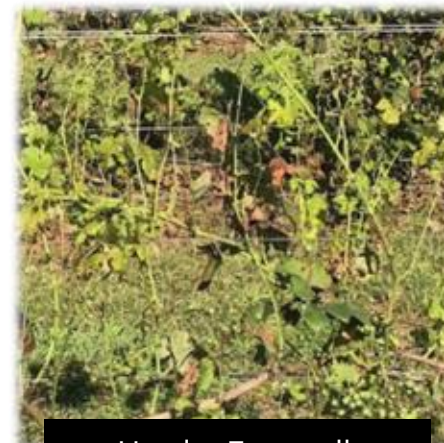
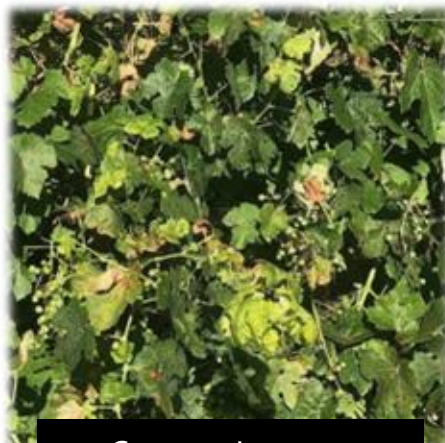
3



2



1



Untreated Control

Manzate Pro-Stick 3 lb

Captan 4L 0.75 qt

Kocide 3000 1.75 lb

Howler Evo 7.5 lb

Fungicide Resistance in *Plasmopara viticola* (other growing areas)



- 1983 FRAC 4: Phenylamides (PA)
 - Metalaxyl, mefenoxam
- 1997 FRAC 27: Cyanoacetamide oximes
 - Cymoxanil
- 2000 FRAC 11: Quinone outside Inhibitors (QoI)
 - Azoxystrobin, pyraclostrobin
- 2003 FRAC P07: Phosphonates
 - Fosetyl-Al, phosphorous acid and salts
- 2007 FRAC 40: Carboxylic acid amides (CAA)
 - Mandipropamid



Growing *Vitis vinifera* grapes in the eastern United States can be challenging, especially without mancozeb. This fungicide is crucial for controlling diseases like downy mildew, black rot, and Phomopsis, which are prevalent in the humid climate of the eastern U.S. If mancozeb is removed from the spray program, grape growers would need to rely on other fungicides like captan and copper, which are less effective. Additionally, growers would need to adopt more rigorous vineyard management practices, such as improved canopy management, to enhance air circulation and reduce humidity around the vines. While it is possible to grow *Vitis vinifera* grapes in the eastern U.S. without mancozeb, it would require significant adjustments and might result in higher disease pressure and potentially lower yields.

We are currently thinking short term, but we also need to be thinking long term – what, where and how are we planting?

Cultural practices (e.g. site selection, trellising system, leaf pulling, etc.) will be more important than ever.

Resistance to multiple diseases of grape (through breeding programs) may be on the horizon, but will the market accept these new cultivars?

Can we replace
mancozeb with ziram?

You can mix and match products for black rot, etc., but fungicide resistance may be a future issue.

Can we utilize the low rate of captan plus a phosphonate, always augmenting with other fungicides at critical points or continually throughout the season?

Fungicide resistance
pressure will increase
over time, and
unfortunately, many
classes will no longer
have utility?

Growing *Vitis vinifera* grapes in the eastern United States can be challenging, especially without mancozeb. This fungicide is crucial for controlling diseases like downy mildew, black rot, and Phomopsis, which are prevalent in the humid climate of the eastern U.S. If mancozeb is removed from the spray program, grape growers would need to rely on other fungicides like captan and copper, which are less effective. Additionally, growers would need to adopt more rigorous vineyard management practices, such as improved canopy management, to enhance air circulation and reduce humidity around the vines. While it is possible to grow *Vitis vinifera* grapes in the eastern U.S. without mancozeb, it would require significant adjustments and might result in higher disease pressure and potentially lower yields.

Endangered Species Act

- Passed in 1973
- Requires government agencies ensure actions they take do not jeopardize a species that has been federally listed as endangered or threatened
- Requires consultation by EPA Office of Pesticides Programs (OPP) with the U.S. Fish and Wildlife Services or the National Marine Fisheries Service when pesticides are registered



New Endangered Species Act Farmer Requirements

- Check the EPA's Bulletins Live! Two website and follow ESA restrictions for pesticide products (<https://www.epa.gov/endangered-species/bulletins-live-two-view-bulletins>)
- Reduce spray drift
- Reduce runoff/erosion
- Reduce pesticide exposure to endangered or threatened species and their habitat



ESA Mitigation

- Option 1. Develop farming practices to obtain 9 runoff points and spray drift reduction of 100%
- Option 2. Select pesticides with fewest possible mitigation requirements
- Option 3. Change crops to use pesticides with the fewest mitigation requirements



Bulletins Live! Two -- View the Bulletins

For assistance in using Bulletins Live! Two, [view the tutorial](#). Also see [background](#), [notes](#) and [a quick start guide for BLT](#).

Directions

This tool displays Pesticide Use Limitation Areas (PULAs) for products with active Endangered Species Protection Bulletins. To generate a printable bulletin, please follow these steps:

1. Navigate to your intended pesticide application area by using the "Location Search" tool or panning and zooming on the map itself.
2. Select your Application Month from the Application Date dropdown.
3. Search specific pesticide product(s) by entering the EPA product registration

Unpin

Location Search:

Find Place

Application Month:

January 2026

EPA Registration Number:



Stay Informed



Pesticide Labels and the Endangered Species Act: ESA 101

"Adapting to ESA" Video Series

ESA Pesticide User Guide

Future Pesticide Regulation One-Pager

CropLife Magazine's ESA Special Report

EPA Educational Resources Toolkit

CropLife America



4201 Wilson Boulevard, Suite 700
Arlington VA 22203
202-296-1585

[Innovative Conversations](#)
[Sustainability](#)
[Regulatory Integrity](#)
[About](#)

[News & Media](#)
[Resources](#)
[Contact](#)

You >


Explore

More from YouTube

Search



Adapting to ESA

 by CropLife America

Playlist · 4 videos · 1,297 views

This video series is part of a new set of educational tools released by CropLife America (CLA), in partnership [...more](#)

▶ Play all



Adapting to ESA: Mitigation Overview

CropLife America · 709 views · 2 months ago

1



Adapting to ESA: Bulletins Live! Two

CropLife America · 401 views · 2 months ago

2



Adapting to ESA: Spray Drift

CropLife America · 356 views · 2 months ago

3



Adapting to ESA: Runoff

CropLife America · 541 views · 2 months ago

4

Pesticides

[Antimicrobial Pesticides](#)[Biopesticides](#)[Contact Us About Pesticides](#)

Pesticide App for Label Mitigations

EPA released the Pesticide App for Label Mitigations (PALM), a mobile-friendly tool to serve as a one-stop shop that helps farmers and applicators use EPA's [mitigation menu](#) to reduce pesticide exposure to nontarget species from agricultural crop uses. PALM combines the functionality of the [spray drift and runoff calculators](#) in a mobile-friendly and easy-to-use web interface. This application also provides a useful summary to show how users calculated their runoff and erosion mitigation points or ecological spray drift buffer reductions and what field characteristics or application parameters are applicable to their individual applications.

These calculators are tools for informational purposes to assist pesticide users in determining whether the necessary level of mitigation has been met before applying a pesticide product. Pesticide users remain responsible for ensuring that all pesticide labeling requirements are met. Not all labels permit use of runoff/erosion mitigation measures or spray drift reduction.

This tool will not retain any of the information entered here.

[Contact Us](#) to ask about questions related to PALM.

[Runoff/Erosion calculator](#)[Spray drift calculator](#)



Captan
Amended Proposed Interim
Registration Review Decision
Case Number 0120

March 2024

A. Updates to the 2022 Proposed Interim Decision

In this amended PID, the Agency has made several changes to the 2022 PID to further reduce ecological risks of concern, including potential exposure to listed species. As stated in the updated ESA workplan, EPA is proposing FIFRA IEM measures in advance of any national consultation process with the Services. For captan, these proposed changes include revised language requiring users to consult EPA's *Bulletins Live! Two* system prior to captan application, revised incident reporting language, additional spray drift reduction measures (requiring measurement of wind speed), modifications to the proposed rain restriction, additional labeling for treated seeds and revised seed bag tag labeling, and a risk advisory for

⁶ This statutory language refers to the formal publication of Notifications of Interim Registration Review Decisions (IDs) in the Federal Register.

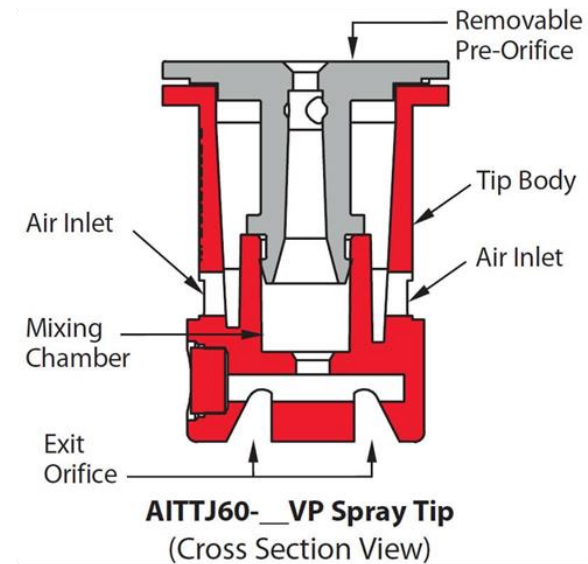
⁷ Federal Food, Drug, and Cosmetic Act (FFDCA) § 408(p), 21 U.S.C. § 346a(p).

EPA Response: The Agency is now proposing a maximum windspeed of 15 mph for aerial and ground applications of captan, except for Pesticide Use Limitation Areas (PULAs) related to the 2011 Salmonid BiOp, which specifies a 10 mph windspeed restriction. The 10 mph restriction will apply to specific regions of California, Idaho, Oregon, and Washington. These PULAs will be listed in *BulletinsLive! Two*, which pesticide applicators must consult within 6 months of application. As for the boom length and swath displacements, EPA is adopting NAA's recommendations for aerial application of captan, as described in Section IV.A.8. of this document.

- *Using a tower anemometer with telemetry or handheld anemometer. Users should read user manual on how to calibrate, operate and interpret the output from an anemometer. Ground applicators should stop every 15 minutes to take a reading with a tower anemometer with telemetry or handheld anemometer. Some anemometers may have software that would allow users to view wind measurements in real time while making an application, and, those cases, applicators would not have to stop to take measurements.*

Air Induction Nozzles

- Inject air into droplets, making them larger
- Should increase penetration/retention into the canopy
- Potential increase in efficacy
- Synergistic effects with surfactants





Factorial Analysis

- Looks at the effect of treatments across samples
- Each independent variable is a 'factor' in the design
- Powerful analysis assuming no interactions
- Interactions occur when the level of one independent variable affects another independent variable

Sulfur	Surfactant
None	None
None	Cohere
None	Hi-Wett
None	Silwet L-77
Sulfur	None
Sulfur	Cohere
Sulfur	Hi-Wett
Sulfur	Silwet L-77

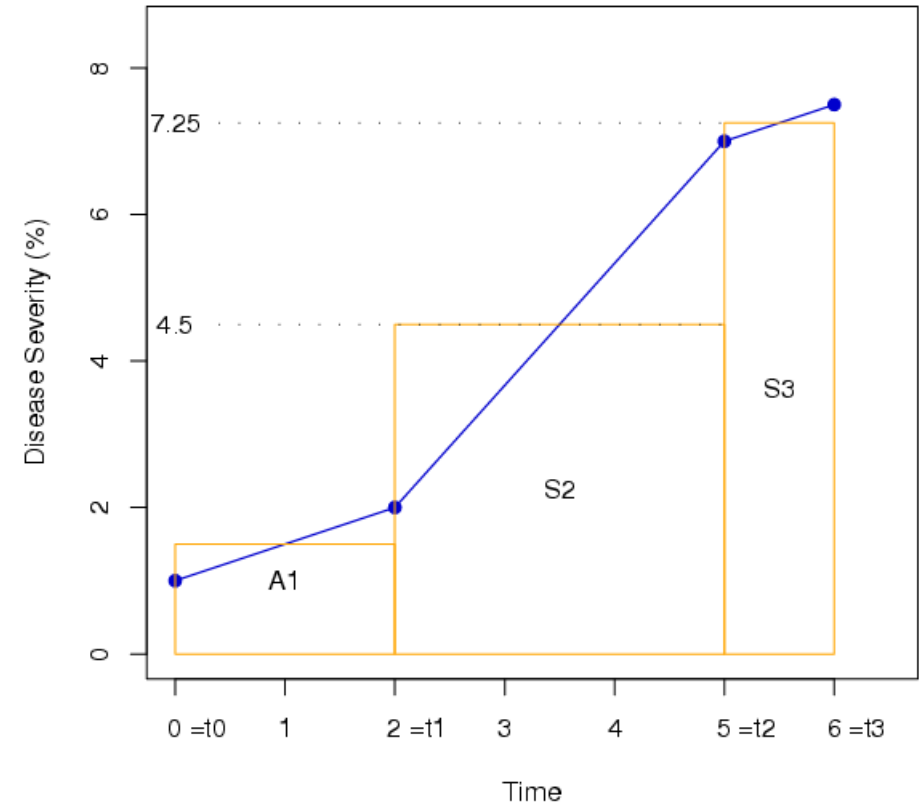


Area Under the Disease Progress Curve (AUDPC)

- AUDPCs are used to incorporate multiple disease ratings into one statistic
- Area under curve added together
- Can analyze ratings across time

$$AUDPC = \sum_{i=1}^{n-1} \frac{y_i + y_{i+1}}{2} \times (t_{i+1} - t_i)$$

Illustration of AUDPC Calculation



Nozzle Trial Experimental Design

- Two surfactant products tank mixed with sulfur
- Two nozzles used:
 - Air induction
 - Cone
- 2 x 3 factorial design applied to a randomized complete block design with five replications
- Powdery mildew incidence and severity rated weekly after disease onset

Surfactants	Nozzles
Microthiol	Cone
Microthiol + Hi-Wett	Cone
Microthiol + Cohere	Cone
Microthiol	Air Induction
Microthiol + Hi-Wett	Air Induction
Microthiol + Cohere	Air Induction

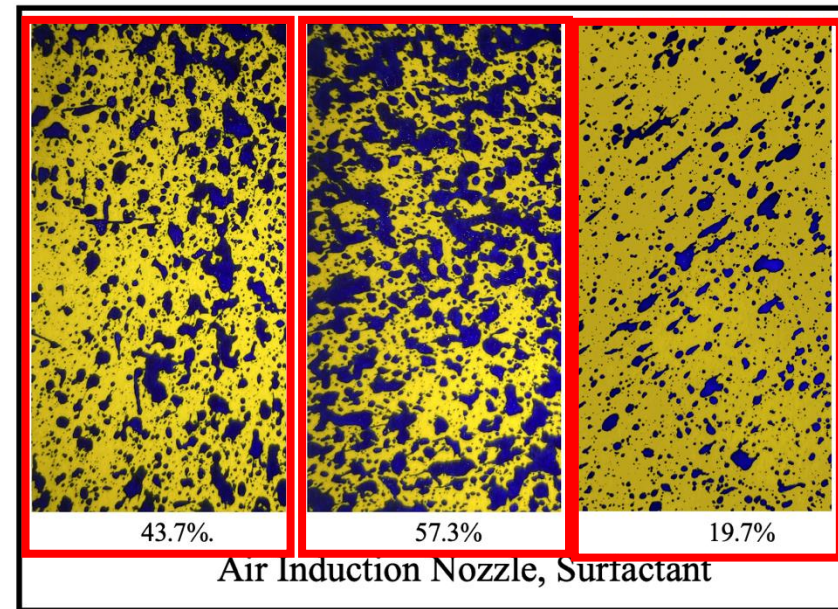
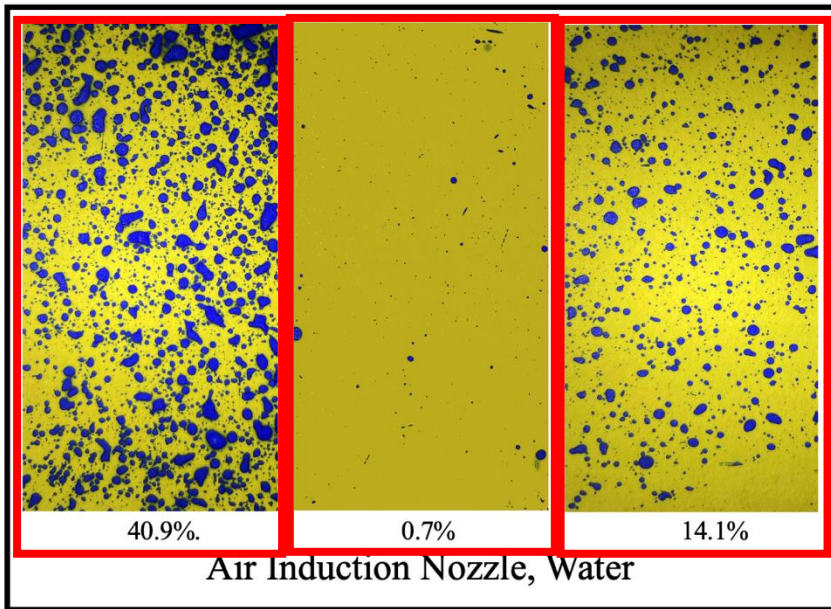
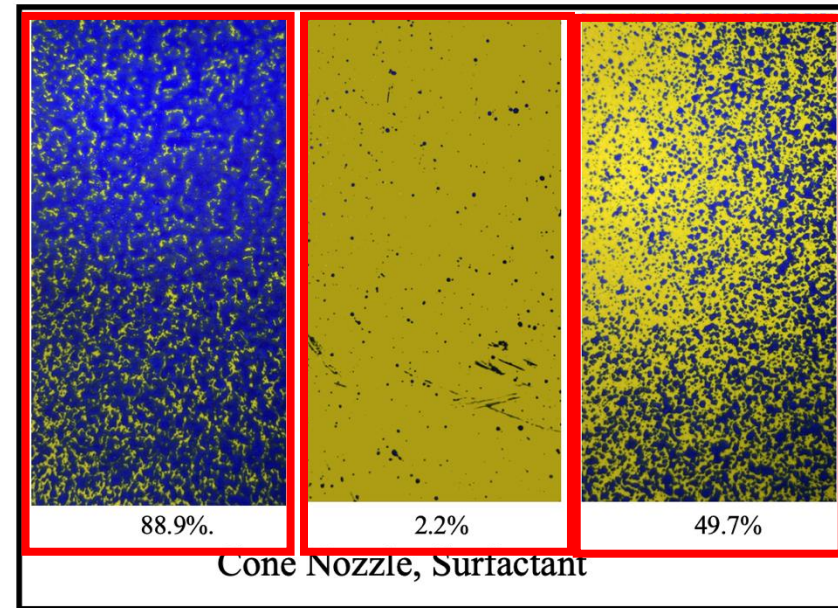
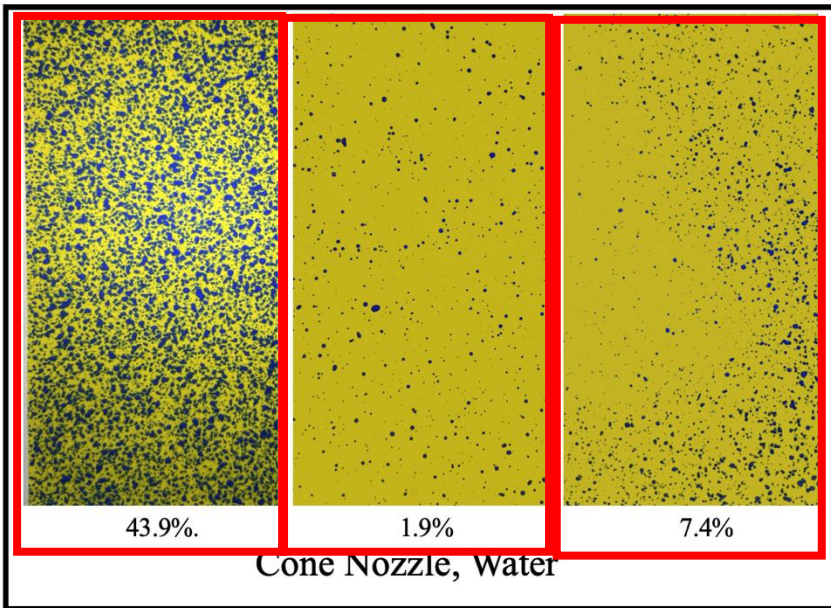


Factorial Analysis of Surfactants and Nozzles

Surfactant	AUDPC for fruit severity		Mean
	Cone	Air induction	
None	1413.3	1379.1	1396.2
Cohere	1010.9	1605.9	1308.4
Hi-Wett	1046.6	1394.7	1220.6
Mean	1156.9	1459.9	

Significant interactions were observed ($P = 0.0230$)







Questions?

