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Vineyard Spray Application and Safety – Resources for Vineyard Managers and Workers

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Today's Outline

1. Pesticide Resistance
2. All about Sprayers
3. Worker Protection Standards (WPS)
4. Pesticide Certification & Training (C&T)

Access this presentation at:

https://npsec.us/picktn

1. Managing for Resistance

- Pesticide Mode of Action (MoA)
- Herbicide Resistance Action Committee (HRAC)
- Insecticide Resistance Action Committee (IRAC)
- Fungicide Resistance Action Committee (FRAC) How pests develop resistance
- How Pests Develop Resistances

HRAC Mode of Action Classification 2021

HERBICIDE RESISTANCE ACTION COMMITTEE

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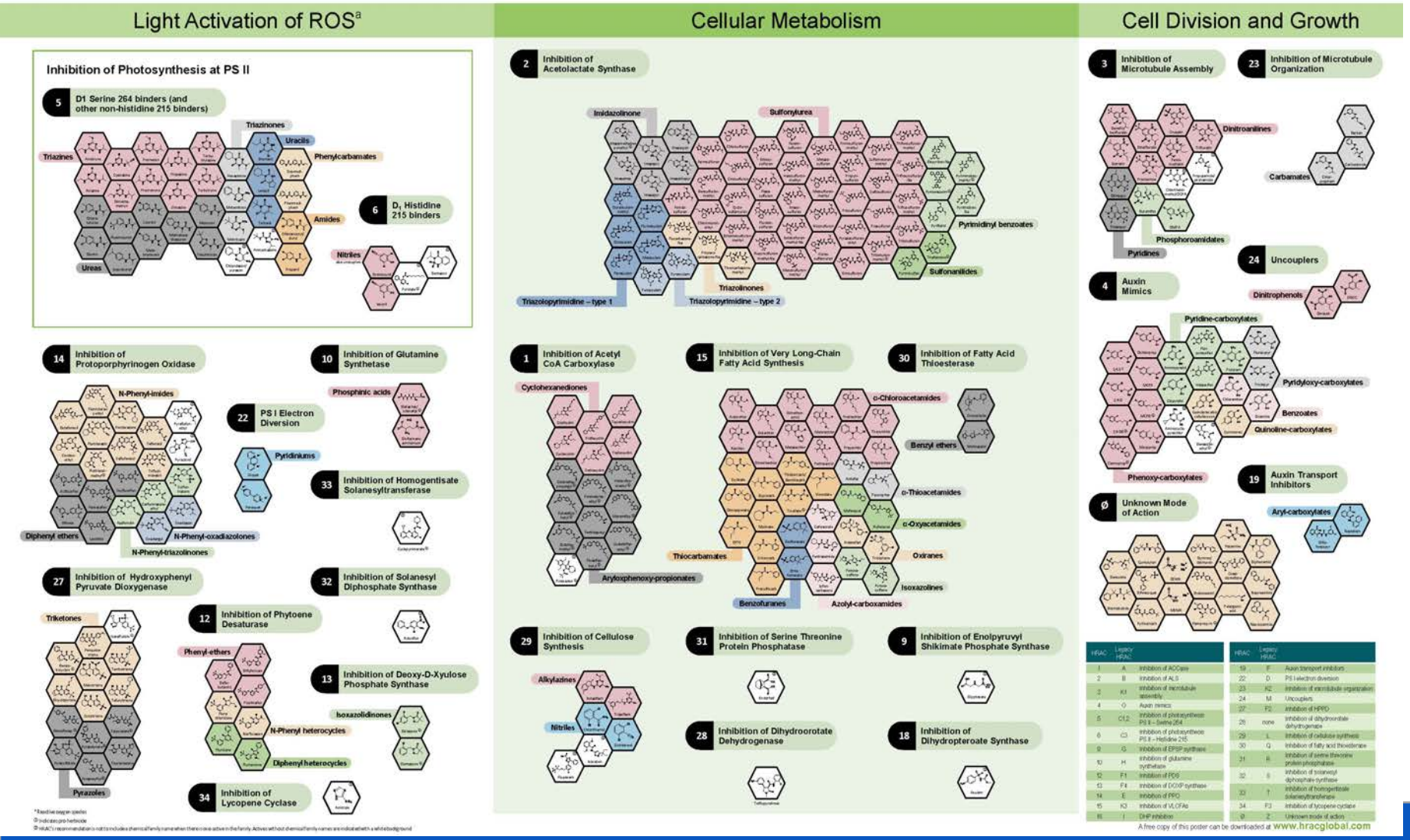

HRAC: https://www.hracglobal.com/

Herbicide Mode of Action: https://hracglobal.com/files/FactSheet.pdf

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7.2. The Classification Table

IRAC MoA Classification Version 10.1, December 2021

See section 7.4 for further information on sub-groups.
See section 7.3 for criteria for descriptors of the quality of MoA information.

Main Group and Primary Site of Action	Sub-group, class or exemplifying Active Ingredient	Active Ingredients
1 **Acetylcholinesterase (AChE) inhibitors** Nerve action {Strong evidence that action at this protein is responsible for insecticidal effects}	**1A** Carbamates	Alanycarb, Aldicarb, Bendiocarb, Benfuracarb, Butocarboxim, Butoxycarboxim, Carbaryl, Carbofuran, Carbosulfan, Ethiofencarb, Fenobucarb, Formetanate, Furathiocarb, Isoprocarb, Methiocarb, Methomyl, Metolcarb, Oxamyl, Pirimicarb, Propoxur, Thiodicarb, Thiofanox, Triazamate,Trimethacarb, XMC, Xylylcarb
	1B Organophosphates	Acephate, Azamethiphos, Azinphos-ethyl, Azinphos-methyl, Cadusafos, Chlorethoxyfos, Chlorfenvinphos, Chlormephos, Chlorpyrifos, Chlorpyrifos-methyl, Coumaphos, Cyanophos, Demeton-S-methyl, Diazinon, Dichlorvos/ DDVP, Dicrotophos, Dimethoate, Dimethylvinphos, Disulfoton, EPN, Ethion, Ethoprophos, Famphur, Fenamiphos, Fenitrothion, Fenthion, Fosthiazate, Heptenophos, Imicyafos, Isofenphos, Isopropyl *O*-(methoxyaminothio-phosphoryl) salicylate, Isoxathion, Malathion, Mecarbam, Methamidophos, Methidathion, Mevinphos, Monocrotophos, Naled, Omethoate, Oxydemeton-methyl, Parathion, Parathion-methyl, Phenthoate, Phorate, Phosalone, Phosmet, Phosphamidon, Phoxim, Pirimiphos-methyl, Profenofos, Propetamphos, Prothiofos, Pyraclofos, Pyridaphenthion, Quinalphos, Sulfotep, Tebupirimfos, Temephos, Terbufos, Tetrachlorvinphos, Thiometon, Triazophos, Trichlorfon, Vamidothion
2 **GABA-gated chloride channel blockers** Nerve action {Strong evidence that action at this protein is responsible for insecticidal effects}	**2A** Cyclodiene Organochlorines	Chlordane, Endosulfan
	2B Phenylpyrazoles (Fiproles)	Ethiprole, Fipronil

IRAC MoA Classification Version 10.1, December 2021

See section 7.4 for further information on sub-groups.
See section 7.3 for criteria for descriptors of the quality of MoA information.

Main Group and Primary Site of Action	Sub-group, class or exemplifying Active Ingredient	Active Ingredients
3 **Sodium channel modulators** Nerve action {Strong evidence that action at this protein is responsible for insecticidal effects}	**3A** Pyrethroids Pyrethrins	Acrinathrin, Allethrin, d-*cis-trans* Allethrin, d-*trans* Allethrin, Bifenthrin, Bioallethrin, Bioallethrin S-cyclopentenyl isomer , Bioresmethrin, Cycloprothrin, Cyfluthrin, *beta*-Cyfluthrin, Cyhalothrin, *lambda*-Cyhalothrin, *gamma*-Cyhalothrin, Cypermethrin, *alpha*-Cypermethrin, *beta*-Cypermethrin, *theta*-cypermethrin, *zeta*-Cypermethrin, Cyphenothrin , (1*R*)-*trans*- isomers], Deltamethrin, Empenthrin (*EZ*)- (1*R*)- isomers], Esfenvalerate, Etofenprox, Fenpropathrin, Fenvalerate, Flucythrinate, Flumethrin, *tau*-Fluvalinate, Halfenprox, Imiprothrin, Kadethrin, Permethrin, Phenothrin [(1*R*)-*trans*- isomer], Prallethrin, Pyrethrins (pyrethrum), Resmethrin, Silafluofen, Tefluthrin, Tetramethrin, Tetramethrin [(1*R*)-isomers], Tralomethrin, Transfluthrin,
	3B DDT Methoxychlor	DDT Methoxychlor
4 **Nicotinic acetylcholine receptor (nAChR) competitive modulators** Nerve action {Strong evidence that action at one or more of this class of protein is responsible for insecticidal effects}	**4A** Neonicotinoids	Acetamiprid, Clothianidin, Dinotefuran, Imidacloprid, Nitenpyram, Thiacloprid, Thiamethoxam,
	4B Nicotine	Nicotine
	4C Sulfoximines	Sulfoxaflor
	4D Butenolides	Flupyradifurone
	4E Mesoionics	Triflumezopyrim
	4F Pyridylidenes	Flupyrimin
5 **Nicotinic acetylcholine receptor (nAChR) allosteric modulators – Site I** Nerve action {Strong evidence that action at one or more of this class of protein is responsible for insecticidal effects}	Spinosyns	Spinetoram, Spinosad

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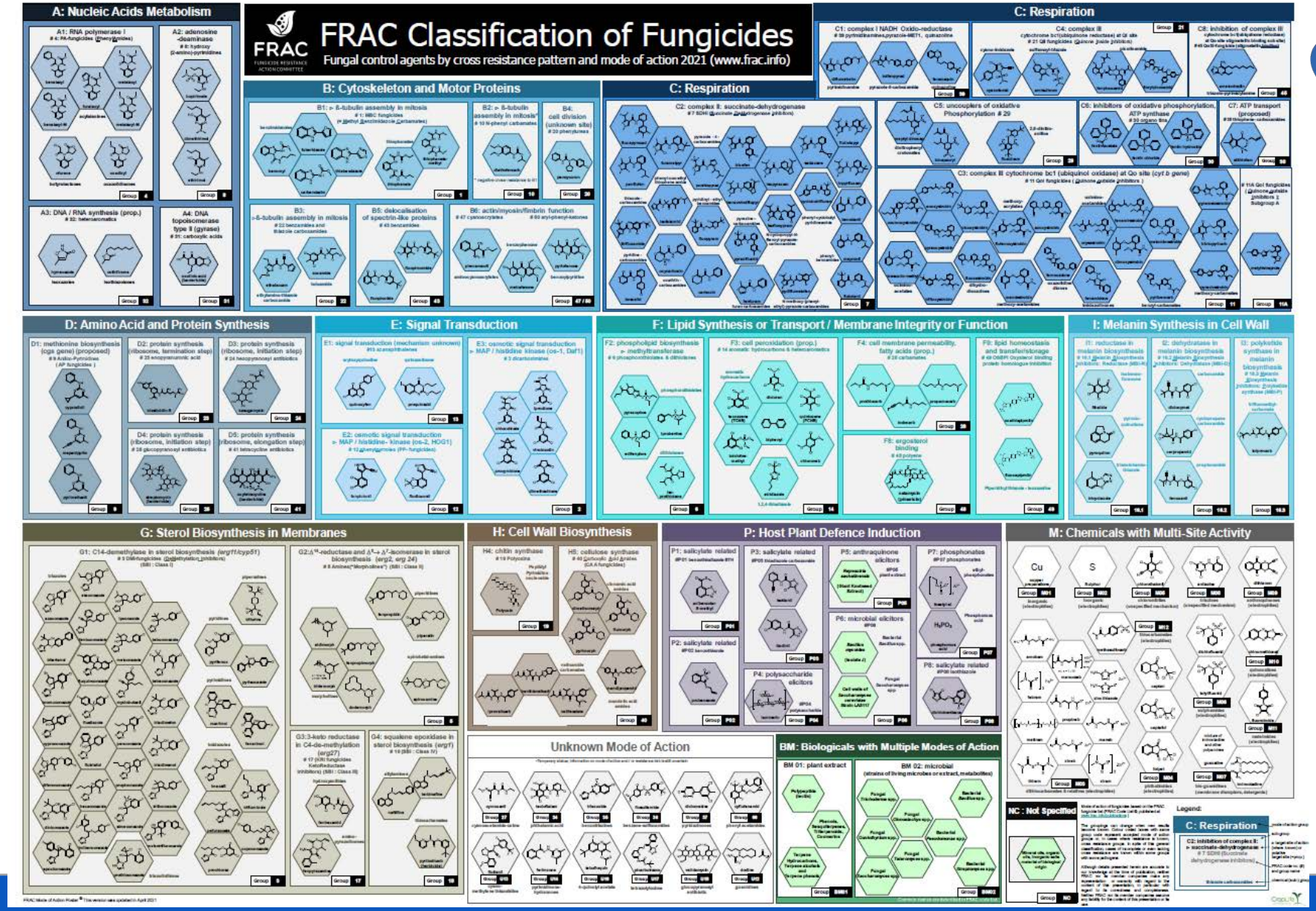
IRAC: https://irac-online.org/

Insecticide Mode of Action: https://irac-online.org/modes-of-action/



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FRAC – Fungicide Mode of Action:
https://www.frac.info/

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PATHOGEN RISK LIST (Sept 2019)

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Plant pathogens accepted as showing a high risk of development of resistance to fungicides:

• Botrytis cinerea	various, especially grapevine	grey mold
• Plasmopara viticola	grapevine	downy mildew

Plant pathogens accepted as showing a medium risk of development of resistance to fungicides:

• Erysiphe necator	grapevine	powdery mildew

Risk list - https://www.frac.info/docs/default-source/publications/pathogen-risk/frac-pathogen-list-2019.pdf

When the pathogen risk is plotted against the inherent resistance risk of the fungicide class, the combined resistance risk for each pathogen/fungicide combination can be estimated (Figure 1).

Figure 1: Combined resistance risk diagram based on inherent fungicide risk and inherent pathogen risk (* only most important classes and groups mentioned) (according to FRAC Monograph No. 2, by K.J. Brent and D.W. Hollomon, 2007, ** SDHI fungicides have been moved from medium to medium to high risk)

↓ Fungicide Classes *	↓ Fungicide Risk	Combined Risk		
benzimidazoles dicarboximides phenylamides QoI fungicides SDHI fungicides**	high = 3	**3**	**6**	**9**
SBI fungicides anilinopyrimidines phenylpyrroles phosphorothiolates	medium = 2	**2**	**4**	**6**
multi site fungicides (e.g. dithiocarbamates Copper, Sulphur) MBI-R inhibitors SAR inducers	low = 1	**1**	**2**	**3**
Pathogen risk →		low = 1	medium = 2	high = 3
Pathogen groups * →		seed borne pathogens (e.g. *Pyrenophora* spp. *Ustilago* spp.) soil-borne pathogens (e.g. *Phytophthora* spp.) rust fungi *Rhizoctonia* spp.	*Rhynchosporium commune* *Zymoseptoria tritici* *Oculimacula* spp.	*Blumeria graminis* *Botrytis cinerea* *Penicillium* spp. *Pyricularia oryzae* *Venturia inaequalis* *Pseudocercospora fijiensis*

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How Pests Develop Resistance

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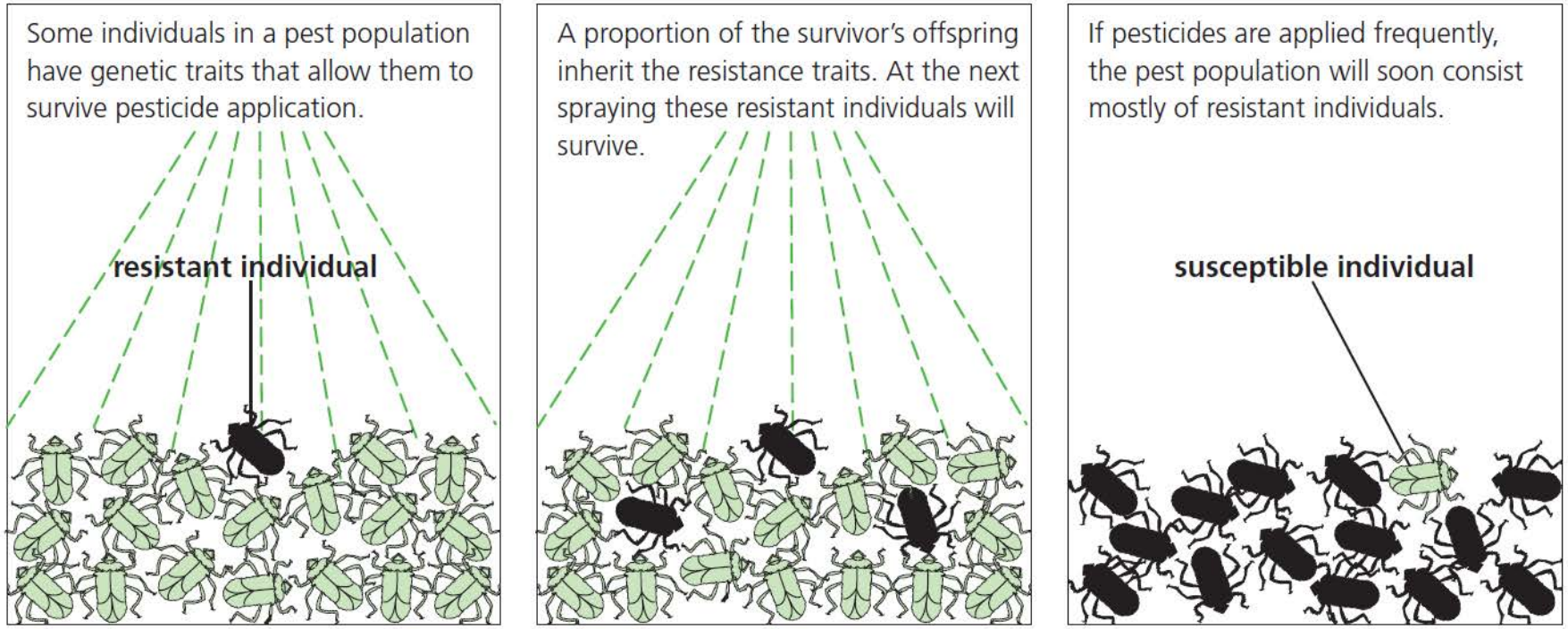
Figure 1.4 Pesticide resistance



Adapted from U. of C. *The Safe and Effective Use of Pesticides*

14 CHAPTER 1

National Pesticide Applicator Certification Core Manual

Midwest Fruit Pest Management Guide 2021 - 2022

https://ag.purdue.edu/hla/hort/documents/id-465.pdf

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Grape Bud Break to Pre-bloom – Diseases

Notes on disease management

- Begin fungicide applications at 1-3 inch new shoot growth; repeat at 7-10 day intervals or according to label instructions and environmental conditions.
- **Powdery mildew:** Primary infections of powdery mildew can occur during this period. Adding a FRAC 3 fungicides (Cevya, Mettle, Procure, Rally, Tebuzol) in the third or fourth spray during this time period improves control of powdery mildew and black rot.

Fungicide Resistance Alert

- The downy and powdery mildew pathogens are especially prone to fungicide resistance. Avoid back-to-back applications of any one systemic fungicide class. See Fungicide Resistance Management, page 140, for information about fungicide resistance development in powdery and downy mildews. See generic fungicides table for product with the same active ingredient, page 218.
- Avoid using fungicides in FRAC group 7 or 11 during this period.

Phytotoxicity Alert

- Inspire Super, Quadris Top, and Revus Top all contain the active ingredient difenoconazole. All fungicides with difenoconazole labeled for grapes have the following precaution: "On *V. labrusca, V. labrusca* hybrids, and other non-vinifera hybrids where sensitivity is not known, the use of Inspire Super, Quadris Top, or Revus Top by itself or in tank mixes with materials that may increase uptake (adjuvants, foliar fertilizers) may result in leaf burning or other phytotoxic effects."
- Revus Top cannot be used on Concord, Concord Seedless, and Thomcord grapes.
- Flint 50WG should not be applied to Concord or other American type grapes, as injury may occur.
- Luna Experience is labeled for wine grapes only and should not be used on Concord grapes.
- Pristine should not be applied to Concord or other American-type grapes, as injury may occur.

Foundation program: This program contains products that are at a lower risk of resistance and serves as foundation for a grape disease management program.

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Foundation Fungicide Program for Early Season Control of Grape Diseases[1]

Product and formulation / Active ingredient	FRAC[2]	Black rot	Downy mildew	Phomopsis	Powdery mildew	REI[4] PHI[3]	Max amt[5] Max app[6]
Captan 80 WDG	M3	1.2-2.5 lb.	1.2-2.5 lb.	1.2-2.5 lb.	1.2-2.5 lb.	48h	12 lb.
captan		F	G	E	i	0d	NA
Microthiol Disperss	M	x	x	3-10 lb.	3-10 lb.	12h	NA
sulfur		x	x	F	E	0d	NA
Ridomil Gold Copper	4+M	x	2 lb.	x	x	48h	8 lb.
mefanoxam + Copper Hydroxide		x	E	x	x	42d	4
Ridomil Gold MZ	4 + M	x	2.5 lb.	x	x	48h	10 lb.
mefenoxam + mancozeb		x	E	x	x	66d	4
Roper DF Rainshield	M	1.5-4 lb.	1.5-4 lb.	1.5-4 lb.	x	24h	24 lb.
mancozeb		E	E	E	x	66d	6

E = excellent control **G** = good control **F** = fair control **[r]** = fungicide/insecticide resistance possible **s** = suppression only **i** = ineffective **u** = unknown efficacy
x = pest not on the label

Effectiveness of Pesticides for Control of Grape Diseases – Bud Break to Pre-Bloom[1] *(continued)*

Product and formulation / Active ingredient	FRAC[2]	Black rot	Downy mildew	Phomopsis	Powdery mildew	REI[4] PHI[3]	Max amt[5] Max app[6]
Topsin-M WSB	1	0.7-1.5 lb.	x	0.7-1.5 lb.	0.7-1.5 lb.	48h	6 lb.
thiophanate methyl		F	x	G	E	7d	NA
Torino (SC)	U6	x	x	x	3.4 oz.	4h	6.8 oz.
cyflufenamid		x	x	x	E	3d	1 or 2
Vangard WG (75WG)	9	x	x	x	See label	12h	30 oz.
cyprodinil		x	x	x	s	7d	See label
Vivando (2.5F)	U8	x	x	x	10.3-15.4 fl. oz.	12h	42.6 fl. oz.
metrafenone		x	x	x	E	14d	3
Zampro	45 + 40	x	11-14 fl. oz.	x	x	12h	56 fl. oz.
ametoctradin + dimethomorph		x	E	x	x	14d	NA
Ziram 76DF	M	3-4 lb.	3-4 lb.	3-4 lb.	x	48h	28 lb.
ziram		E	G	G	x	21d	NA

E = excellent control **G** = good control **F** = fair control **[r]** = fungicide/insecticide resistance possible **s** = suppression only **i** = ineffective **u** = unknown efficacy
x = pest not on the label

Ridomil Gold®
MZ WG

syngenta®

Fungicide

For the control of certain diseases of cucumbers, melons, summer squash, grapes, onions, potatoes, sugar beets, and tomatoes

KEEP OUT OF REACH OF CHILDREN.

CAUTION

See additional precautionary statements and directions for use inside booklet.

5 pounds
Net Weight

MEFENOXAM	GROUP	4	FUNGICIDE
MANCOZEB	GROUP	M03	FUNGICIDE

Active Ingredients:

Mefenoxam* 4.0%

Mancozeb: A coordination product of zinc ion and Manganese ethylene bisdithiocarbamate** 64.0%

in which the ingredients are:

Manganese^{++} 12.8%

Zinc 1.6%

Ethylene bisdithiocarbamate ion ($C_4H_6N_2S_4$) 49.6%

Other Ingredients: 32.0%

Total: 100.0%

*CAS Nos. 70630-17-0 and 69516-34-3

**Same as the active ingredient found in Dithane® M-45 and Manzate® 200.

Ridomil Gold MZ WG is a dry flowable containing 0.04 lb of mefenoxam and 0.64 lb of mancozeb per pound of product.

EPA Reg. No. 100-1269 EPA Est. 054675-MEX-001

Product of France

SCP 1269A-L1F 1119 4115038

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To delay fungicide resistance, take one or more of the following steps:

- Rotate the use of Ridomil Gold MZ WG or other Group 4 fungicides and Group M03 fungicide within a growing season sequence with different groups that control the same pathogens.
- Use tank mixtures with fungicide from a different group that are equally effective on the target pest when such use is permitted. Use at least the minimum application rate as labeled by the manufacturer.
- Adopt an integrated disease management program for fungicide use that includes scouting, uses historical information related to pesticide use, and crop rotation, and which considers host plant resistance, impact of environmental conditions on disease development, disease thresholds, as well as cultural, biological and other chemical control practices.
- Where possible, make use of predictive disease models to effectively time fungicide applications. Note that using predictive models alone is not sufficient to manage resistance.

- Monitor treated fungal populations for resistance development.
- Contact your local extension specialist or certified crop advisor for any additional pesticide resistance-management and/or IPM recommendations for specific crops and pathogens.
- For further information or to report suspected resistance contact Syngenta at 1-866-Syngent(a) (866-796-4368). You can also contact your pesticide distributor or university extension specialist to report resistance.

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Managing for Resistance

Take Home Messages

- Know your pest – Pest ID
- What is the pest severity – do you need to treat?
- What are the environmental conditions now and in the near future – will these reduce or increase the pest damage
- Is the product labeled for the pest and labeled for the crop **READ the LABEL**
- What is the Mode of Action (MoA)?
- **Alternate products having different MoAs!**

2. All about Sprayers

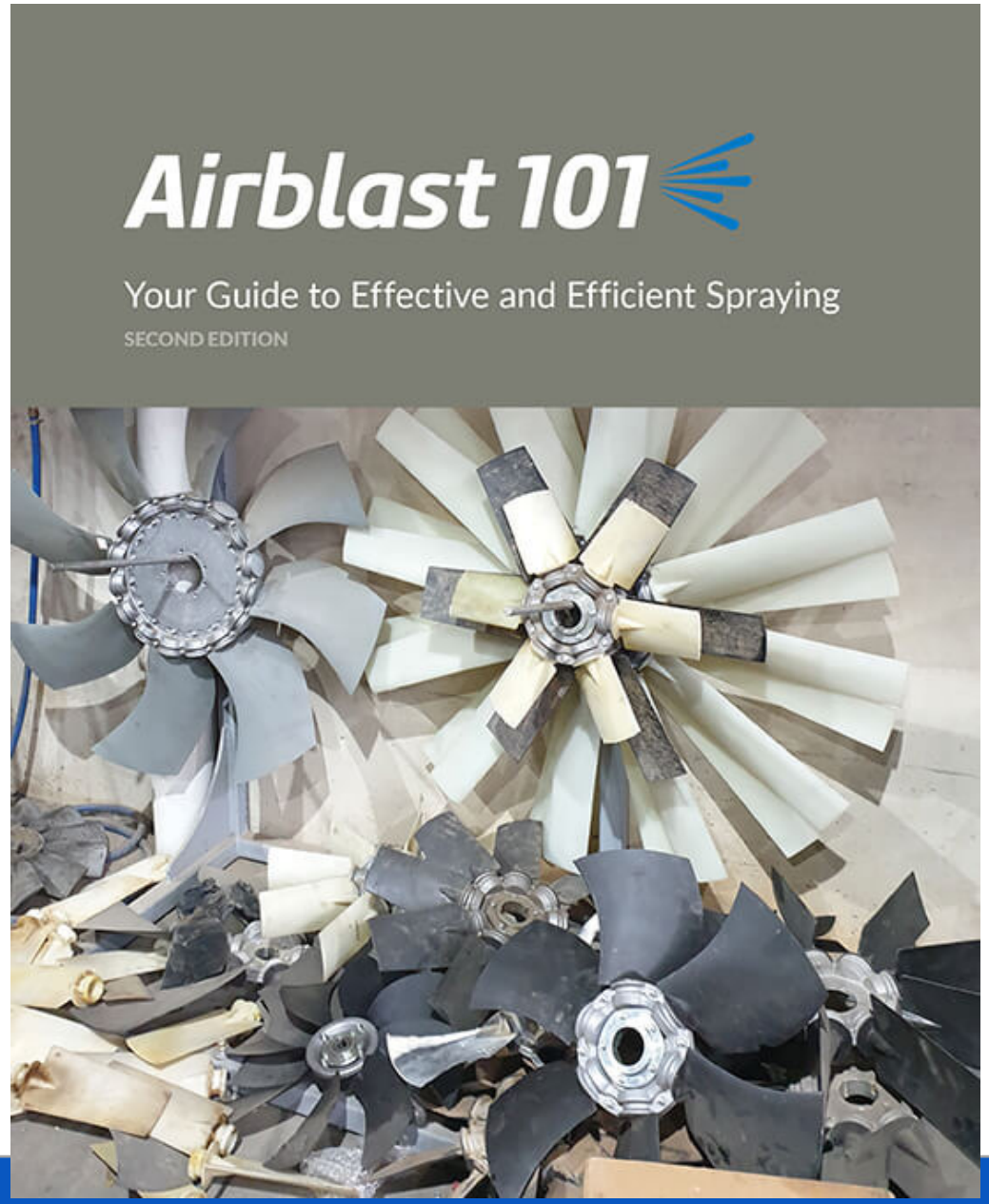
- Sprayer type
- Nozzles
- Calibration
- Label Directions
- Apply properly

Sprayer type

- FABE-533: Sprayers for Effective Pesticide Application in Orchards and Vineyards https://ohioline.osu.edu/factsheet/fabe-533
- FABE-538: Advancements in Technology for Effective Spraying in Orchards and Vineyards https://ohioline.osu.edu/factsheet/fabe-53
- Airblast 101 Your Guide to Effective and Efficient Spraying https://sprayers101.com/airblast101/

- ***Effective and efficient spraying in vineyards and orchards fact sheets - Erdal Ozkan, Ohio State University Extension***
- ***Aiblast 101(Deveau, Ledebuhr, Manketelow)***

Airblast 101



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Nozzles

- FABE-534: Selecting the Right Type and Size of Nozzles for Effective Spraying in Orchards and Vineyards https://ohioline.osu.edu/factsheet/fabe-534

- Effective and efficient spraying in vineyards and orchards fact sheets - Erdal Ozkan, Ohio State University Extension

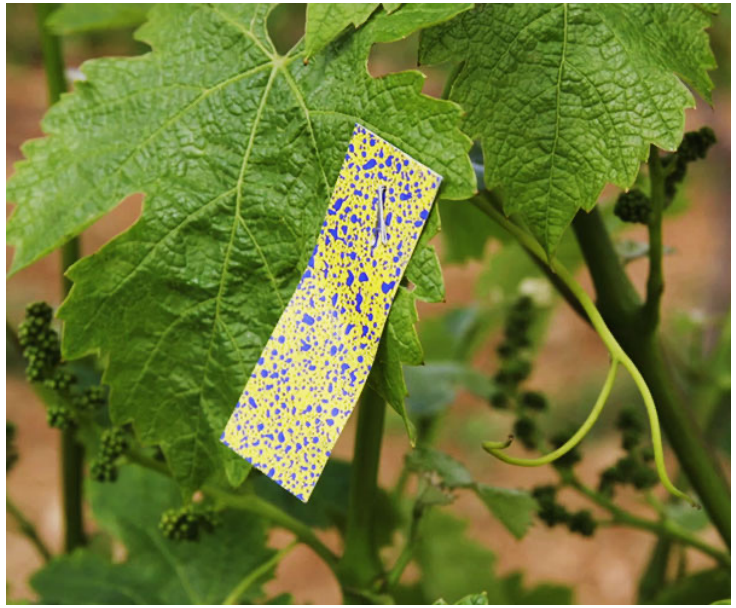
SPRAY EQUIPMENT

Nozzles

- Equip sprayers with nozzles that provide accurate and uniform application.
- Nozzles should be the same size and uniformly spaced across the boom.
- Calibrate sprayer before use.
- It is suggested that screens be used to protect the pump and to prevent nozzles from clogging.
- Screens placed on suction side of pump should be 16-mesh or coarser.
- Do not place a screen in the recirculation line.
- Use 50-mesh or coarser screens between the pump and boom, and where required, at the nozzles.
- Check nozzle manufacturer's recommendations.

Calibration

- Air Blast Sprayer calibration - https://youtu.be/NYbVtoP-C4M
- FABE-537: Calibration of Orchard and Vineyard Sprayers https://ohioline.osu.edu/factsheet/fabe-539



- George Hamilton – University of New Hampshire

- Effective and efficient spraying in vineyards and orchards fact sheets - Erdal Ozkan, Ohio State University Extension

Label Directions

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PRODUCT USE INSTRUCTIONS

Application: Thorough coverage is necessary to provide good disease control. Make up no more spray solution than is needed for application. Avoid spray overlap, as crop injury may occur.

Efficacy: Under certain conditions conducive to extended infection periods, use another registered fungicide for additional applications if maximum amount of Ridomil Gold MZ WG has been used. If resistant isolates to Group 4 fungicides are present, efficacy can be reduced.

Crop Tolerance: Plant tolerance has been found acceptable for all crops on the label, however, not all possible tank-mix combinations have been tested under all conditions. When possible, it is recommended to test the combinations on a small portion of the crop to ensure a phytotoxic response will not occur as a result of application.

IPM: Ridomil Gold MZ WG should be integrated into an overall disease and pest management strategy (IPM) whenever the use of a fungicide is required. Cultural practices known to reduce disease development should be followed. Consult your local agricultural authorities for additional IPM strategies established for your area.

Apply properly

- FABE-536: Strategies to Maximize Pesticide Deposit and Coverage for Effective Spraying in Orchards and Vineyards https://ohioline.osu.edu/factsheet/fabe-536
- FABE-539: Best Practices for Effective Spraying in Orchards and Vineyards https://ohioline.osu.edu/factsheet/fabe-539
- Quick Tips For Using Your Sprayers - https://npsec.us/sprayers

- Effective and efficient spraying in vineyards and orchards fact sheets - Erdal Ozkan, Ohio State University Extension

- George Hamilton – University of New Hampshire

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All about Sprayers

Take Home Messages

- Select the Correct Sprayer
- Select the correct nozzles
- Calibrate the sprayer correctly
- **READ the LABEL**

Use the right product
Mix and load properly
Apply properly

3. Worker Protection Standards (WPS)

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AGRICULTURAL USE REQUIREMENTS

Use this product only in accordance with its labeling and with the Worker Protection Standard, 40 CFR Part 170. This Standard contains requirements for the protection of agricultural workers on farms, forests, nurseries, and greenhouses, and handlers of agricultural pesticides. It contains requirements for training, decontamination, notification, and emergency assistance. It also contains specific instructions and exceptions pertaining to the statements on this label about personal protective equipment (PPE) and restricted-entry interval. The requirements in this box only apply to uses of this product that are covered by the Worker Protection Standard (WPS).

Do not enter or allow worker entry into treated areas during the restricted-entry interval (REI) of 48 hours.

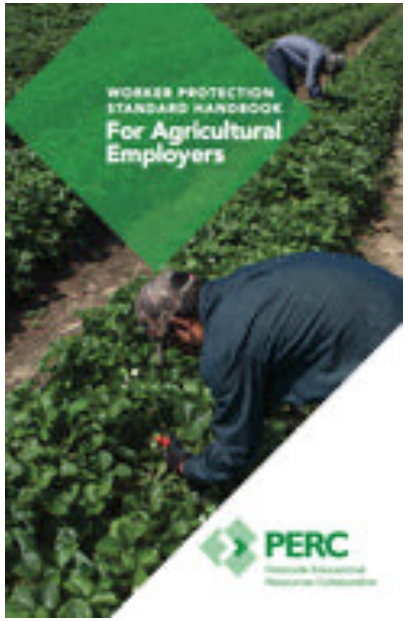
AGRICULTURAL USE REQUIREMENTS (continued)

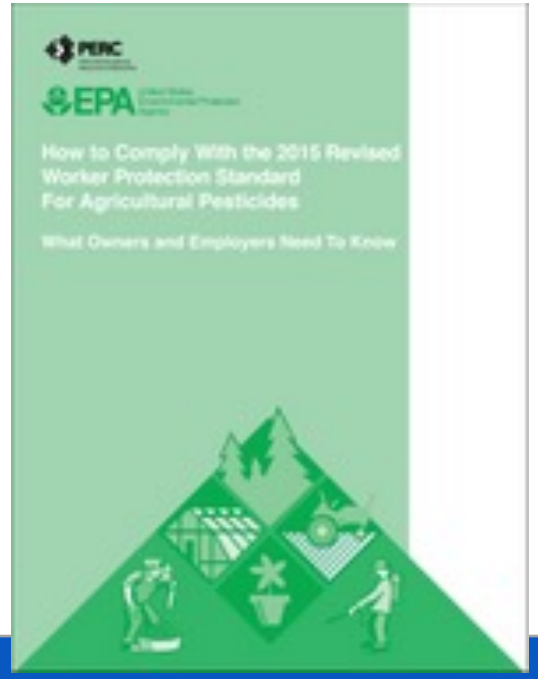
PPE required for early entry to treated areas that is permitted under the Worker Protection Standard and that involves contact with anything that has been treated, such as plants, soil, or water is:

- Coveralls
- Shoes and socks
- Chemical-resistant gloves made of barrier laminate, butyl rubber ≥ 14 mils, nitrile rubber ≥ 14 mils, neoprene rubber ≥ 14 mils, natural rubber ≥ 14 mils, polyethylene, polyvinyl chloride (PVC) ≥ 14 mils, or Viton® ≥ 14 mils

WPS Resources

NPSEC WPS resources - https://npsecstore.com/pages/perc-page





ORDER YOUR PERC POSTERS HERE

Worker Protection Standards (WPS)

Take Home Messages

WPS Label requirements

WPS Compliance – Training, Posting and Recordkeeping

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4. Pesticide Certification & Training

(C&T)

- Private Applicators
- Commercial Applicators
- TN Department of Agriculture Online Pesticide System - https://agriculture.tn.gov/default.asp
- Tennessee's PSEP website http://psep.utk.edu

VESTA Resource Center

- Repository for the Grape and Wine Industry
- Integrates the resources of V&E alliance organizations
- Promotes the Grape and Wine Industry

- Collaborative Alliance:
  - Universities
  - Community Colleges
  - Grape and Wine Industry
  - Grape and Wine Associations
  - Viticulture and Enology Programs
- Partnership to advance Registered Apprenticeships to increase the GWI workforce

Resources Available

- Nationwide V&E Programs
- Grape and Wine Industry Associations
- Webinars
- Publications
- Newsletters
- Workforce Development Tools
- VESTA educational courses

- Scholarships
- Grant funding sources
- Continuing Education for Faculty
- Mentoring for 2-year Colleges

- New Website Launch May 2022

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VESTA
VITICULTURE & ENOLOGY
SCIENCE & TECHNOLOGY ALLIANCE

Exhibit Booth 36

Access this presentation at:

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