

# **WHAT AM I ALLOWED TO SPRAY ON MY HOPS?**

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# WHAT DO I SPRAY IF I HAVE “X” PROBLEM?

Objective: Equip you to make your product and spray decisions, in compliance with the law, using the right tools.

This info applies for organic and conventional growers.

Specific spray recommendations are situation-dependent!



Disclaimer: Commercial products are named in this presentation for informational purposes only. We do not endorse these products and do not intend discrimination against other products which also may be suitable.



# BACKGROUND: DEFINITIONS, OVERSIGHT, PRODUCT REGISTRATION

- Pesticide - **Any substance or mixture of substances intended for destroying, repelling, or mitigating any pest.....or intended for use as a plant regulator, defoliant, or desiccant....**
- Roles:
- EPA – Registration of Pesticides
- **General Use (or unclassified use):** normally lower toxicity and no special licenses or permits required
- **Restricted Use (RUP):**
  - may cause adverse effects to human health or the environment
  - must be stated on the federal label
  - sold only to certified applicators
  - applied only by certified applicators or employees under their direct supervision



# **BACKGROUND: DEFINITIONS, OVERSIGHT, PRODUCT REGISTRATION**

- States – Lead Role in Enforcement, State Laws may be more stringent
- What about organic products: Most organic pesticides are registered with EPA and have EPA Registration Numbers - yes they are pesticides too!
- Except for – Minimum-Risk Pesticides - exempt from EPA review or label approval
  - See FIFRA Section 25b chemical list

# KEYWORDS

- |                          |                                     |
|--------------------------|-------------------------------------|
| • Herbicide              | Controls weeds and other plants     |
| • Insecticide            | Controls insects                    |
| • Fungicide              | Controls plant diseases             |
| • Plant Growth Regulator | Regulates growth of crops           |
| • Rodenticide            | Kills rats, mice, and other rodents |



# STATE PESTICIDE APPLICATOR CERTIFICATION

- A Way to Manage Risks of Pesticides
  - Ensures Competency! Certification requires applicators to demonstrate broad-based knowledge and competency in understanding label language, pesticide use and handling.
  - Protect the user
  - Protect the public
  - Protect the environment
- U. S. EPA: FIFRA
  - Certification of competency for use of RUPs





# APPLICATOR RESPONSIBILITIES (FOR ALL STATES AND CROPS)

- Only use registered products on sites specified by the label
- Follow the label: the label is the law!
- FIFRA 2 (ee) – Exceptions
  - **in a manner inconsistent with its labeling - DOES NOT INCLUDE:**
  - **Dilution less than rate unless specified**
    - **Addition of a pest - if legal site**
    - **Using application method not prohibited**
    - **Mixing with a fertilizer**

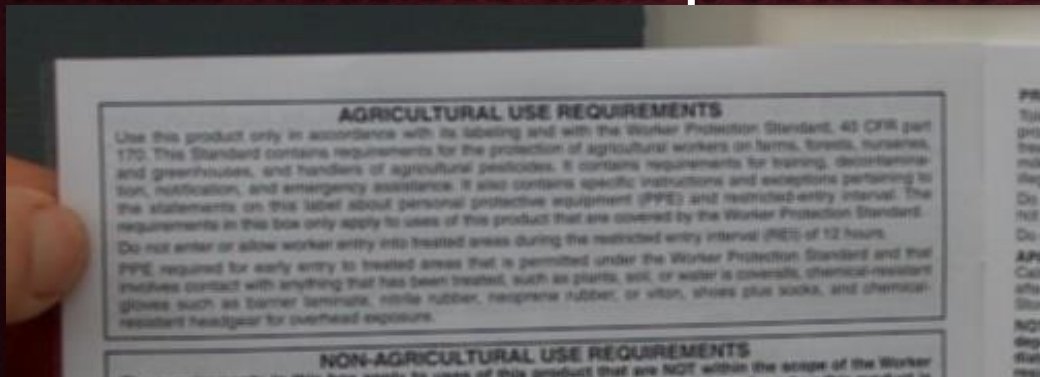


# **APPLICATOR RESPONSIBILITIES (FOR ALL STATES AND CROPS)**

- Report spills and incidents
- Keep Records of RUP Applications and WPS
- Be responsible for your actions and for following all applicable laws
- Don't sell any pesticides, apply on public property, and/or apply for hire without license or proper pesticide business paperwork—different requirements for these!

# THE WORKER PROTECTION STANDARD (WPS - AGRICULTURE ONLY)

- Applies to owners and operators who produce ag. plants and apply Ag. Use Pesticides on agricultural establishments
- Employers must provide protections against possible harm from pesticides (training, safety information, decontamination, ppe, notification, etc)
- Reduces pesticide risks to:
  - agricultural workers and pesticide handlers





# FEDERAL LAW: WORKER PROTECTION STANDARD

- **Employ**

- *Employ* means to obtain, directly or through a labor contractor, the services of a person in exchange for a salary or wages, including piece-rate wages, without regard to who may pay or who may receive the salary or wages. It includes obtaining the services of a self-employed person, an independent contractor, or a person compensated by a third party, except that it does not include an agricultural employer obtaining the services of a handler through a commercial pesticide handler employer or a commercial pesticide handling establishment.
- For work done with 30 days after the expiration of an REI or to do any handler task (applying a pesticide)

- **All resources available - Pesticide Education Resource Collaborative**  
**<http://pesticideresources.org//index.html>**

# VIRGINIA APPLICATOR CERTIFICATION

VDACS' Office of Pesticide Services enforces the law, certifies applicators, licenses pesticide businesses, and registers all pesticides used in the state

- Private Applicators: Apply restricted-use pesticides on farm for agricultural production, not for-hire
- Registered Technicians and Commercial Applicators: For-Hire, pesticide businesses, government/teaching role



# **VIRGINIA PRIVATE APPLICATOR CERTIFICATION PROCESS**

- **Self-Study: Virginia Pesticide Manuals (Private applicators and others)**
  - **Core: Applying Pesticides Correctly**
  - **Category Manuals for Commercial Applicators**
- Optional classroom or on-line training
  - Extension office, schools, or employer
- Testing: Schedule appointment with Extension office, or apply to VDACS to get authorization to take test at DMV
- Continuing education required every 2 years, before your certificate expires

# NORTH CAROLINA APPLICATOR CERTIFICATION

NCDA&CS Pesticide Section enforces the law, certifies applicators, licenses pesticide applicators, and registers all pesticides used in the state

- Private Applicators: Apply restricted-use pesticides on farm for agricultural production, not for-hire
- Commercial Applicators: For-Hire applying pesticides to the property of another



# **NORTH CAROLINA PRIVATE APPLICATOR CERTIFICATION PROCESS**

- **Self-Study: Virginia Pesticide Manuals (Private applicators and others)**
  - **Core: Applying Pesticides Correctly**
  - **Category Manuals for Commercial Applicators**
- Optional classroom training at Pesticide Schools offered by Cooperative Extension
- Testing: Schedule appointment with Extension or Contact NCDA&CS 919-733-3556
- Continuing education required every 3 years, before your certificate expires
  - 2 Hours of Core Safety and 2 hours of Specialty

# PESTICIDES: THE LABEL IS THE LAW

- The LABEL IS THE LAW
- The pesticide product label is a binding legal agreement between three parties:
  - US Environmental Protection Agency,
  - the product registrant, and
  - the product user.
- Failure to follow directions is a violation of federal, state, and local laws
- Contains important information for protection of human health and environment
- Ensures proper, effective, least-risk application
- Ensures compliance with Residue tolerances set by EPA and monitored by Food and Drug Administration



# **LABEL CONTAINS VALUABLE INFORMATION ABOUT THE PRODUCT**

- **Product acute toxicity – signal words**
- **Active ingredients**
- **Registered uses, directions for use**
- **Use restrictions**
- **Worker Protection Standard**
  - **Personal protective equipment**
  - **Restricted-entry interval**
  - **Notification requirements**
- **Environmental hazards**
- **Emergency treatment procedures**
- **Storage and disposal**

# **LABEL: PERSONAL PROTECTIVE EQUIPMENT**

PPE requirements based on....

- The **toxicity** of the pesticide
- The **formulation** of the pesticide
- The **activity you are performing**
  - Measuring, mixing and loading
  - Applying
  - Maintenance

## **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 F on an EPA chemical resistance category selection chart.

Applicators and other handlers must wear: A) Long-sleeved shirt; B) Long pants; C) Chemical-resistant gloves such as Barrier Laminate, Butyl Rubber, Nitrile Rubber or Viton; D) Shoes plus socks.

Follow manufacturer's instructions for cleaning/maintaining PPE. If no such instructions for washables, use detergent and hot water. Keep and wash PPE separately from other laundry.





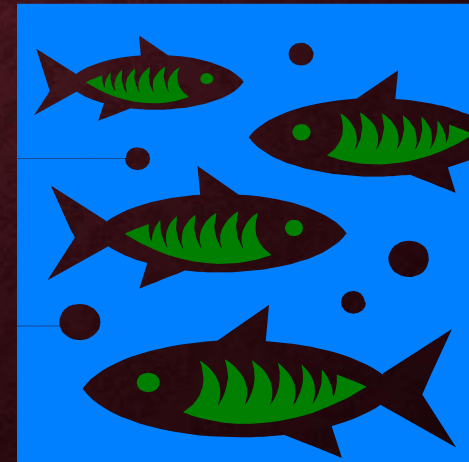
# **LABEL: GENERAL INSTRUCTIONS AND DIRECTIONS FOR APPLICATION**

- Application method, rates, and instructions
- User of surfactants
- Rainfastness
- Droplet size selection
- Spray volume
- Tank mixes
- Measures to avoid plant burn, plant injury, and other problems

If the crop you want to treat is not listed here or in a special auxiliary booklet, it is illegal to use this product on that particular crop.

# **LABEL: ENVIRONMENTAL SAFETY CAUTIONS**

- **Wildlife**
  - **Some products may be toxic to birds, fish or other animals.**
  - **Keep products and spray equipment away from:**
    - **streams**
    - **lakes**
    - **ponds**
    - **sources of drinking water**
  - **Follow specific label directions**






# **LABEL: PHI AND REI**





- PHI = Pre-harvest interval: the minimum time permitted between spray application and harvest
- REI = The time required between application and safe entry of people into the treated area without PPE



- **Product acute toxicity – signal words**
- **Active ingredients**
- **Registered uses, directions for use**
- **Use restrictions**
- **Worker Protection Standard**
  - **Personal protective equipment**
  - **Restricted-entry interval**
  - **Notification requirements**
- **Environmental hazards**
- **Emergency treatment procedures**
- **Storage and disposal**






**FOR ORGANIC PRODUCTION**

GROUP 3A

INSECTICIDE

Active Ingredient:	
Pyrethrins	5.00%
Other Ingredients	95.00%
	100.00%

MGK® and PyGanic® are registered trademarks of McLaughlin Gormley King Company. All other marks are property of their respective holders.

**KEEP OUT OF REACH OF CHILDREN**

**CAUTION**

**PRECAUCIÓN**

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.)

**FIRST AID**

**IF SWALLOWED:** Call a poison control center or doctor immediately for treatment advice. Have person sip a glass of water if able to swallow. Do not induce vomiting unless told to do so by the poison control center or doctor. Do not give anything by mouth to an unconscious person.

**IF IN EYES:** Hold eye open and rinse slowly and gently with water for 15-20 minutes. Remove contact lenses, if present, after the first 5 minutes, then continue rinsing eye. Call a poison control center or doctor for treatment advice.

**IF ON SKIN OR CLOTHING:** Take off contaminated clothing. Rinse skin immediately with plenty of water for 15-20 minutes. Call a poison control center or doctor for treatment advice. Have the product container or label with you when calling a poison control center or doctor, or going for treatment. You may also contact 1-888-740-8712 for emergency medical treatment information.

**PRECAUTIONARY STATEMENTS**

**HAZARDS TO HUMANS AND DOMESTIC ANIMALS**

**CAUTION**

Harmful if absorbed through skin. Harmful if swallowed. Causes moderate eye irritation. Wash hands thoroughly with soap and water after handling and before eating, drinking, chewing gum, using tobacco or using the toilet. Avoid contact with skin, eyes or clothing. Prolonged or frequently repeated skin contact may cause allergic reactions in some individuals. Wear long-sleeved shirt and long pants, socks, shoes, and chemical-resistant gloves.

**PERSONAL PROTECTIVE EQUIPMENT (PPE)**

Some materials that are chemical-resistant to this product are made of any waterproof material. If you want more options, follow the instructions for category E on an EPA chemical-resistance category selection chart.

Mixers loaders, applicators, and other handlers must wear the following:

- long-sleeve shirt,
- long pants,
- shoes and socks, and
- chemical resistant gloves.

In addition to the above PPE, applicators using hand held foggers in an enclosed area must wear a half-face, full-face, or hood-style NIOSH-approved respirator with:

- a dust/mist filtering cartridge (MSHA/NIOSH approval number prefix TC-21C), or
- a canister approved for pesticides (MSHA/NIOSH approval number prefix TC-14G) or
- a cartridge or canister with any R,P or HE filter.

Follow manufacturer's instructions for cleaning/maintaining PPE. If no such instructions for washables, use detergent and hot water. Keep PPE and wash PPE separately from other laundry. Discard clothing and other absorbent material that have been drenched or heavily contaminated with the product's concentrate. Do not reuse them.

When handlers use aircraft in a manner that meets the requirements listed in the Worker Protection Standard (WPS) for agricultural pesticides 40 CFR 170.240 (d) (4-6), the handler PPE requirements may be reduced or modified as specified in the WPS.

#### User Safety Recommendations:

Users should wash hands before eating, drinking, chewing gum, using tobacco, or using the toilet.

User should remove clothing/PPE immediately if pesticide gets inside. Then wash thoroughly and put on clean clothing.

Users should remove PPE immediately after handling this product. As soon as possible, wash thoroughly and change into clean clothing.

#### ENVIRONMENTAL HAZARDS

This product is toxic to aquatic organisms, including fish and invertebrates. Drift and runoff may be hazardous to aquatic organisms in water adjacent to treated areas. This product may contaminate water through runoff. This product has a potential for runoff for several weeks after application. Poorly draining soils and soils with shallow water tables are more prone to produce runoff that contains this product. This product is highly toxic to bees exposed to direct treatment on blooming crops or weeds. Do not apply this product or allow it to drift to blooming crops or weeds while bees are actively visiting the treatment area. Do not apply directly to water, to areas where surface water is present or to intertidal areas below the mean high water mark. Do not contaminate water when disposing of equipment wash-waters or rinsate.

#### DIRECTIONS FOR USE

It is a violation of Federal Law to use this product in a manner inconsistent with its labeling. SEE INSIDE BOOKLET FOR DIRECTIONS FOR USE

Manufactured by:



8810 Tenth Avenue North, Minneapolis, MN 55427

EPA Reg. No. 1021-1772

Rev. 0512-0512

EPA Est. Nos. 1021-MN-2<sup>A</sup>, 48498-CA-01<sup>B</sup>

Superscript is the first character of the lot number.

F7444-128

**NET CONTENTS 1 GALLON**



# WHO GETS TO SEE MY SPRAY RECORDS?

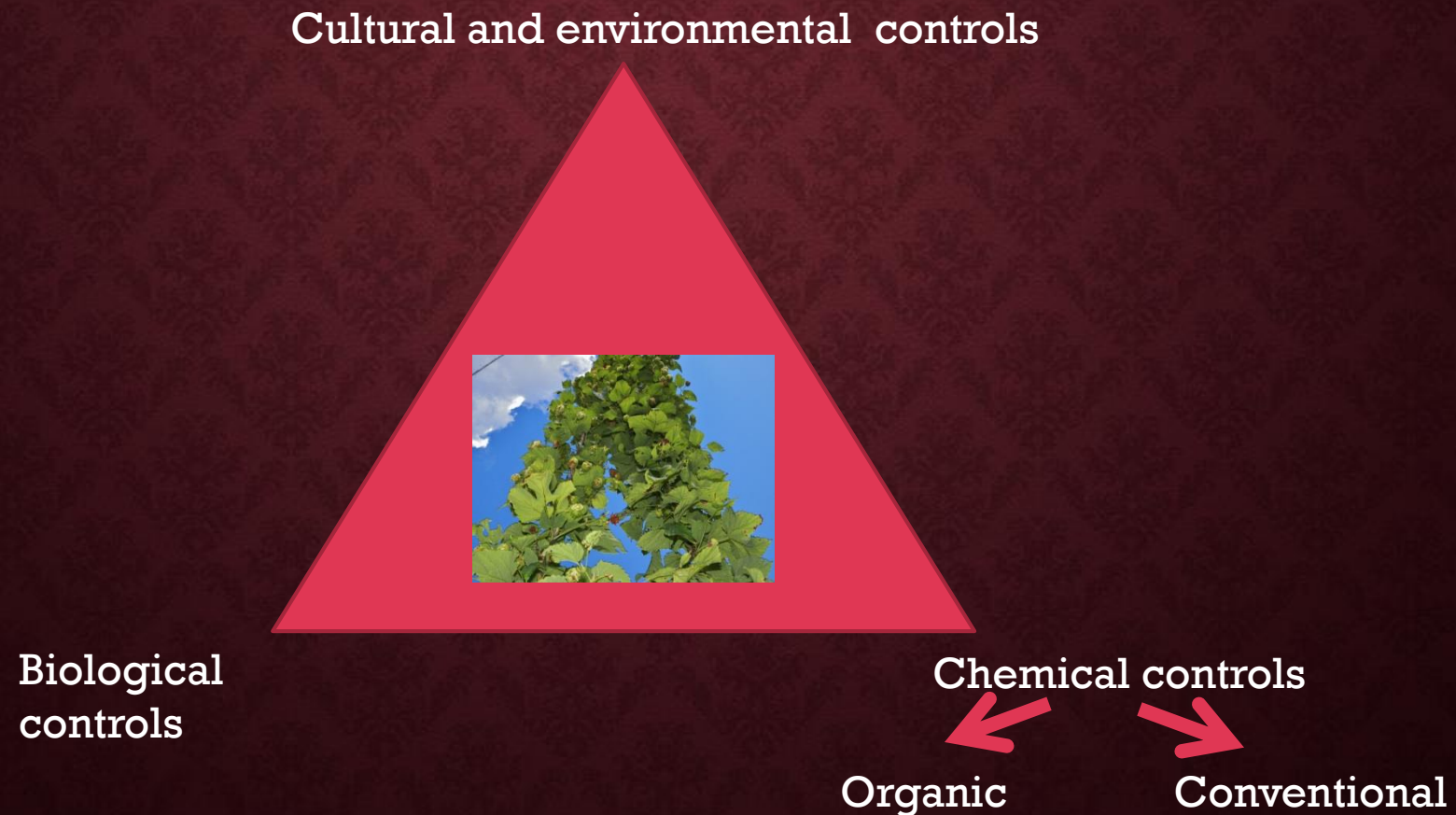
- Your state agriculture officials, in the event of an inspection or in response to complaint
- Workers at your operation

If you are part of an INDUSTRY-DRIVEN quality assurance/food safety program (ex: GAPs programs), you might have additional pesticide recordkeeping or record-sharing requirements as part of your participation. This is not to be confused with state+federal laws.

Do brewers need your records?



# HOW DO I MANAGE DISEASES AND PESTS RESPONSIBLY?





# PRINCIPLES OF RESPONSIBLE PESTICIDE USE AROUND HOPS

Get pesticide....

- On target.
- In correct amount.
- On time/at correct pest stage

Prevent first. Use integrated approaches.

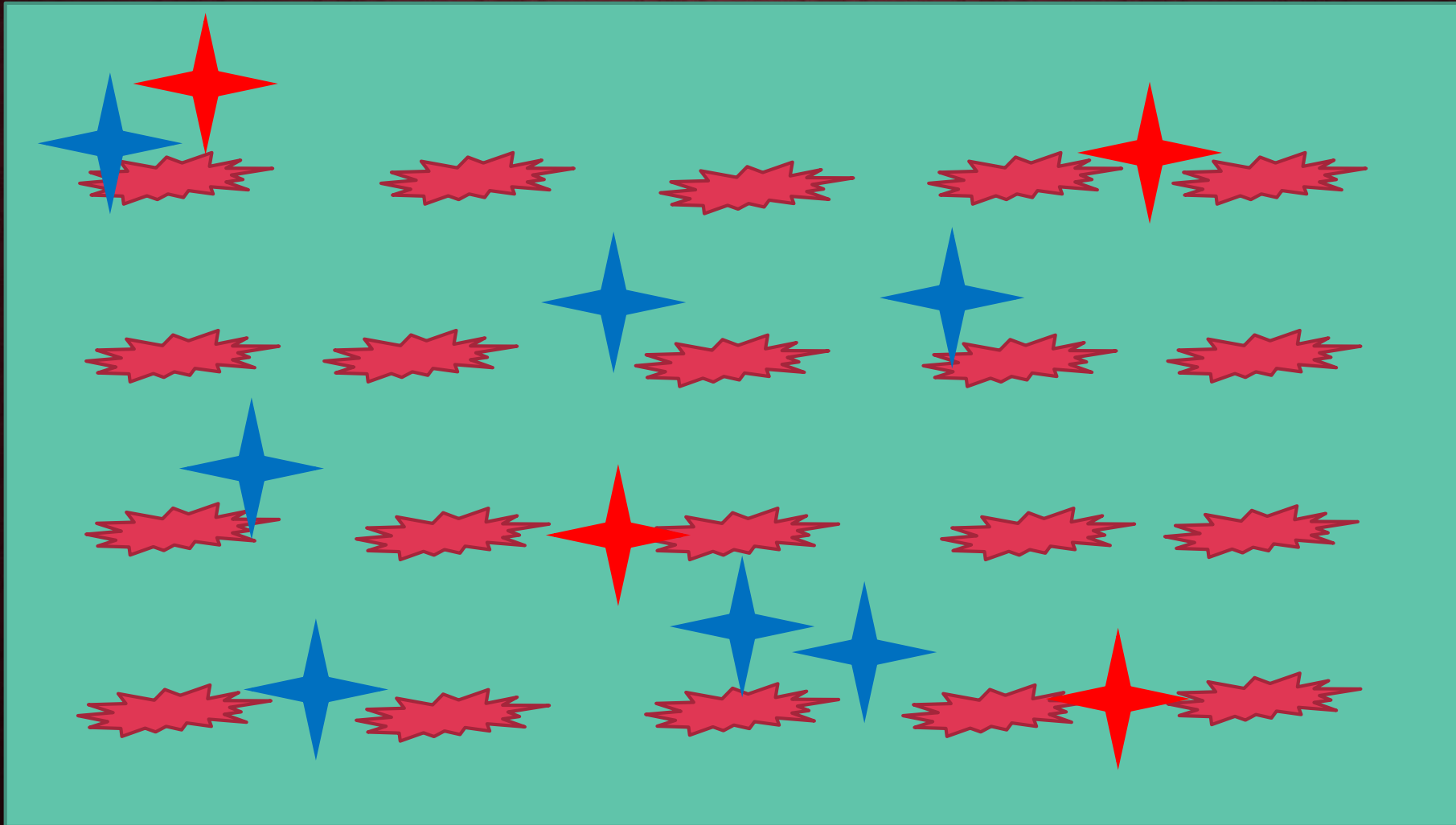
Treat when economic thresholds necessitate it.

Manage (and avoid) resistance problems.



# RESISTANCE EXAMPLE

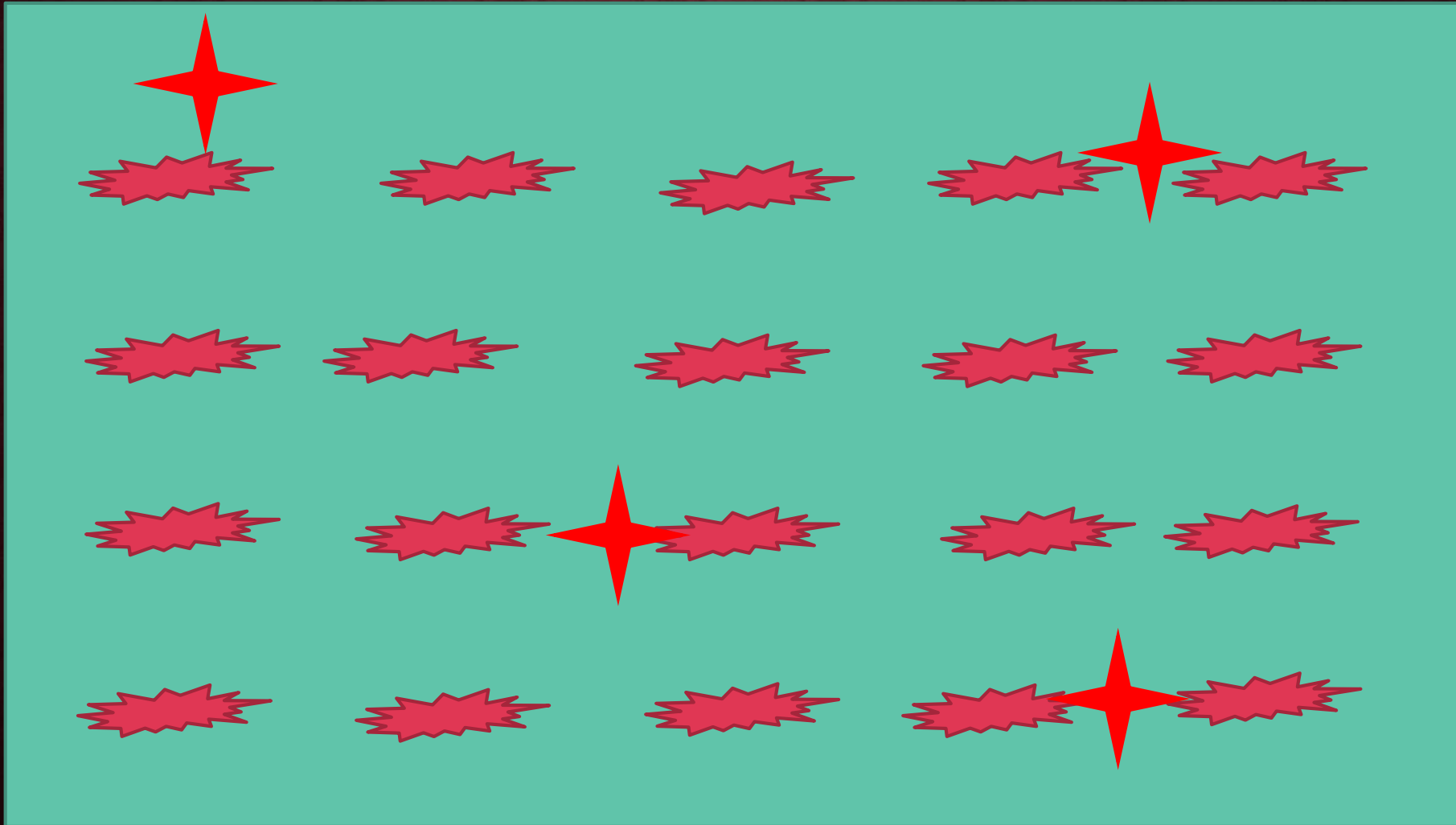
PLANTING AREA: PRE-TREATMENT





# RESISTANCE EXAMPLE

PLANTING AREA: POST-TREATMENT



Change/Combine/Rotate Between MOAs, when recommended

GROUP	21	FUNGICIDE
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- MOA = the biochemical means by which the product affects the pest



EPA Reg. No. 71512-3-279

EPA Est. No.

<b>Active Ingredient:</b>	
Cyazofamid* .....	34.5%
<b>Other Ingredients:</b> .....	65.5%
	100.0%

\*4-chloro-2-cyano-*N,N*-dimethyl-5-(4-methylphenyl)-1*H*-imidazole-1-sulfonamide (CA)  
Contains 3.33 pounds Cyazofamid Per Gallon (400 grams per liter)

FIRST AID	
If on skin	<ul style="list-style-type: none"><li>• Take off contaminated clothing.</li><li>• Rinse skin immediately with plenty of soap and water for 15-20 minutes.</li><li>• Call a poison control center or doctor for treatment advice.</li></ul>
If in eyes	<ul style="list-style-type: none"><li>• Hold eye open and rinse slowly and gently with water for 15-20 minutes.</li><li>• Remove contact lenses, if present, after the first 5 minutes, then continue rinsing eye.</li></ul>



# APPLYING PESTICIDES

Can a backpack sprayer cut it?





# CALIBRATE YOUR SPRAYER

- Put right amount of product on plants
- Calibration differs for each sprayer set-up
- Lots of pubs online-Extension & state pesticide staff can direct you to calibration instructions for the sprayer you are using.





# WHAT ABOUT POLLINATORS AND BENEFICIALS?



- We don't rely on pollinators for cone production, but pollinators and beneficial insects may be present in the hopyard
- Insecticides with highest risk to pollinators will have new "Bee Box" advisory and label guidance for pollinator protection. Examples:
  - Don't spray when bees are actively foraging
  - Don't spray when crop or groundcover is in bloom
  - Spray at a particular time of day—evening when bees aren't out
- Bees: Least/Highest Risk insecticide charts are available—talk to Extension!
- Loss of beneficials: cost/benefit decision. Use treatment thresholds.

# SO....WHAT DO I ACTUALLY SPRAY???

- Southeastern Vegetable Crop Handbook: Hops Section
- Virginia Cooperative Extension Pest Management Guide : Hops section
- Field Guide for Integrated Pest Management in Hops
- MSU, Vermont, and others....Make sure that the products on the list are also registered for use on hops in YOUR state
  - Ask your state department of ag and/or Extension for help checking this



# SOUTHEASTERN VEGETABLE CROP HANDBOOK

- The cultural practices for growing hops and recommended varieties can be found on page 60. In the back of the book you will find insect management recommendations (i.e., insecticides and miticides) on page 141 in Table 2-12. Disease control management recommendations (i.e., fungicides) can be found on page 190 in Table 3-18. Remember to always read and follow label directions.
- [http://www.thepacker.com/sites/produce/files/2017\\_SEVG\\_web\\_Final\\_linked.pdf](http://www.thepacker.com/sites/produce/files/2017_SEVG_web_Final_linked.pdf)

## SE Vegetable Crop Handbook

**TABLE 2-12. INSECT CONTROL FOR HOPS**

Insect	Insecticide, Mode of Action Code, and Formulation	Amount of Formulation Per Acre	Restricted Entry Interval (REI)	Pre harvest Interval (PHI) (Days)	Precautions and Remarks
Aphids and leafhoppers	imidacloprid, MOA 4A (Admire) 4.6 F (generics) 2	2.8 fl oz 6.4 fl oz	12 hrs 12 hrs	28	
	pymetrozine, MOA 9B (Fulfill) 50 WDG	4 to 6 oz	12 hrs	14	For aphids only. Will not control leafhoppers.
	spirotetramat, MOA 23 (Movento) 2 F	5 to 6 fl oz	24 hrs	7	Do not exceed 12.5 fl oz per acre per season. Will also control twospotted spider mite.
	malathion, MOA 1B 5 EC 8 EC	1 pt 0.63 pt	12 hrs 12 hrs	10 10	May suppress twospotted spider mite.
	pyrethrins, MOA 3 Pyganic EC 1.4 II Pyganic EC 5 II	16 to 64 fl oz 4.5 to 17 fl oz	12 hrs 12 hrs	0 0	<b>OMRI approved.</b> Pyrethrins degrade very quickly in sunlight. Do not expect residual control.
Japanese beetle	bifenthrin, MOA 3 (Brigade) 2 EC (Brigade) WD	3.8 to 6.4 fl oz 9.6 to 16 of oz	12 hrs 12 hrs	14 14	See Table of Generic Insecticides for other bifenthrin products.
	imidacloprid, MOA 4A (Admire) 4.6 F (generics) 2	2.8 fl oz 6.4 fl oz	12 hrs 12 hrs	28	
Armyworms, cutworms, loopers, leafroller	<i>Bacillus thuringiensis</i> , MOA 11A (Dipel) DF, MOA (Crymax) WDG	0.5 to 1 lb 0.5 to 1.5 lb	4 hrs	0	
	bifenthrin, MOA 3 (Brigade) 2 EC (Brigade) WD	3.8 to 6.4 fl oz 9.6 to 16 of oz	12 hrs 12 hrs	14 14	See Table of Generic Insecticides for other bifenthrin products.
	chlorantraniliprole, MOA 28 (Coragen) 1.67 SC	3.5 to 5 fl oz	4 hrs	0	Foliar or drip chemigation. Drip chemigation must be applied uniformly to the root zone. See label for instructions.
	spinosad, MOA 5 (SpinTor) 2 SC (Entrust)	4 to 6 fl oz 1.25 to 2 oz	4 hrs 4 hrs	1 1	<b>OMRI approved.</b>
	spinetoram, MOA 5 (Dalanto) 25WG	2.5 to 4 oz	4 hrs	1	



# VIRGINIA COOPERATIVE EXTENSION PEST MANAGEMENT GUIDES

- Go to “Horticultural and Forest Crops” PMG
- Hops : pages 4-1 to 4-12
- Disease, Insect, and Weeds sections

Visit your VA Extension agent for copy, or download from:

<https://pubs.ext.vt.edu/456/456-017/456-017.html>

Or purchase a hard copy of whole book (\$15) at:

<https://apps.cals.vt.edu/flex/PMGOrdering/PMGOrdering.html>

## **Hops: Diseases**

*Mizuho Nita, Extension Plant Pathologist, Alson H. Smith Jr. AREC*

### **Nonchemical Approaches**

#### ***Preplanting Considerations***

##### **Site Selection and Evaluation**

Air circulation and water drainage are the two key factors when it comes to disease management. Poorly drained soil promotes some soilborne pathogens, such as black root rot (caused by *Phytophthora citricola*) and crown gall (caused by *Agrobacterium tumefaciens* aka *Rhizobium radiobacter*). Poor air circulation will promote diseases such as downy mildew and Botrytis gray mold because the pathogens for these diseases thrive in moist environments. Also, please note that variety selection can depend on site characteristics. For example, cultivars such as Magnum and Perle have been grown for centuries in European countries with well-drained and low pH (5.5-6.2) soil conditions. Therefore, it is recommended that you examine characteristics of your site, such as water drainage, pH, air circulation, sun exposure, availability of nutrients, etc., prior to the selection of cultivars.

##### **Cultivar Selection**

Both downy mildew (caused by *Pseudoperonospora humuli*) and powdery mildew (caused by *Podosphaera macularis*) are destructive diseases of hop. Considering environmental conditions during the growing season, it is best to select varieties that are not susceptible to these two diseases. Cascade, Fuggle, Magnum, Newport, and Perle are considered resistant to downy mildew. Comet, Crystal, First Gold, Newport, and Nugget are resistant to powdery mildew, and other cultivars, such as Cascade, Centennial, Hallertauer Tradition, Liberty, Pioneer, and Teamaker are moderately resistant to powdery mildew. On the other hand, cultivars such as Cluster, East Kent Golding, Tolhurst, and Vanguard are known to be susceptible to both powdery and downy mildew; thus, these cultivars should be avoided.

##### **Quality of Rhizomes**

The downy mildew pathogen as well as viral pathogens can survive in plant tissues. Therefore, it is very important to obtain certified rhizomes from reputable sources. Unfortunately, even certified, disease-tested rhizomes have a chance of carrying pathogens; however, certified rhizomes will be much cleaner than noncertified rhizomes and will greatly minimize the risk of



## VA PEST MANAGEMENT GUIDE

**Table 4.1 Fungicides Registered for Control of Hop Diseases in Virginia (cont.)**

Pest	Fungicide	Rate/Acre	FRAC* Grouping	Spray Timing and Remarks
Downy mildew	Fixed cop- per (various formulations)	See label	M1	With other crops, downy mildew strains that are resistant to Flint, Pristine, and other strobilurin (aka Qol) and Metastar (metalaxyl) fungicides are common. Rotating and tank mixing with a different anti-downy-mildew material (e.g., copper) is highly recommended.
	Curzate 60 DF	3.2 oz	27	
	Flint	4 oz	11	
	Forum	6 oz	40	There are many formulations of phosphorous acid and fosetyl-Al (both are FRAC group 33) and copper products; refer to the label for the rate for the product. A high concentration of a phosphorous acid may cause plant injury. Also, some formulations of phosphorous acid and copper may cause plant injury.
	Fosetyl-Al (various formulations)	See label	33	
	Metastar 2E	1 qt	4	
	Phosphorous acid (various formulations)	See label	33	Group 40 materials (Forum, Revus, and Zampro) provide very good protection against downy mildew; however, as with others, tank mix, rotation, and limited usage (2-3 times/year) are recommended.
	Pristine	14 oz	7+11	
	Ranman	2.1-2.75 fl oz	21	
	Revus	11-14 oz	40	Curzate, Metastar, or Tanos has to be tank mixed with another broad-spectrum fungicide active against downy mildew, such as copper.
	Ridomil Gold SL	0.5 pt	4	
	Tanos	8 oz	11+27	
	Ultra Flourish	1 pt	4	
	Zampro	8 fl oz	40 + 45	
Powdery mildew	Fixed cop- per (various formulations)	See label	M1	10-14-day interval application (depends on the environmental conditions).

## VA PEST MANAGEMENT GUIDE

**Table 4.2 Chemical Names, Restricted Entry Interval (REI), and Preharvest Interval (PHI) (cont.)**

Chemical (other names)	Manufacturer	REI (hours)	PHI (days)
Neem oil (various formulations: Trilogy, Green Light, etc.)	Various	4	0
Phosphorous acid (phosphite; various formulations: Agri-Fos, Prophyt, Phostrol, etc.)	Various	4	0
Potassium bicarbonate (various formulations: Armicarb, Kaligreen, etc.)	Various	4	0-1 (see label)
Pristine (pyraclostrobin + boscalid)	BASF	12	14
Procure 480 SC (triflumizole)	Chemtura	12	7
Quintec (quinoxifen)	Dow Agrosciences	12	21
Myclobutanil (Rally, Sonoma, etc)	Various	24	14
Regalia, Regalia PTO, and Regalia Rx ( <i>Reynoutria sachalinensis</i> )	Marrone Bioinnovations	4	0
Revus (mandipropamid)	Syngenta	4	7
Ridomil Gold SL (Mefenoxam)	Syngenta	48	45
Serenade (various formulations)	Bayer Cropscience	4	0
Sonata (various formulations)	Bayer Cropscience	4	0
Suffoil-X (aliphatic petroleum solvent)	Bioworks	4	0
Sulfur (various formulations: Acoidal, Kumulus DF, Microthiol D, etc.)	Various	24	0
Tanos (cymoxanil + famoxadone)	Dupont	12	7
Tebuconazole (various formulations: AmTide Tebu 3.6 F, Orius, etc.)	Various	12	14
Ultra Flourish (mefenoxam)	Nufarm	48	45



# FIELD GUIDE FOR INTEGRATED PEST MANAGEMENT IN HOPS

- Download: <https://www.usahops.org/resources/field-guide.html>

(link also has hard-copy order instructions: \$5)

### **At a Glance:** **Black Root Rot**

- ◆ Plant resistant varieties when possible.
- ◆ Avoid poorly drained fields and excessive irrigation.
- ◆ Avoid damaging roots during cultivation.
- ◆ Phosphorous acid fungicides and various Ridomil formulations may provide some control.

## **Black Root Rot**

Frank S. Hay and David H. Gent

The fungus-like organism *Phytophthora citricola* causes a crown-and-root rot of hop referred to as black root rot. The disease tends to be most damaging to hop plants in poorly drained soils and areas with high water tables. Certain Cluster varieties such as Cluster types E-2 and L-8 are particularly susceptible. The pathogen has a relatively broad host range that includes cherry, fir trees, raspberry, strawberry, and walnut.

### **Symptoms**

Infected roots and crowns have a characteristic water-soaked and blackened appearance with a distinct boundary between diseased and healthy tissue (Fig. 5). Infection can spread from the crown for several inches up the base of the bine. In severe cases, leaves become yellow and bines wilt rapidly during warm weather or when plants become moisture-stressed. Young plants irrigated too heavily to encourage production in the first year can wilt later in the season as a result of black root rot. As the disease progresses, leaves turn black and remain attached to the bine. Severely infected plants are weakened and may die during winter or the following spring. Affected plants often are found in areas of hop yards with poor drainage. Wilting symptoms caused by black root rot can be mistaken for Verticillium wilt, Fusarium canker, or damage caused by California prionus beetle.

## **Disease Cycle**

The black root rot pathogen survives in soil as dormant sexual spores (oospores), which can survive 18 months or longer. In the presence of free water and host roots, oospores or the asexual spores (sporangia) germinate and infect the plant directly or may release motile spores (zoospores) that are attracted to compounds released from host roots (e.g., ethanol and certain amino acids and sugars). The motile zoospores settle on roots and later produce mycelia that infect and grow through the host tissues.

### **Management**

Avoid establishing hop yards in areas with poor water drainage, especially with highly susceptible varieties such as Cluster types E-2 and L-8. Cluster L-1 and Galena are considered partially resistant, while Brewer's Gold, Bullion, Cascade, Columbia, Comet, Eroica, Fuggle, Hallertau, Nugget, Olympic, Tettnanger, and Willamette reportedly are highly resistant to black root rot. Reducing cultivation and avoiding injury to crowns and roots can provide some reduction in disease since infection is favored by wounds. Certain phosphorous acid fungicides are registered for control of black root rot, but their efficacy has not been reported. Phenylamide fungicides (i.e., various formulations of Ridomil) applied for control of downy mildew may provide some control, although these products are not registered specifically for control of black root rot.





# CASE STUDY: HOPS DOWNY MILDEW

1. Choose resistant/tolerant cultivar
2. Use reputable plant source
3. Strip lower leaves after training
4. Use row spacing, no overhead watering
5. Keep plants happy
6. Remove diseased material and burn
7. Prune infected basal spikes in early spring (short internodes, chlorotic, cupped leaves)
8. Treat with effective fungicide (before, during, after infection?)



## VA PEST MANAGEMENT GUIDE

**Table 4.1 Fungicides Registered for Control of Hop Diseases in Virginia (cont.)**

Pest	Fungicide	Rate/Acre	FRAC* Grouping	Spray Timing and Remarks
Downy mildew	Fixed copper (various formulations)	See label	M1	With other crops, downy mildew strains that are resistant to Flint, Pristine, and other strobilurin (aka QoI) and Metastar (metalaxyl) fungicides are common. Rotating and tank mixing with a different anti-downy-mildew material (e.g., copper) is highly recommended.
	Curzate 60 DF	3.2 oz	27	
	Flint	4 oz	11	
	Forum	6 oz	40	There are many formulations of phosphorous acid and fosetyl-Al (both are FRAC group 33) and copper products; refer to the label for the rate for the product. A high concentration of a phosphorous acid may cause plant injury. Also, some formulations of phosphorous acid and copper may cause plant injury.
	Fosetyl-Al (various formulations)	See label	33	
	Metastar 2E	1 qt	4	
	Phosphorous acid (various formulations)	See label	33	Group 40 materials (Forum, Revus, and Zampro) provide very good protection against downy mildew; however, as with others, tank mix, rotation, and limited usage (2-3 times/year) are recommended.
	Pristine	14 oz	7+11	
	Ranman	2.1-2.75 fl oz	21	
	Revus	11-14 oz	40	Curzate, Metastar, or Tanos has to be tank mixed with another broad-spectrum fungicide active against downy mildew, such as copper.
	Ridomil Gold SL	0.5 pt	4	
	Tanos	8 oz	11+27	
	Ultra Flourish	1 pt	4	
	Zampro	8 fl oz	40 + 45	
Powdery mildew	Fixed copper (various formulations)	See label	M1	10-14-day interval application (depends on the environmental conditions).
	Flint	4 oz	11	Due to the risk of fungicide resistance development, do not use sterol inhibitors (aka DMI; FRAC group 3) or strobilurins (aka QoI; FRAC group 11) continuously; rotate with other groups of fungicides. It is recommended that sterol inhibitors and strobilurins be tank mixed with sulfur or copper material, and limit the use of FRAC groups 3 and 11 to 2-3 times/season. Pristine contains a strobilurin along with a different active chemical (SDHI) that has an efficacy
	Luna Experience	8.0-17 fl oz	7+3	
	Luna Privilege	3.2-6.84 fl oz	7	
	Luna Sensation	3.0-7.6 fl oz	7+11	



# CASE STUDY: WEEDS IN PLANTED ROWS

- Are they annual or perennial? Are they broadleaf weeds or grasses?

Options:

- Weeding
- Mowing
- Mulching
- Spraying



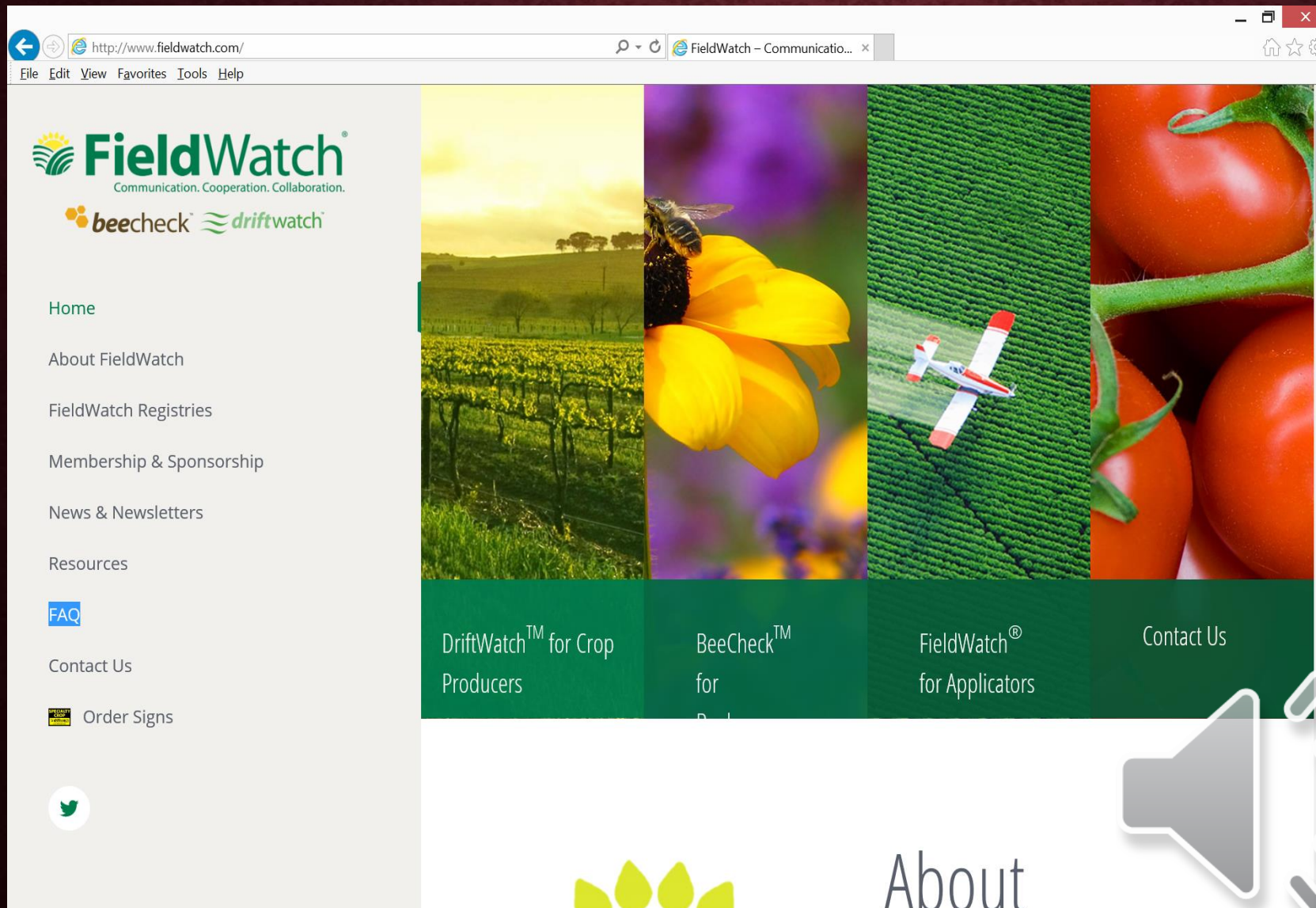
**Table 4.5. Herbicide Common and Trade Names, Rate per Acre, and Comments**

Application	Common Name (Trade Name)	Rate of Active Ingredient per Acre (Rate of Product per Acre)	Timing and Remarks
Preemergence to weeds	Flumioxazin (Chateau)	3 oz (6 oz)	Apply to dormant hops in January-March as a 1-1.5-foot strip on each side of the row. Make only 1 application/year. For small areas, apply 0.13 oz Chateau/1,000 sq ft. Controls a range of annual weeds
	Norflurazon (Solicam)	2-4 lb (2.5-5.0 lb)	Apply as a directed spray to hops established at least 6 months. Use lower rates on sandy soils. For small areas, apply 0.9-1.8 oz Solicam/1,000 sq ft. Controls a range of annual weeds and suppresses yellow nutsedge.
	Trifluralin (Treflan 4EC or other labeled formulation)	0.50-0.75 lb (1.0-1.5 pt)	Apply as a directed spray to dormant, established hops, avoiding hops crowns. Immediately incorporate 1-2 inches deep. Do not spray over hops. For small areas, apply 0.37-0.55 fl oz Treflan 4EC/1,000 sq ft. Controls annual grasses and certain small-seeded annual broadleaf weeds.
Postemergence to weeds	Clethodim (Select Max)	0.07-0.12 lb (9-16 fl oz)	Apply to actively growing annual and perennial grassy weeds. Will not control nongrass monocots or any broadleaf weeds. Perennial grasses like johnsongrass and bermudagrass generally will require retreatment. Add a nonionic surfactant at 0.25% V/V. There is a 21-day PHI.
	2,4-D (2,4-D Amine 4 or other labeled formulation)	0.48 lb ae (1 pt)	Make a directed spray to the row middles. Use a shielded or hooded sprayer to prevent contact with hops foliage. Controls certain annual broadleaf weeds. The PHI is 28 days.



# FieldWatch – DriftWatch

## Specialty Crop Site Registry



# QUESTIONS?

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- Speak with your local agent and state pesticide staff for certification information and other assistance!