

Fungicides for Hop Powdery Mildew Management, 2012

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As of spring 2012 hop growers in Eastern Washington have a variety of fungicides at their disposal for managing powdery mildew. A list of currently available powdery mildew compounds is presented in Table 1. The table includes fungicide class information, and Fungicide Resistance Action Committee (FRAC; <http://www.frac.org>) group code. The FRAC code represents the mode of action of the fungicide. This information is critical when designing a fungicide program that conforms to FRAC resistance management guidelines. It is important to remember that if a pathogen population develops resistance to fungicides within a FRAC group, it is likely to be resistant to all members of that group. In addition, when one fungicide class is no longer available or effective, additional pressure for selection of resistant pathogen strains is placed on any remaining fungicide classes. Resistance is much more likely to develop if the pathogen is frequently treated with one or multiple fungicides within a given FRAC group. Included in the table are members of the fungicide classes (or FRAC Groups) known as DMI (demethylation inhibitors, Group 3), QoI (quinone outside inhibitors; previously called strobilurins, Group 11), carboxamide (boscalid, Group 7) quinolines (quinoxyfen, Group 13), sulfur (Group M2), various “biological” fungicides (Group 44), inducer of host defense mechanisms (Group P), petroleum derived spray oils, and potassium bicarbonate. Petroleum spray oils and potassium bicarbonate are listed as “Not Classified” (NC) by FRAC. The resistance risk is product-dependent (Table 1). Consult product labels for appropriate rates and spray intervals. All of the aforementioned “new” products have been evaluated in efficacy trials at WSU-IAREC. Efficacy reports are available on the PNW Hop Information Network Sharepoint server at <http://hops.wsu.edu/>. Look in the “Shared Documents” section for reports sorted via disease, year, and/or active ingredient.

Several companies are now marketing formulations or “premixes” of two different fungicide classes (modes of action, or FRAC groups). The availability of “premix” fungicide formulations is a relatively recent trend in agriculture. The hop toolbox contains one of these product types: Pristine (pyraclostrobin; FRAC Group 11 + boscalid; FRAC Group 7). When both modes of action have activity against the target organism, some level of resistance management is built into the products provided that they are used rationally. The use of “premix” types of products can provide better disease control, provide disease control security if there is field resistance to one of the two active ingredients, and help prevent resistance if resistant strains are not already present in the population.

Products containing QoI (Group 11) fungicides (Flint and Pristine) are important components in the hop industry’s defense against powdery mildew. The resistance risk of these Group 11 fungicides (formerly known as strobilurins) is high while the risk of other important classes (DMI and quinolines) is considered medium. The resistance risk of contact fungicides sulfur, narrow range petroleum oil, and potassium bicarbonate is low. We have no evidence of fungicide resistant hop powdery mildew populations in Eastern Washington but this could change rapidly given the nature of powdery mildew

and the resistance history of Group 11 and Group 3 fungicides, especially to powdery mildews in other perennial crops. Therefore it is imperative that resistance management guidelines be followed beginning with the introduction of any group.

General resistance management guidelines include the incorporation of cultural practices that lower disease pressure. For example, basal leaf removal can reduce disease pressure. The incorporation of such practices serves to lower selection pressure on pathogen populations. Always use fungicides in a protective, rather than reactive, manner: It is far easier to prevent powdery mildew than to cure it. Additional guidelines include limiting the number of applications of individual modes of action per season and limiting sequential applications. Do not tank mix or alternate fungicides with the same FRAC number in a spray program. Medium risk compounds such as DMI (FRAC Group 3) and quinoline compounds (FRAC Group 13) should be applied no more than 3 times per season and no more than twice in sequence. High risk QoI (FRAC Group 11) compounds or premixed formulations containing them (Flint and Pristine) fungicides should be preferably alternated 1:1 with other modes of action or FRAC Groups and applied no more than twice per growing season. It is preferable to make only one application of any resistance-prone compound and then switch to a fungicide from a different class or FRAC group. **Never** exceed more than two QoI applications in sequence. It also helps to tank-mix fungicides from different groups that are both effective against powdery mildew. However, all components of a tank mix or premix must be counted toward the maximum sequential and seasonal applications of the components modes of action.

In hop where QoI (FRAC Group 11) fungicides may be used to control both powdery mildew and downy mildew, care must be taken when counting the maximum sequential and seasonal applications. Although primarily used to control powdery mildew, the QoI (FRAC Group 11) fungicides Flint and Pristine are also effective against downy mildew. These products are often applied when both pathogens are present and sometimes specifically to control downy mildew. In addition, products containing QoI (FRAC Group 11) fungicides used to control downy mildew include not only Pristine and Flint, but also Reason (fenamidone; Group 11) and Tanos: a premix of the QoI famoxidone (FRAC Group 11) and cymoxanil (FRAC Group 27). The biology of the powdery mildew and downy mildew pathogens render both prone to develop races resistant to the fungicides used to control them. These very effective, but high risk Group 11 products should be used with extreme care to delay or avoid resistance problems in two challenging diseases of hop.

Recent research has identified a period in July and early August (during bloom and early cone development) when management of powdery mildew on cones can be enhanced with applications of certain products. Of the products available for 2012, Quintec (quinoxifen, Group 13) and possibly Pristine (pyraclostrobin; FRAC Group 11 + boscalid; FRAC Group 7) are the most effective products to apply during this period. FRAC guidelines indicate that application of either of these highly effective products during this critical period reduces the availability these or other members of the same FRAC group at other times during the season.

Always follow label instructions pertaining to application rates and intervals, always use a properly calibrated sprayer and sufficient spray volume to provide good coverage, and always apply fungicides under good spray conditions.

Table 1. Fungicide choices for powdery mildew management in Washington hops, 2012.

Trade Names	Active Ingredients	Class	FRAC Group ¹	Resistance Risk
Accrue	spiroxamine	Spiroketal-amine	5	Medium
Armicarb	potassium bicarbonate	Carbonate	NC	Low
Flint	trifloxystrobin	QoI	11	High
Folicur Solara, Tebuzol, Toledo, Orius	tebuconazole	DMI	3	Medium
JMS Stylet Oil	narrow-ranged petroleum oil	PDSO	NC	Low
Kaligreen	potassium bicarbonate	Carbonate	NC	Low
Pristine	pyraclostrobin	QoI	11	High
	boscalid	Carboxamide	7	Medium
Procure	triflumizole	DMI	3	Medium
Rally	myclobutanil	DMI	3	Medium
Regalia	<i>Reynoutria sachalinensis</i>	Host plant defense induction	P	Low
Rubigan Focus Vintage	fenarimol	DMI	3	Medium
Serenade Max	<i>Bacillus subtilis</i>	Biological	44	Low
Sonata	<i>Bacillus pumilis</i>	Biological	44	Low
Quintec	quinoxifen	Quinoline	13	Medium
Sulfur	sulfur	Sulfur	M2	Low

¹ Fungicide Resistance Action Committee

Use pesticides with care. Apply them only to plants, animals, or sites listed on the labels. When mixing and applying pesticides, follow all label precautions to protect yourself and others around you. It is a violation of the law to disregard label directions. If pesticides are spilled on skin or clothing, remove clothing and wash skin thoroughly. Store pesticides in their original containers and keep them out of the reach of children, pets, and livestock.

YOU ARE REQUIRED BY LAW TO FOLLOW THE LABEL. It is a legal document. Always read the label before using any pesticide. You, the grower, are responsible for safe pesticide use. Trade (brand) names are provided for your reference only. No discrimination is intended, and other pesticides with the same active ingredient may be suitable. No endorsement is implied.