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## 2014 Chart Book: Resistance Management

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### iii Resistance Management

## RESISTANCE MANAGEMENT 2014

Prepared by Martha M. Sylvia

In an effort to manage resistance with our pesticides, many labels now come with a “group” number assigned to them. The group ID is specific among insecticides, herbicides and fungicides. Most of our cranberry pesticides are in their own group with the exception of organophosphates and neonicotinoids. The following 3 pages show the groupings for our cranberry pesticides. The goal in resistance management is for growers to not repeatedly use compounds that fall within the same group. Resistance management may include alternating products with different modes of action or limiting the total number of applications per season.

### Fungicide Resistance Action Committee (FRAC) (<http://www.frac.info/frac/index.htm>)

The group that advises for fungicide resistance is the Fungicide Resistance Action Committee (FRAC). Their goal is to prolong the effectiveness of fungicides that are likely to encounter resistance problems and to limit crop losses should resistance appear. For cranberry, Ridomil and Abound are fungicides that are at high risk for resistance development, while Indar and Proline are at medium risk. They should not be used repeatedly and should be carefully alternated with other fungicides from other groupings. See grouping of cranberry fungicides on page vi. Only a few of our cranberry fungicides are labeled for resistance, but for those that are, a box like this would appear on the front of the label:

GROUP      **11**      FUNGICIDE

### Herbicide Resistance Action Committee (HRAC)

(<http://www.hracglobal.com/Home/tabid/122/Default.aspx>)

The Herbicide Resistance Action Committee developed a classification of herbicides according to their mode of action. A similar system to FRAC has been developed by the Weed Science Society of America (WSSA) using numbers instead of letters to designate the categories. This classification is found on a few herbicide labels, for example Callisto labels have this marking:

GROUP      **27**      HERBICIDE

Herbicide resistance is a world-wide phenomenon with 218 documented cases. Selection of herbicide-resistant weed populations is often the result of the continuous use of the same herbicide or herbicides with the same mode of action. A key step in resistance management is to minimize the continuous use of herbicides with the same mode of action through rotations and combinations of products. One of the purposes of these classification systems is to make it easier for farmers and farm advisors to understand which herbicides share the same site of action without having to actually know the biochemical basis.

In cranberry, our biggest concern is our new reliance on Callisto. Be sure to rotate other compounds into your herbicide schedule. Do not treat the same bog with Callisto year after year. See table of cranberry herbicides by grouping on page v.

### Insecticide Resistance Action Committee (IRAC) (<http://www.irax-online.org/>)

An Insecticide Resistance Action Committee (IRAC) has been formed to assemble the information for insecticides. Their goal is to manage resistance to keep agriculture sustainable. For cranberry, organophosphates and neonicotinoids have the most compounds within their group. We are reliant on several compounds in these groupings. As long as growers remember to alternate between groupings and not repeat same mode-of-action compounds over and over, we should be able to keep newer compounds viable for decades. See Cranberry Insecticides by grouping on next page. Insecticides are grouped clearly by chemical makeup and most insecticide labels now included markings such as this:

GROUP      **5**      INSECTICIDE

INSECTICIDE RESISTANCE ACTION COMMITTEE (IRAC) GROUPING  
FOR CRANBERRY INSECTICIDES

<b>GROUP 1</b>	ORGANOPHOSPHATES AND CARBAMATES Acetylcholine esterase inhibitor	<b>Diazinon</b> <b>Imidan</b> <b>Lorsban</b> <b>Orthene</b> <b>Sevin</b>	diazinon phosmet chlorpyrifos acephate carbaryl
<b>GROUP 3</b>	PYRETHRINS Sodium channel modulators	<b>Pyreth-It</b> <b>Pyganic</b>	pyrethrin pyrethrin
<b>GROUP 4</b>	4A NEONICOTINOIDS Nicotinic Acetylcholine receptor agonists	<b>Actara</b> <b>Admire</b> <b>Assail</b> <b>Belay</b> <b>Scorpion/Venom</b>	thiamethoxam imidacloprid acetamiprid clothianidin dinotefuran
<b>GROUP 5</b>	SPINOSYNS Nicotinic Acetylcholine receptor allosteric activators	<b>Delegate</b> <b>Entrust</b>	spinetoram spinosad
<b>GROUP 11</b>	Microbial disruptors of insect midgut membranes	<b>Dipel, Xentari</b> <b>Biobit</b>	<i>Bacillus</i> <i>thuringiensis</i>
<b>GROUP 15</b>	Inhibitors of chitin biosynthesis	<b>Rimon</b>	novaluron
<b>GROUP 18</b>	Ecdysone agonists / molting disruptors	<b>Confirm</b> <b>Intrepid</b>	tebufenozide methoxyfenozide
<b>GROUP 21</b>	Mitochondrial complex / electron transport inhibitor	<b>Nexter</b>	pyridaben
<b>GROUP 22</b>	Voltage-dependent sodium channel blockers	<b>Avaunt</b>	indoxacarb
<b>GROUP 23</b>	Inhibitors of acetyl CoA carboxylase	<b>Oberon</b>	spiromesifen
<b>GROUP 28</b>	DIAMIDES Ryanodine receptor modulators	<b>Altacor</b>	chlorantraniliprole

## HERBICIDE RESISTANCE ACTION COMMITTEE (HRAC) GROUPING FOR CRANBERRY HERBICIDES

Group numbering at right from Weed Science Society of America (WSSA) as on pesticide labels

HRAC GROUP	SITE OF ACTION	CHEMICAL FAMILY	ACTIVE INGREDIENT	BRAND NAME	WSSA GROUP
A	Inhibition of acetyl CoA carboxylase (ACCase)	Aryloxyphenoxy-propionate 'FOPs'	fluazifop-P-butyl	Fusilade	1
		Cyclohexanedione 'DIMs'	clethodim sethoxydim	Prism, Select, Poast	1
C1	Inhibition of photosynthesis at photosystem II	Triazine	simazine	Princep	5
F1	Bleaching: Inhibition of carotenoid biosynthesis at the phytoene desaturase step (PDS)	Pyridazinone	norflurazon	Evital	12
F2	Bleaching: Inhibition of 4-hydroxyphenyl-pyruvate-dioxygenase (4-HPPD)	Triketone	mesotrione	Callisto	27
G	Inhibition of EPSP synthase	Glycine	glyphosate	Roundup	9
K3	Inhibition of VLCFAs (Inhibition of cell division)	Acetamide	napropramide	Devrinol	15
L	Inhibition of cell wall (cellulose) synthesis	Nitrile	dichlobenil	Casoron	20
L	Inhibition of cell wall (cellulose) synthesis	Quinoline carboxylic acid	quinclorac	Quinstar	26
O	Action like indole acetic acid (synthetic auxins)	Quinoline carboxylic acid	quinclorac	Quinstar	4
O	Action like indole acetic acid (synthetic auxins)	Phenoxy-carboxylic-acid	2,4-D	2,4-D Weedar 64	4
O	Action like indole acetic acid (synthetic auxins)	Pyridine carboxylic acid	clopyralid	Stinger	4

## FUNGICIDE RESISTANCE ACTION COMMITTEE (FRAC) GROUPING FOR CRANBERRY FUNGICIDES

<b>Mode of Action</b>	<b>TARGET SITE</b>	<b>GROUP NAME</b>	<b>CHEMICAL GROUP</b>	<b>COMMON NAME</b>	<b>TRADE NAME</b>	<b>FRAC CODE</b>	<b>comments</b>
<b>A</b>	A1: RNA polymerase I	PA - fungicides PhenylAmides	acylalanines	mefonoxam metalaxyl	<b>Metastar</b> <b>Ridomil</b> <b>Ultra Flourish</b>	<b>4</b>	<b>High Risk</b>
<b>C</b>	C3: cytochrome bc1 at Qo site	Qol-fungicides Quinone outside inhibitors	methoxy-acrylates	azoxystrobin	<b>Abound</b>	<b>11</b>	<b>High Risk</b>
			dihydro-dioxazines	fluoxastrobin	<b>Aftershock</b> <b>Evito</b>	<b>11</b>	<b>High Risk</b>
<b>G</b>	G1: c14-demethylase in sterol biosynthesis	DMI-fungicides DeMethylation Inhibitors	triazoles	fenbuconazole prothioconazole	<b>Indar</b> <b>Proline</b>	<b>3</b>	<b>Medium Risk</b>
<b>Unk</b>	Unknown	phosphonates	ethyl phosphonates	fosetyl-Al aluminum-tris	<b>Aliette</b> <b>Legion</b>	<b>33</b>	Low Risk
				phosphorous acids and salts	<b>Fosphite</b> <b>Fungi-Phite</b> <b>K-Phite, Phostrol</b> <b>ProPhyt, Rampart</b>	<b>33</b>	Low Risk
<b>MS</b>	Multi-site contact activity	inorganic	inorganic	copper (salts)	<b>Champ</b> <b>Kocide</b>	<b>M1</b>	Low Risk
<b>MS</b>	Multi-site contact activity	dithiocarbamates EBDC's Ethylene bis dithio carbamate	dithiocarbamates	ferbam	<b>Ferbam</b>	<b>M3</b>	Low Risk
				mancozebs	<b>Manzate</b> <b>Dithane</b> <b>Penncozeb</b>		
<b>MS</b>	Multi-site contact activity	chloronitriles	chloronitriles	chlorothalonil	<b>Bravo</b> <b>Chloronil</b> <b>Echo, Equus</b> <b>Initiate</b>	<b>M5</b>	Low Risk