RESISTANCE MANAGEMENT 2015

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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. Many of our cranberry pesticides are in their own group. The largest groups with the same ID are the 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/home)
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 7. A box like this would appear on the front of the label:

GROUP **11** **FUNGICIDE**

Herbicide Resistance Action Committee (HRAC) (http:// http://www.hracglobal.com/pages/Home.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 6.

Insecticide Resistance Action Committee (IRAC) (http:// http://www.irac-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 the 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

GROUP 1 ORGANOPHOSPHATES AND CARBAMATES **Acetylcholine esterase inhibitor**	**Diazinon** **Imidan** **Lorsban** **Orthene** **Sevin**	diazinon phosmet chlorpyrifos acephate carbaryl
GROUP 3 PYRETHRINS **Sodium channel modulators**	**Pyreth-It** **Pyganic**	pyrethrin pyrethrin
GROUP 4 **4A** NEONICOTINOIDS **Nicotinic Acetylcholine receptor agonists**	**Actara** **Admire** **Assail** **Belay** **Scorpion/Venom**	thiamethoxam imidacloprid acetamiprid clothianidin dinotefuran
GROUP 5 SPINOSYNS **Nicotinic Acetylcholine receptor allosteric activators**	**Delegate** **Entrust**	spinetoram spinosad
GROUP 11 **Microbial disruptors of insect midgut membranes**	**Dipel, Xentari** **Biobit**	*Bacillus* *thuringiensis*
GROUP 15 **Inhibitors of chitin biosynthesis**	**Rimon**	novaluron
GROUP 18 **Ecdysone agonists / molting disruptors**	**Confirm** **Intrepid**	tebufenozide methoxyfenozide
GROUP 21 **Mitochondrial complex / electron transport inhibitor**	**Nexter**	pyridaben
GROUP 22 **Voltage-dependent sodium channel blockers**	**Avaunt**	indoxacarb
GROUP 23 **Inhibitors of acetyl CoA carboxylase**	**Oberon**	spiromesifen
GROUP 28 DIAMIDES **Ryanodine receptor modulators**	**Altacor**	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	Glysine	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		Phenoxy-carboxylic-acid	2,4-D	**2,4-D Weedar 64**	**4**
O		Pyridine carboxylic acid	clopyralid	**Stinger**	**4**

FUNGICIDE RESISTANCE ACTION COMMITTEE (FRAC) GROUPING FOR CRANBERRY FUNGICIDES

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