

iii Resistance Management

RESISTANCE MANAGEMENT 2013

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 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 (and potentially Indar) are fungicides that are at high risk for resistance development. 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/121/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.iraconline.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 are our biggest concern. 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

| | | | |
|-----------------|--|--|---|
| 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 | thiamethoxam imidacloprid acetamiprid clothianidin |
| GROUP 5 | SPINOSYNS Nicotinic Acetylcholine receptor allosteric activators | Delegate SpinTor Entrust | spinetoram spinosad |
| GROUP 11 | Microbial disruptors of insect midgut membranes | Dipel, Xentari Biobit | <i>Bacillus thuringiensis</i> |
| 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 | 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

| 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 | metalaxyl | Ridomil Ultra Flourish | 4 | High Risk |
| C | C3: cytochrome bc1 at Qo site | Qol-fungicides Quinone outside inhibitors | methoxy-acrylates dihydro-dioxazines | azoxystrobin | Abound | 11 | High Risk |
| | | | | fluoxastrobin | Evito | 11 | High Risk |
| G | G1: c14-demethylase in sterol biosynthesis | DMI-fungicides DeMethylation Inhibitors | triazoles | fenbuconazole | Indar | 3 | Medium Risk |
| Unk | Unknown | phosphonates | ethyl phosphonates | fosetyl-Al aluminum-tris | Alette Legion | 33 | Low Risk |
| | | | | phosphorous acids and salts | Phostrol ProPhyt | 33 | Low Risk |
| MS | Multi-site contact activity | inorganic | inorganic | copper (salts) | Champ Kocide | M1 | Low Risk |
| MS | Multi-site contact activity | dithiocarbamates | dithiocarbamates | ferbam mancozebs | Ferbam Manzate Dithane Penncozeb | M3 | Low Risk |
| MS | Multi-site contact activity | chloronitriles | chloronitriles | chlorothalonil | Bravo Chloronil Echo Equus | M5 | Low Risk |