

Pesticide Properties & LD₅₀ Values 10

(updated October 2008)

This chapter is intended for reference and background information only; it is by no means intended to replace labels. Always consult the label; it is the primary source for information on safety, rates, and application methods. Material in this chapter was compiled from the following sources: *Farm Chemicals Handbook '99*, MeisterPro Reference Guides; pesticide labels; *The Pesticide Manual*, Eleventh and Twelfth Editions, Editor C. D. S. Tomlin, British Crop Protection Council; *The BioPesticide Manual*, British Crop Protection Council, 2001; and the *Handbook for Pesticide Applicators and Dispensers* by BC Ministry of Environment, Lands and Parks.

The relative acute toxicity of a pesticide is expressed by its LD₅₀ value. The LD₅₀ value represents the amount of active ingredient (a.i.) of a chemical in milligrams used per kilogram of test animal weight that kills 50% of the population. It is measured for both oral (e.g. the amount ingested through the mouth or nose) and dermal exposure (e.g. the amount that penetrates through the skin). The higher the LD₅₀ figure, the less toxic the product is to humans. However, the figures do not indicate the long-term or chronic health effects of a pesticide. Always keep pesticide exposure to a minimum by wearing protective clothing, even when working with products that have high LD₅₀ values.

Pesticides can lose their effectiveness due to the development of resistance by pests. When an insect population develops resistance to one pesticide it may also prove to be resistant to compounds in the same chemical class. To prevent the development of pesticide resistance: use a pest control program based on integrated pest management (IPM) practices, monitor treated populations for resistance development, never rely on a single pesticide class, and rotate the use of pesticides based on their resistance groups and chemical family classifications.

The pesticides referenced in this guide are categorized as closely as possible into resistance management groups (RMG) and families of chemical compounds to aid in the planning of rotation schedules for avoiding the development of

resistance. RMG numbers used in this guide are preceded by an **I**, **F** or **H** to separate Insecticide, Fungicide and Herbicide resistance groups. Typically, resistance management groups are stated on the product label or can be determined by the chemical families. The group number given on the product label will not include **I**, **F** or **H**. Some pesticide products have not been assigned to a specific resistance management group due to a lack of understanding of their target site or mode of action, or because there is presently no history of resistance development for the product. Pesticides in group M have multiple modes of action.

Pesticides are covered in the following order: adjuvants, disinfectants and algicides, fumigants, fungicides and bactericides, herbicides, insecticides and miticides, plant growth regulators, and rodenticides and molluscicides.

Adjuvants

Adjuvants can be an important part of a pest control program as they help to overcome some of the variables that potentially reduce the effectiveness of a pesticide. Adjuvants are used as spray solution additives to prevent problems associated with spray application such as beading, incomplete coverage, run-off, adverse water quality or removal through rain and wind. Adjuvant products include surfactants, wetting agents, crop oils, thickeners, drift control agents, penetrants, anti-foam agents, stickers and spreaders. When choosing an adjuvant, decide which aspects of the spray application need improvement. The environmental conditions before, during and after the application (e.g. temperature, rain and wind) as well as the characteristics of the plant surface should also be considered.

Surfactants are perhaps the most frequently used class of adjuvant. Surfactants reduce the surface tension of a solution so that it can spread and cover a surface more efficiently. Surfactants are classified as non-ionic (uncharged), cationic (positively charged), and anionic (negatively charged). Spray coverage can also be improved by the type and set-up of the application equipment.

Not all pesticides are labelled to be used with adjuvants. Always consult the product labels as some combinations can be hazardous for your health, damaging to crops, or cause the product to be ineffective.

nonylphenoxy polethoxy ethanol (Agral 90) - A non-ionic liquid wetting and spreading agent registered for use with a range of specific crops and controlled products. Controlled products that can be mixed with Agral 90 include Gramoxone and Reglone. This product may cause eye and skin irritation so proper protective wear should be used. Applying more than the recommended rate, or combining this product with pesticides that already contain a wetting agent, can lead to loss of spray due to excess run-off. Specific spray mix and usage instructions vary and are available on the pesticide labels. Refer to the Agral 90 product label for a complete list of compatible products.

octylphenoxypolyethoxy ethanol (Super Spreader, Citowett Plus, Companion) - A non-ionic, water soluble product that forms a continuous, uniform film on the leaf surface to improve foliage wettability. When added, this adjuvant agent improves the adherence of the pesticide to the leaf surface and prevents the product from dripping off, resulting in longer spray activity. Citowett Plus is especially useful for application to plants with hairy, dusty or waxy leaf and bud surfaces. Compatible with a number of chemical products at a range of mix rates. Take precautions when applying this product as contact with eyes can cause severe burning and stinging or lead to loss of vision. Get medical attention immediately if this product gets in eyes. Consult the product labels for a full list of products approved for use with these adjuvants along with their specific use instructions.

ethoxylated alkyl phenols (AquaGro 2000 L) - A non-ionic surfactant for growing media that is designed to ensure easy rewetting and uniform distribution and availability of moisture in the root zone. It lasts 4-6 weeks and is biodegradable and non-toxic to plants. It causes eye irritation and may be fatal if absorbed through the skin. The use of proper protective wear is important.

dimethylpolysiloxane (Fighter-F 10, Halt, Valid) - Use in the spray tank to control foam formation or existing foam. For best results, add it to the spray tank before adding the pesticide. Keep from freezing.

polyacrylamide (On Target) - A drift retarding compound for deposition improvement and drift

retardation during spray operations. On Target is compatible with most water soluble and wettable powder pesticides and desiccants. This product can be irritating to the eyes, skin and respiratory system. Keep from freezing.

Disinfectants and Algicides

didecyl dimethyl ammonium chloride (KleenGrow) - A mild quaternary ammonium chloride compound with wide spectrum fungicidal and bactericidal properties. Use to disinfectant greenhouse surfaces. Aids in controlling *Fusarium*, *Botrytis*, *Penicillium* and *Didymella*. It must contact surfaces for at least 30 seconds to be effective. Corrosive, causes eye damage and skin irritation and is harmful if swallowed. Contains a source of chlorine and can form dangerous gas if mixed with incompatible materials.

Fumigants

dazomet (Basamid) - A granular soil fumigant that is applied dry. It controls unencysted nematodes, soil fungi, and most germinating weed seeds commonly found in soil and mixtures of soil and peat used in propagation beds. On contact with moist soil the active ingredient releases toxic gases that spread in the air phase of the soil. Granules are applied to moist, well prepared soil when the soil temperature is above 6°C. Immediately following incorporation to a depth of 20 to 25 cm, the soil surface must be sealed by rolling or packing and possibly light irrigation. After 7 to 10 days the soil is cultivated to allow phytotoxic gases to escape. Depending on soil temperatures, 2 to 6 weeks must pass before any crop can be safely planted. It is toxic to all growing plants. Do not use treated soil until a safety germination test with lettuce or radish seeds has been carried out and has shown the soil to be safe. If very early spring planting is anticipated, it is best applied in September or October of the preceding year when the soil is warm. It has a moderate mammalian acute toxicity (LD₅₀: oral = 519) and may be irritating to skin. It is toxic to fish and nontoxic to bees.

dichloropropene (Telone II, Telone C-17) - It is used for preplant treatments in both field and greenhouse soils. It kills nematodes, controls some fungal diseases, and suppresses germination of some weed seeds. It can be phytotoxic to crops planted too soon after the fumigation. Soils need to be

exposed to the fumigant for a minimum of 7 to 14 days; colder soils require a longer treatment period. Once the exposure period is complete, the soil should be cultivated and left to aerate for a minimum of one week. Aerate longer if: a high application rate was used; the soil temperature is below 15.5°C; the soil is very wet; or if an organic soil was treated (muck). If applied in the fall or winter, then the aeration period should extend until spring. Do not plant if you can still smell the fumigant. While it has a moderate mammalian acute toxicity (LD₅₀: oral = 125; dermal = 423), it is hazardous to use because of the toxic gas it produces (LD₅₀: inhalation = 9 mg/L). Telone may be fatal if inhaled. It is irritating to the skin, eyes, and upper respiratory tract. It has a relatively low toxicity to birds but is highly toxic to fish.

metam-sodium (Vapam) - A liquid soil fumigant that may be injected into the soil, applied to the soil surface as a drench, or metered into irrigation systems. Do not use in greenhouses that contain growing plants or where fumes may enter nearby houses that contain growing plants. In the presence of water, it releases the more toxic methyl isothiocyanate which is then lost to the atmosphere by vaporization. It controls germinating weed seeds (it does not control dormant seeds), fungi that cause damping-off and root rot, and nematodes. It has a low mammalian acute toxicity (LD₅₀: oral = 820; dermal = 2,000), but it may be irritating to the eyes, nose, throat, and skin. It is hazardous to use because of the gas it produces. It is toxic to fish, but is nontoxic to bees.

Fungicides and Bactericides

Bacillus subtilis (Rhapsody) – A naturally occurring soil bacterium that can colonize plant surfaces and out compete disease-causing organisms. It is a broad spectrum, preventive biofungicide for the control or suppression of many diseases of ornamental plants. Do not tank mix with other pesticides, surfactants or fertilizers. It has a low mammalian acute toxicity (LD₅₀: oral > 5,000; dermal > 5,000). May be irritating to skin and eyes.

captan (Captan, Maestro) – A broad-spectrum, protective and curative dicarboximide that controls a wide range of leaf spots, as well as seed and soil-borne diseases. It is also used as a bulb dust and as a soil drench to control bedding plant damping-off diseases. Do not combine with oil or strongly alkaline materials such as hydrated lime. Do not use

in combination with, immediately before or closely following an oil spray. It has a low mammalian acute toxicity (LD₅₀: oral = 8,400), but it may cause skin and eye irritation. It is toxic to fish.

chlorothalonil (Daconil 2787, Exotherm Termil) - A broad-spectrum, nonsystemic chlorinated hydrocarbon with foliar protectant activity. Daconil is used as a foliar spray for the control of botrytis, leaf spots, and rusts of certain greenhouse and field grown crops. Exotherm Termil is used as a smoke fumigator for the control of *Botrytis* in greenhouse crops. It has a very low mammalian acute toxicity (LD₅₀: oral > 10,000), but it causes severe eye damage. May cause allergic side effects in some people. Toxic to fish.

copper complex (Phyton 27) - A copper complex with systemic fungicide and bactericide properties, broad spectrum action, and low phytotoxicity. Used as a flower dip to control *Botrytis* and as a foliar spray or cutting dip to control certain diseases. Rates above 125 mL/100 L may damage tender, open blooms. Use of low volume equipment is effective against botrytis, but is ineffective against established powdery mildew and bacterial infections. It has a low mammalian acute toxicity (LD₅₀: oral = 4,500), but is corrosive to both the eyes and skin. Direct contact causes irreversible eye damage and severe skin burns. Toxic to fish. Do not tank-mix any copper containing compounds with B-Nine and do not apply B-Nine within 7 days, either before or after, a copper application. Burning of the leaves may result. Avoid mixing with other metals, or salts and stickers. Use ionically active stickers only at low rates. Do not mix with Aliette, horticultural oil, or Senator.

copper oxychloride (Copper Spray) - A foliar fungicide and bactericide with protective action. It works as a preventive, so application must be made to the crop before spore germination. It controls leaf spot and downy mildew on ornamental crops. Copper oxychloride is strongly absorbed by soils. It is non-toxic to bees and moderately toxic to fish and it has a low mammalian acute toxicity but may be irritating to skin and eyes (LD₅₀: oral = 700 – 800; dermal > 2,000).

copper sulfate (Copper 53W) - A protective foliar fungicide and bactericide. It is non-toxic to bees and moderately toxic to fish. It has a low mammalian acute toxicity but may be irritating to skin and eyes (LD₅₀: oral = 1,000; dermal > 8,000).

dimethomorph (Acrobat) – Is a locally systemic fungicide that has protectant and curative activity. It is very effective against downy mildew, which is caused by *Peronospora* species. It inhibits the formation of cell walls in susceptible species. Refer to the label for precautions to delay the onset of fungicide resistance. It has a low mammalian acute toxicity (LD₅₀: oral = 2,939; dermal > 2,000), and is not irritating to eyes and skin.

dodemorph-acetate (Meltatox) - An systemic organic compound with foliar protectant and eradicant activity against powdery mildew. It has a low mammalian acute toxicity (LD₅₀: oral = 2,500), but it can cause skin irritation and serious, permanent eye damage. It is toxic to fish and is slightly toxic to bees.

etridiazole (Truban) - A selective thiazole soil fungicide to control damping-off caused by *Pythium* and *Phytophthora* in greenhouse and field grown crops. It is a contact fungicide with protective and curative action. It has a low mammalian acute toxicity (LD₅₀: oral = 1,077). It is toxic to fish.

fenhexamid (Decree) - A nonsystemic, protectant hydroxylanilide compound for the control of botrytis in ornamental crops. It acts by preventing the penetration of fungi into the plant by inhibiting germ tube elongation, mycelial growth, and spore germination. It should be applied in advance of infection; the frequency of applications varies with environmental conditions. Thorough coverage is essential. Spray solution should be constantly agitated during application. For resistance management purposes, it should not be applied in successive applications. It has a low mammalian acute toxicity (LD₅₀: oral > 5,000; dermal > 5,000). It is practically nontoxic to birds, slightly toxic to freshwater invertebrates, and moderately toxic to freshwater fish. It is not harmful to honeybees and ladybug beetles.

formaldehyde (Formalin) ☠ - Formaldehyde is used as a seed treatment and as hot or cold water treatment for tubers and bulbs against a wide variety of plant diseases. While it has moderate mammalian acute dermal toxicity, its vapours are highly toxic; its inhalation LD₅₀ is very low and severe obstructive tracheobronchitis may result from inhalation. High concentrations may produce pulmonary edema or spasm of the larynx. Vapors are very irritating to eyes, nose, and upper respiratory tract. A gas mask is required in confined areas. *It should be treated and handled as a very toxic product.*

fosetyl-aluminum (Aliette) - A systemic fungicide for foliar or drench applications; used to control diseases caused by phytophthora and pythium, also protects against some bacterial plant pathogens. It is most effective when used as a preventive treatment; it inhibits spore germination and blocks pathogen penetration into the plant. In infected plants, Aliette blocks mycelial development and sporulation, and may also reinforce the defensive mechanisms of the plant to seal off the invading organism. It has a low mammalian toxicity (LD₅₀: oral > 2,000; dermal > 2,000) and is irritating to the eyes. It is not toxic to bees or fish.

***Gliocladium catenulatum* Strain J1446**

(Prestop) – Is a biological fungicide that suppresses soil-borne and foliar diseases on greenhouse ornamentals. It contains a naturally occurring soil fungus. By colonizing plant roots in advance of pathogens, Prestop deprives pathogens of living space and nourishment. It also is a hyperparasite of some harmful fungi. It has a low mammalian acute toxicity (LD₅₀: oral > 2,000; dermal > 2,000). It may cause sensitization by skin contact, and can be mildly irritating to eyes.

iprodione (Rovral) - A broad-spectrum, systemic, contact carboximide with protectant and eradicant properties. It's used to control *Botrytis* and damping-off caused by *Rhizoctonia*. It has a low mammalian acute toxicity (LD₅₀: oral > 4,400). It is mildly irritating to the eyes.

mancozeb (Manzate 200, Penncozeb) - A broad-spectrum, protective carbamate used to control leaf spots and blights. It is similar to maneb, but with the addition of zinc. It has a low mammalian acute toxicity (LD₅₀: oral = 7,900), it may irritate eyes, nose, throat, and skin. Toxic to fish and nontoxic to birds.

metalaxyl (Subdue Maxx, Subdue 2G) - An alanine methylester compound with systemic and curative properties used to control damping-off caused by *Pythium* and *Phytophthora*. Do not tank-mix with other pesticides or fertilizers. It has a low mammalian acute toxicity (LD₅₀: oral = 670), but it may cause skin irritation. Relatively nontoxic to fish.

myclobutanil (Nova 40W, Eagle) - A sterol-inhibiting product that is locally systemic and has both eradicant and protectant properties. Effective against rusts and powdery mildew of specific crops. It is important not to exceed the maximum of six applications per growing season or to use higher

than label rates. *Note the phytotoxicity disclaimer on the label.* In the United States, myclobutanil labels carry the warning that over-dosage can result in observable foliar greening and shortened internodes. Use extra caution during cool, dark periods when plants are not growing rapidly. It has a low mammalian acute toxicity (LD₅₀: oral = 1,600; dermal > 5,000). It is hazardous to fish.

oxine benzoate (No-Damp) - An organic compound used as a soil drench for the control of damping-off diseases of seedlings and cuttings. It has a low mammalian acute toxicity.

potassium bicarbonate (MilStop) - A contact fungicide that controls/suppresses powdery mildew. The addition of a surfactant or wetting agent is not required. Do not adjust the spray solution pH after mixing; acidification of the solution will cause reduced performance. It has a low mammalian toxicity (LD₅₀: oral = 2,700; dermal > 5,000), but is a skin and eye irritant

propiconazole (Banner) - A broad-spectrum, systemic, sterol inhibitor fungicide with protective and curative action. For best results, use in a preventive disease control program in rotation with other fungicides. Cross-resistance may occur to myclobutanil (Nova). Do not add surfactants or wetting agents as this may result in phytotoxicity. It has a low mammalian acute toxicity (LD₅₀: oral = 1,517; dermal > 4,000), and causes skin and eye irritation. Skin sensitization may occur in some individuals. It is toxic to fish.

quintozene (Quintozene) - A long lasting aromatic hydrocarbon soil fungicide. It is effective against *Rhizoctonia* and *Sclerotinia* root and stem rots, and *Sclerotinia* bulb rots. Repeated use will result in soil build-up. Treated soil must not be used to produce food crops other than when used for club root control in cole crops. It has a low mammalian acute toxicity (LD₅₀: oral = 1,700 - 5,000), but it may cause skin irritation. It is toxic to fish.

Streptomyces griseoviridis (MycoStop) - Bacterium used as a microbial fungicide for control of damping off, root and stem rot, and wilt caused by *Fusarium* of greenhouse ornamentals. The bacterium out competes fungal pathogens for essential nutrients and secretes various enzymes and metabolites which inhibit pathogen growth. Do not tank mix with chemical pesticides. Not toxic to animals but inhalation should be avoided (LD₅₀: dermal = 5,000). May cause sensitization by inhalation and skin contact. Toxic to fish; do not

apply directly to water or to areas where surface water is present.

sulphur (Sulphur 92) - A naturally occurring element used to control certain diseases, especially powdery mildew. It may injure plants during hot, dry weather. Do not tank-mix with an oil pesticide, or apply immediately before or immediately after an oil spray. Do not use when temperatures are above 30°C. Relatively nontoxic to man, but it may be irritating to the eyes and skin. Relatively nontoxic to animals and bees.

thiophanate-methyl (Senator) - A benzimidazole compound similar to benomyl. It is systemic with protectant and eradicant properties and long residual activity. It is effective as a spray against powdery mildew and other diseases, or as a systemic soil treatment against *Botrytis*, powdery mildew, and other diseases, such as leaf spots on orchids. Do not tank mix with lime or other alkaline material. It has a low mammalian acute toxicity (LD₅₀: oral = 7,500). It is toxic to fish and slightly toxic to birds.

Trichoderma harzianum (RootShield) - A fungus that actively grows onto plant roots as they develop and suppresses root diseases caused by *Pythium*, *Rhizoctonia* and *Fusarium*. It also improves growth of the plant root system and aids in soil nutrient solubility. Not a skin irritant but may cause skin sensitization. Avoid contact with eyes and clothing and avoid inhalation. It has a slight to moderate acute mammalian toxicity (LD₅₀: oral > 500). Not toxic to bees.

trifloxystrobin (Compass) - A broad spectrum fungicide with primarily preventive activity. It is rain-fast and penetrates the plant to control powdery mildew and rhizoctonia root rot on ornamental crops. Applying to poinsettia after bract formation may cause injury to bracts. It may cause injury to petunias, violets, and New Guinea impatiens. It has a low mammalian acute toxicity but is irritating to eyes and may cause skin sensitization (LD₅₀: oral > 5,000). It is toxic to fish and other aquatic organisms and practically non-toxic to bees. Harmful to beneficial predatory or parasitic arthropods.

Herbicides

acetic acid (EcoClear) - A foliar active herbicide for non-selective post-emergent control of broadleaf and grass weeds. Contains organic acids that are components of vinegar and lemon juice. Overspray or drift will injure contacted vegetation. This

product is non-residual in the soil. Avoid application to reactive metals. Severe eye, skin and respiratory tract irritant. Avoid contact with skin, eyes and clothing. May be toxic to aquatic organisms. Do not use in greenhouses.

amitrole (Amitrol 240) - A nonselective, postemergent triazole compound particularly useful for controlling many perennial weeds such as quackgrass, horsetail, poison-ivy, milk-weed, Canada thistle, and cattails. It is used for spot treatment of weeds on noncropped land. Avoid spray drift onto foliage of any crops or desirable plants. It is a systemic herbicide readily absorbed by roots and foliage and is translocated to growing tips during active growth. It affects plants by upsetting the formation of chlorophyll, causing them to turn yellow or yellow-white within two weeks. Persistence in the soil is usually two to four weeks. It has a low mammalian acute toxicity (LD₅₀: oral = 1,100). Not toxic to fish, bees, and birds. Do not use in greenhouses.

dichlobenil (Casoron) - A selective, preemergent benzonitrile granular herbicide used to control grasses and broadleaf weeds in established trees and shrubs. It inhibits germination. It also inhibits actively dividing meristems, acting primarily on growing points and root tips. Apply to prepared weed-free soil only in early spring or late fall. Early spring treatment is preferred in coastal areas. Do not apply on sandy soils, soils with less than 2 to 3% organic matter. Do not apply when temperatures are over 16°C. Do not apply until at least four weeks after transplanting. Do not apply within three months prior to or following grafting or budding of root stocks or planting of new grafts. Do not apply until six months after rooting of cuttings in the field. Do not use on gladiolus, herbaceous perennials, and certain Ilex (*I. crenata*, *I. rotunda*, *I. vomitoria*). It has a low mammalian acute toxicity (LD₅₀: oral = 3,160; dermal = 1,350). Do not use in greenhouses.

diquat (Reglone) - A pyridine compound that interferes with the photosynthetic process. It is a nonselective, postemergent contact herbicide for use on noncropped land. It is absorbed by all leaf and stem tissues but it is not translocated. Avoid spray drift onto foliage of any crops or desirable plants. It is not effective for long-term control of perennial weeds as they grow back after their tops are burned off. It is very rapidly and completely deactivated by soil. It should only be used with clean water since muddy water adsorbs diquat and reduces its effectiveness. It is most effective when it's applied

during the evening or dull days. While it has a moderate mammalian acute toxicity (LD₅₀: oral = 215; dermal > 3,000), it should be treated and handled as a very toxic product; use protective gear for handling and application. It may be irritating to the skin. Do not use in greenhouses.

fluazifop-p-butyl (Venture L) - A selective, postemergent herbicide for control of a broad range of annual and perennial grasses in many newly transplanted or established non-grassy ornamentals. It will not control broadleaf weeds, fescue, bluegrass species, or sedges. See label for a list of tolerant crop species. It is absorbed by the foliage and moves quickly to the growing points to stop growth of both shoots and roots or rhizomes. It has a low mammalian acute toxicity (LD₅₀: oral = 3,300; dermal > 2,400), but it causes severe skin and eye irritation. Experimental feeding studies in rats have demonstrated that the active ingredient in this product can produce birth defects and other adverse effects in the developing fetus of rats. *Women in child bearing years should be particularly careful when handling this product.* Do not use in greenhouses.

glyphosate (Roundup) - A broad-spectrum, postemergent phosphono amino acid compound. It is used for control of many annual and deep-rooted perennials weeds in noncropped land. Avoid spray drift onto foliage of any crops or desirable plants as damage will occur. It is useful in preparing soil for planting. It is readily translocated to the roots and growing points. It is quickly deactivated in soil, so no residues remain in the soil to affect subsequent crops. It is not effective against horsetail. It has a low mammalian acute toxicity (LD₅₀: oral = 4,300; dermal > 7,900), but it may cause eye irritation. It has a low toxicity to fish. Do not use in greenhouses.

napropamide (Devrinol) - A selective, preemergent alkanamide herbicide for certain established field stocks. It does not control established weeds. Seed germination is stopped. Growth of grass roots is inhibited. It must be applied to freshly weeded soils before weeds germinate or during fall and winter months. Rainfall or irrigation must carry it to a depth of five to ten cm soon after application. If rainfall or irrigation is not available, mechanical incorporation is required to a depth of 2.5 to 5 cm. Do not apply to soils high in organic matter. Do not apply more than once per growing season. It has an average persistence in the soil of 8 to 12 weeks. It has a low mammalian acute toxicity (LD₅₀: oral = 5,000; dermal > 5,000). Do not use in greenhouses.

paraquat (Gramoxone) ☠ - This herbicide has no known antidote. A pyridine compound that provides nonselective, postemergent, contact control of herbaceous plants. Use only as a directed spray or on noncropped land. Avoid spray drift onto foliage of any crops or desirable plants. It is water-soluble and results in rapid foliar kill. It translocates slightly in perennial grasses such as quack grass and bluegrasses. It is not effective against clover or prostrate knotweed. It is absorbed and inactivated in the soil. It is slightly more corrosive than diquat, especially at high concentrations. Equipment should be thoroughly cleaned after use. It has a moderate mammalian acute toxicity (LD₅₀: oral = 150; dermal = 80), but it should be treated and handled as a very toxic product because of its lack of antidote. All solutions should be handled with caution. Use protective gear for handling and applying the product. The lung is the primary organ affected. Avoid any intake by mouth or breathing of fine mists of the spray solution. Slightly toxic to fish, moderately toxic to birds. Do not use in greenhouses.

simazine (Simazine, Simadex Simazine, Princep Nine-T) - A triazine compound similar to atrazine but less soluble and therefore more residual. It is applied as a preemergence or postemergence herbicide for select ornamental crops. Treated areas cannot be used for seedbeds for at least 12 months after treatment. It is tightly held by the soil. It will not leach readily and breaks down slowly in soil. If application was uneven, or if rates exceeded label rates, a longer period should elapse before use. Continued use over several years will also produce longer residual affects. It controls several annual broad-leaved and grassy weeds but is not effective against deep-rooted perennials such as dandelion. Some weeds, such as groundsel, pigweed, and lambsquarters have developed resistance to simazine (triazine herbicides). It is absorbed mostly through plant roots with little or no leaf penetration. It does not adhere well and is readily washed-off by rain. After it is absorbed by roots, it moves up the plant to growing tips and leaves. At high rates it is a good soil sterilant. Do not treat coarse, sandy, or gravelly soil. It has a low mammalian acute toxicity (LD₅₀: oral = 5,000; dermal > 20,000). Nontoxic to fish and bees. Do not use in greenhouses.

trifluralin (Bonanza, Treflan) - A dinitroaniline compound used as a selective, preplant incorporated herbicide for control of several annual broad-leaved and grassy weeds. It prevents cell division in root

and shoot tips as they emerge from the seed. Weeds are killed as they germinate. To work effectively, it must be uniformly mixed throughout the soil in the zone of weed seed germination since it acts on the growing points of the root and shoot as they emerge from the seed. It inhibits cell division and the actively growing points in the root and shoot. Do not apply to peat or muck soils. Do not apply to wet soils, soils in poor working condition or soils which contain more than 15% organic matter. It is not effective against nightshade, shepherd's purse, groundsel, lady's thumb, cudweed or wild mustard. It has an average half-life of 45 to 120 days. It has a low mammalian acute toxicity (LD₅₀: oral = 3,700; dermal > 2,000). It may cause eye irritation and damage. It is toxic to fish, nontoxic to bees and earthworms. Do not use in greenhouses.

Insecticides and Miticides

abamectin (Avid) - A naturally derived miticide/insecticide produced by the soil micro-organism *Streptomyces avermitilis*. It acts by stimulating the presynaptic release of GABA, an inhibitory neurotransmitter. Pests become immobilized shortly after ingesting or coming in contact with it. It may take three to four days to achieve maximum mortality; pests will continue moving, but will not feed or breed. It has translaminar activity and penetrates the leaf tissue and remains there, so when it's applied to upper leaf surfaces, it penetrates into tissue and kills pests that inhabit and feed on lower leaf surfaces. Surface residues rapidly dissipate and degrade in sunlight. It is effective against all mite stages except the egg stage; it is effective against leafminer larvae and adults. Do not use on *Adiantum* spp. ferns, *Leucanthemum* spp. (Shasta daisy), and conifers. Do not use with a spreader sticker. Do not tank mix with copper or use shortly after the application of a copper spray. It has a moderate mammalian acute toxicity (LD₅₀: oral = 300; dermal > 1,800). It causes substantial, but temporary eye injury. It is toxic to predatory mites, fish, wildlife, and highly toxic to bees. *For resistance management purposes, it's recommended not to use it in successive applications. Rotate sprays with at least one other product before using it again. Do not apply more than twice in sequence or more than six times per year or per crop for perennials.*

acephate (Orthene T & O) - An organophosphorous compound with contact and systemic activity. It has moderate persistence with residual activity of 6 to 9 days. It has a low mammalian acute toxicity (LD₅₀: oral = 866; dermal = 2,000). It is moderately toxic to birds, slightly toxic to fish, and highly toxic to bees.

acequinocyl (Kanemite, Shuttle) - A contact miticide that provides quick knockdown and long residual control of 2-spotted and spruce spider mites. Thorough coverage of the foliage is required for optimal control. It controls all life stages of susceptible mite species. Do not use in successive applications in order to manage against pest resistance. It has a low mammalian acute toxicity (LD₅₀: oral > 5,000; dermal > 2,000), and causes mild skin irritation.

acetamiprid (Tristar) - A systemic insecticide that is effective through contact and ingestion. It is used as a foliar spray to provide control of aphids, European pine sawfly, leaf miners, leafhoppers and whiteflies on a wide range of crops. It has a low to moderate mammalian acute toxicity and is irritating to skin, eyes, and through inhalation (LD₅₀: oral = 147 - 217; dermal > 2,000). It is practically not toxic to fish. Acetamiprid is toxic to honey bees exposed to direct treatment.

Bacillus thuringiensis (Dipel, Vectobac) - A microbial insecticide based on toxins produced by a bacterium species. There are a number of varieties of this bacterium which are toxic to specific groups of insects. The two main varieties used in commercial products are *Bacillus thuringiensis* Berliner var. *kurstaki*, used to kill leaf-eating caterpillars and *Bacillus thuringiensis* var. *israeliensis*, used to kill fungus gnat larvae. Products are formulated as a wettable powder, dust, or suspension of spores and crystals produced by the bacteria. They must be eaten by the target insects to cause toxic effects; there is no contact activity. Thorough coverage is essential. The pest stops all further eating and death occurs within one to three days. It has a short residual effect, so applications must be repeated every few days until control is achieved. Products do not control the adult stage life cycle, so applications must be timed for when the target pest is in the correct stage of its life cycle. For example, when fungus gnat larvae are present. Avoid applying in conjunction with fertilizers or fungicides that contain copper or chlorine because they may neutralize the active ingredient. Do not apply to plants under stress or follow application with excessive amounts of water. It has a low

mammalian acute toxicity (LD₅₀: oral = 5,000 - 13,000; dermal = 75,000).

bifenazate (Floramite) - A selective miticide that provides quick knockdown through contact activity and long residual activity (up to 21 days). It is not effective against rust mites, broad mites, and flat mites. Do not apply more than twice per year or in successive applications. It has a low mammalian acute toxicity (LD₅₀: oral > 5,000; dermal > 5,000). It is an eye irritant and is toxic to aquatic organisms. Do not discharge effluent, waste and drainage water containing this product into water bodies.

carbaryl (Sevin) - A broad spectrum carbamate with stomach and contact action and slight systemic properties. Under dry conditions it has long residual action, but its effectiveness decreases markedly following rain or overhead sprinkler irrigation. It is effective against many insects, but it does not control spider mites. To avoid possible injury to tender foliage, do not apply to wet foliage or when rain or high humidity is expected during the next two days. It is unstable under highly alkaline conditions. It has a moderate mammalian acute toxicity (LD₅₀: oral = 400; dermal > 2,000), but it is extremely toxic to honey bees. Foraging bees may be killed up to two weeks after treatment. For maximum honey bee hazard reduction, apply from late evening to early morning or when bees are not foraging.

chlorpyrifos (Dursban) - A nonsystemic organophosphorous compound with contact, stomach, and respiratory action. Spraying open blooms may cause petal drop. Do not use with wetting agents or spreader stickers. It has a moderate mammalian acute toxicity (LD₅₀: oral = 82; dermal = 202), but it causes substantial eye injury. It is toxic to birds and wildlife, and extremely toxic to fish and aquatic organisms. Do not apply directly to water. It is highly toxic to bees, avoid application if bees are actively visiting the treatment area.

clofentezine (Apollo) - An acaricide that has long residual, contact activity. It acts primarily as an ovicide but also has an effect on young motile stages. It does not control adult stages. It has a low mammalian acute toxicity (LD₅₀: oral > 5,200; dermal > 2,100). It is a mild eye and skin irritant.

cyromazine (Citation 75WP) - An insect growth regulator for the control of leafminers, shore flies and fungus gnats. It acts by interfering with molting and pupation, so it affects only immatures and not

adults. Affected insects usually die during molting. If they do reach maturity, they are often unable to reproduce. It provides gradual control rather than a quick knock-down of the target pest. It exhibits translaminar effects, so its action is somewhat systemic. While it reaches the mining larvae within leaves, it does not prevent the initial damage caused by the adult stage. It is only effective on leafminer of the *Liriomyza* genus; this includes all our greenhouse leafminers. Use with caution if you're using beneficial biologicals as it is slightly harmful to several beneficials including, but not limited to, *Encarsia formosa* and *Hypoaspis*. It has a low mammalian acute toxicity (LD₅₀: oral = 3,387; dermal > 3,100).

deltamethrin (Decis) - A fast acting pyrethroid compound that is nonsystemic, controlling insects through contact and/or ingestion. Thorough coverage is essential. Deltamethrin is temperature-sensitive in its effect against insects, being most toxic at cool temperatures and becoming less effective as temperatures rise. A reduction in control occurs at temperatures above 25°C. It has a moderate mammalian acute toxicity (LD₅₀: oral, oily solvent = 128; aqueous suspension > 5,000). It is a severe eye and skin irritant. It is toxic to fish, aquatic organisms, bees, and other beneficial insects.

diazinon (Diazinon) - A broad-spectrum organophosphorous compound that is nonsystemic with contact, stomach, and respiratory action. It has moderate residual activity. Phytotoxic to some plants. Emulsifiable concentrates may cause more plant damage than wettable powders. It has a moderate mammalian acute toxicity (LD₅₀: oral = 300 - 400; dermal = 3,600). It is toxic to fish, bees (highly), birds, and wildlife.

dicofol (Kelthane) - An organochlorine material that controls various mites. It is nonsystemic with high initial kill and high residual activity. Repeat applications will be necessary once eggs hatch. It is a specific miticide with little or no effect on beneficial insect predators. It has a low mammalian acute toxicity (LD₅₀: oral = 575; dermal = 2,000 - 5,000), it is toxic to fish and nontoxic to bees.

diflubenzuron (Dimilin) - A non-systemic insect growth regulator that can be applied as a soil spray or a drench. It is used to control soil dwelling insects such as fungus gnats and shore flies. It acts at the time of insect molting or at egg hatch, interfering with exoskeleton development. Insect mortality

occurs several days after treatment. Emerging adults may lay eggs, but any new larvae should be controlled. Exceeding label rates, volumes or number of applications can cause serious foliar injury to some crops. Care should be exercised when using Dimilin with capillary mat watering systems. Repeat applications could result in build-up and phytotoxicity. It may cause injury to poinsettia, hibiscus, and varieties of begonia. It is not toxic to bees but is highly toxic to fish. It has a low mammalian toxicity (LD₅₀: oral > 4,640; dermal > 2,000).

dimethoate (Cygon, Lagon) - A broad spectrum, systemic organophosphorous compound with stomach and contact action. It is phytotoxic to a large number of plant species, including chrysanthemums. It has a moderate mammalian acute toxicity (LD₅₀: oral = 215; dermal = 400), it is toxic to birds, bees, and other wildlife.

endosulfan (Endosulfan, Thiodan, Thionex) ☠ - An organochlorine compound that is nonsystemic with contact and stomach action. It is fairly persistent, undergoes slow hydrolysis, and is stable in sunlight. It has a high mammalian acute toxicity (LD₅₀: oral = 22.7 - 160; dermal = 359). It is very toxic to fish and moderately toxic to bees and birds.

fenbutatin oxide (Vendex) - An organic tin compound that is nonsystemic with contact and stomach action. It controls two-spotted spider mites, but is relatively harmless to predaceous mites. It has good residual control. Damage to tender plants has been observed when used with wetting agents. It has a low mammalian acute toxicity (LD₅₀: oral = 2,630; dermal > 2,000), but it is irritating to the skin and eyes. It is nontoxic to bees but toxic to fish and birds.

Heterorhabditis megidis - An insect pathogenic nematode used to control vine weevil larvae. Nematodes actively seek target pest in the media and they penetrate either via body openings or directly through the cuticle. Upon entry, symbiotic bacteria (*Photobacterium luminescens*) are released and infect the host, resulting in rapid death. Nematodes then reproduce in the cadaver. It's effective up to four weeks. For optimum results, the media temperature must not fall below 12°C. The most important time to apply is when the larvae are present from August to the end of September and April/May. It is considered nontoxic to mammals.

imidacloprid (Intercept, Merit) - A cloronicotinyl that combines systemic activity with long residual control of aphids and whiteflies. *It has no effects on spider mites. Do not use it as a foliar spray.* It should be applied as a soil drench to actively growing plants with a developed root system. It is translocated upwards within the plant. Use drip irrigation, overhead irrigation, or hand-held or motorized calibrated irrigation equipment to apply the soil drench. For best results, do not leach for ten to fourteen days after treatment. It's affect on biologicals is generally unknown, but it is harmful to *Aphidius* and *Aphidoletes*. It has a moderate mammalian acute toxicity (LD₅₀: oral = 450; dermal > 500). It is highly toxic to aquatic invertebrates.

kinoprene (Enstar II) - An insect growth regulator for the control of whiteflies and aphids. It does not produce an immediate insect kill, but results in a gradual reduction of the insect population. At the preventative (low) rate, it shows morphological, ovicidal, and sterilizing effects. At the high rate, it kills adults. To minimize potential phytotoxic effects, it should be used in the prebloom stage. Application to certain varieties of poinsettias and roses has produced damage. It has a low mammalian acute toxicity (LD₅₀: oral = 4,900; dermal = 9,000).

malathion (Malathion) - A nonsystemic organophosphorous with contact, stomach, and respiratory action. It controls a broad spectrum of pests in greenhouse and field grown crops. It is phytotoxic to a number of plants, including ferns, orchids, and petunias. It is nonpersistent and has a low mammalian acute toxicity (LD₅₀: oral = 1,000; dermal = 4,100). It is highly toxic to fish and bees and has a very strong odour.

permethrin (Pounce) - A broad spectrum synthetic pyrethroid. It is nonsystemic with fast acting stomach and contact action, but no fumigant effects. Thorough coverage is essential. Do not tank-mix with other pesticides or fertilizers. It has a low mammalian acute toxicity (LD₅₀: oral = 430 - 4,000; dermal > 2,000). May cause skin or eye irritation. It is highly toxic to fish, aquatic organisms, and bees.

pymetrozine (Endeavor) - A foliar spray insecticide that provides control of aphids and reduces whitefly populations by stopping their feeding activity. Insects stop feeding within hours, but remain on the plant for a short time (2-4 days). It should not be applied to poinsettias pre-bract. On hard-to-wet plants, such as chrysanthemum and roses, add a non-ionic or organosilicone-based

surfactant such as Agral 90 at a rate of 250 mL/100L (0.25% v/v) to improve coverage. For ornamentals grown for cut flower production (e.g. rose, chrysanthemums, gerbera) or those requiring significant foliar contact during cultivation (e.g. pinching, pruning, hand harvesting), do not apply more than three applications per greenhouse per year. It is not toxic to fish or bees and has a low mammalian toxicity (LD₅₀: oral = 5,820; dermal > 2,000). It is a potential skin sensitizer.

pyridaben (DYNO-Mite) - A pyridazinone that acts as a mitochondrial electron transport inhibitor; it blocks cell respiration causing the pest to lose motile co-ordination and eventually die. It is nonsystemic with contact action, so thorough spray coverage is essential, especially of the lower leaf surfaces. It has rapid knock-down of the susceptible stages and has long residual activity for white flies. With spider mites, the most susceptible stages are the larval and first two nymph stages (protonymphal and deutonymphal). The egg stage is less susceptible and the adult stage is least susceptible. If adult females represent more than 15% of the population, then a product that provides quick adult knock-down should be used before applying DYNO-Mite. For whiteflies, the most susceptible stages are adults and the first two nymphal stages; the third nymph stage is less susceptible, while the eggs and pupae are least susceptible. The full extent of its efficiency is not seen until 4 to 7 days after application; a point that should be considered when evaluating its efficacy. It has a low mammalian acute toxicity (LD₅₀: oral = 820 - 1350; dermal > 2,000). *For resistance management purposes, it's recommended not to use DYNO-Mite in successive applications. Rotate sprays with at least one other product before using it again.*

pyriproxyfen (Distance) - A juvenile hormone mimic that suppresses embryogenesis and adult formation. It is registered to control whiteflies on greenhouse ornamentals. It is not irritating to skin or eyes, and has a low mammalian toxicity (LD₅₀: oral > 5,000; dermal > 2,000). This pesticide is toxic to fish and aquatic invertebrates. Do not apply directly to water, or to areas where surface water is present. It is toxic to certain beneficial insects.

soap (Insecticidal Soap) - An organic substance consisting of the salts of oleic acid - a natural constituent of oils and fats. Thorough coverage of all surfaces of the sprayed plants is essential as it kills only by contact action at the time of application and has no residual effect. It may injure soft plant

tissues. Do not use on delicate ferns, nasturtiums, and sweetpeas. While its mammalian toxicity is very low, it may cause minor lung irritation if misting occurs during application. Use an approved respirator. Eye exposure to concentrated soap may cause irritation

spinosad (Success 480) - A compound derived from the fermentation of *Saccharopolyspora spinosa*. It is active by contact and ingestion and causes insect paralysis. For control of thrips, gypsy moth, leaf beetles and tent caterpillars. Uniform spray coverage is critical for effective insect control. Do not spray if rain is expected within 48 hours of application. Low mammalian acute toxicity but may cause eye and skin irritation (LD₅₀: oral = 3,783 – 5,000; dermal > 2,000). It is toxic to aquatic invertebrates and to bees when sprayed directly, but residuals have little effect when dry.

Steinernema feltiae (Nemasys, Nemasys F, Exhibitline SF) - An entomopathogenic nematode used to control the larval stage of fungus gnats in greenhouse and nursery crops, and Western flower thrips and leafminer larvae in a range of protected crops. The nematodes actively seek target pests and penetrate via body openings. Upon entry, symbiotic bacteria are released and infect the host, resulting in rapid death. Nematodes then reproduce in the cadaver. Apply as a soil drench to control fungus gnats. Expect a population decline 18 to 21 days after the first curative treatment. *Water and media temperatures must be between 15 and 30°C*. Keep the spray tank constantly agitated to prevent the nematodes from settling to the bottom of the tank. Apply to moist growing media and irrigate within 30 minutes to distribute the nematodes from the surface. Do not irrigate to the point of leaching. Apply as a foliar spray to control Western flower thrips and leafminer larvae. Applications should be made out of direct sunlight and early evening applications are best.

spiromesifen (Forbid) – A contact insecticide and miticide with translaminar movement throughout the leaf surface. However, to assure optimum effectiveness, the product should be applied to wet both the upper and lower surfaces. It is effective against whitefly nymphs and it has an effect on the pupal stage. It will not knock down adult whitefly populations. It is active on all mite developmental stages, although juvenile stages are often more susceptible than adults. An adjuvant may be used to improve coverage on hard to wet foliage. It has a low mammalian acute toxicity (LD₅₀: oral > 2,000;

dermal > 2,000) and is an eye irritant. It is toxic to aquatic organisms and certain beneficial organisms.

Steinernema kraussei (Exhibitline SK, Nemasys L) - A new insect parasitic nematode used to control the black vine weevil (*Otiiorhynchus sulcatus*). The nematode moves through the soil in water films and seeks out black vine weevil larvae. Once the nematode enters a larva, it releases a symbiotic bacterium that kills the pest. *S. kraussei* is tolerant of low temperatures, and is reported to be effective at temperatures as low as 5°C. Apply when larvae are active in March to May or August to November.

tebufenozide (Confirm 240) - An insecticide that mimics the action of a Lepidopteran molting hormone. Larvae stop feeding within hours after ingesting a toxic dose, although they may continue moving for several days. They begin to undergo an unsuccessful and lethal molt, and die within 3 to 10 days. Use on early larval stages. Good spray coverage is essential for control. It has a low mammalian acute toxicity rate but is irritating to skin and eyes (LD₅₀: oral = 5,000; dermal > 2,000). It is moderately toxic to fish and also highly toxic to certain invertebrates. Not toxic to bees.

trichlorfon (Dylox) - A nonsystemic organophosphorous material with contact and stomach action. It should not significantly affect beneficial insects, especially when applied at minimum label rates. It has a moderate mammalian acute toxicity (LD₅₀: oral = 450; dermal = 2,000). It can cause irreversible eye damage. Keep spray away from streams, lakes, and ponds. Toxic to fish, birds, and other wildlife.

Plant Growth Regulators

ancymidol (A-Rest) - A pyrimidinyl carbinol that inhibits gibberellin synthesis. It is absorbed by the leaves and roots and is readily translocated throughout the plant in the phloem tissue. It inhibits internode elongation to produce more compact plants. It is active as a spray or a drench. Foliar application may cause phytotoxicity that appears as necrotic spots on leaves and leaf margins. It is more likely to occur at temperatures above 21°C. It has a low mammalian acute toxicity (LD₅₀: oral = 4,500; dermal > 5,000). It is nontoxic to bees.

chlormequat chloride (Cycocel, Cycocel Extra) - A quaternary ammonium compound that inhibits gibberellin biosynthesis. It inhibits cell elongation, hence shortening and strengthening the stem and

producing a sturdier plant. It also influences the developmental cycle, leading to increased flowering and harvest. It may also increase chlorophyll formation and root development. It is effective both as a drench and as a foliar spray. When used as a spray it may cause phytotoxicity that appears as chlorotic spotting. It is most obvious on leaves that were expanding at the time of application. The symptoms appear in 3 to 5 days and are due to damage to the chloroplast. Drenches do not usually cause phytotoxicity, however it has low activity in media. It has a low mammalian acute toxicity (LD₅₀: oral = 883; dermal > 4,000). It is nontoxic to bees.

daminozide (B-Nine, Dazide) - An organic acid that interferes with gibberellic acid biosynthesis. It is absorbed by the leaves and readily translocated throughout the plant. It produces more compact plants by inhibiting internode elongation. It is not active as a drench because it is broken down quickly in media mixes. Under warm temperatures and low humidity, the spray solution may dry too quickly leading to poor plant absorption. The solution must remain wet on the plant to be effective. Do not tank-mix with wetting agents, alkaline materials, oils, and copper-containing compounds (such as Phyton 27). Do not apply to wilted or water-stressed plants. Leaves should be dry when spray is applied. Do not wet foliage within 24 hours of application. It has a low mammalian acute toxicity (LD₅₀: oral = 5,000; dermal > 5,000). It is nontoxic to bees.

paclobutrazol (Bonzi, Piccolo) - An azole compound that inhibits gibberellin and sterol biosynthesis and hence the rate of cell division. It produces more compact plants and enhances flowering. It is taken into the xylem through the leaves, stems, or roots, and is translocated to growing sub-apical meristems. Bonzi residues cannot be removed by washing with soap or by steaming, therefore do not reuse trays or pots from a treated crop. This is especially important for crops that are sensitive to Bonzi (e.g. begonias). It has a low mammalian acute toxicity (LD₅₀: oral = 5,346; dermal > 1,000). *See below for more information on using Bonzi.*

uniconazole (Sumagic) - An azole compound that inhibits gibberellin biosynthesis that is absorbed by stems and roots with translocation in the xylem to growing points. It has a low mammalian acute toxicity (LD₅₀: oral = 2,020; dermal > 2,000). *See below for more information on using Sumagic.*

Bonzi and Sumagic - Both products are extremely active at very low concentrations. It's recommended to do a test spray at the low label rate on each cultivar if you have not used either product before to avoid over-stunting or plant damage. They do not move readily within the plant. Transportation is most effective when they're applied to the stem or if absorbed through the roots. When applied as a drench and absorbed by the roots, the xylem carries them up through the stem to the growing points. However, they don't move in the phloem tissue, so material that is sprayed on the leaves will not move out into the stem or roots. When it is applied as a foliar spray, it is the stems that absorb it to move it to the growing points, so it's important to ensure that the stems as well as the leaves are uniformly covered. Spray application technique is very important with these two products; they both require precise application of a known volume of spray each time. Use your most experienced spray applicator for these two products. Any variation in spray coverage will produce variation in plants. Spray volumes are important and affect efficacy. Caution should be taken during foliar sprays to not spray to the point of excessive run-off. Excess product will run down the plant and into the soil where it acts as a drench and result in plants becoming shorter than expected. Spray drift can be a problem if crops are closely grown together that have significantly different rates.

Rodenticides and Molluscicides

bromadiolone (Just One Bite) ⚠ - Bait rodenticide to control rats and mice including those resistant to warfarin. Mammalian toxicity is very high (LD₅₀: oral = 1.125; dermal = 1.71). Not toxic to bees.

bromethalin (Terminator) ⚠ - An acute bait rodenticide for control against rats and mice. Effective against rodents resistant to anticoagulant rodenticides. Does not induce bait shyness. It has a high mammalian toxicity (LD₅₀: oral = 2; dermal = 1,000).

brodifacoum (Ratak) ⚠ - An acute bait rodenticide that controls rodent pests at a lower dose than is necessary with many other anticoagulant rodenticides. It has an extremely high mammalian toxicity (LD₅₀: oral = 0.4). It is also a mild skin and eye irritant and a moderate skin sensitizer and is highly toxic to fish.

difethialone (Hombre) ☞ – An anticoagulant bait formulation for the control of Norway rats, roof rats and house mice on farms. It has a high mammalian toxicity (LD₅₀: oral = 0.55). May be harmful if swallowed or absorbed through the skin., and may cause mild irritations to eyes. Prolonged or repeated exposures (ingestion and skin absorption) may cause cumulative toxicity.

diphacinone (Ramik Brown) ☞ - A water resistant bait rodenticide for nursery and outdoor use. Ramik Brown is an anticoagulant that is lethal to rodents after multiple feedings, it is also lethal to other animals, so it is recommended to recover rodent bodies and unused bait and dispose of them through burial. It has a high mammalian toxicity (LD₅₀: oral = 2.3; dermal > 200) and it is also moderately toxic to fish.

ferric phosphate (Slug and Snail Bait) - Controls species of slugs and snails through ingestion. After ingesting even small amounts of the bait slugs and snails cease feeding. Affected slugs and snails die within 3 to 6 days. Appropriate for use in the field or in the greenhouse. Uneaten bait degrades into the soil where it is harmless to pets and wildlife. The soil should be moist when applied but with little or no standing water. Ferric phosphate has a low mammalian toxicity (LD₅₀: oral > 5,000; dermal > 5,000) and it is practically not toxic to fish.

metaldehyde (various products) - An attractant bait that controls slugs and snails through ingestion and contact. It has a moderate mammalian toxicity (LD₅₀: oral = 283; dermal > 5,000) and it is slightly toxic to fish and not toxic to bees. Dogs are attracted to metaldehyde baits and accidental poisoning may result.

zinc phosphide (Rodent Pellets) ☞ – Formulated as pellets to control pocket gophers, meadow voles, mice, and Norway and roof rats. Not recommended for use in areas prone to being wet. It has a high mammalian toxicity (LD₅₀: oral = 40; dermal > 2,000). It is irritating to eyes, skin, and mucus membranes.