



New Jersey Agricultural
Experiment Station

This is a section from the

2012 DISEASE CONTROL RECOMMENDATIONS FOR ORNAMENTAL CROPS

Publication E036

The full manual, containing recommendations specific to New Jersey, can be found on the Rutgers NJAES website in the publications section:

njaes.rutgers.edu/pubs/publication.asp?pid=E036

Note: The label is a legally-binding contract between the user and the manufacturer. The user must follow all rates and restrictions as per label directions. The use of any pesticide inconsistent with the label directions is a violation of Federal law.

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2012

**DISEASE CONTROL RECOMMENDATIONS
FOR ORNAMENTAL CROPS**

**Section II
Synthetic Fungicides and Bactericides, Biopesticides, and
Biorational Products for use in
Ornamental Crops:
Common Names and Trade Names**

Table of Contents

Single-use Synthetic Compounds.....	II-1
azoxystrobin	II-1
calcium polysulfide	II-2
captan	II-3
chlorothalonil	II-4
copper ammonium complex	II-7
copper hydroxide	II-8
copper octanoate (copper soap)	II-10
copper oxychloride.....	II-11
copper salts of fatty and rosin acids	II-12
copper sulfate (basic)	II-13
copper sulfate (pentahydrate).....	II-14
cuprous oxide	II-15
cyazofamid	II-16
dicloran	II-17
dimethomorph	II-18
etridiazole.....	II-19
fenamidone.....	II-20
fenarimol	II-21
fenhexamid.....	II-22
fluopicolide	II-23
fludioxonil	II-24
fluoxastrobin	II-25
flutolanil	II-26
fosetyl-AI	II-27
imazalil.....	II-28
iprodione	II-29
kresoxim-methyl	II-30
mancozeb	II-31
mandipropamid	II-33
mefenoxam, metalaxyl.....	II-34
myclobutanil	II-35
oxytetracycline hydrochloride	II-36
PCNB (quintozene).....	II-37
phosphorous acid and salts.....	II-38
piperalin	II-40
polyoxin-D zinc salt.....	II-41
propamocarb hydrochloride	II-42
propiconazole	II-43
pyraclostrobin	II-45
streptomycin sulfate	II-46
sulfur	II-47
tebuconazole	II-49
thiabendazole	II-50
thiophanate-methyl	II-51
thiram	II-53
triadimefon	II-54
trifloxystrobin.....	II-55
triflumizole	II-56
ziram	II-57

Table of Contents (cont.)

Synthetic Combination Products.....	II-58
boscalid + pyraclostrobin	II-58
chlorothalonil + propiconazole	II-59
chlorothalonil + thiophanate-methyl.....	II-60
copper hydroxide + copper oxychloride	II-61
copper hydroxide + mancozeb	II-62
copper oxychloride + basic copper sulfate.....	II-63
cyprodinil + fludioxonil	II-64
debacarb + carbendazim	II-65
debacarb + carbendazim + abamectin.....	II-66
debacarb + carbendazim + imidacloprid.....	II-67
fludioxonil + mefenoxam.....	II-68
iprodione + thiophanate-methyl.....	II-69
phosphorous acids and salts + sulfur	II-70
thiophanate-methyl + etridiazole	II-71
triadimefon + trifloxystrobin.....	II-72
Biopesticides and Biorational Products	II-73
aliphatic petroleum solvents	
JMS Stylet Oil.....	II-73
Saf-T-Side	II-73
SuffOil-X	II-73
TriTek.....	II-73
oils	
essential oils	
Sporatec.....	II-73
neem oil	
70% Neem Oil.....	II-74
DeBug Turbo.....	II-74
Triact 70	II-74
Trilogy.....	II-75
Triple Action Neem Oil.....	II-75
soybean oil	
Oleotrol - M	II-75
disinfestants	
Consan Triple Action 20	II-75
ZeroTol.....	II-76
potassium bicarbonate	
Armicarb 100	II-76
MilStop	II-77
potassium silicate	
Sil-Matrix	II-77
insecticidal soap (soap salts)	
M-Pede Insecticide/Fungicide	II-77

Table of Contents (cont.)

biological controls	
<i>Agrobacterium radiobacter</i>	
Galltrol-A	II-78
<i>Bacillus pumilus</i>	
Sonata	II-78
<i>Bacillus subtilis</i>	
Companion	II-78
Subtilex NG	II-79
AmorTech Sonnet	II-79
Cease	II-79
Rhapsody	II-80
Serenade Garden	II-80
Taegro	II-81
<i>Coniothyrium minitans</i>	
Contans WG	II-82
<i>Gliocladium virens</i>	
SoilGard 12G	II-82
<i>Reynoutria sachalinensis</i>	
Regalia	II-82
<i>Streptomyces lydicus</i>	
ActinoGrow T&O	II-83
<i>Trichoderma asperellum</i> + <i>T. gamsii</i>	
Tenet WP	II-83
<i>Trichoderma harzianum</i>	
Plantshield HC	II-83
RootShield Granules	II-83
RootShield WP	II-84
<i>Trichoderma harzianum</i> + <i>T. virens</i>	
RootShield Plus Granules	II-84
RootShield Plus WP	II-84
Fungicide Resistance Management for Ornamentals.....	II-85
Table 1: Resistance risk for many compounds labeled for diseases of ornamentals	II-86

DISCLAIMER – USE OF TRADE NAMES

In many instances it is advisable to use trade names to avoid using long and complicated chemical names. No endorsement of named products is intended, nor is criticism implied of similar products that are not mentioned. The label is a legally-binding contract between the user and the manufacturer. It remains the responsibility of the user to follow all label directions, ensuring that application site, method, and timing, host crop, and disease are legal for the pesticide being used.

SINGLE USE SYNTHETIC PRODUCTS

azoxystrobin

FRAC: Group 11 fungicide (QoI-fungicides, methoxy-acrylates)

Resistance risk: resistance known for several fungal species; high risk; resistance management required

Sites: Christmas tree; greenhouse (bed, bench, flat, plug); landscape; nursery (container, field, retail); shade house

REI: 12 hours

Application: foliar spray; soil drench or directed spray

Application interval: 7 to 28 days (ornamental plants); 7 to 21 days (Christmas trees)

Uses: **broadleaf trees and shrubs; Christmas trees; flowering plants; foliage plants; ornamental grasses; roses** (commercial production) [tolerant hosts include: Abelia, Ageratum (Flossflower, Pussy Foot), Aglaonema (Chinese Evergreen), Ajuga (Bugleweed), Alyssum (Sweet), Andromeda (Japanese) (Pieris), Aphelandra (Zebra Plant), Arborvitae (White Cedar), Artemisia (Mugwort, Sagebrush, Wormwood), Aster (including Starwort), Aucuba (Japanese Laurel), Azalea (including Glacier)/Rhododendron, Barberry (Japanese), Begonia (except Rieger Begonia), Birch (River), Blanket Flower (Gaillardia), Bougainvillea, Boxwood, Buddleja (Butterfly Bush), Cactus (Holiday), Caladium, Camellia (Japanese), Ceanothus (including California Lilac, Snowball, Wild Lilac), Cedar (including Atlas), Chamaecyparis (Sawara Cypress), Cherry (Sand), Christmas Trees, Chrysanthemum, Cinquefoil (Potentilla), Clethra (White Alder), Coleus (Plectranthus), Cotoneaster (Creeping, Variegated Rockspray), Crabapple (some), Cranesbill (Geranium), Crape Myrtle, Cyclamen, Daisy (Gerbera, Transvaal), Delphinium (Larkspur), Dianthus (Carnation, Pink), Dieffenbachia, Dietes (African Iris, Butterfly Iris), Dogwood, Douglas Fir, Euonymus (Dwarf Winged, Evergreen), False Arborvitae, Fatsia (Japanese, Paper-plant), Ficus (Fig), Fir (Fraser), Forsythia, Foxglove, Gardenia (Cape Jasmine), Geranium, Grass (Ornamental) (Cortaderia, Pennisetum (Fountain Grass), Phalaris, Ribbon), Heather (Darley Heath), Hemlock, Hibiscus (China Rose, Rose of Sharon, Rose Mallow), Holly (including Winterberry, Yaupon), Hosta, Houseleek (Liveforever), Hydrangea (including French), Impatiens (including Balsam), Indian Hawthorn, Ivy (Algerian, English), Juniper (including Eastern Red Cedar, Procumbens, Rocky Mountain), Laurel, Leyland Cypress, Liriope (Lilyturf), Magnolia (Saucer, Southern), Maple (Japanese, Sugar), Marigold, Nandina, Oak (Pin, Red), Oleander (Rose-bay), Palm (Date, Parlor, Queen, Roebelin, Sago), Pear (Bradford), Peperomia (Baby Rubber-plant), Petunia, Philodendron, Phlox, Photinia (Red-tip), Pine (including Black, Eastern White, Mugo, Scotch), Pittosporum (Japanese Mock-orange), Plum (Flowering) (non bearing) (including Purple-leaf), Poinsettia, Poplar (Aspen), Pothos, Primula, Redbud (Western), Rose, Rosemary (Prostrate), Rudbeckia (Black-eyed Susan), Salvia (Sage), Schefflera (Rubber Tree, Umbrella Tree), Sedge (Cyperus), Sedum (Orpine, Stonecrop), Snapdragon, Spathiphyllum (Peace Lily), Spiraea (Japanese), Spruce (Blue, Norway, White), Swedish Ivy, Sweetspire (Virginia), Thyme (Creeping), Verbena (Vervain), Viburnum, Vinca (including Catharanthus), Viola (Pansy), Weigela (Pink), Yew (spreading), Yucca, Zinnia]

Diseases (fungal): anthracnose (*Colletotrichum*, *Elsinoë*); **black spot of rose**; **Botrytis blight**; **downy mildew** (bedding plants, Rose) (*Peronospora*); **blossom or leaf spot or blight** (*Alternaria*, *Cercospora*, *Cladosporium*, *Colletotrichum*, *Elsinoë*, *Entomosporium*, *Marssonina*, *Mycosphaerella*, *Myrothecium*, *Septoria*); **conifer shoot blight** (*Phomopsis*, *Sirococcus*); **needle cast** (*Lophodermium*, *Phaeocryptopus*); *Phytophthora* (aerial); **powdery mildew** (*Erysiphe*, *Microsphaera*, *Sphaerotheca*); **rust** (*Gymnosporangium*, *Melampsora*, *Phragmidium*, *Puccinia*); **scab** (*Venturia*); **soilborne diseases (non-water molds)** (*Fusarium*, *Rhizoctonia*, *Sclerotium*); **tip blight of pine** (*Sphaeropsis* [*Diplodia*])

Tolerant varieties of Malus: Arkansas Black, *M. atrosanguinea*, *M. baccata*, *M. baccata* var. *jackii*, *M. baccata* var. *mandshurica*, Callaway, Candymint Sargent, Christmas Holly, *M. coronaria*, David, Dolgo, Donald Wyman, Dorothea, Doubloons, Eleyi, Enterprise, Evereste, Eyelynn, *M. floribunda*, Gloriosa, Golden Delicious, Golden Raindrops, Hopa, Indian Magic, Island, Katherine, Lancelot, Louisa, Mary Potter, Molten Lava, New Centennial, Ormiston Roy, Pink Satin, Prairie Maid, Prairifire, Profusion, *M. pumila*, Ralph Shay, Red Jade, Red Baron, Sargent, *M. sargentii*, *M. sieboldii*, Selkirk, Sentinel, Silver Moon, Silverdrift, Sinai Fire, *M. spectabilis*, Sugar Tyme, Van Eseltine, White Angel, Williams Pride, Winter Gold, Yellow Delicious, *M. x zumi* Calocarpa

Approved for use in greenhouses: yes

Use restrictions:

Ornamentals: do not more than 10 lb product per acre per year, or 8 applications per crop per year.

Conifers: do not apply more than 4 lb product per acre per season.

Cautions: product is extremely toxic to certain Apple varieties. To avoid phytotoxicity, do not apply to Apple (*Malus domestica*); Crabapple (Flame, Brandywine, Novamac varieties); Cherry (Yoshino) varieties; or to Fern (Leatherleaf) (Rumohra and other species). Follow crop specific resistance management recommendations in directions for use.

Trade name	Formulation	Manufacturer
Heritage Fungicide [EPA Reg. No. 100-1093]	50 WDG	Syngenta Professional Products
Quadris Flowable [EPA Reg. No. 100-1098] (Christmas trees only)	2.1 F	Syngenta Crop Protection

calcium polysulfide [lime sulfur, (Ca(S_x))] (as gypsum)

FRAC: Group M2 fungicide (inorganic)

Resistance risk: generally considered low (no indication of fungicide resistance); no cross resistance between group members M1 to M9

Sites: landscape; other uses not specified

REI: 48 hours

Application: dormant disease control; foliar spray

Application interval: 7 to 10 days; fall (dormant application) and repeat before bud swell

Uses: **berries; broadleaf trees; flowering plants; shrubs** [such as Begonia (Tuberous), Boxwood, Crape Myrtle, Dahlia, Delphinium, Euonymus, Lilac, Marigold, Rose, Sweet Pea, Zinnia]

Diseases (fungal): **anthracnose; black spot of rose; boxwood canker; powdery mildew; rust**

Additional uses for dormant application: clean-up spray (Rose)

Approved for use in greenhouses: not specified

Cautions: sulfur may burn foliage. To avoid phytotoxicity, do not apply sulfur over 90oF, in full sun, or 30 days after an oil spray. Avoid drift. Do not use on Apricot.

Trade name	Formulation	Manufacturer
Green Cypress Lime-Sulfur Solution [EPA Reg. No. 66196-2-17545]	3 SC	Monterey AgResources
Lime-Sulfur Solution [EPA Reg. No. 66196-2]	3 SC	Tessenderlo Kerley Inc. (Ag Formulators)
Rex Lime Sulfur Solution [EPA Reg. No. 71096-6]	3 SC	OR-CAL Inc.

captan

FRAC: Group M4 fungicide (phthalimides)

Resistance risk: generally considered low (no indication of fungicide resistance); no cross resistance between group members M1 to M9

Sites: greenhouse; nursery; commercial use only for ornamentals

REI: 48 to 96 hours (see label)

Application: bench treatment; corm, cutting, and tuber dip; foliar spray; soil drench

Application interval: 7 to 14 days

Uses: **flowering plants**; **ornamental grasses** (non pasture areas only); **woody shrubs** [Azalea, Begonia (Tuberous), Camellia, Chrysanthemum, Dianthus (Carnation), Dichondra, Gladiolus, Grass (Ornamental) (non pasture areas), Rose]

Diseases (fungal): **black spot of rose**; **corm and tuber rot** (Begonia, Gladiolus); **leaf spot and blight** (*Alternaria*, *Botrytis*, *Septoria*); **petal blight** (Camellia, Chrysanthemum); **rust** (Dianthus [Carnation]); **soilborne diseases (damping-off; root rot)** (seedlings, transplants)

Additional uses for ornamental grasses: damping-off; brown patch; brown spot; **leaf spot**; melting out

Approved for use in greenhouses: yes

Cautions: do not apply spray to ornamental plants beyond the point of drip from the leaf surface. For soil drench, apply sufficient product to wet the soil surface.

Trade name	Formulation	Manufacturer
Captan 4L [EPA Reg. No. 19713-156]	4 FC	Drexel Chemical Company
Captan 50 Wettable Powder [EPA Reg. No. 66330-234]	49 WP	Arysta LifeScience North America LLC
Captan 50W [EPA Reg. No. 19713-235]	50 WSP	Drexel Chemical Company
Captan 80W [EPA Reg. No. 19713-405]	78 WSP	Drexel Chemical Company
Captec 4L [EPA Reg. No. 66330-239]	4 FC	Arysta LifeScience North America LLC

chlorothalonil

FRAC: Group M5 fungicide (chloronitriles)

Resistance risk: generally considered low (no indication of fungicide resistance); no cross resistance between group members M1 to M9

Sites: Christmas tree; forest stands; greenhouse; nursery

REI: 12 hours

Application: bulb and corm dip; foliar spray

Application interval: 7 to 14 days (ornamental plants); 1 to 8 weeks (conifers)

Uses: **broadleaf trees and shrubs; conifers; ferns; flowering plants and bulbs; foliage plants** [ornamentals recommended for treatment: Aesculus (Buckeye, Horse Chestnut), Aglaonema (Chinese Evergreen), Almond (Flowering) (non bearing), Aluminum Plant, Andromeda (Pieris), Aphelandra (Zebra Plant), Artemisia, Ash, Azalea/Rhododendron, Baby's Breath, Begonia, Bougainvillea, Cactus (Holiday), Caladium, Calathea (Peacock Plant), Camellia, Carissa (Natal Plum), Cherry (Flowering) (non bearing) (including Sand), Cherry Laurel, China Aster, Chrysanthemum, Clerodendrum, Cordyline (Ti Plant), Crabapple, Crassula (Jade Plant), Crocus, Croton, Daisy (including Gerbera), Dianthus (Carnation), Dieffenbachia (Dumb cane), Dogwood, Douglas Fir, Dracaena, Eucalyptus, Euonymus, Exacum (Arabian Violet), False Aralia, Fatsia (Aralia), Fern (Bird's Nest, Boston, Florida Ruffle, Japanese Holly, Leatherleaf, Staghorn), Ficus, Fittonia (Silver Nerve Plant), Flame Violet, Geranium, Gladiolus, Hawthorn, Holly (including Chinese, Japanese), Hollyhock, Hoya (Wax Plant), Hydrangea (foliage only), Impatiens, Iris (including Bulbous), Lilac, Lily (including Asiatic), Limonium (Statice), Lipstick Plant, Magnolia, Maple, Marigold, Ming Aralia, Mountain Laurel, Narcissus (Daffodil), Norfolk Island Pine, Oak (red group only), Oregon Grape Holly, Oyster Plant, Pachysandra, Palm (Areca, Parlor), Peach (Flowering) (non bearing), Peperomia, Petunia, Philodendron, Phlox, Photinia, Pine, Plum (Flowering) (non bearing), Poinsettia, Poplar (Aspen), Pothos (Golden), Prayer Plant (Maranta), Privet (Ligustrum), Purple Passion Vine, Pyracantha (Firethorn), Quince (Flowering) (non bearing), Rose, Sansevieria (Bird's Nest), Sequoia, Spiraea, Spruce, Sycamore/Plane tree, Syngonium, Tolmiea (Piggyback Plant), Tulip, Urn Plant, Venus Fly Trap, Viburnum, Viola (Pansy), Walnut (non bearing), Yucca (Spineless), Zinnia]

Uses (Exotherm Termil): African Violet, Ageratum, Aglaonema, Aphelandra (Zebra Plant), Artemisia, Aster, Azalea, Begonia, Caladium (foliage only), Calceolaria, Celosia, Chrysanthemum, Cineraria, Coleus (foliage only), Crocus, Cyclamen, Daisy, Delphinium (foliage only), Dianthus, Dieffenbachia, Douglas Fir, Dracaena, Euonymus, Exacum (Arabian Violet), Fatsia (Aralia), Fern (Asparagus, Boston, Florida Ruffle, Leatherleaf), Ficus, Fir, Fuchsia, Geranium, Gladiolus, Gloxinia, Hollyhock, Hoya (Variegated) (foliage only), Hydrangea (foliage only), Impatiens (including Balsam) (foliage only), Iris, Ivy (foliage only), Lantana, Lily (including Easter), Limonium (Statice), Lipstick Plant, Lobelia (foliage only), Marigold, Ming Aralia, Narcissus, Nasturtium, Norfolk Island Pine, Oregon Grape Holly (Mahonia), Oyster Plant (Rhoeo), Palm (including Areca, Parlor) (foliage only), Peperomia, Petunia, Philodendron, Phlox, Pine (Ponderosa), Poinsettia, Pothos, Prayer Plant (Maranta), Primula, Rose, Salvia (including Scarlet Sage), Schizanthus, Snapdragon, Spiraea, Syngonium, Tulip, Velvet Plant, Verbena, Vinca (foliage only), Viola (Pansy), Zinnia

Diseases (fungal): anthracnose; black knot of Prunus (orchard use); **black spot of rose; blossom or leaf spot or blight** (*Actinopelte*, *Alternaria*, *Ascochyta*, *Bipolaris*, *Botrytis*, *Cephalosporium*, *Cercospora*, *Cercosporidium*, *Corynespora*, *Coryneum*, *Curvularia*, *Cylindrosporium*, *Dactylaria*, *Didymellina*, *Drechslera*, *Entomosporium*, *Fabraea*, *Gloeosporium*, *Marssonina*, *Monilinia*, *Myrothecium*, *Nematostoma*, *Phyllosticta*, *Ramularia*, *Rhizopus*, *Septoria*, *Sclerotinia*); brown rot (*Monilinia*); **canker** (Pine) (*Scleroderris*); **Discula anthracnose** (Dogwood); **ink spot** (*Drechslera*); **leaf blister** (*Taphrina*); **leaf spot and blight leaf scorch** (*Stagonospora*); **needle cast** (*Cyclaneusma*, *Lophodermium*, *Phaeocryptopus*, *Rhabdocline*, *Rhizosphaera*, *Scirrhia*); **Ovulinia petal blight; Phytophthora** (aerial); **powdery mildew** (*Erysiphe*, *Microsphaera*); **ray blight** (*Mycosphaerella*); **rust** (*Chrysomyxa*, *Gymnosporangium*, *Puccinia*, *Pucciniastrum*); **stem canker** (*Cylindrocladium*); **scab** (*Venturia*); **Scirrhia brown spot; tip blight of pine** (*Sirococcus*, *Sphaeropsis* [*Diplodia*]); **twig blight and canker** (*Phoma*); **Volutella leaf blight; web blight** (*Rhizoctonia*)

Approved for use in greenhouses: variable (see label)

Use restrictions:

Ornamentals: do not apply more than 36.4 lb a.i. per acre per growing season to field-grown ornamentals (see label for other restrictions).

Conifers: do not apply more than 16.5 lb a.i. per season to conifers; minimum retreatment interval is 21 days (field) and 7 days (nursery bed) (see label for other restrictions).

Cautions: not recommended for use on Schefflera and Pittosporum (Green, Variegated). Some products may not be applied to Fern (see label). Applications during bloom or bract formation may damage tissues. Treated plants and fruits from treated plants must not be eaten. Do not apply to home orchards/fruit trees after fruit set.

Trade name	Formulation	Manufacturer
ArmorTech CLT 720 FL [EPA Reg. No. 86064-2]	6 EC	United Turf Alliance
ArmorTech CLT 825 DF [EPA Reg. No. 86064-1]	82.5 WDG	United Turf Alliance

Trade name	Formulation	Manufacturer
Bravo Ultrex [EPA Reg. No. 50534-201-100] (conifers only)	82.5 WDG	Syngenta Crop Protection
Bravo Weather Stik [EPA Reg. No. 50534-188-100] (conifers only)	6 EC	Syngenta Crop Protection
Chloronil 720 [EPA Reg. No. 50534-188-100] (conifers only)	6 EC	Syngenta Crop Protection
Chlorothalonil 82.5 WDG [EPA Reg. No. 66330-382] (includes bulb and corm dip)	82.5 WDG	Arysta LifeScience North America LLC
Chlorothalonil 720 Flowable Fungicide [EPA Reg. No. 66330-362]	6 FC	Arysta LifeScience North America LLC
Chlorothalonil 720 SC Flowable Fungicide [EPA Reg. No. 66330-362] (conifers only)	6 FC	Arysta LifeScience North America LLC
Daconil Ultrex Turf Care [EPA Reg. No. 50534-202-100] (includes bulb and corm dip)	82.5 WDG	Syngenta Professional Products
Daconil Weather Stik [EPA Reg. No. 50534-209-100]	6 FC	Syngenta Professional Products
Daconil Zn Flowable Fungicide [EPA Reg. No. 50534-211-100]	4.17 FC	Syngenta Professional Products
Echo 90DF Agricultural Fungicide [EPA Reg. No. 60063-10] (conifers only)	90 WDG	SipcamAdvan
Echo 720 Agricultural Fungicide [EPA Reg. No. 60063-7] (conifers only)	6 EC	SipcamAdvan
Echo 720 Turf and Ornamental Fungicide [EPA Reg. No. 60063-7]	6 EC	SipcamAdvan
Echo Ultimate Turf and Ornamental Fungicide [EPA Reg. No. 60063-3]	82.5 WDG	SipcamAdvan
Echo Zn Agricultural Fungicide [EPA Reg. No. 60063-4] (conifers only)	4.17 EC	SipcamAdvan
Echo Zn Turf and Ornamental Fungicide [EPA Reg. No. 60063-4]	4.17 EC	SipcamAdvan
Ensign 82.5% Turf and Ornamental Fungicide [EPA Reg. No. 34704-965] (includes bulb and corm dip)	82.5 WDG	Loveland Products
Ensign 720 Flowable Fungicide [EPA Reg. No. 34704-966]	6 FC	Loveland Products
Equus 500 ZN [EPA Reg. No. 66222-150] (conifers only)	4.17 FC	Makhteshim Agan of North America, Inc.
Equus 720 SST [EPA Reg. No. 66222-154] (conifers only)	6 SC	Makhteshim Agan of North America, Inc.
Equus DF [EPA Reg. No. 66222-149] (conifers only)	82.5 WDG	Makhteshim Agan of North America, Inc.
Exotherm Termil [EPA Reg. No. 70-223] (greenhouse fumigant)	20% pressurized liquid	AllPro (Value Garden Supply)
Initiate 720 Flowable Fungicide [EPA Reg. No. 34704-881]	6 EC	Loveland Products
Initiate ZN [EPA Reg. No. 34704-1050] (conifers only)	4.17 EC	Loveland Products
Legend Turf and Ornamental Fungicide [EPA Reg. No. 1001-85]	6 FC	Cleary Chemical Corporation
Pegasus 6L [EPA Reg. No. 81943-15]	6 EC	Phoenix Environmental Care LLC
Pegasus 82.5 DF [EPA Reg. No. 81943-24]	82.5 WDG	Phoenix Environmental Care LLC
Pegasus DF [EPA Reg. No. 60063-3-81943]	82.5 WDG	Phoenix Environmental Care LLC
Pegasus HPX [EPA Reg. No. 81943-26]	6 EC	Phoenix Environmental Care LLC

Trade name	Formulation	Manufacturer
PrimeraOne Chlorothalonil 720 SFT [EPA Reg. No. 66222-154-73220]	6 SC	Primera Turf
PrimeraOne Chlorothalonil DF [EPA Reg. No. 66222-149-73220]	82.5 WDG	Primera Turf
Prosolutions Thalonil 6L [EPA Reg. No. 9779-320]	6 EC	Winfield Solutions LLC
Prosolutions Thalonil 90DF [EPA Reg. No.9779-280]	90 WDG	Winfield Solutions LLC
PROKōZ Mainsail 6.0 F [EPA Reg. No. 72112-6]	6 FC	PROKōZ, Inc.
PROKōZ Mainsail WDG [EPA Reg. No. 72112-5]	82.5 WDG	PROKōZ, Inc.
Quali-Pro Chlorothalonil 500 ZN [EPA Reg. No. 66222-150-73220]	4.17 FC	Quali-Pro
Quali-Pro Chlorothalonil 720 SFT [EPA Reg. No. 66222-154]	6 SC	Quali-Pro
Quali-Pro Chlorothalonil DF [EPA Reg. No. 66222-149-73220]	82.5 WDG	Quali-Pro

copper ammonium complex [Cu(NH₃)₄²⁺]

FRAC: Group M1 fungicide (inorganic)

Resistance risk: generally considered low (no indication of fungicide resistance); no cross resistance between group members M1 to M9

Sites: greenhouse (bed, bench, container); interiorscape; landscape (professional use only); nursery

REI: 12 hours

Application: foliar spray

Application interval: 7 to 14 days (ornamentals); 3 to 4 weeks (Douglas Fir)

Uses: **broadleaf trees and shrubs; conifers** (including Christmas trees); **ferns; flowering plants; foliage plants** [Arborvitae, Azalea/Rhododendron, Begonia, Bougainvillea, Camellia, Camphor Tree, Canna, Chinese Tallowtree, Chrysanthemum, Cotoneaster, Dahlia, Dianthus (including Carnation), Dogwood (Flowering), Douglas Fir, Dusty Miller, Echinacea, Elm (Drake's Chinese), Euonymus, False Aralia, Fern (Japanese Holly), Gardenia, Geranium, Gladiolus, Golden Rain Tree, Hibiscus, Hosta, Impatiens, Indian Hawthorn, Ivy (Algerian, English), Ixora, Juniper, Lantana, Lilac, Lily (Easter), Loblolly Bay, Loquat (non bearing), Magnolia (Southern, Sweet Bay), Mandevilla, Marigold, Mulberry (non bearing) (Weeping), Oak (Laurel), Oleander, Pachysandra, Palm (Date, European Fan, Queen, Washingtonia), Pear (Flowering) (non bearing), Pentas, Peony, Philodendron, Phlox, Photinia, Pistachio (non bearing), Powder Puff Plant, Pyracantha, Rose, Sycamore, Tulip, Verbena, Viburnum, Vinca (Periwinkle), Viola (Pansy), Willow (Weeping), Yucca (Adam's Needle)]

Diseases (fungal, bacterial): anthracnose; bacterial leaf spot (*Pseudomonas*, *Xanthomonas*); **bacterial soft rot; blossom or leaf blight or spot** (algal, *Alternaria*, *Botrytis*, *Cercospora*, *Colletotrichum*, *Entomosporium*, *Exosporium*, *Pestalotia*, *Septoria*); **Botrytis blight** (gray mold); **Discula anthracnose** (Dogwood); **downy mildew; fire blight; needle cast; Phytophthora** (aerial); **powdery mildew; scab; twig blight** (*Phomopsis*); **Volutella leaf blight**

Approved for use in greenhouses: yes

Cautions: check for phytotoxicity before large-scale use of copper fungicides; to prevent residues on many plants, avoid use of copper compounds just before selling season.

Trade name	Metallic copper equivalent	Formulation	Manufacturer
Copper-Count-N [EPA Reg. No. 10465-3]	8%	SC	Mineral Research & Devel. Corp.

copper hydroxide [Cu(OH)₂]

FRAC: Group M1 fungicide (inorganic)

Resistance risk: generally considered low (no indication of fungicide resistance); no cross resistance between group members M1 to M9

Sites: greenhouse (bed, bench, container); interiorscape; landscape (professional use only); nursery

REI: 24 hours

Application: foliar spray

Application interval: 7 to 14 days (ornamentals); 2 to 4 weeks (conifers)

Uses: **broadleaf trees and shrubs; conifers** (including Christmas trees); **ferns; flowering plants; foliage plants** [Aglaonema (Chinese Evergreen), Andromeda (Japanese), Arborvitae, Aster, Azalea/Rhododendron, Beech, Begonia, Bougainvillea, Boxwood, Camellia, Camphor Tree, Canna, Cedar, Cherry (Nanking), Chinese Tallowtree, Chrysanthemum, Corylus (Filbert) (Ornamental) (non bearing), Cotoneaster, Crabapple, Cypress, Dahlia, Delphinium, Dianthus (including Carnation), Dogwood (Flowering, Kousa), Douglas Fir, Dieffenbachia, Dracaena, Dusty Miller, Echinacea, Elm (Chinese, Chinese 'Drake'), Euonymus, False Aralia, Fern (Boston, Japanese Holly), Ficus (Weeping), Fir, Gardenia, Geranium, Gladiolus, Gleditsia (including Honey Locust), Golden Rain Tree, Grape Ivy (ground cover), Hawthorn, Hibiscus (including Rose of Sharon), Holly, Honeysuckle (Tatarian), Hosta, Impatiens, Indian Hawthorn, Iris, Ivy (Algerian, English), Ixora, Juniper, Lantana, Leyland Cypress, Lilac, Lily (Easter), Linden, Loblolly Bay, Loquat (non bearing), Magnolia (Saucer, Southern, Sweet Bay), Mandevilla, Maple, Marigold, Mountain Ash, Mulberry (non bearing) (Contorted, Weeping), Narcissus, Oak (including Laurel), Oleander, Oregon Grape Holly, Pachysandra, Palm (Date, European Fan, Parlor, Queen, Washingtonia), Peach (Flowering) (non bearing), Pear (Flowering) (non bearing), Pentas, Peony, Philodendron, Phlox, Photinia (Red-tip), Pine, Pistachio (non bearing), Plum (Flowering) (non bearing), Pothos, Powder Puff Plant, Pyracantha, Rose, Schefflera (Umbrella Tree), Snapdragon, Spathiphyllum, Spiraea, Spruce, Sycamore, Syngonium, Tulip, Verbena, Viburnum, Vinca (Periwinkle), Viola (Pansy, Violet), Willow, Yew, Yucca (Adam's Needle), Zinnia]

Diseases (fungal, bacterial): **anthracnose; bacterial leaf spot** (*Pseudomonas*, *Xanthomonas*); **bacterial soft rot; blossom or leaf blight or spot** (algal, *Alternaria*, *Botrytis*, *Cercospora*, *Colletotrichum*, *Entomosporium*, *Exosporium*, *Pestalotia*, *Sclerotinia*, *Septoria*); **Botrytis blight** (gray mold); **brown rot; canker; Discula anthracnose** (Dogwood); **downy mildew; filbert blight; fire blight; needle blight; needle cast; Phytophthora** (aerial); **powdery mildew; scab; tar spot; twig blight** (*Phomopsis*); **Volutella leaf blight**

Approved for use in greenhouses: yes

Use restrictions: do not apply more than 20 lb Cu+ per acre per year (see label for other restrictions).

Cautions: check for phytotoxicity before large-scale use of copper fungicides; to prevent residues on many plants, avoid use of copper compounds just before selling season.

Trade name	Metallic copper equivalent	Formulation	Manufacturer
3 lb. Copper Flowable [EPA Reg. No. 5905-491]	24.4%	FC	Helena Chemical Company
Champ Dry Prill [EPA Reg. No. 55146-57]	37.5%	WDG	Nufarm Agricultural Products
Champ Formula 2 Flowable [EPA Reg. No. 55146-64]	24.4%	FC	Nufarm Agricultural Products
Champ WG [EPA Reg. No. 55146-1]	50%	WP	Nufarm Agricultural Products
CuPRO 2005 T/N/O [EPA Reg. No. 67690-37]	35%	WDG	SePRO Corporation
CuPRO 5000 [EPA Reg. No. 80289-2-67690]	40%	DF	SePRO Corporation
Kentan DF [EPA Reg. No. 80289-2]	40%	WDG	Isagro USA, Inc.
Kocide 2000 [EPA Reg. No. 352-656]	35%	WDG	DuPont Crop Protection
Kocide 3000 [EPA Reg. No. 352-662]	30%	WDG	DuPont Crop Protection
KOP-Hydroxide [EPA Reg. No. 19713-301]	24.4%	FC	Drexel Chemical Company
KOP-Hydroxide 50W [EPA Reg. No. 19713-321]	50%	WP	Drexel Chemical Company
Nu-Cop 3L [EPA Reg. No. 42750-75]	24.4%	FC	Albaugh, Inc./Agri Star
Nu-Cop 50DF [EPA Reg. No. 45002-4]	50%	WDG	Albaugh, Inc./Agri Star
Nu Cop 50 WP [EPA Reg. No. 45002-7]	50%	WP	Albaugh, Inc./Agri Star

Trade name	Metallic copper equivalent	Formulation	Manufacturer
Nu-Cop HB [EPA Reg. No. 42750-132]	50%	WP	Albaugh, Inc./Agri Star

copper octanoate (copper soap) [C₈H₁₆O₂Cu]

FRAC: Group M1 fungicide (inorganic)

Resistance risk: generally considered low (no indication of fungicide resistance); no cross resistance between group members M1 to M9

Sites: greenhouse; field; interiorscape; nursery

REI: 4 hours

Application: foliar spray

Application interval: 7 to 10 days (ornamentals); 3 weeks (Pine)

Uses: broadleaf trees and shrubs; ferns; flowering plants; foliage plants; palms [Abelia, African Violet, Aglaonema (Chinese Evergreen), Aluminum Plant, Anthurium, Aphelandra, Cactus (Holiday), Caladium, Calathea (Rattlesnake Plant), Cordyline (Ti Plant), Crape Myrtle, Croton, Deutzia, Dieffenbachia, Dracaena, Earth Star, Euphorbia (Crown of Thorns), Fatsia (Japanese), Fern (Bird's Nest, Boston, Staghorn), Ficus (India Rubber Tree, Weeping), Fittonia, Forsythia, Grape Ivy, Hoya (Wax Plant), Hydrangea, Ivy (English), Lipstick Plant, Ming Aralia, Mock-orange, Norfolk Island Pine, Oyster Plant, Palm (Areca, Fishtail, Lady, other species of Chamaedorea), Peperomia, Philodendron (Selloum), Pine, Pothos, Prayer Plant (Maranta), Pyracantha, Quince (Japanese), Rose, Sansevieria (Snake Plant), Schefflera (including Dwarf), Sedum, Spathiphyllum, Summersweet, Swiss Cheese Plant, Sycamore, Syngonium, Urn Plant, Willow, Yucca]

Diseases (fungal, bacterial): anthracnose (*Colletotrichum*, *Glomerella*); **bacterial leaf blight or spot** (*Erwinia*, *Pseudomonas*, *Xanthomonas*); **black spot of rose; Botrytis blight** (gray mold); **downy mildew** (*Plasmopara*); **leaf spot** (*Acremonium*, *Alternaria*, *Cephalosporium*, *Cercospora*, *Colletotrichum*, *Corynespora*, *Curvularia*, *Dactylaria*, *Drechslera*, *Exserohilum*, *Glomerella*, *Myrothecium*, *Phyllosticta*, *Phytophthora*); **needle blight; powdery mildew; rust** (Rose); **soft rot** (*Erwinia*); **sycamore anthracnose; web blight** (*Rhizoctonia*)

Approved for use in greenhouses: yes

Cautions: check for phytotoxicity before large-scale use of copper fungicides; to prevent residues on many plants, avoid use of copper compounds just before selling season.

Trade name	Metallic copper equivalent	Formulation	Manufacturer
Camelot O Fungicide [EPA Reg. No. 67702-2-67690]	1.8%	FC	SePRO Corporation

copper oxychloride [Cu₂(OH)₃Cl]

FRAC: Group M1 fungicide (inorganic)

Resistance risk: generally considered low (no indication of fungicide resistance); no cross resistance between group members M1 to M9

Sites: greenhouse; field

REI: 24 hours

Application: foliar spray

Application interval: 7 to 10 days (ornamentals); 3 weeks (Pine); 4 weeks (Poplar)

Uses: **forest trees; hedges; ornamental plants** [Arborvitae, Aster, Azalea/Rhododendron, Begonia, Boxwood, Chrysanthemum, Dahlia, Dianthus (Carnation), Dogwood, Gardenia, Geranium, Gladiolus, Hollyhock, Ivy, Lilac, Lily, Maple, Marigold, Nasturtium, Oak, Palm, Peony, Phlox, Pine, Poplar, Rose, Snapdragon, Sweet Pea, Tulip, Viola (Pansy, Violet), Virginia Creeper, Zinnia]

Diseases (fungal): anthracnose; Botrytis blight (gray mold); **downy mildew; leaf blight or spot; needle blight** (Pine); **powdery mildew**

Approved for use in greenhouses: yes

Cautions: check for phytotoxicity before large-scale use of copper fungicides; to prevent residues on many plants, avoid use of copper compounds just before selling season.

Trade name	Metallic copper equivalent	Formulation	Manufacturer
Agri Star COC DF [EPA Reg. No. 45002-17]	50%	DF	Albaugh, Inc./Agri Star
Agri Star COC WP [EPA Reg. No. 45002-17]	50%	WP	Albaugh, Inc./Agri Star

copper salts of fatty and rosin acids [mixture of compounds]

FRAC: Group M1 fungicide (inorganic)

Resistance risk: generally considered low (no indication of fungicide resistance); no cross resistance between group members M1 to M9

Sites: greenhouse; landscape; nursery (outdoor); shade house

REI: 12 hours

Application: foliar spray

Application interval: 7 to 14 days

Uses: **broadleaf trees and shrubs; conifers; ferns; flowering plants; foliage plants; palms** [Aglaonema, Andromeda (Japanese), Arborvitae, Aster, Azalea/Rhododendron, Beech, Begonia, Bougainvillea, Boxwood, Camellia, Camphor Tree, Canna, Cedar, Chinese Tallowtree, Chrysanthemum, Cotoneaster, Crabapple, Cypress, Dahlia, Dianthus (including Carnation), Delphinium, Dieffenbachia (Dumb Cane), Dogwood (Flowering), Douglas Fir, Dracaena, Dusty Miller, Echinacea, Elm (Chinese), Euonymus, False Aralia, Fern (Boston, Japanese Holly), Ficus (Weeping), Filbert (Ornamental) (non bearing), Gardenia, Geranium, Gladiolus, Gleditsia (Honey Locust), Golden Rain Tree, Grape Ivy, Hawthorn, Hibiscus (including Rose of Sharon), Holly, Honeysuckle (Tatarian), Hosta, Hydrangea, Impatiens, Indian Hawthorn, Iris, Ivy (Algerian, English), Ixora, Juniper, Lantana, Leyland Cypress, Lilac, Lily (Easter), Linden, Lisianthus, Loblolly Bay, Loquat (non bearing), Magnolia, Mandevilla, Maple, Marigold, Mountain Ash, Mulberry (non bearing), Narcissus, Oak (including Laurel), Oleander, Oregon Grape Holly, Pachysandra, Palm (Date, European Fan, Parlor, Queen, Washingtonia), Peach (Flowering) (non bearing), Pear (Flowering) (non bearing), Pentas, Peony, Philodendron (Selloum), Phlox, Photinia (Red-tip), Pine, Pistachio (non bearing), Plum (Flowering) (non bearing), Poinsettia, Pothos, Powder Puff Plant, Pyracantha, Rose, Schefflera (Umbrella Tree), Snapdragon, Spathiphyllum, Spiraea, Spruce, Sycamore, Syngonium, Tulip, Verbena, Viburnum, Vinca (Periwinkle), Viola (Pansy, Violet), Willow, Yew, Yucca (Adam's Needle), Zinnia]

Diseases (fungal, bacterial): anthracnose; bacterial leaf spot (*Erwinia*, *Pseudomonas*, *Xanthomonas*); **bacterial soft rot; black spot of rose; blossom or leaf blight or spot** (algal, *Alternaria*, *Botrytis*, *Cercospora*, *Colletotrichum*, *Entomosporium*, *Exosporium* [*Stigmina*], *Pestalotia*, *Septoria*); **Botrytis blight** (gray mold); **brown rot; canker; conifer shoot/tip blight** (*Phomopsis*); **downy mildew; filbert blight; fire blight; needle blight; needle cast; Phytophthora** (aerial); **powdery mildew; rust** (*Gymnosporangium*); **scab; soilborne diseases (oomycetes)** (*Pythium*); **tip blight of pine** (*Sphaeropsis* [*Diplodia*]); **Volutella leaf blight**

Approved for use in greenhouses: yes

Use restrictions: do not apply more than 20 lb Cu+ per acre per year. Do not apply more than once every 7 days (see label for other restrictions).

Cautions: check for phytotoxicity before large-scale use of copper fungicides; to prevent residues on many plants, avoid use of copper compounds just before selling season.

Trade name	Metallic copper equivalent	Formulation	Manufacturer
Camelot Fungicide [EPA Reg. No. 67690-36]	5.14%	EC	SePRO Corporation

copper sulfate (basic) [3Cu(OH)₂ • Cu(SO)₄]

FRAC: Group M1 fungicide (inorganic)

Resistance risk: generally considered low (no indication of fungicide resistance); no cross resistance between group members M1 to M9

Sites: Christmas tree plantations; forest stands (conifers); greenhouse; nursery (field, silviculture); shade house

REI: 48 hours

Application: foliar spray

Application interval: 7 to 14 days; 3 to 4 weeks (conifers)

Uses: **bedding plants; broadleaf trees and shrubs; conifers; ferns; flowering plants; foliage plants; ornamental grasses; palms** [Arborvitae, Azalea/Rhododendron, Begonia, Bougainvillea, Camellia, Camphor Tree, Canna, Chinese Tallowtree, Chrysanthemum, Cotoneaster, Dahlia, Dianthus (including Carnation), Dogwood, Douglas Fir, Dusty Miller, Echinacea, Elm (Chinese), Euonymus, False Aralia, Fern (Japanese Holly), Fir, Geranium, Gladiolus, Golden Rain Tree, Hibiscus (including Rose of Sharon), Hosta, Impatiens, Indian Hawthorn, Ivy (Algerian, English), Ixora, Juniper, Lantana, Leyland Cypress, Lilac, Lily (Easter), Loblolly Bay, Loquat (non bearing), Magnolia (including Southern, Sweet Bay), Mandevilla, Marigold, Mulberry (non bearing) (Weeping), Oak (Laurel), Oleander, Pachysandra, Palm (Date, European Fan, Queen, Washingtonia), Pear (Flowering) (non bearing), Pentas, Peony, Philodendron, Phlox, Photinia (Red-tip), Pine, Pistachio (non bearing), Powder Puff Plant, Pyracantha, Rose, Spruce, Sycamore, Tulip, Verbena, Viburnum, Vinca (Periwinkle), Viola (Pansy), Willow (Weeping), Yucca (Adam's Needle)]

Diseases (fungal, bacterial): anthracnose; bacterial leaf spot (*Erwinia*, *Pseudomonas*, *Xanthomonas*); **bacterial soft rot; black spot of rose; blossom or leaf blight or spot** (algal, *Alternaria*, *Botrytis*, *Cercospora*, *Colletotrichum*, *Entomosporium*, *Exosporium*, *Pestalotia*, *Septoria*); **Botrytis blight** (gray mold); **downy mildew; fire blight; needle blight; needle cast; Phytophthora** (aerial); **powdery mildew; scab; sycamore anthracnose; twig blight** (*Phomopsis*); **Volutella leaf blight**

Approved for use in greenhouses: yes

Use restrictions: do not apply more than 20 lb Cu+ per acre per year. Do not apply more than once every 7 days; see label for other restrictions).

Cautions: check for phytotoxicity before large-scale use of copper fungicides; to prevent residues on many plants, avoid use of copper compounds just before selling season.

Trade name	Metallic copper equivalent	Formulation	Manufacturer
Cuprofix Ultra 40 Disperss [EPA Reg. No. 70506-201] (basic)	40%	DF	United Phosphorus, Inc.

copper sulfate (pentahydrate) [CuSO₄ • 5H₂O]

FRAC: Group M1 fungicide (inorganic)

Resistance risk: generally considered low (no indication of fungicide resistance); no cross resistance between group members M1 to M9

Sites: field; greenhouse; interiorscape; landscape; nursery

REI: 24 or 48 hours (see label)

Application: bulb and cutting dip; foliar spray; post-harvest dip (cut flowers); soil drench; tree injection; trunk spray

Application interval: 7 to 14 days; 3 to 4 weeks (conifers); once per season (tree injection)

Uses: **bedding plants (annual and perennial); broadleaf trees and shrubs; conifers; ferns; flowering plants (cut flowers, potted crops); foliage plants; ornamental grasses; palms** [African Violet, Almond (Flowering) (non bearing), Astroemeria, Alyssum, Amelanchier, Anemone, Apple (Flowering) (non bearing), Arborvitae, Argyranthemum, Ash, Aster, Azalea/Rhododendron, Bacopa, Baptisia, Barberry, Begonia, Birch, Bougainvillea, Boxwood, Calla Lily, Cactus (Holiday), Cherry (Flowering) (non bearing), Cherry Laurel, Chrysanthemum, Cineraria, Cinquefoil (Potentilla), Citrus (non bearing), Clematis, Coleus, Columbine, Coneflower, Conifers, Coreopsis, Cotoneaster, Crabapple, Crape Myrtle, Cuphea, Cyclamen, Dahlia, Daisy (including Gerbera), Daylily, Delphinium, Dianthus (including Carnation), Dogwood, Douglas Fir, Dracaena, Dusty Miller, Echinacea, Elm, Euonymus, Exacum, Fern, Ficus, Fir, Forsythia, Freesia, Fuchsia, Gardenia, Geranium, Gingko, Gladiolus, Gleditsia (Honey Locust, Locust), Gloxinia, Grape (non bearing), Grass (Ornamental), Geum (Prairie Smoke), Hackberry, Hawthorn, Hemlock, Hibiscus, Holly, Hollyhock, Hosta, Hyacinth, Hydrangea, Impatiens (including New Guinea), Indian Hawthorn, Ipomoea, Iris, Ivy, Juniper, Kalanchoe, Lantana, Lavender, Lead Plant, Leyland Cypress, Liatris, Lilac, Lily (Easter), Linden, Lisianthus, Lobelia, Lupine, Magnolia, Maple (including Japanese), Marigold, Mock-orange, Monarda, Mountain Ash, Nandina, Narcissus (Daffodil), Ninebark, Oak, Orchid, Pachysandra, Palm, Peach (Flowering) (non bearing), Pear (Flowering) (non bearing), Pentas, Peony, Petunia, Phlox, Photinia, Pine, Pittosporum, Plum (Flowering) (non bearing), Poinsettia, Poplar, Poppy, Primula, Pulmonaria, Pyracantha, Ranunculus, Redbud, Ribes, Rose, Rudbeckia, Ruscus, Salvia, Scabiosa, Sedum, Silphium, Smoke Tree, Snapdragon, Spathiphyllum, Spiraea, Spruce, Sycamore, Sweet Pea, Tulip, Tropical Foliage (general), Verbena, Veronica, Viburnum, Vinca (Periwinkle), Viola (Pansy), Weigela, Wisteria, Yew, Zinnia]

Diseases (fungal, bacterial): anthracnose; bacterial leaf spot (*Erwinia, Pseudomonas, Xanthomonas*); **black spot of rose; blossom or leaf blight or spot** (*Alternaria, Botrytis, Cercospora, Colletotrichum, Entomosporium*); **Botrytis blight** (gray mold); **canker** (*Botryodiplodia, Cytospora, Nectria, Tubercularia*) (tree injection); **conifer shoot/tip blight** (*Phomopsis*); **crown gall; downy mildew; Dutch elm disease; fire blight; needle blight; Phytophthora** (aerial); **powdery mildew; rust** (*Dracaena, Geranium, Hawthorn*); **scab; soilborne diseases (root rot)** (non-water molds) (*Cylindrocladium, Rhizoctonia*); **sycamore anthracnose; tip blight of pine** (*Sphaeropsis [Diplodia]*); **Verticillium wilt; Volutella leaf blight**

Applications for tree injection: **anthracnose** (Sycamore); **Dutch elm disease**

Approved for use in greenhouses: yes

Use restrictions: do not apply more than 20 lb Cu+ per acre per year. Do not apply product more than once every 7 days.

Cautions: check for phytotoxicity before large-scale use of copper fungicides; to prevent residues on many plants, avoid use of copper compounds just before selling season. Do not apply sulfur over 90oF, in full sun, or 3 weeks after an oil spray.

Trade name	Metallic copper equivalent	Formulation	Manufacturer
Copper Sulfate Crystals [EPA Reg. No. 56576-1] (prepare as Bordeaux) (Botrytis blight control for bulbs only)	25%	crystalline	Chem One Ltd.
MasterCop [EPA Reg. No. 55272-18-66222] (sycamore anthracnose only)	5.4%	FC	Makhteshim Agan of North America, Inc.
Phyton 27 [EPA Reg. No. 49538-2] (pentahydrate) (includes label for bulb dip; tree injection)	5.5%	SC	Phyton Corporation

cuprous oxide [Cu₂O]

FRAC: Group M1 fungicide (inorganic)

Resistance risk: generally considered low (no indication of fungicide resistance); no cross resistance between group members M1 to M9

Sites: greenhouse (bed, bench, container); interiorscape; landscape; nursery; shade house (professional use only)

REI: 24 hours

Application: foliar spray

Application interval: 7 to 14 days; 3 to 4 weeks (conifers)

Uses: **broadleaf trees and shrubs; conifers; ferns; flowering plants; foliage plants; palms** [Arborvitae, Azalea/Rhododendron, Begonia, Bougainvillea, Camellia, Camphor Tree, Canna, Chinese Tallowtree, Chrysanthemum, Cotoneaster, Dahlia, Dianthus (including Carnation), Dogwood (Flowering), Douglas Fir, Echinacea, Elm (Drake's Chinese), Euonymus, False Aralia, Fern (Japanese Holly), Gardenia, Geranium, Gladiolus, Golden Rain Tree, Hibiscus (including Rose of Sharon), Hosta, Impatiens, Indian Hawthorn, Ivy (Algerian, English), Ixora, Juniper (including Eastern Red Cedar), Lantana, Lilac, Lily (Easter), Loblolly Bay, Loquat (non bearing), Magnolia (Saucer, Southern, Sweet Bay), Mandevilla, Marigold, Mulberry (non bearing) (Weeping), Oak (Laurel), Oleander, Pachysandra, Palm (Date, European Fan, Queen, Washingtonia), Pear (Flowering) (non bearing), Pentas, Peony, Philodendron, Phlox, Photinia, Pine, Pistachio (non bearing), Powder Puff Plant, Pyracantha, Rose, Sycamore, Tulip, Verbena, Viburnum, Vinca (including Periwinkle), Viola (Pansy), Willow (Weeping), Yucca (Adam's Needle)]

Diseases (fungal, bacterial): anthracnose; bacterial leaf spot (*Erwinia*, *Pseudomonas*, *Xanthomonas*); **bacterial soft rot; black spot of rose; blossom or leaf blight or spot** (algal, *Alternaria*, *Botrytis*, *Cercospora*, *Colletotrichum*, *Entomosporium*, *Exosporium*, *Pestalotia*, *Septoria*); **Botrytis blight** (gray mold); **conifer shoot/tip blight** (*Phomopsis*); **downy mildew; fire blight; needle blight; needle cast; Phytophthora** (aerial); **powdery mildew; scab; sycamore anthracnose; tip blight of pine** (*Sphaeropsis* [*Diplodia*]); **Volutella leaf blight**

Approved for use in greenhouses: yes

Cautions: check for phytotoxicity before large-scale use of copper fungicides; to prevent residues on many plants, avoid use of copper compounds just before selling season.

Trade name	Metallic copper equivalent	Formulation	Manufacturer
Nordox 75 WG [EPA Reg. No. 48142-4]	75%	WDG	Monterey AgResource
Nordox Super Micronized Fungicide [EPA Reg. No. 48142-1]	50.1%	WP	Monterey AgResources

cyazofamid

FRAC: Group 21 fungicide (Qil fungicides, cyano-imidazole)

Resistance risk: resistance risk unknown but assumed to be medium to high (mutations at target site known in model organisms); resistance management required

Sites: forest nursery; greenhouse; landscape; nursery (container, field)

REI: 12 hours

Application: foliar spray; soil drench; soil surface spray

Application interval: 14 to 28 days

Uses: **broadleaf trees and shrubs; conifers; flowering plants; foliage plants**

Diseases (fungal): **downy mildew; *Phytophthora* (aerial); soilborne diseases (including damping-off)** (oomycetes) (*Phytophthora, Pythium*); **downy mildew**

Approved for use in greenhouses: yes

Use restrictions: do not apply more than two consecutive applications per season, and do not apply more than four foliar sprays per season. Application by homeowners to residential turf is prohibited.

Trade name	Formulation	Manufacturer
Segway Fungicide [EPA Reg. No. 71512-13-279]	3 EC	FMC Professional Solutions

dicloran

FRAC: Group 14 fungicide (aromatic hydrocarbons)

Resistance risk: resistance risk known in some fungi; low to medium risk

Sites: forest nursery (bare root, container); greenhouse; nursery (container, field)

REI: 12 hours

Application: bulb soak; dormant application; foliar spray; furrow application

Application interval: 7 to 14 days

Uses: **conifers** (includes Christmas trees); **select ornamentals** [Arborvitae (Western Red Cedar), Chrysanthemum, Douglas Fir, Fir (Noble), Geranium, Gladiolus, Hemlock, Hydrangea, Rose, Sequoia (Redwood), Spruce (Sitka)]

Diseases (fungal): **Botrytis blight** (grey mold); **dry rot** (*Stromatinia*)

Approved for use in greenhouses: yes

Use restrictions: do not apply more than 5-1/3 lb formulated product per acre per year.

Trade name	Formulation	Manufacturer
Botran 75-W Fungicide [EPA Reg. No. 10163-189]	75 WP	Gowan Company

dimethomorph

FRAC: Group 40 fungicide (carbolic acid amides, cinnamic acid amides)

Resistance risk: resistance known in some fungi; low to medium risk

Sites: artificial substrate and hydroponic systems; greenhouse (bed, bench, container); lath and shade house; nursery (field, outdoor container)

REI: 12 hours

Application: foliar spray; soil drench; soil surface spray

Application interval: 10 to 14 days; 2 to 4 weeks (non-circulating hydroponic systems); 4 weeks (circulating hydroponic systems)

Uses: **bedding plants; broadleaf trees and shrubs; conifers; cut flowers; foliage plants; flowering plants; groundcovers; herbaceous ornamentals; potted crops; perennials** [African Violet, Andromeda (Pieris), Anthurium, Alyssum, Azalea (including Florist)/Rhododendron, Begonia, Camellia, Candytuft, Chrysanthemum, Cordyline, Daisy (Gerbera), Dianthus (including Pink), Dieffenbachia, Dogwood (Flowering), Douglas Fir, Dusty Miller, Exacum, Ficus, Fir (Fraser, Noble), Geranium, Honeysuckle (check species), Impatiens, Limonium (Statice), Lisianthus, Oak, Petunia, Phlox, Poinsettia, Pothos, Primula, Rose (Cut, Hybrid Tea, Miniature), Snapdragon, Spathiphyllum, Stock, Tanoak, Verbena (Vervain), Viburnum, Vinca (Periwinkle), Viola (including Pansy)]

Diseases (fungal): **downy mildew** (*Bremia*, *Peronospora*, *Pseudoperonospora*, *Plasmopara*); **Phytophthora** (aerial, root, crown, and stem rot) (includes *Phytophthora ramorum*)

Approved for use in greenhouses: yes

Use restrictions: do not apply more than eight applications per crop per season for greenhouse ornamentals. Do not apply more than 30.6 (SC) or 32 (WP) oz product per acre per year for outdoor grown ornamentals (see label).

Trade name	Formulation	Manufacturer
Stature DM [EPA Reg. No. 241-419]	50 WP	BASF Specialty Products
Stature SC [EPA Reg. No. 241-428]	4.18 SC	BASF Specialty Products

tridiazole

FRAC: Group 14 fungicide (heteroaromatics, 1,2,4-thiadiazoles)

Resistance risk: resistance known in some fungi; low to medium risk

Sites: greenhouse (commercial use only)

REI: 12 hours

Application: soil drench (also at time of seeding or transplant)

Application interval: 4 to 12 weeks

Uses: bedding plants, foliage plants, ferns; flowering plants, palms; woody ornamentals [African Violet, Ageratum, Aglaonema (Chinese Evergreen), Ajuga, Aluminum Plant (Pilea), Alyssum, Andromeda (Pieris), Anthurium, Arborvitae, Arctostaphylos, Aster, Azalea/Rhododendron, Baby's Breath (Gypsophila), Begonia, Boxwood, Buckthorn (Rhamnus), Cactus (including Holiday), Caladium, Calathea, Calceolaria, Calendula, Camellia, Carissa, Ceanothus, Celosia, Chrysanthemum, Cineraria, Coleus, Crassula (Jade Plant), Dahlia, Daisy (Gerbera), Daphne, Delphinium, Dianthus (including Carnation), Dieffenbachia, Dusty Miller, Echeveria, Euonymus, Fern (Boston), Ficus, Fir, Foxglove, Geranium, Gloxinia (Sinningia), Gynura, Heather, Hemlock, Hoya, Impatiens (Balsam), Ivy, Juniper, Kalanchoe, Laurel, Leucothoe, Lily (Easter), Limonium (Statice), Magnolia, Maple, Marigold, Nephthytis, Norfolk Island Pine, Orchid, Palm (Areca, Parlor), Peperomia, Petunia, Philodendron, Phlox, Pine (Red, Southern, Western), Podocarpus, Poinsettia, Portulaca, Pothos, Prayer Plant (Maranta), Privet (Ligustrum), Salvia, Sansevieria, Schefflera (Brassaia), Snapdragon, Stokesia, Stromanthe, Verbena, Vinca, Viola (Pansy), Yew, Zinnia]

Diseases (fungal): Soilborne diseases (damping-off; crown, root, and stem rot) (oomycetes) (*Phytophthora*, *Pythium*)

Approved for use in greenhouses: yes

Use restrictions: use in residential greenhouse use and other indoor sites prohibited.

Trade name	Formulation	Manufacturer
Terrazole 35% Wettable Powder [EPA Reg. No. 400-416]	35 WP	Chemtura Corporation
Truban 25 EC [EPA Reg. No. 58185-8]	25 EC	Everiss (Scotts Company)
Truban 30 WP [EPA Reg. No. 58185-7]	30 WP	Everiss (Scotts Company)

fenamidone

FRAC: Group 11 fungicide (QoI-fungicides, imidazolinones)

Resistance risk: resistance known in various fungal species; high risk; resistance management required

Sites: greenhouse (commercial use only)

REI: 12 hours

Application: foliar spray; soil drench

Application interval: 28 days

Uses: **foliage plants; flowering plants; woody ornamentals** [Alyssum, Azalea/Rhododendron, Geranium, Ivy (including English), Lilac, Lily (Easter), Monarda (Bee Balm), Poinsettia, Rose (Hybrid Tea), Spathiphyllum, Vinca]

Diseases (fungal): **soilborne diseases (damping-off; crown, root, and stem rot)** (oomycetes) (*Phytophthora*, *Pythium*); **downy mildew**

Approved for use in greenhouses: yes

Use restrictions: use in residential greenhouse use and other indoor sites prohibited. Do not apply more than two foliar or four drench **applications of** the maximum label rate product per season.

Trade name	Formulation	Manufacturer
FenStop [EPA Reg. No. 432-1389-59807]	4.13 SC	OHP, Inc.

fenarimol

FRAC: Group 3 fungicide (demethylation inhibitors, pyrimidines)

Resistance risk: resistance known in some fungi; medium risk

Sites: greenhouse; landscape; nursery (container, field)

REI: 12 hours

Application: foliar spray

Application interval: 10 to 14 days

Uses: **flowering plants; woody ornamentals** [Ajuga, Begonia, Calendula, Chrysanthemum, Crabapple, Crape Myrtle, Dahlia, Delphinium, Dogwood, Euonymus, Hawthorn, Hydrangea, Phlox, Photinia, Rose (field and landscape), Sweet Pea, Verbena, Zinnia]

Diseases (fungal): powdery mildew; scab (Crabapple, Hawthorn); **rust** (Crabapple, Hawthorn)

Approved for use in greenhouses: yes

Use restrictions: commercial use only. Do not apply product more than once in 60 days or more than 3 times per year.

Trade name	Formulation	Manufacturer
Rubigan A.S. [EPA Reg. No. 10163-274]	1 EC	Gowan Company

fenhexamid

FRAC: Group 17 fungicide (hydroxyanilides)

Resistance risk: low to medium risk; resistance management required

Sites: forest (conifer) nursery; greenhouse; nursery; post-harvest (cut flowers, rose budwood, bare-root nursery stock)

REI: 12 hours

Application: foliar spray

Application interval: 7 to 14 days

Uses: **conifers; flowering plants; non-bearing fruit and vines; woody ornamentals** [African Violet, Crabapple, Daisy (Gerbera), Douglas Fir, Fuchsia, Geranium, Hemlock (Western), Impatiens, Iris, Lily (Asiatic, Oriental), Lisianthus, Narcissus (Daffodil), Petunia, Plum (Flowering) (non bearing), Poinsettia, Ranunculus, Rose, Snapdragon, Spathiphyllum, Tulip, Viola (Pansy)]

Diseases (fungal): Botrytis blight (gray mold)

Approved for use in greenhouses: yes

Use restrictions: not for residential use. Do not treat plants used for food or feed. Do not apply more than 3 lb a.i. per acre per season (outdoors) or 2.2 oz product per 1,000 square feet per crop cycle (greenhouse). Do not make more than two consecutive applications of product.

Cautions: Poinsettia bracts may be sensitive to product under certain conditions; use caution.

Note: when this product is used for Botrytis control, suppression of powdery mildew may also be achieved.

Trade name	Formulation	Manufacturer
Decree 50 WDG Fungicide [EPA Reg. No. 66330-35-67690]	50 WDG	SePRO Corporation

fluopicolide

FRAC: Group 43 fungicide (benzamides, pyridinylmethyl-benzamides)

Resistance risk: unknown

Sites: Christmas tree; greenhouse (bed, bench, container); lath and shade house; landscape; nursery (outdoors)

REI: 12 hours

Application: foliar spray; soil drench

Application interval: 14 to 28 days

Uses: **bedding plants; Christmas trees; conifers; flowering plants; foliage plants; ground covers; non bearing fruit and nut trees; ornamental shrubs and trees; vines** [Alder, African Violet, Azalea/Rhododendron, Camellia, Coleus, Crabapple, Cucurbita (Squash) (Ornamental), Daisy (Gerbera, Transvaal), Apple, Flowering (non bearing), Ivy (English), Fir (Grand, Noble), Gardenia, Geranium, Lavender (English), Liriope (Lilyturf) (Big Blue), Marigold, Pothos, Snapdragon, Spathiphyllum, Vinca (Periwinkle), Viola (Pansy)]

Diseases (fungal): **soilborne diseases (damping-off; crown, root, and stem rot)** (oomycetes) (*Phytophthora*, *Pythium*); **downy mildew**

Approved for use in greenhouses: yes

Use restrictions: do not apply more than two applications of product per cropping cycle. Do not apply product sequentially; alternate with another fungicide registered for use on ornamentals.

Trade name	Formulation	Manufacturer
Adorn Fungicide [EPA Reg. No. 59639-141]	4 FC	Valent U.S.A. Corporation Professional Products

fludioxonil

FRAC: Group 12 fungicide (phenylpyrroles)

Resistance risk: resistance sporadic; low to medium risk; resistance management required

Sites: forest nursery; greenhouse; interiorscape; landscape (commercial, residential); lath and shade house; nursery (container, field)

REI: 12 hours

Application: Medallion: foliar spray; soil drench; pre-potting media mix; Mozart TR: pressurized liquid

Application interval: Medallion: 7 to 14 days; 21 to 28 days (at transplant); Mozart TR: 2 applications at 7-day intervals

Uses: **bedding plants; flowering and foliage plants; perennials; woody ornamentals** [African Violet, Ageratum, Alyssum, Aster, Astilbe (Bridal Veil), Azalea (including Florist)/Rhododendron, Barberry, Begonia, Cactus (Holiday), Caladium, Calendula, Celosia, Centrosema, Chenille, Chrysanthemum (Garden Mum), Coleus, Cotoneaster, Coreopsis, Cuphea (Mexican Heather), Cyclamen, Dahlia, Daisy (including Gerbera), Dicentra (Bleeding Heart), Dianthus (Carnation), Euonymus, Fern (including Boston), Fuchsia, Geranium, Gomphrena, Heuchera, Hibiscus, Holly, Ivy, Juniper, Kalanchoe, Lantana, Lily, Lisianthus, Marigold, Monarda, Nephthytis, New Guinea Impatiens, Oak, Orchid, Petunia, Philodendron, Pine, Pittosporum, Poinsettia, Portulaca, Pothos, Rose, Rudbeckia, Salvia, Schefflera, Snapdragon, Spathiphyllum, Spiraea, Spruce, Sunflower (Ornamental), Tobacco (Flowering), Tradescantia (Wandering Jew), Verbena, Veronica, Viburnum, Vinca, Viola (Pansy), Yew, Zinnia]

Diseases (fungal): **black root rot** (*Thielaviopsis*); **Botrytis blight; downy mildew; leaf spot and blight** (*Alternaria*, *Cercospora*, *Myrothecium*, *Septoria*); **powdery mildew; rust; soilborne diseases (root and stem rot)** (non-water molds) (*Cylindrocladium*, *Fusarium*, *Rhizoctonia*); **southern blight** (*Sclerotium*); **web blight** (*Rhizoctonia*)

Approved for use in greenhouses: yes

Use restrictions: maximum use rate of Medallion is 80 lb product per acre per year. Restrict use of Mozart TR to four

Applications per crop cycle.

Cautions: drench or at-seedling **applications** to Impatiens or New Guinea Impatiens may cause stunting and/or chlorosis; foliar or drench **applications** to some Geranium varieties may cause stunting or chlorosis at higher rates. Note that for many hosts (i.e., Astilbe, Dicentra, Centrosema, Chenille, Coreopsis, Dahlia, Daisy, Fuchsia, Lantana, Cuphea, Nephthytis, Portulaca, Sunflower, Tobacco, Tradescantia), only foliar **applications** have been tested for plant safety.

Trade name	Formulation	Manufacturer
Medallion Fungicide [EPA Reg. No. 100-769]	50 WP	Syngenta Professional Products
Mozart TR Fungicide [EPA Reg. No. 499-534] (commercial greenhouse use only)	6.5% Pressurized liquid	BASF Specialty Products

fluoxastrobin

FRAC: Group 11 fungicide (QoI-fungicides, dihydro-dioxazines)

Resistance risk: resistance known for several fungal species; high risk; resistance management required

Sites: greenhouse (beds, benches, flats, plugs); enclosed structures; interiorscape; landscape (commercial, municipal, residential); nursery (container, outdoor, retail); shade house

REI: 12 hours

Application: crown and soil surface spray; foliar spray; soil drench

Application interval: 7 to 28 days

Uses: broadleaf trees and shrubs; flowering plants; foliage plants [African Violet, Ageratum, Angelonia, Argyranthemum, Bacopa, Begonia, Calibrachoa, Chrysanthemum, Coleus, Dahlia, Daisy (Gerbera), Dianthus, Dogwood, Geranium, Hollyhock, Impatiens (New Guinea, Walleriana), Lantana, Lobelia, Lupine, Monarda, Nemesia, Osteospermum, Pentas, Petunia, Rose, Scaevola, Snapdragon, Torenia, Verbena, Zinnia]

Diseases (fungal): anthracnose (*Colletotrichum*, *Elsinoë*); **blossom or leaf blight or spot** (*Ascochyta*, *Alternaria*, *Cercospora*, *Corynespora*, *Diplocarpon*, *Myrothecium*, *Sclerotinia*, *Septoria*); **Botrytis blight; downy mildew** (*Bremia*, *Peronospora*, *Plasmopara*, *Pseudoperonospora*); **Phytophthora** (aerial); **powdery mildew** (*Erysiphe*, *Microsphaera*, *Podosphaera*, *Sphaerotheca*, *Uncinula*); **rust** (*Melampsora*, *Phragmidium*, *Puccinia*, *Uromyces*); **scab** (*Venturia*); **soilborne diseases (root and stem rot)** (non-water molds) (*Fusarium*, *Rhizoctonia*, *Sclerotium*) and (oomycetes) (*Phytophthora*)

Approved for use in greenhouses: yes

Use restrictions: maximum use rate is 2.2 lb a.i. per acre per year.

Trade name	Formulation	Manufacturer
Disarm 480 SC [EPA Reg. No. 66330-64]	4 FC	Arysta LifeScience North America LLC

flutolanil

FRAC: Group 7 fungicide (succinate dehydrogenase inhibitors, phenyl-benzamides)

Resistance risk: resistance known for several fungal species; medium to high risk; resistance management required

Sites: greenhouse, nursery (container, field), saran and shade house

REI: 12 hours

Application: bulb, corm, and rhizome dip; cutting dip; foliar spray, soil drench

Application interval: 14 to 21 days

Uses: **bedding plants; broadleaf trees and shrubs; conifers; flowering and foliage plants; non bearing fruit trees** [Apple (Flowering) (non bearing), Azalea, Cedar, Chrysanthemum, Crabapple, Douglas Fir, Geranium, Fern, Hawthorn, Holly, Hollyhock, Iris, Ivy (English), Lily, Pear (Flowering) (non bearing), Petunia, Pittosporum, Poinsettia, Pothos, Rose, Snapdragon]

Diseases (fungal): **rust; soilborne diseases (non-water molds)** (*Rhizoctonia*, *Sclerotium*); **web blight** (*Rhizoctonia*)

Approved for use in greenhouses: yes

Use restrictions: maximum use rate is four **Applications** of product per year.

Trade name	Formulation	Manufacturer
ProStar 70 WDG Fungicide [EPA Reg. No. 432-1477]	70 WSP	Bayer Environmental Science

fosetyl-Al [aluminum tris (O-ethylphosphonate)]

FRAC: Group 33 fungicide (phosphonates, ethyl phosphonates)

Resistance risk: few cases of resistance reported; low risk

Sites: forest nursery; greenhouse; landscape; nursery

REI: 12 hours

Application: conifer transplant dip; foliar spray; soil drench; soil media incorporation

Application interval: 7 days (Roses, fireblight, bacterial blight); 14 days (bedding plants); 30 days (other uses)

Uses: **bedding plants; broadleaf trees and shrubs; conifers; flowering and foliage plants** [Aglaonema (Chinese Evergreen), Andromeda (Pieris), Anthurium, Aphelandra, Azalea/Rhododendron, Begonia, Bougainvillea, Boxwood, Dieffenbachia, Douglas Fir, Fern (Leather-leaf), Ficus, Flowering (non bearing) Pear, Geranium, Grape Ivy (Cissus), Hawthorn, Hibiscus, Holly (Japanese), Impatiens, Ivy (English), Juniper, Marigold, Orchid (Skinner's Cattleya), Petunia, Philodendron, Pine (Monterey), Pittosporum, Pothos, Pyracantha, Rose, Schefflera, Spathiphyllum, Spruce, Syngonium, Vinca, Viola (Pansy), Yew (Taxus x media), Zinnia]

Diseases (fungal, bacterial): **downy mildew** (Rose); **bacterial blight** (*Xanthomonas*); **fire blight; soilborne diseases** (oomycetes) (*Phytophthora*, *Pythium*)

Approved for use in greenhouses: yes

Use restrictions: not for home or residential use.

Cautions: to avoid phytotoxicity, do not tank mix product with copper-based compounds.

Trade name	Formulation	Manufacturer
Aliette WDG [EPA Reg. No. 432-890]	80 WDG	Bayer Environmental Science
Flanker WDG Ornamental Fungicide [EPA Reg. No. 61842-9]	80 WDG	Tessenderlo Kerley, Inc. (NovaSource)
Quali-Pro Fosetyl-Al 80 WDG [EPA Reg. No. 66222-161]	80 WDG	Quali-Pro

imazalil

FRAC: Group 3 fungicide (demethylation inhibitors, imidazoles)

Resistance risk: resistance known in some fungi; medium risk

Sites: greenhouse (commercial)

REI: 24 hours

Application: pressurized liquid

Application interval: two to four applications at 7-day intervals

Uses: bedding plants, broadleaf trees and shrubs, flowering and foliage plants [African Violet, Azalea (including Florist)/ Rhododendron, Barberry, Begonia, Chrysanthemum (including Garden Mum), Cotoneaster, Dianthus (Carnation), Euonymus, Fern (Boston), Fuchsia, Geranium, Heuchera, Hibiscus, Holly, Impatiens (New Guinea), Ivy, Juniper, Kalanchoe, Lantana, Lily, Marigold, Monarda, Oak, Orchid, Petunia, Philodendron, Pine, Poinsettia, Rose, Rudbeckia, Schefflera, Spiraea, Spruce, Veronica, Viburnum, Yew]

Diseases (fungal): **Botrytis blight; leaf blight** (*Alternaria*); **downy mildew; powdery mildew; rust**

Approved for use in greenhouses: yes

Use restrictions: commercial greenhouse use only. Up to eight applications per crop is permitted.

Trade name	Formulation	Manufacturer
Fungaflor TR Dry Micro Total Release Fungicide [EPA Reg. No. 499-508]	14% Pressurized liquid	BASF Specialty Products

iprodione

FRAC: Group 2 fungicide (dicarboximides)

Resistance risk: common in *Botrytis* and other pathogens; medium to high risk

Sites: greenhouse; landscape; nursery (field, conifer nurseries) (commercial use only)

REI: 12 hours

Application: foliar spray; plant dip; soil drench

Application interval: 7 to 14 days (foliar); 14 days (drench)

Uses: **broadleaf trees and shrubs; conifers; flowering plants; foliage plants; palm** [Ageratum, Ajuga, Almond (Flowering) (non bearing), Aluminum Plant (Pilea), Alyssum, Andromeda (Pieris), Aphelandra, Artemisia, Aster, Azalea/Rhododendron, Baby's Breath (Gypsophila), Boxwood, Cactus, Calendula, Cherry (Flowering) (non bearing), Chrysanthemum, Cineraria, Coleus, Columbine, Crape Myrtle, Crassula (Jade Plant), Croton, Cyclamen, Dahlia, Delphinium, Deutzia, Dianthus (including Carnation), Dieffenbachia, Dogwood, Dracaena, Euonymus, False Aralia (Dizygotheca), Ficus, Flame Violet (Episcia), Forsythia, Gazania, Geranium, Gladiolus, Gloxinia, Hawthorn, Heuchera, Holly, Hoya, Hydrangea, Impatiens, Iris, Ivy (English), Juniper, Kalanchoe, Lily, Limonium (Statice), Lipstick Plant, Marigold, Monarda, Narcissus (Daffodil), Pachysandra, Palm, Peach (Flowering) (non bearing), Peperomia, Philodendron, Phlox, Pine, Pittosporum, Plum (Flowering) (non bearing) (including Cistena Plum, Rose Tree of China), Poinsettia, Poppy, Pothos, Primula, Privet, Protea, Pyracantha, Rose, Salvia, Schefflera, Snapdragon, Tulip, Viburnum, Vinca (Periwinkle), Viola (Pansy, Violet), Zinnia]

Diseases (fungal): **blossom or leaf blight or spot** (*Alternaria*, *Fusarium*, *Helminthosporium*, *Monilinia*); **Botrytis blight; Botrytis storage rot; corm rot** (*Fusarium*); **Cylindrocladium blight; daffodil leaf scorch** (*Stagonospora*); **ink spot** (*Drechslera*); **ray blight** (*Ascochyta*); **soilborne diseases (root and stem rot)** (non-water molds) (*Rhizoctonia*); **tulip fire; web blight** (*Rhizoctonia*)

Applications for plant dip: **Botrytis storage rot** (Rose); **Cylindrocladium blight** (Azalea/Rhododendron); **Fusarium corm rot** (Gladiolus)

Approved for use in greenhouses: yes

Use restrictions: not for residential use. Do not make more than 4 applications per crop per year (foliar spray). Do not apply more than 6 applications or more than 24 lb a.i. per acre per year (drench).

Cautions: Not recommended for use on *Spathiphyllum* or as a drench on *Impatiens*, *Pothos*.

Trade name	Formulation	Manufacturer
26 GT [EPA Reg. No. 432-888]	2 EC	Bayer Environmental Science
Chipco 26019 [EPA Reg. No. 432-889]	2 EC	Bayer Environmental Science
Chipco 26019 N/G [EPA Reg. No. 432-889]	50 WP	Bayer Environmental Science
Quali-Pro Ipro 2SE [EPA Reg. No. 66222-214]	2 EC	Quali-Pro
Iprodione Pro 2SE [EPA Reg. No. 66330-305-7969]	2 EC	BASF Specialty Products
OHP 26 GT-O [EPA Reg. No. 432-888-59807]	2 EC	OHP, Inc.
OHP Chipco 26019 N/G [EPA Reg. No. 432-889-59807]	50 WP	OHP, Inc.
Raven Fungicide [EPA Reg. No. 81943-13]	2 EC	Phoenix Environmental Care LLC

kresoxim-methyl

FRAC: Group 11 fungicide (QoI-fungicides, oximino acetates)

Resistance risk: resistance known for several fungal species; high risk; resistance management required

Sites: greenhouse; landscape (nonresidential); lath- and shade house; nursery (outdoor, retail)

REI: 12 hours

Application: foliar spray

Application interval: 7 to 14 days

Uses: broadleaf trees and shrubs; conifers; ferns; flowering plants; foliage plants [Ageratum, Alstroemeria, Amelanchier (Serviceberry), Artichoke Thistle, Apple (Flowering) (non bearing), Aster, Azalea/Rhododendron, Celosia, Centaurea, Cherry (Flowering) (non bearing) (including Kwanzan, Mt. Fuji, Shirofugen, Yoshino, Okame), Cherry Laurel, Chrysanthemum, Cinquefoil (Shrubby), Citrus (nonbearing), Clematis, Columbine, Coreopsis (Tick Seed), Crabapple, Cryptomeria (Japanese Cedar), Dahlia, Daisy (Gerbera), Delphinium, Dianthus (Carnation), Dogwood, Dracaena, Euonymus, Fern (Asparagus), Gazania, Geranium, Gladiolus, Hawthorn, Honeysuckle, Hosta, Hydrangea, Impatiens, Indian Hawthorn, Iris, Juniper, Lilac, Lily, Limonium, Loquat (non bearing), Magnolia (Saucer), Maple (Hedge, Norway, Southern, Sycamore), Marigold, Monarda, Oak (English, Swamp Chestnut, Water), Peach (including Nectarine) (Flowering) (non bearing), Pear (Flowering) (non bearing), Petunia, Phlox, Plum (Flowering) (non bearing), Poinsettia, Portulaca, Ribes, Rose, Rosemary, Sedum, Snapdragon, Spiraea, Spruce (Alberta), Tradescantia (Spiderwort), Tulip, Verbena, Veronica, Viburnum, Vinca, Viola (Pansy), Yew, Zinnia]

Diseases (fungal): anthracnose (*Colletotrichum*); black spot of rose; downy mildew (*Peronospora*); leaf spot and blight (*Alternaria*, *Blumeriella*, *Didymellina*, *Drepanopeziza*, *Mycosphaerella*, *Phyllosticta*, *Septoria*); powdery mildew (*Erysiphe*, *Microsphaera*, *Oidium*, *Phyllactinia*, *Podosphaera*, *Sphaerotheca*, *Uncinula*); rust (*Gymnosporangium*, *Phragmidium*, *Puccinia*); scab (*Venturia*)

Approved for use in greenhouses: yes

Use restrictions: do not make more than 6 (outdoors) or 8 (greenhouse) applications of product per season (outdoors) or year (greenhouse).

Intolerant varieties: may cause injury to Asian Pear variety Olympic and certain sensitive Sweet Cherry varieties (Angela, Cavalier, Chelan, Coral Champagne, Emperor Francis, Royalton, Schmidt, Somerset, Summit, Sweetheart, Valera, Van, Vandalay, Vista, Viva).

Trade name	Formulation	Manufacturer
Cygnus Fungicide [EPA Reg. No. 7969-124]	50 WDG	BASF Specialty Products

mancozeb [a coordination product of zinc ion and manganese bisdithiocarbamate]

FRAC: Group M3 fungicide (dithiocarbamates)

Resistance risk: generally considered low (no indication of fungicide resistance); no cross resistance between group members M1 to M9

Sites: Christmas tree; greenhouse, lath, hoop, and shade house; landscape (professional use only); nursery (field)

REI: 24 hours

Application: foliar spray

Application interval: 7 to 14 days; 2 to 3 times weekly (blossoms)

Uses: **broadleaf trees and shrubs; conifers; cut flowers; flowering plants; ferns; foliage plants; orchids; palms; roses** [Abutilon, Aesculus (Buckeye, Horse Chestnut), African Violet, Ageratum, Aglaonema (Chinese Evergreen), Almond (Flowering) (non bearing), Aluminum Plant (Pilea), Alyssum, Andromeda (Pieris), Anthurium, Aphelandra (Zebra Plant), Apple (Flowering) (non bearing), Arborvitae (Western Red Cedar), Ash (including White), Aster, Aucuba (Japanese, Gold-dust Tree), Azalea/Rhododendron, Baby's Breath, Begonia, Birch, Boston Ivy, Bougainvillea, Boxwood, Buffalo Berry, Cactus (Holiday), Camellia, Carya (Hickory), Catalpa, Cedar, Celosia (Cockscomb), Centaurea (Dusty Miller), Cherry (Flowering) (non bearing) (including Sand Cherry); Cherry Laurel, China Aster, Christmas Trees, Chrysanthemum (Chrysanthemum, Dendranthema), Coleus, Columbine, Conifers, Cordyline, Cotoneaster, Crabapple, Cranesbill (Geranium), Crape Myrtle, Crassula (Jade Plant), Croton, Cuphea (Mexican Heather), Cyclamen, Cypress (including Arizona), Dahlia, Daisy (including Gerbera), Daylily, Delphinium, Dianthus (Carnation), Dieffenbachia, Dogwood, Douglas Fir, Dracaena, Elm, Euonymus (Spindle Tree), Fatsia, Fern (Boston, Polypodium, Polystichum, Pteris), Ficus (Ornamental Fig), Fir (including Fraser), Fittonia, Four O'Clock, Fuchsia, Gardenia, Geranium, Gladiolus, Gloxinia, Gomphrena, Hawthorn (Thornapple), Hemlock (Eastern), Hibiscus, Holly, Hollyhock, Honeysuckle, Hydrangea, Impatiens (including Garden Balsam), Indian Hawthorn, Iris, Ivy (English), Juniper (including Red Cedar), Kalanchoe, Leyland Cypress, Lilac, Lily, Limonium (Statice), Linden (Basswood), Liriope, Lobelia (Cardinal Flower), Loquat (non bearing), Madagascar Palm, Magnolia, Maple, Marigold, Mountain Ash, Mountain Laurel, Myrtle, Narcissus, Nasturtium, Nephthytis, Nierembergia, Norfolk Island Pine, Oak, Orchid (including Cattleya, Cymbidium, Dendrobium, Epidendrum, Odontoglossum, Phalaenopsis, Vanda), Oregon Grape Holly, Osmanthus, Oxalis, Pachysandra (Spurge), Palm (Areca, Arenga, Cabbage, Chamaedorea, Coconut, Date, King, Phoenix, Queen, Royal, Washingtonia), Peach (Flowering) (non bearing), Pear (Flowering) (non bearing), Peony, Peperomia, Petunia, Philodendron, Phlox, Photinia (Red-tip), Pine (including Austrian, Scotch), Pittosporum, Pleomele, Plum (Flowering) (non bearing), Poinsettia, Poplar (Aspen), Portulaca, Pothos, Prayer Plant, Primula, Privet (Ligustrum), Protea, Pyracantha, Quince (Flowering) (non bearing), Rose, Rosemary, Russian Olive, Salvia (Sage), Sansevieria (Snake Plant), Santolina (including Cotton Lavender), Schefflera, Senecio, Sequoia (Redwood), Snapdragon, Spathiphyllum, Spiraea, Spruce, Strawflower, Sumac (Skunkbush), Sunflower (Ornamental), Sycamore/Plane Tree, Syngonium, Tobacco (Flowering), Tulip, Venus Flytrap, Verbena, Viburnum (including Nannyberry), Vinca (including Catharanthus), Viola (Pansy), Walnut (non bearing), Willow, Wisteria, Yucca, Zinnia]

Diseases (fungal): anthracnose (*Colletotrichum*, *Elsinoë*, *Gloeodes* (*Phyllachora*), *Gloeosporium*, *Glomerella*, *Gnomonia*, *Guignardia*, *Kabatella*); **black spot of elm; black spot of rose; blossom or leaf blight or spot** (*Actinopelte*, *Alternaria*, *Ascochyta*, *Bipolaris*, *Blumeriella*, *Botrytis*, *Botryotinia*, *Cephalosporium*, *Cercospora*, *Coccomyces*, *Coryneum*, *Curvularia*, *Cylindrocladium*, *Cylindrosporium*, *Dactylaria*, *Didymascella*, *Didymellina*, *Diplocarpon*, *Discosia*, *Drechslera*, *Entomosporium*, *Exserohilum*, *Fabraea*, *Fusarium*, *Fusicladium*, *Guignardia*, *Helminthosporium*, *Herpobasidium*, *Leptosphaeria*, *Leptothyrium*, *Marssonina*, *Monilinia*, *Monochaetia*, *Mycosphaerella*, *Myrothecium*, *Pestalotia*, *Phoma*, *Phyllosticta*, *Ramularia*, *Rhytisma*, *Sclerotinia*, *Septoria*, *Stemphylium*, *Stigmata*, *Whetzelinia*); **Botrytis blight** (gray mold); **brown rot** (*Monilinia*, *Sclerotinia*, *Whetzelinia*); **conifer tip and twig blight** (*Kabatina*, *Sirococcus*, *Phomopsis*, *Sphaeropsis* [*Diplodia*]); **dieback** (*Botryosphaeria*, *Phomopsis*); **Discula anthracnose** (Dogwood); **downy mildew** (*Peronospora*, *Plasmopara*); **felt** (*Septobasidium*); **ink spot** (*Ciborinia*, *Mystrosporium*, *Sclerotinia*, *Whetzelinia*); **leaf and flower gall** (*Exobasidium*); **leaf blister** (*Taphrina*); **needle cast** (*Cyclaneusma*, *Ismiella*, *Lophodermium*, *Naemacylus*, *Pestalotia*, *Phaeocryptopus*, *Rhabdocline*, *Rhizosphaera*, *Scirrhia*, *Sphaeropsis*); **Ovulinia petal blight; Phytophthora** (aerial); **rust** (*Cronartium*, *Endocronartium*, *Gymnosporangium*, *Melampsora*, *Melampsoridium*, *Phragmidium*, *Puccinia*, *Uromyces*); **scab** (*Cladosporium*, *Fusicladium*, *Sphaceloma*, *Venturia*); **Volutella leaf blight; web blight** (*Rhizoctonia*)

Approved for use in greenhouses: yes (not for home greenhouse use)

Use restrictions: not for residential use. Maximum seasonal application rates apply – variable by product and use. Do not use for food or feed.

Cautions: due to highly variable plant responses, use caution on Marigold. Pachysandra has been deleted from some labels.

Trade name	Formulation	Manufacturer
Dithane 75DF Rainshield Specialty Fungicide [EPA Reg. No. 62719-402]	75 WDG	Dow AgroSciences LLC

Dithane DF Rainshield Fungicide [EPA Reg. No. 62719-402] (conifers only)	75 WDG	Dow AgroSciences LLC
Dithane F-45 Rainshield Fungicide [EPA Reg. No. 62719-396] (conifers only)	4 FC	Dow AgroSciences LLC
Dithane M45 Fungicide [EPA Reg. No. 62719-387] (conifers only)	80 WP	Dow AgroSciences LLC
Fore 80WP Rainshield Specialty Fungicide [EPA Reg. No. 62719-388]	80 WP	Dow AgroSciences LLC
Penncozeb 4FL [EPA Reg. No. 70506-194]	4 FC	United Phosphorus, Inc.
Penncozeb 75DF Turf and Ornamental [EPA Reg. No. 70506-185]	75 WDG	United Phosphorus, Inc.
Penncozeb 80WP [EPA Reg. No. 70506-183] (conifers only)	80 WP	United Phosphorus, Inc.
Pentathlon DF Fungicide [EPA Reg. No. 67690-39]	75 WDG	SePRO Corporation
Pentathlon LF Flowable Fungicide [EPA Reg. No. 67690-38]	4 FC	SePRO Corporation
Protect DF [EPA Reg. No. 1001-77]	75 DF	Cleary Chemical Corporation
Roper DF Rainshield [EPA Reg. No. 34704-1063] (conifers only)	75 DF	Loveland Products Inc.
Wingman DF Fungicide [EPA Reg. No. 81943-22]	75 WDG	Phoenix Environmental Care LLC

mandipropamid

FRAC: Group 40 fungicide (carboxylic acid amides, mandelic acid amides)

Resistance risk: low to medium risk; resistance management required

REI: 4 hours

Sites: greenhouse (bench, flat, plug, liner); lath and shade house or other indoor ornamental production structures; nursery (bed, container, field, forest)

Application: soil drench

Application interval: 7 to 14 days

Uses: flowering and woody ornamentals [Alyssum, Anise Hyssop, Arborvitae, Azalea/Rhododendron, Birch (River), Bougainvillea, Boxwood (including Common, Japanese), Buddleja (Butterfly Bush), Caladium, Calibrachoa, Camellia, Ceanothus, Chrysanthemum (Shasta Daisy), Clethra (Summersweet), Coleus, Coreopsis, Crabapple, Daisy (Gerbera), Euonymus (Wintercreeper), Forsythia (including Weeping), Gaillardia, Gardenia (Dwarf), Geranium, Grass, Ornamental (including Fountain, Variegated Japanese Silver), Hibiscus, Holly (including Burford, Schillings), Honeysuckle, Hydrangea, Impatiens (including New Guinea), Ivy (including Algerian, English), Ixora, Jasmine (Star), Juniper, Laurel, Leyland Cypress, Ligustrum, Lilac, Liriope (Lilyturf), Magnolia, Marigold, Mexican Cliffrose, Mock-orange, Palm (Queen), Petunia, Phlox, Pine (including Eastern White, Mugo), Podocarpus, Poinsettia, Pothos, Privet (Ligustrum), Rose (including Miniature), Rudbeckia (Black-eyed Susan), Salvia, Sedum (Stonecrop), Snapdragon, Spiraea, Spruce (Colorado Blue), Stock, Sunflower, Verbena, Viburnum, Vinca (including Periwinkle), Viola (Pansy, Violet), Weigela, Yucca]

Diseases (fungal): downy mildew (*Bremia*, *Peronospora*, *Plasmopara*); **soilborne diseases** (oomycetes) (*Phytophthora*)

Approved for use in greenhouses: yes

Use restrictions: for ornamental applications, do not apply more than 32 fl oz of product (0.52 lb a.i.) per acre per calendar year.

Trade name	Formulation	Manufacturer
Micora [EPA Reg. No. 100-1388]	2.08 lb	Syngenta Crop Protection

mefenoxam (metalaxyl-M)/metalaxyl

FRAC: Group 4 fungicide (phenylamides, acylalanines)

Resistance risk: resistance common in various fungal species; high risk; resistance management required

Sites: Christmas tree (nursery, plantation); greenhouse (bed, bench, container); interiorscape; landscape (commercial, residential); lath and shade house; nursery (container, outdoor)

REI: 48 hours

Application: foliar and stem spray; pre-potting media mix; soil drench; soil surface spray

Application interval: 6 weeks to 4 months; once (some applications)

Uses: **broadleaf trees and shrubs; Christmas trees; conifers; flowering plants; foliage plants; nonbearing fruit and nut trees** [African Violet, Ageratum, Aglaonema (Chinese Evergreen), Andromeda (Pieris), Anthurium, Aphelandra, Arborvitae (White Cedar), Artemisia, Aster, Aucuba (Japanese), Azalea/Rhododendron, Baby’s Breath, Begonia, Blanket Flower (Gaillardia), Boxwood, Cactus (Holiday), Caladium, Ceanothus, Chrysanthemum, Coleus, Columbine, Cotoneaster, Daisy, Delphinium, Dianthus (Carnation, Pink), Dieffenbachia, Dogwood, Ficus, Foxglove, Geranium, Gloxinia, Holly, Honeysuckle (Halls), Houseleek, Impatiens, Ivy (Algerian, English), Juniper, Lily (Easter), Marigold, Peperomia, Petunia, Philodendron, Phlox, Photinia, Pine (including White), Pittosporum, Poinsettia, Pothos, Primula, Rose, Rosemary (prostrate), Salvia (Sage), Schefflera, Sedum, Snapdragon, Verbena, Vinca, Viola (Pansy), Yew, Zinnia]

Diseases (fungal): **downy mildew; *Phytophthora* (aerial); Ramorum blight; soilborne diseases (damping-off; crown and root rot)** (oomycetes) (*Phytophthora*, *Pythium*)

Approved for use in greenhouses: yes

Use restrictions: maximum application rates apply – variable by product and use.

Cautions: to minimize injury, restrictions apply for applications of product to Azalea, Euonymus, Ivy (English), Lily (Easter), and Pothos (see label).

Trade name	Active ingredient	Formulation	Manufacturer
Quali-Pro Mefenoxam 2 AQ [EPA Reg. No. 66222-216]	mefenoxam	2 FC	Quali-Pro
Subdue GR [EPA Reg. No. 100-794]	mefenoxam	1 G	Syngenta Professional Products
Subdue MAXX [EPA Reg. No. 100-796]	mefenoxam	2 EC	Syngenta Professional Products
Vireo MEC Fungicide [EPA Reg. No. 81943-28]	metalaxyl	2 EC	Phoenix Environmental Care LLC

myclobutanil

FRAC: Group 3 fungicide (demethylation inhibitors, triazoles)

Resistance risk: resistance known in some fungi; medium risk

Sites: forest nursery; greenhouse; landscape; nursery

REI: 24 hours

Application: foliar spray; pre-stick dip treatment (Chrysanthemum)

Application interval: 10 to 14 days; 7 to 10 days (black spot); 10 days to 3 weeks (conifers)

Uses: broadleaf trees and shrubs; Christmas trees; conifers; ferns; flowering plants [Abelia, Aesculus (Buckeye, Horse Chestnut), African Violet, Ageratum, Alder, Almond (Flowering) (non bearing), Amelanchier (Juneberry, Shadbush), Amorpha (False Indigo), Anemone, Angelica, Ash, Aster, Azalea/Rhododendron, Barberry, Begonia, Birch, Bittersweet, Blanket Flower (Gaillardia), Buttonbush, Calendula, California Poppy, Campanula (Bellflower), Canna, Catalpa, Centaurea (Cornflower), Chenille, Cherry (Flowering) (non bearing), China Aster, Chokeberry, Chrysanthemum, Cinquefoil (Potentilla), Columbine, Cosmos, Crabapple, Crape Myrtle, Cucurbita (Gourd) (Ornamental), Dahlia, Daisy (Gerbera), Delphinium, Dianthus (Carnation), Dogwood, Douglas Fir (nursery only), Elm, Euonymus, Fern, Fir, Fleabane, Four O'Clock, Fuchsia, Gardenia, Geranium, Gleditsia (Locust), Grape Ivy, Hackberry, Hawthorn, Hibiscus, Holly, Hollyhock, Honeysuckle, Hydrangea, Ipomoea (Moonflower), Iris, Juniper, Leucothoe, Leyland Cypress, Lilac, Maple, Marigold, Mock-orange, Mountain Laurel, Narcissus, Nephthytis, Ninebark, Oak, Pear (Flowering) (non bearing), Petunia, Phlox, Photinia, Pine (including Austrian, Loblolly, Slash [nursery only]), Poinsettia, Poplar (including Cottonwood), Privet, Pyracantha, Quince (Flowering) (non bearing), Rose, Russian Olive, Salvia, Sedum, Smoke Tree, Snapdragon, Spiraea, Spruce, Sunflower (Ornamental), Sycamore, Trumpet Creeper, Viburnum, Viola (Pansy), Walnut (non bearing), Willow, Yarrow, Zinnia]

Diseases (fungal): black spot of rose; blossom or leaf blight or spot (*Ascochyta*, *Cephalosporium*, *Cercospora*, *Didymellina*, *Entomosporium*, *Fabraea*, *Monilinia*, *Septoria*); **Discula anthracnose** (Dogwood); **needle rust** (Douglas Fir); **Ovulinia petal blight; powdery mildew; rust; scab; twig blight; web blight** (*Rhizoctonia*); **white rust** (Chrysanthemum)

Approved for use in greenhouses: yes

Use restrictions: do not apply more than 0.6 or 2.0 lb a.i. per acre per year for forest nursery or ornamentals, respectively. Do not use for food or feed.

Cautions: do not apply to Abutilon.

Trade name	Formulation	Manufacturer
Agri Star Sonoma 40WSP [EPA Reg. No. 42750-141] (forest nursery only)	40 WSP	Albaugh, Inc./Agri Star
Eagle 20EW Specialty Fungicide [EPA Reg. No. 62719-463]	1.67 EC	Dow AgroSciences LLC
PROK?Z Hoist [EPA Reg. No. 62719-417-72112]	40 WP	PROK?Z, Inc.
Quali-Pro Myclobutanil 20 EW T&O [EPA Reg. No. 66222-185]	1.67 EC	Quali-Pro
Rally 40WSP Fungicide [EPA Reg. No. 62719-410] (forest nursery only)	40 WP	Dow AgroSciences LLC
Siskin Fungicide [EPA Reg. No. 81943-37]	1.67 EC	Phoenix Environmental Care LLC
Sythane WSP Specialty Fungicide [EPA Reg. No. 62719-432]	40 WP	Dow AgroSciences LLC

oxytetracycline hydrochloride

FRAC: Group 41 bactericide (tetracycline antibiotic)

Resistance risk: resistance known; high risk; resistance management required

Sites: outdoors; other sites not specified

REI: 12 hours

Application: tree injection; ready-to-use capsules

Application interval: yearly

Uses: non crop bearing ornamental trees and large woody shrubs [Ash, Elm, Mountain Ash, Oak, Oleander, Palm, Pear (Flowering) (non bearing), Sweet Gum, Sycamore]

Diseases (bacterial, phytoplasma): ash yellows; bacterial leaf scorch; fire blight; palm lethal yellows; phloem necrosis

Approved for use in greenhouses: not specified

Use restrictions: do not use for food or feed.

Cautions: trees in advanced stages of disease may not respond to treatment.

Trade name	Formulation	Manufacturer
Mycoject Ultra [EPA Reg. No. 7946-32]	4.3% ready-to-use capsules	J.J. Mauget Co.

PCNB (quintozene) (pentachloronitrobenzene)

FRAC: Group 14 fungicide (aromatic hydrocarbons)

Resistance risk: resistance known in some fungi; low to medium risk

Sites: greenhouse; interiorscape; landscape; nursery; shade house

REI: 12 hours

Application: bulb soak; plant dip; foliar spray (storage); pre-plant broadcast incorporation; soil band application, drench, in-furrow application

Application interval: 15 days (band application); 3 to 4 weeks (directed soil spray); 4 to 6 weeks (soil drench)

Uses: **bedding plant; broadleaf trees and shrubs; conifers; flowering plants; foliage plants; palm** [Abutilon, Aglaonema, Ajuga, Alyssum, Anthurium, Aphelandra, Arborvitae, Aucuba, Azalea/Rhododendron, Boxwood, Cactus (Holiday), Caladium, Calceolaria, Calendula, Camellia, Canna, Carissa, Chrysanthemum, Cineraria, Columbine, Cyclamen, Dahlia, Delphinium, Dianthus (including Carnation), Dieffenbachia, Dracaena, Ficus, Fittonia, Foxglove, Fuchsia, Gardenia, Gazania, Geranium, Gladiolus, Gloxinia, Grape Ivy (Cissus), Gynura, Heuchera (Coral Bells), Holly, Houseleek (Sempervivum), Hoya, Hyacinth, Impatiens, Iris (Bulbous, Dutch), Ivy (English), Juniper, Lily (including Asiatic, Easter, Oriental), Lupine, Magnolia (Southern), Maple, Marigold, Monarda, Narcissus, Palm, Peperomia, Petunia, Pine (including Southern seedlings), Podocarpus, Poinsettia, Portulaca, Pothos, Prayer Plant (Maranta), Privet, Rose, Salvia, **Scabiosa**, Schefflera, Sedum, Snapdragon, Spathiphyllum, Sweet Pea, Syngonium, Tradescantia, Tulip, Verbena, Viburnum, Vinca, Viola (Pansy), Zinnia]

Diseases (fungal): **Botrytis storage rot; dry rot** (*Sclerotinia*, *Stromatinia*); **flower blight** (*Sclerotinia*) (Camellia); **leaf spot** (*Phyllosticta*) (Magnolia); **needle blight; Ovulinia petal blight; soilborne diseases (damping-off; bulb, crown, stem, and root rot)** (non-water molds) (*Pellicularia*, *Rhizoctonia*, *Sclerotinia*, *Sclerotium*)

Approved for use in greenhouses: yes

Use restrictions: use of some products is prohibited in residential settings, school yards, parks, playgrounds, and athletic fields (see label).

Cautions: do not apply to Philodendron or Aluminum Plant (Pilea) as injury may occur.

Trade name	Formulation	Manufacturer
Par-Flo 4F [EPA Reg. No. 5481-472]	4 FC	Amvac Chemical Corporation
Terraclor 75WP [EPA Reg. No. 5481-8981]	75 WP	Amvac Chemical Corporation
Terraclor 75% WP [EPA Reg. No. 400-399-829]	75 WP	Southern Agricultural Insecticides, Inc.
Terraclor 400 [EPA Reg. No. 5481-8992] (bulb soak)	4 FC	Amvac Chemical Corporation

phosphorous acid and salts (mono- and di-potassium salts of phosphorous acid)

FRAC: Group 33 fungicide (phosphonates, ethyl phosphonates)

Resistance risk: few cases of resistance reported; low risk

Sites: Christmas tree plantation; forest stand; greenhouse; landscape (commercial, municipal, residential); lath and shade house; nursery (conifer, container, field); parks

REI: 4 hours

Application: bare root dip at transplant; basal bark spray; foliar spray (Fungi-Phite); soil drench, incorporation; tree injection

Application interval: 2 to 4 weeks; 1 to 4 weeks (Rose)

Uses: **bedding plants; broadleaf and evergreen trees and shrubs; conifers; ferns; flowering plants; foliage plants; ground covers; palms** [such as, but not limited to, Ageratum, Aglaonema, Almond (Flowering) (non bearing), Alyssum, Andromeda (Japanese, Pieris), Anthurium, Aphelandra, Arborvitae (White Cedar), Artemisia, Ash, Aster, Azalea/Rhododendron, Baby's Breath, Bedding Plants, Beech, Begonia, Birch (Sweet), Blanket Flower (Gaillardia), Bougainvillea, Boxwood, Bushes, Cactus (Holiday), Caladium, Ceanothus, Cedar, Chestnut, Christmas Trees, Chrysanthemum, Coleus, Columbine, Cotoneaster, Crabapple, Daisy, Delphinium, Dianthus (Carnation, Pink), Dieffenbachia, Dogwood, Douglas Fir, Elm, Eucalyptus, Fern (including Leather Leaf), Ficus, Fir, Flowering Trees Foxglove, Geranium, Gloxinia, Grape Ivy (Cissus), Hardwood Trees, Hawthorn, Hibiscus, Holly (including Japanese), Houseleek (Sempervivum), Impatiens, Ivy (Algerian, English), Juniper, Lily (Easter), Linden, Magnolia, Maple, Marigold, Oak, Orchid (Cattleya), Palm, Pear (Flowering) (non bearing), Petunia, Peperomia, Petunia, Philodendron, Phlox, Photinia, Pine (including Monterey, White), Pittosporum, Poinsettia, Pothos, Primula, Pyracantha, Redwood, Rosemary (Prostrate), Rose (container, field, landscape, and mini varieties), Salvia, Schefflera, Sedum, Shrubs, Snapdragon, Spathiphyllum, Spruce, Sweet Gum, Sycamore, Syngonium, Verbena, Vinca, Viola (Pansy), Willow, Yew (*Taxus x Media*), Zinnia]

Diseases (bacterial, fungal) (foliar and soil applications): **bacterial blight** (*Erwinia, Ralstonia, Xanthomonas*); **black spot of rose; downy mildew; fire blight; Phytophthora** (aerial); **powdery mildew; soilborne diseases (root rot)** (non-water molds) (*Fusarium, Rhizoctonia*) and (oomycetes) (*Phytophthora, Pythium*)

Applications for tree injection or basal bark spray: **anthracnose; Armillaria root rot; bacterial blight** (*Xanthomonas*); **pine pitch canker; scab; tree declines** (*Phytophthora* and *Pythium*) [such as Almond (Flowering) (non bearing), Apple (Flowering) (non bearing), Arborvitae, Beech, Birch (Sweet), Cedar, Cherry (Flowering) (non bearing), Chestnut, Crabapple, Dogwood, Elm, Fir, Hawthorn, Juniper, Linden, Pine (Monterey, White), Oak (Coastal, Live, Shreve, Black, Canyon), Peach (Flowering) (non bearing), Pear (Flowering) (Asian) (non bearing), Plum (Flowering) (non bearing), Pyracantha, Sweet Gum, Willow]

Approved for use in greenhouses: yes

Cautions: do not apply to plants in dormancy or stressed by moisture or heat.

Trade name	Formulation	Manufacturer
Alude [EPA Reg. No. 71962-1-1001]	3.35 EC	Cleary Chemical Corporation
ArborFos [EPA Reg. No. 7946-26]	3.35 lbs a.i./ gal ready-to-use capsules	J.J. Mauget Co.
ArborFos Hp [EPA Reg. No. 7946-31]	3.35 EC	J.J. Mauget Co.
Confine Extra [EPA Reg. No. 1381-244]	4 EC	Winfield Solutions LLC
Confine Extra T&O [EPA Reg. No. 1381-244]	4 EC	Winfield Solutions LLC
Fosphite Fungicide [EPA Reg. No. 68573-2]	3.9 EC	JH Biotech Inc.
Fungi-Phite [EPA Reg. No. 83472-1]	3.38 SC	Plant Protectants LLC
Helena ProPhyt [EPA Reg. No. 42519-22-5905] (conifers only)	4.2 SC	Helena Chemical Company
Monterey Agri-Fos Systemic Fungicide [EPA Reg. No. 71962-1-54705]	3.35 EC	Monterey Lawn and Garden
Nutrol [EPA Reg. No. 70644-1] (mono-potassium phosphate)	100% WSP	LidoChem, Inc.
Phiticide [EPA Reg. No. 19713-625]	4.3 SC	Drexel Chemical Company
pHorcepHite Fungicide [EPA Reg. No. 34704-1039] (potassium phosphate, monobasic + mono- and di-potassium salts of phosphorous acid)	5.4 + 3.9 a.i. EC	Loveland Products, Inc.

PHOSPHOJet [EPA Reg. No. 74578-3]	3.35 SC	Arborjet
Phostrol [EPA Reg. No. 55146-83] (mono- and di-basic sodium, potassium, and ammonium phosphites)	4.32 SC	Nufarm Agricultural Products
Quanta [EPA Reg. No. 5905-566] (contains indole-3-butyric acid)	5.67 EC	Helena Chemical Company
Rampart Fungicide [EPA Reg. No. 34704-924]	3.9 EC	Loveland Products, Inc.
Vital Fungicide [EPA Reg. No. 42519-24-81943] (includes tree injection)	4.2 EC	Phoenix Environmental Care LLC
Whippet Fungicide [EPA Reg. No. 69117-5]	3.35 lbs a.i./gal ready-to-use containers	ArborSystems

piperalin

FRAC: Group 5 fungicide (morpholines, piperidines)

Resistance risk: decreased sensitivity for powdery mildews; low to medium risk

Sites: greenhouse and similar structures with non porous covers (commercial use only)

REI: 12 hours

Application: foliar spray

Application interval: see label

Uses: flowering plants; foliage plants; shrubs [African Violet, Begonia, Catalpa, Chrysanthemum, Dahlia, Daisy (Gerbera), Grape Ivy, Hydrangea, Kalanchoe, Lilac, Monarda, Phlox, Poinsettia, Rose (cut, potted), Verbena (annual), Zinnia]

Diseases (fungal): powdery mildew

Approved for use in greenhouses: yes

Use restrictions: commercial use only.

Cautions: certain cultivars such as Hiemalis Begonia and Poinsettia may be sensitive; check for sensitivity by testing a small number of plants prior to treating the entire area. Wait several days before evaluating for crop injury. Do not use on Hydrangea after flower buds are visible.

Trade name	Formulation	Manufacturer
Pipron Fungicide [EPA Reg. No. 67690-1]	2 EC	SePRO Corporation

polyoxin D zinc salt (polyoxorim-zinc)

FRAC: Group 19 fungicide (polyoxins, peptidyl pyrimidine nucleosides)

Resistance risk: resistance known; medium risk; resistance management required

REI: 4 hours

Sites: greenhouse; lath or shade house; landscape (commercial, residential); nursery (container, field) (professional applicators only)

Application: foliar spray; soil drench

Application interval: 7 to 10 days (foliar spray); 14 to 28 days (soil drench)

Uses: **Christmas tree** (nursery, plantation); **ornamentals; non bearing fruit trees, nut trees; vines**

Diseases (fungal): **Alternaria blight; anthracnose** (*Colletotrichum*); **black root rot** (*Thielaviopsis*); **Botrytis blight; downy mildew** (*Peronospora, Plasmopara*); **leaf spot** (*Curvularia*); **petiole rot** (*Myrothecium*); **powdery mildew** (*Erysiphe, Oidium, Sphaerotheca*); **soilborne diseases (root and crown rot)** (non-water molds) (*Rhizoctonia*); **scab; web blight** (*Rhizoctonia*)

Approved for use in greenhouses: yes

Use restrictions: professional use only.

Trade name	Formulation	Manufacturer
Affirm WDG [EPA Reg. No. 68173-3-1001]	11.3% WDG	Cleary Chemical Corporation
Veranda O [EPA Reg. No. 66330-56-59807]	11.3% WDG	OHP, Inc.

propamocarb hydrochloride

FRAC: Group 28 fungicide (carbamates)

Resistance risk: low to medium risk; resistance management required

REI: 12 hours (Proplant); 24 hours (Banol)

Sites: greenhouse; nursery (container) (commercial use only)

Application: soil treatment (spray, drench) at seeding, potting, or transplant

Application interval: 6 weeks (annuals, perennials); 3 to 4 months (woody ornamentals)

Uses: **bedding plants; ferns; flowering and potted plants; woody ornamentals** [African Violet, Ageratum, Alyssum, Aster, Azalea, Browallia, Celosia, Chrysanthemum, Coleus, Dahlia, Dianthus (Carnation), Dusty Miller, Fern, Geranium, Gloxinia, Impatiens, Lily (Easter), Lobelia, Marigold, Petunia, Poinsettia, Portulaca, Salvia, Snapdragon, Verbena, Vinca, Viola (Pansy, Violet), Woody Ornamentals]

Diseases (fungal): **soilborne diseases (damping-off and root rot)** (oomycetes) (*Phytophthora*, *Pythium*)

Approved for use in greenhouses: yes

Use restrictions: commercial use only. Do not use for field grown ornamentals.

Trade name	Formulation	Manufacturer
Banol [EPA Reg. No. 432-942]	6 SC	Bayer Environmental Science
Proplant [EPA Reg. No. 55260-9]	6 SC	SipcamAdvan

propiconazole

FRAC: Group 3 fungicide (demethylation inhibitors, triazoles)

Resistance risk: resistance known in some fungi; medium risk

REI: 12 or 24 hours (see label)

Sites: landscape; nursery (field)

Application: foliar spray; tree injection

Application interval: 7 to 30 days; 12 to 36 months (tree injection)

Uses: **herbaceous ornamentals** [Ajuga, Calendula, (non bearing), Chrysanthemum, Delphinium, Dianthus (Carnation, Sweet William), German Statice, Gomphrena, Hollyhock, Impatiens, Iris, Ivy (English), Liriope, Marigold, Monarda, Peony, Phlox, Snapdragon, Vinca, Zinnia]; **non bearing fruits and nuts** (nurseries and landscape plantings) [Flowering (non bearing) Apple, Carya (Pecan), Cherry, Citrus, Peach (including Nectarine), Pear (Bartlett), Plum, and Walnut]; **woody ornamentals** [Amelanchier, Ash, Azalea/Rhododendron, Bayberry (Wax Myrtle), Camellia, Candytuft, Cotoneaster, Crabapple, Crape Myrtle, Dogwood, Douglas Fir, Elm, Euonymus, Fir (Shasta), Hawthorn, Holly, Indian Hawthorn (Raphiolepis), Juniper, Lilac, Linden, Magnolia, Maple, Oak, Photinia (Red-tip), Pine, Poplar, Privet, Pyracantha, Redbud, Rose (outdoor use only), Sweet Gum, Sycamore, Tulip Tree]

Diseases (fungal): **anthracnose** (*Gnomonia*); **black spot of rose; blossom or leaf blight or spot** (*Alternaria*, *Cercospora*, *Cladosporium*, *Coccomyces*, *Colletotrichum*, *Cristulariella*, *Fabraea* (syn. *Entomosporium*), *Heterosporium*, *Monilinia*, *Mycosphaerella*, *Septoria*, *Spilocaea*, *Tubakia* (syn. *Actinopelte*); **conifer tip and twig blight** (*Phomopsis*, *Sirococcus*, *Sphaeropsis* [*Diplodia*]); **Discula anthracnose** (Dogwood); **Ovulinia petal blight; powdery mildew** (*Erysiphe*, *Microsphaera*, *Oidium*, *Phyllactinia*, *Podosphaera*, *Sphaerotheca*); ray blight (*Ascochyta*); **rust** (*Gymnosporangium*, *Melampsora*, *Phragmidium*, *Puccinia*, *Pucciniastrum*, *Uromyces*); **scab** (*Venturia*); **web blight** (*Rhizoctonia*)

Applications for tree injection: **oak wilt** (note: this disease has not been detected in New Jersey); **Dutch elm disease; sycamore anthracnose; scab** (*Venturia*); **rust** (*Gymnosporangium*, *Pucciniastrum*) (Malus)

Approved for use in greenhouses: no

Use restrictions: application limits apply; see label.

Cautions: not recommended for use on African Violet, Begonia, Fern (Boston), Geranium. Tree injections should be administered by those trained in injection techniques.

Trade name	Formulation	Manufacturer
Agri Star Propi-Star EC [EPA Reg. No. 42750-211]	3.6 EC	Albaugh, Inc./Agri Star
Alamo Fungicide [EPA Reg. No. 100-741] (tree injection only)	1.3 EC	Syngenta Professional Products
AmTide Propiconazole 41.8%EC Fungicide [EPA Reg. No. 83851-10]	3.6 EC	AmTide, LLC
Banner MAXX II [EPA Reg. No. 100-1326]	1.3 EC	Syngenta Professional Products
Fathom 14.3 MEC [EPA Reg. No. 72112-3]	1.3 EC	PROK?Z, Inc.
Fitness Fungicide [EPA Reg. No. 34704-1031]	3.6 EC	Loveland Products, Inc.
Honor Guard PPZ [EPA Reg. No. 662222-41-53883]	1.3 EC	Control Solutions Inc.
Kestrel Fungicide [EPA Reg. No. 66222-41-81943]	1.3 EC	Phoenix Environmental Care LLC
Kestrel MEX Fungicide [EPA Reg. No. 81943-6]	1.3 EC	Phoenix Environmental Care LLC
Nufarm Propiconazole SPC 14.3 MEC [EPA Reg. No. 228-623]	1.3 EC	Nufarm Americas Inc.
PPZ 143 MC [EPA Reg. No. 86064-4]	1.3 EC	United Turf Alliance
PrimeraOne Propiconazole 14.3 [EPA Reg. No. 66222-41]	1.3 EC	PrimeraTurf
Procon-Z Fungicide [EPA Reg. No. 34704-879]	1.3 EC	Loveland Products, Inc.
ProPensity 1.3ME [EPA Reg. No. 60063-27]	1.3 EC	SipcamAdvan
Propicon 3.6EC Fungicide [EPA Reg. No. 87290-7]	3.6 EC	Willowood USA
Propiconazole 41.8% EC - Fungicide [EPA Reg. No. 82542-20]	3.6 EC	Solera Source Dynamics LLC
Quali-Pro Propiconazole 14.3 [EPA Reg. No. 66222-41]	1.3 EC	Quali-Pro

Shar-Shield PPZ [EPA Reg. No. 83529-22]	3.6 EC	Sharda USA LLC
Shepherd Fungicide [EPA Reg. No. 69117-3] (tree injection only)	14.3% a.i./gal. ready-to-use containers	ArborSystems
Strider Turf and Ornamental Fungicide [EPA Reg. No. 1001-84]	1.3 EC	Cleary Chemical Corporation
Topaz Fungicide [EPA Reg. No. 42750-211-1381]	3.6 EC	Winfield Solutions LLC

pyraclostrobin

FRAC: Group 11 fungicide (QoI-fungicides, methoxy-carbamates)

Resistance risk: resistance known for several fungal species; high risk; resistance management required

Sites: greenhouse; interiorscape; landscape (commercial, residential); lath and shade house; nursery (conifer, container, field, forest, retail); recreation areas

REI: 12 hours

Application: bulb dip; foliar spray (directed to crown or foliage); soil drench

Application interval: 7 to 14 days (foliar application); 7 to 21 days (soil drench)

Uses: **bulbs; conifers; herbaceous ornamentals; ferns; flowering plants; foliage plants; nonbearing fruit and nuts; palm; woody shrubs and trees** [tolerant plants include African Violet, Ageratum, Ajuga, Almond (Flowering) (nonbearing), Aloe Vera, Apple (Flowering) (non bearing), Apricot (Flowering) (non bearing), Arborvitae, Ardisia, Artemisia (Wormwood), Ash (Red), Astilbe, Aucuba, Azalea/Rhododendron, Baby's Breath (Alpine), Balloon Flower, Barbados Lily, Barberry (Japanese), Basket of Gold, Bayberry (Southern Wax Myrtle), Begonia (Wax), Blanket Flower, Boxwood (Common, Japanese), Brachycome, Buddleja (Butterfly Bush), Caladium, Camellia (Japanese), Canna, Campanula (Bellflower), Carya (Pecan) (non bearing), Centaurea (Bachelors Button, Dusty Miller), Chamaecyparis (Sawara Cypress), Cherry (Kwanzan, Mt. Fuji Shirotae, Sour, Wild) (Flowering) (non bearing), Chestnut (American), Citrus (non bearing), Chinquapin, Chrysanthemum, Columbine, Coreopsis (Tick Seed), Corylus (Hazel), Cotoneaster (Cranberry), Crabapple, Crape Myrtle, Cryptomeria (Japanese Cedar), Cupid's Dart, Cyclamen, Dahlia, Daisy (Gerbera), Daylily, Delphinium (Candle Larkspur), Deutzia, Dianthus (Carnation, Sweet William), Dietes (African Iris), Dogwood, Douglas Fir, Echinacea, Enkianthus (Redvein), Elder, Euonymus (Burning Bush), Evening Primrose, Fern (Asparagus, Kimberly Queen, Wood), Fir (Silver), Forsythia (including Golden Bells), Foxglove, Gardenia (Cape Jasmine), Gazania, Geranium, Germander, Geum (Avens), Gingko, Gladiolus, Globe Thistle, Grape (non bearing) (European), Grass (Cortaderia, Monkey, Pennisetum), Hemlock (Canadian), Heuchera (Coral Bells), Hibiscus (China Rose, Rose Mallow), Holly (Chinese, Japanese, Yaupon), Hosta, Hydrangea, Hypericum (St. John's Wort), Impatiens (Balsam, New Guinea), Indian Hawthorn, Ipomoea (Morning Glory), Iris, Ivy (California, English), Jasmine (Asian Trache, Star), Jessamine, Juniper (Chinese, Creeping), Lamb's Ear, Lantana (Trailing), Leopard's Bane, Leucophyllum, Liatris (Gay Feather), Lilac, Lily, Liriope (Lilyturf), Lisianthus, Lobelia, Loropetalum, Lupine, Magnolia (Saucer, Star), Mandevilla, Maple (Amur, Boxelder, Japanese, Norway, Silver [Soft], Sugar), Marigold, Monarda, Mountain Laurel, Myrtle, Nandina (Heavenly Bamboo), Narcissus (Wild Daffodil), Oak (Bur, Red), Oleander, Osmanthus (Tea Olive), Pachysandra (Japanese), Palm (Sago), Peach (including Nectarine) (Flowering) (non bearing), Pear (Flowering) (non bearing), Petunia, Phlox, Photinia (Red-tip), Pine (Eastern White, Japanese Black, Mugo, Stone), Pistachio (non bearing), Pittosporum (Japanese Mock-orange), Plum (including Common, Purple Leaf) (Flowering) (non bearing), Poinsettia, Poplar (Black Cottonwood, Cottonwood), Portulaca (Moss Rose, Purslane), Privet, Quince (Flowering) (non bearing), Ranunculus, Redbud, Rockcress, Rose, Rudbeckia, Ruellia, Russian Arborvitae, Russian Olive, Sage (Silverado), Sago Cycad, Salvia (Meadow Sage, Texas Sage), **Scabiosa** (Sweet), Sedum, Snapdragon, Spiraea (including Bridal Wreath), Spruce, Sweetpire, Thrift, Tulip, Vaccinium (Bilberry, Cranberry), Verbena, Veronica (Speedwell), Viburnum (including Arrowwood, Water Elder), Vinca (including Catharanthus), Viola (including Pansy), Walnut (Black, Common) (non bearing), Yarrow, Zinnia]

Diseases (fungal): anthracnose (*Colletotrichum*, *Gloeosporium*); **black spot of rose; blossom or leaf blight or spot** (*Alternaria*, *Botrytis*, *Cercospora*, *Didymellina*, *Entomosporium*, *Monilinia*, *Mycosphaerella*, *Ramularia*, *Sclerotinia* *Septoria*); **Botrytis blight; bulb rot** (*Fusarium*, *Penicillium*); **downy mildew; Phytophthora** (aerial); **powdery mildew** (*Erysiphe*, *Microsphaera*, *Oidium*, *Phyllactinia*, *Podosphaera*, *Sphaerotheca*, *Uncinula*); **soilborne diseases (basal, crown, and root rot)** (non-water molds) (*Fusarium*, *Rhizoctonia*) and (oomycetes) (*Phytophthora*, *Pythium*); **rust** (*Gymnosporangium*, *Melampsora*, *Puccinia*); **scab** (*Cladosporium*, *Venturia*); **web blight** (*Rhizoctonia*)

Approved for use in greenhouses: yes

Use restrictions: do not apply more than 15 lb (WDG formulation) or 13.37 lb (SC formulation) product per acre per year, respectively (outdoors). Do not use on crops intended for food or feed.

Cautions: to avoid phytotoxicity, do not expose the following ornamentals to product: Grape (Concord, Worden, Fredonia, Niagara), Impatiens, Ninebark, Petunia, Wintercreeper (Euonymus).

Trade name	Formulation	Manufacturer
Insignia [EPA Reg. No. 7969-184]	80 WDG	BASF Specialty Products
Insignia SC Intrinsic Brand Fungicide [EPA Reg. No. 7969-290]	2.08 SC	BASF Specialty Products

streptomycin sulfate

FRAC: Group 25 fungicide/bactericide (glucopyranosyl antibiotic)

Resistance risk: resistance known; high risk; resistance management required

Sites: landscape (including control of fire blight in residential gardens); other sites not specified

REI: 12 hours

Application: cutting soak; foliar spray

Application interval: 3 to 7 days

Uses: **herbaceous ornamentals; foliage plants; nonbearing fruit; woody shrubs** [specified on label: Amelanchier, Apple (Flowering) (non bearing), Barberry, Calla Lily, Chrysanthemum, Cotoneaster, Dianthus (Carnation), Dieffenbachia (cutting), Forsythia, Geranium, Gladiolus, Honeysuckle, Hydrangea, Impatiens, Ivy, Lilac, Mock-orange (Philadelphus), Orchid, Pear (Flowering) (non bearing), Philodendron, Poinsettia, Pyracantha, Rose, Rudbeckia, Salvia, Viburnum]

Diseases (bacterial): **bacterial leaf and stem rot, wilt** (*Erwinia*, *Pseudomonas*, *Xanthomonas*); **crown gall** (New Jersey); **fire blight** (*Erwinia*)

Approved for use in greenhouses: not specified

Cautions: resistance management is required.

Trade name	Formulation	Manufacturer
AG Streptomycin [EPA Reg. No. 66222-121]	17% WP	Makhteshim Agan of North America, Inc
Agri-Mycin 17 [EPA Reg. No. 55146-96]	17% WSP	Nufarm Agricultural Products
Firewall 17 WP [EPA Reg. No. 80990-4]	17% WP	AgroSource Inc./Sipcam Adva
Repar Streptomycin 17 [EPA Reg. No. 69361-9]	17% SC	Repar Corporation

sulfur [S_x]

FRAC: Group M2 fungicide (inorganic)

Resistance risk: generally considered low (no indication of fungicide resistance); no cross resistance between group members M1 to M9

Sites: greenhouse (variable); landscape (some labels permit residential use); other sites not specified

REI: 24 hours

Application: dust; spray (aerial or ground application)

Application interval: 5 to 14 days (variable) (see label)

Uses: **herbaceous and woody ornamentals; palms** [Aesculus (Horse Chestnut), Alder, Amaranthus, Aster, Azalea/ Rhododendron, Bittersweet, Boston Ivy, Buttonbush, Cactus (Golden Barrel), Calendula, Catalpa, Cedar, Cherry Laurel, Chrysanthemum, Clematis, Columbine, Cosmos, Crape Myrtle, Cucurbita, Dahlia, Daisy, Delphinium, Dianthus (Carnation), Dogwood, Euonymus, Euphorbia (Gopher Plant), Foxglove, Gladiolus, Golden Fleece, Hibiscus, Holly, Hollyhock, Honeysuckle, Hydrangea, Ivy (English), Juniper, Lady’s Mantle, Lavender, Laurel, Lead Tree, Lilac, Linden, Lupine, Magnolia, Marigold, Matrimony Vine, Nasturtium, Palm (Date, Sago), Petunia, Phlox, Poplar, Privet (Ligustrum), Rose, Salvia (Sage), Sumac (Staghorn), Silver Vine, Smilax, Snapdragon, Spiraea, Spruce, Sweet Pea, Sunflower (Ornamental), Sycamore, Trumpet Creeper, Verbena, Viola (Violet), Willow, Witch Hazel, Zinnia]

Diseases (fungal): **black spot of rose; Botrytis blight** (Hydrangea); **brown canker** (Rose); **leaf spot; powdery mildew; rust** (Aster, Chrysanthemum, Dianthus, Hollyhock, Marigold, Rose, Snapdragon)

Approved for use in greenhouses: variable (see label)

Use restrictions: to avoid phytotoxicity, do not apply sulfur in full-sun or when temperatures exceed 90 F. Do not apply within 21 days of an oil spray.

Notes: also controls red spider mite.

Trade name	Formulation	Manufacturer
Ben-Sul 85 [EPA Reg. No. 2935-506]	85% Dust	Wilbur-Ellis Company
CSC Dusting Sulfur [EPA Reg. No. 82571-3]	98% Dust	Martin Operating Partnership
CSC Thioben-90 [EPA Reg. No. 82571-1]	90% Wettable/ Dust	Martin Operating Partnership
CSC 80% Thiosperse 80% [EPA Reg. No. 55429-4]	80% Wettable/ Dust	Martin Operating Partnership
CSC Wettable Sulfur [EPA Reg. No. 82571-1]	90% Wettable/ Dust	Martin Operating Partnership
Dusting Sulfur [EPA Reg. No. 2935-48-71058]	98% Dust	Independent Agribusiness Professionals
Dusting Sulfur [EPA Reg. No. 2935-48]	98% Dust	Wilbur-Ellis Company
Dusting Sulfur Fungicide-Insecticide [EPA Reg. No. 34704-735]	98% Dust	Loveland Products Inc.
First Choice Dusting Sulfur [EPA Reg. No. 34704-1020]	98% Dust	Loveland Products Inc.
Kumulus DF [EPA Reg. No. 51036-352-66330]	80 WDG	BASF Sparks LLC
Micro Sulf [EPA Reg. No. 55146-75]	80 WP	Nufarm Agricultural Products
Microfine Sulfur [EPA Reg. No. 6325-13-34704]	90% Wettable/ Dust	Loveland Products, Inc.
Micronized Gold [EPA Reg. No. 19713-238]	90% Wettable/ Dust (WSP)	Drexel Chemical Company
Microthiol Disperss [EPA Reg. No. 70506-187]	80 WP	United Phosphorus, Inc.
ProGanic Micronized Sulfur [EPA Reg. No. 2935-407]	92 WP	Wilbur-Ellis Company
ProNatural Micronized Sulfur [EPA Reg. No. 2935-407]	92 WP	Wilbur-Ellis Company
Special Electric [EPA Reg. No. 2935-503]	98% Dust	Wilbur-Ellis Company
Spray Sulfur [EPA Reg. No. 2935-92]	97% Wettable/ Dust	Wilbur-Ellis Company
Suffa [EPA Reg. No. 19713-39]	6 FC	Drexel Chemical Company
Sulfur 6L [EPA Reg. No. 66330-211]	6 FC	Arysta LifeScience North America LLC

Sulfur 90W [EPA Reg. No. 19713-238]	90% Wettable/ Dust	Drexel Chemical Company
Sulfur DF [EPA Reg. No. 51036-352-2935]	80 WDG	Wilbur-Ellis Company
Sul-Preme 52 [EPA Reg. No. 1381-220]	6 FC	Winfield Solutions LLC
THAT Flowable Sulfur [EPA Reg. No. 57538-5]	6 FC	Stoller Enterprises Inc.
Wettable Sulphur [EPA Reg. No. 5905-289] (Roses only)	90 WP	Helena Chemical Company
Yellow Jacket Special Dusting Sulfur [EPA Reg. No. 6325-17]	98% Dust	Georgia Gulf Sulfur Corporation
Yellow Jacket Wettable Dusting Sulfur II [EPA Reg. No. 6325-13]	90 WP	Georgia Gulf Sulfur Corporation

tebuconazole

FRAC: Group 3 fungicide (demethylation inhibitors, triazoles)

Resistance risk: resistance known in some fungi; medium risk

Sites: landscape (commercial, residential); nursery (container, field) (professional use only)

REI: 12 hours

Application: foliar spray; tree injection (ready-to-use capsules)

Application interval: 14 to 21 days; 2 to 3 times weekly (petal blight)

Uses: **flowering plants; ground covers; woody shrubs and trees; vines** [including Azalea/Rhododendron, Camellia, Crabapple, Dogwood, Hawthorn, Oak, Rose]

Diseases (fungal): anthracnose; black spot of rose; leaf spot; petal blight; powdery mildew; rust; scab; Southern blight

Applications for tree injection: anthracnose; Dutch elm disease; leaf spot (Hawthorn); **oak wilt** (note: this disease has not been detected in New Jersey); **scab** (Crabapple)

Approved for use in greenhouses: not specified

Use restrictions: not for homeowner use. Not for use in woodlands or forest management. Do not apply more than 3.38 lb a.i. per acre per year. Do not make more than 4 applications at the highest rate.

Cautions: do not use on African Violet, Begonia, Fern (Boston), or Geranium.

Trade name	Formulation	Manufacturer
Clearscape [EPA Reg. No. 69361-27-60063]	3.6 L	SipcamAdvan
Monsoon Turf [EPA Reg. No. 34704-1060]	3.6 SC	Loveland Products, Inc.
Offset 3.6F Fungicide [EPA Reg. No. 83100-1-83979]	3.6 EC	Rotam North America Inc.
Quali-Pro Tebuconazole 3.6F [EPA Reg. No. 66222-117]	3.6 EC	Quali-Pro
TEB 360 [EPA Reg. No. 69361-27-86064]	3.6 SC	United Turf Alliance
Tebuject 16 [EPA Reg. No. 7946-28] (tree injection only)	16% a.i./gal ready-to-use capsules	J.J. Mauget Co.
Torque Fungicide [EPA Reg. No. 1001-87]	3.6 SC	Cleary Chemical Corporation

thiabendazole

FRAC: Group 1 fungicide (methyl benzimidazole carbamates, benzimidazoles)

Resistance risk: resistance common in various fungal species; high risk; resistance management required

Sites: landscape (other sites not specified)

REI: 12 hours

Application: bulb and corm dip; tree (root flare) injection

Application interval: once (bulb and corm dip); 3 years (tree injection)

Uses: ornamental bulbs, corms, shade trees [Elm, Sycamore]

Diseases (fungal): **basal rot** (*Fusarium*); **blue mold** (*Penicillium*)

Applications for tree injection: **anthracnose** (Sycamore); **Dutch elm disease**

Approved for use in greenhouses: not specified

Cautions: dry bulbs and corms in a shaded, well-ventilated area after treatment. Arbotect 20-S reserved for professional use; treatment may not be effective for trees where crown symptoms of Dutch elm disease exceed 5%.

Trade name	Formulation	Manufacturer
Arbotect 20-S [EPA Reg. No. 100-892] (tree injection)	20% SC	Syngenta Professional Products
Mertect 340-F [EPA Reg. No. 100-889] (bulb and corm dip)	4.1 FC	Syngenta Crop Protection

thiophanate-methyl

FRAC: Group 1 fungicide (methyl benzimidazole carbamates, thiophanates)

Resistance risk: resistance common in various fungal species; high risk; resistance management required

Sites: greenhouse; interiorscape; lath or shadehouse; landscape; nursery (field, container)

REI: 12 hours

Application: foliar spray; media mix; plant dip; seedling treatment; soil broadcast, drench

Application interval: 7 to 14 days (foliar spray); 14 to 28 days (soil drench)

Uses: **annual and perennial flowering plants; bedding plants; broadleaf and evergreen trees and shrubs; foliage plants; ground covers; ornamental fruit and nut trees** [including, but not limited to: ornamental bulbs, corms, tubers, rhizomes (Caladium, Gladiolus, Iris, Lily (Easter), Narcissus (Daffodil), Tulip); conifers/Christmas trees (Douglas Fir, Fir, Larch, Pine [Austrian, Loblolly, Longleaf, Red, Scots, Slash], Spruce); deciduous trees (Ash, Maple, Oak, Sycamore/Plane Tree, Walnut [non bearing]); flowering plants (Chrysanthemum, Hydrangea, Hollyhock, Iris, Lily, Poinsettia); flowering trees (Crabapple, Flowering (non bearing) Cherry and Pear, Hawthorn, Mountain Ash); herbaceous bedding plants (Ageratum, Begonia, Canna, Coleus, Coreopsis (Tick Seed), Dahlia, Dianthus (Pink), Dusty Miller, Foxglove, Fuchsia, Geranium, Impatiens, Lavender, Limonium (Statice), Marigold, Petunia, Primula, Salvia, Strawflower, Verbena, Viola [Pansy]); tropical foliage (Dieffenbachia, Dracaena, Ivy (English), Philodendron, Pothos); woody ornamentals (Azalea/Rhododendron, Hibiscus, Holly, Privet (Ligustrum), Pyracantha, Rose)

Diseases (fungal): anthracnose (*Colletotrichum*); black root rot (*Thielaviopsis*); black spot of rose; brown needle blight (*Scirrhia*) (seedling treatment); brown rot (*Monilinia*, *Sclerotinia*, *Whetzelinia*); bulb, corm, and rhizome rot (*Botrytis*, *Cylindrocladium*, *Fusarium*, *Gliocladium*, *Myrothecium*, *Penicillium*, *Ramularia*, *Rhizoctonia*, *Sclerotinia*, *Thielaviopsis*); conifer twig blight and canker (*Diaporthe*, *Kabatina*, *Phoma*, *Phomopsis*); leaf spot and blight (*Ascochyta*, *Blumeriella*, *Botrytis*, *Cercospora*, *Coccomyces*, *Corynespora*, *Curvularia*, *Didymellina*, *Entomosporium*, *Fabraea*, *Fusarium*, *Ramularia*, *Rhizoctonia*, *Marssonina*, *Mycosphaerella*, *Myrothecium*, *Phoma*, *Physalospora*, *Schizothyrium*, *Septoria*, *Sphaceloma*); needle cast (*Rhabdocline*, *Phaeocryptopus*); **Ovulinia petal blight; powdery mildew (*Erysiphe*, *Microsphaera*, *Oidium*, *Phyllactinia*, *Podosphaera*, *Sphaerotheca*); soilborne diseases (crown, cutting, root, and stem rot) (non-water molds) (*Botrytis*, *Cylindrocladium*, *Fusarium*, *Gliocladium*, *Myrothecium*, *Penicillium*, *Ramularia*, *Rhizoctonia*, *Sclerotinia*); rust (*Gymnosporangium*, *Puccinia*, *Uromyces*); scab (Crabapple, Hawthorn, Mountain Ash, Pear, Pyracantha) (*Fusicladium*, *Venturia*); tip blight of pine (*Sphaeropsis* [*Diplodia*])**

Approved for use in greenhouses: yes

Use restrictions: maximum use rate is 300 lb a.i. per acre per crop per season (soil application) or 0.5 lb a.i. per acre per application (cut flowers). For seedling treatments, do not permit roots to dry during treatment, and keep temperatures between 32 and 90 F. Do not apply to home orchards/fruit trees after fruit set. Do not use fruit or nuts from treated trees as food or feed.

Cautions: not recommended for use on Cactus (Easter), Fern (Boston), Swedish Ivy. The root-infecting organisms *Cylindrocladium spathiphyllii*, *Phytophthora*, and *Pythium* are not controlled by this product.

Trade name	Formulation	Manufacturer
3336 DG Lite [EPA Reg. No. 1001-70] (soilborne diseases)	2.08% G	Cleary Chemical Corporation
3336 F [EPA Reg. No. 1001-69]	41.25% EC	Cleary Chemical Corporation
3336 G [EPA Reg. No. 1001-70] (soilborne diseases)	2.08% G	Cleary Chemical Corporation
3336 GC [EPA Reg. No. 1001-70] (soilborne diseases)	2.08% G	Cleary Chemical Corporation
3336 PLUS [EPA Reg. No. 1001-78]	2 EC	Cleary Chemical Corporation
3336 WP [EPA Reg. No. 1001-63]	50 WP	Cleary Chemical Corporation
AllBan 50 WSB [EPA Reg. No. 58185-30]	50 WSP	Everiss (Scotts Company)
AllBan FLO Fungicide [EPA Reg. No. 58185-33]	4.5 FC	Everiss (Scotts Company)
Fungo Flo [EPA Reg. No. 9198-222]	4.5 EC	Andersons Inc.
Incognito 4.5 F [EPA Reg. No. 66222-134] (conifers only)	4.5 FC	Makhteshim Agan of North America, Inc.
Nufarm T-Methyl 4.5 F Fungicide [EPA Reg. No. 228-652] (conifers only)	4.5 EC	Nufarm Americas Inc.

Nufarm T-Methyl 70 WSB Fungicide [EPA Reg. No. 228-655] (conifers only)	70 WSP	Nufarm Americas Inc.
Nufarm T-Methyl SPC 4.5 F Fungicide [EPA Reg. No. 228-626]	4.5 FC	Nufarm Turf & Specialty
Nufarm T-Methyl SPC 50 WSB Fungicide [EPA Reg. No. 228-628]	50 WSP	Nufarm Turf & Specialty
Nufarm T-Methyl SPC Granular Fungicide [EPA Reg. No. 228-631]	2.08% G	Nufarm Americas Inc.
OHP 6672 4.5 F [EPA Reg. No. 59807-5]	4.5 FC	OHP, Inc.
OHP 6672 50 WP [EPA Reg. No. 59807-6]	50 WP	OHP, Inc.
PrimeraOne 4.5 Flowable [EPA Reg. No. 73545-13-70506]	4.5 FC	PrimeraTurf
PROKōZ Transom 4.5 F [EPA Reg. No. 72112-2]	4.5 EC	PROKōZ, Inc.
PROKōZ Transom 50 WSB [EPA Reg. No. 72112-1]	50 WSP	PROKōZ, Inc.
Quali-Pro TM 4.5 [EPA Reg. No. 66222-134]	4.5 FC	Quali-Pro
Quali-Pro TM 85 WDG [EPA Reg. No. 48234-13-73220]	85 WDG	Quali-Pro
T-Bird 4.5L [EPA Reg. No. 81943-4]	4.5 EC	Phoenix Environmental Care LLC
T-Bird 85 WDG [EPA Reg. No. 81943-3]	85 WDG	Phoenix Environmental Care LLC
T-Methyl Granular [EPA Reg. No. 53883-183-32802] (soilborne diseases)	2.08% G	Howard Johnsons
Tee-Off 4.5F [EPA Reg. No. 83070-1]	4.5 FC	SipcamAdvan
Thiophanate Methyl 85 WDG [EPA Reg. No. 66222-145] (conifers only)	85 WDG	Makhteshim Agan of North America, Inc.
Thiophanate Methyl 85% WDG [EPA Reg. No. 84229-3]	85 WDG	Tide International USA Inc
Topsin 4.5FL [EPA Reg. No. 73545-13-70506] (conifers only)	4.5 FC	United Phosphorus, Inc.
Topsin M 70WDG [EPA Reg. No. 73545-18-70506] (conifers only)	70 WDG	United Phosphorus, Inc.
Topsin M 70WP [EPA Reg. No. 73545-11-70506] (conifers only)	70 WP	United Phosphorus, Inc.
Topsin M WSB [EPA Reg. No. 73545-16-70506] (conifers only)	70 WP	United Phosphorus, Inc.

thiram

FRAC: Group M3 fungicide (dithiocarbamates)

Resistance risk: generally considered low (no indication of fungicide resistance); no cross resistance between group members M1 to M9

Sites: not specified

REI: 24 hours (after treated seeds/bulbs have been planted)

Application: commercial seed treatment (coniferous, ornamental bulbs, corms, and tubers); dry (conifers) or in suspension (ornamentals)

Application interval: once

Uses: conifer seed; ornamental bulbs, corms, and tubers

Diseases (fungal): **damping-off**

Approved for use in greenhouses: not specified

Use restrictions: professional applicators only. Do not use treated seeds/bulbs for food, feed, or oil purposes.

Trade name	Formulation	Manufacturer
Signet 480 FS Seed Treatment [EPA Reg. No. 45728-26-55146] (seed treatment)	4 FC	Nufarm Agricultural Products

triadimefon

FRAC: Group 3 fungicide (demethylation inhibitors, triazoles)

Resistance risk: resistance known in some fungi; medium risk

Sites: garden center; greenhouse; interiorscape, nursery (commercial, conifer); landscape (including ornamental gardens and parks)

REI: 12 hours; 0 hours (tree injection)

Application: foliar spray; tree injection

Application interval: 7 to 21 days (most labels); annually or longer (tree injection)

Uses: **Christmas trees** (except Concolor Fir); **flowering plants and foliage plants** [African Violet, Ageratum, Aster, Azalea, Begonia, Calendula, Canna, Chrysanthemum, Cineraria, Crassula, Dahlia, Daisy (including Gerbera), Delphinium, Dianthus, Fern (Boston), Four O'Clock, Geranium, Grape Ivy, Hollyhock, Hydrangea, Iris, Kalanchoe, Marigold, Nephthytis, Orchid (Dendrobium), Petunia, Phlox, Poinsettia, Rose, Salvia, Sedum, Snapdragon, Sunflower (Ornamental), Sweet Pea, Viola (Pansy), Zinnia]; **ornamental trees and shrubs** [Amelanchier, Azalea/Rhododendron, Barberry, Buckthorn, Camellia, Cedar, Cinquefoil (Potentilla), Crabapple, Crape Myrtle, Dogwood, Euonymus, Gardenia, Hawthorn, Hemlock, Holly, Juniper, Leucothoe, Lilac, Mock-orange, Mountain Laurel, Ninebark, Paulownia, Pear (Flowering) (non bearing), Photinia, Pine (seed, seedlings), Privet, Pyracantha, Spiraea, Viburnum, Vitex]; **shade trees** [Aesculus (Buckeye), Ash, Birch, Chestnut, Elm, Fir, Gleditsia (Locust), Maple, Oak, Poplar (Aspen, Cottonwood), Russian Olive, Sycamore, Walnut (non bearing), Willow]

Diseases (fungal): **flower blight** (*Colletotrichum*, *Ovulinia*, *Sclerotinia*); **leaf and flower gall** (*Exobasidium*); **leaf blight and spot** (*Cephalosporium*, *Cercospora*, *Didymellina*, *Didymascella*, *Entomosporium*); **needle cast** (*Lophodermium*); **powdery mildew** (*Erysiphe*, *Microsphaera*, *Oidium*, *Podosphaera*, *Phyllactinia*, *Sphaerotheca*, *Uncinula*); **rust** (*Coleosporium*, *Cronartium*, *Gymnosporangium*, *Melampsora*, *Melampsoridium*, *Peridermium*, *Phragmidium*, *Puccinia*, *Uromyces*, *Uredinopsis*); **tip blight** (*Sirococcus*)

Applications for tree injection: **anthracnose** (shade trees, *Gnomonia*); **Dutch elm disease**; **leaf spot and blight** (*Cercospora*); **oak wilt** (note: this disease has not been detected in New Jersey); **powdery mildew** (*Erysiphe*, *Microsphaera*, *Oidium*, *Podosphaera*, *Phyllactinia*, *Sphaerotheca*, *Uncinula*); **rust** (*Coleosporium*, *Cronartium*, *Gymnosporangium*, *Melampsora*, *Melampsoridium*, *Peridermium*, *Phragmidium*, *Puccinia*, *Uromyces*, *Uredinopsis*); **tip blight** (*Sirococcus*)

Approved for use in greenhouses: yes

Use restrictions: tree injection product for commercial arborist use only. Do not use treated plants for food or feed.

Trade name	Formulation	Manufacturer
Bayleton 50 Turf and Ornamental Fungicide [EPA Reg. No. 432-1360]	50 WP	Bayer Environmental Science
Bayleton 50% Dry Flowable Fungicide [EPA Reg. No. 264-737-5481] (conifers only)	50 WP	Amvac Chemical Corporation
Bayleton Flo [EPA Reg. No. 432-1445]	4.15 FC	Bayer Environmental Science
Strike 50 WDG [EPA Reg. No. 432-1367-59807]	50 WDG	OHP, Inc.
Systrex/Nutrient [EPA Reg. No. 64014-3] (tree injection; contains fertilizer)	0.88% ready-to-use	Tree Tech

trifloxystrobin

FRAC: Group 11 fungicide (QoI-fungicides, oximino acetates)

Resistance risk: resistance known for several fungal species; high risk; resistance management required

Sites: forest nursery; greenhouse; interiorscape; lath and shade house; landscape (commercial, residential); nursery (container, field)

REI: 12 hours

Application: foliar spray; soil drench

Application interval: 7 to 14 days (foliar spray); 3 to 4 weeks (soil drench)

Uses: **herbaceous ornamentals ferns; flowering plants; foliage plants; nonbearing fruit; palm; woody shrubs and trees**

[Ajuga, Aloe Vera, Alyssum, Apple (Flowering) (non bearing), Aptenia, Aster, Azalea/Rhododendron, Bamboo, Barberry (Japanese), Begonia, Bellis, Birch, Blue Daze, Bottlebrush, Brachycome, Buddleja (Butterfly Bush), Caladium, Camellia, Campanula (Bellflower), Cast Iron Plant, Catnip, Cedar, Celosia, Cherry (Flowering) (non bearing), Chrysanthemum, Citrus (non bearing), Coleus, Coreopsis, Cosmos, Crabapple, Crape Myrtle, Cuphea (Mexican Heather), Daisy (including Gerbera), Daylily, Delphinium, Dianthus, Dieffenbachia, Dogwood, Dracaena, Dusty Miller, Euonymus, Exacum, Fern (Rabbit Foot), Ficus, Foxglove (Digitalis), Geranium, Grass (Ornamental) (Avena, Blue Fescue, Cortaderia (Pink, White), Harestail (Rabbit Tail), Pennisetum, Reed Canary Grass, Silver Banner), Hawthorn, Houseleek (Hen and Chicks), Hibiscus, Holly, Hosta, Hydrangea, Hypericum, Hypoestes, Impatiens, Indian Hawthorn, Ipomoea (Moonflower), Iris (Dwarf, Japanese, Siberian), Ivy (Dwarf, Hedera), Jasmine, Juniper (Torulosa), Lantana, Lilac, Liriope, Lupine, Marigold, Mint, Monarda (Bee Balm), Nandina, Palm (Coontie), Peach (including Nectarine) (Flowering) (non bearing), Penstemon, Petunia, Phlox, Photinia, Pittosporum, Plum (Flowering) (non bearing), Poinsettia, Poppy, Pothos, Primula, Privet (Ligustrum), Ranunculus, Rose, Salvia, Snapdragon, Spathiphyllum, Spiraea, Syngonium, Verbena, Veronica, Viburnum, Vinca (Catharanthus, Minor), Viola (Pansy), Zinnia]

Diseases (fungal): anthracnose (*Colletotrichum*); black root rot (*Thielaviopsis*); black spot of rose, blossom blight (*Monilinia*); Botrytis blight; downy mildew (*Peronospora*); leaf spot and blight (*Alternaria*, *Myrothecium*, *Septoria*); *Phytophthora* (aerial); powdery mildew (*Erysiphe*, *Microsphaera*, *Oidium*, *Podosphaera*, *Sphaerotheca*); soilborne diseases (damping-off; root and stem rot) (non-water molds) (*Cylindrocladium*, *Rhizoctonia*) and (oomycetes) (*Phytophthora*); rust (*Gymnosporangium*, *Phragmidium*, *Puccinia*); scab (*Cladosporium*, *Sphaeloma*, *Venturia*)

Approved for use in greenhouses: yes

Use restrictions: maximum use rate is 34.5 oz product per acre per year or crop cycle in outdoor settings (nursery, seedbed, field, landscape). Maximum use rate is 120 oz product per acre per year or crop cycle in greenhouse use and other enclosed structures.

Cautions: Do not drench Pansy. Do not use on Fern (Leatherleaf). Apply with caution on open flowers (Gerbera Daisy).

Trade name	Formulation	Manufacturer
Compass [EPA Reg. No. 432-1371]	50 WDG	Bayer Environmental Science
Compass O 50 WDG [EPA Reg. No. 432-1371-59807]	50 WDG	OHP, Inc.

triflumizole

FRAC: Group 3 fungicide (demethylation inhibitors, imidazoles)

Resistance risk: resistance known in some fungi; medium risk

Sites: Christmas tree (nursery, plantation); greenhouse; interiorscape; landscape (commercial, parks and other public spaces, residential); nursery

REI: 12 hours

Application: cutting soak; foliar spray; soil drench

Application interval: 7 to 14 days (foliar spray); 2 to 4 weeks (soil drench)

Uses: **Christmas trees; non bearing fruit trees** [Flowering (non bearing) Apple, Pear, Grape]; **ornamental trees and shrubs; vines**

Diseases (fungal): **black root rot** (*Thielaviopsis*); **Botrytis blight; leaf spot** (*Alternaria, Exserohilum, Helminthosporium*); **petiole rot** (*Myrothecium*); **powdery mildew** (*Erysiphe, Oidium, Podosphaera, Sphaerotheca, Uncinula*); **soilborne diseases (root rot, crown canker, wilt)** (non-water molds) (*Cylindrocladium, Fusarium, Rhizoctonia*); **rust** (*Gymnosporangium, Puccinia*); **scab** (*Venturia*); **web blight** (*Rhizoctonia*)

Approved for use in greenhouses: yes

Use restrictions: for ornamental trees and shrubs, do not exceed 96 fl oz product per acre per season. For flowering fruit trees, do not exceed 64 fl oz product per acre per season. For non bearing Grape, do not exceed 32 fl oz product per acre per season. For bedding plant plugs, do not exceed 2 fl oz per 100 gal water. Not for use on agricultural establishments for non bearing fruit trees.

Cautions: use caution for Impatiens: do not use on Impatiens plugs, and do not exceed 2 fl oz per 100 gal water for Impatiens transplants. To prevent root injury as soil drench to bed or bench, do not exceed 8 oz per 600 sq ft.

Trade name	Formulation	Manufacturer
Terraguard SC [EPA Reg. No. 400-521] (nursery, greenhouse)	4 SC	Chemtura Corporation
Terraguard SC/LS [EPA Reg. No. 400-535] (landscape)	4 EC	Chemtura Corporation

ziram

FRAC: Group M3 fungicide (dithiocarbamates)

Resistance risk: generally considered low (no indication of fungicide resistance); no cross resistance between group members M1 to M9

Sites: conifers (nursery, Christmas tree plantations); other ornamental sites not specified

REI: 48 hours

Application: foliar spray; soil drench to mulch and litter around Azalea, Camellia for petal blight

Application interval: 7 to 10 days; 3 to 5 days (fusiform rust); single application in spring (needle rust)

Uses: **Christmas trees** [Douglas Fir, Fir (Shasta), Pine (seedlings)]; **ornamental crops** [Aster, Azalea, Camellia, Chrysanthemum, Cyclamen, Dahlia, Delphinium, Dianthus (Carnation), Gardenia, Gladiolus, Hollyhock, Ipomoea (Morning Glory), Marigold, Phlox, Rose, Rudbeckia (Golden Glow), Snapdragon]

Diseases (fungal): **black spot of rose; Botrytis blight; leaf spot; petal blight; powdery mildew; rust** (including needle rust and fusiform rust for conifers)

Approved for use in greenhouses: not specified

Cautions: treat small samples of new varieties for phytotoxicity prior to widespread use.

Trade name	Formulation	Manufacturer
Ziram 76DF [EPA Reg. No. 70506-173]	76 WDG	United Phosphorus, Inc.

SYNTHETIC COMBINATION PRODUCTS

boscalid + pyraclostrobin

FRAC: Group 7 fungicide (succinate dehydrogenase inhibitors, pyridine carboxamides) + Group 11 fungicide (QoI-fungicides, methoxy-carbamates)

Resistance risk: Groups 7 and 11: high risk. Resistance management required. (See Note xx.)

Sites: forest nursery; greenhouse (bed, bench, container, flat, plug); interiorscape; landscape (commercial, residential); lath and shade house; nursery (conifer, container, field, retail); recreation areas

REI: 12 hours

Application: chemigation; foliar spray (directed to foliage, crown, or ground); soil drench

Application interval: 7 to 14 days (foliar application); 7 to 21 days (soil drench)

Uses: **flowering plants; foliage plants; herbaceous ornamentals; nonbearing fruit and nuts; ornamental grasses; woody shrubs and trees** [Abelia, African Violet, Almond (Flowering) (non bearing), Agapanthus, Apple (Flowering) (non bearing), Apricot (Flowering) (non bearing), Aucuba, Azalea/Rhododendron, Barberry (Japanese), Bayberry (Wax Myrtle), Begonia, Boxwood, Buddleja (Butterfly Bush), Cactus (Holiday), Caladium (including Elephant Ear), Calibrachoa, Camellia (including Tea Plant), Candytuft, Carya (Pecan) (non bearing), Cherry (Flowering) (non bearing), Chestnut, Chrysanthemum, Coleus, Coreopsis (Tick Seed), Corylus (American Hazel, European Hazel), Cosmos, Crabapple, Crape Myrtle, Cyclamen, Dahlia, Daisy (Gerbera, Transvaal), Daylily, Dianthus (Carnation, Pink), Dieffenbachia, Dogwood, Douglas Fir, Echinacea (Purple Coneflower), Euonymus (including Spreading, Wintercreeper), Gardenia (Cape Jasmine), Geranium, Gladiolus, Goldenrod, Grape (non bearing), Grass (Ornamental) (Pennisetum), Hawthorn, Hemlock (Western), Holly (including Dwarf Yaupon, Japanese, Meserve), Hollyhock, Honeysuckle (Japanese), Hyacinth, Hydrangea, Hypericum (St. John's Wort), Impatiens, Indian Hawthorn, Iris, Juniper, Lamium (Deadnettle), Lantana, Lavender, Lilac, Lily, Limonium (Statice), Liriope (Lilyturf or Bordergrass), Lisianthus, Mandevilla, Maple (Amur), Marigold, Monarda (Bee Balm, Bergamot), Myrtle, Nandina (Heavenly Bamboo), Narcissus (Daffodil), Oak (Chinquapin), Pachysandra, Peach (including Nectarine) (Flowering) (non bearing), Pear (Asian, Common) (Flowering) (non bearing), Petunia, Phlox, Photinia, Pistachio (non bearing), Pittosporum, Plum (Flowering) (non bearing), Poinsettia, Primula, Quince (Flowering) (non bearing), Rose, Rudbeckia (including Goldsturm), Russian Olive (Elaeagnus), Sage (Russian), Salvia, Sedum (Stonecrop), Snapdragon, Spathiphyllum (Peace Lily), Spiraea, Stock, Sumac, Sweet Flag, Thrift, Trumpet Creeper, Tulip, Verbena, Veronica (including Spiked Speedwell), Viburnum (including Water Elder), Vinca (including Catharanthus), Viola (Pansy), Walnut (Black, Common) (non bearing), Zinnia]

Diseases (fungal): **anthracnose** (*Colletotrichum*); **blossom or leaf blight or spot** (*Alternaria*, *Blumeriella*, *Botrytis*, *Cercospora*, *Helminthosporium*, *Monilinia Mycosphaerella*, *Myrothecium*, *Phoma*, *Phomopsis*, *Phyllosticta*, *Sphaceloma*, *Wilsonomyces*); **Botrytis blight; downy mildew** (*Peronospora*, *Plasmopara*); **leaf and flower gall** (*Exobasidium*); **Phytophthora** (aerial); **powdery mildew** (*Erysiphe*, *Oidium*, *Podosphaera*, *Sphaerotheca*, *Uncinula*); **rust** (*Coleosporium*, *Gymnosporangium*, *Puccinia*, *Uromyces*); **scab** (*Cladosporium*, *Venturia*); **soilborne diseases (basal, crown, and root rot)** (non-water molds) (*Cylindrocladium*, *Fusarium*, *Rhizoctonia*, *Sclerotinia*); **stem blight** (*Botryosphaeria*, *Botrytis*, *Coniothyrium*)

Approved for use in greenhouses: yes

Use restrictions: do not apply more than 7.3 lb product per use site acre per year. Do not use treated plants for food or feed.

Cautions: to avoid phytotoxicity, do not expose the following ornamentals to product: Grape (Concord, Fredonia, Niagara, Noiret, Rougeon, Steuben, Worden), Ninebark, Wintercreeper (Euonymus). Be cautious when applying product to Impatiens, Petunia during flowering.

Trade name	Formulation	Manufacturer
Pageant Fungicide [EPA Reg. No. 7969-251]	12.8% pyraclostrobin + 25.2% boscalid (WDG)	BASF Specialty Products

chlorothalonil + propiconazole

FRAC: Group M5 fungicide (chloronitriles) + Group 3 fungicide (demethylation inhibitors, triazoles)

Resistance risk: Group M5: low risk; Group 3: medium risk. (See Note xx.)

Sites: landscape; nursery (field)

REI: 12 hours

Application: foliar spray

Application interval: 14 to 30 days

Uses: **herbaceous ornamentals** [Calendula, Chrysanthemum, Delphinium, Dianthus (Carnation, Sweet William), Gomphrena, Iris, Marigold, Monarda, Phlox, Zinnia]; **woody ornamentals** [Amelanchier, Apple (Flowering) (non bearing), Apricot (Flowering) (non bearing), Ash, Azalea/Rhododendron, Cherry (Flowering) (non bearing), Crabapple, Crape Myrtle, Dogwood, Hawthorn, Lilac, Oak, Peach (including Nectarine) (Flowering) (non bearing), Pine, Plum (Flowering) (non bearing), Poplar, Pyracantha, Photinia (Red-tip), Rose (outdoor use only), Walnut (non bearing)]

Diseases (fungal): **anthracnose** (*Gnomonia*); **black spot of rose; blossom or leaf blight or spot** (*Alternaria*, *Cladosporium*, *Coccomyces*, *Colletotrichum*, *Entomosporium* (syn. *Fabraea*), *Heterosporium*, *Monilinia*, *Tubakia*); **Discula anthracnose** (*Dogwood*); **Ovulinia petal blight; powdery mildew** (*Erysiphe*, *Microsphaera*, *Oidium*, *Podosphaera*); **ray blight** (*Ascochyta*); **rust** (*Gymnosporangium*, *Melampsora*, *Phragmidium*, *Puccinia*, *Uromyces*); **scab** (*Cladosporium*, *Spilocaea*, *Venturia*); **tip blight of pine** (*Sirococcus*, *Sphaeropsis* [*Diplodia*])

Approved for use in greenhouses: no

Use restrictions: maximum season application rates range from 3.8 (non bearing fruit and nuts) to 4.1 (conifers) or 9.0 (other Uses) gal product per acre per crop per year. For use on non bearing fruits and nuts only; do not harvest fruit within 12 months of application.

Cautions: do not apply product to African Violet, Begonia, Fern (Boston), Geranium, Pittosporum (Green, Variegated), Schefflera. Avoid **applications** during bloom when flower injury is unacceptable.

Trade name	Formulation	Manufacturer
Concert [EPA Reg. No. 100-1192]	38.5% (4.0 lb a.i.) chlorothalonil + 2.9% (0.3 lb a.i.) propiconazole (EC)	Syngenta Professional Products
Concert II [EPA Reg. No. 100-1347]	38.5% (4.0 lb a.i.) chlorothalonil + 2.9% (0.3 lb a.i.) propiconazole (EC)	Syngenta Professional Products

chlorothalonil + thiophanate-methyl

FRAC: Group M5 fungicide (chloronitriles) + Group 1 fungicide (methyl benzimidazole carbamates, thiophanates)

Resistance risk: Group M5: low risk; Group 1: high risk. Resistance management required. (See Note xx.)

Sites: greenhouse; interiorscape; landscape; nursery (including conifer seed beds)

REI: 12 hours

Application: foliar spray

Application interval: 7 to 14 days (foliar application); 2 to 4 weeks (conifers); 4 to 6 days (petal blight)

Uses: foliage plants [Aechmea, Aglaonema, Aluminum Plant, Aphelandra, Artemisia, Bougainvillea, Cactus (Holiday), Caladium, Calathea (Peacock Plant), Cordyline (Ti Plant), Crassula (Jade Plant), Dieffenbachia, Dracaena, False Aralia, Fatsia, Fern (Asparagus, Bird's Nest, Florida Ruffle, Japanese Holly, Leatherleaf, Staghorn), Ficus, Fittonia, Gynura (Purple Passion Vine), Hoya, Lipstick Plant, Ming Aralia, Oyster Plant, Palm, Peperomia, Philodendron, Piggyback Plant (Tolmiea), Pothos, Prayer Plant (Maranta), Syngonium, Tradescantia (Oyster Plant), Venus Flytrap, Yucca]; **bulbs, ground covers, and ornamental plants** [Aster, Baby's Breath, Begonia, Camellia, Carissa (Natal Plum), Chrysanthemum, Crocus, Croton, Daisy (Gerbera), Dianthus (Carnation), Dicentra (Bleeding Heart), Exacum (Arabian Violet), Geranium, Flame Violet (Episcia), Gladiolus, Hollyhock, Hydrangea (foliage only), Impatiens, Iris, Lily, Limonium (Statice), Marigold, Narcissus (Daffodil), Pachysandra, Petunia, Phlox, Poinsettia, Rose, Sansevieria, Tulip, Viola (Pansy), Zinnia]; **trees and shrubs** (broadleaf, evergreen) [Aesculus (Buckeye, Horse Chestnut), Almond (Flowering) (non bearing), Andromeda (Pieris), Ash, Azalea/Rhododendron, Cherry (including Sand) (Flowering) (non bearing), Cherry Laurel, Crabapple, Dogwood, Douglas Fir, Conifers, Eucalyptus, Euonymus, Fir, Hawthorn, Holly, Lilac, Magnolia, Maple, Mountain Laurel, Norfolk Island Pine, Oak, Oregon Grape Holly, Peach (Flowering) (non bearing), Photinia, Pine, Plum (Flowering) (non bearing), Poplar (Aspen), Privet (Ligustrum), Pyracantha, Quince (Flowering) (non bearing), Sequoia, Spiraea, Spruce, Sycamore/Plane Tree, Viburnum, Walnut (non bearing)]

Diseases (fungal): anthracnose (shade trees); **black spot of rose; blossom or leaf blight or spot** (*Actinopelte*, *Alternaria*, *Ascochyta*, *Bipolaris*, *Blumeriella*, *Botrytis*, *Cephalosporium*, *Cercospora*, *Cercosporidium*, *Coccomyces*, *Colletotrichum*, *Corynespora*, *Coryneum*, *Curvularia*, *Cylindrosporium*, *Dactylaria*, *Didymellina*, *Drechslera*, *Entomosporium* [*Fabraea*], *Fusarium*, *Gloeosporium*, *Marssonina*, *Monilinia*, *Myrothecium*, *Nematostoma*, *Phoma*, *Phyllosticta*, *Ramularia*, *Rhizopus*, *Schizothyrium*, *Sclerotinia*, *Septoria*, *Sphaceloma*); **Botrytis blight; canker** (Pine) (*Scleroderris*); **conifer twig blight and canker** (*Kabatina*, *Phoma*, *Phomopsis*, *Sirococcus*); **crown and stem rot** (non-water molds only) (*Bipolaris*, *Botrytis*, *Cylindrocladium*, *Fusarium*, *Gliocladium*, *Myrothecium*, *Rhizoctonia*, *Sclerotinia*); **downy mildew; leaf and flower gall** (*Exobasidium*); **leaf blister** (*Taphrina*); **leaf scorch** (*Stagonospora*); **needle cast** (*Cyclaneusma*, *Lophodermium*, *Rhabdocline*, *Rhizosphaera*, *Phaeocryptopus*); **Ovulinia petal blight; Phytophthora** (aerial); **powdery mildew** (*Erysiphe*, *Microsphaera*, *Oidium*, *Phyllactinia*, *Podosphaera*, *Sphaerotheca*); **ray blight** (*Mycosphaerella*); **rust** (*Gymnosporangium*, *Puccinia*, *Uromyces*); **stem canker** (Pine) (*Scleroderris*); **scab** (*Fusicladium*, *Venturia*); **Scirrhia brown spot** (Pine); **tip blight of pine** (*Sphaeropsis* [*Diplodia*]); **Volutella leaf blight; web blight** (*Rhizoctonia*)

Approved for use in greenhouses: yes

Use restrictions: maximum season application rates range from 22.9 (conifers) to 50.6 (other uses) lb product per acre (field grown only). Do not use treated plants for food or feed.

Cautions: do not use this product on Cactus (Easter), Fern (Boston), Swedish Ivy. Do not apply product to Schefflera or green or variegated Pittosporum more than once.

Trade name	Formulation	Manufacturer
Peregrine Fungicide [EPA Reg. No. 81943-7]	50% chlorothalonil + 16.7% thiophanate-methyl (WDG)	Phoenix Environmental Care LLC
Quali-Pro TM/C WDG [EPA Reg. No. 48234-7-66222]	50% chlorothalonil + 16.7% thiophanate-methyl (WDG)	Quali-Pro
Spectro 90 WDG [EPA Reg. No. 1001-72]	72% chlorothalonil + 18% thiophanate-methyl (WDG)	Cleary Chemical Corporation
Tee-1-Up WDG [EPA Reg. No. 83070-2]	50% chlorothalonil + 16.7% thiophanate-methyl (WDG)	SipcamAdvan
TM + CTN SPC 66.6 WDG [EPA Reg. No. 228-638]	50% chlorothalonil + 16.7% thiophanate-methyl (WDG)	Nufarm Turf & Specialty

copper hydroxide + copper oxychloride [Cu(OH)₂ + Cu₂(OH)₃Cl]

FRAC: Group M1 fungicide (inorganic) + Group M1 fungicide (inorganic)

Resistance risk: generally considered low (no indication of fungicide resistance); no cross resistance between group members M1 to M9

Sites: greenhouse; landscape (outdoors); nursery; shade house

REI: 48 hours

Application: foliar spray; dormant dip or spray

Application interval: 7 to 14 days (ornamentals); 1 to 4 weeks (conifers)

Uses: **broadleaf trees and shrubs; conifers** (including Christmas trees); **ferns; flowering plants; foliage plants; palm**

[Aglaonema, Andromeda (Japanese), Arborvitae, Aster, Azalea/Rhododendron, Beech, Begonia, Bougainvillea, Boxwood, Camellia, Camphor Tree, Canna, Cedar, Cherry (Nanking), Chinese Tallowtree, Chrysanthemum, Corylus (Filbert) (Ornamental) (non bearing), Cotoneaster, Crabapple, Cypress, Dahlia, Delphinium, Dianthus (including Carnation), Dogwood (Flowering, Kousa), Douglas Fir, Dieffenbachia, Dracaena, Dusty Miller, Echinacea, Elm (Chinese), Euonymus, False Aralia, Fern (Boston, Japanese Holly), Ficus (Weeping), Fir, Gardenia, Geranium, Gladiolus, Gleditsia (Honey Locust), Golden Rain Tree, Grape Ivy (ground cover), Hawthorn, Hibiscus (including Rose of Sharon), Holly, Honeysuckle (Tatarian), Hosta, Impatiens, Indian Hawthorn, Iris, Ivy (Algerian, English), Ixora, Juniper, Lantana, Leyland Cypress, Lilac, Lily (Easter), Linden, Loblolly Bay, Loquat (non bearing), Magnolia (Saucer, Southern, Sweet Bay), Mandevilla, Maple, Marigold, Mountain Ash, Mulberry (non bearing) (Contorted, Weeping), Narcissus, Oak (including Laurel), Oleander, Oregon Grape Holly, Pachysandra, Palm (Date, European Fan, Parlor, Queen, Washingtonia), Peach (Flowering) (non bearing), Pear (Flowering) (non bearing), Pentas, Peony, Philodendron, Phlox, Photinia (Red-tip), Pine, Pistachio (Ornamental), Plum (Flowering) (non bearing), Pothos, Powder Puff Plant, Pyracantha, Rose, Schefflera (Umbrella Tree), Snapdragon, Spathiphyllum, Spiraea, Spruce, Sycamore, Syngonium, Tulip, Verbena, Viburnum, Vinca (Periwinkle), Viola (Pansy, Violet), Willow, Yucca (Adam's Needle), Zinnia]

Diseases (fungal, bacterial): anthracnose; bacterial leaf spot (*Erwinia*, *Pseudomonas*, *Xanthomonas*); **black spot of rose; blossom or leaf blight or spot** (algal, *Alternaria*, *Botrytis*, *Cercospora*, *Colletotrichum*, *Entomosporium*, *Exosporium*, *Pestalotia*, *Septoria*); **Botrytis blight** (gray mold); **brown rot; canker; downy mildew; filbert blight; fire blight; needle blight; needle cast; Phytophthora** (aerial); **powdery mildew; scab; tar leaf spot; twig blight** (*Phomopsis*); **Volutella leaf blight**

Additional uses for dormant application: Spray or dip to dormant rootstock for management of Botrytis blight or *Phytophthora* root and crown rot. Do not apply to rootstock <2 years old.

Approved for use in greenhouses: yes

Use restrictions: do not apply more than 20 lb Cu+ per acre per year. Do not apply more than once every 7 days (see label for other restrictions).

Cautions: to prevent residues on commercial Azalea, Chrysanthemum, Dianthus (Carnation), Ivy, Rose, do not spray just before selling season. Do not apply to Hibiscus in flower. Some cultivars of Hosta, Iris may be sensitive to product. Check for phytotoxicity before large-scale use of copper fungicides; to prevent residues on many plants, avoid use of copper compounds just before selling season.

Trade name	Metallic copper equivalent	Formulation	Manufacturer
Badge SC Fungicide/Bactericide [EPA Reg. No. 80289-3]	20%	SC	Isagro USA, Inc.
Badge X2 WDG [EPA Reg. No. 80289-12]	28%	WDG	Isagro USA, Inc.

copper hydroxide + mancozeb

FRAC: Group M1 fungicide (inorganic) + Group M3 fungicide (dithiocarbamates)

Resistance risk: generally considered low (no indication of fungicide resistance); no cross resistance between group members M1 to M9

Sites: Greenhouse or outdoor use (sites not specified)

REI: 24 hours

Application: foliar spray

Application interval: 7 to 14 days; 5 days (fireblight)

Uses: **broadleaf trees and shrubs; conifers; flowering plants; nonbearing fruits and nuts** [Aesculus (Buckeye, Horse Chestnut), Almond (Flowering) (non bearing), Apple (Flowering) (non bearing), Apricot (Flowering) (non bearing), Arborvitae, Ash, Azalea/Rhododendron, Banana (Ornamental), Barberry, Beech, Begonia, Birch, Bittersweet, Camellia, Carya (Hickory, Pecan) (non bearing), Catalpa, Cherry (Flowering) (non bearing), Cherry Laurel, Chrysanthemum, Cotoneaster, Crabapple, Dahlia, Dianthus (Carnation), Dogwood, Douglas Fir, Elm, Euonymus, Fir, Forsythia, Geranium, Gladiolus, Holly, Honeysuckle, Hydrangea, Impatiens (including New Guinea), Indian Hawthorn, Juniper (Eastern Red Cedar), Lilac, Lily (Easter), Linden (Basswood), Magnolia, Maple (including Boxelder), Marigold, Mountain Ash, Mulberry (non bearing), Oak (Laurel), Pachysandra, Peach (including Nectarine) (Flowering) (non bearing), Pear (Flowering) (non bearing), Peony, Photinia, Pine, Plum (Flowering) (non bearing), Poplar (Aspen, Cottonwood), Privet, Pyracantha, Ribes (Alpine Currant), Rose, Russian Olive, Spathiphyllum, Sumac, Sycamore/Plane Tree, Tulip, Viburnum, Vinca (Periwinkle), Viola (Pansy), Walnut (including Butternut) (non bearing), Witch Hazel, Zinnia]

Diseases (fungal, bacterial): anthracnose; bacterial leaf spot (*Pseudomonas*, *Xanthomonas*); **bacterial soft rot; black spot of rose; leaf blight, blotch, or spot** (including algal, *Alternaria*, *Cercospora*, *Colletotrichum*, *Entomosporium*, *Gloeosporium*, *Septoria*); **Botrytis blight; brown rot; downy mildew; fire blight, Honeysuckle leaf blight; leaf and flower gall** (*Exobasidium*); **leaf blister; needle blight** (*Dothistroma*, *Phomopsis*, *Scirrhia*); **needle cast** (*Cyclaneusma*, *Lophodermium*, *Rhabdocline*, *Rhizosphaera*); **peach leaf curl and plum pocket; petal blight; Phytophthora** (aerial); **rust; scab; shot hole** (*Prunus*); **spot anthracnose; tar spot; tip blight of pine** (*Sphaeropsis* [*Diplodia*]); **twig blight** (*Alternaria*, *Phomopsis*); **Volutella leaf blight**

Approved for use in greenhouses: yes

Use restrictions: no post-bloom application for non bearing stone fruit permitted. Not intended for use on fruit trees by homeowners. Do not treat plants intended for food or feed.

Cautions: To prevent residues on commercial Azalea, Chrysanthemum, Dianthus (Carnation), Rose, do not spray just before selling season. Not recommended for use on French Marigold as phytotoxicity may occur.

Trade name	Formulation	Manufacturer
Junction [EPA Reg. No. 67690-35]	46.1% copper hydroxide (30% metallic copper equivalent) + 15% mancozeb (DF)	SePRO Corporation

copper oxychloride + basic copper sulfate [$\text{Cu}_2\text{Cl}(\text{OH})_3 + 3\text{Cu}(\text{OH})_2 \cdot \text{Cu}(\text{SO})_4$]

FRAC: Group M1 fungicide (inorganic) + Group M1 fungicide (inorganic)

Resistance risk: generally considered low (no indication of fungicide resistance); no cross resistance between group members M1 to M9

Sites: greenhouse; field

REI: 24 hours

Application: foliar spray

Application interval: 7 to 14 days

Uses: **ornamental flowering plants; trees and shrubs** [Azalea, Dahlia, Maple, Nasturtium, Oak (White), Pachysandra, Peony, Rose, Vinca, Sycamore]

Diseases (fungal): **anthracnose; black spot of rose; Botrytis blight; canker; leaf spot and blight** (including *Botrytis*); **rust** (Rose); **tar leaf spot; twig blight; Volutella leaf blight**

Approved for use in greenhouses: yes

Cautions: check for phytotoxicity before large-scale use of copper fungicides; to prevent residues on many plants, avoid use of copper compounds just before selling season. To ensure effectiveness, pH of spray solution should not be <6.5 or >9.0.

Trade name	Metallic copper equivalent	Formulation	Manufacturer
C-O-C-S WDG [EPA Reg. No. 34704-326]	50%	WDG	Loveland Products, Inc.

cyprodinil + fludioxonil

FRAC: Group 9 fungicide (anilino-pyrimidines) + Group 12 fungicide (phenylpyrroles)

Resistance risk: Group 9: medium risk; Group 12: low to medium risk. Resistance management required. (See Note xx.)

Sites: forest nursery; greenhouse (bed, bench, container, flat, plug); lath and shade house; landscape (commercial); nursery (container, field) (not for residential use)

REI: 12 hours

Application: foliar spray

Application interval: 7 to 14 days

Uses: flowering and foliage plants; perennials [Abutilon, Ageratum, Alternanthera (Joseph's Coat), Alyssum, Aptenia, Astilbe (Bridal Veil), Begonia, Brachycome (Swan River Daisy), Caladium, Calendula (Pot Marigold), Callisia, Calibrachoa (Trailing Petunia), Celosia (Cockscomb), Centrosema, Chenille, Chlorophytum (Spider Plant), Coleus, Cosmos, Cuphea (Mexican Heather), Dahlia (including Dahlietta), Daisy (Gerbera), Dianthus, Dicentra (Bleeding Heart), Dimorphotheca (African Daisy), Dusty Miller, Fuchsia, Germander, Hibiscus, Hypoestes, Ipomoea (Moonflower), Iresine, Iris (Bulbous), Ivy (English), Lamium (Deadnettle), Lantana, Lily (Asiatic), Lisianthus, Lysimachia, Marigold (including African), Narcissus (Daffodil), Nemesia, Nephthytis, Osteospermum (Cape Daisy), Oxalis, Pachysandra, Pentas, Persicaria (Fleece Flower), Philodendron, Poinsettia, Portulaca (Purslane), Pothos, Rose, Salvia, Scaevola, Snapdragon, Spathiphyllum, Strawflower, Streptocarpella (Dancing Flower), Strobilanthes, Sunflower (Ornamental), Swedish Ivy, Syngonium, Torenia (Wishbone Flower), Tradescantia (Purple Heart, Setcreasea), Tulip, Verbena, Vinca, Viola (Pansy), Zinnia]

Diseases (fungal): anthracnose (*Colletotrichum*); **Botrytis blight; leaf spot and blight** (*Alternaria*, *Cercospora*, *Myrothecium*, *Septoria*); **leaf scorch** (*Stagonospora*); **powdery mildew** (*Erysiphe*, *Sphaerotheca*); **stem dieback or rot** (non-water molds) (*Cylindrocladium*, *Fusarium*, *Phoma*, *Phomopsis*, *Sclerotinia*); **southern blight** (*Sclerotium*); **web blight** (*Rhizoctonia*)

Approved for use in greenhouses: yes

Use restrictions: for outdoor or enclosed structure uses, do not apply more than 56 oz product per acre per plot per year or crop cycle, respectively. Do not use product on residential ornamentals.

Cautions: to avoid stunting and/or chlorosis, use caution in seedling applications to Impatiens or New Guinea Impatiens or foliar applications to Geranium. Do not apply product to Fern (Leatherleaf) or other field grown Fern intended for cutting/harvest for floral arrangements. Test for safety before applying to Poinsettia bracts in full color.

Trade name	Formulation	Manufacturer
Palladium [EPA Reg. No. 100-1328]	37.5% cyprodinil + 25.0% fludioxonil (WDG)	Syngenta Professional Products

debacarb + carbendazim

FRAC: carbendazim: Group 1 fungicide (methyl benzimidazole carbamates, benzimidazoles)

Resistance risk: resistance common in various fungal species; high risk; resistance management required

Sites: outdoors; other sites not specified

REI: not specified

Application: tree injection; ready-to-use capsules

Application interval: 3 months to yearly

Uses: **non crop bearing ornamental trees and large woody shrubs** [Alder, Arborvitae, Ash, Birch, Buckthorn, Camphor Tree, Carob, Catalpa, Cedar, Cypress, Douglas Fir, Elm, Fir, Laurel (Bay Tree), Madrone, Magnolia, Maple, Mimosa, Mulberry (non bearing), Oak, Olive, Palm, Pine, Pistachio (non bearing), Poplar, Sequoia (Redwood), Spruce, Sweet Gum, Sycamore, Walnut (Black) (non bearing), Willow]

Applications for tree injection (diseases [fungal]): **anthracnose; canker and dieback** (*Atropellis, Botryosphaeria, Ceratocystis, Cytospora, Fusarium, Leptographium, Melanconium, Nectria, Phomopsis, Physalospora, Vermicularia*); **conifer shoot/tip blight** (*Coryneum, Kabatina, Phomopsis, Sphaeropsis [Diplodia]*); **Dutch elm disease; oak decline** (Live Oak); **oak wilt** (note: this disease has not been detected in New Jersey); **wilt** (*Dothiorella [Cephalosporium], Fusarium, Verticillium*)

Approved for use in greenhouses: not specified

Use restrictions: do not inject trees that are less than two inches in diameter. Do not use on trees which will produce food within the year following treatment.

Cautions: trees in advanced stages of disease may not respond to treatment.

Trade name	Formulation	Manufacturer
Fungisol [EPA Reg. No. 7946-14]	1.7% debacarb + 0.3% carbendazim (ready-to-use capsules)	J.J. Mauget Co.

debacarb + carbendazim + abamectin

FRAC: carbendazim: Group 1 fungicide (methyl benzimidazole carbamates, benzimidazoles)

Resistance risk: resistance common in various fungal species; high risk; resistance management required

Sites: outdoors (non commercial use only); other sites not specified

REI: not specified

Application: tree injection; ready-to-use capsules (contains abamectin insecticide)

Application interval: 3 months to yearly

Uses: **non crop bearing ornamental trees and large woody shrubs** [Alder, Arborvitae, Ash, Birch, Buckthorn, Camphor Tree, Carob, Catalpa, Cedar, Cypress, Douglas Fir, Elm, Fir, Laurel (Bay Tree), Madrone, Magnolia, Maple, Mimosa, Mulberry (non bearing), Oak, Olive, Palm, Pine, Pistachio (non bearing), Poplar, Sequoia (Redwood), Spruce, Sweet Gum, Sycamore, Walnut (Black) (non bearing), Willow]

Applications for tree injection (diseases [fungal]): **anthracnose; canker and dieback** (*Atropellis, Botryosphaeria, Ceratocystis, Cytospora, Fusarium, Leptographium, Melanconium, Nectria, Phomopsis, Physalospora, Vermicularia*); **conifer shoot/tip blight** (*Coryneum, Kabatina, Phomopsis, Sphaeropsis [Diplodia]*); **Dutch elm disease; oak decline** (Live Oak); **oak wilt** (note: this disease has not been detected in New Jersey); **pine wilt nematode; wilt** (*Dothiorella [Cephalosporium], Fusarium, Verticillium*)

Approved for use in greenhouses: not specified

Use restrictions: not for use on ornamental trees grown for sale or other commercial purposes. Post-bloom **Application** only. Do not inject trees that are less than two inches in diameter. Do not use on trees which will produce food within the year following treatment.

Cautions: trees in advanced stages of disease may not respond to treatment.

Note: Abasol is also labeled for control of certain insects on ornamental trees (see label).

Trade name	Formulation	Manufacturer
Abasol [EPA Reg. No. 7946-20]	1.7% debacarb + 0.3% carbendazim + 0.46% abamectin (ready-to-use capsules)	J.J. Mauget Co.

debacarb + carbendazim + imidacloprid

FRAC: carbendazim: Group 1 fungicide (methyl benzimidazole carbamates, benzimidazoles)

Resistance risk: resistance common in various fungal species; high risk; resistance management required

Sites: outdoors; other sites not specified

REI: not specified

Application: tree injection; ready-to-use capsules (contains imidacloprid insecticide)

Application interval: 3 months to yearly

Uses: **non crop bearing ornamental trees and large woody shrubs** [Alder, Arborvitae, Ash, Birch, Buckthorn, Camphor Tree, Carob, Catalpa, Cedar, Cypress, Douglas Fir, Elm, Fir, Laurel (Bay Tree), Madrone, Magnolia, Maple, Mimosa, Mulberry (non bearing), Oak, Olive, Palm, Pine, Pistachio (non bearing), Poplar, Sequoia (Redwood), Spruce, Sweet Gum, Sycamore, Walnut (Black) (non bearing), Willow]

Applications for tree injection (diseases [fungal]): **anthracnose; canker and dieback** (*Atropellis, Botryosphaeria, Ceratocystis, Cytospora, Fusarium, Leptographium, Melanconium, Nectria, Phomopsis, Physalospora, Vermicularia*); **conifer shoot/tip blight** (*Coryneum, Kabatina, Phomopsis, Sphaeropsis [Diplodia]*); **Dutch elm disease; oak decline** (Live Oak); **oak wilt** (note: this disease has not been detected in New Jersey); **wilt** (*Dothiorella [Cephalosporium], Fusarium, Verticillium*)

Approved for use in greenhouses: not specified

Use restrictions: do not inject trees that are less than two inches in diameter. Do not use on trees which will produce food within the year following treatment.

Note: Imisol is also labeled for control of certain insects on ornamental trees (see label).

Trade name	Formulation	Manufacturer
Imisol [EPA Reg. No. 7946-21]	11.7% debacarb + 0.3% carbendazim + 5.0% imidacloprid (ready-to-use capsules)	J.J. Mauget Co.

fludioxonil + mefenoxam

FRAC: Group 12 fungicide (phenylpyrroles) + Group 4 fungicide (phenylamides, acylalanines)

Resistance risk: Group 12: low to medium risk; Group 4: high risk. Resistance management required. (See Note xx.)

Sites: greenhouse; interiorscape; other enclosed structures

REI: 48 hours

Application: soil drench (seeding, cutting, transplant) (including pre-potting media mix)

Application interval: once (to seedlings); 21 to 28 days (cuttings and transplants)

Uses: flowering plants; foliage plants; herbaceous ornamentals; woody shrubs [African Violet, Ageratum, Alyssum, Aster, Azalea, Begonia, Cactus (Holiday), Caladium, Calendula, Celosia, Chrysanthemum, Coleus, Cyclamen, Daisy (Gerbera), Dianthus (Carnation), Gomphrena, Marigold, Petunia, Rose, Salvia, Snapdragon, Spathiphyllum, Verbena, Vinca, Viola (Pansy), Zinnia]

Diseases (fungal): soilborne diseases (damping-off; basal, crown, root, and stem rot) (non-water molds) (*Rhizoctonia*) and (oomycetes) (*Phytophthora*, *Pythium*)

Approved for use in greenhouses: yes

Use restrictions: do not apply more than 46 oz product per 1,000 sq ft per year or crop cycle. Do not apply more than 2 pt drench mixture per sq ft per application. For ornamental crops grown in the ground, up to 12.5 lb product per acre per year may be used.

Cautions: applications to Easter Lily, Geranium, Impatiens, New Guinea Impatiens, Pothos may cause stunting and/or chlorosis.

Trade name	Formulation	Manufacturer
Hurricane [EPA Reg. No. 100-951]	32% fludioxonil + 16% mefenoxam (WDP)	Syngenta Professional Products

iprodione + thiophanate-methyl

FRAC: Group 2 fungicide (dicarboximides) + Group 1 fungicide (methyl benzimidazole carbamates, thiophanates)

Resistance risk: Group 2: medium to high risk; Group 1: high risk. Resistance management required. (See Note xx.)

Sites: greenhouse; landscape; nursery (conifer, container, field) (commercial use only)

REI: 12 to 24 hours (see label)

Application: foliar spray; soil drench; plant dip

Application interval: 7 to 14 days (foliar spray); 2 to 4 weeks (soil drench)

Uses: **broadleaf trees and shrubs; conifers; flowering plants; foliage plants** [Ageratum, Ajuga, Almond (Flowering) (non bearing), Aluminum Plant (Pilea), Alyssum, Andromeda (Pieris), Aphelandra, Artemisia, Aster, Azalea/Rhododendron, Baby’s Breath (Gypsophila), Boxwood, Cactus, Calendula, Cherry (Flowering) (non bearing), Chrysanthemum, Cineraria, Coleus, Columbine, Conifers, Crape Myrtle, Crassula (Jade Plant), Croton, Cyclamen, Dahlia, Delphinium, Deutzia, Dianthus (including Carnation), Dieffenbachia, Dogwood, Dracaena, Euonymus, False Aralia (Dizygotheca), Ficus, Flame Violet (Episcia), Forsythia, Gazania, Geranium, Gladiolus, Gloxinia, Hawthorn, Heuchera, Holly, Hoya, Hydrangea, Impatiens, Iris, Ivy (Common, English), Juniper, Kalanchoe, Lily, Limonium (Statice), Lipstick Plant, Marigold, Monarda, Narcissus (Daffodil), Pachysandra, Palm, Peach (Flowering) (non bearing), Peperomia, Petunia, Philodendron, Phlox, Pine, Pittosporum, Plum (Flowering) (non bearing) (including Cistena Plum, Rose Tree of China), Poinsettia, Poppy, Pothos, Primula, Privet, Protea, Pyracantha, Rose, Salvia, Schefflera, Snapdragon, Tulip, Viburnum, Vinca (Periwinkle), Viola (Pansy, Violet), Zinnia]

Diseases (fungal): anthracnose; black spot of rose, blossom or leaf blight or spot (*Alternaria, Cercospora, Corynespora, Cyindrocladium, Didymellina, Entomosporium, Fusarium, Helminthosporium, Monilinia, Ramularia, Septoria*); **Botrytis blight and storage rot; corm rot** (*Fusarium*); **Cylindrocladium blight; daffodil leaf scorch** (*Stagonospora*); **ink spot** (*Drechslera*); **petal blight** (*Ovulinia*); **powdery mildew, ray blight** (*Ascochyta*); **soilborne diseases** (crown, root, and stem rot) (non-water molds) (*Cylindrocladium, Fusarium, Rhizoctonia, Sclerotinia, Thielaviopsis*); stem blight (*Phomopsis*); **scab; tip blight of pine** (*Sphaeropsis [Diplodia]*); **tulip fire** (*Botrytis*); **web blight** (*Rhizoctonia*)

Applications for plant dip: **Botrytis storage rot** (Rose); **Cylindrocladium blight** (Azalea/Rhododendron); **Fusarium corm rot** (Gladiolus)

Approved for use in greenhouses: yes

Use restrictions: do not apply more than 12 gal of product per acre in a single application. Use on residential sites is prohibited; commercial use only (landscape and nursery personnel). Application maximums differ among products; see label.

Cautions: do not use product as a drench on Impatiens, Petunia, and Pothos. Do not apply product to New Guinea Impatiens, Spathiphyllum. Residue may be noticeable on Cyclamen, Poinsettia; use caution during bloom. Do not make repeat applications at high drench rates to Chrysanthemum.

Trade name	Formulation	Manufacturer
26/36 Fungicide [EPA Reg. No. 432-1414-1001]	19.65% (1.9 lb a.i.) iprodione + 19.65% (1.9 lb a.i.) thiophanate-methyl (EC)	Cleary Chemical Corporation
Dovetail Fungicide [EPA Reg. No. 81943-14]	19.65% (1.9 lb a.i.) iprodione + 19.65% (1.9 lb a.i.) thiophanate-methyl (EC)	Phoenix Environmental Care LLC
Nufarm TM + IP SPC [EPA Reg. No. 228-630]	19.65% (1.9 lb a.i.) iprodione + 19.65% (1.9 lb a.i.) thiophanate-methyl (EC)	Nufarm Turf & Specialty

phosphorous acids and salts (mono-potassium salts of phosphorous acid) + sulfur

FRAC: Group 33 fungicide (phosphonates, ethyl phosphonates) + Group M2 fungicide (inorganic)

Resistance risk: Group 33: low risk; Group M2: low risk. (See Note xx.)

Sites: outdoors; other sites not specified

REI: 24 hours

Application: foliar spray

Application interval: 7 to 14 days

Uses: **ornamentals** (including woody and herbaceous ornamentals)

Diseases (fungal): **powdery mildew**

Approved for use in greenhouses: not specified

Cautions: sulfur may burn foliage. To avoid phytotoxicity, do not apply sulfur over 90oF, in full sun, or 14 days after an oil spray. Do not combine product with copper sprays.

Trade name	Formulation	Manufacturer
Sanction Fungicide [EPA Reg. No. 34704-1040]	31% (4.1 lb a.i.) mono-potassium phosphate + 31% (4.1 lb a.i.) sulfur (EC)	Loveland Products, Inc.

thiophanate-methyl + etridiazole

FRAC: Group 1 fungicide (methyl benzimidazole carbamates, thiophanates) + Group 14 fungicide (heteroaromatics, 1,2,4-thiadiazoles)

Resistance risk: Group 1: high risk; Group 14: low to medium risk. Resistance management required. (See Note xx.)

Sites: greenhouse (bedding, bench); nursery (container)

REI: 12 hours

Application: soil drench (seeding and transplant) (wetable powder); dry soil mix, broadcast, and side dress (granular)

Application interval: 4 to 12 weeks (soil drench); once (soil incorporation)

Uses: **bedding plants** [Ageratum, Ajuga, Alyssum, Aster, Begonia, Celosia, Coleus, Dahlia, Delphinium (Larkspur), Dianthus (Carnation), Dusty Miller, Gynura, Impatiens (including Balsam), Marigold, Nasturtium, Petunia, Phlox, Salvia, Snapdragon, Verbena, Viola (Pansy), Zinnia)]; **foliage plants** [Aglaonema, Aluminum Plant (Pilea), Cactus (including Holiday), Caladium, Dieffenbachia, Dracaena, Fatsia (Aralia), Fern, Ficus, Fittonia, Hoya, Nauticalyx, Peperomia, Philodendron, Pothos (Epipremnum), Prayer Plant (Maranta), Schefflera, Syngonium, Tradescantia (Spiderwort)]; **herbaceous ornamentals** [African Violet, Arborvitae (Thuja), Baby's Breath (Gypsophila), Begonia, Calendula, Chrysanthemum, Coleus, Dahlia, Daisy (Gerbera), Delphinium, Dianthus (Carnation), Geranium, Gloxinia, Gynura, Ivy, Kalanchoe, Lily (Easter), Limonium (Statice), Lobelia]; **woody ornamentals** [Aucuba, Azalea/Rhododendron, Boxwood, Camellia, Cedar, Crape Myrtle, Croton, Euonymus, Fatsia, Ficus, Fir, Gardenia, Holly (Ilex), Hydrangea, Ixora, Juniper, Leucothoe, Maple, Palm (Parlor), Photinia, Pine, Pittosporum, Podocarpus, Poinsettia, Privet (Ligustrum), Spruce, Yew]

Diseases (fungal): **soilborne diseases (damping-off; root and stem rot)** (non-water molds) (*Fusarium*, *Rhizoctonia*, *Thielaviopsis*) and (oomycetes) (*Phytophthora*, *Pythium*)

Approved for use in greenhouses: yes

Use restrictions: commercial use only; use in residential greenhouse use or other indoor sites is prohibited.

Trade name	Formulation	Manufacturer
Banrot 8G [EPA Reg. No. 58185-23]	5% thiophanate-methyl + 3% etridiazole (G)	Everiss (Scotts Company)
Banrot 40 WP [EPA Reg. No. 58185-10]	25% thiophanate-methyl + 15% etridiazole (WP)	Everiss (Scotts Company)

triadimefon + trifloxystrobin

FRAC: Group 3 fungicide (demethylation inhibitors, triazoles) + Group 11 fungicide (QoI-fungicides, oximino acetates)

Resistance risk: Group 3: medium risk; Group 11: high risk. Resistance Management Required. (See Note xx.)

Sites: interiorscape; landscape (commercial, residential)

REI: 12 hours

Application: foliar spray

Application interval: 14 to 28 days

Uses: **Christmas trees** (except Concolor Fir); **flowering plants and foliage plants** [Ageratum, Aster, Begonia, Calendula, Canna, Chrysanthemum, Cineraria, Crassula (Jade Plant), Dahlia, Daisy (including Gerbera), Delphinium, Dianthus (including Carnation), Four O'Clock, Geranium, Grape Ivy, Hollyhock, Hydrangea, Iris, Kalanchoe, Marigold, Nephthytis, Petunia, Phlox, Poinsettia, Rose, Salvia, Sedum, Snapdragon, Sunflower (Ornamental), Viola (Pansy), Zinnia]; **ornamental trees and shrubs** [Amelanchier, Apple (Flowering) (non bearing), Azalea/Rhododendron, Barberry, Buckthorn, Camellia, Cedar, Cherry (Flowering) (non bearing), Cinquefoil (Potentilla), Crabapple, Crape Myrtle, Dogwood, Euonymus, Gardenia, Hawthorn, Hemlock, Holly, Juniper, Leucothoe, Leyland Cypress, Lilac, Mock-orange, Mountain Laurel, Ninebark, Paulownia, Pear (Flowering) (non bearing), Photinia, Pittosporum, Plum (Flowering) (non bearing), Privet, Pyracantha, Spiraea, Viburnum, Vitex]; shade trees [Aesculus (Buckeye), Ash, Birch, Chestnut, Elm, Fir, Gleditsia (Locust), Maple, Oak, Pine, Poplar (including Aspen, Cottonwood), Russian Olive, Sycamore, Walnut (non bearing), Willow]

Diseases (fungal): anthracnose (*Apiognomonina*, *Colletotrichum*, *Discula*, *Gloeosporium*, *Glomerella*); **black spot of rose** (*Diplocarpon*); **downy mildew** (*Peronospora*); **leaf spot and blight** (*Cercospora*, *Entomosporium*, *Septoria*); **needle cast** (*Lophodermium*); **powdery mildew** (*Erysiphe*, *Microsphaera*, *Oidium*, *Podosphaera*, *Sphaerotheca*, *Uncinula*); **rust** (*Coleosporium*, *Cronartium*, *EndoCronartium*, *Gymnosporangium*, *Melampsoridium*, *Phragmidium*, *Puccinia*, *Uromyces*); **scab** (*Cladosporium*, *Venturia*); **tip blight** (*Sirococcus*)

Approved for use in greenhouses: not specified

Cautions: do not exceed 207.1 oz product per acre per year.

Trade name	Formulation	Manufacturer
Armada 50 WDG [EPA Reg. No. 432-1513]	41.7% triadimefon + 8.3% trifloxystrobin (WDG)	Bayer Environmental Science
Armada 50 WP [EPA Reg. No. 432-1412]	41.7% triadimefon + 8.3% trifloxystrobin (WSP)	Bayer Environmental Science

BIOPESTICIDES AND BIORATIONAL PRODUCTS

aliphatic petroleum solvents

Trade name: JMS Stylet Oil [EPA Reg. No. 65564-1]
Active ingredient (% a.i.): mineral oil (97.1%)
Manufacturer: JMS Flower Farms Inc.
REI: 4 hours
Application: foliar spray
Application interval: 7 to 14 days
Sites: greenhouse; other sites not specified
Hosts: ornamentals
Diseases (fungal): black spot; powdery mildew (roses only)
Cautions: do not spray when freezing temperatures are anticipated within 48 h of an oil application, above 90 F, or when plants are under heat or moisture stress.

Trade name: Saf-T-Side [EPA Reg. No. 48813-1]
Active ingredient (% a.i.): petroleum oil (80%)
Manufacturer: Brandt Consolidated
REI: 4 hours
Application: foliar spray
Application interval: as needed
Sites: greenhouse; landscape
Hosts: conifers; bedding, flower, and foliage plants; shade trees; shrubs; vines [Azalea/
Rhododendron, Camellia, Chrysanthemum, Dianthus, Fuchsia, Gladiolus, Hibiscus, Iris, Lily,
Orchid, Poinsettia, Rose]
Diseases (fungal): powdery mildew
Cautions: do not spray when plants exhibit moisture stress. Oil might remove the glaucous bloom from evergreens such as Colorado Blue Spruce and Koster Spruce. Use with caution for summer application on Japanese Red Maple, Amur Maple, and Black Walnut.

Trade name: SuffOil-X [EPA Reg. No. 48813-1-68539]
Active ingredient (% a.i.): petroleum oil (80%)
Manufacturer: Bioworks, Inc.
REI: 4 hours
Application: foliar spray
Application interval: as needed
Sites: greenhouse; landscape
Hosts: conifers; bedding, flower, and foliage plants; shade trees; shrubs; vines [Azalea/
Rhododendron, Camellia, Chrysanthemum, Dianthus, Fuchsia, Gladiolus, Hibiscus, Iris, Lily,
Orchid, Poinsettia, Rose, Vines]
Diseases (fungal): powdery mildew, rust
Cautions: do not spray when plants exhibit moisture stress. Oil might remove the glaucous bloom from evergreens such as Colorado Blue Spruce and Koster Spruce. Use with caution for summer application on Japanese Red Maple, Amur Maple, and Black Walnut.

Trade name: TriTek [EPA Reg. No. 48813-1]
Active ingredient (% a.i.): mineral oil (80%)
Manufacturer: Brandt Consolidated
REI: 4 hours
Application: foliar spray
Application interval: as needed
Sites: greenhouse; landscape
Hosts: conifers; bedding, flower, and foliage plants; shade trees; shrubs; vines [Azalea/
Rhododendron, Camellia, Chrysanthemum, Dianthus, Fuchsia, Gladiolus, Hibiscus, Iris, Lily,
Orchid, Poinsettia, Rose, Vines]

Diseases (fungal): powdery mildew
Cautions: do not spray when plants exhibit moisture stress. Oil might remove the glaucous bloom from evergreens such as Colorado Blue Spruce and Koster Spruce. Use with caution for summer application on Japanese Red Maple, Amur Maple, and Black Walnut.

oils: essential oils (rosemary + clove + thyme oils)

Trade name: Sporatec [EPA Reg. No. FIFRA 25(b) Exempt]
Active ingredient (% a.i.): oil (38% oil, Liquid)
Manufacturer: Brandt Consolidated
REI: 0 hours
Application: foliar spray
Application interval: 7 to 14 days
Sites: greenhouse; landscape; nursery
Hosts: potted plants; flowering bench crops; outdoor woody plants
Diseases (fungal): anthracnose (*Colletotrichum*); black spot of rose; Botrytis blight; downy mildew (*Peronospora*); leaf spot (*Myrothecium*, *Septoria*); powdery mildew (*Erysiphe*, *Microsphaera*, *Oidium*, *Podosphaera*, *Sphaerotheca*); rust (*Gymnosporangium*, *Phragmidium*); scab (*Cladosporium*, *Venturia*)
Cautions: do not apply to wilted or otherwise stressed plants or to newly transplanted materials prior to root establishment.

oils: neem oil

Trade name: 70% Neem Oil [EPA Reg. No. 70051-2-54705]
Active ingredient (% a.i.): neem oil (70% oil)
Manufacturer: Monterey Lawn and Garden
REI: 0 hours
Application: foliar spray
Application interval: 7 to 14 days
Sites: houseplants; outdoors
Hosts: houseplants, ornamental shrubs and trees, roses
Diseases (fungal): primarily for powdery mildew management. Other uses on label: Alternaria blight; anthracnose; black spot of rose; Botrytis blight; downy mildew; rust; scab
Cautions: thorough coverage of the plant, including the lower leaf surface, is essential.

Trade name: DeBug Turbo (contains azadirachtin) [EPA Reg. No. 70310-5]
Active ingredient (% a.i.): neem oil (5.32 EC)
Manufacturer: Agro Logistic Systems, Inc.
REI: 4 hours
Application: foliar spray
Application interval: 7 to 14 days; 5 to 7 days (greenhouse crops)
Sites: greenhouse
Hosts: greenhouse crops [such as Chrysanthemum, Dahlia, Daisy, Dianthus, Geranium, Lily, Poinsettia, Rose, Salvia]
Diseases (fungal): powdery mildew; rust; soilborne diseases (non-water molds) (*Rhizoctonia*, *Sclerotinia*, *Sclerotium*)
Cautions: thorough coverage of the plant, including the lower leaf surface, is essential.

Trade name: Triact 70 [EPA Reg. No. 70051-2-59807]
Active ingredient (% a.i.): neem oil (70% oil, 5.46 lb a.i. per gallon)
Manufacturer: OHP, Inc.
REI: 4 hours
Application: foliar spray
Application interval: 7 to 14 days
Sites: greenhouse (and other covered structures); landscape (including interiorscape); nursery

Hosts: flowering plants; shrubs and trees
Diseases (fungal): Alternaria blight; anthracnose; black spot of rose; Botrytis blight; downy mildew; powdery mildew; rust; scab; tip blight
Cautions: do not apply to known sensitive plant species such as some Dianthus varieties, ornamental Olive, or flowers of Impatiens, Fuchsia, Hibiscus, and some Roses without prior testing. Do not apply to wilted or otherwise stressed plants or to newly transplanted materials prior to root establishment.

Trade name: Trilogy [EPA Reg. No. 70051-2]
Active ingredient (% a.i.): neem oil (70% oil, 5.46 lb a.i. per gallon)
Manufacturer: Certis USA, L.L.C.
REI: 4 hours
Application: foliar spray
Application interval: 7 to 14 days
Sites: landscape; nursery
Hosts: landscape and nursery ornamentals
Diseases (fungal): Alternaria blight; anthracnose; black spot of rose; Botrytis blight; downy mildew; powdery mildew; rust; scab; tip blight
Cautions: do not apply to known sensitive plant species such as some Dianthus varieties, ornamental Olive, or flowers of Impatiens, Fuchsia, Hibiscus, and some Roses without prior testing. Do not apply to wilted or otherwise stressed plants or to newly transplanted materials prior to root establishment.

Trade name: Triple Action Neem Oil [EPA Reg. No. 70051-2-829]
Active ingredient (% a.i.): neem oil (70% oil)
Manufacturer: Southern Agricultural Insecticides, Inc.
REI: 4 hours
Application: foliar spray
Application interval: 7 to 14 days
Sites: indoor and outdoor ornamentals; residential landscapes
Hosts: flowers; houseplants; roses; shrubs; trees
Diseases (fungal): Alternaria blight; anthracnose; black spot of rose; Botrytis blight; downy mildew; powdery mildew; rust; scab; tip blight
Cautions: do not apply to known sensitive plant species such as some Dianthus varieties, ornamental Olive, or flowers of Impatiens, Fuchsia, Hibiscus, and some Roses without prior testing. Do not apply to wilted or otherwise stressed plants or to newly transplanted materials prior to root establishment.

oils: soybean oil

Trade name: Oleotrol - M [EPA Reg. No. FIFRA 25(b) Exempt]
Active ingredient (% a.i.): oil (45% oil, Liquid)
Manufacturer: Natural Forces LLC
REI: 0 hours
Application: foliar spray
Application interval: 10 to 14 days
Sites: Christmas trees; indoor and outdoor landscapes
Hosts: bedding, flowering and tropical plants; transplants
Diseases (fungal): Botrytis blight; downy mildew; powdery mildew; rust

disinfestants

Trade name: Consan Triple Action 20 [EPA Reg. No. 58044-3]
Active ingredient (% a.i.): ammonium chlorides (20% SC)
Manufacturer: Brandt Consolidated
REI: 0 hours

Application: foliar spray; bulb and cutting soak
Application interval: 10 to 14 days
Sites: outdoors
Hosts: bulbs; cut flowers; flowering annuals and perennials; shrubs and trees [African Violet, Andromeda (Pieris), Ash, Aucuba, Begonia, Cactus, Calendula, China Aster, Chrysanthemum, Crape Myrtle, Crassula, Dahlia, Dianthus, Dogwood, Fuchsia, Gardenia, Geranium, Gesneria, Gladiolus, Hawthorn, Heliotrope, Hollyhock, Hyacinth, Iris, Kalanchoe, Lilac, Lily (Easter), Narcissus, Oak (Live), Orchid, Palm, Peony, Pear (Flowering) (non bearing), Rose, Rubber-plant, Sedum, Snapdragon, Sycamore, Tulip]
Diseases (bacterial, fungal): anthracnose; black spot of rose; Botrytis blight; downy mildew; fire blight; leaf blight and spot; powdery mildew; rust; soilborne diseases (non-water molds) (damping-off; crown and root rot); stem rot
Cautions: do not apply during wet weather.

Trade name: ZeroTol [EPA Reg. No. 70299-1]
Active ingredient (% a.i.): hydrogen dioxide (27% SC)
Manufacturer: BioSafe Systems, LLC
REI: 0 hours
Application: foliar spray; dormant application (*Botrytis*); pre-plant dip; soil drench
Application interval: 5 to 7 days
Sites: commercial greenhouse; garden center; interiorscape; landscape; nursery
Hosts: Azalea/Rhododendron; bedding plants; bulbs; conifers; cut flowers; cuttings; flowering plants; Poinsettia; Rose; seedlings; shrubs; shade trees
Diseases (fungal): disease suppression [*Botrytis* blight; downy mildew; powdery mildew; soilborne diseases [non-water molds (*Fusarium*, *Rhizoctonia*, *Thielaviopsis*) and oomycetes (*Phytophthora*, *Pythium*)]

potassium bicarbonate

Trade name: Armicarb 100 [EPA Reg. No. 5905-541]
Active ingredient (% a.i.): potassium bicarbonate (85% SC)
Manufacturer: Helena Chemical Company
REI: 4 hours
Application: foliar spray
Application interval: 5 to 14 days
Sites: greenhouse; landscape (commercial, residential); interiorscape; lathhouse; shadehouse; nursery (container, field)
Hosts: annual and perennial flowers; ornamental nut and fruit trees; woody and herbaceous ornamentals [*Ageratum*, *Ajuga*, Almond (Flowering) (non bearing), Aluminum Plant (*Pilea*), *Alyssum*, *Andromeda*, *Aphelandra*, Apple (Flowering) (non bearing), Apricot (Flowering) (non bearing), *Artemisia*, Aster, Azalea/Rhododendron, Baby's Breath (*Gypsophila*), Boxwood, *Calendula*, *Centaurea*, Cherry (Flowering) (non bearing), *Chrysanthemum*, *Cineraria*, Citrus, *Coleus*, *Columbine*, Crape Myrtle, *Crassula*, *Croton*, *Delphinium*, *Dianthus*, Dogwood, *Euonymus*, False *Aralia* (*Dizygotheca*), Fern, Flame Violet (*Episcia*), *Forsythia*, *Gazania*, *Geranium*, *Gladiolus*, *Gloxinia*, Hawthorn, *Heliopsis*, *Heuchera* (Coral Bells), *Hibiscus* (including Rose of Sharon), Holly, *Hoya*, *Hydrangea*, *Impatiens*, *Iris*, Ivy (Common, English), Juniper, *Kalanchoe*, Lavender, Lemon Balm, *Limonium* (*Statice*), Lipstick Balm, Lipstick Plant (*Aeschynanthus*), Marigold, *Monarda*, *Pachysandra*, Palm, Peach (including Nectarine) (Flowering) (non bearing), *Peperomia*, *Philodendron*, Phlox, Pine, *Pittosporum*, Plum (including Prune) (Flowering) (non bearing), *Poinsettia*, Poppy, *Pothos*, Primrose, Privet, *Protea*, *Pulmonaria*, *Pyracantha*, Rose, *Schefflera*, Snapdragon, *Verbena*, *Viburnum*, *Vinca* (Periwinkle), *Viola* (Pansy, Violet), *Zinnia*]
Diseases (fungal): *Alternaria* blight; anthracnose; black spot of rose; *Botrytis* blight; downy mildew; ink spot; leaf spot and blight (*Aschochyta*, *Corynespora*, *Didymella*, *Entomosporium*, *Fusarium*, *Helminthosporium*, *Ramularia*, *Septoria*); *Ovulinia* petal blight; *Phomopsis* blight; powdery mildew; ray blight; scab; tip blight (*Sphaeropsis* [*Diplodia*])
Cautions: final spray solution should not be lower than pH 7.0.

Trade name: MilStop [EPA Reg. No. 70870-1-68539]
Active ingredient (% a.i.): potassium bicarbonate (85% SC)
Manufacturer: BioWorks, Inc.
REI: 1 hour
Application: foliar spray
Application interval: 7 to 14 days
Sites: greenhouse; landscape (commercial, residential); interiorscape; lathhouse; shadehouse; nursery (container, field)
Hosts: annual and perennial flowers; bedding and foliage plants; ground covers; ornamental nut and fruit trees; woody and herbaceous ornamentals [Ageratum, Ajuga, Almond (Flowering) (non bearing), Aluminum Plant (Pilea), Alyssum, Andromeda, Aphelandra, Apple (Flowering) (non bearing), Apricot (Flowering) (non bearing), Artemisia, Aster, Azalea/Rhododendron, Baby's Breath (Gypsophila), Begonia, Boxwood, Calendula, Centaurea, Cherry (Flowering) (non bearing), Chrysanthemum, Cineraria, Citrus, Clematis, Coleus, Columbine, Crape Myrtle, Crassula, Croton, Daisy (Gerbera), Daylily, Delphinium, Dianthus, Dogwood, Euonymus, False Aralia (Dizygotheca), Fern, Fir, Flame Violet (Episcia), Forsythia, Gazania, Geranium, Ginseng, Gladiolus, Gloxinia, Hawthorn, Heliopsis, Heuchera (Coral Bells), Hibiscus (including Rose of Sharon), Holly, Hoya, Hydrangea, Impatiens, Indian Hawthorn, Iris, Ivy (Common, English), Juniper, Kalanchoe, Lavender, Lemon Balm, Limonium (Statice), Lipstick Balm, Lipstick Plant (Aeschynanthus), Marigold, Monarda, Pachysandra, Palm, Peach (including Nectarine) (Flowering) (non bearing), Peperomia, Philodendron, Phlox, Photinia, Pine, Pittosporum, Plum (including Prune) (Flowering) (non bearing), Poinsettia, Poppy, Pothos, Primrose, Privet, Protea, Pulmonaria, Pyracantha, Rose, Schefflera, Snapdragon, Spruce, Verbena, Viburnum, Vinca (Periwinkle), Viola (Pansy, Violet), Zinnia]
Diseases (fungal): Alternaria blight; anthracnose; black spot of rose; Blossom blight (*Monilinia*); Botrytis blight; downy mildew; leaf spot and blight (*Cercospora*, *Corynespora*, *Septoria*), Phomopsis blight; powdery mildew; rust; scab
Cautions: do not use on Pansy at early stages of growth. Discontinue use on New Guinea Impatiens when blossom buds are visible.

potassium silicate

Trade name: Sil-Matrix [EPA Reg. No. 82100-1]
Active ingredient (% a.i.): potassium silicate (29% SC)
Manufacturer: Certis USA, L.L.C.
REI: 4 hours
Application: foliar spray
Application interval: 7 to 10 days
Sites: Christmas trees; greenhouse; indoor and outdoor plantings
Hosts: bedding and flowering plants; Christmas trees; landscape shrubs and trees
Diseases (fungal): powdery mildew
Cautions: do not spray during drought or under hot (>90 F), humid conditions. Do not make more than three sequential applications at 7-day intervals. Use caution when applying to tender new foliage (narrow-leaved evergreens). Do not apply to very sensitive plants such as Aesculus (Horse Chestnut), Cherimoya, Dicentra (Bleeding Heart), Maple (Japanese), Mountain Ash, or Sweetpea. The following plants may be sensitive to this product (use with caution): Aphelandra (Zebra Plant), Begonia, Birch (River), Chrysanthemum, Crassula (Jade Plant), Cucumber, Dieffenbachia, Euphorbia (including Crown of Thorns), Evergreen (narrow-leaved), Fern (delicate forms), Fuchsia, Gardenia, Impatiens, Ivy (Ornamental), Lantana, Palm, Poinsettia, Redbud, Schefflera, Succulents (some), Taxodium (Bald Cypress). Use care when applying product to these plants during bloom: African Violet, Ageratum, Azalea, Begonia, Camellia, Chrysanthemum, Dahlia, Geranium, Gloxinia, Impatiens, Lily, Marigold, Orchid, Petunia, Poinsettia (bracts), Rose, Salvia, Snapdragon, Vinca, Viola (Pansy), Zinnia.

insecticidal soap (soap salts)

Trade name: M-Pede Insecticide/Fungicide [EPA Reg. No. 62719-515]
Active ingredient (% a.i.): potassium salts of fatty acids (3.8 SC)

Manufacturer: Gowan Company
REI: 12 hours
Application: foliar spray
Application interval: 7 days
Sites: site not specified
Hosts: bulbs; broadleaf trees and shrubs; flowering and foliage plants [Aesculus (Buckeye), African Violet, Aglaonema, Almond (Flowering) (non bearing), Andromeda, Aphelandra (Zebra Plant), Artemisia, Ash, Azalea/Rhododendron, Begonia, Camellia, Cherry (Flowering) (non bearing), Cherry Laurel, Chrysanthemum, Crabapple, Crocus, Daisy, Dianthus, Dieffenbachia, Dogwood, Dracaena, Eucalyptus, Euonymus, Fatsia, Fern (Boston, Florida Ruffle, Leatherleaf), Ficus, Geranium, Gladiolus, Hawthorn, Holly, Hollyhock, Hydrangea, Iris, Laurel, Lilac, Lily, Limonium (Statice), Lipstick Plant, Magnolia, Maple, Marigold, Ming Aralia, Narcissus, Oak, Oyster Plant, Pachysandra, Palm (Parlor), Peach (Flowering) (non bearing), Peperomia, Petunia, Philodendron, Phlox, Photinia (Red-tip), Plum (Flowering) (non bearing), Poplar (including Aspen), Prayer Plant, Privet, Pyracantha (Firethorn), Quince (Flowering) (non bearing), Rose, Sequoia, Spiraea, Sycamore, Syngonium, Tulip, Viburnum, Violet (Pansy), Walnut, Zinnia]
Diseases (fungal): powdery mildew
Cautions: do not apply foliar sprays to open blooms of Geranium, Marigold, Pansy, and Petunia.

biological controls: *Agrobacterium radiobacter*

Trade name: Galltrol-A [EPA Reg. No. 40230-1]
Strain: K84
Manufacturer: AgBioChem, Inc.
REI: 12 hours
Application: plant (seeds, roots, or stems) spray or dip
Application interval: ---
Sites: nursery
Hosts: Species susceptible to crown gall: ornamental nursery stock [Cherry (Weeping), Clematis, Euonymus, Poplar, Rose, Willow, etc.]; Flowering (non bearing) fruit and nut nursery stock [Almond, Apple, Apricot, Blueberry, Caneberry (Blackberry, Boysenberry, Raspberry, Youngberry), Cherry, Grape, Kiwifruit, Peach (Nectarine), Pear, Pecan, Plum, Prune, Walnut]
Diseases (bacterial): crown gall
Notes: refrigerate until use. Do not use if frozen or allowed to become dry or hot. Product bacterium infects through fresh plants wounds: dip or spray treated stock the same day (within 12 hours) that wounding occurs (e.g., during cutting, lifting, digging, root pruning, or other handling).

biological controls: *Bacillus pumilus*

Trade name: Sonata [EPA Reg. No. 69592-13]
Strain: QST 2808
Manufacturer: AgraQuest, Inc.
REI: 4 hours
Application: foliar spray
Application interval: 7 to 14 days
Sites: field
Hosts: Rose (field)
Diseases (fungal): powdery mildew, rust
Notes: begin application when environmental conditions and plant stage are conducive to disease development. Increase rate or shorten application interval under heavy disease pressure.

biological controls: *Bacillus subtilis*

Trade name: Companion [EPA Reg. No. 71065-3]
Strain: GB03
Manufacturer: Growth Products Ltd

REI: 4 hours
Application: foliar spray; soil drench
Application interval: established plantings: 7 to 14 days; new plantings and transplants: 14 to 28 days
Sites: interiorscape and outdoors (field and landscape) (professional use only)
Hosts: annuals and perennials; bedding plants; container grown plants; foliage plants; ground covers; palms; potted flowers; woody ornamentals; deciduous and evergreen trees and shrubs; tropical foliage
Diseases (fungal): anthracnose (*Colletotrichum*); powdery mildew (*Golovinomyces* [*Erysiphe*]); soilborne diseases (damping-off; crown, root, and stem rot) [non-water molds (*Fusarium*, *Rhizoctonia*, *Sclerotinia*) and oomycetes (*Phytophthora*, *Pythium*)]; web blight (*Rhizoctonia*)
Cautions: apply when ground temperature reaches 45 F or above until frost.

Trade name: Subtilex NG [EPA Reg. No. 71840-8]
Strain: MBI 600
Manufacturer: Becker Underwood Inc.
REI: 4 hours
Application: pre- and post-plant soil medium treatment
Application interval: 21 to 28 days
Sites: greenhouse
Hosts: bedding plants; flowering plants; ornamental plants, tropical plants
Diseases (fungal): powdery mildew; soilborne diseases [non-water molds (*Fusarium*, *Rhizoctonia*) and oomycetes (*Pythium*)]
Cautions: ensure that product is thoroughly mixed into the soil or growing medium.

Trade name: AmorTech Sonnet [EPA Reg. No. 69592-11-86064]
Strain: QST 713
Manufacturer: United Turf Alliance
REI: 4 hours
Application: foliar spray; soil drench
Application interval: 3 to 10 days (foliar spray); 21 to 28 days (soil drench)
Sites: agricultural, outdoors (commercial, residential)
Hosts: annuals and perennials; bedding plants; flowering and foliage plants; deciduous shrubs and trees [tested for phytotoxicity: Aglaonema, Alyssum, Aster, Azalea (Gumpo), Azalea/Rhododendron, Bee-balm (Dwarf), Begonia, Boxwood, Calla Lily, Chrysanthemum, Crape Myrtle, Cyclamen, Daisy (Gerbera), Dianthus, Dieffenbachia, Dogwood, Dracaena, Fern (Leatherleaf), Geranium, Goldenstar, Hibiscus, Holly (Soft Touch), Hydrangea, Impatiens, Indian Hawthorn, Ivy (English), Kalanchoe, Lilac, Lily (Easter), Linaria, Lisianthus, Lobelia, Loropetalum, Maple (Japanese), Marigold, Orchid, Petunia, Phlox, Photinia, Poinsettia, Portulaca, Privet (Japanese), Ranunculus, Rosaceae, Rose, Salvia, Snapdragon, Spathiphyllum, Spiraea, Stock, Verbena, Vinca, Viola (including Pansy), Zinnia]
Diseases (bacterial, fungal): anthracnose (*Colletotrichum*); bacterial diseases; black spot of rose; Botrytis blight; downy mildew (*Peronospora*); leaf spot (*Alternaria*, *Cercospora*, *Entomosporium*, *Helminthosporium*, *Myrothecium*, *Septoria*); powdery mildew (*Erysiphe*, *Oidium*, *Podospaera*, *Sphaerotheca*); rust (*Puccinia*); scab (*Venturia*); soilborne diseases [non-water molds (*Fusarium*, *Rhizoctonia*) and oomycetes (*Phytophthora*, *Pythium*)]
Cautions: thorough coverage is needed for effective disease control.

Trade name: Cease [EPA Reg. No. 69592-19-68539]
Strain: QST 713
Manufacturer: BioWorks, Inc.
REI: 4 hours
Application: foliar spray; plant dip; soil drench
Application interval: 3 to 10 days (foliar spray); 21 to 28 days (soil drench)
Sites: agricultural; indoors, outdoors (commercial, residential); conifers for reforestation; container, field; greenhouse; interiorscape; nursery; shade house
Hosts: annuals and perennials; bedding plants; cut flowers; flowering plants and foliage plants; forestry seedlings; palms, potted plants; landscape shrubs and trees; tropical plants [tested

for phytotoxicity: Aglaonema, Alyssum, Aster, Azalea (Gumpo), Azalea/Rhododendron, Bee-balm (Dwarf), Begonia, Boxwood, Calla Lily, Chrysanthemum, Crape Myrtle, Cyclamen, Daisy (Gerbera), Dianthus, Dieffenbachia, Dogwood, Dracaena, Fern (Leatherleaf), Geranium, Goldenstar, Hibiscus, Holly (Soft Touch), Hydrangea, Impatiens, Indian Hawthorn, Ivy (English), Kalanchoe, Lilac, Lily (Easter), Linaria, Lisianthus, Lobelia, Loropetalum, Maple (Japanese), Marigold, Orchid, Petunia, Phlox, Photinia, Poinsettia, Portulaca, Privet (Japanese), Ranunculus, Rosaceae, Rose, Salvia, Snapdragon, Spathiphyllum, Spiraea, Stock, Verbena, Vinca, Viola (including Pansy), Zinnia]

Diseases (bacterial, fungal): anthracnose (*Colletotrichum*), bacterial diseases; black spot of rose; Botrytis blight; downy mildew (*Peronospora*); leaf spot (*Alternaria*, *Cercospora*, *Entomosporium*, *Helminthosporium*, *Myrothecium*, *Septoria*); powdery mildew (*Erysiphe*, *Oidium*, *Podosphaera*, *Sphaerotheca*); rust (*Puccinia*), scab (*Venturia*), soilborne diseases [non-water molds (*Fusarium*, *Rhizoctonia*) and oomycetes (*Phytophthora*, *Pythium*)]

Cautions: thorough coverage is needed for effective disease control.

Trade name: Rhapsody [EPA Reg. No. 69592-19]

Strain: QST 713

Manufacturer: AgraQuest Inc.

REI: 4 hours

Application: foliar spray; soil drench

Application interval: 3 to 10 days (foliar spray); 21 to 28 days (soil drench)

Sites: agricultural; indoors, outdoors (commercial, residential); conifers for reforestation; container, field; greenhouse; nursery; shade house

Hosts: annuals and perennials; bedding plants; flowering plants and foliage plants; forestry seedlings; potted plants, landscape shrubs and trees; tropical plants [tested for phytotoxicity: Aglaonema, Alyssum, Aster, Azalea (Gumpo), Azalea/Rhododendron, Bee-balm (Dwarf), Begonia, Boxwood, Calla Lily, Chrysanthemum, Crape Myrtle, Cyclamen, Daisy (Gerbera), Dianthus, Dieffenbachia, Dogwood, Dracaena, Fern (Leatherleaf), Geranium, Goldenstar, Hibiscus, Holly (Soft Touch), Hydrangea, Impatiens, Indian Hawthorn, Ivy (English), Kalanchoe, Lilac, Lily (Easter), Linaria, Lisianthus, Lobelia, Loropetalum, Maple (Japanese), Marigold, Orchid, Petunia, Phlox, Photinia, Poinsettia, Portulaca, Privet (Japanese), Ranunculus, Rosaceae, Rose, Salvia, Snapdragon, Spathiphyllum, Spiraea, Stock, Verbena, Vinca, Viola (including Pansy), Zinnia]

Diseases (bacterial, fungal): anthracnose (*Colletotrichum*); bacterial diseases; black spot of rose; Botrytis blight; downy mildew (*Peronospora*); leaf spot (*Alternaria*, *Cercospora*, *Entomosporium*, *Helminthosporium*, *Myrothecium*, *Septoria*); powdery mildew (*Erysiphe*, *Oidium*, *Podosphaera*, *Sphaerotheca*); rust (*Puccinia*); scab (*Venturia*); soilborne diseases [non-water molds (*Fusarium*, *Rhizoctonia*) and oomycetes (*Phytophthora*, *Pythium*)]

Cautions: thorough coverage is needed for effective disease control.

Trade names: Serenade Garden Concentrate [EPA Reg. No. 69592-12], Serenade Garden Disease Ready to Use [EPA Reg. No. 69592-16]

Strain: QST 713

Manufacturer: AgraQuest Inc.

REI: 0 hours

Application: foliar spray

Application interval: 7 days

Sites: residential landscape (home and garden)

Hosts: annuals and perennials; flowering and foliage plants; houseplants; ornamental trees and shrubs; roses; tropical foliage [tested for phytotoxicity: Aglaonema, Alyssum, Aster, Azalea (Gumpo), Azalea/Rhododendron, Bee-balm (Dwarf), Begonia, Boxwood, Calla Lily, Chrysanthemum, Crape Myrtle, Cyclamen, Daisy (Gerbera), Dianthus, Dieffenbachia, Dogwood, Dracaena, Fern (Leatherleaf), Geranium, Goldenstar, Hibiscus, Holly (Soft Touch), Hydrangea, Impatiens, Indian Hawthorn, Ivy (English), Kalanchoe, Lilac, Lily (Easter), Linaria, Lisianthus, Lobelia, Loropetalum, Maple (Japanese), Marigold, Orchid, Petunia, Phlox, Photinia, Poinsettia, Portulaca, Privet (Japanese), Ranunculus, Rosaceae, Rose, Salvia, Snapdragon, Spathiphyllum, Spiraea, Stock, Verbena, Vinca, Viola (including Pansy), Zinnia]

Diseases (bacterial, fungal): Alternaria diseases; anthracnose (*Colletotrichum*); bacterial diseases; black spot of rose, Botrytis blight; downy mildew (*Peronospora*); leaf spot (*Alternaria*, *Cercospora*, *Entomosporium*, *Helminthosporium*, *Myrothecium*, *Septoria*); powdery mildew (*Erysiphe*, *Leveillula*, *Oidiopsis*, *Oidium*, *Podosphaera*, *Sphaerotheca*, *Uncinula*); rust (*Puccinia*); scab (*Venturia*)

Cautions: spray plants to run-off; ensure thorough coverage to upper and lower leaf surfaces. Do not water foliage within 4 hours of application (Ready to Use).

Trade names: Taegro [EPA Reg. No. 70127-5]

Strain: B. subtilis var. amyloliquefaciens strain FZB24

Manufacturer: Novozymes

REI: 24 hours

Application: bulb and plant dip; medium incorporation; seed treatment; soil drench; transplant drench

Application interval: 7 days

Sites: interiorscapes; greenhouses; outdoors

Hosts: annuals; bedding plants; bulbs, corms, and tubers; bromeliads; Christmas trees; conifers; cut flowers; cut florists greens; ferns; foliage plants; forest seedlings and trees; ground covers; nursery crops; orchids; ornamental shrubs and trees; plugs; potted flowering plants; seed beds; seedlings [*Abelia*, *Abutilon*, *Acacia*, *Aesculus* (Buckeye), *African Violet* (*Saintpaulia*), *Ageratum*, *Aglaonema* (Chinese Evergreen), *Ajuga*, *Alder*, *Allamanda*, *Allium*, *Alocasia*, *Aluminum Plant* (*Pilea*), *Alyssum*, *Amelanchier* (Juneberry), *Andromeda*, *Andromeda* (Bog Rosemary), *Anemone*, *Anthurium*, *Aphelandra*, *Arborvitae*, *Arctostaphylos* (*Manzanita*), *Artemisia*, *Ash*, *Aster*, *Aucuba*, *Azalea/Rhododendron*, *Baby's Breath* (*Gypsophila*), *Bamboo*, *Barbados Lily* (*Amaryllis*), *Bayberry* (*Wax Myrtle*), *Beauty Bush*, *Beech*, *Beefsteak Plant*, *Begonia*, *Birch*, *Bird of Paradise*, *Blanket Flower* (*Gaillardia*), *Bottlebrush*, *Bougainvillea*, *Boxwood*, *Bromeliad*, *Broom*, *Buckthorn* (*Rhamnus*), *Buddleja* (*Butterfly Bush*), *Cactus*, *Caladium*, *Calathea*, *Calceolaria*, *Calendula*, *Calla Lily*, *Camellia*, *Campanula*, *Candytuft*, *Caragana*, *Carob*, *Carya* (*Hickory*), *Catalpa*, *Ceanothus*, *Cedar*, *Celosia* (*Cockscomb*), *Centaurea* (including *Bachelors Button*), *Cerastium*, *Chamaecyparis*, *Cherry* (*Wild*) (*Flowering*) (*nonbearing*), *Chestnut*, *Chrysanthemum*, *Cineraria*, *Cinquefoil* (*Potentilla*), *Cleyera*, *Coleus*, *Columbine*, *Cordyline*, *Coreopsis*, *Cosmos*, *Cotoneaster*, *Crabapple*, *Crape Myrtle*, *Crocus*, *Crossandra*, *Croton*, *Cyclamen*, *Cypress*, *Dahlia*, *Daisy* (including *Gerbera*), *Daphne*, *Daylily*, *Delphinium*, *Deutzia*, *Dianthus* (*Pinks*, *Sweet William*), *Dicentra* (*Bleeding Heart*), *Dieffenbachia*, *Dietes* (*Yellow Morea*), *Dogwood*, *Douglas Fir*, *Dracaena*, *Duty Miller*, *Echeveria*, *Elderberry*, *Elm*, *Escallonia*, *Eugenia*, *Euonymus*, *Euphorbia* (*Crown of Thorns*), *Euphorbia* (including *Crown of Thorns*), *Exacum*, *False Aralia* (*Dizygotheca*), *False Dragonhead*, *Fatsia* (including *Aralia*), *Fern* (*Ray*), *Ficus*, *Ficus* (*Fig*, *Rubber-plant*), *Fittonia*, *Flame Violet* (*Episcia*), *Forsythia*, *Foxglove*, *Freesia*, *Fuchsia*, *Gardenia*, *Gazania*, *Geranium* (*Pelargonium*), *Geum*, *Gingko*, *Gladiolus*, *Gleditsia* (*Locust*), *Gloxinia*, *Grape* (*non bearing*), *Grass* (*Ornamental*), *Grass* (*Ornamental*) (*Mondo Grass*, *Ophiopogon*), *Guava*, *Gum* (*Sweet*), *Gynura*, *Hackberry*, *Hawthorn*, *Heath*, *Heather*, *Hemlock*, *Heuchera* (*Coral Bells*), *Hibiscus*, *Hollyhock*, *Honeysuckle*, *Hornbeam*, *Hosta*, *Houseleek* (*Sempervivum*), *Hoya*, *Hyacinth*, *Hydrangea*, *Hypericum* (*St. John's Wort*), *Ice Plant*, *Impatiens*, *Indian Hawthorn*, *Iris*, *Ironwood*, *Ivy* (*Algerian*, *English*), *Ivy* (*Hedera*, *Jasmine*, *Jessamine*, *Juniper*, *Kalanchoe*, *Lamb's Ear* (*Stachys*), *Lantana*, *Larch*, *Larch* (*Tamarack*), *Laurel*, *Leucothoe*, *Liatris*, *Lilac*, *Lily*, *Lily* (*Easter*), *Agapanthus* (*Lily of the Nile*), *Limonium* (*Statice*), *Linden* (*Basswood*), *Lippia*, *Liriope*, *Lobelia*, *Loosestrife*, *Lupine*, *Magnolia*, *Mandevilla*, *Maple* (*Flowering*), *Marigold*, *Mimosa*, *Mock-orange*, *Monarda*, *Mulberry* (*non bearing*), *Myrtle*, *Nandina*, *Narcissus*, *Nasturtium*, *Nigella*, *Oak*, *Oleander*, *Orchid*, *Oregon Grape Holly*, *Ornithogalum*, *Osmanthus*, *Oxalis*, *Pachistima*, *Pachysandra*, *Palm*, *Paw Paw* (*non bearing*), *Peony*, *Peperomia*, *Petunia*, *Philodendron*, *Phlox*, *Photinia*, *Pine*, *Pittosporum*, *Podocarpus*, *Poinciana*, *Poinsettia*, *Poplar* (*Aspen*, *Cottonwood*), *Poppy*, *Portulaca*, *Pothos*, *Powder Puff Plant* (*Calliandra*), *Prayer Plant*, *Primula*, *Privet*, *Privet* (*Ligustrum*), *Pyracantha*, *Pyracantha* (*Firethorn*), *Quince* (*Flowering*) (*non bearing*), *Ranunculus* (including *Buttercup*), *Redbud*, *Rhododendron*, *Rockrose*, *Rose*, *Rosemary*, *Rudbeckia*, *Salvia*, *Sansevieria*, *Santolina*, *Sassafras*, *Schefflera*, *Scilla*, *Sedge* (*Carex*), *Sedum*, *Senecio*, *Sequoia* (*Redwood*), *Sinningia*, *Snapdragon*, *Snowberry*, *Sourwood*, *Spathiphyllum*, *Spicebrush*, *Spiraea* (including *Bridal Wreath*), *Spruce*, *Stock*, *Stokesia*, *Strawberry* (*Wild*), *Strawflower*, *Sumac*, *Sweet Pea*, *Sycamore*, *Syngonium*, *Tradescantia* (*Wandering Jew*), *Tulip*, *Tulip Tree*, *Vaccinium*

(Blueberry) (Ornamental), Verbena, Veronica, Viburnum, Vinca (including Periwinkle), Viola (Pansy, Violet), Virginia Creeper, Wallflower, Walnut (Butternut), Weigela, Willow, Wisteria, Yarrow (Achillea), Yellowwood, Yew, Yucca, Zinnia]
Diseases (fungal): soilborne diseases [non-water molds (*Fusarium*, *Rhizoctonia*)]
Cautions: do not use treated seed for food or feed.

biological controls: *Coniothyrium minitans*

Trade name: Contans WG [EPA Reg. No. 72444-1]
Strain: CON/M/91-08
Manufacturer: SipcamAdvan
REI: 4 hours
Application: pre-plant; in crop; post harvest by broadcast, band, and aerial application
Application interval: established plantings: 7 to 14 days; new plantings and transplants: 14 to 28 days
Sites: interiorscape and outdoors (field and landscape) (professional use only)
Hosts: bulbs; bedding plants; herbaceous potted flowers [Chrysanthemum, Cyclamen, Geranium, Hollyhock, Lily, Petunia, Poinsettia, Primula, Snapdragon, Viola (Pansy)]
Diseases (fungal): soilborne diseases (non-water molds) (*Sclerotinia*)
Cautions: product is less effective in soils with temperatures below 50 F and above 81 F.

biological controls: *Gliocladium virens*

Trade name: SoilGard 12G [EPA Reg. No. 70051-3]
Strain: GL-21
Manufacturer: Certis USA, L.L.C.
REI: 0 hours
Application: bare-root dip; medium incorporation; soil drench or spray
Application interval: established plantings: 7 to 14 days; new plantings and transplants: 14 to 28 days
Sites: indoor and outdoor; greenhouse (flats, plug trays, pots); potted crops (greenhouse, nursery, interiorscape)
Hosts: ornamental flower beds and plants
Diseases (fungal): soilborne diseases (damping-off and root rot) [non-water molds (*Rhizoctonia*) and oomycetes (*Pythium*)]
Cautions: delay planting 24 hours after soil treatment with product; do not use in media devoid of organic matter.

biological controls: *Reynoutria sachalinensis*

Trade name: Regalia [EPA Reg. No. 84059-3]
Manufacturer: Marrone Bio Innovations
REI: 4 hours
Application: foliar spray
Application interval: 7 to 14 days
Sites: indoor and outdoor
Hosts: annual and perennial flowering plants; shrubs; trees; tropical foliage [Aglaonema, Azalea (Gumpo), Azalea/Rhododendron, Begonia, Boxwood, Crape Myrtle, Daisy (Gerbera), Dieffenbachia, Dogwood, Dracaena, Fern (Leatherleaf), Freesia, Hibiscus, Holly (Soft Touch), Indian Hawthorn, Ivy (English), Lilac, Lisianthus, Loropetalum, Maple (Japanese), Photinia, Poinsettia, Privet (Japanese), Rosaceae, Rose, Salvia, Snapdragon, Spathiphyllum, Spiraea, Zinnia]
Diseases (fungal): anthracnose (*Colletotrichum*); black spot of rose; Botrytis blight; leaf spot (*Alternaria*, *Cercospora*, *Entomosporium*, *Myrothecium*, *Septoria*); powdery mildew (*Oidium*), rust (*Puccinia*); scab (*Venturia*)
Cautions: delay planting 24 hours after soil treatment with product; do not use in media devoid of organic matter. Do not use on Daisy (Gerbera) or Lisianthus plugs.

biological controls: *Streptomyces lydicus*

Trade name: ActinoGrow T&O [EPA Reg. No. 73314-1]
Manufacturer: SipcamAdvan
REI: 1 day
Application: 3 to 14 days (foliar spray); 4 to 12 weeks (soil drench)
Application interval: established plantings: 7 to 14 days; new plantings and transplants: 14 to 28 days
Sites: landscape and interiorscape
Hosts: landscape and interiorscape beds and plants
Diseases (bacterial, fungal): black spot of rose; Botrytis blight; downy mildew (*Peronospora*); fire blight; leaf spot (*Alternaria*); powdery mildew (*Erysiphe*, *Oidium*, *Podosphaera*, *Sphaerotheca*); rust (*Puccinia*); soilborne diseases [non-water molds (*Fusarium*, *Rhizoctonia*, *Sclerotinia*, *Thielaviopsis*, *Verticillium*) and oomycetes (*Phytophthora*, *Pythium*)]
Cautions: delay planting 24 hours after soil treatment with product; do not use in media devoid of organic matter.

biological controls: *Trichoderma asperellum* + *T. gamsii*

Trade name: Tenet WP [EPA Reg. No. 80289-9]
Strain: ICC 012 + ICC 080
Manufacturer: SipcamAdvan
REI: 1 hour
Application: dip (cutting, bare root, transplant, crown, or bulb); soil treatment (broadcast, in-furrow spray, ground banded applications); pre-plant dust; soil drench
Application interval: 2 or more applications recommended
Sites: interiorscape and outdoors (field and landscape) (professional use only)
Hosts: bulbs; Christmas trees and conifers; herbaceous potted flowers and bedding plants; non-bearing fruit trees; nursery shrubs and woody ornamentals; ornamental shrubs and trees; tropical foliage plants [Arborvitae, Ash, Azalea, Cedar, Cherry (Flowering) (non bearing), Chrysanthemum, Crabapple, Cyclamen, Elm, Fern, Fir, Geranium, Hawthorn, Hollyhock, Ivy (English), Lily, Linden, Maple, Pear (Flowering) (non bearing), Petunia, Pine, Pittosporum, Plum (Flowering) (non bearing), Poinsettia, Pothos, Primula, Rose, Snapdragon, Spruce, Sycamore, Viola (Pansy), Yew]
Diseases (fungal): soilborne/seedling diseases [non-water molds (*Armillaria*, *Fusarium*, *Rhizoctonia*, *Rosellinia*, *Sclerotinia*, *Sclerotium*, *Thielaviopsis*, *Verticillium*) and oomycetes (*Phytophthora*, *Pythium*)]
Cautions: delay planting 7 days after treatment with product.

biological controls: *Trichoderma harzianum*

Trade name: Plantshield HC [EPA Reg. No. 68539-4]
Strain: Rifai strain KRL-AG2
Manufacturer: Bioworks Inc.
REI: 1 hour (to plants); 0 hours (to soil)
Application: plant dip (cuttings, bulbs, bare-rooted transplants); foliar spray; growing medium treatment (drench, in-soil furrow, potting soil, broadcast)
Application interval: 7 to 14 days (foliar spray)
Sites: greenhouse; shadehouse; outdoor nursery
Hosts: greenhouse and nursery crops; deciduous trees (Maple, Oak, etc.); ornamentals; Pine; tree seedlings for reforestation
Diseases (fungal): soilborne/seedling diseases [non-water molds (*Cylindrocladium*, *Fusarium*, *Rhizoctonia*, *Thielaviopsis*) and oomycetes (*Pythium*)]
Cautions: greenhouse foliar applications are for non-food crops only. Product is not effective in cold (< 50 F) soil.

Trade name: RootShield Granules [EPA Reg. No. 68539-3]
Strain: Rifai strain KRL-AG2
Manufacturer: Bioworks Inc.

REI: 0 hours
Application: growing medium treatment (in-furrow soil, sidedress, transplant mix, greenhouse and nursery potting soil)
Application interval: ---
Sites: greenhouse; shadehouse; outdoor nursery
Hosts: greenhouse and nursery crops; deciduous trees (Maple, Oak, etc.); ornamentals; Pine; tree seedlings for reforestation
Diseases (fungal): soilborne/seedling diseases [non-water molds (*Cylindrocladium*, *Fusarium*, *Rhizoctonia*, *Thielaviopsis*) and oomycetes (*Pythium*)]
Cautions: product is not effective in cold (< 50 F) soil.

Trade name: RootShield WP [EPA Reg. No. 68539-7]
Strain: Rifai strain KRL-AG2
Manufacturer: Bioworks Inc.
REI: dry (to field); 0 hours (indoors)
Application: plant dip (cuttings, bulbs, bare-rooted transplants); growing medium treatment (drench, in-soil furrow, potting soil, broadcast)
Application interval: ---
Sites: greenhouse; shadehouse; outdoor nursery
Hosts: bedding plants; flowers, greenhouse and nursery crops; deciduous trees (Maple, Oak, etc.); ornamentals; Pine; tree seedlings for reforestation
Diseases (fungal): soilborne/seedling diseases [non-water molds (*Cylindrocladium*, *Fusarium*, *Rhizoctonia*, *Thielaviopsis*) and oomycetes (*Pythium*)]
Cautions: product is not effective in cold (< 50 F) soil.

biological controls: *Trichoderma harzianum* + *T. virens*

Trade name: RootShield Plus Granules [EPA Reg. No. 68539-10]
Strain: Rifai strain T-22 + G-41
Manufacturer: Bioworks Inc.
REI: 0 hours
Application: growing medium treatment (in-furrow soil, sidedress, transplant mix, greenhouse and nursery potting soil)
Application interval: ---
Sites: greenhouse; shadehouse; outdoor nursery
Hosts: bedding plants; greenhouse and nursery crops; flowers, deciduous trees (Maple, Oak, etc.); ornamentals; Pine
Diseases (fungal): soilborne/seedling diseases [non-water molds (*Cylindrocladium*, *Fusarium*, *Rhizoctonia*, *Thielaviopsis*) and oomycetes (*Pythium*)]
Cautions: product is not effective in cold (< 50 F) soil.

Trade name: RootShield Plus WP [EPA Reg. No. 68539-9]
Strain: Rifai strain T-22 + G-41
Manufacturer: Bioworks Inc.
REI: 4 hours
Application: plant dip (cuttings, bare-rooted transplants); growing medium treatment (drench, in-furrow and transplant spray)
Application interval: ---
Sites: greenhouse; shadehouse; outdoor nursery
Hosts: bedding plants; greenhouse and nursery crops; conifer trees and seedlings; flowers; deciduous trees (Maple, Oak, etc.); ornamentals; Pine; tree seedlings for reforestation
Diseases (fungal): soilborne/seedling diseases [non-water molds (*Cylindrocladium*, *Fusarium*, *Rhizoctonia*, *Thielaviopsis*) and oomycetes (*Pythium*)]
Cautions: product is not effective in cold (< 50 F) soil.

FUNGICIDE RESISTANCE MANAGEMENT IN ORNAMENTAL CROPS

Infectious fungi sometimes develop resistance to particular fungicides, especially when a product is used repeatedly without alternating with chemically unrelated fungicides. Fungicide resistance becomes evident when fungicides don't work as well, or at all, on populations of fungi that have become less sensitive to them. When this occurs, there is no value in increasing rates, shortening intervals between sprays, or using other fungicides with similar modes of action.

Development of resistance is tied to the fungicide mode of action depending on whether the fungicide acts on a single site or at multiple sites within the fungus. In general, fungi are less prone to develop resistance to contact fungicides, which inhibit several vital functions in the fungal cell, than to many penetrant fungicides, which may inhibit only one vital function in the fungal cell. A single fungus needs to mutate only once to overcome the action of a single-site fungicide but must mutate more often to overcome the action of a multi-site fungicide, and the likelihood of this is rare.

In general, several strategies are recommended to minimize the risk of fungicide resistance. First, don't rely on fungicides alone for disease control. Follow good management practices and use resistant host plant material as it becomes available. Second, avoid repeated use of the same fungicide or materials with closely related modes of action. Third, alternate or tank mix fungicides with different modes of action (see FRAC coding*). Refer to product labels before tank-mixing products to ensure compatibility and to avoid phytotoxicity. In some cases, several premix fungicides that contain products with differing modes of action are available. Finally, use recommended rates and proper management techniques. Although these general principles can help to reduce risk of fungicide resistance, they do not eliminate it. Pathogen populations resistant to a particular fungicide can still develop, even when

good management practices are employed, but the changes of this happening are generally greatly reduced. The risk of fungicide resistance for many compounds labeled for turf and ornamental diseases is found in Table 1.

Note for combination products:

Some combination products contain one or more materials that, if applied on their own, would be at high risk for fungicide resistance. In addition, one material in a combination product may control a given pathogen more effectively than the other. Resistance management, therefore, depends not only on the individual resistance risk of each material but also on the pathogen for which control is desired. If a pathogen controlled by one high-risk material in the combination product is not controlled by the other material, then the product essentially acts as a "single mode of action" compound and the risk of fungicide resistance is high. If a pathogen is controlled equally well by both materials then the risk of resistance is lower. For combination products, therefore, it is best to use them with a sound resistance management strategy in mind.

*FRAC stands for Fungicide Resistance Action Committee (FRAC). The purpose of this group is to "provide fungicide resistance management guidelines to prolong the effectiveness of these "at risk" fungicides and to limit crop losses should resistance occur." Chemistries with different modes of action have different FRAC coding. Do not tank mix or alternate fungicides with the same FRAC number in a pesticide application program. Compounds labeled "M" act upon multiple sites and resistance risk is low.

For more information on FRAC, visit the following web site: <http://www.frac.info/frac/index.htm>.

Table 1. Resistance risk for many compounds labeled for diseases of ornamentals.

Chemical class	Motility	Role in protection	Mode of action	Activity	FRAC	Risk of fungicide resistance
AH-fungicides (aromatic hydrocarbons) (dicloran, PCNB), heteroaromatics (etridiazole)	contact	preventive	interferes with lipids and membrane synthesis	multi-site	14	low to moderate ¹
Amines, piperidines (piperalin) (SBI Class II)	contact	eradicator	inhibits sterol biosynthesis in membranes	single	5	low to moderate ^{1, 2, 4}
benzamides, pyridinylmethyl-benzamides (fluopicolide)	acropetal penetrant	preventive/curative	interferes with mitosis and cell division	single	43	resistance not known ²
CAA-fungicides (carboxylic acid amides), cinnamic acid amides (dimethomorph), mandelic acid amides (mandipropamid)	localized penetrant, trans laminar	preventive	inhibition of phospholipid biosynthesis and cell wall (cellulose) synthesis	multi-site	40	low to moderate ^{1, 2, 4}
carbamates (propamocarb-HCl)	contact	preventive	inhibits enzyme activity, membrane function, or fatty acid metabolism	multi-site	28	low to moderate ²
chloronitriles (phthalonitriles) (chlorothalonil)	contact	preventive	stops energy production in fungus and is toxic to cell membranes	multi-site	M5	low ³
DMI fungicides (demethylation inhibitors), imidazoles (imazalil, triflumizole), piperazines (triforine), pyrimidines (fenarimol), triazoles (myclobutanil, propiconazole, tebuconazole, triadimefon) SBI Class I	acropetal penetrant	preventive/curative	interferes with cell membrane by inhibiting ergosterol	single	3	moderate ^{1, 2, 4, 5}
dicarboximides (iprodione)	localized penetrant	preventive	interferes with lipids and membrane synthesis	multi-site	2	moderate to high ^{1, 2, 4}
dithiocarbamates (mancozeb, thiram, ziram)	contact	preventive	inhibits enzyme activity, membrane function, or fatty acid metabolism	multi-site	M3	low to moderate ³
glucopyranosal antibiotic (streptomycin)	acropetal penetrant	bactericide	inhibits amino acid and protein synthesis	single	25	high ^{1, 2}

Table 1 (continued).

Chemical class	Motility	Role in protection	Mode of action	Activity	FRAC	Risk of fungicide resistance
hydroxyanilides (fenhexamid) SBI Class III	contact	preventive	inhibits sterol biosynthesis in membranes	multi-site	17	low to medium ²
inorganics (copper salts, sulfur)	contact	preventive	inhibits energy production (sulfur) or denatures proteins and enzymes (copper)	multi-site	M1/ M2	low ³
MBC fungicides (methyl benzimidazole carbamates), benzimidazoles (carbendazim, thiabendazole), thiophanates (thiophanate-methyl)	acropetal penetrant	preventive/ curative	inhibits DNA synthesis and interferes with cell division (mitosis)	single	1	high ^{1,2,4}
Microbial (<i>Bacillus subtilis</i> QST 713)	---	preventive	nonspecific disruption of pathogen cell membranes	---	44	none
PA fungicides (phenylamides), acylanilines (mefenoxam, metalaxyl)	acropetal penetrant	preventive	interferes with ribosomal RNA	single	4	high ^{1,2,4}
phenylpyrroles (fludioxonil)	contact	preventive	cell lysis and inhibits amino acid uptake	multi-site	12	low to moderate ²
phosphonates (phosphorous acid and salts), ethyl phosphonates (fosetyl-Al)	amphi-mobile penetrant	curative	unknown	single	33	low
phthalimides (captan)	contact	preventive	interferes with respiration and glycolysis	multi-site	M4	low ³
polyoxins, peptidyl pyrimidine nucleoside (polyoxin-D zinc salt)	acropetal penetrant	preventive/ curative	interferes with chitin synthesis	single	19	medium ^{1,2}
SDHI (succinate dehydrogenase inhibitors), phenylbenzamides (flutolanil), pyridine-carboxamides (boscalid)	acropetal penetrant	preventive	blocks activity of respiratory enzymes	single	7	moderate to high ^{1,2}

Table 1 (continued).

Chemical class	Motility	Role in protection	Mode of action	Activity	FRAC	Risk of fungicide resistance
Qil-fungicides (quinone inside inhibitors), cyanoimidazole (cyazofamid)	contact	preventive	inhibits respiration	single	21	moderate to high ²
QoI-fungicides (quinone outside inhibitors), dihydro-dioxazines (fluoxastrobin) imidazolinones (fenamidone), methoxy-acrylates (azoxystrobin), methoxy-carbamates (pyraclostrobin), oximino acetates (kresoxim-methyl, trifloxystrobin)	acropetal penetrant	preventive	interferes with respiration	single	11	high ^{1,2,4}
tetracycline antibiotic (oxytetracycline)	systemic	bactericide	inhibits protein synthesis	single	41	high ^{1,2}

¹Resistance known in some fungi

²Resistance management required; see guidelines for resistance management

³No cross resistance between group members M1 to M9

⁴Cross resistance common between and/or among group members

⁵Activity spectra of DMI fungicides varies greatly