

## Chapter Four

# DISEASES OF GREENHOUSE CROPS

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# GENERAL DISEASE CONTROL METHODS FOR GREENHOUSE CROPS

Successful disease control relies on proper disease prevention practices and plant disease diagnosis. Once the major diseases and pest problems have been identified, an integrated pest management (IPM) program can be followed. Several important cultural practices to control diseases should be integrated into all greenhouse IPM programs to control diseases. These serve to both prevent and minimize/eradicate diseases. Analogous cultural control methods may be applied to specific diseases that are common to several crops. These methods will be discussed in detail here to avoid repetition in the text.

## Good Growing Practices

Greenhouse producers must strive to provide environmental conditions that are more favorable to plant growth and development than to disease development. Careful attention to such details helps to prevent the onset and spread of diseases and may reduce the need for an expensive eradication program.

### a. Damping-off, root and stem rots, and vascular wilt

- plant in a light, well drained, well prepared, pasteurized soil or a rooting medium such as sand, soil, rockwool, vermiculite, perlite, foam or sphagnum moss maintained at the recommended temperature. If pasteurized rooting media are not available, apply fungicides such as metalaxyl (COM) or quinterozone (COM) as granules, drenches, or powders and mix well into the media. Softwood and hardwood cuttings of ornamentals can be dipped in etridiazole + indolebutyric acid (DOM) for control of stem rot caused by *Pythium* spp. Follow label recommendations for crop use, rates and whether pre- or post-plant applications should be made.
- where possible, keep soil on the dry side.
- use new pots, flats, etc., or ones that have been disinfected.
- disinfect tools prior to taking cuttings.
- use disease-free certified seeds or propagation stock.
- maintain healthy vigorously growing stock plants.
- avoid overcrowding, and planting too deeply.
- provide good ventilation and air circulation to reduce humidity.
- water in the morning to allow plants and soil surfaces to dry before evening.
- avoid overfertilizing, especially with nitrogen.
- irrigate with clean water.
- do not sow seeds too closely.
- fungus gnats should be controlled to prevent infection and spread of fungi and bacteria.
- remove any plant materials and debris from soil or rooting medium surface.
- provide adequate bottom heat where appropriate.

### b. Gray mold, powdery mildew, rust, and leaf spots (bacterial and fungal)

- purchase disease-free stock plants from a reputable supplier.
- isolate any new plant shipments in a separate, thoroughly disinfected area of the greenhouse
- rogue out diseased plants early.
- avoid overcrowding and placing plants in damp, shady locations.
- do not sprinkle foliage, particularly in late afternoon or evening.
- avoid overhead-irrigation to minimize leaf wetness and disease spread.
- take cuttings from healthy plants only and disinfect tools between cuts. See chart in Bench and Equipment Sterilization section.
- provide good air circulation by venting and raise night temperatures to reduce humidity; avoid sudden changes in climate and condensation on plants.
- avoid overfertilizing, especially with nitrogen.

- take cuttings off dry plants only.
- do not use wet mulches.
- space plants to promote air circulation and eliminate foliage contact, especially 'mother' plants used for cuttings.
- control weeds in the greenhouse.

**c. Viruses**

- purchase virus indexed or certified plant material, if possible.
- propagate cuttings from healthy plants only.
- disinfest cutting tools between stock plants from which cuttings are being taken.
- avoid mixing old and new plants, or plants from different sources.
- keep insect pests (vectors), especially aphids, whiteflies and thrips under control.
- space plants to eliminate foliage contact, especially 'mother' plants used for cuttings.
- the evening prior to transplanting or handling seedlings which are susceptible to tobacco mosaic, pepper mild mottle and related viruses, spray them with a 10% skim milk powder solution. Always dip hands in the skim milk solution prior to handling susceptible plants.
- handle plants as little as necessary.

**d. Nematodes (root and foliar)**

- if possible, use pasteurized or fumigated soil or rooting medium.
- procure root and foliar stock that is nematode-free.
- avoid introducing soil-borne nematodes from gardens and other greenhouses by strict sanitation procedures including foot baths or overshoes for visitors.
- avoid spreading foliar nematodes by not allowing leaves and stems to stay wet for long periods.
- if possible, take soil samples and have them checked for plant parasitic nematodes. Careful, representative sampling is essential if harmful nematodes are to be detected.

## **Sanitation**

Sanitation should be an integral part of a greenhouse pest control program. If a source of infection is constantly present, control measures may be expensive and ineffective.

- Remove all dead and dying leaves and flowers from the greenhouse. Take debris to an off-site disposal area or a covered compost area.
- Keep walks and the surfaces of beds and benches clean, including free of algae.
- Control weeds in and around greenhouses.
- Hang up the ends of hoses.
- When bringing new stock into the greenhouse, check carefully for possible diseases or insect infestations. Isolate new stock until you are sure it is healthy.
- Use a foot bath with Chemprocide (PCP# 13148).
- Keep traffic flows from clean to dirty, i.e. do not go into the greenhouse after working at the cull pile.
- Between crops, pressure wash the entire greenhouse interior from ceiling to walls, supports, wires and walkways. Use a strong detergent to start then repeat the wash with a registered disinfectant, Chemprocide (PCP 13148) following label directions. Disinfectants are toxic so follow all safety precautions and label directions. Wear protective clothing including rubber or neoprene gloves that are unlined, goggles and an approved respirator. Waterproof clothing consisting of boots, jacket, pants and a wide brimmed hat is needed. Do not tuck pant legs into boots. After any spraying, clean the protective clothing separately from other laundry. Any sprayed area should be well ventilated before work is conducted in that area. When planting chlorine sensitive crops, such as poinsettia, ensure bleach-treated areas are well rinsed. See the BCMAFF "Greenhouse Vegetable Clean-Up" factsheet <http://www.agf.gov.bc.ca/cropprot/cleanup.htm> (accessed March 31, 2008) for more detailed information.

## Soil Pasteurization

Soil pasteurization eliminates organisms that could be harmful to plants. Ideally it can be accomplished with minimum injury to beneficial organisms. Soil should be in fine tilth to allow rapid, uniform penetration of steam or fumigants. Freedom from clods, large lumps and undecomposed crop remains is also desirable. If possible, incorporate fertilizers and organic amendments before treatment. Soil should be moist, but not wet. The soil temperature at 15 cm depth must be 13°C or higher for successful treatment with chemicals.

### a. Soil Steaming

Steam is the most common source of heat for pasteurization. To pasteurize large volumes, many pot plant growers find it efficient to inject steam into the bottom of a wagon or old truck body. After cooling, the pasteurized soil can be moved without further handling to the area in which it will be used. Growers using groundbeds may use surface or subsurface techniques. If their ground beds are drained with agricultural tile (top of tile 38 cm below the surface and rows on 60 cm centers), it may be possible to inject steam into these tiles and effectively pasteurize the soil to the sides and above them. If tiles are not installed, the steam is injected directly under a tarp covering the bed through either a canvas hose or a perforated, flexible plastic field tile to obtain even distribution.

Aerated steam is being used widely today. In this system, live steam is mixed with air in a chamber and the mixture at 71°C is used to pasteurize soil. Lower steam temperatures allow the soil to be pasteurized and avoid any of the hazards of over steaming. Unless there are specific problems requiring higher temperatures, 71°C is adequate to control most insect and disease problems.

The following chart gives an idea of the time-temperature relationships necessary to destroy undesirable organisms during steaming:

Organism	Temperature ( °C)	Time (min.)
Weeds (most)	70-80	15
Insects & mites	60-70	20
Bacteria (most)	60	10
<i>Fusarium</i>	57	30
<i>Botrytis</i>	55	15
Nematodes	55	15
<i>Rhizoctonia</i>	52	30
<i>Sclerotinia</i>	50	5
<i>Pythium</i>	46	40

Most undesirable organisms can be eliminated, under ideal conditions, by 60°C for 30 min. Above 82°C, some beneficial soil organisms are destroyed. Soil heated at too high a temperature for too long becomes sterile and liable to a greater degree of infestation than before simply because all beneficial organisms have been destroyed. Other undesirable effects of over-steaming include:

- excessive ammonia release.
- manganese toxicity may occur on steamed soils with a pH below 6.0.
- higher total salts levels.
- destruction of organic matter.

## b. Soil Fumigation

***CANADIAN LAWS EXIST TO PROTECT APPLICATORS, BYSTANDERS, CONSUMERS AND THE ENVIRONMENT WHEN PESTICIDES ARE USED. THERE ARE SPECIFIC PROVINCIAL RULES ABOUT THE SALE AND USE OF PESTICIDES. GREENHOUSE GROWERS NEED TO KNOW PESTICIDE REGULATIONS AND SAFETY. CONSULT CURRENT PROVINCIAL PRODUCTION GUIDES. WHEN USING FUMIGANTS, FOLLOW ALL PRESCRIBED PESTICIDE REGULATIONS AND SAFETY MEASURES. EXERCISE EXTREME CAUTION TO MINIMIZE HEALTH RISKS WHEN USING SOIL FUMIGANTS.*** An effective, full gas mask with correct canister **must** be used during treatment and at any time when fumes remain in the greenhouse. Seal the soil with a plastic cover after the chemical is injected. **All** label recommendations must be carefully followed.

The commercial use of chemicals such as methyl bromide (RES), methyl isothiocyanate (COM), dazomet (COM), metam sodium (COM), 1,3-dichloropropene (COM), or chloropicrin (COM) for soil pasteurization has become more popular with the increasing cost of steaming. The bromide residue that lingers in the soil after methyl bromide fumigation may reduce the germination and/or growth of salvia, dianthus, ageratum, alyssum, antirrhinum, aster, calendula, celosia, chrysanthemum, cleome, coleus, coreopsis, dahlia, digitalis, godetia, helichrysum, iberis, lobelia, matricaria, myosotis, nemesia, nierembergia, portulaca, salpiglossis, verbena, viola, and vinca.

Some fumigants control fungi, bacteria, nematodes, insects, and weeds, whereas others, which are more specific in their action, control only nematodes or fungi. Soil fumigation is not always an adequate substitute for soil steaming. Fumigants do not destroy all soil-borne viruses harbored in root debris and other plant parts.

## c. Other Methods

Electric soil pasteurizers are useful for small volumes of soil when no other method is available. Overcooking the soil can occur very easily because, for the temperature between the finned heat sources to reach 82°C, the fins themselves must be at a higher temperature.

Hobby greenhouse growers can pasteurize small quantities of soil in an oven, pressure cooker, or suitable covered container. A soil temperature of 60°C should be maintained for at least 30 min. The soil to be treated must be moist, but not too wet. Poor heat penetration can be expected if too great a volume of soil is treated, or if it is too compacted in the container. If pasteurization is impractical, fungicides such as oxine benzoate (COM, DOM) or captan can be mixed into the soil to control damping-off.

Prevent recontamination of treated soil by disease-causing organisms by disinfecting all cultivating tools, pots, flats, and other equipment that could come in contact with the treated soil. Plants grown in contaminated soil, or contaminated soil itself, should not be placed in treated soil. Plant only disease-free or fungicide-treated seed in pasteurized soil.

## Bench, Tools, Equipment, Irrigation Line and Structural Sanitation

Benches and equipment should be disinfected regularly as part of every greenhouse management program. To help eliminate disease organisms, all production equipment should be as clean as possible. Tools, potting benches, carts, walkways and growing benches should be disinfected between crops. For a general greenhouse cleanup, use a commercial disinfectant such as Chemprocide (PCP# 13148) or a 0.5% bleach dilution. Growers should also sterilize automatic watering systems and equipment in the propagating area. Wash hands between crops or houses. If available, a steam hose is ideal to clean tools, wheelbarrows and other equipment. Knives used to make cuttings should be sterilized between individual 'mother' plants.

Many greenhouse vegetable growers in B.C. are disinfecting irrigation lines and structures at the end of the cropping season. See the BCMAFF factsheet “Greenhouse Vegetable Crop Clean-Up” <http://www.agf.gov.bc.ca/cropprot/cleanup.htm> (accessed March 31, 2008) for further information. The following chart is based on tests conducted by BCMAFF and lists guidelines only.

Disinfectant for Pruning Knives	Immersion Time	Pathogens Controlled
0.525% sodium hypochlorite	quick dip	bacteria, most fungi*
DCD Floralife (16 mL/L)	quick dip	bacteria
70% ethyl alcohol	20 seconds	bacteria, fungi
50% concentrated Lysol	60 seconds	bacteria**
undiluted Roccal	60 seconds	bacteria**

\* Where Penicillium is a concern, dip for 10 seconds

\*\* Tests were not conducted with fungi.

## Wood Preservatives

Copper 8-quinolinolate is the only preservative specifically recommended for treatment of picking baskets, boxes, etc., where contact with food is a possibility. Copper naphthenate, although not specifically recommended, is often used for the treatment of flats, benches, etc., in greenhouses. There have been several reports of damage to young plants where this material has been used for such purposes. In such cases, it appears that the solvent rather than the active ingredient (copper) is phytotoxic. Two commonly available wood preservatives, creosote and pentachlorophenol, are very efficacious **but can be extremely injurious to crops**. Therefore, do not use these materials around or in a greenhouse.

## Disinfesting Recirculating Nutrient Solutions

With mounting environmental concerns, untreated drain to waste systems will no longer be appropriate. Recirculation of nutrient solutions is one feasible option. However, pathogens such as *Erwinia*, *Fusarium*, *Pythium* and *Phytophthora* will spread in recirculating nutrient solutions. Technology to reduce pathogen levels in recirculating systems is being developed and includes heat pasteurization, slow sand filtration, ultraviolet radiation and/or ozone. See the BCMAFF factsheet “Bio-Sand Filtration” <http://www.agf.gov.bc.ca/resmgmt/publist/500series/512000-2.pdf> (accessed March 31, 2008) for information on using slow-sand filtration which has been quite effective in grower trials.

## AFRICAN VIOLET (*Saintpaulia ionantha*)

### DAMPING-OFF

See Bedding Plants, DAMPING OFF AND ROOT ROT on page 14.

### GRAY-MOLD BLIGHT

*Botrytis cinerea*

**Cultural:** Refer to ‘General Disease Control Methods for Greenhouse Crops’ at the beginning of this chapter. It is important to control spider mites as their injury is often followed by *Botrytis*.

**Resistant Cultivars:** None.

**Chemical:** Fenhexamid (COM) WG; iprodione (COM) WG, WP. Limitations: As per label.

**Notes:** When applying iprodione, use tepid water to prepare the spray mixture. Phytotoxicity may occur if cold water is used. Repeated use of iprodione may induce resistance in *Botrytis* to the fungicide.

### PETIOLE ROT

Physiological - chemical injury due to accumulated salts on pot rims or the soil surface.

**Cultural:** Petiole rot may be prevented by avoiding the excessive use of fertilizer and flushing the soil occasionally by watering heavily. A collar made of metal foil, cardboard dipped in paraffin, or paraffin dripped on the rim of the pot will prevent contact of the petioles with the accumulated salts.

**Resistant Cultivars:** None.

**Chemical:** None.

### POWDERY MILDEW

*Erysiphe cichoracearum*

**Cultural:** Refer to ‘General Disease Control Methods for Greenhouse Crops’ at the beginning of this chapter.

**Resistant Cultivars:** None.

**Chemical:** None.

**RING SPOT**

Physiological - cold water on the foliage or strong sunshine on wet leaves.

**Cultural:** Ring spot can be avoided by watering plants from below or by applying the water carefully to keep it off the leaves. It may be helpful to use water that is a few degrees warmer than the air temperature.

**Resistant Cultivars:** None.

**Chemical:** None.

**ROOT and CROWN ROT**

*Pythium* spp.

**Cultural:** Refer to 'General Disease Control Methods for Greenhouse Crops' at the beginning of this chapter.

**Resistant Cultivars:** None.

**Biological:** *Streptomyces griseoviridis* Strain K61 (COM) GR; *Trichoderma harzianum* Rifai strain KRL-AG2 (COM) GR, WP. Limitations: As per label.

**Chemical:** Etridiazole (COM) EC. Limitations: As per label.

**ALSTROMERIA****DAMPING-OFF**

See Bedding Plants, DAMPING-OFF AND ROOT ROT on page 14.

**GRAY MOLD**

See Bedding Plants, GRAY MOLD on page 15.

**ANEMONE (*A. coronaria*)****DAMPING-OFF**

See Bedding Plants, DAMPING-OFF AND ROOT ROT on page 14.

**DOWNY MILDEW***Plasmopara pygmaea*

**Cultural:** Refer to ‘General Disease Control Methods for Greenhouse Crops’ at the beginning of this chapter. Discard badly infected plants or remove spotted flowers and leaves.

**Resistant Cultivars:** None.

**Chemical:** None.

**FOLIAR NEMATODE***Aphelenchoides* sp.

**Cultural:** Refer to ‘General Disease Control Methods for Greenhouse Crops’ at the beginning of this chapter.

**Resistant Cultivars:** None known.

**Chemical:** None.

**GRAY MOLD**

See Bedding Plants, GRAY MOLD on page [15](#).

**AZALEA (*Rhododendron* spp.)****DAMPING-OFF**

See Bedding Plants, DAMPING-OFF AND ROOT ROT on page [14](#).

**GRAY MOLD***Botrytis cinerea*

**Cultural:** Refer to ‘General Disease Control Methods for Greenhouse Crops’ at the beginning of this chapter.

**Resistant Cultivars:** None.

**Chemical:** Iprodione (COM) WG, WP. Limitations: As per label.

**RED LEAF and STEM GALL***Exobasidium vaccinii***Cultural:** Young galls should be hand-picked and destroyed.**Resistant Cultivars:** None.**Chemical:** None.**BEDDING PLANTS****(also anemone, begonia, celosia, chrysanthemum, coleus, geranium, salvia)****BLACK ROOT ROT***Thielaviopsis basicola* (*Chalara elegans*)**Cultural:** Adjust the pH of the potting mix to 5.5 or below if the crop will tolerate it. *Thielaviopsis* is suppressed at lower pH levels. See section on 'General Disease Control Methods for Greenhouse Crops' at the beginning of this chapter for general management.**Resistant Cultivars:** None.**Chemical:** None.**References:**

1. 1999 Floriculture Production Guide, BCMAFF.

**DAMPING-OFF AND ROOT ROT***Fusarium* spp., *Phytophthora* spp., *Pythium* spp., *Rhizoctonia solani***Cultural:** Refer to 'General Disease Control Methods for Greenhouse Crops' at the beginning of this chapter.**Resistant Cultivars:** None.**Biological:** *Streptomyces griseoviridis* Strain K61 (COM) WP; *Trichoderma harzianum* Rifai strain KRL-AG2 (COM) GR, WP. Limitations: As per label.**Chemical:** Captan (COM) WG, WP; carbathiin + thiram (COM) WP; etridiazole (COM) WP, EC; fosetyl-Al (COM) WG, WP; iprodione (COM) WG, WP; metalaxyl-M & S (COM) EC; oxine benzoate (COM, DOM) SN; quintozone (COM) WP.**Limitations:** As per label. Iprodione is safe for use on celosia and salvia only. Check tolerance to iprodione on a few plants before large scale use. Fosetyl-Al is registered for use on azalea, begonia, celosia, geranium, impatiens, petunia, salvia and vinca.

**Notes:** Quintozene and iprodione are effective against *Rhizoctonia*. Captan, etridiazole, fosetyl-Al and metalaxyl will control *Pythium* and *Phytophthora*. Carbathiin + thiram will control *Pythium* and *Rhizoctonia*.

**References:**

1. Pervaiz, A.A. *et al.* 2004. Suppression of *Rhizoctonia* and *Pythium* damping-off of radish and cucumber seedlings by addition of fish emulsion to peat mix soil. *Can. J. Plant Path.* 26: 177-187.

## DOWNY MILDEW

*Peronospora* spp., *Plasmopara* spp.

**Cultural:** Refer to ‘General Disease Control Methods for Greenhouse Crops’ at the beginning of this chapter. Discard badly infected plants or remove infected leaves. Carryover to new crops is via dead infested plant material and soil.

**Resistant cultivars:** None.

**Chemical:** None.

## GRAY MOLD

*Botrytis cinerea*

**Cultural:** Refer to ‘General Disease Control Methods for Greenhouse Crops’ at the beginning of this chapter.

**Resistant Cultivars:** None.

**Chemical:** Copper complex (COM) SN; fenhexamid (COM) WG; iprodione (COM) WG, WP; thiophanate-methyl (COM) WP. Limitations: As per label.

**Notes:** Repeated use of iprodione may induce resistance in *Botrytis* to the fungicide.

## IMPATIENS NECROTIC SPOT

Impatiens Necrotic Spot Virus

**Cultural:** Use disease-free propagative stock. Control weeds in and around the greenhouse as they can harbour INSV and TSWV. The use of ‘double doors’ in greenhouses may be useful in preventing the entry of thrips. The use of indicator plants such as petunia ‘Calypso’, ‘Summer Madness’ and ‘Super Blue Magic’ are good indicators for INSV and TSWV infection.

**Resistant Cultivars:** None.

**Chemical:** None.

**Notes:** Use recommended methods to control the vectors of INSV and TSWV (western flower thrips and other thrips).

**References:** See Tomato, TOMATO SPOTTED WILT references on page 58.

**POWDERY MILDEW**

*Erysiphe* spp., *Microsphaera* spp., *Sphaerotheca* spp.

**Cultural:** Refer to ‘General Disease Control Methods for Greenhouse Crops’ at the beginning of this chapter.

**Resistant Cultivars:** None.

**Chemical:** Copper complex (COM) SN for begonia and New Guinea impatiens; thiophanate-methyl (COM) WP for begonia and cineraria. Potassium bicarbonate (COM) DU for multiple species. Limitations: As per label.

**BEGONIA (*Begonia* spp.)****DAMPING-OFF**

See Bedding Plants, DAMPING-OFF AND ROOT ROT on page 14.

**FOLIAR NEMATODES**

*Aphelenchoides fragariae*, *Aphelenchoides ritzemabosi*

**Cultural:** Refer to ‘General Disease Control Methods for Greenhouse Crops’ at the beginning of this chapter.

**Resistant Cultivars:** None.

**Chemical:** None.

**GRAY MOLD**

*Botrytis cinerea*

**Cultural:** Refer to ‘General Disease Control Methods for Greenhouse Crops’ at the beginning of this chapter.

**Resistant Cultivars:** None.

**Chemical:** Iprodione (COM) WG, WP; thiophanate-methyl (COM) WP. Limitations: As per label.

**Notes:** Repeated use of iprodione may induce resistance in *Botrytis* to the fungicide.

**IMPATIENS NECROTIC SPOT**

See Bedding Plants, IMPATIENS NECROTIC SPOT on page 15.

**POWDERY MILDEW***Erysiphe cichoracearum***Cultural:** Refer to ‘General Disease Control Methods for Greenhouse Crops’ at the beginning of this chapter.**Resistant Cultivars:** None.**Chemical:** Copper complex (COM) SN; thiophanate-methyl (COM) WP. Limitations: As per label.**ROOT and STEM ROT***Fusarium* spp., *Phytophthora* spp., *Pythium* spp., *Rhizoctonia solani***Cultural:** Refer to ‘General Disease Control Methods for Greenhouse Crops’ at the beginning of this chapter.**Resistant Cultivars:** None.**Biological:** *Streptomyces griseoviridis* Strain K61 (COM) WP; *Trichoderma harzianum* Rifai strain KRL-AG2 (COM) GR, WP. Limitations: As per label.**Chemical:** Captan (COM) WG, WP; etridiazole (COM) EC; fosetyl-Al (COM) WG, WP; metalaxyl-M & S (COM) EC; oxine benzoate (COM, DOM) SN; thiophanate-methyl (COM) WP; trifloxystrobin (COM) WG; quintozone (COM) WP. Limitations: As per label.**Notes:** Quintozone is only effective against *Rhizoctonia*. Fosetyl-Al, etridiazole and captan will control *Pythium* and *Phytophthora*. Thiophanate-methyl is registered for *Fusarium* and *Rhizoctonia*. *Streptomyces griseoviridis* has activity against *Fusarium*, *Pythium*, *Phytophthora* and *Rhizoctonia*.**BULBS****(also Amaryllis, Calla Lily, Narcissus, Dahlia, Dutch Iris, Freesias, Gladiolus, Hyacinth, Liatris, Ranunculus and Tulips)****BACTERIAL SOFT ROT***Erwinia carotovora* var. *aroideae* (on Calla Lily)**Cultural:** Refer to ‘General Disease Control Methods for Greenhouse Crops’ at the beginning of this chapter. Discard all badly infected corms and tubers.**Resistant Cultivars:** None.**Chemical:** None.**References:**

1. Gracia-Garza, J.A. *et al.* 2002. Pre- and post-plant applications of copper-based compounds to control *Erwinia* soft rot of calla lilies. *Can. J. Plant Pathol.* 24: 274-280.

**DAMPING-OFF**

**Cultural:** See bedding plants, DAMPING-OFF AND ROOT ROT on page 14.

**Resistant Cultivars:** None.

**Biological:** *Trichoderma harzianum* Rifai strain KRL-AG2 (COM) GR, WP. Limitations: As per label.

**Chemical:** Captan + carbaryl (DOM) DU; captan (COM) WP, WG; carbathiin + thiram (COM) WP. Limitations: As per label.

**DRY ROT**

*Stromatinia gladioli* (on Gladiolus)

**Cultural:** Refer to ‘General Disease Control Methods for Greenhouse Crops’ at the beginning of this chapter. Discard badly infected bulbs. Rogue out and destroy yellowed or stunted plants when they are seen.

**Resistant Cultivars:** None.

**Chemical:** Dip corms for 30 minutes in water at 53-55°C to which formaldehyde (COM) LI has been added at the rate of 500 mL/100 L. Dry quickly and store at cool temperatures until replanting. Fumigate with dazomet (COM) GR or metam-sodium (COM) SN if it is necessary to replant in infested soil. Follow label directions and fumigate during the fall preceding planting.

**FUSARIUM BULB ROT**

*Fusarium* spp. Narcissus are most commonly affected by Fusarium. Other diseases include sour rot of tulip, gladiolus yellows and Fusarium rot of lily, iris and freesia.

**Cultural:** Harvest during dry weather taking care not to injure bulbs. Keep harvested bulbs away from the heat of the sun and provide cool, well-ventilated storage. Discard infected bulbs well away from the site. Rotate for as long as possible with a non-host crop.

**Resistant Cultivars:** None.

**Biological:** *Trichoderma harzianum* Rifai strain KRL-AG2 (COM) GR, WP. Limitations: As per label.

**Chemical:** Captan (COM) WG, WP; captan + carbaryl (DOM) DU. Limitations: As per label.

**GRAY MOLD**

*Botrytis* spp. See Bedding Plants, GRAY MOLD on page 15 and Bulbs, LEAF SPOTS on page 19.

**LEAF SCORCH**

*Stagonospora curtisii* (on Amaryllis)

**Cultural:** Refer to ‘General Disease Control Methods for Greenhouse Crops’ at the beginning of this chapter. Discard badly infected bulbs. Plenty of light should be provided; the temperature in forcing houses should be kept as low as possible. Remove infected leaves and bulb scales.

**Resistant Cultivars:** None.

**Chemical:** None.

## LEAF SPOTS

*Botrytis* spp., *Penicillium* spp., *Curvularia* spp.

**Cultural:** Avoid replanting in infested areas for at least 3 years. Remove primary infections. Hot water treatments for nematodes helps to reduce infection on narcissus and gladiolus. Refer to ‘General Disease Control Methods for Greenhouse Crops’ at the beginning of this chapter.

**Resistant Cultivars:** None.

**Chemical:** Iprodione (COM) WG, WP for *Botrytis*. Iris, lily, gladiolus - chlorothalonil (COM) WG, SU. Limitations as per label.

## NEMATODES

*Ditylenchus dipsaci*, *Pratylenchus* spp.

**Cultural:** Follow a 3-4 year rotation between crops and avoid fields known to be infested.

**Resistant Cultivars:** None.

**Chemical:** Treat narcissus stocks routinely with hot water every two years. Bulbs must be dormant and should not be treated until 2 weeks after digging. To minimize flower damage, hold the bulbs at 30°C for one week prior to treatment and then immerse in cool (25°C) water plus formaldehyde overnight to re-activate the nematodes. Bulbs should then be treated for 3-4 hours at 43-44°C in water containing formaldehyde (COM) LI at 500 mL/100 L. Dry quickly and return bulbs to cool storage. Also see ‘General Disease Control Methods for Greenhouse Crops’ on page 7.

### References:

1. 1999 Floriculture Production Guide, BCMAFF.

## POWDERY MILDEW

See Bedding Plants, POWDERY MILDEW on page 16.

## VIRUS DISEASES

**Cultural:** Refer to ‘General Disease Control Methods for Greenhouse Crops’ at the beginning of this chapter.

**Resistant Cultivars:** None.

### References:

1. 1999 Floriculture Production Guide, BCMAFF.

## CALCEOLARIA (*Calceolaria* spp.)

### GRAY MOLD

*Botrytis cinerea*

**Cultural:** Refer to ‘General Disease Control Methods for Greenhouse Crops’ at the beginning of this chapter.

**Resistant Cultivars:** None.

**Chemical:** None.

## CARNATION (*Dianthus caryophyllus*)

### ALTERNARIA BLIGHT

*Alternaria dianthi* and *Alternaria dianthicola*

**Cultural:** Refer to ‘General Disease Control Methods for Greenhouse Crops’ at the beginning of this chapter.

**Resistant Cultivars:** None.

**Chemical:** Chlorothalonil(COM) SU, WG. Limitations: As per label.

**Notes:** Captan (COM) WP is registered for control of Alternaria blight of carnation, but is not specifically labeled for greenhouse use.

**References:** See Forsberg (1975) under General References at the end of this chapter.

### DAMPING-OFF

See Bedding Plants, DAMPING-OFF AND ROOT ROT on page [14](#).

### GRAY MOLD

*Botrytis cinerea*

**Cultural:** Refer to ‘General Disease Control Methods for Greenhouse Crops’ at the beginning of this chapter.

**Resistant Cultivars:** None.

**Chemical:** Chlorothalonil (COM) SU, WG; thiophanate-methyl (COM) WP. Limitations: As per label.

**Notes:** Apply chlorothalonil when foliage and blossoms are dry and when greenhouse temperatures do not exceed 24°C.

**RUST**

*Uromyces dianthi*, *Puccinia arenariae*

**Cultural:** Refer to ‘General Disease Control Methods for Greenhouse Crops’ at the beginning of this chapter.

**Resistant Cultivars:** None.

**Chemical:** Oxycarboxin (COM) LI. Limitations: As per label.

**STEM ROT**

*Rhizoctonia solani* and *Fusarium* spp.

**Cultural:** Refer to ‘General Disease Control Methods for Greenhouse Crops’ at the beginning of this chapter.

**Resistant Cultivars:** None.

**Biological:** *Streptomyces griseoviridis* strain K61 (COM) WP; *Trichoderma harzianum* Rifai strain KRL-AG2 (COM) GR, WP. Limitations: As per label.

**Chemical:** Captan (COM) WP, WG; thiophanate-methyl (COM) WP; quintozone (COM) WP. Limitations: As per label.

**Notes:** Quintozone is only effective against *Rhizoctonia*.

**WILT**

*Fusarium oxysporum* f. sp. *dianthi*, *Phialophora cinerescens*

**Cultural:** Remove wilted plants as soon as possible after detection. Use disease-free cuttings. Disinfest benches with steam or chemicals. Refer to ‘General Disease Control Methods for Greenhouse Crops’ at the beginning of this chapter.

**Resistant Cultivars:** Among the most commonly grown flower colours, pink cultivars are most susceptible, red most resistant and white intermediate or variable (1).

**Biological:** *Streptomyces griseoviridis* strain K61 (COM) WP. Limitations: As per label.

**Chemical:** None. See Notes.

**Notes:** It has been observed that thiophanate-methyl, registered for control of gray mold, or metam-sodium registered for control of damping-off, will also control wilt, but are not registered for this use.

**References:**

1. Baker, R. 1980. Measures to control fusarium and phialophora wilt pathogens of carnations. *Plant Disease* 64: 743-749.

## CHRISTMAS CACTUS

### ROOT ROT

See Bedding Plants, DAMPING-OFF AND ROOT ROT, page 14.

## CHRYSANTHEMUM (*Chrysanthemum* spp.)

### DAMPING-OFF

See Bedding Plants, DAMPING-OFF AND ROOT ROT on page 14.

### FOLIAR NEMATODES

*Aphelenchoides fragariae* and *Aphelenchoides itzemabosi*

**Cultural:** Refer to ‘General Disease Control Methods for Greenhouse Crops’ at the beginning of this chapter.

**Resistant Cultivars:** None.

**Chemical:** None.

### GRAY MOLD

*Botrytis cinerea*

**Cultural:** Refer to ‘General Disease Control Methods for Greenhouse Crops’ at the beginning of this chapter.

**Resistant Cultivars:** None.

**Chemical:** Chlorothalonil (COM) SU, WG; dicloran (COM) WP; iprodione (COM) WG, WP; thiophanate-methyl (COM) WP. Limitations: As per label.

**Notes:** Apply chlorothalonil only when foliage and blossom surfaces are dry, and when greenhouse temperatures do not exceed 24°C. Repeated use of iprodione may induce resistance in *Botrytis* to the fungicide.

### IMPATIENS NECROTIC SPOT

See Bedding Plants, IMPATIENS NECROTIC SPOT on page 15.

### POWDERY MILDEW

*Erysiphe cichoracearum*

**Cultural:** Refer to ‘General Disease Control Methods for Greenhouse Crops’ at the beginning of this chapter.

**Resistant Cultivars:** None.

**Chemical:** Myclobutanil (COM) WP for cut chrysanthemum; thiophanate-methyl (COM) WP and myclobutanil (COM) WP for chrysanthemums. Limitations: As per label.

## ROOT and STEM ROT

*Fusarium* spp., *Pythium* spp. and *Rhizoctonia solani*

**Cultural:** Refer to ‘General Disease Control Methods for Greenhouse Crops’ at the beginning of this chapter.

**Resistant Cultivars:** None.

**Biological:** *Streptomyces griseoviridis* Strain K61 (COM) WP; *Trichoderma harzianum* Rifai strain KRL-AG2 (COM) GR, WP. Limitations: As per label.

**Chemical:** Etridiazole (COM) EC; metalaxyl (COM) GR; oxine benzoate (COM, DOM) SN; thiophanate-methyl (COM) WP; trifloxystrobin (COM) WG; quintozene (COM) WP. Limitations: As per label.

**Note:** Quintozone is only effective against *Rhizoctonia*. Thiophanate-methyl is not effective on *Pythium*.

## VIRUS DISEASES

Chrysanthemum stunt virus, aster yellows, impatiens necrotic spot virus, tomato spotted wilt virus

**Cultural:** Refer to ‘General Disease Control Methods for Greenhouse Crops’ at the beginning of this chapter.

**Resistant Cultivars:** None.

**Chemical:** None.

## WILT

*Fusarium oxysporum*, *Verticillium albo-atrum*

**Cultural:** Use clean stock only. Discard and destroy all infected plant material. The causal organism is usually soil-borne. Follow other cultural control practices discussed under ‘General Disease Control Methods for Greenhouse Crops’ at the beginning of this chapter.

**Resistant Cultivars:** None.

**Biological:** *Streptomyces griseoviridis* Strain K61 (COM) WP. Limitations: As per label.

**Chemical:** None.

## QUARANTINE DISEASES

The following disease of chrysanthemum does not occur or is of limited distribution in Canada and is under quarantine regulations:

**White Rust** (*Puccinia horiana*) - See Agriculture and Agri-Food Canada <http://www.inspection.gc.ca/english/sci/surv/sit2001e.shtml#Chrysanthemumwr> (accessed March 31, 2008), and B.C. Ministry of Agriculture, Fisheries and Food bulletin, October, 1993 or [www.agf.gov.bc.ca/cropprot/cwrust.htm](http://www.agf.gov.bc.ca/cropprot/cwrust.htm) (accessed March 31, 2008).

## CINERARIA (*Senecio cruentus*)

### GRAY MOLD

*Botrytis cinerea*

**Cultural:** Refer to ‘General Disease Control Methods for Greenhouse Crops’ at the beginning of this chapter.

**Resistant Cultivars:** None.

**Chemical:** Iprodione (COM) WG, WP Limitations: As per label.

**Notes:** When applying iprodione use tepid water to prepare spray mixture. Phytotoxicity may occur if cold water is used. Repeated use of iprodione may induce resistance in *Botrytis* to the fungicide.

### IMPATIENS NECROTIC SPOT

See Bedding Plants, IMPATIENS NECROTIC SPOT on page 15.

### POWDERY MILDEW

*Erysiphe cichoracearum*

**Cultural:** Refer to ‘General Disease Control Methods for Greenhouse Crops’ at the beginning of this chapter.

**Resistant Cultivars:** None.

**Chemical:** None

## COLEUS (*Coleus* spp.)

### DAMPING-OFF

See Bedding Plants, DAMPING-OFF AND ROOT ROT on page 14.

### GRAY MOLD

*Botrytis cinerea*

**Cultural:** Refer to ‘General Disease Control Methods for Greenhouse Crops’ at the beginning of this chapter.

**Resistant Cultivars:** None.

**Chemical:** None.

### IMPATIENS NECROTIC SPOT

See Bedding Plants, IMPATIENS NECROTIC SPOT on page 15.

### ROOT-KNOT NEMATODE

*Meloidogyne* spp.

**Cultural:** Refer to ‘General Disease Control Methods for Greenhouse Crops’ at the beginning of this chapter.

**Resistant Cultivars:** None.

**Chemical:** Fumigate soil (preplant) with - methyl bromide (RES) LI; dazomet (COM) GR; metam-sodium (COM) SN; methyl isothiocyanate (COM) LI; chloropicrin + 1,3-dichloropropene (COM) SN; 1,3-dichloropropene (COM) SN. Limitations: As per label.

## CUCUMBER (*Cucumis sativus*)

### ALTERNARIA LEAF SPOT

*Alternaria cucumerina*

**Cultural:** Use disease-free seed. Avoid prolonged periods of high humidity. Minimize injury to leaves. Do not grow other cucurbits, especially melons, in the same greenhouse. Follow other cultural control practices listed under ‘General Disease Control Methods for Greenhouse Crops’ at the beginning of this chapter.

**Resistant Cultivars:** None.

**Chemical:** None.

## ANGULAR LEAF SPOT

*Pseudomonas lachrymans*

**Cultural:** Use disease-free seed. Avoid prolonged periods of high humidity. Minimize injury to leaves. Avoid working with plants if foliage or fruit is wet. Follow other cultural control practices listed under ‘General Disease Control Methods for Greenhouse Crops’ at the beginning of this chapter.

**Resistant Cultivars:** None.

**Chemical:** None.

## BLACK ROOT ROT

*Phomopsis sclerotioides*

**Cultural:** Use soilless growing media such as sawdust. Keep soil floor covered to reduce contamination onto growing mixes. Avoid introducing the disease from gardens and other greenhouses by strict sanitation procedures including footbaths or overshoes for visitors. If using soil, steam or chemically pasteurize soil (refer to ‘General Disease Control Methods for Greenhouse Crops’ at the beginning of this chapter). Use only fresh sawdust or steam soil thoroughly before replanting. Rotate cucumbers with tomatoes. If discovered in early stages, mound the base of the stem with sawdust as soilless mix to initiate new root growth. Avoid growing transplants under ‘slow growing conditions’. Maintain day and night temperatures of 21-22°/24°C. Thick basal stem transplants are more prone to disease infection.

**Resistant Cultivars:** None (see Note 2).

**Chemical:** None.

### Notes:

1. *Gliocladium roseum* has shown promise as a biological control agent for *Phomopsis* (1).
2. *Cucurbita ficifolia* is resistant. Susceptible commercial cultivars can be grafted on *C. ficifolia* root stocks to obtain resistant plants.

### References:

1. Moody, A.R. and Gindrat, D. 1977. Biological control of cucumber black root rot by *Gliocladium roseum*. *Phytopathology* 67: 1159-1162.
2. Ormrod, D.J. and Christie, W.D. 1972. *Phomopsis* root rot of greenhouse cucumbers in British Columbia. *Plant Dis. Rep.* 56: 53-55.

## CUCUMBER MOSAIC

Cucumber mosaic virus

**Cultural:** Minimal handling of plants is important to reduce virus spread. Always handle ‘healthy’ plants before working in diseased zones. Work along the row in one direction only. Control weeds that may act as reservoir hosts. Control aphid vectors.

**Resistant Cultivars:** None.

**Intermediate:** Burpee Hybrid and High Mark II varieties of American type cucumbers.

**Susceptible:** Most of the European seedless varieties.

**Chemical:** None.

**Notes:** Avoid growing chrysanthemums near a cucumber crop. Chrysanthemums are latent carriers of CMV.

## CUCUMBER PALE FRUIT

Cucumber Pale Fruit Viroid

**Cultural:** During pruning and harvesting, use good sanitation practices. Remove infected plants. Take extra precautions by surface sterilizing pruning tools and when handling plants.

**Resistant Cultivars:** None.

**Chemical:** None.

**Notes:** The cucumber pale fruit viroid has been transmitted experimentally in seed, but not by insects and does not overwinter in crop residue.

### References:

1. Diener, T.O. 1987. Chapter 12, Cucumber pale fruit *in* The viroids, T.O. Diener (ed).
2. van Dorst, H.J.M. and Peters, D. 1974. Some biological observations on pale fruit, a viroid-incited disease of cucumber. *Neth. J. Plant Pathol.* 80: 85-96.

## DAMPING-OFF

*Pythium* spp., *Rhizoctonia solani*, *Fusarium* spp.

**Cultural:** **Early damping-off** - plant fresh, good quality seed of high percentage germination. Use new rockwool cubes, or pasteurize soil and follow other cultural control practices outlined under ‘General Disease Control Methods for Greenhouse Crops’ at the beginning of this chapter. Avoid high temperature irrigation water (>23°C) especially in summer plantings.

**Late damping-off** - use only vigorous, disease-free transplants. Plant into a well prepared, warm soil or growing mix (16-21°C). Avoid cold water shock to young plants by using tepid water at about 20-23°C.

**Resistant Cultivars:** None.

**Biological:** *Streptomyces griseoviridis* Strain K61 (COM) WP; *Trichoderma harzianum* Rifai strain KRL-AG2 (COM) GR, WP. Limitation: As per label.

**Chemical:** Metalaxyl-M & S (COM) EC; oxine benzoate (COM, DOM) SN; propamocarb hydrochloride (COM) SN; Limitations: As per label. Propamocarb hydrochloride and metalaxyl M & S will only control *Pythium*.

**Notes:** *Pythium* can also cause root rot in mature plants (see under Root Rot on page 31).

**References:**

1. Pervaiz, A.A. *et al.* 2004. Suppression of *Rhizoctonia* and *Pythium* damping-off of radish and cucumber seedlings by addition of fish emulsion to peat mix soil. *Can. J. Plant Path.* 26: 177-187.
2. Punja, Z.K. and Yip, R. 2003. Biological control of damping-off and root rot caused by *Pythium aphanidermatum* on greenhouse cucumbers. *Can. J. Plant Pathol.* 25: 411-417.

**FUSARIUM ROOT & STEM ROT**

*Fusarium oxysporum* f.sp. *radicis-cucumerinum*

**Cultural:** Refer to ‘General Disease Control Methods for Greenhouse Crops’ at the beginning of this chapter. Many spores are produced on infected stems which can spread from routine crop handling. Control fungus gnats and shore flies to reduce spread. Remove infected plants and growing media. Disinfect irrigation lines.

**Resistant Cultivars:** Varieties with reduced infection levels include ‘Kariboe’, ‘Imagine’, and ‘Ventura’. The most susceptible are ‘Serami’, ‘Mustang’, and ‘Flamingo’. The rootstock *Cucurbita ficifolia* is resistant.

**Biological:** *Streptomyces griseoviridis* Strain K61 (COM) WP; *Trichoderma harzianum* Rifai strain KRL-AG2 (COM) GR, WP. Limitation: As per label.

**Chemical:** None.

**References:**

1. Punja, Z.K. 1999. Fusarium rot and stem rot of greenhouse cucumbers. Greenhouse vegetable factsheet, BCMAFF.
2. Vakalounakis, D.J. 1996. Root and stem rot of cucumber caused by *Fusarium oxysporum* f.sp. *radicis-cucumerinum* f.sp. *nov.* *Plant Dis.* 80: 313-316.
3. 1996-97 Greenhouse Vegetable Production Guide, BCMAFF.

**GRAY MOLD**

*Botrytis cinerea*

**Cultural:** Refer to ‘General Disease Control Methods for Greenhouse Crops’ at the beginning of this chapter. Problem periods are spring and fall when humidity is high and plant surfaces may be wet for extended periods. Reduce humidity by providing good air circulation and higher temperatures and ventilation. If detected, early disease areas on the stem may be cleaned up by removing with a knife (scraper) and applying a fungicide paste of iprodione (COM) WP. Avoid full venting when outside temperatures are less than 15°C. Cool air ‘dropping’ from roof vents creates a climate that favours establishment of the disease.

**Resistant Cultivars:** None.

**Chemical:** Ferbam (COM) WG; iprodione (COM) WG, WP (see Notes).

**Limitations:** Preharvest interval - 1 day (ferbam); 2 days (iprodione).

**Notes:**

1. The U.S. has a zero tolerance for iprodione (Rovral) residues.
2. Ferbam causes severe damage to English cucumber.
3. Anilazine which is registered for the control of certain other foliage diseases of greenhouse cucumbers, is also effective against gray mold.
4. Repeated use of iprodione may induce resistance in *B. cinerea* to the fungicide.

**GUMMY STEM BLIGHT**

*Didymella bryoniae*

**Cultural:** Plant disease-free seed. Consider growing two or three crops per year to minimize disease build-up. Follow other cultural control practices discussed under ‘General Disease Control Methods for Greenhouse Crops’ at the beginning of this chapter.

**Resistant Cultivars:** None.

**Chemical:** Iprodione (COM) WG, WP; mancozeb (COM) WP; myclobutanil (COM) WP stem sprays. Alternate between the recommended fungicides to avoid buildup of resistance.

**Limitations:** Preharvest intervals - 2 days (iprodione, myclobutanil); 14 days (mancozeb).

**LEAF SCORCH**

Physiological - salt toxicity

**Cultural:** Plants growing in soils with high levels of soluble salts lack vigorous growth, have small blossoms and scorched or mottled leaves, and generally fail to respond to fertilizer applications. A soil analysis should be used to determine salt levels. To correct the problem, leach with water. In soilless culture, reduce the electrical conductivity of the nutrient solution to 1.8 to 2.0 millisiemens (1). Avoid using water containing high salt concentrations for irrigation. Since leaf scorch is accentuated by a low relative humidity, intermittent misting of the foliage is recommended if angular leaf spot is not a problem.

**Resistant Cultivars:** None.

**Chemical:** None.

**References:**

1. Mirza, M. and Howard, R.J. 1984. Personal communication. Alta. Hort. Res. Center, Brooks, Alta.

**PENICILLIUM STEM ROT**

*Penicillium oxalicum*

**Cultural:** Refer to ‘General Disease Control Methods for Greenhouse Crops’ at the beginning of this chapter. Disinfect pruners and work disease rows last. Dispose of infected stems. Leave 5 mm of stem on the fruit when harvesting and quickly cool fruit. Carefully handle fruit to avoid wounds.

**Resistant Cultivars:** None.

**Chemical:** None.

**Notes:** Rovral applied for gummy stem blight will control the fungus, but limit sprays as resistance can develop quickly.

**References:**

1. BCMAFF. Pest Management Note 95-04. 1995.
2. Jarvis, W.R. and Barrie, S.D. 1988. Stem rot of greenhouse cucumbers caused by *Penicillium crustosum*. Plant Dis. 72: 363.
3. Jarvis, W.R. 1989. Spotting the *Botrytis* look-alike. Grower (Lond.) III (14): 16-19.

## POWDERY MILDEW

*Sphaerotheca fuliginea*, *Erysiphe cichoracearum*

**Cultural:** The amendment of hydroponic nutrient solutions with 100 ppm of soluble silicon in the form of potassium silicate can help control this disease. Use 50 ppm for mildew tolerant cultivars. Maintain a uniform RH of 70-80%. Refer to 'General Disease Control Methods for Greenhouse Crops' at the beginning of this chapter.

**Resistant Cultivars:** Bella, Cordoba, Fidelio, K8200, Marillo, Milanda, Profito, TW242. Mildew tolerant cultivars: DR347, Enigma, Flamingo. Consult your seed company.

**Biological:** *Pseudozyma flocculosa* (COM) SU. *Bacillus subtilis* Strain QST 713 (COM) WP. Limitations: As per label.

**Chemical:** Myclobutanil (COM) WP; potassium bicarbonate (COM) DU; sulphur (COM) WG, WP.

**Limitations:** Preharvest intervals - 1 day (sulphur); 2 days (myclobutanil); 0 days (*Pseudozyma flocculosa*).

**Notes:**

1. Repeated application of sulphur may cause leaf injury. Avoid use during high temperatures (+29°C).
2. Allow two to three weeks between crops to thoroughly clean the greenhouse.

**References:**

1. Kharbanda, P. and Howard, R. 1981. Identity and control of powdery mildew of greenhouse cucumbers in southern Alberta. Can. J. Plant Pathol. 3: 115.
2. Menzies, J.G. *et al.* 1991. Effects of soluble silicon on the parasitic fitness of *Sphaerotheca fuliginea* on *Cucumis sativus*. Phytopathology 81: 84-88.

## ROOT-KNOT NEMATODE

*Meloidogyne* spp.

**Cultural:** Refer to ‘General Disease Control Methods for Greenhouse Crops’ at the beginning of this chapter.

**Resistant Cultivars:** None.

**Chemical:** Fumigate soil (preplant) with - chloropicrin + 1,3-dichloropropene (COM) SN; 1,3-dichloropropene (COM); methyl bromide (RES) LI, SN; metam-sodium (COM) SN. Limitations: As per label.

## ROOT ROT, STEM ROT and WILT

*Fusarium* spp., *Pythium* spp., *Verticillium* spp.

**Cultural:** Follow cultural control practices listed under ‘General Disease Control Methods for Greenhouse Crops’ at the beginning of this chapter.

**For soil culture** - use individual containers rather than beds to avoid spread from plant to plant; reduce watering on infected plants to allow soil surface to dry; rotate cucumbers with tomatoes.

**For sawdust culture** - use only fresh sawdust or thoroughly steam it before replanting.

**For hydroponic culture** - employ ultra-violet sterilization of nutrient solution to prevent spread of the pathogens (2). Activated slow sand filtration will remove *Pythium* in recirculated nutrient solutions and 95% of *Fusarium* propagules (3).

**Resistant Cultivars:** None. (See Note 2).

**Biological:** For *Fusarium*, *Streptomyces griseoviridis* strain K61 (COM) WP; for *Fusarium* and *Pythium* root infections, *Trichoderma harzianum* Rifai strain KRL-AG2 (COM) GR, WP. Limitations: As per label.

**Chemical:** Captan (COM) WP, propamocarb hydrochloride (COM) LI or thiram (COM) WP may be applied as protective seed treatments; metalaxyl-M & S (COM) EC. Limitations: As per label. Metalaxyl-M & S and propamocarb hydrochloride will only control *Pythium*. Captan may cause phytotoxicity on some varieties; test first on a small batch.

### Notes:

1. On occasion, *Fusarium* may be carried on seed.
2. Remove crop debris off site or bury.

### References:

1. Ehret, D. 1998. Personal communication. Pacific Agricultural Research Centre, Agassiz, B.C.
2. Howard, R.J. 1982. Efficacy of the Trojan ultra-violet water sterilizer for the control of plant pathogens in hydroponic systems. *Can. J. Plant Pathol.* 4: 306.
3. Ng, K. 1999. Personal communication. Ng Consulting, Vancouver, B. C.
4. Punja, Z.K. and Yip, R. 2003. Biological control of damping-off and root rot caused by *Pythium aphanidermatum* on greenhouse cucumbers. *Can. J. Plant Pathol.* 25: 411-417.

**SCAB and LEAF MOLD***Cladosporium cucumerinum*

**Cultural:** Maintain night temperatures at or above 18°C and ventilate to reduce humidity. Follow other cultural control procedures given under 'General Disease Control Methods for Greenhouse Crops' at the beginning of this chapter.

**Resistant Cultivars:** All Long English varieties.

**Chemical:** None.

**References:**

1. Anonymous. 1980. Grower Guide 15: Cucumbers. Grower Books, London, Eng. 71 pp.

**STEM and FRUIT ROT (Sclerotinia)***Sclerotinia sclerotiorum*

**Cultural:** Refer to 'General Disease Control Practices for Greenhouse Crops' at the beginning of this chapter. It is especially important to collect and destroy infected plant debris as large numbers of persistent sclerotia may be present. These fall to the soil and later act as a major inoculum source. Avoid planting tomato or lettuce in rotation with cucumbers where stem and fruit rot occurs.

**Resistant Cultivars:** None.

**Chemical:** None.

**CYCLAMEN (*Cyclamen indicum*)****CORM ROT***Erwinia carotovora*

**Cultural:** Avoid wounding of tubers. Plant into sterilized growth media.

**Resistant Cultivars:** None.

**Chemical:** Copper complex (COM) SN. Limitations: As per label.

**FUSARIUM WILT**

*Fusarium oxysporum* f.sp. *cyclaminis*

**Cultural:** Follow cultural control practices listed under ‘General Disease Control Methods for Greenhouse Crops’ at the beginning of this chapter.

**Resistant Cultivars:** None.

**Biological:** *Streptomyces griseoviridis* Strain K61 (COM) WP. Limitations: As per label.

**Chemical:** None.

**Notes:**

1. It is very important to sterilize the plug trays when seeding cyclamen. Styrofoam plug trays are extremely difficult to sterilize and are a good source of this pathogen (1).
2. Fusarium spores spread easily in recirculated nutrient solutions.

**References:**

1. Copeman, R. Personal communication. U.B.C., British Columbia

**GRAY MOLD**

*Botrytis cinerea*

**Cultural:** Refer to ‘General Disease Control Methods for Greenhouse Crops’ at the beginning of this chapter.

**Resistant Cultivars:** None.

**Chemical:** Copper complex (COM) SN; iprodione (COM) WG, WP. Limitations: As per label.

**Notes:** Repeated use of iprodione may induce resistance in *Botrytis* to the fungicide.

**IMPATIENS NECROTIC SPOT**

See Bedding Plants, IMPATIENS NECROTIC SPOT on page 15.

**ROOT-KNOT NEMATODE**

*Meloidogyne* spp.

**Cultural:** Refer to ‘General Disease Control Methods for Greenhouse Crops’ at the beginning of this chapter.

**Resistant Cultivars:** None.

**Chemical:** Fumigate soil (preplant) with - methyl bromide (RES) LI; dazomet (COM) GR; metam-sodium (COM) SN; methyl isothiocyanate + 1,3-dichloropropene + chloropicrin (COM) SN; chloropicrin + 1,3-dichloropropene (COM) SN; 1,3-dichloropropene (COM) SN. Limitations: As per label.

## FUCHSIA (*Fuchsia* hybrids)

### BLACK ROOT ROT

*Thielaviopsis basicola* (see under BEDDING PLANTS, page 14)

### GRAY MOLD

*Botrytis cinerea*

**Cultural:** Refer to ‘General Disease Control Methods for Greenhouse Crops’ at the beginning of this chapter.

**Resistant Cultivars:** None.

**Chemical:** Copper complex (COM) SN; iprodione (COM) WG, WP;. Limitations: As per label.

**Notes:** Repeated use of iprodione may induce resistance in *Botrytis* to the fungicide.

### RUST

*Pucciniastrum epilobii*

**Cultural:** Pick and destroy infected leaves. Destroy fireweed (*Epilobium*) the alternate host for fuchsia rust, if practical. Follow other control measures discussed under ‘General Disease Control Methods for Greenhouse Crops’ at the beginning of this chapter.

**Resistant Cultivars:** None.

**Chemical:** None.

## GERANIUM (*Pelargonium* spp.)

### BACTERIAL LEAF SPOT and STEM ROT, BLACK ROT

*Xanthomonas campestris* pv. *pelargonii*

**Cultural:** Control measures must be based upon establishing disease-free planting stock and practicing strict sanitary measures. Avoid wetting the foliage when watering. For details refer to ‘General Disease Control Methods for Greenhouse Crops’ at the beginning of this chapter.

**Resistant Cultivars:** None.

**Biological:** *Bacillus subtilis* Strain QST 713 (COM) Aqueous Suspension. Limitations, as per label

**Chemical:** Copper complex (COM) SN will reduce spread from plant to plant but will not cure infected plants.

**Notes:** *Xanthomonas* can survive on leaves or wounded stems of ornamentals such as tuberous begonia, chrysanthemum, coleus, fuschia, impatiens, lantana, spike, verbena and vinca vine.

**References:**

1. BCMAFF Floriculture Production Guide.

## BLACK ROOT ROT

*Thielaviopsis basicola* (see under BEDDING PLANTS, page 14)

## BLACKLEG

*Pythium* spp.

**Cultural:** Plant only disease-free stock. Refer to ‘General Disease Control Methods for Greenhouse Crops’ at the beginning of this chapter.

**Resistant Cultivars:** None.

**Biological:** *Streptomyces griseoviridis* Strain K61 (COM) WP; *Trichoderma harzianum* Rifai strain KRL-AG2 (COM) GR, WP. Limitations: As per label.

**Chemical:** Oxine benzoate (COM, DOM) SN. Limitations: As per label.

## DAMPING-OFF

*Pythium* spp., *Rhizoctonia solani*

See Bedding Plants, DAMPING-OFF AND ROOT ROT on page 14.

## GRAY MOLD

*Botrytis cinerea*

**Cultural:** Refer to ‘General Disease Control Methods for Greenhouse Crops’ at the beginning of this chapter.

**Resistant Cultivars:** None.

**Biological:** *Bacillus subtilis* Strain QST 713 (COM) Aqueous Suspension. Limitations, as per label

**Chemical:** Chlorothalonil (COM) SU, WG; copper complex (COM) SN; dicloran (COM) WP; fenhexamid (COM) WG; iprodione (COM) WG, WP. Limitations: As per label.

**Notes:**

1. Apply chlorothalonil only when foliage and blossom surfaces are dry, and when greenhouse temperatures do not exceed 24°C.
2. Repeated use of iprodione may induce resistance in *Botrytis* to the fungicide.

## OEDEMA

Physiological - Excessive soil moisture, low light, retarded transpiration

**Cultural:** If plants are given sufficient air circulation and light without excessive relative humidity, oedema is rarely a problem. Once a leaf has oedema symptoms, it will not recover. New growth will be normal if beneficial environmental changes are made.

**Resistant Cultivars:** See Notes.

**Chemical:** None.

**Notes:** Ivy leaf geraniums are more prone to oedema than other types.

## RUST

*Puccinia pelargonii-zonalis*

**Cultural:** Refer to 'General Disease Control Methods for Greenhouse Crops' at the beginning of this chapter.

**Resistant Cultivars:** None.

**Chemical:** Chlorothalonil (COM) SU, WG; myclobutanil (COM) WP. Limitations: As per label.

**Notes:**

1. Apply chlorothalonil only when foliage and blossom surfaces are dry, and when greenhouse temperatures do not exceed 24°C.
2. This was previously a quarantine disease in Canada under regulations of the Plant Health Division, Agriculture & Agri-Food Canada, but is no longer classified as such.

## VIRUS DISEASES

Pelargonium leaf-curl virus, cucumber mosaic virus, impatiens necrotic spot virus

**Cultural:** Propagate only from virus-free mother plants. Follow other cultural control methods listed under 'General Disease Control Methods for Greenhouse Crops' at the beginning of this chapter.

**Resistant Cultivars:** None.

**Chemical:** None. Control thrips.

## QUARANTINE DISEASES

The following disease of geranium and potato does not occur in Canada and is under quarantine regulations. The North American Plant Protection Organization (NAPPO) recently listed this pathogen as a quarantine pest of potatoes for the NAPPO region:

**Bacterial Wilt** (*Ralstonia solanacearum* race 3-biovar 2) - See Agriculture and Agri-Food Canada, <http://www.inspection.gc.ca/english/sci/surv/data/ralsole.shtml> (accessed March 31, 2008) and B.C. Ministry of Agriculture, Fisheries and Food, [www.agf.gov.bc.ca/cropprot/ralstonia.htm](http://www.agf.gov.bc.ca/cropprot/ralstonia.htm).

## GLOXINIA (*Sinningia speciosa*)

### BUD ROT

*Botrytis cinerea*

**Cultural:** Refer to ‘General Disease Control Methods for Greenhouse Crops’ at the beginning of this chapter.

**Resistant Cultivars:** None.

**Chemical:** Iprodione (COM) WG, WP. Limitations: As per label.

**Notes:** Repeated use of iprodione may induce resistance in *Botrytis* to the fungicide.

### DAMPING-OFF

See Bedding Plants, DAMPING-OFF AND ROOT ROT on page 14.

### CROWN ROT AND LEAF BLIGHT

*Sclerotinia sclerotiorum*

**Cultural:** Refer to ‘General Disease Control Methods for Greenhouse Crops’ at the beginning of this chapter. Collect and destroy infected plant debris as large numbers of persistent sclerotia may be present.

**Resistant Cultivars:** None.

**Chemical:** None.

### ROOT, STEM AND CROWN ROTS

*Fusarium* spp., *Pythium* spp., *Rhizoctonia* spp. *Phytophthora* spp.

**Cultural:** Refer to ‘General Disease Control Methods for Greenhouse Crops’ at the beginning of this chapter.

**Resistant Cultivars:** None.

**Biological:** *Streptomyces griseoviridis* Strain K61 (COM) WP; *Trichoderma harzianum* Rifai strain KRL-AG2 (COM) GR, WP. Limitations: As per label.

**Chemical:** Captan (COM) WP, WG; etridiazole (COM) EC; metalaxyl-M & S (COM) EC; quintozone (COM) WP; oxine benzoate (COM, DOM) SN. Limitations: As per label.

**Note:** Etridiazole and metalaxyl-M & S are effective against *Pythium* and *Phytophthora*. Quintozone is only effective against *Rhizoctonia*.

### IMPATIENS NECROTIC SPOT

See Bedding Plants, IMPATIENS NECROTIC SPOT on page 15.

## HIBISCUS (*Hibiscus syriacus*)

### GRAY MOLD

*Botrytis cinerea*

**Cultural:** Refer to ‘General Disease Control Methods for Greenhouse Crops’ at the beginning of this chapter.

**Resistant Cultivars:** None.

**Chemical:** Copper complex (COM) SN;. Limitations: As per label.

## HYDRANGEA (*Hydrangea macrophylla*)

### GRAY MOLD

*Botrytis cinerea*

**Cultural:** Refer to ‘General Disease Control Methods for Greenhouse Crops’ at the beginning of this chapter.

**Resistant Cultivars:** None.

**Chemical:** Dicloran (COM) WP; thiophanate-methyl (COM) WP. Limitations: As per label.

### POWDERY MILDEW

*Erysiphe cichoracearum*

**Cultural:** Refer to ‘General Disease Control Methods for Greenhouse Crops’ at the beginning of this chapter.

**Resistant Cultivars:** None.

**Chemical:** Copper complex (COM) SN; potassium bicarbonate (COM) DU. Limitations: As per label.

### LEAF SPOTS

*Cercospora* spp. and *Septoria* spp.

**Cultural:** Refer to ‘General Disease Control Methods for Greenhouse Crops’ at the beginning of this chapter.

**Resistant Cultivars:** None.

**Chemical:** Chlorothalonil (COM) WG, SU. Limitations: As per label.

**Notes:** Apply chlorothalonil only when foliage and blossom surfaces are dry, and when greenhouse temperatures do not exceed 24°C.

**ROOT ROT**

*Pythium* spp.

See Bedding Plants, DAMPING-OFF AND ROOT ROT page 14.

**ROOT, STEM AND CROWN ROTS**

*Fusarium* spp., *Pythium* spp., *Rhizoctonia* spp. *Phytophthora* spp.

**Cultural:** Refer to ‘General Disease Control Methods for Greenhouse Crops’ at the beginning of this chapter.

**Resistant Cultivars:** None.

**Biological:** *Streptomyces griseoviridis* Strain K61 (COM) WP; *Trichoderma harzianum* Rifai strain KRL-AG2 (COM) GR, WP. Limitations: As per label.

**Chemical:** Captan (COM) WG, WP; etridiazole (COM) EC; oxine benzoate (COM, DOM); quintozone (COM) WP SN. Limitations: As per label.

**Note:** Quintozone is only effective against *Rhizoctonia*.

**LETTUCE (*Lactuca sativa*)****DAMPING-OFF**

*Pythium* spp., *Rhizoctonia solani*

**Cultural:** Refer to ‘General Disease Control Methods for Greenhouse Crops’ at the beginning of this chapter.

**Resistant Cultivars:** None.

**Chemical:** Oxine benzoate (COM, DOM) SN. Limitations: As per label.

**DOWNY MILDEW**

*Bremia lactucae*

**Cultural:** Can be a problem in fall and spring under conditions of high humidity and where leaf tissue remains wet for prolonged periods. Control climate with temperature and ventilation.

**Resistant Cultivars:** Consult seed companies.

**Biological:** *Bacillus subtilis* Strain QST 713 (COM) WP. Limitations, as per label

**Chemical:** Fosetyl-al (COM) WG, WP. Limitations: For use in B.C. only. Preharvest interval - 14 days (fosetyl-Al).

**Notes:** Spray within 1 week of transplanting and repeat in 2 weeks. Ensure good foliage coverage.

**References:**

1. Publication 365, 1990 Pest Management Recommendations for Ontario Greenhouse Crops.

**GRAY MOLD***Botrytis cinerea***Cultural:** Refer to ‘General Disease Control Methods for Greenhouse Crops’ at the beginning of this chapter.**Resistant Cultivars:** None.**Chemical:** Ferbam (COM) WG; iprodione (COM) WG, WP; fenhexamid (COM) WG  
Limitations: Preharvest interval -1 day (ferbam); 14 days (iprodione), 3 days (fenhexamid)**SCLEROTINIA ROT (DROP)***Sclerotinia sclerotiorum***Cultural:** Refer to ‘General Disease Control Methods for Greenhouse Crops’ at the beginning of this chapter. Collect and destroy infected plant debris as large numbers of persistent sclerotia may be present. Avoid planting cucumbers or tomatoes in rotation with lettuce where Sclerotinia rot occurs.**Resistant Cultivars:** None.**Biological:** *Bacillus subtilis* Strain QST 713 (COM) WP. Limitations, as per label**Chemical:** Iprodione (COM) WG, WP. Limitations: 14 days (iprodione).**TIPBURN**

Nonpathogenic

**Cultural:** Maintain a steady rate of plant growth. Avoid wide fluctuations in moisture stress and air temperature. Lettuce is more prone to visible tip burn in the later stages of maturity. Ensure adequate levels of calcium in the media, and that the EC is not too high.**Resistant Cultivars:** Consult seed companies.**Chemical:** None.**Notes:** Harvesting heads before full maturity is one approach to reducing visible damage.**TOMATO SPOTTED WILT**

See Tomato, TOMATO SPOTTED WILT on page 58.

## LILY (EASTER) (*Lilium* spp.)

### GRAY MOLD and BLIGHT

*Botrytis cinerea*, *B. elliptica*

**Cultural:** Refer to ‘General Disease Control Methods for Greenhouse Crops’ at the beginning of this chapter.

**Resistant Cultivars:** None.

**Chemical:** Chlorothalonil (COM) WG, SU. Limitations: As per label.

**Notes:** Apply chlorothalonil only when foliage and blossom surfaces are dry, and when greenhouse temperatures do not exceed 24°C.

### ROOT and BULB ROT

*Rhizoctonia solani*, *Fusarium* spp., *Pythium* spp., *Phytophthora* spp., *Cylindrocarpon radicum*

**Cultural:** Propagating from healthy planting stock is the most effective means of controlling this disease complex. Also follow the other cultural practices listed under ‘General Disease Control Methods for Greenhouse Crops’ at the beginning of this chapter.

**Resistant Cultivars:** None.

**Biological:** *Streptomyces griseoviridis* Strain K61 (COM) WP. Limitations: As per label.

**Chemical:** Etridiazole (COM) EC, WP. Limitations: As per label.

**Notes:** Etridiazole is only effective against *Pythium* and *Phytophthora*.

## PANSY (*Viola* spp.)

### BLACK ROOT ROT

*Thielaviopsis basicola* (see under BEDDING PLANTS, page 14)

**Notes:** Black root rot may be confused with *Pythium* root rot.

#### References:

1. Pearce, M. 2005. Pansy diseases in the landscape. Bulletin 1281. U. of Georgia College of Ag. And Env. Science.

## ROOT ROTS

*Fusarium oxysporum* var. *aurantiacum*, *Helicobasidium purpureum*, *Phymatotrichum omnivorum*, *Rhizoctonia solani*, *Ciborinia violae*, *Pellicularia filamentosa*

**Cultural:** These soil inhabiting fungi are difficult to control once they infest growth media. Drastic measures are necessary, such as steam-pasteurization. Refer to ‘General Disease Control Methods for Greenhouse Crops’ at the beginning of this chapter.

**Resistant Cultivars:** None.

**Biological:** *Streptomyces griseoviridis* Strain K61 (COM) WP. Limitations: As per label.

**Chemical:** None.

## ROOT AND STEM ROTS

*Pythium* spp., *Rhizoctonia* spp., *Phytophthora* spp.

**Cultural:** Refer to ‘General Disease Control Methods for Greenhouse Crops’ at the beginning of this chapter.

**Resistant Cultivars:** None.

**Biological:** *Streptomyces griseoviridis* Strain K61 (COM) WP; *Trichoderma harzianum* Rifai strain KRL-AG2 (COM) GR, WP. Limitations: As per label.

**Chemical:** Etridiazole (COM) EC; metalaxyl-M & S (COM) EC; trifloxystrobin (COM) WG. Limitations: As per label.

**Notes:** Trifloxystrobin is only effective against *Rhizoctonia*. Etridiazole and metalaxyl are only effective against *Pythium* and *Phytophthora*

## PEPPER (SWEET PEPPER [*Capsicum* spp.])

### BLOSSOM END ROT

Nonpathogenic

**Cultural:** Avoid plant stresses mentioned under notes. Apply calcium chloride at 100-200 g/100 litres water as a foliar spray at the first sign of blossom end rot. Maintain reasonably high humidity levels in the afternoon or warm days by restricting venting. Ensure soluble salts in the growing medium are below 2.5 EC during conditions that favour BER.

**Resistant Cultivars:** None.

**Chemical:** None.

**Notes:** This is a very common physiological disorder of peppers. It is caused by a moisture shortage within the plant in relation to calcium movement. Water soaked spots appear at the blossom end which enlarge and take on a black, leathery appearance. Moisture shortages can be caused by a number of factors. Underwatering during warm periods, high concentrations of fertilizer salts which impede root uptake of calcium, root problems, very low humidity causing high transpiration rates, and sudden changes in the weather from cool to hot periods can all cause moisture stress on the plant, affecting calcium mobility. Often more blossom end rot occurs during periods of rapid fruit expansion. Actual calcium deficiency is usually a secondary factor, since regular feeding should supply adequate amounts.

**References:**

1. 1996-97 Greenhouse Vegetable Production Guide, BCMAFF.

## DAMPING-OFF or CROWN ROT

*Phytophthora* spp., *Pythium* spp., *Rhizoctonia* spp.

**Cultural:** Refer to ‘General Disease Control Methods for Greenhouse Crops’ at the beginning of this chapter.

**Resistant Cultivars:** None.

**Biological:** *Streptomyces griseoviridis* Strain K61 (COM) WP as a seedling treatment but not a seed treatment. Limitations: As per label.

**Chemical:** Buy treated seed or apply thiram as a seed treatment. Captan (COM) WP or oxine benzoate (COM, DOM) SN, as a seedling drench. Limitations: As per label.

**References:**

1. 1996-97 Greenhouse Vegetable Production Guide, BCMAFF.

## ROOT AND STEM ROT AND WILT

*Phytophthora* spp.

**Cultural:** Refer to ‘General Disease Control Methods for Greenhouse Crops’ at the beginning of this chapter.

**Resistant Cultivars:** None.

**Biological:** *Streptomyces griseoviridis* Strain K61 (COM) WP; *Trichoderma harzianum* Rifai strain KRL-AG2 (COM) GR, WP. Limitations: As per label.

**Chemical:** None.

**References:**

1. Nielsen, C.J. *et al.* 2006. Efficacy of biosurfactants in the management of *Phytophthora capsici* on pepper in recirculating hydroponic systems. *Can. J. Plant Path.* 28: 450-460.

## ROOT AND CROWN ROT AND WILT

*Fusarium* spp.

**Cultural:** Refer to ‘General Disease Control Methods for Greenhouse Crops’ at the beginning of this chapter.

**Resistant Cultivars:** None.

**Biological:** *Streptomyces griseoviridis* Strain K61 (COM) WP; *Trichoderma harzianum* Rifai strain KRL-AG2 (COM) GR, WP. Limitations: As per label.

**Chemical:** None.

## FUSARIUM STEM ROT and FRUIT ROT

*Fusarium solani*, *Nectria haematococca*

**Cultural:** Refer to ‘General Disease Control Methods for Greenhouse Crops’ at the beginning of this chapter.

**Resistant Cultivars:** None.

**Biological:** *Streptomyces griseoviridis* strain K61 (COM) WP as a seedling drench. Limitations: As per label.

**Chemical:** None.

### References:

1. 1996-97 Greenhouse Vegetable Production Guide, BCMAFF.

## GRAY MOLD

*Botrytis cinerea*

**Cultural:** Refer to ‘General Disease Control Methods for Greenhouse Crops’ at the beginning of this chapter. Reduce humidity and improve air circulation around the plants. Strictly control greenhouse climate by adequate heating and venting to prevent condensation on plants. Practice a high degree of sanitation by removing crop debris including prunings from the greenhouse.

**Resistant Cultivars:** None.

**Chemical:** None.

### References:

1. 1996-97 Greenhouse Vegetable Production Guide, BCMAFF.

## PEPPER MILD MOTTLE

Pepper mild mottle virus

**Cultural:** Refer to ‘General Disease Control Methods for Greenhouse Crops’ at the beginning of this chapter. Seed should be treated against virus infection (one hour in 10% solution of tri-sodium phosphate (TSP) unless already treated by the seed company). The evening prior to picking out seedlings or prior to any handling, spray the seedlings with 10% skim milk powder solution. Use 10% low fat milk (containing 35% protein per litre of water). Always dip hands in skim milk solution before handling the plants.

**Resistant Cultivars:** Adele, Cubico, DRS 5033, Kelvin, Madara, and Samantha. Consult your seed company.

**Chemical:** None.

### References:

1. 1990 Pest Control Notes, PMMV, BCMAFF.
2. Stace-Smith, R. 1990. Pepper mild mottle virus on greenhouse grown peppers. *Phytopathology* 80: 892.

## POWDERY MILDEW

*Leveillula taurica*

**Cultural:** Powdery mildew of greenhouse pepper is a new and serious disease. Avoid introducing this disease into your greenhouse. Follow strict sanitation and guidelines under ‘General Disease Control Methods’. Early infection causes serious crop yield losses depending on the cultivar.

**Resistant Cultivars:** Inspiration. Check with seed suppliers.

**Biological:** *Bacillus subtilis* Strain QST 713 (COM) WP; *Streptomyces lydicus* (COM) SP. Limitations, as per label

**Chemical:** Myclobutanil (COM) WP foliar spray as soon as mildew is detected and again 12 days later if disease pressure warrants control. Maximum number of applications is three and re-entry interval is 12 hours. Sulphur (COM) WP as required but do not exceed 10 applications per crop cycle. Apply on a minimum interval of 14 days. Potassium bicarbonate (COM) DU.

**Limitations:** preharvest interval - 3 days for myclobutanil. As per label.

### References:

1. Cerkauskas, R.F and A. Buonassisi. 2003. First report of powdery mildew of greenhouse pepper caused by *Leveillula taurica* in British Columbia, Canada. *Plant Dis.* 87: 1151.

## SHRINK CRACKING

Nonpathogenic

**Cultural:** Control is achieved by lower humidity levels early in the morning plus providing adequate leaf cover for the fruit during the summer. The first flush of fruit that takes longer than 8 weeks to harvest from flower are more prone to shrink cracking.

**Resistant Cultivars:** None. The variety Delphin has been noted to be particularly susceptible. Yellow (Samantha) and orange cultivars tend to be more prone to shrink cracking.

**Chemical:** None.

**Notes:** Numerous small cracks may appear on the fruit as they mature. They are usually associated with swelling of the fruit caused by excessive water uptake, or possible fruit expansion due to heating of the fruit by the sun.

**References:**

1. 1996-97 Greenhouse Vegetable Production Manual, BCMAFF.

## SUNSCALD

Nonpathogenic

**Cultural:** Peppers are very susceptible to sun scald, which causes light tan coloured areas on exposed fruit. Maintain good leaf canopy and apply shading or use moveable screen during bright hot weather.

**Resistant Cultivars:** None.

**Chemical:** None.

**References:**

1. 1996-97 Greenhouse vegetable production guide, BCMAFF.

## TOBACCO MOSAIC

Tobacco mosaic virus

**Cultural:** Refer to 'General Disease Control Methods for Greenhouse Crops' at the beginning of this chapter. This disease can be transmitted by seeds, soil, water, insects and pruning. Use one year old seed, soak seed for one hour in a 10% solution of tri-sodium phosphate (TSP). Before handling plants dip hands in a 10% solution of skim milk powder (100 g/L water). Do not smoke near plants or in the greenhouse since tobacco carries the virus. Rogue out any suspicious plants and handle plants as little as possible. Sprays of dried milk powder have been shown to slow the spread of TMV.

**Resistant Cultivars:** None.

**Chemical:** None.

**Notes:** Symptoms include mosaic mottling on leaves and necrosis of leaf veins. Defoliation often follows. Fruit may be bronze in appearance or malformed.

**References:**

1. 1996-97 Greenhouse vegetable production guide, BCMAFF.

## TOMATO SPOTTED WILT

Tomato spotted wilt virus

**Cultural:** Use disease-free propagative stock. Control weeds in and around the greenhouse as they can harbour TSWV. The use of 'double doors' in greenhouses may be useful in preventing the entry of thrips. The use of indicator plants such as petunia 'Calypso', 'Summer Madness' and 'Super Blue Magic' are good indicators for INSV and TSWV infections.

**Resistant Cultivars:** None.

**Chemical:** None.

**Notes:** Use recommended methods to control the western flower thrips vector of TSWV (see Tomato).

## WHITE ROT

*Sclerotinia sclerotiorum*

**Cultural:** Refer to 'General Disease Control Methods for Greenhouse Crops' at the beginning of this chapter. Use soilless culture methods. In areas with a history of Sclerotinia, lay white plastic ground sheets to completely cover exposed soil and place bags on top to isolate the bags from infection.

**Resistant Cultivars:** None.

**Chemical:** None.

### References:

1. 1996-97 Greenhouse Vegetable Production Guide, BCMAFF.

## POINSETTIA (*Euphorbia pulcherrima*)

### BLACK ROOT ROT

*Thielaviopsis basicola* (see under BEDDING PLANTS, page 14)

### GRAY MOLD

*Botrytis cinerea*

**Cultural:** Refer to 'General Disease Control Methods for Greenhouse Crops' at the beginning of this chapter. Humidity should be kept below 93%. Do not allow canopy to close; move pots apart as necessary.

**Resistant Cultivars:** None.

**Biological:** *Bacillus subtilis* Strain QST 713 (COM) AS. Limitations, as per label

**Chemical:** Copper complex (COM) SN; fenhexamid (COM) WG; iprodione (COM) WG, WP; thiophanate-methyl (COM) WP. Limitations: As per label.

**Notes:** Repeated use of iprodione may induce resistance in *Botrytis* to this fungicide.

**References:**

1. Benson, D. M. *et al.* 2002. The history and diseases of poinsettia, the Christmas flower. Online. Plant Health Progress doi:10.1094/PHP-2002-0212-01-RV.

## MOSAIC

Poinsettia mosaic virus

**Cultural:** Propagate poinsettias from virus-free stock.

**Resistant Cultivars:** None.

**Chemical:** None.

**Notes:**

1. Symptoms are enhanced in plants grown at 20°C or lower, but are generally mild or non-existent in plants grown at higher temperatures.
2. Virus-free poinsettias have been obtained from infected stocks by procedures involving heat therapy or tissue culture. However, virus-indexed poinsettias are apparently not currently available in commercial quantities.

**References:**

1. Chiko, A.W. 1983. Poinsettia mosaic virus in British Columbia. *Plant Dis.* 67: 427-428.
2. Pfannenstiel, M.A., Mintz, K.P., and Fulton, R.W. 1982. Evaluation of heat therapy of poinsettia mosaic and characterization of the viral components. *Phytopathology* 72: 252-254.

## POWDERY MILDEW

*Oidium* sp.

**Cultural:** Check cuttings to ensure they do not have powdery mildew. If detected, remove infected leaves and place into bags at the site.

**Resistant Cultivars:** None.

**Biological:** *Bacillus subtilis* Strain QST 713 (COM) AS. Limitations, as per label

**Chemical:** Copper complex (COM) SN; myclobutanil (COM) WP; potassium bicarbonate (COM) DU.

**Notes:** Use caution when applying fungicides when the bracts are fully developed.

## ROOT AND STEM ROT

*Rhizoctonia solani*, *Pythium* spp., *Fusarium* spp., *Cylindrocladium* spp.

**Cultural:** Refer to ‘General Disease Control Methods for Greenhouse Crops’ at the beginning of this chapter. Use a well-drained potting mix and avoid overwatering.

**Resistant Cultivars:** None.

**Biological:** *Streptomyces griseoviridis* Strain K61 (COM) WP; *Trichoderma harzianum* Rifai strain KRL-AG2 (COM) GR, WP. Limitations: As per label.

**Chemical:** Etridiazole (COM) WP; quintozone (COM) WP. Limitations: As per label.

**Notes:** Etridiazole is only effective against *Pythium*.

## PRIMROSE (*Primula* spp.)

### BACTERIAL LEAF SPOT

*Pseudomonas primulae*

**Cultural:** Refer to ‘General Disease Control Methods for Greenhouse Crops’ at the beginning of this chapter. Older leaves have been reported to be more susceptible.

**Resistant Cultivars:** Some varieties of *Primula* have been proven to be more susceptible than others.

**Chemical:** None.

**Notes:** Severe outbreaks can be curbed with copper fungicides.

### DAMPING OFF AND ROOT AND STEM ROTS

*Pythium* spp., *Phytophthora* spp.

**Cultural:** Refer to ‘General Disease Control Methods for Greenhouse Crops’ at the beginning of this chapter.

**Resistant Cultivars:** None.

**Biological:**

**Chemical:** Metalaxyl-M & S (COM) EC. Limitations: As per label.

### GRAY MOLD

See under BEDDING PLANTS, page 15.

### RUST

*Puccinia aristidae*, *Uromyces apiosporus*

**Cultural:** Refer to ‘General Disease Control Methods for Greenhouse Crops’ at the beginning of this chapter.

**Resistant Cultivars:** None.

**Chemical:** None.

## VIRUS DISEASES

Cucumber Mosaic Virus (CMV), Impatiens Necrotic Spot Virus (INSV)

**Cultural:** Refer to ‘General Disease Control Methods for Greenhouse Crops’ at the beginning of this chapter. Remove and destroy infected plants. For CMV, control weeds and aphids that may harbor and spread the virus. For INSV, see under BEDDING PLANTS, Impatiens Necrotic Spot on page 15.

**Resistant Cultivars:** None.

**Chemical:** None.

## ROSE (*Rosa* spp.)

### BLACK SPOT

*Diplocarpon rosae*

**Cultural:** Refer to ‘General Disease Control Methods for Greenhouse Crops’ at the beginning of this chapter.

**Resistant Cultivars:** None.

**Chemical:** Chlorothalonil (COM) WG, SU; dicloran (COM) WP; thiophanate-methyl (COM) WP. Limitations: As per label.

**Notes:** Apply chlorothalonil only when foliage and blossom surfaces are dry, and when greenhouse temperatures do not exceed 24°C.

### DOWNY MILDEW

*Peronospora sparsa* (see under BEDDING PLANTS, page 15).

### GRAY MOLD

*Botrytis cinerea*

**Cultural:** Refer to ‘General Disease Control Methods for Greenhouse Crops’ at the beginning of this chapter.

**Resistant Cultivars:** None.

**Chemical:** Chlorothalonil (COM) WG, SU; copper complex (COM) SN; dicloran (COM) WP; fenhexamid (COM) WG; thiophanate-methyl (COM) WP. Limitations: As per label.

**Notes:** Apply chlorothalonil only when foliage and blossom surfaces are dry, and when greenhouse temperatures do not exceed 24°C.

**POWDERY MILDEW***Sphaerotheca macularis***Cultural:** Refer to ‘General Disease Control Methods for Greenhouse Crops’ at the beginning of this chapter.**Resistant Cultivars:** None.**Biological:** *Pseudozyma flocculosa* (COM) SU; *Bacillus subtilis* (COM) AS. Limitations: As per label.**Chemical:** Copper complex (COM) SN; dodemorph acetate (COM) EC; myclobutanil (COM) WP; thiophanate-methyl (COM) WP. Limitations: As per label.**SNAPDRAGON (*Antirrhinum majus*)****DAMPING-OFF**

See Bedding Plants, DAMPING-OFF AND ROOT ROT on page 14.

**DOWNY MILDEW***Peronospora antirrhini***Cultural:** Can be a problem under conditions of high humidity and where leaf tissue remains wet for prolonged periods. Control climate with temperature and ventilation.**Resistant Cultivars:** None.**Chemical:** None.**GRAY MOLD***Botrytis cinerea***Cultural:** Refer to ‘General Disease Control Methods for Greenhouse Crops’ at the beginning of this chapter.**Resistant Cultivars:** None.**Chemical:** None.**POWDERY MILDEW***Erysiphe cichoracearum***Cultural:** Refer to ‘General Disease Control Methods for Greenhouse Crops’ at the beginning of this chapter.**Resistant Cultivars:** None.**Chemical:** None.

**RUST***Puccinia antirrhini*

**Cultural:** Refer to ‘General Disease Control Methods for Greenhouse Crops’ at the beginning of this chapter. Propagation from seed is preferable to the use of cuttings. The disease is also spread from plant to plant by insects, which carry the uredospores; the control of insects therefore helps to control rust. Since the uredospores germinate very rapidly at low temperatures, infection is most likely in cool conditions. It has been reported that rust can be controlled if the temperature of the greenhouse is kept above 21°C and not below 16°C at night.

**Resistant Cultivars:** Rust-resistant varieties are available.

**Chemical:** None.

**STEM AND CROWN AND ROOT ROTS***Sclerotinia sclerotiorum*, *Fusarium* spp., *Pythium* spp., *Rhizoctonia solani*, *Phytophthora* spp.

**Cultural:** Refer to ‘General Disease Control Methods for Greenhouse Crops’ at the beginning of this chapter.

**Resistant Cultivars:** None.

**Biological:** *Streptomyces griseoviridis* Strain K61 (COM) WP; *Trichoderma harzianum* Rifai strain KRL-AG2 (COM) GR, WP. Limitations: As per label.

**Chemical:** Captan (COM) WG, WP; etridiazole (COM) WP, EC; metalaxyl-M & S (COM) EC; oxine benzoate (COM, DOM) SN; quintozone (COM) WP. Limitations: As per label.

**Notes:** Etridiazole and metalaxyl will only control *Pythium* and *Phytophthora*. Quintozone alone will only control *Rhizoctonia* and *Sclerotinia*.

**TOMATO (*Lycopersicon esculentum*)****BACTERIAL CANKER***Clavibacter michiganensis* subsp. *michiganensis*

**Cultural:** Sow only hot water-treated seed. For hot water treatment of seed of doubtful status, place seed in a loose cheesecloth bag and soak in water at 50°C for 30 min. Treatment at 53°C may be carried out if the seed is planted within a few days. Use an accurate thermometer and keep the seed agitated during treatment. Spread seed out to dry immediately after treatment. Also follow a rigid schedule of sanitation throughout the season (refer to ‘General Disease Control Methods for Greenhouse Crops’ at the beginning of this chapter).

**Resistant Cultivars:** None.

**Chemical:** Copper oxychloride (COM) WP may be used as a foliar spray. Limitations: Preharvest interval - 1 day (copper oxychloride). A copper fungicide applied to the area of outbreak may help reduce the disease, however preventative applications of copper-containing fungicides have not been effective in controlling the disease in field studies (1).

**References:**

1. Hudgins, E. 2000. Bacterial Canker of Greenhouse Tomatoes. BCMAFF factsheet.
2. Maitland, A. E. 1976. Bacterial canker of tomato. Ont. Ministry Agric. Food, Factsheet 76-014.

## BLOSSOM-END ROT

Physiological

**Cultural:** Maintain a steady rate of plant growth. Avoid wide fluctuations in soil water, soil compaction, and air temperature. Increase root zone temperature at night. Make sure calcium levels are between 150 to 200 ppm in the nutrient solution. In soil or soil based media, calcium levels should be maintained between 200 to 300 ppm based on the water extraction method. In soilless media, rockwool and NFT, the electrical conductivity should be around 2.0 millisiemens/cm when air temperature is above 26°C. If BER has already appeared, remove the fruit. Reduce carbon dioxide and temperature to avoid vigorous fruit growth. Remove leaves at the bottom of the plant. This will remove sites of calcium accumulation that compete with the fruit. Spray developing trusses with calcium chloride or calcium nitrate at 100 to 200 g/100 L of water on a 2-3 sprays/week basis. Avoid relative humidity above 80% in the greenhouse. Avoid high nitrogen levels when plants are small.

**Resistant Cultivars:** None.

**Chemical:** None.

**Notes:** Blossom-end rot may be a serious problem on tomatoes grown in peat moss.

**References:**

1. Mayodan, M. 1985. Personal Communication. Alberta Tree Nursery and Hort. Centre, Edmonton, Alta.

## BLOTCHY RIPENING

Physiological and tobacco mosaic virus.

**Cultural:** Provide adequate space per plant, e.g., 0.3 to 0.4 m<sup>2</sup>. Control tobacco mosaic virus (see page 57). Maintain relatively high soil potassium levels. In hydroponic culture, increase potassium levels to 400 to 500 ppm (2). Keep greenhouse temperatures as low as possible during hot weather. Avoid heavy de-leafing. Increase leaf canopy on plants in June. Maintain 18-20 leaves per plant.

**Resistant Cultivars:** None.

**Chemical:** None.

**References:**

1. Mayodan, M. 1983. Personal communication. Alta. Hort. Res. Center, Brooks, Alta.
2. Piedrahita, O. 1984. Tomato fruit disorders. Ont. Minist. Agric. Food, Factsheet 84-051.
3. Stace-Smith, R. 1975. Virus control in greenhouse tomatoes. Can. Agric. 21(1): 15-16.
4. 1996-97 Greenhouse Vegetable Production Guide, BCMAFF.

**DAMPING-OFF**

*Pythium* spp., *Rhizoctonia solani*

**Cultural:** Refer to ‘General Disease Control Methods for Greenhouse Crops’ at the beginning of this chapter.

**Resistant Cultivars:** None.

**Biological:** *Streptomyces griseoviridis* Strain K61 (COM) WP; *Trichoderma harzianum* Rifai strain KRL-AG2 (COM) GR, WP. Limitations: As per label.

**Chemical:** None.

**DIDYMELLA STEM AND FRUIT ROT**

*Didymella lycopersici*

**Cultural:** Remove any infected plant and burn. Do not handle or cut lesions. Minimize water splashing around affected areas. Follow other cultural control practices discussed on ‘General Disease Control Methods for Greenhouse Crops’ at the beginning of this chapter.

**Resistant Cultivars:** None.

**Chemical:** None.

**References:**

1. Wright, R.G. 1983. Didymella stem and fruit rot of tomato. ADAS leaflet 560, Ministry of Agriculture, Fisheries and Food, U.K.
2. 1996-97 Greenhouse Vegetable Production Guide, BCMAFF.

**EARLY BLIGHT, LATE BLIGHT, SEPTORIA LEAF SPOT**

*Alternaria solani*, *Septoria lycopersici*, *Phytophthora infestans*

**Cultural:** Refer to ‘General Disease Control Methods for Greenhouse Crops’ at the beginning of this chapter.

**Resistant Cultivars:** None.

**Chemical:** Copper oxychloride (COM) WP; mancozeb (COM) WG, WP. Limitations: As per label. Preharvest interval - 7 days (mancozeb).

**Notes:** Attempt to keep new growth covered with protectant sprays and dusts.

**FUSARIUM CROWN and ROOT ROT***Fusarium oxysporum* f. sp. *radicis-lycopersici*

**Cultural:** Use resistant cultivars. Graft onto resistant rootstock varieties, B82.864. Removal of the first fruit of a heavily infected plant will allow the plant to recover with relatively little loss thereafter. The mounding of soil or a soil-peat mixture around the base of the stem of infected plants to a height of 20-30 cm allows the growth of adventitious roots. These roots generally remain disease free and allow the plants to recover.

**Resistant Cultivars:** Apollo, B8-864 (pink fruited), Cobra (red fruited), CR-6 (pink), 83W186, Furon (red), Farao (red), Larma (red), Match, Red Giant (red), Trust (red), Vicores (red), W1601 (red), 1627, and 518. Consult seed companies.

**Biological:** *Streptomyces griseoviridis* Strain K61 (COM) WP; *Trichoderma harzianum* Rifai strain KRL-AG2 (COM) GR, WP. Limitations: As per label.

**Chemical:** None. See notes.

**Notes:** General sanitation and soil sterilization may reduce disease inoculum but will not prevent disease.

**References:**

1. 1986-87 Greenhouse Vegetable Production Guide, BCMAFF.
2. Jarvis, W.R. 1976. Fusarium crown and root rot in greenhouse tomatoes. Canadex 257. 635.

**GRAY LEAF SPOT***Stemphylium solani*

**Cultural:** Refer to 'General Disease Control Methods for Greenhouse Crops' at the beginning of this chapter.

**Chemical:** Captan (COM) WP.  
Limitations: Preharvest interval - 2 days (captan).

**Notes:** Maneb, mancozeb, and chlorothalonil are reported to be effective against gray leaf spot.

**GRAY MOLD (STEM ROT)***Botrytis cinerea*

**Cultural:** Refer to 'General Disease Control Methods for Greenhouse Crops' at the beginning of this chapter. If detected early, disease areas on the stem may be cleaned by removing with a knife (scrape) and applying a paste of iprodione.

**Resistant Cultivars:** None.

**Chemical:** Dicloran (COM) WP; fenhexamid (COM) WG; ferbam (COM) WG; iprodione (COM) WG, WP.  
Preharvest intervals - 1 day (dicloran, fenhexamid); 2 days (iprodione). Limitations: As per label.

**References:**

1. Utkhede, R. et al. 2001. Effects of biological and chemical treatments on *Botrytis* stem canker and fruit yield of tomato under greenhouse conditions. Can. J. Plant Pathol. 23: 253-259.

## LEAF MOLD

*Cladosporium fulvum*

**Cultural:** Refer to ‘General Disease Control Methods for Greenhouse Crops’ at the beginning of this chapter.

**Resistant Cultivars:** Ontario Red 775, Ontario Pink 774, and Buffalo.

**Intermediate:** Dombito and Laura. Use varieties with C5 resistance for western Canada.

**Chemical:** None.

### References:

1. Committee 1984. 1985-86 Greenhouse Vegetable Production Recommendations. Ont. Min. Agric. Food Pub. 365.

## MAGNESIUM DEFICIENCY

Physiological - Inadequate availability of magnesium.

**Cultural:** Rotate plantings to new beds. Apply magnesium sulphate (Epsom salts) to the soil at 1 kg/100 m<sup>2</sup> or to the leaves once as a spray at 25 g/100 L. In greenhouses where the problem has occurred on previous crops, magnesium sprays should be applied even before the symptoms occur.

**Resistant Cultivars:** None.

**Chemical:** None.

**Notes:** High potassium levels in the soil may induce magnesium deficiency.

## PEPINO MOSAIC

Pepino Mosaic Virus

**Cultural:** Practice prevention methods based on strict greenhouse sanitation and hygiene excluding all off site tomatoes and prohibiting visitor access to crop. Ensure that workers have a separate uniform including footwear that is only for greenhouse use. Follow an intensive, year end greenhouse clean up to prevent virus carry over to new crop. Dip hands and tools in undiluted skim milk (at least 3.5% protein). Disinfect tools and greenhouse surfaces.

**Resistant Cultivars:** None.

**Chemical:** None.

### References:

1. Ferguson, G. 2003. Management of pepino mosaic virus in greenhouse tomato. Ontario Ministry of Agriculture and Food factsheet <http://www.omafra.gov.on.ca/english/crops/facts/01-017.htm> (accessed March 31, 2008).

## PITH NECROSIS

*Pseudomonas corrugata*

**Cultural:** Remove and destroy infected plants. Low night temperatures, high humidity, and high nitrogen levels appear to contribute to disease development.

**Resistant Cultivars:** None.

**Chemical:** None.

## POWDERY MILDEW

*Erysiphe* sp.

**Cultural:** Refer to ‘General Disease Control Methods for Greenhouse Crops’ at the beginning of this chapter.

**Resistant Cultivars:** None.

**Biological:** *Bacillus subtilis* Strain QST 713 (COM) WP. Limitations, as per label

**Chemical:** Myclobutanil (COM) WP; potassium bicarbonate (COM) DU; Sulphur (COM) WP.  
Preharvest interval - 3 days (myclobutanil) with no more than 2 applications per crop cycle. Limitations:  
As per label.

### References:

1. BCMAFF. 1996-97 Greenhouse Vegetable Production Guide.
2. Ehret, D.L. *et al.* 2002. Foliar applications of fertilizer salts inhibit powdery mildew on tomato. *Can. J. Plant Pathol.* 24: 437-444.

## ROOT, STEM and FRUIT ROTS

*Colletotrichum coccodes*, *Sclerotinia sclerotiorum*, *Rhizoctonia solani*, *Pyrenochaeta lycopersici*, *Botrytis cinerea*, *Pythium* spp., *Phytophthora* spp. *Fusarium* spp.

**Cultural:** Refer to ‘General Disease Control Methods for Greenhouse Crops’ at the beginning of this chapter.  
Consider soilless culture as an alternative to soil in severe recurring cases. Avoid rotating tomatoes with lettuce or cucumbers when *S. sclerotiorum* is present.

**Resistant Cultivars:** None.

**Biological:** *Streptomyces griseoviridis* Strain K61 (COM) WP; *Trichoderma harzianum* Rifai strain KRL-AG2 (COM) GR, WP. Limitations: As per label.

**Chemical:** None.

### References:

1. BCMAFF. 1996-97 Greenhouse Vegetable Production Guide.
2. Nielsen, C.J. *et al.* 2006. Efficacy of biosurfactants in the management of *Phytophthora capsici* on pepper in recirculating hydroponic systems. *Can. J. Plant Pathol.* 28: 450-460.

## TOMATO SPOTTED WILT

Tomato spotted wilt virus

**Cultural:** Use disease-free propagation stock. Control weeds in and around the greenhouse as they can harbour TSWV. The use of 'double doors' in greenhouses may be useful in preventing the entry of thrips. Use indicator plants. Petunias such as 'Calypso', 'Summer Madness' and 'Super Blue Magic' are good indicator plants for INSV and TSWV infections.

**Resistant Cultivars:** None.

**Chemical:** None.

**Notes:** Use recommended methods to control the western flower thrips vector of TSWV (2).

### References:

1. Allen, W.R. and Broadbent, A.B. 1986. Transmission of tomato spotted wilt virus in Ontario greenhouses by *Frankliniella occidentalis*. *Can. J. Plant Pathol.* 8: 33-38.
2. Best, R.J. 1968. Tomato spotted wilt virus *in* *Advances in Virus Research*. Smith, K.M. and Lauffer, K.M. (eds.) Vol. 13: 65-145. Academic Press, New York, New York.
3. Bitterlich, I. and MacDonald, L. 1993. The prevalence of tomato spotted wilt virus in weeds and crops in Southwestern B.C. *Can. Plant Dis. Surv.* 73(2): 137-142.
4. Cho, J.J. *et al.* 1989. A multidisciplinary approach to management of tomato spotted wilt virus in Hawaii. *Plant Dis.* 73: 375-383.
5. MacDonald, L. 1988. Tomato spotted wilt virus now in B.C. *Pest Control Notes*, B.C. Ministry of Agriculture and Fisheries.

## VIRUS DISEASES

Tobacco mosaic virus (TMV), potato virus X (PVX), cucumber mosaic virus (CMV)

**Cultural:** TMV - Use 1-year-old seed. Spray seed flats with skim milk the evening before pricking out. Do not smoke or handle any form of tobacco in tomato greenhouses. Dry heating of seeds at 70°C for 3 days inactivates the virus within the seed-coat (1).

PVX - Avoid handling potatoes before working in tomatoes.

CMV - Control weeds and aphids that may harbor and spread the virus.

Follow other cultural control practices outlined under 'General Disease Control Methods for Greenhouse Crops' at the beginning of this chapter.

**Resistant Cultivars:** Use only resistant cultivars. Bruinsma 493, Dombito, Laura, Ohio CR-6, Ohio MR-13, Ohio Hybrid 7, Ontario Pink 774, Ontario Red 775, B8-864, Buffalo. Consult your seed companies.

**Chemical:** To destroy surface-borne TMV on tomato seed, soak seed for 20 min. in 10% trisodium phosphate. Rinse thoroughly in clean water and dry.

**Notes:** Inoculation of tomato seedlings with a mild strain of TMV may confer protection against severe strains (3).

**References:**

1. Committee. 1985-86 Greenhouse Vegetable Production Recommendations. Ont. Min. Agric. Food Pub. 365.
2. Harkin, C. 1977. Tomato mosaic disease and its control in the greenhouse. Agric. For. Bull. Univ. Alta., Edmonton 35: 6-8.
3. Stace-Smith, R. 1975. Virus control in greenhouse tomatoes. Can. Agric. 21(1): 15-16.

## WILT

*Verticillium* spp., *Fusarium oxysporum* f. sp. *lycopersici*

**Cultural:** Rotate tomatoes with cucumbers. Follow other cultural control practices given under 'General Disease Control Methods for Greenhouse Crops' at the beginning of this chapter.

**Resistant Cultivars:** **Verticillium wilt** - Bruinsma 493, Bruinsma 732, Buffalo, Laura, Ohio CR-6, Ohio Hybrid 7, B8-864. Consult seed companies.  
**Fusarium wilt** - Dombito (not recommended because it is highly susceptible to Fusarium crown and root rot), Laura, Buffalo, B8-864.

**Biological:** For Fusarium root diseases, *Streptomyces griseoviridis* Strain K61 (COM) WP and *Trichoderma harzianum* Rifai strain KRL-AG2 (COM) GR, WP are labeled and may offer some preventive disease suppression. Limitations: As per label.

**Chemical:** Fumigate soil (preplant) with - chloropicrin (COM) SN; methyl bromide (RES) PS, LI; dazomet (COM) GR; 1,3 dichloropropene (COM) SN; metam sodium (COM) SN. Limitations: As per label.

**Notes:** Methyl bromide soil fumigant does not appear to be effective against *Verticillium* (1).

**References:**

1. Committee, 1984. 1985-86 greenhouse vegetable production recommendations. Ont. Min. Agric. Food Pub. 365.

## GENERAL REFERENCES

1. Blancard, D. *et al.* 1994. A colour atlas of cucurbit diseases. Manson Publishing. 299 pp.
2. Blancard, D. *et al.* 2006. A color atlas of diseases of lettuce and related salad crops. Academic Press. 375 pp.
3. Blancard, D. *et al.* 2000. A colour atlas of tomato diseases. Manson Publishing. 212 pp.
4. Daughtrey, M.L., Wick, R.L. and Peterson, J.L. 1995. Compendium of Flowering Potted Plant Diseases. APS Press, Minnesota. 90 pp.
5. Dreistadt, S.H. *et al.* 2001. Integrated Pest Management for Floriculture and Nurseries. University of California Statewide Integrated Pest Management Project. Pub. #3402. pp. 422.
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8. Hicock, H.W. and Olson, R.A. 1954. The toxicity to plants of wood preservatives and their solvents. Conn. Agric. Exp. Sta., Circ. 189.
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11. Jarvis, W.R. 1992. Managing Diseases in Greenhouse Crops. APS Press, Minnesota. 288 pp.
12. Koch, Christine. 1999. Floriculture Production Guide for Commercial Growers. B. C. Ministry of Agriculture Food and Fisheries.
13. Krahn, T.R. 1982. Wood preservatives for home and horticultural use. Alberta Agric., Agdex.
14. MacDonald, L. & J. Portree. 2000. Greenhouse Vegetable Crop Clean-Up. BCMAFF Factsheet. Oct. 2000.
15. Mastalerz, J.W. (Ed.). 1971. Geraniums. Pa. Flower Grow., University Park, Pa.
16. Mulder, D. (Ed.). 1979. Soil disinfestation. Developments in Agriculture and Managed Forest Ecology 6. Elsevier Scientific Publishing Co., New York.
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18. Pirone, P.P. 1978. Diseases and Pests of Ornamental Plants (5th ed.). John Wiley and Sons, New York.
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20. Strider, D.L. (Ed.). 1985. Diseases of Floral Crops. Vol. 1 and Vol. 2. Praeger Publishers. Vol. 1. 638 pp. & Vol. 2. 579 pp.
21. Thompson, W.T. 1995. Agricultural Chemicals. III - Fumigants, growth regulators, repellents, and rodenticides (rev.). Thompson Publications, Fresno, Calif.
22. Thompson, W.T. 1997. Agricultural Chemicals. IV. Fungicides (Rev.). Thompson Publications, Fresno, Calif.

## APPENDIX I. Fungicides Registered for Use Against Diseases of Greenhouse Crops in Canada.

**NOTE: The following is a guide only. Always read the label before using a product. Check label for applicability on a specific crop.**

**TABLE 1. General Fungicide Registrations for Use on Greenhouse Ornamentals**

Host	Disease	Trade Name	Active Ingredient	Formulation	PCP#
All crops	Damping-off	No-Damp	oxine benzoate	3.2% SN	3794, 11880
		Rootshield Drench Rootshield Granules	<i>Trichoderma harzianum</i> Rifai strain KRL-AG2	1 x 10 <sup>7</sup> cfu/g WP 1 x 10 <sup>7</sup> cfu/g GR	27115 27116
	Damping-off, root, crown and stem rot and wilt	Mycostop Biofungicide	<i>Streptomyces griseoviridis</i> strain K61	1 x 10 <sup>6</sup> cfu/g GR	26265
Bedding Plants	Gray mold or bud rot	Rovral WP Rovral WDG	iprodione iprodione	50% WP 50% WG	15213 24709
		Rovral WP Rovral WDG Rootshield Drench Rootshield Granules	iprodione iprodione <i>Trichoderma harzianum</i> Rifai strain KRL-AG2	50% WP 50% WG 1 x 10 <sup>7</sup> cfu/g WP 1 x 10 <sup>7</sup> cfu/g GR	15213 24709 27115 27116
	Damping-off	No-Damp	oxine benzoate	3.2% SN	3794, 11880
	Root, stem and crown rots and damping-off	Captan 80WP Captan 80 WDG Supra Captan 80 WDG Maestro 80DF	captan	80% WP	9582
			captan	80% WG	23691
			captan	80% WG	24613
			captan	80% WG	26408
	Root and stem rots and damping-off ( <i>Pythium</i> , <i>Phytophthora</i> )	Truban Truban Aliette WDG Aliette T&O Aliette WP Aliette Ornamental Subdue MAXX Rootshield Drench* Rootshield Granule*	etr Diazole	25% EC	12222
etr Diazole			30% WP	11460	
fosetyl-AL			80% WG	24458	
fosetyl AL			80% WG	27557	
fosetyl AL			80% WP	24564	
fosetyl AL			80% WP	28585	
metalaxyl-M & S-isomer	240 g/L EC	27055			
<i>Trichoderma harzianum</i> Rifai strain KRL-AG2	1 x 10 <sup>7</sup> cfu/g WP 1 x 10 <sup>7</sup> cfu/g GR	27115 27116			
Damping off and root rot caused by <i>Pythium</i> & <i>Rhizoctonia</i>	Vitavax-Captan 30W	carbathiin + captan	6% + 24% WP	13051	
Stem rot ( <i>Rhizoctonia</i> )	Quintozene (Terraclor) Quintozene 75% Quintozene 75WP	quintozene	75% WP	7251	
		quintozene	75% WP	11425	
		quintozene	75% WP	27416	
Bulbs	Damping-off, bulb rot	Later's Bulb Dust Wilson's Bulb Dust	captan + carbaryl captan + carbaryl	5% + 5% DU 5% + 5% DU	12146 14852
		Captan 80WP Captan 80 WDG Supra Captan 80 WDG Captan 50W Captan 50WP Maestro 80DF Rootshield Drench Rootshield Granules	captan	80% WP	9582
			captan	80% WG	23691
			captan	80% WG	24613
			captan	50% WP	14823
			captan	50% WP	4559
			captan	80% WG	26408
<i>Trichoderma harzianum</i> Rifai strain KRL-AG2	1 x 10 <sup>7</sup> cfu/g WP 1 x 10 <sup>7</sup> cfu/g GR	27115 27116			
Fusarium bulb rot	Rootshield Drench	<i>Trichoderma harzianum</i> Rifai strain KRL-AG2	1 x 10 <sup>7</sup> cfu/g WP	27115	
Nematodes	Formalin	formaldehyde	37 % LI	6998	
Sclerotinia bulb rot	Quintozene 75% Quintozene (Terraclor) 75WP Quintozene 75WP Crusoe 75WP Adobe 75WP	quintozene	75% WP	11425	
		quintozene	75% WP	7251	
		quintozene	75% WP	27416	
		quintozene	75% WP	28238	
		quintozene	75% WP	28663	
Bulbs and Corms	Damping off and root rot caused by <i>Pythium</i> & <i>Rhizoctonia</i>	Vitavax-Captan 30W	carbathiin + captan	6% & 24%	13051
	Bulb rot, damping off	Later's Bulb dust Wilson's Bulb dust	carbaryl + captan carbaryl + captan	5% + 5% DU 5% + 5% DU	12146 14852

\*Rootshield is not labeled for *Phytophthora* control.

**TABLE 1. General Fungicide Registrations for Use on Greenhouse Ornamentals (continued)**

Host	Disease	Trade Name	Active Ingredient	Formulation	PCP#
Foliage Plants	Damping-off and root and stem rot (caused by <i>Pythium</i> and <i>Phytophthora</i> )	Subdue MAXX Truban Truban	metalaxyl-M & S-isomer etridiazole etridiazole	240g/L EC 25% EC 30% WP	27055 12222 11460
	Various leafspots and Blights	Daconil 2787 Flowable	chlorothalonil	40.4% SU	15724
Greenhouse ornamentals	Gray mold	Decree 50 WDG	fenhexamid	50% WG	26132
	Damping-off, root and crown rot, and wilt caused by <i>Fusarium</i>	Mycostop Biofungicide	<i>Streptomyces griseoviridis</i> Strain K61	1 x 10 <sup>6</sup> cfu/g GR	26265
		Rootshield Drench Rootshield Granules	<i>Trichoderma harzianum</i> Rifai strain KRL-AG2	1 x 10 <sup>7</sup> cfu/g WP 1 x 10 <sup>7</sup> cfu/g GR	27115 27116
		Mycostop Biofungicide	<i>Streptomyces griseoviridis</i> Strain K61	1 x 10 <sup>6</sup> cfu/g GR	26265
	Damping-off, root, crown and stem rot and wilt caused by <i>Pythium</i>	Mycostop Biofungicide	<i>Streptomyces griseoviridis</i> Strain K61	1 x 10 <sup>6</sup> cfu/g GR	26265
	Root and stem rot and wilt caused by <i>Phytophthora</i>	Mycostop Biofungicide	<i>Streptomyces griseoviridis</i> Strain K61	1 x 10 <sup>6</sup> cfu/g GR	26265
<i>Phytophthora</i> and <i>Pythium</i>	Aliette WP Aliette Ornamental	fosetyl AL fosetyl AL	80% WP	24564	
			80% WP	28585	
Powdery mildew (various species)	Milstop	potassium bicarbonate	85% DU	28095	
Greenhouse potted ornamentals	Powdery Mildew	Senator 70WP 1	thiophanate-methyl	70% WP	12279
		Senator 70WP	thiophanate-methyl	70% WP	25343
		Senator 70WP WSB1	thiophanate-methyl	70% WP	27297
		Easout Turf & Ornamental	thiophanate-methyl	70% WP	19465
	Botrytis	Senator 70WP 1	thiophanate-methyl	70% WP	12279
		Senator 70WP	thiophanate-methyl	70% WP	25343
		Senator 70WP WSB1	thiophanate-methyl	70% WP	27297
		Easout Turf & Ornamental	thiophanate-methyl	70% WP	19465
	Leafspots	Senator 70WP 1	thiophanate-methyl	70% WP	12279
		Senator 70WP	thiophanate-methyl	70% WP	25343
		Senator 70WP WSB1	thiophanate-methyl	70% WP	27297
		Easout Turf & Ornamental	thiophanate-methyl	70% WP	19465
Stem, crown & root rots caused by <i>Fusarium</i> and <i>Rhizoctonia</i>	Senator 70WP 1	thiophanate-methyl	70% WP	12279	
	Senator 70WP	thiophanate-methyl	70% WP	25343	

**TABLE 2. Fungicides Registered for Use on Greenhouse Ornamentals.**

Host	Disease	Trade Name	Active Ingredient	Formulation	PCP#
African violet ( <i>Saintpaulia ionantha</i> )	Gray mold or bud rot	Rovral WP	iprodione	50% WP	15213
		Rovral WDG	iprodione	50% WG	24709
		Decree 50WDG	fenhexamid	50% WG	26132
	Damping off, <i>Pythium</i> root rot	Rootshield Drench Rootshield Granules	<i>Trichoderma harzianum</i> Rifai strain KRL-AG2	1 x 10 <sup>7</sup> cfu/g WP 1 x 10 <sup>7</sup> cfu/g GR	27115 27116
		Root, stem and crown rots and damping-off	Truban Rootshield Drench* Rootshield Granules*	etridiazole <i>Trichoderma harzianum</i> Rifai strain KRL-AG2	25% EC 1 x 10 <sup>7</sup> cfu/g WP 1 x 10 <sup>7</sup> cfu/g GR
Stem rot ( <i>Rhizoctonia</i> )	Quintozene (Terraclor) 75WP Quintozene 75WP Quintozene 75% WP Crusoe 75WP Adobe 75WP	quintozene quintozene quintozene quintozene quintozene	75% WP 75% WP 75% WP 75% WP 75% WP	7251 27416 11425 28238 28663	
Ageratum	Damping-off and root and stem rot (caused by <i>Pythium</i> and <i>Phytophthora</i> )	Subdue MAXX Truban	metalaxyl-M & S-isomer etridiazole	240 g/L EC 30% WP	27055 11460

\*Rootshield is not labeled for *Phytophthora* control.

TABLE 2. Fungicides Registered for Use on Greenhouse Ornamentals (continued)

Host	Disease	Trade Name	Active Ingredient	Formulation	PCP#
Algerian Ivy	Damping-off and root and stem rot (caused by <i>Pythium</i> and <i>Phytophthora</i> )	Subdue MAXX	metalaxyl-M & S-isomer	240g/L EC	27055
Alyssum	Damping-off and root and stem rot (caused by <i>Pythium</i> and <i>Phytophthora</i> )	Truban	etr Diazole	25% EC	12222
		Truban	etr Diazole	30% WP	11460
Artemesia / Artemisia	Rhizoctonia root rot	Compass 50WG	trifloxystrobin	50% WG	27527
	Damping-off and root and stem rot (caused by <i>Pythium</i> and <i>Phytophthora</i> )	Subdue MAXX	metalaxyl-M & S-isomer	240g/L EC	27055
Aster	Damping-off and root and stem rot (caused by <i>Pythium</i> and <i>Phytophthora</i> )	Subdue MAXX	metalaxyl-M & S-isomer	240g/L EC	27055
		Truban	etr Diazole	30% WP	11460
	Powdery Mildew	Nova 40W	myclobutanil	40% WP	22399
Azalea ( <i>Rhododendron</i> spp.)	Rust	Nova 40W	myclobutanil	40% WP	22399
	Gray mold or bud rot	Rovral WP	iprodione	50% WP	15213
		Rovral WDG	iprodione	50% WG	24709
	<i>Pythium</i> and <i>Phytophthora</i>	Aliette WDG	fosetyl-AL	80% WG	24458
		Aliette WP	fosetyl-AL	80% WP	24564
		Aliette T&O	fosetyl-AL	80% WP	27557
		Rootshield Drench*	<i>Trichoderma harzianum</i>	1 x 10 <sup>7</sup> cfu/g WP	27115
		Rootshield Granules*	Rifai strain KRL-AG2	1 x 10 <sup>7</sup> cfu/g GR	27116
	Rhizoctonia root rot	Compass 50WG	trifloxystrobin	50% WG	27527
	<i>Cylindrocladium</i>	Phyton 27	copper complex	5.5% SN	21699
Stem rot of cuttings	Captan 50W	captan	50% WP	14823	
	Folpan 50WP (Folpet)	folpet	50% WP	15654	
	Folpan 80 WDG Captan 80 WDG	folpet captan	80% WG 80% WG	27733 23691	
Damping off/rot of cuttings	Maestro 80DF Supra Captan 80 WDG	captan captan	80% WG 80% WG	26408 24613	
Balsam	Damping-off and root and stem rot (caused by <i>Pythium</i> and <i>Phytophthora</i> )	Truban	etr Diazole	30% WP	11460
Begonia ( <i>Begonia</i> spp.)	Gray mold or bud rot	Easout Turf & Ornamental	thiophanate-methyl	70% WP	19465
		Senator 70 WP1	thiophanate-methyl	70% WP	12279
		Senator 70WP	thiophanate-methyl	70% WP	25343
		Senator 70WP WSB1	thiophanate-methyl	70% WP	27297
		Rovral WP	iprodione	50% WP	15213
		Rovral WDG	iprodione	50% WG	24709
	Powdery mildew	Easout Turf & Ornamental	thiophanate-methyl	70% WP	19465
		Senator 70 WP1	thiophanate-methyl	70% WP	12279
		Senator 70WP Senator 70WP WSB1 Phyton 27	thiophanate-methyl thiophanate-methyl copper complex	70% WP 70% WP 5.5% SN	25343 27297 21699
	Root, stem and crown rots and damping-off, <i>Pythium</i> and <i>Phytophthora</i>	Truban	etr Diazole	30% WP	11460
		Aliette WP	fosetyl AL	80% WP	24564
		Aliette T&O	fosetyl AL	80% WG	27557
Aliette WDG		fosetyl AL	80% WG	24458	
Aliette Ornamental		fosetyl AL	80% WP	28585	
Subdue MAXX		metalaxyl-M & S-isomer	240g/L EC	27055	
Rootshield Drench*	<i>Trichoderma harzianum</i>	1 x 10 <sup>7</sup> cfu/g WP	27115		
Rootshield Granules*	Rifai strain KRL-AG2	1 x 10 <sup>7</sup> cfu/g GR	27116		

\*Rootshield is not labeled for *Phytophthora* control.

TABLE 2. Fungicides Registered for Use on Greenhouse Ornamentals (continued)

Host	Disease	Trade Name	Active Ingredient	Formulation	PCP#
Begonia (continued)	Root, stem and crown rots and damping-off	Captan 80WP	captan	80% WP	9582
		Captan 80 WDG	captan	80% WG	23691
		Supra Captan 80 WDG	captan	80% WG	24613
		Maestro 80DF	captan	80% WG	26408
		No-Damp	oxine benzoate	2.5% SN	3794
		Senator 70 WP1	thiophanate-methyl	70% WP	12279
		Senator 70WP	thiophanate-methyl	70% WP	25343
		Rootshield Drench	<i>Trichoderma harzianum</i>	1 x 10 <sup>7</sup> cfu/g WP	27115
		Rootshield Granules	Rifai strain KRL-AG2	1 x 10 <sup>7</sup> cfu/g GR	27116
		Stem rot ( <i>Rhizoctonia</i> )	Senator 70 WP1	thiophanate-methyl	70% WP
Senator 70WP	thiophante-methyl		70% WP	25343	
Quintozene (Terraclor) 75WP	quintozene		75% WP	7251	
Quintozene 75%	quintozene		75% WP	11425	
Quintozene 75WP	quintozene		75% WP	27416	
Crusoe 75WP	quintozene		75% WP	28238	
Bulb rot, damping off	Later's Bulb dust	captan + carbaryl	5% + 5% DU	12146	
	Wilson's Bulb dust	captan + carbaryl	5% + 5% DU	14852	
Rhizoctonia root rot	Compass 50WG	trifloxystrobin	50% WG	27527	
Caladium	Damping-off and root and stem rot (caused by <i>Pythium</i> and <i>Phytophthora</i> )	Subdue MAXX	metalaxyl-M & S-isomer	240g/L EC	27055
		Rhizoctonia root rot	Compass 50WG	trifloxystrobin	50% WG
Calendula	Sclerotinia rot	Quintozene (Terraclor) 75WP	quintozene	75% WP	7251
		Quintozene 75WP	quintozene	75% WP	27416
		Crusoe 75WP	quintozene	75% WP	28238
		Adobe 75WP	quintozene	75% WP	28663
	Damping-off and root and stem rot (caused by <i>Pythium</i> and <i>Phytophthora</i> )	Truban	etridiazole	25% EC	12222
Truban		etridiazole	30% WP	11460	
Carnation ( <i>Dianthus</i> sp.)	Alternaria leaf spot & branch rot	Daconil 2787 Flowable	chlorothalonil	40.4% SU	15724
		Daconil Ultrex	chlorothalonil	82.5% WG	28354
	Gray mold or bud rot	Daconil 2787 Flowable	chlorothalonil	40.4% SU	15724
		Daconil Ultrex	chlorothalonil	82.5% WG	28354
		Easout Turf & Ornamental	thiophanate-methyl	70% WP	19465
		Senator 70 WP1	thiophanate-methyl	70% WP	12279
		Senator 75WP	thiophanate-methyl	70% WP	25343
	Senator 70WP WSB1	thiophanate-methyl	70% WP	27297	
	Root, stem and crown rots and damping-off	Captan 80WP	captan	80% WP	9582
		Captan 80 WDG	captan	80% WG	23691
		Supra Captan 80 WDG	captan	80% WG	24613
		Maestro 80DF	captan	80% WG	26408
		No-Damp	oxine benzoate	2.5% SN	3794
		Senator 70 WP1	thiophanate-methyl	70% WP	12279
Senator 70WP		thiophanate-methyl	70% WP	25343	
Rootshield Drench		<i>Trichoderma harzianum</i>	1 x 10 <sup>7</sup> cfu/g WP	27115	
Rootshield Granules	Rifai strain KRL-AG2	1 x 10 <sup>7</sup> cfu/g GR	27116		
Stem rot ( <i>Rhizoctonia</i> )	Senator 70 WP1	thiophanate-methyl	70% WP	12279	
	Senator 70WP	thiophanate-methyl	70% WP	25343	
	Quintozene (Terraclor) 75WP	quintozene	75% WP	7251	
	Quintozene 75%	quintozene	75% WP	11425	
	Quintozene 75WP	quintozene	75% WP	27416	
	Crusoe 75WP	quintozene	75% WP	28238	
Adobe 75WP	quintozene	75% WP	28663		
Carnation rust	HRC Liquid	oxycarboxin	5% LI	10878	
Damping off/rot of cuttings	Maestro 80DF	captan	80% WG	26408	
	Supra Captan 80 WDG	captan	80% WG	24613	

TABLE 2. Fungicides Registered for Use on Greenhouse Ornamentals (continued)

Host	Disease	Trade Name	Active Ingredient	Formulation	PCP#
Carnation (continued)	Stem rot of cuttings	Captan 50W	captan	50% WP	14823
		Captan 80 WDG	captan	80% WG	23691
	Damping off & root and stem rot (caused by <i>Pythium</i> and <i>Phytophthora</i> )	Subdue MAXX Truban	metalaxyl-M & S-isomer etridiazole	240g/L EC 30% WP	27055 11460
Celosia	Damping-off	Rovral WP	iprodione	50% WP	15213
		Rovral WDG	iprodione	50% WG	24709
		Rootshield Drench	<i>Trichoderma harzianum</i>	1 x 10 <sup>7</sup> cfu/g WP	27115
		Rootshield Granules	Rifai strain KRL-AG2	1 x 10 <sup>7</sup> cfu/g GR	27116
	<i>Pythium</i> , <i>Phytophthora</i>	Aliette WDG	fosetyl-AL	80% WG	24458
		Aliette WP	fosetyl AL	80% WP	24564
Aliette T&O		fosetyl AL	80% WG	27557	
Damping-off and root and stem rot (caused by <i>Pythium</i> and <i>Phytophthora</i> )	Aliette Ornamental	fosetyl AL	80% WP	28585	
	Rootshield Drench* Rootshield Granules*	<i>Trichoderma harzianum</i> Rifai strain KRL-AG2	1 x 10 <sup>7</sup> cfu/g WP 1 x 10 <sup>7</sup> cfu/g GR	27115 27116	
Rhizoctonia root rot	Truban	etridiazole	25% EC	12222	
	Truban	etridiazole	30% WP	11460	
	Vitavax-Captan 30W	carbathiin + captan	6% + 24% WP	13051	
	Compass 50WG	trifloxystrobin	50% WG	27527	
Chrysanthemum ( <i>Chrysanthemum</i> spp.)	Gray mold or bud rot	Botran 75W	dicloran	75% WP	8772
		Daconil 2787 Flowable	chlorothalonil	40.4% SU	15724
		Daconil Ultrex	chlorothalonil	82.5% WG	28354
		Rovral WP	iprodione	50% WP	15213
		Rovral WDG	iprodione	50% WG	24709
		Easout Turf & Ornamental	thiophanate-methyl	70% WP	19465
		Senator 70 WP1	thiophanate-methyl	70% WP	12279
		Senator 70WP	thiophanate-methyl	70% WP	25343
		Senator 70WP WSB1	thiophanate-methyl	70% WP	27297
		Powdery mildew	Nova 40W	myclobutanil	40% WP
	Easout Turf & Ornamental		thiophanate-methyl	70% WP	19465
	Senator 70 WP1		thiophanate-methyl	70% WP	12279
	Senator 70WP		thiophanate-methyl	70% WP	25343
	Root, stem and crown rots and damping-off	Senator 70WP WSB1	thiophanate-methyl	70% WP	27297
		Captan 80WP	captan	80% WP	9582
		Captan 80 WDG	captan	80% WG	23691
		Supra Captan 80 WDG	captan	80% WG	24613
		Maestro 80DF	captan	80% WG	26408
		No-Damp	oxine benzoate	2.5% SN	3794
		Senator 70 WP1	thiophanate-methyl	70% WP	12279,
		Senator 70WP	thiophanate-methyl	70% WP	25343
	Root, stem and crown rots and damping-off, <i>Pythium</i> and <i>Phytophthora</i>	Rootshield Drench	<i>Trichoderma harzianum</i>	1 x 10 <sup>7</sup> cfu/g WP	27115
		Rootshield Granules	Rifai strain KRL-AG2	1 x 10 <sup>7</sup> cfu/g GR	27116
Compass 50WG		trifloxystrobin	50% WG	27527	
Subdue MAXX		metalaxyl-M & S-isomer	240g/L EC	27055	
Stem rot ( <i>Rhizoctonia</i> )	Truban	etridiazole	25% EC	12222	
	Rootshield Drench*	<i>Trichoderma harzianum</i>	1 x 10 <sup>7</sup> cfu/g WP	27115	
	Rootshield Granules*	Rifai strain KRL-AG2	1 x 10 <sup>7</sup> cfu/g GR	27116	
	Senator 70 WP1	thiophanate-methyl	70% WP	12279,	
	Senator 70WP	thiophanate-methyl	70% WP	25343	
	Quintozene (Terraclor) 75WP	quintozene	75% WP	7251	
	Quintozene 75%	quintozene	75% WP	11425	
	Quintozene 75WP	quintozene	75% WP	27416	
Damping off/rot of cuttings	Crusoe 75WP	quintozene	75% WP	28238	
	Adobe 75WP	quintozene	75% WP	28663	
Damping off/rot of cuttings	Captan 50WP	captan	50% WP	4559	
	Maestro 80DF	captan	80% WG	26408	
	Supra Captan 80 WDG	captan	80% WG	24613	

\*Rootshield is not labeled for *Phytophthora* control.

**TABLE 2. Fungicides Registered for Use on Greenhouse Ornamentals (continued)**

Host	Disease	Trade Name	Active Ingredient	Formulation	PCP#
Chrysanthemum (continued)	Stem rot of cuttings	Captan 50W	captan	50% WP	14823
		Captan 80 WDG	captan	80% WG	23691
	Rhizoctonia root rot	Compass 50WG	trifloxystrobin	50% WG	27527
	Rust	Nova 40W	myclobutanil	40% WP	22399
	Mycosphaerella ray blight	Daconil 2787 Flowable	chlorothalonil	40.4% SU	15724
Daconil Ultrex		chlorothalonil	82.5% WG	28354	
Septoria leafspot	Daconil Ultrex	chlorothalonil	82.5% WG	28354	
		Daconil 2787 Flowable	chlorothalonil	40.4% SU	15724
Chrysanthemum, cut	Powdery mildew, rust	Nova 40W	myclobutanil	40% WP	22399
Cineraria ( <i>Senecio cruentus</i> )	Gray mold or bud rot	Rovral WP	iprodione	50% WP	15213
		Rovral WDG	iprodione	50% WG	24709
Coleus ( <i>Coleus</i> spp.)	Root, stem and crown rots and damping-off	Captan 80WP	captan	80% WP	9582
		Captan 80 WDG	captan	80% WG	23691
		Supra Captan 80 WDG	captan	80% WG	24613
		Maestro 80DF	captan	80% WG	26408
		No-Damp	oxine benzoate	3.2% SN	11880
		No-Damp	oxine benzoate	3.2% SN	3794
Rootshield Drench	<i>Trichoderma harzianum</i>	1 x 10 <sup>7</sup> cfu/g WP	27115		
Rootshield Granules	Rifai strain KRL-AG2	1 x 10 <sup>7</sup> cfu/g GR	27116		
Root, stem and crown rots and damping-off, <i>Pythium</i> and <i>Phytophthora</i>	Subdue MAXX	Truban	metalaxyl-M	240g/L EC	27055
		Rootshield Drench*	etridiazole	30% WP	11460
		Rootshield Granules*	<i>Trichoderma harzianum</i>	1 x 10 <sup>7</sup> cfu/g WP	27115
		Rootshield Granules*	Rifai strain KRL-AG2	1 x 10 <sup>7</sup> cfu/g GR	27116
Rhizoctonia root rot	Compass 50WG	trifloxystrobin	50% WG	27527	
Cosmos	Rhizoctonia root rot	Compass 50WG	trifloxystrobin	50% WG	27527
Cyclamen ( <i>Cyclamen indicum</i> )	Gray mold or bud rot	Rovral WP	iprodione	50% WP	15213
		Rovral WDG	iprodione	50% WG	24709
	Gray mold	Phyton 27	copper complex	5.5% SN	21699
	Erwinia soft rot	Phyton 27	copper complex	5.5% SN	21699
Dahlia	Damping-off and root and stem rot (caused by <i>Pythium</i> and <i>Phytophthora</i> )	Truban	etridiazole	25% EC	12222
		Truban	etridiazole	30% WP	11460
	Bulb rot, damping off	Later's Bulb dust	carbaryl + captan	5% + 5% DU	12146
		Wilson's Bulb dust	carbaryl + captan	5% + 5% DU	14852
		Captan 50W	captan	50% WP	14823
		Captan 50WP	captan	50% WP	4559
Captan 80WP		captan	80% WP	9582	
Captan 80 WDG		captan	80% WG	23691	
Supra Captan 80 WDG	captan	80% WG	24613		
Maestro 80DF	captan	80% WG	26408		
Daisy	Rhizoctonia root rot	Compass 50WG	trifloxystrobin	50% WG	27527
	Mycosphaerella ray blight	Daconil 2787 Flowable	chlorothalonil	40.4% SU	15724
		Daconil Ultrex	chlorothalonil	82.5% WG	28354
	Septoria leafspot	Daconil 2787 Flowable	chlorothalonil	40.4% SU	15724
		Daconil Ultrex	chlorothalonil	82.5% WG	28354
Powdery mildew	Milstop	potassium carbonate	85% LI	28095	
Botrytis flower blight (Grey mould)	Daconil Ultrex	chlorothalonil	82.5% WG	28354	
Daisy (Shasta)	Damping-off and root and stem rot (caused by <i>Pythium</i> and <i>Phytophthora</i> )	Subdue MAXX	metalaxyl-M & S-isomer	240g/L EC	27055

\*Rootshield is not labeled for Phytophthora control.

TABLE 2. Fungicides Registered for Use on Greenhouse Ornamentals (continued)

Host	Disease	Trade Name	Active Ingredient	Formulation	PCP#
Day Lily	Rhizoctonia root rot	Compass 50WG	trifloxystrobin	50% WG	27527
	Leaf Spot	Rhapsody ASO	<i>Bacillus subtilis</i> - QST 713 strain	1 x 10 <sup>9</sup> CFU/g SU	28627
Delphinium	Rhizoctonia root rot	Compass 50WG	trifloxystrobin	50% WG	27527
Dusty Miller	Rhizoctonia root rot	Compass 50WG	trifloxystrobin	50% WG	27527
	Alternaria leaf spot	Phyton 27	copper complex	5.5% SN	21699
Dwarf Ivy	Rhizoctonia root rot	Compass 50WG	trifloxystrobin	50% WG	27527
English Ivy	Damping-off and root and stem rot (caused by <i>Pythium</i> and <i>Phytophthora</i> )	Subdue MAXX	metalaxyl-M & S-isomer	240g/L EC	27055
Foliage Plants	Damping-off and root and stem rot (caused by <i>Pythium</i> and <i>Phytophthora</i> )	Subdue MAXX Truban Truban	metalaxyl-M & S-isomer etridiazole etridiazole	240g/L EC 25% EC 30% WP	27055 12222 11460
	Various leafspots and Blights	Daconil 2787 Flowable Daconil Ultrex	chlorothalonil chlorothalonil	40.4% SU 82.5% WG	15724 28354
Foxglove ( <i>Digitalis</i> spp.)	Damping-off and root and stem rot (caused by <i>Pythium</i> and <i>Phytophthora</i> )	Subdue MAXX Truban	metalaxyl-M & S-isomer etridiazole	240g/L EC 30% WP	27055 11460
Fuchsia ( <i>Fuchsia</i> hybrids)	Gray mold or bud rot	Rovral WP Rovral WDG Phyton 27	iprodione iprodione copper complex	50% WP 50% WG 5.5% SN	15213 24709 21699
Gaillardia	Damping-off and root and stem rot (caused by <i>Pythium</i> and <i>Phytophthora</i> )	Subdue MAXX	metalaxyl-M & S-isomer	240g/L EC	27055
Geranium ( <i>Pelargonium</i> spp.)	Blackleg	No-Damp No-Damp	oxine benzoate oxine benzoate	3.2% SN 3.2% SN	11880 3794
	Gray mold or bud rot	Botran 75W	dicloran	75% WP	8772
		Daconil 2787 Flowable	chlorothalonil	40.4% SU	15724
		Daconil Ultrex	chlorothalonil	82.5% WG	28354
		Rovral WP Rovral WDG	iprodione iprodione	50% WP 50% WG	15213 24709
	Gray mold	Phyton 27	copper complex	5.5% SN	21699
		Decree 50WDG Rhapsody ASO	fenhexamid <i>Bacillus subtilis</i> – QST 713 strain	50% WG 1 x 10 <sup>9</sup> CFU/g SU	26132 28627
	Root, stem and crown rots and damping-off	Captan 80 WDG	captan	80% WG	23691
		Supra Captan 80 WDG	captan	80% WG	24613
Maestro 80DF		captan	80% WG	26408	
No-Damp		oxine benzoate	3.2% SN	11880	
No-Damp		oxine benzoate	3.2% SN	3794	
Rootshield Drench Rootshield Granules		<i>Trichoderma harzianum</i> Rifai strain KRL-AG2	1 x 10 <sup>7</sup> cfu/g WP 1 x 10 <sup>7</sup> cfu/g GR	27115 27116	
Root, stem and crown rots and damping-off, <i>Pythium</i> and <i>Phytophthora</i>	Aliette WDG	fosetyl-Al	80% WG	24458	
	Aliette WP	fosetyl AL	80% WP	24564	
	Aliette T&O	fosetyl AL	80% WG	27557	
	Aliette Ornamental	fosetyl AL	80% WP	28585	
	Subdue MAXX	metalaxyl-M & S-isomer	240g/L EC	27055	
	Truban Rootshield Drench* Rootshield Granules*	etridiazole <i>Trichoderma harzianum</i> Rifai strain KRL-AG2	25% EC 1 x 10 <sup>7</sup> cfu/g WP 1 x 10 <sup>7</sup> cfu/g GR	12222 27115 27116	
Rust	Nova 40W	myclobutanil	40% WP	22399	
	Daconil 2787 Flowable	chlorothalonil	40.4% SU	15724	
	Daconil Ultrex	chlorothalonil	82.5% WG	28354	
Stem rot ( <i>Rhizoctonia</i> )	Quintozene (Terraclor) 75WP	quintozene	75% WP	7251	
	Quintozene 75%	quintozene	75% WP	11425	
	Quintozene 75WP	quintozene	75% WP	27416	

TABLE 2. Fungicides Registered for Use on Greenhouse Ornamentals (continued)

Host	Disease	Trade Name	Active Ingredient	Formulation	PCP#	
Geranium (continued)	<i>Xanthomonas campestris</i>	Phyton 27 Rhapsody ASO	copper complex <i>Bacillus subtilis</i> – QST 713 strain	5.5% SN 1 x 10 <sup>9</sup> CFU/g SU	21699 28627	
	Powdery Mildew	Nova 40W	myclobutanil	40% WP	22399	
Gerbera	Gray mold	Phyton 27	copper complex	5.5% SN	21699	
	Powdery mildew	Nova 40W Actinovate SP	myclobutanil <i>Streptomyces lydicus</i> – strain WYEC 108	40% WP 1.0 x 10 <sup>7</sup> CFU/g SP	22399 28672	
Gladiolus	Curvularia leaf/flower spot	Daconil Ultrex Daconil 2787 Flowable	chlorothalonil chlorothalonil	82.5% WG 40.4% SU	28354 15724	
	Botrytis leaf/flower spot	Daconil Ultrex Daconil 2787 Flowable	chlorothalonil chlorothalonil	82.5% WG 40.4% SU	28354 15724	
Gloxinia ( <i>Sinningia speciosa</i> )	Gray mold or bud rot	Rovral WP Rovral WDG	iprodione iprodione	50% WP 50% WG	15213 24709	
	Root, stem and crown rots and damping-off, <i>Pythium</i> and <i>Phytophthora</i>	Subdue MAXX Truban Rootshield Drench* Rootshield Granules*	metalaxyl-M & S-isomer etridiazole <i>Trichoderma harzianum</i> Rifai strain KRL-AG2	240g/L EC 25% EC 1 x 10 <sup>7</sup> cfu/g WP 1 x 10 <sup>7</sup> cfu/g GR	27055 12222 27115 27116	
	Root, stem and crown rots and damping-off	Captan 80WP Captan 80 WDG Supra Captan 80 WDG Maestro 80DF No-Damp No-Damp Rootshield Drench Rootshield Granules	captan captan captan captan oxine benzoate oxine benzoate <i>Trichoderma harzianum</i> Rifai strain KRL-AG2	80% WP 80% WG 80% WG 80% WG 3.2% SN 3.2% SN 1 x 10 <sup>7</sup> cfu/g WP 1 x 10 <sup>7</sup> cfu/g GR	9582 23691 24613 26408 11880 3794 27115 27116	
	Stem rot ( <i>Rhizoctonia</i> )	Quintozene (Terraclor) 75WP Quintozene 75% Quintozene 75WP	quintozene quintozene quintozene	75% WP 75% WP 75% WP	7251 11425 27416	
	Hens & Chickens (flowering)	Rhizoctonia root rot	Compass 50WG	trifloxystrobin	50% WG	27527
	Hibiscus ( <i>Hibiscus syriacus</i> )	Gray mold	Phyton 27	copper complex	5.5% SN	21699
Hollyhock	Rust	Daconil 2787 Flowable Daconil Ultrex	chlorothalonil chlorothalonil	40.4% SU 82.5% WG	15724 28354	
Hosta	Rhizoctonia root rot	Compass 50WG	trifloxystrobin	50% WG	27527	
Hydrangea ( <i>Hydrangea macrophylla</i> )	Gray mold or bud rot	Botran 75W Easout Turf & Ornamental Senator 70 WP1 Senator 70WP Senator 70WP WSB1	dicloran thiophanate-methyl thiophanate-methyl thiophanate-methyl thiophanate-methyl	75% WP 70% WP 70% WP 70% WP 70% WP	8772 19465 12279 25343 27297	
	Root, stem and crown rots and damping-off, <i>Pythium</i> and <i>Phytophthora</i>	Truban Rootshield Drench* Rootshield Granules*	etridiazole <i>Trichoderma harzianum</i> Rifai strain KRL-AG2	25% EC 1 x 10 <sup>7</sup> cfu/g WP 1 x 10 <sup>7</sup> cfu/g GR	12222 27115 27116	
	Root, stem and crown rots and damping-off	Captan 80WP Captan 80 WDG Supra Captan 80 WDG Maestro 80DF No-Damp No-Damp Rootshield Drench Rootshield Granules	captan captan captan captan oxine benzoate oxine benzoate <i>Trichoderma harzianum</i> Rifai strain KRL-AG2	80% WP 80% WG 80% WG 80% WG 3.2% SN 3.2% SN 1 x 10 <sup>7</sup> cfu/g WP 1 x 10 <sup>7</sup> cfu/g GR	9582 23691 24613 26408 11880 3794 27115 27116	
	Stem rot ( <i>Rhizoctonia</i> )	Quintozene (Terraclor) 75WP Quintozene 75% Quintozene 75WP	quintozene quintozene quintozene	75% WP 75% WP 75% WP	7251 11425 27416	
	Powdery Mildew	Milstop Phyton 27	potassium bicarbonate copper complex	85% DU 5.5% SN	28095 21699	
	Cercospora and Septoria leafspots	Daconil 2787 Flowable** Daconil Ultrex**	chlorothalonil chlorothalonil	40.4% SU 82.5% WG	15724 28354	
	Rust	Daconil 2787 Flowable** Daconil Ultrex**	chlorothalonil chlorothalonil	40.4% SU 82.5% WG	15724 28354	

\*Rootshield is not labeled for *Phytophthora* control.

\*\* Hydrangea – foliage only

TABLE 2. Fungicides Registered for Use on Greenhouse Ornamentals (continued)

Host	Disease	Trade Name	Active Ingredient	Formulation	PCP#
Impatiens	Damping-off and root and stem rot (caused by <i>Pythium</i> and <i>Phytophthora</i> )	Subdue MAXX Truban	metalaxyl-M & S-isomer etridiazole	240g/L EC 30% WP	27055 11460
	Rhizoctonia root rot	Compass 50WG	trifloxystrobin	50% WG	27527
	Botrytis	Rovral WP Rovral WDG	iprodione iprodione	50% WP 50% WG	15213 24709
	<i>Pythium</i> & <i>Phytophthora</i>	Aliette WP Aliette WDG Aliette T&O Aliette Ornamental	fosetyl AL fosetyl AL fosetyl AL fosetyl AL	80% WP 80% WG 80% WG 80% WP	24564 24458 27557 28585
Iris (African/Siberian)	Rhizoctonia root rot	Compass 50WG	trifloxystrobin	50% WG	27527
	Botrytis blossom blight	Daconil 2787 Flowable Daconil Ultrex	chlorothalonil chlorothalonil	40.4% SU 82.5% WG	15724 28354
	Didymellina leafspot	Daconil 2787 Flowable Daconil Ultrex	chlorothalonil chlorothalonil	40.4% SU 82.5% WG	15724 28354
	Bulb rot, damping off	Captan 80WP Captan 80 WDG Supra Captan 80 WDG Captan 50W Captan 50WP Maestro 80DF Later's Bulb dust Wilson's Bulb dust	captan captan captan captan captan captan carbaryl + captan carbaryl + captan	80% WP 80% WG 80% WG 50% WP 50% WP 80% WG 5% + 5% DU 5% + 5% DU	9582 23691 24613 15823 4559 26408 12146 14852
	Bulb Rot (Sclerotinia)	Crusoe 75WP Quintozene (Terraclor) 75WP Quintozene 75WP Quintozene 75% WP Adobe 75WP	quintozene quintozene quintozene quintozene quintozene	75% WP 75% WP 75% WP 75% WP 75% WP	28238 7251 27416 11425 28663
	Kalanchoe	Gray mold	Phyton 27 Rovral WP Rovral WDG	copper complex iprodione iprodione	5.5% SN 50% WP 50% WG
Larkspur	Sclerotinia rot	Crusoe 75WP Quintozene (Terraclor) 75WP Quintozene 75WP Adobe 75WP	quintozene quintozene quintozene quintozene	75% WP 75% WP 75% WP 75% WP	28238 7251 27416 28663
Lily ( <i>Lilium</i> spp.)	Gray mold or bud rot	Daconil 2787 Flowable Daconil Ultrex	chlorothalonil chlorothalonil	40.4% SU 82.5% WG	15724 28354
Marigold	Damping-off and root and stem rot (caused by <i>Pythium</i> and <i>Phytophthora</i> )	Subdue MAXX Truban Truban	metalaxyl-M & S-isomer etridiazole etridiazole	240g/L EC 25% EC 30% WP	27055 12222 11460
	Rhizoctonia root rot	Compass 50WG	trifloxystrobin	50% WG	27527
New Guinea impatiens	Gray mold, Powdery mildew	Phyton 27	copper complex	5.5% SN	21699
	<i>Pythium</i> and <i>Phytophthora</i>	Aliette WDG Aliette WP Aliette T&O Aliette Ornamental Rootshield Drench* Rootshield Granules*	fosetyl-Al fosetyl AL fosetyl AL fosetyl AL <i>Trichoderma harzianum</i> Rifai strain KRL-AG2	80% WG 80% WP 80% WG 80% WP 1 x 10 <sup>7</sup> cfu/g WP 1 x 10 <sup>7</sup> cfu/g GR	24458 24564 27557 28585 27115 27116
	Rhizoctonia root rot	Compass 50WG	trifloxystrobin	50% WG	27527
	Orchid	Gray mold Leaf spots	Phyton 27 Easout Turf & Ornamental	copper complex thiophanate-methyl	5.5% SN 70% WP
Pansy	Damping-off and root and stem rot (caused by <i>Pythium</i> and <i>Phytophthora</i> )	Subdue MAXX Truban Truban	metalaxyl-M & S-isomer etridiazole etridiazole	240g/L EC 25% EC 30% WP	27055 12222 11460
	Rhizoctonia root rot	Compass 50WG	trifloxystrobin	50% WG	27527

\* Rootshield is not labeled for Phytophthora control.

TABLE 2. Fungicides Registered for Use on Greenhouse Ornamentals (continued)

Host	Disease	Trade Name	Active Ingredient	Formulation	PCP#				
Petunia	Gray mold	Daconil 2787 Flowable	chlorothalonil	40.4% SU	15724				
		Daconil Ultrex	chlorothalonil	82.5% WG	28354				
		Decree 50WDG	fenhexamid	50% WG	26132				
		Rhapsody ASO	<i>Bacillus subtilis</i> – QST 713 strain	1 x 10 <sup>9</sup> CFU/g SU	28627				
	<i>Pythium</i> and <i>Phytophthora</i>	Aliette WDG Aliette WP Aliette T&O Aliette Ornamental Rootshield Drench* Rootshield Granules*	fosetyl-Al	80% WG	24458				
			fosetyl AL	80% WP	24564				
fosetyl AL			80% WG	27557					
fosetyl AL			80% WP	28585					
<i>Trichoderma harzianum</i> Rifai strain KRL-AG2			1 x 10 <sup>7</sup> cfu/g WP 1 x 10 <sup>7</sup> cfu/g GR	27115 27116					
Damping-off and root and stem rot (caused by <i>Pythium</i> and <i>Phytophthora</i> )	Subdue MAXX Truban Truban	metalaxyl-M & S-isomer	240g/L EC	27055					
		etrifiazole	25% EC 30% WP	12222 11460					
Rhizoctonia root rot	Compass 50WG	trifloxystrobin	50% WG	27527					
Phytophthora blight (foliar phase only)	Daconil 2787 Flowable Daconil Ultrex	chlorothalonil	40.4% SU	15724					
		chlorothalonil	82.5% WG	28354					
Phlox	Powdery mildew	Milstop Phyton 27 Rhapsody ASO	potassium bicarbonate	85% DU	28095				
			copper complex	5.5% SN	21699				
			<i>Bacillus subtilis</i> – QST 713 strain	1 x 10 <sup>9</sup> CFU/g SU	28627				
Damping-off and root and stem rot (caused by <i>Pythium</i> and <i>Phytophthora</i> )	Subdue MAXX	metalaxyl-M & S-isomer	240g/L EC	27055					
					Rhizoctonia root rot	Compass 50WG	trifloxystrobin	50% WG	27527
					Pinks (Dianthus)	Damping-off and root and stem rot (caused by <i>Pythium</i> and <i>Phytophthora</i> )	Subdue MAXX Truban Truban	metalaxyl-M & S-isomer	240g/L EC
etrifiazole	25% EC 30% WP	12222 11460							
Rhizoctonia root rot	Compass 50WG	trifloxystrobin	50% WG	27527					
Heterosporium echinulatum	Phyton 27	copper complex	5.5% SN	21699					
					Poinsettia ( <i>Euphorbia pulcherrima</i> )	Gray mold or bud rot	Rovral WP	iprodisone	50% WP
Rovral WDG	iprodisone	50% WG	24709						
Easout Turf & Ornamental	thiophanate-methyl	70% WP	19465						
Senator 70 WP1	thiophanate-methyl	70% WP	12279						
Senator 70WP	thiophanate-methyl	70% WP	25343						
Senator 70WP WSB1	thiophanate-methyl	70% WP	27297						
Gray mold	Phyton 27 Decree 50WDG Rhapsody ASO	copper complex	5.5% SN	21699					
		fenhexamid	50% WG	26132					
Powdery mildew	Nova 40W Phyton 27 Milstop Rhapsody ASO	myclobutanil	40% WP	22399					
		copper complex	5.5% SN	21699					
Root, stem and crown rots and damping-off, <i>Pythium</i> and <i>Phytophthora</i>	Truban Rootshield Drench* Rootshield Granules*	potassium bicarbonate	85% DU	28095					
		<i>Bacillus subtilis</i> – QST 713 strain	1 x 10 <sup>9</sup> CFU/g SU	28627					
Stem rot ( <i>Rhizoctonia</i> )	Crusoe 75WP Quintozone (Terraclor) 75WP Quintozone 75WP Quintozone 75% WP Adobe 75WP	quintozone	75% WP	28239					
		quintozone	75% WP	7251					
Rhizoctonia root rot	Phyton 27 Compass 50WG	quintozone	75% WP	27416					
		quintozone	75% WP	11425					
Scab	Phyton 27	quintozone	75% WP	28663					
		copper complex	5.5% SN	21699					
Pythium root rot	Folpan 50 WP (Folpet) Folpan 80 WDG	trifloxystrobin	50% WG	27527					
		folpet	50% WP	15654					
Erwinia soft rot (of cuttings)	Phyton 27	folpet	80% WG	27733					
		copper complex	5.5% SN	21699					

\*Rootshield is not labeled for *Phytophthora* control.

TABLE 2. Fungicides Registered for Use on Greenhouse Ornamentals (continued)

Host	Disease	Trade Name	Active Ingredient	Formulation	PCP#
Portulaca	Damping-off and root and stem rot (caused by <i>Pythium</i> and <i>Phytophthora</i> )	Truban	etr Diazole	30% WP	11460
Primula	Gray mold	Phyton 27 Rovral WP Rovral WDG	copper complex iprodione iprodione	5.5% SN 500 g/kg WP 500 g/kg WG	21699 15213 24709
Primrose ( <i>Primula</i> spp.)	Damping-off and root and stem rot (caused by <i>Pythium</i> and <i>Phytophthora</i> )	Subdue MAXX	metalaxyl-M & S-isomer	240g/L EC	27055
Prostrate Rosemary	Damping-off and root and stem rot (caused by <i>Pythium</i> and <i>Phytophthora</i> )	Subdue MAXX	metalaxyl-M & S-isomer	240g/L EC	27055
Rose ( <i>Rosa</i> spp.)	Black spot	Daconil 2787 Flowable	chlorothalonil	40.4% SU	15724
		Daconil Ultrex	chlorothalonil	82.5% WG	28354
		Botran 75W	dicloran	75% WP	8772
		Senator 70WP 1	thiophanate-methyl	70% WP	12279
		Senator 70WP	thiophanate-methyl	70% WP	25343
		Senator 70WP WSB1	thiophanate-methyl	70% WP	27297
		Easout Turf & Ornamental	thiophanate-methyl	70% WP	19465
	Gray mold or bud rot	Daconil 2787 Flowable	chlorothalonil	40.4% SU	15724
		Daconil Ultrex	chlorothalonil	82.5% WG	28354
		Botran 75W	dicloran	75% WP	8772
Easout Turf & Ornamental		thiophanate-methyl	70% WP	19465	
Senator 70 WP 1		thiophanate-methyl	70% WP	12279	
Gray mold	Phyton 27	copper complex	5.5% SN	21699	
	Decree 50WDG	fenhexamid	50% WG	26132	
Powdery mildew	Phyton 27	copper complex	5.5% WP	21699	
	Meltatox	dodemorh-acetate	384g/L EC	11798	
	Nova 40W	myclobutanil	40% WP	22399	
	Rhapsody ASO	<i>Bacillus subtilis</i> – QST 713 strain	1 x 10 <sup>9</sup> CFU/g SU	28627	
	Easout Turf & Ornamental	thiophanate-methyl	70% WP	19465	
	Senator 70 WP 1	thiophanate-methyl	70% WP	12279	
Rhizoctonia root rot	Compass 50WG	trifloxystrobin	50% WG	27527	
	Damping-off & fungus root diseases	Captan 50WP	captan	50% WP	4559
Salvia	Damping-off	Captan 50WP	captan	50% WP	14823
		Captan 80WP	captan	80% WP	9582
		Maestro 80DF	captan	80% WG	26408
		Supra Captan 80 WDG	captan	80% WG	24613
		Rovral WP	iprodione	50% WP	15213
	Pythium and Phytophthora	Rovral WDG	iprodione	50% WG	24709
		Aliette WDG	fosetyl-Al	80% WG	24458
		Aliette WP	fosetyl AL	80% WP	24564
		Aliette T&O	fosetyl AL	80% WG	27557
		Aliette Ornamental	fosetyl AL	80% WP	28585
Rootshield Drench*		<i>Trichoderma harzianum</i>	1 x 10 <sup>7</sup> cfu/g WP	27115	
Damping-off and root and stem rot (caused by <i>Pythium</i> and <i>Phytophthora</i> )	Rootshield Granules*	Rifai strain KRL-AG2	1 x 10 <sup>7</sup> cfu/g GR	27116	
	Subdue MAXX	metalaxyl-M & S-isomer	240g/L EC	27055	
	Truban	etr Diazole	25% EC	12222	
		Truban	etr Diazole	30% WP	11460

\*Rootshield is not labeled for Phytophthora control.

**TABLE 2. Fungicides Registered for Use on Greenhouse Ornamentals (continued)**

Host	Disease	Trade Name	Active Ingredient	Formulation	PCP#
Snapdragon ( <i>Antirrhinum majus</i> )	Root, stem and crown rots and damping-off, <i>Pythium</i> and <i>Phytophthora</i>	Subdue MAXX	metalaxyl-M & S-isomer	240g/L EC	27055
		Truban	etridiazole	25% EC	12222
		Truban	etridiazole	30% WP	11460
		Rootshield Drench*	<i>Trichoderma harzianum</i>	1 x 10 <sup>7</sup> cfu/g WP	27115
		Rootshield Granules*	Rifai strain KRL-AG2	1 x 10 <sup>7</sup> cfu/g GR	27116
	Root, stem and crown rots and damping-off	Captan 80WP	captan	80% WP	9582
		Captan 80 WDG	captan	80% WG	23691
		Supra Captan 80 WDG	captan	80% WG	24613
		Maestro 80DF	captan	80% WG	26408
		No-Damp	oxine benzoate	3.2% SN	11880
		No-Damp	oxine benzoate	3.2% SN	3794
		Rootshield Drench Rootshield Granules	<i>Trichoderma harzianum</i> Rifai strain KRL-AG2	1 x 10 <sup>7</sup> cfu/g WP 1 x 10 <sup>7</sup> cfu/g GR	27115 27116
	Stem rot ( <i>Rhizoctonia</i> )	Crusoe 75WP	quintozene	75% WP	28238
		Quintozene (Terraclor) 75WP	quintozene	75% WP	7251
		Quintozene 75WP	quintozene	75% WP	27416
		Quintozene 75% WP	quintozene	75% WP	11425
Adobe 75WP		quintozene	75% WP	28663	
Sclerotinia rot	Crusoe 75WP	quintozene	75% WP	28238	
	Quintozene (Terraclor) 75WP	quintozene	75% WP	7251	
	Quintozene 75WP	quintozene	75% WP	27416	
	Quintozene 75% WP	quintozene	75% WP	11425	
	Adobe 75WP	quintozene	75% WP	28663	
Spathiphyllum	Gray mold	Phyton 27	copper complex	5.5% SN	21699
	<i>Pythium</i> and <i>Phytophthora</i>	Aliette WDG	fosetyl-Al	80% WG	24458
		Aliette WP	fosetyl AL	80% WP	24564
		Aliette T&O	fosetyl AL	80% WP	27557
		Aliette Ornamental	fosetyl AL	80% WP	28585
Rootshield Drench* Rootshield Granules*		<i>Trichoderma harzianum</i> Rifai strain KRL-AG2	1 x 10 <sup>7</sup> cfu/g WP 1 x 10 <sup>7</sup> cfu/g GR	27115 27116	
<i>Cylindrocladium</i>	Phyton 27	copper complex	5.5% SN	21699	
Statice	Leaf blights (Anthracnose/ <i>Cercospora</i> / <i>Alternaria</i> / <i>Botrytis</i> )	Daconil Ultrex	chlorothalonil	82.5% WG	28354
		Daconil 2787 Flowable	chlorothalonil	40.4% SU	15724
Stokesia	Damping-off and root and stem rot (caused by <i>Pythium</i> and <i>Phytophthora</i> )	Truban	etridiazole	30% WP	11460
Sweet Pea	Sclerotinia rot	Crusoe 75WP	quintozene	75% WP	28238
		Quintozene (Terraclor) 75WP	quintozene	75% WP	7251
		Quintozene 75WP	quintozene	75% WP	27416
Adobe 75WP		quintozene	75% WP	28663	
<i>Botrytis</i> (on cut flowers)	Phyton 27	copper complex	5.5% SN	21699	
Tulip	Botrytis	Captan 80WP	captan	80% WP	9582
		Captan 80 WDG	captan	80% WG	23691
		Supra Captan 80 WDG	captan	80% WG	24613
		Maestro 80DF	captan	80% WG	26408
		Crusoe 75WP	quintozene	75% WP	28238
	Bulb rot (caused by Sclerotinia)	Quintozene (Terraclor) 75WP	quintozene	75% WP	7251
		Quintozene 75WP	quintozene	75% WP	27416
		Quintozene 75% WP	quintozene	75% WP	11425
Bulb rot, damping off	Adobe 75WP	quintozene	75% WP	28663	
	Captan 50W	captan	50% WP	14823	
Damping off and root rot ( <i>Pythium</i> , <i>Rhizoctonia</i> )	Later's Bulb dust	carbaryl + captan	5% + 5% DU	12146	
	Wilson's Bulb dust	carbaryl + captan	5% + 5% DU	14852	
Vitavax-captan 30W	carbathiin + thiram	6% + 24% WP	13051		
Verbena	Damping-off and root and stem rot (caused by <i>Pythium</i> and <i>Phytophthora</i> )	Subdue MAXX	metalaxyl-M & S-isomer	240g/L EC	27055
		Truban	etridiazole	25% EC	12222
		Truban	etridiazole	30% WP	11460
Rhizoctonia root rot	Compass 50WG	trifloxystrobin	50% WG	27527	
Powdery mildew	Phyton 27	copper complex	5.5% SN	21699	

\*Rootshield is not labeled for Phytophthora control.

**TABLE 2. Fungicides Registered for Use on Greenhouse Ornamentals (continued)**

Host	Disease	Trade Name	Active Ingredient	Formulation	PCP#
Vinca	<i>Pythium</i> and <i>Phytophthora</i>	Aliette WDG	fosetyl-Al	80% WG	24458
		Aliette WP	fosetyl AL	80% WP	24564
		Aliette T&O	fosetyl AL	80% WG	27557
		Aliette Ornamental	fosetyl AL	80% WP	28585
		Rootshield Drench*	<i>Trichoderma harzianum</i>	1 x 10 <sup>7</sup> cfu/g WP	27115
		Rootshield Granules*	Rifai strain KRL-AG2	1 x 10 <sup>7</sup> cfu/g GR	27116
	Damping-off and root and stem rot (caused by <i>Pythium</i> and <i>Phytophthora</i> )	Truban	etridiazole	25% EC	12222
		Truban	etridiazole	30% WP	11460
		Subdue MAXX	metalaxyl-M & S-isomer	240g/L EC	27055
Zinnia	Damping-off and root and stem rot (caused by <i>Pythium</i> and <i>Phytophthora</i> )	Vitavax-captan 30W	carbathiin + captan	6% + 24% WP	13051
		Truban	etridiazole	25% EC	12222
		Truban	etridiazole	30% WP	11460
	Subdue MAXX	metalaxyl-M & S-isomer	240g/L EC	27055	
	Powdery mildew	Daconil 2787 Flowable	chlorothalonil	40.4% SU	15724
		Daconil Ultrex	chlorothalonil	82.5% WG	28354

\*Rootshield is not labeled for Phytophthora control.

**TABLE 3. Fungicides Registered for Use on Greenhouse Vegetables.**

Host	Disease	Trade Name	Active Ingredient	Formulation	PCP#
Greenhouse vegetables such as cucumber, tomato, pepper	Damping off, root and stem rot, and Wilt caused by <i>Fusarium</i>	Mycostop Biofungicide	<i>Streptomyces griseoviridis</i> Strain K61	1 x 10 <sup>6</sup> cfu/g GR	26265
	Powdery Mildew	Milstop	Potassium bicarbonate	85% DU	28095
Green house vegetables such as cucumber, tomato, lettuce.	Botrytis (Gray mold)	Ferbam 76 WDG	ferbam	76% WG	20136
		Ferbam 76 WDG	ferbam	76% WG	20536
Greenhouse cucumber and tomato	Pythium, Rhizoctonia, Fusarium root rot	Rootshield Drench	<i>Trichoderma harzianum</i>	1 x 10 <sup>7</sup> cfu/g WP	27115
		Rootshield Granules	Rifai strain KRL-AG2	1 x 10 <sup>7</sup> cfu/g GR	27116
	Gray mold	Ferbam 76 WDG	ferbam	76% WG	20136
		Ferbam 76 WDG	ferbam	76% WG	20536
	Powdery Mildew	Milstop	potassium bicarbonate	85% DU	28095
Nova 40W		myclobutanil	40% WP	22399	
	Damping off, root & crown rot caused by <i>Pythium</i>	Mycostop Biofungicide	<i>Streptomyces griseoviridis</i> Strain K61	1 x 10 <sup>6</sup> cfu/g GR	26265
Greenhouse tomato and pepper	Root and stem rot and Wilt caused by <i>Phytophthora</i>	Mycostop Biofungicide	<i>Streptomyces griseoviridis</i> Strain K61	1 x 10 <sup>6</sup> cfu/g GR	26265
Cucumber ( <i>Cucumis sativus</i> )	Downy mildew	Tanos 50DF	famoxadone + cymoxanil	25% WG + 25% WG	27435
	Fusarium	Rootshield Drench	<i>Trichoderma harzianum</i>	1 x 10 <sup>7</sup> cfu/g WP	27115
		Rootshield Granules	Rifai strain KRL-AG2	1 x 10 <sup>7</sup> cfu/g GR	27116
	Gray mold	Ferbam 76 WDG	ferbam	76% WG	20136
		Ferbam 76 WDG	ferbam	76% WG	20536
		Rovral WP	iprodione	50% WP	15213
		Rovral WDG	iprodione	50% WG	24709
	Gummy stem blight	Rovral WP	iprodione	50% WP	15213
		Rovral WDG	iprodione	50% WG	24709
		Nova 40W	myclobutanil	40% WP	22399
Manzate 200 WP		mancozeb	80% WP	10526	
Powdery mildew	Nova 40W	myclobutanil	40% WP	22399	
	Milstop	potassium bicarbonate	85% DU	28095	
	Sporodex L	<i>Pseudozyma flocculosa</i>	1.3% SU	27161	
	Kumulus DF	sulphur	80% WG	18836	
	Microscopic sulphur	sulphur	92% WP	14653	
	Serenade Max	<i>Bacillus subtilis</i> – QST 713 strain	7.3 10 <sup>9</sup> CFU/g WP	28549	
Pythium root diseases	Previcur N	propamocarb hydrochloride	722 g/L SN	26288	
	Rootshield Drench	<i>Trichoderma harzianum</i>	1 x 10 <sup>7</sup> cfu/g WP	27115	
	Rootshield Granules	Rifai strain KRL-AG2	1 x 10 <sup>7</sup> cfu/g GR	27116	
<i>Pythium</i> spp.	Ridomil Gold 480EC	metalaxyl-M & S-isomer	480 g/L EC	25384	

TABLE 3. Fungicides Registered for Use on Greenhouse Vegetables (continued)

Host	Disease	Trade Name	Active Ingredient	Formulation	PCP#
Cucumber (continued)	Seed decay, seedling blight and damping-off	No-Damp	oxine benzoate	3.2% SN	11880
		No-Damp	oxine benzoate	3.2% SN	3794
	Rootshield Drench	<i>Trichoderma harzianum</i>	1 x 10 <sup>7</sup> cfu/g WP	27115	
	Rootshield Granules	Rifai strain KRL-AG2	1 x 10 <sup>7</sup> cfu/g GR	27116	
	Damping off and root & crown rot caused by <i>Pythium</i>	Mycostop Biofungicide	<i>Streptomyces griseoviridis</i> Strain K61	1 x 10 <sup>6</sup> cfu/g GR	26265
	Damping off, root & crown rot and wilt caused by <i>Fusarium</i>	Mycostop Biofungicide	<i>Streptomyces griseoviridis</i> Strain K61	1 x 10 <sup>6</sup> cfu/g GR	26265
Lettuce ( <i>Lactuca sativa</i> )	Downy mildew	Aliette WDG (B. C. only)	fosetyl-Al	80% WG	24458
		Aliette WP (B.C. only)	fosetyl AL	80% WP	24564
		Aliette Systemic WDG (B.C. only)	fosetyl AL	80% WG	27688
		Serenade Max	<i>Bacillus subtilis</i> – QST 713 strain	7.3 x 10 <sup>9</sup> CFU/g WP	28549
	Gray mold	Ferbam 76 WDG	ferbam	76% WG	20136
		Ferbam 76 WDG	ferbam	76% WG	20536
Rovral WP		iprodione	50% WP	15213	
Rovral WDG		iprodione	50% WG	24709	
	Decree 50 WDG	fenhexamid	50% WG	26132	
Sclerotinia drop	Rovral WP	iprodione	50% WP	15213	
	Rovral WDG	iprodione	50% WG	24709	
	Serenade Max	<i>Bacillus subtilis</i> – QST 713 strain	7.3 x 10 <sup>9</sup> CFU/g WP	28549	
Seed decay, seedling blight and damping-off	No-Damp	oxine benzoate	3.2% SN	11880	
	No-Damp	oxine benzoate	3.2% SN	3794	
Powdery Mildew	Serenade Max	<i>Bacillus subtilis</i> – QST 713 strain	7.3 x 10 <sup>9</sup> CFU/g WP	28549	
Pepper ( <i>Capsicum</i> spp.)	Powdery mildew	Nova 40W	myclobutanil	40% WP	22399
		Microscopic Wettable Sulphur	sulphur	92% WP	00873
		Milstop	potassium bicarbonate	85% DU	28095
		Actinovate SP	<i>Streptomyces lydicus</i> – WYEC 108 strain	1.0 x 10 <sup>9</sup> CFU/g	28672
		Serenade Max	<i>Bacillus subtilis</i> – QST 713 strain	7.3 x 10 <sup>9</sup> CFU/g WP	28549
	Root, crown & stem rots and damping off	Captan 80WP	captan	80% WP	9582
	Captan 80WDG	captan	80% WG	23691	
	Supra Captan 80 WDG	captan	80% WG	24613	
	Maestro 80DF	captan	80% WG	26408	
Seed decay, seedling blight and damping-off	No-Damp	oxine benzoate	3.2% SN	11880	
	No-Damp	oxine benzoate	3.2% SN	3794	
Root and stem rot and wilt caused by <i>Phytophthora</i>	Mycostop Biofungicide	<i>Streptomyces griseoviridis</i> Strain K61	1 x 10 <sup>6</sup> cfu/g GR	26265	
Damping off, root & crown rot and wilt caused by <i>Fusarium</i>	Mycostop Biofungicide	<i>Streptomyces griseoviridis</i> Strain K61	1 x 10 <sup>6</sup> cfu/g GR	26265	
Bacterial spot (greenhouse seedlings for transplant)	Coppercide WP	copper hydroxide	50% WP	16047	
	Kocide 101	copper hydroxide	50% WP	14417	
Tomato ( <i>Lycopersicon esculentum</i> )	Bacterial canker	Copper Spray	copper oxychloride	50% WP	19146
		Guardzman Copper Oxychloride	copper oxychloride	50% WP	13245
	Early blight, late blight, Septoria leaf spot	Manzate 200 WP	mancozeb	80% WP	10526
		Manzate DF	mancozeb	75% WG	21057
	Manzate Pro-Stick	mancozeb	75% WG	28217	
	Guardzman Copper Oxychloride	copper oxychloride	50% WP	13245	
Damping off, root & crown rot and wilt caused by <i>Fusarium</i>	Mycostop Biofungicide	<i>Streptomyces griseoviridis</i> Strain K61	1 x 10 <sup>6</sup> cfu/g GR	26265	
Root and stem rot and Wilt caused by <i>Phytophthora</i>	Mycostop Biofungicide	<i>Streptomyces griseoviridis</i> Strain K61	1 x 10 <sup>6</sup> cfu/g GR	26265	

**TABLE 3. Fungicides Registered for Use on Greenhouse Vegetables (continued)**

Host	Disease	Trade Name	Active Ingredient	Formulation	PCP#	
Tomato (continued)	Damping off, root & crown rot caused by <i>Pythium</i>	Mycostop Biofungicide	<i>Streptomyces griseoviridis</i> Strain K61	1 x 10 <sup>6</sup> cfu/g GR	26265	
	Bacterial spot (greenhouse seedlings for transplant)	Coppercide WP Kocide 101	copper hydroxide copper hydroxide	50% WP 50% WP	16047 14417	
	Stem canker (Botrytis)	Botran 75W	Dicloran <i>Streptomyces griseoviridis</i> Strain K61	75% WP	8772	
	Gray mold		Decree 50WDG	fenhexamid	50% WG	26132
			Ferbam 76 WDG	ferbam	76% WG	20136
			Ferbam 76 WDG	ferbam	76% WG	20536
			Rovral WP	iprodione	50% WP	15213
			Rovral WDG	iprodione	50% WG	24709
	Powdery mildew		Bartlett Microscopic Wettable Sulphur	sulphur	92% WP	00873
			Nova 40 W	myclobutanil	40% WP	22399
Milstop			potassium bicarbonate	85% DU	28095	
Serenade Max			<i>Bacillus subtilis</i> – QST 713 strain	7.3 x 10 <sup>9</sup> CFU/g WP	28549	
Root, crown & stem rots and damping off		Captan 50W	captan	50% WP	4559	
		Captan 80WP	captan	80% WP	9582	
		Captan 80WDG	captan	80% WG	23691	
		Supra Captan 80 WDG	captan	80% WG	24613	
		Maestro 80DF	captan	80% WG	26408	
		Rootshield Drench*	<i>Trichoderma harzianum</i> Rifai	1 x 10 <sup>7</sup> cfu/g WP	27115	
		Rootshield Granules*	strain KRL-AG2	1 x 10 <sup>7</sup> cfu/g GR	27116	
Seed decay, seedling blight and damping-off		No-Damp	oxine benzoate	3.2% SN	11880	
		No-Damp	oxine benzoate	3.2% SN	3794	
		Rootshield Drench*	<i>Trichoderma harzianum</i> Rifai	1 x 10 <sup>7</sup> cfu/g WP	27115	
		Rootshield Granules*	strain KRL-AG2	1 x 10 <sup>7</sup> cfu/g GR	27116	

\*Rootshield is not labeled for Phytophthora control.

**APPENDIX II. Soil Fumigants and Nematicides Registered for Use in Greenhouses in Canada.****NOTE: The following is a guide only. Always read the label before using a product.**

Fumigant/ Nematicide	PCP#	Active Ingredients	Spectrum of Control	Crops	Pre-Plant Interval (days)
Telone C-17	16324	chloropicrin + 1,3-dichloropropene (COM) SN	nematodes	lettuce, pepper, tomato, ornamentals, vegetables	14+
Basamid Granular	15032	dazomet (COM) GR	fungi, weeds, nematodes (uncysted)	lettuce, pepper, eggplant, tomato, annual flower beds, vegetable seedbeds,	10-40
Telone II	15893	1,3-dichloropropene (COM) SN	nematodes	vegetables, ornamentals	14+
Methyl Bromide Meth-O-Gas	16495 9564	methyl bromide (RES) LI	damping off organisms ( <i>Fusarium</i> , <i>Pythium</i> , <i>Rhizoctonia</i> ), insects, nematodes, weed seeds	ornamentals, vegetable transplants, compost, manure, topsoil	7
Vapam	6453	metam-sodium (COM) SN	damping-off, nematodes, symphyllids, weeds, root rots	ornamentals vegetables	21-30