

Chapter Seven

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Notes on ornamental registrations for Benlate and Dithane M-45:

Dupont has discontinued the use of benomyl on commercial ornamental plants. Domestic labels remain in Canada for home garden products containing benomyl but the company will not manufacture the product after December 31/01.

Dow Chemical has replaced Dithane M-45 (mancozeb 80% WP) with Dithane DG (75%). Manzate 200 WP (80%) is still available for fruit and vegetables, but Dupont has added Manzate 200 DF (75%). Most ornamental uses have not yet been transferred to the new labels, although requests are pending with the Pest Management Regulatory Agency.

AMELANCHIER spp. (Serviceberry)

RUST

Gymnosporangium spp.

Cultural: Spores produced on amelanchier do not re-infect this host. Do not grow near junipers or cedars that are alternate hosts. Witches brooms, stem swellings or galls are symptoms on alternate hosts.

Resistant Varieties: No information available.

Chemical: Apply myclobutanil (COM) WP at 10-14 day intervals when disease is first seen. Overuse may lead to disease resistance. For fruiting saskatoons, one application of triforine (COM) EC can be applied at bud break or propiconazole (COM) EC can be applied up to 3 times per year at white tip, petal drop and green fruit.

ASH (*Fraxinus* spp.)

ANTHRACNOSE

Discula sp. (*Apiognomonium errabunda*)

Cultural: Rake up and destroy fallen leaves and prune out dead branches if practical. Control measures are warranted only when the disease occurs annually.

Resistant Cultivars: 'Modesto' ash is highly susceptible and should not be grown in coastal areas. Other cultivars have some resistance or tolerance.

Chemical: Mancozeb (COM) WP at bud-break and every 7-14 days in wet weather.

AZALEA (*Rhododendron* spp.)

See *Rhododendron* page 23 and *Azalea* in Chapter 4.

BEGONIA (*Begonia* spp.)

See *Begonia* in Chapter 4.

BULBS - GLADIOLUS (*Gladiolus hortulanus*)

CORE ROT (BOTRYTIS ROT)

Botryotinia draytonii

Cultural: Avoid continuous cropping in the same field. Rogue diseased plants when they are seen. Harvest, clean, and cure corms promptly. Remove diseased corms when they are seen during storage.

Resistant Cultivars: None.

Chemical: Captan (COM) WP, (DOM) DU as a post-harvest dip or dust may be helpful. Limitations: As per label.

Notes: It has been observed that benomyl, used for control of yellows and corm rot, may also help to control this disease but is not registered for this use.

CORM DRY ROT

Stromatinia gladioli

Cultural: Avoid planting infected corms. Once established in a field, the fungus can persist indefinitely. Avoid heavy, poorly drained soils. Rogue crops; cure and grade corms carefully before storage.

Resistant Cultivars: None.

Chemical: Dip corms for 30 minutes in water at 53-55°C to which formaldehyde (COM) 37% SN has been added at the rate of 500 mL/100 L. Dry quickly and store at cool temperatures until replanting. Fumigate with dazomet (COM) 98% GR or metam sodium (COM) LI if it is necessary to replant into infested soil.

References:

1. Ormrod, D.J. 1995. Personal communication. BC Ministry of Agriculture, Fisheries & Food, Abbotsford.

SCAB

Pseudomonas marginata

Cultural: Do not grow gladioli in the same field more than 1 year in 3. Avoid heavy, poorly drained soils. Carefully examine corms before planting and discard those with scab lesions. Rogue out infected plants as they are seen. Crocus and freesia can also be infected by this bacterium.

Resistant Cultivars: None.

Chemical: None.

YELLOW S and CORM ROT*Fusarium oxysporum* f. sp. *gladioli*

Cultural: Do not grow gladiolus, bulbous iris, or crocus in the same field more than 1 year in 4. Carefully examine corms and discard those with signs of infection. Cure corms promptly after harvest.

Resistant Cultivars: None.

Chemical: Captan (COM) or benomyl (DOM) WP as a post-harvest dip at 30°C for 30 minutes to cleaned corms prior to curing and storage. For smaller quantities, use captan (DOM) DU prior to storage and/or just before planting. Limitations: As per label.

Notes: Use of benomyl 50% WP as a corm dust resulted in production of small corms in one test (1). Benomyl will not be effective if tolerant strains of the pathogen are present (2). Where benomyl tolerance is a problem, 2-(thiocyanomethylthio)benzothiazole (COM) has been observed to control corm rot but is not registered for this purpose.

References:

1. Forsberg, J.L. 1969. An unexpected effect of benomyl on two gladiolus varieties. Plant Dis. Rep. 53: 318-319.
2. Magie, R.O. and G.J. Wilfret. 1974. Tolerance of *Fusarium oxysporum* f. sp. *gladioli* to benzimidazole fungicides. Plant Dis. Rep. 58: 256-259.
3. Paulus, A.O. *et al.* 1970. Fungicides and dipping interval for control of fusarium corm rot of gladiolus. Plant Dis. Rep. 54: 689-691.

BULBS - IRIS (*Iris* spp.)**BULB NEMATODE***Ditylenchus destructor*

Cultural: Harvest bulbs promptly when mature. Destroy infected debris. Avoid infested soils.

Resistant Cultivars: None.

Chemical: Within 2 weeks of harvest, treat bulbs at 48°C for 3 hours with formaldehyde (COM) 37% SN diluted 1:200 with water. When necessary to plant in infested soil, fumigate thoroughly cultivated, warm soil with dazomet (COM) 98% GR, metam sodium (COM) LI, methyl isothiocyanate (COM) LI or other effective nematicide. Allow at least 30 days after fumigation before planting.

Limitations: Follow all label precautions when using fumigants.

Notes: This nematode also attacks potato tubers.

References:

1. Gould, C.J. and R.S. Byther. 1979. Diseases of bulbous iris. West Wash. Res. Ext. Center, Puyallup. Pp. 19-20.

BULB ROT

Penicillium spp.

Cultural: Avoid sunburning, overheating, or bruising bulbs at all stages of handling. Dry harvested bulbs rapidly and keep humidity between 70 and 85% in storage. Disinfect trays with a 1% solution of formaldehyde (COM) 37% SN.

Resistant Cultivars: Emperor, Van Vliet.

Intermediate: Wedgewood.

Susceptible: Blue Ribbon.

Chemical: Dip cleaned bulbs in a solution of captan (COM) DF or benomyl (DOM) WP plus captan (COM) WG, WP as soon as possible after harvest and/or just before forcing. Dip bulbs for 1 to 15 minutes. For smaller quantities, use captan (DOM) DU prior to storage and/or forcing. Limitations: As per label.

Notes: It has been observed that benomyl bulb dip used for controlling fusarium basal rot may also control bulb rot but is not registered for this purpose. Where benzimidazole-tolerant strains of the pathogen are present, neither thiabendazole nor benomyl will be effective. Although used elsewhere, 2-(thiocyanomethylthio)-benzothiazole is not registered for use on iris in Canada.

References:

1. Gould, C.J. and R.S. Byther. 1979. Diseases of bulbous iris. West Wash. Res. Ext. Center, Puyallup. Pp. 10-11.

BULBS - LILY (*Lilium* spp.)

See also Lily in Chapter 4.

VIRUS DISEASES

Lily mosaic virus and others

Cultural: Do not plant bulbs that are believed to be infected with viruses in the vicinity of plantings that are believed to be virus-free. Control aphids. Rogue obviously infected plants from otherwise healthy appearing plantings.

Resistant Cultivars: None.

Chemical: None.

BULBS - NARCISSUS (*Narcissus* spp.)

BASAL ROT

Fusarium oxysporum f. sp. *narcissi*

Cultural: Harvest promptly in dry weather if possible. Discard infected bulbs. Provide cool, well ventilated storage and replant as soon as possible.

Resistant Cultivars: The Jonquilla, Tazetta, Triandrus, and cup types are resistant (1). The large trumpet varieties are most susceptible and of these Golden Harvest is much more susceptible than King Alfred.

Chemical: Dip bulbs in captan (COM) DF, WG or benomyl (DOM) WP as soon as possible after harvest (see Notes) or use formaldehyde (COM) 37% SN (1 part in 200 parts of water) during hot water treatment for nematode control. For smaller quantities, use captan (DOM) DU prior to storage and/or just before planting. Limitations: As per label.

Notes: Repeated use of benomyl may result in loss of effectiveness. Although used elsewhere, 2-(thiocyanomethylthio) benzothiazole is not registered for use on narcissus in Canada.

References:

1. Gould, C.J. and R.S. Byther. 1979. Diseases of narcissus. West. Wash. Res. Ext. Center, Puyallup. Pp. 5-7.

NEMATODES

Ditylenchus dipsaci, *Pratylenchus* spp.

Cultural: Avoid infested fields. Follow a 3 to 4 year rotation between crops. During this time, control weeds and remove all volunteer bulbs. Rogue out and destroy suspicious plants while they are still green.

Resistant Cultivars: None.

Chemical: For control of *Ditylenchus* in bulbs, use hot water-formalin treatment at 43-44°C for 3-4 hours as soon as possible after harvest (see Notes). *Pratylenchus* spp. are not carried on bulbs. Wash all tools and equipment which come into contact with infested soil or bulbs with a solution of 1 part formaldehyde (COM) 37% SN and 9 parts water. Fumigate thoroughly cultivated warm soil with dazomet (COM) 98% GR, metam sodium (COM) LI, or methyl isothiocyanate (COM) LI. Allow at least 30 days after fumigation before planting.

Limitations: Follow all label precautions when using fumigants.

Notes: Cultivars vary in their sensitivity to hot water treatment. Flower production in the first year after treatment may be severely damaged.

References:

1. Gould, C.J. and R.S. Byther. 1979. Diseases of narcissus. West Wash. Res. Ext. Center Puyallup. Pp. 7-10.

BULBS - TULIP (*Tulipa* spp.)

BASAL ROT

See Narcissus, BASAL ROT, page 8. Do not use hot water treatment on tulips as they damage too easily.

BREAKING

Tulip breaking virus and others.

Cultural: Control aphids. Avoid planting tulips and lilies in close proximity. Rogue early, removing plants exhibiting mottled or streaked foliage or 'off-type' flower color.

Resistant Cultivars: None.

Chemical: None.

Notes: Pink and red flowered cvs. show most pronounced symptoms and are easiest to rogue.

References:

1. Gould, C.J. and R.S. Byther. 1979. Diseases of tulips. West Wash. Res. Ext. Center, Puyallup. Pp. 15-17.

BULB ROT

See Iris, BULB ROT, page 7.

FIRE (BOTRYTIS BLIGHT)

Botrytis tulipae

Cultural: Clean bulbs before planting and discard any showing spots. Plant in areas with good soil and air drainage. Avoid overcrowding. Carefully remove and destroy fireheads (infected primary shoots) as soon as they are detected. Do not replant in soils known to be infested with sclerotia for at least 3 years.

Resistant Cultivars: None.

Chemical: Benomyl (DOM) WP + captan (COM) WP, (DOM) DU; captan (COM) WP, (DOM) DU; fenhexamid (COM) WG; iprodione (COM) WP. Apply before disease appears and at intervals of 7-10 days as needed. Limitations: As per label. Fenhexamid has a general label for control of Botrytis on ornamentals: test on a small area first for phytotoxicity. Efficacy on tulip fire is unknown.

References:

1. Gould, C.J. 1979. Diseases of tulips. West Wash. Res. Ext. Center, Puyallup. Pp. 7-10.

GRAY BULB ROT*Sclerotium tuliparum*

Cultural: Sort bulbs carefully after harvest and before planting. Destroy infected bulbs. Avoid infested fields. Follow 3 to 5 year rotation avoiding other bulbs, especially iris.

Resistant Cultivars: None.

Chemical: Dip bulbs in a suspension of 7.5% quintozone (COM) WP for 5 min. before planting stock of questionable health. Limitations: As per label.

Notes: Soil treatment with quintozone is not registered in Canada, but is used elsewhere.

References:

1. Gould, C.J. and R.S. Byther. 1979. Diseases of tulips. West Wash. Res. Ext. Center, Puyallup, WA. P. 12.

CHRYSANTHEMUM (*Chrysanthemum* spp.)

See Chrysanthemum in Chapter 4.

CLEMATIS (*Clematis* spp.)**LEAF SPOT, STEM BLIGHT, STEM ROT, WILT***Ascochyta clematidina, Septoria clematidis*

Cultural: In propagation, use disease free stock, maintain strict sanitation, remove and destroy diseased cuttings when they appear. Prune out disease vines.

Resistant Cultivars: None.

Chemical: Benomyl (DOM) WP for control of clematis stem rot. Thiophanate-methyl (COM) WP for leaf spot; water soil thoroughly with spray solution and repeat at 7 day intervals as required. Foliar sprays and/or drenches of the crown area with benomyl (DOM) WP + captan (DOM) WP or sulphur (DOM) DU, as applied for powdery mildew, may be helpful.

Limitations: As per labels. Benomyl may not be used on commercial nursery stock. Benomyl may interfere with rooting of cuttings. Sulphur may cause yellowing leaves and poor growth on some varieties.

OTHER DISEASES

The following disease has been reported in Europe but has not yet been found in Canada.

Wilt (*Coniothryium clematidis-rectae*)

COTONEASTER (*Cotoneaster* spp.)

DARK BERRY

Phytophthora cactorum

Cultural: Avoid planting in areas where soil splashing may be a problem or mulch the plants to prevent soil splashing.

Resistant Cultivars: None.

Chemical: None.

FIRE BLIGHT

See Pear, FIRE BLIGHT in Chapter 11.

RUST

See Juniper, RUST on page 20.

SCAB

See Apple, SCAB in Chapter 11.

SILVER LEAF

Chondrostereum purpureum

Cultural: Prune out diseased or damaged branches well below the affected area and protect cut surface with pruning paint. Badly diseased plants should be removed. Do heavy pruning during dormant season.

Resistant Cultivars: None.

Chemical: None.

Notes: The fungus infects only through wounds on wood that is more than 1 year old.

References:

1. Duczek, L.J. 1975. Silver leaf (sapwood rot). Sask. Dep. Agric., Fact sheet. P. 12 in Garden clippings, Sask. Hort. Soc., June, 1975.

CRABAPPLE (*Malus* spp.)

FIRE BLIGHT, POWDERY MILDEW, SCAB

Erwinia amylovora, Podosphaera leucotricha, Venturia inaequalis

Cultural: See Pear, FIRE BLIGHT; Apple, POWDERY MILDEW and Apple, SCAB in Chapter 11.

Resistant Cultivars: (1, 2, 3, 4) Some of these cultivars may not be hardy in the prairie region.

Crabapple Cultivar Susceptibility:

	<u>Fire blight</u>	<u>Powdery mildew</u>	<u>Scab</u>
Adams	Res.	Res.	Mod. to H. res
Almey	Res.	Res.	H. susc.
<i>M. baccata</i>	Res.	?	Res.
<i>M. baccata columnaris</i>	H. susc.	?	Res.
Bob White	Res.	Res.	Res.
Centennial	?	?	Res.
Chestnut	?	?	Mod. to H. res.
Christmas Holly	Res.	Res.	Res.
<i>M. coronaria</i>	Susc.	?	Susc.
David	Res.	Res.	Res.
Dolgo	Res.	Res.	Susc.
Donald Wyman	Res.	Res.	Mod. to H. res.
Echtermeyer	?	?	Susc.
<i>M. floribunda</i>	*Res.	Res.	Res.
German	?	?	Mod. to H. res.
Hopa	?	?	H. susc.
Indian Magic	Res.	Res.	Mod. res.
Indian Summer	Res.	Res.	Res.
Jacki	Susc.	Susc.	Res.
Jewelberry	Res.	Res.	Res.
Kelsey	Res.	?	Susc.
Liset	Res.	Res.	H. res.
Makamik	Res.	?	Res.
Manchurian	Susc.	?	?
Martha Dolgo	?	?	Susc.
Molten Lava	Res.	Res.	Res.
Ormiston Roy	Res.	Res.	Res.
Prairie Fire	Res.	Res.	Mod. to H. res.
Prince Georges	Res.	?	Susc.
Professor Sprenger	Res.	Res.	Res.
Profusion	Res.	Susc. to Mod. res.	Res.
Radiant	Res.	?	Susc.
Ralph Shay	Res.	Susc.	Mod. to H. res.
Red Jade	Res.	?	Mod. Res.
Red Jewel	Res.	Res.	Res.
Red Splendor	Res.	Res.	Res.
<i>M. robusta persicifolia</i>	Res.	Res.	Res.
Royalty	H. susc.	Susc.	Susc.
<i>M. sargentii</i>	Res.	Res.	Mod. to H. res.
Selkirk	Res.	?	Res.
Silver Moon	Res.	Res.	Mod. to H. res.
Snowdrift	Susc.	Res.	Mod. to H. res.
Strathmore	?	?	Susc.
Sugar Tyme	Res.	Res.	Mod. to H. res.
Thunderchild	Res.	?	?
<i>M. Tschonoskii</i>	Res.	Res.	Res.
Van Eseltine	?	?	H. res.
Weeping Candied Apple	?	?	Mod. res.
White Angel	Res.	Res.	Res.
Whitney	?	?	Mod. to H. res.
<i>M. x Zumi</i> var. <i>calocarpa</i>	Res.	Res.	Mod. to H. res.

*Reported in some cases to be susceptible, listed as resistant in (1).

H (Res) High disease resistance; some leaves may be affected

M (Mod) Moderate disease resistance; leaves and shoots affected but no defoliation.

Susc. Low disease resistance; heavy infection, defoliation

? Information not available

Chemical: For scab, propiconazole (COM) EC every 14 days beginning at green tip, or chlorothalonil (COM) SU at spring budbreak and every 7-14 days thereafter until dry weather begins. (See also: Pear, FIRE BLIGHT; Apple, POWDERY MILDEW; Apple, SCAB; in Chapter 11.) Limitations: As per label. Myclobutanil (COM) WP applied at 10-14 day intervals will also control powdery mildew, scab and rust (see RUST below).

References:

1. Pscheidt, J.W. and C.M. Ocamb. 1999. Pacific Northwest Plant Disease Control Handbook. Oreg. State Univ., Corvallis, which cites referenced A-D below:
 - A. Benson, D.M. and B.I. Daughtry. 1993. "Crabapple" in Biological and Cultural Tests for Control of Plant Diseases. St. Paul, MN: APS Press, 8: 127. H=0-1; M=2; L=3-4 in Benson *et al.* evaluation.
 - B. Hartman, J., J. Doney, and R. McNeil. 1991. "Crabapple" in Biological and Cultural Tests for Control of Plant Diseases. St. Paul, MN: APS Press, 6: 107. H=0-2; M=3; H=4 in Hartman *et al.* evaluation.
 - C. Norton, R.A. and J. King. 1993. "Crab Apples Revisited" Washington Park Arboretum Bulletin 55: 10-13.
 - D. Unpublished field evaluations from the Pacific Northwest.
2. Nichols, L.P. 1975. Disease resistant crabapples. Pa. State Univ., University Park.
3. Smith, E.M. 1979. A 10-year evaluation of flowering crabapple susceptibility to apple scab in Ohio. Ohio Ag. Res. Dev. Center. Wooster, Ohio.
4. Smith, E.M. and S. Treaster. 1986. Evaluation of flowering crabapple susceptibility to apple scab in Ohio. Ohio Ag. Res. Dev. Centre, Wooster, Ohio.

RUST

Gymnosporangium spp.

Cultural: Alternate hosts of crabapple rusts are juniper, incense cedar (*Calocedrus decurrens*) and yellow cedar (*Chamaecyparis nootkatensis*). Cedar-apple rust, common in the east, has not been reported in the west. Remove alternate hosts near crabapples. Prune out rust galls when seen on alternate hosts.

Resistant Varieties: No information available.

Chemical: Myclobutanil (COM) WP applied at 10-14 day intervals when the disease is first seen will help to control rust. Chlorothalonil applied for powdery mildew and scab (see above) will also help to control rust. However, the only permanent control is removal of the alternate host.

SILVER LEAF

See Cotoneaster, SILVER LEAF, page 11.

DOGWOOD (*Cornus* spp.)

ANTHRACNOSE

Discula destructiva

Cultural: On small plants isolated from large, infected trees, picking off the first diseased leaves seen in spring may be beneficial. Rake and burn fallen leaves to reduce overwintering inoculum.

Resistant Cultivars: *Cornus* "Eddie's White Wonder", *C. florida* and *C. kousa* have more resistance than *C. nuttallii*.

Chemical: Myclobutanil (COM) WP or propiconazole (COM) EC, every 14 days; maximum 4 applications per year. On small plants, dormant sprays with lime sulphur (DOM) LI, (COM) WP followed by early growing season sprays with benomyl (DOM) WP + captan (DOM) WP may be helpful if practical. Chlorothalonil (COM) for Septoria leaf spot also helps to reduce anthracnose infection. Limitations: As per label.

Notes: This disease is now well established in the B.C. Lower Mainland and Vancouver Island and in many other parts of North America where *Cornus* is grown.

References:

1. Byther, R.S. and R.M. Davidson. 1979. Dogwood anthracnose. Ornamentals Northwest. V.3-2 Oreg. State Univ., Corvallis.
2. Hibben, C.R. and M.L. Daughtrey. 1988. Dogwood anthracnose in northeastern United States. Plant Dis. 72: 199-203.

COLLAR ROT (CROWN CANKER)

Phytophthora cactorum and other spp.

Cultural: Avoid soils known to be contaminated with *Phytophthora*. Avoid damage to the crown area. On large trees, surgery to remove infected tissue may slow the disease.

Resistant Cultivars: None.

Chemical: None.

ELDER (*Sambucus* spp.)

CROWN ROT

Phytophthora citricola, *P. cactorum*

Cultural: Obtain disease-free stock from a reliable nursery and plant in clean soil that has not previously grown elders or lilacs.

Resistant Cultivars: None.

Chemical: None.

POWDERY MILDEW

Microsphaera spp.

Cultural: Avoid overcrowding of nursery plants.

Resistant Cultivars: None.

Chemical: Sulphur (DOM, COM) SN; benomyl (DOM) WP. Limitations: As per label.

FALSE CYPRESS (*Chamaecyparis* spp.)

ROOT and CROWN ROT

Phytophthora lateralis and other spp.

Cultural: Avoid poorly drained soils especially for hedge plantings.

Resistant Cultivars: *C. nootkatensis*, *C. pisifera*, *C. thyoides*, *Thuja* spp., and *Juniperus* spp. are all resistant to *P. lateralis* but may be susceptible to other *Phytophthora* spp..

Susceptible: All varieties of Lawson's cypress (*C. lawsoniana*) and Hinoki cypress (*C. obtusa*) are highly susceptible to *P. lateralis*.

Chemical: None.

FIRETHORN (*Pyracantha* spp.)

FIRE BLIGHT, SCAB

Erwinia amylovora, *Spilocaea pyracanthae*

Cultural: See Pear, FIRE BLIGHT and Apple, SCAB in Chapter 11.

Resistant Cultivars:**Cultivar Susceptibility:**

	<u>Fire blight</u>	<u>Scab</u>
<i>P. atalantoides</i> Aurea	Susc.	Res.
<i>P. augustifolia</i>	Susc.	?
<i>P. coccinea</i> v. <i>lalandii</i>	M. Res.	?
<i>P. crenulata</i>	M. Susc.	?
<i>P. fortuneana</i>	M. Res.	?
<i>P. koidzumii</i>	Susc.	?
<i>P. koidzumii</i> Santa Cruz Prostrata	M. Res.	Res.
<i>P. rogersiana</i> Watereri	M. res.	Res.
<i>P. x</i> Golden Charmer	M. res.	Res.
<i>P. x</i> Government Red	?	Res.
<i>P. x</i> Mohave	Res.	Res.
<i>P. x</i> Navaho	Res.	Res.
<i>P. x</i> Orange Glow	M. res.	Res.
<i>P. x</i> Shawnee	Res.	Res.
<i>P. x</i> Teton	Res.	Res.
<i>P. x</i> Teton (pyramid type)	?	Res.

Chemical: For scab apply chlorothalonil (COM) SU at spring bud break and repeat at 7-14 day intervals or propiconazole (COM) EC every 14 days beginning at green tip, while wet weather occurs. (See Pear, FIRE BLIGHT and Apple, SCAB in Chapter 11). Limitations: As per label.

References:

1. Pscheidt, J.W. and C.M. Ocamb. 1999. Pacific Northwest Plant Disease Control Handbook. Oreg. State. Univ. Corvallis.
2. Vassey, W.E., C.J. Gould and G.F. Ryan. 1977. Disease-resistant pyracantha for the Pacific Northwest. *Ornamentals Northwest* 1(18): 4-6.

GERANIUM (*Pelargonium* spp.)

See Geranium in Chapter 4.

HAWTHORN (*Crataegus* spp.)**FIRE BLIGHT**

See Pear, FIRE BLIGHT in Chapter 11.

LEAF BLIGHT/FABREA BLIGHT

Diplocarpon mespili (*Entomosporium mespili*, *Fabraea maculata*)

Cultural: Rake and burn or dispose of fallen leaves.

Resistant Cultivars: Cockspur and Washington

Susceptible: Paul's Scarlet.

Chemical: Chlorothalonil (COM) SU; captan + sulphur (DOM) DU; mancozeb (COM) DF, WP; zineb + sulphur (DOM) DU; benomyl (DOM) WP + captan (DOM) DU may be applied during the leaf emergence and enlargement period. Limitations: As per label instructions for ornamentals.

Notes: This is primarily a disease of the English hawthorn (*C. oxyacantha*) in the coastal area.

RUST

Gymnosporangium spp.

Cultural: In the prairie region, avoid planting in close proximity to *Juniperus communis*, *J. horizontalis* and *J. scopulorum*, the alternate host for *Gymnosporangium* rusts of *Crataegus* and *Amelanchier* spp.

Resistant Cultivars: See Notes.

Chemical: Chlorothalonil (COM) SU starting before bloom or myclobutanil (COM) WP every 14 days when disease appears. Zineb + sulphur (DOM) DU, applied to hawthorn at weekly intervals in the spring when juniper infections are sporulating, may be helpful in certain situations. Limitations: As per label for ornamentals.

Notes: In most areas, Rocky Mountain juniper (*J. scopulorum*) is a greater hazard as an alternate host than low growing species such as *J. horizontalis* and *J. communis*.

References:

1. Parmelee, J.A. 1971. The genus *Gymnosporangium* in Western Canada. *Can. J. Bot.* 49: 903-926.
2. Ziller, W.G. 1974. The Tree Rusts of Western Canada. *Can. For. Serv., Publ.* 1329. 272 pp.

HOLLY (*Ilex* spp.)**LEAF AND TWIG BLIGHT**

Phytophthora ilicis

Cultural: Select a site with good air drainage. Prune and space trees to encourage air circulation.

Resistant Cultivars: Unknown

Chemical: Apply mancozeb (COM) DF, WP in the fall before the onset of fall rains. Avoid applications close to harvest to reduce visible residues from the wettable powder. See notes.

Notes: These applications will also reduce green algae.

HOLLYHOCK (*Alcea or Althaea* spp.)

RUST

Puccinia malvacearum

Cultural: Remove and burn all above-ground plant parts at end of season. Remove and destroy infected leaves as they are seen. Do not use seed from infected plants. Destroy common mallow weeds in the vicinity as the disease will also overwinter on them.

Resistant Cultivars: None.

Chemical: Apply chlorothalonil (COM) SU beginning in the early seedling stage or zineb + sulphur (DOM) DU at frequent intervals during the early part of the growing season. Rotate with applications of myclobutanil (COM) WP at 10-14 day intervals. This fungicide is also registered for control of powdery mildew on hollyhock. Limitations: As per label.

Notes: Sulphur may be phytotoxic under certain conditions.

HYDRANGEA (*Hydrangea* spp.)

See Hydrangea in Chapter 4.

IRIS (*Iris germanica*)

RHIZOME ROT

Botrytis convoluta

Cultural: Control iris borer. Avoid continuous plantings of iris in the same area. Rogue diseased plants when seen.

Resistant Cultivars: None.

Chemical: Apply benomyl (DOM) WP to bases of plants in fall. Limitations: As per label.

Notes: Fungus infects in late fall or early spring.

References:

1. Jackson, R.S. 1972. Botrytis rhizome rot, review. Bull. Am. Iris Soc. 204: 35-40.

LEAF SPOT

Didymellina macrospora

Cultural: Remove and destroy all diseased leaves.

Resistant Cultivars: None.

Chemical: Zineb (COM) DU or chlorothalonil (COM) SU every 7-14 days under cool, moist conditions. Limitations: As per label. Myclobutanil (COM) WP applied as for rust control may also help to control leaf spot.

References:

1. Randolph, L.F. 1959. Garden irises. Am. Iris Soc., St. Louis.

JUNIPER (*Juniperus* spp.)**MAGNESIUM DEFICIENCY**

Nutritional

Cultural: Avoid highly acidic soils. Ratio of magnesium to calcium should not be lower than 1:10. Apply magnesium sulphate 1 kg/50 liters of water as a foliar spray for a quick response.

Resistant Cultivars: None.

Chemical: None.

References:

1. Hartley, D.E. and R.L. Ticknor. 1964. Magnesium deficiency in juniper. Oreg. Orn. Nurs. Dig. 7: 2.

ROOT ROT

Phytophthora spp.

Cultural: Container grown plants purchased from nurseries may have partially infected root systems. To prevent subsequent losses in the landscape, avoid deep planting in heavy or poorly drained soils.

Resistant Cultivars: The following are reported to be susceptible or very susceptible in Oregon: *J. chinensis* 'Pfitzeriana', 'Aurea Gold Coast', *J. horizontalis* 'Prince of Wales' and 'Wiltonii'; *J. procumbens* 'Nana' and *J. sabina* 'Tamariscifolia'.

Chemical: For greenhouse-grown container plants, metalaxyl (COM) GR added to the potting mix at transplanting or applied to the surface and watered in may help to prevent infection. Overuse will lead to resistance.

References: See reference 4, p. 30.

RUST

Gymnosporangium spp.

Cultural: Prune out and destroy rust galls. In the prairie region, avoid planting junipers - especially *J. scopulorum* - in close proximity to *Amelanchier*, *Cotoneaster*, *Crataegus*, *Malus*, *Pyrus*, or *Sorbus*. In coastal B.C., do not plant any species except *J. communis* and *J. horizontalis* within 30 m of *Pyrus*.

Resistant Cultivars: Some species of junipers are resistant to some species of *Gymnosporangium* but none are resistant to all.

Chemical: Myclobutanil (COM) WP in a tank-mix with mancozeb (COM) DG, every 14 days in late summer/early fall. Maximum 6 applications per year. See Hawthorn, RUST on page 17. In coastal B.C., junipers grown for shipment to other areas must be protected with mancozeb in the fall during the time when *G. fuscum* aeciospores are being shed from infected pear leaves.

References:

1. Anonymous. 1994. Pear trellis rust in British Columbia. B.C. Ministry of Agriculture and Food. 20 pp.
2. Parmelee, J.A. 1971. The genus *Gymnosporangium* in Western Canada. Can. J. Bot. 49: 903-926.
3. Ziller, W.G. 1974. The Tree Rusts of Western Canada. Can. For. Serv., Publ. 1329. 272 pp.

TWIG BLIGHT and DIEBACK

Kabatina juniperi, *Phoma* spp., *Phomopsis* spp., *Sclerophoma* spp., *Coniothyrium* spp., other fungi and physiological

Cultural: Propagate only from disease-free mother plants. Avoid planting out in heavy clay soils that tend to crack in dry weather. Avoid injury to established plants. Minimize frequency and duration of overhead irrigation.

Resistant Cultivars: Cultivars that break easily under weight of snow or traffic are most subject to dieback.

Chemical: Cuttings and young plants should be protected in April, May and June on a 10 day spray schedule using mancozeb (COM) WP; or copper oxychloride (COM, DOM) WP. Limitations: As per label for ornamentals.

References:

1. Brener, W.D. *et al.* 1974. *Sclerophoma pythiophila* associated with a tip dieback of juniper in Wisconsin. Plant Dis. Rep. 58: 653-657.
2. Hall, R. 1971. Juniper Dieback. Ont. Dep. Agric. Food, Agdex 276 636.
3. Peterson, G.W. *et al.* 1965. Control of phomopsis blight of eastern red cedar seedlings. Plant. Dis. Rep. 9: 529-531.

LILAC (*Syringa* spp.)

BACTERIAL BLIGHT

Pseudomonas syringae pv. *syringae*

Cultural: Prune out infected shoots as they are seen. Space nursery plants to obtain good air circulation. Individual plastic hoop houses or covers staked down and open at the bottom, are effective in protecting small outdoor nursery shrubs if put on in January and removed in April after risk of late frost has passed but before flower buds open.

Resistant Cultivars: White-flowered cultivars are the most susceptible. Most cultivars of *S. vulgaris* are susceptible but 'Edith Cavell', 'Glory', 'Ludwig Spaeth' and 'Pink Elizabeth' have shown some resistance when planted in gardens. 'Ludwig Spaeth' is highly susceptible in crowded nursery conditions. Resistance has been observed in western Washington in species *S. josikaea*, *S. Komarowii*, *S. microphylla*, *S. pekinensis* and *S. reflexa*.

Chemical: Apply copper oxychloride (COM, DOM) WP at leaf fall before fall rains and at 7- to 10-day intervals during bud opening and shoot elongation in spring. Limitations: As per label.

Notes: Bacterial blight is a common problem on a number of woody ornamentals in coastal B.C. including *Acer*, *Cornus*, *Magnolia*, *Prunus* and *Rosa* spp.

References:

1. Canfield, M.L., S. Baca and L.W. Moore. 1986. Isolation of *Pseudomonas syringae* from 40 cultivars of diseased woody plants with tip dieback in pacific northwest nurseries. *Plant Dis.* 70(7): 647-650.
2. Delbridge, R.W. 1975. Lilac blight. N.S. Dep. Agric., Unnumbered Fact Sheet.
3. Pscheidt, J. W and C. M. Ocamb. 1999 Pacific Northwest Plant Disease Control Handbook. Oreg. State Univ., Corvallis.

BOTRYTIS FLOWER BLIGHT

Botrytis cinerea

Cultural: Grow in a sunny location with good air circulation.

Resistant Cultivars: No information available.

Chemical: Captan (COM) DF or fenhexamid (COM) WG may be applied when disease first appears and repeated at intervals of 7 to 10 days as required.

CROWN ROT and SHOOT BLIGHT

See Elder, CROWN ROT, Page 14.

POWDERY MILDEW

Microsphaera sp.

Cultural: Avoid overcrowding of nursery plants.

Resistant Cultivars: None.

Chemical: Begin application in late summer before first appearance of mildew. Use: myclobutanil (COM) WP; sulphur (DOM, COM) SN; or benomyl (DOM) WP. Limitations: As per label.

Notes: Late infection generally does not warrant a spray program. However, nursery plants should be protected to improve saleability.

MOUNTAIN ASH (*Sorbus* spp.)

CHLOROSIS

See Rhododendron, CHLOROSIS, page [23](#).

FIRE BLIGHT

See Pear, FIRE BLIGHT in Chapter 11.

SCAB

See Apple, SCAB in Chapter 11.

SILVER LEAF

See Cotoneaster, SILVER LEAF, page [11](#).

PEONY (*Paeonia* spp.)

GRAY MOLD, BOTRYTIS BLIGHT

Botrytis cinerea, *B. paeoniae*

Cultural: Remove and destroy diseased parts as seen. Avoid dense plantings and plant in an area with good air circulation. Do not mulch in spring when shoots are emerging. Remove tops just below ground level in fall. Avoid overhead watering.

Resistant Cultivars: None.

Chemical: Apply fenhexamid (COM) WG; zineb + sulphur (DOM) DU; benomyl (DOM) WP + captan (DOM) WP; or iprodione (COM) WG, WP at 7- to 10-day intervals during shoot elongation before flowering.
Limitations: As per label.

RINGSPOT

Peony ringspot virus

Cultural: Remove and destroy plants exhibiting symptoms of ringspot, mosaic, or stunting.

Resistant Cultivars: None.

Chemical: None.

References:

1. Smith, K.F. 1972. A Textbook of Plant Virus Diseases. Academic Press, New York. 388 pp.

RHODODENDRON (*Rhododendron* spp.)

CHLOROSIS

Iron deficiency

Cultural: Chlorosis of rhododendrons and azaleas is usually due to alkaline soil conditions. Use of peat moss and acid-producing fertilizers will usually overcome this problem.

Resistant Cultivars: None.

Chemical: A foliar spray of ferrous sulphate at 100 g/50 liters of water can also be used.

LEAF GALL

See Azalea, LEAF GALL in Chapter 4.

ROOT ROT

Phytophthora cinnamomi and other species.

Cultural: Use disease-free propagating stock. Follow strict hygiene in media preparation and potting. Disinfect all tools and equipment used in propagation. Place containers on well drained beds free of standing water. Plant out in well drained locations. Once established in soil, *Phytophthora* species may remain indefinitely. *Phytophthora* may also cause foliar blight and stem dieback on rhododendrons.

Resistant Cultivars: The following is a partial list of root rot-resistant cultivars from the Pacific Northwest Disease Control Handbook:

Resistant Hybrids

‘Caroline’
 ‘Martha Isaacson’
 ‘Pink Trumpet’
 ‘Professor Hugo de Vries’
 ‘Red Head’

Resistant Species

R. davidsonianum ‘Serenade’
R. delavayi
R. gomeratum
R. hyperethrum
R. lapponicum
R. occidentale
R. pseudochrysanthum
R. quinquefolium
R. sanctum
R. simsii
R. websterianum

Note: *R. poubanense* is a resistant azalea.

Chemical: Apply etridiazole (COM) WP, EC as a soil drench or chlorothalonil (COM) SU for foliar blight. NB: Chlorothalonil may discolour blooms. For nursery container stock, metalaxyl (COM) G can be added to the potting mix or applied to the surface and watered-in. Overuse will lead to disease resistance.

References:

1. Pscheidt, J. W. and C.M. Ocamb. 1999. Pacific Northwest Plant Disease Control Handbook. Oreg. State Univ., Corvallis.

RUST

Chrysomyxa spp.

Cultural: Rake up and dispose of fallen leaves. Early leaf yellowing and drop may occur but is not usually serious except on a few very susceptible varieties. Spores will continue to re-infect rhododendrons throughout the growing season without an alternate host.

Resistant Varieties: Many varieties are resistant or tolerant of infection.

Chemical: No products are registered for control of rust on rhododendron. Chlorothalonil applied for foliar Phytophthora blight may also help to control rust if applied when first symptoms are seen. This product may discolour blooms (see ROOT ROT, above).

ROSE (*Rosa* spp.)

BLACK SPOT, POWDERY MILDEW, RUST

Diplocarpon rosae, *Sphaerotheca macularis*, *Phragmidium* spp.

Cultural: Remove all remaining foliage during dormant season. Pick off infected leaves as they are seen during the growing season. Avoid planting in damp, shaded locations.

Resistant Cultivars:**Cultivar Susceptibility:**

Hybrid Tea	<u>Black spot</u>	<u>Powdery Mildew</u>	<u>Rust</u>
Aztec	Res.	Res.	Intermed.
Blue Nile*	Mod. Res.	Mod. Res.	Mod. Res.
Bewitched	Res.	Res.	Susc.
Bob Hope	Res.	Intermed.	Res.
Charlotte	Res.	Intermed.	Intermed.
Chicago Peace	Mod. Res.**	Intermed.	Intermed.
Chrysler Imperial	Res.	Susc.	Susc.
Color Magic*	Mod. Res.	Mod. Res.	Mod. Res.
Command Performance	Res.	Susc.	Res.
Dainty Bess*	Mod. Res.	Mod. Res.	Mod. Res.
Double Delight*	Mod. Res.	Mod. Res.	Mod. Res.
Eclipse	?	Susc.	Res.
Electron*	Res.	Res.	Res.
Ena Harkness	Res.	Susc.	Susc.
Folklore*	Mod. Res.	Mod. Res.	Mod. Res.
Fragrant Cloud	Mod. Res.**	Mod. Res.**	Res. To Mod. Res.
Garden Party	Res.	Intermed.	Res.
Granada*	Mod. Res.	Susc.	Mod. Res.
Headliner*	Mod. Res.	Susc.	Mod. Res.
Heirloom*	Mod. Res.	Mod. Res.	Mod. Res.
Helen Traubel	Res.	Intermed.	Intermed.
Helmut Schmidt*	Res.	Mod. Res.	Res.
Honor*	Mod. Res.	Mod. Res.	Mod. Res.
Irish Gold	Mod. Res.**	Mod. Res.**	Mod. Res.**
Just Joey*	Res.	Res.	Res.
Keepsake*	Res.	Res.	Res.
Kordes Perfecta	Res.	Res.	Susc.
Las Vegas*	Res.	Res.	Res.
Medallion*	Mod. Res.	Mod. Res.	Mod. Res.
Miss All American Beauty	Res.	Res.	Susc.
Mister Lincoln	Mod. Res.**	Susc.	Susc.
Mojave	Intermed.	Intermed.	Intermed.
New Day*	Res.	Mod. Res.	Res.
Olympiad*	Mod. Res.	Mod. Res.	Res.
Paradise*	Mod. Res.	Mod. Res.	Mod. Res.
Pascali	Mod. Res.**	Intermed.	Intermed.
Peace	Mod. Res.**	Intermed.	Susc. to Mod. Res.
Peter Frankenfeld*	Res.	Mod. Res.	Res.
Pink Peace	Res.	Intermed.	Susc.
Polarstern*	Res.	Mod. Res.	Res.
Precious Platinum*	Res.	Mod. Res.	Res.
Princess Margaret*	Mod. Res.	Mod. Res.	Res.
Pristine*	Mod. Res.	Mod. Res.	Res.
Red Devil	Intermed.	Mod. Res.	Res.
Royal Highness	Intermed.	Susc.	Susc.
Silver Jubilee*	Res.	Res.	Res.
Tiffany	Mod. Res.**	Intermed.	Intermed.
Touch of Class*	Mod. Res.	Susc.	Res.
Tropicana	Res.	Susc.	Res.
Voodoo*	Res.	Res.	Res.

Cultivar Susceptibility continued:

	<u>Black spot</u>	<u>Powdery Mildew</u>	<u>Rust</u>
Grandiflora			
Aquarius	Mod. Res.**	Intermed.	Intermed.
Camelot	Mod. Res.**	Intermed.	Susc.
Comanche	Res.	Susc.	Intermed.
Gold Medal*	Mod. Res.	Mod. Res.	Mod. Res.
Love*	Res.	Res.	Res.
Montezuma	Res.	Susc.	Susc.
New Year*	Res.	Mod. Res.	Res.
Pink Parfait	Intermed.	Intermed.	Intermed.
Queen Elizabeth	Mod. Res.**	Susc.	Intermed.
Scarlet Knight	Intermed.	Intermed.	Intermed.
Shreveport*	Mod. Res.	Mod. Res.	Mod. Res.
Tournament of Roses*	Res.	Res.	Res.
Floribunda			
Bonica*	Res.	Mod. Res.	Res.
Cherish*	Mod. Res.	Mod. Res.	Res.
Class Act*	Mod. Res.	Res.	Res.
Escapade*	Res.	Mod. Res.	Mod. Res.
Europeana*	Res.	Res.	Res.
Eye Paint*	Mod. Res.	Res.	Res.
French Lace*	Mod. Res.	Mod. Res.	Mod. Res.
Iceberg*	Mod. Res.	Mod. Res.	Mod. Res.
Impatient*	Res.	Res.	Res.
Intrigue*	Mod. Res.	Mod. Res.	Res.
Little Darling*	Mod. Res.	Mod. Res.	Mod. Res.
Liverpool Echo*	Res.	Res.	Res.
Marina*	Mod. Res.	Mod. Res.	Res.
Matangi*	Mod. Res.	Mod. Res.	Res.
Orangeade*	Res.	Mod. Res.	Mod. Res.
Play Girl*	Res.	Res.	Res.
Playboy*	Res.	Res.	Res.
Redgold*	Res.	Mod. Res.	Res.
Regensberg*	Res.	Res.	Res.
Sarabande*	Res.	Res.	Res.
Sexy Roxy*	Res.	Res.	Res.
Shocking Blue*	Mod. Res.	Mod. Res.	Mod. Res.
Showbiz*	Res.	Res.	Res.
Sun Flare*	Mod. Res.	Mod. Res.	Res.
Sunsprite*	Mod. Res.	Mod. Res.	Mod. Res.
Trumpeter*	Res.	Res.	Res.
Viva*	Res.	Res.	Res.
Shrub Roses			
Adelaide	Susc.	Res.	-
Champlain	Susc.	Intermed.	-
Charles Albanel	Res.	Res.	-
Cuthbert Grant	Res.	Res.	Intermed.
David Thompson	Res.	Res.	-
Henry Hudson	Res.	Res.	-
Henry Kelsey	Susc.	Res.	-
Jens Munk	Res.	Res.	-

Cultivar Susceptibility continued:

<u>Black spot</u>	<u>Powdery Mildew</u>	<u>Rust</u>
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Shrub Roses con't

John Cabot	Intermed.	Intermed.	-
John Franklin	Intermed.	Intermed.	-
Martin Frobisher	Res.	Res.	-
Prairie Princess	Intermed.	-	Res.
William Baffin	Res.	Res.	-

Climbers

Altissimo*	Mod. Res.	Mod. Res.	Res.
Dortmund*	Res.	Res.	Res.
Dublin Bay*	Res.	Res.	Res.
Golden Showers*	Mod. Res.	Mod. Res.	Mod. Res.
Handel*	Mod. Res.	Mod. Res.	Res.
Joseph's Coat*	Mod. Res.	Mod. Res.	Mod. Res.
Royal Sunset*	Res.	Res.	Res.

* New listings from the Pacific Northwest Plant Disease Control Handbook, 1999. (4)

** Listed as "Resistant" in earlier entries

Disease Reaction: Res. = Resistant, little or no disease
 Mod. Res./Intermed. (in older references) = moderate disease, some resistance.
 Susc. = Susceptible, severe disease.

Chemical: Lime sulphur (DOM) SN 1:9 as a dormant spray followed by folpet (COM, DOM) WP, captan (COM, DOM) WP, DF or benomyl (DOM) WP; sulphur (COM, DOM) WP, DU, LI; trifenox (COM) EC; zineb (DOM) DU in growing season (see Notes). Chlorothalonil (COM) SU is registered for control of black spot and Botrytis blight when applied starting at budbreak. Thiophanate-methyl (COM) WP or Phyton 27 (elemental copper) (COM) LI may also be used for black spot and powdery mildew control. Myclobutanil (COM) WP, applied at 10-14 day intervals is registered for control of powdery mildew, rust and black spot. Apply in a tank-mix with mancozeb (COM) DG for black spot. Limitations: As per label.

Notes: Benomyl, folpet and captan will not control rust; captan, ferbam, and zineb will not control mildew. There are a number of fungicide-insecticide mixtures registered for use on roses. See Chapter 4 for fungicides recommended to control these diseases on greenhouse roses.

References:

1. Cole, T.J. 1979. Growing Roses, Publ. 1675E. Agriculture Canada, Ottawa.
2. Horst, R. Kenneth. 1983. Compendium of Rose Diseases. Am. Phytopathol. Soc. St. Paul, Minn.
3. Svejda, Felicitas. 1984. New winter-hardy roses and other flowering shrubs. publ. 1727. Agriculture Canada, Ottawa.
4. Pscheidt, J.W. and C.W. Ocamb. 1999. Pacific Northwest Plant Disease Control Handbook. Oreg. State Univ., Corvallis.

DOWNY MILDEW

Peronospora sparsa

Cultural: Remove and destroy fallen leaves and prune back infected twigs and stems. Since the disease can infect crowns and roots, pruning may not eliminate the fungus. If the disease appears annually in landscape plants and foliar loss is severe, replace with different cultivars or other plants. Space plants for good air circulation. Avoid overhead watering or water during the day so leaves can dry off before evening dew. Take cuttings only from uninfected plants and avoid overhead misting.

Resistant Cultivars: Most mini-roses, ‘Mediland’ and ‘Austin’ cultivars are highly susceptible. There has been little or no systematic screening for resistance.

Chemical: Metalaxyl (COM) GR mixed with potting media or applied as a granular at the base of plants to prevent stem and root rot of cuttings will also control downy mildew for up to 4 to 6 weeks. Re-apply as necessary. Repeated use of metalaxyl will lead to disease resistance. Metalaxyl is only registered for use in greenhouses, not on outdoor plants in the landscape or nursery. Phyton 27 (elemental copper) (COM) applied for black spot and powdery mildew may also provide some control.

THUJA (*Thuja* spp.)

NEEDLE BLIGHT (KEITHIA BLIGHT)

Didymascella thujina

Cultural: Avoid prolonged overhead sprinkling of *T. plicata*. Space nursery plants to maximize air circulation. Locate beds well away from native stands that may be infected.

Resistant Cultivars: *T. occidentalis* cultivars. The *T. plicata* cultivar known as ‘Emerald Giant’ in B.C. and *T. plicata* ‘Aurea’.

Susceptible: *T. plicata* cultivars such as ‘Excelsa’ and ‘Atrovirens’.

Chemical: Apply mancozeb (COM) WP 3 times between March and June and twice more prior to fall rains or propiconazole (COM) EC every 4 weeks with a maximum of 6 applications per year.

References:

1. Kope, H. 1996. The use of propiconazole (Topas) to control keithia blight on container-grown western red cedar seedlings in British Columbia reforestation nurseries. Contact Biologicals, 17 Jedburgh Rd., Victoria, B.C. V9B 1K7.

ROOT ROT

Armillaria spp.

Cultural: Avoid growing Thujas in land that has recently been cleared of forest in which *Armillaria* was established. Remove as much root debris as possible before planting recently cleared land.

Resistant Cultivars: Resistant and susceptible species are listed in reference 3.

Chemical: None.

References:

1. Foster, A.T. and J.A. Baranyay. 1971. *Armillaria* root rot. Pac. For. Res. Cent., Can. For. Serv., Pest Leaflet 35.
2. Morrison, D.J. 1981. *Armillaria* root disease. Pacific Forest Res. Centre, Victoria B.C. BC-X-203.
3. Raabe, R.D. 1979. Plants resistant or susceptible to *Armillaria* root rot. Univ. Calif., Agric. Ext. Serv. Leaflet 2591.
4. Wargo, P.M. and C.G. Shaw. 1985. *Armillaria* root rot: the puzzle is being solved. Plant Dis. 69: 826-832.

GENERAL REFERENCES

1. Anon. 1980-1994. Proceedings of the Northwest bulb growers' conference. Washington State University and Northwest Bulb Growers' Association, Puyallup, WA.
2. Coyier, Duane L. *et al.* 1986. Compendium of Rhododendron and Azalea Diseases. Am. Phytopathol. Soc., St. Paul, Minn. 65 pp.
3. Gould, C.M. and R.S. Byther. 1979. Diseases of Narcissus. Washington State Univ. Ext. Bull. 709.
4. Gould, C.M. and R.S. Byther. 1979. Diseases of Bulbous Iris. Washington State Univ. Ext. Bull. 710.
5. Gould, C.M. and R.S. Byther. 1979. Diseases of Tulips. Washington State Univ. Ext. Bull. 711.
6. Horst, Kenneth R. *et al.* 1983. Compendium of Rose Diseases. Am. Phytopathol. Soc., St. Paul, Minn. 50 pp.
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8. Moore, W.C., A.A. Brunt, D. Price and A.R. Rees 1979. Diseases of bulbs. Ministry of Agriculture, Fisheries and Food, London.
9. Pirone, P.P. 1978. Diseases and Pests of Ornamental Plants (5th ed.). John Wiley, N.Y. 566 pp.
10. Sinclair, W.A. *et al.* 1987. Diseases of Trees and Shrubs. Cornell University Press. 574 pp.

www.bulbsonline.org/bulletin/usa_n1.html

APPENDIX 1. Fungicides Registered for Use on Ornamentals (See Appendix 2 for bulbs)

Active Ingredient	Trade Name	Formulation	PCP#	C/D	Diseases Controlled			
AMELANCHIER (serviceberry):								
myclobutanil	Nova	40% WP	22399	C	rust, powdery mildew			
triforine	Funginex	190 g/L EC	14701	C	rust, Entomosporium			
propiconazole	Topas	250 g/L EC	24030	C	rust, Entomosporium			
	Propiconazole	250 g/L EC	24029	C	Entomosporium			
ASH:								
mancozeb	Dithane M-45 Manzate 200 DF	80% WP	8556	C	anthracnose			
		75% DF	21057	C				
myclobutanil	Nova	40% WP	22399	C	rust			
AZALEA: see RHODODENDRON, page 37								
CLEMATIS:								
<i>Agrobacterium radiobacter</i>	Dygal	–	21106	C	crown gall			
benomyl	Later's Benomyl	50% WP	11542	D	powdery mildew, stem rot			
	Wilson's Benomyl		17546					
	Greenleaf Benomyl		21890					
sulphur	Safer's Sulphur Dust	92% WP	19703	D	powdery mildew			
	Wilson Garden Sulphur		17546					
	Green Earth Sulphur		21890					
	Later's Garden Sulphur		90% WP			5293	D	powdery mildew
	Safer's Defender Garden Fungicide		12% LC			19691	D	powdery mildew
Safer's Defender Garden Fung.	Wilson Green Earth Sulphur	0.9% L	21880	D	powdery mildew			
	Safer's Defender Garden Fung.	0.4% L	20812, 19061	D	powdery mildew			
	Safer' Liquid Sulphur		19451					
thiophanate methyl	Senator 70 WP	70% WP	12279, 25343	C	leaf spot			
COTONEASTER:								
copper oxychloride	Guardman copper oxy. Clean Crop Copper Spray	50% WP	13245 19146	C	fire blight			
	Later's Copper Greenleaf Copper		50% WP	16140 16637		D		
sulphur	Safer's Sulphur Dust Wilson Garden Sulphur Green Earth Sulphur	92% WP	19703 17546 21890	D	rust			

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COTONEASTER con't					
sulphur con't	Later's Garden Sulphur	90% WP	5293	D	rust
	Safer's Defender Garden Fungicide	12% LC	19691	D	rust
	Wilson Green Earth Sulphur	0.9% L	21880	D	rust
	Safer's Defender Garden Fung. Safer' Liquid Sulphur	0.4% L	20812, 19061 19451	D	rust
sulphur + tribasic copper sulphate + carbaryl + malathion	Wilson's Rose & Flower Dust	20% DU 5% 5% 2%	18632	D	rust
tribasic copper sulphate	Wilson's Bordo	53%	17842	D	fire blight
CRABAPPLE:					
benomyl	Later's Benomyl	50% WP	11542	D	scab, cedar-apple rust, leaf spot
	Wilson's Benomyl		17546		
	Greenleaf Benomyl		21890		
chlorothalonil	Daconil 2787	40.4% SU	15724	C	scab, powdery mildew, sooty blotch
copper oxychloride	Guardsman copper oxychloride Clean Crop Copper Spray	50% WP	13245 19146	C	fire blight
	Later's Copper Greenleaf Copper	50% WP	16140 16637	D	fire blight
folpet	Folpan	50% WP	15654	C	scab, alternaria leaf spot, sooty blotch, black rot, Brooks fruit spot, fly speck
myclobutanil	Nova	40% WP	22399	C	rust, powdery mildew, scab
propiconazole	Banner	130 g/L EC	23693	C	scab
sulphur	Safer's Sulphur Dust Wilson Garden Sulphur Green Earth Sulphur	92% WP	19703 17546 21890	D	scab, powdery mildew, rust
	Later's Garden Sulphur	90% WP	5293	D	scab, powdery mildew, rust
	Safer's Defender Garden Fungicide	12% LC	19691	D	scab, powdery mildew, rust powdery mildew

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CRABAPPLE con't					
sulphur con't	Wilson Green Earth Sulphur	0.9% L	21880	D	scab, powdery mildew, rust
	Safer's Defender Garden Fung. Safer' Liquid Sulphur	0.4% L	20812, 19061 19451	D	scab, powdery mildew, rust

DOGWOOD:					
benomyl	Later's Benomyl Wilson's Benomyl Greenleaf Benomyl	50% WP	11542 17546 21890	D	powdery mildew, anthracnose, leaf spot
captan + carbaryl + malathion	Green Cross Fruit Tree & Garden Spray	10% WP 10% 5%	9986	D	leaf spot
chlorothlonil	Daconil 2787	40.4% SU	15724	C	septoria leaf spot
myclobutanil	Nova	40% WP	22399	C	powdery mildew, anthracnose, Septoria leaf spot
propiconazole	Banner	130 g/L EC	23693	C	anthracnose
sulphur + tribasic copper sulphate + carbaryl + malathion	Wilson's Rose & Flower Dust	20% DU 5% 5% 2%	18632	D	leaf spot

ELDER:					
benomyl	Later's Benomyl Wilson's Benomyl Greenleaf Benomyl	50% WP	11542 17546 21890	D	powdery mildew, rust
sulphur	Safer's Sulphur Dust Wilson's Garden Sulphur Green Earth Sulphur	92% WP	19703 17546 21890	D	powdery mildew, rust
	Later's Garden Sulphur	90% WP	5293	D	powdery mildew, rust
	Safer's Defender Garden Fungicide	12% LC	19691	D	powdery mildew, rust
	Wilson Green Earth Sulphur	0.9% L	21880	D	powdery mildew, rust
	Safer's Defender Garden Fung. Safer' Liquid Sulphur	0.4% L	20812, 19061 19451	D	powdery mildew, rust
sulphur + tribasic copper sulphate + carbaryl + malathion	Wilson's Rose & Flower Dust	20% DU 5% 5% 2%	18632	D	powdery mildew, rust

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FIRETHORN:					
chlorothalonil	Daconil 2787	40.4% SU	15724	C	scab
propiconazole	Banner	130 g/L EC	23693	C	scab
FORSYTHIA:					
copper oxychloride	Guardsman copper oxychloride Clean Crop Copper Spray	50% WP	13245 19146	C	bacterial blight
HAWTHORN:					
chlorothalonil	Daconil 2787	40.4% SU	15724	C	<i>Fabraea</i> , rust
copper oxychloride	Guardsman copper oxychloride Clean Crop Copper Spray	50% WP	13245 19146	C	fire blight
	Later's Copper Greenleaf Copper	50% WP	16140 16637	D	fire blight
mancozeb	Dithane M-45 Manzate 200 DF	80% WP	8556	C	<i>Fabraea</i>
		75% DF	21057	C	
myclobutanil	Nova	40% WP	22399	C	rust
sulphur + zineb + rotenone + methoxychlor	Greenleaf Rose Dust	50% DU 4.5% 0.75% 5%	15392	D	<i>Fabraea</i>
sulphur + tribasic copper sulphate + carbaryl + malathion	Wilson's Rose & Flower Dust	20% DU 5% 5% 2%	18632	D	<i>Fabraea</i> , rust
tribasic copper sulphate	Wilson's Bordo	53% WP	17482	D	<i>Fabraea</i> , fire blight
HOLLY:					
chlorothalonil	Daconil 2787	40.4% SU	15724	C	rhizoctonia web blight
mancozeb	Dithane M-45 Manzate 200 DF	80% WP	8556	C	leaf & twig blight
		75% DF	21057	C	
HOLLYHOCK:					
chlorothalonil	Daconil 2787	40.4% SU	15724	C	rust
myclobutanil	Nova	40% WP	22399	C	rust, powdery mildew
sulphur	Safer's Sulphur Dust Wilson Garden Sulphur Green Earth Sulphur	92% WP	19703 17546 21890	D	powdery mildew, rust
	Later's Garden Sulphur	90% WP	5293	D	powdery mildew, rust

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HOLLYHOCK con't					
sulphur con't	Safer's Defender Garden Fungicide	12% LC	19691	D	powdery mildew, rust
	Wilson Green Earth Sulphur	0.9% L	21880	D	powdery mildew, rust
	Safer's Defender Garden Fung. Safer' Liquid Sulphur	0.4% L	20812, 19061 19451	D	powdery mildew, rust
sulphur + tribasic copper sulphate + carbaryl + malathion	Wilson's Rose & Flower Dust	20% DU 5% 5% 2%	18632	D	powdery mildew, rust
sulphur + zineb + rotenone + methoxychlor	Greenleaf Rose Dust	50% DU 4.5% 0.75% 5%	15392	D	powdery mildew, rust
IRIS GERMANICA:					
benomyl	Later's Benomyl Wilson's Benomyl Greenleaf Benomyl	50% WP	11542 17546 21890	D	rhizome rot
chlorothalonil	Daconil 2787	40.4% SU	15724	C	leaf spot, <i>Botrytis</i> blossom blight
myclobutanil	Nova	40 WP	22399	C	rust
JUNIPER:					
captan + thiophanate methyl + carbaryl + malathion	Green Cross Gardal Rose & Evergreen Dust	5% DU 3% 5% 4%	14851	D	foliar blight
copper oxychloride	Guardsman copper oxychloride Clean Crop Copper Spray	50% WP	13245 19146	C	needlecast, twig blight
	Later's Copper Greenleaf Copper	50% WP	16140 16637	D	needlecast, twig blight
mancozeb	Dithane M-45	80% WP	8556	C	coryneum blight, dieback, keithia blight, pear trellis rust
	Manzate 200 DF	75% DF	21057	C	coryneum blight, dieback, keithia blight
myclobutanil	Eagle T & O	40% WP	26585	C	rust

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KALMIA:					
chlorothalonil	Daconil 2787	40.4% SU	15724	C	cercospora leaf spot
tribasic copper sulphate	Wilson's Bordo	53% WP	17482	D	leaf spot
LILAC:					
captan	Clean Crop Captan	50% WP	5371	C	botrytis blight
	Clean Crop Captan	80% WP	10780	C	botrytis blight
	Captan 80 WP Instapak	80% WP	22423		
	Clean Crop Supra Captan	80% WDG	24613		
Maestro	80% DF	26408			
captan + methoxychlor + rotenone	Later's Golden Garden Dust	5% DU 5% 0.75%	17544, 17545	D	botrytis blight
copper oxychloride	Guardsman copper oxychloride Clean Crop Copper Spray	50% WP	13245 19146	C	bacterial blight
	Later's Copper Greenleaf Copper	50% WP	16140 16637	D	bacterial blight
fenhexamid	Decree	50% WG	26132	C	botrytis blight
myclobutanil	Nova	40% WP	22399	C	powdery mildew
LILY:					
chlorothalonil	Daconil 2787	40.4% SU	15724	C	gray mold
MAHONIA:					
chlorothalonil	Daconil 2787	40.4% SU	15724	C	rust
MOUNTAIN ASH:					
captan + carbaryl + malathion	Green Cross Fruit Tree & Garden Spray	10% WP 10% 5%	9986	D	scab
copper oxychloride	Guardsman copper oxychloride Clean Crop Copper Spray	50% WP	13245 19146	C	fire blight
	Later's Copper Greenleaf Copper	50% WP	16140 16637	D	bacterial blight

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PEONY:					
fenhexamid	Decree	50% WG	26132	C	<i>Botrytis</i>
sulphur + tribasic copper sulphate + carbaryl + malathion	Wilson's Rose & Flower Dust	20% DU 5% 5% 2%	18632	D	<i>Botrytis</i>
sulphur + zineb + rotenone + methoxychlor	Greenleaf Rose Dust	50% DU 4.5% 0.75% 5%	15392	D	<i>Botrytis</i>
iprodione	Rovral	50% WP	15213	C	<i>Botrytis</i>
PHOTINIA:					
chlorothalonil	Daconil 2787	40.4% SU	15724	C	<i>Fabraea</i> leaf spot
RHODODENDRON & AZALEA:					
captan	Maestro	80% DF	26408	C	damping off, rot of cuttings
chlorothalonil	Daconil 2787	40.4% SU	15724	C	ovulinia flower blight, phytophthora foliar blight
etridiazole	Truban	30% WP 25% EC	11460 12222	C	phytophthora root rot
metalaxyl	Subdue 2G	2% GR	18818	C	phytophthora root rot
myclobutanil	Nova	40% WP	22399	C	powdery mildew
propiconazole	Banner	130 g/L EC	23693	C	powdery mildew
sulphur	Safer's Sulphur Dust Wilson's Garden Sulphur Green Earth Sulphur	92% WP	19703 17546 21890	D	powdery mildew, rust
	Later's Garden Sulphur	90% WP	5293	D	powdery mildew, rust
	Safer's Defender Garden Fungicide	12% LC	19691	D	powdery mildew, rust
	Wilson Green Earth Sulphur	0.9% L	21880	D	powdery mildew, rust
	Safer's Defender Garden Fung. Safer' Liquid Sulphur	0.4% L	20812, 19061 19451	D	powdery mildew, rust

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ROSE:					
<i>Agrobacterium radiobacter</i>	Dygal	-	21106	C	crown gall
benomyl	Later's Benomyl Wilson's Benomyl Greenleaf Benomyl	50% WP	11542 17546 21890	D	black spot, powdery mildew
captan	Clean Crop Captan Captan 50W	50% WP 50% WP	5371 14823	C	black spot, <i>Botrytis</i>
	Clean Crop Captan Captan 80 WP Instapak Clean Crop Captan Cleanpak Clean Crop Captan Clean Crop Supra Captan Maestro	80% WP 80% WP 80% WP 80% WDG 80% WDG 80% DF	10780 22423 23190 23691 24613 26408	C	black spot, <i>Botrytis</i>
captan + methoxychlor + rotenone	Later's Golden Garden Dust Greenleaf Golden Garden Dust	5% DU 5% 0.75%	17544 17545	D	black spot
captan + thiophanate methyl + carbaryl + malathion	Green Cross Gardal Rose & Evergreen Dust	5% DU 3% 5% 4%	14851	D	black spot
chlorothalonil	Daconil 2787	40.4% SU	15724	C	black spot, <i>Botrytis</i>
copper oxychloride	Guardsman copper oxychloride Clean Crop Copper Spray	50% WP	13245 19146	C	bacterial blight
	Later's Copper Spray Greenleaf Copper Spray	50% WP	16140 16637	D	bacterial blight
copper (picric cupric ammonium formate and tannate complex)	Phyton 27	5.5% LI	21699	C	<i>Botrytis</i> , black spot, powdery mildew
copper (tribasic copper sulphate)	Clean Crop Copper	53% WP	9934	C	black spot, powdery mildew
	Wilson's Bordo	53% WP	17482	D	
dicloran	Botran	75% WP	8772	C	<i>Botrytis</i>
dodemorph-acetate	Meltatox	400 g/L LI	11798, 22540	C	powdery mildew
folpet	Folpan	50% WP	15654	C	black spot, powdery mildew
	Later's Folpet	50% WP	15798	D	
folpet + malathion + carbaryl	C-I-L Rose Dust	5% DU 4% 5%	10565	D	black spot, powdery mildew
metalaxyl	Subdue 2G	2% GR	18818	C	stem rot of cuttings
myclobutanil	Nova Eagle T & O	40% WP	22399 26585	C	powdery mildew, rust, black spot

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ROSE con't					
propiconazole	Banner	130 g/L EC	23693	C	powdery mildew
sulphur	Safer's Sulphur Dust Wilson's Garden Sulphur Green Earth Sulphur	92% WP	19703 17546 21890	D	black spot, powdery mildew, rust
	Later's Garden Sulphur	90% WP	5293	D	
	Safer's Defender Garden Fungicide	12% LC	19691	D	
	Wilson Green Earth Sulphur	0.9% L	21880	D	
	Safer's Defender Garden Fung. Safer' Liquid Sulphur	0.4% L	20812, 19061 19451	D	black spot, powdery mildew
	Wilbur-Ellis Sulphur	80% DF	23171	C	
sulphur + tribasic copper sulphate + carbaryl + malathion	Wilson's Rose & Flower Dust	20% DU 5% 5% 2%	18632	D	black spot, powdery mildew, rust
sulphur + zineb + rotenone + methoxychlor	Greenleaf Rose Dust	50% DU 4.5% 0.75% 5%	15392	D	black spot, <i>Botrytis</i> , powdery mildew, rust
sulphide sulphur	C-I-L Liquid Lime Sulphur Greenleaf Lime Sulphur	23% LI 21% LI	7386 9243	D	black spot, canker, powdery mildew
thiophanate-methyl	Green Cross Easout	70% WP	19465	C	black spot, powdery mildew
triforine	Funginex	190 g/L EC	14701	C	black spot, powdery mildew
	Green Cross Funginex	6.5% LI	15727	D	
zineb + sulphur + rotenone + methoxychlor	Greenleaf Rose Dust	4.5 DU 50 % 0.75% 5%	15392	D	black spot, <i>Botrytis</i> , powdery mildew, rust
THUJA:					
copper oxychloride	Guardsman copper oxychloride Clean Crop Copper Spray	50% WP	13245 19146	C	tipblight, leaf blight
	Later's Copper Spray Greenleaf Copper Spray	50% WP	16140 16637	D	
mancozeb	Dithane M-45	80% WP	8556	C	keithia blight, coryneum blight
propiconazole	Topas	250 g/L EC	24030	C	keithia blight
	Propiconazole	250 g/L EC	24029	C	

APPENDIX 2. Fungicides Registered for Use on Bulbs in Canada

Active Ingredient	Trade Name	Formulation	PCP#	C/D	Diseases Controlled
GLADIOLUS, IRIS, NARCISSUS, TULIP: (See below for individual registrations)					
benomyl	Later's Benomyl Wilson's Benomyl Greenleaf Benomyl	50% WP	11542 17546 21890	D	fusarium bulb and corm rot
captan	Clean Crop Captan	50% WP	5371	C	bulb rot, damping off
	Captan 50W	50% WP	14823		
	Clean Crop Captan	80% WP	10780	C	
	Captan 80 WP Instapak	80% WP	22423		
	Clean Crop Captan Cleanpak	80% WP	23190		
	Clean Crop Captan	80% WDG	23691		
Clean Crop Supra Captan	80% WDG	24613			
Maestro	80% DF	26408			
captan + carbaryl	Greenleaf Bulb Dust Later's Bulb Dust Wilson's Bulb & Soil Dust	5% DU 5%	15389 12146 14852	D	Bulb rot, root rot, damping off
formaldehyde	Clean Crop Formalin	37% LI	6998	C	nematodes in stored bulbs
GLADIOLUS:					
chlorothalonil	Daconil 2787	40.4% SU	15724	C	flower & leaf spot <i>Botrytis, Curvularia</i>
IRIS:					
chlorothalonil	Daconil 2787	40.4% SU	15724	C	flower & leaf spot <i>Botrytis, Curvularia</i>
folpet	Folpan	50% WP	15654	C	leaf spot
	Later's Folpet	50% WP	15798	D	
myclobutanil	Nova	40% WP	22399	C	rust
quintozene	Quintozene (Terraclor)	75% WP	11425, 7251	C	bulb rot
NARCISSUS:					
quintozene	Quintozene (Terraclor)	75% WP	11425	C	bulb rot

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APPENDIX 2. Fungicides Registered for Use on Bulbs in Canada con't

TULIP:					
captan	Clean Crop Captan Captan 50W	50% WP 50% WP	5371 14823	C	flower blight, <i>Botrytis</i>
	Clean Crop Captan Cleanpak Clean Crop Supra Captan Maestro	80% WP 80% WDG 80% DF	23190 24613 26408	C	
captan + methoxychlor + rotenone	Later's Golden Garden Dust Greenleaf Golden Garden Dust	5% DU 5% 0.75%	17544 17545	D	botrytis blight
quintozene	Quintozene (Terraclor)	75% WP	11425, 7251	C	bulb rot

APPENDIX 3. General Ornamental Registrations in Canada

Active Ingredient	Trade Name	Formulation	PCP#	C/D	Diseases Controlled
<i>Agrobacterium radiobacter</i>	Dygal	-	21106	C	crown gall
benomyl	Later's Benomyl Wilson's Benomyl Greenleaf Benomyl	50% WP	11542 17546 21890	D	<i>Botrytis</i> , powdery mildew
dazomet	Basamid	98% GR	15032	C	nematodes
etridiazole	Truban	30% WP	11460	C	stem rot, root rot, damping off
fenhexamid	Decree	50% WG	26132	C	<i>Botrytis</i>
iprodione	Rovral	50% WP	15213	C	<i>Rhizoctonia</i> , damping off
metalaxyl	Subdue 2G	2% GR	18818	C	damping off, root rot (greenhouse only)
metalaxyl-m	Subdue Maxx	240 g/L EC	27055	C	damping off, root and stem rot caused by <i>Pythium</i> spp., <i>Phytophthora</i> spp. (nurseries & greenhouse only)
metam sodium	Vapam	380 g/L LI	6453	C	soil fungi, weeds, nematodes
oxine benzoate	No-Damp	2.5% LI	3794 11880	C D	damping off
thiophanate-methyl	Easout	70% WP	19465	C	powdery mildew, <i>Botrytis</i> , leaf spots
	Senator	70% WP	12279, 25343	C	