

Chapter Eleven

DISEASES OF TREE FRUIT AND SMALL FRUIT CROPS

The B.C. Certified Budwood Program	11-6
Plant Breeders' Patent and Trademark Rights	11-6
Okanagan Plant Improvement Co. Ltd. (PICO)	11-6
APPLE (<i>Malus sylvestris</i>)	11-7
Anthracnose Canker	11-7
Apple Replant Disease	11-7
Crown Gall	11-8
Crown And Root Rot	11-9
Fire Blight	11-9
Nectria Canker	11-10
Perennial Canker, Bull's-eye Rot	11-10
Powdery Mildew	11-11
Scab	11-12
Silver Leaf	11-13
Other Diseases	11-14
Blister Spot	11-14
Chlorotic Leaf Spot	11-14
Dieback and Canker	11-14
Dry Eye Rot	11-14
Flat Apple	11-14
Flat Limb	11-14
Fruit Rots	11-14
Graft Union Disorder	11-14
Ltb Rot	11-14
Mosaic	11-14
Puckerleaf	11-14
Ring Russeting	11-14
Rubbery Wood	11-14
Sour Sap	11-14
Stem Grooving	11-14
Stem Pitting	11-14
APRICOT	11-14
Bacterial Canker	11-14
Brown Rot	11-14
Crown And Root Rot	11-15
Leucostoma Canker	11-15
Replant Disease	11-15
Ring Pox (Ring Spot)	11-15
Shot Hole	11-16
Other Diseases	11-16
Apricot Freckles	11-16
Crown Gall	11-16
Fruit Rots	11-16
Silver Leaf	11-16
Quarantine Diseases	11-16
Plum Pox (Sharka)	11-16
BLUEBERRY	11-16

Alternaria Fruit Rot	11-16
Anthracnose Fruit Rot	11-17
Bacterial Blight	11-17
Crown Gall	11-18
Godronia Stem Canker	11-18
Gray Mold Blight	11-18
Mummy Berry, Blossom Blight	11-19
Other Diseases	11-19
Scorch Virus	11-19
Blueberry Shock Virus	11-19
CHERRY, SOUR AND SWEET	11-20
Alternaria Rot	11-20
Bacterial Canker (Blast)	11-20
Brown Rot	11-21
Crown And Root Rot	11-22
Crown Gall	11-22
Leaf Spot (Shot Hole)	11-22
Little Cherry	11-23
Necrotic Ring Spot (Tatterleaf, Rusty Mottle)	11-23
Powdery Mildew	11-24
Replant Disease	11-24
Shot Hole	11-24
Other Diseases	11-25
Chlorotic Leaf Spot	11-25
Decline	11-25
Dieback and Canker	11-25
Fruit Rots	11-25
Green Fruit Rot	11-25
Green Ring Mottle	11-25
Lambert Mottle	11-25
Mottle Leaf	11-25
Rasp Leaf	11-25
Twisted Leaf	11-25
Verticillium Wilt	11-25
X-disease	11-25
Quarantine Diseases	11-25
Plum Pox (Sharka)	11-25
CHOCHECHERRY	11-25
Brown Rot	11-25
Other Diseases	11-26
Bacterial Blast	11-26
Black Knot	11-26
Dieback	11-26
Fire Blight	11-26
Gray Mold Fruit Rot	11-26
Powdery Mildew	11-26
Shot Hole	11-26

CRANBERRY	11-26
Fruit Rot	11-26
Hard Rot (Cotton Ball)	11-27
Twig Blight	11-27
CURRENT, GOOSEBERRY	11-28
Powdery Mildew	11-28
Other Diseases	11-29
Blister Rust	11-29
Leaf Spot	11-29
Rust	11-29
Nectria	11-29
GRAPE	11-29
Bunch Rot	11-29
Crown Gall	11-30
Powdery Mildew	11-30
Other Diseases	11-31
Crown and Root Rot	11-31
Phomopsis Cane and Leaf Spot	11-31
Downy Mildew	11-31
Fan Leaf	11-31
Corky Bark	11-31
Leafroll	11-31
HAZELNUT	11-31
Bacterial Blight	11-31
PEACH	11-32
Brown Rot	11-32
Crown And Root Rot	11-32
Crown Gall	11-33
Leaf Curl	11-33
Leucostoma Canker	11-33
Powdery Mildew	11-34
Replant Disease	11-34
Rhizopus Fruit Rot	11-34
Shot Hole	11-35
X-disease	11-35
Other Diseases	11-35
Bacterial Canker	11-35
Bacterial Spot	11-35
Fruit Rots	11-35
Silver Leaf	11-35
Quarantine Diseases	11-36
Plum Pox (Sharka)	11-36
PEAR	11-36
Crown And Root Rot	11-36
Crown Gall	11-36
Decline	11-36
Fire Blight	11-36
Pear Trellis Rust	11-37
PEAR (continued)	
Replant Disease	11-38

Other Diseases	11-38
Chlorotic Leaf Spot	11-38
Powdery Mildew	11-38
Scab	11-38
Stony Pit	11-38
Vein Yellows	11-38
PLUM and PRUNE	11-38
Black Knot	11-38
Brown Rot	11-39
Silver Leaf	11-39
Other Diseases	11-40
Crown and Root Rot	11-40
Crown Gall	11-40
Plum Pockets	11-40
Prune Dwarf	11-40
Replant Disease	11-40
Verticillium Wilt	11-40
Quarantine Diseases	11-40
Plum Pox	11-40
RASPBERRY	11-41
Anthracnose	11-41
Bacterial Blight	11-41
Cane Blight	11-42
Crown Gall	11-42
Gray Mold Fruit Rot	11-43
Gray Mold Wilt	11-43
Powdery Mildew	11-44
Raspberry Bushy Dwarf	11-44
Raspberry Mosaic	11-44
Root Rot	11-45
Spur Blight	11-45
Tomato Ringspot	11-46
Yellow Rust	11-47
Other Diseases	11-47
Fire Blight	11-47
Late Yellow Rust	11-47
SASKATOON	11-47
Black Leaf, Witches' Broom	11-47
Brown Rot, Blossom and Twig Blight	11-48
Cytospora Dieback And Canker	11-48
Entomosporium Leaf And Berry Spot	11-49
Powdery Mildew	11-49
Rust	11-50
Other Diseases	11-50
Bacterial Blast	11-50
Crown Gall	11-50
Dieback	11-50
Fire Blight	11-50
Gray Mold Fruit Rot	11-50
Silverleaf	11-50
STRAWBERRY	11-50
Black Root Rot	11-50
Fruit Rot	11-51

Gray Mold Fruit Rot	11-51
Powdery Mildew	11-52
Red Stele	11-52
Verticillium Wilt	11-53
Virus Diseases	11-53
Other Diseases	11-53
Leaf Spot	11-53
GENERAL REFERENCES	11-54
APPENDIX I. Fungicides Registered for Use on Apples and Pears	11-56
APPENDIX II. Fungicides Registered for Use on Stone Fruits	11-58
APPENDIX III. Fungicides Registered for Use on Grapes	11-60
APPENDIX IV. Fungicides Registered for Use on Blueberries, Cranberries, and Currants	11-61
APPENDIX V. Fungicides Registered for Use on Raspberry and Strawberry	11-62
APPENDIX VI. Fungicides Registered for Use on Saskatoons	11-64
APPENDIX VII. Fungicides Registered for Use on Filbert/Hazelnut	11-64

NOTE: Benomyl (Benlate) products are coming off production December, 2001 and existing stocks will only be available until 2002. Anilazine (Dyrene) will be discontinued as of December 31, 2002 and growers have until December 31, 2005 to use up existing stocks.

The B.C. Certified Budwood Program

The B.C. Certified Budwood Program has become a reliable source of fruit-propagating material that is true-to-variety name and free of harmful viruses. Apple, pear, peach, apricot, prune, and sweet and sour cherry material is available. This material is indexed into categories such as VF and BA (Virus-Free and Best Available). Virus-free (VF) material has been fully indexed for all viruses and found to be clean. Best Available (BA) is material of varieties that are not found in virus-free form anywhere in the world. The viruses in this stock are already present in British Columbia and do not constitute a major threat.

Plant Breeders' Patent and Trademark Rights

Canadian Plant Breeders' Rights (PBR) and US plant patent laws prohibit the propagation of protected plant materials for personal use and sale without written permission of the owner or the owner's agent prior to topworking or propagation. The use of trademarks without authorization is prohibited.

Okanagan Plant Improvement Co. Ltd. (PICO)

The Okanagan Plant Improvement Co, Ltd. was established in 1993 by the BC Fruit Growers Association to initiate, plan, coordinate, and administer activities related to the improvement and commercial development of varieties on behalf of the Canadian fruit industry. The company has three main functions which link:

1. The budwood program provides the best propagation material of varieties for the production of quality trees and fruit to assist growers in optimizing their returns.
2. The product development/evaluation program facilitates and coordinates the evaluation of varieties and management techniques, collates information, and communicates results to industry to assist growers and extension personnel in planting and variety management decisions.
3. The variety commercialization program provides management and leadership in sourcing plant material, seeking intellectual property rights, in planning and monitoring product development, negotiating licenses, promoting and marketing varieties to meet grower and industry needs.

*Okanagan Plant Improvement Co. Ltd.
P.O. Box 6000
Summerland, B.C. V0H 1Z0 Canada
Tel: (250) 404-0088 or 494-5157
Fax: (250) 494-7472
General Manager: James Calissi*

APPLE (*Malus sylvestris*)

ANTHRACNOSE CANKER

Neofabraea malicorticis (= *Pezicula malicorticis*)

Cultural: Prune out and remove all cankers during winter pruning. Flag and record the locations of these trees because they will have latent infections. Prune out any new cankers as they appear during the spring and summer, and remove them from the orchard. Destroy cankered wood. Developing cankers often girdle 1-year-old wood; remove any shoots that wilt or die suddenly during April through July.

Resistant Cultivars: All cultivars are susceptible to anthracnose canker. Bramleys, Gravenstein, King, Northern Spy, Spartan and Spigold appear to be more tolerant to the disease than highly susceptible cultivars such as Belle de Boskoop, Cox Orange, Elstar, Empire, Gala, Idared and Sinta.

Chemical: None.

Notes:

1. Spores from first year cankers can spread over short distances by rain or overhead irrigation during the late summer and fall months. Spores from overwintered cankers are discharged into the air during spring through summer and can spread over long distances. Cankers become visible in the year following infection.
2. Anthracnose canker is prevalent in the south coastal region of British Columbia and isolated pockets of the Kootenay Valley. It occurs only rarely in interior districts.
3. New perennial cankers are indistinguishable in appearance from anthracnose cankers. Spores from anthracnose cankers cause a storage fruit rot that is indistinguishable from bull's-eye rot.

References:

1. Grove, G. 1990. Anthracnose and perennial canker. Page 36-38 in *Compendium of Apple and Pear Diseases*. APS Press, St. Paul, MN.
2. Rahe, J. 1997. Anthracnose canker of apples: put away the sprayer and get out the knife and brush. *Cider Press*. 10: 6-9. (P.O. Box 48123, 3575 Douglas St., Victoria BC V8Z 7H5).
3. DeJong, S.N., Levesque, C.A., Verkley, G.J, Albeln, E.C.A., Rahe, J.E. and Braun, P.G. 2001. Phylogenetic relationships among *Neofabraea* species causing tree cankers and bull's eye rot of apple based on DNA sequencing of ITS nuclear rDNA, mitochondrial rDNA, and the beta-tubulin gene. *Mycol. Res.* 105: 658-669.

APPLE REPLANT DISEASE

Biotic/abiotic complex (see note 1)

Cultural: Testing of orchard soil for replant disease prior to planting is recommended for proper diagnosis and to determine the best treatments (see note 2). Soil analysis is also recommended to detect nutrient deficiencies and to determine whether lime or sulphur is required to adjust pH. Soil replacement with 20 L or more of new soil or well prepared, steamed planting soil mixture, or soil replacement with a ratio of 1 part peat to 2 parts planting-hole soil can be satisfactory alternatives to chemical treatment of the planting site. Application of ammonium phosphate fertilizer (11-55-0 or 11-51-0) is a beneficial treatment in most orchards when mixed with planting hole soil at a rate of 1.0 g/L. Care must be taken to avoid fertilizer

concentrations close to roots or burning and death may result. Handle trees carefully and plant as early as possible. Pay special attention to all cultural practices, including irrigation and mineral sprays.

Chemical: Soil fumigants registered for control of nematodes and soil-borne diseases in orchard soils prior to planting include dazomet (COM); 1,3-dichloropropene + chloropicrin (COM); metam sodium (COM). A soil test for apple replant disease is recommended to determine whether fumigants are necessary (see note 1). Limitations: As per labels.

Notes:

1. Apple replant disease is one of the components of apple replant problem and contributes to the poor growth of apple trees planted on old apple or pear orchard sites. Both biological and abiological factors have been associated with this disease in different parts of the world. In British Columbia, interactions of fungi (including *Penicillium janthinellum*, *Constantinella terrastris*, *Trichoderma* spp.), bacteria and nematodes (*Pratylenchus penetrans*) are associated with replant disease. Other suspected factors include poor soil structure, moisture stress, low or high pH, insufficient available phosphorous, and cold stress.
2. Because of the variability of possible treatments in different soils, B.C. growers are advised to have soil tested for replant disease prior to planting to determine the best treatments for their site. A commercial apple replant testing service is available in the Okanagan.

References:

1. Beulah, J.E. 1990. Alternatives to chemical control of apple replant disease. ARSDA Project 11016 report. 48 pp.
2. Okanagan Valley Tree Fruit Authority. 1995. Soil Fumigation for Orchards: An Overview. 12pp.
3. Slykhuis, J.T. and T.S.C. Li. 1985. Responses of apple seedlings to biocides and phosphate fertilizers in orchard soils in British Columbia. Can. J. Plant Pathol. 7: 294-301.
4. Utkhede, R.S. and T.S.C. Li. 1989. Chemical and biological treatments for control of apple replant disease in British Columbia. Can. J. Plant Pathol. 11: 143-147.

CROWN GALL

Agrobacterium radiobacter var. *tumefaciens*

Cultural: Plant disease-free stock. Avoid injuring trees when planting as bacteria enter through injuries. Remove trees found with large galls surrounding the crowns when the trees become unproductive.

Resistant Cultivars: None.

Chemical: Remove soil around underground galls and allow them to dry one or more days before treatment. Cut off the major portions of the galls larger than 7 cm in diameter. Paint gall, cut surfaces and 1 cm of surrounding healthy bark with 2,4-xylenol + meta-cresol [Gallex] COM and allow galls to dry before replacing soil (see notes 1 and 2). Limitations: As per label.

Notes:

1. To prevent sudden shock by loss of water and food movement in severely galled and girdled trees, treat only half the girdled trunk at one time. Treat the remaining galled surface four to six months later when an examination of the initial treatment is made.
2. The chemical Gallex has temporary registration.

CROWN AND ROOT ROT*Phytophthora cactorum*

Cultural: The most important control is the selection of resistant root stocks. Trees already diseased can be saved if damage is not extensive. Expose the crown and scrape away diseased tissue to permit air drying. Inarching around the diseased area can save a diseased tree but is often not worth the labour.

Resistant Cultivars: None.

Intermediate: M4, M9, M111, Mark and O2 rootstocks.

Susceptible: M2, M26, B9, A2, seedling rootstocks

Very Susceptible: M7, M104, M106 (see note 2)

Chemical: Apply fosetyl aluminum (COM) WG as a foliar spray (bearing trees) or a drench (non-bearing trees) as per label directions up to three times per season. For non-bearing trees only, apply metalaxyl (COM) in 5 litres of water per tree as a drench to the surface of the soil around the crown. The first application should be at the time of planting and repeated in late August. Repeat in following years if necessary but on non-bearing trees only.

Limitations: Metalaxyl: for use on non-bearing trees only. Do not use fosetyl aluminum as a drench on bearing trees. Do not use fosetyl aluminum within 30 days of harvest.

Notes:

1. Severity and distribution of the disease is variable and unpredictable.

References:

1. Utkhede, R.S. 1987. Chemical and biological control of crown and root rot of apple caused by *Phytophthora cactorum*. Can. J. Plant Pathol. 9: 295-300.
2. Utkhede, R.S. 1987. Control of crown rot (*Phytophthora cactorum*) of apple trees with the systemic fungicides metalaxyl and fosetyl aluminum. Pesticide Science 19: 289-295.

FIRE BLIGHT*Erwinia amylovora*

See pear, FIRE BLIGHT on page 11-36.

NECTRIA CANKER (=EUROPEAN CANKER)

Nectria galligena

Cultural: Prune out diseased wood. Disease incidence and severity are greater in trees that are overly vigorous and succulent and can be reduced by use of less fertilizer.

Resistant Cultivars: None.

Intermediate: Golden Delicious, Jonathan and Rome Beauty

Susceptible: Bismark, Cox's Orange Pippin, Golden Winter Pearmain, Gravenstein, McIntosh, Newtown, Red Delicious, Spitzenburg, and White transparent.

Chemical: None.

Notes:

1. This canker resembles perennial canker except that Nectria canker appears deeper and the edges more eroded. Scraping and excision of cankers is useful.
2. Nursery trees should be examined carefully for symptoms of the disease. Trees with cankers should be returned to the nursery for replacement or discarded.

References:

1. Grove, G. 1990. Nectria canker. Pages 35-36 in *Compendium of apple and pear diseases*. APS Press, St. Paul, MN.
2. Jones, A.L. and Sutton, T.B. 1996. Nectria canker. Page 37 in *Diseases of Tree Fruits in the East*. NCR 45 Michigan State Univ., East Lansing, MI.

PERENNIAL CANKER, BULL'S-EYE ROT

Neofabraea perennans (= *Pezicula malicorticis*)

Cultural: Avoid planting young trees under old diseased trees. Prune out cankers in these trees. See Anthracnose Canker (page 11-7) for details on pruning out cankers. Keep fruit dry after harvest. Commercial growers should move fruit to the packing house quickly after harvest especially in wet weather.

Resistant Cultivars: Delicious, McIntosh, Stayman, Winesap and Wealthy

Susceptible: Spitzenburg, Newtown, Rome Beauty, Golden Delicious, Jonathan, Granny Smith, and Gravenstein.

Chemical: In mid-summer, scrape dead bark from around cankers and paint the surface with a 50:50 mixture of boiled linseed oil and either ferbam (COM, DOM) SU, WG, WP or ziram (COM) WP. Limitations: As per label.

Notes:

1. Bull's-eye rot is caused by the same fungi that cause perennial and anthracnose cankers on the limbs and trunks of trees.
2. Spores may be spread from cankers to fruit by rain or overhead irrigation.
3. Woolly aphids numbers may contribute to the spread of perennial canker. Usually the parasite *Aphelinas mali* and several predators keep population levels low, however in some cases insecticides are necessary.
4. Fungicides applied for apple scab in August will suppress bull's-eye rot.
5. Bull's-eye rot of fruit is more likely to develop on long-stored fruit, particularly Newtown, Winesap, Golden Delicious and Spartan.

References:

1. Koepsell, P. *et al.* 1988. Pacific N.W. Plant Dis. Control Handbook. Ore. State Univ. Corvallis. Pp. 7-8.
2. Grove, G. 1990. Anthracnose and perennial canker. Pages 36-38 *in* Compendium of Apple and Pear Diseases. APS Press, St. Paul, MN.

POWDERY MILDEW*Podospaera leucotricha*

Cultural: Avoid close dense plantings especially in areas with poor air drainage. Prune out twigs with white fungal growth on the surface during the dormant season.

Dormant monitoring: The number of mildew sprays required prior to blossom can be predicted by estimating the percentage of one-year shoots showing the white fungus on the bark surface during the dormant season. If more than 15% of one-year-old shoots have mildew, two pre-bloom sprays are required. Spray once prior to bloom for levels between 5 and 15%. No pre-bloom spray is needed if the mildew level is below 5%.

Resistant Cultivars: None.

Intermediate: Empire, Fuji, Red Delicious, Spartan.

Susceptible: Braeburn, Elstar, McIntosh, Golden Delicious, Jonathan, Jonagold, Gala, Granny Smith, Shamrock, Sunrise.

Chemical: Apply dinocap (COM) WP; myclobutanil (COM) WP; flusilazole (COM) DF; kresoxim-methyl (COM) WG; sulphur (COM, DOM) SU, WP; thiophanate-methyl (COM) WP; benomyl (COM, DOM) WP + metiram (COM) DF; benomyl + captan (COM, DOM) WP, when green tips of buds are visible at pink and at 7-14-day intervals until shoot growth ceases. Triforine (COM) EC may be applied to non-bearing trees only.

Limitations: Preharvest interval - 1 day (sulphur, thiophanate-methyl); 7 days (benomyl + metiram, benomyl + captan); 14 days (myclobutanil); 21 days (dinocap); 30 days (kresoxim-methyl); 77 days (flusilazole). Do not use benomyl + captan on Golden Delicious, Rome or Stayman. Do not graze benomyl + captan-treated areas or feed clippings from treated areas to livestock. Do not feed benomyl + captan-treated crop refuse to livestock. Benomyl + captan may cause russetting on sensitive varieties. Do not apply sulphur or dinocap at temperatures above 32°C. Do not exceed 6 applications of myclobutanil per season. Do not exceed 4 applications of flusilazole per season. Do not exceed 4 applications of kresoxim-methyl per season.

Notes:

1. Early sprays are required when it is hot to achieve effective control throughout the season on susceptible varieties.
2. Repeated use of sulphur can result in mite build-up.
3. Severe cold will reduce the amount of overwintering inoculum.
4. Jonagold fruit are more sensitive to sulphur injury than other varieties.

References:

1. Yoder, K.S., and Hickey, K.D. 1983. Control of apple powdery mildew in the mid-Atlantic region. *Plant Disease* 67: 245-248.
2. Spotts, R.A. and Cervantes, L.A. 1986. Effects of fungicides that inhibit ergosterol biosynthesis on apple powdery mildew control, yield and fruit growth factors. *Plant Disease* 70: 305-306.
3. Sholberg, P.L., Lane, W.D., Haag, P., Bedford, K. and Lashuk, L. 2001. A novel technique for evaluation of apple (*Malus x domestica* Borkh.) cultivars for susceptibility to powdery mildew. *Can. J. Plant Sci.* 81: 289-296.

SCAB

Venturia inaequalis

Cultural: Scab infections are initiated by spores that are discharged from overwintered apple leaves on the orchard floor beginning at the silver tip to green tip stage of bud development in the spring. The amount of overwintering leaves can be reduced by raking, mulching or winter ground sprays with dilute urea to enhance decomposition. Infection requires prolonged leaf wetness, and pruning and vegetation control that improves air circulation in tree canopies can significantly reduce the number of infection periods.

Resistant Cultivars: Bramleys, Discovery, Dayton, Goldrush, Liberty, Prima, Redfree, and Florina

Susceptible: Red and Golden Delicious, Spartan, Granny Smith, Jonagold

Highly Susceptible: McIntosh, Red Rome, Gala, Empire, Mutsu.

Chemical: Scab infections produce new spores within the canopy that cause intensification of the disease. Young leaf and fruit tissue is more susceptible than older tissue, and good control during the period between early green tip and chemical thinning is critical. If infection periods are likely, protectant sprays should begin at early green tip, and continue as weather dictates.
Use metiram (COM) DF, mancozeb (COM) WG, captan (COM) WG, WP, cyprodinil (COM) WG, or

kresoxim-methyl (COM) WG as protectant sprays. Initiate sprays at green tip and every 7-10 days until late June or early July. Do not use captan during bloom as it can inhibit pollination in some varieties. As eradicants, use myclobutanil (COM) WP, flusilazole (COM) DF, kresoxim-methyl (COM) WG, thiophanate-methyl (COM) WP or benomyl (COM, DOM) WP in combination with a protectant fungicide as per labels. Dodine (COM) WP has both eradicant and protectant activity. Excessive or unnecessary use of eradicant chemicals will favour selection for fungicide insensitive strains of *V. inaequalis*.

Limitations: Preharvest interval - 1 day (thiophanate-methyl); 7 days (dodine, benomyl + captan, captan + thiophanate-methyl); 30 days (kresoxim-methyl); 45 days (metiram, mancozeb, myclobutanil + mancozeb); 72 days (cyprodinil); 77 days (flusilazole). Do not use benomyl + captan on Golden Delicious, Rome or Stayman. Do not graze benomyl + captan or dodine-treated areas or feed clippings from treated areas to livestock. Benomyl + captan, and dodine may cause russetting of sensitive varieties. Do not exceed 6 applications of myclobutanil per season. Do not apply more than 2 applications of cyprodinil alone. Do not apply cyprodinil more than 6 times per season or more than 1.5 kg/ha product/season. Do not apply flusilazole more than 4 times per season. Do not apply kresoxim-methyl more than 4 times per season.

Notes: Resistance to benomyl is widespread in the central and north Okanagan and Vancouver Island areas of British Columbia. Dodine resistance is present in British Columbia but at a much lower level. Tank-mixing or alternating products having different modes of action will delay development of fungicide resistance.

References:

1. Biggs, A.R. 1990. Apple Scab. Pages 6-9 in *Compendium of Apple and Pear Diseases*. APS Press, St. Paul, MN.
2. MacHardy, W.E. 1996. *Apple Scab: Biology, Epidemiology, and Management*. APS Press. St. Paul, MN. 570 pp.
3. Sholberg, P.L., Yorston, J.M. and Warnock, D. 1989. Resistance of *Venturia inaequalis* to benomyl and dodine in British Columbia, Canada. *Plant Disease* 73: 667-669.

SILVER LEAF

Stereum purpureum

(See plum and prune, SILVER LEAF, on page 11-39).

OTHER DISEASES

The following diseases of apple are currently of minor importance (MI) and/or are diseases for which no practical control measures are currently recommended (NC):

Blister Spot (*Pseudomonas syringae* pv. *papulans*) MI

Chlorotic Leaf Spot (chlorotic leaf spot virus (CLSV) MI, NC

Dieback and Canker (*Cytospora* sp.) MI, NC

Dry Eye Rot (*Botrytis cinerea*) MI, NC

Flat Apple (flat apple virus) MI

Flat Limb (flat limb virus) MI

Fruit Rots (*Penicillium* sp., *Botrytis cinerea*, *Mucor piriformis*, *Monilinia* spp.) NC

Graft Union Disorder (tomato ring spot virus, tobacco ring spot virus) MI

Ltb Rot (Low-temperature basidiomycete fungus) MI, NC

Mosaic (apple mosaic virus (AMV) MI

Puckerleaf (apple puckerleaf virus) MI

Ring Russetting (Apple ring russetting viruses) MI

Rubbery Wood (Apple rubbery wood phytoplasma) MI

Sour Sap (a basidiomycete) MI

Stem Grooving (apple stem grooving virus) MI

Stem Pitting (apple stem pitting virus) MI

APRICOT (*Prunus armeniaca*)

BACTERIAL CANKER

Pseudomonas syringae

(See Cherry, BACTERIAL CANKER on page 11-20).

BROWN ROT

Monilinia fructicola, *M. laxa*

Cultural: Remove mummified fruit from the trees and soil surface. Prune out diseased twigs. Handle fruit carefully to avoid bruising and skin punctures.

Resistant Cultivars: None.

Chemical: For blossom brown rot: use iprodione (COM) WG, WP, captan (COM, DOM) SU, WP; benomyl (COM) WP + captan; cyprodinil (COM)WG; propiconazole (COM) EC. Sprays are necessary only during wet weather and should be applied when first blossoms open. If wet weather persists, further treatments are necessary at 50% bloom and at full bloom. The same materials and rates are used to prevent fruit brown rot by applying preharvest just as fruit begins to colour.

Limitations: Preharvest interval - 1 day (iprodione); 2 days (cyprodinil); 3 days (propiconazole); 7 days (captan, benomyl + captan). Do not apply cyprodinil more than 2 times for blossom blight or more than 2 times for fruit brown rot.

Notes: Control of insects that serve as vectors and/or provide wounds for infection is essential for effective brown rot control.

References:

1. Ogawa, J.M *et al.* 1995. Brown rot. Pages 7-10 in Compendium of Stone Fruit Diseases. APS Press, St. Paul, MN.

CROWN AND ROOT ROT

Phytophthora cactorum

(See Apple, CROWN AND ROOT ROT on page 11-9).

LEUCOSTOMA CANKER

Cytospora cincta, Cytospora leucostoma

(See Peach, LEUCOSTOMA CANKER on page 11-33).

REPLANT DISEASE

(see Apple, APPLE REPLANT DISEASE on page 11-7).

RING POX (RING SPOT)

Apricot ring pox virus

Cultural: Infected trees do not recover so should be replaced with virus free ones (see page 11-6). Any chokecherry occurring within 450 m of apricot orchards should be removed.

Resistant Cultivars: None.

Chemical: None.

Notes: Chokecherry is a symptomless carrier of the virus.

SHOT HOLE

Wilsonomyces carpophilus = *Stigmina carpophila*

(See Peach, SHOT HOLE on page 11-35).

OTHER DISEASES

The following diseases of apricot are currently of minor importance:

Apricot Freckles (*Alternaria alternata*)

Crown Gall (*Agrobacterium radiobacter* var. *tumefaciens*)

Fruit Rots (*Rhizopus* spp., *Penicillium* spp., *Botrytis cinerea*)

Silver Leaf (*Stereum purpureum*)

QUARANTINE DISEASES

Plum Pox (Sharka) (Plum pox potyvirus) (see Plum, page 11-40)

BLUEBERRY (*Vaccinium corymbosum*)**ALTERNARIA FRUIT ROT**

Alternaria tenuissima

Cultural: Cool fruit rapidly after harvest.

Resistant Cultivars: None.

Chemical: Apply chlorothalonil (COM) SU. Fungicides used to control grey mold will also help control *Alternaria*.

Limitations: Preharvest interval is 54 days (chlorothalonil). Maximum of 3 applications per season.

References:

1. Caruso, F.L. and D.C. Ramsdell. 1995. Compendium of blueberry and cranberry diseases. APS Press

ANTHRACNOSE FRUIT ROT

Colletotrichum gloeosporioides

Cultural: Prune out dead wood and remove prunings or till them into the ground. Avoid overhead irrigation especially late in the day. Avoid introducing infested equipment or totes into uninfested fields. Cool fruit as soon as possible after harvest.

Resistant Cultivars: None.

Chemical: Apply chlorothalonil (COM) SU. Captan applied for grey mold control will reduce anthracnose.

Limitations: Preharvest interval is 54 days (chlorothalonil). Maximum of 3 applications per season.

References:

1. Pest Control Note 94-10. Blueberry anthracnose - a new and potentially serious fruit rot disease. BCMAF.

BACTERIAL BLIGHT

Pseudomonas syringae pv. *syringae*

Cultural: Use disease-free stock when establishing new plantings. Prune out diseased wood as soon as possible in the fall to prevent spread during fall rains. Avoid succulent new growth in the fall as it is susceptible to infection.

Resistant Cultivars: June, Rancocas and Weymouth appear to have resistance in the field.

Susceptible: Bluecrop, Bluetta and Jersey are susceptible in the field.

Chemical: Spray copper oxychloride (COM) WP with a spreader sticker according to label rates. Apply once before fall rains, at 50% leaf fall, at bud burst and at two week intervals after bud burst during wet weather.

Limitations: Preharvest interval is one day. Maximum of six applications per year.

Notes:

1. Bacterial blight caused by this bacterium is common in many nurseries on a variety of crops.
2. Because the bacterium is ice-nucleation active, the disease is more severe if freezing temperatures occur after the plants have started leafing out.

References:

1. Moore, L.W. 1988. *Pseudomonas syringae*: Disease and ice nucleation activity. *Ornamentals Northwest* 12: 4-16.

CROWN GALL

Agrobacterium radiobacter var. *tumefaciens*

Cultural: Use disease-free stock when establishing new plantings. Establish new plantings on uninfested land wherever possible. Control weevils because their feeding sites can act as entry points for bacteria. Stem galls should be pruned out and destroyed. Pruning shears should be disinfected with alcohol after each cut on diseased plants to prevent spread.

Resistant Cultivars: None.

Chemical: None.

Biological Control: Dygall is registered on a temporary basis as a preventive treatment that is applied to susceptible plants before possible exposure to crown gall or field planting. Immerse roots or cuttings in the Dygall solution just prior to planting. Keep the treated planting stock cool and prevent any exposure to sunlight.

Notes: Dygall contains the biological control agent *Agrobacterium radiobacter* strain K84 which produces agrocin.

GODRONIA STEM CANKER

Godronia cassandrae

Cultural: Prune out and burn diseased wood before fall rains.

Resistant Cultivars: Rubel, Rancocas.

Susceptible: Berkeley, Jersey, Pemberton, Bluecrop.

Chemical: None.

Notes: Infections take place between early March and July.

References:

1. Caruso, F.L. and D.C. Ramsdell. 1995. Compendium of blueberry and cranberry diseases. APS Press.

GRAY MOLD BLIGHT

Botrytis cinerea

Cultural: Annually prune to remove infected twigs and to open canopy for good air circulation. Avoid late-season fertilization and practice good weed control.

Resistant Cultivars: None.

Chemical: Apply captan (COM) WG, WP; ferbam (COM) WG; or anilazine (COM) WP at bud-break and repeat at intervals of 7 to 10 days up to and including mid-bloom.

Limitations: Preharvest interval - 2 days (captan); 14 days (anilazine); 40 days (ferbam).

Notes: The disease occasionally causes significant losses of fruit if wet weather occurs at harvest.

References:

1. Caruso, F.L. and D.C. Ramsdell. 1995. Compendium of blueberry and cranberry diseases. APS Press.

MUMMY BERRY, BLOSSOM BLIGHT

Monilinia vaccinii-corymbosi

Cultural: In mineral soils, rake mummified fruit into pathway between rows and rotovate into the soil in late winter to destroy apothecia. Improve air circulation.

Resistant Cultivars: Dixi, Rubel (in B.C.).

Chemical: Spray triforine (COM) EC on bushes when buds start to swell. Ensure the apothecia have begun to open (usually late March). Repeat in 10-14 days and make a third application in another 10-14 days if primary infections developed. Alternatively apply propiconazole (COM) EC on highbush blueberry at or near flower bud swelling, followed by a second application at leaf bud swelling.

Limitations: Preharvest interval - 60 days (triforine, propiconazole). Maximum 2 applications per year of propiconazole.

References:

1. Pepin, H.S. and Toms, H.N.W. 1969. Susceptibility of highbush blueberries to *Monilinia vaccinii-corymbosi*. Phytopathology 59: 1876-1878.
2. Pepin, H.S. and Ormrod, D.J. 1974. Control of mummy berry of highbush blueberry. Plant Dis. Rep. 58: 840-843.

OTHER DISEASES

The following diseases of blueberries are currently of minor importance (MI) and/or are diseases for which no practical control measures are currently recommended (NC):

Scorch Virus

The following disease of blueberry does not occur in Canada but occurs in Washington and Oregon where planting stock may originate:

Blueberry Shock Virus

CHERRY, SOUR AND SWEET (*Prunus avium*)

ALTERNARIA ROT

Alternaria alternata and other species of *Alternaria*

Cultural: Infection occurs in mature fruit with skin breaks so careful handling to avoid injury is important.

Resistant Cultivars: Lapins, Summit, Sylvia.

Susceptible Bing, Sunburst, Sweetheart

Chemical: None.

Notes: Sprays with captan or iprodione for control of brown rot will also control Alternaria rot.

References:

1. McPhee, W.J. 1980. Some characteristics of *Alternaria alternata* strains resistant to iprodione. Plant Disease 64: 847-849.
2. Sholberg, P. 2000. Postharvest handling of pome fruits, soft fruits, and grapes. Agriculture and Agri-Food Canada electronic publication. http://res2.agr.ca/parc-crapac/english/3electronic_publications/phhandbook/default.htm

BACTERIAL CANKER (BLAST)

Pseudomonas syringae

Cultural: Use F 12-1 Mazzard as a rootstock and framework. Use scions or buds from virus-free, canker-free trees. Remove trees with girdled trunks. Prune out branches with cankers. Cankers can be cleaned up by cutting away bark from above and around the edges of the infected area. Cover the wounds with dressing. Sterilize tools between cuts with 10% bleach solution or 70% ethyl alcohol.

Resistant Cultivars: None.

Intermediate: Corum, Sam, Sue.

Susceptible: Royal Anne, Bing, Lambert, Van, Hardy Giant, Schmidt, Windsor.

Chemical: Two sprays of copper sulphate (COM) + lime are suggested for trial. Spray the upper portions and tree trunk thoroughly in October and early January (see Note 2). A spring spray before bud swell is recommended in Ontario, as well as 4 sprays at 14 day intervals beginning in the third week of September.

Limitations: Preharvest interval - 1 day (copper sulphate).

Notes:

1. There is no satisfactory control for this disease. It thrives in areas with moist, warm winters such as found in the coastal region.
2. Locate orchard in an area less likely to be affected by frost.
3. Copper sulphate is not registered for use on cherry in Canada but is an acceptable spray as it is used only in the dormant season.
4. Copper-containing compounds are of limited value because strains of *P. syringae* will develop resistance to them.

References:

1. Cameron, H.R. 1971. Effect of root and trunk stock on susceptibility of orchard trees to *Pseudomonas syringae*. Plant Dis. Rep. 55: 421-423.
2. 1990-91 Fruit production Recommendations, Ontario Ministry of Agriculture and Food, Publication 360.
3. Jones, A.L. and Sutton, T.B. 1996. Bacterial Canker. Pages 71-72 in Diseases of Tree Fruits in the East. NCR 45 Michigan State Univ. East Lansing, MI.

BROWN ROT

Monilinia fructicola, *M. laxa*

Cultural: Prune out any twigs killed by the fungus. Remove mummified fruit from the trees and the soil surface. Handle fruit carefully to avoid bruising and skin punctures.

Resistant Cultivars: None.

Chemical: Sprays are necessary only under wet conditions. Spray with chlorothalonil (COM) SU; propiconazole (COM) EC; myclobutanil (COM) WP, benomyl (COM, DOM) WP + captan (COM, DOM) WP; thiophanate-methyl (COM) WP; triforine (COM) EC (up to petal fall only); iprodione (COM) WG, WP at 14-day intervals throughout the season. For sour cherries only, apply benomyl when blossoms first open and repeat at 50% bloom if the weather is wet, and as a protectant on the fruit beginning when fruit begins to colour up.

Limitations: Preharvest interval - 1 day (iprodione myclobutanil, thiophanate-methyl); 3 days (propiconazole); 7 days (benomyl + captan); 40 days (chlorothalonil); 60 days (triforine). Do not apply chlorothalonil after shuck split. Do not exceed 3 chlorothalonil applications per year.

References:

1. Ogawa, J.M., *et al.* 1975. *Monilinia* life cycle on sweet cherries and its control by overhead sprinkler fungicide applications. Plant Dis. Rep. 59: 876-880.
2. Ogawa, J.M., and English, H. 1991. Brown rot of stone fruit. Pages 143-153 in Diseases of Temperate Zone Tree Fruit and Nut Crops. University of California, Oakland, CA. Publication 3345.

CROWN AND ROOT ROT

Phytophthora cactorum

(See Apple, CROWN AND ROOT ROT on page 11-9).

CROWN GALL

Agrobacterium tumefaciens

Cultural: Plant disease-free stock. Plant in well-drained fields and rotate contaminated field sites with non-host plants such as monocots. Avoid injuring trees when planting as bacteria enter through injuries. Remove trees found with large galls surrounding the crowns when the trees become unproductive.

Resistant Cultivars: None.

Chemical: Remove soil around underground galls and allow them to dry one or more days before treatment. Cut off the major portions of the galls larger than 7 cm in diameter. Paint gall, cut surfaces and 1 cm of surrounding bark with 2,4-xylenol + meta-cresol [Gallex] and allow galls to dry before replacing soil (see notes 1 and 2). Limitations: As per label.

Biological Control: Dygall is registered as a preventative treatment that is applied to non-bearing susceptible nursery stock before possible exposure to crown gall or field planting. Immerse roots or cuttings in the Dygall solution just prior to planting. Keep the treated planting stock cool and prevent any exposure to sunlight (see note 3).

Notes:

1. To prevent sudden shock by loss of water and food movement in severely galled trees, treat only half the girdled trunk at one time. Treat the remaining galled surface four to six months later when an examination of the initial treatment is made.
2. The chemical Gallex has temporary registration.
3. Dygall contains the biological control agent *Agrobacterium radiobacter* strain K84 which produces agrocin and is effective for stone fruit crown gall.

LEAF SPOT (SHOT HOLE)

Blumeriella jaapii (*Coccomyces hiemalis*)

Cultural: None.

Resistant Cultivars: Sweet types generally have greater resistance.

Chemical: On sweet and sour cherry use - benomyl (COM) WP + captan (COM, DOM) WP; dodine (COM) WP; captan (COM, DOM) SO, SU, WP; ferbam (COM, DOM) WDG; myclobutanil (COM) WP. Chlorothalonil (COM) SU may be used at shuck split with up to two additional sprays to the leaves following harvest.

Limitations: Preharvest interval - 1 day (myclobutanil); 7 days (benomyl + captan, captan, dodine); 4 days (ferbam). Do not graze dodine-treated areas or feed clippings from dodine-treated areas to livestock.

Notes: This disease is serious only during wet weather in wet climate areas.

References:

1. Anon. 1992-1993. Fruit production recommendations. Ont. Minist. Agriculture and Food. Publ. 360. Pp. 31-33.

LITTLE CHERRY

Little cherry virus

Cultural: Plant only virus-free cherry stock. Remove all affected cherry trees found in surveys. Do not grow Japanese flowering cherry in Little Cherry control areas.

Resistant Cultivars: None.

Chemical: None.

Notes:

1. Apple mealy bug (*Phenacoccus aceris*) is the only known insect vector of little cherry disease. All cherry growers with trees that have been diagnosed as having little cherry disease should apply sprays to control apple mealy bug throughout the season (2).
2. The "Little Cherry Control Regulation" of the B.C. Plant Protection Act has defined two little cherry control areas in B.C. Control areas cover the Okanagan-Similkameen valleys and the Creston area in the east Kootenays. Trees diagnosed with little cherry virus which are within the control areas must be removed. Transportation of cherry nursery stock or budwood into the control areas is also regulated.

References:

1. Raine, J. *et al.* 1986. Transmission of the agent causing little cherry disease by the apple mealybug *Phenacoccus aceris* and the dodder *Cuscuta lupuliformis*. Can. J. Plant Pathol. 8: 6-11.
2. Jespersen, G.D. 1995. Little cherry disease in British Columbia. BC Ministry Agric., Fisheries & Food factsheet. 8 pp.

NECROTIC RING SPOT (TATTERLEAF, RUSTY MOTTLE)

Peach ring spot virus (PRSV)

Cultural: When planting new cherry orchards, try to locate them as far as possible from existing (and usually infested) older cherry orchards. Use only virus-free budwood and understock (see page 6).

Resistant Cultivars: None.

Chemical: None.

Notes: PRSV also causes apple mosaic.

POWDERY MILDEW

Podosphaera clandestina

Cultural: Avoid dense plantings. Heavy pruning to increase air drainage may be desirable in densely planted orchards. Remove infected water sprouts. Keep grass low under trees with low hanging branches.

Resistant Cultivars: None.

Susceptible: Black tartarian, Bing, Chapman, Rainier and Lapins sweet cherries and Montmorency sour cherries.

Chemical: Apply myclobutanil (COM) WP; sulphur (COM, DOM) WP at husk-fall stage and repeat in 10 days. On sour cherries only, apply benomyl (COM, DOM) WP, at first signs of foliar infection and 10-14 days later if required.

Limitations: Preharvest interval - 1 day and before 30 June (sulphur); 1 day (benomyl, myclobutanil).

Notes: If benomyl + captan is used for brown rot control, it will also control powdery mildew. Losses in sweet cherry are serious only if the fruit becomes mildewed and the probability of damage increases when fruit is left on the trees for cannery pick. Foliage infection can damage younger trees. Sulphur should not be applied within 2 weeks of harvest if the cherries are going to the cannery.

References:

1. Grove, G.G., and Boal, R.J. 1991. Overwinter survival of *Podosphaera clandestina* in eastern Washington. *Phytopathology* 81: 385-391.

REPLANT DISEASE

(See Apple, APPLE REPLANT DISEASE on page 11-7).

SHOT HOLE

Wilsonomyces carpophilus = *Stigmina carpophila*

(See peach, SHOT HOLE on page 11-35).

OTHER DISEASES

The following diseases of cherry are currently of minor importance:

Chlorotic Leaf Spot (chlorotic leaf spot virus)

Decline (Target Spot, Xylem Aberration) (Tobacco ring spot virus, tomato bushy stunt virus, tomato ring spot virus) MI

Dieback and Canker (*Cytospora spp.*)

Fruit Rots (*Botrytis cinerea*, *Mucor piriformis* *Rhizopus spp.*, *Penicillium spp.*)

Green Fruit Rot (*Botrytis cinerea*)

Green Ring Mottle (green ring mottle virus)

Lambert Mottle (lambert mottle virus)

Mottle Leaf (cherry mottle leaf virus)

Rasp Leaf (cherry rasp leaf virus)

Twisted Leaf (cherry twisted leaf virus)

Verticillium Wilt (*Verticillium spp.*)

X-disease (peach X-disease phytoplasma)

QUARANTINE DISEASES

Plum Pox (Sharka) (Plum pox potyvirus) (See Plum, page 11-40)

CHOKECHERRY (*Prunus virginiana*)

BROWN ROT

Monilinia fructicola, *M. demissa*

Cultural: Remove and burn all mummified berries, all fallen leaves and berries, and infected twigs and pedicels. Remove wild chokecherries to a distance of 0.5 km. Do not plant adjacent to hedges or windbreaks containing chokecherries.

Resistant Cultivars: None.

Chemical: None.

Notes: Most mummified berries drop to the ground, thus thorough raking and/or incorporation into the soil are required. The fungus can also cause bud and blossom blight. Cultural control will at best only reduce the disease.

References:

1. Davidson, J.G.N. 1978. Personal communication. Agric. & Agri-Food Can. Res. Sta., Beaverlodge, AB.

OTHER DISEASES

The following diseases of chokecherry are currently of minor importance:

Bacterial Blast (*Pseudomonas syringae*)

Black Knot (*Dibotryon morbosum*)

Dieback (*Nectria cinnabarina*, *Stereum purpureum*, *Valsa* spp.)

Fire Blight (*Erwinia amylovora*)

Gray Mold Fruit Rot (*Botrytis cinerea*)

Powdery Mildew (*Podosphaera clandestina*)

Shot Hole (*Coccomyces lutescens*)

CRANBERRY (*Vaccinium macrocarpon*)

FRUIT ROT

Botryosphaeria vaccinii (*Phyllosticta elongata*), *Godronia cassandrae* (*Fusicoccum putrefaciens*), *Ceuthospora lunata*, *Botrytis* spp., *Diaporthe vaccinii*, *Phyllosticta vaccinii*, *Sporonema oxycocci*.

Cultural: The organisms causing fruit rot are always present in the bogs. Each has different requirements for infection and it will depend on the growing conditions during the infection period as to just which rot will be prevalent for any given year. Many will develop further during storage but losses will be reduced by storing at 4-5°C. Excessive nitrogen and injuries to the developing berries increases susceptibility to fruit rot.

Resistant Cultivars: None.

Intermediate: To end rot caused by *Godronia cassandrae* - McFarlane, Stevens, Pilgrim, Bergman.

Susceptible: To end rot - Crowley.

Chemical: Apply chlorothalonil (COM) SU or copper oxychloride (COM) WP. Start protection at early bloom, then apply at late bloom and 10 to 14 days later. Do not apply to fields when flooded or allow release of irrigation water for at least 3 days after application. Chlorothalonil may be applied through solid set sprinkler irrigation system, but not copper. Folpet (COM) WP and anilazine (COM) WP are also registered but have not provided good control in the past.

Limitations: Preharvest interval - 50 days chlorothalonil; 1 day copper (maximum of 3 applications per year); 7 days anilazine; 30 days folpet.

References:

1. Averill, M.M. 1996. Cranberry Chart Book, Management Guide for Massachusetts. University of Massachusetts.
2. Antonelli, A. et al. 1996. Cranberry Insect, Disease & Weed Control Program. Washington State University, Extension Bulletin EB0845.
3. 1995-96 Berry Production Guide, BCMAFF
4. Caruso, F.L., Bristow, P.R., and Oudemands, P.V. 2000. Cranberries: the most intriguing native North American fruit. Electronic publication: <http://www.apsnet.org/online/feature/cranberry/top.html>

HARD ROT (COTTON BALL)

Monilinia oxycocci

Cultural: Remove and destroy infected fruit during harvest to prevent disease buildup in bog.

Resistant Cultivars: McFarlin.

Intermediate: Pilgrim.

Susceptible: Bergman.

Chemical: Apply triforine (COM) EC when first buds start to swell. Repeat 14 days later. Applications by aircraft using a minimum volume of 112 L/ha are effective. Alternatively apply propiconazole (COM) EC beginning at leaf bud break, repeating at 10-14 day intervals to a maximum of 4 applications per year.

Limitations: Preharvest interval - 45 days (propiconazole), 60 days (triforine).

References:

1. Pepin, H.S. and Ormrod, D.J. 1974. Control of cotton ball of cranberry. Pp. 339-340 *in* Pesticide Research Report, CCPUA, Ottawa.
2. Pepin, H.S., *et al.* 1975. Control of cotton ball of cranberry. Pp. 260-262 *in* Pesticide Research Report. CCPUA, Ottawa.

TWIG BLIGHT

Lophodermium oxycocci, *Diaporthe vaccinii*, *Botryosphaeria vaccinii*.

Cultural: Conditions that favour vigorous but not rank growth help vines resist fungus infection. Avoid excessive nitrogen. Provide adequate moisture and cool beds by sprinkling with water during hot, dry periods.

Resistant Cultivars: None.

Chemical: Apply chlorothalonil (COM) SU or copper oxychloride (COM) WP. Start protection at bud break, then apply at early bloom and late bloom. Do not apply to fields when flooded or allow release of irrigation water for at least 3 days after application. Chlorothalonil may be applied through solid set sprinkler irrigation system, but not copper. Anilazine (COM) WP is also registered but has not provided good control in the past.

Limitations: Preharvest interval - 50 days chlorothalonil; 1 day copper (maximum of 3 applications per year); 30 days folpet.

Notes: The folpet sprays applied for fruit rot control will also control twig blight but are not registered for this purpose.

References:

1. Averill, M.M. 1996. Cranberry Chart Book, Management Guide for Massachusetts. University of Massachusetts.
2. Antonelli, A. *et al.* 1996. Cranberry Insect, Disease & Weed Control Program. Washington State University, Extension Bulletin EB0845.
3. 1996-96 Berry Production Guide, BCMAFF

CURRANT, GOOSEBERRY (*Ribes* spp.)

POWDERY MILDEW

Sphaerotheca mors-uvae

Cultural: Avoid shaded or partially shaded locations. Prune to maintain open growth form and remove weak or crowded branches.

Resistant Cultivars: White currants - White Grape, Large White, White Imperial; small fruited American gooseberries - Pixwell; Albol currants variously referred to as Missouri, California, or cross currants; black currants - Ben Nevis, Black Dawn, Brod Torp, Jet.

Intermediate: Albol currants, red currants - Large Knight, Red Lake, Red Cross, Perfection; black currants - Willoughby, Ben Lomand, Boskoop, Tsema.

Susceptible: All European gooseberries and black currants and many North American and European black currants.

Chemical: Apply sulphide sulphur (DOM, COM) SN at delayed dormant (green tip stage). At prebloom, full bloom and early fruit set apply sulphur (DOM, COM) WP. Omit full bloom spray for currants. Some varieties are sulphur sensitive.

Limitations: Preharvest interval - 1 day (sulphide sulphur, sulphur).

Notes: Under shaded or semi-shaded conditions, the disease can cause severe stunting or death of European gooseberry and black currant cultivars. On black currants with mildew resistance, the disease can break dormancy in buds that would normally form next season's flowers.

References:

1. Evans, I.R. 1979. Personal communication. Alberta Agric., Edmonton.

OTHER DISEASES

The following diseases of currant and gooseberry are currently of minor importance:

Blister Rust (*Cronartium ribicola*)

Leaf Spot (*Mycosphaerella ribis*)

Rust (*Puccinia caricina*)

Nectria (*Nectria cinnabarina*)

GRAPE (*Vitis vinifera*, *V. rotundifolia*, *V. labrusca*)**BUNCH ROT**

Botrytis cinerea

Cultural: Maintain good air circulation by summer pruning. Remove leaves adjacent to clusters just after bloom or during shatter. Clean out infected mummified fruit. Avoid excessive vegetative growth through rootstock management and judicious use of nitrogen fertilization.

Resistant Cultivars: None.

Intermediate: Cabernet Sauvignon, Gewurtztraminer

Susceptible: Chardonay, Pinot Noir, Riesling

Chemical: Apply iprodione (COM) WP; fenhexamid (COM) WG; cyprodinil (COM) WG. Captan applied for black rot, dead arm or downy mildew will also help to control bunch rot.

Limitations: Preharvest interval - 30 days (iprodione), 7 days (fenhexamid, cyprodinil, captan). Do not apply fenhexamid more than 3 times per season. Do not apply iprodione or cyprodinil more than 2 times per season.

Notes:

1. Do not use spreaders or stickers with iprodione. Do not use captan after bunch closing on wine grapes.
2. Sunburn can be avoided by removing the east side leaves only.

References:

1. Bulit, J. and Dubos, B. 1988. Botrytis bunch rot and blight. Pp. 13-15 in: Eds. R.C. Pearson and A.C. Goheen, Compendium of Grape Diseases, APS Press, St. Paul, MN.

CROWN GALL

Agrobacterium vitis

Cultural: Avoid sucker removal near ground level with susceptible varieties. When this cannot be avoided, immediately spray cut ends with a 1:10 solution of household bleach.

Resistant Cultivars: None.

Susceptible: *V. vinifera* varieties and most of the French hybrids such as Verdelet (S9110) and Rougeon (S5898).

Chemical: Paint or smear the gall with 2,4-xylenol + meta cresol [Gallex] (COM) EC. Limitations: As per label.

Notes:

1. Gallex is registered on a temporary basis.
2. The pathogen is transmitted through vegetative propagation of grapevine, and remains symptomless until frost or physical damage initiates the disease.
3. *A. vitis* can be eliminated from grapevine by hot water treatment or shoot tip culture.

POWDERY MILDEW

Uncinula necator

Cultural: Drain wet areas in the vineyard. Prune the vines to spread them over the entire trellis. Plant to permit good air drainage and as much sun penetration as possible.

Resistant Cultivars: *V. labrusca*.

Intermediate: Auxerrois, Castel 19637, Chelois, Chenin Blanc, Foch, Baco Noir, Cascade, Cayuga White, Concord, Merlot, Ortega, Pinot Gris, Rougeon, Sheridan, Semillon, White Riesling, Vidal Blanc, Weissburgunder, White Diamond.

Susceptible: Bacchus, De Chaunac, Cabernet Sauvignon, Gewurtztraminer, Chardonnay, Seyval Blanc, Okanagan Riesling, Chancellor, Pinot Noir, Himrod, Muller Thurgau, Madeline Sylvaner, Madeleine Angevine, Pearl of Csaba, Siegerebe, Schonburger, Verdelet.

Chemical: Apply sulphur (COM, DOM) WP; myclobutanil (COM) WP; benomyl (COM, DOM) WP; dinocap + mancozeb (COM) WP; benomyl + mancozeb (COM) WP; at the following stages of growth: when new growth is 5-10 cm long; just before bloom; after the berries are set but before they reach 1/4 full size; between the time berries are 1/2 and full size; just as grapes begin to soften and when blue varieties begin to develop colour and white varieties change from green to white or yellow.

Limitations: Preharvest interval - 1 day (sulphur); 7 days (benomyl); 14 days (myclobutanil); 30 days (dinocap, benomyl + mancozeb). Do not apply sulphur to Concord or Sheridan.

Notes:

1. Disease forecasting models exist for predicting powdery mildew infection and severity. The models depend on monitoring weather parameters such as temperature and leaf wetness within the grape plot.
2. Resistance by *Uncinula necator* to myclobutanil has been reported in California, New York, and Ontario.
3. Do not apply sulphur to wine grapes within 30 days of harvest.

References:

1. Pearson, R.C. 1988. Powdery mildew. Pp. 9-11 *in*: Eds. R.C. Pearson and A.C. Goheen, Compendium of Grape Diseases, APS Press, St. Paul, MN.
2. Gubler, W.D., and Thomas, C.S. 1999. Forecasting powdery mildew risk. *Fruit Grower*, March Issue pp. 6-7.
3. Northover, J. and Homeyer, C.A. 2001. Detection and management of myclobutanil-resistant grapevine powdery mildew (*Uncinula necator*) in Ontario. *Can. J. Plant Pathol.* 23:337-345.

OTHER DISEASES

The following diseases of grape are currently of minor importance (MI) and/or are diseases for which no practical control measures are currently recommended:

Crown and Root Rot (*Phytophthora* and *Pythium* spp.) MI

Phomopsis Cane and Leaf Spot (*Phomopsis viticola*) MI

Downy Mildew (*Plasmopara viticola*) MI

Fan Leaf (grapevine fan leaf virus)

Corky Bark (virus)

Leafroll (virus)

HAZELNUT (*Corylus avellana*)**BACTERIAL BLIGHT**

Xanthomonas campestris pv. *corylina*

Cultural: Clean pruners with 70% ethyl alcohol between cuts. Prune out infected branches 2-3 feet below lesions.

Resistant Cultivars: Of the edible varieties, Barcelona is highly susceptible; Du chilly is susceptible; Davianna is intermediate and Hall's Giant is resistant. Susceptibility of the ornamental varieties is unknown.

Chemical: Apply copper oxychloride (COM) WP during August/September before fall rains, at 3/4 leaf fall when rains are heavy, and in early spring before bud set.

Limitations: Maximum of 3 applications per year (copper oxychloride).

References:

1. Koepsell, P.A. and J.W. Pscheidt. 1995. Pacific Northwest Plant Disease Control Handbook. Extension Services of Oregon State University, Washington State University and the University of Idaho.

PEACH (*Prunus persica*)

BROWN ROT

Monilinia fructicola, *M. laxa*

Cultural: See cherry, BROWN ROT on page 11-21.

Resistant Cultivars: None.

Chemical: For blossom brown rot; apply benomyl (COM, DOM) WP + captan (COM, DOM) WP; thiophanate-methyl (COM) WP; cyprodinil (COM) WG; cyprodinil + myclobutanil; cyprodinil + iprodione (COM) WP; iprodione (COM) WG, WP; triforine (COM) EC; chlorothalonil (COM) SU; propiconazole (COM) EC beginning at early bloom and repeat after wet weather. For fruit brown rot; apply captan; benomyl + captan; cyprodinil; cyprodinil + myclobutanil; cyprodinil + iprodione; iprodione; thiophanate-methyl; propiconazole at 14-day intervals throughout the season.

Limitations: Preharvest interval - 1 day (iprodione, thiophanate-methyl); 2 days (cyprodinil); 3 days (propiconazole); 7 days (benomyl + captan, captan); 60 days (chlorothalonil, triforine). Do not apply cyprodinil more than 2 times for the control of blossom blight or more than 2 times for the control of fruit brown rot.

Notes:

1. Brown rot losses may be severe during wet weather at blossom or harvest. Conidia produced on the infected blossoms are often the only inoculum present in the orchard in midsummer when fruit infection begins. Therefore it is important to control blossom brown rot.
2. Control of insects that serve as vectors and/or provide wounds for infection is essential for effective brown rot control.

References:

1. Ogawa, J.M. *et al.* 1995. Brown rot. Pages 7-10 in Compendium of Stone Fruit Diseases. APS Press, St. Paul, MN.

CROWN AND ROOT ROT

Phytophthora cactorum

See Apple, CROWN AND ROOT ROT on page 11- 9.

CROWN GALL

Agrobacterium tumefaciens

See Cherry, CROWN GALL on page 11-22.

LEAF CURL

Taphrina deformans

Cultural: None.

Resistant Cultivars: None. (See Notes).

Chemical: Spray with tribasic copper sulphate (COM, DOM) WP; copper oxychloride, (fixed Copper) (COM, DOM) WP; or chlorothalonil (COM) SU in September; ferbam (COM, DOM) SU, WG, WP; sulphide sulphur (COM, DOM) SN; or chlorothalonil (COM) SU in full dormant stage in early spring.

Limitations: Preharvest interval: 21 days (ferbam); 60 days (chlorothalonil). Do not apply sulphide sulphur after the husk fall stage. Use copper oxychloride after harvest only.

Notes:

1. It is very important to apply dormant sprays in the full dormant stage. Once symptoms of the disease appear no chemical treatments are effective.
2. No variety is immune to leaf curl, but Redhaven and most varieties derived from Redhaven have some tolerance.

References:

1. Anon. 1976. Peach leaf curl disease. BC Ministry Agric., Plant Pathol. Circ. 76-10. 4 pp.

LEUCOSTOMA CANKER (PEACH PERENNIAL CANKER, CYTOSPORA CANKER)

Leucostoma persoonii, *L. cincta*

Cultural: Pruning should be done as late in the spring as possible. Sporulating infections on scaffold limbs or trees should be removed immediately and destroyed. Practices that minimize winter injury, sunburn and insect damage will reduce development of cankers.

Resistant Cultivars: None.

Intermediate: Sunhaven, Redhaven, Babygold, Garnet Beauty, Vanity, Veeglo, Loring.

Susceptible: Candor, Madison, Vivid, Earlired

Chemical: None.

Notes:

1. To avoid southwest injury, trunks and scaffolds should be covered with white latex paint.
2. This disease is also known as cytospora canker and peach perennial canker.

References:

1. Biggs, A.R. 1995. Leucostoma canker. Pages 28-30 *in* Compendium of Stone Fruit Diseases. APS Press, St. Paul, MN.
2. Cujec, T.P., Copeman, R.J., and Sholberg, P.L. 1988. Cytospora canker of stonefruits - an update. BCMAF Pest Control Notes.

POWDERY MILDEW

Sphaerotheca pannosa var. *persicae*

Cultural: Avoid vigorous shoot growth. Prune trees to allow for maximum ventilation within the tree.

Resistant Cultivars: None.

Intermediate: Cling peaches, nectarines, seedling peaches.

Susceptible: Reo-Oso-Gem, Redskin.

Chemical: Spray with sulphur (DOM, COM) WP; myclobutanil (COM) WP at husk fall and again in 2 weeks.

Limitations: Sulphur can be applied on peach on the day of harvest but peaches destined for the cannery should not be sprayed with sulphur later than 2 weeks before harvest. Preharvest interval: 1 day (myclobutanil).

REPLANT DISEASE

(See Apple, APPLE REPLANT DISEASE, on page 11-7).

RHIZOPUS FRUIT ROT

Rhizopus stolonifer

Cultural: Handle fruit carefully to avoid bruising. Pre-cool harvested fruit and maintain low temperatures in transit and market. Do not pack overripe fruit. Do not overfill containers.

Resistant Cultivars: None.

Chemical: A preharvest spray of dicloran (COM) WP or postharvest dip of dicloran will give control. Limitations: As per label.

Notes: Dicloran gives only fair control of brown rot.

References:

1. Ogawa, J.M. and English, H. 1991. Postharvest diseases of stone fruit. Pages 227-241 in *Diseases of Temperate Zone Tree Fruit and Nut Crops*. University of California, Oakland, CA. Publication 3345.

SHOT HOLE

Wilsonomyces carpophilus = *Stigmina carpophila*

Cultural: Prune out diseased wood. Provide adequate spacing and good air circulation when overtree irrigation is used.

Resistant Cultivars: None.

Intermediate: Lovell, Muir.

Susceptible: All commercial varieties in B.C. are susceptible.

Chemical: Spray tri-basic copper sulphate (COM, DOM) WP or copper oxychloride (fixed copper) (COM, DOM) WP in September after harvest but before leaf fall. This spray prevents twig infection. For prevention of fruit infection, use ziram (COM) WP, ferbam (COM, DOM) SU, WP at the husk fall stage.

Limitations: Preharvest interval - 21 days (ferbam); husk fall (ziram).

Notes: This disease can be serious in wet seasons. Control of shot hole by tribasic copper sulphate or copper oxychloride also controls peach leaf curl. This disease is also known as coryneum blight.

X-DISEASE

Peach X-disease phytoplasma

Cultural: Eradicate chokecherry and greasewood (*Sarcobatus vermiculatus*) within 450 m of the orchard. Remove affected limbs and if disease spreads, remove the tree. Use only virus-free budwood and understock.

Resistant Cultivars: Mahaleb rootstocks are immune.

Chemical: None.

OTHER DISEASES

The following diseases of peach are currently of minor importance:

Bacterial Canker (*Pseudomonas syringae*) (See Cherry, page 11-20)

Bacterial Spot (*Xanthomonas campestris* pv. *pruni*)

Fruit Rots (*Botrytis cinerea*, *Penicillium* spp., *Mucor* spp.)

Silver Leaf (*Stereum purpureum*)

QUARANTINE DISEASES

Plum Pox (Sharka) (plum pox potyvirus) (See plum, page 11-40)

PEAR (*Pyrus communis*)

CROWN AND ROOT ROT

Phytophthora cactorum

See Apple, CROWN AND ROOT ROT on page 11-9.

CROWN GALL

Agrobacterium tumefaciens

See Cherry, CROWN GALL on page 11-22.

DECLINE

Pear decline spiroplasm

Cultural: Avoid oriental understock. Use disease-free budwood and understock (see page 11-6).

Resistant Cultivars: Domestic Bartlett root stock.

Chemical: None.

Notes: Similar symptoms may be due to incompatibility, girdling, poor drainage, malnutrition, winter injury, and drought.

References:

1. Posnette, A.F. (ed.). 1963. Virus diseases of apples and pears. East Malling Bur. Hort., Tech. Commun. 30. 141 pp.

FIRE BLIGHT

Erwinia amylovora

Cultural: Avoid vigorous growth by reducing nitrogen fertilizer application. Prune out overwintering cankers during dormant season. Prune out current season cankers as they appear. Cuts should be made at least 25 cm into healthy wood and shears must be disinfected between each cut. Soaking the contaminated blade in either full strength or 1:5 dilution of household bleach, Lysol, or Pine-Sol will destroy *E. amylovora*. Frequent pruning is necessary if the infection is serious. Avoid overhead irrigation and use drip irrigation where needed. Use a hygrothermograph or a minimum-maximum thermometer and consult weather forecasts frequently, especially before and during bloom, to learn whether environmental conditions are conducive to infection. If at all possible, follow a fire blight prediction system such as Maryblyt.

Resistant Cultivars: Old Home and Old Home crosses can be used for framework.

Chemical: During the blossom and early summer period when weather is warm (18°C) and moist, spray with fixed copper or streptomycin sulphate. These treatments give protection for only 72 hr. If more rain occurs and copper or streptomycin has not been applied within the last 72 hr, an additional spray should be applied. Repeat sprays as necessary under warm moist conditions. These treatments can be used on crabapple. Copper oxychloride is not registered for apple blossom protection, but may be used at silvertip or postharvest. Dormant copper sprays act to reduce or delay the production of inoculum in overwintering cankers. When summer infections are too numerous to cut, treat the cankers with a zinc chloride solution. The solution is made by adding 6 mL of hydrochloric acid to 100 mL water, followed by 226 g zinc chloride and 340 mL methyl hydrate. This solution is painted over the infected areas and on the bark 25-40 cm below the edge of the canker. Control of sucking insects, particularly aphids, plant bugs and pear psylla is important in limiting the spread of vegetative shoot infections.

Limitations: Preharvest interval: 1 day - copper oxychloride; 30 days (pear) or 50 days (apple) - streptomycin sulphate. Do not apply copper to D'Anjou variety or apples because it causes russetting. Do not use zinc chloride solution on young trees.

Notes:

1. Fire blight may be very severe after hail damage. Late, secondary blossom provides ideal entry for the bacteria.
2. Other hosts: cotoneaster, crabapple (*Malus* spp.), firethorn, hawthorn, mountain ash.
3. Streptomycin-resistant isolates of *Erwinia amylovora* occur in British Columbia. In a recent survey of BC orchards, 46% of the isolates obtained from diseased wood were resistant.

References:

1. Sholberg, P. L., Bedford, K.E., Haag, P. and Randall, P. 2001. Survey of *Erwinia amylovora* isolates from British Columbia for resistance to bactericides and virulence on apple. *Can. J. Plant pathol.* 23: 60-67.
2. Teviotdale, B.L., *et al.* 1991. How disinfectants compare in preventing transmission of fire blight. *California Agriculture* 45(4): 21-23.
3. van der Zwet, T. and Beer, S.V. 1995. Fire blight - its nature, prevention and control: A practical guide to integrated disease management. U.S.D.A., Agriculture Information Bulletin No. 631, 91 pp.

PEAR TRELLIS RUST

Gymnosporangium fuscum

Cultural : Avoid planting pear trees within 30 m of susceptible junipers if possible. If an obvious disease center exists remove infected junipers. Pick off infected pear leaves as you see them during the growing season and destroy them.

Chemical: Dithane M-45 (mancozeb) is a very effective protectant fungicide for junipers. This use was registered in Canada under the Minor Use Pesticides Program and is currently part of the nursery certification program

Notes: The juniper varieties of *J. chinensis*, *J. sabina*, and *J. virginiana* were susceptible while *J. communis* and *J. horizontalis* appeared to be immune in recent trials.

References:

1. Anonymous. 1994. Pear trellis rust in British Columbia. Province of British Columbia, Ministry of Agriculture, Fisheries and Food, Extension Systems Branch, Victoria, B. C.

REPLANT DISEASE

See Apple, APPLE REPLANT DISEASE on page 11-7.

OTHER DISEASES

The following diseases of pear are currently of minor importance:

Chlorotic Leaf Spot (chlorotic leaf spot virus)

Powdery Mildew (*Podosphaera leucotricha*)

Scab (*Venturia pirina*)

Stony Pit (Stony pit virus)

Vein Yellows (pear vein yellows virus)

PLUM and PRUNE (*Prunus domestica*)**BLACK KNOT**

Dibotryon morbosum

Cultural: Remove wild plums and cherries near orchard. Prune out all wood with black knots before 1 March. Make the cut 15 cm below the swelling. Collect and burn all prunings with knots.

Resistant Cultivars: European plums, prunes and damsons are most susceptible.

Chemical: Sulphur (COM, DOM) WP; captan (COM, DOM) SU, WG, WP.

Limitations: Preharvest interval - 0 days (sulphur), 7 days (captan).

Notes:

1. Knots left lying on the ground are a source of spores that start new infections.
2. Use of benomyl for brown rot control will assist in reducing black knot.
3. Research results indicate that full rates of captan (3-4 sprays) applied from the popcorn stage (prebloom) to first cover will reduce infections up to 90%.

References:

1. Anon. 1992-93. Fruit production recommendations. Ont. Minist. Agric., Publ. 360. P. 57.
2. Ritchie, D.F., *et al.* 1975. Epidemiology of black knot of 'Stanley' plums and its control with systemic fungicides. Plant Dis. Rep. 59: 499-503.

BROWN ROT

Monilinia fructicola, *M. laxa*

Cultural: See cherry, BROWN ROT (page 11-21).

Resistant Cultivars: None.

Chemical: For blossom blight, apply - benomyl (COM) WP + captan (COM, DOM) WP; cyprodinil (COM) WG; triforine (COM) EC; iprodione (COM) WG, WP, propiconazole (COM) EC; thiophanate-methyl (COM) WP. For fruit brown rot, apply - captan (COM) SO, SU, WG, WP; benomyl + captan; cyprodinil (COM) WG; iprodione (COM) WG, WP; propiconazole (COM) EC; thiophanate-methyl (COM) WP.

Limitations: Preharvest interval - 1 day (iprodione, thiophanate-methyl); 2 days (cyprodinil); 3 days (propiconazole); 7 days (benomyl + captan; captan); 60 days (triforine). Do not apply cyprodinil more than 2 times for the control of blossom blight or more than 2 times for the control of fruit brown rot.

Notes: Postharvest dips of benomyl are no longer registered.

SILVER LEAF

Stereum purpureum

Cultural: Remove and burn all wood showing fruiting bodies. Paint large pruning cuts with a sealing material immediately after cutting. Carry out adequate thinning and propping to prevent limb breakage.

Resistant Cultivars: None.

Chemical: None.

Notes:

1. The incidence is higher after severe winter injury.
2. The fungus produces spores year around but spore release is much reduced during the summer. Therefore, summer pruning (after harvest) is recommended.

References:

1. Atkinson, J.D. 1971. Diseases of tree fruits in New Zealand. Dep. Sci. Ind. Res., Wellington, Inf. Ser. 81: 251-255.

OTHER DISEASES

The following diseases of plum are currently of minor importance:

Crown and Root Rot (*Phytophthora cactorum*)

See Apple, CROWN AND ROOT ROT on page 11-9.

Crown Gall (*Agrobacterium radiobacter* var. *tumefaciens*)

See cherry, CROWN GALL on page 11-22.

Plum Pockets (*Taphrina communis*)

Prune Dwarf (prune dwarf virus)

Replant Disease

See Apple, APPLE REPLANT DISEASE on page 11-7.

Verticillium Wilt (*Verticillium albo-atrum*)

QUARANTINE DISEASES

Plum Pox (plum pox virus)

The disease known as sharka is caused by plum pox potyvirus. It is one of the most serious diseases of *Prunus*. This disease has been kept out of North America by very strict quarantine regulations until 1999 when it was found in Pennsylvania. The disease is now present in the Niagra region of Ontario, but eradication is being attempted. Sharka is found throughout Europe, Egypt, Turkey, Syria, India and Chile. It is caused by several strains of the virus which are transmitted by several aphid species. It is also spread by propagative materials and possibly through seed. Because it takes several years for symptoms to appear the virus could be more widespread in North America. Every effort should be made to prevent any further spread of this virus. All strains can be detected by graft inoculations to woody indicators, by monoclonal and polyclonal antisera, and several variations of RT-PCR. A highly resistant plum clone (C-5) has been identified. This resistance has been transferred into plums through hybridization of transgenic plants to produce plum pox resistant plums.

References:

1. Damsteegt, V.D. 1999. New and emerging plant viruses. APSnet, <http://www.apsnet.org/online/feature/NewViruses/Top.html>
2. Levy, L. *et al.* 2000. Plum Pox Potyvirus Disease of Stone Fruits. APSnet <http://www.apsnet.org/online/feature/PlumPox/Top.html>
3. PennState University. 2000. Sharka - A Virus of Stone Fruits. <http://sharka.cas.psu.edu/>

RASPBERRY (*Rubus idaeus* var. *strigosus*)

ANTHRACNOSE

Elsinoe veneta

Cultural: Avoid close plantings. Avoid excessive use of nitrogen. Use disease-free stock. Cut away old fruiting canes close to the ground and burn at once.

Resistant Cultivars: Amity, Chilcotin, Haida, Heritage, Meeker, Nootka, Willamette.

Susceptible: Skeena, Chilliwack, Comox.

Chemical: Apply Lime-sulphur (DOM) at the delayed dormant (bud-bursting) stage. If leaves are open, spray only when they are dry. Follow the lime-sulphur application with the normal captan sprays for fruit rot control with an additional application after harvest.

Limitations: Preharvest interval - 7 days (captan).

Notes:

1. Cultural methods usually control this disease making spraying unnecessary. The disease occurs occasionally on red raspberry.
2. Fungicides used for control of bacterial blight and spur blight will assist in anthracnose control.

References:

1. Ellis, M.A., R.H. Converse, R.N. Williams and B. Williamson. 1991. Compendium of Raspberry and Blackberry Diseases and Insects. APS Press.

BACTERIAL BLIGHT

Pseudomonas syringae

Cultural: Curtail active growth in the autumn by avoiding excessive nitrogen. Do not top canes too early in the autumn. Resumption of plant growth following summer drought can also stimulate growth in the autumn (1).

Resistant Cultivars: None.

Susceptible: Meeker.

Chemical: Copper oxychloride (COM) WP as required. Limitations: As per label.

References:

1. Sinnott, N.M. and Copeman, R.J. 1977. The etiology and epidemiology of bacterial blight of raspberry in B.C. Proc. Can. Phytopath. Soc. 44: 44-45.

CANE BLIGHT

Leptosphaeria coniothyrium

Cultural: Avoid close plantings. Avoid excessive use of nitrogen. Use disease free stock. Avoid wounding of canes during harvest. Cut away old fruiting canes close to ground in fall and destroy.

Resistant Cultivars: None.

Chemical: Lime sulphur (DOM, COM) SN at the delayed dormant or bud bursting stage for anthracnose will help to control cane blight. Ferbam (COM) WP at the delayed dormant stage or when new leaves on canes are in the green tip or bud bursting stage. Repeat application when shoots are 25-30 cm high and make a third application just before bloom. Do not apply after berries start to form. Captan (COM, DOM) WG, WP. Apply when shoots are 20-25 cm high.

Limitations: Preharvest interval: 2 days (captan).

CROWN GALL

Agrobacterium tumefaciens

Cultural: Use disease-free certified stock when establishing a planting. Avoid planting susceptible cultivars on land known to be infested. Control root lesion nematodes which increase crown gall incidence and hasten plant death. Where only a few plants in a field are infected, the entire plants including the complete root system should be carefully removed and burned. Avoid close and deep cultivation which creates wounds on the roots through which the bacteria can enter.

Resistant Cultivars: Willamette (to biovar 2)

Intermediate: Nootka, Canby. Meeker does not normally develop galls when exposed to crown gall in the field.

Susceptible: Chilliwack, Chilcotin, Comox, Cuthbert, Haida, Newburgh, Skeena, Sumner.

Biological Control: Dygall is registered on a temporary basis as a preventive treatment that is applied to susceptible plants before possible exposure to crown gall or field planting. Immerse roots or cuttings in the Dygall solution just prior to planting. Keep the treated planting stock cool and prevent any exposure to sunlight.

Chemical: None.

Notes: Dygall contains the biological control agent *Agrobacterium radiobacter* strain K84 which produces agrocin.

References:

1. Vrain, T.C. and Copeman, R.J. 1987. The interaction between *Agrobacterium tumefaciens* and *Pratylenchus penetrans* in the roots of two red raspberry cultivars. Can. J. Plant Pathol. 9: 236-240.
2. Zurowski, C.L. *et al.* 1985. Relative susceptibility of red raspberry clones to crown gall. Phytopathology 75: 1289 (Abstr).

GRAY MOLD FRUIT ROT*Botrytis cinerea***Cultural:** Avoid dense planting.**Resistant Cultivars:** Pre- and postharvest: Chilliwack**Intermediate:** Preharvest: Meeker, Nootka, Skeena, Comox.
Postharvest: Chilcotin, Heritage, Meeker, Nootka, Skeena, Comox.**Chemical:** When blossoms first open, spray with - captan (COM, DOM) SU, WG, WP; iprodione (COM) WG, WP. Repeat at 7-10 day intervals for at least three sprays.**Limitations:** Preharvest interval - 2 days (captan); 1 day (iprodione). Maximum of 8 iprodione applications per year.**Notes:**

1. The severity of this disease increases with wet weather.
2. Repeated applications of benomyl alone may lead to development of benomyl-resistant populations of *Botrytis*.

References:

1. Daubeny, H.A. and Pepin, H.S. 1981. Resistance of red raspberry fruit and canes to *Botrytis*. J. Amer. Soc. Hort. Sci. 106: 423-426.
2. Freeman, J.A. and Pepin, H.S. 1976. Control of pre and post harvest fruit rot in raspberries. Pp. 292-293 in Pesticide Research Report. CCPUA, Ottawa.

GRAY MOLD WILT*Botrytis cinerea***Cultural:** Cut out and destroy affected canes. Do not permit dense cane growth within the row. Prune out old canes as soon as possible after harvest.**Resistant Cultivars:** Chilcotin, Meeker, Nootka, Willamette.**Susceptible:** Haida, Skeena, Chilliwack, Comox.**Chemical:** Treatment for botrytis fruit rot gives some control.

POWDERY MILDEW*Sphaerotheca macularis***Cultural:** None.**Resistant Cultivars:** Amity, Chilcotin, Heritage, Meeker, Skeena, Willamette.**Intermediate:** Haida, Chilliwack, Comox.**Chemical:** Spray with benomyl (COM, DOM) WP + captan (COM, DOM) WP; thiophanate-methyl (COM) WP when first blossoms open and at weekly intervals until all fruit is set. For control after harvest apply benomyl 3 to 4 times at intervals of 14 days starting at first signs of disease.**Limitations:** Preharvest interval - 1 day (thiophanate-methyl); 2 day (benomyl + captan).**Notes:** Sulphide sulphur applied as a dormant spray for spur blight control will also control powdery mildew.**RASPBERRY BUSHY DWARF**

Raspberry bushy dwarf virus

Cultural: The virus is pollen-borne and is thought to be transmitted from an infected plant to a healthy plant via wind-borne pollen. If care is taken to establish new plantings with virus-tested clones, the virus is relatively rare in red raspberry. If a new planting contains a few infected plants, virus spread is rapid in susceptible cultivars. The cultivar Willamette, which is widely planted in the Pacific Northwest, appears to be immune to this virus.**Resistant Cultivars:** Willamette, Chilliwack.**Chemical:** None (see Note 1.)**Notes:** There is some evidence that thrips play a role in the spread of pollen-borne viruses. Applications of insecticides may reduce the rate of spread of raspberry bushy dwarf virus.**References:**

1. Stace-Smith, R. 1984. Red raspberry virus diseases in North America. *Plant Disease* 68: 274-279.
2. Converse, R.H. ed. 1987. Virus diseases of small fruits. USDA-ARS Agriculture Handbook No. 631.

RASPBERRY MOSAIC

Raspberry mosaic virus

Cultural: Mosaic disease of red raspberry results from multiple infections with at least two separate viruses, both transmitted in a semipersistent manner by the raspberry aphid *Amphorophora agathonica*. Use virus-free certified stock when establishing a planting. Use cultivars that are highly resistant to the aphid vector.**Resistant Cultivars:** None (to the virus). Chilliwack, Comox, Haida, Skeena and Nootka are resistant to the aphid vector.**Chemical:** None (see Note 1.)

Notes:

1. Applications of insecticides to control the aphid vector is ineffective and the expense is not warranted.

References:

1. Stace-Smith, R. 1984. Red raspberry virus diseases in North America. *Plant Disease* 68: 274-279.
2. Converse, R.H. ed. 1987. Virus diseases of small fruits. USDA-ARS Agriculture Handbook No. 631, pages 11-39.

ROOT ROT

Phytophthora fragariae var. *rubi* and others

Cultural: Obtain plants from root rot-free plantings. Plant in fertile well-drained soils that have not grown small fruits for many years. Subsoiling to improve drainage between rows in October may help. Rotate raspberries with grass or legume crops.

Resistant Cultivars: None.

Intermediate: Amity, Meeker, Chilliwack.

Susceptible: Chilcotin, Skeena, Willamette, Comox.

Chemical: Apply metalaxyl (COM) EC to the soil surface as a drench in the spring on new plantations as a post planting treatment, and on bearing plants again in mid-October (but no later than November 30). Apply fosetyl-Al on red/black raspberry and blackberry, up to 4 times per year (twice in spring and twice in fall).

Limitations: Preharvest interval - 60 days (fosetyl-Al)

Notes:

1. Nematode activity will intensify root rot losses.

References:

1. Barritt, B.H. *et al.* 1979. Breeding for root rot resistance in red raspberry. *J. Amer. Soc. Hort. Sci.* 104: 92-94.

SPUR BLIGHT

Didymella applanata

Cultural: Avoid thick plantings and excessive rates of nitrogen fertilizer. Prune out surplus canes during the growing season and old canes after harvest.

Resistant Cultivars: Haida.

Intermediate: Chilliwack, Chilcotin, Skeena.

Susceptible: Comox, Meeker, Nootka, Willamette.

Chemical: Captan (COM) WP, WG; ferbam (COM) WG; lime sulphur (DOM, COM) SU at the delayed dormant (bud bursting) stage for anthracnose control will control spur blight. Limitations: As per label.

Notes:

1. Useful post harvest, autumn sprays are listed in reference 1, General References.
2. Control measures do not apply to primocane fruiting types.

References:

1. Daubeny, H.A. and Pepin, H.S. 1974. Susceptibility variations for spur blight (*Didymella applanata*) among red raspberry cultivars and selections. Plant Dis. Rep. 58: 1024-1027.
2. Pepin, H.S. 1976. Control of spur blight and cane *Botrytis* of red raspberry. P. 294 in Pesticide Research Report. CCPUA, Ottawa.

TOMATO RINGSPOT

Tomato ringspot virus

Cultural: Field spread of this virus disease in red raspberry is restricted to areas where nematode vectors belonging to the genus *Xiphinema* occur. Fields with a known history of tomato ringspot infections should be avoided. There are no cultivars that are immune to the virus although some cultivars (e.g. Fairview) are highly susceptible. All new plantings should be established with certified virus-free stock.

Resistant Cultivars: None.

Chemical: None (see Note 2.)

Notes:

1. The red raspberry cultivar Fairview is highly susceptible.
2. It is difficult to eliminate viruliferous *Xiphinema* spp. from an infected area by soil fumigation. Some post-planting treatments can reduce the numbers of *Xiphinema* spp. and slow the rate of spread but are unlikely to eliminate populations from deep soil layers.

References:

1. Stace-Smith, R. 1984. Red raspberry virus diseases in North America. Plant Disease 68: 274-279.
2. Converse, R.H. ed. 1987. Virus diseases of small fruits. USDA-ARS Agriculture Handbook No. 631, pages 11-39.

YELLOW RUST

Phragmidium rubi-idaei

Cultural: Practice sanitation. Cultivate in late fall or early spring to cover fallen leaves, old stubs, and refuse. Remove old fruiting canes as soon as possible after harvest, cutting flush with the ground.

Resistant Cultivars: None.

Intermediate: Willamette.

Chemical: Apply anilazine (COM) WP as per label.

Limitations: Preharvest interval - 14 days.

Note: Lime sulphur (DOM) applied for anthracnose at the delayed dormant stage will help to control rust.

OTHER DISEASES

The following diseases of raspberry are currently of minor importance:

Fire Blight (*Erwinia amylovora*)

Late Yellow Rust (*Pucciniastrum americanum*)

SASKATOON (*Amelanchier alnifolia*)

BLACK LEAF, WITCHES' BROOM

Apiosporina collinsii

Cultural: Rogue infected seedlings, cuttings, and root sprouts. On established bushes, prune out all twigs, shoots, and branches having infected leaves or witches' brooms about 10 cm below all signs of infection. This may be done in early spring before bud break, but is more easily done in the fall immediately after the main fall of leaves since infected leaves tend to persist. Remove and burn all infected leaves and prunings. Bushes with infected root crowns must be rogued and burned.

Resistant Cultivars: None.

Intermediate: Smoky.

Chemical: None.

Notes: The fungus, which is closely related to *Dibotryon morbosum* that causes black knot of *Prunus* spp., becomes systemic in woody parts and invades all new growth but does not invade older wood. It also survives on dead leaves on the bush or on the ground from which it infects new growth in the spring.

References:

1. Davidson, J.G.N. 1987. The principal diseases of commercial saskatoon. Univ. of Alberta, Agric. and Forestry Bull. 10: 6-9.
2. Harris, R.E. 1972. The saskatoon. Agric. Can., Publ. 1246 (rev.). 8 pp.
3. Kennedy, L.L. and Stewart, A.W. 1967. Development and taxonomy of *Apiosporina collinsii*. Can. J. Bot. 45: 1597-1604.

BROWN ROT, BLOSSOM and TWIG BLIGHT*Monilinia amelanchieris*

Cultural: Remove and burn all mummified berries, all fallen leaves and berries, and infected twigs and pedicels.

Resistant Cultivars: None.

Chemical: None.

Notes: The fungus can also cause blossom blight since the fungus may persist in fruit pedicels and small twigs. Ascospores are released during leaf-bud break. Cultural control will at best only reduce the disease.

References:

1. Davidson, J.G.N. 1987. The principal diseases of commercial saskatoon. Univ. of Alberta, Agric. and Forestry Bull. 10: 6-9.
2. Harris, R.E. 1972. The saskatoon. Agric. Can., Publ. 1246 (rev.). 8 pp.

CYTOSPORA DIEBACK AND CANKER*Leucocytophora leucostoma*

Cultural: Choose a suitable site for orchard establishment. Do not plant in low-lying areas subject to frequent and/or severe frosts. Select healthy stock for planting and ensure that roots don't dry out before and after transplanting. Follow cultural practices that promote vigorous but not excessive growth. Do not fertilize or irrigate late in the growing season as this tends to delay hardening off. Irrigate during dry periods, where possible. Prune out all dead and dying stems and branches whenever observed, or as soon after detection as possible. Cut at least 30 cm below observed infection and, if there is internal blackstain, cut below these areas into healthy wood. Disinfect pruning tools between cuts. Burn all clippings. Avoid unnecessary mechanical damage during maintenance and harvesting operations.

Resistant Cultivars: None.

Chemical: None.

Notes:

1. Cytospora canker is the most important dieback disease of commercial saskatoons in Alberta (1). *Leucostoma persoonii*, the perfect stage of *Leucocytophora leucostoma*, has been observed in some orchards in Alberta (2). Preliminary studies have suggested that saskatoon strains of *L. leucostoma* may be pathogenic to black cherry and poplar (2).

References:

1. Davidson, J.G.N. 1991. Principal diseases of saskatoon in the prairies. NRG News 90-10, Agriculture Canada, Beaverlodge, AB. 9 pp.
2. Pluim, R.A. 1990. Studies of dieback and canker diseases of saskatoon caused by *Cytospora leucostoma*. M.Sc. Thesis, Univ. Alberta, Edmonton, AB. 132 pp.

ENTOMOSPORIUM LEAF AND BERRY SPOT*Entomosporium mespili*

Cultural: Grow seedlings in separate containers instead of in dense nursery beds. Water seedlings at the soil surface rather than overhead. Space plants so as to provide good air circulation. In orchards, remove suckers and lower branches to improve air circulation. Disc under fallen leaves at the end of the season, if practical. Open furrow planting followed by a stringent annual pruning regime during the training and maintenance phases will help to reduce disease spread.

Resistant Cultivars: None.

Chemical: Apply sulphur (COM) DF; triforine (COM) EC; propiconazole (COM) EC according to supplemental label.

Limitations: Preharvest interval 60 days (triforine); 1 day (sulphur); 38 days (propiconazole).

Notes:

1. Do not apply fungicides during full flower of the saskatoon plant.
2. The sulfur smell of Kumulus may linger on the fruit if the application is made within one week before harvest.

References:

1. Lange, R.M., Bains, P.S. and Howard, R.I. 1998. Efficacy of fungicides for control of entomosporium leaf and berry spot of saskatoon. Plant Dis. 82: 1137-1141.

POWDERY MILDEW*Podosphaera clandestina*

Cultural: None

Resistant Cultivars: Recommended cultivars are all moderately resistant.

Chemical: Apply myclobutanil (COM) WP according to supplemental label.

References:

1. Davidson, J.G.N. 1990. Principal diseases of saskatoons in the prairies. NRG News 90-10, Agriculture Canada, Beaverlodge, AB. 9 pp.

RUST

Gymnosporangium spp.

Cultural: Remove all junipers up to a distance of at least 2.0 km.

Resistant Cultivars: None.

Chemical: Apply propiconazole (COM) EC; triforine (COM) EC according to supplemental label.

Limitations: Preharvest interval 38 days (propiconazole); 60 days (triforine).

Notes : Leaves and berries may be heavily infected, but the perennial stage (woody telial galls) occurs on junipers (*J. communis*, *J. horizontalis*, and *J. scopulorum*). Adequate separation of the alternate hosts reduces disease incidence to a very low level.

References:

1. Davidson, J.G.N. 1987. The principal diseases of commercial saskatoon. Univ. of Alberta, Agric. and Forestry Bull. 10: 6-9.
2. Ziller, W.G. 1974. The tree rusts of Western Canada. Can. For. Serv., Publ. 1239. p. 272.

OTHER DISEASES

The following diseases of saskatoon are currently of minor importance:

Bacterial Blast (*Pseudomonas syringae*)

Crown Gall (*Agrobacterium radiobacter* var. *tumefaciens*)

Dieback (*Nectria cinnabarina*, *Valsa* spp.)

Fire Blight (*Erwinia amylovora*)

Gray Mold Fruit Rot (*Botrytis cinerea*)

Silverleaf (*Stereum* sp.)

STRAWBERRY (*Fragaria chiloensis* var. *ananassa*)**BLACK ROOT ROT**

Fusarium sp., *Cylindrocarpon* sp., *Rhizoctonia* sp., and several other fungi

Cultural: Use foundation or certified stock. Plant in well drained, fertile locations. Rotate with grass or legume crops. Improve winter drainage with subsoiling between the rows.

Resistant Cultivars: None.

Chemical: None.

Notes: The same fungus complex is involved in raspberry root rot. Root lesion nematode (*Pratylenchus* sp.) is often associated with black root rot of strawberry.

References:

1. Maas, J.L. *et al.* 1984. Compendium of strawberry diseases. Am. Phytopathol. Soc., St. Paul, Minn. p. 90.

FRUIT ROT

Botrytis cinerea, *Penicillium* sp., *Alternaria* spp., *Rhizopus* spp.

Cultural: None.

Resistant Cultivars: None.

Intermediate: Benton, Hood, Totem.

Susceptible: Northwest, Rainier, Sumas.

Chemical: When first blossoms open spray with benomyl (COM, DOM) WP + captan (COM, DOM) WP, iprodione (COM) WG, WP, thiophanate-methyl (COM) WP. Repeat every 7 days. Continue the spray program regularly throughout the picking season.

Limitations: Preharvest interval - 2 days (benomyl + captan), 1 day (iprodione, thiophanate-methyl).

References:

1. Freeman, J.A. and Pepin, H.S. 1975. Control of pre- and post-harvest fruit rot in strawberries. P. 274 in Pesticide Research Report. CCPUA, Ottawa.
2. Freeman, J.A. 1976. Control of preharvest fruit rot in strawberries. Pp. 295-296 in Pesticide Research Report. CCPUA, Ottawa.

GRAY MOLD FRUIT ROT

Botrytis cinerea

Cultural: Space plants to facilitate rapid drying of the foliage, pick fruit as it ripens and move it quickly to cold storage.

Resistant Cultivars: None.

Intermediate: Totem.

Susceptible: Northwest, Rainier, Shuksan, Sumas.

Chemical: When first blossoms open, spray with captan (COM, DOM) DU, SU, WG, WP; vinclozolin (COM) DF; benomyl (COM, DOM) WP + captan; iprodione (COM) WG, WP; fenhexamid (COM) WG; thiram (COM) WP. Repeat every 7 days. Continue the spray program regularly throughout the picking season. Apply chlorothalonil (COM) SU once in the fall, and as 2 pre-bloom sprays in the spring when growth first appears and 10-12 days later.

Limitations: Preharvest interval - 1 day (fenhexamid); 2 days (captan, benomyl + captan); 1 day

(iprodione); 3 days (vinclozolin); 7 days (thiram); 30 days (chlorothalonil).

Notes:

1. Captan and benomyl + captan also control *Rhizopus* fruit rot (soft rot). Thiram, anilazine, and folpet may be used for control of gray mold fruit rot alone.
2. Time of renovation is important since fall fruit can provide considerable inoculum for the next growing season.

References:

1. Freeman, J.A. and Pepin, H.S. 1975. Control of pre- and post-harvest fruit rot in strawberries. P. 274 in Pesticide Research Report CCPUA, Ottawa.
2. Freeman, J.A. 1976. Control of preharvest fruit rot in strawberries. Pp. 295-296 in Pesticide Research Report. CCPUA, Ottawa.

POWDERY MILDEW

Sphaerotheca macularis

Cultural: Destruction of old leaves after harvest may be useful.

Resistant Cultivars: None.

Intermediate: Shuksan, Sumas, Totem.

Susceptible: Benton, Hood, Northwest.

Chemical: Spray with sulphur (COM, DOM) SU or benomyl (COM, DOM) WP + captan (COM, DOM) WP at 14-day intervals throughout the latter part of August and September when day temperatures are high and leaves wet with dew during the night.

Limitations: Preharvest interval - 1 day (sulphur), 2 days (benomyl + captan).

Notes: Some recent research shows that postharvest powdery mildew infections do not influence yield in the following year, making control sprays of questionable value. Preharvest infection can reduce fruit flavour.

RED STELE

Phytophthora fragariae

Cultural: Use certified plants. Plant in well drained soil where red stele is not known to occur. Improve winter drainage with furrows or by subsoiling between the rows.

Resistant Cultivars: Benton.

Intermediate: Hood, Rainier, Shuksan, Sumas, Totem.

Susceptible: Northwest.

Chemical: For new plantings, apply metalaxyl (COM) EC in spring as a post planting soil drench and again in the fall

prior to freeze-up. For established plantings, apply metalaxyl (COM) EC in the fall prior to freeze-up, and no later than November 30th. Apply fosetyl-Al (COM) WG when plants start active growth, and up to 4 times per season.

Limitations: Preharvest interval - 30 days (fosetyl-Al). Do not apply metalaxyl in the spring to established plantings.

Notes:

1. Not usually a problem on alkaline soils.

VERTICILLIUM WILT

Verticillium dahliae

Cultural: Avoid planting strawberries after susceptible crops such as potato, tomato, raspberry, stone fruits, eggplants, sunflowers, and peppers. Control weeds as solanaceous weeds are particularly susceptible. Use certified planting stock. Rotate strawberries with cereals and grasses. Reduce spread by roguing diseased plants and those adjacent. Do not replant in rogued areas.

Resistant Cultivars: None.

Chemical: Before planting, apply chloropicrin + 1,3-dichloropropene [Telone C-17] (COM) SN or chloropicrin + 1,3-dichloropropene + methyl isothiocyanate [Vorlex Plus CP] (COM) SN. Limitations: As per label.

VIRUS DISEASES

Cultural: Start new plantings with certified stock. Plant tolerant varieties. Avoid planting susceptible varieties in close proximity to established plantings.

Resistant Cultivars: Northwest, Sumas, Totem.

Susceptible: Hood, Shuksan.

Chemical: None.

Notes: Control aphids, particularly in old established fields close to new plantings.

OTHER DISEASES

The following diseases of strawberry are currently of minor importance and/or are diseases for which no practical control measures are currently recommended:

Leaf Spot (*Mycosphaerella fragariae*)

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3. Averill, M.M. 1996. Cranberry Chart Book, Management Guide for Massachusetts. University of Massachusetts.
4. Caruso, F.L. and D.C. Ramsdell. 1995. Compendium of blueberry and cranberry diseases. APS Press.
5. Committee. 1996-97. Berry production guide. B.C. Minist. Agric., Fish. and Food, Unnumbered publication.
6. Committee. 1977. Virus diseases and noninfectious disorders of stone fruits in North America. U.S. Dep. Agric., Agric. Handb. 437. 434 pp.
7. Committee. 1994-95. Management Guide for Grapes. B.C. Minist. Agric., Fish. & Food. Unnumbered Publ.
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12. Fridlund, P.R., ed. 1989. Virus and viruslike diseases of pome fruits and simulating noninfectious disorders. Wash. State Univ. Coop. Ext. Publ. SP0003. 330 pp.
13. Jones, A.L. and Aldwinckle, H.S., eds. 1990. Compendium of apple and pear diseases. Am. Phytopathol. Soc., St. Paul, Minn. 100 pp.
14. Jones, A.L. and Sutton, T.B. 1996. Diseases of tree fruits in the east. NCR 45. Michigan State Univ. East Lansing, MI. 95 pp.
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18. Ogawa, J.M. and English, H. 1991. Diseases of temperate zone tree fruit and nut crops. Univ. of Calif. Publication 3345. 461 pp.
19. Ogawa, J.M. *et al.* 1995. Compendium of Stone Fruit Diseases. Am. Phytopathol. Soc., St. Paul, Minn. 98 pp.
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of Saskatchewan, Saskatoon SK.

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APPENDIX I. Fungicides Registered for Use on Apples and Pears

Active Ingredient	Product	Formulation	C or D ¹	PCP#	APPLE							PEAR	
					SC	PM	BE	FB	FR	CR	R	FB	FR
benomyl	Benlate	50% WP		11062	x	x							
	Benlate Toss N Go	50% WP	C	24678	x	x							
	Benomyl	50% WP	D	11542, 15373, 11548	x	x							
captan	Captan 50	50% WP	C	14823	x								
	Captan 80	80% WP	C	10780, 23190	x								
	Captan 80	80% WG	C	23691	x								
	Supra Captan 80	80% WG	C	24613	x								
	Maestro 75	75% DF	C	23350	x		x						
	Maestro 80	80% DF	C	26408	x		x						
chinomethionat	Morestan	25% WP	C	8588, 21367		x							
copper oxychloride	Copper oxychloride	50% WP	C	13245								x	
	Copper Spray	50% WP	C	19146				x				x	
	Copper Spray	50% WP	D	16140								x	
	Copper Spray	50% WP	D	16637								x	
cyprodinil	Vangard	75% WG	C	25509	x								
dazomet	Basamid	98% GR	C	15032							x		
dodine	Equal	65% WP	C	15608	x								
dinocap + mancozeb	Dikar	4.6% WP + 72%	C	10495	x	x							
ferbam	Ferbam	76% WG	C	20136, 20138, 20536	x								
flusilazole	Nustar	20% DF	C	25547	x	x							
fosetyl-Al	Aliette	80% WG	C	24458						x			
kresoxim-methyl	Sovran	50% WG	C	26257	x	x							

SC = apple scab
BE = Bull's Eye Rot

R = replant disease
PM = powdery mildew

FB = fire blight
CR = crown rot
FR = fruit rot (post harvest), *Penicillium* spp. & *Botrytis cinerea*

¹ C or D - commercial or domestic registration

APPENDIX I. Fungicides Registered for Use on Apples and Pears con't

Active Ingredient	Product	Formulation	C or D	PCP#	APPLE							PEAR	
					SC	PM	BE	FB	FR	CR	R	FB	FR
mancozeb	Manzate 200 DF	75% DF	C	21057	x								
	Dithane DG	75%	C	20553	x								
metalaxyl-M	Ridomil Gold	480 g/L EC	C	17274						x			
metam sodium	Vapam	380 g/L LI	C	6453							x		
metiram	Polyram DF	80% WG	C	20087	x	x							
myclobutanil	Nova	40% WP	C	22399	x	x							
sulphide sulphur	Lime Sulphur	22% LI	C	16465	x	x							
	Lime Sulphur	21% LI	D	9243	x								
	Lime Sulphur	22% LI	D	6335, 7386	x	x							
sulphur	Kumulus	80% WG	C	18836	x	x							
	Hollysul microsul		C	16249	x	x							
	Flowable sulphur	52% FL	C	16674	x	x							
	Microscopic sulphur	92% WP	C	14653	x	x							
	Sulphur	92% DU	D	19703	x	x							
streptomycin	Streptomycin 17	17% WP	C	10305				x					
thiabendazole	Mertect	45% FL	C	13975					x				x
thiophanate-methyl	Senator	70% WP	C	12279, 25343	x	x							
thiram	Thiram	75% WP	C	15933	x								
tribasic copper sulphate	Copper 53W	53% WP	C	9934				x				x	
	Basicop	53% WP	C	19003				x				x	
triforine	Funginex	195 g/L EC	C	14701		x							
1,3-dichloropropene + chloropicrin	Telone C-17	78% + 3%	C	16324							x		

SC = apple scab

PM = powdery mildew

BE = bull's eye rot

FB = fire blight

FR = fruit rot (post harvest), *Penicillium* spp. & *Botrytis cinerea*

CR = crown rot

R = replant disease

APPENDIX II. Fungicides Registered for Use on Stone Fruits (apricot = A, cherry = C, peach = Pe, plum = P)

Active Ingredient	Product	Formulation	C or D	PCP#	Diseases						
					BR	CB	LS	PM	LC	FR	BK
benomyl	Benlate Benlate Toss N Go	50% WP 50% WP	C	11062 24678	A, C Pe, P		C	C			
	Benomyl (Laters)	50% WP	D	11542	A, C Pe, P		C	C			
	Benomyl (Wilson) Benomyl (Greenleaf)	50% WP 50% WP	D D	11548 15373				C			
captan	Captan 50 Captan 80	50% WP 80% WP	C C	14823 23190	A, C Pe, P		C				P
	Captan 80	80% WP	C	10780	A, C Pe, P		C				
	Captan 80 Supra Captan	80% WG 80% WG	C C	23691 24613	A, C Pe, P		C				P
	Maestro 75 DF Maestro 80 DF	75% DF 80% DF	C C	23350 26408	A, C Pe, P		C				P
chlorothalonil	Bravo 500	40.4%S U	C	15723	C, Pe		C		Pe		C
copper oxychloride	Copper oxychloride Copper Spray	50% WP 50% WP	C C	13245 19146	C	A, Pe	C		Pe		
	Copper Spray	50% WP	D	16637	C	A, Pe	C		Pe		
	Copper Spray	50% WP	D	16140	C	A, Pe			Pe		
cyprodinil	Vanguard	75% WG	C	25509	A, Pe P						
dicloran	Botran	75% WP	C	8772	Pe					Pe	
dodine	Equal	65% WP	C	15608			C				
iprodione	Rovral Rovral WDG	50% WP 50% WG	C C	15213 24709	A, C Pe, P						
lime sulphur	Lime Sulphur	22% LI	C	16465				Pe	Pe		
	Lime Sulphur	21% LI	D	9243	C, P				Pe		
	Lime Sulphur	22% LI	D	6335				Pe	Pe		
myclobutanil	Nova	40% WP	C	22399	C, Pe		C	C, Pe			
propiconazole	Topas	250g/L EC	C	24030	A, C Pe, P						

Diseases:

BR = brown rot

CB = coryneum blight

LS = leaf spot (shot hole)

PM = powdery mildew

LC = leaf curl

FR = Rhizopus fruit rot

BK = black knot

APPENDIX II. Fungicides Registered for Use on Stone Fruits (apricot = A, cherry = C, peach = Pe, plum = P) con't

Active Ingredient	Product	Formulation	C or D ¹	PCP#	Diseases						
					BR	CB	LS	PM	LC	FR	BK
sulphur	Kumulus	80% WG	C	18836	C, Pe P			C, Pe			
	Hollysul Micro-sul	92% WP	C	16249	C, Pe P			C			P
	Flowable sulphur	52% FL	C	16674	C, Pe P		C				
	Sulphur	92% DU	D	19703	C, Pe P		C	C			
	Microscopic Sulphur	92% WP	C	14653	Pe, P			C			P
	Garden Sulphur	90% WP	D	5293	C, Pe P						
thiophanate-methyl	Senator	70% WP	C	12279, 25343	C, Pe P						
tribasic copper sulphate	Copper 53W	53% WP	C	9934	C	A, Pe	C		Pe		
	Basicop	53% WP	C	19003	C	A, Pe	C		Pe		
	Bordo	53% WP	D	17482		Pe	Pe		Pe		
triforine	Funginex	190 EC	C	14701	C, Pe P						
ziram	Ziram	85% WP	C			A, Pe					

Diseases:

BR = brown rot

LC = leaf curl

CB = coryneum blight

FR = Rhizopus fruit rot

LS = leaf spot (shot hole)

BK = black knot

PM = powdery mildew

¹ C or D - commercial or domestic registration.

APPENDIX III. Fungicides Registered for Use on Grapes.

Active Ingredient	Product	Formulation	C or D ¹	PCP#	Diseases		
					Botrytis Bunch Rot	Powdery Mildew	Downy Mildew
anilazine	Dyrene	50% WP	C	6731		x	
benomyl	Benlate	50% WP	C	11062		x	
	Benlate Toss n Go	50% WP	C	24678			
	Benomyl (Wilson)	50% WP	D	11548		x	
copper oxychloride	Copper oxychloride	50% WP	C	13245		x	x
	Copper Spray	50% WP	C	19146		x	x
	Copper Spray	50% WP	D	16637		x	x
	Copper Spray	50% WP	D	16140		x	x
copper sulphate, tribasic	Copper 53W	53% WP	C	09934			x
	Basicop	53% WP	C	19003			x
	Bordo	53% WP	D	17482			x
cyprodinil	Vangard	75% WG	C	25509	x		
dinocap + mancozeb	Dikar	4.6% WP+ 72%	C	10495		x	x
fenhexamid	Elevate	50% WG	C	25900	x		
folpet	Folpan	50% WP	C	15654		x	x
iprodione	Rovral	50% WP	C	15213	x		
	Rovral WDG	50% WG	C	24709	x		
metiram	Polyram DF	80% WG	C	20087			x
myclobutanil	Nova	40% WP	C	22399		x	
sulphur	Kumulus	80% WG	C	18836		x	
	Hollysul Micro-sul	92% WP	C	16249		x	
	Microscopic Sulphur	92% WP	C	14653		x	
	Sulphur	92% DU	D	19703		x	
	Natural Garden Sulphur	0.4% SU 12% SU	D D	19061 19691		x	

¹ C or D - commercial or domestic registration.

APPENDIX IV. Fungicides Registered for Use on Blueberries, Cranberries, and Currants

Active Ingredient	Product	Formulation	C or D ¹	PCP#	Diseases							
					Blueberry				Cranberry			Cur-rant
					AN	BB	GM	MB	FR	HR	TB	PM
anilazine	Dyrene	50% WP	C	6731			x				x	
captan	Captan	50% WP	C	5371, 14823				x				
	Captan	80% WP	C	10780, 23190				x				
	Captan Supra Captan	80% WG 80% WG	C C	23691 24613				x				
	Maestro Maestro	75% DF 80% DF	C C	23350 26408				x				
chlorothalonil	Bravo 500	40.4% SU	C	15723	x				x		x	
copper oxychloride	Copper Spray	50% WP	C	19146		x						
	Copper oxychloride	50% WP	C	13245		x			x		x	
copper sulphate, tribasic	Basicop	53% WP	C	19003								x
	Copper 53	53% WP	C	9934								x
	Bordo	53% WP	D	17482								x
ferbam	Ferbam	76% WG	C	20136, 20536			x	x	x			
folpet	Folpan	50% WP	C	15654			x		x			
propiconazole	Topas	250g/L	C	24030				x		x		
sulphide sulphur	Lime Sulphur	23% LI	D	7386								x
sulphur	Sulphur	92% DU	D	19703								x
	Garden Sulphur	0.4% SU	D	19061								x
	Garden Sulphur	12% SU	D	19691								x
	Microscopic Sulphur	92% WP	C	14653								x
triforine	Funginex	190 EC	C	14701				x		x		

Blueberry:

BB = bacterial blight
 GM = gray mold
 MB = mummy berry
 AN = anthracnose fruit rot

Cranberry:

FR = fruit rot
 HR = hard rot
 TB = twig blight

Currant:

PM = powdery mildew

¹ C or D - commercial or domestic registration.

APPENDIX V. Fungicides Registered for Use on Raspberry and Strawberry (R = raspberry, S = strawberry)

Active Ingredient	Product	Formulation	C or D	PCP#	Diseases											
					Raspberry or Strawberry		Raspberry						Strawberry			
					GM	PM	AN	BB	CB	RR	RU	SB	LS	RS	VW	
benomyl	Benlate	50% WP	C	11062, 24678	R, S	R, S										
	Benomyl (Wilson)	50% WP	D	11548	R, S	R, S										
captan	Captan	50% WP	C	5371	R, S		x					x				
	Captan	50% WP	C	14823	R, S							x				
	Captan 80	80% WP	C	10780, 23190	R, S							x				
	Captan 80 WDG Supra Captan	80% WG 80% WG	C C	23691 24613	R, S							x	x			
	Maestro Maestro	75% DF 80% DF	C C	23350 26408	R, S							x				
chinomethionat	Morestan	25% WP	C	8588		S										
chlorothalonil	Bravo 500	40.4% SU	C	15723	S											
copper oxychloride	Copper Spray	50% WP	D	16637				x								
	Copper Spray	50% WP	C	19146				x								
	Copper oxychloride	50% WP	C	13245				x								
copper sulphate, tribasic	Copper 53W	53% WP	C	9934				x						x		
	Basicop	53% WP	C	19003				x						x		
	Bordo	53% WP	D	17482										x		

GM = gray mold/Botrytis
PM = Powdery mildew

Raspberry:
AN = anthracnose
BB = bacterial blight
CB = cane blight

Raspberry:
RR = Phytophthora root rot
SB = spur blight
RU = rust

Strawberry:
LS = leaf spot
RS = red stele
VW = verticillium wilt

APPENDIX V. Fungicides Registered for Use on Raspberry and Strawberry (R = raspberry, S = strawberry) con't

Active Ingredient	Product	Formulation	C or D	PCP#	Diseases											
					Raspberry or Strawberry		Raspberry						Strawberry			
					GM	PM	AN	BB	CB	RR	RU	SB	LS	RS	VW	
fenhexamid	Elevate	WG	C	25900	S											
ferbam	Ferbam	76% WG	C	20138			x					x				
	Ferbam	76% WG	C	20136, 20536			x				x	x				
folpet	Folpan	50% WP	C	15654	S											
fosetyl-Al	Aliette	80% WG	C	24458						x					x	
iprodione	Rovral	50% WP	C	15213	R, S											
	Rovral	50% WG	C	24709												
metalaxyl-M	Ridomil Gold 480	480g/L EC	C	25384						x					x	
sulphide sulphur	Lime Sulphur	22% LI	C	16465	S	S			x		x	x				
	Lime Sulphur	22% LI	D	6335	S	S			x		x	x				
	Lime Sulphur	23% LI	D	7386			x		x		x	x				
sulphur	Sulphur	92% DU	D	19703		S										
	Natural Garden Sulphur	0.4% SU 12% SU	D D	19061 19691		S										
thiophanate-methyl	Senator	70% WP 70% WP	C	12279, 25343	R, S	R										
thiram	Thiram	75% WP	C	15933	S											
vinclozolin	Ronilan	50% DF	C	22981	S											
1,3-dichloro-propene + methyl isocyanate	Vorlex Plus	LI	C	18353												x

APPENDIX VI. Fungicides Registered for Use on Saskatoons

Active Ingredient	Product	Formulation	C/D	PCP#	PM	EN	RU
myclobutanil	Nova	40% WP	C	22399	x		
propiconazole	Topas	250 g/L EC	C	24030		x	x
sulphur	Kumulus DF	80% WG	C	18836		x	
triforine	Funginex	195 g/L EC	C	14701		x	x

Diseases:

PM = powdery mildew

EN = Entomosporium

RU = Saskatoon-Juniper rust

APPENDIX VII. Fungicides Registered for Use on Filbert/Hazelnut

Active Ingred.	Product	Formulation	C/D	PCP#	Diseases
copper oxychloride	Copper oxychloride	50% WP	C	13245	bacterial blight