

Chapter Ten

DISEASES OF SPECIAL FIELD CROPS

BUCKWHEAT	10-4
Botrytis Rot	10-4
Downy Mildew	10-4
Seed Rot, Seedling Blight and Root Rot	10-5
Other Diseases	10-5
Aster Yellow	10-5
Sclerotinia Stem Rot	10-5
CANARYSEED	10-5
Leaf Mottle	10-5
Other Diseases	10-6
Anthracnose	10-6
Common Root Rot	10-6
Ergot	10-6
Spot Blotch	10-6
CHICKPEA	10-6
Ascochyta Blight	10-6
Seed Rot and Seedling Blight	10-7
Other Diseases	10-7
Gray Mold Stem and Pod Rot	10-7
Sclerotinia White Mould	10-7
CORN	10-8
Common Smut	10-8
Ear and Kernel Rots	10-8
Head Smut	10-9
Holcus Spot	10-9
Root and Stalk Rots	10-9
Seed Rot and Seedling Blight	10-10
Other Diseases	10-10
Rust	10-10
Quarantine Diseases	10-10
Goss' Wilt (Leaf Freckles)	10-10
DILL	10-11
Blight	10-11
Other Diseases	10-11
White Mould	10-11
FABABEAN	10-11
Anthracnose	10-11
Chocolate Spot	10-12
Leaf and Pod Spot	10-12
Mosaic	10-12
Rust	10-13

Seed Rot, Seedling Blight and Root Rot	10-13
Other Diseases	10-14
Alternaria Leaf Spot	10-14
Aster Yellows	10-14
Powdery Mildew	10-14
Sclerotinia Stem Rot	10-14
FIELD BEAN	10-14
Anthracnose	10-14
Common Blight, Fuscous Blight, and Halo Blight	10-15
Rust	10-15
Seed Rot, Seedling Blight and Root Rot	10-15
Stem Rot (White Mold)	10-16
Virus Diseases	10-16
Other Diseases	10-17
Gray Mold	10-17
FIELD PEA	10-17
Bacterial Blight	10-17
Downy Mildew	10-17
Mycosphaerella Blight, Foot Rot	10-18
Leaf and Pod Spot	10-19
Powdery Mildew	10-19
Seed Rot, Seedling Blight and Root Rot	10-20
Stem and Pod Rot	10-20
Virus Diseases	10-21
Other Diseases	10-21
Anthracnose	10-21
Leaf Blotch	10-21
Leaf Spot	10-21
Rust	10-21
GINSENG	10-21
Alternaria Blight	10-21
Botrytis Blight	10-22
Damping-off of Seeds and Young Seedlings	10-22
Nematode Diseases	10-23
Phytophthora Root Rot and Foliar Blight	10-24
Rhizoctonia Disease/tip over	10-24
Other Diseases	10-25
Disappearing Root Rot/ Rusty Root	10-25
Sclerotinia White Mold	10-25
Stromatinia Rot	10-25
Verticillium Wilt	10-25
HEMP	10-25
Hemp Canker	10-25
Other Diseases	10-26
Gray Mould	10-26
Yellow Leaf Spot	10-26
LENTIL	10-26
Anthracnose	10-26
Ascochyta Blight	10-27

Botrytis Stem and Pod Rot (Grey Mold)	10-28
Seed Rot, Seedling Blight and Root Rot	10-28
Sclerotinia Stem and Pod Rot	10-29
Other Diseases	10-29
Septoria Leaf Spot	10-29
Stemphylium Blight	10-29
Virus Diseases	10-29
PEPPERMINT	10-29
Powdery Mildew	10-29
Verticillium Wilt	10-29
SORGHUM	10-30
Bacterial Leaf Spot (Holcus Spot)	10-30
Seed Rot and Seedling Blight	10-30
SPEARMINT	10-30
Powdery Mildew	10-30
Verticillium Wilt	10-30
Rust	10-30
SOYBEAN	10-31
Bacterial Blight, Bacterial Pustule	10-31
Downy Mildew	10-31
Sclerotinia Stem Rot	10-31
Seed Rot and Seedling Blight	10-31
SUGAR BEET	10-32
Damping-off, Black Leg	10-32
Leaf Spot	10-32
Sugar Beet Cyst Nematode	10-33
Other Diseases	10-33
Powdery Mildew	10-33
Storage Rot	10-33
GENERAL REFERENCES	10-34
APPENDIX I. Foliar Fungicides Registered for Use on Special Crops	10-35
APPENDIX II. Fungicides Registered for Use on Ginseng	10-36
APPENDIX III. Seed Treatments Registered for Use on Special Crops	10-37

BUCKWHEAT (*Fagopyrum esculentum*)

BOTRYTIS ROT

Botrytis cinerea

Cultural: Practice a rotation with cereals, corn, or grasses to reduce disease incidence. Avoid fababeans, field beans and lentils in the rotation. Follow cultural practices that avoid a dense planting.

Resistant Cultivars: None.

Chemical: None.

Notes: Pathogen is seed-borne (1,3) and overwinters in crop residue and soil.

References:

1. Mills, J.T. and Wallace, H.A.H. 1971. Microflora of buckwheat seed, changes in storage and effects of seed treatments on seedling emergence. *Can. Plant Dis. Surv.* 51: 154-158.
2. Morrall, R.A.A. and McKenzie, D.L. 1975. Diseases of specialty crops in Saskatchewan: I. Notes on buckwheat and sunflower 1972-1973. *Can. Plant Dis. Surv.* 55: 69-72.
3. Savitskiy, K.A. 1970. Grechika [Buckwheat]. Moscow: 'Kolos', 312 pp.

DOWNY MILDEW

Peronospora ducometi

Cultural: Plant populations that allow good air circulation and fast drying of the leaves should help reduce severity of the disease. The disease is seedborne; if possible plant seed from mildew-free crops (1). Planting buckwheat seed when soil temperature is 20°C or above may reduce the incidence of downy mildew (2).

Resistant Cultivars: None (see Notes).

Chemical: None.

Notes: Intermediate to good resistance is available and attempts to transfer this resistance to advanced research germplasm are being made (2).

References:

1. Savitskiy, K.A. 1970. Grechika (Buckwheat). Moscow: 'Kolos'. 312 pp.
2. Zimmer, R.C. 1990. Personal communication. Agric. Can., Research Stn., Morden, Man.

SEED ROT, SEEDLING BLIGHT and ROOT ROT

Fusarium spp. and *Rhizoctonia solani*

Cultural: Practice a crop rotation with cereals, corn or grasses. Avoid pulses, vegetables, and potatoes in the rotation.

Resistant Cultivars: None.

Chemical: None.

References:

1. Morrall, R.A.A. and McKenzie, D.L. 1975. Diseases of specialty crops in Saskatchewan: I. Notes on buckwheat and sunflower 1972-1973. Can. Plant Dis. Surv. 55: 69-72.

OTHER DISEASES

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

Aster Yellows (aster yellows phytoplasma)

Sclerotinia Stem Rot (*Sclerotinia sclerotiorum*)

CANARYSEED (*Phalaris canariensis*)**LEAF MOTTLE**

Septoria triseti

Cultural: A crop rotation of two years between canaryseed crops should reduce disease buildup.

Resistant Cultivars: None

Chemical: Foliar application of propiconazole (COM) EC. Refer to minor use label (Tilt 250E) for details.

Notes:

1. Leaf mottle was the most serious disease of canaryseed in Saskatchewan in 1988.
2. *Septoria triseti* has also been reported on *Agrostis* and *Koeleria* species in North and South America.

References:

1. Berkenkamp, B., G.D. Jespersen and J. Bissett. 1989. Leaf mottle, a new disease of canarygrass caused by *Septoria triseti* Speg. Plant Dis. 73: 859.

OTHER DISEASES

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

Anthraxnose (*Colletotrichum graminicola*)

Common Root Rot (*Cochliobolus sativus*, *Fusarium* spp.)

Ergot (*Claviceps purpurea*)

Spot Blotch (*Cochliobolus sativus*)

CHICKPEA (*Cicer arietinum*)

ASCOCHYTA BLIGHT

Ascochyta rabiei

Cultural: Use disease-free seed (see Note 1). Where possible chickpeas should not be grown more than once every four years on the same field. This will minimize the risk of re-infection from crop residues. Plant as far as possible from the previous year's chickpea fields, because crop residues could be an important source of windblown spores. Rolling is not recommended for chickpea because of the potential to damage plants and spread infection.

Resistant Cultivars:

Chickpea Type	Cultivar	Ascochyta Blight Disease Rating VP = very poor; P = poor; F = fair	Leaf Type F = fern U = unifoliate
Kabuli	Sanford	VP	U
	B-90 (Amit)	F	F
	CDC Chico	P	F
	CDC Diva	VP	U
	CDC Xena	VP	U
	CDC Yuma	P	F
	Dwelley	VP	U
	Evans	VP	U
Desi	Myles	F	F
	CDC Anna	F	F
	CDC Desiray	F	F
	CDC Nika	F	F

Reference for table "Varieties of Grain Crops 2002, Saskatchewan Agriculture, Food and Rural Revitalization"

Chemical: Treat seed with carbathiin + thiabendazole (COM) LI. Foliar application of chlorothalonil (COM) SU. Foliar

fungicide application should commence before the onset of disease.

Limitations: Chlorothalonil - preharvest interval: 48 days. Maintain high water volumes for coverage of canopy. Do not make more than 3 applications per season.

Notes:

1. An agar plate test can be carried out by seed laboratories accredited to conduct ascochyta tests. Although large seed size may limit the number of seeds routinely tested and increase the cost of the seed test, it is recommended to use a minimum of 1000 seeds.

References:

1. Wiese, M. V., Kaiser, W. J., Smith, L. J., and Muehlbauer, F. J. 1995. Ascochyta blight of chickpea. University of Idaho, College of Agriculture Bulletin CIS 886 (revised). 4 pp.
2. Armstrong, C. L., Chongo, G., Gossen, B. D. and Duczek, L. J. 2001. Mating type distribution and incidence of the teleomorph of *Ascochyta rabiei* (*Didymella rabiei*) in Canada. Can. J. Plant Pathol. 23: 110-113.
3. Ascochyta blight of chickpea: 2002 Guidelines for Fungicide Applications. Prepared by the Saskatchewan Ascochyta Blight Response Team. Available on the following website: <http://www.agr.gov.sk.ca>.
4. Chongo, G. and Gossen, B.D. 2002. Effect of plant age on resistance to *Ascochyta rabiei* in chickpea. Can. J. Plant Pathol. 23: 358-363.

SEED ROT and SEEDLING BLIGHT

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

Cultural: Avoid deep planting into cool, wet soils. Use clean seed with good germination..

Resistant Cultivars: None. Kabuli types are very susceptible to seed rot by *Pythium* spp.

Chemical: Seed treatment with metalaxyl (COM) SU will protect against *Pythium* spp. only.

OTHER DISEASES

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

Gray Mold Stem and Pod Rot (*Botrytis cinerea*) NC

Sclerotinia White Mould (*Sclerotinia sclerotiorum*)

CORN (*Zea mays*)

COMMON SMUT

Ustilago maydis

Cultural: Follow a 2-year minimum crop rotation, using broadleaf special crops. Avoid injuring plants during cultivation. Maintain balanced soil fertility; particularly avoid high nitrogen. Where practical, remove and destroy galls as soon as possible after detection.

Resistant Cultivars: Current field corn hybrids have adequate resistance to common smut.

Chemical: None.

References:

1. Christensen, J.J. 1963. Corn smut caused by *Ustilago maydis*. Am. Phytopath. Soc., St. Paul, MN., Monogr. 2.

EAR and KERNEL ROTS

Diplodia maydis, *Fusarium* spp., *Gibberella zeae*, *Aspergillus* spp., *Penicillium* spp.

Cultural: Maintain balanced soil fertility. Harvest grain when mature and store initially at a moisture level below 18% for ears and 15% for shelled grain at temperatures of 4-10°C.

Resistant Cultivars: Choose varieties from recommended hybrids.

Chemical: None.

Notes: *Aspergillus* and *Penicillium* are important storage rot pathogens. Moldy corn, particularly if *Fusarium*, *Aspergillus*, and *Penicillium* spp. are involved, may contain harmful levels of mycotoxins, notably aflatoxin, zearalenone, and ochratoxin.

References:

1. Scott, P.M. 1973. Mycotoxins in stored grain, feeds and other cereal products. Pp. 343-365 in Sinha, R.N. and Muir, W.E. (eds.) Grain storage: part of a system. A.V.C. Publishing Co., Westport, Conn.
2. Sutton, J.C. 1982. Epidemiology of wheat head blight and corn ear rot caused by *Fusarium graminearum*. Can. J. Plant Pathol. 4: 195-209.

HEAD SMUT

Sphacelotheca reiliana

Cultural: Head smut is accentuated by stress conditions on the seedling plant, e.g., soil compaction, low soil fertility, low soil temperatures. Spores are known to survive in animals and are readily distributed in manure (1).

Resistant Cultivars: Cargill SX104, HL2428.

Chemical: Treat seed with carbathiin + thiram (COM) SU. Limitations: As per label. Seed treatment will not control soil-borne inoculum.

References:

1. Edgington, L.V. and Lynch, K. 1981. Head smut of corn - decisions to make. *Can. J. Plant Pathol.* 3: 273-276.
2. Lynch, K.V. *et al.* 1980. Head smut, a new disease of corn in Ontario. *Can. J. Plant Pathol.* 2: 176-178.

HOLCUS SPOT

Pseudomonas syringae pv. *syringae*

Cultural: Rotate with broadleaf special crops. Maintain a high level of potassium. Inoculum carryover can occur on corn and sorghum refuse and on susceptible grass hosts such as green foxtail.

Resistant Cultivars: None.

Chemical: None.

Notes: *Pseudomonas syringae* pv. *syringae* has a wide host range that includes many herbaceous and woody ornamental plants. Seed transmission is not confirmed in corn but can occur in sorghum.

References:

1. Kendrick, J.B. 1926. Holcus bacterial spot of *Zea mays* and *Holcus* species. *Iowa Agric. Exp. Sta., Bull.* 100: 303-334.

ROOT and STALK ROTS

Diplodia maydis, *Fusarium* spp., *Pythium* spp.

Cultural: Rotate for at least 1 year excluding cereals and grasses. Excessively high plant populations cause stress on individual plants increasing stalk rot and lodging. Maintain a balanced soil fertility based on soil tests. High levels of nitrogen and low levels of potassium increase risk of stalk rot.

Resistant Cultivars: None.

Chemical: None.

Notes: *Fusarium moniliforme* and *F. graminearum* may also infect ears, kernels, and seedlings. (See EAR and KERNEL ROTS)

SEED ROT and SEEDLING BLIGHT

Diplodia maydis, *Fusarium* spp., *Penicillium* spp., *Pythium* spp., other seed decay fungi.

Cultural: Follow a crop rotation that avoids cereals and grasses for three years. Delay seeding until soil temperature is above 10°C. Avoid planting in poorly drained soils. Follow recommended practices for fertilizer and herbicide applications.

Resistant Cultivars: None.

Chemical: Treat seed with - captan (COM) SU, WP; captan + diazinon (COM) WP; captan + diazinon + lindane (COM) DU, WP; captan + malathion (COM) SU; captan + methoxychlor (COM) SU, WP; carbathiin + thiram (COM) SU; mancozeb (COM) WP; thiram (COM) WP; fludioxonil (COM) SU, metalaxyl (COM) SU.

Limitations: Do not use treated seed for food or feed.

Notes: The most important organisms causing seedling blights are species of *Pythium*. *Aspergillus* appears to be more important as an ear rot or storage rot pathogen.

OTHER DISEASES

The following disease of corn is currently of minor importance and is a disease for which no practical control measures are currently recommended:

Rust (*Puccinia sorghi*)

QUARANTINE DISEASES

The following diseases of corn do not occur at present or are of limited distribution in Canada and are subject to quarantine regulations:

Goss' Wilt (Leaf Freckles) (*Corynebacterium nebraskensis*)

DILL (*Anethum graveolens*)

BLIGHT

Phoma anethi

Cultural: Use a 3-year crop rotation. Use seed from disease-free fields. Turn under stubble and refuse and plant fields distant from previous year's fields to prevent infection from the air-borne spores.

Resistant Cultivars: None.

Chemical: At first bloom and again 2 weeks after bloom, spray with benomyl (COM) WP (note 1).
Limitations: As per label.

Notes:

1. DuPont can sell the product to industry only until the end of 2001; industry can sell the product to growers until the end of 2004.
2. This disease has become a serious disease of dill production in Manitoba (1).

References:

1. Platford, G. 1993. Personal communication. MB Dept. Agric., Carman.

OTHER DISEASES

The following disease of dill is currently of minor importance and/or is a disease for which no practical control measures are currently recommended:

White Mould (*Sclerotinia sclerotiorum*)

FABABEAN (*Vicia faba*)

ANTHRACNOSE

Colletotrichum truncatum

Cultural: Avoid growing fababean after lentil in areas where the disease is present. Follow a crop rotation of 4 years.

Resistant Cultivars: None

Chemical: None

CHOCOLATE SPOT

Botrytis fabae, *Botrytis cinerea*

Cultural: Follow a crop rotation of 4 years between successive crops of fababeans and avoid buckwheat in the rotation. Use seed from disease-free fields.

Resistant Cultivars: None.

Chemical: None.

LEAF and POD SPOT

Ascochyta fabae

Cultural: Follow a crop rotation of 4 years between successive crops of fababeans. Use disease-free seed.

Resistant Cultivars: None.

Chemical: None.

References:

1. Kharbanda, P.D. and Bernier, C.C. 1979. Effectiveness of seed and foliar applications of fungicides to control ascochyta blight of fababeans. *Can. J. Plant Sci.* 59: 661-666.
2. Rashid, K.Y., Bernier, C.C., and Conner, R.L. 1991. Evaluation of fava bean for resistance to *Ascochyta fabae* and development of host differentials for race identification. *Plant Dis.* 75: 852-855.

MOSAIC

Bean yellow mosaic virus (BYMV)

Cultural: Other legumes are susceptible to this virus; therefore, avoid planting fababeans in close proximity to established fields of forage legumes.

Resistant Cultivars: None.

Chemical: None.

Notes:

1. BYMV may be seed transmitted.
2. A mild strain causing leaf mosaic and a severe strain causing mosaic and stem necrosis have been recognized in Manitoba (2).

References:

1. Evans, I.R. 1973. Seed-borne bean yellow mosaic virus of fababeans in Canada. *Can. Plant Dis. Surv.* 53: 123-126.
2. Frowd, J.A. and Bernier, C.C. 1977. Virus diseases of fababeans in Manitoba and their effect on growth and yield. *Can. J. Plant Sci.* 57: 845-852.

RUST

Uromyces viciae-fabae

Cultural: A crop rotation of at least 2 years between fababean crops should reduce disease build-up.

Resistant Cultivars: None.

Chemical: None.

Notes: All isolates of *U. viciae-fabae* collected from native species of *Vicia* and *Lathyrus* infected fababean, pea and lentil, suggesting that native legumes may be important in the epidemiology of rust on these crops (1).

References:

1. Conner, R.L. and Bernier, C.C. 1982. Host range of *Uromyces viciae-fabae*. *Phytopathology* 72: 687-689.
2. Rashid, K.Y. and Bernier, C.C. 1991. The effect of rust of faba bean cultivars and slow-rusting populations. *Can. J. Plant Sci.* 71: 967-972.

SEED ROT, SEEDLING BLIGHT and ROOT ROT

Fusarium spp., *Rhizoctonia solani*, *Aphanomyces euteiches*

Cultural: Follow a crop rotation that does not include fababeans or other legumes more than once in 4 years. Plant in well-drained soil.

Resistant Cultivars: None.

Chemical: None.

References:

1. McKenzie, D.L. and Morrall, R.A.A. 1975. Fababean diseases in Saskatchewan in 1973. *Can. Plant Dis. Surv.* 55: 1-7.
2. Lamari, L. and Bernier, C.C. 1985. Etiology of seedling blight and root rot of fababean (*Vicia faba*) in Manitoba. *Can. J. Plant Pathol.* 7: 139-145.
3. Rashid, K.Y. and Bernier, C.C. 1993. Genetic diversity among isolates of *Rhizoctonia solani* and sources of resistance in *Vicia faba*. *Can. J. Plant Pathol.* 15: 23-28.

OTHER DISEASES

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

Alternaria Leaf Spot (*Alternaria alternata*)

Aster Yellows (aster yellows phytoplasma)

Powdery Mildew (*Microsphaera penicillata* var. *ludens*)

Sclerotinia Stem Rot (*Sclerotinia sclerotiorum*)

FIELD BEAN (*Phaseolus vulgaris*)

ANTHRACNOSE

Colletotrichum lindemuthianum

Cultural: Follow a 3-year crop rotation to reduce carry-over of pathogen on infected crop debris. Sow disease-free seed grown in semi-arid regions where the pathogen is less likely to occur. Turn under crop refuse. Avoid cultivating or entering bean fields during wet weather to prevent spreading infection.

Resistant Cultivars: See Note 2.

Chemical: Treat seed with captan + diazinon + thiophanate-methyl (COM) DU (see Reference 2). Apply foliar spray of tribasic copper sulfate (COM) WP.

Limitations: Preharvest interval - 1 day (tribasic copper sulfate).

Notes:

1. Anthracnose is an important disease of beans in Ontario and in the states of North Dakota, Michigan and New York; it is an important disease in south Manitoba, however not a problem in Saskatchewan or Alberta.
2. Many cultivars are susceptible to the alpha, beta and alpha Brazil races.
3. Plant quarantine regulations require that all seed imported into Canada be treated with a registered fungicide to restrict the spread of new races of the pathogen.
4. Most current recommendations suggest that beans are not responsive to Rhizobium inoculation and are best grown with applied fertilizer.

References:

1. Tu, J.C. 1982. Effect of temperature on incidence and severity of anthracnose on white bean. Plant Dis. 66: 781-783.
2. Graham, P.H. *et al.* 1980. Survival of *Rhizobium phaseoli* in contact with chemical seed protectants. Agron. J. 72: 625-627.

COMMON BLIGHT, FUSCOUS BLIGHT, and HALO BLIGHT

Xanthomonas phaseoli, *X. phaseoli* var. *fuscans*, *Pseudomonas phaseolicola*

Cultural: Bury crop debris. Avoid successive plantings of beans. Bacteria survive on the stubble for about 2 years, but do not survive very long in soil. Avoid cultivating or entering bean fields during wet weather, or when dew is on the plants. Use seed grown in the western United States, or certified free from bacterial blights.

Resistant Cultivars: See Notes.

Chemical: Apply foliar spray of tribasic copper sulphate (COM) WP; cupric hydroxide (COM) WP.

Notes: All bean cultivars are susceptible to common blight and halo blight.

References:

1. Wallen, V.R. and Galway, D.A. 1979. Effective management of bacterial blight of field beans in Ontario - a 10-year program. *Can. J. Plant Pathol.* 1: 42-46.

RUST

Uromyces appendiculatus

Cultural: Follow a crop rotation that allows a minimum of 3 years between successive crops of beans. After harvest, turn under all bean refuse as completely as possible.

Resistant Cultivars: None.

Chemical: None.

Notes: In Manitoba, coloured beans have had a higher incidence of rust than white beans (1).

References:

1. Brolley, B. 2001. Personal communication. Manitoba Ag. and Food, Carman, MB.

SEED ROT, SEEDLING BLIGHT and ROOT ROT

Fusarium solani f.sp. *phaseoli*, *Pythium* spp., *Rhizoctonia solani*

Cultural: Rotate beans with non-host crops such as corn, wheat, barley or alfalfa to reduce *Pythium*, and avoid sugar beets and potatoes to reduce *Rhizoctonia solani*. Include beans in rotation only once every 5 years. Planting into soil in which the top 15 cm is at least 16°C and contains adequate moisture should help reduce the incidence of infection by these pathogens.

Resistant Cultivars: None.

Chemical: Treat seed with captan (COM) SU; captan + diazinon + lindane (COM) DU, WP; captan + diazinon + thiophanate methyl (COM) WP; captan + methoxychlor (COM) SU, WP; carbathiin + thiram (COM) SU; metalaxyl (COM) SU; thiram (COM) WP. Limitations: As per label.

References:

1. Hagedorn, D.J. and Rand, R.E. 1979. Research for integrated control of bean root rot. Pp. 425-430 in B. Schippers and W. Gams (eds.). Soil-borne plant pathogens. Academic Press Inc., London.

STEM ROT (WHITE MOLD)

Sclerotinia sclerotiorum

Cultural: Rotate to cereals, corn and grasses, crops that are immune. Allow at least 4 years between the susceptible crops buckwheat, canola/rapeseed, mustard, safflower, sunflower, fababeans, lentils, peas and other legumes in the rotation. Space plants to allow for good air circulation. Apply only the recommended amount of fertilizer to avoid excess canopy development. Avoid irrigation procedures that prolong excessive moisture levels at the soil surface 10 days prior to and during flowering..

Resistant Cultivars: None. See notes.

Chemical: Apply the following as sprays - benomyl (COM) WP (see note 1); iprodione (COM) WP; thiophanate-methyl (COM) WP; dicloran (COM) WP; vinclozolin (COM) EG.

Limitations: As per label. Preharvest interval - not after full bloom (iprodione); 14 days (thiophanate-methyl); 2 days (benomyl); 2 days (dicloran); 45 days (vinclozolin). Do not feed treated foliage to livestock.

Notes:

1. DuPont can sell the product to industry only until the end of 2001; industry can sell the product to growers until the end of 2004.
2. Cultivars with an erect growth habit (architype) are generally less prone to white mold because of lower humidity levels in the plant canopy.

References:

1. Tu, J.C. and Beversdorf, W.D. 1982. Tolerance to white mold (*Sclerotinia sclerotiorum*) in Ex Rico 23, a cultivar of white bean (*Phaseolus vulgaris*). Can. J. Plant Sci. 62: 65-69.

VIRUS DISEASES

Bean yellow mosaic virus (BYMV), Bean common mosaic virus (BCMV)

Cultural: Avoid locating fields adjacent to sweet clover and other clovers as spread of BYMV can occur from these crops via aphids. Do not plant seed from fields that were infected the previous year. BYMV is not seed-borne; BCMV is carried in the seed.

Resistant Cultivars: Seafarer.

Chemical: None.

Notes: Pedigreed seed may not be completely free from bean common mosaic virus.

References:

1. Frowd, J.A. and Bernier, C.C. 1977. Virus diseases of fababeans in Manitoba and their effect on growth and yield. *Can. J. Plant Sci.* 57: 845-852.
2. Evans, I.R. and Zettler, F.W. 1970. Aphid and mechanical transmission properties of Bean Yellow Mosaic Virus isolates. *Phytopathology* 60: 1170-1174.

OTHER DISEASES

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

Gray Mold (*Botrytis cinerea*)

FIELD PEA (*Pisum sativum*)**BACTERIAL BLIGHT**

Pseudomonas syringae pv. *pisii*

Cultural: Turn under crop refuse as soon after harvest as possible. Use seed from fields free of bacterial blight.

Resistant Cultivars: None.

Chemical: None.

DOWNY MILDEW

Peronospora viciae

Cultural: To reduce the threat of this disease extended rotations and deep tillage are useful methods; removal or deep tillage of infected crop debris helps reduce the level of oospores, which can survive 10-15 years in the soil. This disease is serious when seed or soil is heavily infested, leading to systemic infections that cause plant stunting and death. Spread is rapid under sustained cool wet conditions. Seed produced in an area of low rainfall should be free of seed-borne inoculum.

Resistant Cultivars: None.

Chemical: None (see Notes).

Notes: Two products containing metalaxyl may be applied to harvested seed destined for export. Consult with the importer to establish what rates are used on the crop in their country.

MYCOSPHAERELLA BLIGHT, FOOT ROT

Mycosphaerella pinodes, *Phoma medicaginis* var. *pinodella*

Cultural: Use seed from disease-free fields if possible (see Note 1). Peas should not be grown more frequently than once every 5 years as chlamydospores can survive in soil up to 5 years. Turn under crop refuse as soon as possible after harvest and control volunteer seedlings soon after emergence in the fall. Locate new plantings as far as possible from the previous year's fields.

Resistant Cultivars: None. However some varieties are more tolerant than others and thus do not respond as much to fungicide application (3, 6). Refer to provincial guides for cultivar recommendations.

Chemical: Chlorothalonil (COM) SU. First application at early flowering. Additional application 10-14 days later if conditions favour disease. Apply seed treatments if seed with a high level of infection is used. Use captan (COM), thiram (COM) and carbathiin (VitaFlo 280) (COM) (Note 2).

Limitations: Preharvest interval: 32 days (chlorothalonil). Do not make more than 3 applications per season.

Notes:

1. If in doubt about the quality of a seed lot, have an agar plate test carried out by an accredited laboratory.
2. Viability of Rhizobium seed inoculum may be reduced by fungicide seed treatment (1).

References:

1. Rennie, R.J. *et al.* 1985. The effect of seed-applied pesticides on growth and N₂ fixation in pea, lentil and fababean. *Can. J. Plant Sci.* 65: 23-28.
2. Warkentin, T. D. *et al.* 1996. Fungicidal control of *Ascochyta* blight of field pea. *Can. J. Plant Sci.* 76: 67-71.
3. Warkentin, T.D., Xue, A.G. and McAndrew, D.W. 2000. Effect of mancozeb on the control of *mycosphaerella* blight of field pea. *Can. J. Plant Sci.* 80: 403-406.
4. Xue, A.G. *et al.* 1997. Effect of timings of inoculation with *Mycosphaerella pinodes* on yield and seed infection of field pea. *Can. J. Plant Sci.* 77: 685-689.
5. Xue, A.G. *et al.* 1996. Genotypic variability in seedborne infection of pea by *Mycosphaerella pinodes* and its relation to foliar disease severity. *Can. J. Plant Pathol.* 18: 370-374.
6. Xue, A.G. and Warkentin, T.D. 2001. Partial resistance to *Mycosphaerella pinodes* in field pea. *Can. J. Plant Sci.* 81: 535-540.

LEAF and POD SPOT*Ascochyta pisi***Cultural:** Follow a crop rotation of 4 years between successive crops of peas.**Resistant Cultivars:** Modern cultivars are not evaluated for reaction to this pathogen.**Chemical:** None.**Notes:** *A. pisi* has not been considered a problem in western Canada for many years. However, high levels of seed infection by *A. pisi* have been detected in samples from southern Saskatchewan in the last two years.**POWDERY MILDEW***Erysiphe pisi***Cultural:** Follow a crop rotation that includes peas or other legumes only once every 5 years (see Note 1). Turn under crop refuse. Locate new plantings distant from previous year's fields. Seed early to escape the disease.**Resistant Cultivars:** DS-Admiral, AC Advantage, DS-Dominator, Eclipse, CDC Handel, Highlight, AC Melfort, CDC Minuet, Miser, CDC Montero, CDC Mozart, SW Parade, SW Salute, CDC Sonata and DS-Stalwarth.**Susceptible:** (See Note)**Chemical:** Sulphur (COM) DF. Limitations: As per label. Preharvest interval - 1 day.**Notes:**

1. Crop rotation may not be effective as the pathogen probably does not survive through the winter (1).
2. Escape from powdery mildew disease may occur by seeding early and by planting early maturing cultivars. Seeding after the first week in May could result in yield and quality reduction, especially in highly susceptible cultivars.

References:

1. Tiwari, K.R., Warkentin, T.D., Penner, G.A and Menzies, J.G. 1999. Studies on the winter survival of *Erysiphe pisi* in Manitoba. Can. J. Plant Pathol. 21: 159-164.

SEED ROT, SEEDLING BLIGHT AND ROOT ROT

Fusarium solani f. sp. *lisi*, *Rhizoctonia solani*, *Pythium* spp., *Aphanomyces euteiches*.

Cultural: Follow a crop rotation with cereals, corn or buckwheat that includes peas only once every 5 years. Avoid field beans, flax, potato, canola/rapeseed, sunflower, and other legumes in rotation. Select well-drained fields as excessive soil moisture favours root rot. Avoid compacting the soil.

Resistant Cultivars: None.

Chemical: Treat seed with - captan (COM) SU; captan + diazinon + lindane (COM) DU, WP; captan + methoxychlor (COM) SU, WP; metalaxyl (COM) SU; thiram (COM) WP; carbathiin + thiram (COM) SU. Limitations: As per label.

Notes:

1. The effectiveness of seed treatments is questionable on poor quality seed (1), but seed treatment can substantially improve establishment of seed that has been damaged during handling e.g. at seeding, or seed infected by *Mycosphaerella pinodes* (3, 4).
2. Viability of *Rhizobium* seed inoculum may be reduced by fungicide seed treatment (2).

References:

1. Morrall, R.A.A. 1986. Evaluation of fungicide treatments on field pea seed of low quality - 1986. Pg. 229 in Pesticide Research Report, Agriculture Canada, Ottawa.
2. Rennie, R.J. *et al.* 1985. The effect of seed-applied pesticides on growth and N₂ fixation in pea, lentil and faba bean. *Can. J. Plant Sci.*: 65: 23-28.
3. Hwang, S.F., Chang, K.F., Howard, R.J., Deneka, B.A. and Turnbull, G.D. 1995. Decrease in incidence of *Pythium* damping-off of field pea by seed treatment with *Bacillus* spp. and metalaxyl. *J. Plant Dis. Prot.* 103: 31-41.
4. Hwang, S.F., Gossen, B.D., Chang, K.F., Turnbull, G.D. and Howard, R.J. 2001. Effect of seed damage and metalaxyl seed treatment on *pythium* seedling blight and seed yield of field pea. *Can. J. Plant Sci.* 81: 509-519.

STEM and POD ROT

Sclerotinia sclerotiorum

Cultural: Rotate to cereals, corn and grasses. Allow at least 4 years between susceptible crops such as buckwheat, canola/rapeseed, fababeans, lentils, mustard, peas, safflower, soybeans and sunflowers. Control broadleaved weeds and volunteers of susceptible crops.

Resistant Cultivars: None.

Chemical: None.

VIRUS DISEASES

Pea mosaic virus, pea enation mosaic virus, pea streak virus, pea seed-borne mosaic virus, bean yellow mosaic virus, alfalfa mosaic virus and red clover vein mosaic virus.

Cultural: Destroy volunteer plants in fall or early spring. Locate pea plantings away from fields of other legumes such as alfalfa and clovers to prevent secondary spread of viruses by aphids to peas.

Resistant Cultivars: None.

Chemical: None.

Notes: Indexing pea germplasm for pea seed-borne mosaic virus (PSbMV) has eradicated it from the breeding program at the Agriculture & Agri-Food Canada Research Centre, Morden, MB. Recent research results indicate that at present most field pea cultivars registered in Canada do not possess a serious potential for high amplification of PSbMV in the seed. PSbMV was found to be transmitted in lentil seed at rates of 32 - 44% (1).

References:

1. Hampton, R.O. and Muehlbauer, F. J. 1977. Seed transmission of pea seed-borne mosaic virus in lentils. Plant Dis. Rep. 61: 235-238.

OTHER DISEASES

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

Anthracose (*Colletotrichum pisi*) NC

Leaf Blotch (*Septoria pisi*) NC

Leaf Spot (*Alternaria alternata*) NC

Rust (*Uromyces viciae-fabae*) NC

GINSENG (*Panax quinquefolium*)

ALTERNARIA BLIGHT

Alternaria panax, *Alternaria alternata*

Cultural: Follow recommended seeding rates, avoid high plant densities which reduce air movement and increase relative humidity which promote disease. Irrigate early in the day so leaves have the opportunity to dry off in the morning. Avoid using high levels of fertilizer or manure that promote excessive leaf growth that is more susceptible to disease and reduces the ability of fungicides to penetrate the crop canopy. Avoid moving equipment through the garden when the leaves are wet as *Alternaria* spores can be spread by the movement of equipment and people.

Resistant Cultivars: None.

Chemical: Mancozeb(COM) DG, WP - apply at 2 week intervals; iprodione (COM) WP - alternate with other fungicides to avoid resistance; anilazine (COM) WP - apply at first sign of disease and follow with 2 subsequent sprays at 4 week intervals. Anilazine may cause injury if applied improperly or in adverse weather conditions; chlorothalonil (COM) SU - start applications when disease threatens and repeat at 7-10 day intervals.

Limitations: Preharvest interval: 14 days (chlorothalonil); 30 days (anilazine, iprodione, mancozeb). Make no more than 3 applications of iprodione per season. Do not apply chlorothalonil more than 6 times per year.

Notes: Good coverage is essential for controlling this disease. Calibrate your sprayer. Use a dye to determine the efficacy of your application if necessary. More frequent applications may be necessary in the spring following emergence until the plants are fully expanded.

References:

1. BC Ministry of Agriculture & Food. 1998. Ginseng Production Guide for Commercial Growers. 125 pp.

BOTRYTIS BLIGHT

Botrytis cinerea

Cultural: Avoid dense plantings or excessive fertilization that promotes the growth of leaves. Large canopy and continued leaf wetness enhance disease development

Resistant Cultivars: None.

Chemical: Chlorothalonil (COM) SU. Start applications when disease threatens and repeat at 7-10 day intervals.

Limitations: Maximum of 6 applications per year. Do not apply within 14 days of harvest.

References:

1. BC Ministry of Agriculture & Food. 1998. Ginseng Production Guide for Commercial Growers. 125 pp.

DAMPING-OFF of SEEDS and YOUNG SEEDLINGS

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

Cultural: Avoid heavy soils and low, wet sites. Prolonged cool and wet soils promote the damping-off problem especially in the spring as plants emerge. Avoid extra thick straw mulch, which keeps the soil cool and wet and increases the risk of damping-off and root diseases. It also reduces the ability of fungicides to penetrate into the soil where the damping-off fungi live. Choosing sites that were not used for alfalfa in previous year can reduce the risk of damping-off and root rot by *Rhizoctonia solani*. Preparing the site, and leaving it fallow for the year preceding planting will also reduce the potential for damping-off and root rots. Avoid excessive chemical fertilizer or manure, which force lush growth and increase the susceptibility to the diseases.

Resistant Cultivars: None.

Chemical: An emergency use registration has been renewed for the product Quadris (azoxystrobin) Flowable Fungicide for the period Sept. 12, 2002 to April 30, 2003 in British Columbia and Ontario. This product is an alternative choice to Quintozene for control of *Rhizoctonia solani*. Product rates and limitations as per supplementary label.

Notes:

1. PCNB [Quintozene 75WP (COM) WP] remains registered for use on ginseng, but its use is no longer recommended due to issues with chemical residues. Quintozene applied at label rates in the year of planting only may result in residues over tolerance in the roots at harvest. Root residues resulting from Quintozene use have recently resulted in trade barriers in Asia and the United States.
2. No other root crops are to be grown for a minimum of one year following the harvest of a ginseng garden that was treated with quintozene.
3. Quadris Flowable Fungicide has been approved by PMRA for use on ginseng on an Emergency Use basis over the last two years. The industry has submitted an URMULE for Minor Use registration of Quadris Flowable fungicide in 2001. This submission has not yet been approved.

References:

1. BC Ministry of Agriculture & Food. 1998. Ginseng Production Guide for Commercial Growers. 125 pp.

NEMATODE DISEASES

Pratylenchus penetrans, *Meloidogyne* spp.

Cultural: Select nematode-free sites for ginseng gardens. Because the host range of root knot nematodes includes many plants besides ginseng, soil from prospective garden sites should be tested for nematodes. Consult your extension agent for labs offering nematode assay services. Like other soil-borne diseases, contaminated equipment, boots, and tools can spread root knot nematodes. Soil fumigation before planting is recommended when over 100/100 cc of soil are found.

Resistant Cultivars: None.

Chemical: None.

References:

1. BC Ministry of Agriculture & Food. 1998. Ginseng Production Guide for Commercial Growers. 125 pp.
2. Parke, J.L. and Shotwell, K.M. 1989. Diseases of Cultivated Ginseng. University of Wisconsin-Madison. 16 pp.

PHYTOPHTHORA ROOT ROT and FOLIAR BLIGHT

Phytophthora cactorum.

Cultural: Avoid poorly drained sites, heavy clay soils and orchard land. Avoid driving heavy machinery on wet soil. Ridge the beds to improve drainage, and design the beds to utilize the contours of the land to prevent low spots in the troughs where water will accumulate. Use seed from *Phytophthora* foliar blight free gardens.

Resistant Cultivars: None.

Chemical: Metalaxyl (COM) GR. Only three applications/year. One pre-emergence in the Spring. Second six weeks later and third six weeks after second. Metalaxyl (COM) EC pre-emergence in spring only.

Fosetyl-AI (COM) WDG. No more than 5 applications/year. Apply first application at full emergence. Final application should be made when foliage is still green.

Limitations: Preharvest interval: 9 days (metalaxyl); 31 days (fosetyl-AI).

Notes: Some strains of *Phytophthora* are now insensitive to Ridomil, i.e., it no longer controls the disease. Over-application increases the chance for these strains to develop. Follow the label.

References:

1. BC Ministry of Agriculture & Food. 1998. Ginseng Production Guide for Commercial Growers. 125 pp.
2. Parke, J.L. and Shotwell, K.M. 1989. Diseases of Cultivated Ginseng. University of Wisconsin-Madison. 16 pp.

RHIZOCTONIA DISEASE/TIP OVER

Rhizoctonia solani.

Cultural: Keep the shade cloth off as long as possible in the spring prior to plant emergence to allow the soil to warm up in the spring. Clean equipment, tools and footwear after working in infested gardens.

Resistant Cultivars: None.

Chemical: An emergency use registration has been renewed for the product Quadris (azoxystrobin) Flowable Fungicide for the period Sept. 12, 2002 to April 30, 2003 in British Columbia and Ontario. This product is an alternative choice to Quintozene for control of *Rhizoctonia solani*. Product rates and limitations as per supplementary label.

Notes:

1. PCNB [Quintozene 75WP (COM) WP] remains registered for use on ginseng, but its use is no longer recommended due to issues with chemical residues. Quintozene applied at label rates in the year of planting only may result in residues over tolerance in the roots at harvest. Root residues resulting from Quintozene use have recently resulted in trade barriers in Asia and the United States.
2. No other root crops are to be grown for a minimum of one year following the harvest of a ginseng garden that was treated with quintozene.
3. Quadris Flowable Fungicide has been approved by PMRA for use on ginseng on an Emergency Use basis over the last two years. The industry has submitted an URMULE for Minor Use registration of Quadris Flowable fungicide in 2001. This submission has not yet been approved.

References:

1. BC Ministry of Agriculture & Food. 1998. Ginseng Production Guide for Commercial Growers. 125 pp.
2. Parke, J.L. and Shotwell, K.M. 1989. Diseases of Cultivated Ginseng. University of Wisconsin-Madison. 16 pp.

OTHER DISEASES

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

Disappearing Root Rot/ Rusty Root (*Cylindrocarpon destructans*)

Sclerotinia White Mold (*Sclerotinia sclerotiorum*)

Stromatinia Rot (*Stromatinia panacis*)

Verticillium Wilt (*Verticillium albo-atrum*, *Verticillium dahliae*)

HEMP (*Cannabis sativus*)**HEMP CANKER**

Sclerotinia sclerotiorum

Cultural: Rotate to cereals, corn and grasses, crops that are immune. Allow at least four years between susceptible crops such as buckwheat, canola/rapeseed, fababeans, lentils, mustard, peas, sunflower, soybeans and safflower. Control broadleaved weeds and volunteers of susceptible crops.

Resistant cultivars: None

Chemical: None

OTHER DISEASES

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

Gray Mould (*Botrytis cinerea*)

Yellow Leaf Spot (*Septoria cannabis*)

LENTIL (*Lens culinaris*)

ANTHRACNOSE

Colletotrichum truncatum

Cultural: Avoid growing lentil after fababean in areas where the disease is present. Follow a crop rotation of at least 4 years as the pathogen is very persistent in the soil (2).

Resistant Cultivars: CDC Robin (Robin is of intermediate resistance).

Chemical: Chlorothalonil (COM) SU, mancozeb (COM) WG. Apply chlorothalonil at beginning of flowering and again 10-14 days later if necessary. Apply first application of mancozeb before bloom when buds are evident, second application 10-14 days later and third application 10-14 days later.

Limitations: Preharvest interval: chlorothalonil 48 days; mancozeb 35 days. Do not make more than 2 applications of chlorothalonil or 3 of mancozeb per season.

Notes: Anthracnose of lentil is now widespread in all lentil growing regions of Manitoba and Saskatchewan (1).

References:

1. Morrall, R.A.A. *et al.* 2002. Seed-borne pathogens of lentil in Saskatchewan in 2001. *Can. Plant Dis. Surv.* 82: 99-101.
2. Buchwaldt, *et al.* 1996. Windborne dispersal of *Colletotrichum truncatum* and survival in infested lentil debris. *Phytopathology* 86: 1193-1198
3. Chongo, G. *et al.* 1999. Control of anthracnose in lentil using partial resistance and fungicide applications. *Can. J. Plant Pathol.* 21: 16-22.
4. Chongo, G., and Bernier, C.C. 2000. Effects of host, inoculum concentration, wetness duration, growth stage and temperature on anthracnose of lentil. *Plant Disease* 84: 544-548.
5. Chongo, G *et al.* 2002. Infection process of *Colletotrichum truncatum* in partially resistant and susceptible lentil genotypes. *Can. J. Plant Pathol.* 24: 81-85.

ASCOCHYTA BLIGHT

Ascochyta lentis

Cultural: Use only disease-free seed (see Note 1), particularly in areas of higher moisture. Practice a crop rotation of at least 4 years. Loss of quality from seed discoloration from this disease continues to increase after swathing, particularly if moist weather prevails (1). Turn under crop refuse soon after harvest. Control volunteer seedlings and avoid planting lentil adjacent to the previous year's lentil field.

Resistant Cultivars: CDC Blaze, CDC Glamis, CDC Grandora, CDC Milestone, CDC Redcap, CDC Redwing, CDC Robin, CDC Sedley, CDC Sovereign, and CDC Vantage.

Chemical: Chlorothalonil (COM) SU, mancozeb (COM) WG. Apply chlorothalonil at beginning of flowering and again during bloom to early pod set if necessary. Make first application of mancozeb before bloom when buds are evident, second application 10-14 days later and third application 10-14 days later. Carbathiin + thiabendazole (COM) LI - seed treatment for the control of seed-borne ascochyta, seedling blights and seed rot.

Limitations: Preharvest interval: chlorothalonil 48 days; mancozeb 35 days. Do not make more than 2 applications of chlorothalonil or 3 of mancozeb per season.

Notes:

1. Have seed tested at an accredited laboratory as high grade seed may still be infected by *Ascochyta*.
2. *Ascochyta* from lentil does not infect pea, fababean or chickpea (3).
3. Growers with a crop adjacent to the previous year's lentil residue should inspect the edge of the crop for disease and apply fungicide to edge of field if disease symptoms appear; and/or harvest the edge separately if it is much more heavily infested than the remainder.

References:

1. Gossen, B.D. and Morrall, R.A.A. 1984. Seed quality loss at harvest due to *Ascochyta* blight of lentil. *Can. J. Plant Pathol.* 6: 233-237.
2. Gossen, B.D. 2001. Impact of burial and survival of *Ascochyta lentis* on lentil residue. *Can. J. Plant Pathol.* 23: 146-148.
3. Morrall, R.A.A. 1997. Evolution of lentil diseases over 25 years in western Canada. *Can. J. Plant Pathol.* 19: 197-207.
4. Ahmed, S. and Morrall, R.A.A. 1996. Field reactions of lentil lines and cultivars to isolates of *Ascochyta fabae* f. sp. *lentis*. *Can. J. Plant Pathol.* 18: 362-369.
5. Pederson, E.A. and Morrall, R.A.A. 1994. Effect of nonhost and fungicide-treated barriers on horizontal spread of ascochyta blight of lentil. *Can. J. Plant Pathol.* 16: 317-325.

BOTRYTIS STEM and POD ROT (GREY MOLD)

Botrytis cinerea

Cultural: Include lentil in rotation only once every 4 years. Using wide row spacing may help to maintain ventilation in the canopy and non-conductive conditions for disease development.

Resistant Cultivars: None.

Chemical: None. It is not known whether seed treatments to control seedling blight induced by *Botrytis* have an effect on late season stem and pod rot.

References:

1. Huang, H.C. and Erickson, R.S. 2000. Survey of diseases of lentil in southern Alberta in 1999. *Can. Plant Dis. Surv.* 80: 99-100.
2. Morrall, R.A.A. 1997. Evolution of lentil diseases over 25 years in western Canada. *Can. J. Plant Pathol.* 19: 197-207.
3. Morrall, R.A.A. et. al. 2001. Seed-borne pathogens of lentil in Saskatchewan in 2000. *Can. Plant Dis. Surv.* 81: 126-129.

SEED ROT, SEEDLING BLIGHT and ROOT ROT

Fusarium spp., *Rhizoctonia solani*, *Botrytis cinerea*, *Pythium* sp. and *Sclerotinia sclerotiorum*

Cultural: Include lentil in rotation only once every 4 years. Avoid other broadleaved special crops in the rotation. Do not use lentil seed that has a high level of infection with *Botrytis* or *Sclerotinia*.

Resistant Cultivars: None.

Chemical: Carbathiin + thiabendazole (COM) LI - seed treatment; metalaxyl (COM) SU -seed treatment only for zero tannin lentil; carbathiin + thiram (COM) SU - seed treatment.

References:

1. Huang, H.C. and Erickson, R.S. 2000. Survey of diseases of lentil in southern Alberta in 1999. *Can. Plant Dis. Surv.* 80: 99-100.
2. Hwang, S.F. et al. 1994. Etiology and severity of fusarium root rot of lentil in Alberta. *Can. J. Plant Pathol.* 16: 295-303.
3. Morrall, R.A.A. et al. 1997. Evolution of lentil diseases over 25 years in western Canada. *Can. J. Plant Pathol.* 19: 197-207.

SCLEROTINIA STEM and POD ROT*Sclerotinia sclerotiorum*

Cultural: Rotate to cereals, corn and grasses. Allow at least 4 years between susceptible crops such as buckwheat, canola/rapeseed, fababean, lentil, mustard, pea, safflower, soybean and sunflower. Control broadleaved weeds and volunteers of susceptible crops.

Resistant Cultivars: None.

Chemical: None.

References:

1. Anderson, K.L. *et al.* 2000. Diseases of lentil in Saskatchewan 1999. Can. Plant Dis. Surv. 80: 96-97.
2. Morrall, R.A.A. *et al.* 2000. Seed-borne pathogens of lentil, pea and chickpea in Saskatchewan in 1999. Can. Plant Dis. Surv. 80: 101-103.

OTHER DISEASES

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

Septoria Leaf Spot (*Septoria* sp.) (Note that this disease may be confused with ascochyta blight, but symptoms usually occur only on the lower leaves.) MI, NC

Stemphylium Blight (*Stemphylium* sp.) NC

Virus Diseases (pea seed-borne mosaic virus). (See Ref. 1, under Field Peas, Virus Diseases) MI

PEPPERMINT (*Mentha piperita*, *M. aquatica* x *M. spicata*)

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

Powdery Mildew (*Erysiphe cichoracearum*)

Verticillium Wilt (*Verticillium albo-atrum*, *V. dahliae*)

SORGHUM (*Sorghum bicolor*)

BACTERIAL LEAF SPOT (HOLCUS SPOT)

Pseudomonas syringae

Cultural: Follow a crop rotation that avoids corn, Sudan grass, and foxtail millet. Control susceptible weeds such as green foxtail. Use seed from disease-free fields as the bacterium is seed-borne. Destroy infected stubble by plowing under after harvest and avoid planting near infected fields of previous season.

Resistant Cultivars: None.

Chemical: None.

SEED ROT and SEEDLING BLIGHT

Fusarium spp., *Penicillium* spp.

Cultural: Sow seed in warm moist soil.

Resistant Cultivars: None.

Chemical: None.

SPEARMINT (*Mentha spicata*)

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

Powdery Mildew (*Erysiphe cichoracearum*)

Verticillium Wilt (*Verticillium albo-atrum*, *V. dahliae*)

Rust (*Puccinia menthae*)

SOYBEAN (*Glycine max*)

BACTERIAL BLIGHT, BACTERIAL PUSTULE

Pseudomonas glycinea, *Xanthomonas phaseoli* var. *sojensis*

Cultural: Use disease-free seed. Follow 2-year minimum crop rotation as bacteria may overwinter in diseased leaves. Do not cultivate or enter fields when plants are wet with dew or rain.

Resistant Cultivars: None.

Chemical: None.

DOWNY MILDEW

Peronospora manchurica

Cultural: The pathogen overwinters as oospores in infected leaves and on seeds. Sow seed from uninfected fields. Plow under soybean residue. Avoid successive soybean plantings or following soybeans with beans.

Resistant Cultivars: None.

Chemical: None.

SCLEROTINIA STEM ROT

Sclerotinia sclerotiorum

Cultural: Rotate to cereals, corn and grasses, crops that are immune. Allow at least 4 years between susceptible crops such as buckwheat, canola/rapeseed, fababeans, lentil, mustard, pea, safflower, soybean and sunflower. Control broadleaved weeds and volunteers of susceptible crops.

Resistant Cultivars: None.

Chemical: None.

SEED ROT and SEEDLING BLIGHT

Pythium spp., *Rhizoctonia solani*

Cultural: None.

Resistant Cultivars: None.

Chemical: Seed treatment with - captan (COM), SU; thiram (COM) WP; diazinon + lindane + captan (COM) DU; captan + methoxychlor (COM) SU; metalaxyl (COM) SU; carbathiin + thiram (COM) SU (see Notes).

Notes: *Rhizobium japonicum* applied on seed was compatible with thiram and carbathiin but not with captan (2). Studies show that granular inoculant applied in soil is not affected by these fungicides (3).

References:

1. See 'General References' at the end of this Chapter.
2. Curley, R.L. and Burton, J.C. 1975. Compatibility of *Rhizobium japonicum* with chemical seed protectants. *Agron. J.* 67: 807-808.
3. Rennie, R.J. and Dubetz, S. 1984. Effect of fungicides and herbicides on nodulation and N₂ fixation in soybean fields lacking indigenous *Rhizobium japonicum*. *Agron. J.* 76: (May-June) 451-454.

SUGAR BEET (*Beta vulgaris*)

DAMPING-OFF, BLACK LEG

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

Cultural: Sow sugar beets early into a firm, moist seed bed.

Resistant Cultivars: None.

Chemical: Treat seed with - captan (COM) SU; captan + methoxychlor (COM) SU; metalaxyl (COM) SU; thiram (COM) WP. Limitations: As per label.

Notes: *Phoma betae* may also cause a leaf spot and storage rot of sugar beet.

LEAF SPOT

Cercospora beticola

Cultural: Use a crop rotation of 3 years. Turn under crop refuse. Locate new fields at least 100 m from those infected the previous year.

Resistant Cultivars: None.

Chemical: Spray foliage with - cupric hydroxide (COM) WP; mancozeb (COM) DF, WP; metiram (COM) WG, WP.

Limitations: Preharvest intervals - 1 day (cupric hydroxide); 21 days (mancozeb, metiram). Do not feed crop refuse treated with maneb, mancozeb, or metiram, to livestock.

Notes:

1. Since the disease rarely occurs in Western Canada, chemical control is seldom required.

SUGAR BEET CYST NEMATODE

Heterodera schachtii

Cultural: Use a crop sequence that includes sugar beet or crucifers only once in 4 years. Control cruciferous weeds. Avoid canola or mustard in rotations that include sugar beets or red beets.

Resistant Cultivars: None.

Chemical: None.

Notes: Sugar beet fields in Alberta are monitored annually for *H. schachtii* and those found to be infested are removed from production.

References:

1. Hawn, E.J., *et al.* 1964. Control of the sugar-beet nematode in Alberta. Agric. Can., Publ. 1216. 4 pp.
2. Snow, J.G. and Hill, A.W. 1976. Alberta sugar beet bulletin. 21. Can. Sugar Factories Co., Lethbridge, AB.

OTHER DISEASES

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

Powdery Mildew (*Erysiphe polygoni*)

Storage Rot (*Penicillium* spp., *Phoma betae*, *Rhizopus* spp., *Erwinia* spp., *Botrytis* spp., and *Fusarium* spp.)

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APPENDIX I. FOLIAR FUNGICIDES REGISTERED FOR USE ON SPECIAL CROPS

Crop	Disease	Active Ingredient	Trade Name	Formulation	PCP #
Chickpea	Ascochyta blight	chlorothalonil	Bravo 500	40.4% SU	15723
Corn	Rust, Leaf blight	propiconazole	Topas 250E	250 g/L EC	24030
Dill	Dill Blight	benomyl	Benlate	50% WP	11062, 24678
Field Beans	Anthracnose	tribasic copper sulphate	Copper 53W	53% WP	9934
	Common blight	tribasic copper sulphate	Copper 53W	53% WP	9934
		copper hydroxide	Kocide 101 Parasol	50% WP 50% WP	14417 24671
	Halo blight	copper hydroxide	Kocide 101 Parasol	50% WP 50% WP	14417 24671
	Stem Rot	benomyl	Benlate	50% WP	11062, 24678
		dicloran	Botran 75W	75% WP	8772
		iprodione	Rovral	50% WP	15213
		thiophanate methyl	Easout Senator	70% WP 70% WP	12279 25343
vinclozolin	Ronilan EG	50% WG	24894		
Field Peas	Mycosphaerella blight	chlorothalonil	Bravo 500	40.4% SU	15723
	Powdery mildew	sulphur	Kumulus DF	80% WG	18836
Lentil	Anthracnose, Ascochyta blight	chlorothalonil	Bravo 500	40.4% SU	15723
		mancozeb	Dithane DG	75% WG	20553
Sugar beet	Leaf spot	cupric hydroxide	Kocide 101	50% WP	14417
		mancozeb	Dithane M-45 Manzate 200 Manzate 200 DF	80% WP 80% WP 75% DF	8556 10526 21057
		metiram	Polyram 80W Polyram DF	80% WP 80% DF	14825 20087

APPENDIX II. FUNGICIDES REGISTERED FOR USE ON GINSENG

Fungicides	PCP#	Alternaria Blight	Botrytis Blight	Phytophthora Root Rot	Phytophthora Foliar Blight	Rhizoctonia Crown Rot	Damping-off
anilazine:							
Dyrene 50WP	6731	x					
azoxystrobin:							
Quadris*	26153					x	x (Rhizoctonia)
chlorothalonil:							
Bravo 500	15723	x	x				
fosetyl-Al:							
Aliette WDG	24458			x	x		
iprodione:							
Rovral	15213	x					
mancozeb:							
Dithane DG	20553	x					
Dithane M-45	8556	x					
Manzate 200 DF	21057	x					
metalaxyl:							
Ridomil 2G	24037			x			x (Pythium)
Ridomil 240EC	17247			x			x (Pythium)
metalaxyl-m:							
Ridomil Gold 480EC	25384			x			x (Pythium)
PCNB:							
Quintozene 75WP	7251, 11425					x	x (Rhizoctonia)

* Emergency use registration only (Sept. 12, 2002 - April 30, 2003) for British Columbia and Ontario.

APPENDIX III. SEED TREATMENTS REGISTERED FOR USE ON SPECIAL CROPS

Seed Treatment	PCP#	Seed Rot & Seedling Blight							Seed-borne Diseases		
		Corn	Chickpea	Field Bean	Field Pea	Lentil	Soybean	Sugar Beets	Bean Anthrac-nose	Corn Head Smut	Lentil Ascochyta
captan:											
Captan Flowable	12028	x		x	x		x	x			
captan + diazinon + lindane:											
Agrox B-3 Dual Purpose	9505	x		x	x		x				
Agrox D-L Plus	10896	x		x	x		x				
Co-op D-L & C Drill Box	11451	x		x	x		x				
Clean Crop D-L-C	11451	x		x	x		x				
captan + diazinon + thiophanate methyl:											
DCT Dual Purpose	14986			x					x		
captan + malathion:											
Evershield II C-M	10856	x									
captan + methoxychlor:											
Captan 30-Methoxychlor 3	12029	x		x			x	x			
carbathiin + thiram:											
Anchor	18788						x				
Vitavax Powder	15538						x				
Vitaflo 280	22473	x		x	x	x	x			x	
carbathiin + thiabendazole:											
Crown	23430					x					x

APPENDIX III. SEED TREATMENTS REGISTERED FOR USE ON SPECIAL CROPS con't

Seed Treatment	PCP#	Seed Rot & Seedling Blight							Seed-borne Diseases		
		Corn	Chickpea	Field Bean	Field Pea	Lentil	Soybean	Sugar Beets	Bean Anthrac-nose	Corn Head Smut	Lentil Ascochyta
fludioxonil:											
Maxim	24732	x					x				
mancozeb:											
Dithane M-45	12215	x									
Manzate 200	10526	x									
metalaxyl:											
Allegiance FL ¹	26674	x	x	x	x	x ^{3,4}	x	x			
Apron FL ¹	24262	x	x	x	x	x ^{3,4}	x ²	x			
Apron XL LS ¹	25585	x	x	x ²	x ²	x ^{3,4}	x ²	x			
thiram:											
Thiram 75WP	15933	x		x	x		x	x			

¹Pythium only²Pythium and Phytophthora³Only on low tannin cv CDC Gold⁴For seed production or export.