Chapter Two

DISEASES OF FORAGE LEGUMES

ALFALFA (*Medicago sativa*)

BACTERIAL WILT

Clavibacter michiganensis subsp. *insidiosum*

Cultural: Use crop sequences that include no more than 4 consecutive years of alfalfa. Thoroughly clean and disinfest mowers between infested and noninfested fields. Harvest young stands before old ones when using the same equipment. Avoid cutting when plants are wet.

Cultivar Resistance:

Resistant (see Notes)	Intermediate	Susceptible
Most cultivars are resistant	G-2852 and Rambler.	Anik, Peace and Rangelander.

Chemical: None.

Notes: Stem nematodes may transmit wilt bacteria; therefore, use nematode and wilt-resistant cultivars where both diseases occur together.

References:

1. Goplen, B.P. *et al.* 1980. Growing and managing alfalfa in Canada. Can. Dep. Agric. Publ. 1705.

2. Nelson, G.A. 1977. Bacterial wilt of alfalfa. Alberta Dep. Agric., Agdex 121/632-1.

3. Peake, R.W. and Cormack, M.W. 1955. Effect of bacterial wilt on hay yield of irrigated alfalfa. Can. J. Agric. Sci. 35: 202-210.

BLACK STEM and LEAF SPOT

Phoma medicaginis var. *medicaginis* (syn. *Ascochyta imperfecta*)

Cultural: Rotate alfalfa with non-legume crops. Spring burning has been recommended, but may injure stand if growth has already begun. When disease is prevalent, early cutting will reduce leaf loss.

Resistant Cultivars: None.

Intermediate: Beaver, Rambler, Vernal

Chemical: Mancozeb (COM) DG may be used for alfalfa grown for seed only.

Notes: Usually 2 years are required for inoculum build-up. Cool moist conditions favour this disease. Thiram used as a seed treatment for the control of seed decay and seedling blight may reduce black stem in the early years of a stand.

References:

1. Cormack, M.W. 1945. Studies on *Ascochyta imperfecta*, a seed and soil-borne parasite of alfalfa. Phytopathology 35: 838-855.

2. Harding, H. 1972. Foliage diseases of alfalfa in northern Saskatchewan: a note on the 1972 survey and the differential reactions of nine varieties. Can. Plant Dis. Surv. 52: 149-150.

3. Mead, H.W. 1964. Resumè of data on black stem of alfalfa caused by *Ascochyta imperfecta* Pk. Can. Plant Dis. Surv. 44: 134-141.

BLOSSOM BLIGHT

Botrytis cinerea, Sclerotinia sclerotiorum

Cultural: High humidity is a prerequisite for blossom blight epidemics. An outbreak is less likely to occur in thin stands because of increased air movement and faster drying.

Resistant Cultivars: None.

Chemical: Benomyl (COM) WP may be used on alfalfa grown for seed.

Notes:

1. This disease is not highly seed borne (2).

2. A test kit has been used by growers to improve the timing of fungicide application.

References:

1. Gossen, B.D., Smith, S.R. and Platford, R.G. 1994. *Botrytis cinerea* blossom blight on alfalfa on the Canadian Prairies. Plant Dis. 78: 1218.

2. Gossen, B.D. and Anderson, K. 1995. Survey of *Botrytis cinerea* in alfalfa seed in Saskatchewan and Manitoba, 1993. Can. Plant Dis. Surv. 75: 166-167.

3. Gossen, B.D., Rimmer, S.R., and Holley, J.D. 2001. First report of resistance to benomyl fungicide in *Sclerotinia sclerotiorum*. Plant Dis. 85: 1206.

4. Lan, Z. 1999. Development and Control of *Botrytis cinerea* in Alfalfa Flowers. M.Sc. Thesis, University of Saskatchewan, Saskatoon, SK. 119 pp.

COMMON LEAF SPOT

Pseudopeziza medicaginis

Cultural: Harvest for hay before defoliation becomes severe.

Resistant Cultivars: Rambler.

Chemical: Mancozeb (COM) WG may be used for alfalfa grown for seed only.

References:

1. Harding, H. 1972. Foliage diseases of alfalfa in northern Saskatchewan; a note on the 1972 survey and the differential reactions of nine varieties. Can. Plant Dis. Surv. 52: 149-150.

CROWN AND ROOT ROT

Rhizoctonia solani, Fusarium roseum, Phoma medicaginis var. *medicaginis, Pseudomonas viridiflava*

Cultural: Use varieties with recommended resistance to cold, bacterial wilt, and alfalfa stem nematode. Fertilize according to results of soil analysis. Cultivars with *M. falcata* backgrounds (winter-hardy cultivars) are generally more resistant than those with *M. sativa* backgrounds.

Resistant Cultivars: None.

Intermediate: Heinrichs, AC Nordica, Rambler and other cultivars with subsp. *falcata* parentage.

Susceptible: Algonquin, Apica, Beaver and other cultivars with subsp. *sativa* parentage.

Chemical: None.

References:

1. Gossen, B.C. 1994. Field response of alfalfa to harvest frequency, cultivar, crown pathogens, and soil fertility: II. Crown rot. Agron. J. 86: 88-93.

2. Gossen, B.D. 1998. Development of secondary crowns reduces crown rot severity in alfalfa cultivars. Agron. J. 90: 587-590.

3. Leath, K.J. and Kendall, W.A. 1978. Fusarium root rot of forage species: pathogenicity and host range. Phytopathology 68: 826-831.

4. Richard, C. *et al.* 1982. Low-temperature interactions in Fusarium wilt and root rot of alfalfa. Phytopathology 72: 293-297.

DAMPING-OFF AND SEEDLING BLIGHT

Pythium spp., *Aphanomyces* spp.

Cultural: Use seed with high percentage germination.

Resistant cultivars: None.

Chemical: Treat seed with thiram 75% (COM) WP; metalaxyl (COM).

Limitations: Metalaxyl is effective against *Pythium* spp. fungi. Apron FL (metalaxyl) contains no colourant. A suitable seed colourant must be added to the slurry prior to application on the seed.

References:

1. Hwang, S.F. 1988. Control of damping-off by chemical seed treatment. Pg. 227 *in* 1988 Pest Management Res. Rep., AAFC, Ottawa, ON.

2. Gossen, B.D. 1994. Effect of fungicide seed treatments on establishment of alfalfa, 1994. Pp. 178-181 *in* 1994 Pest Management Res. Rep., AAFC, Ottawa, ON.

3. Hwang, S.F., *et al.* 2002. Seedbed preparation, timing of seeding, fertility and root pathogens affect establishment and yield of alfalfa. Can. J. Plant Sci. 82: 371-381.

DOWNY MILDEW

Peronospora trifoliorum

Cultural: Rotation with non-legume crops. Harvest cleanly to prevent reinfection from crop residue.

Resistant Cultivars: Algonquin, Angus, Anik.

Intermediate: Beaver, Rambler, Roamer, Vernal.

Susceptible: Rangelander.

Chemical: None.

References:

1. Berkenkamp, B. *et al.* 1978. Resistance of alfalfa cultivars to downy mildew. Can. J. Plant. Sci. 58: 893-894.

2. Ellis, P. and Berkenkamp, B. 1983. Alfalfa yield losses due to disease. Can. Dep. Agric., Canadex 632.121.

STEM NEMATODE

Ditylenchus dipsaci

Cultural: Avoid late cutting and excessive grazing. Limit stand life to 4 years. Use fertilizer as indicated by soil fertility analysis. Rotate alfalfa with non-host crops such as grains, pulses, and sugar beets.

Resistant Cultivars: 53Q60, 53V08, Affinity+Z, Alfagraze, AmeriGraze 401+Z, Blazer XL, Class, Geneva, Haygrazer, Magnum IV, Ultra, WL327.

Intermediate: 630, 5246, 5262, 5454, Arrow, Class, DK 124, DK 140, GH777, Magnum III, Magnum III-Wet, MultiKing I, Proleaf, Rocket, Spredor 3, WL 252HQ, WL 324

Susceptible: 5312, 54V54, DK 134, Trident II.

Chemical: None.

VERTICILLIUM WILT

Verticillium albo-atrum

Cultural: Plough down infested fields as soon as possible. Control susceptible weeds and volunteer alfalfa in ploughed fields with herbicides or cultivation and do not plant alfalfa or other forage legumes in infested land for at least 3 years. Rotate alfalfa with resistant crops such as corn, grasses, and cereals. If both diseased and healthy fields are to be harvested, cut healthy fields first. Clean plant debris from harvesting equipment when moving it from field to field. Forage from infested fields should not be fed on forage land and should preferably be used on the producing farm. Prevent irrigation run-off from diseased to healthy fields. Control insect vectors such as pea aphid, alfalfa weevil and grasshopper.

Resistant Cultivars: Most cultivars are now resistant.

Susceptible: AC Grazeland Br, Algonquin, Alouette, Angus, Anik, Apica, Comsel, G-2852, Magnum Plus, OAC Minto, Olinda, Runner, Spredor 2, Stampeder, 120, 5262.

Chemical: Seed may be treated with thiram (COM) WP or thiram (COM) SU. Limitations: As per label.

Notes:

1. Resistant cultivars are also resistant to bacterial wilt.

2. Thiram seed treatment does not interfere with *Rhizobium* inoculum provided seed is sown soon after the inoculum is applied.

3. Not thiram seed treatment is required prior to movement and sale if the field inspection did not show disease or seed-testing did not show *V. albo-atrum* in the seedlot.

References:

1. Busch, L.V. and Smith, E. 1981. Susceptibility of Ontario-grown alfalfa cultivars and certain *Medicago* species to *Verticillium albo-atrum*. Can. J. Plant Pathol. 3: 169-172.

2. Gagne, S. et Richard, C. 1982. La verticilliose de la luzerne en Amerique du Nord. Can. J. Plant Pathol. 4: 47-53.

3. Huang, H.C. and Atkinson, T.G. (eds.). 1983. Verticillium wilt of alfalfa. Agric. Can. Publ. 1982-8E (rev.).

4. Jefferson, P.G., and Gossen, B.D. 2002. Irrigation increases stand and yield losses due to Verticillium wilt in a susceptible alfalfa cultivar. Plant Dis. 86: 588-592.

WINTER CROWN ROT (COTTONY SNOW MOLD)

Coprinus psychromorbidus

Cultural: Plant winter-hardy varieties. Seed early.

Resistant Cultivars: None.

Intermediate: *M. falcata* with *M. sativa* subsp. *falcata*., AC Nordica and other cultivars with *M. falcata* parentage.

Chemical: None.

References:

1. Cormack. M.W. 1952. Winter crown rot or snow mold of alfalfa, clovers and grasses in Alberta. II. Field studies on host and varietal resistance and other factors related to control. Can. J. Bot. 30: 537-548.

2. Traquair, J.A. and Hawn, E.J. 1982. Pathogenicity of *Coprinus psychromorbidus* on alfalfa. Can. J. Plant Pathol. 4: 106-108.

3. Gossen, B.D. *et al.* 1992. Evaluation of alfalfa lines for reaction to winter crown rot in field trials in Saskatchewan. Can. J. Plant Pathol. 14: 159-168.

4. Hwang, S.F. and D.A. Gaudet. 1995. Effects of plant age and cold hardening on development of resistance to winter corwn rot in first-year alfalfa. Can. J. Plant Science 75: 421-428.

5. Hwang, S.F. and D.A. Gaudet. 1998. Effects of low-temperature stress and freezing resistance on development of winter crown rot in the first year alfalfa. Can. J. Plant Sci. 78(4): 689-696.

YELLOW LEAF BLOTCH

Leptotrochila medicaginis

Cultural: Rotate alfalfa with non-legume crops. Spring burning reduces overwintering inoculum, but may injure stand if growth has already begun. Cutting for hay before leaf drop reduces load of overwintering inoculum and minimizes leaf loss.

Resistant Cultivars: Anik, Rambler.

Intermediate: Angus, Beaver, Rangelander, Vernal.

Susceptible: Peace.

Chemical: None.

References:

1. Berkenkamp, B. and Meeres, J. 1979. Resistance of alfalfa cultivars to yellow leaf blotch. Can. J. Plant Sci. 59: 873-874.

2. Harding, H. 1972. Foliage diseases of alfalfa in northern Saskatchewan: a note on the 1972 survey and the differential reactions of nine varieties. Can. Plant Dis. Surv. 52: 149-150.

OTHER DISEASES

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

Anthracnose (*Colletotrichum destructivum*) MI

Brown Root Rot (*Phoma sclerotioides*) See sweet clover, BROWN ROOT ROT on page 12. NC

Gray Leaf Spot (Stagonospora Leaf Spot) (*Leptosphaeria pratensis*) MI

Leaf Spot (*Stemphylium botryosum*) Mancozeb (COM) WG may be used for alfalfa grown for seed only.

Mosaic (alfalfa mosaic virus) NC

Pepper Spot (*Leptosphaerulina briosiana*) Mancozeb (COM) WG may be used for alfalfa grown for seed only.

Root Rot (*Cylindrocarpon* spp., *Fusarium* spp., *Phytophthora megasperma*, *Pseudomonas* spp.) MI

Rust (*Uromyces striatus*) MI

Stem Rot (*Sclerotinia trifoliorum, S. sclerotiorum*) MI

White Spot (moisture stress or potassium deficiency) NC

Witches'-broom (witches'-broom phytoplasma) MI

RED CLOVER (*Trifolium pratense*)

BLACK STEM

Ascochyta viciae (syn. *A. meliloti*)

Cultural: Rotate red clover with non-legume crops. Spring burning has been recommended but may injure stand if growth has already begun.

Resistant Cultivars: None.

Chemical: None.

References:

1. Edmunds, L.K. and Hanson, E.W. 1960. Host range, pathogenicity and taxonomy of *Ascochyta imperfecta*. Phytopathology 50: 105-108.

NORTHERN ANTHRACNOSE

Kabatiella caulivora

Cultural: Rotation with non-legume crops.

Resistant Cultivars: Norlac.

Intermediate: Altaswede.

Chemical: None.

Notes: The disease is favoured by wet cool weather.

References:

1. Folkins, L.P. *et al.* 1976. Norlac red clover. Can. J. Plant Sci. 56: 757-758.

OTHER DISEASES

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

Aster Yellows And Witches' Broom (aster yellows and witches'-broom phytoplasmas) MI

Black Patch (*Rhizoctonia leguminicola*) MI

Brown Root Rot (*Phoma sclerotioides*) See SWEET CLOVER, Brown Root Rot on page 12. NC

Damping-off and Seedling Blight (*Pythium* spp.) NC

Leaf Spot (*Stagonospora recedens*) NC

Mosaic (bean yellow mosaic virus) MI

Pepper Spot (*Leptosphaerulina briosiana*) MI

Phyllody (phyllody phytoplasma) MI

Powdery Mildew (*Erysiphe polygoni*) NC

Sooty Blotch (*Cymadothea trifolii*) NC

Stem Rot (*Sclerotinia trifoliorum, S. sclerotiorum*) MI

Target Spot (*Stemphylium sarcinaeforme*) MI

Winter Crown Rot (*Coprinus psychromorbidus*) NC - See ALFALFA, Winter Crown Rot on page 8.

SWEETCLOVER (*Melilotus alba* and *M. officinalis*)

BLACK STEM AND GREY STEM CANKER

Ascochyta viciae (syn. *A. meliloti, A. caulicola*)

Cultural: Rotate with non-legume crops. Early spring burning may be effective but may damage crops if growth has already begun.

Resistant Cultivars: Yukon.

Chemical: None.

Note: This is a seed-borne disease, but no seed treatment is currently recommended for its control.

References:

1. Berkenkamp, B. and Baenziger, H. 1962. Reaction of sweet clover varieties to black stem. Can. Plant Dis. Surv. 42: 265.

2. Berkenkamp, B. *et al.* 1969. Floral infection by *Ascochyta caulicola* (gray stem canker) and varietal reaction of sweet clover. Plant Dis. Rep. 53: 348-349.

BROWN ROOT ROT

Phoma sclerotioides (syn. *Plenodomus meliloti*)

Cultural: None (see Notes).

Resistant Cultivars: None.

Chemical: None.

Notes: Alfalfa, red clover, alsike clover, and bird's-foot trefoil are less severely affected than sweetclover.

References:

1. Berkenkamp, B. and Baenziger, H. 1969. The reaction of sweet clover varieties to brown root rot. Can. J. Plant Sci. 49: 181-183.

OTHER DISEASES

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

Downy Mildew (*Peronospora trifoliorum*) See ALFALFA, Downy Mildew on page 6.

Leaf Spot, Stem Blight and Root Rot (*Leptosphaeria pratensis*)

Winter Crown Rot (*Coprinus psychromorbidus*, syn. low temperature basidiomycete)

ALSIKE CLOVER (*Trifolium hybridum*)

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

Black Stem (*Phoma medicaginis*) MI - See ALFALFA, Black Stem on page 3.

Brown Root Rot (*Phoma sclerotioides*) NC - See SWEET CLOVER, Brown Root Rot on page 12.

Leaf Spot (*Leptosphaeria pratensis*) MI

Mosaic (bean yellow mosaic virus) MI

Pepper Spot (*Leptosphaerulina briosiana*) MI

Phyllody (clover proliferation virus) MI

Powdery Mildew (*Erysiphe polygoni*) NC

Rust (*Uromyces trifolii*) MI

Sooty Blotch (*Cymadothea trifolii*) NC

Winter Crown Rot (*Coprinus psychromorbidus*) NC - See ALFALFA, Winter Crown Rot on page 8.

BIRD'S-FOOT TREFOIL (*Lotus corniculatus*)

The following diseases of bird's-foot trefoil are currently of minor importance (MI) and/or are diseases for which no practical control measures (NC) are currently recommended:

Blossom Blight (*Botrytis cinerea, Sclerotinia sclerotiorum*) MI - see ALFALFA, Blossom Blight on page 4.

Leaf Spot (*Stemphylium loti*) MI

Root And Crown Rot (*Pseudomonas viridiflava*) MI

Wilt (*Sclerotinia trifoliorum*) MI

Winter Crown Rot (*Coprinus psychromorbidus*) MI - see ALFALFA, Winter Crown Rot on page 8.

CICER MILKVETCH (*Astragalus cicer*)

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

Leaf Spot (*Stemphylium* sp.) MI

SAINFOIN (*Onobrychis viciifolia*)

CROWN AND ROOT ROT

Fusarium spp., *Pseudomonas* spp., *Erwinia* spp.

Cultural: Do not seed sainfoin in mixtures with other legumes or grasses unless planting is in alternate rows. Limit stand life to 4 to 5 years. Fertilize as indicated by results of soil analysis. See Notes.

Resistant Cultivars: None.

Chemical: None.

Notes: Sainfoin persisted better under heavy grazing or frequent cutting when planted in mixed stands with grass (1). Crown and root rot was less severe when crop was cut once for hay and allowed to set seed (2).

References:

1. Kilcher, M.R. 1982. Persistence of sainfoin under semiarid conditions. Can. Dep. Agric., Canadex 125.11.

2. Sears, R. G. *et al.* 1975. Root and crown rotting organisms affecting sainfoin (*Onobrychis viciifolia*) in Montana. Plant Dis. Rep. 59: 423-426.

3. Gaudet, D.A. *et al.* 1980. The role of bacteria in the root and crown rot complex of irrigated sainfoin in Montana. Phytopathology 70: 161-167.

OTHER DISEASES

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

Brown Root Rot (*Phoma sclerotioides*) NC - See SWEET CLOVER, Brown Root Rot on page 12.

Damping-off and Seedling Blight (*Pythium* spp., *Aphanomyces* spp.) NC - See ALFALFA, Damping-off on page 6.

Leaf and Stem Spot (*Ascochyta orobi*) MI

Leaf Spot (*Stemphylium* sp.) MI

Septoria Leaf Spot (*Septoria orobina*) MI

Wilt (*Sclerotinia trifoliorum*) MI

Winter Crown Rot (*Coprinus psychromorbidus*) NC - see ALFALFA, Winter Crown Rot on page 8.

WHITE CLOVER (*Trifolium repens*)

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

Leaf Spot (*Cercospora zebrina, Stagonospora meliloti*) MI

Pepper Spot (*Pseudoplea trifolii*) MI

Root Rot (*Cylindrocarpon* spp., *Fusarium* spp.) MI

Rust (*Uromyces trifolii*) MI

Sooty Blotch (*Cymadothea trifolii*) NC

Winter Crown Rot (*Coprinus psychromorbidus*) NC - See ALFALFA, Winter Crown Rot on page 8.

GENERAL REFERENCES

1. Dickson, J.G. 1956. Diseases of field crops, Second Ed. McGraw Hill Book Co., New York. 517 pp.

2. Stuteville, D.L. and Erwin, D.C. 1990. Compendium of alfalfa diseases. Am. Phytopathol. Soc., St. Paul, Minn. 84 pp.

3. Martens, J.W. *et al*. 1984. Diseases of field crops in Canada. Can. Phytopathol. Soc. 160 pp.

APPENDIX I. Fungicides registered for use on forage legumes.

Active Ingredient	Trade Name	Formulation	Commercial/ Domestic	PCP Number	Diseases Controlled
ALFALFA:					
benomyl[a]	Benlate	50% WP	C	11062, 24678	blossom blight
captan	Captan 75	75% WP	C	6007	Seed treatment. Seed rots, seedling rots
mancozeb	Dithane DG Rainshield NT	75% WG	C	20553	leaf spots
metalaxyl	Apron FL Allegiance FL	317 g/L 317 g/L	C C	24262 26674	Seed treatment. Pythium seed rots & seedling blight
metalaxyl-m	Apron XL LS	33%	C	25585	Seed treatment. Pythium damping off and early season Phytophthora root rot.
thiram	Thiram 75	75% WP	C	15933	Seed treatment. Verticillium wilt
thiram	Thiram 42-S	42% SU	C	16420	Seed treatment. Verticillium wilt
BIRD'S-FOOT TREFOIL:					
metalaxyl	Apron FL Allegiance FL	317 g/L 317 g/L	C C	24262 26674	Seed treatment. Pythium seed rots & seedling blight
metalaxyl-m	Apron XL LS	33%	C	25585	Seed treatment. Pythium damping off and early season Phytophthora root rot.
CLOVER:					
captan	Captan 75	75% WP	C	6007	Seed treatment. Seed rots, seedling rots
metalaxyl	Apron FL Allegiance FL	317 g/L 317 g/L	C C	24262 26674	Seed treatment. Pythium seed rots & seedling blight
metalaxyl-m	Apron XL LS	33%	C	25585	Seed treatment. Pythium damping off and early season Phytophthora root rot.

[a] Benomyl (Benlate) is no longer being manufactured and retail supplies are becoming limited.

APPENDIX I continued on next page

APPENDIX I. Fungicides registered for use on forage legumes. Continued

SAINFOIN:					
metalaxyl	Apron FL Allegiance FL	317 g/L 317 g/L	C C	24262 26674	Seed treatment. Pythium seed rots & seedling blight
metalaxyl-m	Apron XL LS	33%	C	25585	Seed treatment. Pythium damping off.
VETCH:					
metalaxyl	Apron FL Allegiance FL	317 g/L 317 g/L	C C	24262 26674	Seed treatment. Pythium seed rots & seedling blight
metalaxyl-m	Apron XL LS	33%	C	25585	Seed treatment. Pythium damping off and early season Phytophthora root rot.