

## Chapter Nine

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## POTATO (*Solanum tuberosum*)

### BACTERIAL RING ROT

*Clavibacter michiganensis* subsp. *sepedonicum*

**Cultural:** Clean then disinfect all storages and potato equipment thoroughly at least once annually. To do this, first remove all soil and plant debris then use a recommended disinfectant (see appendix II). When planting, use only certified disease free seed, and disinfect all equipment (please see note 4) between seed lots. Use cup rather than pick type planters to minimize wounding. At harvest, use only new bags for seed since it is impossible to disinfect old ones. If disease is found, dispose of all potatoes as soon as possible then thoroughly disinfect the premises as described previously. Practice crop rotation and do not plant potatoes in an infested field for 2 seasons.

**Resistant Cultivars:** None.

**Chemical:** None.

#### Notes:

1. All grades of Canadian seed potatoes have a zero tolerance for bacterial ring rot.
2. Bacterial ring rot was declared a 'pest' under the Agricultural Pests Act of Alberta in 1939. In 1942 it was also declared a 'pest' in British Columbia. Legislation aims to eradicate the disease on commercial potato farms.
3. Symptomless (latent) infections of ring rot occur (5).
4. *C. michiganensis* can survive for several years on equipment and storage surfaces (6).

#### References:

1. Slack, S.A. and Westra, A.A.G. 1998. Evaluation of flusaulfamide for the control of bacterial ring rot of potato. *Am. J. Potato Res.* 75:225-230.
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7. Letal, J.R. 1977. Efficacy of disinfectants against potato ring rot and blackleg bacteria. *Am. Potato J.* 54:405-409.

### BACTERIAL SOFT ROT

*Erwinia carotovora* pv. *carotovora*

**Cultural:** Do not over-irrigate fields during the growing season. Harvest only mature tubers when soil temperatures are less than 10°C. Minimize mechanical damage during harvest and handling. Protect tubers from desiccation by sun and wind. Cool tubers of early cultivars to 10°C. For late potatoes, store tubers for 7-10 days at 10°-15°C to promote wound healing, then lower temperature to 2-5°C (7°-10°C for processing tubers). Provide good ventilation to prevent low oxygen concentrations and development of moisture films on tuber surfaces. Do not wash

tubers before storage; however, if washing is necessary before marketing, dry the tubers as soon as possible and package them in well-aerated containers. When washing use only clean water and change it frequently to reduce the soft rot inoculum level. Control other diseases that predispose tubers to soft rot. Remove culls and other plant refuse to prevent insect transmission in storage.

**Resistant Cultivars:** None.

**Chemical:** None.

**Notes:** Blackleg symptoms also can be caused by *E. carotovora pv. carotovora*

**References:**

1. Bartz, J.A. 1999. Suppression of bacterial soft rot in potato tubers by application of kasugamycin. *Am. J. Potato Res.* 76: 127-136.
2. Reeves, A.F., *et al.* 1999. Evaluation of potato varieties and selections for resistance to bacterial soft rot. *Am. J. Potato Res.* 76: 183-189.
3. Toth, I.K., *et al.* 1999. A one step PCR-cased method for the detection of economically important soft rot *Erwinia* species on micropropagated potato plants, *J. Appl. Microbiol.* 87: 158-166.
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7. Elphinstone, J.G. and Perombelon, C.M. 1986. Contamination of potatoes by *Erwinia carotovora* during grading. *Plant Pathol.* 35: 25-33.
8. Harrison, M.D. *et al.* 1977. Waste potato dumps as sources of insects contaminated with soft rot coliform bacteria in relation to recontamination of pathogen-free potato stocks. *Potato Res.* 20:37-52.
9. Lund, B.M. and Kelman, A. 1977. Determination of the potential for development of bacterial soft rot of potatoes. *Am. Potato J.* 54:211-225.
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## **BLACK DOT**

*Colletotrichum coccodes*

**Cultural:** Use certified seed. Rotate with grains (preferably five years). Other solanaceous crops and weeds such as tomatoes, peppers, eggplant, and nightshades should not be used in rotations. Soil should be adequately fertilized. Irrigate but avoid excess watering. Avoid skinning or bruising tubers at harvest.

**Resistant cultivars:** There are no potato cultivars resistant to black dot. Cultivars producing thin-skinned tubers are more susceptible.

**Chemical:** There are no registered chemical control measures for black dot.

**Note:** In storage, keep relative humidity at or above 90 percent. If possible, store at 40°F

## References

1. Lees, A.K. and Hilton, A.J. 2003. Black dot (*Colletotrichum coccodes*): an increasingly important disease of potato. *Plant Pathol.* 52: 3-12.
2. Denner, F.D.N., *et al.* 2000. Effect of soil solarisation and mouldboard ploughing on black dot of potato, caused by *Colletotrichum coccodes*. *Potato Res.* 43: 195-201.
3. Andrivon, D., *et al.* 1998. Colonization of roots, stolons, tubers, and stems of various potato (*Solanum tuberosum*) cultivars by the black-dot fungus *Colletotrichum coccodes*. *Plant Pathol.* 47: 440-445.
4. Denner, F.D.N., *et al.* 1998. The effect of seed- and soilborne inoculum of *Colletotrichum coccodes* on the incidence of black dot on potatoes. *Potato Res.* 41: 51-56.
5. Johnson, D.A., *et al.* 1997. Incidence of *Colletotrichum coccodes* in certified potato seed tubers planted in Washington State. *Plant Dis.* 81: 1199-1202.
6. Denner, F.D.N. *et al.* 1997. Treatment of seed potatoes with prochloraz for simultaneous control of silver scurf and black dot on progeny tubers. *Potato Res.* 40: 221-227.
7. Read, P.J., and Hide, G.A. 1995. Development of black dot disease (*Colletotrichum coccodes* (Wallr.) Hughes) and its effects on the growth and yield of potato plants. *Ann. Appl. Biol.* 127: 57-72.
8. Read, P.J. 1991. The susceptibility of tubers of potato cultivars to black dot (*Colletotrichum coccodes* (Wallr.) Hughes). *Ann. Appl. Biol.* 119: 475-482.

## BLACKLEG

*Erwinia carotovora* subsp. *atroseptica*

**Cultural:** Plant whole seed that is free from blackleg. Plant in well-drained soil, especially when using cut seed. Treat cut seed with approved fungicides then plant immediately or suberize it well before planting to reduce infection by *Fusarium* spp. and other pathogens that predispose it to bacterial invasion (see Note 1). Plant on land with at least two or three years between potato crops. Avoid excessive irrigation to prevent seed-piece decay and subsequent stem invasion. Remove potato culls and other plant refuse to avoid insect transmission. Frequently clean and disinfest seed cutting and handling equipment as well as planters, harvesters and conveyers to eliminate contamination. This should be done at least between different seed lots. Avoid washing seed potatoes and exercise care during handling operations to minimize damage. Remove infected plants as soon as they appear, if practical.

**Resistant Cultivars:** None  
**Intermediate:** Russet Burbank (Netted Gem).

**Chemical:** None.

### Notes:

1. Fungicidal seed piece treatments do not directly control blackleg.
2. Seed potatoes in Canada are inspected in the field for blackleg.
3. Blackleg bacteria may be present on tuber surfaces even in the absence of foliage or tuber symptoms.

### References:

1. Hyman, L.J., *et al.* 2000. A competitive PCR-based method for the detection and quantification of *Erwinia carotovora* subsp. *atroseptica* on potato tubers. *Let. Appl. Microbiol* 30: 330-335.
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7. Perombelon, M.C.M. *et al* 1988. Effects of contamination by *Erwinia carotovora* subsp. *atroseptica* of potato seed tubers and of cultivar resistance on blanking or non-emergence and blackleg development in Valencia, Spain. *Potato Research* 31: 591-599.
8. Harrison, M.D. *et al.* 1977. Waste potato dumps as sources of insects contaminated with soft rot coliform bacteria in relation to recontamination of pathogen-free potato stocks. *Potato Res.* 20:37-52.
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Also see the references under BACTERIAL SOFT ROT on page 3.

## COMMON SCAB

*Streptomyces scabies*

**Cultural:** Use a 3-5 year rotation, preferably with legumes. Plant scab-free or treated seed on land free of scab. Use an acidic fertilizer, such as ammonium sulfate, for nitrogen and irrigate adequately especially during tuber initiation. Neutralizing excessively acidic or alkaline soils may help to reduce levels of common scab.

**Resistant Cultivars:** None.

**Intermediate:** Chieftain, Russet Burbank, Norchip, Norgold Russet, Norland, Superior, Viking.

**Chemical:** None recommended.

**Note:** The addition of sulfur to increase soil acidity is generally not recommended because of high cost and the danger of causing excessive soil acidity.

### References:

1. Waterer, D. 2002. Management of common scab of potato using planting and harvest dates. *Can. J. Plant Sci.* 82: 185-189.
2. Mishra, K.K. and Srivastava, J.S. 2001. Screening potato cultivars for common scab of potato in a naturally infested field. *Potato Res.* 44: 19-24.
3. Errampalli, D., and Johnston, H.W. 1999. Effect of chlorine disinfection prior to planting on black scurf (*Rhizoctonia solani*) and common scab (*Streptomyces scabies*) of potatoes. *Phytopathol.* 89:S24.
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5. Faucher, E., *et al.* 1995. Characterization of streptomycetes causing deep-pitted scab of potato in Quebec, Canada. *Int. J. Syst. Bacteriol.* 45:222-225.
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## DRY ROT

*Fusarium spp.*

**Cultural:** Harvest during dry, cool weather if possible. Top killing prior to harvest encourages a good skin set which helps to reduce damage at harvest. Avoid bruising the tubers when harvesting. Store tubers for 7-10 days at 12°C to favour wound healing, then lower temperature to 2-5°C (10°C for processing tubers). Maintain humidity at 90% RH with adequate air circulation. Treat seed-pieces with a fungicide for control of seed-piece decay (see Appendix I). Handle seed with non contaminated equipment and store in clean containers.

**Chemical:** See Appendix I.

**Notes:** Cross-resistance to thiabendazole and thiophanate-methyl has been identified for one species of the fusarium dry rot pathogen complex, i.e. *Fusarium sambucinum*.

### References:

1. Mecteau, M.R., *et al.* 2002. Effect of organic and inorganic salts on the growth and development of *Fusarium sambucinum*, a causal agent of potato dry rot. *Mycol. Res.* 106: 688-696.
2. Carnegie, S.F., *et al.* 2000. The effect of treating seed potato tubers with benzimidazole, imidazole and phenylpyrrole fungicides on the control of rot and skin blemish diseases. *Ann. Appl. Biol.* 133:343-363.
3. Schisler, D.A., *et al.* 2000. Biological control of fusarium dry rot of potato tubers under commercial storage conditions. *Am. J. Potato Res.* 77:29-40.
4. Venter, S.L., and Steyn, P.J. 1998. Correlation between fusaric acid production and virulence of isolates of *Fusarium oxysporum* that causes potato dry rot in South Africa. *Potato Res.* 41: 289-294.
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13. Leach, S.S. and Nielsen, L.W. 1975. Elimination of fusarial contamination of seed potatoes. *Am. Potato J.* 52:211-218.
14. Boyd, A.E.W. 1952. Dry-rot disease of the potato. *Ann. Appl. Biol.* 39:322-357.

## EARLY BLIGHT

*Alternaria solani*

**Cultural:** Minimize stress by maintaining adequate soil moisture and fertility. Avoid potatoes, tomatoes, or egg plants in the crop rotation for at least 2 consecutive years. Use seed potatoes free of the disease. Permit tubers to mature in the ground before digging. Avoid bruising during digging and handling.

**Resistant Cultivars:** None.

**Chemical:** See Appendix I.

### References:

1. Guenther, J.F., *et al.* 1999. Assessment of pesticide use in the U.S. potato industry. *Am. J. Pot. Res.* 76:25-29.
2. Shtienberg, D., *et al.* 1999. Integrated management of early and late blight in potatoes. In: *Modern fungicides and antifungal compounds II*. pp. 247-255.
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14. Harrison, M.D. and Venette, J.R. 1970. Chemical control of potato early blight and its effect on potato yield. *Am. Potato J.* 54: 81-86.

## FUSARIUM WILT

*Fusarium* spp.

**Cultural:** Grow potatoes on land free from wilt fungi. Use disease-free potatoes for seed. Do not add inoculum from infested soil, diseased tubers or plant refuse to clean fields. Practice crop rotation. Follow good soil management, including the use of proper irrigation practices.

**Resistant Cultivars:** None.

**Chemical:** See Appendix I.

## References:

1. Mantecon, J.D. 1993. Evaluation of seed-piece treatments for the control of fusarium potato wilt and stem-end rot in Argentina. *Tests Agrochem. Cultiv.* 14: 52-53.
2. Emmond, G.S. and Ledingham, R.J. 1972. Effects of crop rotation on some soil-borne pathogens of potato. *Can. J. Plant Sci.* 52: 605-611.

## LATE BLIGHT

### *Phytophthora infestans*

**Cultural:** Destroy cull piles by burying or spraying them with a herbicide. Plant only healthy seed potatoes. Kill infected potato tops 2 weeks before harvest to reduce tuber infection during harvest (see appendix IV for desiccants and top killers). Remove diseased tubers before storage and maintain adequate air circulation in the pile. Maintain good air circulation to dry out decaying tubers. Infected tubers should be held at a temperature that is as low as practical. Cool temperatures needed for suppression of tuber rot tend to have a negative impact on frying colour.

**Resistant Cultivars:** None.

**Chemical:** Follow label instructions when applying registered fungicides listed in Appendix I. Time spray applications according to late blight forecasts for your region. Apply sprays every 10-14 days in hot dry weather when the risk of infection is low. Apply fungicides every 5 to 7 days in late blight favourable weather particularly when late blight warnings are high.

## References:

1. Daayf, F. and Platt, H.W. 2003. Differential pathogenicity on potato and tomato of *Phytophthora infestans* US-8 and US-11 strains isolated from potato and tomato. *Can. J. Plant Pathol.* 25: 150-154.
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6. Daayf, F., and H.W. Platt. 2002. Variability in responses of US-8 and US-11 genotypes of potato and tomato isolates of *Phytophthora infestans* to commercial fungicides in vitro. *Am. J. Potato Res.* 79: 433-441.
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10. Stein, J.M. and Kirk, W.W. 2002. Containment of existing potato late blight (*Phytophthora infestans*) foliar epidemics with fungicides. *Crop Prot.* 21: 575-582.
11. Daayf, F., *et al.* 2001. Relationships between RAPDs, Gpi-allozyme patterns, mating types, and resistance to metalaxyl of *Phytophthora infestans* in Canada in 1997. *Am. J. Potato Res.* 78: 129-139.

12. Glass, J.R., *et al.* 2001. Assessment of barriers to prevent the development of potato tuber blight caused by *Phytophthora infestans*. *Plant Dis.* 85: 521-528.
13. Guenther, J.F., *et al.* The economic impact of potato late blight on US Growers. *Potato Res.* 44: 121-125.
14. Kirk, W.W., *et al.* 2001. Effect of host plant resistance and reduced rates and frequencies of fungicide application to control potato late blight. *Plant Dis.* 85: 1113-1118.
15. Mayton, H., *et al.* 2001. The roles of three fungicides in the epidemiology of potato late blight. *Plant Dis.* 85: 1006-1012.
16. Daayf, F. *et al.* 2000. Changes in mating types, resistance to metalaxyl, and Gpi-allozyme genotypes of *Phytophthora infestans* in Canadian provinces from 1996 to 1998. *Can. J. Plant Pathol.* 22: 110-116.
17. Garrett, K.A., and Mundt, C.C. 2000. Host diversity can reduce potato late blight severity for focal and general patterns of primary inoculum. *Phytopathology* 90: 1307-1312.
18. Leonard, R., *et al.* 2000. The effect of air assistance on spray deposition and biological effect in the control of *Phytophthora infestans* in potatoes. *Aspects Appl. Biol.* 57: 243-249.
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## LEAF ROLL

Potato leaf roll virus

**Cultural:** Plant leaf roll-free seed. Rogue out infected plants if practical. Control aphids to limit virus spread. Top-kill seed potatoes as early as possible after aphid vectors appear.

**Resistant Cultivars:** None.

**Chemical:** None. (See note).

**Note:** Limit virus spread by reducing aphid vector populations with registered insecticides.

### References:

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## LEAK

*Pythium ultimum*

**Cultural:** Grow potatoes on well-drained soils. Do not irrigate soils heavily. Harvest tubers when they are mature in cool weather. Avoid bruising and injuring potatoes. Store the potatoes at the proper temperature and humidity (refer to section on dry rot above for more details). Tubers harvested in hot, sunny weather are likely to develop leak and should be cooled below 10°C and marketed as soon as possible.

**Resistant Cultivars:** None.

**Chemical:** See Appendix I.

### References:

1. Charron, C.S., and Sams, C.E. 1999. Inhibition of *Pythium ultimum* and *Rhizoctonia solani* by shredded leaves of Brassica species. J. Am. Soc. Hortic. Sci. 124: 462-467.
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## MOSAIC

Potato virus X, potato virus S, potato virus A, potato virus Y

**Cultural:** Use seed that is free of viruses. Avoid rubbing foliage with clothing, machinery, etc. Disinfest cutting knives and equipment as often as possible. Rogue diseased plants from seed fields. Reduce aphid populations to limit spread of viruses A and Y as described for leaf roll.

**Resistant Cultivars:** None.

**Chemical:** None (see note 2).

### Notes:

1. Disinfest equipment (see Appendix II).
2. Insecticides recommended for leaf roll limit spread of viruses A and Y.

### References:

1. de Bokx, J.A. (ed.). 1972. Viruses of potatoes and seed-potato production. Pudoc, Wageningen. 233 pp.
2. Peterson, L.C., *et al.* 1961. Viricidal disinfectants for the potato-cutting knife. Am. Potato J. 38: 382-387.

## PINK ROT

*Phytophthora erythroseptica*

**Cultural:** Plant potatoes in well-drained soil. Do not over irrigate potatoes during the growing season. Allow tubers to mature underground for 2-3 weeks after top-killing. Do not harvest potatoes when soil temperatures rise above 17-18°C. Minimize bruising and cutting at harvest. Remove field heat from healthy potatoes gradually in a humid environment (90-95% relative humidity) to thicken skin and increase tuber resistance to infection in storage. Remove field heat as rapidly as possible from potatoes harvested from warm damp soil if symptoms of pink rot appear in storage after harvest. Store pink rot infected potatoes at or below 8°C in a continuously

ventilated dry storage facility (80-85% relative humidity) until all affected tubers have dried up. Process potatoes as rapidly as possible if continuous ventilation fails to stop the spread of pink rot decay. If possible, harvest wet areas of fields last and store separately from healthy tubers

**Resistant Cultivars:** None.

**Chemical:** See Appendix I.

**Notes:**

1. Symptoms of leak and pink rot are so similar that it can be difficult to correctly identify the causal agent.
2. Tuber flesh adjacent to darkened areas colonized by the *P. erythroseptica* pathogen turn pink 30-45 minutes after an infected tuber is cut open.

**References:**

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2. Secor, G.A., and Gudmestad, N.C. 1999. Managing fungal diseases of potato. *Can. J. Plant Pathol.* 21: 213-221.
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## **POWDERY SCAB**

*Spongospora subterranea* f. sp. *subterranea*

**Cultural:** Crop rotation (6 years). Use well-drained soils and avoid planting on contaminated land. Plant only disease-free seed. Do not use manure from animals fed infected tubers as the resting spores of the fungus will pass unharmed through the digestive tract. Do not over-irrigate at tuber set.

**Resistant cultivars:** Russet Norkotah. Some cultivars are moderately susceptible, such as: Superior, Atlantic, Russet Burbank, and Snowden.

**Chemical:** No registered fungicides are available.

**Note:** It is important to differentiate between common and powdery scab before making management decisions.

**References:**

1. Harrison, J.G. *et al.* 1997. Powdery scab disease of potato - a review. *Plant Pathol.* 46: 1-25.
2. Torres, H. *et al.* 1995. Resistance of potato to powdery scab (*Spongospora subterranea*) under Andean field conditions. *Am. Potato J.* 72: 355-363.
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4. De-Boer, R.F. 1991. Evaluation of potato cultivars in the greenhouse and field for resistance to powdery scab. *Aust. J. Exp. Agric.* 31: 699-703.

5. Gans, P.T. *et al.* 1987. The susceptibility of potato cultivars to powdery scab caused by *Spongospora subterranea* (Wallr.) Lagerh. J. Natl. Inst. Agric. Bot. 17: 337-343.
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## **RHIZOCTONIA (BLACK SCURF)**

### *Rhizoctonia solani*

**Cultural:** Use disease-free seed. Avoid planting in cold, wet soil and cover seed pieces with not more than 5 cm (2 inches) of soil when planting early in cool soil. Harvest the tubers as soon as they are mature. Avoid growing potatoes in fields or portions of fields where the disease has been severe.

**Resistant Cultivars:** None.

**Chemical:** See Appendix I.

### **References:**

1. Tsror, L., *et al.* 2001. Biological control of black scurf on potato under organic management. Crop Prot. 20: 145-150.
2. Errampalli, D., and Johnston, H.W. 1999. Effect of chlorine disinfection prior to planting on black scurf (*Rhizoctonia solani*) and common scab (*Streptomyces scabies*) of potatoes. Phytopathol. 89: S24.
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4. Simons, S.A., and Gilligan, C.A. 1997. Factors affecting the temporal progress of stem canker (*Rhizoctonia solani*) on potatoes (*Solanum tuberosum*). Plant Pathol. 46: 642-650.
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6. Wicks, T.J., *et al.* 1996. Influence of soil fumigation and seed tuber treatment on the control of *Rhizoctonia solani* on potatoes. Aust. J. Exp. Agric. 36: 339-345.
7. Bains, P.S., and Bisht, V.S. 1995. Anastomosis group identity and virulence of *Rhizoctonia solani* isolates collected from potato plants in Alberta, Canada. Plant Dis. 79: 241-242.
8. Firman, D.M., and Allen, E.J. 1995. Effects of seed size, planting density and planting pattern on the severity of silver scurf (*Helminthosporium solani*) and black scurf (*Rhizoctonia solani*) diseases of potatoes. Assoc. Appl. Biol. 127: 73-85.
9. Jager, G., and Velvis, H. 1995. Dynamics of *Rhizoctonia solani* (black scurf) in successive potato crops. Eur. J. Plant Pathol. 101: 467-478.
10. Wicks, T.J., *et al.* 1995. Chemical and biological control of *Rhizoctonia solani* on potato seed tubers. Aust. J. Exp. Agric. 35: 661-664.
11. Leach, S.S., *et al.* 1993. Effects of moldboard plowing, chisel plowing and rotation crops on the *Rhizoctonia* disease of white potato. Am. Potato J. 70: 329-337.
12. Otrysko, B.E., and Banville, G.J. 1993. Effect of infection by *Rhizoctonia solani* on the quality of tubers for processing. Am. Potato J. 69: 645-652.
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15. Carling, D.E. and Leiner, R.H. 1990. Effect of temperature on virulence of *Rhizoctonia solani* and other *Rhizoctonia* on potato. Phytopathol. 80: 930-934.
16. Banville, G.J. 1989. Yield losses and damage to potato plants caused by *Rhizoctonia solani* Kuhn. Am. Potato J. 66: 821-834.

17. Carling, D.E., *et al.* 1989. Symptoms, signs and yield reduction associated with *Rhizoctonia* disease of potato induced by tuber borne inoculum of *Rhizoctonia solani* AG-3. *Am. Potato J.* 66: 693-701.
18. Hide, G.A. and Firmager, J.P. 1989. Effects of soil temperature and moisture on stem canker (*Rhizoctonia solani*) disease of potato. *Potato Research* 32: 75-80.
19. Platt, H.W. 1989. Potato growth and tuber production as affected by inoculation of cut and whole seed with *Rhizoctonia solani* (AG 3) and the use of seed treatment fungicides. *Am. Potato J.* 66: 365-378.
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## SEED PIECE DECAY

*Fusarium* spp., *Pythium* spp., *Erwinia carotovora*

**Cultural:** Cut, treat, and plant the seed the same day. If cut seed cannot be planted the same day, then store it at 10-15°C with high humidity to facilitate suberization. Never allow cut seed to stand in the hot sun or in a drying wind. Plant in soils sufficiently warm and moist to promote good sprout growth and wound healing. Whole seed is quite resistant to decay. Stressing seed by putting it in direct contact with systemic insecticides or bands of liquid fertilizer apparently increase levels of seed piece decay.

**Resistant Cultivars:** None.

**Chemical:** See Appendix I.

**Notes:** Thiophanate-methyl may be phytotoxic under some conditions (1).

### References:

1. Escande, A.R. and Echandi, E. 1988. Wound-healing and the effect of soil temperature, cultivars, and protective chemicals on wound-healed potato seed pieces inoculated with seed piece decay fungi and bacteria. *Am. Potato J.* 65: 741-752.
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4. Nielsen, L.W. 1949. *Fusarium* seed piece decay of potatoes in Idaho and its relation to blackleg. *Idaho Agric. Exp. Sta. Res. Bull.* 15. 31 pp.

## SILVER SCURF

*Helminthosporium solani*

**Cultural:** Plant disease-free seed tubers and practice crop rotation. Harvest tubers as soon as they are mature. Cull out noticeably infected ones at digging and grading. Rid the field of all tubers left after harvest. Maintain stable levels of relative humidity and temperature in storage after harvest.

**Resistant Cultivars:** None.

**Chemical:** See Appendix I.

**Notes:** Resistance of *H. solani* to thiabendazole may limit this product's effectiveness.

### References:

1. Hervieux, V., *et al.* 2002. Effect of organic and inorganic salts on the development of *Helminthosporium solani*, the causal agent of potato silver scurf. *Plant Dis.* 86: 1014-1018.
2. Errampalli, D., *et al.* 2000. Emergence of silver scurf (*Helminthosporium solani*) as an economically important disease of potato. *Plant Pathol.* 50: 141-153.
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9. Holley, J.D., and Kawchuk, L.M. 1996. Distribution of thiabendazole and thiophanate-methyl resistant strains of *Helminthosporium solani* and *Fusarium sambucinum* in Alberta potato storages. *Can. Plant Dis. Surv.* 76: 21-27.
10. Rodriguez, D.A., *et al.* 1996. Sporulation of *Helminthosporium solani* and infection of potato tubers in seed and commercial storages. *Plant Dis.* 9: 1063-1070.
11. Firman, D.M., *et al.* 1995. Effects of seed size, planting density and planting pattern on the severity of silver scurf (*Helminthosporium solani*) and black scurf (*Rhizoctonia solani*) diseases of potatoes. *Assoc. Appl. Biol.* 127: 73-85.
12. Rodriguez, D.A., *et al.* 1995. Screening tuber-bearing Solanum species for resistance to *Helminthosporium solani*. *Am. Potato J.* 72: 669-679.
13. Hide, G. A., *et al.* 1994. Control of skin spot and silver scurf on stored cv. King Edward potatoes by chemical and nonchemical methods. *Ann. Appl. Biol.* 125: 87-96.
14. Kawchuk, L.M. *et al.* 1994. Resistance to thiabendazole and thiophanate-methyl in isolates of *Fusarium sambucinum* and *Helminthosporium solani*. *Am. Potato J.* 71: 185-192.
15. Merida, C.L., and Loria, R. 1994. Survival of *Helminthosporium solani* in soil and in vitro colonization of senescent plant tissue. *Am. Potato J.* 71: 591-598.
16. Merida, C.L., *et al.* 1994. Effects of potato cultivar and time of harvest on the severity of silver scurf. *Plant Dis.* 78:146-149.
17. Szeto, S.Y., *et al.* 1993. Persistence and efficacy of thiabendazole on potatoes for control of silver scurf. *J. Agric. Food Chem.* 41: 2156-2159.

18. Ogilvy, S.E. 1992. The use of pre-planting and post-harvest fungicides and storage temperatures for the control of silver scurf in ware potatoes. *Aspects Appl. Biol.* 33: 151-158.
19. Hide, G.A., *et al.* 1988. Resistance to thiabendazole in isolates of *Helminthosporium solani*, the cause of silver scurf disease of potato. *Plant Pathol.* 37: 377-380.
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## SPINDLE TUBER

Potato spindle tuber viroid (PSTV)

**Cultural:** Use seed tubers known to be free from PSTV. Avoid mechanical transmission by planting whole, rather than cut seed, and avoid leaf contact by equipment in field operations. Decontaminate knives and other equipment as frequently as possible (see Note 1). Rogue diseased plants in seed fields.

**Resistant Cultivars:** None.

**Chemical:** None.

### Notes:

1. For disinfection use sodium hypochlorite 6% (household bleach, dil. 1:10 not a.i.); ammonium based disinfectants or soapy water.
2. Amendments to the Canada Seeds Act call for a zero tolerance for spindle tuber in all classes of seed potatoes.

### References:

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2. Weidemann, H.L., and Buchta, U. 1998. A simple and rapid method for the detection of potato spindle tuber viroid (PSTVd) by RT-PCR. *Potato Res.* 41: 1-8.
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## VERTICILLIUM WILT

*Verticillium albo-atrum*, *Verticillium dahliae*

**Cultural:** Treat seed pieces to prevent soil- and seed-borne infection. Use a 3-or 4-year rotation with cereals or grasses to reduce soil-borne inoculum. Control susceptible weeds.

**Resistant Cultivars:** None.

**Chemical:** See Appendix I.

**Notes:** Plant parasitic nematodes may increase the incidence and severity of verticillium wilt. Nematicides or soil fumigants (please see appendix III) applied for the control of these nematodes may also suppress verticillium wilt. (Preharvest interval - 90 days).

### References:

1. Morgan, G.D., *et al.* 2002. Plant pathogen population dynamics in potato fields. *J. Nematol.* 34: 189-193.
2. Rowe, R.C. and Powelson, M.L. 2002. Potato early dying: management challenges in a changing production environment. *Plant Dis.* 86: 1184-1193.
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## OTHER DISEASES

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

- **Calico** (Alfalfa mosaic virus)
- **Corky Ring Spot (Spraing)** (Tobacco rattle virus)
- **Phoma Rot** (*Phoma* sp.)
- **Potato Mop Top Virus**
- **Purple-top Wilt** (aster yellows phytoplasma)
- **Witches'-broom** (potato witches'-broom phytoplasma)

## QUARANTINE DISEASES

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

- **Columbia Root-knot Nematode** (*Meloidogyne chitwoodi*)
- **Golden Nematode** (*Globodera rostochiensis*) - Confined to areas of Vancouver Island, B.C. and Newfoundland.
- **Wart** (*Synchytrium endobioticum*) - Confined to areas of Newfoundland and Prince Edward Island
- **PVY-n** (Potato virus Y - necrotic strain)

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**APPENDIX I. Fungicides Registered for Controlling Plant Diseases on Potato**

<b>Disease</b>	<b>Active Ingredient</b>	<b>Trade Name</b>	<b>C* or D</b>	<b>Formulation</b>	<b>PCP No.</b>
<b>Bacterial Soft Rot</b>	hydrogen peroxide	Oxidate	C	27% LI	27432
<b>Blackleg</b>	thiophanate-methyl	Senator PSPT Seed Piece Treatment	C	10% DU	14599
<b>Dry Rot</b>	fludioxonil	Maxim PSP	C	0.5% PO	26647
	hydrogen peroxide	Oxidate	C	27% LI	27432
	mancozeb	Dithane F-45	C	37%	20552
	metiram	Polyram 16D Fungicide Dust Polyram 16D Seed Piece Treat.	C	16% DU 16% DU	22029 25867
	thiabendazole	Mertect SC Fungicide	C	45% SU	13975
	thiophanate-methyl	Senator PSPT Seed Piece Treatment	C	10% DU	14599
<b>Early Blight</b>	anilazine	Dyrene Solupak	C	50% WP	22090
	azoxystrobin	Quadris	C	250 g/L FL	26153
	boscalid	Lance	C	70% WG	27495
	chlorothalanil	Bravo 500	C	500 g/L SU	15723
	chlorothalanil + carbaryl	C-I-L Deecop Insecticide-Fungicide for Vegetables	D	18% + 18% SU	13723
	copper oxychloride	Copper Spray Guardman Copper Oxychloride	C	50% WP	19146 13245
		Later's Copper Spray Fungicide	D	50% WP	16140
	copper oxychloride + carbaryl	Later's Potato and Tomato Dust Insecticide Fungicide	D	7% + 5% DU	16106
		Co-op Potato-Tomato Dust	D		17423
dimethomorph + mancozeb	Acrobat MZ	C	9% + 60% WP	24546	

**APPENDIX 1. Fungicides Registered for Controlling Plant Diseases on Potato** continued

<b>Disease</b>	<b>Active Ingredient</b>	<b>Trade Name</b>	<b>C* or D</b>	<b>Formulation</b>	<b>PCP No.</b>
<b>Early Blight (continued)</b>	famoxadone + cymoxanil	Tanos	C	25% + 25% DF	27435
	fenamidone	Reason	C	500g/ L SU	27462
	mancozeb	Dithane DG Rainshield NT Manzate 200 DF Dithane F-45 Fungicide Penncozeb 75DF	C	75% WG 75% DF 37% 75% DF	20553 21057 20552 25397
	mancozeb + zoxamide	Gavel 75 DF	C	66.7% + 8.3% DF	26842
	maneb	Dithane M-22	C	80% WP	4918
	metalaxyl-m + chlorothalonil	Ridomil Gold/Bravo Twin Pak	C	480 g/L + 500 g/L SU	24125
	metiram	Polyram DF Polyram 16D	C	80% WG 16% DU	20087 22029
	pyraclostrobin	Headline	C	250 g/L EC	27322
	tribasic copper sulfate	Griffin Basicop Fungicide	C	53% WP	19003
		Wilson Bordo Fungicide Spray	D	53% WP	17482
	tribasic copper sulfate + carbaryl	Wilson Garden Doctor CIL Deecop CIL Garden Doctor	D	7% + 5% DU	17424 14160 26445
	zineb	Clean Crop Zineb 80W	C	80% WP	14562
	zineb + carbaryl	Co-op Bug & Blight Control King PTV Potato Dust Manchester 2 in 1 Bug Killer	D	4% + 5% DU	10644 10711 11515
<b>Late Blight</b>	anilazine	Dyrene Solupak	C	50% WP	22090
	azoxystrobin	Quadris	C	250 g/L FL	26153
	chlorothalonil	Bravo 500	C	500 g/L SU	15723
	chlorothalonil + carbaryl	C-I-L Deecop Insecticide- Fungicide for Vegetables	D	18% + 18% SU	13723
	copper oxychloride	Copper Spray Guardsman Copper Oxychloride	C	50% WP	19146 13245
		Later's Copper Spray Fungicide	D	50% WP	16140

\* C = Comercial or D = Domestic registration

**APPENDIX I. Fungicides Registered for Controlling Plant Diseases on Potato** continued

<b>Disease</b>	<b>Active Ingredient</b>	<b>Trade Name</b>	<b>C* or D</b>	<b>Formulation</b>	<b>PCP No.</b>
<b>Late Blight (continued)</b>	copper oxychloride + carbaryl	Later's Potato and Tomato Dust	D	7% + 5% DU	16106
		Insecticide Fungicide Co-op Potato-Tomato Dust	D		17423
	cymoxanil	Curzate 60 DF	C	60% DF	26284
	dimethomorph + mancozeb	Acrobat MZ	C	9% + 60% WP	24546
	famoxadone + cymoxanil	Tanos	C	25% + 25% DF	27435
	fenamidone	Reason 500SC	C	500 g/L SU	27462
	fluazinam	Allegro	C	40%	27517
	mancozeb	Dithane DG Rainshield NT Manzate 200 DF Dithane F-45 Fungicide Penncozeb 75DF	C	75% WG	20553
				75% DF	21057
				37%	20552
				75% DF	25397
	mancozeb + zoxamide	Gavel 75 DF	C	66.7% + 8.3% DF	26842
	maneb	Dithane M-22	C	80% WP	4918
	metalaxyl-m + chlorothalonil	Ridomil Gold/Bravo Twin Pak	C	480 g/L + 500 g/L SU	24125
	metiram	Polyram DF Polyram 16D	C	80% WG	20087
				16% DU	22029
pyraclostrobin	Headline	C	250 g/L EC	27322	
tribasic copper sulfate	Griffin Basicop Fungicide	C	53% WP	19003	
	Wilson Bordo Fungicide Spray	D	53% WP	17482	
tribasic copper sulfate + carbaryl	Wilson Garden Doctor CIL Deecop CIL Garden Doctor	D	7% + 5% DU	17424	
				14160	
				26445	
zineb + carbaryl	Co-op Bug & Blight Control King PTV Potato Dust Manchester 2 in 1 Bug Killer	D	4% + 5% DU	10644	
				10711	
				11515	
<b>Pink Rot and Pythium Leak</b>	metalaxyl-m + chlorothalonil	C	480 g/L + 500 g/L SU	24125	
	metalaxyl-m + mancozeb	C	4% WP + 64%	25379	

\* C = Commercial or D = Domestic registration

**APPENDIX I. Fungicides Registered for Controlling Plant Diseases on Potato** continued

<b>Disease</b>	<b>Active Ingredient</b>	<b>Trade Name</b>	<b>C* or D</b>	<b>Formulation</b>	<b>PCP No.</b>
<b>Rhizoctonia Canker and Black Scurf</b>	azoxystrobin	Quadris (in-furrow)	C	250g/ L FL	26153
	fludioxonil	Maxim PSP	C	0.5% PO	26647
	thiabendazole	Mertect SC Fungicide	C	45% SU	13975
<b>Seed Piece Decay</b>	captan + diazinon	Co-op Potato Seed piece Treatment	C	7.5% + 0.1% DU	15755
	mancozeb	MancoPlus Potato Seed Piece T. Tuberseal Potato Seed Piece D. Potato ST 16	C	16% DU	26157 17042 24734
	metiram	Polyram 16D Fungicide Dust Polyram 16D Seed Piece Treat.	C	16% DU 16% DU	22029 25867
	thiophanate-methyl	Senator PSPT Seed Piece Treatment	C	10% DU	14599
<b>Silver Scurf</b>	fludioxonil	Maxim PSP	C	0.5% PO	26647
	hydrogen peroxide	Oxidate	C	27% LI	27432
	thiophanate-methyl	Senator PSPT Seed Piece Treatment	C	10% DU	14599
<b>Verticillium Wilt</b>	thiophanate-methyl	Senator PSPT Seed Piece Treatment	C	10% DU	14599

\* C = Comercial or D = Domestic registration

**APPENDIX II. Products Registered for Disinfecting Farm Machinery and Storage Areas**

<b>Disease</b>	<b>Active Ingredient</b>	<b>Trade Name</b>	<b>Formulation</b>	<b>PCP No.</b>
<b>Bacterial Ring Rot</b>	dimethyl benzyl ammonium chloride	Ag-Services Incorporated General Storage Disinfectant	10% LI	14957

**APPENDIX III. Soil Sterilants and Nematicides Registered for Controlling Soil Borne Diseases**

Active Ingredient	Trade Name	Formulation	PCP No.
metam	Vapam Liquid Solution	33% S	6453
methyl bromide*	Methyl Bromide Fumigant	100% S	16495
1,3-dichloropropene	Telone II	94% S	15893
1,3-dichloropropene + chloropicrin	Telone C17	78.3 + 16.5% S	16324
1,3-dichloropropene+ methyl-isothiocyanate	Vorlex Plus Liquid Soil Fumigant	40% + 20% S	18353
1,3-dichloropropene+ methyl-isothiocyanate+ chloropicrin	Vorlex Plus C.P. Liquid Soil Fumigant	34% + 17% + 15% S	18354

\*Registration for methyl bromide will not be renewed the next time the label is reviewed. Consequently methyl bromide will only be available for the next two to three years. Registration for this chemical is being withdrawn because of the potential damage this product may do to human health and the environment.

**APPENDIX IV. Registered Topkillers and Desiccants**

Active Ingredient	Trade Name	Formulation	Next Registration	PCP No.
diquat	Reglone Liquid Herbicide and Dessicant	240 g/L	2007	26396
glufosinate ammonium	Ignite 15 SN Herbicide and Dessicant (British Columbia)	15% SN	2003	23180
	Liberty (Prairie Provinces)	150 g/L EC	2004	24081

\*Dessicants are applied so that foliage infected with late blight dies and dries out completely before harvest. This control measure decreases levels of tuber infection at harvest and in so doing reduces levels of storage decay.