

Research on biology and control of sclerotinia diseases in Western Canada

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 Agriculture and Agri-Food Canada

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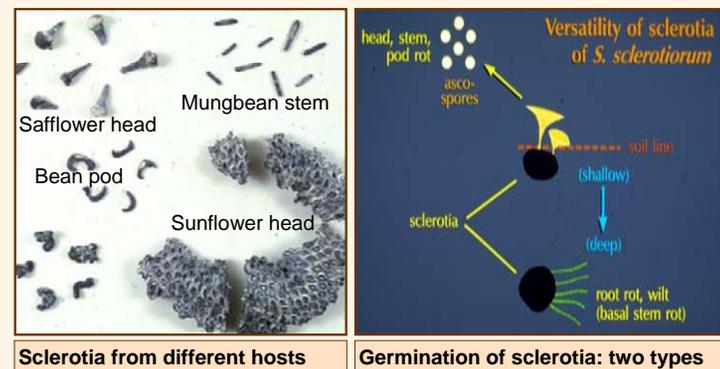
Contents: *Sclerotinia sclerotiorum*

- **Disease in Western Canada**
 - Mainly on pulse, oilseed and vegetable crops
- **Pathogen**
 - *Sclerotinia sclerotiorum* (most important)
 - *S. minor* (no reports in commercial fields)
- **Biology**
 - New types of sclerotia (tan and abnormal)
 - Avirulent strains
 - Sclerotial germination
- **Control**
 - Biocontrol, soil amendment, and disease resistance

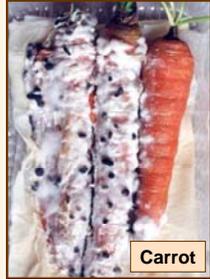
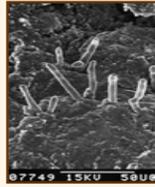
White mold of common bean in Alberta

Year	# fields surveyed	White mold		Gray mold	
		#	%	#	%
1983	17	13	77	-	-
1984	21	21	100	-	-
1985	31	31	100	-	-
1986	33	33	100	-	-
1987	25	24	96	-	-
1993	31	31	100	19	61
1994	37	33	89	23	62
1995	18	18	100	15	83
1998	21	20	95	8	38
1999	22	22	100	14	64

Sclerotia of *S. sclerotiorum*: two types of germination and two distinct diseases



Diseases by myceliogenic germination of sclerotia



Carrot



Sunflower



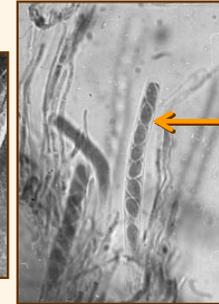
Carpogenic germination of sclerotia: apothecia, asci and ascospores



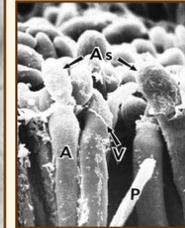
Apothecia



Hymenium



Ascospores in each ascus



Release of spores

Diseases by carpogenic germination of sclerotia

Bean white mold



Sunflower head rot



Pea pod rot



Sclerotinia blight of canola

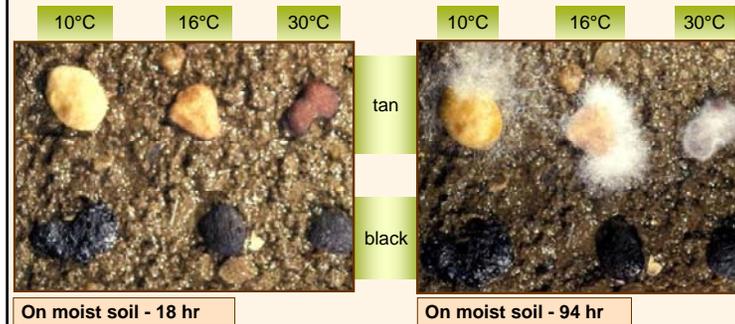


Safflower head rot

Factors affecting myceliogenic germination:

1) sclerotial color

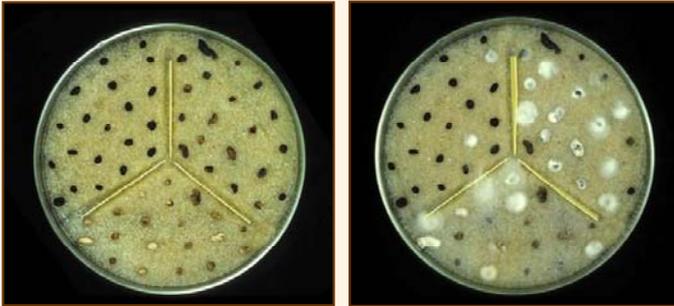
- Role of melanized rind: tan sclerotia vs black sclerotia
- Sclerotia from PDA cultures at 20°C for 3 weeks



On moist soil - 18 hr

On moist soil - 94 hr

Myceliogenic germination of sclerotia*:
2) sclerotial maturity



On moist sand - 1 day

On moist sand - 4 days

*Sclerotia collected from diseased sunflower plants

Myceliogenic germination:
3) sclerotial injury (physical injury, dry and wet, freezing)*



Physical injury (moist 4 days)

Physical injury (moist 4 days)

Injury by wet and dry

*Sclerotia collected from diseased plant in the field

Effect of RH (%) and dry treatment on sclerotial germination and sunflower wilt*

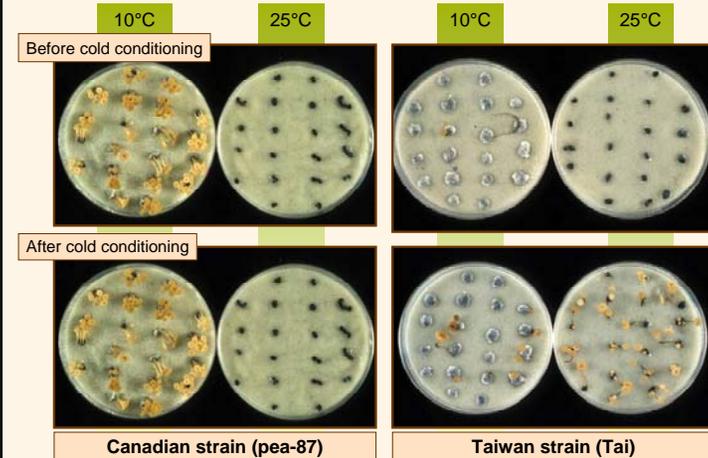


Germination of sclerotia (100% RH)

Wilt of sunflower

*Sclerotia collected from PDA cultures at 20°C for 3 weeks

Carpogenic germination of sclerotia: temperature and strains



Canadian strain (pea-87)

Taiwan strain (Tai)

Both types of germination occur on the same sclerotium

Sun-87, on sand 20°C, 0 hr

30 days

48 hr

34 days

The sclerotium was from PDA culture at 10°C for 8 wks

Abnormal sclerotia of *Sclerotinia sclerotiorum*

- Medullar tissues: amber color (cell death)
- Formation: due to physiological changes
- Reduced longevity (defective sclerotia)

Gr. Ab. St. Ab. Normal White medulla (viable)

Chemical components of medullar tissues

- Amino acids (GC): 21 detected; no quantitative and qualitative differences, except **tryptophan (low in abnormal sclerotia)**
- 5-HT (5-Hydroxytryptamine) and 5-HIAA (5-Hydroxyindole-3-acetic acid) (HPLC)
- N scl. (high 5-HT)
- Ab scl. (high 5-HIAA)

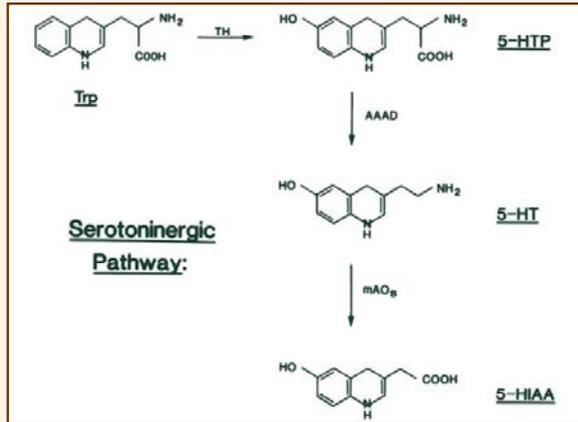
Normal Abnormal

Formation of abnormal sclerotia: 5-HT (serotonin) and 5-HIAA in medullar tissues

Normal Abnormal

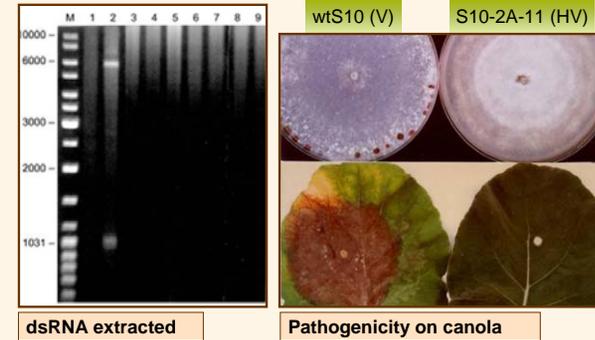
1986 field samples; HPLC

Formation of abnormal sclerotia: Serotonergic pathway

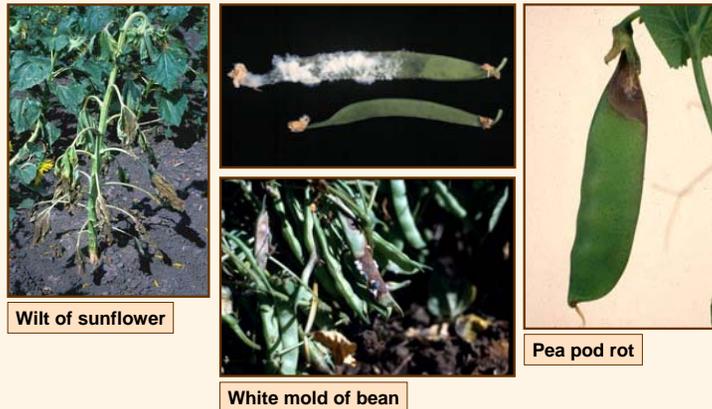


Cause of hypovirulence (HV) in tan-sclerotial strains

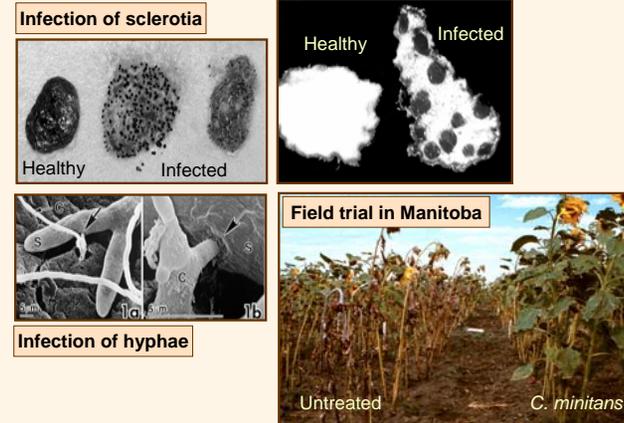
- dsRNA extracted: 1 = China (V), 2 = China (HV), 3 = S10 (V), 4-5 = S10 (MV), 6-9 = S10 (HV)
- Pathogenicity on canola



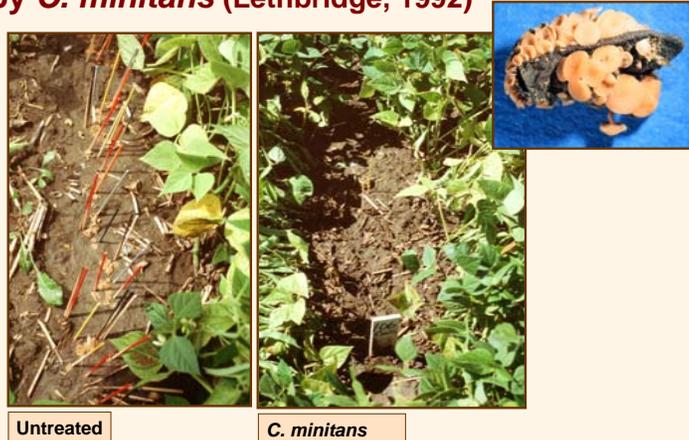
Biocontrol of *Sclerotinia sclerotiorum*



Biocontrol of *Sclerotinia sclerotiorum* by *Coniothyrium minitans*



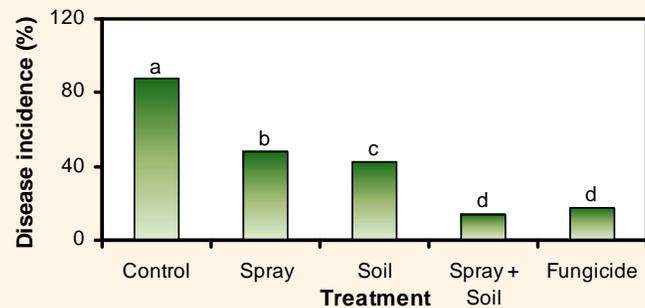
Control of apothecia of *S. sclerotiorum* by *C. minitans* (Lethbridge, 1992)



Control of white mold of bean by *C. minitans* (foliar application) (Lethbridge, 1993)



Control of white mold of bean by *Coniothyrium minitans* (Lethbridge, 2004)



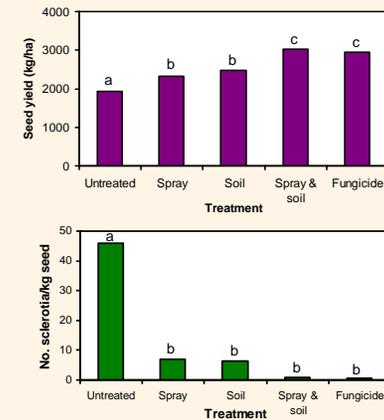
Spray = 2 applications of *C. minitans* (3×10^8 spores/m²) at early bloom, 7 days apart
 Soil = *C. minitans* (3×10^8 spores/m²) liquid applied, cultivated to 2 cm deep, before planting
 Fungicide = 2 applications of Lance (770 g/ha) at early bloom, 7 days apart

Effect of *Coniothyrium minitans* on yield and quality of bean (Lethbridge, 2004)

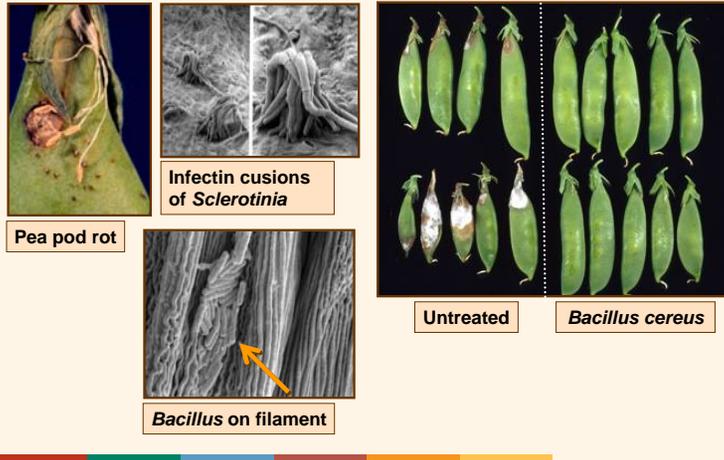


Diseased Healthy

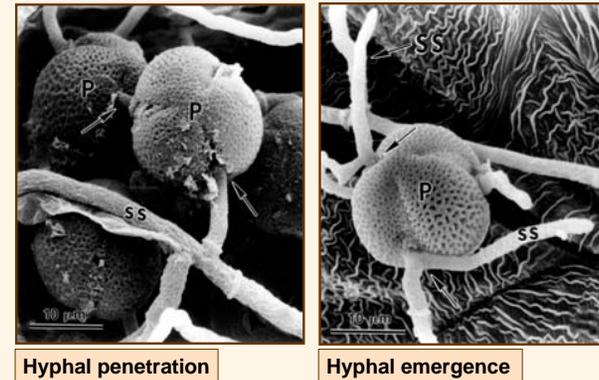
- *C. minitans* reduced white mold of bean
- Improved seed yield
- Improved seed quality (reduced dockage and no. sclerotia/kg seed)



Protection of infection sites by *Bacillus cereus*, *C. minitans* or *Epicoccum purpurascens*

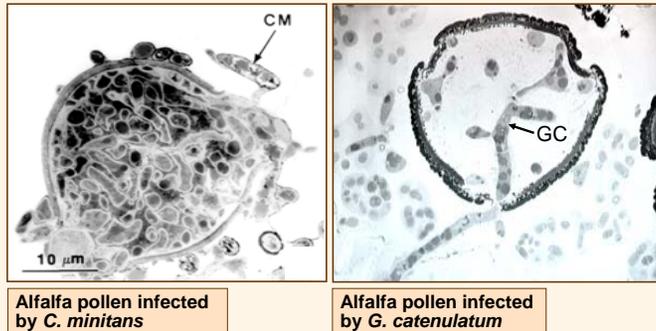


Infection of canola pollen by *Sclerotinia sclerotiorum* (SEM)

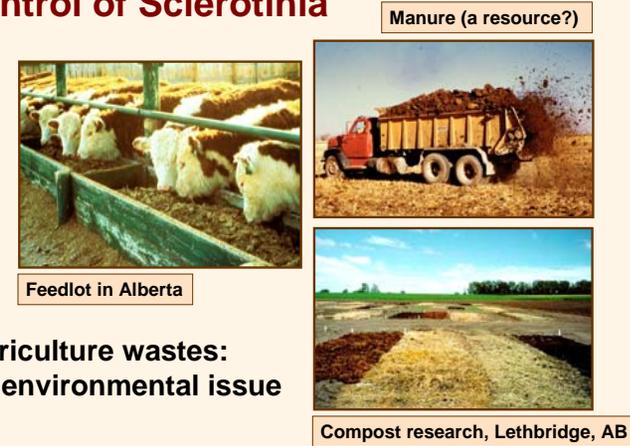


Pollinators for control of blossom blight and pod rot (*Sclerotinia sclerotiorum*)?

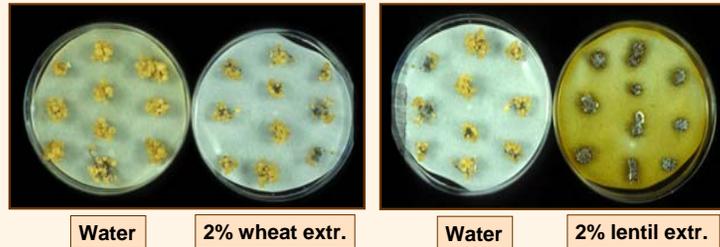
- Alfalfa pollen is susceptible to mycoparasites e.g., *Coniothyrium minitans* and *Gliocladium catenulatum*
- Use bees to enhance biocontrol of blossom rot?



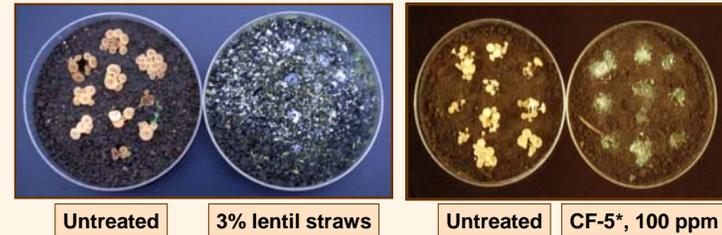
Allelopathy, soil amendment and control of *Sclerotinia*



Water extracts of wheat and lentil straws on carpogenic germination of sclerotia



Soil amendment (lentil straws or CF-5*) on carpogenic germination of sclerotia



- CF-5 is a fermented product for control of *Rhizoctonia* damping-off of vegetable crops (JW Huang *et al.* 1993. *Pl. Path. Bull.* 2:259)
- CF-5 controlled apothecia of *Sclerotinia* and stimulated *Trichoderma* spp.



White mold resistance in bean (physiological and archetype resistance)

Line (Class)	Phys. resist.*	Type	Disease incidence (%)	
			Vauxhall 1998	Lethbridge 1999
AC Skipper (Navy)	A	Upright	20 d	8 e
L94D031 (Red)	C	Upright	16 d	14 d
L94F025 (Black)	C	Upright	-	4 e
US1140 (GN)	B	Viny	48 bc	55 c
NW63 (Red)	B	Viny	62 ab	66 b
Viva (Pink)	A	Viny	65 ab	66 b
L94C356 (Pink)	D	Upright	57 b	100 a

*A, least susceptible; D, most susceptible

White mold resistance of dry bean (Field, Sept 7, 1999)



NW63 (Red)
Viny, B (54%)

UI906 (Black)
Upright, A (8%)

White mold resistance of dry bean (Field, Sept 7, 1999)



AC Skipper (Navy)
Upright, A (9%)

US1140 (GN)
Viny, B (48%)

White mold resistance of dry bean (Field, Sept 7, 1999)



L94F025 (Black)
Upright, C (7%)

AC Skipper (Navy)
Upright, A (11%)

Conclusions I.

- Sclerotinia is a **versatile pathogen**; understanding its biological behavior is the key to the control of this pathogen
- **Biocontrol** appears feasible under prairie conditions; it warrants further research efforts
- **Cultural practice** e.g. soil amendment is of merit
- There is a **low level of physiological resistance** in most hosts
- **Disease avoidance** by plant archetype is also useful

Conclusions II.



- Learn to treat *Sclerotinia* with respect
- Be humble; don't treat ourselves as *Sclerotinia* experts too soon!