Biocontrol of apothecial production of *Sclerotinia sclerotiorum* in pulse and oilseed crops

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Introduction

Sclerotinia rot or white mold caused by *Sclerotinia sclerotiorum* is the most important disease of dry beans, dry peas, canola and safflower in western Canada. It is an important factor limiting production and expansion of pulse and oilseed crops in the Canadian prairies. Ascospores released from apothecia (tiny mushrooms) which are produced on sclerotia of *S. sclerotiorum* are the primary source of inoculum for the diseases in these crops. Crop rotation and the use of chemical fungicides are the only methods currently available for the control of this disease. The objective of this study was to determine the efficacy of five indigenous species of fungal agents for the control of apothecial production of *S. sclerotiorum* under the canopy of pulse and oilseed crops.

Materials and Methods

The biocontrol agents used in this study included four mycoparasites: *Coniothyrium minitans*; *Talaromyces flavus*; *Trichoderma virens*; *Trichothecium roseum*; and one antagonist *Epicoccum purpurascens*. They all originated from the southern part of the Canadian prairies. Inoculum of each organism was prepared by inoculation of sterilized wheat bran with a spore suspension. After incubation under light at 20°C for 28 days, the cultures were air-dried, crushed manually, and weighed into either 15 or 30 g lots.

Sclerotia of *Sclerotinia sclerotiorum* were produced by growing the pathogen on a red kidney bean substrate. Cooked beans were pureed in a food processor and poured into 250 mL clear plastic containers, 25 mL each. Each container was inoculated with four PDA plugs (5 mm diameter) containing mycelial mats of *S. sclerotiorum* from 5-day-old cultures. After incubation in the dark at 10°C for 8-10 weeks, sclerotia produced on the bean substrate in each container were harvested by washing them in distilled water. They were air-dried, divided into lots of 100, and stored at 10°C for approximately two weeks.

Field experiments were conducted during 1993 and 1994 using dry bean, dry pea, canola and safflower crops. Individual plots were set up by digging two trenches between rows, 1 m long and 0.12 m wide for each trench. One kg of soil was removed from each trench, mixed with inoculum on bran, 15 g/trench for low rate and 30 g/trench for high rate, in a container, and half (500 g) of the amended soil was put back in the trench. One hundred sclerotia were spread evenly in the trench and covered with the remaining amended soil (500 g). For controls, 100 sclerotia/trench were buried in soil without the treatment of biocontrol agent. Treatments were set up in each year approximately 3 weeks after seeding, and were arranged in a randomized complete block design with four replicates for each treatment.

From late bloom to maturity, data on the number of sclerotia germinated carpogenically and the number of apothecia produced on sclerotia in each plot were collected. For all crops and years, the percent of sclerotia germinated carpogenically and number of apothecia produced were analysed statistically. For percent germination of sclerotia, a log transformation was required.

Results and discussion

Results of the two-year study in dry beans showed that treatment with *C. minitans* ($P < 0.001$) or *T. flavus* ($P < 0.05$) significantly reduced carpogenic germination of *S. sclerotiorum* and apothecial production for both years (Figure 1). Treatment with *C. minitans* resulted in carpogenic germination of 11.2% and 2.1% in 1993 and 1994, respectively, whereas the carpogenic germination for the untreated control was 47.7 % and 41.6 % in 1993 and 1994, respectively. This effect was also reflected in the number of apothecia produced; the *C. minitans* treatment had 53 and 10 apothecia/plot in 1993 and 1994, respectively, while untreated plots had 503 and 291 apothecia/plot in 1993 and 1994, respectively. Treatment with *T. flavus* resulted in carpogenic germination of 27.0 % and 14.3 % in 1993 and 1994, respectively, and apothecial production of 221 and 94 apothecia/plot in 1993 and 1994, respectively.

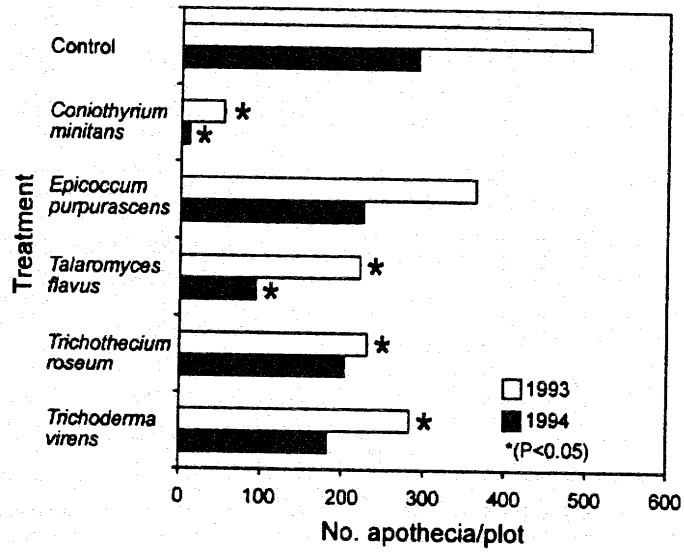

Figure 1. Field trials on control of apothecia of *S. sclerotiorum* by biocontrol agents in dry beans (1993 and 1994).

Similar results were obtained for *C. minitans* in dry peas, canola and safflower for both years. *C. minitans* significantly reduced the percentage of sclerotia germinated carpogenically and the number of apothecia per plot in all three crops. Treatment with *T. flavus* did not result in consistent control of carpogenic germination and apothecial production. It was effective in dry bean in both years, whereas it was effective in dry pea and safflower in 1994 only. Treatment with *T. flavus* was ineffective under the canopy of canola in both years.

The two years of field trials indicate that application of fungal agents to soil, *C. minitans* in particular, is effective in controlling carpogenic germination of sclerotia and production of apothecia of *S. sclerotiorum*. This study suggests that soil treatment with *C. minitans* is feasible in reducing the inoculum potential of *S. sclerotiorum* under the crop canopies of dry bean, dry pea, canola and safflower. The use of this biological control approach to manage sclerotinia diseases is environmentally sound and offers an alternative for the control of white mold.

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