Report to the Oregon Processed Vegetable Commission: December 2009

Title: Integrated management of white mold in snap bean.
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Introduction

White mold (WM, caused by *Sclerotinia sclerotiorum, Ss*) is a serious foliar and pod disease of snap beans grown for processing in western Oregon. Ronilan , a highly effective fungicide used through 2005 for the control of both white and gray mold (*Botrytis cinerea*), is no longer available to bean growers.

Coniothyrium minitans **:** *Coniothyrium minitans* (*Cm*) is a mycoparasite of *Ss* under natural conditions and was recently developed as a commercial product for WM suppression (Contans, www.prophyta.com). *Cm* can penetrate sclerotial tissue in less than 14 days. Infection of a sclerotium can be achieved by a single spore. *Cm* parasitizes sclerotia optimally over a temperature range of 50 - 68°F, with little activity occurring at > 80° or < 41°F. Contans has typically been applied at 2-6 pounds per acre several months before or at planting of susceptible crops, but this strategy is costly and not very effective.

Biocontrol epidemic: This project is investigating whether low rate (goal: one pound per acre) early fall Contans applications to flailed diseased residues left on the soil surface can increase *Cm* inoculum and reduce *Ss* sclerotial viability. Colonized sclerotia produce pycnidia. If left on the surface, these pycnidia produce conidial droplets under warm, wet conditions. During rain events, these droplets will splash and disperse, generating new sclerotial infections. This project has demonstrated that the mild, wet, winter conditions in western Oregon can generate a series of *Cm* colonization cycles - a “biological control epidemic” -increasing *Cm* inoculum levels over time and increasing the efficacy of an initial low rate Contans application.

Impact of Contans on sclerotial survival: We were unable to maintain Contans minus plots over the 07-08 winter as the Contans splashed throughout the fields, contaminating the control plots with Cm. A goal of this year’s research was to establish Contans plus and Contans minus FIELDS to eliminate Cm contamination so we are better able to evaluate the impact of Contans applications on the survival of sclerotia.

Summer burial and irrigation: While some proportion of sclerotia generated in the fall will die, some will survive the winter. What is the impact of subsequent management (irrigation and tillage)? In 2009 we repeated the 2008 irrigation experiment to determine the impact of summer irrigation and burial on sclerotial survival in fields in which Contans was applied the previous fall.

Objectives: *to determine the impact of*

1. *low rate fall Contans applications*
2. *burial at 2 inch depth*
3. *summer irrigation*

on Sclerotinia sclerotiorum (white mold) sclerotial survival and colonization by Coniothyrium minitans (Cm) and other fungi.

Results Summary:

1. Fall Cm applications significantly reduced sclerotial survival.
2. During the winter (in fields in which Cm is applied in the fall), sclerotia left on the soil surface lost viability to a greater extent than buried sclerotia.
3. In fields in which Cm was NOT applied in the fall, burial had little impact on survival of sclerotia over the winter.
4. During the summer (in fields in which Cm was applied in the fall), buried sclerotia lost viability to a greater extent than sclerotia left on the soil surface.
5. During the summer (in fields in which Cm was applied in the fall), irrigation significantly reduced viability of sclerotia left on the soil surface and slightly reduced viability of buried sclerotia.
6. Sclerotia on the soil surface were more frequently colonized by *Coniothyrium* than 'other fungi'; the reverse was true for buried sclerotia.

Materials and methods:

Contans experiment:

A variety of bean fields were planted in July 2008 at the OSU Vegetable Research Farm and inoculated (by hand or naturally) with *Sclerotinia sclerotiorum* mycelia at bloom. The fields were flailed but not incorporated in late September 2008. Contans treatments were applied within 5 days after flailing to the surface of Contans plus fields at approximately 1.5 lbs per acre. No treatment was applied to the Contans minus fields. Contans contamination was detected in Contans minus fields at the OSU Vegetable Farm in October 2008. As the result, sclerotia were grown in the lab on PDA (October-applied lab-grown sclerotia) or autoclaved potatoes (winter and spring-applied lab-grown sclerotia), placed in mesh bags (15 sclerotia per bag) and placed in Contans-plus fields and newly-identified Contans-minus fields at the OSU Vegetable and Lewis Brown Farms; the Contans-minus fields were not planted to bean in 2008 and therefore did not have native populations of sclerotia in the field. Bags were collected and evaluated as described below.

Irrigation Experiment**:**

An irrigation/burial trial was conducted in a Contans plus field (Field 14) at the OSU Vegetable Research Farm during the summer of 2009. Native sclerotia were collected from the soil surface in late June and placed into mesh bags (15 sclerotia per bag). On July 3, bags were placed on the soil surface and also buried at 1-2 inches below the soil surface at 0, 40 and 60 feet from a single irrigation line run through the center of the field (10 reps per location and depth). The field was irrigated for 2 hours weekly for 8 weeks. No irrigation water was applied at 60 ft from the irrigation line. The volume of irrigation water applied at 40 ft from the irrigation line was on average 15% of the volume applied at 0 ft from the irrigation line. Mean gravimetric soil moisture content at 60 ft from the irrigation line was 0.10. Mean gravimetric soil moisture contents at 40 ft from the irrigation line ranged from 0.16 to 0.20, and at 0 ft from the irrigation line from 0.19 to 0.24. Bags were removed from the field in September. After bags were collected, intact sclerotia were washed, counted, surface sterilized, and plated on PDA. Plates were evaluated for mycelial growth of *Sclerotinia sclerotiorum* at 1 week after plating and colonization by *Cm* and other fungi at 2 weeks after plating.

Evaluation of sclerotia:
Mesh bags containing 15 sclerotia were affixed to the soil surface or buried at 2 inches in the various field locations on various dates as indicated in the figures below. Bags were collected (10 bags per treatment) on the dates indicated and intact sclerotia were washed, counted, surface sterilized, and plated on PDA. Plates were evaluated for mycelial growth of *Sclerotinia sclerotiorum* at 1 week after plating and colonization by *Cm* and other fungi at 2 weeks after plating.

Results:

Figs 1a-1d: In fields at the OSU Vegetable Research Farm in which Cm was applied to diseased flailed residues, sclerotia left in bags on the soil surface on October 10 were predominantly non-viable (dead) by Feb 16. In contrast, 6 out of 15 sclerotia in bags buried at 2 inches were viable.
In a field that was not irrigated over the summer, 9 of 15 sclerotia were viable in September when bagged and placed on the soil surface in March; seven of 15 were viable from bags incubated at a 2 inch depth. In a field that WAS irrigated over the summer, 3 of 15 sclerotia were viable in September when placed on the soil surface in March; 4.5 of 15 were viable when buried at 2 inches.
Figs 2a-d: In a field at the OSU Vegetable Farm in which Cm was NOT applied, 15 of 15 sclerotia were viable in February in bags placed on the soil surface or buried at 2 inches in October, and approximately 14 of 15 were viable in June when placed on the soil surface or buried in April. In a field at the OSU Lewis Brown Farm in which Cm was NOT applied, 14 of 15 sclerotia were viable when placed on the soil surface in April and collected in June; approximately 15 of 15 sclerotia were viable when buried in that location. There was some Cm contamination of surface-incubated sclerotia in both of these fields.
Figs 3a-c: Survival of native sclerotia in a field in which Cm was applied in fall 2009 was significantly reduced by summer burial regardless of irrigation level. Summer irrigation significantly reduced survival of sclerotia on the soil surface, but had little impact on buried sclerotial survival.
Incubation on the soil surface increased the proportion of native sclerotia colonized by Cm. Burial increased the proportion of sclerotia colonized by other fungi.

Figures:

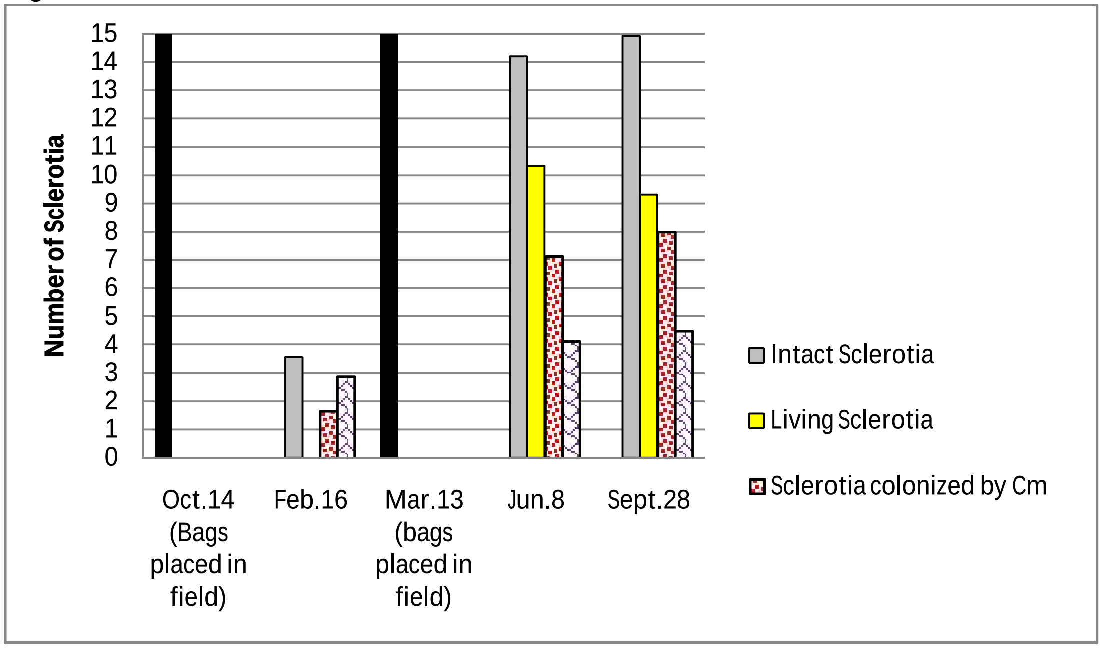

Fig. 1a. Condition of lab-grown sclerotia incubated in Vegetable Research Farm Field No. 2 in which Contans was applied in fall 2008. Sclerotia collected from soil surface. No irrigation was applied in summer 2009.

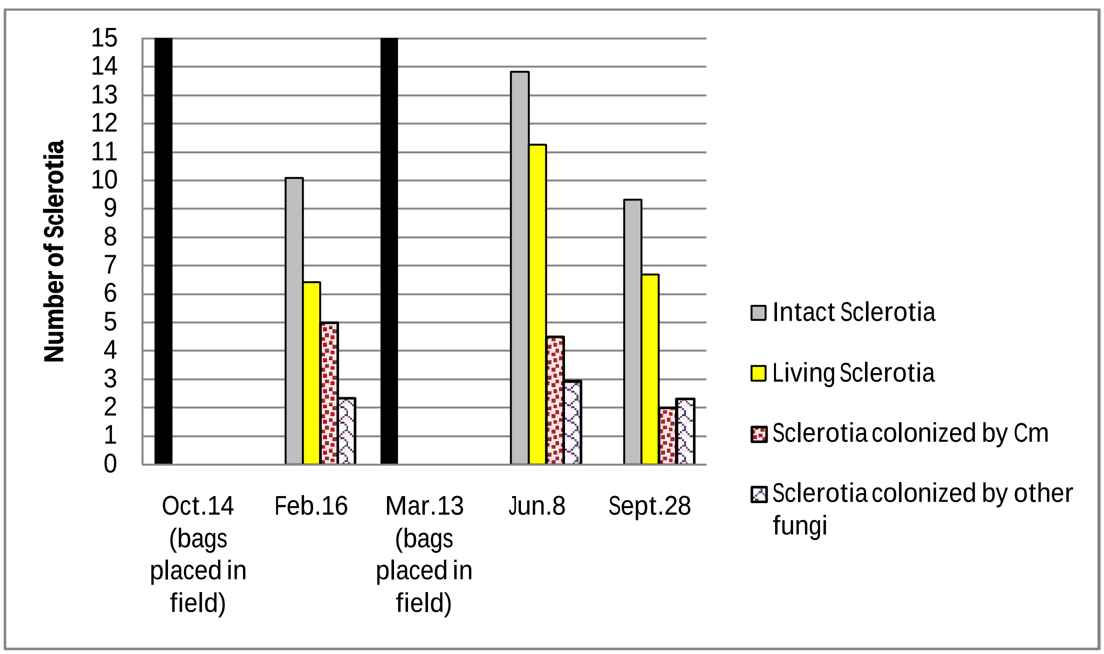

Fig. 1b. Condition of lab-grown sclerotia incubated in Vegetable Research Farm Field No. 2 in which Contans was applied fall 2008. Sclerotia collected from 2 inch depth. No irrigation applied in summer 2009.

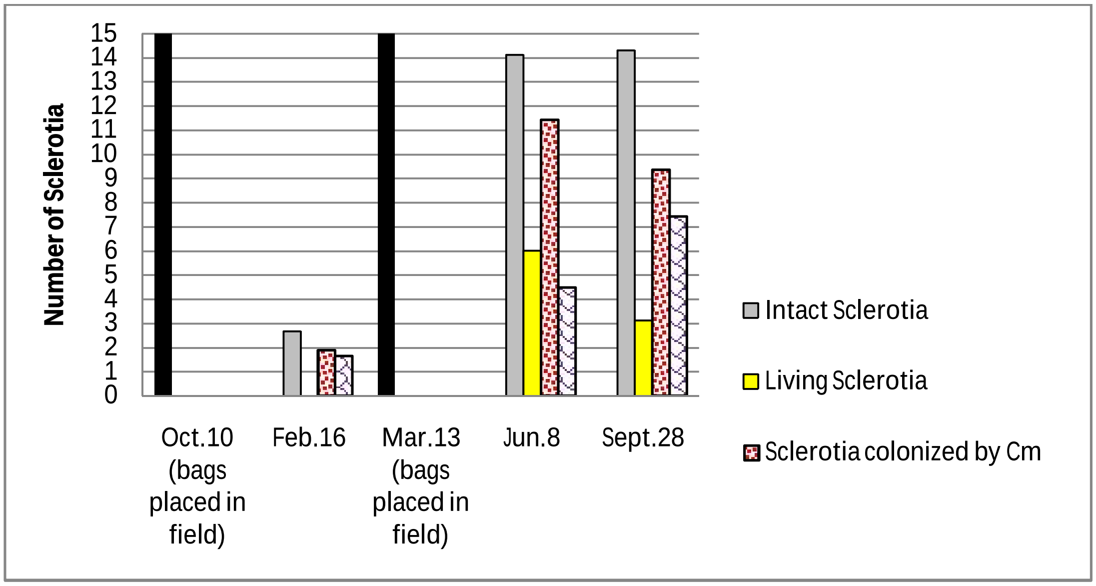

Fig. 1c. Condition of lab-grown sclerotia incubated in Vegetable Research Farm Field No. 14 in which Contans was applied fall 2008. Sclerotia collected from soil surface. Irrigation applied in summer 2009.

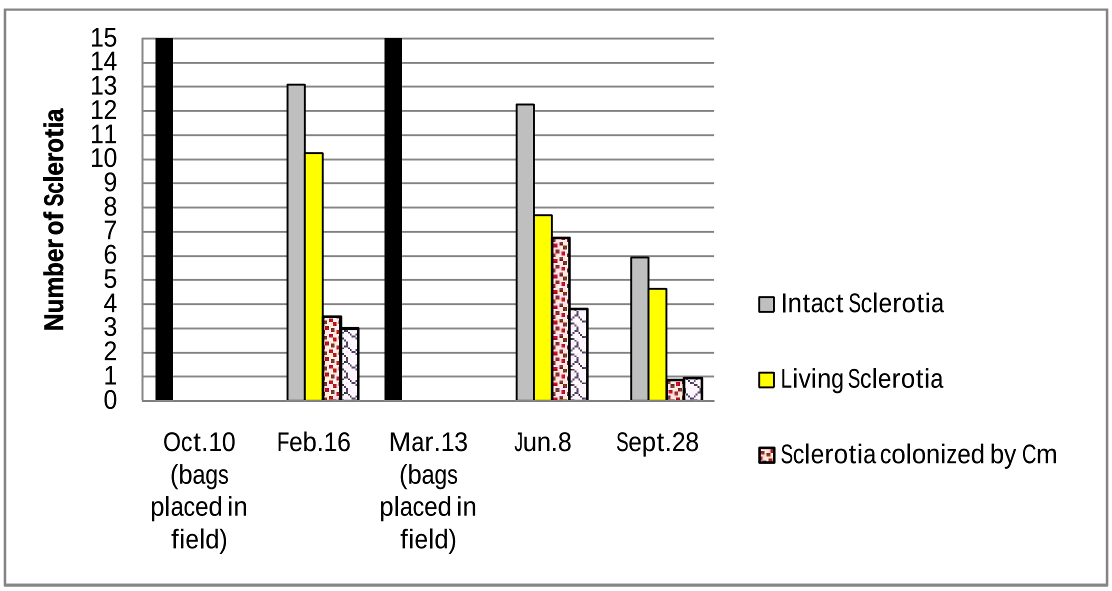

Fig. 1d. Condition of lab-grown sclerotia incubated in Vegetable Research Farm Field No. 14 in which Contans was applied fall 2008. Sclerotia collected from 2 inch depth. Irrigation applied in summer 2009.

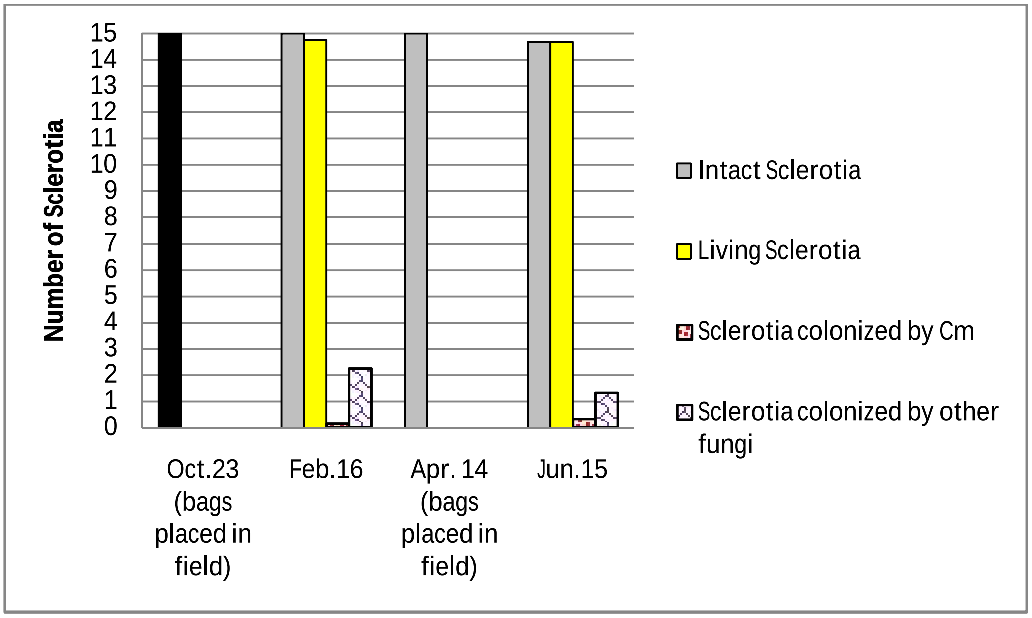

Fig. 2a. Condition of lab-grown sclerotia in OSU Vegetable Research Farm Field 22 in which Contans was not applied in fall 2008. Sclerotia collected from soil surface.

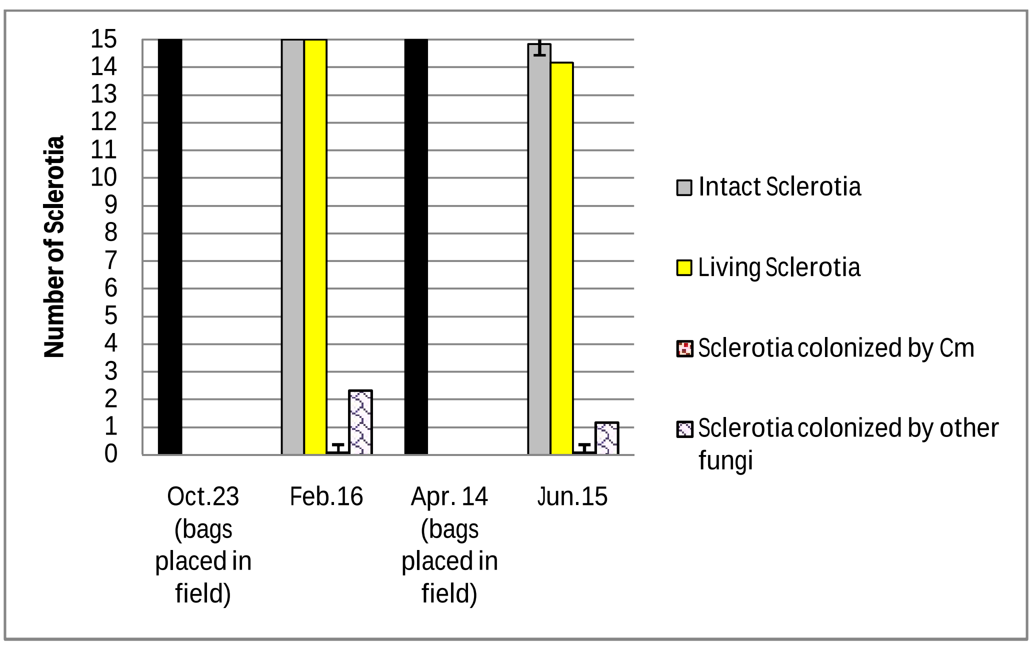

Fig. 2b. Condition of lab-grown sclerotia in OSU Vegetable Research Farm Field 22 in which Contans was not applied in fall 2008. Sclerotia collected from 2 inch depth.

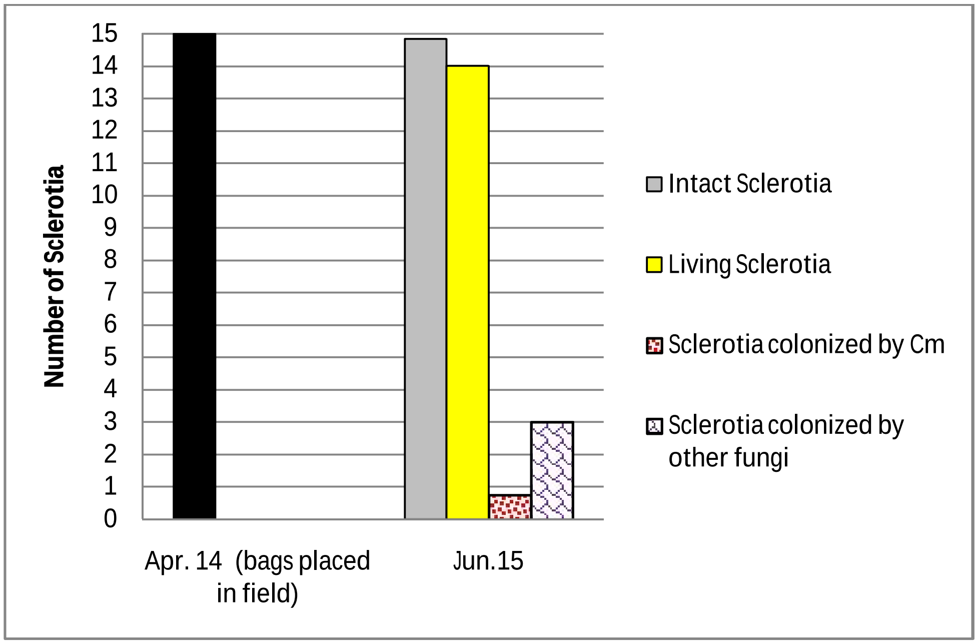

Fig. 2c. Condition of lab-grown sclerotia in OSU Lewis Brown field in which no Contans was applied fall 2008. Sclerotia collected from soil surface.

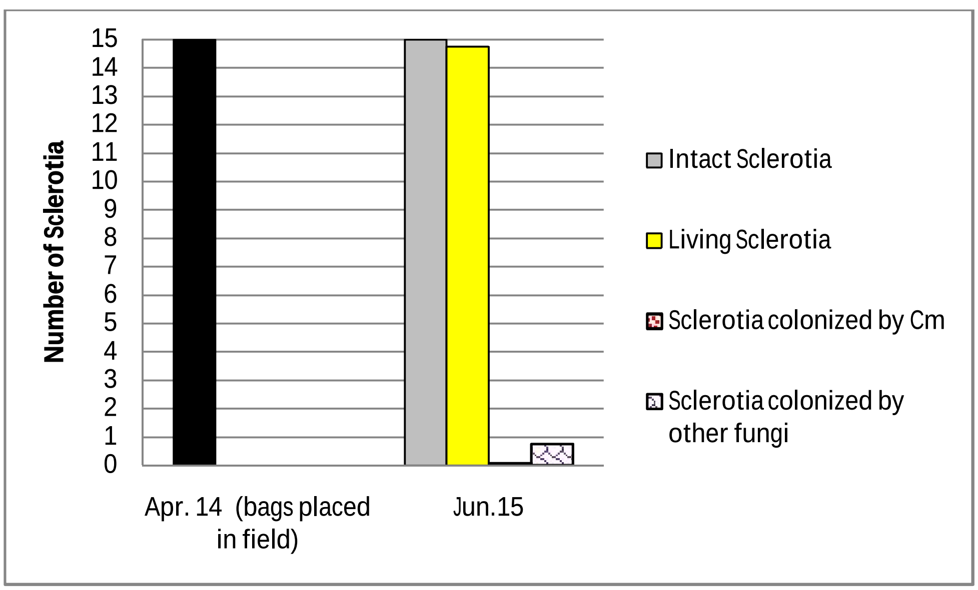

Fig. 2d. Condition of lab-grown sclerotia in OSU Lewis Brown field in which no Contans was applied fall 2008. Sclerotia collected from 2 inch depth.

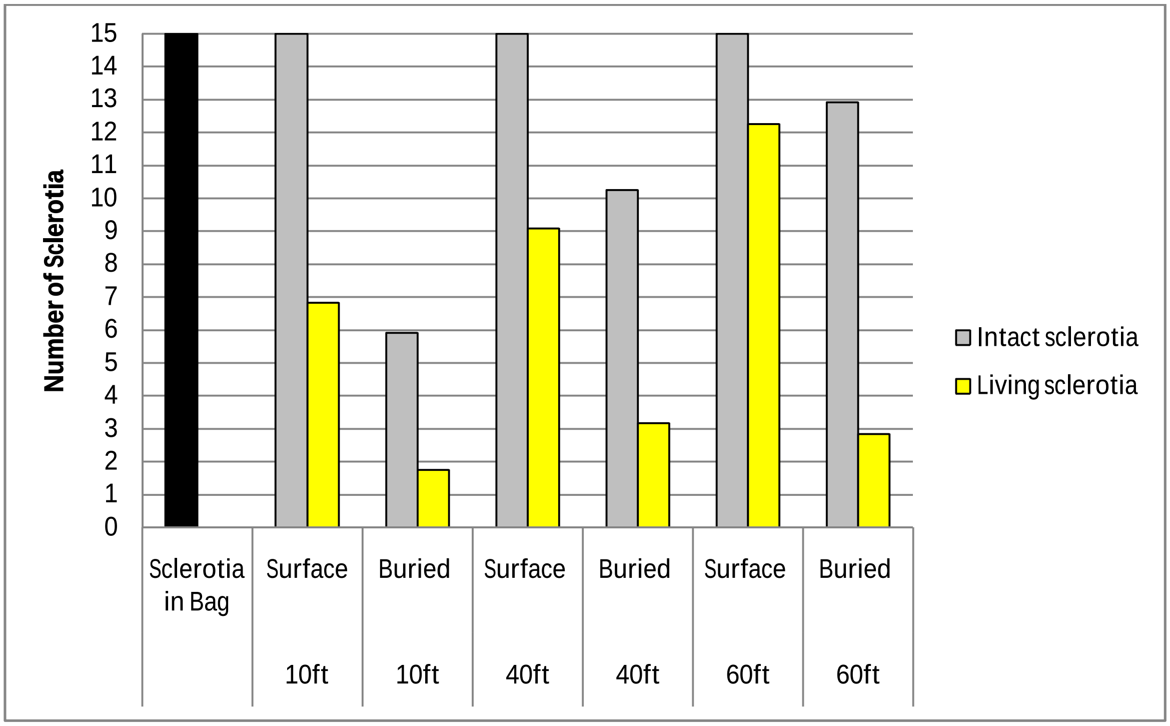

Fig. 3a. Impact of irrigation and burial on survival of native sclerotia in summer 2009 irrigation experiment.

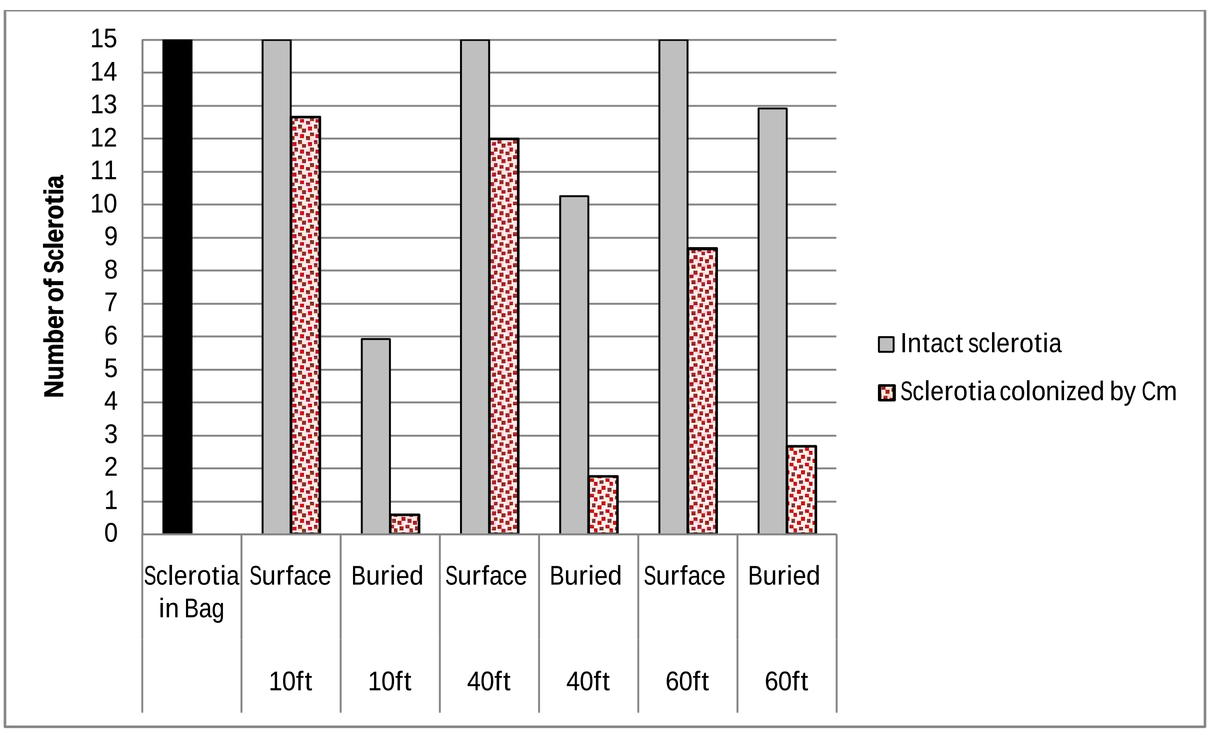

Fig. 3b. Impact of irrigation and burial on Cm infection of native sclerotia in summer 2009 irrigation experiment.

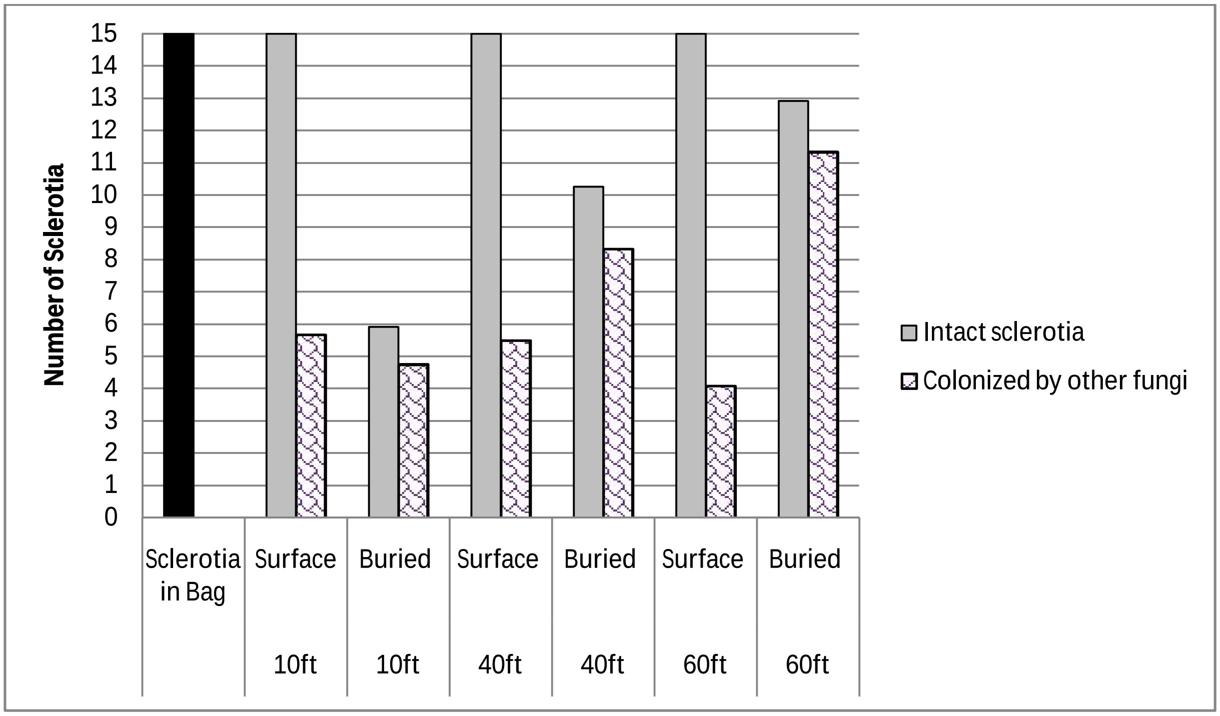

Fig. 3c. Impact of irrigation and burial on infection of native sclerotia by other fungi in summer 2009 irrigation experiment.