REPORT TO THE AGRICULTURAL RESEARCH FOUNDATION
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Project Title: Mold Management and *Sclerotinia* Ascospore Trapping in Snap Bean

Principal Investigator: Cynthia M. Ocamb, Ext. Specialist & Associate Professor
Botany and Plant Pathology, OSU - Corvallis
Telephone: (541) 737-4020
ocambc@science.oregonstate.edu

Cooperators: David H. Gent, USDA-ARS, Corvallis
Robert B. McReynolds, North Willamette Research & Ext. Center, OSU
Jim Myers, Dept. of Horticulture, OSU

Background and Justification: *Sclerotinia sclerotiorum* (causal agent of White mold) can cause serious economic losses in snap bean as well as many other crops in the Pacific Northwest. Infection of blossoms by airborne spores is the way disease commonly commences in a field, and the way an epidemic begins. Once blossoms are infected, the fungus grows onto stems and pods from colonized blossoms, spreading within the plant and onto neighboring plants if conditions remain conducive. The spores are produced in apothecia (mushroom-like structures) that develop from over-wintering structures (sclerotia) in the soil. Sclerotia are long-lived, durable hyphal survival structures produced by the fungus (black in coloration, similar to rat droppings in appearance and size) and these sclerotia can survive up to eight years between hosts. Recent cool, wet growing seasons have promoted white mold incidence, and Ocamb has observed white mold epidemics in a number of fields where disease exceeded 10% plant incidence (snap bean, bell pepper, cauliflower, winter squash, and experimental canola fields). Gray mold (*Botrytis* sp.) can also infect bean as well as many other crop species but usually it occurs at lower levels in our fungicide trials in the Willamette Valley (<0.5 % plant incidence) and its presence on plants is usually preceded or accompanied by white mold in our field studies.

Snap bean fungicide efficacy trials for mold management have been conducted on the OSU-Botany and Plant Pathology farm since the loss of Ronilan label in snap bean after the 2005 field season and have shown that a number of fungicides that are currently labeled are effective for mold management. Currently registered fungicides for snap bean mold control include thiophanatemethyl formulations (Topsin M 70WP, Topsin 4.5FL, and T-Methyl 4.5F AG), iprodione formulations (Rovral 4F, Nevado 4F), Endura (boscalid), Switch 62.5WG (fludioxonil plus cyprodinil), Cannonball (fludioxonil), and Omega 500F (fluazinam). Thiophanatemethyl (Topsin M 70WP, Topsin 4.5FL, and T-Methyl 4.5F AG) controls white mold well but has little effect on gray mold because many gray mold strains are resistant to this active ingredient. Iprodione (Rovral 4F, Nevado 4F) controls both gray mold and white mold. Gray mold strains resistant to Rovral do not survive well in the field. Endura (boscalid) and Switch 62.5WG (fludioxonil plus cyprodinil) are both newer materials that have shown good efficacy on white mold in field studies conducted by OSU. Studies on Endura done at Cornell have shown good control of both white and gray mold. Omega 500F (fluazinam) is also registered and limited studies by OSU show that it controls white and gray mold in a 2-spray program. Chlorothalonil products (Bravo Ultrex, Echo 720) also are registered but do not control gray mold as well as dicarboximide fungicides (Rovral) and are ineffective against white mold; however, they may be useful if resistance to other fungicides is a problem. Botran 75W (dichloran) is registered for white mold control on snap bean but use in the past has shown poor efficacy. Spray trials that we conducted during 2004 through 2010 evaluated various rates of Topsin/Rovral tank mixes as a 1- or 2-spray program in addition to examining both unregistered and registered materials for bean mold control. During 2011, we conducted a general comparison of fungicides in snap bean when used alone in a 1- and 2-spray program that commenced at 10% bloom (one plant out of ten has at least one open blossom) and we conducted additional studies on relative product efficacy during 2012.

Objectives for 2012 and Accomplishments:

1. Evaluate ascospore detection of *S. sclerotiorum* using multiple Rotorod spore traps and monitor environmental conditions within commercial and experimental snap bean fields to begin model development of ascospore absence or detection events.

- *Ascospores of the white mold pathogen were detected in 25 out of 79 Rotorod samples.*

The snap bean cultivar '91G' was planted in two fields at the OSU Botany Field Laboratory, Corvallis, OR. Both of these fields have been infested with *S. sclerotiorum* and have been shown to have high disease pressure under environmental conditions conducive for disease. Field #1 was planted on June 6th and Field #2 was planted on Jul 29th using 18-in. row spacing and approximately 206,000 seeds/A. Fertilizer (400 lb/A of 12-29-10-8) was banded at planting followed by 100 lb/A of 40-0-0-6 banded at the second to third trifoliolate leaf stage. For weed control, Eptam 7E (4.5 pt/A) and Treflan 4L (2 pt/A) were broadcast and incorporated 4 days before planting; Raptor (4 oz/A) + Basagran (16 oz/A) were applied at the second trifoliate stage. The field was sprinkler-irrigated weekly as needed.

There was great difficulty and a delay in finding replacement motors for the Rotorod spore traps; they are no longer available from the spore trap manufacturer so we were unable to deploy Rotorod spore traps in commercial snap bean plantings during the early part of the growing season. Rotorod spore traps were placed in our BPP snap bean fields prior to 10% bloom and remained through the harvest in order to monitor the presence of *S. sclerotiorum* ascospores. Rods were replaced every 48 to 72 hrs and subsequently tested for the presence of ascospores using a polymerase chain reaction (PCR) specific for *S. sclerotiorum*. Four Rotorod spore traps were placed in each field by July 25, one towards the center of each of four quadrants in each field. Prior to that, two Rotorod spore traps were in place in field 1. Environmental data was collected from a HOBO U30 Data Logger (Onset, Cape Cod Mass). Air temperature, relative humidity and leaf wetness were monitored within the canopy. Soil temperature was monitored at 1- and 3-inch depths in the soil, and soil moisture was monitored at the 3-inch depth. Weather equipment was moved between the two fields to obtain data during crucial plant and disease development times.

Table 1. Detection of ascospores produced by *Sclerotia sclerotiorum* in Rotorod spore traps

Snap bean field 1[x]		**Snap bean field 2[x]**	
Date Collected	**# spore trap[+*Sclerotinia*]**	**Date Collected**	**# spore trap[+*Sclerotinia*]**
*07/09/2012	0	08/20/2012	0
*07/11/2012	0	08/23/2012	1
*07/13/2012	0	08/24/2012	0
*07/16/2012	0	08/27/2012	0
*07/19/2012[y]	0	08/28/2012	0
*07/23/2012	1	08/30/2012[y]	0
07/27/2012[z]	0	09/04/2012	0
07/30/2012	1	09/07/2012[z]	3
08/01/2012	0	09/10/2012	4
08/03/2012	1	09/12/2012	2
08/06/2012	1	09/14/2012	2
08/08/2012	0	09/17/2012	2
08/10/2012	0	09/19/2012	4
08/12/2012	0	09/21/2012	3

[x] Four Rotorod spore traps were placed in each field (except for dates with *, where there were two Rotorod spore traps deployed). Rods were replaced every 48 to 72 hrs and subsequently tested for the presence of ascospores using a polymerase chain reaction (PCR) specific for *S. sclerotiorum*.

[y] 10% bloom.

[z] time of second fungicide application.

Ascospores were detected in 25 out of 79 Rotorod samples (Table 1). In the first planting, four out of fourteen dates of rod collection had positive PCR tests for *Sclerotinia* detection, but acospores were detected from only one Rotorod spore trap sample on each date of collection (Fig.1A). In the second bean field, there were 21 ascospore-positive rods detected on eight out of fourteen dates of collection (Fig. 1B). After 10% bloom, ascospore detection in field 2 occurred more frequently in multiple spore traps on each date of detection, indicated by the numerals with asterisks in the graph of Field 2 below (Fig. 1B). Both fields were being monitored with four spore traps per field by the second spray date, so the increased frequency of *Sclerotinia*-positive trap samples on each detection date after that point in time probably reflects a greater density of ascospores in the second field.

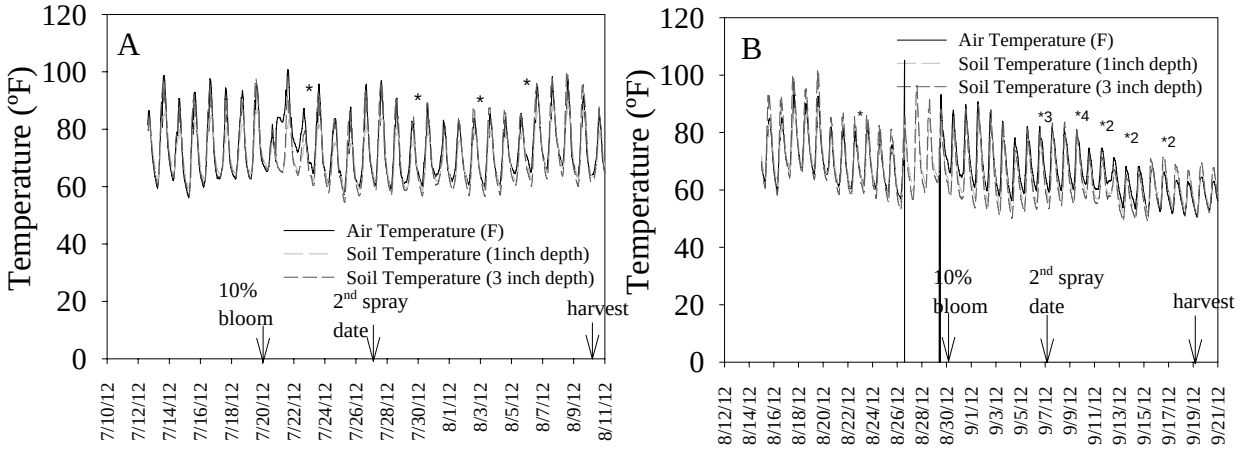

Figure 1. Ambient and soil temperatures (1 and 3 inch depths) as well as *Sclerotinia sclerotiorum* detection events during 2012 on Rotorod spore traps in the snap bean '91 G' fields 1 (A) and 2 (B). * indicates a detection of *S. sclerotiorum*, and if accompanied by a number, the number indicates the number of traps that detected this fungal pathogen on the date the spore traps samples were collected from the field.

Leaf wetness, soil moisture (at 3- inch soil depth), % relative humidity, and dew points for field 1 and 2 are shown in Figure 2. It's apparent that field 1 had fewer days with free moisture on leaves and also had a lower relative humidity within the canopy around 10% bloom (where 1 out of 10 plants has 1 open bloom). The relative humidity stayed low past the second spray date. Soil moisture levels in field 1 also tended to be drier in comparison to second planting. Both of these plantings ended up with very little disease by harvest, though field 2 had more ascospore detection events and appeared to have a higher incidence of white mold post-harvest, as observed in the remaining plants which were allowed to fully mature in the field.

Examination of the different field conditions associated with and without white mold incidence will be underway after December, to see if any environmental factors monitored have a significant association with ascospore presence or absence. 2012 data will be combined with the previous four years of data to look for trends, and findings will be reported.

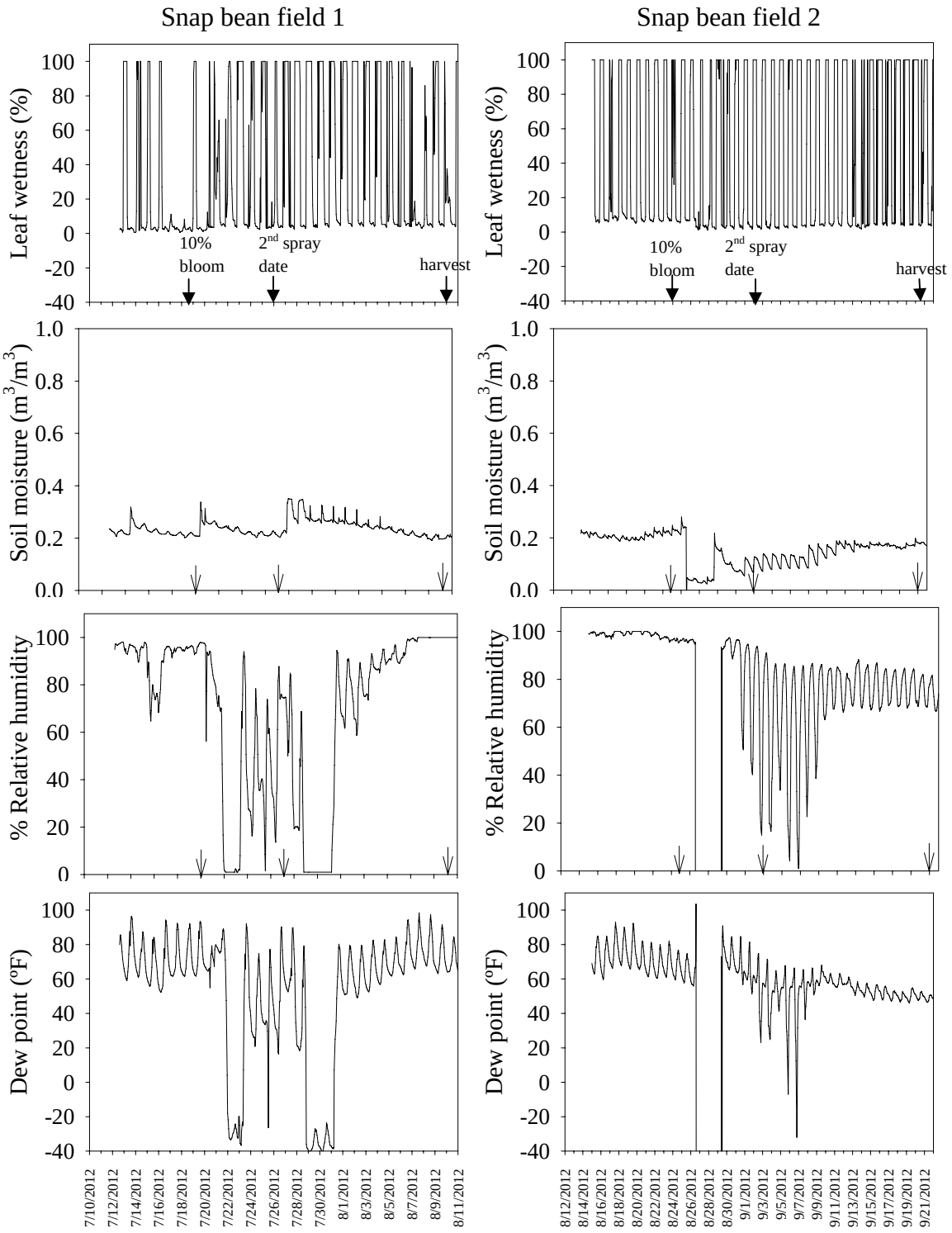

Figure 2. Record of % leaf wetness, soil moisture at 3-inch depth (m3/m3), % relative humidity, and dew point (ºF) within the canopy of snap bean '91 G' fields 1 and 2.

Objective 2 for 2011 and Accomplishments: Compare the efficacy of fungicides registered for white mold in snap bean.

- *Fields were mechanically sown this season for the first time on the BPP farm. The brief period of hot weather that 2012 had occur temporally around our bean fields' blossoming times. Low mold levels were found at harvest in both fields, averaging less than one marketable pod per plant.*

Three-row plots (5 by 15 ft), arranged in a randomized complete block design with three (field 2) to four replications (field 1), were established within each of the two '91G' bean fields outlined in Objective 1. Treatments (Table 2) with fungicides as a 2-spray program were applied at 10% bloom and repeated a week later while the single-application treatments were applied at 10% bloom. Sprays were applied with a CO_2 backpack sprayer calibrated to deliver 22 gal of water/A at 38-40 psi using three 8002 flat fan nozzles on 19 in. spacings. On the 21st day after the initial fungicide application was made at 10% bloom, the plants were harvested (field 1 was harvested 10-Aug-12; field 2 was harvested 20-Sep-12). The number of pods, presence of white or gray mold on pods > 2 inches in length as well as pin beans, and number of stems with white or gray mold were determined for 30 individual plants selected arbitrarily from the center row of each plot.

White mold levels were very low in both plantings this season and virtually no gray mold was detected (data not shown). White mold levels averaged < 1 marketable pod per plant in any of the nontreated control plots in either field. White mold in field 2 (Table 2) was found at slightly greater levels than that found in field 1, and continued to increase in field 2 after harvest. Phytotoxicity was not observed at harvest in either trial.

Table 2. Treatments applied at 10 & 100 % bloom to snap bean '91G and results from Field 2

Fungicide Treatment (rate/acre)[z]	Application #	Healthy pod #		% pods and pin beans with white mold		Stem # with white mold	
nontreated (water control)	2	10.59	def	0	c	0	c
Rovral 4F (2 pt) + Topsin 4.5FL (30 fl oz)	2	12.27	abc	0	c	0	c
Topsin 4.5FL (30 fl oz)	2	9.67	fg	0	c	0	c
Endura (8 oz) + JMS Stylet Oil (0.5 gal)	2	11.97	bc	0	c	0	c
Rovral 4F (2 pt)	2	10.53	ef	0	c	0	c
Switch 62.5WG (11 oz)	2	13.43	a	0	c	0	c
Omega (13.6 oz)	2	9.86	efg	0	c	0	c
JMS Stylet-Oil (1 gal)	2	9.40	fg	0	c	0	c
Regalia (2 qt)	2	9.77	fg	0	c	0	c
Fontelis (30 fl oz)	2	11.76	bcd	0.32	ab	0.07	a
Regalia (2 qt) + Topsin (20 fl oz)	2	9.08	g	0.09	bc	0	c
Rovral 4F (2 pt) + Topsin 4.5FL (40 fl oz)	1	11.06	cde	0.52	a	0	c
Topsin 4.5FL (30 fl oz)	1	12.74	ab	0	c	0	c
Endura (8 oz) + JMS Stylet Oil (0.5 gal)	1	9.70	fg	0	c	0	c
Rovral 4F (2 pt)	1	10.17	efg	0	c	0	c
Switch 62.5WG (11 oz)	1	9.44	fg	0.09	bc	0.06	a
Omega (13.6 oz)	1	9.81	fg	0.09	bc	0.03	b
Fontelis (30 fl oz)	1	10.04	efg	0	c	0	c

[z] 10% and 100% bloom applications were made on 20-Jul-12 and 27-Jul-12 in field 1, and on 30-Aug-12 and 6-Sep-12 in field 2, respectively.

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