Epidemiology and Management of White Mold in Snap Bean in New York

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INTRODUCTION

White mold caused by the fungus, *Sclerotinia sclerotiorum* is a persistent problem for processing snap bean production and other crops in regions with an environment favorable for the disease. Airborne ascospores are the inoculum for the disease which originate from the germinated apothecia produced from sclerotia close to the soil surface. Infected and senesced flowers fall onto the leaves and stems and contribute to disease spread within and between plants. When the incidence of white mold is high, the disease may lead to severe reductions in the number of marketable pods because of premature pod abscission, fungal growth on the pods that remain attached to the plant, and canopy collapse due to lodging making harvest problematic and exacerbating economic losses from white mold and other diseases. Sclerotia which form on the diseased parts of the plant fall back to the soil and serve as inoculum for future susceptible crops.

The control of white mold in processing snap bean in New York is based on preventative applications of fungicides aimed at protecting the flowers from infection by ascospores. This is because of the potential for high crop loss incurred from the disease and absence of fungicides registered for use with substantial eradicant activity. Until the early 2000s, Ronilan® was the most commonly used fungicide for the management of white mold. The fungicide was highly efficacious and due to its strong eradicant activity, applications were not made until disease symptoms were observed in the field. Registration of Ronilan® was removed because of human health and environmental concerns and they were replaced with fungicides that had predominantly protectant activity, such as Topsin®. Topsin® is now the most commonly used fungicide for white mold control due primarily to its low cost. However, there have been sporadic reports of suboptimal control despite the use of this fungicide in snap, dry and lima beans. One potential explanation for suboptimal control is the development of resistance to thiophanate-methyl, the active ingredient within Topsin®. However, studies in our program conducted to date have found evidence for reduced sensitivity within the New York *S. sclerotiorum* population to thiophanate-methyl but not resistance.

The objectives of this study were to evaluate the efficacy and timing of thiophanate-methyl and alternative fungicides for white mold control in snap bean under field conditions. Integration of this information will be vital in the design of integrated management strategies for white mold control in processing snap bean and other leguminous crops in New York as well as in the surrounding production regions.

MATERIALS AND METHODS

Two small plot, replicated trials were conducted at the New York State Agricultural Experiment Station in Geneva, NY in 2016 to evaluate (i) the efficacy of thiophanate-methyl and other conventional and biorational fungicides, and (ii) quantify the optimal timing of thiophanate-methyl and fluazinam for the control of white mold in processing snap bean. The snap bean crops were established with a Monosem planter at the rate of 8.7 seeds/ft with 30 in. row spacing with var. Huntington. *Sclerotinia sclerotiorum* ascospore suspensions were used to inoculate plants within the entire plot area in both trials.

In the **efficacy trial**, products were applied twice at optimal timings (10% and 100% flowering). Each treatment was replicated five times in a completely randomized block design including a nontreated control.

In the **timing trial**, each of the two fungicides, Topsin® 4.5 FL (30 fl oz/A) and the newer product, Omega® 500 F (0.85 pt/A) was applied at either 10% or 100% flowering (+/- an additional application at pin-pod). Each treatment was also replicated five times.

In both trials, the effect of treatment was statistically analyzed on the incidence of white mold on plants and pods at harvest. Diseased pods either had white mold symptoms and/or signs of the pathogen (mycelia and/or sclerotia).

RESULTS

Efficacy of fungicides for the control of white mold in processing snap bean. Disease incidence in the nontreated plots was high with 49.2% and 10.3% of plants and pods, respectively affected by white mold at harvest (Table 1). The incidence of plants with white mold was significantly reduced by all treatments, however Topsin® 4.5FL, Endura®, Badge X_2, Double Nickel 55™ (2.1 q/A), and Omega® 500 F were the most efficacious and not significantly different from each other. Serenade® Opti was less efficacious than other products tested but still resulted in a significant reduction in the incidence of plants with white mold compared to nontreated plots. The incidence of plants with white mold was not significantly different in plots treated with either rate of Double Nickel 55™ (Table 1).

Timing of Topsin® 4.5FL and Omega® 500 F for optimizing white mold control. The incidence of white mold on plants and pods was not significantly affected by delaying the first application of Omega® 500 F to 100% flowering. Moreover, no significant reductions in white mold incidence were found from making a second application at pin-pod irrespective of whether the first application was made at 10% or 100% flowering (Table 2). The timing of Topsin® 4.5 FL did significantly affect the incidence of plants and pods with white mold. Significant reductions in disease incidence were obtained when applications were made at 10% flowering compared to when delayed until 100% flowering. Moreover, when the first application was delayed until 100% flowering, a second application at pin-pod significantly reduced the incidence of white mold on pods and plants (Table 2).

Table 1. Effect of conventional and OMRI-listed products on white mold, marketable yield, and the average weight of a healthy pod in a small plot replicated trial at Geneva in 2016.

Fungicide (rate/A)	Active Ingredient	Incidence of plants with white mold (%)	Incidence of pods with white mold (%)
Topsin® 4.5FL (30 fl oz)	Thiophanate-methyl	0.6 e	0.3 d
Endura® (11 oz)	Boscalid	1.9 e	0.9 d
Omega® 500 F (0.85 pt)	Fluazinam	7.6 de	2.8 bcd
DoubleNickel55™ (1.06 q)	*Bacillus amyloliquefaciens*	14.7 cd	2.9 bcd
DoubleNickel55™ (2.1 q)		10.3 de	1.6 cd
Badge X_2 (2 lb)	Copper oxychloride + copper hydroxide	6.4 de	1.1 cd
Serenade® Opti (18 oz)	*Bacillus subtilis*	32.8 b	5.3 bc
Nontreated		49.2 a	10.3 a

Table 2. Effect of fungicide and timing on the incidence of white mold on plants and pods in a small plot replicated trial at Geneva, New York in 2016.

Treatment Fungicide and Timing (% flowering and/or pin-pod)	Incidence of plants with white mold (%)	Incidence of pods with white mold (%)
Topsin® 4.5 FL (10%)	9.9 cd	4.1 bc
Topsin® 4.5 FL (10% + pin-pod)	5.6 d	0.9 d
Topsin® 4.5 FL (100%)	40.2 b	11.9 a
Topsin® 4.5 FL (100% + pin-pod)	5.0 d	6.2 b
Topsin® 4.5 FL (pin-pod)	13.4 c	10.6 a
Omega® 500 F (10%)	7.9 cd	2.6 cd
Omega® 500 F (10% + pin-pod)	3.2 d	0.6 d
Omega® 500 F (100%)	3.9 d	1.5 cd
Omega® 500 F (100% + pin-pod)	3.5 d	0.4 d
Omega® 500 F (pin-pod)	10.8 cd	1.5 cd
Nontreated	67.7 a	11.2 a

DISCUSSION

Inoculation with *S. sclerotiorum* ascospores led to a high incidence of white mold in nontreated plots in both trials providing ideal conditions to quantify the efficacy and optimal timing of products available to growers for processing snap bean production. The active ingredient of Topsin® 4.5FL (thiophanate-methyl) belongs to Fungicide Resistance Action Committee (FRAC) group 1 and consequently has a high risk of resistance development. However, Omega® 500 F (FRAC group 29) and Endura® (FRAC group 7) offer rotational advantages with no significant difference in disease control. The widespread adoption of the latter two products is limited by high cost. Applications of DoubleNickel55™ (2.1 quarts/A) resulted in reductions in the incidence of plants (81%) and pods (85%) with white mold compared to the nontreated plots. Moreover, disease control was not significantly reduced by halving the rate of DoubleNickel55™. DoubleNickel55™ is a biofungicide containing the bacterium, *Bacillus amyloliquefaciens* D747 strain and is registered as approved for organic production by the National Organic Program and approved for use in certified organic vegetable production by the Organic Materials Review Institute. In contrast, relatively poorer control of white mold on pods and plants was obtained using Serenade® Opti which contains the bacterium, *Bacillus subtilis*. Disease control using the OMRI-registered copper formulation, Badge X_2 was not significantly different to either rate of DoubleNickel55™. This finding may assist in the control of white mold in organic snap bean production in New York.

The timing of the fungicides, Topsin® 4.5 FL and Omega® 500 F was found to significantly affect the incidence of white mold. For example, the optimal timing of Topsin® 4.5 FL was 10% flowering. Delaying the application of Topsin® 4.5 FL to 100% flowering resulted in the incidence of white mold being not significantly different from in nontreated plots. The application timing of Omega® 500 F was found to be more plastic with no significant difference in disease control between 10% and 100% flowering.

The suboptimal control of white mold from delaying the application of Topsin® 4.5 FL may explain some of the perceived control failures when using this product in the field. Incorporation of Omega® 500 F into the pod disease management program for processing snap bean would have rotational benefits but may also be more effective if optimal fungicide timing (early flowering) is missed.

Further Work. The long-term goal of this program is to develop new, innovative and practical tactics for adoption by growers for white mold management in processing snap bean in New York. We are continuing our white mold research to work collaboratively with the Center for Imaging Science, Rochester Institute of Technology to determine how we may effectively harness the potential benefits offered by precision agriculture for improved management of this disease.

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