

CONTROL OF DOWNY MILDEW AND WHITE MOLD IN LIMA BEANS.

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Yields of lima beans (*Phaseolus lunatus*) produced in Delaware are threatened by Downy mildew (*Phytophthora phaseoli*) and White mold (*Sclerotinia sclerotiorum*). Over the past five years, two new races of *P. phaseoli* have been detected in Delmarva lima bean fields. White mold has been a chronic problem for decades, but incidence seems to be increasing in recent years.

Downy mildew

During the 2000 season race E of *P. phaseoli*, caused losses in excess of one million dollars. The 2003 growing season was similar climatologically to the 2000 season. A number of lima beans fields suffered losses caused by *P. phaseoli* and the prevalent genotype for the 2003 season was determined to be race F. These losses were lessened in part due to the timely application of copper or Ridomil-Gold fungicides. Field studies were established in 2002 and 2003 to determine resistance of lima bean varieties to races E and F at separate locations. Varieties were planted in rows 30 inches apart and the middle ten feet of each row was evaluated for the percent of plants infected approximately 2 weeks after inoculation and percent pods infected at harvest. The plots were irrigated as needed. Sporangial suspensions of race E and F were applied on 29 Aug for both locations and a second inoculation of race F on 11 Sept. The plots were misted nightly after inoculation to increase humidity and leaf wetness. The results of the 2003 studies are reported in Tables 1 and 2.

Table 1. Reactions to *P. phaseoli* race E – Newark, DE. 2003.

Variety	Type	Resistance(E)	% plants Infected ^a	% pods infected
M-15	Baby	S ^b	13.8 b ^c	25.5 c
Eastland	Baby	S	20.0 a	83.1 a
8-78	Baby	S	12.3 bc	75.7 a
184-85	Baby	R	0.0 f	5.4 d
Cypress	Baby	R	0.0 f	4.3 d
C-elite select	Baby	R	0.0 f	2.4 d
Sussex	Fordhook	MS	5.5 de	50.3 b
Dixie Butter Pea	*	MS	2.3 ef	50.6 b
Early Thorogreen	Baby	MS	8.0 cd	43.4 b

^a Percent plants infected includes infection of any plant part including racemes, petioles, or pods.

^b Resistance reactions: HS = highly susceptible (>85% infected plants), S = susceptible (>40% infected plants), MS = moderately susceptible (5-25% infected plants), R = resistance (<2% infected plants).

^c Means followed by the same letter are not significantly different (Fisher's LSD, P=0.05).

* Indicates neither a baby nor a Fordhook type of lima bean.

Table 2. Reactions to *P. phaseoli* race F – Georgetown, DE. 2003^a

Variety	Type	Resistance(F)	% Plants Infected	% Pods Infected
M-15	Baby	R	0.0 e	1.8 d
Eastland	Baby	R	0.0 e	2.2 d
8-78	Baby	R	0.0 e	0.0 d
184-85	Baby	S	85.5 a	23.7 ab
Cypress	Baby	MS	34.0 cd	9.1 cd
C-elite select	Baby	S	79.0 cd	24.5 ab
Sussex	Fordhook	MS	3.5 de	1.5 d
Dixie Butter Pea	*	MS	50.5 bc	18.1 bc
Early Thorogreen	Baby	MS	80.0 ab	29.3 a

^a Refer to explanations at the bottom of table 1.

The results obtained in 2002 are consistent with those obtained in 2003. The cultivars 184-85, Cypress, and C-elite select are resistant to race E, while M-15 and 8-78 are resistant to race F. The variety Sussex was determined to be moderately susceptible to both race E and F. It should be noted that the variety Cypress, which was determined to be susceptible to race F, was determined to have a “slow mildewing” characteristic. When large plots of only Cypress were inoculated with race F, it performed like a resistant variety, presumably because of the reduced levels of secondary inoculum.

Three experiments were conducted in 2003 to evaluate the efficacy of several preventative fungicides, the proper timing of application, and the impact of post-infection fungicide applications. The disease severity in the field was very high, all plants in the control plants were infected. Sixteen treatments were evaluated in the efficacy trial. Ridomil Gold/Copper WP 2.0 lb was the only treatment that significantly increased yield compared to the controls. Phostrol 4.0 pt, Phostrol 2.0 pt, and Champ DP 2.0 lb all performed well and were found to be significantly better than the controls for percent plant and percent pod infection.

In the timing trial, the best was Ridomil Gold//Copper 2.0 lb applied one time followed by three applications of Champ DP 2.0 lb every seven days. The two best post-infection application schedules tested were Ridomil Gold/Copper WP 2.0 lb applied two times, seven days apart and Ridomil Gold/Copper WP 2.0 lb applied one time followed by one application of Champ DP 2.0 lb.

White Mold

White mold consistently causes reduced yield in lima beans and contamination during processing. The causal agent of white mold, *Sclerotinia sclerotiorum*, overwinters in residue or as sclerotia in and near bean fields. The sclerotia survive in the soil for many years. When soil is moist for a period of 6 to 10 days, the sclerotia in the top two inches of the soil germinate, form apothecia, and release spores that are carried to plants by wind. The spores may infect senescing leaves and flowers, and spread to other plant parts.

Studies were initiated in 2002 and 2003 to evaluate Contans WG, a new bio-fungicide (biocontrol agent, *Coniothyrium minitans*), which attacks the white mold sclerotia. Contans is incorporated into the upper two inches of the soil, three to four months prior to disease development. In a 2002 trial in Delaware, Contans WG applied once prior to planting, once at

the seedling stage, and at both times, significantly reduced the number of infected pods at harvest. The test was not definitive because disease level was low, however, the results indicate Contans WG has potential to manage white mold in lima beans.

A fungicide evaluation study was established with the fordhook lima bean cultivar 'Sussex', seeded in 30 in. rows on 27 Jun, 2003. Fungicides were applied on 6 Aug with a CO₂ backpack sprayer equipped with 4 nozzles spaced 18 in. apart. White mold severity was high in the field. On 17 Sep, plots sprayed with Endura 70WG alone or in combination with Penetrator Plus had significantly fewer pods infected with white mold than nontreated plots. Endura 70WG plus HyperActive, Serenade 10WP, Switch 62WG at 11 and 14.1 oz/A and Omega 4SC had intermediate levels of pods infected with white mold that were not significantly different than the nontreated plots. There were no significant differences in the number of infected pods at harvest. Plots sprayed with Endura 70WG, alone, with HyperActive, or Penetrator Plus, and Pristine 38WG had significantly higher yield than nontreated plots. The active ingredient (a.i.) in Endura is boscalid. Pristine contains the a.i. boscalid and also pyraclostrobin. Yield in plots sprayed with Topsin M 70WP, Topsin M 4.5F, Switch 62WG and Omega 4SC was intermediate, and due to field variability, not significantly different than the nontreated plots.

Table 3. Results of white mold fungicide evaluation study - 2003.

Treatment and rate/A *	Infected pods/A 17 Sep	Infected pods/A at harvest	Yield (T/A)
Endura 70WG 7 oz + HyperActive 10.5 fl oz	9332 cd**	11258	0.79 a
Endura 70WG 7 oz + Penetrator Plus 2.7 pts	6652 d	13543	0.86 a
Endura 70WG 7 oz	7354 d	4875	0.86 a
TopsinM 70WP 2 lbs.	20570 ab	9536	0.71 ab
TopsinM 4.5F 3.1 pts.	15948 abcd	12826	0.71 ab
Serenade 10WP 6 lbs.	11242 bcd	10297	0.62 ab
Sonata F 8 pts	15895 abcd	14282	0.53 b
Switch 62WG 11 oz	10582 bcd	12166	0.68 ab
Switch 62WG 14.1 oz	11279 abc	9466	0.67 ab
Omega 4SC 8 fl oz	9321 bcd	11946	0.72 ab
Pristine 38WG/lb	18614 cd	15644	0.79 a
Serenade 10WP 4 lbs plus TopsinM 70WP 1 lb	26546 a	11872	0.54 b
Nontreated	19229 abc	12645	0.54 b
LSD (<i>P</i> = 0.05)	10,689	n.s.	0.24

* Fungicides were applied on 6 Aug.

** Mean values in each column followed by the same letter are not significantly different at *P*=0.05 according to Fisher's protected least significant difference test.