ECO-TILLAGE, BIOPESTICIDE and RESISTANCE MANAGEMENT OF WHITE MOLD in DRY BEAN

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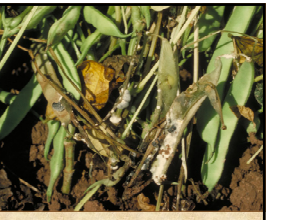

ABSTRACT:

This project is investigating the roles of cultural practices (plant growth habit, plant spacing) and timely application of chemicals in reducing damage from *Sclerotinia sclerotiorum* to *Phaseolus vulgaris*. A field experiment was continued in 2004 to investigate the roles of plant growth habit (Type III vine- 'Montrose' vs Type II upright- 'Vision'), plant spacing (1 vs 2 lines per 75 cm wide bed), and timely application of chemicals (none, thiophanate methyl, and boscalid) within an Integrated Pest Management context. Unfortunately, the regional drought effects of 2004 did not support appreciable disease development in this nursery in spite of our inoculation with white mold sclerotia prior to planting. The hot, dry conditions did favor a moderate outbreak of Mexican Bean Beetle after pod initiation.

The field data were analyzed as a factorial, and plant spacing was the only significant main effect for yield (lb/acre). There was a significant interaction between cultivar and spacing, as one would expect when comparing vine (Montrose) and upright (Vision) growth habits in different plant spacings. Both cultivars yielded more with the 2-line spacing that provided more uniform distribution and utilization of resources (light, moisture, nutrients). Yield of the vine cultivar was increased by 10%, while the yield of the upright cultivar was increased by 50%. This field study will be repeated during 2005, hopefully with adequate disease pressure provided by the reinoculation and a more typical growing season than our region has experienced in recent years.

During the spring of 2004, a set of laboratory and greenhouse experiments systematically evaluated the efficacy of a standard (Topsin) and new (Endura) fungicide applied to foliage of susceptible cultivars 'Montrose' and 'Vision' before inoculation of leaf disks with the white mold pathogen. The rate of leaf colonization by the fungus was recorded over time (2 to 5 days post-inoculation and incubation at 23ºC). This series of replicated experiments was run 4 times, and statistical analyses allowed us to combine data over cultivars since there were no differences in responses between the susceptible cultivars (Montrose vs Vision). Topsin provided 80 to 84% control of white mold, even after 5 days of incubation; and Endura provided 97 to 99% control.

During the fall of 2004, other experiments evaluated efficacy of fungicides applied in varying gallonage to foliage of susceptible cultivar 'Montrose' before inoculation of leaf disks with the white mold pathogen. The rate of leaf colonization by the fungus was recorded over time (2 to 5 days post-inoculation and incubation at 23ºC). This series of replicated experiments was run 2 times, and statistical analyses allowed us to combine data over runs since there were no differences in responses between the two runs. Topsin applied in 5 to 250 gallons of water per acre, provided 84 to 96% control of white mold. Endura provided 39 to 93% control. Both fungicides were more efficacious when applied in 25 or more gallons or water per acre. These rates are typically associated with ground rig or low volume chemigation equipment; while rates less than 25 gallons per acre are typically associated with aerial equipment.

Additional greenhouse/laboratory experiments with fungicide rain fastness will be conducted during Winter to Spring of 2005.

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Field Results: Bean Cultivar Response to Varying Plant Spacing

Cultivar	Spacing	Yield (lb / A)*	100 Seed Wt (g)
Vision	1 Line	2030.14	73.45
	2 Lines/Bed	3046.31	72.24
Montrose	1 Line	2376.79	76.66
	2 Lines/Bed	2621.56	74.751

** To convert yield to kg/ha, multiply lb/A x 1.12*

Greenhouse Results Experiment I:

Fungicide Efficacy (25 gpa); combined for 4 runs, 4 reps each, 2 dry bean cultivars

Treatment	% of Total Infection Day 2	Day 3	Day 4	Day 5
Control	16.62 A	41.96 A	75.60 A	93.46 A
Topsin	3.33 B	6.91 B	11.81 B	16.83 B
Endura	0.26 C	0.60 C	1.55 C	2.88 C

P = 0.001%

Greenhouse Results Experiment II:

Fungicide Gallonage; combined for 2 runs, 10 reps each, pinto cultivar Montrose

Treatment	% of Total Infection Day 2	Day 3	Day 4	Day 5
Control	17.46 A	48.26 A	66.26 A	93.56 A
Topsin - 5 gpa	2.14 D	3.94 C	7.88 CDE	13.75 DE
Topsin – 10	2.00 D	4.12 C	9.00 CDE	10.86 E
Topsin – 25	2.51 CD	4.93 C	8.03 CDE	12.30 E
Topsin – 50	1.03 D	2.09 C	2.83 E	4.83 E
Topsin – 100	0.89 D	1.65 C	2.52 E	8.26 E
Topsin – 150	0.77 D	1.40 C	2.53 E	3.54 E
Topsin – 200	0.74 D	1.56 C	2.49 E	3.52 E
Topsin – 250	0.53 D	1.35 C	2.39 E	3.67 E
Endura – 5 gpa	6.73 B	22.80 B	41.66 B	61.17 B
Endura – 10	5.87 BC	17.86 B	33.56 B	61.59 B
Endura – 25	1.42 D	5.98 C	13.42 CD	28.06 C
Endura – 50	1.33 D	6.11 C	13.92 C	26.41 CD
Endura – 100	0.44 D	1.90 C	4.32 CDE	10.33 E
Endura – 150	0.13 D	0.97 C	2.97 DE	7.20 E
Endura – 200	0.77 D	3.69 C	7.43 CDE	14.59 DE
Endura – 250	0.70 D	2.80 C	6.29 CDE	13.46 E

P = 0.001%

GOALS and OBJECTIVES:

Our goal was to reduce bean (*Phaseolus vulgaris*) losses caused by *Sclerotinia sclerotiorum*.

Our objectives were to investigate components of Integrated Pest Management such as:

- varietal growth habit,
- plant spacing,
- timely applications of fungicides,
- and application methodology.

MATERIALS AND METHODS:

Field Evaluations in 2004 & 2005

Components included:

- **Plant Spacing:** 1 vs 2 lines per 75 cm wide bed;
- **Growth Habit:** pinto cultivars 'Vision' with Type II upright growth habit vs 'Montrose' with Type III vine growth habit; both cultivars are susceptible to white mold but resistant to prevalent strains of rust, and have a similar maturity
- **Fungicide Protection**: at 50% bloom and 7 days later, apply control, nothing vs Topsin M @ 1.68 kg/ha vs Endura @ 77 g a.i./ha

Plant Spacing (2 treatments) x Cultivar (2 treatments) x Fungicide Protection (3 treatments) x 4 reps in a split-split plot design. Each plot was 4 rows (75 cm wide) wide x 4 m long. Plots were planted at the density of 210,000 seed/hectare in a white mold-infested, furrow-irrigated nursery at the CSU Research Facility (ARDEC). Field evaluations from each plot were conducted for disease development, yield as kg/ha, seed size as 100 seed weight).

Laboratory Evaluations in 2004 & 2005

During the spring of 2004, a set of laboratory and greenhouse experiments (Experiment I) systematically evaluated the efficacy of a standard (Topsin) and new (Endura) fungicides applied to foliage of susceptible cultivars 'Montrose' and 'Vision' before inoculation of leaf disks with the white mold pathogen. The rate of leaf colonization by the fungus was recorded over time (2 to 5 days post-inoculation and incubation at 23ºC). This series of replicated experiments was run 4 times, and statistical analyses allowed us to combine data over cultivars since there were no differences in responses between the susceptible cultivars (Montrose vs Vision) as expected.

During the fall of 2004, a set of laboratory and greenhouse experiments (Experiment II) systematically evaluated the response (efficacy) of a standard and new fungicide applied in varying gallonage to foliage of susceptible cultivar 'Montrose' before inoculation of leaf disks with the white mold pathogen. The rate of leaf colonization by the fungus was recorded over time (2 to 5 days post-inoculation and incubation at 23ºC). This series of replicated experiments was run 2 times, and statistical analyses allowed us to combine data over runs since there were no differences in responses between the two runs.

Additional greenhouse/laboratory experiments (Experiment III) with fungicide rain fastness will be conducted during Winter to Spring of 2005.

RESULTS and DISCUSSION:

Field Evaluations

Unfortunately, the regional drought effects of 2004 did not support appreciable disease development in this nursery in spite of our inoculation with white mold sclerotia prior to planting. The hot, dry conditions did favor a moderate outbreak of Mexican Bean Beetle after pod initiation.

The field data were analyzed as a factorial, and plant spacing was the only significant main effect for yield (lb/acre). There was a significant interaction between cultivar and spacing, as one would expect when comparing vine (Montrose) and upright (Vision) growth habits in different plant spacings. Both cultivars yielded more with the 2-line spacing that provided more uniform distribution and utilization of resources (light, moisture, nutrients). Yield of the vine cultivar was increased by 10%, while the yield of the upright cultivar was increased by 50%. Plans are underway to repeat this field study during 2005, hopefully with adequate disease pressure provided by the reinoculation of the nursery and a more typical growing season than our region has experienced in recent years.

Laboratory / Greenhouse Evaluations

The Experiment I Series demonstrated that the conventional fungicide, Topsin, provided very good control (80 to 84%) of white mold, even after 5 days of incubation. The newer fungicide Endura provided even greater control (97 to 99%), and offers a lot of potential for enhanced fungicide management for future IPM programs on dry bean and other crops that are affected by *Sclerotinia sclerotiorum*.

The Experiment II Series demonstrated that the conventional fungicide, Topsin applied in 5 to 250 gallons of water per acre, provided very good control (84 to 96%) of white mold, even after 5 days of incubation. The newer fungicide Endura provided less control (39 to 93%) in this series of experiments with different gallonages, but still offers a lot of potential for enhanced fungicide management for future IPM programs on dry bean and other crops that are affected by *Sclerotinia sclerotiorum*. Both fungicides were more efficacious when applied in 25 or more gallons or water per acre. These rates are typically associated with ground rig or low volume chemigation equipment; while rates less than 25 gallons per acre are typically associated with aerial equipment.

The Experiment III Series will be conducted during the winter and spring of 2005.

References Consulted:

Brick, M. A., and Grafton, K. F. 1999. Improvement of medium-sized race Durango cultivars. 253. *In* S. P. Singh (ed.) Common Bean Improvement in the Twenty-First Century. Kluwer Aca Publishers, Boston.

Brick, M. A., Schwartz, H. F., Ogg, J. B., Johnson, J. J., and Judson, F. 2001. Registration of 'Mo pinto bean. Crop Sci. 41:260.

Coyne, D. P., Nuland, D. S., Lindgren, D. T., and Steadman, J. R. 1994. 'Chase' pinto dry bean. HortScience 29:44-45.

Fuller, P. A., Coyne, D. P., Steadman, J. R., and Mumm, R. F. 1984. Inter- and intra-row inter-ge competition influences selection for avoidance of white mold disease in dry edible beans. J. Am Hort. Sci. 109:567-572.

Hall, R. and Nasser, L. C. B. 1996. Practice and precept in cultural management of bean diseases. of Plant Path. 18:176-185.

Kerr, E. D., Steadman, J. R., and Nelson, L. A. 1978. Estimation of white mold disease reduction and yield components of dry edible beans. Crop Sci. 18:275-279.

Schwartz, H. F., and Pearrs, F. B. 1999. Integrated pest management. P. 371-388. *In* S.P. Singh Common Bean Improvement in the Twenty-First Century. Kluwer Academic Publishers, Bosto

Schwartz, H. F. and Steadman, J. R. 1978. Factors affecting sclerotium populations of, and apothe production by, *Sclerotinia sclerotiorum*. Phytopathology 68:382-388.

Schwartz, H. F., and Steadman, J. R. 1989. White mold. Pp. 211 – 230, in: Bean Production Prob the Tropics, 2nd ed. Edited by H. F. Schwartz and M. A. Pastor Corrales. CIAT, Cali, Colombia

Schwartz, H. F., McMillan, M. S., and Lancaster, G. F. 1994a. Volunteer beans with rust and whi inocula in winter wheat. Plant Disease Note 78:1216.

Schwartz, H. F., McMillan, M. S., and Lienert, K. 1994b. Evaluations of foliar fungicides and the for white mold control in dry beans, 1992. APS Fungicide & Nematicide Test Results 49:85.

Schwartz, H. F., Casciano, D. H., Asenga, J. A., and Wood, D. R. 1987. Field measurement of wh effects upon dry beans with genetic resistance or upright plant architecture. Crop Science 27:66

Steadman, J. R. 1979. Control of plant diseases caused by *Sclerotinia* species. Phytopathology 6 907.

Steadman, J. R. 1983. White mold: a serious yield-limiting disease of bean. Plant Disease 67:34

Weiss, A., Kerr, E. D., and Steadman, J. R. 1980. Temperature and moisture influences on develo white mold disease (*Sclerotinia sclerotiorum*) on Great Northern beans. Plant Disease 64:757-

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