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

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ABSTRACT:

White mold [caused by *Sclerotinia sclerotiorum* Lib de Bary] is a major concern to common bean (*Phaseolus vulgaris* L.) growers throughout the USA with yield losses averaging 30% in the central high plains and individual field losses as high as 90%. Moreover, white mold incidence is increasing in the western states with the expansion of overhead irrigation. Only partial physiological resistance to white mold is found in common bean, and adequate control has been difficult to achieve. Our objective was to investigate the roles of cultural practices (irrigation interval, tillage at planting), timely application of chemicals, and partial plant resistance in reducing damage from *Sclerotinia sclerotiorum* to *Phaseolus vulgaris*.

Work was conducted in 2002 and to investigate the roles of irrigation interval (5 vs 10 days), tillage (deep ripping or not at planting to improve root health and water-use efficiency later in the season), plant resistance (susceptible pinto cultivar 'Montrose' vs partially resistant pinto cultivar 'Chase'), and timely application of chemicals (none, thiophanate methyl, and thiophanate methyl + systemic acquired resistance inducer – Acibenzolar) within an Integrated Pest Management context.

The more frequent irrigation interval increased yield of both cultivars by 10% and seed weight by 2%. Planting-time ripping with less frequent irrigation increased yield by nearly 10% for cultivar 'Montrose', but decreased yield by 40% for cultivar 'Chase' due to its susceptibility to Fusarium Wilt. White mold disease did not develop in the disease nursery due to the serious drought and high temperature conditions which persisted throughout both years.

In 2003, a set of laboratory and greenhouse experiments evaluated the potential usefulness of conventional and experimental fungicides and biopesticides (systemic acquired resistance inducers) applied to foliage of a susceptible cultivar 'Montrose' before inoculation with the white mold pathogen. Data will include rate of leaf colonization.

Results will support an IPM approach to reducing white mold yield and economic impacts on susceptible bean cultivars through cultural practices and the timely application of effective fungicides. These bean results should be applicable to other crop/white mold combinations.

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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 resistance,
- irrigation interval,
- tillage practices, and
- timely applications of fungicides and biopesticides.

MATERIALS AND METHODS:

Field Evaluations in 2002 & 2003

Components included:

- **Irrigation:** 4 – 5 cm of irrigation water applied by furrow every A = 5 vs B = 10 days;
- **Tillage:** C = deep ripping to 20 cm depth at planting vs D = no ripping (compacted);
- **Resistance:** E = pinto cultivar 'Chase' with partial resistance vs F = pinto cultivar 'Montrose' with no resistance to white mold; both cultivars are resistant to prevalent strains of rust, have type III vine growth habits and similar maturity
- **Fungicide Protection**: at 50% bloom and 7 days later, apply G = control, nothing vs H = Topsin M @ 1.68 kg/ha vs I = Topsin + Actigard @ 26 g a.i./ha

Irrigation (2 treatments) x Tillage (2 treatments) x Resistance (2 treatments) x Fungicide Protection (3 treatments) x 3 reps in a split-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 soil bulk density or compaction, soil moisture, disease development, yield as kg/ha, seed size as 100 seed weight). An economical analysis will also be made for the cost/benefit effects of each treatment for a grower and the dry bean industry.

Laboratory Evaluations in 2003

This experiment evaluated the potential usefulness of conventional fungicides and biopesticides when applied to foliage of dry bean as the bioassay platform. These products vary in their mode of action and activity (i.e. protectant, systemic, inducer of systemic acquire resistance - SAR). SAR treatments were applied 7 days prior, while all other treatments were applied 1 day prior to inoculation. A composite of 3 disks (each 3.5 mm^2) from 1 trifoliolate leaf of each of 12 treated plants (reps) were challenged with 3 mm agar plugs of actively growing white mold. The inoculated disks from each treatment/rep were placed on a Petri plate with moist paper in an incubator at 22 C. The rate of fungal colonization after inoculation was determined at daily intervals until the mycelium reached the outer edge of the disk. The experiment was repeated.

Product:	*Company:*	*Formulation:*
Control		
Dithane	DOW	Mancozeb (EBDC), protectant
Bravo	Syngenta	Chlorothalonil, protectant
Topsin M	Cerexagri	Thiophanate methyl, protectant
Fluazinam	Syngenta	Toluidine material, protectant
Endura	BASF	Boscalid, protectant/systemic
Headline	BASF	Pyraclostrobin, protectant/systemic
Pristine	BASF	Pyraclostrobin, protectant/systemic
Quadris	Syngenta	Azoxystrobin, protectant/systemic
Blocker	AMVAC	Pentachloronitrobenzene, protectant
Omega	Bayer	Prochloraz, protectant/systemic
Tilt	Syngenta	Propiconazole, protectant/systemic
Scala	Bayer	Pyrimethanil, protectant
Actigard	Syngenta	Acibenzolar, SAR inducer
Messenger	Eden Bio.	Harpin protein, SAR inducer

Fig. 1

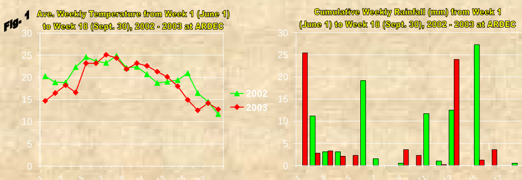


Fig. 2

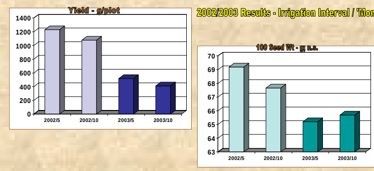


Fig. 3

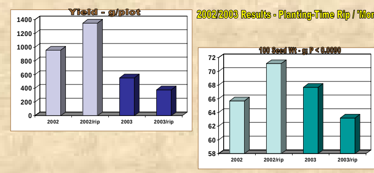
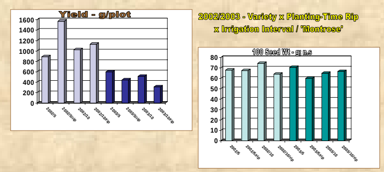


Fig. 4



RESULTS and DISCUSSION:

Field Evaluations

The severe drought and prolonged high temperatures during 2002 and 2003 adversely affected development of the dry bean crop and white mold pathogen in this nursery at our experimental research farm near Colorado State University. We decided to evaluate the effects of our main cultural practice treatments, i.e., cultivar, irrigation interval and planting time ripping, upon the crop development in the absence of white mold. The fungicide program did not show any differences in plot yields in the absence of white mold, and these data are not included in this report.

We encountered an interesting but unexpected differential impact of a second soil-borne fungal pathogen, *Fusarium oxysporum* f. sp. *phaseoli* upon the two pinto cultivars that were selected for this experiment. Chase was highly susceptible to the pathogen, regardless of the other treatments imposed, i.e., irrigation or ripping. The infection was so severe that we decided to eliminate the yield data from Chase, and concentrate on the impact of cultural practices upon the less susceptible cultivar Montrose in this report and poster.

Overall plant development was more severely affected by the drought and high temperatures in 2003 than in 2002 (Fig. 1), as evidenced by the reduced plot yields. The more frequent furrow irrigation interval (5 versus 10 days) increased yields by 14 % in 2002 and 26 % in 2003 (Fig. 2). Seed size was not affected to any great extent either year.

Planting-time ripping in the 15 to 20 cm depth increased yield of Montrose by 41 % in 2002, but reduced it by 46 % in 2003 (Figs. 3 & 4). Shallow to deep ripping is generally reported to provide a positive impact upon early-season root development and health, and to facilitate mid to late-season access to deeper sources of moisture and nutrients. This late-season access can be especially beneficial during high water requirements late in the season for maintenance of plant canopy and developing pods and seeds. The 2003 reduction in yield due to ripping was apparently compounded by the presence of the Fusarium Wilt pathogen in these lower soil depths.

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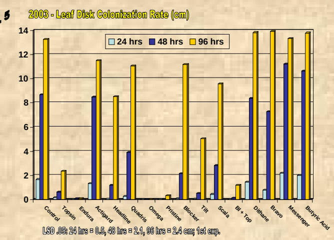
Pesticide Candidates for Leaflet Assay:

Topsin M	thiophanate methyl
Fluazinam	toluidine material
Endura	boscalid (BAS 510)
Pristine	boscalid + pyraclostrobin (BAS 516)
Headline	pyraclostrobin (BAS 500)
Quadris	Azoxystrobin
Blocker	quintozene (PCNB)
Blocker + Topsin	PCNB + thiophanate methyl
Tilt	propiconazole
Scala	pyrimethanil
Actigard	Acibenzolar (SAR inducer)
Dithane	ethylenebisdithiocarbamate
Bravo	chlorothalonil
Messenger	Harpin protein (SAR inducer)
Butyric Acid	(SAR Inducer)

Fig. 5



Laboratory Evaluations

The detached leaflet method provided an efficient means to evaluate and compare the efficacy of various pesticides against the white mold pathogen under controlled conditions in the laboratory (Fig. 5).

No biopesticide evaluated in this study provided sufficient control when compared against a conventional fungicide such as Thiophanate Methyl or newer chemistry such as that provided by Boscalid. Acibenzolar (systemic acquired resistance product) did reduce pathogen development when compared to the other biopesticides, and could be useful if applied in combination with other pesticides. Additional research is warranted to determine if control can be enhanced by tank-mixing or sequential applications of products with different chemistries and modes of action.

Combinations of older fungicides such as Topsin (Thiophanate Methyl) + Blocker (PCNB) and new fungicides such as Endura (Boscalid), Omega (Prochloraz) and Pristine (Pyrachlostrobin) provided excellent control of the white mold pathogen in these detached leaf studies with dry bean; and are good IPM candidates for chemical control of white mold in other susceptible crops.

Future research should continue to focus on the evaluation of diverse pesticides, including biopesticides, and application technology that can improve the timing and delivery of effective products when warranted by Integrated Pest Management principles.

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