ETIOLOGY AND CONTROL OF DRY BEAN ROOT ROT IN MINNESOTA

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ABSTRACT

Bean (*Phaseolus vulgaris* L.) root rot is an increasingly important disease in Minnesota. Current control consists of seed treatment with Captan, Streptomycin and Lorsban. However, in the last few years, root rot has become more common because of the increased acreage and use of susceptible cultivars. The objectives of this study were to determine the causal organisms involved in root rot in Minnesota and to examine chemical and cultural factors that may be important in its control. A survey was conducted during the summers of 1997, 1998 and 1999 in Central Minnesota (Park Rapids, Perham and Staples areas) involving in fields with previous history of bean root rot. Results summarized in Chapter I indicated that bean root rot is a disease complex with *Fusarium solani* f. sp. *phaseoli* as the primary pathogen. *Rhizoctonia solani* anastomosis groups AG-4 and AG-2-2 and *Fusarium oxysporum* were also shown to be important in the etiology of the disease. Simultaneous inoculation of all three pathogens increased disease severity. *Pythium* spp. and/or *Aphanomyces* spp., important in other bean growing regions, were not identified in the surveyed areas. In Chapter II, host range and pathogen survival studies are described. The root rot pathogens infect other several important rotational crops and can survive in their residues. *F. solani* f. sp. *phaseoli* infects beans, peas and sovbean, and the residue of these crops can also sustain the pathogen over winter. *Rhizoctonia solani* AG-4 infects alfalfa (*Medicago sativa*), bean (*Phaseolus vulgaris*), canola (*Brassica campestris*), peas (*Pisum sativum*), soybeans (*Glycine max*), sugar

beet (*Beta vulgaris*), red clover (*Trifolium repens*), potato (*Solanum tuberosum*), quackgrass (*Elytrigia repens*) and lambsquarters (*Chenopodium album*). The wide host range exhibited by these pathogens further complicates management strategies.

Chapter III describes three years of greenhouse and field studies using seed applied biocontrol agents in comparison with various chemical seed treatments. In the first and second years, *Bacillus subtilis* GBO3 (Kodiak) Gustafson, and *Trichoderma harzianum* (T-22) inoculation resulted in reduced disease severity, and increased plant and root dry weight and yield compared to the untreated seeds. Kodiak applied alone and Captan + Kodiak treatments outperformed all others in yield. *Rhizobium tropici* strain UMR1899 also increased yield and was superior to T-22 alone or in combination with the seed treatments. However, in both cases disease was not eliminated. In the third year, in a new field study, *B. subtilis* strain MBI600 (Epic) and Kodiak granular were included. Kodiak (granular) had encouraging results increasing yields when compared to the untreated control and even the standard seed treatment. From these results, it appeared that granular formulations could be combined with other seed treatment to open a new era of management of *F. solani*, *F. oxysporum* and *R. solani*. There are still many epidemiological factors of the disease that are unknown; monitoring qualitatively and quantitatively soil inoculum and predicting the risk of disease may also help to better manage disease.

Resistance to root rot has been difficult to obtain and Chapter IV reports a study that was conducted using 44 cultivars/lines to determine their relative resistance to *F. solani* f. sp. *phaseoli* and *R. solani* AG-4. The black bean cultivars, Black Knight, T-39 and Shadow were resistant both to *F. solani* f. sp. *phaseoli* and *R. solani* AG-4. Resistance to *Rhizoctonia solani* AG-4 was more common, with 'Sacramento' (light red kidney), 'Aztec' (pinto), and 'Avanti' (navy) possessing resistance, but these cultivars were susceptible to *F. solani* f. sp. *phaseoli*. Common bean cultivars grown extensively in Minnesota (Drake, Isles, Montcalm and Red Hawk) all were susceptible to *F. solani* f. sp. *phaseoli* and *R. solani* AG-4. Results of ongoing efforts to select resistant lines originated from North Dakota State University are also reported. The use of the biocontrol *Bacillus subtilis* GBO3 on cultivars/lines further decreased disease severity and increased yield.