

A NEW METHOD FOR SCREENING RESISTANCE OF COMMON BEANS (*PHASEOLUS VULGARIS* L.) TO *FUSARIUM* ROOT ROT

S. Chaudhary, T.R. Anderson, S. J. Park, K. Yu. Greenhouse and Processing Crops Research Centre, Agriculture and Agri-Food Canada, 2585 County Road 20, Harrow, Ontario N0R 1G0, Canada yuk@agr.gc.ca

Introduction:

Root rot of common beans, is a soil-borne disease that may be incited by several fungal pathogens including *Fusarium solani*, *F. oxysporum*, *Pythium ultimum*, and *Rhizoctonia solani*. It occurs in all bean-growing areas of the world. Root rot caused by *F. solani* f. sp. *phaseoli* is a major concern for common bean producers in Ontario, Canada. Different greenhouse screening methods have been used for screening common beans for resistance to *Fusarium* root rot. In this study, we modified a method developed for soybeans by Schmitthenner and Bhat (1994) to screen for tolerance to *Phytophthora* root rot and compared it to the screening procedure developed by Schneider and Kelly, (2000) with common bean cultivars and breeding lines.

Materials and Methods

Plant materials: A recombinant inbred line (RIL) population, derived from a cross between AC Compass (susceptible to root rot) and NY2114-12 (*P. coccineus*-derived line tolerant to root rot), was developed and advanced to the F₃ by single seed descent. The F₃ seeds were bulked and advanced to the F₇ to produce 80 F₃ derived RILs. In preliminary trials, 30 RILs including parents were used to evaluate the appropriate distance above the root to section hypocotyls to observe vascular discolouration using the inoculum layer method (ILM). In additional experiments, 80 F_{3,7} RILs of the population including parents were evaluated for resistance to root rot by both root rot rating and the vascular discolouration method using the ILM. These RILs were also used in conjunction with root rot rating to evaluate the consistency of the liquid inoculum method (LIM). This procedure was essentially the same as that developed by Schneider and Kelly (2000). We adapted and modified the ILM developed by Schmitthenner and Bhat (1994) to screen for soybean tolerance to *Phytophthora* rot. This method has not been evaluated for effectiveness with common beans and *Fusarium* root rot. The modified method is described by Chaudhary et al. 2006.

Pathogen strain: The isolate of *F. solani* f. sp. *phaseoli*, Huron 2a, used in the current study was obtained from Dr. J. Kelly, Michigan State University, MI and was isolated from common beans in Huron county in Michigan (Schneider and Kelly, 2000).

Data analysis: The arithmetic average of the ratings of 5 to 10 single plants per line was calculated. Pearson correlation coefficients between trials in all experiments were calculated using the PROC CORR procedure of SAS System (SAS Institute, 1994). Analysis of variance (ANOVA) for cross section experiments was performed using AGROBASE (Agronomix Software Inc., Winnipeg, MB, Canada).

Results and discussion:

With the ILM, disease severity was rated with two methods: (1) root discoloration and hypocotyl lesion, and (2) the number of discoloured vascular bundles in hypocotyl cross sections (Fig.1). The vascular bundle method of scoring in ILM gave us the highest reproducibility among experiments (Tables 1 and 2). The only limitation of this method is that it is a destructive method in that we have to sacrifice the plant in order to rate it.

Table 1. Analysis of the number of discoloured vascular bundles in common bean hypocotyls at 4 distances above the root 10 days after inoculation with *Fusarium solani* f.sp. *phaseoli* using the inoculum layer technique.

Distance from root (cm)	Trial I. Mean number of discoloured bundles	CV (%)	Trial II. Mean number of discoloured bundles	CV (%)	Correlation coefficient I vs II
0.5	4.7	32.83	2.3	66.70	-0.0155
1.0	3.7	45.60	2.6	50.60	0.5038***
2.0	2.3	51.77	2.3	54.64	0.5714***
3.0	1.2	78.12	1.2	86.94	0.2430

*** = significant at P < 0.001 level of probability. cv = coefficient of variation.

Table 2. Pearson's correlation coefficients (r_p) between trials and methods for evaluating F_{3:7} RILs for resistance to *Fusarium solani* f.sp. *phaseoli*.

		Method					
		Inoculum layer (ILM)			Liquid inoculum (LIM)		
		VB		RD	RD		
	T ₁	T ₂	T ₁	T ₂	T ₁	T ₂	
ILM VB	T ₁	1					
	T ₂	0.7113***	1				
RD	T ₁	0.7723***	0.5166***	1			
	T ₂	0.5742***	0.6854***	0.5555***	1		
LIM RD	T ₁	-0.0293 ^{ns}	0.2156 ^{ns}	-0.0534 ^{ns}	0.0704 ^{ns}	1	
	T ₂	0.1239 ^{ns}	0.2165 ^{ns}	0.1083 ^{ns}	-0.099 ^{ns}	0.1084 ^{ns}	1

VB = Vascular bundle, RD = Root discoloration, T = trial

*** = significant at P = <0.001, ns = not significant at P = <0.05 level of probability.



Figure 1: Hypocotyl cross sections of root rot infected (A) and healthy control (B) common bean plants. Brown discoloration can be seen in the major vascular bundles within the vascular cylinder in the infected plant. A plant normally has 8-10 large vascular bundles at this stage of development, 1 cm above the root.

References: 1. Schmitthenner, A.F., R.G. Bhat (1994). OARDC special circular 143. The Ohio State University, Wooster, OH.; 2. Schneider, K.A., J. D. Kelly. 2000. HortScience 35:1095-1098. 3. Chaudhary et al. 2006. Journal of Phytopathology (in press).