Dry bean genotypes and *Macrophomina phaseolina* (Tassi) Goid in inoculated and non-inoculated field plots[1]

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ABSTRACT

Forty dry bean genotypes were tested in the semi-arid south coast of Puerto Rico to determine the effect of inoculation of experimental plots with bean plant debris highly infected with *Macrophomina phaseolina* Analysis of variance indicated that significant differences (P=0.05) were found among the genotypes for disease severity indexes. The ashy stem blight infection increased approximately 40% between pod set and physiological maturity. A highly significant correlation (r=0.66) was found between the disease severity ratings taken at 70 and 90 days after planting. Among 40 genotypes evaluated, Cuarentena and RIZ 44 showed high levels of susceptibility, whereas 8437-22 was the most resistant genotype to *M. phaseolina***

INTRODUCTION

Ashy stem blight (ASB) caused by *Macrophomina phaseolina* (Tassi) Goid is recognized as an important disease of dry beans (*Phaseolus vulgaris* L.) in parts of the tropics, particularly in drought-stressed areas of Latin America and East Africa (6, 12). Until recently, there has been little research to develop bean germplasm with resistance to *M. phaseolina.* A small group of lines from a CIAT BYDIT nursery planted at the University of California-Riverside in 1984 was identified to have some degree of resistance to ASB (6). A few bean lines also have been identified to be moderately resistant to inoculated and natural infection of *M. phaseolina* in Colombia and Puerto Rico, respectively (1, 5, 11,). Problems in screening bacterial blight bush bean genotypes for resistance to natural infection of ASB have been reported in Puerto Rico because the inoculum was not uniformly distributed in the field test (13). This faulty distribution points to the need to develop techniques which improve the reliability of field screening of bean genotypes for resistance to ASB. Therefore, the objective of this study was to determine the

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FIG. 1.—Whole bean plant residues highly infected with *Macrophomina phaseolina* applied 5 days after planting.

effect of inoculation of plots with infected debris and the incidence and severity of *M. phaseolina* in the field.

MATERIALS AND METHODS

This experiment was conducted during the dry season of 1985–86 at the Fortuna Substation located on the semi-arid south coast of Puerto Rico. Minimum and maximum temperatures averages 18 C and 30 C, respectively. There was a total 43 mm of rainfall during the period of the experiment. Irrigation was limited in order to induce moisture stress in plants, a factor considered to be important for the development of ASB (3, 7). The soil is a Mollisol (Cumulic Haplustolls) with a pH of 7.35 and high fertility. Forty dry bean genotypes from the University of Puerto Rico (UPR), Tropical Agriculture Research Station (TARS, USDA), Centro Internacional de Agricultura Tropical (CIAT), the University of Wisconsin (UW), Michigan State University (MSU), the Dominican Republic (DR), Guatemala (Guat), Honduras and Haiti, were planted in a split plot arrangement of a randomized complete block with four replications. The whole plots consisted of a control and two combinations of soil inoculations with bean plant debris highly infected with *M. phaseolina*. One whole plot treatment consisted of ground plant residues in water suspension placed in the rows before planting. The other combination

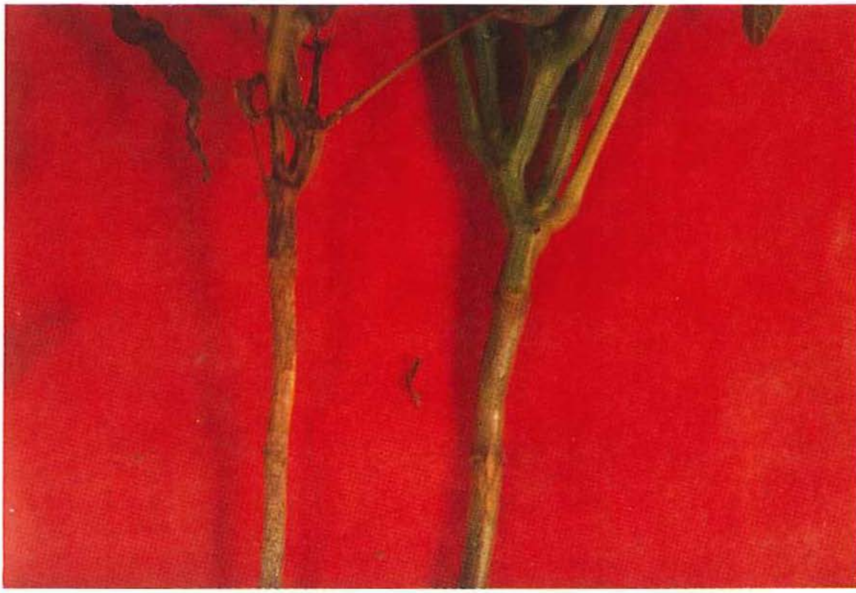

FIG. 2.—Cuarentena variety showing infected stem by *Macrophomina phaseolina*. Note the dark brown lesion on one node (left). Healthy stem of the 8437-22 bean line (right).

consisted of the previous treatment plus whole plant residues applied 5 days after planting (fig. 1). The presence of the fungus in the debris was confirmed in isolated studies. A visual rating was used to measure the severity along the length of the stem of adult plants: grade 1 = no symptoms, or the appearance of an irregular dark brown lesion on one node upward from near the cotyledonary node; grade 2 = lesions on two or three nodes; grade 3 = lesions on more than three nodes; grade 4 = lesion on three or more nodes, infected branches, and tiny fruiting bodies (picnidia or sclerotia) on the surface of the infected stem; and grade 5 = complete defoliation and plant death. The number of healthy and infected plants per row was considered in estimating percentage of the disease incidence. Disease severity was assessed at 70 and 90 days after planting. Standard agronomic practices were conducted in this experiment.

RESULTS AND DISCUSSION

There was a significant difference among the genotypes for ASB severity indexes (table 1). However, no significant differences were found between inoculated and noninoculated plots. This result could be due in part to a high level of natural ASB inoculum in the field test. Beans have been grown on that field for the past 5 years. A highly significant correlation (r=0.66**) was found between the disease severity ratings taken

TABLE 1.—*Reactions of 40 dry bean genotypes to the ashy stem blight* (Macrophomina phaseolina) *in inoculated and non-inoculated field plots*

		Macrophomina phaseolina			
		Severity index[1]			
Genotype	Origin	70	90	Increase	Incidence[z]
				%	%
Cuarentena	UPR	4.4	4.0	–10	49
Guayamera	UPR	1.3	2.7	52	47
2W-33-2	UPR/TARS	2.5	2.6	4	60
La Vega	UPR/TARS	1.6	2.4	33	50
8325-7	UPR/TARS	1.5	2.7	44	44
4M-99	UPR/TARS	1.4	2.8	50	36
8241-258A	UPR/TARS	2.5	2.9	14	45
B-190	UPR/TARS	1.4	2.3	39	54
8241-372	UPR/TARS	1.1	2.7	59	54
3M-152	UPR/TARS	2.8	3.3	15	58
8325-16	UPR/TARS	1.6	2.8	43	49
L-227	UPR/TARS/MSU	1.0	2.5	60	51
8437-22	TARS	1.3	2.1	38	56
H-270	MSU	1.1	3.0	63	47
Sanilac	MSU	1.8	2.3	22	56
W-21-16	UW	2.3	3.4	32	42
A-493	CIAT	1.5	2.7	44	58
BAT 1289	CIAT	2.0	3.3	39	46
PAN 33	CIAT	1.4	3.2	56	47
BAT 1716	CIAT	1.5	3.5	57	51
RIZ 44	CIAT	3.1	4.1	24	44
VA 38A-419	CIAT	1.2	2.5	52	48
BAT 1515	CIAT	2.2	2.5	12	54
PVAR 1505	CIAT	1.6	2.5	36	56
BAT 1572	CIAT	1.1	2.3	52	63
C-1409	CIAT	2.3	3.1	26	37
RAB 26	CIAT	1.3	2.4	46	52
BAT 85	CIAT	1.2	2.7	56	46
BAT 1577	CIAT	1.6	2.7	41	43
BAT 1654	CIAT	1.0	2.7	63	49
BAT 1336	CIAT	1.2	2.7	56	56
RIZ 30	CIAT	2.2	3.4	35	57
BAT 1493	CIAT	2.2	2.5	12	57
EMP. 131	CIAT	1.4	2.5	44	51
BAT 1532	CIAT	1.2	2.7	56	47
CNPAF-0105	CIAT	1.8	2.4	25	45
ICTA Tamazulapa	Guat.	1.9	3.5	46	49
Zamorano	Honduras	1.5	2.5	40	41
Pompadour	Dom. Rep.	2.2	3.2	31	45
Damien 544	Haiti	2.0	3.3	39	26
Mean		1.76	2.80	39	49
L.S.D. (0.05)			1.32		NS

[1]Readings taken at 70 and 90 days after planting. Severity: 1 = no symptoms or lesion on one node; 5 = defoliation and plant death.

at 70 and 90 days after planting. The disease infection increased approximately 40% from 70 to 90 days after planting. This fact indicates that the ASB developed at the greatest rate during pod fill. Similar results have been reported (5, 8) when seeds and stems were artificially inoculated with *M. phaseolina*. When ASB infection increases in the last stages of the bean plant, seeds may be infected with the fungus, resulting in a seedborne inoculum. Seedborne *M. phaseolina* has been reported on *P. vulgaris* (2, 4, 10). Although dry conditions prevailed throughout the experiment, plants did not develop symptoms before pod fill. Seedling infection with *M. phaseolina* has also been reported in the tropics during hot dry climatic conditions (1, 7, 12). The most resistant genotype 8437-22 (fig. 2) was rated 1.3 and 2.1 at 70 and 90 days, respectively, after planting. BAT 1572, B-910 and Sanilac also showed good resistance to ASB. The most susceptible genotypes in the trial were RIZ 44 and Cuarentena (fig. 2), rated 4.1 and 4.0, respectively, at 90 days after planting. Cuarentena (unpublished data) and RIZ 44 were highly susceptible and 8437-22 was immune to *M. phaseolina* in artificial inoculations under greenhouse conditions (9). Disease incidence among genotypes, on the other hand, was not significantly different. The great variability in the incidence of ASB may have contributed to the inability to detect differences among genotypes in disease incidence. Inoculation techniques which provide a more uniform distribution of ASB in the field need to be developed. Another approach would be to develop effective techniques in the greenhouse for screening for ASB resistance (9).

RESUMEN

Respuesta de varios genotipos de habichuelas al hongo *Macrophomina phaseolina* en parcelas inoculadas y sin inocular

En la costa suroeste semiárida de Puerto Rico se probaron 40 genotipos de habichuela seca para determinar en parcelas experimentales el efecto de la inoculación con los residuos de cosecha de habichuela que estuvieron altamente infectados con *Macrophomina phaseolina*.

Los análisis de varianza indicaron que hubo diferencias significativas entre los índices de severidad en los genotipos probados. La pudrición gris del tallo aumentó aproximadamente 40% entre las fases de la formación de la vaina y la madurez fisiológica. Hubo una relación altamente significativa (r=0.66) en la severidad de la enfermedad cuando se midió a los 70 y 90 días después de sembrar. Entre los 40 genotipos de habichuela evaluados, Cuarentena y RIZ 44 mostraron altos grados de susceptibilidad; 8437-22 fue el genotipo más resistente a *M. phaseolina*.**

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