ADULT PLANT RUST RESISTANCE IN COMMON BEANS

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Genotypes of Phaseolus vulgaris L. that have long straight hairs on the abaxial leaf surface have been reported to have reduced infection intensity to several mixed and individual rust Uromyces appendiculatus cultures under field environments (BIC 33:61-2; J. Ag. Univ. of P.R. 74:111-9; Phytopath. 75:478-81; Phytopath 79:1028-35; HortSci. 664-65). Although low rust receptivity has been associated with abaxial leaf pubescence, this association was based on only a few pubescent genotypes and the mechanism of rust resistance has not been demonstrated. The objective of this research was to determine the relationship of leaf pubescence to rust resistance and susceptibility in diverse common bean genotypes in the glasshouse and field.

Pubescent genotypes used in the glasshouse experiments were Pompadour Checa selection 83-30 (PC83-30) from a Dominican Republic landrace, Jamaica Red (JR) from a landrace in Jamaica, Alubia 25-1 (A25-1), Alubia 33-1 (A33-1) and Alubia 42-2 (A42-2) from an Argentina Alubia landrace, Diacol Calima (DC) from Colombia, Kabanima (Kab) and Uyole 221 (UAC 221) from Tanzania, and GO79/420LY (GO) and TB 5621 LY (TB) chosen from CIAT African breeding lines. Glabrous genotypes were Pinto UI 114 (P114) and the Pompadour type Chichara (Chi) which are rust susceptible and California Small White 643 (CSW 643) and Arroyo Loro (AL) which have specific resistance against a number of races. Additional pubescent genotypes used in a field experiment were Tanzanian cv. Lyamungu 85 (LY85) and Pompadour AE(PAE) and glabrous genotypes EMP8GLY, TMO 959, Pompadour E (PE) and Pompadour U (PU).

Comparisons of disease intensity were made between pubescent and glabrous genotypes and within each genotype, comparisons were also made between the glabrous primary leaves and the potentially pubescent fourth trifoliolate leaves. Two plantings 21 days apart produced plants with primary leaf and fourth trifoliolate leaf stages available at the same time. The abaxial leaf surfaces were spray inoculated with a urediniospore suspension of mixed and pure cultures of Nebraska derived 87HP2-7 and US85NP10-1, 5.0 mg/100 ml of water. Talcum powder was used for field inoculation. Inoculated plants in the glasshouse were incubated for 16 hrs at 100% relative humidity and 20-22°C. Size and density of uredinia were measured 14 days after inoculation.

In the glasshouse experiments all the pubescent genotypes developed uredinia 450-550 μm in diam representing a moderately susceptible (MS) reaction on the primary leaves except genotypes GO and TB which had uredinia 350-400 μm diam. for a moderately resistant (MR) reaction. The fourth trifoliolate leaves of all the pubescent genotypes developed uredinia 350-400 μm in diam. Glabrous genotypes P114, AL and CSW643 developed uredinia that represented S, MS and R reactions, respectively (Table 1) on both the primary and the trifoliolate leaves. Both pubescent and glabrous genotypes had reduced uredinia density on the trifoliolate leaves, but the differences were inconsistent and often insignificant. The rust reactions derived from primary and trifoliolate leaf infections from individual or mixed rust cultures were classified as MR for all pubescent genotypes, S for the glabrous P114 and Chi and R for AL and CSW643.

Similar results were obtained in the field experiment where P114 was the only fully susceptible genotype with large uredinia averaging 700 μm in both primary and trifoliolate leaves (Table 1). The

pubescent genotypes produced a MS reaction on the primary leaves with reduced uredinia resulting in MR or R reactions on the upper trifoliolate leaves. None of the glabrous genotypes showed reduced uredinia size on the upper leaves. All the pubescent genotypes also showed reduced infection density in the upper leaves but the difference was significant only in TB and G0. Some glabrous genotypes also had reduced infection density on the upper leaves, but this was significant only in Pompadour E. The overall rust severity on the primary leaves was less than 5% in most genotypes except in TB, PAE, P114 and PE, and this low severity probably reduced the chances of demonstrating intensity differences.

TABLE 1. Average rust uredinia size and number in the primary (Pr) and trifoliolate trifoliolate (Tr) leaves of diverse genotypes in the glasshouse and field.

		Glasshouse				Field			
		Uredinia Size (μm)		Uredinia No. Pu 9cm^2		Uredinia Size (μm)		Uredinia No. Pu 9cm^2	
Genotype	Pubesc. rating #	Pr.	Tr.	Pr.	Tr.	Pr.	Tr.	Pr.	Tr.
PC83-30	6	550	530	34	20	400	300	3	2
J.R.	5	550	350	47	35	500	375	4	2
A25-1	4•5	500	400	78	58	-	-	3	
A33-1	4•5	500	350	78	70	400	300	4	3
A42-2	4•5	600	400	45	21	-	-		
DC	5	550	350	35	34	500	375	4	3
Kab.	5	500	350	17	8	-	-		
UAC221	5	425	325	22	5	300	300	2	2
GO	5	400	400	22	5	400	300	4	2
TB	5	385	350	32	5	425	350	7	3
Ly85	5	-	-	-	-	500	350	3	3
P.AE	5	-	-	-	-	550	375	13	4
CSW643	1	300	300	39	12	250	250	4	4
A.L.	1	300	300	30	12	400	400	4	3
P114	1	700	725	44	35	700	700	18	50
Chi	1	650	700	12	20	-	-		
EMP	1	-	-	-	-	250	300	2	1
TMO	1	-	-	-	-	375	300	1	1
PE	1	-	-	-	-	250	250	8	5
PU	1	-	-	-	-	550	575	5	4

*Pubescence rating scale 1-9 (J. Agr. Univ. P.R. 74:111-19)

All the pubescent genotypes had lower uredinia size in the trifoliolate leaves than in the primary, except in TB and GO the change wasn't significant. In addition to the reduced uredinia size, density was also reduced on the upper trifoliolate leaves resulting in reduced susceptibility or "Adult plant resistance". This resistance has been recognized to be race-nonspecific by Groth and Urs (Phytopathology 72:374-8). Although uredinia density can be affected by precision in inoculation and by inoculum viability, care in controlling these variables can allow the effect of leaf pubescence to be studied. Since pubescence has been proposed to act by physical interference of the hairs in the U. appendiculatus infection process, one would expect fewer uredinia in pubescent genotypes. Since both glabrous and pubescent genotypes exhibited reduced uredinia density in the trifoliolate, leaves pubescence cannot be the only factor involved with adult plant resistance. Pubescence still seems linked to small uredinia size and could be operating by delaying infection due to high leaf hair density in young leaves. Irrespective of the mechanism, screening for rust resistance at the primary leaf stage may eliminate useful germplasm that could provide the durable race-nonspecific resistance expressed in adult plants.