INHERITANCE OF RESISTANCE TO ANGULAR LEAF SPOT IN BEAN PODS

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INTRODUCTION

Angular leaf spot (ALS), caused by *Pseudocercospora griseola* (Sacc.) Crous & U. Braun, is one of the most important disease in common bean. The fungus shows great pathogenic variability which requires search and characterization of new sources of resistance. Knowledge of genetic reaction of bean cultivars to pathogen is essential in plant breeding programs for resistance. Usually, disease reaction is evaluated in the first trifoliate leaf. However, reaction has been shown to vary according to the organ plant studied. Previously, in Universidade Federal de Lavras the line ESAL 686 was obtained. This line is characterized by symptoms on the leaves but not on the pods. Thus, this work aimed to study genetic control of angular leaf spot reaction in pods and to estimate genetic parameters of breeding interest.

MATERIAL AND METHODS

ESAL 686 line (resistant) was crossed with Carioca MG cultivar (susceptible) to generate the populations F_1, F_2 and backcrosses, susceptible (BCs) and resistant (BCr). In dry season of 2009, parents and derived populations were evaluated in the field conditions under natural incidence of the pathogen. The number of evaluated plants was: 27 of ESAL 686, 38 of Carioca MG, 24 of F_1, 190 of F_2, 41 of BCr and 33 of BCs. Five evaluators used a diagrammatic scale to assess the severity on pods. From each plant were collected 4 pods randomly. Nine scale degree was based on: 1 – absence of pod symptoms; 2 - symptoms covered until 5% of pod area; 3 - symptoms covered 5-15% of pod area; 4 - symptoms covered 15-30% of pod area; 5 - symptoms covered 30-45% of pod area; 6 - symptoms covered 45-65% of pod area; 7 - symptoms covered 65-80% of pod area; 8: symptoms covered 80-90% of pod area; 9 - symptoms covered more than 95% of pod area. Average severity score of individual plants ≤ 3 were classified as resistant. It was analyzed the segregation of resistant and susceptible plants of F_2, as well as the genetic components of means and variance were estimated considering all populations. Model without epistasis was used for parameters estimate as described by Cruz et al. (2004).

RESULTS AND DISCUSSION

ESAL 686 line did not show symptoms of angular leaf spot on pods as expected. On the other hand, Carioca MG cultivar showed serious symptoms and was confirmed as susceptible. F_1 population was resistant like the resistant backcross (BCr) and ESAL 686. Susceptible backcross (BCs) showed higher severity (Table 1). The model used for estimating the mean components, containing only *m* (average of the contribution of the homozygous loci), *a* (the algebraic sum of the effects of the homozygous loci measured as deviations from the mean, additive effect) and *d* (deviations of the heterozygous from the mean, dominance effect), was sufficient to explain all observed variation. The estimates of the coefficient of determination (R^2) were higher than 99% and 85% for mean and variance components respectively (Table 1), indicating a well-fitting model. These results indicated that in the genetic control of angular leaf spot reaction did not occur epistasis (Ramalho et al., 1993).

Estimates of both additive and dominant effects were similar and important in the control of reaction on pods. Estimate of genetic effects were different from zero and the standard errors were low. Dominance effects (*d*) were in the direction of decrease the severity what is explained by negative estimate (Table 2). Additive variance ($\hat{\sigma}_A^2$) and dominant variance ($\hat{\sigma}_D^2$) estimates were higher than environmental variance ($\hat{\sigma}_E^2$). This result indicated the reaction on pods was less influenced by environment. Lower limit for the variance components were positives, thus estimates were different from zero (Table 2). Pods reaction heritability, in broad and narrow sense, was high. F_2 generation showed segregation of three resistant plants to one susceptible. Chi-square was not significant (Table 1). Segregation analyses suggest that one gene with dominant allele for resistance is involved in the control of character.

TABLE 1. Average severity of angular leaf spot (ALS) in bean pods, segregation analysis for reaction to *P. griseola* in the parents, ESAL 686 and Carioca MG, and in the populations derived from crosses.

Populations	ALS Severity	Expected ratio	Observed ratio	χ^2	P (%)
		R:S	R: S		
ESAL 686	1.0	1:0	27: 0		
Carioca MG	8.05	0:1	0: 38		
F_1	1.21	1:0	24: 0		
F_2	2.5	3:1	144: 46	0.06	80.16^{NS}
BCr	1.15	1:0	41: 0		
BCs	3.23	1:1	21: 12	2.45	11.72^{NS}

TABLE 2. Variance and mean genetical components, heritability in the broad and narrow sense estimates for ALS reaction in bean pods.

Mean components	Estimates ± Standard error	Variance components	Estimates
$\hat{m}$	4.46 ±0.04	$\hat{\sigma}_A^2$	1.57 [1.31; 1.91][1]
$\hat{a}$	-3.46 ±0.04	$\hat{\sigma}_D^2$	0.22 [0.17; 0.29]
$\hat{d}$	-3.28 ±0.07	$\hat{\sigma}_E^2$	0.15 [0.11; 1.21]
ALD[3]	0.95	*ALD*[3]	0.53
R^2	99.99	R^2	86.79
Heritability in broad sense	Estimate		
$\hat{h}_b^2$	0.92 ± 0.05[2]		
Heritability in narrow sense	Estimate		
$\hat{h}_n^2$	0.81 ± 0.30[2]		

[1]Lower and Upper Limits; [2]Associate error; [3]Average level of dominance.

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