Trop. Sci. 2005, **45**, 63–66

Evaluation of bean (*Phaseolus vulgaris*) genotypes for multiple resistance to angular and floury leaf spot diseases

Fikre Lemessa[1]* *and Abush Tesfaye*[2]
[1]Department of Plant Sciences and Horticulture, Jimma University College of Agriculture, POBox 307, Jimma, Ethiopia. [2]Jimma Agricultural Research Center, Ethiopia. *Present address: Institute for Biological Control, Heinrichstrasse 243, 64287 Darmstadt, Germany (lemessaf@yahoo.com)

Abstract *Angular leaf spot and floury leaf spot are the major bean diseases in hot and humid parts of Ethiopia. Of 70 genotypes evaluated, EMP-233, EMP-212, G-10843 and Dicta-65 were consistently resistant to both diseases and the first three were also high yielding. For angular leaf spot, disease severity was positively correlated with seed size and 100-seed weight.*

Keywords: bean, *Phaseolus vulgaris*, leaf spot, multiple resistance.

Introduction

Common bean (*Phaseolus vulgaris*) is an important crop in Ethiopia and the average yield is low, due largely to disease, particularly common bacterial blight (*Xanthomonas campestris* pv. *phaseoli*), rust (*Uromyces appendiculatus*), anthracnose (*Colletotrichum lindemuthianum*), angular leaf spot (*Phaeoisariopsis griseola*), floury leaf spot (*Mycovellosiella phaseoli*) and bean common mosaic virus (Habtu 1987). Angular leaf spot (ALS) and floury leaf spot (FLS) are the major bean diseases in wet and humid areas like Jimma, where the inoculum is abundant throughout the cropping season (Tesfaye 1991). Infected seeds and plant debris are the main source of infection for ALS, so the use of clean seed, burial of infected debris and rotation can decrease the severity (Allen et al. 1996). However, rotation is difficult in smallholdings due to land scarcity and bean is often interplanted with other crops. Fungicidal seed dressing is effective (Allen et al. 1996) but too expensive for most smallholders, so the most effective control strategy is the use of resistant cultivars. This study sought to identify bean genotypes that have multiple resistance to ALS and FLS.

Materials and methods

Seventy dwarf bean genotypes originally supplied by the International Center for Tropical Agriculture were obtained from the Melkassa Agricultural Research Center, Ethiopia, and evaluated against ALS and FLS in 1999 at Jimma University. The land race Red Wolaita and the widely cultivated cultivars Brownspeckled and ICA 15541 were included as checks. Each

Accepted 31 May 2004

genotype was planted in a double row 3 m long with 10 cm between plants without replication. Disease rating was on the CIAT (1987) scale; resistant = 1–3, intermediate = 4–6 and susceptible = 7-9.

Five resistant genotypes and four that performed well (irrespective of resistance) were studied further with the same three checks, in a randomized complete block design with three replications in 2000 and 2001. Genotype SXWW-2-6 was resistant in the preliminary evaluation against both diseases, but it was not included in the second stage because of its poor germination and establishment. Plots consisted of two rows 4 m long. Yield data were taken from both rows, while assessment of disease and yield parameters was made on 20 randomly selected plants.

Disease severity grades were converted to disease index (Wheeler 1969). Analysis of variance of disease severity and yield per hectare were carried out using MSTAT-C statistical package (MSU 1989). Comparisons of means were made with Duncan's Multiple Range Test. Simple linear correlations were made between disease severity and seed yield, seed size, 100-grain weight, days to flowering and physiological maturity. For the correlation with seed size, genotypes were categorized from the 100-grain weight into small < 25 g, medium 25–40 g and large > 40 g (Singh et al. 1991) on the three years' data.

Results and discussion

High levels of infection and variability among genotypes were evident in the preliminary evaluation (Table 1). The genotypes EMP-233, EMP-212, G-10843, Dicta-65 and NZBR-2-2 were resistant to both diseases, whereas CIFAAC 87110, REN-19 and NAZ-29-63 were susceptible. Red Wolaita and ICA15541 were susceptible to ALS and intermediate to FLS, while Brown speckled was intermediate to ALS and resistant to FLS.

The field reaction during the first stage of the genotypes tested further are in Table 2. There were significant differences in disease severity, time to 50% flowering, 100-seed weight and yield. Combined analysis of variance of these parameters for the two years are in Table 3. EMP 212 and EMP-233 had the lowest severity scores for both diseases, 15–15%. The greatest severity was with Brownspeckled, CIFAAC 87110 and ICA 15541 for ALS, over 80%, and

Table 1. Rating of genotypes, 1999

ALS	FLS	No. of genotypes
Resistant	Resistant	6
Resistant	Intermediate	8
Resistant	Susceptible	14
Intermediate	Resistant	6
Intermediate	Intermediate	11
Intermediate	Susceptible	14
Susceptible	Resistant	5
Susceptible	Intermediate	6
Susceptible	Susceptible	3

Table 2. Disease reaction and yield in 1999 (seed size on 3 years' data)

Genotypes	Seed size	Disease severity score		Yield/plot (g)
		Angular leaf spot	Floury leaf spot	
Brownspeckled	Large	6	3	406
CIFAAC 87110	Large	8	7	1444
ICA 15541	Large	7	5	976
Rde Wolaita	Small	7	5	624
SXWW-1-8	Small	5	6	1819
A-445	Medium	6	5	1637
AFR-907	Medium	6	6	1339
NZBR-2-2	Small	2	3	1330
Dicta-65	Medium	3	2	1222
G-10843	Small	2	1	1579
EMP-212	Small	2	1	1242
EMP-233	Small	1	1	1203

Table 3. Disease severity and yield in 2000 and 2001

Genotype	Disease severity (%)		Days to 50% flowering	Days to physiological maturity	100-seed weight (g)	Yield (kg/ha)
	ALS	FLS				
Brownspeckled	85.2a	40.7de	44c	72a	34b	1704e
CIFAAC 87110	81.5ab	68.5ab	44c	71a	35b	2819abcd
ICA 15541	81.5ab	64.8ab	44c	72a	40a	2714abcde
Rde Wolaita	72.2bc	50.0cd	41c	70a	18e	2039de
SXWW-1-8	70.4c	74.1a	47c	72a	19e	2556bcde
A-445	66.7cd	55.6bc	44c	72a	25d	3186abc
AFR-907	64.8cd	66.7ab	43c	72a	36b	2528bcde
NZBR-2-2	59.3d	59.3bc	63a	70a	14f	2226cde
Dicta-65	48.1e	18.5f	47c	71a	30c	2363cde
G-10843	40.7e	27.8ef	47c	72a	19e	3484ab
EMP-212	24.1f	14.8f	54b	74a	19e	3635a
EMP-233	22.2f	14.8f	46c	72a	20e	3097abc
Mean	59.7	46.3	47	72	26	2696
CV (%)	13.5	24.1	8.3	3.2	6.2	28.6

with SXWW-1-8 and AFR-907 for FLS, around 70%. There were significant ($p = 0.05$) differences in 50% flowering and 100-seed weight but none in physiological maturity. In general, EMP-212, EMP-233 and G-10843 had the lowest disease severity and highest yield. There was no significant correlation between FLS and any of the parameters, or between ALS and days to 50% flowering or maturity. There were significant ($p = 0.05$) correlation between ALS and seed ($r = 0.666$), 100-seed weight ($r = 0.600$) and yield ($r = -0.650$). In ICA 15541, the disease develops at a later stage, which may be why it gave a high yield although the disease severity was high. However, CIFAAC 87110 gave a high yield despite relatively severe disease starting at an early stage, so this may be a tolerant plant which can give good yield even in the presence of infection.

The correlations indicate that bean genotypes with small seed size and weight are more resistant than those with larger seeds. Similar results were obtained for ALS by Pastor-Corrales et al. (1998) and Liebenberg et al. (1996). In Ethiopia, cultivars combining large seed with good taste and fast cooking are preferred by farmers (Abush and Leta, unpublished data). However, perhaps the genotypes EMP-233, EMP-212 and G-10843, which are small-seeded and have multiple resistance to ALS and FLS, could be used in back-crossing programmes to improve the resistance of large-seeded cultivars.

Acknowledgements

We thank Jemal Hangie, Mulatu Wakjira and Waraka Daba for their assistance in data collection and field management, and Dr Habtu Assefa for providing the bean genotypes.

References

Allen DJ, Ampofo JKO and Wortmann CS (1996) Pests, diseases and nutritional disorders of the common bean in Africa: a field guide. Cali, Colombia: International Center for Tropical Agriculture; Wageningen, The Netherlands: Technical Center for Agricultural and Rural Cooperation.

CIAT (1987) Standard system for the evaluation of bean grmplasm. Cali, Colombia: International Center for Tropical Agriculture.

Habtu A (1987) Haricot bean diseases and their importance in Ethiopia. Ethiopian Journal of Agricultural Sciences 9: 55–67.

Liebenberg MM, Pretorious ZA and Swart WJ (1996) Differences in lesion size caused by Andean-specific and Andean-non-specific isolates of *Phaeoisariopsis griseola*. Annual Report of the Bean Improvement Cooperative 18: 199–269.

MSU (1989) User's guide to MSTAT-C. Michigan State University.

Pastor-Corrales MA, Jara C and Singh SP (1998) Pathogenic variation in, sources of, and breeding for resistance to *Phaeoisariopsis griseola* causing angular leaf spot in common bean. Euphytica 103: 161–171.

Singh SP, Gutierrez JA, Molina A, Urrea C and Gepts P (1991) Genetic diversity in cultivated common bean. II: Marker-based analysis of morphological and agronomic traits. Crop Science 31: 23–29.

Tesfaye B (1991) Research on anthracnose disease of haricot bean in Ethiopia. Proceedings, 1st Pan-African Working Group Meeting on Anthracnose of Beans, pp. 51–54. Ambo, Ethiopia.

Wheeler E (1969) An introduction to plant diseases. London: John Wiley.