Evaluation of Ornamental Pineapple Hybrids for Resistance to *Fusarium subglutinans* f. sp. *ananas*

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Abstract

***Fusarium subglutinans* f. sp. *ananas,* the causal agent of pineapple fusariosis, is the most serious problem of that crop in Brazil. The cultivation of resistant cultivars is the most efficient control measure and this concept is also useful to ornamental plants. This work aimed at evaluating ornamental pineapple hybrids for resistance to fusariosis. Forty hybrids from five crosses (FRF-22×FRF-1387), (FRF-1392×FRF-32), (G-44×FRF-1387), (FRF-1392×FRF-224) and (FRF-1387×FRF-224) were evaluated. Pineapple slips, about 25 cm long, were wounded at their bases with a 2-mm diameter needle and immersed into a conidial suspension for about 3 min and then transferred to a greenhouse. After 90 days, evaluation was performed considering both internal and external symptoms and a scale of notes was applied. The experimental design was a completely randomized with six replications and four controls: cultivars 'Pérola' and 'Smooth Cayenne' (susceptible) and PE×SC73 and 'Perolera' (resistant). Results showed that 14 hybrids were resistant, 15 were moderately resistant and 11 were susceptible. Nevertheless, in the cross FRF-1392×FRF-224, 100% of the hybrids were resistant. The behaviour of the controls was adequate to give support to the results obtained in the present work.**

INTRODUCTION

The Pineapple Active Germplasm Bank (PAGB) located at Embrapa Cassava & Tropical Fruits contains 628 accessions of *Ananas* and related genera (Cabral et al., 2004, 2006). Since 2003 pre-improvement actions at Embrapa aim at identifying and characterizing accessions with potential to be cultivated as ornamentals or to be used as parentals in breeding program (Souza et al., 2006, 2007, 2009; Souza, 2010).

Considering the available variability already characterized in the PAGB, several crosses were carried out involving pineapple botanical varieties to generate ornamental pineapples (Cabral and Souza, 2006; Souza et al., 2007; Souza, 2010). Knowing the behavior of the progeny is a very important step in the pineapple breeding program since it makes possible the recommendation of ornamental hybrids resistant to pests and diseases as well as providing useful information to select parents to be used in crossing (Souza et al., 2007; Souza, 2010). In this regard, *Fusarium subglutinans* (Wollenweber & Reinking) Nelson, Toussoun & Marasas f. sp. *ananas* Ventura, Zambolim & Gilbertson, causal agent of pineapple fusariosis, constitutes the most serious pathological constraint

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of that crop in Brazil.

The cultivation of resistant cultivars is the most efficient measure to control plant diseases (Matos and Cabral, 1988, 2006; Matos et al., 1991) and this concept is also useful to ornamental plants. Thus this work aimed at evaluating ornamental pineapple hybrids for resistance to *F. subglutinans* f. sp. *ananas*.

MATERIALS AND METHODS

This work was carried out at Embrapa Cassava & Tropical Fruits, 12°40'S and 39°06'W, municipality of Cruz das Almas, State of Bahia, Brazil. Forty pineapple hybrids, obtained from crosses involving *Ananas comosus* var. *bracteatus* (FRF-22) × *A. comosus* var. *erectifolius* (FRF-1387), *A. comosus* var. *erectifolius* (FRF-1392) × *A. comosus* var. *bracteatus* (FRF-32), *A. comosus* var. *ananassoides* (G-44) × *A. comosus* var. *erectifolius* (FRF-1387), *A. comosus* var. *erectifolius* (FRF-1392) × *A. comosus* var. *ananassoides* (FRF-224) and *A. comosus* var. *erectifolius* (FRF-1387) × *A. comosus* var. *ananassoides* (FRF-224), were evaluated (Table 1).

Inoculation was performed according to the wounding and dipping technique (Matos, 1978). Slips, about 25 cm long, were wounded at their bases with a 2-mm diameter needle and immersed into a suspension containing 10^5 conidia ml^{-1} (Matos and Cabral, 2006) for about 3 min and then planted in a Yellow Latosol (Typic Oxisol), sandy clay loam texture, in nursery beds about 1.0 m wide and 6.0 m long. The pathogen isolate used in this work was the CAL001/2009.

Three months after inoculation the plants were pulled out of soil and evaluated for symptoms development. The following scale was used to grade fusariosis intensity: zero = no symptoms; 1 = lesion up to 3% of the stem; 2 = lesion from 3 to 10% of the stem; 3 = lesion from 10 to 50% of the stem; 4 = more than 50% of the stem infected; 5 = dead plant.

A completely randomized design with six replicates was used. Controls were 'Pérola' and 'Smooth Cayenne', which are susceptible to the pathogen, and 'Perolera' and 'PEXSC73', which are resistant. Data were analyzed by the Scott-Knott test, 1% probability (SAS Institute, 2004). Ornamental hybrid reaction to fusariosis was graded as follows: 0.00 (no infection) = resistant; 0.1 to 2.0 = moderately resistant; and 2.1 to 5.0 = susceptible.

RESULTS AND DISCUSSION

Plants of the susceptible controls 'Pérola' and 'Smooth Cayenne' started to show fusariosis symptoms five weeks after inoculation. Disease severity increased over time and three months after inoculation all plants of the susceptible controls were dead. Similar reaction was observed in plants of the ornamental pineapple hybrid *A. comosus* var. *bracteatus* (FRF-22) × *A. comosus* var. *erectifolius* (FRF-1387), PL10, as well as of *A. comosus* var. *ananassoides* (G-44) × *A. comosus* var. *erectifolius* (FRF-1387) PL01 (Table 1). No infection was observed in the resistant 'Perolera' or in 'PEXSC73', thus indicating that the pathogen was not able to overcome resistance genes present in these cultivars. High disease intensity in susceptible control plants shows clearly that the pathogen isolate used in this work was virulent to pineapple.

Reactions of several ornamental pineapple hybrids and the susceptible 'Pérola' inoculated with *F. subglutinans* f. sp. *ananas* (Fig. 1) show that disease severity varies from no infection to death of plant. The reactions of ornamental pineapple hybrids to inoculation with *F. subglutinans* f. sp. *ananas* (Table 1) vary from 0 to 5. Plants of the susceptible controls 'Pérola' and 'Smooth Cayenne' were dead three months after inoculation. It was also observed that disease symptoms were more severe in leaves than in stem. Fourteen out of the 40 ornamental pineapple hybrids were resistant to the pathogen, 15 were moderately resistant and 11 were susceptible. No infection was observed in plants belonging to the cross *A. comosus* var. *erectifolius* (FRF-1392) × *A. comosus* var. *ananassoides* (FRF-224). These results are in accordance with previous reports by Matos and Souto (1984) and Cabral et al. (1985) who found different reactions

to inoculation with *F. subglutinans* f. sp. *ananas* in several botanical varieties of the genus *Ananas*. It was also found that 35.3% of the progeny from crosses involving *A. comosus* var. *bracteatus* and *A. comosus* var. *erectifolius* behaved as susceptible to the pathogen, 47.1% expressed moderate resistance and 17.6% showed complete resistance. On the other hand, 23.8% of the progeny from crosses involving *A. comosus* var. *ananassoides* and *A. comosus* var. *erectifolius* were susceptible, 23.8% were moderately resistant while 52.4% expressed complete resistance to fusariosis. Similar results were reported by Matos (1987), Matos et al. (1991), Matos and Cabral (2006), who found that pineapple accessions *A. comosus* var. *bracteatus*, *A. comosus* var. *erectifolius* and *A. comosus* var. *ananassoides* showed different reactions to inoculation with the fusariosis causal agent. Additionally, Cabral et al. (1997), evaluating the reaction of edible pineapple hybrids to inoculation with the fusariosis causal agent, found that progenies resulting from crosses involving *A. comosus* var. *bracteatus* and *A. comosus* var. *comosus* behaved as resistant to that pathogen.

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Tables

Table 1. Evaluation of ornamental pineapple hybrids for resistance, where 0 is resistant and 5 is susceptible, to *Fusarium subglutinans* f. sp. *ananas*.

Plant code	Fusariosis severity		Reaction
	Stem	Leaf	
PEXSC73	0.00a[1]	0.00a	Resistant
Perolera	0.00a	0.00a	Resistant
Smooth Cayenne	5.00d	5.00c	Susceptible
Pérola	5.00d	5.00c	Susceptible
A. comosus var. *bracteatus* (FRF-22) × *A. comosus* var. *erectifolius* (FRF-1387)			
PL01	4.71d	5.00c	Susceptible
PL02	0.80a	1.12b	Moderately resistant
PL03	0.00a	0.10a	Resistant
PL04	0.00a	0.00a	Resistant
PL05	2.00b	2.10b	Moderately resistant
PL07	0.00a	0.00a	Resistant
PL08	1.14a	1.85b	Moderately resistant
PL09	2.28c	2.80b	Susceptible
PL10	5.00d	5.00c	Susceptible
PL11	1.28a	2.00b	Moderately resistant
PL12	0.28a	1.20b	Moderately resistant
PL13	3.50c	4.80c	Susceptible
PL14	1.83b	2.00b	Moderately resistant
A. comosus var. *erectifolius* (FRF-1392) × *A. comosus* var. *bracteatus* (FRF-32)			
PL01	1.42b	2.00b	Moderately resistant
PL02	2.00c	2.00b	Moderately resistant
PL03	4.83d	5.00c	Susceptible
PL04	4.42d	5.00c	Susceptible
PL05	1.42b	2.00b	Moderately resistant
PL09	0.57a	1.50b	Moderately resistant
A. comosus var. *ananassoides* (G-44) × *A. comosus* var. *erectifolius* (FRF-1387)			
PL01	5.00d	5.00c	Susceptible
PL02	0.00a	0.00a	Resistant
PL03	0.00a	0.20a	Resistant
PL04	1.83b	2.00b	Moderately resistant
PL05	4.50d	5.00c	Susceptible
PL06	2.00c	2.10b	Moderately resistant
PL07	0.00a	0.00a	Resistant
PL08	0.25a	1.00b	Moderately resistant

[1] Values followed by the same letter are not significantly different according to Scott-Knott test (P=0.01).

Table 1. Continued.

Plant code	Fusariosis severity		Reaction
	Stem	Leaf	
A. comosus var. *erectifolius* (FRF-1392) × *A. comosus* var. *ananassoides* (FRF-224)			
PL01	0.00a	0.00a	Resistant
PL02	0.00a	0.00a	Resistant
PL03	0.00a	0.00a	Resistant
PL04	0.00a	0.00a	Resistant
PL05	0.00a	0.00a	Resistant
A. comosus var. *erectifolius* (FRF-1387) × *A. comosus* var. *ananassoides* (FRF-224)			
PL01	0.00a	0.00a	Resistant
PL02	0.83a	1.80b	Moderately resistant
PL03	0.00a	0.00a	Resistant
PL04	0.00a	0.20a	Resistant
PL05	4.71d	5.00c	Susceptible
PL06	0.28a	1.00b	Moderately resistant
PL07	4.66d	5.00c	Susceptible
PL08	2.42c	3.80c	Susceptible
VC (%)	27.47	14.98	
Fc	41.89**	37.99**	
MS	23.19	2.00	

[1] Values followed by the same letter are not significantly different according to Scott-Knott test (P=0.01).

Figures

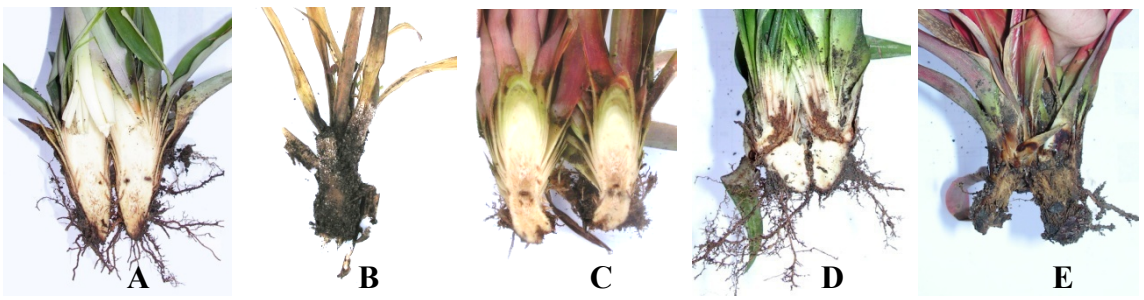

Fig. 1. Reaction of 'Perola' and ornamental pineapple hybrids to inoculation with *Fusarium subglutinans* f. sp. *ananas*. A) 'PEXSC73', resistant. B) 'Pérola', susceptible control. C) *Ananas comosus* var. *bracteatus* (FRF-22) × *Ananas comosus* var. *erectifolius* (FRF-1387) PL03, resistant. D) *Ananas comosus* var. *erectifolius* (FRF-1392) × *Ananas comosus* var. *bracteatus* (FRF-32) PL09, moderately resistant. E) *Ananas comosus* var. *ananassoides* (G-44) × *Ananas comosus* var. *erectifolius* (FRF-1387) PL01, susceptible.