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Fusarium wilt resistant bananas considered appropriate replacements for cultivars susceptible to the disease in Uganda.

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Abstract

Fusarium wilt of bananas (Panama disease), caused by the soil-borne fungus *Fusarium oxysporum* Schlecht.f.sp. *cubense* (E.F.Smith) & Hans is a serious disease occurring virtually in every banana-growing area. In Uganda, it severely affects important exotic bananas (Bogoya, Kayinja, Kisubi and apple bananas). The most effective control method for the disease is use of resis tant cultivars. The objective of this study was to evaluate recently imported germplasm for resistance to the disease and consumer acceptability. Twenty two cultivars, including reference cultivars for different races of FOC, were planted in a farmer's field at Kichwamba, Bushenyi district and were completely randomized in each of the 15 replicates. Data was taken on: disease severity/incidence, yield and consumer acceptability for the promising ones. Seventeen cultivars, five of which yielded higher than or similarly to Bogoya were resistant or tolerant and 5 susceptible cultivars. Consumer acceptability tests suggested FHIA 17 and Cavendish were as good as Bogoya (local check), FHIA 23 and KM5 were slightly acceptable as desserts. FHIA 17, FHIA 23 and Cavendish appear appropriate replacements for the susceptible dessert bananas (e.g. Bogoya) but Cavendish should be tried in areas without black Sigatoka while KM5 appears a suitable replacement for the juice bananas (Kisubi and Kayinja).

Key words: *Fusarium wilt, Exotic bananas, Resistance, acceptability*

Introduction

Fusarium wilt of bananas (Panama disease), caused by the soil-borne fungus *Fusarium oxysporum* Schlecht.f.sp. *cubense* (E.F.Smith) & Hans. (FOC), is a serious disease occurring virtually in every banana-growing areas of the world (Stover & Simmonds 1987). The pathogen manifests itself into three races pathogenic to bananas, e.g. races 1 and 2 (Stover and Waite, 1960) and race 4 (Su *et al.*, 1977; Sun *et al.*, 1978; Hwang *et al.*, 1984 and Su *et al.*, 1986). Although races 1 and 2 are widespread throughout the tropics where their susceptible hosts are commonly encountered, race 4 has been exclusively reported in the subtropics such as Taiwan, Canary Islands, Australia and South Africa where it is presumed to have evolved independently from race 1 (Stover and Simmonds, 1987). According to recent reports (Kangire, 1998), race 1 is the primary cause of fusarium wilt disease in Uganda. The disease severely affects important exotic banana cultivars, e.g. Bogoya, Kayinja, Kisubi and Ndiizi which are the major dessert and juice producers in the country (Kangire, 1998). Recent surveys and pathogenicity tests showed that Bluggoe, Cavendish, plantains and highland bananas are unaffected by fusarium wilt and it is therefore assumed that races 2 and 4 of the pathogen are not present in Uganda (Kangire, 1998). The disease is most commonly found in the lowlands where most of the susceptible cultivars are cultivated primarily for dessert, juice and local beer production. Control measures like use of chemicals, biological control, or crop rotation which are normally recommended for other diseases are not effective against fusarium wilt. The most practical and economical measure for controlling the disease is use of resistant cultivars. The objective of this study was to evaluate recently introduced germplasm for resistance to the disease.

Materials and Methods

Twenty two cultivars, including the host differentials for the three known races of FOC, i.e. Gros Michel (race 1), Bluggoe (race 2) and Williams (race 4) and a local check (Mbwazirume), were planted in a farmer's field at Kichwamba sub-county, Bushenyi district. The trial was a Completely Randomised Design with 15 replicates. It was planted in a field with severe fusarium wilt pathogen infestation. Wilt infected pseudostems/and corms were chopped up and ploughed into the soil to enhance, and ensure uniform levels, of inoculum prior to planting. Tissue-

culture-derived plantlets of each cultivar to be evaluated were accessed through the International Network for Improvement of Banana and Plantain (INIBAP), International Transit Centre (ITC), Leuven, Belgium. The trial was established when plants were four months old and disease severity and incidence based on internal corm symptoms were assessed at harvest. Fruit yield was recorded by the farmer while juice yield ability was assessed by both researchers and the farmer. Additionally, consumer acceptability was assessed using the Hedonic scale ranging from extreme approval to extreme disapproval (Stone & Sindel, 1985).

Results and discussion

Most cultivars tested were resistant/tolerant to fusarium wilt indicating they had potential use as replacements for the susceptible banana cultivars (Table 1). Earlier studies (Gold *et a.*, 1993) had revealed that farmers try cultivar replacements whenever faced with pests and diseases.

Table 1. Host reaction to fusarium wilt and yield of introduced banana cultivars.

Cultivar	*Severity score	No. with score (4-6)	Mean bunch weight	Reaction status
FHIA 03	1-4	1 (6)	25.0 ± 2.0	Susceptible
Gros Michel	1-6	4 (10)	18.4 ± 1.1	Susceptible
Pisang ceylan	1-6	1 (13)	16.9 ± 2.7	Susceptible
Calcutta	1-6	10 (13)	2.0 ± 0.9	Susceptible
FHIA 01	1-3	0 (10)	18.3 ± 2.7	Tolerant
Pisang Nangak	1-2	0 (17)	16.5 ± 2.2	Tolerant
FHIA 17	1	0 (10)	40.8 ±4.3	Resistant
FHIA 23	1	0 (10)	37.1 ± 1.6	Resistant
Yagambi KM5	1	0 (11)	15.5 ± 1.3	Resistant
Bluggoe	1	0 (13)	14.2 ± 0.9	Resistant
Williams	1	0 (6)	15.0 ± 3.9	Resistant
GCTC215	1	0 (7)	18.4 ± 1.1	Resistant
Burro Cemsa	1	0 (5)	13.2 ± 1.2	Resistant
Saba	1	0 (3)	11.0 ± 1.0	Resistant
EMB 402	1	0 (10)	10.5 ± 0.8	Resistant
EMB 404	1	0 (8)	6.0 ± 0.6	Resistant
GCTCV119	1	0 (5)	7.0	Resistant
Pisang Mas	1	0 (6)	4.0 ± 0.7	Resistant
Cultivar Rose	1	0 (9)	6.0 ± 1.1	Resistant
Pisang Jari Buaya	1	0 (5)	5.6 ± 0.9	Resistant
Pisang Lilin	1-6	1(1)	4.8 ± 4.2	Susceptible
Mbwazirume	1	0 (8)	16.3 ± 2.6	Resistant
LSD			3.4	

() = number of plants assessed
*Severity: 1 = resistant, 2-3 = tolerant, 4 -6 = susceptible
In some cases farmers replaced affected higher yielding cultivars with lower yielding types, for instance Kayinja with Kisubi. This has the effect of reducing productivity to levels below the potential returns from the same field under the susceptible cultivar in the absence of the disease. This makes such a replacement less appropriate in terms of yield.

Ugandan farmers grow four types of fusarium wilt susceptible cultivars for which replacement with resistant types appears the most feasible remedy: Bogoya (Gros Michel), a high yielding dessert banana susceptible to black Sigatoka disease as well; Ndiizi (apple banana), a low yielding, excellent tasting dessert banana but also susceptible to black Sigatoka; Kayinja (Pisang Awak) a moderate yielding beer banana resistant to black Sigatoka; and Kisubi, a low yielding beer banana tolerant to black Sigatoka. Appropriate replacements for these cultivars should be close or better than these cultivars in terms of taste, yield and resistance to other constraints (weevils, nematodes, other diseases and drought).

Five of the cultivars tested had close or higher yield than Bogoya (the local check). However, consumer acceptability tests indicated that only one clone (FHIA 17) was similar to Bogoya in taste while another was close (slightly acceptable). Additionally, these cultivars appear to be resistant to the banana weevil and they were originally bred for black Sigatoka resistance. These results suggest that the two cultivars can be used to replace the susceptible Bogoya in areas where fusarium wilt and black sigatoka are constraints to the cultivar, the low elevation areas (below 1400m.a.s.l.). Bogoya is known to be tolerant to the banana weevil which is not considered a limiting factor to its production.

For the high elevation areas (above 1400m.a.s.l.) where black sigatoka is not a production constraint, Cavendish cultivars have been available as suitable replacements but the technology had not been transferred to Ugandan farmers. Cavendish was represented by Williams cultivar in the Bushenyi trial. Its yield in this trial (15 kg) was abnormally low (table 1). It is not clear whether this was caused by planting it in the middle of taller plants (randomised design) or an off type was imported. In similar places in central Uganda, its bunch is as heavy as that of Bogoya. Cavendish cultivars replaced Bogoya which used to be the commercial banana on the world market before fusarium wilt prevented its continued production (Stover, 1972). Therefore, acceptability of its fruits is not likely to limit its adoption. Its main weakness is susceptibility to black Sigatoka. The cultivars are currently being multiplied in preparation for transferring them to the farmers.

An assessment of the juice producing characteristic of the five high yielding accessions revealed that juice could be easily extracted using local methods from two of them (FHIA 03 and Yangambi Km 5), (Table 2).

Table 2. Aspects of utilization of some introduced banana cultivars.

Cultivar	Dessert	Juice production
Yagambi KM 5	Slightly Acceptable	Good
FHIA 23	Slightly acceptable	Good
FHIA 17	Acceptable	None
Pisang ceylan	Slightly acceptable	None
Gros Michel	Acceptable	None
Ndiizi	Acceptable	None

Note: Rating was done on a hedonic scale ranging from extreme approval to extreme disapproval

In fact, FHIA 03 yielded more juice than Kayinja (unpublished data). Unfortunately, it succumbed to fusarium wilt rendering it unusable as a replacement for the susceptible beer bananas. However, its high juice yield makes it an attractive clone to use in uninfected areas. Farmers are already accessing it from Kawanda in large quantities with the advice to plant it in clean soil.

Yangambi Km 5, the other good juice yielding clone, was resistant to fusarium wilt. It is also known to be resistant to weevils and nematodes. This appears to be the most appropriate replacement for Kisubi and Kayinja in places where the two beer cultivars have succumbed to the disease.

Conclusion

It is concluded that FHIA 17 and FHIA 23 hybrids are appropriate replacements of Bogoya, particularly in areas where black Sigatoka is also a production constraint. However, in areas where black Sigatoka is not a constraint Cavendish cultivars are identified as the most appropriate replacement for Bogoya. Yangambi Km5 is identified as an appropriate replacement for Kisubi but can also be used to replace infected Kayinja as the search for an appropriate replacement for Kayinja continues. An appropriate replacement for Ndizi (Apple banana), a dessert banana with a unique taste was not identified in the test clones.

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