PROJECT: Banana Tropical Race 4 Panama Disease Management

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Location: Coastal Plains Banana Quarantine Station (CPBQS)

Objectives:

To find and develop a commercially acceptable banana variety resistant or tolerant to Panama tropical race 4 for the NT banana industry.

To develop field management methods to reduce the spread of the disease and to extend the commercial life of existing plantations in the NT.

Specifically to:

1. Commission and operate the CPBQS incorporating the CPBQA secure area to conduct secure research on Fusarium oxysporum cubense - tropical race 4 (FOCTR4).
2. Locate and source banana varieties with likely or reputed resistance to FOCTR4 and screen them for resistance or tolerance to FOCTR4 within the CPBQA secure facility.
3. Test the commercial acceptability of any variety found resistant or tolerant to FOCTR4.
4. Develop and commercialise any resistant or tolerant variety found to be commercially acceptable.
5. Develop field management techniques to reduce the spread of the disease and extend the commercial life of existing plantations in the NT.
6. Develop field techniques to disinfest currently infested areas.
7. Assist other research organisations to conduct research on FOCTR4 which may benefit the NT and Australian banana industries.

Results:

CPBQS has been successfully operating since 2001 and has passed an external audit every year.

Thirty one banana varieties have been tested or are in the process of being tested.

Four fully resistant varieties have been identified including:

FHIA 25: It is a high yielding tetraploid cooking banana. It is resistant to yellow Sigatoka and was obtained from a breeding program in Central America.

Malaccensis: Three selections of seeded diploids were obtained from Indonesia. They have no commercial value. However, seeds and genetic material are useful for breeding and genetic improvement work.

Highly resistant or tolerant types have been identified:

GCTV119: It is a soma-clonal variant Cavendish which was obtained from a Taiwanese breeding program. It is a very weak plant with small bunches. It is therefore of no commercial value.

FHIA 18: It is a sweet acid dessert type banana which was obtained from a breeding program in Central America. Losses were observed in the plant crop to FOCTR4 but there were few losses in ratoons. It has some commercial potential but has ripening problems. It is resistant to yellow Sigatoka.

FHIA 01: 'Gold-finger' is a sweet acid banana which was obtained from a breeding program in Central America. It has commercial potential and was released in Queensland 10 years ago but has post-harvest problems when grown in the tropics.

All other varieties tested so far are susceptible to FOCTR4.

Out of all the varieties tested so far (see Table 1) only three have produced commercial yields and have shown significant resistance to FOCTR4. They are FHIA 01 'Gold-finger', FHIA18 and FHIA 25.

FHIA 25 (Figure1) is high yielding and highly resistant to FOCTR4 and yellow Sigatoka. However, it is a cooking type with unacceptably poor taste and texture and a long crop cycle. It is still grown on a small area but all further commercial development work has been suspended until there is some more interest in the market. Spacings of 1450–1550 plants per hectare in a double row configuration with a Cavendish fertiliser program are giving high yields in the trial plots. However, a density of 1450 plants per hectare would probably be most suitable due to the large size of the plants. Small-scale commercial testing this year has indicated that ripe fruit is able to produce acceptable fruit leather (flattened and dried ripe bananas).

FHIA 01(Figure 2) is also known as Gold-finger in Queensland and NSW where it was released a little over 10 years ago. It is a moderately yielding sweet acid type with moderate resistance to FOCTR4 in the plant crop and high resistance in ratoons when grown under high inoculum pressure. It is resistant to yellow Sigatoka and is a robust plant with a vertical bunch producing well-shaped even hands and prata type fingers. Unfortunately, the eating quality is variable when grown under tropical conditions. The pulp does not darken when pealed or cut and is adequate when used in desserts or salads. It may have some potential as a niche banana for local sale. Ripe fruit produces very acceptable dried and leather product. Further small scale testing of a commercial planting is planned to see if there is local interest. Plant density of 1500 - 1600 plants per hectare would appear to be most suitable for NT conditions. From limited data, it appears to cycle some two to four weeks faster than Grand Nain.

FHIA 18 (Figure 3) is a close relative of FHIA01 but is not as robust or as high yielding. It is similar to FHIA01 in that it is only moderately resistant to FOCTR4 in plant crops but highly resistant in ratoon crops. It is resistant to yellow Sigatoka .It is currently grown in NSW in very small quantities as a substitute for lady finger.

The plant sun-burns badly and would need some protection if it is to be grown successfully in the NT. This is an issue that can be addressed in commercial production. In ratoons the plant is than FHIA01. It is a sweet acid type with generally acceptable taste but a slight core in the pulp. The semi vertical bunch produces long squarish fingers not as distorted as lady finger. Dropping fingers when the fruit is ripe is a major problem which needs to be overcome before FHIA 18 becomes a fully commercial variety.

Both FHIA 01 and FHIA 18 were almost abandoned after losses of 10-20% to FOCTR4 in the plant crop under high inoculation pressure. Subsequent ratoons have suffered less than 1% losses.

If the plant losses can be reduced by reducing inoculum levels before planting, these two types offer some opportunity to replant FOCTR4-infected patches and produce commercial yields of sweet acid bananas. They are not a substitute for Cavendish.

Figure1. FHIA 25

Figure 2. FHIA 01

Figure 3. FHIA 18

Table 1. Summary of characters of varieties being tested against FOCTR4 at CPBQS (HAL project FR00043)

Varieties being tested	Type	FOCTR4 plant cycle	Susceptible ratoon cycles	Agronomic yield	Characters/ production attributes	Market acceptance	Leaf spot resistance
Cavendish (Williams)	AAA	VS	VS	High	Good	Good	No
Cavendish (GCTV-119) ex Taiwan	AAA	SS	SS	Low	Poor	Good	No
FHIA-01 (Gold finger)	AAAAB	S	SS	High	Very good	Variable	Yes
FHIA-17	AAAA	VS	VS	Variable	Good	Good	Yes
FHIA-18	AAAB	S	S	Medium	Poor	Good	Yes
FHIA-25	Cooking type	R	R	High	Very good	Poor	Yes
SH-3640 (High Noon)	AAAB	VS	VS	Good	Good	Good	Some
Malaccensis (FOC susceptible)	AA	S	S	Very low	Good	Seeded	Yes
Malaccensis (FOC susceptible)	AA	S	S	Very low	Good	Seeded	Yes
Malaccensis (FOC susceptible)	AA	S	S	Very low	Good	Seeded	Yes
Malaccensis (FOC resistant)	AA	R	R	Very low	Good	Seeded	Yes
Malaccensis (FOC resistant)	AA	R	R	Very low	Good	Seeded	Yes
Malaccensis (FOC resistant)	AA	R	R	Very low	Good	Seeded	Yes
FHIA-23	AAAA	VS	VS	High	Poor	Average	Yes
Pissang berungan (Lakatan)	AAA	EX	EX	High	Good	Good	No
Mutiaria E	AAB	VS	VS	Low	Good	Good	Some
Novaria D	AAA	VS	VS	High	Good	Good	No
Novaria G	AAA	VS	VS	High	Good	Good	No
Pissang embung	AA	S	S	Low	Good	Good	No
Pissang jari buva	AA	S	S	Medium	Good	Poor (smell)	Some
Ducasse*	AAB	S*	VS	Medium*	Good*	Good*	Some*
Cavendish (Grande Nain)*	AAA	S*	S	High*	Good*	Good*	No*
Improved ladies finger*	AAB	VS*	VS	Low*	Good*	Good*	No*
Pacific plantain**	AAB	VS	VS	High**	Good**	Cooking**	No**
Pissang Celon (Mysore)**	AAB	S		Low	Good	Good	No
Cavendish (GCTV-Formosana)**	AAA	S		High	Very Good	Good	No
D5 (ex South Africa)**	AAA	VS	VS	N/A	n/a	n/a	n/a
DPM25 (ex South Africa)**	AAA	VS	VS	N/A	n/a	n/a	n/a
PKZ (ex South Africa)**	AAAB?	VS	VS	N/A	n/a	n/a	n/a
RSS3 (ex South Africa)**	AAA	VS	VS	N/A	n/a	n/a	n/a
Parfit ex QDPIF	AAA	S	?	?	Good	?	No

FOCTR4 susceptibility

EX- Extremely susceptible (dies before emergence)

VS – Very susceptible (most develop symptoms and die before harvest)

S – Susceptible (few show symptoms at bunch emergence but many by harvest)

SS – Slowly susceptible (few plants show symptoms at harvest)

R – Resistant (nil or very rare plant symptoms at harvest)

Agronomic characters

High-medium - commercially acceptable

Good-very good – commercially acceptable

Field management procedures developed to contain and slow the disease

Prevention through quarantine

New legislation has been developed in the NT in close collaboration with current growers and the Resource Protection Division to contain and manage the disease. Prevention has been shown to be both practical and feasible in the NT.

Containment of new outbreaks

A number of techniques have been trialled. The burning of the first individual plants as soon as they are detected appears to be the most effective and has been adopted as the preferred treatment. Trials have established that water temperatures above 60°C and for longer than 20 minutes will kill FOCTR4 in plant tissue. These results are the basis of some experimental field control trials currently being established.

Containment and restriction of spread from established infections

The 'early intervention' approach where infected plants are detected early and killed by glyphosate injection has reduced the spread rate in existing infected plantings. Its efficacy is attributed to a reduced above ground inoculum.

Prospecting for antagonistic or suppressive organisms from existing FOCTR4 infected sites

This is a joint project between DPIFM and CDU. Currently three Trichoderm isolates capable of parasitising FOCTR4 in laboratory plates have been identified. Samples from existing FOCTR4-infected sites are currently being assessed in the laboratory.

Use of commercially available Trichoderma preparation

A large field trial was established on a commercial planting at risk to FOCTR4. Preliminary results after the first 12 months indicate that the number of plants infected with FOCTR4 is higher in the Trichoderma-treated plots than in the untreated plots. One possible explanation of this is the extra traffic within the Trichoderma plots. The data will be analysed after the second year.

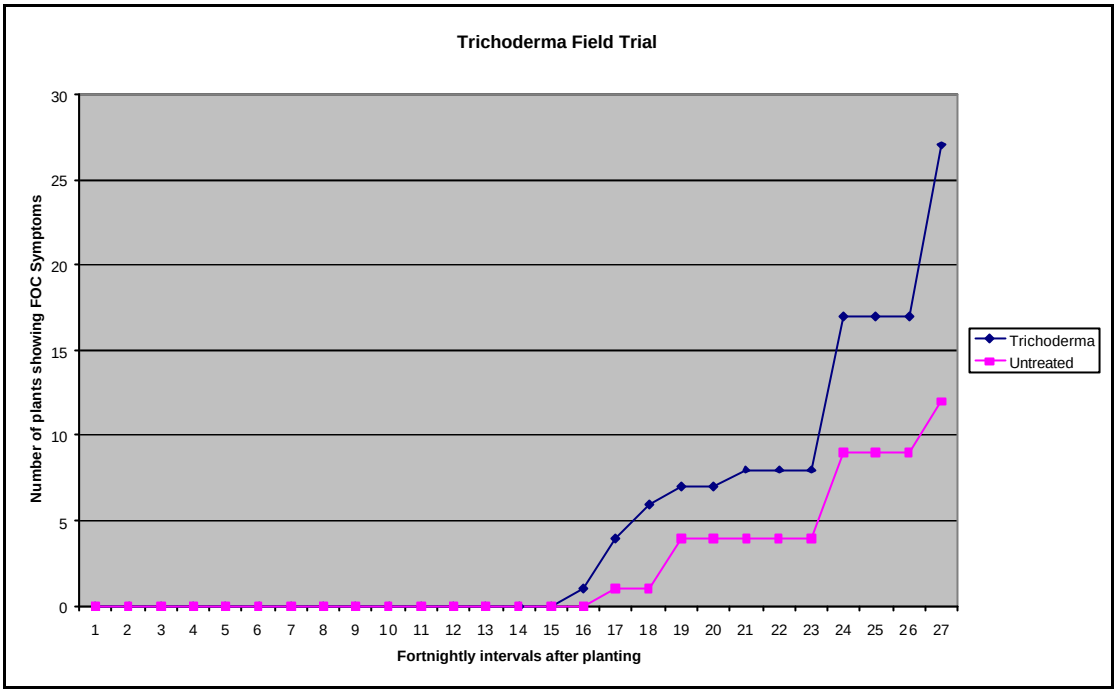

Figure 4. Biological suppressants – two Trichoderma isolates from local sources have shown activity against FOCTR4 in laboratory tests

A field trial on a commercial property of a commercial Trichoderma preparation has been commenced and the preliminary results for the first 12 months are shown.