Marc Jackson
P.O. Box 946
TULLY 4854 QLD
AUSTRALIA

The Secretariat,
The Senate Rural and Regional
Affairs and Transport Legislation Committee
Room SG.62.
PARLIAMENT house
CANBERRA ACT. 2600

RECEIVED
27 APR 2004
Senate Rural and Regional Affairs and Transport Committee

Dear Senators,

I was on the understanding that I may respond to how the draft IRA would effect a small/medium farmer. I had prepared a speech and although I never had the opportunity to give it I would like to enclose it for your perusal.

I have also travelled the world studying bananas on a Nuffield scholarship and have included a CD of my report.

Thank you for the opportunity to respond to the impact these imported diseases may have on the Great Barrier Reef.

I believe for Black Sigatoka and Freckle the extra chemical usage would create some impact on our environment and the extra chemical usage would jeopardize our clean green image, let alone extra chemical run off and leaching to the Great Barrier Reef Lagoon. But another control for Black Sigatoka is drainage. The disease cannot be controlled where water is lying on the ground. Water combined with heat causes high humidity and that is the best conditions for Black Sigatoka to develop, multiply and spread. Ref- Dr Jones book D*iseases of Banana page 71. " Another important practice is the reduction of the relative humidity inside the crop. This is achieved through an efficient drainage system, which rapidly takes ground water out of the plantation"*

Page 18 of my Nuffield scholars report (included) shows the extent of the damage systems used. My farm is 32ha in size and I have one man-made drain of 300m long, 1m deep and 2m across the top, all the other drainage is natural with some modification work. A 32ha parcel of overseas drained Black Sigatoka affected land would contain 7,680 meters of tertiary drainage of 1m deep and 500mm-700mm, 3500 meters of secondary drainage up to 3m deep and 10 m wide and a primary drain of up to 4m deep and 30m wide.

I am in the process of developing an I.S.O. 14001 environmental management systems, this type of drainage could only harm the environment. I am also working with the Queensland Fruit and Vegetables Limited and Natural Resources Management for to reduce sediment and nutrient run off into the Great Barrier Reef lagoon. These extensive drainage systems will only add to the pressure, we farm in the wettest place in Australia up to 5 meters of rain, annually.

I have attached a document from my EMS manual, called "Environmental Aspects of Banana Production".

If we have to live with Black Sigatoka the consequences will be catastrophic, that is why we banded together and with some help from the government, the banana industry and individual growers, we put our heads down and eradicated this disease against all odds. In world banana growing regions Australians are noted for doing the impossible. Risk analyses panel member and D.P.I. employee Rob Allen was involved in the eradication program. He was criticised for stating that it would be impossible for the disease to be eradicated and that funding not be supported.

Page 190 of the draft IRA under the heading, "The indirect impact of Black Sigatoka" with regards to the cost of controlling the disease and also the indirect effects on the environment, the IRA team has that wrong. The Black Sigatoka problem and drainage is also the same for Freckle and Moko. Moko may be worse because of the continued constructions of roads and drains, to avoid the areas of infestation.

This should be taken very seriously, and no additional impacts should be placed on the environment or the Great Barrier Reef marine park.

Thank-you, yours Faithfully

Marc Jackson

DISEASES OF BANANA, ABACÁ AND ENSET

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CABI Publishing

Fyffes

are removed from plants and small areas of necrotic leaf tissue excised as soon as they appear. The rationale behind this practice is to accelerate the decomposition of the necrotic sporulating tissue by rapid deposition on the ground. If the necrotic tissue is left on the plant, production of perithecia continues and ascospores can be released for several weeks.

Another important practice is the reduction of the relative humidity inside the crop. This is achieved through an efficient drainage system, which rapidly takes groundwater out of the plantation, and by maintaining an adequate balance between the distribution and number of plants to avoid overlapping of foliage. As well as increasing humidity levels, overlapping foliage also makes it difficult to cover all leaf surfaces with fungicide. In areas where irrigation is necessary, the use of under-tree or drip irrigation is preferred (Wielemaker, 1990). This is because overhead sprinkling systems maintain favourable humidity for spore germination in the upper leaves where most ascospores of *M. fijiensis* are deposited.

Chemical control

FUNGICIDE APPLICATION Aircraft are used to spray fungicides in most export banana plantations, but tractors or motorized backpack sprayers are used on small farms growing fruit for local markets. However, ground sprays are less efficient than aerial sprays. In most operations in Central America, the Ayres Trush Commander and the Ayres Turbo Jet, with capacity for 1135 l and 1514 l, respectively, are the most widely used aircraft (Stover and Simmonds, 1987). These aircraft are equipped with satellite-linked, geographical positioning systems, which direct the pilot to application targets and can be seen on an electronic screen inside the aircraft. This technology avoids unnecessary spray overlaps, missed paths and oversprays. The number of hectares that can be sprayed by an aircraft in 1 h depends on the configuration of the farms and the distance from the mixing and loading facility. However, it is usually in the range of 125–175 ha.

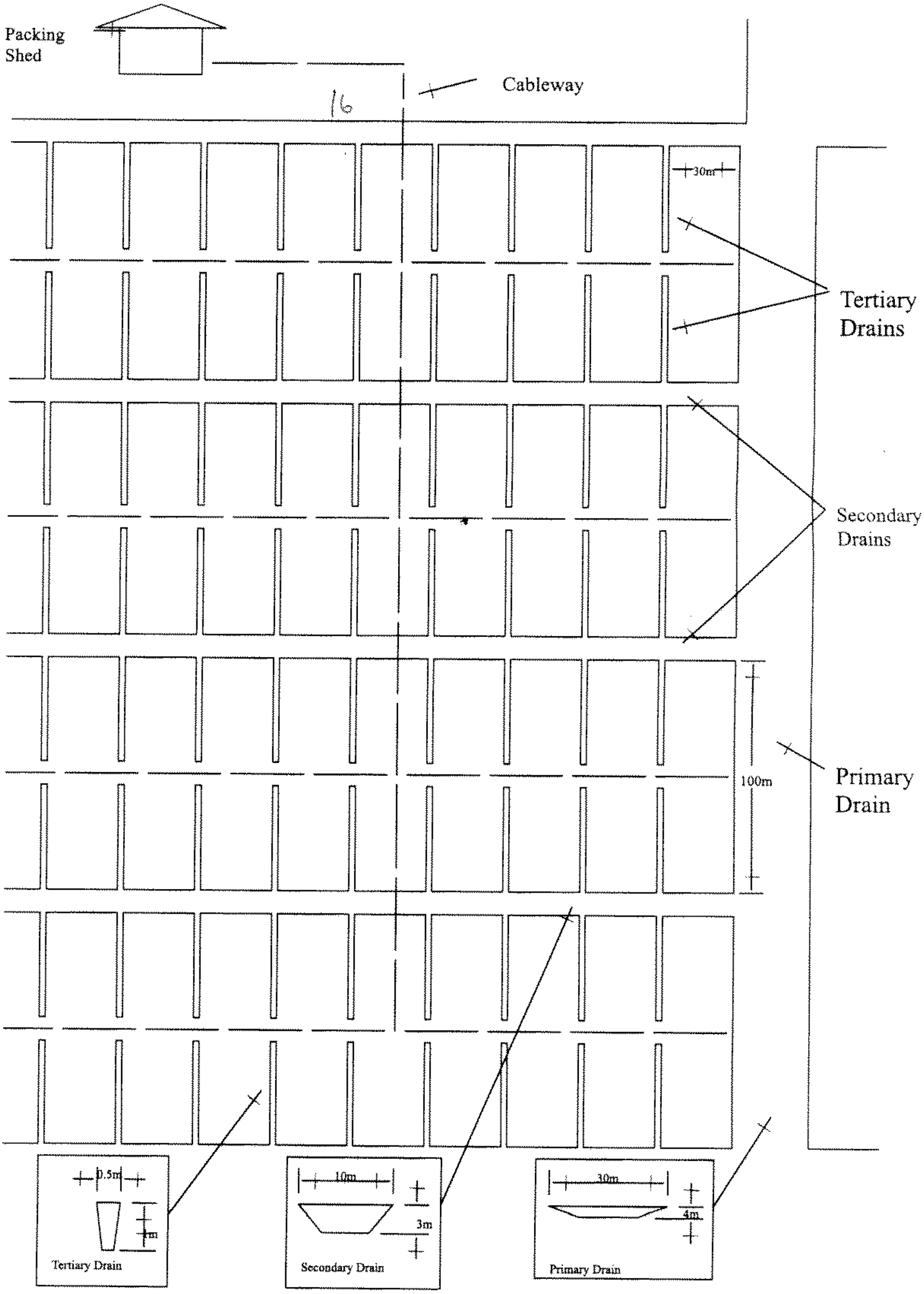
PROTECTANT FUNGICIDES Protectant fungicides remain on the surface of the leaf and do not penetrate underlying tissues. They have a broad spectrum of activity and exert a multi-site effect on the pathogen, mostly reacting with essential thiol groups (SH-groups) of enzymes, causing a non-selective toxicity (Gasztonyi and Lyr, 1995). The protectant fungicides approved for control of Sigatoka diseases are dithiocarbamates and chlorothalonil.

Dithiocarbamate fungicides available for use on banana are different formulations of mancozeb, which is a complex of zinceb and maneb (zinc and manganese salts of ethylene bisdithiocarbamate). Some formulations can be used in oil–water emulsion (Vondozeb SC®, Manzate 43SC®, Manzate 35SC®, Dithane MB®, Dithane OS®, Dithane SC®) or in straight oil (Dithane OS®, Dithane SC®, Vondozeb SC® and Manzate 35SC®). Others can be applied only in water (Vondozeb DG® and Manzate DF®). The rate of active ingredient ranges from 1000 to 1500 g ha^{-1}.

Chlorothalonil (Daconil®, Bravo®) has a low water solubility, which favours its fungitoxic activity and reduces the risk of phytotoxicity. This compound has to be sprayed in water alone. Care must be taken when leaves have a deposition of oil from previous treatments and when applying oil following a chlorothalonil treatment, because the interaction of oil and chlorothalonil causes damage to leaf tissues. The rate of active ingredient of chlorothalonil ranges from 1000 to 2000 g ha^{-1}.

SYSTEMIC FUNGICIDES Systemic fungicides have the ability to penetrate the leaf and exert a toxic effect on the pathogen after infections have taken place. Most systemic fungicides have a specific mode of action on the pathogen, which makes them non-phytotoxic to banana.

The benzimidazole group of systemic fungicides comprises several compounds, of which benomyl and thiophanate-methyl


Packing Shed
Cableway
16
30m
Tertiary Drains
Secondary Drains
100m
Primary Drain
0.5m
1m
Tertiary Drain
10m
3m
Secondary Drain
30m
4m
Primary Drain

6

Environmental Aspects of Banana Production

Considerable research has been carried out on environmental aspects of cane and banana production in the Wet Tropics. The appendices of the EMS Manual provide details of some of these studies. They have been recently summarised in the Reef Science Report and by the Productivity Commission.

A review of relevant publications and reports, along with meetings held with environmental management agencies have identified four critical environmental issues relevant to fruit growers in the Wet Tropics. Three key issues emerged consistently and should be addressed through on-farm environmental management:

1. Run-off of sediments and nutrients from agricultural land to waterways and the Great Barrier Reef lagoon. Nutrient runoff has two components of concern:
    - nitrogen, and
    - phosphorous.
2. Solid and liquid wastes, in particular waste water from packing sheds and large volumes of waste fruit and plant matter.
3. The loss of native vegetation and habitats through land clearing, especially in riparian areas. This clearing may have occurred many years ago.

River plumes carrying sediment, nitrogen and phosphorus affect the reefs of the inner GBR lagoon, particularly between Port Douglas and Hinchinbrook, and the Whitsundays to Mackay. This occurs especially after storms. Some two hundred inshore reefs are at highest risk as well as coastal mangroves, soft bottom communities and seagrass.

The major contribution of sediment and nutrient is believed to be grazing in the Dry Tropics. Sewage and other urban sources contribute significant amounts. The contribution of intensive agriculture in the Wet Tropics is also significant and can have impacts on the reefs closest to the mouths of the rivers. It appears that dissolved fertiliser is more important than sediment in the Wet Tropics.

The evidence of connecting landuse with the impacts already present or at risk of occurring is not yet clear. None the less there is a risk that the increasing intensification of agriculture in the Wet Tropics region will have locally important impacts.

Significant reductions in riparian vegetation and in wetlands have taken place over time in this region. Such vegetation provides a biological filter that minimises the impacts of agriculture on the catchment. Prevention of further losses of at-risk vegetation and strategic rehabilitation of watercourses are regarded as regional priorities

By the time that all causal pathways are identified and measured, damage may already have been done to those two hundred reefs in the GBR lagoon that are at risk. Processes that are impractical to reverse may be underway by the time all uncertainty is gone. The intensification of agriculture may interact with changes in other environmental factors, such as global warming, and the combined effects could be worse than the total of individual causes. This is called the synergistic effect.

It is prudent to minimise the risk to the World Heritage marine park, consistent with sustainable agriculture and communities.

There are areas of "at risk" vegetation across the Wet Tropics. It is prudent to ensure riparian zone vegetation is maintained and enhanced as appropriate, and that appropriate approval processes are followed when considering the clearing of vegetation.

The *Report on the Study of Land-Sourced Pollutants and Their Impacts on Water Quality In and Adjacent to the Great Barrier Reef* was presented to the state government of Queensland by the Panel of Scientists in January 2003. Below is a quote from the Report describing impacts on the reef:

"....the Panel advises that:-

1. Reefs at a number of locations along the coast have been disturbed and have remained in a disturbed state. These reefs exhibit characteristics consistent with altered ecological function due to enhanced nutrient availability or sedimentation. These effects include: local reductions in biodiversity, reduced or failed coral recruitment, enhanced mortality of juvenile corals, reduced photosynthetic performance of corals and the replacement of reefbuilding hard corals by space-occupying algal communities.

2. Nearshore coral reefs in the Reef are influenced by increased sediment and nutrients in runoff from catchments with significant land clearing and fertiliser utilisation on a recurrent basis ranging from intervals of a decade or longer in the southern Reef to near annually in sections of the central Reef (16°-19°S) coast bordering the wet tropics

3. River plumes following periods of heavy rainfall are observed well into the Reef lagoon. Apart from the mass of fresh water entering the coastal waters, turbidity has a major impact on available light and coral photosynthesis and coral death has been observed in a range of experimental conditions. Concentrations of nutrients in river runoff plumes reflect increased concentrations in river waters due to land use in catchments. This level of concentrated nutrients gives potential for harm.

4. Detectable concentrations of herbicides (principally diuron) have been found in coastal and intertidal sediments and sea grasses at a number of sites along the coast in close proximity to catchments with substantial sugarcane farming.

5. Elevated concentrations of fat-soluble pesticide residues have been found in dugongs and other marine mammals within the Reef, suggesting that land-based pollutants are finding their way into the food chain of biota associated with the Reef.

6. There is a significant body of well- documented evidence regarding coral reef systems outside of Australia demonstrating harmful effects of excess nutrient availability (eutrophication) and excess sedimentation. The principal effects of excess sedimentation and/or nutrient availability are through disruptions to normal ecological processes in reef systems, especially the capacity of coral-dominated reef communities to recover from natural disturbance events and to maintain naturally biodiverse communities.

We can summarise the risk from banana plantations as the risk of excess nutrients reaching the inner Reef lagoon. The pathway appears to be primarily erosion, but leaching may also be very important and is not well understood.

Mr. Chairman, Senators.

Just to give you some background on my-self. I started banana farming just south of Tully at Murray Upper 13 years ago. My plantation is 32 ha and I employ 10 permentants and 2 casuals. I have studied banana production in the Philippines on a number of occasions, and in 2000 I was awarded a Nuffield farming scholarship to study banana production in the Caribbean, Central and South America.

I first would like to talk about the revised IRA that states Black Sigatoka and Freckle are of a low risk, or that Black Sigatoka, a risk management would not be required.

In Dr. Jones book, (My banana bible) Diseases of Banana, page 413 (attached) it states; *"There is also a risk that leaf trash with viable fruiting bodies of fungal pathogens may also accompany bananas packed in cartons. For those reasons, the risk associated with the movement of banana fruit from one banana growing country to another need to be carefully evaluated."*

Native and cooking bananas, with a heavy infection of these diseases, surround the Philippines plantations. Local and cooking bananas are also gown within some plantations. Land reform makes it hard to farm a complete farm, as some farmers refuse to lease their portion to the big multi-nationals. These multi-nationals also purchase fruit from the smaller farmers who have different faming and hygiene practices. Freckle and Black Sigatoka are in epidemic proportions and can be seen on every plantation, and if it were to come to Australia's growing areas it would have dramatic effects, unlike the IRA low or no risk.

Black Sigatoka and Freckle are the biggest cost to banana production, the added cost includes spraying up to 50 times, de-leafing, manicuring, de-suckering up to twice per week, and the next biggest cost is their drainage systems. These are designed so that no water will live in the paddock. Just think of the damage to the Great Barrier Reef if we had to do the same. (Attached is an explanation)

Black Sigatoka has cost the government and banana growers large amounts of money to control and eradicate against all odds. I would like to give an example of how Black Sigatoka affected my farm.

I have kept very accurate records of my bunch emergence rates, for my management and forecasting production. My bunch emergence rate is times 2 to give me a pack-out forecast for 12 weeks in advance. By this it also gives me a record of production verses forecasts. A summery of my records is;

Year	Estimate cartons to be packed	Variance	Reasons
1995	64,572	+5,614	
1996	75,938	-2,883	
1997	78,256	+2,674	
1998	69,678	-1,055	
1999	77,936	-3,214	Cyclone Rona
2000	110,998	-4,626	Record wet year
2001	110,420	-39,089	Black Sigatoka
2002	97,294	-39,936	Black Sigatoka
2003	48,500	-1,339	

We lost our markets, I only sent to Perth and Sydney; bans were placed on both these markets along with Queensland and Brisbane. I then had no choice but to Melbourne and Adelaide resulting in returns of $7.00 or less, because these markets were now over supplied and I was not a previous customer of the markets. Perth market sold fruit for around an average of $30.00 per carton. The costs of managing this outbreak also doubled and I can tell you that the IRA has that wrong also. My cost of just spraying and deleafing Yellow Sigatoka are $2350 /ha and with Black Sigatoka the costs could be up to $5000 /ha plus the other management practices that I would have to put in place and reduction in yield. To achieve a zero leaf disease, we cut bunches to the ground. I also reduced my acreage to manage the disease better going from over 100 acres down to 35 acres, and along with that 10 employees lost their jobs.

This outbreak has cost my fellow farmers, and me, many hundreds of thousands of dollars, many farmers have lost their farms, many, including myself, are still trying to recover, and some just wont, and for the IRA panel to say that the impact would be minor is ludicrous. The IRA needs to be changed, and the impact upgraded to high risk.

I have since sent to Perth and I can tell you that one of my loads was inspected and rejected because of leaf trash. I disputed this because of my harvesting and packing hygiene and procedures, I was shocked. Then the following week paid special attention, and yes it could happen very easy with all these procedures in place. The inspection process in Western Australia is that my fruit is placed under a very bright light and magnification is used to find any leaf or insect, and I notice in the IRA that there is no need for this thorough inspection.

Moko

I have also seen Moko on all the Philippine plantations that I had visited. To control the spread of Moko areas of the infected plant is roped off. These areas are approximately 6m X 6m, the banana plants are removed from the ground and the area is burnt with rice husks. The area is quarantined for a period of two years, and some farmers are replanting after six months and others one year. Footbaths are also installed and used along with a sterilization sheaf or bucket for knives. Moko still spreads and no mater how careful you may think your workers are they will take short cuts, and that is how it also spreads.
Insects are also known to spread the disease up to 90 km [Jones page 219 (Wardlaw 1972)]
Moko is known to survive for up to 6 months without causing symptoms (Jones page 219).

Again the same as Black Sigatoka and Freckle, Moko is epidemic in the feral bananas and the local plantations. These local plantations border the exporting plantations and as stated before areas of land within the exporting plantation have local banana production.

Dr Jones Disease of Bananas Page 413, *"Banana can also be affected by serious bacterial diseases and not show obvious external symptoms. Often, the presence of these diseases is only discovered when the fingers of fruit is peeled or cut to expose the pulp. Diseased fruit could be moved from one location to another and then discarded in the garden when found to be rotten. This may allow the pathogen to spread to nearby banana plantations."*

Moko will spread through Australia if infected bananas are imported. Many Heliconia and Ginger plants and weeds are a host to Moko.

The cost to my farm would not support the cost and return from production, and I'm sure that goes for all farmers.

- Moko – if it becomes established on a Tully farm, the consequences are expected to be as follows;

    - Induction costs to ensure workers are aware of the hygiene and in-field quarantine requirements to manage the risk of the disease
    - Cost of preparing the induction manuals and operational procedures (BS cost $30,000)
    - In-field operational costs due to working with Moko infection presence and managing the problem to avoid further disease spread.
        - Extra time for de-suckering for knife sterilization
        - Extra time for de-leafing for knife sterilization
        - Extra time for bell injecting, bunch pruning and leaf removal for knife sterilization.
        - Extra time for harvesting for knife sterilization.
        - Extra requirement for separate roadways construction
        - Extra cost for separate drainage construction to manage water flow
        - Provision of in-field footbaths for workers
        - Provision of in-field tractor baths

Mealy Bugs and Other Insects.

In my Nuffield Farming Scholars report I have observed that in New Zealand the MAF demand that all consignments of bananas be fumigated, due to the occurrence of intercepted pests. (Marketing Bananas in New Zealand page 8)

And in Japan a greater risk is from special banana refer vessels and a lower risk from containerised fruit. (Banana Retailing in Singapore and Japan page 18)

Conclusion

I haven't had a chance to look at the rest of the pests and the diseases that could enter Australia, but I know from experience with Papaya Fruit Fly and Black Sigatoka that it causes serious concerns for banana growers let alone the other crops and our natural fauna and flora that may be affected in Australia. I believe that BA should be accountable and pay for any damage to the farmers of Australia. There is not a month pass by, when some pest or disease is imported into Australia. Any extra pest and disease will damage our clean, green, image.

Thank You.

not eliminated and there is still the possibility that some pathogens, which may not show obvious symptoms, could be present.

It is known that *F. oxysporum* f. sp. *cubense* is disseminated with rhizomes and infested soil. Bancroft (1876) first recognized the importance of planting uninfected rhizomes to control the disease. However, as corms can carry the disease without showing obvious symptoms, his recommendations were easier said than done. Nematodes have also been introduced to uninfested land with planting material and accompanying soil. The appearance of the burrowing nematode in some new areas has been associated with shipments of rhizomes of highly susceptible Cavendish cultivars. It has been suggested that the bacterium that causes Moko disease was introduced to Mindanao in the Philippines on Cavendish rhizomes imported from Central America (Buddenhagen, 1986). BBTV was almost certainly introduced into Australia with planting material from Fiji (Dale, 1987).

Some pathogens may move with true seed. Seed is produced in fruit of wild banana species (Plate 13.3), sometimes in fruit of edible cultivars, such as 'Pisang Awak' (ABB), which retains a high degree of fertility, and in fruit of plants following artificial pollination in breeding programmes. There is strong evidence that BSV is seed-borne (Daniells *et al.*, 1995) and it is possible that cucumber mosaic virus may also be seed-borne (Gold, 1972; Stover, 1972). Although not absolutely proved, it is likely that the bacterial agents of Moko, bugtok and blood diseases, which attack fruit, may also move with seed as surface contaminants.

In many parts of the banana-growing world, banana leaves are used to wrap food and pack produce, which may be carried or taken long distances by travellers and traders. Although it is unlikely that heavily diseased leaves would be deliberately utilized for this purpose, it is possible that an occasional leaf with an odd lesion may be selected. Banana leaves are not allowed entry into Australia, because of the risk of introducing foliar pathogens (Jones, 1991). Dried leaf tissue could also harbour foliar and fruit disease pathogens (Stover, 1977).

Banana fruit can carry crown-rot fungi and other pathogens. Fungi causing crown rot are found everywhere, and quarantine measures to exclude them are not warranted. However, bananas can also be affected by serious bacterial diseases and not show obvious external symptoms. Often, the presence of these diseases is only discovered when fingers are peeled or cut to expose the pulp. Diseased fruit could be moved from one location to another and then discarded in the garden when found to be rotten. This may allow the bacterial pathogen to spread to nearby banana plants. A quarantine regulation restricting the movement of bananas in Indonesia, as well as vegetative parts of banana, may well have delayed the spread of blood disease from Sulawesi to West Java until 1987 (Eden-Green, 1994). There is also a risk that leaf trash with viable fruiting bodies of fungal pathogens may also accompany bananas packed in cartons. For these reasons, the risks associated with the movement of banana fruit from one banana-growing country to another need to be carefully evaluated.

Some banana pathogens can affect alternative hosts, which then become sources of infection. Not much is known about the host range of many banana pathogens so risks have not been totally defined. However, some threats have been identified. *Heliconia* is known to pose a significant risk, as it has long been recognized as a host of the bacterium that causes Moko disease of banana. In 1989/90, a survey of 20 commercial Heliconia farms in Hawaii found five with plants affected by Heliconia wilt. Of 17 isolates of *Ralstonia solanacearum* obtained from diseased Heliconia, five were pathogenic on banana. Fortunately for the banana industry in Hawaii, these banana-attacking isolates had not spread from *Heliconia* to banana. The results of the survey suggested that quarantine regulations governing the import of *Heliconia* into Hawaii and intrastate movement of vegetative cuttings or rhizomes were needed (Ferreira *et al.*, 1991).

injury (Kelman and Sequeira, 1965), but most plant-to-plant spread results from either insect or human activities. The bacterium may be spread in contaminated irrigation water and on pruning knives, the shoes of workers and animal hooves. Insect-mediated dissemination of over 90 km has been recorded (Wardlaw, 1972) and epidemics which occur via this route, such as those in Honduras (Buddenhagen and Elsasser, 1962) and Peru (French and Sequeira, 1970), spread very rapidly. This is a result not only of the rapid plant-to-plant spread afforded by insect dissemination, but also of the rapidity with which symptoms ensue following infection of the inflorescence. Bacterial ooze starts to appear on peduncles and bract bases approximately 15 days after infection of flowers by SFR strains (Buddenhagen and Elsasser, 1962), providing a focus for new infections. B strains produce less bacterial ooze than do SFR strains and so are less frequently transmitted by insects. Both SFR and B strains are capable of inflorescence infection (Stover, 1972), but banana cultivars with dehiscent bracts, such as 'Bluggoe', are particularly susceptible. Following infection, the bacterium spreads to the vascular tissue and the disease usually becomes systemic, eventually reaching the rhizome. Bacteria may remain viable in the rhizome for several months and any suckers or other propagating material removed for planting will also carry the disease.

Host reaction

Very few studies on resistance to Moko disease have been published. Stover (1972) reported that all clones of commercial importance are susceptible to B and SFR strains. Cultivars with dehiscent bracts, notably 'Bluggoe', are particularly susceptible to infection by insect-transmitted strains. The cooking-banana cultivar 'Pelipita' (ABB), which possesses indehiscent male bracts and has strong field resistance, has been recommended for replanting in Moko-infested areas in Central America as a replacement for 'Bluggoe' (Stover and Richardson, 1968). 'Horn' plantain (AAB) is said to have some degree of inherent field resistance (Stover, 1972). Stover (1993) reported that East African highland cultivars of the Lujugira–Mutika subgroup (AAA) are susceptible to the SFR strain.

In artificial inoculation tests in Honduras, bacteria were injected into the pseudostems of 345 accessions of banana (Stover, 1972). 'Pelipita' was highly resistant to the SFR strain, as were accessions of *Musa balbisiana*. The 'Manang' accession of *M. acuminata* ssp. *banksii* showed moderate resistance. In all, about 10% of the accessions showed some degree of resistance to the SFR strain. Clones of 'Sucrier' (AA), 'Inarnibal' (AA), 'Laknau' (AAB), 'Saba' (ABB), 'Pitogo' (ABB) and others were rated as susceptible. In tests with the B strain, only *M. balbisiana* showed resistance. Some *M. acuminata* accessions have also been shown to exhibit a degree of resistance to race 1 strains and race 2 distortion strains of *R. solanacearum* (Vakili, 1965; Wardlaw, 1972).

More recently, the bred tetraploid 'FHIA-03' (ABBB) has been observed to remain healthy after planting in Moko-infested areas of Grenada (see Rowe and Rosales, Chapter 14, pp. 435–449). However, this apparent 'resistance' should be used with caution. Bacteria injected into 'resistant' plants in the Honduran breeding programme were found to survive for up to 6 months without causing symptoms. As such symptomless plants could, in theory, serve as a hidden source of inoculum, this tolerance to infection was considered to be an undesirable trait and is no longer exploited (P. Rowe, Honduras, 1997, personal communication).

Control

The systemic nature of infection by the Moko disease bacterium means that the pathogen cannot be destroyed without also killing the host plant. Where the pathogen is present, the only means of effective control is the eradication of infected plants, coupled with the adoption of improved cultural practices to limit pathogen dispersal.

However, since the distribution of Moko remains fairly limited, the primary means of Moko control is exclusion from areas where the disease does not occur. As Moko strains also affect *Heliconia*, which is traded internationally as an ornamental, quarantine authorities must be alert to the possibility of spread on this alternative host (see Jones and Diekmann, Chapter 13, pp. 409–423). The importation of vegetative *Heliconia* into banana-growing countries should be treated with extreme caution.

Eradication

Successful management of Moko in areas where the disease occurs relies on early detection, followed by the destruction of any infected mats. Experienced Moko inspectors inspect banana plants in commercial plantations in advance of pruning operations. Regular inspections, every 2–4 weeks, depending on local disease incidence, are required for early identification of symptoms. All parts of diseased plants are destroyed *in situ* by injections with a systemic herbicide, such as glyphosate. Healthy mats surrounding the diseased plants are also destroyed by herbicide injection and weeds in this 'buffer zone' are treated with herbicide in order to reduce the chances of the bacterium surviving. Buffer zones of 5 m and 10 m have been recommended for SFR and B strain infections, respectively (Stover, 1972), and this area may either be left fallow or planted with wilt-suppressive crops, such as maize. Recommendations vary for the length of the fallow period required to eliminate the bacterium, but all are based on investigations and observations conducted under field conditions. Fallow periods of 6 and 12 months for SFR and B strains, respectively, have been suggested (Stover, 1972), although a banana-free (but not weed-free) period of up to 2 years has been recommended in Grenada, where Moko is caused by SFR strains (Hunt, 1987). Where weeds are effectively controlled, the fallow period may be considerably reduced. Lehmann-Danziger (1987) reported that a weed-free period of only 5 months was necessary for Moko control in Nicaragua. Shallow ploughing or disc-harrowing serves to desiccate the soil and has been shown to reduce the necessary fallow period (Sequeira, 1958). The same study also investigated treatment of infected soil with bactericidal chemicals, but these did not reduce disease incidence in subsequent crops. Soil fumigation with methyl bromide is, however, effective in dramatically reducing the fallow period (Stover and Simmonds, 1987), although this method is impractical for small-scale farmers and environmental concerns have arisen over the role of the fumigant in atmospheric ozone depletion.

In Belize, systematic surveys of 'Bluggoe' and smallholder dessert banana cultivars, coupled with glyphosate treatment of all banana plants within a 5-m radius, effectively eradicated Moko. The only outbreaks recorded now are possible incursions of the disease over the border from Guatemala. In Belize, eradication was achieved with the cooperation of the public and without the need for compensation for healthy plants (mostly 'Bluggoe') destroyed. In the eradication programme in Grenada, compensation had to be given for healthy mats of 'Bluggoe' destroyed, as the fruit is highly valued as a food (P. Hunt, UK, 1998, personal communication).

Cultural practices

It has been estimated that, without sufficient precautions against contamination, almost 97% of the dissemination of Moko type B strains may be due to cultural practices alone (Wardlaw, 1972). Disinfection of digging and cutting tools is therefore considered to be of great importance in disease control, and sterilization systems suitable for routine field use have been designed (Buddenhagen and Sequeira, 1958; Sequeira, 1958; Stover, 1972; Wardlaw, 1972). Pruning knives may be disinfected by contact with a 10% solution of formaldehyde for 10 s or a 5% solution for 30 s. Plantation workers undertaking pruning operations usually carry two knives. One knife is sterilized in a scabbard lined with felt soaked in a 5% or 10% formaldehyde solution while the other is in use. Tools need to be sterilized between each plant and a dye, such as crystal violet, is often added to the disinfectant in order to monitor the operation. Since the bacterium may also be spread on contaminated footwear, the same sterilizing solution is used to treat the shoes of workers when they leave infested areas.

Removal of the male bud from 'Bluggoe' as soon as the last female fingers had emerged was said to prevent the spread of the SFR strain from plant to plant via male bract scars in Honduras (Stover and Richardson, 1968). The practice of breaking the peduncle with the bud by hand has been recommended for all cultivars with dehiscent bracts (Stover, 1972).

Plant quarantine

Ralstonia solanacearum race 2 is currently listed as an important threat to banana cultivation by the Asian and Pacific Plant Protection Commission, the Caribbean Plant Protection Commission, the Pacific Plant Protection Organization and China. It should be excluded from any Moko-free area where *Musa* is grown for local consumption or as a cash crop. Importation of *Musa* planting material into an area considered at risk should only be undertaken after a thorough assessment of the risks. Information on the safe international movement of *Musa* germplasm is provided by Jones and Diekmann, Chapter 13, pp. 409–423.

Blood Disease

Introduction

The first report of 'Penyakit Darah', or blood disease, was from the Saleiren Islands off the south coast of Sulawesi in Indonesia in 1906. The outbreak was so serious that it forced the abandonment of newly established dessert banana plantations (Rijks, 1916). Subsequent investigations by Gäumann (1921b, 1923) showed that the disease was widespread in southern Sulawesi, where it was frequently found both in local banana cultivars and in wild *Musa* species. The disease was apparently not present in Java or on other islands, and quarantine restrictions were placed on the export of banana plants and fruit from Sulawesi to prevent further spread of the disease. Gäumann (1923) traced the cause of the disease to a Gram-negative bacterium, which he named *Pseudomonas celebensis*. Blood disease was later regarded as an anomalous appearance of Moko disease. In the late 1980s, the presence of a vascular bacterial disease of banana was noted on the Indonesian Island of Java (Eden-Green and Sastraatmadja, 1990). Investigations revealed that the causal bacterium was not the same as the Moko pathogen. Blood disease is now spreading rapidly among both dessert and cooking-banana cultivars in Java and constitutes a substantial limiting factor in banana cultivation. More recently, the disease has been reported from Sumatra, Kalimantan, the Moluccan Islands and Irian Jaya (Baharuddin *et al.*, 1994). To date, there have been no records of blood disease outside Indonesia.

Symptoms

Blood disease affects both dessert and cooking-banana cultivars. The latter are more widely grown in Sulawesi, perhaps due to the higher susceptibility of dessert varieties, and the symptoms of blood disease are described from this ABB group. In mature leaves, the disease causes a conspicuous yellowing, which is followed by wilting, necrosis and collapse near the junction with the pseudostem (Plate 5.5). Younger leaves turn bright yellow, before becoming necrotic and dry, and the emergence of the youngest leaf is arrested. The male flower bud and youngest fruit bunches may be blackened and shrivelled (Plate 5.6), although often they appear outwardly unaffected. However, internally the fruit exhibit a reddish-brown discoloration and are rotten or dry (Plate 5.7). The name blood disease derives from the reddish

Pest is put into three categories:

Risk group 1
Pests which if introduced into New Zealand would cause unacceptable economic impacts on production and the environment.

Risk group 2
Pests which if introduced into New Zealand would cause a major disruption to market access (importing countries' requirements) and would cause unacceptable economic impacts on production and the environment.

Risk group 3
Pests (fruit fly) which if introduced into New Zealand would cause a major disruption to market access (importing countries' requirements) for a wide range of host fruit, and would cause unacceptable economic impacts on production and the environment.

In resent times New Zealand has intercepted many pests, and is now demanding that all consignments of fruit be fumigated. This is a major concern and financial expense to the importing companies. Each fumigation would cost approximately NZ$15,000-NZ$20,000 plus labour. The labour is for the unloading and cutting the vacuum packed bag. Fumigation takes place in the ship in specially fabricated fumigation rooms and in the ripening rooms.

The reason for the interception of more and more pests these days is that pressure by the work place and safety is to reduce the amount of chemicals used. Consumers are demanding a clean and green product and many plantations are moving to organics. Workers safety is now a major issue in the underdeveloped countries.

Maff are only concerned with the fruit and the impact the fruit will have if infected with an insect or disease, while Australia is not only concerned with the fruit but also with the rest of the plant (roots, leaves, stems etc.).

Supermarket chains hold a 50% market share, with 26 national chains. All pre pack bananas are sold at a fix-contracted price and mostly done in the Philippines. Loose product does fluctuate although the super-market chains prefer a fixed price of 3 months in advance.

Dole is looking into the future and is preparing to have consumer retail sales via the Internet within the next 3-5 years.

Any fruit and vegetables that are not directly contracted to the supermarkets are sold by way of auction. The wholesaler offers the produce at a price and if no one bids the price then goes down, until a bid is made. Member Companys of The Japan Banana Importers Association pay an •1 per carton levy for a national advertising campaign.

The Marketing System

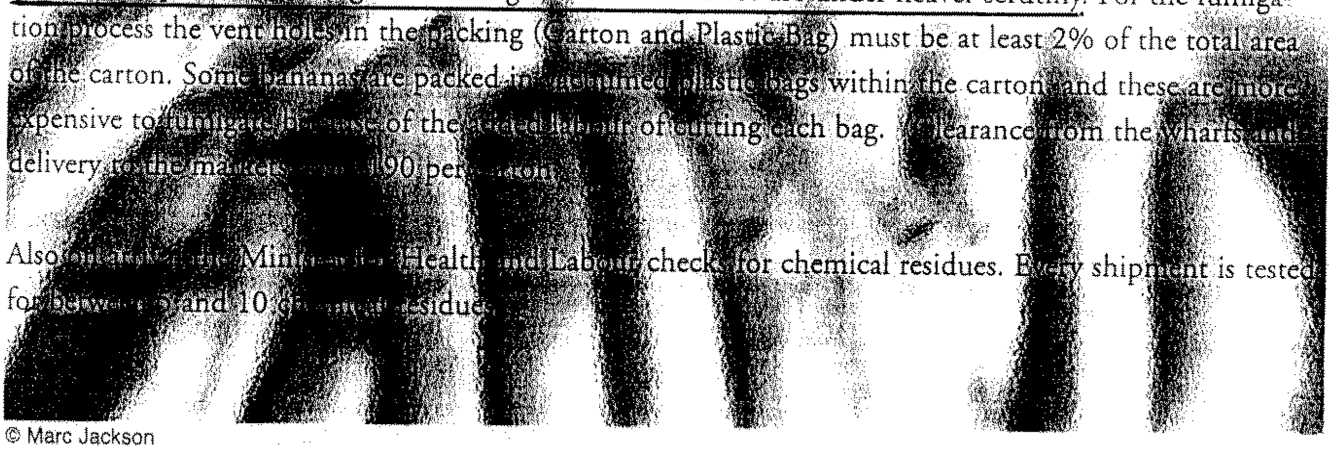
Prices are determined by auction, which means the price will be reasonably determined as the highest bid price will be the price of the goods, reflecting the day's supply and demand. Wholesalers appointed by the Minister of Agriculture, Forestry and Fishery sell the goods at the auction. Their commission is a fixed fee at 7 percent. Intermediate wholesalers are the ones purchasing the goods from the auction, they in turn sell on to the retail stores. A retailer or supermarket agent usually buys goods from these intermediate wholesalers, but also buy direct from the auction if they first get approval from the Market Authority.

The Tokyo Metropolitan Government has established 11 Central Wholesale Markets, in order to assure the fresh foods transported to the markets are delivered to the consumers in safety and at reasonable prices and promptly. The Government administers the construction of markets, maintenance and management of the facilities.

Fumigation

If insects are found in a consignment the consignment must be fumigated, destroyed or returned to point of departure. For example if Queensland Fruit Fly was found the shipment would have to fumigate with Methyl Bromide. The fruit packed in container present a lower risk than fruit packed in the hull of a ship, full ship loads are categorized as high risk and there for are under heaver scrutiny. For the fumigation process the vent holes in the packing (Carton and Plastic Bag) must be at least 2% of the total area of the carton. Some bananas are packed in [illegible] plastic bags within the carton and these are more expensive to fumigate because of the [illegible] of cutting each bag. Clearance from the wharfs and delivery to the markets [illegible] 90 per [illegible].

Also [illegible] Ministry of Health and Labour check for chemical residues. Every shipment is tested for between [illegible] and 10 [illegible] residues.



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