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CARIBBEAN FOOD CROPS SOCIETY

47

**Forty-Seventh
Annual Meeting 2011**

**Bridgetown, Barbados
Volume XLVII – Number 1
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Bridgetown, Barbados

“Assuring Caribbean food and nutrition security in the context of climate change”

**United States Department of Agriculture,
T-STAR Sponsored Invasive Species Symposium**

**Toward a Collective Safeguarding System for the Greater Caribbean Region:
Assessing Accomplishments since the first Symposium in Grenada (2003)
and Coping with Current Threats to the Region**

**Special Symposium Edition
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RECENT RESEARCH FINDINGS ON MOKO DISEASE AND PROSPECTS FOR MITIGATING ITS IMPACT ON THE BANANA INDUSTRY IN THE CARIBBEAN REGION

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BACKGROUND

Moko disease is a deadly disease of banana and plantains. It is caused by a bacterium, *Ralstonia (Pseudomonas) solanacearum* (Race 2), that evolved from pathogens of wild *Heliconia* species.

The disease affects all parts of the plant, but the route of infection and the nature of the causal strain determine the type of symptoms. Infection of dessert banana cultivars typically occurs via the roots or rhizome. In these cases, the first signs of the disease are yellowing and wilting of the oldest leaves which eventually become necrotic and collapse. The symptoms spread to the younger leaves which develop pale green or whitish panels before becoming necrotic. The disease may cause the suckers to wilt, possibly without exhibiting the foliar symptoms of yellowing and necrosis. Fruit development is affected, and fingers ripen prematurely and split. Internally, the fruit become discolored and eventually rot. Vascular tissues become discolored and when cut they exude bacterial ooze from which the causal organism can be isolated. In the later stages of infection, the vascular discoloration may be brown or black. In fruit bearing plants, the internal symptoms are most evident in the fruit stem and at the bases of younger leaves. Symptoms of insect-transmitted Moko disease are first seen in the flower buds and peduncles which become blackened and shriveled. The bacterium spreads to the fruit, which may ripen prematurely, and initiates a rot. The infection continues towards the pseudostem, causing blackening of the vascular tissue. Eventually, the bacterium becomes systemic and the whole mat is diseased.

RESEARCH FINDINGS

Moko Disease Prevalence in Jamaica

Moko disease was diagnosed by the Banana Board on bananas in St. James in February 2004, with the CABI International Mycological Institute Identification Services confirming the disease in six locations. This disease is a notifiable disease which means that it is required by law to be reported to government authorities. This collation of information allows the authorities to monitor the disease and provides early warning of possible outbreaks. The department developed a program for the emergency eradication of Moko.

Strains of Moko Disease in Jamaica

The isolates of *Ralstonia* from the Eastern Banana Estate in St. Thomas and the St. Mary Banana Estate in St. Mary (eastern Jamaica) were confirmed by Dr. Alvarez and Professor Buddenhagen as ‘SFR’ strain while the isolates from the Maroon Town and Heliconia farms in St. James (western Jamaica) were confirmed as ‘B’ strain.

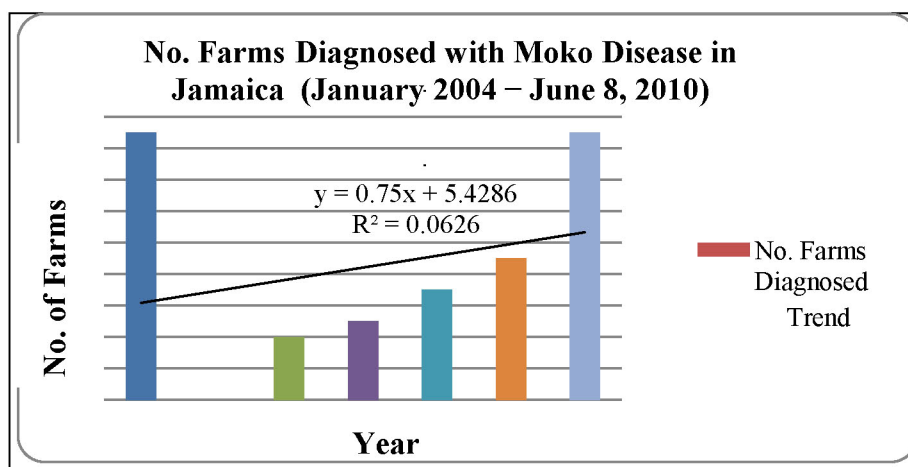
Pathogenicity Test

The pathogenicity test (Koch’s postulate) was administered using local isolates. The results of the tests showed the pathogenic nature of the isolates to banana seedlings.

Spread of the Disease

After the eradication attempt at the first outbreak in 2004, the spread of Moko disease of banana and plantains in Jamaica has increased to the original level in just six years (Figure 1). The disease remains in the very same districts of initial outbreak in St. James (the red zone). The average rate of spread up to June 2010 was eight cases per year, or 0.5% of the mats on the infected farms, which is admirably below the target of 10 cases per year. Without the current control measures, the spread of Moko disease would have been exponential, with infection rapidly spreading from farm to farm.

Figure 1. Number of farms diagnosed with Moko disease in Jamaica (January 2004 to June 2010)



Technical, Social, and Legislative Issues

Unavailability of income during the fallow period

After eradication of the infected mats, the field should be left fallow for at least one year to eliminate the bacterium. In the previous eradication attempt, some farmers disregarded the recommendation and replanted the fields with bananas before the fallow period had expired. This practice resulted in plants becoming re-infected with the pathogen. The reason that the farmers gave for replanting before the fallow period had expired was that they needed the income, although they had received lump sum payments in the amount of annualized earnings from Banana Export Company. This may suggest that the payments should have been in installments and supervised.

Compensation

Compensation had advantages and disadvantages. The advantages included assisting farmers to recover from losses, and motivating farmers to declare infected fields and to observe the fallow period. The disadvantages were that the compensation was unsustainable and, in some cases, was utilized for the wrong purposes; encouraged unscrupulous activity; required strict monitoring; and payment had to be verified by proven land tenure, which did not exist in some disease situation.

Non-cooperation by affected farmers to allow their fields to be eradicated

The Moko bacterium cannot be destroyed without killing the host plant, and where the pathogen exists, the only means of effective control is eradication and improved cultural practices. Some farmers refused to allow the eradication exercise on their farms, sold infected planting material to other farmers, and neglected to follow the recommended cultural practices. This contributed to the disease re-emerging and threatening to spread all over the parish and eventually the entire island. This could have resulted in the devastation of the banana industry, with thousands losing their jobs. An economic crisis would have occurred and food security would be threatened.

Refusal to plant suppressive crops

Some of the farmers objected to planting suppressive crops because of the unavailability of a guaranteed market while other farmers refused to have their fields treated for eradication until they could be provided with a compensation package. The proposed package by the farmers included cash compensation per plant, allocation of new land for the period of at least one year and guaranteed market for the suppressive crops grown in the infected fields. If demands were not met, farmers were reluctant to sacrifice their fields. They preferred to get some returns from the bananas and plantains before they die from the Moko disease, although this puts the other farmers and the entire industry at risk.

Failure of law enforcement

The constabulary forces are not convinced that farmers should be prosecuted for non-cooperation according to the Plant Quarantine Order. As a result, some farmers flaunted the law, even when compensated.

Unavailability of clean planting material

The disease is spread via seedlings; therefore tissue culture plantlets are the guaranteed mechanism to prevent spread of the disease when planting. However, the availability of tissue culture plantlets locally was not readily accessible because there were no contractual arrangements in place with The Scientific Research Council (the only local supplier) or any other manufacturer. A lead time of at least six months was required for production of pre-nursery plantlets (before potting). In addition, nurseries for hardening and distribution were not in place.

RECOMMENDATIONS FOR MITIGATION STRATEGIES

1. A comprehensive program is recommended that involves a technical program of the total eradication exercise, followed by a monitoring program in which any new cases are dealt with swiftly. However, unless the social and legal issues are resolved, the technical program will be unsuccessful.
2. The full cooperation and commitment of farmers, administrative and legal functionaries, and all stakeholders must be maintained and agreed to in a memorandum of understanding.
3. Farmers must be assisted with planting materials for disease-suppressive crops during the two-year period after all banana fields are destroyed.
4. A compensation package to replace income loss (during the year of fallow) by the affected farmers should be paid in installments and supervised to ensure that farmers comply with all the recommendations so as to prevent practices that encourage resurgence of the disease. The compensation package must include the provision of planting materials for the appropriate suppressive crops accompanied by assistance in land preparation.
5. Clean banana and plantain planting materials should be available to the farmers after the requisite two-year rest from banana and plantain crops in the soil. Planting material should be tissue-cultured plantlets or suckers from certified nurseries.
6. The monitoring and surveillance program must continue throughout the three years subsequent to the eradication procedures.
7. Should funding not be available for a full-scale eradication program, the monitoring, surveillance, and partial treatment of infected crops remains an essential long-term program to curtail spread and empower farmers to protect their banana farming enterprises.
8. The Action Plan to prevent the outbreak in other areas must be implemented and maintained.