

Discussion

Griffith: The spear rot disease is related to new countries. What is the origin of the material for your breeding programme?

Barcelos: Various countries in Latin America and Africa.

Griffith: I suggest a reduction of imports from the old world.

Van de Lande: Are insects, especially pollinators, attracted to *E. oleifera*?

Barcelos: Yes. Insects visit inflorescences of hybrids too.

PHYTOPATHOLOGICAL RESEARCH ON AMARELECIMENTO FATAL OF OIL PALM PLANTATIONS (*Elaeis guineensis* Jacq.) IN PARÁ, BRAZIL¹

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In tropical countries cultivation of the oil palm is one of the most promising agro-industrial activities. Brazil has great potential for expanding cultivation of this tree, particularly in the Amazon Region where there are vast areas with edapho-climatic conditions suited to the growth of this oil-bearing crop.

At present approximately 50,000 hectares of oil palm are being cultivated in Brazil. About 30,000 of these are located in Pará which is the largest oil palm growing area in Brazil, and, consequently, the largest producer of palm oil. Table 1 shows the distribution of the area under cultivation in Brazil.

Table 1. Area planted with oil palm in Brazil.

States	Area planted (ha)
Pará	30,975
Amapá	4,331
Amazonas	1,687
Bahia	11,750

Source: PPD, UEPAE/Belém.

The oil palm has been cultivated in the State of Pará for more than 20 years and, until recently, there had been no phytosanitary problems that limited its expansion. Since 1984,

however, cultivation has been restricted by the appearance of an epidemic disease variously defined as "bud rot" and "spear rot", or "amarelecimento fatal", which is the name proposed by Turner (1981).

In the municipality of Benevides, Pará, which has the largest concentration of oil palm trees in the state, the disease has been known since 1974. It first appeared in a sporadic way, affecting very few plants and, thus, was not a major cause for concern (Freire, 1988).

Beginning in 1984 the number of cases detected in producing plants increased sharply, thus attracting greater attention to the disease. The first studies were aimed at characterizing the symptoms of the disease, so that it would be possible to diagnose its presence with certainty, under field conditions. However, the precise diagnosis of the disease is quite difficult due to the fact that the symptoms vary from one area to another as a consequence of differing conditions of climate, soil, vegetation, genetic origin of the plants, and so forth. This research is made even more difficult due to the fact that the causal agent of the disease is unknown, thus making the

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study of the factors associated with the evolutionary cycle of the disease impossible.

The symptoms of this disease can be confused with those of other diseases that attack the oil palm, such as vascular wilt, red ring disease, dry heart rot, as well as with those of nutritional deficiencies. Since precise diagnosis of the disease is so difficult, it is probable that some plants suspected of being diseased with amarelecimento fatal have been eliminated when, in fact, they were suffering from other maladies. With the passing of time, practical knowledge on the symptomatology of the disease has facilitated the task of precise diagnosis and, today, some plantations have workers or technicians who are capable of identifying the disease when the first symptoms appear, though this diagnosis is still not absolutely reliable.

Amarelecimento fatal reached epidemic proportions in the period between 1984 and 1987, and, since efficient methods of control have yet to be found, the strategy adopted has been that of eliminating the diseased plants as soon as the first symptoms appear, in an attempt to reduce the spread of the disease.

Table 2 shows the number of plants eliminated up to December 1987, as a consequence of the major diseases that have afflicted the plantations of Denpasa, Brazil.

Symptoms

The observable symptoms of amarelecimento fatal normally begin with a slight chlorosis of the younger leaves, generally the numbers 4 to 10. This is followed by the yellowing of the younger leaves and the drying of the leaflets starting at their extremities. In extreme conditions, when the disease

Table 2. Diseased plants eliminated in 1987.

Cause	No. of plants	Area (ha)
Amarelecimento fatal	32.660	228
Vascular wilt	917	7
Red ring disease	1.127	8
Other	3.078	21

Source: Denpasa EMBRAPA-AF Group Report.

has reached an advanced stage, particularly after plantations have been abandoned for some time, humid rot with its characteristic odor occurs and destroys the center of the crown, moving down until it affects the base of the spears. In some cases, the stems of the spears and young leaves become dark gray and hardened with superficial fissures, below which one can observe a layer of orange colored tissues. In extreme cases, after a certain period of time, only the base and middle leaves remain green. The upper leaves dry, no new spears are formed and the plant stops producing. In rare cases, plants that have presented symptoms of amarelecimento fatal have regenerated with the passing of time. Up to the present, no anomalies have been found on the stems and roots of the plants analyzed. Attempts made to isolate the disease have produced no evidence that a stem or root pathogen is associated with the disease.

In the light of the seriousness of the problem caused by amarelecimento fatal, the Brazilian Agricultural Research Company - EMBRAPA - formed a team of scientists in 1986 with the task of developing studies of the disease. The team is composed of scientists from EMBRAPA and Dendê do Pará S.A. Denpasa, together with scientists from several international institutions, such as the IRHO and HVA, and the research program has received the financial support of the producers association APRODEN.

The team consists of: Pedro Celestino Filho, Entomologist EMBRAPA (Coordinator), Wouter van Slobbe, Agronomist Denpasa/HVA, Hercules Martins e Silva, Phytopathologist EMBRAPA, Franco Lucchini, Entomologist EMBRAPA, Claude Louise, Entomologist IRHO/EMBRAPA, Lindaurea Alves, Entomologist EMBRAPA, Antonio Müller, Plantbreeder EMBRAPA, Eduardo Alves, Agronomist Denpasa.

Based on international agreements, the EMBRAPA/APRODEN project is periodically visited by specialists from IRHO, HVA, GTZ and the University of Suriname, who render consulting services in the areas of entomology, phytopathology and genetic improvement. According to the program submitted for approval to the work group and the consultants and which was elaborated with the effective participation of all members of the AF team, the following studies were made in the sector of phytopathology:

1. Isolation of the fungi probably associated with amarelecimento fatal, utilizing plants that had already presented the symptoms of the disease. Up to the present time, more than 20 species of fungi have been isolated from the diseased plants, including from the roots, leaves, stems, spears and meristems. The fungi most commonly isolated have been *Fusarium* spp., *Pythium* spp., *Colletotrichum gloeosporioides*, *Rhizoctonia* spp., *Curvularia* spp., *Thielaviopsis paradoxa*, *Graphium* spp., *Microsphaeropsis olivacea*, *Pestalotiopsis* spp., *Dactylaria* spp., *Mucor racemosus*, *Schizotrichum* spp., *Microsphaera olivacea*, *Lasiodiplodia theobromae*.
2. Isolation of bacteria. The bacteria most frequently isolated from the diseased plants were the following species: *Aerobacter aerogenes*, *Bacillus polymyxe*, *Erwinia herbicola*, *Pseu-*

domonas aeruginosa, *P. fluorescens* and *P. putida*.

The isolated fungi and bacteria have been taken from both diseased and healthy plants once a month. These were then inoculated into nursery plants and five year old field plants every 15 days. After one year, the symptoms of the disease were not reproduced as a consequence of the inoculation of fungi and bacteria. This leads one to think that organisms of the virus, viroid or mycoplasma type may be involved in the process of manifestation of the symptoms of the disease.

3. Histopathological studies were carried out with an electronic microscope by the Institute of Cellular Biology of the University of Brasilia and by the Virology Laboratory of the Institut de Recherches pour les Huiles et Oleagineux, IRHO, Montpellier, France. In each of these examinations no organisms of the mycoplasma (MLO), virus viroid, rickettsia, protozoan or bacterial type were detected.

4. Chemical control. In areas in which the disease is common, plants that are apparently healthy and/or plants that have shown only the initial symptoms of the disease have received systematic applications of antibiotics and fungicides, with the purpose of observing the differential reactions of the plants. It is thought that in this way it will be possible to gain some knowledge regarding the organism involved in the disease.

The products utilized were:

Tetracycline, which acts on organism of the mycoplasma type, injected into a group of 96 plants in a concentration of 5 g of the active ingredient diluted with 100 ml of distilled water per plant every four months.

Streptomycine, which acts basically on bacteria, applied to 50 plants in a concentration of 5 g of the active ingre-

dient diluted with 50 ml of distilled water per plant every four months.

Aluminum phosetyl, a systematic fungicide that acts on fungi of the *Pythiaceae* family, utilized for the purpose of combatting species of the *Pythium* type, which are suspected of being involved in the process of the disease. The product was injected into 49 trees in a concentration of 8 g of the active ingredient diluted with 80 ml of distilled water per plant every four months. Metalaxyl + Pholpet, a product characterized as having systemic action, utilized for the purpose of controlling species of the genus *Phytophthora*, a fungus that is also suspected of being involved in the process of the disease. This product was injected in a concentration of 7 g of the active ingredient in 142 ml of distilled water per plant every four months. A total of 56 plants received applications.

Benomyl, a systemic fungicide that acts on fungi of the genus *Fusarium*, injected into 49 plants in a concentration of 10 g of the active ingredient diluted with 100 ml of distilled water per plant every four months.

Monocrotophos, a systemic insecticide included in the test for the purpose of controlling the sucking-biting insects that are probably involved in the process of transmission of the causal agent of the disease. The applications were composed of 20 g of the active ingredient (50 ml of the commercial product) per plant. A total of 48 plants were treated every two months, through the process of root absorption.

Up to the moment, no observable differences have been noted in the progression of the disease that could be attributed to the action of the products applied. Since the disease would seem to have an incubation period of about 10 months, it is probable that some

indication as to the action of these products will come to light with the passing of time. (Renard, 1987, personal communication).

Control

Since the causal agent of amarelecimento fatal has not been identified, specific control measures cannot be recommended. However, some companies have sought to hinder or delay the spread of the disease through phytosanitary inspections every 15 days. The purpose is to identify the initial symptoms of the disease, mark the plants and then call in a team to eliminate the plants.

The plants are cut with a power saw and the leaves and trunks are pulverized with mixture of fungicide + insecticide (endosulphan 0.2% + benomyl 0.2%).

The "caiaué" or "dendê" plants of Amazonia (*Elaeis oleifera*) and the hybrids *E. oleifera* x *E. guineensis* have shown resistance to the disease, and should be further studied as a possible source of greater resistance.

In 1988, phytopathological and genetic improvement studies will be intensified for the purpose of enhancing resistance to amarelecimento fatal.

In the area of phytopathology, studies will be carried forward on the fungi and bacteria that have been most commonly isolated from diseased plants, such as:

- a) studies of fungi isolation, cultivation and sporulation techniques;
- b) study of the inoculation techniques suited to each fungus, in an attempt to reproduce the symptoms of the disease;
- c) studies of the evolution of the symptomatology;
- d) studies of the epidemiology and of control methods will be carried out simultaneously.

Acknowledgements

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References

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Abstract

Phytopathological research on amarelecimento fatal of oil palm plantations (*Elaeis guineensis* Jacq.) in Para, Brazil. Brazil has large areas with potential for the cultivation of oil palm (*Elaeis guineensis* Jacq.); particularly in the Amazon region where the edapho-climatic conditions are suited to the development of this palm. In the state of Para the oil palm was cultivated without difficulty for more than 20 years until 1984, when the disease called amarelecimento fatal was found to exist in epidemic proportions. This disease has caused significant production losses of this oil-bearing crop.

Since efficient control measures had not been developed it was decided that the plants with the initial symptoms should be eradicated, thus slowing the spread of the disease until new studies were able to indicate control methods. By the end of December 1987, 32.660 plants with symptoms of the disease had been eradicated from a single plantation in the state of Pará. In the light of the tremendous losses that the disease has caused to producers, the Brazilian Agricultural Research Company (EMBRAPA) and the Association of Oil Palm Producers of Para and Amapa (APRODEN) formed a technical commission with the task of studying this disease.

Acting through international agreement, the EMBRAPA/APRODEN effort periodically hosts trips of specialists from IRHO, HVA, GTZ, and the Universities of Suriname and Brasilia in the areas of phytopathology, entomology and genetic improvement. This paper reports on the research activities carried out in the field of phytopathology during the course of 1987.

Resumen

El Amarillamiento Fatal (AF) de la palma aceitera (*Elaeis guineensis* Jacq.). Brasil posee grandes áreas con potencialidad para el cultivo de la palma aceitera (*Elaeis guineensis* Jacq.), especialmente en la Región Amazónica, donde las condiciones edafoclimáticas son propicias para el desarrollo de dicha palma. En el Estado de Para, la palma aceitera era cultivada sin problemas limitantes desde hace más de 20 años, hasta que, en 1984, se constató la ocurrencia, en forma epidémica de la enfermedad denominada Amarillamiento Fatal, que ha causado pérdidas significativas en la produc-

cion de esa oleaginosa.

Como no se conocen métodos eficaces de control para tal enfermedad, de decidió erradicar las plantas con síntomas iniciales, retardando la diseminación de la enfermedad hasta que nuevos estudios puedan indicar medidas de control. Hasta fines de diciembre de 1987 fueron eliminadas 32.660 plantas con síntomas de (AF) en una única plantación en el Estado de Pará. Debido a los grandes perjuicios que tal enfermedad está causando a los productores, la Empresa Brasileira de Investagacion Agropecuaria - EMBRAPA y la Asociación de Productores de Palma Aceitera de Pará y Amapá - APRODEN formaron una comisión técnica para desarrollar estudios sobre la enfermedad citada.

A través de acuerdos internacionales, el convenio EMBRAPA/APRODEN recibe periódicamente la visita de especialistas de IRHO, HVA, GTZ, Universidad de Suriname y Universidad de Brasilia, como consultores en los campos de Fitopatología, Entomología y Mejoramiento Genético. En el presente trabajo se relatan las acciones de investigación del campo de Fitopatología en el año de 1987.

Resumo

O Amarelecimento Fatal (AF) do dendzeiro (*Elaeis Guineensis* Jacq.) no Brasil. O Brasil possui grandes áreas com potencialidade para o cultivo do dendzeiro (*Elaeis guineensis* Jacq.), especialmente na Região Amazônica, onde as condições edafoclimáticas são propícias ao desenvolvimento dessa palmeira. No Estado do Pará, o dendzeiro era cultivado sem problemas limitantes há mais de 20 anos, até que em 1984 constatou-se a ocorrência, em forma epidêmica, da doença denominada Amarelecimento Fatal (AF), que tem causado perdas significativas na produção dessa oleaginosa.

Como não se conhecem métodos eficazes de controle dessa doença, decidiu-se erradicar as plantas com sintomas iniciais, retardando a disseminação da mesma até que novos estudos possam indicar medidas de controle. Até o final de dezembro de 1987, foram eliminadas 32.660 plantas com sintomas de AF em uma única plantação no Estado do Pará. Debido aos grandes prejuízos que a doença vem causando aos produtores, a Empresa Brasileira de Pesquisa Agropecuária - EMBRAPA e a Associação dos Produtores de Dendê do Pará e Amapá - APRODEN constituíram uma comissão técnica para desenvolver estudos sobre a referida doença.

Através de acordos internacionais, o convênio EMBRAPA/APRODEN recebe, periodicamente, a visita de especialistas do IRHO, HVA, GTZ, Universidade do Suriname e Universidade do Brasília, como consultores nas áreas de fitopatologia, entomologia e melhoramento genético. No presente trabalho são relatadas as ações de pesquisa da área de fitopatologia, no ano de 1987.

Discussion

Griffith: No mycoplasma has been found. Can we conclude that there is a similarity with lethal yellowing in coconut?

Martins e Silva: There were no indications of viroids, viruses or MLO. The causal organisms are still unknown.

Van de Lande: Lethal yellowing has been found in several palms, but not in oil palm plantations. Spear rot is also called fatal yellowing.