

## Note technique

# Blood Disease of Bananas in Sulawesi

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**ABSTRACT** - Symptoms of blood disease (*Pseudomonas celebensis*) in Sulawesi, Indonesia, and their similarity to those of insect-transmitted Moko disease (*Pseudomonas solanacearum*, race 2, strain SFR) in Central America are described. Both diseases are transmitted either by insects to fresh abscised male flower cushions and bract scars on the male flower bud and by contaminated cutting tools. The identifying symptoms in both diseases are shrivelling and blackening of the infected male bud, withering of the adjacent peduncle, and the movement of pathogens up the peduncle and into the fruit. After causing a reddish to brown discoloration of the pulp the pathogens move downward through the fruit stalk and pseudostem into the suckers. Cooking bananas in the ABB group with nonpersistent bracts are the most susceptible but other groups are also infected. These bacterial wilt diseases are closely related and have evolved a similar pathology in Central America and Sulawesi. Evolution began on jungle *Heliconia* in Central America and probably on wild *Musa* in the jungle of southern Sulawesi.

### La maladie de "Blood disease" observée sur bananiers au Sulawesi.

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**RESUMÉ** - Les symptômes de la maladie appelée "Blood disease" (*Pseudomonas celebensis*) au Sulawesi, en Indonésie, sont décrits en analogie avec ceux de la maladie de Moko (*Pseudomonas solanacearum*, race 2, souche SFR) transmise par insectes en Amérique Centrale. Les deux maladies sont transmises par des outils de coupe contaminés ou aux cicatrices des bractées fraîches du bouton floral mâle par insectes. Les symptômes qui permettent d'identifier les deux maladies sont le recroquevillement et le noircissement des boutons mâles infectés, le dessèchement de son pédoncule et la circulation d'agents pathogènes sur le pédoncule et dans le fruit. Après avoir provoqué une décoloration de la pulpe allant du rougeâtre au brun, les agents pathogènes descendent au travers de la hampe des fruits et du pseudotrone jusque dans les rejets. Les bananes à cuire du groupe ABB qui n'ont pas de bractées persistantes sont les plus sensibles mais d'autres groupes sont également touchés. Ces maladies de wilt d'origine bactérienne sont étroitement apparentées et se sont développées selon une pathologie similaire en Amérique Centrale et au Sulawesi. L'évolution a commencé dans la jungle à *Heliconia* en Amérique Centrale et probablement sur les plantes sauvages du groupe *Musa* dans la jungle du sud du Sulawesi.

**MOTS CLES :** *Musa*, Sulawesi, "Blood disease", maladie de Moko, *Pseudomonas celebensis*, *Pseudomonas solanacearum*, symptôme, agent pathogène.

**KEYWORDS:** *Musa*, Sulawesi, "Blood disease", Moko disease, *Pseudomonas celebensis*, *Pseudomonas solanacearum*, symptoms, pathogenes.

Blood disease of bananas in Sulawesi was first reported in the yearbook of the Department of Agriculture of the Dutch East Indies in 1916 (GAÜMANN, 1921). Subsequently, GAÜMANN (1921, 1923) studied and described this bacterial wilt disease in detail and named the pathogen *Pseudomonas celebensis* after the Indonesian island of Celebes (now called Sulawesi). Recently, EDEN-GREEN (1988) described the pathogen and its spread to Java (EDEN-GREEN and SASTRASTMDJA, 1990).

During a recent visit to Sulawesi the authors were able to observe a large number of cooking bananas of the Pisang manurung ABB variety infected with the blood disease

pathogen. Observations were made from very early to late stages of infection and plants were dissected to trace the movement of the pathogen. Occasionally other cultivars including Bluggoe (ABB) were observed. Representative photographs were taken and some are presented here along with a description of symptoms.

Blood disease symptoms were conspicuous on plants with fruit and could be recognized from a long distance by the pronounced yellowing and necrosis of the upright leaves (photo 1, top).

The earliest symptoms appeared on the male flower bud and adjacent peduncle which were shrivelled and discoloured (photo 1, bottom; photo 2). The first leaf symptoms appeared on leaf 3 or 4 and gradually all leaves became yellow and necrotic.

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Photo 1. Top. Leaf symptoms of blood disease on Pisang manurung. Symptoms almost always appear on plants with fruit. Bottom. Blood disease symptoms on Pisang manurung fruit. Note the black shrivelled male flower bud and greyish shrivelled peduncle.



Photo 2. Diseased (left) and healthy (right) bunches of Pisang manurung. Note the shrivelled male flower bud and adjacent discoloured peduncle in the diseased bunch.



Photo 3. Left. Sucker symptoms that were probably caused by the use of a contaminated tool to cut down the adjacent mother plant. Right. Advanced pseudostem symptoms. The central fruit stalk was also infected but does not show in this photograph.

From the infected, shrivelled male flower bud the pathogen moved up the discoloured peduncle into the fruit where it caused a reddish dry rot of the pulp (photo 1, bottom). From the fruit the pathogen moved down the fruit stalk and pseudostem into the suckers (photo 3) where the foliage turned yellow. A bacteria-laden white to cream sap oozed from young infected tissue; it was occasionally tinged pink.

The blackened male flower bud and shrivelled adjacent peduncle are also symptoms of the insect-transmitted SFR strain of Moko disease on Bluggoe plants in Central America. Infection in both cases was caused by contaminated insects visiting fresh bract scars on the male flower bud. Bluggoe plants bearing the same symptoms as in Central America were also observed in Sulawesi.

Moko disease (*Pseudomonas solanacearum*, race 2) was reported from Trinidad by RORER in 1911. The first epidemic resulting from the evolution of an insect-transmitted strain in Honduras was described by BUDDENHAGEN and ELSASSER (1962). In the early 1960s this pathogen, designated the SFR strain, swept through Central America and decimated the popular Bluggoe cooking variety. This fast-moving strain had evolved from a slower strain that was spread through contaminated cutting tools and root-to-root contact. The non-insect-transmitted strain evolved on jungle *Heliconia* in Costa Rica in the early 1950s (BUDDENHAGEN, 1985) and spread to cultivated bananas as the jungle was cleared and planted. It was carried to other countries in Central America through infected seed rhizomes.

In 1916 blood disease was limited to southwestern Sulawesi. By late 1920 it had spread throughout southern Sulawesi and to the adjacent island of Salayar (now Benteng). GAÜMANN (1921, 1923) mentioned that the application of bacteria to the stigma led to fruit infection in the field. He suspected that the disease was spread by insects and wind.

GAÜMANN observed infected wild bananas in virgin forest to establish the origin of blood disease. At least three species of wild *Musa* grow in clearings and along streams in the virgin forest (NASUTION, 1984). Blood disease probably evolved on wild *Musa* in the jungles of southwestern Sulawesi, just as Moko disease evolved on jungle *Heliconia* in Central America.

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### Enfermedad del "blood disease" en los bananeros en Sulawesi.

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**RESUMEN** - Los síntomas de la enfermedad llamada "blood disease" (*Pseudomonas celebensis*) en el Sulawesi, en Indonesia, son descritos en analogía con los de la enfermedad de Moko (*Pseudomonas solanacearum*, raza 2, cepas SFR<sup>+</sup>) transmitidos por insectos en América Central. Las dos enfermedades son transmitidas por herramientas de cortar contaminadas o en las cicatrices de las brácteas frescas del botón floral macho por insectos. Los síntomas que permiten de identificar las dos enfermedades son el encogimiento y ennegrecimiento de los botones machos infectados, la desecación de su pedúnculo y la circulación de agentes patógenos sobre el pedúnculo y el fruto. Después de un descoloramiento de la pulpa, del rojizo al pardo, los agentes patógenos bajan a través de la raquis del fruto y del pseudotrónico hacia los retoños. Los bananos de cocinar del grupo ABB que no tienen brácteas persistentes son las más sensibles pero otros grupos son atacados también. Esas enfermedades de wilt de origen bacteriana son estrechamente emparentadas y se desarrollan según una patología similar en América Central y en el Sulawesi. La evolución comenzó en la jungla a *Heliconia* en América Central y probablemente en plantas salvajes del grupo *Musa* en la jungla del sur del Sulawesi.

**PALABRAS CLAVES:** *Musa*, Sulawesi, "Blood disease", enfermedad de Moko, *Pseudomonas celebensis*, *Pseudomonas solanacearum*, síntomas, organismos patógenos.