PN PAC - 868

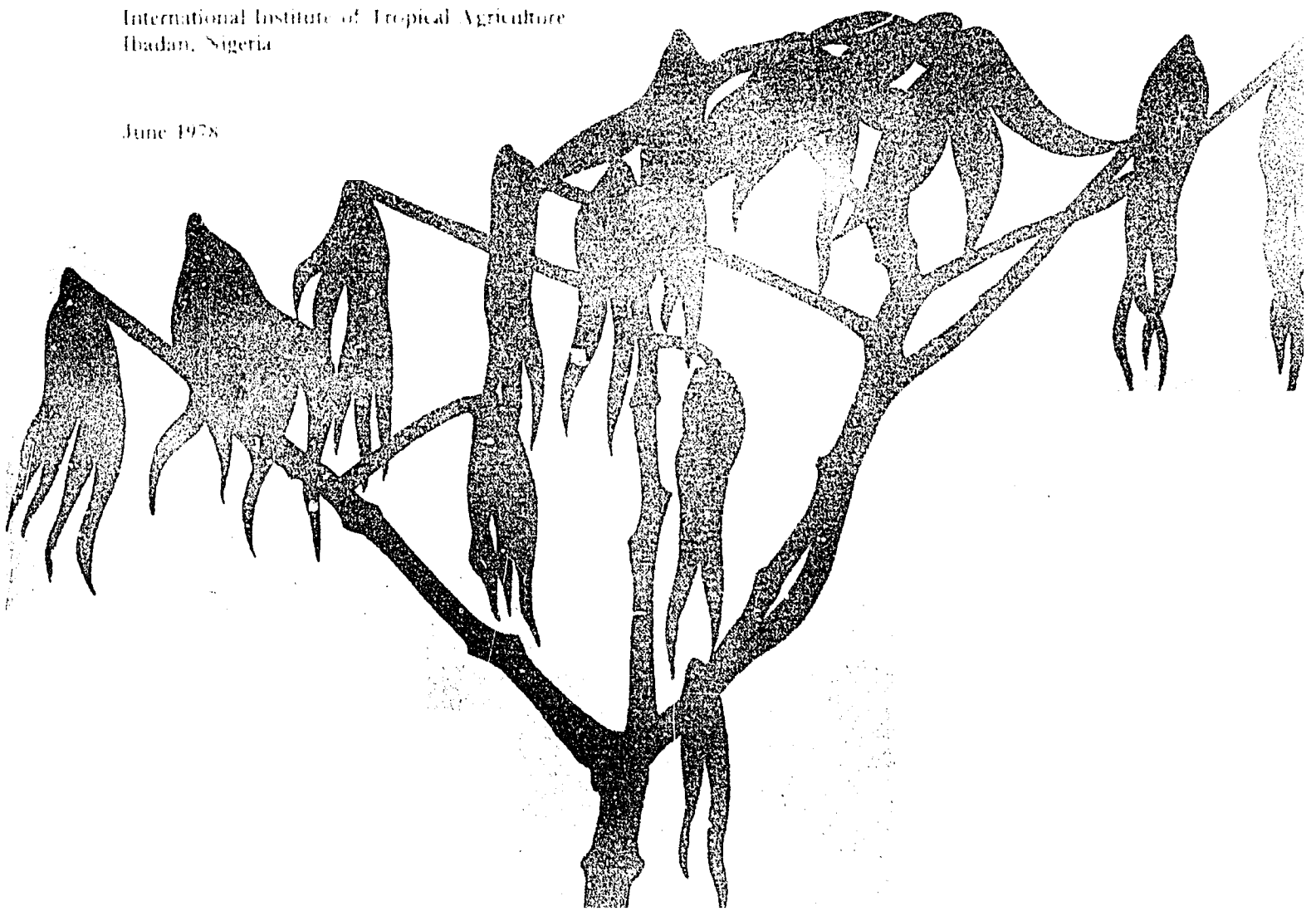
CASSAVA BACTERIAL BLIGHT

Abstracts of Literature

G.O. Ibekwe

International Institute of Tropical Agriculture
Ibadan, Nigeria

June 1978



CASSAVA BACTERIAL BLIGHT: ABSTRACTS OF LITERATURE

BY

G. O. IBEKWE

LIBRARY AND DOCUMENTATION CENTER
INTERNATIONAL INSTITUTE OF TROPICAL AGRICULTURE
IBADAN, Nigeria JUNE 1978.

PREFACE

In the context of the IDRC/IITA Workshop on Cassava [illegible] blight (CBB), the Library and Documentation Center [illegible] is pleased to present this compilation of abstracts [illegible] world literature on CBB. It includes abstracts of [illegible] publications as well as mimeographed reports and [illegible] non-conventional literature.

The abstracts are written to highlight the information on cassava bacterial blight disease and on its causal bacterium (*Xanthomonas manihotis*, its earlier nomenclature and misnomers). Thus, where a publication covers subjects other than cassava bacterial blight, only the portion on cassava bacterial blight is abstracted.

This compilation benefitted greatly from the work of CIAT's Cassava Information Center. The Center has published three volumes of abstracts on cassava and maintains additional abstracts on cards. Ninety (90), including the Spanish and Portuguese literature, of the 187 entries in this compilation are from CIAT's cassava abstracts.

Most of the publications and reports whose abstracts are contained here are, with the exception of papers in Spanish and Portuguese, available in the IITA Library. Xerox copies will be provided on request. We hope that this information package will be a definite help to all those engaged in solving the cassava bacterial blight problem.

S. M. Lawani
Head, Library and Documentation Services

C O N T E N T S

INTRODUCTION

Cassava (*Manihot esculenta* Crantz) is a staple carbohydrate food in many countries of the world, particularly in Africa and Central and South America. Its leaves are eaten as vegetable and in some countries such as Zaire and Congo Republic, they constitute major vegetable for soup. In addition, it is used as livestock feed and for industrial purposes in some of the countries. Thus, the importance of cassava as one of the world's staple food stuffs is evident, and therefore large scale destruction of the crop by diseases and pests would cause famine to large populations.

Cassava bacterial blight (CBB) caused by *Xanthomonas manihotis* damages the entire cassava plant in various ways. Epidemics of this disease have been reported in Brazil and Colombia; Benin Republic, Cameroun, Central African Empire, Congo Republic, Ghana, Malagasy Republic, Malawi, Nigeria, Togo, Zaire; Indonesia and Taiwan. It has caused considerable yield losses in some areas, namely 57% in some susceptible cassava varieties in Colombia (CIAT 1973), 90% in parts of Brazil (Lima 1944), US $33 million worth of yield in 1973 in parts of Nigeria (Ene and Agbo 1974). Consequently, CBB has been recognised to be potentially more serious than the cassava mosaic disease at least in Africa (Hahn and Howland 1977).

The purpose of this collection of abstracts on CBB then is to place at the disposal of scientists, agriculturists, institutions and others interested in the problem, all the relevant documented information on it as one information package. This will enable them orient their work or support in the right direction, avoid expensive duplication of research effort, and above all conclusively solve the problem of CBB.

They are classified into the following aspects of the subject:- etiology, geographical distribution, and epidemology. Others are cultural and chemical control, and control through varietal resistance. To facilitate its use, the collection is generously provided with indexes: Author, subject, bacteria species and geographical.

The assistance of the librarians of CIAT in supplying the index cards on cassava is gratefully acknowledged. Some of the abstracts were also taken from CIAT's Abstracts on cassava vols. 1 & 2. Thanks also go to Mr. A. O. Akinola for typing the scripts.

A. GENERAL

1. ALBUQUERQUE, M. DE. 1961.
Notas sobre mandioca. (Notes on cassava). Boletim Tecnico do Instituto Agronomico do Norte No. 41. 92p.

CBB caused by *X. manihotis* is one of the diseases studied.

2. ANONYMOUS. 1975.
Country presentations: summary of information on cassava production in Africa and Sri Lanka. In Terry, E. and R. MacIntyre eds. The International exchange and testing of cassava germ plasm in Africa; proceedings of an inter-disciplinary workshop held at IITA, Ibadan, Nigeria, 17-21 Nov., 1975. pp.32-33.

Information is tabulated under various headings and by country. CBB is shown to have occurred in Cameroon, Ghana and Togo. (Some countries, notably Nigeria, were omitted in this tabulation).

3. ARENE, O.B. 1974.
A short epistemology of some diseases of cassava in Nigeria. Technical Bulletin of FARTS, Umudike. 1, 12-23.

CBB is among the diseases covered in this paper.

4. BAH, P. 1977.
La maladie des cierges du manioc en Côte d'Ivoire. In IDRC/IITA cassava bacterial blight workshop held at IITA, Ibadan, 1-4 Nov., 1976. 1p. mimeo.

Selon des prospections sanitaires réalisées par deux pathologistes de l'ORTOM, on croit que jusqu'en 1976 la flétrissure bactérienne du manioc n'y a pas encore été trouvée.

(By 1976 CBB had not yet been reported in Ivory Coast where two pathologists from ORSTOM carried out some surveys).

5. CERIGHELLI, R. 1955.
Manioc. (Cassava). In his Cultures tropicales. I. Plantes vivrières. Paris, Librairie J.B. Bailliere. (Nouvelle Encyclopédie Agricole). pp. 289-378.

CBB is included in the diseases and pests of cassava studied.

6. DRUMMOND-GONCALVES, R. 1953.
A bacteriose e a mandioca guaxupé. (Bacterioses en la yuca guaxupe). Biologico 19: 114-117.

Bacteria encontrada por primera vez en Brasil en 1911. La enfermedad se debe a *Xanthomonas manihotis* (Arthaud Berthet) Burk. (Summary from CIAT's 2000 Abstracts on Cassava. vol.1)

CARVALHO, E. P. 1956.
A mandioca e a sua cultura. (Cassava and its cultivation).
Agronomia 15(3): 155-180.

One of the main diseases of cassava described is bacterial leaf spot caused by *Xanthomonas manihotis* Ferrugen.

CHAN, B. and COCK J. 1976.
Cassava: the development of an international research network.
Ottawa, IDRC. 69p.

The cassava research programs at CIAT and IITA and in Canada are described and reviewed. On page 25 under pathology, it is noted that major outbreaks of CBB in Colombia dispelled the notion that diseases were not vital in the crop. The objectives of CIAT's cassava program are given including identification of important diseases of that crop such as CBB and the development of methods for disease control through varietal resistance and simple cultural and sanitary practices. Considerable progress in controlling CBB is said to have been achieved and adequate methods for eliminating it in the region covered by CIAT have been developed. CBB had recently been reported in Thailand and Malaysia. CBB is transmitted through leaf infection, soil splash infection, insect infection, infection from tools used on diseased material and through infected stakes but not through true seed. *X. manihotis* can survive for up to six months in plant debris but flooding and desiccation can reduce the survival time.

On page 38, under pathology the objectives of the cassava program of IITA are given together with achievements in research on CBB and application of the research results. These comprise plant breeding, screening, evaluation in off-site satations and viable cultural control practices.

Pages 55, cassava programs in some national institutes are discussed briefly involving measures aimed at controlling CBB in South America and Africa.

CARVALHO, A. G. 1970.
O trabalho de melhoramento da mandioca no Instituto Agronômico do Estado de Sao Paulo, Campinhas, S.P., Brasil. (Work on cassava breeding at the Instituto Agronomico do Estado de Sao Paulo).
In Encontro de Engenheiros-Agronomos, Pesquisadores de Mandioca dos Paises Andinos e do Estado de Sao Paulo, 1º, Campinas, Brazil. 1970. Trabalhos. Campinas, Brazil, Instituto Agronomico do Estado de Sao Paulo.

More than twenty clones have been developed for cultivation. CBB was among the diseases encountered.

importance of the bacterial blight of cassava around
. In Okpala, E. U. and H. J. Glaser, eds. Workshop
in Nigeria, 1st, Umudike, Nigeria, pp.15-21.

losses in other crops that started too mildly to cause
noted epiphytotic proportions are presented with the
the danger of cassava bacterial blight *Xanthomonas*
Africans, who depend on this staple food. Research
and results passed on to the farmers. (Summary
Digests on Cassava. Vol.1)

Fletcher. Literature review. Ibadan, IITA. 25p. mimeo.

distribution of the disease, and previous studies on
the host range, epidemiology and control of the
cultural practices and breeding of resistant varieties
North America as well as in Africa. (Author's summary).

phytopathogenic bacteria.
requirements of the genus *Xanthomonas*. Journal
131-144.

requirements of 111 isolates of phytopathogenic
to 20 species and varieties of the genus *Xanthomonas*
under conditions of controlled inoculum, carefully cleaned
the medium components.

nutritional conditions, it was learned that most, but not all,
strains can grow to some extent in the simplest medium used:
, and salts. Methionine, glutamic acid and nicotinic acid
various combinations served to furnish the stimulation factors and
factors necessary for the prompt development of the more
species.

pattern in these simple media shows promise of utility as a taxonomic
character of the generic and specific levels. Six isolates of
Phytomonas translucens obtained in 1941 were among those studied. Their
in the media used was not determined during the experiment.
growth in the media was good within 3 to 6 days.

It is noted that *Phytomonas* was used homonymously for a group of
protozoan flagellates and for the phytopathogenic bacteria formerly
lumped in the genus *Phytomonas* Bergey et al. The bacterial genus
Phytomonas was dropped and its species placed in somewhat more suitable
genera viz *Aerobacterium* (Conn, 1942), *Corynebacterium* (Jensen, 1934;
Dowson, 1942), *Pseudomonas*, *Xanthomonas* (Dowson, 1939) with a few species
in the genus *Bacterium* in the sense used by Breed and Conn (1936).

1. [illegible] DA BAHIA. ESCOLA DE AGRONOMIA. 1974.
[illegible] Mandioca; boletorio semestral de pesquisas, No. 5, (Project [illegible]). [illegible] das Almas, Bahia, Brasil, U.F. Ba. of BRASCAN Nordeste,

[illegible] investigations undertaken was the study of diseases of cassava, [illegible], causal agent of CBB. Quarantine field was [illegible] (Abstract).

ETIOLOGY & SYMPTOMATOLOGY

[illegible]

[illegible] do *Xanthomonas manihotis* e *X. rubrisubalbicans* e suas [illegible] Burkholder (Schizomycetes, Pseudomonacea). (Biochemical [illegible] *manihotis* and *X. rubrisubalbicans*; their position [illegible] 57 key for this genus). Arquivos do Instituto Biologico [illegible].

[illegible] Burkholder's key for *Xanthomonas* (12: 154), it was verified that [illegible] *manihotis* (Arthaud-Berthet, 1912) Starr, 1946 and [illegible] *rubrisubalbicans* (Christopher et Edgerton, 1930) Savulescu, 1947 are not correctly placed. After biochemical studies, the author found that 3 samples of *X. manihotis* hydrolyzed starch but were unable to produce nitrites from nitrates. The following alterations are proposed for this key: Item II. Colonies whitish to cream: pigment nonwater soluble; (A) GELATIN LIQUIFIED. (1) Starch hydrolyzed. (a) Nitrites produced from nitrates. 56. *X. manihotis*. (2) Starch not reported. 57. *X. cannae*. 58. *X. conjac*. 59. *X. zingiberi*. (B) GELATIN NOT LIQUIFIED. (1) Starch hydrolyzed. (a) Nitrites not reported. 60. *X. rubrisubalbicans*. (Summary from CIAT's Abstracts on Cassava vol.II).

2. AMARAL, J. Franco do. 1942.
Estudo do organismo causador la bacteriose da mandioca (Un estudio del organismo causante de la bacteriosis de la yuca). Arquivos do Instituto Biologico 13: 119-126.

La bacteriosis es una enfermedad vascular que causa marchitamiento en la yuca *Manihot utilissima* Pohl. Ataca a un gran numero de variedades y donde aparece es un factor de importancia economica. La patogenicidad de la bacteria se probo experimentalmente con seis aislados differentes. Fueron efectuadas pruebas con la enfermedad por inoculacion de las variedades: "vassourinha", "manipeba", "cambaia", y "gemedeira". Morfologia - El micro-organismo aparece como varilla motil con puntas redondeadas con un diâmetro de 0.6 a 0.9μ por 1.6μ a 2μ de largo. Gram-negativo. No forma esporas. Flageios monotricomos facilmente tenidos. Placa de Agar - 48 horas, 30°C. Colonias redondas de 2-3mm. de diâmetro, levantados, con superficie brillante, borde entero, consistencia viscosa. Bioquimica - Buen crecimiento en azucares sin fermentacion. Hidrolisis del almidon: completa, no solo en los cultivos sino tambien con los infiltrados de cultivos en medios liquidos. Reduccion negativa de H_2S, indol, NH_3 y nitrato, licuacion de gelatina en el octavo dia. Leche digerida sin coaqulacion; L.M., peptonizacion, sin descoloracion. El organismo se clasifico como una *Phytomonas*. Mayor identificacion sobre la investigacion precisa de la especie, se publicara, en el futuro. (Resumen del autor).

... Franco de ... J. A. ... 1945.
... estudos do agente etiologico da bacteriose da mandioca. (Nuevos ... del agente etiologico de la bacteriosis de la yuca). Arquivos Instituto Biologico ... Sol-Jen.

... estudio del autor ... sobre un cultivo del agente ... de la bacteriosis de yuca, ... Pohl y M. dipt Pohl, ... autores lo compararon con un cultivo de *Phytomonas manihotis* aislado ... W. Burkholder y con otro de *Bacillus manihotus*, Drummond e ..., ambos recibidos de Burkholder. El cultivo aislado por Arthaud-Berthet y Bondar no se encuentra disponible. No se encontraron diferencias ... entre los tres aislados en cuanto a caracteres morfologicos, ... fisiologicos o serologicos, contrario a lo inferido previamente ... descripciones de Burkholder, Drummond e Hipolito. Se halla que el ... de la bacteriosis de la yuca es *Phytomonas manihotis* (Arthaud-Berthet) ..., con Xanthomonas ... como sinonimo. (Resumen del autor).

... A. ...
... BACTERIOSE da mandioca e do alpim. (Bacteriosis of cassava). Porto Alegre, Brasil, Directoria de Agricultura, Industria e Commercio. Secção de Fomento Agricola. Circular No. 2)

Bacterial disease, caused by *Bacillus manihotis* Bondar (reclassified as *Xanthomonas manihotis*) is characterized by leaf spotting, wilting, latex ..., blisters and necrosis of the stems. Susceptibility of two ... is compared. Control measures are included. (CIAT's 2000...Vol.I).

17. ..., A. ... 1931.
Pesquizas sobre *Phytomonas* ... (Research on *Xanthomonas manihotis* (*Phytomonas* ...). Memorias do Instituto Oswaldo Cruz 25(4): 299-302.

Different culture media were tested for ... *manihotis* (*Phytomonas* ...), a flagellate found in the latex of *Manihot esculenta* (*M. palmata*). ...evy and Machwal's, Noeller's and the classical N.N.N. media were evaluated, all ... which are based on horse blood. Human blood gave the best results. Plant-to-plant inoculation procedures were tried, using latex or grafts from infected plants. This last method gave positive results. (Summary from CIAT, entry No. 2477).

... ..., A. A. 1941.
O agente da bacteriose da mandioca. (The causal agent of cassava ...). O Biologico 7(2): 37.

Cassava bacteriosis causes serious damage in the State of Sao Paulo, Brazil. Modifications on the taxonomic nomenclature of cassava are discussed. The first name was *Bacillus manihotus* Arthaud-Berthet. Other names have been used: *Bacillus manihot* sp. nov. (1931), *Bacillus manihotus* Arthaud-Berthet (1930), *Bacillus manihotis* Berthet et Bondar (1940), *Phytomonas manihotis* (Arthaud-Berthet e Bondar) Viegas. Finally, the author of this paper established that, according to the nomenclature priority laws, the name should be *Phytomonas manihotis* (Arthaud-Berthet) Viegas. (Summary from CIAT's 2000 Abstracts on Cassava Vol.1).

19. BONDAR, G. 1939.
A bacteriose da mandioca. (Cassava bacterial blight). Campo 10(119): 28-30.

A description is given of the symptoms of cassava bacterial blight caused by *Xanthomonas manihot*, with the purpose of supplying farmers with a field identification guide and some methods of control. Symptoms differ between sweet and bitter varieties, but the intensity of the attack is equally devastating. Root wt and starch content of heavily affected plants are reduced considerably. The causal agent was confirmed by means of the Koch test. A description is presented of the bacterium culture in nutritive broth and agar. It was concluded that (1) disease transmission is through vector or by direct contact; (2) healthy cuttings from infected plants are susceptible to the disease; (3) sweet varieties are more susceptible than bitter varieties. Preventive measures recommended are (1) plant as soon as possible cuttings from healthy plants of resistant varieties; (2) prepare the cuttings without damaging the peel in any way; (3) disinfect the cuttings; (4) avoid planting cassava in fields affected by the disease in previous seasons; (5) control pests; and (6) avoid direct contact of cuttings with manure. (Summary from CIAT's Abstracts on Cassava Vol. II).

20. BONDAR, G. 1940.
Molestia bacteriana da mandioca. (A bacterial disease in cassava). Boletim de Agricultura (Sao Paulo) 16: 513-524.

Information in this paper is concerned with the isolation, ifentification and etiology of *Bacillus manihot* causal agent of a bacterial disease in cassava. Symptoms are characterized by decay of young shoots, latex exudation, defoliation and necrosis of aerial parts. The bacterium is also found in cuttings stored for long periods. A significant decrease of starch content in the tubers was observed; chemical analysis of sick tubers showed the following: moisture 84.98%; starch content 9.60%; starch content on dry matter basis 62%. Pathogenicity trials and control measures are included. (Summary from CIAT's 2000 Abstracts on Cassava Vol.I).

21. BONDAR, G. 1941.
Uma nova molestia bacteriana das hastes da mandioca. (A new bacterial disease of cassava stems). Chacaras e Quintaes 5(4). 15-18.

A description is given of the symptoms found in cassava plantations attacked by the bacterium *Bacillus manihotis (=Xanthomonas manihotis)*. In recently planted fields, the plants die from the attack. When infected cuttings are used, they rot before germinating. Some preventive measures recommended are planting healthy material, rotating crops and using resistant varieties. (Summary from CIAT's Abstracts on Cassava Vol.II).

[illegible] Weber, pp. [illegible].

[illegible] cytological [illegible] of cassava bacterial blight disease. The incidence of [illegible], entomophagous fungi, is [illegible] and [illegible] of the causal [illegible] and macroscopic data are given of the latter. [illegible] Abstracts on Cassava, Vol.II).

[illegible] of cassava. Plant [illegible] 64.

[illegible] on the identities of the causal agents of bacterial [illegible] cassava throughout the world are discussed. (Author's [illegible].

[illegible] sp. n., [illegible] sp. n., and [illegible]. (Arthaud-[illegible] Vieqas. Phytopathology 62(2): 141-149.

A description is given of 3 bacterial pathogens. Two are new species, [illegible] sp. n. which causes a wilt and root rot of carnations, and [illegible] sp. n., which causes a bulb rot of onions. The third description is of *Xanthomonas manihotis* (Arthaud-Berthet et Bondar) Vieqas, a bacterium causing a wilt of cassava and of which no adequate description has been given hitherto. (Author's summary).

25. [illegible] A., J. J. 1972.
Foliar bacterial de la yuca. *Manihot esculenta* Pohl. (Cassava leaf bacterial blight). Revista de la Facultad Nacional de Agronomia de Medellin 27(1): 56-59.

From healthy and infected leaf tissue, a bacteria resembling *Pseudomonas solanacearum* was purified. The pathogenicity of the bacterium was proved by inoculating healthy plants of cassava. New bacteria were isolated from the inoculated plants and showed to be similar to the first purified. Although Bouriquet mentioned the occurrence of *Pseudomonas solanacearum* in cassava as promoter of drastic foliage wilt he considered that *Bacteria robici* was the agent causing the blight in leaves. This was confirmed by Dulong in Madagascar. Observations made by the author showed that the spread of the bacteriosis is favoured by the rainy season and is restricted by the dry season. The Author considered that both *B. robici* and *P. solanacearum* in cassava may correspond to special different forms within the *P. solanacearum* species; in such a case, reference must be made to *P. solanacearum F. robici* and *P. solanacearum F. manihotis* respectively. Control measures are given. (Summary from CIAT's 2000 Abstracts of Cassava, Vol.I).

26. CASTAÑO A., J. J. 1972.
Marchitez bacterial de la yuca, *Manihot utilissima* Pohl. (Bacterial wilt of cassava, *Manihot utilissima* Pohl). Revista de la Facultad de Agronomia, Medellin, 27(1): 43-55.

A bacterial disease affecting yuca, *Manihot utilissima* Pohl, was found in plant material submitted from several areas of the Atlantic Coast of Colombia. The disease appeared as a mucilaginous exudation on the stems, a wilting or yellowing of the leaves and a subsequent drying. The causal agent was found to be a gram-negative bacterium which showed some characteristics quite similar to those of the vascular *Xanthomonas* group. This bacterium coincides with the one reported by Duarte Silveira as *Bacillus manihotis* (Arthaud-Berthet) Breed et al., that causes a wilting of yuca in Brazil. Also, with *Bacillus manihotis* (Arthaud-Berthet et Bondar) Viegas, and with *Xanthomonas manihotis* n. sp., all of which seem to be synonyms of the same organism. The name *Xanthomonas manihotis* (Arthaud-Berthet) Breed et al. f. specialis, is suggested for the causal agent of the bacterial wilt described. The disease is different from the one described as "fire" or "blight" of the yuca leaves caused by *Bacterium manihotis* (E. F. S.) Berney et al. (Author's summary)

27. [illegible], J. B. DE. 1957.
A cultura da mandioca e a bacteriose. (Cassava cultivation and bacterial blight). Suplemento Agricola No.6.

A brief description is given of the importance of cassava bacterial blight as a factor limiting the production of this crop. The seriousness of the disease is associated with the susceptibility of the variety and planting in poor soils. Symptoms observed in the field are explained in detail. (Summary from CIAT's Abstracts on Cassava Vol.II)

28. CENTRO INTERNACIONAL DE AGRICULTURA TROPICAL. 1973.
Cassava bacterial blight. Cassava Technical Bulletin No. 1.

CBB was first recorded in Brazil, later in Colombia and other S. American and African countries. The symptoms observed and described here are similar to those induced by *X. manihotis* (Arthaud-Berthet) Starr. Studies in S. America suggested it is different to some degree from some *X. manihotis* and similar to some *Pseudomonas* sp. The modes of transmission of CBB are detailed including through tools, machinery, clothing, vegetative materials and rainsplash. Cultural control measures are recommended.

29. CENTRO INTERNACIONAL DE AGRICULTURA TROPICAL. 1971.
Cassava production systems; bacterial disease. In its Annual report. Cali, CIAT. pp.25, 31-32.

Using isolates from infected plants it was found that *X. manihotis* entered the plant through stomata or injured tissue causing symptoms of leaf spots, blight, dieback, and wilting depending on the susceptibility of a particular cultivar; it spread by means of rain drops splashing the bacterium from plant to plant or by using contaminated tools. Using infected cuttings spread the disease from one season to another.

30. CENTRO INTERNACIONAL DE AGRICULTURA TROPICAL. 1973.
Plant pathology; cassava bacterial blight. In its Annual report, Cali, CIAT. pp.81-84.

Studies on the etiology of *X. manihotis* in Africa and America were performed to determine if the causal agent of CBB in both continents was the same organism. It was concluded that CBB isolates from Africa and America belong to the same bacterial species, except for *X. cassavae*. Other studies dealt with dissemination, survival and control of CBB, and the estimation of losses due to the American strain of the disease.

31. CENTRO INTERNACIONAL DE AGRICULTURA TROPICAL. 1974.
Pathology; cassava bacterial blight. In its Annual report. Cali, CIAT. pp.62-66.

Comparative studies showed that isolates of CBB from Asia were physiologically similar to some isolates from Africa and America. Further study showed that CBB moves inside the host plant mainly through the xylem tissues. Screening for resistance under field conditions was continued to attain perfection. CBB dissemination through root infection, soil splash, insect vectors and true seeds were studied with remarkable results. Conditions favourable to CBB survival were also investigated.

32. COSTA NETO, J. P. DA. 1937.
Relacao das doencas ate agora encontradas, pelo servico de biologia agricola, nas plantas cultivadas e algumas selvagens no Rio Grande do Sul. (Diseases identified in some cultivated and wild plants in Rio Grande do Sul): Revista Agronomica (Brazil) 1(6/10): 286-297.

The diseases attacking cultivated and wild plants in the state of Rio Grande do Sul are identified. Class, order, family and species of the pathogen (bacteria or fungus), common name of the disease and susceptible plant species, visible morphological symptoms, and origin of material attacked are presented. Cassava is attacked by *Xanthomonas manihotis*, the causal agent of bacterial blight. Diseased material was collected in Cai, Gravatai, Lageado, Osorio, Taquari and Tupaceretan. (Summary from CIAT's Abstracts on Cassava Vol.II)

33. DESLANDES, J. A. 1974.
Observacoes fitopatologicas na Amazônia. (Phytopathological observations in the Amazon region). Boletim Fitosanitario 1(3/4): 198-242.

This is a study on the main diseases of several tropical crops. As regards cassava, the most important disease is root rot, which presents symptoms similar to those of bacterial blight but whose causal agent is unknown. Bacterial blight, *Xanthomonas manihotis*, is found throughout the state. Of minor economic importance are the leaf spots caused by *Cercospora caribaea* and *C. henningsii*. (Summary from CIAT's Abstracts on Cassava Vol.II)

34. DRUMMOND, O. A. and O. HIPOLITO. 1941.
Notas sôbre a bacteriose da mandioca. (Cassava bacteriosis) O. A. Drummond and O. Hipolito. Ceres (Brazil) 2: 281-307.

The authors describe the disease known as bacteriosis or "... disease" of cassava, *Manihot utilissima* Pohl, *M. dulcis* Poh... serious and widely disseminated disease, caused by *Bacte...* sp. This organism grows well only in a special medium ma... shoots. Several isolations were made from diseased plant... inoculations with pure cultures gave 77% positive result... was studied in pure cultures obtained from isolation... an... The following characteristics are described: size 1.0-4 ... bacilli lopho or monotrichia; gram negative; gelatin lic... sacciform type, in 3 to 4 days; nitrates are reduced to ... hydrolization of starch; no production of indol; capsul... from lactose, manite, salicine, amigdaline and inosite; ... xilese, arabinose, levulose, maltose, glucose and dextrin ... attacked, but some tests gave positive results. Galact... results. The bacteria is killed at 77.5°C, when exposed ... organism is named *Bacterium manihotus* n. sp. since it ... and polar cilia. The nomenclature of Smith is ... with which the authors do not agree, for ... given by Bergey in 1923 to the bacteria of the ... Donovan in 1909 to describe the forms of leptomonas and ... live in the latex of plants. The best authorities of the ... flagellate accept this terminology. *Phytomonas* Bactris is ... to *Phytomonas* flagellate and this is an older name. Accord... of nomenclature, accepted at the II International Congress ... held in London in 1936, "generic homonyms are not permitt... Protista." (2) As shown by Buckholder, the group *Phyto...* Bergey, is an artificial one so the name *Bacter...* given ... to the bacilli with polar cilia is as good as ... Experiments were undertaken to study the transmissibility ... and two types of spreading the disease were found: by dis... are commonly used to plant the cassava and by contaminat... The disease can be controlled by the following methods: ... of contaminated stems which can be the only source of ... regions where it does not exist yet; eradicating the ... the dew and rain drops are able to carry the disease from ... raising resistant varieties of cassava. Seventy varieties ... and 5 showed some resistance. This work will be continued ... summary)

35. FERREIRA FILHO, J. C. et al. 1942.
Manual da mandioca, a mais brasileira das plantas uteis ... e doencas, industria. (Manual on cassava: its cultivation ... diseases, industry) Sao Paulo, Edicao da Chacaras e Quint...

The geographic distribution, importance, history, ... study of the organism in different media, bacteriophage, ... control and resistant varieties, are discussed for bacter... *manihotis*.

36. PEREIRA, J. R. J. 1955.
Consideracoes acêrca da provável identidade entre *Bacterium robicei* Bour. e *Xanthomonas manihotis* (Arthaud Berthet) Burk. (Considerations regarding the probable identity of *Bacterium robicei* Bour and *Xanthomonas manihotis* (Arthaud Berthet) Burk. Agros, Porto Alegre, 6, 3, pp. 111-117.

The symptoms of the foliar diseases of cassava caused by *Bacterium robicei* in Madagascar and *Xanthomonas manihotis* in Brazil are similar; the latter also attacks the stems. Moreover, there are certain resemblances in the characters of the two organisms which point to their possible identity, but so far the author has been unable to produce a culture of *B. robicei* for the necessary comparative studies.

37. PROLICH, G. et al. 1970
Yuca o mandioca. (Cassava). In their Enfermedades y plagas de las plantas tropicales; descripcion y lucha. Leipzig, Alemania, Edition Leipzig.

The symptoms and causal agent, *Xanthomonas manihotis*, responsible for CBB, are briefly described.

38. GALL, F. et al. 1968.
Doencas da mandioca, *Manihot utilissima* Pohl. (Cassava diseases, *Manihot utilissima* Pohl). In their Manuel de Fitopatologia. Sao Paulo, Agronomica Ceres. pp.298-305.

Nine cassava diseases are described. Causal agents are *Xanthomonas manihotis*, *Cercospora henningsii*, *C. Caribaea*, *Oidium manihotis*, *Sclerotium* , *Phyllosticta manihotis*; witches-broom disease, cassava common mosaic and cassava nerve mosaic are caused by viruses. Data given concern general aspects, symptoms, etiology and control.

39. HAHN, S. K. and R. J. WILLIAMS. 1973.
Investigations on cassava in the Republic of Zaire. Report to the Commissaire d'Etat à l'Agriculture, République de Zaire. Ibadan, IITA. Mimeo.

CBB was first observed in Gungu region of Bandundu province between 1969 and 1970. It was widespread between Bandundu province and Bas Zaire, and was more severe in the savanna than in the forest, and on hill tops than in wooded valleys. Insects are said to aid its spread. The symptoms as observed there are given. Isolates were examined to confirm that the causal agent was *X. manihotis*.

40. HANSFORD, C. G. 1938.
Annual report of the plant pathologist, 1936. In Report, Department of Agriculture, Uganda, 1936-37 (Part II). (Entebe), Department of Agric. pp.43-49.

Some cassava varieties were widely affected by *Bact. caseavae* n. sp., producing dark green, water soaked, angular leafspots 1 to 2mm. in diameter, especially on the lower surface. The older spots became confluent, and were often arranged in irregular lines along the main veins, though they often developed round the edges of the spots caused by *Cercospora cassavae (C. henningsii)*. On very susceptible varieties complete ringing at the original site of infection was followed by the death of distal parts. In culture, the bacteria (inoculations with which into young cassava roots gave typical symptoms) with a few peritrichiate flagella; agar colonies were round, smooth, lens-shaped with entire edges, translucent, yellow, and of uniform structure. (Abstract from Review of Applied Mycology Vol.17, 1938.)

41. IKOTUN, T. 1977.
Survival of *Xanthomonas manihotis*, the cassava bacterial blight pathogen. In Persley, G., E.R. Terry and R. MacIntyreed, eds. Cassava bacterial blight; report of an interdisciplinary workshop held at IITA, Ibadan, Nigeria, 1-4 Nov. 1976. Ottawa, IDRC. pp.24-27.

This study investigated the modes of survival of the causal agent of CBB enabling the pathogen to be transferred from one rainy season to another to reinfect new cassava crops. *X. manihotis* s us to be restricted to the 0.5 cm. zone in soils infested with CBB. As this is the part of the soil that is usually disturbed during cultural practices, *X. manihotis* in the soil can be controlled to some degree by loosening and exposing the surface soil for a given period before planting. Additionaly pieces of infected plants should be burnt on infected farms. In experiments in which cultures of *X. manihotis* were added to different soil types, the bacteria survived 21-28 days. It survived longer in near neutral than in acid soils. Hence it is felt that planting cassava in acid soils may help to check infection through soil splashes.

The study discovered that bacterial exudates and infected host plant materials are more important factors than infected soils in the survival and transfer of CBB from one planting season to another because *X. manihotis* survives longer in those media; hence the author emphasises the removal and destruction, by burning or burying, of infected plant parts to prevent the survival and transfer of the causal agent.

42. INTERNATIONAL INSTITUTE OF TROPICAL AGRICULTURE. 1976?
Description and evaluation of major cassava diseases in Africa. Ibadan, Root and Tuber Improvement Program, IITA. 14p.

Cassava bacterial blight is among the five diseases of cassava covered by this paper. Its symptoms are described, graded into primary and secondary. Five classes of CBB severity are recommended for field surveys.

45. INTERNATIONAL INSTITUTE OF TROPICAL AGRICULTURE. 1973.
Root and Tuber Improvement. In its Report 1972/1973. Ibadan, IITA. pp.21-22.

CBB was first identified in West Africa in 1972. A survey of CBB attack was conducted in 1972 in IITA nurseries. Symptoms observed were described. Studies showed that resistance to CBB is associated with resistance to CMD.

46. LOZANO, J.C. 1973.
Bacterial blight of cassava in Central and South America: etiology, epidemiology and control. In International Symposium on Tropical Root Crops. 3rd, Ibadan, IITA. 19p.

Bacterial blight of cassava, *Manihot esculenta*, is a serious problem in Central and South America and has been observed in parts of Africa. Symptoms include leaf spotting, wilting, dieback, gum exudation on young shoots and vascular discoloration in mature stems and roots of susceptible cultivars. Dispersal by rain splashing is the most important means of dissemination within localized areas. Dissemination from one area to another occurs through infected planting material or through the use of contaminated tools. Delay in spread of the disease has been obtained by pruning infected plants. The use of resistant varieties and the production of certified bacterial-free planting material, obtained from plants propagated from shoot tip cuttings, give satisfactory control. (Author's summary).

47. LOZANO, J.C. 1972.
Bacterial blight of cassava, *Manihot esculenta* Crantz, in Colombia: etiology, epidemiology, and control. Ph.D. Thesis. Madison, University of Wisconsin. 114p.

A bacterial blight of cassava, *Manihot esculenta*, Crantz has become an increasingly important problem in Columbia because it causes extensive losses to an important source of food. Studies reported here were concerned with the isolation, identification, pathogenicity and dissemination of the casual organism and with the development of control measures. Symptoms of the disease are characterised by leaf spotting and blight of leaf tissues; wilting, dieback, and exudation of gum on young shoots; and vascular discoloration and necrosis in mature and old stem portions of susceptible cultivars. These symptoms are similar to those reportedly induced by *Xanthomonas manihotis* (Arthaud-Berthet) Starr: but studies on the morphology, physiology, serology, and phage susceptibility of the bacterium isolated in Colombia and Brazil suggest that it is sufficiently different from *X. manihotis* to be considered a separate species.

46. LOZANO, J. C. 1973 (Cont'd)

The cassava blight bacterium (CBB) differs from *X. manihotis* in cell size, motility and flagellation, production of H_2S, utilization of nitrate, starch hydrolysis, and in several serological relationships. A comparison of CBB with the type culture of *X. manihotis* revealed that the two bacteria also differed in pathogenicity, growth rate, serological characteristics and phage susceptibility. CBB is a gram-negative slender rod, motile by means of a single polar flagellum, not encapsulated and does not form spores. It is an aerobic, fast-growing bacterium, which forms no pigment on sugar-containing media. It hydrolyzes starch and gelatin and reduces litmus milk. It does not induce a hypersensitive raction on tobacco leaves or cause soft rotting of potato tubers, or cassava roots. It produces levan, catalase, arginine dihydrolase and lipase but does not produce H2S, indole, urease, tyrosinase, or phynylalanine deaminase. It is able to grow in ordinary media plus NaCl or tetrazolium chloride at maximum concentrations of 2.5 and 0.2%, respectively. The bacterium utilizes nitrate and ammonium as sources of N; most simple sugars can serve as sources of C, but acid is not produced; various amino acids and other organic acids are readily utilized. CBB can be separated by serological and phage-typing methods from species of *Erwinia* (3), *Pseudomonas* (2), and *Xanthomonas* (10), including *X. manihotis*. A *Bdellovibrio* sp. caused lysis specifically on CBB and could be used to separate CBB from other plant pathogenic bacteria. Isolates of CBB from distinct geographical areas could not be grouped on the basis of differences in virulence or biochemical characteristics. They belonged to two different serological groups; and two additional groups could be distinguished on the basis of differences in ability to hydrolyze starch and utilize sucrose, cellobiose and trehalose. However, these serological and biochemical groups were not correlated, nor were they related to geographical origin. Cassava leaves were inoculated by spraying aqueous suspensions of CBB cells and maintaining the plants under high moisture conditions for 6 h after inoculation. Addition of Tween 20(0.01%) increased effectiveness of this procedure. Stem puncture was an effective method of inoculation as well. CBB normally penetrates the host via stomatal openings and wounds of epidermal tissues. The bacterium eventually invades the vascular tissues and in leaves and young shoots, it causes extensive breakdown of parenchymatous tissues. In mature, highly lignified tissues of old stems or roots, the bacterium remains restricted to the vascular tissues. CBB moves systemically into vascular strands of roots of susceptible cultivars; in very susceptible cultivars it was found infecting roots 4 months after leaf spray-inoculation. Dispersal by splashing raindrops is probably the most important means of dissemination of CBB in localized areas. Dissemination from one area to another can also occur by means of infested vegetative "seed." Infested tools can also spread the bacterium. Controlled inoculation experiments in the field revealed that spread is correlated with total rainfall and occurs in the direction of prevailing winds. No dissemination occurred to plants growing 15 m away from an inoculum source. Satisfactory control of the disease was obtained by pruning most of the aboveground portion of infected plants, leaving only a 30-40 cm section at the base of the stem. However, this control method was dependent on (a) the susceptibility of the cultivars and (b) the length of time between initial infection and pruning.

[illegible]

[illegible] thermotherapy provided a good control method since healthy plants were obtained from infected cultivars. This control method seems promising to clean up promising cultivars in breeding and selection programs or as a routine method for the production of certified cassava "seed." Disinfestation of tools used during routine cultivation procedures is also suggested to prevent dissemination of the pathogen. Twenty-one cassava cultivars were classified as resistant to CBB after greenhouse inoculation of more than 1200 cultivars obtained from the Centro Internacional de Agricultura Tropical CIAT, Cali(Colombia). The resistance of these cultivars appeared related to restriction of penetration and systemic invasion by the parasite. Two cultivars, M. Col. [illegible] and M. Col. [illegible], were characterized by a hypersensitive reaction which limited the size of the lesions on leaves. The use of resistant cultivars remains the most promising method for control of the disease in the tropics. (Author's summary)

47. LOZANO, J. C. 1978.
Enfermedades importantes de la yuca. (Important diseases of cassava). In Curso sobre producción de yuca. Cali, Colombia. Centro Internacional de Agricultura Tropical. pp.1-15.

A description is given of some diseases that attack cassava, and some control measures are given. Diseases dealt with are bacterial blight, bacterial stem rot, African mosaic, common mosaic, leave vein mosaic, witches'-broom, brown leaf spot, superelongation, cassava ash, anthracnose, rust, infected propagating material, pre- and post-harvest root rots. A key for identifying said diseases is included. (Summary from CIAT card No. 7447

48. LOZANO, J. C. and R.H. BOOTH, 1974.
Diseases of cassava (Manihot esculenta Crantz.) Pans 20(1): 30-54.

The paper reviews much of the literature relating to the major bacterial, including CBB, viral and fungal diseases of cassava and presents this together with additional information gained by the authors. The importance of these diseases in reducing yields of this important source of carbohydrate is stressed. However, while much information is presented on symptoms and nature of the pathogens, little data is available on control measures. The authors emphasise the need for more active research, in particular into identifying and describing sources of disease resistance and into other simple means of disease control. (Authors' summary)

49. LOZANO, J. C. and SEQUEIRA, L. 1974.
Bacterial blight of cassava in Colombia; Etiology. Phytopathology 64(1): 74-82.

The bacterial blight of cassava *Manihot esculenta* has increased in severity in Colombia during the past 5 years. Symptoms on susceptible cultivars include leaf spotting, wilting, die-back, and gum exudation on young shoots, and vascular discoloration in mature stems. The bacterium (CBB) penetrates via the stomata or through wounds in epidermal tissues. It invades the vascular tissues of leaves and young shoots, resulting in extensive breakdown of parenchymatous tissues. In highly lignified tissues of old stems or roots, the bacterium remains restricted to the vascular strands. These symptoms are similar to those reportedly induced by *Xanthomonas manihotis*, but the isolates of CBB differ from the former in cell size, motility, production of H_2S_2, utilization of nitrate, hydrolysis of starch, and in several serological characteristics. CBB is a gram-negative, motile, slender rod, with a single polar flagellum. It is aerobic, fast-growing, and forms no pigments on carbohydrate-containing media. It hydrolyzes starch and gelatin, and reduces litmus milk. It produces levan, catalase, arginine dihydrolase, and lipase, but not H_2S, indole, urease, tyrosinase, or phenylalanine deaminase. It grows in ordinary media plus NaCl or tetrazolium chloride at a maximum concentration of 2.5 and 0.2%, respectively. It utilizes nitrate and ammonium as sources of nitrogen, and most of the simple sugars as sources of carbon, but acid is not produced; various amino acids and other organic acids are readily utilized. Isolates of CBB from distinct geographical areas induced similar symptoms on cassava, but belonged to two different serological groups, each separable into two additional groups on the basis of their ability to utilize sucrose, cellobiose, and trehalose as carbon sources. However, these groupings were not correlated with geographical origin of the isolates. CBB was separated by serological - and phage-typing methods from three species of *Erwinia*, two of *Pseudomonas*, and ten of *Xanthomonas*, including *X. manihotis*. *A Bdellovibrio sp.* caused lysis of CBB specifically and was used to separate CBB from other plant pathogenic bacteria. (Author's summary).

[illegible]

Bacterial [illegible] ing a severe [illegible]
tuber yield [illegible] heim part of Zaire [illegible]
transmitted [illegible] lace through [illegible] Distant. System[illegible]
[illegible] tion of the stem [illegible] to vascular browning, formation of [illegible]
pockets in the [illegible] which exude a yellow-white exudate [illegible]
drying of the [illegible] and necrosis of the stem tips. Angular [illegible]
spots [illegible] small droplets of exudate on the [illegible]
of the [illegible] slight chlorosis of areas of the lamina [illegible]
infection was [illegible] in Zaire. Epidemics develop under [illegible]
heavy rainfall. The cultural [illegible] morphology, the [illegible]
[illegible] cross-inoculation [illegible]
[illegible] leaf spotting of [illegible]
[illegible] [illegible] from a Brazilian [illegible]
[illegible] by a lower amylase activity. A critical [illegible]
[illegible] suggests a world-wide distribution of the [illegible]
[illegible] Development of bacterial wilt in Zaire [illegible]
control by resistant cultivars are discussed. (Author's summa[illegible]

[illegible]. BRIAN, [illegible]
Division of [illegible] Biology, [illegible] of the Depart[illegible]
Agriculture, Mauritius, [illegible]

In the study of cassava bacterial blight inoculations [illegible]
[illegible] were carried out [illegible] isolates from the
[illegible] and also [illegible] from diseased
and [illegible] cassava. All inoculations of cassava leaf
and cassava [illegible] gave positive results whereas those with
[illegible] proved negative. The cassava organism was [illegible]
filed by [illegible]. (Summary from Review of Applied
Mycology [illegible] p.325).

[illegible]. PACCA, [illegible]
[illegible] estudo das doenças da mandioca. (Contribution to the
study of cassava diseases). Bragantia 3: 171-176.

The author's observations are reported. Distribution, symptoms, aetiology and control of 4 diseases are described: a bacterial blight (very similar to *Bacillus manihotis* Arnaud et Berthet), cassava rust (very similar to *Uromyces manihotis Henn.*) and 2 leaf spots (*Cercospora cruenta* Ciferri Phaeoisariopsis manihotis Stev et Wolf and possibly *Helminthosporium manihotis nov. sp.* (Summary from CIAT's 2000 Abstracts on Cassava)

53. PARADELA FILHO, O. 1971.
Principais doencas da mandioca. (Principal diseases of cassava). Agronômico 23: 116-124.

A description is given of different aspects of cassava diseases caused by (1) *Xanthomonas manihotis* (etiology, geographical distribution, symptomatology and control; (2) *Cercospora henningsii* and *C. Caribaea* (symptomatology and control); (3) *Oidium manihotis;* (4) *Rosellinia bunodes;* (5) *Diplodia manihotis;* (6) *Sclerotium rolfsii.* Symptomatology is the only aspect dealt with for the last 4 diseases. The economic impact of these diseases is also discussed. (Summary from CIAT's Abstracts on Cassava Vol.II)

54. PEREGRINE, W. and M. SIDDIQI. 1972
A revised and annotated list of plant diseases in Malawi. Phytopathological Papers No. 16, 25.

This list includes 250 disease records. The annotated host list includes cassava *Manihot esculenta* Crantz which is attacked by *Xanthomonas* sp. causing angular, translucent spots with brown margins, angular and yellow-grey exudate on lower surface, and severe defoliation in the rains.

55. PEREIRA, A.L.G. and A. G. ZAGATTO, 1967.
Etiologia da "mancha angular" na folha da mandioca, *Manihot utilissima.* (Etiology of angular leaf spot of cassava, *Manihot utilissima*). Arquivos do Instituto Biologico (Brasil) 34(3): 153-160. 1967.

An experiment was conducted to establish the etiology of the cassava leaf spot present in the regions of Piracununga, Aquaí and Moji-Guacu, State of Sao Paulo (Brazil), affecting the Branca de Santa Catarina variety which was resistant to bacterial disease. A study was carried out comparing the bacteria isolated from leaf spots to the bacteria from stem tissues with typical symptoms of the disease. No obvious differences were found in the morphological, cultural, biochemical, physiological and pathogenic characters in both cases. The two organisms were classified as *Xanthomonas manihotis* (Arthaud-Berthet) Starr. It was also verified that the leaf spot disease, located at first in the leaf, can extend to the petiole and later to the stem. (Author's summary).

59. TERRY, E. R. 1974.
A mode of survival of *Xanthomonas manihotis*, the cassava bacterial blight pathogen. Paper presented at the 4th Annual Conference of the Nigerian Society for Plant Protection, IITA, Ibadan, Nigeria, February 11-13, 1974. NSPP Abstracts 1972-1975. Occasional Publication of NSPP. 1: 19.

Pelleted particles with varying dimensions viz: weight 9-70mg and diameter 0.3-0.7mm are formed from gum exudation on the abaxial leaf surfaces of cassava bacterial blight infected plants. One thousand three hundred and forty five (1,345) individual pelleted particles have been dislodged by gently prodding from a single plant during periods of heavy dew deposit. Each pelleted particle contains about 1.5×10^5 viable cells of *Xanthomonas manihotis*. Foliar inoculation with a suspension of bacterial cells derived from pellets and shake cultured for 48 hours in nutrient broth medium induces the typical cassava bacterial blight symptoms on susceptible varieties.

60. TERRY, E. R. 1976.
Diagnosis of cassava bacterial blight disease. In Persley, G, E.R. Terry and R. MacIntyre eds. Cassava bacterial blight, report of an interdisciplinary workshops held at IITA, Ibadan, Nigeria, 1-4 Nov. 1976. Ottawa, IDRC. pp.5-8.

Five characteristic symptoms of CBB are given, the most specific of them being the water-soaked angular leaf spots in the absence of which a cassava plant disease should not be diagnosed as CBB. The author further recommends the procedures for isolating the causal agent, *Xanthomonas manihotis*, on the diseased leaves and stem pieces. Spray inoculation, leaf rubbing, stem puncture, petiole puncture and leave clipping are advised to be carried out to confirm pathogenicity. Finally, reactions to be anticipated after applying those five methods of inoculation are outlined.

61. TERRY, E. R. 1977.
Fear of cassava bacterial blight in Africa makes control imperative. Field Crops and Livestock 29(3): 107-108.

The present state of knowledge on cassava bacterial blight is reviewed. Attention is paid to etiology and symptomatology, geographic distribution, epidemiology and control. (Summary from Abstracts on Tropical Agriculture)

62. VIEGAS, A. P. 1976.
Estudos sobre a mandioca. (Studies on cassava). Sao Paulo, Brasil, Instituto Agronômico do Estado de Sao Paulo, 214p.

Detailed information is given on the distribution, economic importance, symptomatology and etiology, of *Xanthomonas (Phytomonas) manihotis* responsible for CBB.

64. [illegible] and W.J. DOWSON, 1953.
[illegible] disease of cassava [illegible] in Nyasaland.
[illegible] Journal of Experimental Agriculture 21(82): 141-143.

A severe leaf-spotting leading to defoliation of 'Manihot' or Cassava [illegible] occurs in Nyasaland and has been shown to be due to a bacterium here described, for which the name *Xanthomonas cassavae* sp. nov. is proposed. A similar disease already recorded from Uganda is probably due to the same pathogen, which was first named *Bacterium cassavae* Hansford in error. *B. cassavae* in Hansford is synonymous with *B. faltans* (Manns and Taubennaus) Burgwitz, a common saprophyte of necrotic plant tissues. The wilt disease of Cassava in South America, said to be caused by *Xanthomonas manihotis* (Arthaud-Berthet) Starr is quite distinct and may not be due to a species of *Xanthomonas*. (Author's summary)

65. WILLIAMS, R. C., S.D. AGBOOLA, and R.W. SCHNEIDER, 1973
Bacterial wilt of cassava in Nigeria. Plant Diseases Reporter 57 (10): 824-827.

A bacterial wilt of cassava was observed in several areas of Nigeria in 1972. Symptoms and pathogen characteristics are similar to those of a cassava disease in South America caused by *Xanthomonas manihotis*. The disease is likely to be economically important in West Africa. (Author's summary)

66. ZAIRE, DEPARTMENT DE L'AGRICULTURE.
Maladies et pestes principales du manioc au Zaire. In its Programme National Manioc, rapport de progrès; décembre 1974 à décembre 1975. M'Vuazi (Gare-Mueke) Programme National Manioc, INERA. pp.6-9.

La flétrissure bactérienne (CBB) causée par *Xanthomonas manihotis* est une des maladies principales du manioc trouvées au Zaire. Pour se multiplier et se diffuser il lui faut une haute pluviosité et une haute humidité. Elle se dissémine généralement par voie de la pluie, du vent et des matériels de sémence. On essaie de produire des plantes de manioc qui soient résistantes aux maladies principales, surtout la flétrissure bactérienne, et qui aient d'autres bonnes qualités agronomiques.

C. EPIDEMIOLOGY & DISTRIBUTION

66. ARENE, O. B. 1975.
Distribution of diseases and pests of local cassava cultivars in Nigeria. Vol.1. East Central State Survey Report. Umudike (Umuahia). F.A.R.T.S. (unpublished).

The author discusses the distribution in Nigeria of CBB among other diseases of cassava.

ARIAS, C. 1975.
Country presentations: Venezuela. In Nestel, B. and R. MacIntyre, eds. The International exchange and testing of cassava germ plasm; proceedings of an interdisciplinary workshop held at CIAT, Palmira, Colombia, 4-6 Feb. 1976. Ottawa, IDRC, pp. 29-30.

The paper reported only those cassava diseases that have occurred and been evaluated in the culture introduction nursery under natural conditions. The most important is cassava bacterial blight. Quarantine restrictions enforced include an official certificate from the country of origin to the effect that the vegetative material is free of pests and diseases harmful to agriculture, and an import authorization from the Vegetal Sanitation Division of Venezuela's Ministry of Agriculture and Breeding.

CHUNSUK, S. and S. SINTHUPRAMA. 1975.
Country presentations: Thailand. In Nestel, B. and R. MacIntyre eds. The International exchange and testing of cassava germ plasm; proceedings of an interdisciplinary workshop held at CIAT, Palmira, Colombia, 4-6 Feb. 1975. Ottawa, IDRC. pp. 26-28.

It is reported that no survey of diseases and pests of cassava has been conducted in Thailand but that the country was apparently free of major diseases of the crop. It was guessed that if CBB was present it was not a major cause of losses. Imports of cassava planting materials from India and Africa have been recently restricted as a precautionary measure against introduction of diseases of the crop.

HAN, S.K., S.L. TAN and S.L. GEH. 1975.
Country presentations: Malaysia. In Nestel, B. and R. MacIntyre eds. The International exchange and testing of cassava germ plasm; proceedings of an interdisciplinary workshop held at CIAT, Palmira, Colombia, 4-6 Feb. 1975. Ottawa, IDRC.

Cassava bacterial blight caused by *Xanthomonas manihotis* and with symptoms of shoot die-back and angular leaf spots were observed in parts of Malaysia. Plant quarantine restrictions are imposed.

CONCEICAO, A.J. DE. 1975.
Country presentations: Brazil. In Nestel, B. and R. MacIntyre eds. The International exchange and testing of cassava germ plasm; proceedings of an interdisciplinary workshop held at CIAT, Palmira, Colombia, 4-6 Feb. 1975. Ottawa, IDRC. pp. 34-35.

Important diseases and pests of cassava in Brazil are enumerated. CBB (*Xanthomonas manihotis*) is said to be economically the most important as it causes the heaviest losses.

71. DHARMAPUTRA, T.S. 1975.
Country presentations: Indonesia. In Nestel, B. and R. MacIntyre eds. The International exchange and testing of cassava germ plasm; proceedings of an interdisciplinary workshop held at CIAT, Palmira, 4-6 Feb. 1975. Ottawa, CIAT.

Introduced in Java in 1852 by the government and successfully popularised throughout Indonesia between 1914 and 1918, cassava has become an important crop in Indonesia which ranks as one of the highest producers of the crop according to F.A.O. Production Yearbook (1971-1976).

It was reported that diseases of cassava were not serious in Indonesia by 1975. Cassava bacterial blight seemed to occur in Java and there is a project to establish cassava clones resistant to CBB.

72. INTERNATIONAL INSTITUTE OF TROPICAL AGRICULTURE. 1976.
Root and tuber improvement program; cassava. In its Highlights of 1976 research. Ibadan, IITA. 73-78

CBB was reported in more African countries. A detailed CBB survey was conducted in Cameroun from which its incidence and severity there were determined.

73. LOZANO, J.C. 1973.
Cassava bacterial blight (CBB). Palmira, Colombia. Centro Internacional de Agricultura Tropical. Information Bulletin No. 2. 10p.

The most important bacterial disease of cassava is Cassava Bacterial Blight (CBB). This disease was first recorded in Brazil, but later was reported in Colombia and observed in several other countries in South America and Africa. Symptoms of this diesease are characterized by leaf spotting, wilting, die-back, gum exudation on young shoots. Vascular strands of infected petioles and stem necrone appear as brownstrings. The bacterium is spread by the use of infected planting material and infected tools. The disease spreads rapidly during the rainy season because of rainsplash. The disease can be erradicated by removing and burning all plant debris, using healthy planting material, preventing the movement of people, tools and planting material from infected to clean areas, and using resistant cultivars. (Summary from CIAT's 2000 Abstracts on Cassava Vol. I).

74. LOZANO, J.C. 1974.
El anublo bacterial de la yuca, *Manihoti esculenta Crantz*, en America; etiologia, epidemiologia y control. (Bacterial wilt of *Manihot esculenta Crantz* in America: etiology, epidemiology and control). Fitopatologia 9(2): 110-119.

Bacterial wilt of cassava, *Manihot esculenta*, is the most serious disease in Central and South America, and it has recently been reported in Africa. The symptoms are foliage lesions, die-back, exudation of gum from the young sprouts, and vascular necrosis of stems and roots of susceptible cultivars. The disease spreads readily in the field through rain splashing. The dissemination from one area to another occurs through the planting of infected cuttings and by tools. Satisfactory control of the diseases was obtained with the use of resistant varieties and with certified seed obtained from healthy young sprouts. (Author's summary).

75. LUJAN, L. 1975.
Country presentations: Colombia. In Nestel, B. and R. MacIntyre eds. The International exchange and testing of cassava germ plasm; proceedings of an interdisciplinary workshop held at CIAT, Palmira, Colombia, 4-6 Feb. 1975. Ottawa, IDRC. pp. 17-18.

Sweet cassava varieties are traditionally grown for home consumption, industrial purposes and animal feed by small farmers in Colombia. Cassava bacterial blight is one of the economically important diseases of the crop there. It is most prevalent in regions of high relative humidity and mean temperatures of 25-30°C.

Quarantine measures are strictly enforced in Colombia which adheres to the international agreement signed in Rome on December 6, 1951.

76. PAZ BRIZ, F.R. 1975.
Country presentations: Ecuador. In Nestel, B. and R. MacIntyre eds. The International exchange and testing of cassava germ plasm; proceedings of an interdisciplinary workshop held at CIAT, Palmira, Colombia, 4-6 Feb. 1975. Ottawa, IDRC. p. 25.

Cassava bacterial blight is among the economically important diseases of cassava in Ecuador where coastal farmers grow the crop traditionally for human food. No quarantine restrictions were enforced by 1975.

77. PERSLEY, G.J. 1976.
Distribution and importance of cassava bacterial blight in Africa. In Persely, G., F.R. Terry and R. MacIntyre eds. Cassava bacterial blight; report on an interdisciplinary workshop held at IITA, Ibadan, Nigeria, 1-4 Nov. Ottawa, IDRC, pp.9-14.

The geographical distribution of CBB based on recent surveys in five countries of West Africa is given in detail. These are the Republic of Benin, Cameroun, Ghana, Nigeria and Togo. In both Nigeria and Cameroun CBB is rare in the forest zones [illegible] more frequently and with the greatest severity in mono-cropped cassava farms in the savanna regions, implying a relationship between CBB development, cropping system and environmental factors. In Nigeria, CBB was more damaging on high yielding varieties released for mosaic tolerance since 1960 than on local farmers' varieties. The occurrence of CBB in isolated parts of West Africa suggests that it has been present for many years. It is suggested that CBB came into West Africa through vegetative materials introduced from South America and Malagasy. It has become more important in recent years with attempts to popularize new varieties which were susceptible to the disease. (French version see No. 78).

78. PERSLEY, G.J. 1976.
Répartition et importance de la maladie des cierges du manioc en Afrique. In IDRC/IITA cassava bacterial blight workshop held at IITA, Ibadan, 1-4 Nov. 1976. 6p. mimeo.

On donne en détail la répartition géographique de la maladie des cierges de manioc (MCM) selon des visites récentes dans cinq pays d'Afrique occidentale, y compris la République Populaire du Bénin, Le Caméroun, le Ghana, le Nigéria et le Togo. Au Nigéria comme au Caméroun la MCM était plus répandue et sévère en monoculture de manioc dans les zones de savane que dans les zones des fôrets. Cela indique un rapport entre le développment de la MCM, les méthodes de culture et les faits de milieu. Au Nigéria les attaques de la MCM étaient plus fréquentes dans les exploitations plantées des variétes à hauts rendements et résistantes à la mosaique vulgarisées depuis 1960 que dans les fermes paysannes. La présence de MCM dans des parties isolées de l'Afrique occidentale suggère qu'elle y existait il y a beaucoup d'années. L'auteur pense que la MCM est entrée en Afrique Occidentale par voie des boutures de manioc introduites de l'Amérique du sud et de Malagasie. Récemment elle est devenue plus importante à cause des essais de vulgarisation de nouvelles varietés qui étaient susceptibles à la mosaique de manioc. (English text, see No.77).

79. PERSLEY, G.J. 1977b
Progress Report on IDRC Cassava Bacterial Blight Project, August, 1976 - July, 1977. Ibadan, IITA. 17p. mimeo.

Results from studies on the biology, ecology, epidemiology and control methods, including resistance screening, are discussed. (Author's summary).

80. PERSLEY, G.J. 1976.
Report on cassava disease survey in Cameroun. Ibadan, IITA, 31p. mimeo.

Cassava bacterial blight was found to be widespread, occurring from the highland savanna around Bamenda (1900m) eastwards across the guinea savanna to Garoua Boulai on the border with the Central African Republic. It also occurred in a localized area around Victoria and Buea in the west of the country. CBB occurred in both forest and savanna regions but was more prevalent in the savanna. (Author's summary).

81. PERSLEY, G.J. 1978.

Report on Cassava disease survey in Kenya. Ibadan, IITA. 16p. mimeo.

CBB was newly reported from Kenya. It occurred in the western cassava-growing region, near Lake Victoria. It was observed on experiment stations at Alupe (on the Ugandan border) and Kakamega, and on local farms between Busia and Kisumu. (Author's summary).

82. PERSLEY, G.J. 1978.
Report on cassava disease survey in Tanzania. Ibadan, IITA. 13p.

CBB is newly reported from Tanzania. It occurred in the Lake Victoria area, in the Mwanza and Bukoba regions. It was not observed on Zanziba nor in coastal region around Dar-es-Salam nor at Kilosa. It occurred on both experiment stations and local farms. (Author's summary).

83. PERSLEY, G.J. 1975.
Report on visit to Togo and Ghana, Ibadan, IITA. 8p. mimeo.

Cassava bacterial blight was newly recorded in Togo and Ghana, in coastal regions. Cultures of *Xanthomonas manihotis* from both countries were deposited in CMI culture collection, Kew, England. (Author's summary).

84. PERSLEY, G.J. 1977c.
Technical Report on IDRC Cassava Bacterial Blight Project. Ibadan, IITA. 21p. mimeo.

The distribution of CBB in Africa as shown by surveys in West and Central Africa is summarized. The results from studies on the ecology and epidemiology of the disease conducted between July, 1975 and December, 1977 are also discussed. A previously unreported potential for seed transmission was demonstrated by the recovery of *X. manihotis* from seed which had been stored at 5°C and 60%RH after 15 months. Treatment of the seed in hot water 60°C/20 mins

the pathogen. The pathogen survives the dry season in Nigeria in plant debris on the soil surface and as epiphytes on the leaf surface. The epiphytic population increases after the onset of the wet season and is a source of inoculum for new angular leaf spots. The pathogen survives in dead plant debris under dry conditions, and numbers decrease rapidly with increasing moisture. Evidence that it survives [illegible] was all negative.

Bacteriophages specific to *X manihotis* were isolated from plant material and these were found useful in the identification of isolates from ecological studies. Limited studies on pathogenic variation showed that cultures varied in aggresiveness, but there was no specific association of a given strain with a particular variety or locality. (Author's summary).

[illegible]LEY, G.J., E.R. TERRY and R. MacIntyre. 1977. Cassava bacterial blight; report of an interdisciplinary workshop held at IITA, Ibadan, Nigeria, 1-4 Nov. 1976. Ottawa, IDRC. 36p.

The papers discuss the diagnosis of CBB, its distribution and importance in Africa, control measures adopted or recommended in Nigeria, Zaire and Ghana. Others discuss breeding for resistance to CBB, survival of *Xanthomonas manihotis*, and the effect of shade and intercropping on the development of CBB. Country statements were presented for the Republic of Benin, Congo, Ghana and Togo. The concluding statement by participants is also included. (Abstract by G.J. Persley).

86. PERSLEY, G.J. and K. LEUSCHNER. 1975. Report on visit to Mid-West and East Central States, Nigeria, 4-9 December. Ibadan, IITA. 12p. mimeo.

This reports the incidence of pests and diseases of cassava in the former Mid-West and East Central States. Cassava bacterial blight was found to be damaging cassava in the two states. (Author's summary).

87. TERRY, E.R. 1975. Cassava germplasm resources, disease incidence and phytosanitary constraints at IITA, Nigeria. In Nestel, B. and R.MacIntyre eds. The International exchange and testing of cassava germplasm, proceedings of an interdisciplinary Workshop held at CIAT, Palmira, Colombia, 4-6 Feb. 1975. Ottawa, IDRC. pp. 38-40.

Under diseases of cassava in Africa, a table of bacterial diseases of *Manihot esculanta* is presented. It is shown that cassava bacterial blight with symptoms of leaf spotting and leaf wilting caused by *Xanthomonas manihotis* is found in Nigeria, Zaire and Cameroun and outside Africa in America and Indonesia. This is the only economically important bacterial disease of cassava that it would be potentially dangerous to introduce with germplasm into areas free from it. The ultimate control measure is the development of

cassava varieties resistant to CBB. Other bacterial diseases of the crop include bacteriosis with symptoms of leaf spotting caused by both *Bacterium cassavae* and *Xanthomonas cassavae* in Uganda, Congo Republic, Rwanda and Malawi. Another type of bacteriosis caused by *Bacterium robici* occurs in Madagascar. None of these bacteriosis has been reported outside Africa.

On the other hand cassava bacterial wilt with symptom of leaf wilting caused by *Pseudomonas solanacearum* occurs in Brazil only. The control for all these other bacterial diseases is not known precisely. Phytosanitary regulations in force in the various countries or regions of Africa are briefly presented.

88. TERRY, E.R. 1976.
Factors affecting the incidence of cassava bacterial blight in Africa. In Symposium of the International Society of Tropical Root Crops. 4th., Cali, Colombia. Proceedings. Ottawa, Canada, International Development Research Centre. pp. 179-184.

Cassava bacterial blight, *Xanthomonas manihotis*, is a widespread and damaging disease in Africa. Its severity varies with locality and climatic conditions. Factors that may affect its severity are soil type, cultural practices and varietal susceptibility. The distribution and economic importance of CBB in Africa and the results of epidemiological studies are included. (Author's summary).

88b. TERRY, E.R. 1974.
Some epidemiological factors affecting the survival and dissemination of *Xanthomonas manihotis*. In Okpala, E.U. and H.J. Glaser, eds. Workshop on Cassava Bacterial Blight in Nigeria. 1st, Umudike, Federal Agricultural Research and Training Station, pp. 39-43.

This report deals with certain epidemiological factors that affect the survival and dissemination of the pathogen, *Xanthomonas manihotis*. Typical symtoms of CBB are described, and data from field observations, laboratory and greenhouse experiments are included. It was found that during periods of heavy early morning dew deposits, water droplets form around the bacterial exudation on leaf surfaces. As solar radiation increases, these droplets evaporate, leaving pelleted particles containing up to 1.5×10^5 viable cells of *X manihotis*. Studies are in progress to determine (1) the possibility of lateral spread of *X manihotis* cells within pelleted bodies over long distances, eventually constituting soil inoculum, (2) the role of the grasshopper, *Zonocerus variegatus*, in the dissemination of the CBB pathogen, and (3) the survival of *X. manihotis* cells within the pelleted bodies under natural field conditions. (Summary from CIAT's Abstracts on Cassava Vol.II).

6. YIELD LOSSES

[illegible]. 1976.
Statement on the status of CBB in Africa by participants at... IDRC/IITA cassava bacterial blight workshop held at IITA, Ibadan, 1-4 Nov. 1976. 4p. mimeo.

CBB was first recognized as a damaging disease in Zaire in 1970, Nigeria in 1972, and has subsequently been reported in Ghana, Togo, Republic of Benin, Cameroon, and Republic of Congo. With the possible exception of Ethiopia, Kenya and Tanzania, CBB amy also be present in other countries, especially in West and Central Africa. It was estimated that in the area now known as Anambra and Imo states losses of cassava due to CBB amounted to ₦24 million naira (US $33 million). Serious economic losses have also been reported from Zaire, Togo and Republic of the Congo. Social implications of damage due to CBB are given. Eight control measures are recommended as well as five future research objectives, including rapid multiplication of high yielding, disease-resistant cultivars, and further study on the effects of agronomic practices on the development of CBB.

[illegible]. DIAZ, R.O. and J.C. LOZANO, 1977.
Enfermedades presentes en el cultivo de la yuca en Colombia. (Diseases found on cassava in Colombia). In Diaz, R. O. and Pinstrup-Andersen, P., eds. Descripcion agroeconomica del proceso de produccion de yuca en Colombia. Cali, Colombia, Centro Internacional de Agricultural Tropical. 14p.

The diseases caused by *Cercospora* spp. and *Xanthomonas manihotis* were found widely distributed in all the samples. Rust(*Uromyces manihotis*,) frog skin root disease and stem cankers (unknown causal agents) were restricted to certain areas of Colomibia. Superelongation (*Sphaceloma manihoticola*)and bacterial blight(*Xanthomonas manihotis*)were found in several zones; Phoma leaf spot (Phoma *Phyllosticta* sp.) was restricted to crops located at 1200 m above sea level, where temperatures are below 20°C during the rainy season. Actual losses caused by bacterial blight, Phoma leaf spot and frog skin root disease were estimated. (Author's summary).

[illegible]. LIMA, A.D.F. 1944.
Mandioca e aipim. (Bitter and sweet cassava). Boletim do Ministerio da Agricultura 33(12): 6-18.

A detailed description is given of a bacteriosis that attacks leaves and stems of cassava plants and affects normal root development. Crop losses up to 90% were recorded in the state of Santa Catarina. The plan designed to control the disease is explained in detail. On the other hand, losses caused by the cassava hornworm(*Erinnyis ello*) amounted to 80% in the district of Rio de Vermelho. Information is given of their growth habits in the field, annual fluctuations and experimental control methods. (Summary from CIAT's Abstracts on Cassava Vol.II) (abridged).

91b. OBIGBESAN, G. O. and E.O. MATULUKU, 1977.
Effect of potassium and bacterial blight on the yield and chemical composition of cassava cultivars. In Symposium of the International Society for Tropical Root Crops, 4th., Cali, Colombia. 1976. Proceedings. Ottawa, Canada, International Development Research Centre. pp. 185-188.

Studies on cassava cultivars having different levels of susceptibility to bacterial blight caused by *Xanthomonas manihotis* revealed that the infection exerted differential influence on the mineral nutrient and starch contents of the cultivars. The disease caused a reduction in macronutrient content, led to a higher accumulation of micronutrients in the diseased leaves, and affected root quality adversely by lowering the percentage of starch content. Despite the relatively greater tolerance of cv. 60506, CBB reduced its root and starch yields significantly. (Author's summary).

E. CULTURAL CONTROL

92. AGU, S.P.C. 1977.
Cassava bacterial blight workshop; suggestions for resolution. In IDRC/IITA cassava bacterial blight workshop held at IITA, Ibadan, 1-4 Nov. 1976. 2p. mimeo.

Objection was raised to the cultural control measures which the farmers were being required to adopt against CBB on the grounds that they are expensive and at the same time not feasible for most farmers. Changing the time of planting cassava as recommended, for instance, would not be practicable in mixed cropping equally recommended. It is absolutely necessary, therefore, for scientists to find through research a solution that would completely eradicate CBB or at least reduce it below epidemic scale.

93. AMARAL, J. F. DO. 1951.
Principais doencas das plantas cultivadas no Estado de Sao Paulo e Seus respectivos tratamentos. (The main diseases of plants cultivated in the State of Sao Paulo and their respective treatments). Biologico 17:179-188.

Control methods are briefly described for 130 diseases and pests attacking 44 crops in the State of Sao Paulo (Brazil). For cassava, two diseases are reported: Bacteriosis caused by *Xanthomonas manihotis* can be controlled by crop rotation and utilization of of resistant varieties. "Superbrotamento" or Witches'-broom disease (burning the plants and taking sanitary measures to select the cuttings for planting). (Summary from CIAT's 2000 Abstracts on Cassava Vol.I)

[illegible]. 1951.
[illegible] (Bacteriosis of cassava).
[illegible] Directoria de Agricultura, Industria e
[illegible] Secção de Agricultura. Circular No. [illegible]. 6p.

[illegible] Kandar (actually re-
[illegible]) is characterized by leaf spotting,
[illegible] & Arthr. [illegible], cankers and necrosis of the stems. Suscep-
[illegible] of varieties is compared. Control measures are included.
(Summary from [illegible] Abstracts on Cassava Vol.I)

[illegible]. [illegible].
[illegible]. Umudike, Umuahia-Ibeku, Nigeria.
[illegible] Agricultural Research and Training Station. Advisory Bul-
letin No. [illegible]. 4p.

[illegible] varieties of cassava in Nigeria are susceptible
to bacterial blight. Most serious outbreaks occur during the rainy
season. The causal agent is [illegible]. Characteristic
symptoms of the disease are wilting of leaves, defoliation and die-
back, accompanied by a creamy yellow exudation from infected parts.
[illegible] disease symptoms are included. Suggested control
measures are as follows: (1) use disease-free cuttings, (2) plant at
a time that will permit plants to establish well before heavy rains
[illegible], (3) use balanced fertilizer, (4) use resistant varieties such
as Nwango and Aburu-Asuo, which have proven to be tolerant in this
area, (5) rogue and burn diseased plants, and (6) rotate crops.
(Summary from IAT. Card No. 4913).

6. ANONYMOUS. 1941.
As Zonas infestadas pela bacteriose da mandioca e as medidas de
vigilancia sanitaria vegetal do Ministerio da Agricultura. (Areas
infected by cassava bacteriosis and sanitary control measures taken
by the Ministry of Agriculture). Biologico 7:135-136.

A government regulation forbids transport of cassava branches or
cuttings outside an area that was infected by *Bacillus manihotus*
Arthaud-Berthet. The area under quarantine covers the states
of Espirito Santo, Rio de Janeiro, Sao Paulo, Parana, Santa
Catarina, Rio Grande do Sul, Minas Gerais, Goyaz and Districto
Federal (Summary from CIAT's 2000 Abstracts on Cassava. Vol. I).

97. ANONYMOUS. 1977.
Concluding statement by participants. In G. Persley, E.R. Terry, R. MacIntyre eds. Cassava bacterial blight, report of an interdisciplinary workshop held at IITA, Ibadan, Nigeria, 1-4 Nov. 1976, Ottawa, IDRC. p. 36.

This summarises the distribution of CBB in Africa. The possible exceptions are Ethiopia, Kenya and Tanzania. Loss in cassava yield due to CBB is estimated to be high in most of the countries affected. Immediate control measures are recommended. These include prevention of movement of cuttings from infected areas to areas free of CBB, selection of local varieties tolerant to CBB until CBB resistant ones are available, use of fertile soils or fertilizers and burning of infected crops. Others are the encouragement of shifting cultivation or fallows where suitable, mixed-cropping, changing the time of planting and using early maturing varieties.

Suggestions are outlined for future research on CBB, including the study of strain differences in *X. manihotis* in different countries, rapid multiplication of high-yielding, disease-resistant varieties, and further study aimed at improving strategies for cultural control of CBB.

98. ANONYMOUS. 1975.
Country presentations; summary of general discussions. In Terry, E., and R. MacIntyre eds. The International exchange and testing of cassava germplasm in Africa; proceedings of an interdisciplinary workshop held at IITA, Ibadan, Nigeria. 17-21 Nov. 1975. pp. 35-36.

Under diseases and pests, it was noted that CBB was newly reported from Ghana and Togo. It was thought that intercropping had apparently reduced the incidence of CBB.

99. ANONYMOUS. 1939.
Sobre a bacteriose da mandioca. (Cassava bacterial blight). Campo 10(5): 22-23.

The Institute Agronômico of the state of Sao Paulo gives historic background on cassava bacterial blight, which was reported in Brazil for the first time in Campinas (Sao Paulo) in 1911. The bacteria causing the disease was identified as *Bacillus manihoti* Bondar. Since 1927 it has become of economic importance in the southern part of the country. It is recommended to prohibit the shipment of cuttings from contaminated zones to other parts of the country, especially to Bahia, where the only problem is the mite, *Tetranychus tanajoa*. (Summary from CIAT. Card No.3477)

[illegible]. Paper presented at the [illegible] Conference of the Nigerian Society for [illegible] Agricultural Research and Training, Ibadan, Nigeria, [illegible]. Abstracts 1:21.

[illegible] cassava bacterial blight (CBB) on [illegible] reviewed based on the triangle of [illegible] production of inoculum and its [illegible] planting material, crop rotation and chemical control were discussed. Use of unfavourable weather conditions and [illegible] cassava through breeding and agronomic practices were discussed.

AKINR[illegible]. 1978.
A short [illegible] cassava in Nigeria. Umudike, Nigeria. Federal Agricultural Research and Training Station. Technical Bulletin. 4pp.

The [illegible] cultural practices, roguing, seed treatment of [illegible] are recommended for cassava mosaic. [illegible] are described for bacterial blight, white-thread [illegible] under field and storage conditions, white and brown [illegible]. (Summary from CIAT's Abstracts on Cassava, Vol. 1).

ARENE, O.B. [illegible]
Influence of [illegible] on the incidence of cassava bacterial blight. In [illegible], Terry and R. MacIntyre eds. Cassava bacterial blight [illegible] disciplinary workshop held at [illegible], Ibadan, Nigeria, [illegible], pp. 28-20.

National cassava survey [illegible] States of Nigeria in 1973 revealed that CBB incidence was [illegible], lowest in homestead farms characterized by continuous intercropping under compound shade trees, and highest in distant farms planted with cassava alone under crop rotation.

The experiments reported here confirmed that by providing shade in cassava farms by means of intercropping cassava with maize, melon, their combination (or any other means of reducing the impact of rain drops such as mulching), CBB was significantly reduced. CBB was highest in cassava planted alone.

The study also showed that soil infestation alone by *X. manihotis* was not a significant factor in incidence of CBB. Another important finding was that, with reference to time, the highest incidence of CBB was recorded on 5 months old cassava plants.

103. BATSIMBA, J. and J. MABANZA. 1977.
Country statements: People's Republic of the Congo. In Persley G., E.R. Terry and R. MacIntyre eds. Cassava bacterial blight; report of an interdisciplinary workshop held at IITA, Ibadan, Nigeria, 1-4 Nov. 1976. Ottawa, IDRC. pp. 32-34. (French version: See no.104).

CBB was not yet widespread in PRC. Cassava varieties grown there were few and unlikely to tolerate CBB to prevent its spread in the country. The symptoms as observed in PRC are given in detail together with CBB distribution in seven geographical zones surveyed. It is remarked that phytosanitary operation in the villages is always difficult. The transmission of CBB over short distances is probably attributable to insects, rain and streams while over long distances it is definitely carried with infected cassava cuttings. The highest incidence is recorded in the rainy season. Damage by CBB poses a peculiar problem in PRC where like in neighbouring Zaire cassava leaves are a source of vegetable protein apart from the tubers that form the staple food of the masses.

Control measures include the isolation of CBB epidemic zones, destruction of heavily attacked cassava farms, epidemiological study of CBB including research on insect vectors and ecology of *X. manihotis*. Other measures are the etiological study of CBB and above all the development and adoption of local and imported cassava varieties resistant to CBB. It is envisaged that CBB resistant varieties would solve the problem decisively.

104. BATSIMBA, J. et J. MABANZA. 1976.
Une nouvelle maladie du manioc en République Populaire du Congo, la bacteriose du manioc. In IDRC/IITA cassava bacterial workshop (held at) IITA, Ibadan, Nigeria, 1-4 Nov. 1976. 12p. mimeo. (English text: see no.103).

La bactériose du manioc semblait en 1976 suffisamment localisée en RPC. La gamme des variétés de manioc cultivées au RPC était relativement restrainte et il existait peu de chance que certaines d'entre elles soient suifisamment résistantes pour enrayer naturellement la dissémination du parasite. Les symptômes de la maladie observés en RPC sont détaillés aussi bien que sa répartition dans sept zones géographiques inspectées; L'intervention des Services Phytosanitaires est toujours difficile en milieu villageois. Il semble que les insectes, la pluie, et les eaux de ruissellement sont responsable de la transmission de la maladie dans le même voisinage. Au sein de diverses régions le transport de boutures infectées sur de longues distances constitue le moyen le plus efficace de sa propagation. Les symptômes de la maladie s'accentuent et se propagent surtout en saison des pluies. Les dégâts causés par la bactériose sont particulièrement sérieux en RPC ou l'on mange les feuilles du manioc à fin d'en obtenir la protéiné végétala.

[illegible] Placement des foyers [illegible] différemment [illegible] l'étude des [illegible] Il faut [illegible] résistantes à [illegible] solution [illegible] au [illegible]

[illegible] international movement of [illegible] In [illegible] international exchange [illegible] proceedings of an [illegible] Nigeria, 17-21 [illegible]

[illegible] quarantine [illegible] importation of [illegible] cuttings or real seed) [illegible] material for export [illegible] from symptoms of CBB and other diseases [illegible] packing materials should be sterilised chemically [illegible] before contact with planting material destined for export [illegible] export, and on arrival in the recipient country [illegible] should be treated with an effective combination [illegible] fungicide. At any juncture any imported material [illegible] of pests or diseases should be destroyed by burning [illegible] material should be planted in an [illegible] area and [illegible] inspected for one year. Shoot tip indexing should [illegible] days after germination of material [illegible] from [illegible] country infested with CBB.

107. BRANDAO FILHO, [illegible] 194[illegible].
Meios de contrôle [illegible] (Cassava bacteriosis and measures for its control). [illegible] (Brazil) 1940:62-63.

A brief historic resumé [illegible] bacteriosis caused by *Bacillus* [illegible] in some Brazilian [illegible]. A detailed description is given of the symptoms, and the following preventive measures are indicated: (1) plant only in disease-free soils and use sound cultural practices; (2) use disease-free cuttings; (3) rotate crops for some years (4-5) and avoid planting host plants of the disease *Bacterium solanacearum*; (4) rogue and burn debris from previous crops; (5) combat vectors of the disease, such as the fly *Lonchaea pendula*, whose larvae infest the growing points of the plant. (Summary from CIAT's Abstracts on Cassava Vol.II)

108. BRANDAO SOBRINHO, J. 1916.
Mandioca (Cassava). Sao Paulo, Casa Duprat. 165p. (Bibliotheca Economica Thelymar, v. 3).

Historical, botanical, agricultural, chemical, industrial, and commercial aspects of cassava are discussed, with emphasis on Brazil. Planting dates, cultural practices and yields are given for the different states. Control of *Xanthomonas manihotis* (*Bacillus manihot*) is recommended by using resistant varieties, healthy planting material with no wounds and insect control. Aspects of processing starch, alcohol and other by products are also dealt with. (Summary from CIAT. Card No.4737)

109. BRAZIL. SAO PAULO. STATE AGRICULTURAL INSTITUTE.
Cultivation of manioc. Sao Paulo, Roots and Tuber Section, S.A. I. (n.d.). 16p. mimeo.

Xanthomonas manihotis causal agent of CBB is among the pathogens discussed. Some control measures are recommended.

110. CASTRO, J.B. DE, GONCALVES, R.P. and NORMANHA, E.S. 1939.
A bacteriose da mandioca. (Cassava bacterial blight). Bahia Rural 6: 225-226.

Cassava bacterial blight was reported for the 1st time by Gregorio Bondar in the state of Sao Paulo in 1911. Symptoms appear at any age of the plant. The disease is characterized by partial or total wilting of the plant and the presence of brown and bluish spots on the leaf upper and undersurface, respectively. In general, spots are located at the borders or at the tip of the leaves. Preventive control measures include the use of healthy cuttings, crop rotation for several years in infected fields, and not planting in poor soils which increase disease severity. (Summary from CIAT's Abstracts on Cassava. Vol. II)

111. CENTRO INTERNACIONAL DE AGRICULTURA TROPICAL. 1972.
Cassava production systems: pathology. In its Annual Report. Cali, CIAT. pp.60-68.

Although the symptoms of cassava bacterial blight are similar to those induced by *Xanthomonas manihotis* (Arthaud-Berthet) Starr, studies of the morphology, physiology, serology, pathogenicity and phage susceptibility of the bacterium isolated in Colombia, Brazil and Venezuela suggest that it is sufficiently different from *X. manihotis* to be considered a distinct strain or even species. Serdogical and phage typing methods show that CBB can also be distinguished from species of *Erwinia*, *Pseudomonas* and *Xanthomonas*.

The symptoms of CBB, its mode of infection of the cassava plant, and its mode of dissemination are covered in detail.

111. CENTRO INTERNACIONAL DE AGRICULTURA TROPICAL. 1972 (Cont'd)
Experimenting on rooting cassava tip cuttings, it was possible to eradicate CBB from 80% of CIAT's cassava germplasm bank of 2,200 clones. Studies on varietal resistance were continued and the 21 most resistant cultivars have been established.

For the time being, it is concluded that the use of clean planting material and CBB- resistant cultivars are the best known methods of practical control of CBB. Studies to evolve other methods of control based on facts of the epidemiology of CBB are continuing.

112/114 -

115. CONCEICAO, A.J. DA. 1975.
Contribucao ao Seminario sobre o "Establecimiento de una red de colaboracion internacional para la prueba y evaluacion de cultivares superiores de yuca", promovido pelo CIAT, de 4 a 6 de 1975. (Contribution to the seminar "The Establishment of an international collaborative network for testing and evaluating promising cassava cultivars", sponsored by CIAT from February 4-6, 1975). Cruz das Almas, Universidade Federal da Bahia, Escola de Agronomica.

The aspects of cassava production in Brazil covered by the report include pests and diseases. The incidence of the bacteria, *Xanthomonas manihotis*, is treated in detail.

116. CONCEICAO, A.J. DA. 1973.
Molestias da mandioca(*Manihot esculenta* Crantz). (Diseases of cassava). Cruz das Almas, Brazil. Universidade Federal da Bahia, Escola de Agronomica. Brascan Nordeste. Serie Pesquisa 1(1): 31-40.

The main cassava diseases that occur in Brazil, especially in the Northeastern Region are considered by the author studying the etiology, symptomatology and certain control measures specially quarantine procedures, in order to avoid the introduction of diseases from outside the region. (Author's summary).

117. CORREA, H. 1970.
Mandioca do indigena a mecanizaco. (Cassava from native methods to mechanization). Brasil, Instituto de Pesquisas e Experimentacao Agropecuarias do Centro-Oeste. Circular No.10.

It is noted in this bulletin that cassava, *Manihot esculenta*, is seriously damaged by bacteriosis(*Xanthomonas manihotis*) among other diseases and pests of the crop.

118. COSTA, F. 1940.
Regioes infestadas pela bacteriose da mandioca. (Regions infected by cassava bacterioses). Biologico 6: 332.

This paper is a short communication of the Agriculture Department of Brazil, declaring some zones infected with *Bacillus manihotus* Arthaud-Berthet, causal agent of cassava bacteriosis. Control measures were taken by sanitary institutions to avoid the removal of cuttings from the infected area. (Summary from CIAT's 2,000 Abstracts on Cassava, Vol.I)

119. DOKU, E. V. and P. LAMPTEY. 1977.
Control of cassava bacterial blight in Ghana. In Persley, G., E.R. Terry and R. Macintyre eds. Cassava bacterial blight; an interdisciplinary workshop held at IITA, Ibadan, Nigeria, 1-4 Nov. 1976. Ottawa, IDRC: p.22.

CBB was first found in Ghana in 1975. The ultimate control measure is the introduction of cassava varieties resistant to CBB. Before that long term objective is achieved, twofold cultural control measures were recommended. These aim first at preventing the causal agent of CBB from further entering, spreading and establishing through the importation of infected cassava cuttings, and secondly at eradicating CBB or reducing its effect where it has already established. Among measures aimed at its eradication are the education of farmers to recognize the disease, establishment of CBB survey teams, prohibition of the transport of cuttings from infected areas, establishment of a disease-free stock under the control of the phytosanitary authorities, encouragement of wide spacing and intercropping and the determination and adoption of the best intercropping systems for large-scale mechanized farms to maximise total yield.

120. DRUMMOND, O. A. 1946.
Doencas da mandioca. (Diseases of cassava). Revista Ceres (Brazil 7(37): 24-33. 1946.

The incidence of cassava diseases has increased in the state of Minas Genrais (Brazil), being of economic importance in areas where the soils are poor and the climate harsh. The following diseases, together with their symptomatoloty, are described: bacterial blight or bacteriosis, witches'-broom, root rot caused by *Diplodia cacaoicola*, rotting or necrosis of the pith area of the branches, cassava ash (*Oidium* sp.). leaf spots (*Cercospora henningsii, C. caribaea, Periconia sp.*). As to their control, the following practices are recommended: use disease-free propagation material and vigorous varieties; plant in adequate soils, rotating crops every two years; rogue infected plants and clean tools which can spread the disease. Where there is root rot, plant disease-free cuttings and use bitter varieties. The state's Department of Agriculture has organized 3 centers for developing disease-free propagation material and evaluating 102 varieties for this purpose. (Summary from CIAT's Abstracts on Cassava, Vol.II)

121. DRUMMOND-GONCALVES, R. 1948.
Bacteriose da mandioca. (Bacterioses of cassava). Biologico 14: 145-146.

The bacteria is caused by *Phytomonas manihotis*. To cure it (1) use land that has not been planted with infected yuca for 4-5 years; (2) use only healthy cuttings; (3) use resistant varieties. (Summary from CIAT's 2,000 Abstracts on Cassava, Vol.I)

123. [illegible], A.N..
Control of cassava bacterial blight in Nigeria. In Persley, G., E.R. Terry and R. MacIntyre eds. Cassava bacterial blight, report of an International multidisciplinary workshop held at IITA, Ibadan, Nigeria, 3-6 Nov. 1980. Ottawa, IDRC. pp.13-17.

The paper reports the activities and achievements of the National Accelerated Agricultural Production Program (NAPPP) in Nigeria with respect to the control of CBB aimed at adequate production of cassava. Seven preliminary CBB control measures adopted are outlined. NAPPP farming practices comprised intercropping cassava with maize and the use of high yielding cassava cultivars resistant to CBB and CMD and having at the same time improved quality and quantity of starch, gari quality and other desirable characteristics as well as developing a breed of trained, organised and progressive farmers who would adopt the new strategies.

124. EZUMAH, H.C. and P.R. TERRY. 1974.
Cultural considerations in control of cassava bacterial blight (CBB). In Okpala, E.U. and P.T. Nweke, eds. Workshop on Cassava Bacterial Blight in Nigeria, 1st, Umudike, Nigeria, 1974. Proceedings. Umudike, Federal Agricultural Research and Training Station.

Although breeding of cassava varieties resistant to bacterial blight should be the long-term goal in CBB control, a few temporary cultural measures, based on observations made on the performance of cassava in different locations, are discussed. Other culturally oriented measures such as sanitation, crop rotation and the use of disease-free planting material have been published elsewhere. Since plants with vigorous top growth may be more likely to escape disease than those with poor growth, it will be necessary in breeding for resistant varieties to be sure that root yields are higher or at least comparable to yields from susceptible cultivars. Lower root yields may result when alternative sinks are formed in stems and leaves at the expense of the roots. Plants with vigorous top growth are more likely to exhibit this phenomenon. Considerations involving plant establishment by use of fertile soils or fertilizer application, choosing planting time to escape disease incidence, pruning of tops and effects of reduced leaf cover on yield are briefly discussed. (Author's summary).

125. FARABELA FILHO, O. 1970.
Doencas fungicas e bacterianas da mandioca. (Fungal and bacterial disease of cassava). In Encontro de Engenheiros Agrônomos Pesquisadores em Mandioca dos Paises Andinos e do Estado de Sao Paulo, 1st Campinas. pp. 1-9.

1.4 ARADELA FILHO, O. (cont'd).
A detailed description is given of the main diseases attacking cassava in Brazil. Bacteriosis (*Xanthomonas manihotis*) is considered the most important; the only effective control method is the use of resistant varieties. Other diseases reported are Cercospora leaf spots caused by *C. caribaea* (white leaf spot) and *C. henningsii* (brown leaf spot), both are economically unimportant so the use of control methods is unnecessary. Black root rot (*Rosellinia bunodes*), dry rot of cuttings (*Diplodia manihotis*) and neck rot or wilting caused by *Sclerotium* (*S. rolfsii*) are also mentioned. (Summary from CIAT. Card No.1614)

1.5. FREIRE, J.R.J. 1951.
Consideracoes sôbre o problema de bacteriose da mandioca. (Cassava bacterial blight). Revista Agronomica 15: 103-104.

Cassava production is greatly reduced by bacterial blight caused by *Xanthomonas manihotis*. Control of the disease should include (1) prophylactic measures such as planting healthy cuttings, crop rotation, postplanting elimination of infected plants, that guarantee the conditions necessary for the vigorous development of the plant and (2) the search for resistant varieties. The implementation of these practices requires a long and difficult educational campaign. (Summary from CIAT's Abstracts on Cassava, Vol.II).

1.6. GLODJINON, S. 1977.
Country statement: Republic of Benin. In Persley G., E.R. Terry and R. MacIntyre eds. Cassava bacterial blight; report of an interdisciplinary workshop held at IITA Ibadan, Nigeria, 1-4 Nov. 1976. Ottawa, IDRC. p. 32. (French text in no.127).

Probably present in the People's Republic of Benin (PRB) since 1968, CBB was reported there only in 1974. It must have entered and spread along with cassava cuttings illegally imported from Nigeria. The recommended control measures include the prohibition of transport of vegetative material from infected areas in PRB or other African countries, tightening phytosanitary quarantine vigilance, educating the farmers on the danger of CBB and finally substituting susceptible varieties with those resistant to CBB.

1.7. GLODJINON, S. 1976.
Intervention... sur la maladie des cierges du manioc (flétrissure bactérienne) causée par *Xanthomonas manihotis*. In IDRC/IITA cassava bacterial blight workshop (held at) IITA, Ibadan. 1-4 Nov. 1976. 4p. mimeo. (la version anglaise: Voir no.126)

129. LEU, L. S. and C. T. CHEN. 1972 (Cont'd)

Bacterial wilt is a systemic disease which occurred recently in many cassava-cultivated areas in Taiwan. The wilt causes the death of the plants and in severe cases total failure for newly planted fields. The disease is thus great concern from the economic point of view. The disease occurs year around on juvenile to old plants, but young plants are most vulnerable to be damaged. Gumming substances exereted on the stem of the diseased plants swell to spongy structure when water is available. Bacteria within the substance, the second [illegible] inoculum, will then be carried by rainy wind to healthy plants [illegible]. Stem cuttings from the diseased stalks [illegible]. Bacterial suspension introduced into the plant [illegible] near the apical [illegible] into the root part of [illegible] days after [illegible] [illegible] including other parts [illegible] gumming substance [illegible]. Symptomatological, bacteriological [illegible] and physiological characteristics [illegible]. For controlling the disease, [illegible] cuttings must be prepared from disease free fields. The fields should be inspected a few days interval soon after budding. [illegible] plants should be [illegible] out and brought back by putting them in plastic bags. The diseased plants should be burned, buried or [illegible] in the [illegible] of the [illegible] plants [illegible]. Rotation is recommended [illegible] and [illegible] new plantations. [illegible]

130. [illegible]

[illegible]

126. [illegible] was (1) to develop a [illegible] planting stocks of cassava [illegible] vegetative [illegible] to [illegible] and [illegible] It was found [illegible] cuttings, [illegible] microwave [illegible] (a lower [illegible]

[illegible]

127. [illegible]

132. LOZANO, J. C. and E. R. TERRY. 1976 (Cont'd)

Preventive measures include the careful selection of propagation material, avoiding damage to said material and adequate selection and preparation of the soil. (2) Among those pathogens attacking the leaves and green parts of the stem are found many fungi (*Cercospora* spp., *Oidium* sp., etc) bacteria, mycoplasma and viral or viruslike agents. Many are endemic and the severity of the attack is related to susceptibility of the cultivar and climatic conditions. Control measures include the use of resistant varieties and disease-free planting material, roguing of diseased plants, suitable cultural practices (planting dates and density, leaf area index). (3) As regards root rots, preharvest deterioration is the result of soil pathogens and postharvest rot is a combination of pathological and/or physiological factors. Roots should be left in the ground until used; resistant cultivars should be used; only sound roots should be stored; surface [illegible], [illegible], [illegible] and paraffin or storage clamps [illegible] and soil can be used to retard deteriotation. [illegible]

133. [illegible]

[illegible] It is known that [illegible] (bacteria, [illegible]

[illegible]

[illegible] movement [illegible] quarantine [illegible] materials with [illegible] pathogenic organisms [illegible]

134. [illegible], A. 1971.
[illegible]enfermedades. In [illegible] Cultivos de raices y tuberculos tropicales: [illegible]. Maracay, Instituto Agronomia, Universidad Central de Venezuela [illegible]. 60 - 66.

The symptoms of CBB and its control measures are given in brief. A table of diseases of cassava on pp. 63-64 shows that *X. manihotis* occurs in Brazil while *Xanthomonas* [illegible] also causing blight occurs in Madagascar, Réunion and Java.

135. MONTEIRO, T. 1956.
Como cultivar a mandioca. (Cassava cultivation). Sao Paulo, Edicoes Melhoramentos.

This paper describes among other features, the symptoms shown by cassava plants attacked by CBB. Control measures and precautions are given.

136. [illegible]GANHA, E. S. 1971.
[illegible]; observaciones y recommendaciones sobre su cultivo en Nicaragua. (Cassava; observations and recommendations for its cultivation in Nicaragua). Managua, Banco Central de Nicaragua.

An agronomic evaluation of cassava in Nicaragua is given. Fungal diseases(*Cercospora spp.*) and bacterioses (*Xanthomonas manihotis*) are briefly discussed; control measures are given as well. The main pests are a *Coleopterous cerambycidae* of the genus *Lagoecheirus spp.* the bud maggot (Silba pendula). Acares, and whiteflies (Aleyrodidae belonging to the species Bemisia tabaci, capable of transmitting virus diseases). (Summary from CIAT's 2,000 Abstracts on Cassava, Vol.I)

137. OKPALA, E.U. 1974.
Cultural and biological control of bacterial blight of cassava caused by *Xanthomonas manihotis* (Burkholder). In Okpala, E.U. and H.J. Glaser, eds. Workshop on Cassava Bacterial Blight, 1st Umudike, Nigeria, 1974. Proceedings, Umudike, Nigeria, Federal Agricultural Research and Training Station, pp. 33-38.

Brief descriptions are given of cassava bacterial blight(*Xanthomonas manihotis*) and the symptoms it produces. Factors favoring the disease and modes of infection/spread are outlined, in addition to 7 cultural and biological control measures. (Summary from CIAT. Card No.5744)

138. OLYMPIO, H. K. 1977.
Country statements: Togo. In Persley, G., E.R. Terry and R. MacIntyre eds. Cassava bacterial blight; report of an interdisciplinary workshop held at IITA, Ibadan, Nigeria, 1-4 Nov. 1976. Ottawa, IDRC. p. 35 (French Version: no 139).

138. OLYMPIO, H.K. (Cont'd).
CBB was first reported in Togo in 1975, and by 1976 was believed to be present in the entire southern region where 92% of the country's cassava is grown. It is believed that CBB entered Togo with illegaly imported cassava cuttings. Water is believed to be an important agent of its spread.

Control measures include prohibition of movement of cuttings from area to area, burning of diseased plants and identification of resistant varieties.

139. OLYMPIO, H.K. 1977.
Rapport sur la flétrissure bactériose du manioc au Togo: In IDRC/ IITA cassava bacterial blight workshop (held at) IITA, Ibadan, Nigeria 1-4 Nov. 1976. 4p. mimeo. (la version anglaise: voir no.138)

Cette maladie a été signalée pour la première fois au Togo en 1975. Vers 1976 on croyait qu'elle s'est dispersée tout entier dans le sud du pays ou se prouduit 92% du manioc togolais. On persait que la maladie s'est introduite par l'intermédiare des boutures frauduleusement importées au Togo. Vu que la maladie prolifiére vite pendant la saison des pluies on suppose que l'eau serait le moyen le plus important de sa dissémination. Les moyens de lutte préconisés comprennent interdiction de transport des boutures d'un endroit à l'autre, destruction des plantes malades par le feu et l'emploi des variétés résistantes à cette maladie.

140. SILVA, J.R. DA. 1970.
O programa de mandioca no Instituto Agronômico do Estado de Sao Paulo. (The cassava program of the Instituto Agronômico do Estado de Sao Paulo). In Encontro de Engenheiros Agronômos Pesquisadores de Mandioca dos Paises Andinose e do Estado de Sao Paulo, 1º, Campinas, 1970. Trabalhos. Campinas, Instituto Agronômico do Estado de Sa Paulo. pp. 100-122.

Because of the great economic importance of cassava and the high susceptibility of Vassourinha (90% of the plants are of this variety) to *Xanthomonas manihotis*, a series of experiments were carried out. Results were as follows: (1) New high-yielding clones were developed and tested in Vale do Paraiba; (2) planting from May to August (before the rainy season) is more advantageous; (3) long cuttings (60 cm) planted vertically or slanted are recommended; (4) cuttings should be planted from 20 to 30 cm deep; (5) planting distances of 1.00 x 0.60 m for fertile soil; (6) fertilization with NPK is summarized in tables; (7) indices of productivity are also given. The rest of the report outlines the present program and analyses different varieties from Bolivia and Paraguay. (Summary from CIAT's Abstracts on Cassava, Vol.II)

141. TERRY, E.R. 1976.
Cassava bacterial blight in Africa. In Terry, E.R. and R. MacIntyre, eds. The International Exchange and Testing of Cassava Germ Plasm in Africa; proceedings of an interdisciplinary workshop, Ibadan, Nigeria, 1975. Ottawa, Canada, International Development Research Centre. pp. 23-25.

This article presents aspects of cassava bacterial blight (*Xanthomonas manihotis*) in Africa with the purpose of highlighting some facts that may serve as a basis for checking its spread and eventual control. Information on CBB etiology, symptomatology, geographic distribution, epidemiology and control is included. The most effective methods of control are the use of resistant varieties and healthy planting material; crop rotation has also been suggested although the survival potential of the pathogen in Africa is unknown. (Summary from CIAT's Abstracts on Cassava, Vol.II)

142. TORCHETTO, A. 1948.
Doencas da mandioca no Rio Grande do Sul e contrôle. (Diseases of cassava in Rio Grande do Sul and their control). Porto Alegre, Brasil, Secretaria de Estado dos Negocios da Agricultura, Industria e Comercio. Seccao de Informacoes e Publicidade Agricola. 18p.

Several aspects of pathogenic and physiogenic diseases of cassava in Rio Grande do Sul (Brazil) are presented. Cassava bacteriosis caused by *Pseudomonas manihotis* is discussed in detail, indicating symptoms, dissemination and control. In addition, the symptomatology and control of root diseases caused by *Diplodia theobromae and Rhizopus nigricans* are presented. The effects of frosts on cassava plants are also described. General aspects of cassava fertilization with farmyard and green manures and compost are included. (Summary from CIAT's Abstracts on Cassava, Vol.II)

143. VARON, R., F.H. 1927.
Enfermadades de la yuca. (Diseases of cassava). In Instituto Colombiano Agropecuario. Curso intensivo del cultivo de yuca. Palmira, Colombia, Centro Nacional de Investigaciones Agropecuarias. pp. 20-29.

Symptoms and control measures of the main diseases of cassava are presented. Among these are mentioned bacterial blight, wilting, root rot,,anthracnose, leaf spot, powdery mildew, rust, root-knot nematode, common mosaic virus and witches'-broom disease. (Summary from CIAT's 2,000 Abstracts on Cassava, Vol.I)

F. CHEMICAL CONTROL

144. AJENI, O. B. 1974.
Preliminary evaluation of some fungicides for the control of bacterial blight diseases of cassava caused by *Xanthomonas manihotis* (Arthaud-Berthat and Boudor) Burkholder. In Okpala, E. U. and H. J. Glaser, eds. Workshop on Cassava Bacterial Blight in Nigeria, 1st, Umudike, Nigeria, 1974. Proceedings. Umudike, Federal Agricultural Research and Training Station. pp.57-60.

Three fungicides: Dithane M-45, Bordeaux mixture (5:5:50) and copper ammonium carbonate - were analyzed to determine their effect in the control of cassava bacterial blight caused by *Xanthomonas manihotis*. Six concentrations were used for each: 0, 10, 100, 1000, 3000 and 6000 ppm. Bordeaux mixture had no effect on the organism in vitro at any of the concentrations used. Dithane showed some bactericidal property at as low as 10 ppm. Copper ammonium demonstrated carbonate bactericidal effect in vitro. The fungicides were not demonstrated to be effective for control of CBB in the field. (Summary from CIAT's Abstracts on Cassava, Vol.II)(Modified).

145. GLASER, H. J. and OGBOGU, F. C. 1974.
Problems and experiences of plant protection extension in the control of cassava bacterial blight disease in East Central State of Nigeria. In Okpala, E. U. and H. J. Glaser, eds. Workshop on Cassava Bacterial Blight in Nigeria, 1st, Umudike, Nigeria, 1974. Proceedings, Umudike, Federal Agricultural Research and Training Station. pp.44-51.

Problems and experiences concerning the Nigerian plant protection extention service are examined, and some practical solutions for the control of cassava bacterial blight are suggested. Among the aspects studied are 1st symptoms of the disease, highly susceptible and disease-free local cultivars, and farmers' superstitious beliefs and practices. Problems found in the expansion of control measures were (1) the farmers' reluctance to adopt crop rotation, (2) the inadequate supply of disease-free planting material, and (3) the lack of trained extensionists. Control measures include the collection and distribution of disease-free materials to farmers, the establishment of CBB-free cassava multiplication plots, the implementation of agrochemical control measures, the use of fertilizers, and coordination of applied agricultural research. (Summary from CIAT's Abstracts on Cassava, Vol.II)

146. NNODU, E. C. 1974.
Chemical aspects of control of bacterial blight of cassava. In Okpala, E.U. and H. J. Glaser, eds. Workshop on Cassava Bacterial Blight in Nigeria, 1st, Umudike, Nigeria, 1974. Proceedings. Umudike, Federal Agricultural Research and Training Station. pp.22-24.

Some chemical methods for controlling cassava bacterial blight are presented. These methods are based on the knowledge of mode of entry and spread of the pathogen. The following treatments are suggested: spraying of foliage with dodine and Bordeaux mixture; use of paints to heal cut surfaces of cuttings; use of systemic fungicides such as benomyl and thiabendazol; application of methyl bromide and chloropicrin to the soil; use of streptomycin to prevent the dissemination of the infection; and control of insect vectors. No supporting data are given as to the effectiveness of the suggested chemical treatments. (Summary from CIAT's Abstracts on Cassava, Vol.II) (Modified).

C. BREEDING FOR RESISTANCE

148. [illegible], E. N. 1974.
Preliminary field screening for cassava bacterial blight resistance. In Okpala, E. U. and H. J. Glaser, eds. Workshop on Cassava Bacterial in Nigeria, 1st, Umudike, Nigeria, 1974. Proceedings. Umudike, Nigeria, Federal Agricultural Research Training Station. pp.52-56.

Cassava bacterial blight (CBB) caused by *Xanthomonas manihotis* was reported in Nigeria for the 1st time in 1971. A practical method for scoring field symptoms to select tolerant cultivars was outlined as a preamble to resistance breeding. No immunity to CBB has been found but high tolerance was exhibited by some selections and local cultivars: 60-506, Nwugo, Iwa-Panya (Congo), Iwa-Bende-2, Alibobuji-Orba, (Author's summary).

149. ANONYMOUS. 1974.
Recommendations (of the study groups). In Okpala, E.U. and H.J. Glaser eds. Workshop on cassava bacterial blight in Nigeria, 1st, Umudike, Nigeria, 1974. Proceedings. Umudike, FARTS. pp.76-80.

The four study groups of the workshop viz:- breeding, plant pathology and protection, agronomy, and extension recommended measures to combact the menace of cassava bacterial blight. Among the recommendations of the breeding study group was the collection in observation plots of all local cultivars in each State of Nigeria. Any clone which proved tolerant should be multiplied and distributed to farmers as an interim measure pending final breeding results. The plant pathology study group recommended the adoption of a standard scoring system applicable in all ecological zones which will facilitate field screening for resistance. Other recommendations include training of plant protection staff, further research for economically feasible methods of chemical control of CBB and prompt report of CBB outbreaks to IITA, Ibadan and FARTS, Umudike. Recommendations of the agronomy study group covered adequate supply of planting material free from CBB, soil and fertiliser, change of planting date, crop rotation and crop sanitation. The extension group made recommendations on planting material, fertiliser and publicity of research findings through publications and the mass media.

150. ARENE, O. B. 1974.
Rating system for cassava cultivars to the resistance of cassava bacterial blight caused by *X. manihotis* at FARTS, Umudike. In Okpala, E. U. and H. J. Glaser, eds. Workshop on Cassava Bacterial Blight in Nigeria, 1st, Umudike, 1974. Proceedings. Umudike, Nigeria, Federal Agricultural Research and Training Station. pp.70-72.

150. ARENE, O. B. (Cont'd).
A description is given of a rating system developed at Umudike to evaluate cassava resistance to bacterial blight(*Xanthomonas manihotis*). This system is based on 2 qualitative (wilting and defoliation) and 2 quantitative (stunting and death) factors. The 5 classes of symptoms are defined. The validity of this system is supported by yield data. (Summary from CIAT's Abstracts on Cassava, Vol.II)

151. CENTRO INTERNACIONAL DE AGRICULTURA TROPICAL. 1975.
Pathology; cassava bacterial blight. In its Annual report. Cali, CIAT. pp. B-15-18.

Studies were carried out to identify cultivars and test F_1 lines for resistance to the major diseases of cassava particularly CBB in America. Further studies were done on estimation of losses due to CBB and the survival of the disease in the exudates and plant tissue.

152. CENTRO INTERNACIONAL DE AGRICULTURA TROPICAL. 1976.
Pathology; bacterial blight. In its Annual report. Cali, CIAT. pp. B-1, B-25-26.

Studies continued on aspects of screening for resistance to CBB, determining the pathogenic variability of *X.manihotis*, evaluating resistance of F_1 hybrids obtained by controlled pollination and determining losses due to the disease.

153. COCK, J.H., D. WHOLEY, and J. C. LOZANO. 1976.
A rapid propagation system for cassava. Cali, CIAT. 10p.

It is stated that CBB is a severe disease of cassava that spreads rapidly through propagating material, thereby reducing establishment and yield and increasing incidence of root rot. The method developped and described here can readily produce healthy planting cassava material and a stock of CBB-free "seed" can be built up. Recommendations are made for four precautionary measures to take if planting material is to be taken from a CBB-infected plantation. Fallowing for six months and crop rotation are recommended if a farm has been infected by CBB. All cassava residue should be destroyed by burning and a large boundary should be maintained between clean and infected farms to prevent infection through wind-borne rain, soil splash, insects, irrigation, drainage, water, and any other mechanical and accidental means of CBB transmission.

154. DRUMMOND, O. A. and O. HIPOLITO. 1941.
Notas sobre a bacteriose de mandioca. (Cassava bacteriosis). Ceres (Brasil) 2: 281-307.

154. DRUMMOND, O.A. and O. HIPOLITO. (Cont'd).
The authors describe the disease named "Bacteriose" or "Leiteira" (Milk Disease) of the Cassava (*Manihot utilissima* Pohl, *M. dipi* Pohl) It is a quite serious and very much disseminated disease, caused by *Bacterium manihotus* n. sp. This organism grows well only in special medium, made with cassava shoots. Several isolations were made from diseased plants and 140 inoculations with pure cultures gave 77% positive results. The organism was studied in pure cultures obtained from isolations and reisolations. The following characteristics are described: size 1, 0-4, 0X0, 4-1, 2 micra; bacilli lopho or monotrichia; Gram negative; gelatin liquified, giving sacciform type, in 3 to 4 days; nitrates are reduced to nitrites; no hydrolisation of starch; no production of indol; capsule absent; no acids from lactose, manite, salicine, amigdaline and inosite. Other sugars, like xilose, arabinose, levulose, maltose, glucose and dextrine are not attacked generally, but some tests gave positive results. Galactose gave 71% positive results. The bacteria is killed at 77.5°C., when exposed 10 minutes. The organism is named as above, *Bacterium manihotus* n.sp., since it has a bacillar form and polar cilis. The nomenclature of Smith is used instead of Bergey's, with which the authors do not agree, due to two reason: (1) - The name *Phytomonas* given by Bergey in 1923 to the bacteria of this type was used before by Donovan in 1909, to describe the forms of *Leptomonas* and *Leishmania* which live in the latex of plants. The best authorities of these groups of flagellate and this is an older name. According to the rules of nomenclature, accepted at the II International Congress of Microbiology held in London, in 1936, "generic homonyms are not permitted in the group Protista". (2) - As it was shown by Burkholder (15) the group *Phytomonas*, created by Bergey, is an artificial one, so the name *Bacterium*, given by Cohn in 1872 to the Bacilli with polar cilis is as good as *Phytomonas* and it has the priority. Experiments were undertaken to study the transmissibility of the organism and two types of spreading the disease were found: by diseased stems, which are commonly used to plant the cassava and by contaminated drops of water. The disease can be controlled by the following methods: avoiding the planting of contaminated stems which can be the only source of the disease in the regions where it does not exist yet; eradicating the diseased plants since the dew and rain drops are able to carry the disease from plant to plant; raising resistant varieties of cassava. Seventy varieties were studied and 5 showed some resistance. This work will be continued. (Author's summary).

155. ENE, L.S.O. and F.M.O. AGBO. 1974.
Breeding for resistance to cassava bacterial blight at Umudike. In Okpala, E.U. and H.J. Glaser, eds. Workshop on Cassava Bacterial Blight in Nigeria, 1st, Umudike, Nigeria, 1974. Proceedings. Umudike, Federal Agricultural Research and Training Station. pp. 3-10.

155. ENE, L.S.O. and F.M.O. AGBO. (Cont'd).
A crop loss of N$25 million, recorded in East Central State (Nigeria), in 1973, gives an idea of the devastating effect of cassava bacterial blight. In the past, breeding was focused on selecting mosaic resistant and high-yielding varieties. The ways in which the disease can be disseminated are explained, and the 3 possible types of resistance found in cultivars are mentioned. The first step in the breeding strategy at Umudike is to collect all varieties grown in Nigeria for their evaluation under greenhouse and field conditions. (Summary from CIAT's Abstracts on Cassava, Vol.II).

156. EZUMAH, H.C. and K. SEBASIGARI. 1977.
Control of cassava bacterial blight in Zaire. In Persley, G., E.R. Terry and R. MacIntyre eds. Cassava bacterial blight; report of an interdisciplinary workshop held at IITA, Ibadan, Nigeria, 1-4 Nov. 1976. Ottawa, IDRC. pp. 20-21.

CBB was first reported in Zaire in 1970. Its spread is attributed to the use of infected cassava cuttings in many parts of Zaire. CBB poses a peculiar nutritional problem in Zaire where cassava leaves are widely consumed as a source of vegetable protein. CBB incidence is higher during the rainy season, and varies from year to year. Disease evaluation in many locations suggest a correlation between the severity of CBB and soil fertility. Assisted by IITA, Ibadan, and Zaire's INERA, Zaire's Programme National Manioc (PRONAM) has made successful efforts to produce and popularise high-yielding, disease-resistant cassava varieties. Through multilocational evaluations cassava clones are exposed to varying ecological conditions.

157. EZUMAH, H.C., S. KAPONYI and K. BEYA. 1976.
Guidelines for the establishment of a cassava improvement project. In Terry, E.R. and R. MacIntyre eds. The International exchange and testing of cassava germ plasm in Africa; proceedings of an interdisciplinary workshop held at IITA, Ibadan, Nigeria, 17-21 Nov. 1975. Ottawa, IDRC. pp. 45-48.

One of the main objectives of Zaire's Programme National Manioc (PRONAM) is to improve the productivity and quality of cassava in Zaire through screening improved varieties for resistance to CBB and other diseases, among other measures. CBB and other diseases are among the problems hampering adequate cassava production. IITA, Ibadan, is a major source of improved cassava varieties for PRONAM.

158. GREENLAND, D. J. 1977.
Increasing food production from the lowland humid tropics of Africa and Latin America. Annals of the New York Academy of Sciences. 300: 112-120.

The major constraints on food crop production in the lowland humid tropics are reviewed. These are nutrient supply and weed competition, soil erosion, plant diseases and insect pests and finally scarcity of hand labour. The case of cassava *(Manihot esculenta)* is used to illustrate the serious problem of the occurrence of damaging plant diseases in the areas of the tropics under consideration.

158. GREENLAND, D. J. 1977. (Cont'd)
All over Africa the crop is almost universally attacked by cassava mosaic disease. In recent years cassava bacterial blight has attained epidemic scale in parts of Nigeria and Zaire and has also been reported in many other countries of West Africa. Solutions are proposed for overcoming the constraints reviewed. Under pest and disease control it is shown that chemical control measures are possible but expensive and difficult, and hence unsuitable for the small scale farmer. The case of cassava is again used to illustrate the possibility of adopting high yielding, disease resistant varieties without making further inputs. This is remarkably true of the control of cassava bacterial blight in Africa.

159. HAHN, S. K. 1976.
Improvement of cassava at the International Institute of Tropical Agriculture. In Terry, E. R., and R. MacIntyre eds. The International exchange and testing of cassava germ plasm in Africa; proceedings of an interdisciplinary workshop held at IITA, Ibadan, Nigeria 17-21 Nov. 1975. Ottawa, IDRC. p .21-22.

CBB and other diseases are the major obstacle to cassava production in Africa where cassava is a very important staple food. The objectives of cassava improvement at IITA, Ibadan, are given including breeding for resistance to CBB, higher yield, improved root characteristics and resistance to lodging. The improved cassava varieties of IITA have been supplied to countries in Africa and Asia.

160. HAHN, S. K. and A. K. HOWLAND. 1977.
Breeding for resistance to cassava bacterial blight. In Persley, G., E.R. Terry and R. MacIntyre eds. Cassava bacterial blight, an interdisciplinary workshop held at IITA, Ibadan, Nigeria, 1-4 Nov. 1976. Ottawa, IDRC. p.23.

CBB has been recognised to be potentially more serious than CMD in Africa because the former could often cause the total failure of the crop. As it is feared that CBB would be difficult to wipe out, the authors feel that the most practical control strategy is the use of host-plant resistance to CBB. With this in mind, IITA root and tuber breeders have since 1972 established many cassava clones and families regularly highly resistant to CBB in widely differing ecological zones in the affected areas. Other desirable qualities including resistance to CMD, high yield, improved root characteristics and resistance to lodging have also been incorporated in the adopted varieties which have been given to farmers especially in Nigeria.

161. HAHN, S. K., A. K. HOWLAND and C. A. OKOLI. 1974.
Breeding for resistance to cassava bacterial blight at IITA. In Okpala, E. U. and H. J. Glaser, eds. Workshop on Cassava Bacterial Blight in Nigeria, 1st, Umudike, Nigeria, 1974. Proceedings. Umudike, Federal Agricultural Research and Training Station. pp.11-14.

IITA has been involved in the search for resistance to cassava bacterial blight in Africa. This is a presentation on the results obtained during the period of 1972-74. The genetic source of resistance to CBB has now been identified; the mechanism of resistance appears to be due to quantitative genes mainly with additive effects, although some present non-additive effects. Based on the results of these trials, it seems possible to produce high-yielding varieties with a high level of resistance to CBB. (Summary from CIAT's Abstracts on Cassava, Vol.II)

162. HAHN, S. K., A. K. HOWLAND and E. R. TERRY. 1973.
Cassava breeding at IITA. Paper presented at International Symposium of Tropical Root Crops, 3rd, IITA, Ibadan, Nigeria, 1973. 46p.

The importance of cassava as a food crop in Africa is stated and major problems involved in production in the area are briefly discussed. The cassava breeding objectives in the Root and Tuber Improvement Program of the International Institute of Tropical Agriculture (IITA) are laid down. Basic considerations in cassava breeding are reviewed and discussed. The paper attempted to produce a cassava breeding system applicable on a world-wide basis and to describe the present state and the future development of cassava breeding. (Author's summary).

163. HEYS, G. 1973.
Cassava improvement in the Niger Delta of Nigeria. In Persley, G., E.R. Terry and R. MacIntyre eds. Cassava bacterial blight, report of an interdisciplinary workshop held at IITA, Ibadan, Nigeria, 1-4 Nov. 1976. Ottawa, IDRC. pp. 18-19.

CBB became a serious obstacle to the adoption of high-yielding cassava varieties in the Niger Delta.

This paper is a description of the cassava improvement project in the area in question by the Shell-BP Development Co. with the assistance of IITA, Ibadan and the cooperation of the Ministries of Agriculture of the States in the area between 1970 and 1976. The combined effort was leading in 1976 to the establishment of improved, high-yielding, disease-resistant cassava varieties best suitable for the climate and poor soils of the Niger Delta. The main control measure applied was changing the time of planting from February/March to early September which gave 8-9 months of uninterrupted growth before CBB disease attacked the plants as against the 4-6 months growth when planted in February/March.

164. HOWLAND, A. K. 1976.
A rapid multiplication technique. In Terry, E. and R. MacIntyre eds. The International exchange and testing of cassava germplasm in Africa; proceedings of an interdisciplinary workshop held at IITA, Ibadan, Nigeria, 17-21 Nov. 1975. Ottawa, IDRC. pp.42-44.

This technique is effective for rapid multiplication of desirable clones and the provision of planting material free from CBB. It makes it possible to produce a number of green rooted cuttings from any one mature stem cutting. As CBB is confined to the vascular system in the mature stem, disease free material can be produced if the young shoots are removed and rooted separately. The success of the method depends on good horticultural practices.

[illegible] [illegible] [illegible]IONAL INSTITUTE OF TROPICAL AGRI[illegible]TURE. 1974.
[illegible] pathology: cassava bacterial blight (CBB). In its [illegible]nual report. Ibadan, IITA. pp143-144.

[illegible] were carried out on the reproduction of field symptoms by [illegible], screening cassava varieties for resistance to CBB, the [s]urvival of CBB and the relationship between cultural practices and the [development] of CBB. Research revealed that *X. manihotis* cells from [illegible] viable for 14 months after they had been remo[ved] from infected plant[s] [illegible]

[illegible] OF TROPICAL AGRICULTURE. 1975.
[illegible] Annual Report. Ibadan, IITA. pp1[illegible]

[illegible] pathology program during 1975 [illegible] epidemiology and control of CBB [illegible] incidence and severity [illegible] screening [illegible]

[illegible]

[illegible] 1975 [illegible] cassava, improved [illegible] resistance to several [illegible] blight (CBB). Clones [illegible] to be usable in [illegible] populations [illegible] and anthracnose was [illegible] 12 mo of age [illegible] Summary from CIAT. Card No. 7015[illegible].

[illegible] 1977.
[illegible]

[illegible] resulted in checking [illegible]

169. INTERNATIONAL INSTITUTE OF TROPICAL AGRICULTURE. 1977.
Improved cassava clones. In its Highlights of 1976 Research. Ibadan, IITA. pp.15-16.

Cassava mosaic disease (CMD) and cassava bacterial blight (CBB) are confirmed as the two devastating diseases of cassava in Africa and other areas where the crop is grown. Consequently, the two major set backs to cassava production are believed to be CMD and CBB as well as the paucity of high yielding cultivars. Cassava breeding activities at IITA within the last ten years have resulted to high-yielding varieties consistently resistant to CMD and CBB. A table is provided giving facts on the field performance of seven improved cassava clones and one local cultivar with respect to incidence of CMD and CBB, yield and gari quality.

170. LEHMAN, P. S. 1972.
Insect and diseases of cassava. In Hendershott, H. C. et al. A literature review and research recommendations on cassava (*Manihot esculenta* Crantz). Athens, Ga. University of Georgia. AID Contract No. CSD/2497. pp.76-78.

Two causal agents of bacterial wilt of cassava, *Xanthomonas manihotis* and *Pseudomonas* sp. are briefly described. They occur in several places in Central and South America. The symptoms of the wilt are given. Recommendations for further research include provision of quantitative data on the influence of many insects and diseases on yield, improving yields through plant breeding, the use of fertilizer and extensive and intensive planting, together with problems associated with them. Research is also needed on the sources of inherent resistance to diseases possessed more by cassava than other plants, including the role of high HCN content in the more resistant cassava clones. Such knowledge would be adopted in cassava breeding programs.

171. LEU, L. S. 1977.
Cassava bacterial blight in Taiwan. In Symposium of the International Society for Tropical Root Crops, 4th., Cali, Colombia, Proceedings. Ottawa, Canada, International Development Research Centre. pp.175-179.

Bacterial blight, the most important cassava disease in Taiwan, was probably present before 1945. The disease is systemic in nature and transmitted primarily by cuttings and secondarily by wind-borne water. Angular leaf spots, wilting, defoliation, gum exudates on leaf lobes, stipules and stems, and death of plants are caused by the vascular-invading bacterium, *Xanthomonas manihotis*, which confines itself to the genus *Manihotis* and shows poor survival ability in the soil. The disease was induced by using bacterial suspension, dipping of healthy cuttings, injecting into young stems, spraying of whole plants, cutting leaves of young plants with contaminated scissors, and pouring into injured roots of young plants. Screening seedlings for resistance was started and is continuing. (Author's summary expanded)

173. [illegible]. 1975.
[illegible]bacterial blight of cassava. PANS 21(1): 38-43.

Bacterial blight of cassava is a serious problem in Central and South America and has been observed in parts of Africa. Symptoms include leaf spotting, wilting, die-back, gum exudation on young shoots, and vascular discoloration in mature stems and roots of susceptible cultivars. Dispersal by rain splashing is the most important means of dissemination within localized areas. Dissemination from one area to another occurs through infected plant propagation material or by the use of contaminated tools. Delay in spread of the disease has been obtained by pruning infected [illegible] use of resistant varieties and the production of certified bacteria-free planting materials obtained from plants propagated from shoot tips. [illegible] have given satisfactory control. (Author's summary)

174. [illegible]. 1974.
[illegible] Cassava bacterial blight in Colombia: epidemiology and control. Phytopathology [illegible]

Dispersal by splashing rain is the most important means of dissemination of the cassava blight bacterium (a possible strain of *Xanthomonas manihotis*) within localized areas in Colombia. Dissemination from one area to another occurs through propagation of infected plant parts and by means of infected tools. In controlled inoculation experiments in the field, plant-to-plant spread occurred in the direction of prevailing winds and disease incidence was correlated with amount of rainfall. However, no dissemination occurred when host plants were located at least 15 m away from the inoculum source. Satisfactory disease control was obtained by excising upper portions of infected plants and allowing the stumps (20-30 cm) to resprout. Effectiveness of this control method was reduced when treating highly susceptible, severely infected cultivars. Rooting excised buds was an efficient method of obtaining healthy planting stock from infected cultivars.

174. LOZANO, J. C. and L. SEQUEIRA. 1974 (Cont'd)

Eight out of 1293 cassava cultivars tested under greenhouse conditions were resistant to bacterial blight. Resistance was dependent on restricition of penetration and systemic invasion by the pathogen; two cultivars ('M. Col. 647' and 'M. Col. 667') exhibited a hypersensitive response which limited the size of leaf lesions. The use of resistant cultivars remains the most promising method of control of the disease in the tropics. (Author's summary)

175. MSAJAHA, M. 1977.
Cassava - rapid multiplication techniques: demonstration. In IDRC/IITA cassava bacterial blight workshop held at IITA, Ibadan, 1-4 Nov. 1976. 5p. mimeo.

Rapid propagation is aimed at getting large short-term increases of CBB - free planting material from the matured plants selected from the CBB infected farm. The materials and methodology used are described. The success of the method depends on good horticultural practices such as clean equipment, controlled moisture, humidity and shade. A second technique used, involved the rapid propagation of improved clones of cassava aimed at maximising shoot production per node.

176. NESTEL, B. 1974.
Current trends in cassava research. Ottawa, IDRC. 32p.

Diseases and pests of cassava as reported in the literature are reviewed. It is noted that the literature relating to the major bacterial, viral and fungal diseases of cassava had recently been reviewed extensively by Lozano and Booth (1974). They presented much information on the control of cassava bacterial blight, a major disease problem in Africa and Latin America. The existence of clones resistant to some of the diseases was noted.

177. NORMANHA, E. S. and A. S. PEREIRA. 1950.
Aspectos agronomicos da cultura da mandioca(*Manihot utilissima* Pohl). (Agronomic aspects of cultivating cassava,(*Manihot utilissima* Pohl). Bragantia 10(7): 179-202.

Studies on cassava bacterial wilt, caused by *X. manihotis* Arthaud-Berthet) Burk, revealed that several common varieties and clones derived from seedlings show more resistance than commonly cultivated types. Cuttings of the resistant types were released to the farmers in Brazil and are now being widely grown.

178. NORMANHA, E. S. and A. S. PEREIRA. 1964.
Cultura da mandioca. (Cassava cultivation). Campinas, Brasil. Instituto Agronomico. Boletim No.124. 29p.

The characteristics of eight industrial and six table and forage varieties are tabulated. Various varieties are recommended for cultivation in Sao Paulo on the basis of their resistance to certain diseases, including *X. manihotis*. (Summary from Field Crops Abstracts).

[illegible], S. 1977.
Preliminary study on the effects of medium and fungicide treatment on rooting of cassava green shoots. In IDRC/IITA cassava bacterial blight workshop held at IITA, Ibadan, 1-4 Nov. 1976. 2pp. mimeo.

This study tried to find the most efficient method for multiplying green shoots of cassava for providing planting material free from CBB, using the cultivar 60444. The plant materials were treated in fungicide formulations. The results were not yet conclusive and further research was continuing.

SCHMIDT, N. C. and A. S. PEREIRA. 1968.
Comportamento do cultivar "mantequeira", e de outros, de mandioca, em solos da série pinhao (terciario), no vale do Paraiba, Estado de Sao Paulo. (Behavior of the cassava cultivar "Mantequeira" and others in soils of the series "Pinhao" (tertiary) of the State of Sao Paulo). Bragantia 27(22): 249-256.

In competition trials of cassava cultivars (*Manihot esculenta* Crantz), carried out in the Paraiba River Valley on a tertiary soil, the new cultivar "Mantequeira" created by the Instituto Agronomico showed to be superior to the others. This cultivar presented precocious initial shoots, high productivity, roots excellent in quality and type, facility in harvesting, straight stand, which makes the cultural treatments easy, an apparent resistance to the root rotting and bacteriosis caused by *Xanthomonas manihotis* (Arthaud-Berthet) Starr, rusticity and tolerance to droughts. It was also free of virus induced mosaic. (Author's summary).

191. ARENE, O.B. and S.O. ODURUKWE. 1978.
Limitations in the use of NPK fertilizer in the control of cassava bacterial blight. Paper presented at IDRC/IITA workshop on cassava bacterial blight held at IITA, Ibadan, 26-30 June, 1978. 14 p. mimeo.

The relationship as reported in the literature is reviewed between NPK-fertilizer on the one hand and plant vigour, disease resistance and crop yield on the other hand with respect to cassava and the cassava bacterial blight. The results of various experiments performed at IITA, Ibadan and NRCRI, Umudike, Nigeria, are interpreted to demonstrate that at the optimum level of NPK-fertilizer in the soil and hence of the N, P and K nutrients in cassava tissues, CBB is reduced by the rise in plant vigour and resultant increase in dry matter. Research is continuing to determine whether the optimum NPK fertilizer levels required for CBB-resistance and for maximum tuber yields are similar.

192. DANIEL, J.F. et B. BOHER. 1978.
Le dépérissement bactérien du manioc en République Populaire du Congo et en Empire Centrafricain. Une communication faite à "1' IDRC/IITA workshop on cassava bacterial blight held at IITA, Ibadan, 26-30 June 1978." Ibadan, IITA. 6p. mimeo.

On confirme la présence de la maladie de cierges du manioc (MCM) causée par *Xanthomonas manihotis* en République Populaire du Congo (RPC) et en même temps on signale officiellement sa présence en Empire Centrafricain (EC) selon les études de la pathogénicité, des caractères morphologiques et biochimiques de la bactérie isolée durant les prospections visées à y etabulir sa distribution.

La bactériose n'était signalée que dans deux régions en RPC en 1976 mais en 1977 elle s'est dispersée dans plusieurs régions du pays y compris deux fermes d'état et surtout des zones proches de la frontière du Zaire d'où viennent des boutures contaminées du manioc.

En E.C. on a observé les effects d'anciennes attaques probablement survenues en 1976. Les zones atteintes sont toujours proches aux régions atteintes par la bactériose au Caméroun d'où on introduit des boutures infectées.

En ce qui concerne l'épidemiologie, on a observé que la maladie est très répandue dans les zones de savanes herbeuses ou arbustives surtout là où le sol est pauvre, mais restreintes dans les régions de forêt. La bactériose est plus intense pendant les saisons des pluies. Une étude sur la microflore bactérienne des parties aériennes

du manioc a révélé la présence de *X. manihotis* sur les feuilles saines du manioc situé dans les champs déjà atteints par MCM d'où elle se disperse.

On présente en détail les caractères biochimiques de l'agent pathogène établis en étudiant vingt isolats obtenus de RPC et dix isolats d'origine centraficaine et huit isolats sud Américaine. Tous les isolats sont très homogènes.

En fin on donne les symptôms détaillés de la bactériose observés dans les deux pays. Ce sont des tâches foliaires, déssechement, flétrissement, défoliation, production de bactérioele et nécrosis vasculaires des tiges.

IKOTUN, T. 1978.
Effect of *Xanthomonas manihotis* on cassava tissues. Paper presented at the IDRC/IITA workshop on cassava bacterial blight, held at IITA, Ibadan, 26-30 June 1978. Ibadan IITA. mimeo.

Xanthomonas manihotis degraded host tissues enzymatically and caused disintegration and collapse but did not block water-conducting vessels. Enzymes involved were polygalacturonases and polygalacturonate trans-eliminases.

Cell walls underwent structural modifications which made them permeable to electrolytes such as calcium, potassium and sodium. Leakage of electrolytes from cassava tissues was used by the author to explain certain symptoms of the disease caused by X. *manihotis*.

LOZANO, J.C. and A. BELLOTTI. 1978.
Erwinia carotovora var. *carotovora*, casual agent of bacterial stem rot of cassava: etiology, epidemiology and control. Paper presented at the IDRC/IITA workshop on cassava bacterial blight held at IITA, Ibadan, 26-30 June 1978. Ibadan, IITA. 29p. mimeo.

A new bacterial disease of cassava associated with damage caused by the cassava fruit fly (*Anastrepha spp.*) in Colombia has been observed within the past four years. Results of etiological studies of the bacterium show that it is similar to *Erwinia carotovora* var. *carotovora*. Before the emergence of this new bacterial pathogen of cassava, the crop had been damaged by four other bacteria species viz:- *Xanthomonas manihotis* (Arthaud-Berthet) Star, X. *cassavae* Wiehe and Dowson, *Agrobacterium sp* and *Erwinia cassavae* (Hansford) Bukholder, included in the E. *herbicola* group. *Pseudomonas solanacearum* is no longer accepted as a pathogen of cassava.

Following damage caused to the stem of cassava by the larvae of the cassava fruit fly (*Anastrepha spp.*) the pathogen

responsible for the cassava bacterial stem rot disease enters the plant. The symptoms are internal rotting of the stem in the pith region, wilting of young shoots or branches, followed by tip collapse and dieback or canker formation of lignified stem parts.

The etiology is described in detail covering the development of CSRB in TZC medium after 48 hour incubation at 25°C, development in a pectate medium, growth in ordinary culture media and sugar-containing media where it makes medium-sized colonies, circular, convex, undulate to caralloid, but not mucoid.

CSRB is a slender gram-negative rod the dimensions of which are presented here. The cells are motile and possess 4 to 8 peritrichous flagella. In 48 hour-old cultures, the cells are single or in chains of 2-3 cells, unencapsulated and non-spores forming.

The results of artifical inoculations are given. Biochemical, physiological and cultural characteristics of CSRB observed in tests on four isolates of the pathogen are presented. From these characteristics it is concluded that CSRB is a close relative of the *E. carotovora* group and is indistinguishable from *E. carotovora* var. *carotovora*. Inversely a comparison between *E. cassavae* and CSRB shows that they are different species. As a result of the comparisons and for some reasons given here, cassava is now reported as a host of *E. carotovora* var. *carotovora*.

The insect vector of CSRB and its epidemiology are then discussed. Under epidemiology, its mode of dissemination, epiphytic survival, disease occurrence and severity, possible disease cycle and yield loss attributable to it are discussed in detail.

Recommendations are made for the control of CSRB and its insect vector. The use of clean, CSRB - uninfected cuttings of cassava varieties resistant to the insect seems to be the most promising control measure as preliminary screening shows that such clones exist. Other methods are the use of insecticides alone, insecticides and attractants (mostly yeast), and finally attractants the most successful of which is hydrolyzed maize.

185. OHUNYON, P.U. and J.A. OGIO-OKIRIKA. 1978
Eradication of cassava bacterial blight/cassava improvement in the Niger Delta. Paper presented at the IDRC/IITA workshop on cassava bacterial blight held at IITA, Ibadan. 26-30 June, 1978. Ibadan, IITA. 7p. mimeo.

Following over 75% yield loss due to CBB epidemic in the Niger Delta in 1972 a cooperative cassava imporvement programme was set up in Bendel State by the Shell-BP Development Company of Nigeria Limited, IITA, Ibadan, and the Bendel State Government. The programm's objective was to screen cassava varieties bred at IITA for clones

resistant to CBB and suitable to the poor soils of the two comprising parts of Bendel, Rivers and [illegible] States. The activities and progress made so far by the programme is presented here.

Of the 1,366 selected cassava clones planted in 1974 over sixteen high-yielding varieties proved remarkably resistant to CBB. Hence, it is concluded that the disease can be completely eradicated through the adoption of high yielding cassava lines resistant to it. A description is presented of the cassava rapid multiplication work carried out by the programme using Lozano Humidity chamber and 2 or 3 node shoot cuttings.

Planting materials of the CBB-resistant varieties are supplied to farmers in the three states in the area.

PERSLEY, [illegible]. 1978.
Studies on the epidemiology and ecology of cassava bacterial blight. Paper presented at the IDRC/IITA workshop on cassava bacterial blight, held at IITA, Ibadan, 29 - 3 June 1978, Ibadan, IITA 6p. mimeo.

Recent field surveys in Africa have shown that cassava bacterial blight is more widespread and damaging in the savanna and forest/savanna transition zone than in the forest. It was considered of interest to investigate this apparent anomaly of the lower incidence of this rain-splash disseminated disease in the rainy forested area. Two aspects were considered: a) epidemic development from inoculated young rooted cuttings; and b) survival of the pathogen during the dry season in the absence of an epidemic.

Epidemic development was tested in a resistant (TMX 4488) and a susceptible cultivar (60447) in three climatic zones in Nigeria in 1977/78. The sites chosen were Warri (forest zone, 2600 mm average annual rainfall, 2 months dry season); Ibadan (forest/savanna transition zone, 1270 mm average annual rainfall, five months dry season); and Mokwa (savanna zone, 1100 mm average annual rainfall, six months dry season).

Young rooted shoots, free of CBB, were planted at each site. Plants at the windward end of each plot were inoculated, and disease development in the non-inoculated plants was monitored at regular intervals. Two plots of each cultivar were also planted at Ibadan 20 m away from the test plots, separated by maize and left uninoculated. Climatic data was collected at each location.

The epidemic developed best in 60447 at Ibadan, both in terms of the disease index and percent defoliation. The epidemic also developed in Mokwa, although there was less defoliation than in Ibadan. At both sites, the

the epidemic developed during the wet season and reached a stationary phase approximately six months after planting at the beginning of the dry season. The epidemic failed to become established in Warri, although there was a high initial death rate in both cultivars. The main climatic difference among the sites in the first two months after planting was that Warri had approximately five times as much rain as either of the other sites. It is likely that this made it difficult for the young rooted shoots to become established, and any that became infected died. It is hypothesized that plant death was sufficiently rapid in the early stages when plants were widely separated to preclude the chain of infection required of an epidemic.

The pathogen was detected in debris on the soil surface approximately six months after planting, at the beginning of the dry season. The numbers fell sharply after the first rains. The results indicate that it should be possible to break the disease cycle by harvesting with the first rains, removing all infected material from the field, and allowing the field to fallow for three months during the early wet season before replanting with healthy material.

187. TERRY, E.R. 1978
Integrated control of cassava bacterial blight (CBB) in Africa. Paper presented at the IDRC/IITA workshop on cassava bacterial blight held at IITA, Ibadan, 26-30 June 1978. Ibadan. IITA 8p. mimeo.

The prominent role of cassava in the nutrition, farming systems and economy of inhabitants in the African "Cassava belt" is discussed. the economic importance of cassava bacterial blight and its short and long term effects on cassava production is briefly reviewed. The most important factors relevant to the structure of an integrated control program are outlined.

AUTHOR INDEX

SUBJECT INDEX

BACTERIA SPECIES INDEX*

Xanthomonas manihotis, the subject of this collection, is excluded.

GEOGRAPHICAL INDEX

* See also individual countries in Africa, Asia, Central and South America.

AGENCY FOR INTERNATIONAL DEVELOPMENT
WASHINGTON, D. C. 20523

BIBLIOGRAPHIC INPUT SHEET

FOR AID USE ONLY

1. SUBJECT CLASSIFICATION
A. PRIMARY: Bibliographies — AH20-1540-0000
B. SECONDARY:

2. TITLE AND SUBTITLE
Cassava bacterial blight; abstracts of literature

3. AUTHOR(S)
Ibekwe, G. O.

4. DOCUMENT DATE	5. NUMBER OF PAGES	6. ARC NUMBER
1978	111p.	ARC 016.63368.112

7. REFERENCE ORGANIZATION NAME AND ADDRESS
IITA

8. SUPPLEMENTARY NOTES (Sponsoring Organization, Publishers, Availability)

9. ABSTRACT

10. CONTROL NUMBER
PN-AAG-868

11. PRICE OF DOCUMENT

12. DESCRIPTORS
Abstracts
Cassava
Bacterial diseases

13. PROJECT NUMBER
931030900

14. CONTRACT NUMBER
AID/ta-G-1491

15. TYPE OF DOCUMENT

AID 590-1 (4-74)

PN-AAG-163

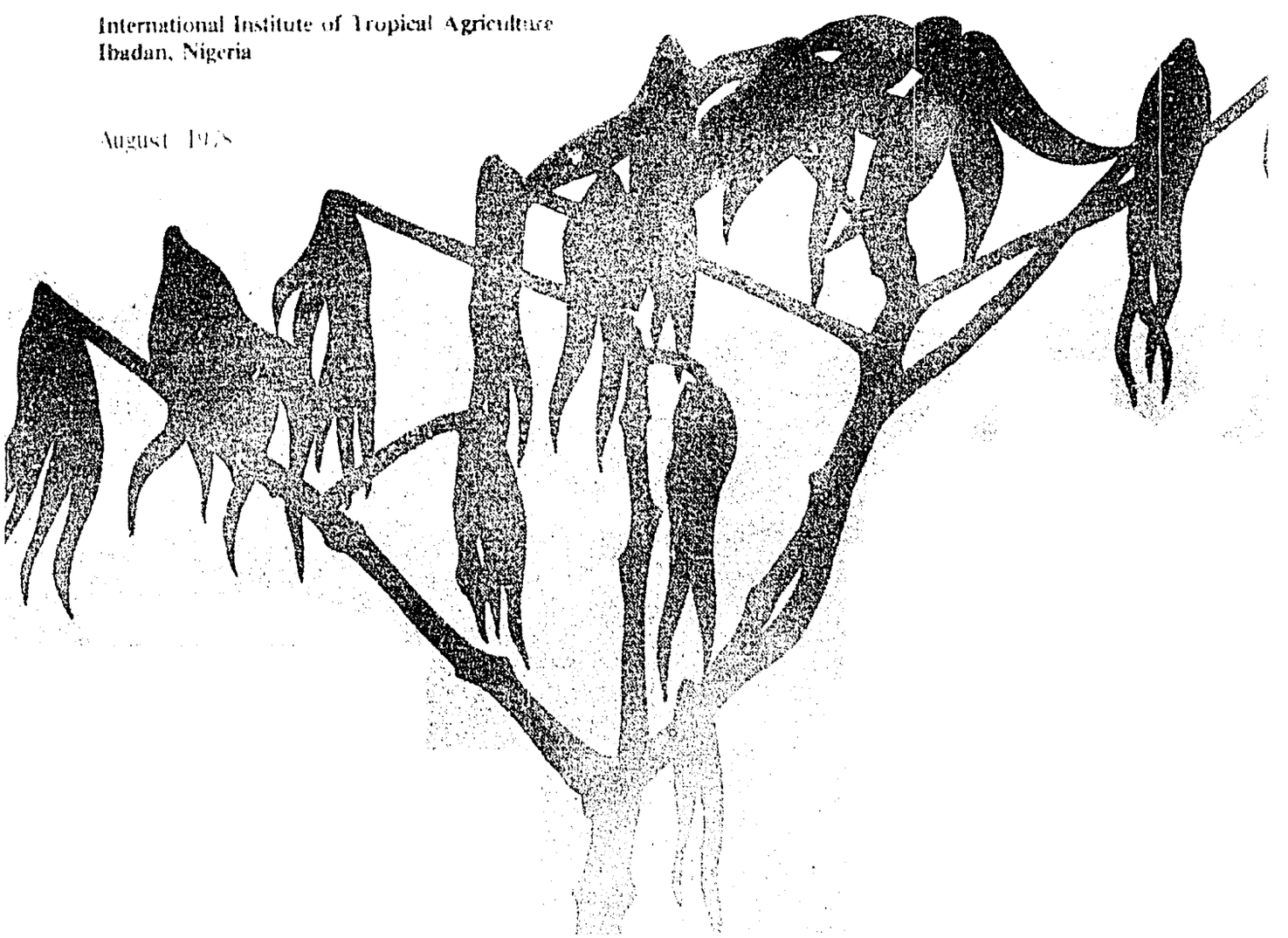
CASSAVA BACTERIAL BLIGHT
Abstracts of Literature

SUPPLEMENT

G.O. Ibekwe

International Institute of Tropical Agriculture
Ibadan, Nigeria

August 1978



CASSAVA BACTERIAL BLIGHT: ABSTRACTS OF LITERATURE.

SUPPLEMENT

BY

G. O. IBEKWE

LIBRARY AND DOCUMENTATION CENTER
INTERNATIONAL INSTITUTE OF TROPICAL AGRICULTURE
IBADAN, Nigeria AUGUST 1978.

C O N T E N T S

LOZANO, J. C. et BELLOTTI. 1978 (Cont'd)
Finalement viennent les recommendations pour lutter contre CSRB et son insecte vecteur. Planter des boutures propres et saines prises des variétés du manioc résistantes à l'insecte vecteur semble le moyen de lutte le plus efficace. Des essais préliminaires de sélection variétales indiguent qu'il y a de telles variétés. On conseille d'autres façons de lutte comme l'emploi unique des insecticides sans des produits chimiques attirants à la fois (surtout la levure), et troisièmement l'emploi unique des produits chimiques attirants, l'emploi des insecticides et des produits chimiques attirants. (For English version see No.154).

LOZANO, J. C. 1978.
General considerations on cassava pathology. In T. Brekelbaum, A. Bellotti and J. C. Lozano eds. Cassava protection work. Proceedings. CIAT Cali, Colombia, 7-12 Nov. 1977. Cali, CIAT. pp. 17-27.

In a table summarising the different characteristics of presently identified bacterial diseases of cassava namely CBB, cassava bacterial leaf spot, cassava bacterial stem rot and cassava bacterial stem gall, it is shown that CBB is caused by X. manihotis with symptoms of leaf spotting, blight, gum exudation, wilting, leaf fall, dieback, dry rotting of vascular strands of stems and roots. The cultural features of the bacteria are fast growth, slimy, mucoid and white colonies. Dissemination is through infected cuttings, rain and soil splashing, insects and infested tools. CBB can be controlled through using resistant varieties, disease-free planting material and crop protection. These are grouped with other methods under the following headings:- regulatory control (quarantine), cultural, (host eradication, crop rotation, sanitary measures, improvement of growing conditions, prevention of high humidity conditions through wider spacing, tissue culture techniques), biological control (use of resistant varieties), physical control (microwaves, ultraviolet light and heat treatments) and chemical control.

Characteristics of the host/pathogen relation to be considered by pathologists are given.

Under methodological problems it is explained that the high degree of overlapping of symptoms caused by diseases, insects and environmental or edaphic factors can easily lead to errors in final evaluations. One or more of the symptoms induced by CBB is also induced by Xanthomonas cassava, Cercospora vicosae and Phoma, shoot flies, Erwinia carotovora var. carotovora (E. cassava), Sphaceloma manihoticola, mites, thrips, soil salinity and drought. Initial greenhouse evaluations are therefore recommended for CBB followed by further evaluations in the field.

3. THURSTON, H. D. et al. 1978.
Summary conclusions and recommendations. In T. Brekelbaum, A. Bellotti and J. C. Lozano eds. Cassava protection workshop. Proceedings. CIAT, Cali, Colombia. 7-12 Nov. 1977. Cali, CIAT.

The summary conclusions are presented under the following headings: integrated pest control, breeding of new cultivars, biological control, chemical control, cassava protection in intercropping systems, allelopathy, and quarantine.

Under quarantine it is noted that three types of cassava planting material exist namely, true seed, tissue culture and stem cuttings. True seeds and tissue culture have limitations because despite the treatment of seeds against surface contaminants, CBB and other pathogens are still transmitted by seed while cassava tissue culture techniques have not been sufficiently developed. So far only apices are successfully obtainable leaving only vegetative material that carries risk of spreading cassava diseases and pests. Quarantine measures should be judiciously applied, cuttings being selected from pest-free farms only and treated with appropriate chemicals. Further research on methods of obtaining, propagating, treating and shipping completely pest-free cassava germplasm is required.

Recommendations include the need for technical assistance to study the nature and genetics of disease and pest resistance, and gene controlling HCN production in cassava.

B. ETIOLOGY & SYMPTOMATOLOGY

4. BOOTH, R. H. 1978.
A review of root rot diseases in cassava. In T. Brekelbaum, T. A. Bellotti, and J. C. Lozano eds. Cassava protection workshop. Proceedings. CIAT, Cali, Colombia. 7-12 Nov. 1977. pp.121-133.

The author reviews cassava diseases under:- (1) diseases of young roots, (2) preharvest diseases of storage roots and (3) post-harvest root rots, distinguishing pathogenic rots from physiological disorders. On page 125 CBB (Xanthomonas manihotis) is classified as a minor dry rot affecting pre-harvest storage roots of very young susceptible cultivars producing symptoms of dryness of roots, necrotic, discoloured vascular strands, making the roots less acceptable. The symptoms resemble those of post harvest vascular streaking.

5. BRADBURY, J. F. 1977.
Xanthomonas manihotis. CMI Descriptions of Pathogenic Fungi and Bacteria. No. 559. 2p.

The various earlier names, misnomers and variant names of Xanthomonas manihotis are given including Aplanobacter rohici (Bouriquet) Magrou, 1953, Xanthomonas ricini (Yoshi Takimata) Dowson f. sp. cassavae (Wiehe & Dawson) Sabet, Ishag & Khalil, 1969, a yellow strain of X. manihotis.

Its etiology in various media is also given in full detail. The description is based on original observations on 9 isolates from various geographical areas, supplemented by Dye (1962), and Lozano & Sequira(1974).

X. manihotis causes cassava bacterial blight with diverse symptoms including spotting, blight and wilt of leaves, wilt and dieback of stems, necrosis of vascular tissue of stems and roots, and exudation of bacterial ooze. Young stems are very susceptible. The roots remain apparently healthy but in some susceptible varieties, dry, rotted spots may develop around necrosed vascular strands (Lozano 1975).

CBB has been found in Argentina, Brazil, Colombia, Venezuela, Nicaragua, Nigeria, Ghana, Togo, Cameroun, Zaire, Uganda, Malawi, Madagascar, Mauritius, India, Malaysia, Indonesia, and Taiwan. The usual modes of transmission are given. It is noted that insects may be its vectors as does Pseudotheraptus devastans in Zaire (Maraite & Meyer, 1975).

It is also noted that many plant pathologists have tried to clarify the relationship or difference between X. manihotis and X. cassavae. In particular, Robbs et al showed that X. manihotis and X. cassavae produce the same range of symptoms and are not distinguishable in culture. Hence his view that X. cassavae is a yellow variant of X. manihotis seems acceptable.

6. BRADBURY, J. F. 1978.
Indentification and characteristics of Xanthomonas manihotis. Paper presented at the IDRC/IITA workshop on cassava bacterial blight held at IITA, Ibadan, 26-30 June 1978. Ibadan, IITA. 4p. mimeo.

The author includes Xanthomonas cassavae under X. manihotis. He discussed the more important of the many characteristics recorded for X. manihotis, selects few of them for purposes of indentification of the pathogen with few simple and repeatable tests. Its indentification is made difficult by its not having the yellow pigment typical of a Xanthomonas sp. belonging to the X. campestris group. It also has some negative or rather weak characteristics. Notwithstanding, positive characteristics should be sought as they are more useful for indentification.

6. BRADBURY, J. F. 1978 (Cont'd)
The author then considers the salient features of X. manihotis and gives the conditions necessary for accurate identification (after careful isolation of the pathogen) using fourteen tests which are described here. The tests are examination and careful description of the colonies as they appear on nutrient agar, gram-stain test, heat test for spores if spores are not seen under the microscope. Others are carbohydrate oxidation/fermentation test preferably using Hayword's method, motility test, nitrate reductase, fluorescent pigment on King's medium B, Kovac's oxidase test, gelatin hydrolysis, starch hydrolysis, pectolytic activity, tolerance of not Triphenyl tetrazolium chloride, Dye's Asparagine medium, and flagella staining tests.

It is remarked that with the isolates he examined the author has not been able to see the kind of difference that led Lozano to separate X. manihotis into two biotypes based on their ability to use cellobiose, trehalose and sucrose. This range of carbohydrates are used only for diagnostic and confirmation purposes.

7. BUYCKX, E. J. E. 1962.
Maladies et insectes nuisibles du manioc: Maladie bactérienne (Bactérium cassavae Hands). In his Précis des maladies et des insectes nuisibles rencontrés sur les plantes cultuvées au Congo, au Rwanda et au Burundi, par la Division de Phytopathologie et d'Entomologie agricole sous la direction d'E. J. E. Buyckx; Bruxelles, INEAC. pp.471-477.

A la page 471 on fait mention de Bactérium cassavae Hands qui provoque sur les feuilles des taches anguleuses et translucides. La maladie n'était ni sévère ni soutenue.

8. DYE, D. W. 1962.
The inadequacy of the usual determinative tests for the identification of Xanthomonas spp. New Zealand Journal of Science. 5: 393-416.

A comparative study has been made of 209 phytopathogenic Xanthomonas cultures comprising 57 recognised species, using the so called standard methods in an attempt to clarify the identification of the species by laboratory procedures. The various species that have been proposed could not be differentiated by any or all of the 30 different tests used. They formed a remarkably uniform group which could easily be distinguished from some other yellow pigment producing organisms that were included for comparative purposes. It is suggested that the many Xanthomonas species could well be regarded as special forms of one species adapted to particular hosts. X. manihotis (Arthaud-Berthet, 1912) Starr was among the cultures tested. It was given code number ZH for this particular study. (Author's summary expanded).

9. FAWOLE, M. O. and T. IKOTUN. 1978.
The production of polygalacturonase by Xanthomonas manihotis. West African Journal of Applied and Biological Chemistry 21. (in Press).

A study has been made of the activity of polygalacturonase in culture filtrates of Xanthomonas manihotis. The activity of the enzyme is enhanced by increasing concentrations of polygalacturonic acid. Activity was also high in media containing starch. The presence of glucose in growth medium depressed enzyme activity. It is suggested that polygalacturonase is an inducible enzyme in this bacterium. (Authors' summary).

10. HANSFORD, C. G. 1945.
Uganda plant diseases. East African Agricultural Journal 10: 147-151.

A leaf spot disease caused by Bacterium cassavae in Uganda is described. It causes small angular spots on the leaves, initially dark green and wet but later dark brown and drying out.

11. IKOTUN, T. 1978.
L'effect de la maladie des cierges de manioc (MCM) sur les tissus du manioc. Une communication présentée à "l'IDRC/IITA workshop on cassava bacterial blight held at IITA, Ibadan, 26-30 June 1978".

Xanthomonas manihotis a enzymatiquement dégradé les tissus de l'hôte. Elle leur a causé également la désagrégation et l'écroulement mais elle n'a pas bloqué les vaisseaux conducteur de l'eau. Il s'agit des enzymes "polygalacturonases et polygalacturonate trans-eliminases"

Les parois cellulaires ont subi des modifications structurales qui les ont rendus permeable aux électrolytes tels que calcium, potassium, et sodium. La fuite des électrolytes à travers les cellules du manioc a permis l'auteur d'expliquer quelques symptômes de la maladie causée par X. manihotis. (For English version see No.183).

12. IKOTUN, T. 1978.
Survival of Xanthomonas manihotis in host tissues. Journal of the Nigerian Society for Plant Protection 3, 35-43

Xanthomonas manihotis, the causal organism of bacterial blight of cassava (Manihot esculenta Crantz) survived for up to 24 months in field-collected bacterial ooze, for 30 months in infected cassava stems and for 6 months in infected leaves.

The pathogen did not block xylem vessels, even long after the whole plant had wilted; The bacterium invaded all tissues of the stem and leaves, degrading cell walls, causing cell separation and disintegration of tissues. In lignified tissues of mature cassava stems, disintegration was not as severe as in young stems. The pathogen did not survive as long in young as in mature stems in which infections were symptomless.

13. IKOTUN, T. 1978.
The nature and function of extracellular polysaccharide produced by Xanthomonas manihotis (Arthaul Berthet). West African Journal of Applied and Biological Chemistry 20, (In Press).

Xanthomonas manihotis, the causal organism of cassava bacterial blight disease, produced loose extracellular slime which is a high molecular weight polysaccharide in culture precipitated with acetone. Acid hydrolysis of a solution of slime yielded glucose, mannose and glucuronic acid on paper chromatograms; Autoclaving solutions of acetone-precipitated slime for 30 to 90 min. drastically decreased its viscosity. Toxicity to plants was probably due to the high molecular weight rather than its effects on plant cell walls or cytoplasm. The slime physically blocked the xylem vessels preventing flow of water. Absorption in the UV spectrum indicated that the extracellular slime probably protected X. manihotis from radiation and other environmental hazards.

14. LOZANO, J. C. et al. 1976.
Field problems in cassava by J. C. Lozano, A. Bellotti, A. van Schoonhoven, R. Howeler, J. Doll, D. Howell and T. Bates. Cali, CIAT. pp.9-11.

It is noted that cassava is damaged by over thirty pathogenic agents including Xanthomonas manihotis causing losses in crop establishment, reduced plant vigour, reduced photosynthetic capacity; or causing pre-or post harvest root rot. Others attack only the stalk normally used for propagation causing tissue necrosis. Others invade the vascular system, the foliar tissues and the tender parts of the stalk causing spots, blight, defoliation, wilting, dieback and hypertrophies. These diseases generally occur during the rainy season.

CBB is one of the most serious diseases of cassava. The symptoms are given. These vary with susceptibility of the variety and the time of infection. CBB transmission is generally through the use of cuttings taken from affected plantations.

Recommendations are given as to agronomic practices for the control of these diseases including of course CBB.

[illegible], H. 1978.
Comparative sym. development in cassava after infection by Xanthomonas manihotis or X. cassavae under controlled environmental conditions. Paper presented at the IDRC/IITA workshop on cassava bacterial blight held at IITA, Ibadan, 26-30 June 1978. Ibadan, IITA. 5p. mimeo.

It is thought that different organisms are causing similar symptoms in cassava which implies that identification of pathogens by symptoms only would not be certain and definite. Thus pseudomonas solanacearum manihotis, Xanthomonas manihotis and X. cassavae seem to have been confused. Inoculation experiments were performed to determine whether Xanthomonas manihotis and X. cassavae are the same or different strains of bacteria. The leaf and stem symptoms induced by both X. manihotis and X. cassavae were compared. It was observed that X. cassavae can be distinguished from X. manihotis on the bases of colour, the former's lower optimum and maximum growth temperature, its more rapid oxidation of maltose, a stranger deficiency for methiomine, a longer delayed oxilase reaction and a different appearance on NA containing 0.01% tetrazalium chloride.

On the grounds of these results the author suggests the nomenclature. X. campestries pathavan manihotis and X. campestris pathavan cassavae The disease caused by the later pathogen may then be termed cassava bacterial necrosis while that caused by the former would remain as cassava bacterial blight characterised by blight and wilt symptoms. Cassava bacterial necrosis would cover the necrotic angular leaf spots and back necrosis observed in the field following infection by X. cassavae.

16. NORMANHA, E. S. 1970.
General aspects of cassava root production in Brazil. In D. L. Plucknett ed. International Symposium on Tropical Root and Tuber Crops, August 23 to 30, 1970. Honolulu, Hawaii and Kapaa, Kauai, Hawaii. Second. Proceedings. Honolulu, University of Hawaii. Vol.1, pp.61-63.

Among the main agricultural problems discussed is cassava bacterial blight caused by Xanthomonas manihotis which is believed to be the most serious cassava disease in Central and Southern Brazilian states where it appeared in Sao Paulo in 1911. Affecting leaves and stems through the vascular system it could intensely decrease root production. Cassava cultivars vary in CBB-resistance and by 1970 no highly resistant clone had been discovered.

17. PERREAUX, D. 1977.
Contribution à l'étude de la bactériose du manioc. Louvain-la-Neuve, Université Catholique de Louvain. (iv), 37p.

L'auteur a étudié trois méthodes d'inoculation à fin d'en déterminer la plus efficace de cribler le manioc pour la résistance des variétés à la bactériose vasculaire du manioc dont l'agent pathogène est Xanthomonas manihotis. Les méthodes sont: 1) piqûre dans la tige entre la troisième et la quatrième feuille à l'aide d'une seringue qui injecte l'inoculum; 2) coupure des feuille (à savoir, la troisième et la quatrième); 3) pulverisation foliaire à l'aide d'un vaporisateur manuel à la surface inférieure des troisième et quatrième feuille.

Il décrit en détail les matériels et les méthodes employés. Il donne aussi une description de l'effet du milieu et d'un traitement fongicide sur l'enracinement des pousses de manioc. Il expose ensuite l'histopathologie des tiges de manioc infectées artificiellement par X. manihotis. Il finit par exposer son étude de la toxicité des filtrats de culture de X. manihotis. On a observé que cette bactérie fait précipiter des polysaccharides ce qui provoque le flétrissement des feuilles de manioc.

Il conclut que la méthode la plus efficace d'inoculation est la piqûre dans la tige. Cette méthode rend plus facile le criblage de la résistance des variétés de manioc à X. manihotis.

(The author comparatively studied three methods of inoculation of cassava shoots with Xanthomonas manihotis).

18. PERREAU, D. 1978.
Studies on screening methods for resistance to Cassava bacterial blight. Paper presented at the IDRC/IITA workshop on cassava bacterial blight held at IITA, Ibadan, 26-30 June 1978. Ibadan, IITA. 7p. mimeo.

It is remarked that adequate inoculation methods are necessary for testing the new cassava clones produced by plant breeders since plant-host resistance is the most effective method of controlling CBB. Three inoculation methods for screening varieties for resistance to CBB in a greenhouse were evaluated. These were puncturing the cassava stem with an hypodermic needle, clipping the leaf with infected scissors, and thirdly spraying the leaf.

The materials and methods used are described, the results are given and discussed. It is concluded that stem puncture is the most reliable method but that leaf clipping being more rapid and well correlated with field results can be accepted too.

19. ROBBS, C. F. et al. 1972.
Variacoes em Xanthomonas manihotis (Arthaud Berthet) Starr.
(Variations in Xanthomonas manihotis (Arthaud Berthet) Starr. by C.F. Robbs, R. de L.D. Ribeiro, O. Kimura and F. Akiba. Revista da Sociedade Brasileira de Fitopatologia 5: 67-75.

Inoculation with an isolate of X. manihotis from cassava showing necrotic leaf spots in Guanabara did not induce systemic wilt symptoms in 2 local cassava cvs. No significant differences in morphological, cultural and biochemical characteristics were found between this str., typical isolates of X. manihotis and X. cassava, except for the yellow pigment in cultures of the last. On inoculation the Guanabara isolate and X. cassava (from Africa) both produced necrotic angular leaf spots, similar in form and size. Neither induced wilt when inoculum was placed on stems after removal of petioles. Three other Brazilian isolates of X. manihotis (ENA-693, ENA-828 and ENA-858) produced typical wilt symptoms on inoculated stems or leaves; On leaf inoculation with these 3 strs. the spots enlarged, causing progressive yellowing of adjacent tissues, followed by wilt of petioles. It is suggested that X. cassavae may referred to as yellow strain of X. manihotis. (Summary from Review of Plant Pathology 55: 4417).

20. TERRY, E. R. 1978.
Disease problems in root crops production. In L. S. O. Ene, H. E. Okereke, S. O. Odurukwe, O. O. Okoli and O. B. Arene eds. National seminar on root and tuber crops. Umudike, March 21-25, 1977. First. Proceedings. Umudike (Nigeria), NRCRI. pp. 81-89.

Cassava bacterial blight is among the diseases of root crops covered. The causal agent of CBB had been identified as Xanthomonas manihotis. Bacteriophages having high specificity for X. manihotis have been determined and are currently used for rapid identification of CBB isolates. Tests for pathogenicity of 9 Nigerian isolates showed four highly virulent, three moderately and two weakly virulent. Of all possible methods leaf clipping has been chosen as the most suitable method of inoculation for resistance screening.

Short term cultural control practices recommended by IITA (Ibadan) and FARTS (Umudike) are effective while breeding for host-plant resistance to CBB has been successful.

21. TERRY, E. R. and O. B. ARENE. 1977.
Identification of cassava diseases and scoring the susceptibility of the cultivars. Paper presented at NAPPP Workshop, NRCRI, Umudike, Nigeria.

Two major diseases of cassava, CBB and CMD, are discussed. The severity of CBB on cassava which is characterized by angular leaf-spot, gum exudation, wilting and die-back is measured by the degree of wilting and die-back observed. This is graded into five classes. CMD is characterized by chlorosis which alternates with islands of deep green tissue thus giving the affected leaves a mosaic pattern. In severe cases there are malformation and stunting. The severity based on chlorosis and malformation is graded also into five classes. (Author's summary):

C. EPIDEMIOLOGY & DISTRIBUTION

72. ANONYMOUS. 1978.
Colloque sur bactériose du manioc: aspects du problème au Togo. "Country presentation: Togo, at the IDRC/IITA workshop on cassava bacterial blight held at IITA , Ibadan, 26-30 June 1978." Ibadan, IITA. 9p. mimeo.

On précise que le Togo est un des grands producteurs du manioc surtout si l'on considère la production par habitant. Le Togo avait subi une grave épidémie de la bactériose de manioc du à Xanthomonas manihotis dans une grande partie du sud-est de la Région Maritime. Hormis cette zone sévèrement infestée, d'autres champs de la Région Maritime n'ont pas été atteints plus de 10% et l'effet sur la production totale ont été négligeable.

En 1976 la bactériose est remontée davantage vers la Région des Plateaux le sud duquel elle a atteint. Heureusement la sécheresse de 1976/1977 a beaucoup réduit sa dissémination et les dégâts causés on été moins sérieux.

On énonce les symptômes observés y compris les taches anguleuses sur les feuilles et les pétioles, étant généralement huileuses et jaunâtres sur les faces inférieures des feuilles, flétrissement de nombreuses feuilles, défoliation progressive, et finalement la nécrose de la plante à partir du sommet.

Les moyens de lutte que l'on a pris sont la destruction immédiate par le feu des champs attaqués, et l'interdiction de transport des boutures hors des champs infectés.

73. BOCCAS, B. et al. 1976.
Une nouvelle maladie du manioc en République Populaire du Congo: la bactériose vasculaire; résultats de l'enquête préliminaire par B. Boccas, B. Boher, K. Kohler and P. Pellegrin. Brazzaville, Centre ORSTOM, Service de Phytopathologie, 8p. mimeo.

On donne les symptômes observés de la bactériose en RPC. Ce sont le flétrissement des feuilles, desséchement et chute des feuilles flétries, brunissement du pétiole et exudation d'une gomme jaunâtre. Ces symptômes progressent en direction de l'apex du rameaux et vers sa basse; un brunissement du bois indique la localisation vasculaire de l'agent pathogène. Enfin on constate une défoliation complète de la plante. La saison des pluies favorise la bactéroe.

Quelques fois comme dans la région de Lakana on observe des taches nécrotiques noirâtres et humides provoquées sur certains rameaux non aoûtés.

23. BOCCAS, B. et al. 1976 (Cont'd)
Il ne faut pas confondre ces symptômes avec ceaux causés par le Colletotrichum, agent de l'anthracnose.

On conçoit qu'une défoliation importante réduise beaucoup l'assimilation chlorophylienne et rétarde la formation des tubercules.

Vient ensuite les faits de l'étiologie de la bactérie isolée des plantes atteintes. On pense que c'est de la souche du Xanthomonas manihotis.

En ce qui conceme sa transmission on suppose que des insectes vecteurs, la pluie et les eaux de ruissellement sont les moyens les plus efficaces de son transport de proche en proche. Au sein de diverses régions ce sont les boutures infectées transportées par l'homme qui sont les moyens les plus efficaces.

On a déterminé la pathogenie de la bactérie isolée en practiquant des inoculations artificielles de jeunes plantes de manioc. Elle a induit, de sept à huit jours aprés son installation, le flétrissement brutal de la feuille inoculée.

Dans de nombreuses régions visitées on a constacté beaucoup de champs atteints à 100%. Ils sont été dévastés et n'ont rien produit. Ce sont la région de Brazzaville, les axes routières Brazzaville-Gambona, Ngo-Djambala-Lekana, Brazzaville-Kinkala-Boko, Kinkala-Loudima et la route Odziba-Ngabe.

Les moyens de lutte preconisés comprennent: 1) les mesures phytosanitaires immédiates visées à enrayer ou retarder la dissemination de la bactérie, et 2) des recherches de fond pour une lutte efficace à plus long terme. Les mesures phytosanitaires immédiates sont l'isolement des foyers épidémiques, destructions des plantations fortement attaquées et tailles santaires des fermes en début d'attaque. Les perspectives de recherches sont les études épidemiologiques et étiologiques, et le criblage des variétés tolérentes à la bactériose.

24. DANIEL, J. F. et B. BOHER. 1978.
[Cassava bacterial blight in Congo Republic and Central African Empire]. Country report for Congo Republic and CAR at the IDRC/IITA workshop on cassava bacterial blight held at IITA, Ibadan, 26-30 June 1978. Ibadan, IITA. 6p. mimeo.

The presence of cassava bacterial blight caused by Xanthomonas manihotis is confirmed in Congo Republic, and officially reported for the first time in the Central African Empire (CAE), as a result of the studies of the pathogenicity, and morphological and biochemical characteristics of the bacteria isolated during disease surveys for the purpose of determining its distribution in the two countries.

24. DANIEL, J. F. et B. BOHER. 1978 (Cont'd)
In the Congo Republic CBB was reported in only two areas in 1976, but by 1977, it had spread to various parts of the country including two experiment stations and particularly in those areas bordering Zaire from where infected planting cassava cuttings unofficially enter Congo Brazzaville.

In the CAE, effects of earlier attacks of CBB probably dating back to 1976 were observed. There too, CBB is most prevalent in those areas bordering parts of Cameroun where CBB epidemic ravages cassava and from where vegetative CBB-contaminated cassava materials are brought into the Empire.

Epidemological studies revealed that CBB is widespread in the savanna and semi-savanna zones especially in poor soils but limited in the forest zones. CBB attack is more severe in the rainy season. A study of bacterial microflora on the aerial parts of the cassava plant revealed X. manihotis on healthy cassava leaves on cassava plants in farms already infested with CBB. This is a source of inoculum.

Detailed biochemical characteristics of the bacterial pathogen based on the comparative study of twenty isolates from Congo Brazzaville, ten from CAE and eight from south America were studied. All the isolates were homogenous.

Finally, the symptoms of CBB as observed in both countries are given in full details including leaf spots, wilting, defoliation, exudates, and vascular necrosis of the stem. (For French version see No. 182).

25. DANIEL, J. F. 1977.
Un nouveau déprissement du manioc en Empire Centrafricain; la bactériose vasculair à Xanthomonas manihotis: résultats de l'enquête phytosanitaire effectuée en mai 1977. Brazzaville, Centre ORSTOM, Service de Phytopathologie. 8p. mimeo.

On remarque que si l'on considère des dégâts et l'extension rapide des en foyers, la bactériose à Xanthomonas manihotis est actuellement le facteur qui limitent la production du manioc.

On décrit les symptômes de la bactériose tels qu'ils sont été observés Empire Centrafricaine (E.C.). Ce sont les taches foliaires suivies d'un dessèchement des feuilles, défoliation progressive des rameaux infectés, production d'exudats sur les pétioles et les tiges non aoutées, formation des lésions nécrotiques, et brunissement des vaisseaux du bois. Son incidence est plus répandue et son attaque plus sévère en saisons des pluies.

Les moyens de lutte prophylactique récommendés sont la détermination de la répartition géographique de la bactériose, isolement des foyers épidemiques et interdiction du transport des boutures hors des régions infectées, destruction des fermes sévérement attaquées et tailles phytosanitaires des rameaux présentant les symptômes de la bactériose. Il faut aussi disinfecter les outils de taille quand on prépare les boutures.

25. DANIEL, J. F. 1977 (Cont'd)
On préconise aussi les moyens de lutte à long term. Ce sont une étude de l'écologie de la bactérie, son étiologie, et le criblage des variétés résistantes. Ce dernier semble être la solution au problème de la bactériose vasculaire du manioc.

26. KORANG-AMOAKO, S. and K. A. ODURO. 1978.
Present situation of cassava bacterial blight disease in Ghana. Country presentation for Ghana at the IDRC/IITA workshop on cassava bacterial blight held at IITA, Ibadan, 26-30 June 1978. Ibadan. IITA. 4p. mimeo.

It is reported that CBB occurred on epidemic sclaes in 1975 and 1976 in Southern Ghana where it has been confined. The incidence was low in 1977. The restriction to Southern Ghana is believed to be due to external and internal quarantine measures strictly observed, and Northern farmers' traditional reluctance to obtain cuttings of the cassava varieties grown in the costal savana zones.

Even in Southern Ghana to which it is confined its incidence has been low owing to: 1) low level of inoculum since 1975 following effective cultural control measures and 2) low rainfall in 1975. CBB surveys conducted in June 1978 have shown that it is on the decline even in previously infested farms.

Further control measures are outlined and re-emphasized, including the adoption of CMD and CBB resistant varieties obtained from IITA, Ibadan.

27. MAKAMBILLA, C. 1978.
La lutte contre la bactériose en République Populaire du Congo. Une communication faite à "l'IDRC/IITA workshop on cassava bacterial blight held at IITA", Ibadan, 26-30 June 1978. 2p. mimeo.

L'auteur fait mention de nombreuses maladies et insectes qui s'attaquent au manioc y compris la bactériose vasculaire du manioc. Ces maladies en limitent la production des tubercules et de feuilles bien comestibles au Congo, et y rendent assez difficile la culture du manioc.

Les Congolais cultivent le manioc dans les zones de savane au centre et au sud du pays. L'incidence est plus répandue et l'attaque plus sévère au nord de la région du pool où la pluviosité est très abandante et étendue sur toute l'année.

Un programme de recherche sur l'amélioration du manioc a été établi. On y utilise deux moyens de lutte contre cette bactériose. Premièrement, des plasmes germinatifs ont été mis en place a quatre localités où l'on a sélectioné des cultivars Congolais à hauts rendements et d'autres variétés qui montrent une capabilité de résister à la bactériose. Ils seront ensuite examinés dans les régions sévèrement attaquées, pour continuer d'en cribler pour la résistance. Deuxièmement on a introduit de l'IITA 5000 genetypes améliorés dont une trentaine semblent resistants et à la bactériose et à l'anthracnose. (Il faudra noter qu' au Congo où la bactériose et l'anthracnose s'attaquent au manioc en même temps dans le même milieu il faudra cribler et multiplier des variétés qui soient à la fois, resistantes aux deux agents pathogènes

28. NYANGO, A. K. 1978.
Cassava bacterial blight (CBB) in four regions of the United Republic of Tanzania: (a preliminary survey). Country presentation for Tanzania at the IDRC/IITA workshop on cassava bacterial blight held at IITA, Ibadan, 26-30 June 1978. Ibadan, IITA. mimeo.

Reports of CBB epidemics in Zaire, neighbouring Malawi and Uganda; the possibility of its presence in Ruanda, Burundi and Kenya, and evidence of staggering losses in both root yield and planting material wherever the epidemics occured, dictated the CBB survey of Tanzania.

A detailed survey of four regions of the Lake Victoria Zone in Tanzania revealed widespread incidence with severity rating ranging from mild to moderate in most of the farms surveyed. The scope of incidence of CBB and the amount of damage to 1½ to 2 year old cassava plants observed in some of the farms imply that the disease must have occurred there for some years past but not reported. CBB severity is reportedly high in Makuru in Bukoba district of the West Lake Region and in the germplasm collection field of 87 clones of the Agricultural Research Institute (ARI) at Ukiriguru. It is noted that CBB was not found in the forested areas surrounded by Muleba and Biharamulo districts in West Lake Region and by Geita district in Mwanza Region.

The symptoms found are initial angular watersoaked leaf spots, leaf blightening and abscission, leaf wilting, yellowish gum exudation on leaf blades and petiole, and semi-lignified stems, severe defoliation and die-back.

Recommendations for control include immediate selection for, and supply of resistant lines to farmers, use of intercropping, shifting cultivation, fallowing, crop rotation, use of clean planting materials, deep ploughing after root harvest, removal and burning of crop residues and imposition of quarantine restrictions on movement of vegetative materials within Tanzania.

Finally, projected future plans for a nation-wide CBB survey and more effective control measures particularly with regard to resistant varieties, and cultural and quarantine measures are given.

29. NYITRA, Z. A. and G. W. OTIM-NAPE. 1978.
Cassava bacterial blight and minor diseases of cassava in Uganda. Country presentation for Uganda at the IDRC/IITA workshop on cassava bacterial blight held at IITA, Ibadan, 26-30 June 1978. Ibadan, IITA. 9p. mimeo.

First observed in the Nile province in 1977 CBB has spread almost all over Uganda by 1978 covering 7 of the 10 provinces.

Control measures recommended include planting disease-free cuttings, other cultural practices and the adoption of CBB resistant cultivars. The role of suspected insect vectors should be further studied.

29. NYIIRA, Z. A. and G. W. OTTM-NAPE. 1978 (Cont'd)
Nine other diseases of cassava in Uganda are also discussed. CBB is discussed in great detail as it is believed to be the most damaging of all. The symptoms as observed are given, as well as the means of dissemination which are believed to include soil movement during farm work, contaminated implements, infected cuttings, rain splash, wind, insect vectors (Drino spp and Musca spp) and small birds.

30. ONYON, P. U. and J. A. OGIO-OKIRIKA. 1978.
[Extirpation de la flétrissure bactérienne du manioc/amélioration du manioc dans le delta du fleuve Niger au Nigéria] "Country report for Nigeria at the IDRC/IITA workshop on cassava bacterial blight held at IITA , Ibadan, 26-30 June, 1978." Ibadan, IITA. 8p. mimeo.

En 1972 il y a eu 75% de perte de rendement du manioc du à la maladie des cierges du manioc (MCM) dans le delta du fleuve Niger au Nigéria. Alors il fut établi un programme de coopération entre "Shell-BP Development Company Limited", L'IITA, Ibadan, et le gouvernement de l'état Bendel du Nigéria. L'objet, du programme est à partir des variétés multipliées, de sélectioner des variétés du manioc résistantes à la MCM et adaptées aux sols pauvres du delta. On présente ici les activités et le progrès faits par le programme.

On y a planté 1,300 variétés du manioc en 1974 des quelles on a sélectioné plus de seize variétés à hauts rendements qui sont devenues remarquablement résistantes à la MCM. Alors on conclut que l'on peut éliminer complétement la bactériose par moyen de telles variétés du manioc. Suit ensuite un rapport du travail de multiplication rapide du manioc à partir des boutures des pousses ayant 2 ou 3 noeuds et employant "Lozano Humidity Chamber".

Des tiges des variétés du manioc résistantes à la MCM ont été distribuées aux cultivateurs dans le delta qui comprend les états de Bendel, Rivers et Ondo. (For English version see No.185).

31. ONYANGO, D. and A. RAMOS. 1978.
Bacterial blight of cassava in Kenya. Country report for Kenya at the IDRC/IITA workshop on cassava bacterial blight held at IITA, Ibadan, 26-30 June, 1978. mimeo.

Thirty three bacterial cultures were isolated from cassava showing leaf blight, twig blight and twig and tip dieback. Of these, twelve were X. cassavae and the remaining were X. manihotis. The latter bacterium produced typical leaf blight, twig dieback and wilt. The former produced leaf blight and water soaked symptoms on twigs which did not spread. In South Nyanza only X. cassavae occurred while in Nyanza and western Kenya both bacteria occurred.

32. OTIM-NAPE, W. 1976.
Report on cassava bacterial blight (CBB) in Nile and Northern Provinces of Uganda. Soroti, Serere Research Station, Department of Agriculture. 5p. mimeo.

This officially reports the occurrence of CBB in the Nile and Northern provinces of Uganda, but it is believed to have been there since late 1960's or 1971. The symptoms as observed there are given, including dark green, water-soaked angular leaf spots, leaf wilting, gum exudation and shoot die-back.

It is noted that Hansford (1936) reported the occurrence of Bacterium cassava (Hansford) later renamed Xanthomonas cassavae sp. Nov. on cassava in Uganda but that CBB is more virulent than the former, suggesting "two strains of the bacterium" in Uganda. It is further suggested that CBB might have evolved from Bacterium cassavae (Hansford) or introduced there along with cassava cuttings, illegally imported from neighbouring Zaire.

Suggested control measures include destruction by fire of all seriously infected plants, pruning infected plants, quarantine of the disease in those two provinces, planting disease-free cuttings, crop sanitation, crop rotation, and above all selection, breeding and planting CBB-resistant cassava cultivars.

33. OTIM-NAPE, W. and T. SEMGOBA. 197?.
A report of the cassava bacterial blight (CBB) survey in the Northern Zone of Uganda. Kampala, Kawand Research Station, Department of Agriculture. 9p. mimeo.

This report continues the CBB survey (OTIM-NAPE 1976) of Northern Uganda, aimed at determining CBB incidence and severity there using a rating scale of 0-5 in which 0 refers to "no wilted plants" and 5 to "all plants wilted".

Wilting is the commonest and severest symptom but blighting and angular leaf spotting are found too. The disease has spread quickly within one year, and is now believed to be widespread in Uganda. Recommended control measures are as in the previous report. (Otim-Nape 1976).

34. PACUMBABA, R. P., H. C. EZUMAH and T. LUKELO.
The present status of cassava bacterial blight in Zaire. Country report for Zaire at the IDRC/IITA workshop on cassava bacterial blight held at IITA, Ibadan, 26-30 June 1978. Ibadan, IITA. 17p. mimeo.

It is noted that CBB was first observed in 1970 in Zaire where it is called the "candle disease". It has been confirmed there long since, its etiology, symptomatology and mode of transmission having been studied. Found today wherever cassava is grown in Zaire CBB attained severe epidemic status there in 1973, local varieties being generally susceptible to it. The danger of CBB in Zaire, where cassava is a staple food, is stressed.

34. PACUMBABA, R. P., H. C. EZUMAH and T. LUKELO. (Cont'd)
The Programme National Manioc (PRONAM) was set up by the Zaire government in cooperation with IITA and is working to control CBB. The results of studies on CBB development in relatively poor soils in given seasons, the relationship of climatic variables with CBB incidence, and screening for resistance to CBB are presented.

It is recommended that breeding for resistance to CBB should continue despite the present success in developing improved CBB resistant varieties. This is because it is feared that a "new" pathogenic race of the Xanthomonas manihotis may appear and render the currently resistant clones susceptible. Moreover no cultivars have been found to be simultaneously resistant to both CBB and mealybugs which also devastate cassava in Zaire.

35. PERSLEY, G. J. 1978.
Etudes sur l'épidémiologie et l'écologie de la maladie des cierges du manioc (MCM). Une communication faite à "l'IDRC/IITA workshop on cassava bacterial blight held at Ibadan, IITA, 26-30 June 1978" 6p. mimeo.

Des enquêtes récentes en Afrique ont montré que la MCM est plus répandue et plus sévère dans les zones de savane et de transition entre savane et forêt que dans les forêts propres. Alors on a eu l'intérêt de déterminer pourquoi cette bactériose survient plus dans les zones non-forestières et pluvieuses. On a voulu établir: a) son développement épidémique à partir de jeunes boutures de pousse ayant déjà des racines et qui sont inoculées; et b) la survivance de l'agent pathogène pendant la saison sèche quand il n'y a pas d'épidémie de MCM.

On a planté une variété (TMX 4488) résistante à MCM et une autre variété (60447) qui lui est susceptible dans trois zones climatiques du Nigéria en 1977/78 à fin de déterminer les faits de son développement épidémique. Les terrains choisis pour les essais étaient Warri (Zone forestière, 2600 mm de pluviosité par an en moyenne, 2 mois de sécheresse); Ibadan (zone de transition entre forêt et savane, 1270 mm de pluviosité par an en moyenne, cinq mois de sécheresse); et Mokwa (zone savane, 1100 mm de pluviosité par an en moyenne six mois de sécheresse).

On a planté des boutures de jeunes pousses ayant déjà des racines et qui n'étaient pas atteintes de la MCM à chaque terrain. Les plantes situées au vent ont été inoculées. Puis on a observé le développement de la bactériose chez les plantes que l'on n'a pas inoculées par intervalles régulières. On a mis aussi deux parcelles de terrain en manioc de ces deux variétés-là à Ibadan, à une distance de 20 m. des terrains de l'essai, séparés par un terrain planté de mais. Les dernières n'ont pas été inoculées. Les faits climatiques ont été également observés à chaque terrain.

35. PERSLEY, G. J. 1978 (Cont'd)
L'épidémie de MCM s'est développée le mieux chez la variété 60447 à Ibadan compte tenu de l'index de la maladie et de pour centage de défoliation. L'épidémie s'est développée aussi à Mokwa mais la defoliation a été moins sévère qu'Ibadan.

A tous les deux terrains (Ibadan et Mokwa) l'épidémie s'est développée pendant la saison des pluies. Elle a atteint une phase stationnaire à peu près six mois àpres la sémence au début de la saison sèche. L'épidemie ne s'est pas développée à Warri bien que beaucoup de plantes de deux variétés soient mortes. La différence majeure des faits de climats entre les trois zones durant deux mois après la semence c'était que Warri a approximativement eu cinq fois plus grande pluviosité que chacun de deux autres zones. Il est probable que cette disparité en pluviosité entre des zones ait empêché les jeunes boutures de pousse d'être établies, et que celles qui ont été infectées ont été mortes. On suppose que la mortalité des plantes était suffisamment rapide au début lorsque les plantes étaient largement séparées que la chaine d'infection qu'il faut pour avoir une épidemie a été prévenue.

L'agent pathogène a été trouvé au milieu des débris sur les champs à peu prés six mois après sémence au début de la saison des pluies. La quantité en ont diminuée après la première partie de la saison des pluies. Les résultats indiquent que l'on peut violer le cycle de la bactériose si l'on récolte au cours de la première partie de cette saison. Puis il faudra enlever du champs tous les débris. Il faudra aussi défricher le terrain durant trois mois au début de la saison des pluies avant de planter des boutures saines. (Voir les illustrations attachees) (For English version see No.186).

36. PERSLEY, G. J. 1977.
Survey of cassava diseases in Africa. Paper presented at IITA/FAO workshop on crop loss assessment and horizontal resistance. IITA, Nigeria, 16-23 Oct., 1977.

Cassava bacterial blight caused by Xanthomonas manihotis is one of the common diseases of cassava in Africa. Nearly 300 cassava farms were inspected in Benin Republic, Cameroun, Ghana, Nigeria and Togo. Cassava bacterial blight has been confirmed in three other African countries, namely, Congo Brazzaville, Rwanda, Zaire in addition to those surveyed. Cultures of X. manihotis from all those countries except Rwanda have been sent to the CMI, London.

The methods of the survey as well as the results are described.

It is felt that CBB has been present in limited areas of West Africa for many years in view of its presence on village farms in isolated areas. It is believed to have entered the region through the introduction of vegetative material from Brazil probably early in this century. Within West Africa it is believed to have spread with new cultivars developed since 1955. In areas where clones susceptible to CBB were introduced the disease has become more economically important.

37. STEINER, K. G. 1975.
Les maladies des plantes cultivées ou utilisées au Togo; liste commentée des hôtes. (Diseases of plants grown or used in Togo; list with comments on host plants). Lomé, Service de la Protection des Végétaux. 60p.

L'auteur indique que le manioc est une des dix cultures principales du Togo qui en a produit 517,000 tonnes en 1973. Le flétrissement bactérien y a été signalé à plusieurs endroits en 1975. Dès lors grâce à des conditions climatiques exceptionnelles il n'y existe que de façon latente. Des mesures valable de lutte sont la quarantine et l'emploi des variétés résistantes à la bactériose.

(The author shows that cassava is one of the ten major agricultural products of Togo which in 1973 produced 517,000 tons of it. CBB was reported there in 1975. Since then it has been quite latent owing to exceptional climatic factors. Quarantine measures and the use of resistant cassava cultivars are the useful control methods).

D. YIELD LOSS

38. COCK, J. H. 1978.
Physiological basis of yield loss in cassava due to pests. In T. Brekelbaum, A. Bellotti and J. C. Lozano, eds. Cassava protection workshop. Proceedings. CIAT, Cali, Colombia 7-12 Nov. 1977. Cali, CIAT. pp.9-16.

The storage roots, apices, leaves, stems and petiols are the parts of the cassava plant that determine its yield. The author demonstrates the ways yield is reduced owing to damage done to those vital parts by pests and diseases. The stem is the avenue for the transport of water and organic materials. It also supports the leaves. By blocking xylem transport through the cassava stem, causing wilting, death and falling of the leaves, cassava bacterial blight evidently causes yield loss.

39. TERRY, E. R. 1978.
Cassava bacterial diseases. In T. Brekelbaum, A. Bellotti and J. C. Lozano, eds. Cassava protection workshop. Proceedings. CIAT, Cali, Colombia, 7-12 Nov. 1977. Cali, CIAT. pp.75-84.

Bacterial diseases of cassava namely, leaf spots, stem rot and blight are discussed, with emphasis on cassava bacterial blight, Xanthomonas manihotis in Africa. The following aspects are dealt with in detail: distribution in Africa, factors contributing to the pattern of CBB development (cultivation systems, rainfall and soil conditions) economic importance, etiology and symptomatology, factors influencing dissemination of the disease (propagating material, vectors, rainfall, soil conditions, sources of inoculum) and integrated control. Yield losses range from 14-100%, depending on variety, locality, time of year and cultivation system. CBB also reduces starch content and availability of planting material, and foilage as a source of protein. (Author's summary).

E. CULTURAL CONTROL

40. LOZANO, J. C. et al. 1977.
Production of cassava planting material, by J. C. Lozano, J. C. Toro, A. Castro and A. C. Bellotti. Cali, CIAT. pp.9-23.

Xanthomonas manihotis is one of the systemic pathogens of the cassava plant, leaving no visible signs in the mature portion of the stem. Such infected but apparently healthy plants may constitute the source of primary inoculum in a new plantation. Through them systemic pathogens are transmitted from different regions, countries and continents.

Healthy seed should be used to avoid this mode of transmission. Healthy plants can be obtained from plants affected with CBB by rooting cuttings obtained from diseased plants in sterilized water. These can then be multiplied by traditional methods or through the rapid propagation method developed by Cock et al.

F. CHEMICAL CONTROL

[illegible] AKINDE, R. O. and T. O. OBILEMAN. 1976.
The effect of potassium nutrition in the bacterial wilt of cassava. Nigerian Journal of Plant Protection. 2: 1-3.

The reaction of a susceptible and a tolerant cultivar of cassava to infection by bacterial blight disease was studied under four levels (0, 60, 90, 120 kg/ha) of potassium nutrition.

At 0 and 60 kg/ha K, the wilt was 74.4 and 70.5 and 56.2 and 44.4% in susceptible and tolerant cultivars respectively. Significant reduction in wilt was obtained at 90 kg/ha K in both varieties. The highest fresh tuber yields were also recorded at this level of potassium. (Author's summary).

42. AKINDE, O. B. and S. O. OBILEMAN. 1978.
Les limites sur l'emploi de l'engrais NPK dans la lutte contre la bactériose du manioc. Une communication faite à "l'IDRC/IITA workshop on cassava bacterial blight held at IITA, Ibadan, 26-30 June, 1978". 14p. mimeo.

Suivant les écrits traitant du sujet, les auteurs passent en revue le rapport entre l'engrais NPK d'une part et la viqueur d'une plante, sa résistance à la maladie et son rendement d'autre part chez le manioc et à l'égard de la bactériose vasculaire du manioc. On discute les résultats de plusieurs essais faits à l'IITA, Ibadan et au NRCRI, Umudike, au Nigeria, pour montrer que lorsqu'il ya la quantité optimale de l'engrais NPK dans le sol et de la, des éléments nutritifs NP. et K dans la plante du manioc, la bactériose est restreinte ou réduite par l'augumentation en vigueur de la plante et en matières végétales. On continue les travaux de recherche pour déterminer si les quantités optimales de l'engrais NPK nécessaires sont les même pour rendre la plante de manioc résistante à la bactériose d'une part et d'autre pour obtenir le rendement le plus haut de tubercule du manioc. (For English version see No.181).

ENE, L. S. O. 1977.
Control of cassava bacterial blight (CBB). Tropical Root and Tuber Crops Newsletter. 10: 30-31.

The author reports the results of studies carried out at the National Root Crops Research Institute, Umudike, Nigeria on the control of CBB through intercropping, the use of NPK fertilizers, and a chemical. The studies showed that providing shade in cassava farms through intercropping it with maize, melon or other crops or by reducing the effect of rainsplash through mulching or other methods appreciably reduced CBB.

It is also reported that the presence of K in the soil through NKP fertilizer reduced both the incidence and severity. In addition, bi-weekly foliar application of Agrimycin 500 at the rate of 800 gm/ 100 litres of water per hectare for three months starting one month after planting significantly but temporatily reduced CBB incidence and severity.

G. BREEDING

44. HAHN, S. K. 1978.
Breeding cassava for resistance to bacterial blight. (Multiplication du manioc pour la résistance à la bactériose vasculaire du manioc). Paper presented at the IDRC/IITA workshop on cassava bacterial blight held at IITA, Ibadan, 26-30 June, 1978. Ibadan, IITA. 10p. mimeo.

It is noted 1) that CBB has been reported in Benin Republic, Burundi, Cameroon, Central African Empire, Congo Republic, Ghana, Kenya, Nigeria, Rwanda, Tanzania, Togo, and Zaire; 2) that CBB can lead to total crop failure when heavily infected, most local varieties being very susceptible to it. Given the widespread incidence of CBB and susceptibility of local clones it is proposed that the best control method is through varietal resistance of the host plant. IITA has made progress in breeding for resistance to both CBB and CMD incorporating simultaneously other desirable agronomic qualities such as high yield, improved root characteristics, low HCN content and resistance to lodging.

The author then discusses the cassava breeding work at IITA since 1972 covering tests of a total of 583 cassava families from CIAT, East Africa and IITA for sources of high resistance to CBB, further test of 748 IITA clones for CBB resistance in a given ecological setting of high rainfall, sandy and acid soil from which the cultivar 58308 emerged highly resistant. Other aspects of the breeding work treated are favourable conditions for effective varietal selection, namely: genetic mechanism of resistance, stability of resistance to CBB over space and time in Africa, high heritability, genetic correlation between resistance to CBB and CMD, correlation of CBB resistance with other characteristics such as tuber yield and leaf defoliation, and finally some factors affecting CBB field scores which are time of planting, age of plant and time of observation. Statistical data are presented to support the facts.

44. HAHN, S. K. 1979 (Cont'd)

It is noted in the conclusion that the sources of high resistance to CBB identified have been quickly and successfully incorporated into promising cassava clones. While retaining other desirable agronomic characteristics, IITA breeders have simultaneously improved promising cassava lines for joint resistance to CBB and CMD following their discovery of correlated resistance to both diseases.

SUMMARY IN FRENCH:

L'auteur remarque 1) que la bactériose du manioc a été signalée dans les pays suivants:- République de Bénin, Burundi, Caméroun, Empire Centrafricain, République Populaire du Congo, Ghana, Kenya, Nigéria, Rwanda, Tanzanie, Togo, Ouganda, et Zaire.

2) Que la bactériose peut causer une perte complète de [illegible] lorsque le [illegible] est fortement infecté étant donné que la [illegible] variétés indigènes du manioc lui sont susceptibles [illegible] répandue de la bactériose et la susceptibilité [illegible] locales ou propres que le meilleur moyen de la lutter [illegible] les variétés résistant[illegible] fait du progrès [illegible] multipliant les qualités résistantes [illegible] ctériose et à la mosaïque [illegible] ajoutant en même temps [illegible] qualités agron[illegible] telles que l'haut[illegible], [illegible] teneur [illegible] en [illegible], et la [illegible] l'égrenage ("shelling").

On présente [illegible] travail de multiplicati[illegible] l'amélioration variétale [illegible] depuis 1972 [illegible] les essais de criblage de [illegible] variétés [illegible] obtenues [illegible], de l'Afrique orientale et de l'IITA [illegible] déterminer [illegible] source de la vive résistance à la bactér[illegible] [illegible] [illegible] criblage de [illegible] variétés [illegible] [illegible] dans un milieu forcé d'[illegible] [illegible] [illegible] On a constaté que [illegible] [illegible] à la bactériose.

D'autres aspects [illegible] des conditions favorables [illegible] [illegible] génétique de la résistance, la [illegible] [illegible] à travers les lieux et le temps [illegible] [illegible] une corrélation génét[illegible] [illegible] à la mosaïque du manioc. [illegible] résistance à la bactériose et d'autres [illegible] de tubercule et la défoliation. [illegible] qui influent les [illegible] [illegible] que le temps de semen[illegible], l'[illegible] la plant[illegible] [illegible] d'[illegible] sélection. Les données statistiq[illegible] [illegible] présentées [illegible] points.

On conclut en remarquant que les sources [illegible] à la bactériose identifiées dans certaines variétés [illegible] été rapidement incorporées avec succès aux cultivars [illegible] de promesses. En gardent d'autres traits agronomiques désirables de ces variétés - là, les scientifiques de l'IITA les ont simultanément améliorées pour les rendre conjointement résistantes et à la bactériose et à la mosaïque du manioc après en avoir découvert des résistances corrélatives aux deux maladies.

46. HAHN, S. K., A. K. HOWLAND, and J. E. WILSON. 1978.
Breeding of root and tuber crops. In L.S.O. Ene, H. E. Okereke, S.O. Odurukwe, O.O. Okoli and O.B. Arene eds. National seminar on root and tuber crops, Umudike, March 21-25, 1977. First. Proceedings. Umudike (Nigeria), NRCRI. pp.36-45.

The breeding of cassava, yams and sweet potatoes is discussed. It is noted that the major biological constraint to cassava production in Nigeria is disease, especially cassava bacterial blight (CBB) and cassava mosaic disease (CMD). Potential yield could reach 20 tons/hectare in 12 months but local cultivars yield only 5-10 tons/hectare as most of them are susceptible to CBB and CMD. The objectives of IITA's Root and Tuber Improvement Program are mentioned. It has achieved significant progress in cassava by producing improved varieties resistant to both CBB and CMD, and having high yield, improved root characteristics, low HCN content and resistance to lodging.

On source population improvement it is reported that half-sib family selection method has been used whereby cassava clones from India and South America which are susceptible to CBB, CMD and lodging, but possess other desirable agronomic characteristics, were crossed twice with local sources.

As for selection, general and specific combining abilities of six cassava cultivars were obtained. The cultivar 58308 had general combining ability for resistance to CBB and CMD, and for yield and HCN. Heritability affects selection and that for CBB was about 40%. There is high genetic correlation between resistance to CMD and CBB. Selection for CBB resistance therefore leads to high genetic gain in CMD resistance. Resistance to both CBB and CMD seems to be attributable to quantitative genes mainly with additive effects and also partly to non-additive effects, being seemingly recessive to heritability.

Using plant-row selection method some 50 cassava families have been selected each year on the basis of origin and resistance to CBB and CMD, and other good traits.

Stability of resistance to CBB over various ecological zones has been noted such as between Nigeria and Zaire.

46. LEYS, G. 1978.
Cassava multiplication. A Paper presented at the IDRC/IITA workshop on cassava bacterial blight held at IITA, Ibadan, 26-30 June 1978. Ibadan, IITA. 3p. mimeo.

It is noted that the main emphasis of the cassava breeding programme at IITA has been on developing high-yielding, disease and insect resistant cassava varieties that would produce good quality starch or gari. The average farmer's multiplication method gives an increase of only 1:10 ratio in planting material per year. CIAT has developed a much faster and more efficient method of multiplying cassava planting materials from clones that are resistant to CBB. IITA breeders have adopted the technique but without sterilizing the soil and the water as the clones used are resistant to CBB, giving an increase of 1:24-40 or double that figure in favourable conditions. IITA breeders use either water or damp sand as media for the process under high humidity conditions. Eight to ten months old hard wood cuttings of cassava are supplied to farmers, co-operators and national trial programmes such as the NAFPP in Nigeria. It is the major work in the IITA multiplication programme to convert the residue, that is, the lighter wood and green tops into 3 or 4 node cuttings which can be rooted in sand and later planted out in plastic bags to harden before being planted in the field, yielding 15-20 cuttings for every 10 hard wood cuttings initially supplied to farmers. When demand for hard wood cuttings is high, more hard wood planting material can be developed in 3 months from prunes made during the initial cutting of hardwood for supplying farmers.

Moreover during trials, rooted cuttings have been planted directly in the field, heavily mulched and irrigated twice daily with a 75% survival rate. It is a cheaper process but needs much land.

47. INTERNATIONAL INSTITUTE OF TROPICAL AGRICULTURE. ROOT AND TUBER IMPROVEMENT PROGRAM. 1977.
In-house report 1977. Ibadan, IITA. (various paginations). mimeo.

The major obstacles to cassava production in Africa are diseases particularly cassava mosaic disease, (CMD), cassava bacterial blight (CBB), and cassava anthracnose disease (CAD) as well as insects like mealybug and green spider mite. Some of the highlights of the TRIP research at IITA in 1977 are the production of high-yielding cassava clones resistant to CBB and CMD and possessing acceptable garri quality; the confirmation of a genetic relationship between resistance to CMD and CBB; and the isolation of bacteriophages with specificity for Xanthomonas manihotis and their use for rapid identification of CBB isolates.

Other highlights include the relationship between soil fertility and acidity as well as NPK nutrient on the one hand and CBB development and severity on the other.

47. INTERNATIONAL INSTITUTE OF TROPICAL AGRICULTURE. ROOT AND TUBER IMPROVEMENT PROGRAM. 1977 (Cont'd)

With regard to cassava breeding for CBB-resistance the following areas are covered: germplasm introduction, seedling nursery, yield trials, cooperative off-site trials, and multiplification and distribution of planting material.

Under pathology it is noted that CBB was newly reported in Rwanda, Kenya, and Tanzania and that CBB can be transmitted through true seed from which the pathogen can be removed by treating with hot water at 60°c for 20 minutes. Other aspects covered include the ecology of CBB, screening for resistance to it and effect of soil fertility on CBB development.

48. JENNINGS, D. L. 1978.

Inheritance of linked resistances to African cassava mosaic and bacterial blight diseases. In T. Brekelbaum , T. A. Bellotti and J. C. Lozano eds. Cassava protection workshop. Proceedings. CIAT, Cali, Colombia, 7-12 Nov. 1977. Cali, CIAT. pp.45-50.

The relationship between resistances to African cassava mosaic disease (AMD) and to cassava bacterial blight (CBB) was studied at IITA in 1975. Resistances to AMD and CBB, derived from M. glaziovii, were conferred by recessive additive effects. For both diseases the degree of recessiveness was influenced by environmental factors which also had correlated effects on the two resistances. M. glaziovii progenies segregated in a discontinous way for joint resistance to AMD and CBB. A similar type of segregation occurred in progenies of 58308, a hybrid 7 generations removed from the interspecies cross. The following hypothesis are considered: (a) that linkage occurs between genes affecting AMD resistance and others affecting CBB resistance, (b) that genes affecting AMD resistance have pleiotropic effects on CBB resistance, (c) that linkage occurs between AMD and CBB, but pleiotropic effects also occur, increasing the degree of correlation. (Author's summary).

49 OKOLI, O. O. 1978.

Source materials for the genetic improvement of root and tuber crops in Nigeria. In S. O. Ene, H. E. Okereke, S; O; Odurukwe, O; O. Okoli and O. B. Arene eds. National seminar on root and tuber crops. Umudike. March 21-25, 1975. First. Proceedings. Umudike (Nigeria), NRCRI. pp.48-57.

The improvement of cassava among other crops is covered by this paper. The areas of genetic improvement are yield, quality, plant type, disease and pest resistance, maturity and protein content. The goals of crop improvement and genetic evaluation are discussed. The scope of source materials for genetic improvement include plant introduction, mutations and chromosome aberrations, hybridization, and protoplast and organ growth.

With respect to cassava, it is noted that cassava bacterial blight (CBB) and cassava mosaic disease (CMD) greatly reduce its yield in Nigeria. Hence a currently important breeding objective is incorporating genes for resistance to both CBB and CMD in local varieties. Hybrid 58308 is a main source of resistance to both diseases, and linkage between resistance to CBB and to CMD has been found. Manihot dichotoma is equally a potential source of resistance to CBB.

H. INTEGRATED CONTROL

50. TERRY, E. R. 1978.
[Lutte intégrée contre la maladie des cierges du manioc (MCM) en Afrique). Une communication faite à "l'IDRC/IITA workshop on cassava bacterial blight held at IITA", Ibadan. Ibadan, IITA. 8p. mimeo.

L'auteur présente ses idées sur le rôle du manioc dans la nutrition, les méthodes culturales et l'économie des Africains qui habitent le "Rideau du manioc" (Cassava belt). Il examine brièvement en suite l'importance économique de la bactériose et ses effets et à long terme et à court terme sur la production du manioc. Finalement il expose à grands traits les facteurs les plus importants qu'il faut pour la structure d'un programme de lutte intégrée. (For English version see No 187).

AUTHOR INDEX
(Supplement)

SUBJECT INDEX (Supplement)

BACTERIA SPECIES INDEX (Supplement)

GEOGRAPHICAL INDEX
(Supplement)