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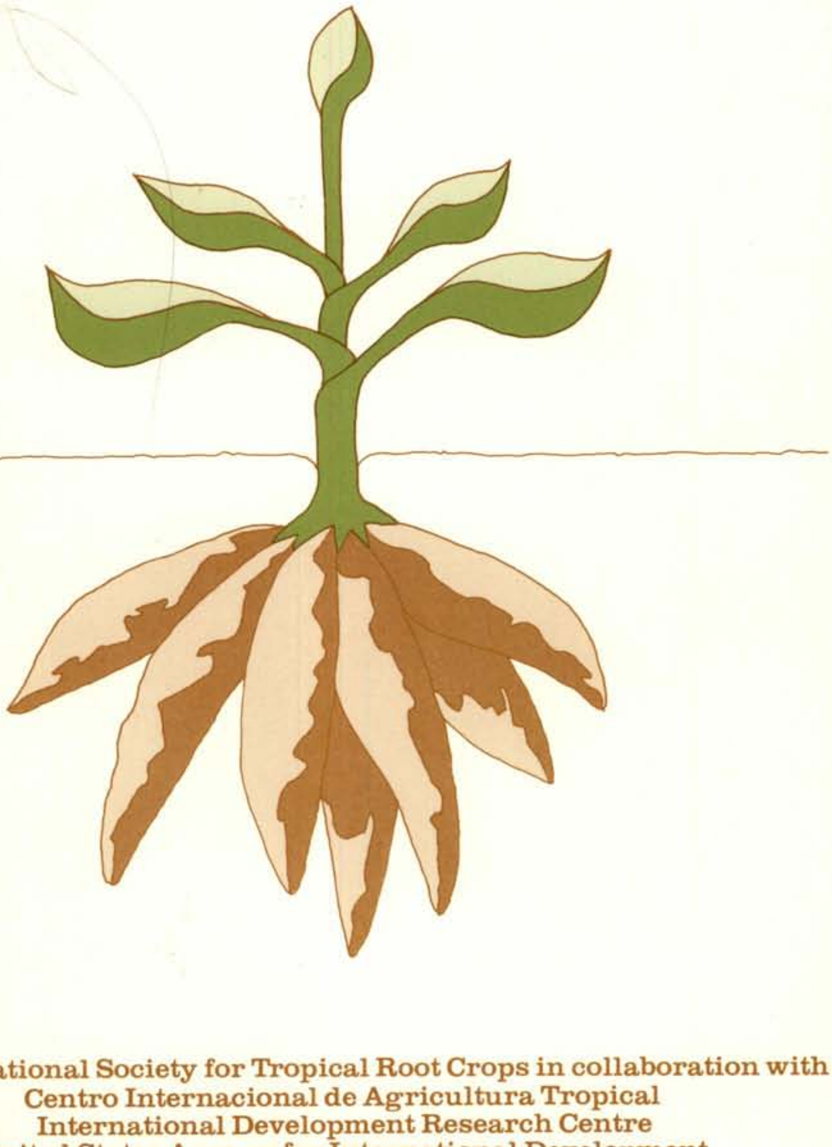
Held at CIAT, Cali, Colombia, 1-7 August 1976

Edited by James Cock, Reginald MacIntyre, and Michael Graham



The International Society for Tropical Root Crops in collaboration with
Centro Internacional de Agricultura Tropical
International Development Research Centre
United States Agency for International Development

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PROCEEDINGS

of the

FOURTH SYMPOSIUM

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IDRC *The international exchange and testing of cassava germ plasm. Proceedings of an interdisciplinary workshop held at CIAT, Palmira, Colombia, 4-6 February 1975.* International Development Research Centre, IDRC-049e, 1975, 74 p.

IIT *La yuca parafinada.* Revista del IIT (Colombia), 78, 1973, 131–148.

IITA *Root and tuber improvement program.* In Annual Report 1973. IITA, Ibadan, Nigeria, 1974, 39 p.

Annual Report 1974. IITA, Ibadan, Nigeria, 1975, 199 p.

Ingram, J. S., and Humphries, J. R. O. *Cassava storage: a review.* Tropical Science, 14, 1972, 131–148.

Kartha, K. K., and Gamborg, O. L. *Elimination of cassava mosaic disease by meristem culture.* Phytopathology, 65, 1975, 826–828.

Krausz, J. *The superelongation disease of cassava.* PhD thesis, Cornell University, Ithaca, N.Y., 1975, 81 p.

Krausz, J., Lozano, J. C., and Thurston, H. D. *A new anthracnose-like disease of cassava.* Ann. Proc. of the Am. Phytopath. Soc. 1976 (in press).

Lozano, J. C. *Status of virus and mycoplasma-like disease of cassava.* In Proceedings of the IDRC/IITA cassava mosaic workshop, International Institute of Tropical Agriculture, Ibadan, Nigeria, 1972, 48 p.

Lozano, J. C., and Booth, R. H. *Diseases of cassava (Manihot esculenta Crantz).* PANS (Pest Articles and News Summaries), Centre for Overseas Pest Research, London, 20, 1974, 30–54.

Lozano, J. C., and Sequeira, L. *Bacterial blight of cassava in Colombia: epidemiology and control.* Phytopathology, 64, 1974, 83–88.

Lozano, J. C., and Wholey, D. W. *The production of bacteria-free planting stock of cassava.* World Crops, 26, 1974, 115–117.

Lozano, J. C. *Bacteria blight of cassava.* PANS (Pest Articles and News Summaries), Centre for Overseas Pest Research, London, 21, 1975, 38–43.

The threat of introducing cassava diseases and pests on propagation material. In Plant health and quarantine problems arising in international genetic resources transfer. FAO (Food and Agriculture Organization), 1976 (in press).

Lozano, J. C., Bellotti, A., van Schoonhoven, A., Howeler, R., Howell, D., and Doll, J. *Field problems in cassava.* CIAT (Centro Internacional de Agricultura Tropical), Cali, Colombia, 1976.

Montaldo, A. *Vascular streaking of cassava root tubers.* Tropical Science, 15, 1973, 39–46.

Singh, K. K., and Mathur, P. B. *Cold storage of tapioca roots.* Central Food Technological Research Institute, Mysore, India, Bulletin, 2, 1953, 181–182.

Takatsu, A., and Lozano, J. C. *Translocación del agente causal del añublo bacterial de la yuca (Manihot esculenta Crantz) en los tejidos del hospedero.* Fitopatologia, 10, 1975, 13–22.

Terry, E. R. *Cassava germ plasm resources, disease incidence, and phytosanitary constraints at IITA.* In Nestel, B., and MacIntyre, R., eds., The international exchange and testing of cassava germ plasm, *Proceedings of an interdisciplinary workshop held at CIAT, Palmira, Colombia, 4-6 February 1975.* IDRC-049e, 1975a, 38–40.

Cassava bacterial blight disease in Africa. In Proceedings of the IDRC/IITA Workshop on Cassava Improvement in Africa. International Institute of Tropical Agriculture, Ibadan, Nigeria, 1975b (in press).

Field Control of Cassava Mosaic in Coast Province, Kenya

K. R. Bock, E. J. Guthrie, and A. A. Seif[1]

A series of simple observational trials to study the epidemiology of cassava mosaic in the field was undertaken at the Coast Agricultural Research Station, Mtwapa, during 1973–76 on moderately tolerant cultivar 46106/27 and highly susceptible cultivar F279. The results indicate that control of mosaic in the field in coastal districts of Kenya is possible by the use of mosaic-free planting material, the roguing of infected plants, and by allowing a reasonable degree of isolation of clean plots from infected plots. They also

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suggest that under the prevailing climatic conditions, man is a more efficient vector, by his use of infected cuttings, than a whitefly. Loss of yield due to mosaic in cv 46106/27 and cv F279 was 70 and 86%, respectively, and the drop in yield was significantly greater for cv F279 than for cv 46106/27.

Over a vast area of East Africa, cassava is far more important than estimates of acreage, Departmental Annual Reports, or export statistics would suggest. It is a staple food of a significant proportion of the population, and in the more arid areas it remains the only reserve against famine. The importance of cassava in East Africa was officially recognized many years ago, when the East African Agriculture and Forestry Research Organization (EAAFRO) mounted a major program of breeding and selection for resistance to cassava mosaic and cassava brown streak diseases. This program spanned a quarter of a century (from 1934 to 1960), and it yielded material of great value. Several selections from the program are widely planted and are among the most popular varieties in East Africa; others, notably *Manihot esculenta* × *M. glaziovii* hybrids backcrossed to *M. esculenta*, form the basis of resistance in international breeding programs such as at the International Institute of Tropical Agriculture, Ibadan.

None of the EAAFRO material can be described as immune to cassava mosaic, nor with very few exceptions can any varieties be described as highly resistant. For example, in 1972 at the Farmers' Training Centre, Mtwapa, we observed a 5-ha bulking plot of the "tolerant" variety 46106/27 that was totally infected with mosaic. In contrast, we had also observed several farmers' plots substantially free of mosaic, and this led us to consider the effect of planting mosaic-free material on the epidemiology of mosaic.

Accordingly, we carried out a series of simple observational trials designed to study the rate of spread of mosaic disease into initially healthy cassava. This paper reports the results of experiments carried out during the period 1973–76.

Materials and Methods

Because our results hold for one climatic regime only (coastal districts of East Africa), it is necessary to give a brief summary of the climate at Mtwapa. The mean annual rainfall of approximately 1200 mm is bimodal; the so-called long rains falling in April to June, and the short rains in October and November. Although most cassava is planted at the beginning of the long rains, it is possible to plant successfully in October or November. Temperature is never a limiting factor for growth, mean maximum being about 30 °C and mean minimum 22 °C. Growth is generally checked during the dry months (January to March) but the equable climate enables cassava to be harvested within 10–12 months of planting.

Cassava Varieties

Two varieties of cassava were used: 46106/27, an EAAFRO selection (third back cross of a *glaziovii* × *esculenta* derivative to *esculenta*) and F279, an import from Java. Both varieties are popular because of high yields and good taste. They are both "sweet" cassavas and may be eaten raw.

46106/27 was released as a clone with a high level of resistance, and one that stood up to the exacting conditions at the coast (Doughty 1958). In our experience, however, plantings of the clone may become totally infected, and the reaction is moderately severe.

F279 is extremely susceptible to mosaic and its reaction to infection is very severe indeed: plants derived from infected cuttings are severely stunted, with small, misshapen leaves and a proliferation of shoots.

Selection of Cuttings

Cuttings were taken only from field-grown plants apparently free of mosaic. They were rooted in isolation in coast sandy soil in 15 × 25 cm polythene bags and the shoots carefully inspected at 2–3-day intervals, over a period of 6 weeks, for mosaic symptoms. Any plant with possible symptoms was immediately removed and destroyed. When the population was free of visible signs of mosaic the cuttings were moved to the field.

Design of Plots

Rate of Spread Within a Plot

Seven centrally placed, mosaic-infected cuttings of 46106/27 were surrounded by 5 concentric hexagons of a total of 156 mosaic-free cuttings of the same variety. Plants were 1.5 m apart. The plot was planted during the short rains (9 November 1972), and recordings began on 20 November. Each plant was inspected for cassava mosaic at weekly intervals; infected plants were *not* rogued. This study was concluded 14 months later, in January 1974.

Rate of Spread into Mosaic-Free Plots

One hundred mosaic-free plants each of 46106/27 and F279 were planted in 10 alternate rows of 20 plants; plants were 1 m apart with 2 m between the double rows.

One such plot (Plot 1) was sited in open grassland in December 1973; it was approximately 300 m downwind of cassava plots with high incidence of mosaic. Weekly records were taken of mosaic incidence, but, unlike the first experiment, infected plants were immediately rogued. The trial was discontinued in December 1974.

To ensure that results were not attributable to site ecology, a further four similar plots were established during the long rains in April 1975 in four areas of differing ecology. These were Plot 2: on the same site as plot 1, initially with some degree of isolation from other infected cassava. Shortly after initiation of this trial, several plots of cassava in which incidence of mosaic was moderately high were planted within 50 m of Plot 2; Plot 3: surrounded by cashew trees; Plot 4: sheltered from the prevailing winds by citrus, cashew, and coconut trees; Plot 5: on a farm near Mtwapa Research Station, surrounded by widely spaced coconut palm and mixed cultivation.

Crop-Loss Assessment Plot

The effect of mosaic on yield has apparently never been assessed or estimated in Kenya, although there are figures for neighbouring Tanzania, and other countries. To estimate the effect of planting infected cuttings on yield of a tolerant and a highly susceptible variety (46106/27 and F279, respectively), a line of 35 plants derived from infected cuttings was planted between two lines of 35 plants derived from mosaic-free cuttings. Rows were 2 m apart with 1.5 m between plants. The trial was established in May 1975 and lifted in February 1976.

The yield of each plant was recorded. Although the design of the plot was not statistical, the results were subjected to an analysis of variance, data being transformed to logs for analysis.

Plot Management

Management of plots was kept to a minimum. Fertilizer at the recommended rate for cassava for Coast Province (150 kg/ha sulfate of ammonia, 200 kg/ha double superphosphate, 200 kg/ha muriate of potash) was applied at planting only.

Results

Rate of Spread Within a Plot

Spread from infected to healthy plants was rapid and continued throughout the growing season; at harvest (14 months) 84 of the 156 plants (54%) were infected.

Rate of Spread into Mosaic-Free Plots

Spread into mosaic-free plots was very slow and did not build up at any time during the season. The incidence of 46106/27 was: plot 1, 2/100; 2, 0/100; 3, 1/100; 4, 4/100; 5, 2/100; of F279: plot 1, 15/100 (8 of these may have been infected at planting); 2, 0/100; 3, 1/100; 4, 2/100; 5, 5/100.

Crop-Loss Assessment Trial

The mean yield per plant (kilograms) for 46106/27 healthy 3.55, diseased 1.19, healthy 4.16; for F279 healthy 3.31, diseased 0.52, healthy 4.03.

Discussion

Our results suggest that control of mosaic in the field in East African coastal districts is possible by the use of mosaic-free planting material, the roguing of infected plants, and by allowing a reasonable degree of isolation of "clean" plots from infected plots. They also suggest that, under the prevailing climatic conditions, man is a more efficient vector, by his use of infected cuttings, than is whitefly.

Whether these results apply to different climatic regimes, for example where annual rainfall is higher and more evenly distributed, or where the growing period is 18 as opposed to 12 months, remains to be seen. It seems that tolerance in 46106/27 is associated with a less severe reaction of above-ground parts to infection; the drop in yield due to disease is significantly greater (5% level) for F279 than for 46106/27. In the untransformed yield data, loss in yield in 46106/27 was 70%, and in F279 86%; it is thus questionable whether, on a yield basis alone, 46106/27 can be described as tolerant. Any variety which sustains a 70% loss would in most circumstances be described as highly susceptible.

Our results call for further experimentation in the field, including studies of the vector in ecologically diverse zones. If the concept of control by relatively simple cultural practices is proved satisfactory, then a reappraisal of breeding objectives might possibly be called for.

Doughty, L. R. *East African Agriculture and Forestry Research Organization Annual Report, 1958.* 48–55.

Synonymy in Sweet Potato Virus Diseases

J. Mukiibi[1]

The literature pertaining to virus or viruslike diseases of sweet potatoes suggests that there are only two diseases definitely caused by viruses: sweet potato mosaic, with many synonyms, and sweet potato internal cork. The other viruslike diseases are either caused by mycoplasma, mites, or are physiological in nature.

Martyn (1968, 1971) and Smith (1972) listed seven virus diseases of sweet potatoes: (1) feathery mottle; (2) internal cork; (3) mosaic virus A; (4) mosaic virus B; (5) russet crack; (6) yellow dwarf; and (7) witches' broom. My observations suggest that there is no difference between mosaic virus A and B.

Sheffield (1957) distinguishes the two diseases on the basis of severity. Virus A is a mild disease transmitted by *Myzus persicae* and not by white flies. Virus B, a severe disease, is transmitted to sweet potato by the white fly *Bemisia tabaci* and not by aphids or mechanical means. I have frequently transmitted mechanically the severe disease to sweet potato. The aphid *Myzus persicae* is almost invariably associated with the severe disease in the field and has also frequently transmitted the disease from affected to healthy sweet potato vines in the greenhouse. The sweet potato feathery mottle disease as described by Doolittle and Harter (1945) is very similar to the sweet potato mosaic syndrome described by Sheffield (1957).

To help clarify the situation, I have reviewed all the available literature on sweet potato virus and viruslike diseases to establish the identities of the diseases. The results of this extensive literature survey have been summarized in Table 1.

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Discussion

A total of 21 virus or viruslike diseases have been reported from various parts of the world. One of the commonest virus diseases of sweet potatoes is mosaic, with symptoms typical of this group of diseases, it has been observed wherever sweet potatoes are grown extensively (Rosen 1920; Hansford 1944; Adsuar 1955; Yoshii 1960). In East Africa the mosaic syndrome has been referred to as mosaic virus A and mosaic virus B (Sheffield 1957). The syndrome is associated with virus particles of flexuous rods of 761, 767, or 844 nm (Nome 1974; Nome et al. 1974) or 850–900 nm (Hollings et al. 1970).

Descriptions of the diseases referred to as mottle leaf (Strydom and Hyman 1965), leaf spot (Martin 1970), ringspot, vein clearing, and leaf pucker (Loebenstein and Harpaz 1960) are identical with descriptions of foliar symptoms of mosaic. These diseases are also transmitted by aphids or white fly. The diseases referred to as rosette (Noble 1935; Steyaert 1946), curly top and yellow dwarf (Hildebrand 1958a,b) are manifestations of severe symptoms of mosaic and their descriptions are identical with those of sweet potato mosaic virus B. Hence it appears that there are 10 names referring to the same disease, namely mosaic, described by different authors on different varieties in different parts of the world. The disease known as celery mosaic (Welman