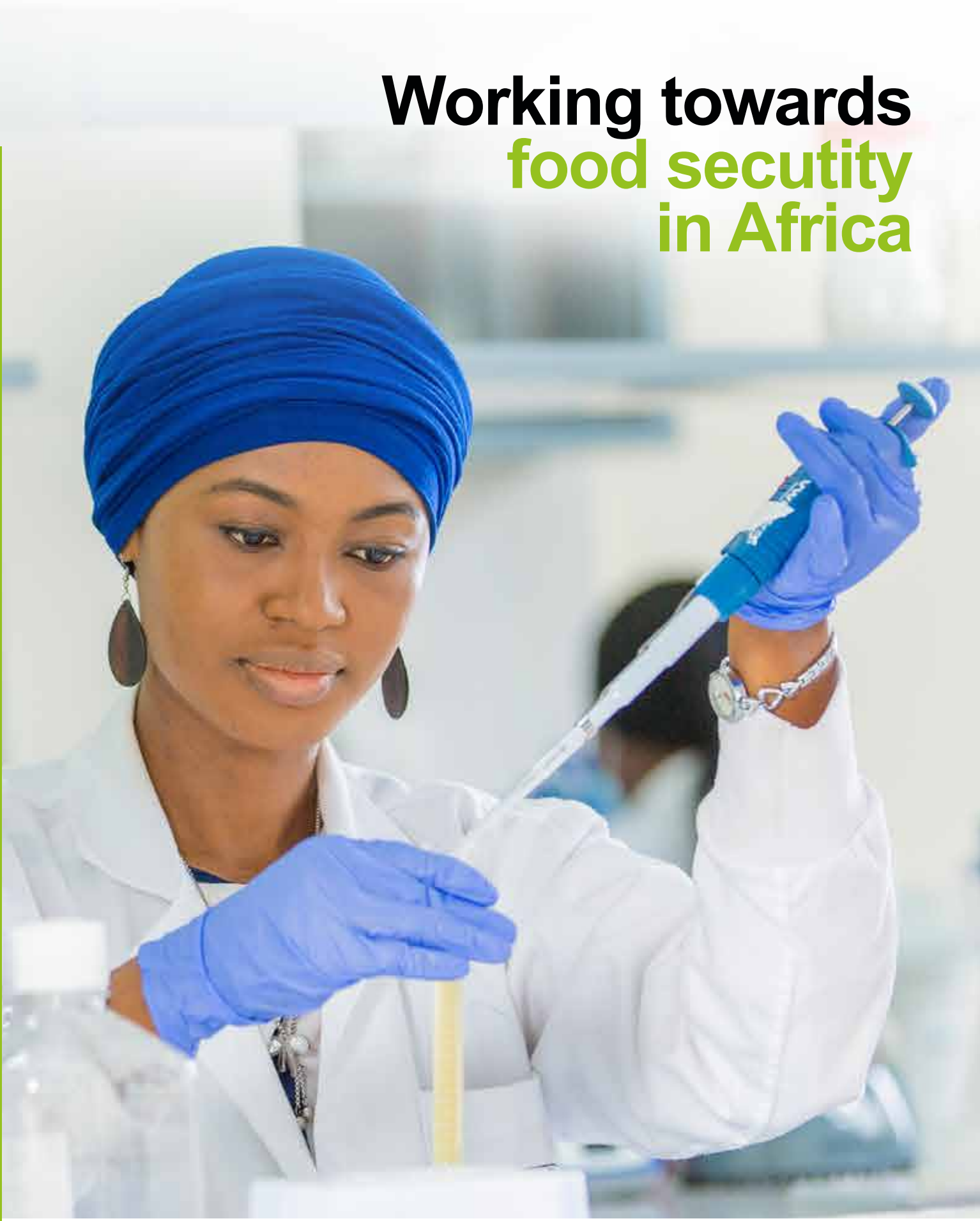
Working towards food secutity in Africa



Do not accept the status quo.
Make WAVEs to change Africa!

Central And West African Virus Epidemiology
WAVE
For Food Security

WAVE FOR FOOD SECURITY

A. WHAT IS WAVE?

The Central and West African Virus Epidemiology (WAVE) is a shared technical platform supported by a network of national scientific and biotechnological research institutions in Central and West Africa.

Phase 1 of WAVE was implemented in seven countries, namely Benin, Burkina Faso, Côte d'Ivoire, Democratic Republic of Congo, Ghana, Nigeria and Togo. Under Phase 2, WAVE's activities were extended to three new countries: Cameroon, Gabon and Sierra Leone. The WAVE network, therefore, comprises 10 countries and 13 institutions (Figure 1).

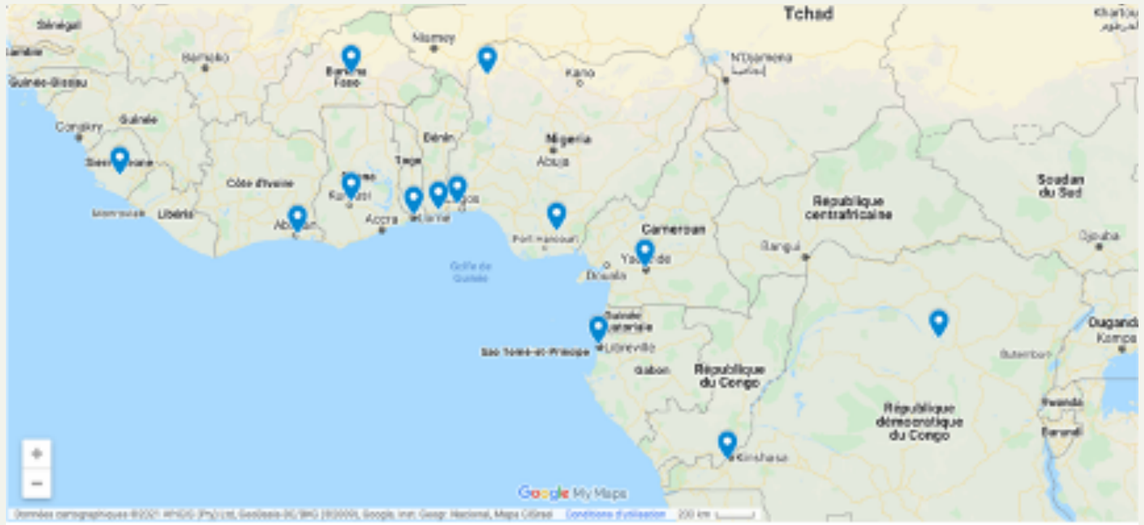


Figure 1: Location of the 13 national agricultural research system institutions of WAVE network. NU-Sierra Leone, INERA-Burkina Fasso, UFHB-Côte d'Ivoire, CRI-Ghana, UL-Togo, UAC-Bénin, C-Nigeria, KSUSTA-Nigeria, NRCRI-Nigeria, IRAF-Gabon, IRAD-Cameroun, IFA-République Démocratique du Congo, INERA-République Démocratique du Congo.

1. Objective

The main objective of the WAVE, which is part of a sub-regional approach, is to increase food production in Central and West Africa in a sustainable manner by developing methods to control and effectively manage plant diseases, as well as prevent the incursion of exotic plant diseases to new areas.

For that purpose, WAVE has made it possible for member countries to set up and/or revitalize functional molecular diagnostics/research laboratories, advocate for the implementation and/or review of relevant policies where necessary, facilitate training, awareness-campaign, disease surveillance and monitoring, and technology transfer mechanisms necessary for securing the production of major staples and food security crops especially root and tuber crops in Central and West Africa.

2. Cassava, the Flagship Crop of WAVE

Cassava, sweet potato and yam are reproduced through vegetative propagation and face similar biotic and abiotic constraints. For this reason and due to growing threats to cassava, production, WAVE activities mainly focused on cassava and the outcomes adapted to sweet potato and yam.

B. CASSAVA

1. Origin of Cassava

Cassava whose scientific name is Manihot esculenta is a shrub native to Central America, the Caribbean and Northern Brazil. It was introduced into West Africa by the Portuguese in the 16th century and into East Africa in the 18th century. It was propagated throughout Africa and South Asia by European explorers from the 18th to the 19th centuries (Figure 2). Its ability to thrive in marginalized environments and the fact that it constitutes a permanent food reserve have promoted its rapid expansion.

http://marlinpeterson.com/how-many-people-in-africa-owe-their-existence-to-cassava-crossing-the-altantic/

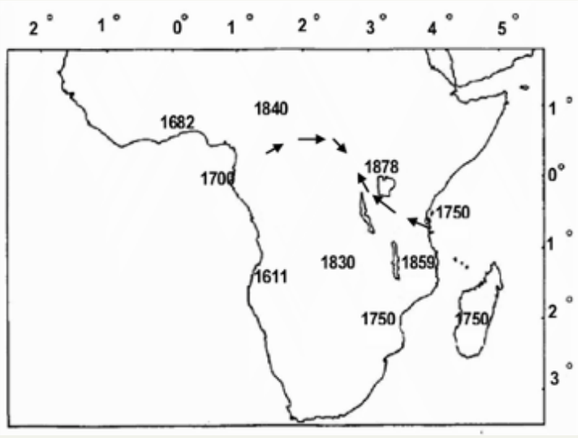


Figure 2. Introduction et de propagation du manioc en Afrique (source : Carter et al.,1992). Les flèches indiquent les routes d'arrivée en Afrique de l'Est.

2. Importance of Cassava to the Populations of Central and West Africa

Cassava is a staple food for an estimated 800 million people worldwide, about 500 million of whom are Africans. Thus, 63% of the world's cassava production is consumed in Africa. In West and Central Africa, tuberous roots and cassava leaves are used primarily for human consumption. From a nutritional viewpoint, the tuberous root of cassava is essentially an energy food which is rich in starch and ascorbic acid (Vitamin C). Cassava leaves are rich in protein, minerals and vitamins. They contain low raw fibers and relatively large amounts of calcium and phosphorus. The use of cassava leaves in infant and child feeding could be encouraged to prevent certain diseases. Cassava tuberous roots and leaves are consumed in various ways in Africa. The most common cassava based food products in West and Central Africa are listed in Table 1 below.

Région d'Afrique	Pays	Mets à base manioc
Centre	Cameroun	Feuilles, Bôbôlô, Miondo, Mintumba
	Gabon	Iporo, kongondé, Sakasaka
	République Démocratique du Congo	Feuilles, bobolo, Chikwanga, Foufou, Pondu (Saka-saka)
Ouest	Bénin	Gari (dossi, pinon), Gari foto
	Burkina Faso	Tô (manioc), Con'godê, Gari
	Côte d'Ivoire	Attiéké, Placali, Kongondé, Feuilles
	Ghana	Banku, Fufu, Gari
	Guinée	Kouti, Gelen, Too (manioc)
	Libéria	Fufu, Gari
	Nigéria	Amala, Gari, Fufu (manioc)
	Sierra Leone	Fufu, Gari
	Togo	Tapioca, Kounkountè, Gari

Table 1. Cassava-based Food Products in WAVE Member Countries

Cassava is also used as animal feed and as raw materials for several industries, including starch, ethanol and biofuels production. As a result, cassava is now a strategic food security and poverty reduction crop. This confirms the statement made by Elisabeth Atangana, President of the Regional Platform of Farmers' Organizations in Central Africa (PROPAC), that "cassava is a gold mine that can significantly contribute to reducing poverty in sub-Saharan Africa, securing jobs for women and youths and reducing excessive dependence on agricultural imports".

3. Cassava production in Africa

According to FAO statistics (2018), world cassava production stood at over 303 million tonnes in 2019 and Africa's contribution to it has increased from 50 to 57% over the last 20 years. Nigeria remains the world's largest cassava producer with 59 million tonnes.

Pays	Production en tonnes (2015)	Production en tonnes (2016)	Production en tonnes (2017)	Production en tonnes (2018)	Production en tonnes (2019)
Nigéria	57,643,271	59,565,916	55,068,732	55,795,814	59,193,708
RDC	34,930,687	35,000,000	37,699,983	38,873,036	40,050,112
Ghana	17,212,756	17,798,217	19,008,725	20,845,960	22,447,635
Cameroun	4,950,000	5,000,000	5,038,370	5,804,599	6,092,549
Côte d'Ivoire	5,087,000	4,548,000	5,367,000	5,600,350	5,238,244
Sierra Leone	4,398,784	4,108,848	4,268,769	4,428,691	4,588,612
Bénin	3,420,665	3,892,287	3,959,450	3,819,804	3,894,777
Togo	1,039,135	1,027,476	1,041,682	1,089,472	1,117,880
Gabon	305,663	315,825	322,953	330,081	337,209
Burkina Faso	4,319	4,147	4,085	4,056	4,046

Table 2. Cassava Production in WAVE Member Countries from 2015 to 2019 (FAOSTAT, 2020)

4. Production constraints

Though Africa is the world's largest cassava producer (57%), paradoxically, the average tuber yield is much lower than the average yield elsewhere around the world. Yet Africa has highly productive cassava varieties with a potential of more than 40 t/ha. These low yields are attributable to several factors including the lack of high-quality planting materials (cuttings), poor agricultural practices, especially poor management of viral diseases.

Cassava is affected by two economically important viral diseases, namely African Cassava Mosaic Disease (CMD) and Cassava Brown Streak Disease (CBSD). These viral diseases are transmitted by insect vectors called whiteflies (Bemiscia tabaci), however, human activities remain the main mode of spread of these diseases in West and Central Africa. These diseases are mostly spread by humans through the use of contaminated cassava cuttings from old infected farms to set up new plantations.

4.1. Cassava Mosaic disease

CMD, caused by geminiviruses (African Cassava Mosaic Virus – ACMV and East African Cassava Mosaic Virus – EACMV) is the most common viral disease in Africa. The symptoms of this pathology vary according to the intensity of the disease. They can range from simple leaf discoloration (chlorosis) forming "mosaic" patterns to the deformation, stunting and death of plants in the most severe cases (Figure 3). Almost all traditional cassava cultivars circulating on the African continent are prone to this disease. Yield losses due to CMD can range from 40 to 70% and result in an economic loss estimated at USD 2 to USD 3 billion per year for sub-Saharan Africa.

Figure 3: Symptoms of African cassava mosaic disease (photos, taken during surveys by Amoakon, WAVE-UFHB) (A) Healthy leaves; (B and C) Leaf Mosaic; (D) Stunted growth; (E and F) Severe mosaic and leaf distortion

In the 1990s, the cassava mosaic epidemic in East Africa highlighted the impact of viral diseases on the livelihoods of root and tuber crops farmers. This epidemic, which began in Northern Uganda in 1990, spread rapidly southwards, devastating cassava farms, causing food shortages and famine in some districts where cassava was the staple food (Otim-Nape et al., 1997). Studies by Pita et al (2001) revealed that the emergence of a new strain of the EACMV known as the East African Cassava Mosaic Virus - Uganda (EACMV-Ug) was one of the main drivers of this epidemic. The epidemic affected around nine countries in East and Central Africa, resulting in an estimated annual economic loss of USD 1.9 billion and causing famine which claimed the lives of thousands of people (Legg et al., 2006).

4.2. Cassava Brown Streak Disease

Currently CBSD is causing production losses of up to 100% in East and Central. This disease, which is caused by a potyvirus, Cassava Brown Streak Virus (CBSV), causes dry necrotic rot in cassava roots, resulting in a significant reduction or complete deterioration in root quality (Figure 4). In most cases, small producers abandon their CBSD-affected farms due to the total loss of crops.

Figure 4: Symptoms of cassava brown streak disease (CBSD) (A) on the leaf, (B, D) on the stem and (D and E) in the root (photos, Monde, WAVE-DRC)

CBSD was initially detected only in Tanzania, on the East African coast. However, since 2004, it has spread to Uganda (Alicai et al., 2007) and other East African countries. Presently, CBSD has spread to the Democratic Republic of Congo (Mulimbi et al., 2012) and into Central Africa (Figure 5). This disease is therefore at the doorsteps of West Africa and poses another serious threat to cassava production, coupled with the already devastating action of CMD.

Figure 5: The Spread of CBSD from East Africa to Central Africa (www.fao.org/emergencies)

C. OUR SUCCESS SO FAR

Funded by the Bill and Melinda Gates Foundation (BMGF) and the UK Foreign, Commonwealth & Development Office (FCDO), WAVE has, in the last six years, strategically developed a strong collaborative network of African national institutions and established functional molecular laboratories. In addition, WAVE successfully implemented three nationwide field surveys for cassava viral diseases in participating countries since 2015 using inhouse harmonised protocols. These surveys and subsequent laboratory analysis of the field samples enabled the generation of incidence, severity, risk and hazard maps for evidence-based decision making. For example, WAVE has developed well-documented country response action plans for pre-emptive management of cassava viral diseases in all 10 participating countries. These plans have been endorsed by the government in each country.

D. WAVE: THE REGIONAL CENTER FOR TRANSBOUNDARY PLANT PATHOGENS

Preventing the incursion of transboundary plant pathogens is always better than scrambling to find solutions since a pathogen becomes very difficult to eradicate and expensive to manage once it is established. Prevention requires a holistic, multi-institutional strategy including surveillance and early warning, implementation of quarantine and phytosanitary regulations, and technological solutions. Availability of open-source monitoring and surveillance data, as well as access to sensitive, easy-to-use and affordable diagnostic tools are essential. These can be implemented concurrently with the proactive deployment of resistant crop varieties.

Focusing on transboundary plant pathogens, the WAVE Regional Center will partner with existing efforts within the Central and West African region and contribute to the region's capacity to advance a holistic plant health strategy. This will contribute to a more resilient and adaptive food system. A shared and inclusive multi-national partnership such as WAVE, along with its network of African and International Research Institutions, will develop and implement harmonised pathogen management strategies that are aligned with regional and international agreements.

E. WAVE: BENEFITING THE CENTRAL AND WEST AFRICAN REGION

By leveraging artificial intelligence in diagnostics and an agriculture information management system WAVE will manage the transboundary plant pathogens component and support the interventions of Member States. With these tools and partnerships, WAVE will better guide the phytosanitary issues, increasing productivity and exports, and prevent the entry and/or spread of pathogens of economic importance. These actions will benefit the Governments of Member States, farmers' associations, individual farmers and consumers, including other players along the agro-processing value chain.

REFERENCES

Alicai T., Ndunguru J., Sseruwagi P., Tairo F., Okao-Okuja G., Nanvubya R. et autres. (2016). Le virus de la striure brune du manioc a un génome en évolution rapide: implications pour la spéciation virale, la variabilité, le diagnostic et la résistance de l'hôte. Sci. Rep. 6: 36164. 10.1038/srep36164

FAOSTAT (2020) Food and Agriculture Organization of the United Nations (FAO). FAOSTAT Database. http://www.fao.org/faostat/en/#data/QC

Legg JP, Owor B., P Sseruwagi, Ndunguru J. 2006. Maladie du virus de la mosaïque du manioc en Afrique orientale et centrale: épidémiologie et gestion d'une pandémie régionale. Adv Virus Res. 67: 355–418.

FAO, 2013. Gérer les maladies à virus du manioc en Afrique: Initiative régionale sur le manioc:http://www.fao.org/fileadmin/user_upload/emergencies/docs/RCI%20Cassava%20brochure_ENG_FINAL.pdf

Otim-Nape, G.W., Bua, A., Thresh, J.M., Baguma, Y., Ogwal, S., Semakula, G.N., Acola, G., Byabakama, B., and Martin, A. (1997). "Cassava Mosaic Virus Disease in Uganda: The Current Pandemic and Control Methods. Natural Resources Institute, Chatham, United Kingdom. 65 p.

Pita J.S., Fondong V.N., Sangare A., Otim-Nape W., Ogwal S., Fauquet C.M. (2001). Recombination, Pseudorecombination and Synergism of Geminiviruses are determinant Keys to the Epidemic of Severe Cassava Mosaic Disease in Uganda Journal of General Virology, 82: 655-665.

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