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DEVELOPMENTS IN ROOT CROPS IN AFRICA

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Abstract

The Collaborative Study of Cassava in Africa (COSCA) has generated useful baseline data on cassava production, marketing, and utilization; it has also given some directions for research. Collaborative activities that have been important in strengthening national agricultural research systems in Africa for sustained root crop production are research; generation, distribution, and evaluation of improved germ plasm; networking; information exchange; biological control of cassava mealy bug; and training of research and technical staff, extension workers, and farmers. The area of post-harvest utilization of root crops needs more emphasis.

Introduction

Root crop research in Africa during the last 20-25 years has concentrated largely on developing high-yielding varieties resistant to diseases and pests; controlling economic pests and diseases; building infrastructure for research; developing manpower for research and extension; making efforts to reach farmers; and conducting socio-economic studies. Emphasis continues on these themes as they are still relevant to the African situation. This paper will therefore highlight achievements in root crops in the aforementioned areas.

Collaborative Study of Cassava in Africa (COSCA)

Background

Authoritative baseline data had never been collected for setting up priorities for cassava research in Africa. In particular, if the potential of cassava for increasing food supply and improving the welfare of the people of sub-Saharan Africa were to be realized, then such information was needed to improve the focus of research on cassava by national agricultural research systems (NARS) and international agricultural research centres (IARCs). COSCA

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therefore aimed to collect such information over a wide range of cassava production systems, processing methods, market prospects, and consumption patterns.

The study began in 1989 with funding from the Rockefeller Foundation and with six countries participating: Côte d'Ivoire, Ghana, Nigeria, Tanzania, Uganda, and Zaire. These countries produce 70% of cassava in Africa, and possess a wide range of climates, altitudes, and demographic and market conditions, all of which influence cassava production and consumption in sub-Saharan Africa. Nine countries joined later, with alternative funding: Burundi, Cameroon, Congo, Kenya, Liberia, Malawi, Rwanda, Sierra Leone, and Zambia.

The study was carried out in three phases: broad characterization of production, production details, and post-harvest issues (detailed studies). COSCA's study methods have been described by Nweke et al. (1991). Data collection is now completed, and data analyses and report writing are advanced.

COSCA Highlights and Findings

(1) COSCA has improved the benchmark database for cassava production and use.

(2) COSCA has enabled eastern and southern African countries to characterize post-harvest handling, rural processing, and utilization of cassava.

(3) COSCA has helped with impact assessment.

(4) Cassava is a highly commercialized crop across western, central, and eastern Africa.

(5) Since 1970, production has increased 70% in 250 villages surveyed in the first six countries.

(6) Production increased in all villages where some or all processing has been mechanized.

(7) Some directions for research include the development of early bulking varieties (10-12 months), development of methods to spread new cassava cultivars, and labour-saving devices for processing harvested cassava.

(8) Collaboration between NARS and IARCs has gained new impetus in survey planning, survey methodology, survey execution, knowledge application (e.g., in

agronomy, breeding, and pest control), data analysis, and writing reports.

(9) NARS have been strengthened.

Networks

African countries have used networking effectively to employ scarce resources efficiently for research; to reduce duplication; disseminate research information; improve collaboration among various NARS, between NARS and IARCs, and between NARS, IARCs, and donors; and sensitize governments and some NARS to take root crops more seriously.

East and Southern Africa Root Crops Research Network (ESARRN)

This network was a collaborative research effort among 12 eastern and southern African countries from 1987 to 1993. The major achievements were in the areas of collaborative research; information exchange; baseline data generation; germ plasm development and distribution; rapid multiplication and distribution of improved varieties; training of research personnel, extension workers, and farmers in root crop technologies; improved research capacity; and integrated pest management for controlling the cassava mealy bug.

Two networks emerged from the ESARRN: the East Africa Root-crops Research Network (EARRNET) and the Southern Africa Root-crops Research Network (SARRNET). Both networks are involved in research: germ plasm development, multiplication and distribution, post-harvest handling, ecologically sustainable plant protection, monitoring and impact assessment, information exchange, training, and capacity building. EARRNET covers Burundi, Kenya, Madagascar, Rwanda, and Uganda. SARRNET covers the country members of the Southern Africa Development Community (SADC): Angola, Botswana, Lesotho, Malawi, Mozambique, Namibia, Swaziland, Tanzania, Zambia, and Zimbabwe. Both the International Institute of Tropical Agriculture (IITA) and the International Potato Center (CIP, its Spanish acronym) are involved in SARRNET; IITA with EARRNET, and CIP with another network in the region for sweet potato and Irish potato.

African Yam Network (AYN). This network, formed as a NARS initiative, brings together expertise in yam research, development, production, and utilization in Africa. It is headquartered at the IITA station in Cotonou, Benin. It has developed projects but lack of funds has prevented effective operation.

Cassava Biotechnology Network (CBN). The CBN was formed in 1988 and is

headquartered at CIAT, Colombia. It provides a forum for discussing biotechnology issues relevant to cassava and promotes the use of biotechnology tools to address priority areas of cassava research.

Cassava Genetic Resources Network (CGRN). This network was founded in 1992 to bring together all relevant agencies and expertise on the conservation and use of cassava genetic resources.

African Plant Biotechnology Network (APBNet). Formed in 1989, the APBNet brings together individuals and institutions that are active or interested in plant biotechnology research and development in Africa. Root crop scientists are active participants.

Collaborative Group on Root and Tuber Improvement and Systems Research (CORTS). This Group was established in 1991 as an amalgamation of two previous collaborative arrangements of IITA programmes with African NARS: (1) the collaborative group for Root and Tuber Improvement Research, coordinated by the Root and Tuber Improvement Programme (TRIP); and (2) the collaborative group for cassava-based cropping systems research, coordinated by the Research and Crop Management Programme. Currently, CORTS is jointly coordinated under the guidance of a steering committee, comprising mainly national programme scientists.

Collaborative Research

The IARCs and NARS in Africa collaborate in various research areas to strengthen the national programmes. This collaboration takes various forms:

1. *Transfer of germ plasm.* IITA, through concerted efforts, has developed improved breeding materials of cassava that combine multiple resistance to major pests and diseases in sub-Saharan Africa. The materials are in the form of improved seed populations and *in vitro* plantlets. These are sent to NARS for evaluation, selection, and refinement under local conditions. Several seed populations, *in vitro* plantlets of cassava and yams (*Dioscorea* spp.), have been distributed (Tables 1 and 2). Several cultivars have been selected by NARS, multiplied and distributed (Table 3).

2. *International Collaborative Testing (ICT).* IITA and CIP have collaborated with NARS in the international testing of improved cassava and sweet potato genotypes. In West Africa, the testing has been a means of germ plasm transfer and information generation of the performance of a range of leading genotypes. It also offers the

opportunity to study genotype x environment interaction in cassava, monitor variation in the prevalent diseases, and determine the stability of crop genetic resistance to the major disease and pests.

In Ghana, three of these clones were officially released to farmers in 1993 by the National Varietal Release Committee. The clones have been named `Abasa Fitaa' for TMS 4(2)1425, `Afisaifi' for TMS 30572, and `Gblemo Duade' for TMS 50395. Their yields far outstrip those of local cultivars.

IITA has collaborated with Shell Petroleum (Nig.) Ltd. since the 1970s. Collaboration takes the form of joint evaluation of breeding populations for adaptability to the humid forest zone, multisite trials of improved genotypes, and multiplication of breeder seed for nationally coordinated research trials. Shell has an excellent record in the multiplication and distribution of improved genotypes released to farmers in Nigeria.

3. *Socio-economic studies.* Apart from COSCA, the IARCs have collaborated with NARS in socio-economic studies. CIP and NARS of eastern and southern African countries have identified the major constraints to sweet potato production through such surveys. Collaborative research projects have followed up the surveys to resolve the identified constraints. A socio-economist has been located at SARRNET to serve both SARRNET and EARRNET.

4. *On-Farm Adaptive Research Projects for Cassava and Yam (OFAR).* This is part of a bigger project that includes maize, rice, cowpeas, and soybeans. It has been funded for West and Central Africa by the EU since 1990. The project emphasizes multisite testing of improved genetic materials, seed multiplication and distribution, training, and research in agronomy. Monitoring tours are conducted to evaluate the trials. High-yielding materials have been identified (Tables 4 and 5); disease variation with location has also been observed. The OFAR has been very effective in enhancing and accelerating the transfer of technology from researchers to farmers and providing feedback to researchers on production problems faced by farmers.

5. *Ecologically Sustainable Cassava Plant Protection (ESCaPP).* This is a joint project among IITA/CIAT and NARS in Africa and South America, Winrock International, the University of Amsterdam, and the University of Florida. ESCaPP was initiated with financial support from UNDP/IITA. It integrates crop improvement, protection, agronomy, socio-economics, and extension of cassava technology in a sustainable way for important cassava pests, diseases, and weeds in Benin, Cameroon, Ghana, and Nigeria. ESCaPP awards grants to encourage strategic

and innovative cassava plant protection research and enhance collaboration in the region. Research with direct relevance to solving farmers' constraints is given highest priority. ESCaPP will be executed by IITA's Plant Health Division during 1993-1997.

6. *Biological control.* The success story of the biological control of the cassava mealy bug (*Phenacoccus manihoti* Matt-Ferr), using mainly the parasitic wasp (*Epidinocarsis lopezi*) is well-known. We expect similar results for the control of the cassava green spider mite (CGM), which inflicts heavy yield losses to cassava in Africa. The African cassava mosaic virus (ACMV) also continues to cause heavy crop losses in Africa despite the resistant materials developed at IITA. A very serious epidemic occurred in Uganda, causing such heavy damage to the crop that planting materials were not available. The Natural Resources Institute (NRI), UK, is working on the problem in collaboration with Ugandan researchers. IITA also continues its work on the virus. Multiplication of resistant cultivars needs to be intensified.

Information Exchange

National workshops. Annual NARS meetings are organized to review national research results and plan future research. Government ministers and officials, universities, collaborating NGOs and research institutions (local and international) participate.

Network meetings. The various networks meet to discuss progress and review results and plans for future work.

IARCs/NARS meetings. These meetings take various forms: for example, meetings with NARS directors to discuss policy issues and research plans. Once decisions are approved by the directors, implementation becomes smoother and governmental input flows easier. NARS are also consulted by the IARCs when preparing project proposals that require their participation.

International Society for Tropical Root Crops-African Branch (ISTRC-AB). The ISTRC-AB had, by 1994, organized five successful triennial symposia, the proceedings of which have now been published. The last symposium was organized in Kampala, Uganda, during 22-27 November 1992, and was attended by 136 participants from 20 countries. The participants presented 71 scientific papers, 6 posters, and 14 country reports on the R&D of their national programmes.

Newsletter. The *Tropical Root Crops Network Newsletter* evolved into the *Tropical*

Root and Tuber Crops Bulletin in 1992. It is produced biannually and distributed to root crop researchers in the NARS and elsewhere. NARS are encouraged to use this medium for exchanging information among themselves and with IITA.

Other publications. In addition, IITA produces and distributes the *African Journal of Root and Tuber Crops* and other, various types of publications, including technical manuals and research guides, of relevance to cassava researchers.

Training

Human resource development for individuals or groups has contributed significantly towards the strengthening of national root crop programmes in Africa. Individual training takes the form of specialized training at an IARC or research towards either an M.Sc. or Ph.D. degree, with thesis work conducted at either an IARC or national or foreign university and the course work at the university. In-country group training courses are also organized by NARS in collaboration with the IARCs. IITA has decentralized its training activities so that group courses are given by the NARS and specialized courses by IITA. This is to encourage NARS to become fully responsible for group courses in the future. Root crops training courses organized on and off campus by IITA are given in Tables 6 and 7.

New Initiatives

Cassava production is expanding to non-traditional areas such as Chad, Lesotho, Mali, Namibia, Niger, South Africa, Swaziland, and Zimbabwe. Cassava seed populations and tissue culture materials from IITA have been sent to these countries, but they need considerable technical and financial assistance. The East and Southern Africa Regional Centre (ESARC) for the improvement of cassava, banana, and plantain, set up at Namulonge, Uganda, by IITA, should collaborate with the eastern and southern African networks in this regard. IITA should take care of the new cassava-growing countries in Africa. This expansion, which proves the resilience of cassava, should attract the attention of donors.

Without a doubt, food security in Africa is tightly linked to the development and sustained support for root and tuber crops. However, for sustainable production, African countries have to pay closer attention to post-harvest and utilization issues.

Conclusions

Future research should emphasize the following areas:

(1) Post-harvest and utilization R&D.

(2) Development of systems for multiplying and distributing improved varieties, and technology transfer.

(3) Development of germ plasm for diverse environments and stresses (e.g., ACMV, drought, and pests).

(4) Increased collaboration within and among countries and with international organizations.

Reference

Nweke FI; Polson R; Strauss J, eds. 1994. Proc. 9th ISTRC Symposium; 20-26 Oct 1991, Accra, Ghana.

Table 1. Distribution of *in vitro* plantlets of virus-tested cassava genotypes by the International Institute of Tropical Agriculture (IITA) during 1988 to 1993.

Year	Countries	Packages (total)[a]	Plantlets (total)
1988	25	50	2000
1989	17	27	1100
1990	16	23	1170
1991	21	24	1295
1992	19	33	3294
1993	18	26	3010

a. Mean of about 15 genotypes per package.

Table 2. Distribution of *in vitro* plantlets or mini-roots of virus-tested white-yam genotypes by the International Institute of Tropical Agriculture (IITA) during 1988 to 1993.

Year	Plantlets			Mini-roots		
	Countries	Packages[a]	Roots	Countries	Packages[b]	Roots
1988	1	1	20	-	-	-
1989	19	27	500	-	-	-
1990	13	23	540	-	-	-
1991	14	15	238	8	13	1020
1992	12	17	390	10	14	1520
1993	14	16	400	7	7	1400

a. Mean of about six genotypes per package.
b. Mean of about four genotypes per package.

Table 3. List of cassava varieties released or nominated for release by national agricultural research systems of various African countries.

Country	Recommended genotypes, or cultivars released
Benin	TMS 30572, 30572 A, and 4(2)1425
Burundi	TMS 40160-3 and 40160-1
Cameroon	8034; 8017; 8061; 820516; 1005; 658; 244
Gabon	CIAM 76-6, 76-7, 76-13, and 76-33
Gambia	TMS 4(2)1425, 60142, 30337, and 30555
Ghana	Afisaifi (TMS 30572); Gblemo Duade (TMS 50395); Abasa Fitaa (TMS 4(2)1425)
Guinea	TMS 30572
Guinea-Bissau	TMS 30572, 60142, 30555, 42025, and 4(2)1425
Liberia	CARICASS 1, 2, and 3
Malawi	TMS 60142
Mozambique	TMS 30001, 30395, and 42025
Niger	TMS 4(2)1425
Nigeria	NC Idi-ose (TMS 30572); NC Savanna (TMS 4(2)1425); TMS 91934
Rwanda	Gakiza (UYT Bulk 1977); Karana (PYT Bulk 1977); TMS 30572
Seychelles	SEY 14, 28, 32, 41, and 52
Sierra Leone	ROCASS 1, 2, and 3; NUCASS 1, 2, and 3; 80140
Togo	TMS 4(2)1425 and 30572; INPT 3121524
Uganda	TMS 60142, 30572, 30786, 4(2)1425, and 60140
Zaire	Kinuani; Kivuru; F100; 3023013
Zambia	LUC 133

Table 4. Yield performance (t/ha) of four exotic and one local cultivars of cassava in two regions of Ghana.

Entry	Region		Mean
	Western	Eastern	
TMS 4(2)1425	44.6	29.9	37.3
TMS 50395	56.7	32.5	44.6
TMS 30572	54.5	39.1	46.8
TMS 91934	48.1	20.6	34.4
Local cultivar	23.6	18.4	20.9

Table 5. Yield (t/ha) of cassava clones evaluated in Gambia.

Entry	Location				Mean
	Daselami	Sotokoi	Tanji	Yunduri	
TMS 42025	42.0	10.0	23.0	11.7	21.7
TMS 30337	13.4	7.0	32.5	19.4	18.1
Local cultivar	6.0	3.8	11.5	3.0	6.1

Table 6. Off-campus root crops training courses organized by the International Institute of Tropical Agriculture (IITA), 1989-1994.

Course title	Location	Year	Parti-cipants (no.)	Type of course	Sponsors[a]
Production and rapid multiplication of root crops	Guinea-Bissau	1989	22	In-country national	IITA/USAID
Cassava and sweet potato production, and post-harvest ...	Mozambique	1989	16	In-country national	ESARRN
Rapid multiplication of root crops	Benin	1989	29	In-country	IITA
Agronomy and rapid multiplication of cassava	Sierra Leone	1990	31	In-country national	IITA/IAR
Root crops production processing and utilization	Guinea	1990	18	In-country	IITA/FAO
Root crops production processing and utilization	Malawi	1990	34	In-country	ESARRN
Agronomy and rapid multiplication of cassava	Uganda	1991	30	In-country	ESARRN
Organization and management of vegetative seed production	Uganda	1991	15	International	UNDP
Rapid multiplication of cassava	Zaire	1992	17	In-country	EEC/OFAR
Root crops production processing and utilization	Tanzania	1992	19	In-country	ESARRN
Rapid multiplication and post-harvest management of root crops	Gambia	1993	13	International	IITA
Root crops production, processing and utilization	Burundi	1993	18	In-country	ESARRN
Agronomy and rapid multiplication of cassava	Madagascar	1994	18	In-country	EARRNET
Rapid multiplication of cassava	Ghana	1994	17	In-country	MOFA

Root research management and development (cassava and sweet potatoes)	Malawi	1994	19	Regional	SARRNET/ EARRNET
Cassava production and utilization	Zimbabwe	1994	20	In-country	ROCKEFELLER FOUNDATION
Root crops research and technology transfer	IITA, Nig.	1989	24		
Root crops research and technology transfer	IITA, Nig.	1990	24		
Root crops research and technology transfer	IITA, Nig.	1991	18		
Root crops research and technology transfer	IITA, Nig.	1992	21		
Breeding of root crops	IITA, Nig.	1994	15		

a. *EARRNET = East Africa Root-crops Research Network;*
EEC = European Economic Community (now European Union);
ESARRN = East and Southern Africa Root Crops Research Network;
FAO = Food and Agriculture Organization of the United Nations;
IAR = Institute of Agricultural Research;
MOFA = Ministry of Food and Agriculture;
OFAR = On-Farm Adaptive Research Projects for Cassava and Yam;
SARRNET = Southern Africa Root-crops Research Network;
UNDP = United Nations Development Programme;
USAID = United States Agency for International Development.