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AN OVERVIEW OF CASSAVA IN AFRICA

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ABSTRACT

Cassava is one of the most important staple food crops in Africa. It is a major source of energy for over 200 million people in the continent. The ten countries in the world whose food energy comes mostly from cassava are all in Africa. More cassava is now being produced in Africa than in South America where the crop originated. Apart from the production of tuberous roots, millions of tons of cassava leaves are harvested and used as a vegetable which provides protein, vitamins and minerals. The crop's production is among the most stable of the world's major food crops. It is adapted to the diverse African farming systems, can grow on a wide range of soils, is an efficient producer of calories and its capability for protein production is higher than commonly realised. Despite the numerous advantages that cassava offers, there were limited research and development activities on the crop in Africa until comparatively recently. This is because the crop was for long and erroneously considered to be of inferior status because it is of low value. There is also a perceived inverse relationship between cassava consumption and standard of living. Most African governments have been importing large quantities of grain, mainly to satisfy politically active urban populations. This discourages farmers in rural areas from producing cassava, which is generally well adapted to local environmental conditions. Concerted national, regional and international efforts are now being made to overcome the numerous constraints that limit cassava production in Africa. There are several serious challenges facing cassava researchers in Africa today; key among these are the need to address the problems of low yield, pests, diseases and weeds. There is also a need for studies on intercropping, cassava farming systems, post-harvest technology and cyanogenesis, and for training cassava researchers and those engaged in technology transfer. Moreover, varieties are required that are adapted to lowland conditions, to a range of growing seasons and with mealy cooking quality and drought tolerance. The effectiveness with which these challenges are met will largely determine whether the need for food security in the continent is realised.

Key Words: *Manihot esculenta,* food security, adaptation, post-harvest, pests, diseases, weeds, intercropping

RÉSUMÉ

Le manioc est une des cultures vivrières les plus importantes en Afrique. C'est une source majeure d'énergie pour plus de 200 millions d'habitants sur le continent. Les dix pays du monde, dont l'énergie alimentaire provient essentiellement du manioc, se trouvent en Afrique. Celle-ci produit aujourd'hui plus de manioc que Amérique du Sud. Indépendamment de la production de tubercules, des millions de tonnes de feuilles de manioc sont récoltées et utilisées comme égume pour un apport en proteines, vitamines et sels minéraux. La production est une des plus stables parmi celles des cultures vivrières mondiales. Le manioc est adapté à la diversité des systèmes de culture africains, peut pousser dans une grande variété de sols, s'avère un efficace producteur de calories et son aptitude à fournir des protéines est plus grande qu'on ne le pense. Malgré les nombreux avantages qu'offre le manioc, les activités de recherche et développement sur cette culture en Afrique ont été réduites, et cela jusqu'à une date relativement récente. C'est parce que cette culture fut considérée pendant longtemps, et de façon erronée, comme de statut inférieur, car peu couteuse. La consommation du manioc est également perçue comme étant en relation inverse avec le niveau de vie. La plupart des gouvernements africains importent de grandes quantités de grains, principalement pour satisfaire politiquement les populations actives des villes, ce qui décourage

les agriculteurs en zones rurales de produire du manioc, généralement bien adapté àl'environnement local. Des efforts concertés, à l'échelle nationale, régionale et internationale, sont actuellement entrepris pour surmonter les contraintes nombreuses qui limitent la production du manioc en Afrique. Les chercheurs qui travaillent aujourd'hui sur le manioc en Afrique sont confrontés à plusieurs défis sérieux. Parmi ceux-ci, la nécessité de se saisir du problème des bas endements et de celui des ravageurs, maladies et mauvaises herbes. Il y a également un besoin de recherche sur les cultures associées, les systèmes de culture, les technologies post-récolte et la cyanogénèse; ainsi qu'un besoin de formation des chercheurs et des personnels qui sont impliqués dans les transferts de technologies. De plus, il y a une demande pour des variétés adaptées aux conditions des basses-terres, a la diversité des conditions saisonnières de la culture, aux qualités de la famine pour les préparations culinaires et à la tolérance à la sécheresse. La sécurité alimentaire, sur le continent, dépend largement de l'efficacité avec laquelle ces défis seront relevés.

***Mots Clés*: *Manihot esculenta*, sécurité alimentaire, adaptation, post-récolte, ravageurs, maladies, mauvaises herbes, cultures intercalaires**

INTRODUCTION

Cassava (*Manihot esculenta* Crantz) originated in South and Central America (Leone, 1977). It was first introduced into Central Africa late in the 16th century, into West Afiica in the early 18th century, and into East Africa in the early 19th century (Jones, 1959). The original introductions were very limited in terms of genetic diversity. Nevertheless, in the 'slash-and-burn' system widely practised in the rainfed areas of Africa, it is likely that clones cross-pollinated and superior seedlings were selected and multiplied to become new varieties (Hershey, 1987). The crop was rapidly adopted by farmers and integrated into the traditional farming and food systems of Africa because of its low input resource requirements and relative ease of cultivation and processing (Hahn *et al.*, 1979).

Cassava is one of the most important staple food crops in Africa. The ten countries in the world whose food energy comes mostly from cassava are all in Africa: Angola, Benin, the Central African Republic, The Comoros, Congo, Liberia, Mozambique, Tanzania, Togo and Zaire (Horton *et al.*, 1984). More cassava is now being produced in Africa than in South America, where the crop originated. In 1991, 68.9 million tonnes of fresh roots were harvested from 8.9 million ha. in Africa (Table 1). This represents 45% of the total world production from 57% of the total area harvested, an indication of the low average production of the crop in the continent. The average African yield of 7.7 mt ha^{-1} compares unfavourably with yields of 13.0 mt ha^{-1} in Asia, I1.2 mt ha^{-1} in Oceania and 12.4 mt ha^{-1} in South America (CIAT, 1994).

Current agricultural statistics do not show the level of cassava leaf production, but experience from several countries indicates that millions of tonnes of cassava leaves are harvested and used as a vegetable by many African families, providing protein, vitamins and minerals. Cassava is a major source of energy for over 200 million people in Africa. The crop's production is among the most stable of the world's major food crops. The storage roots can be left in the ground for up to three or more years, making it available to consumers for a long period.

Cassava can grow on a wide range of soils and can yield satisfactorily, even on poor acid soils where most other crops fail (Hahn, 1984). It can grow in high rainfall areas and also in semi-arid regions because of its drought tolerance. The crop, therefore, plays a vital role in alleviating famine by providing sustained food supplies when other crops fail.

In general, cassava is well adapted to the diverse African traditional farming systems. It is an efficient producer of calories providing twice as many calories, per hectare as maize and at a considerably lower cost. The efficiency of protein production is also higher than commonly realised. Cassava leaves contain 5.1 to 6.9 % protein (Onwueme, 1978; Oomen and Grubben, 1978; Gomez and Valdivieso, 1985). In Zaire, cassava leaves are the basic vegetable, being the cheapest and richest source of protein (Lutaladio and Ezumah, 1981). Cassava leaves are also widely consumed as a vegetable in several other countries in Africa including, Sierra Leone, Congo, Cameroun, Guinea, Tanzania, Liberia and Gabon. Despite the numerous advantages that cassava offers to millions of African producers and consumers, there were very limited research and development activities on the crop in the continent until recently.

This is partly due to the fact that the crop was and still is considered erroneously as inferior since it is cheaper than cereals. There is also a perceived inverse relationship between cassava consumption and standard of living among certain people. Moreover, cassava is cultivated exclusively in developing countries and benefits to only a limited extent from research done in developed countries of the temperate regions, unlike other crops such as sweet potato, potato, maize and rice which are grown more widely.

Most African governments have not helped the situation by importing large quantities of grain, mainly to satisfy the politically active urban populations. Thereby, they discourage millions of farmers in the rural areas from producing cassava which is generally more adapted to local environmental conditions. However, in the recent past, there has been an increasing political awareness in the continent that most nations cannot depend entirely on cereals for food security, especially in the face of the intermittent drought conditions that have affected several countries.

As a result, concerted national, regional and international efforts are being made to overcome the numerous constraints that limit cassava production in the continent. There are therefore several challenges that face cassava researchers in Africa. Since cassava is such an important crop in many countries, the manner in which these challenges are met will go far in determining whether the need for food security in the continent is realised.

CHALLENGES TO CASSAVA PRODUCTION IN AFRICA

There are several serious challenges facing cassava researchers in Africa today. The main one is to find ways to produce more productive and better quality cassava to feed the growing population in the continent. The capability and potential exist to meet this challenge. Key challenges that need to be addressed as a matter of urgency range from low crop performance, agronomic, edaphic and socioecomic constraints to training, technology development and transfer.

TABLE 1. Cassava production in selected African countries, continents and the world (CIAT, 1994)

Country/Region	Area ('000 ha) (1991)	Yield (t ha^{-1}) (1991)	Production ('000 t) (1991)	Per capita consumption kg yr^{-1}-1990)	Daily cassava calorie supply (per capita)	Cassava as % total calories
Country						
Angola	500	3.7	1,850	190	571	30
Ghana	535	6.7	3,600	160	483	24
Madagascar	343	6.7	2,290	121	302	14
Malawi	72	2.3	168	16	29	1
Mozambique	972	3.8	3,690	251	751	42
Nigeria	1,700	11.8	20,000	192	432	20
Sierra Leone	22	4.1	90	29	88	5
Tanzania	604	10.4	6,266	207	394	1 8
Uganda	380	8.8	3,350	155	421	19
Zaire	2,388	7.6	18,227	391	1,123	54
Region						
Africa	8,922	7.7	68,931	96	247	1 1
Asia	3,950	13.0	51,460	7	1 7	1
S. America	2,593	12.4	32,155	42	98	4
World	15,671	9.8	153,689	18	46	2

Low yield. The average yield of cassava in many African countries is low and the solution lies in more research. Crop improvement by breeding and selection should result in the identification of more productive cultivars. Cultural practices and fertilizer recommendations which will enable higher yields to be realised must be devised for the various ecologies in which the crop is cultivated.

Pests, diseases and weeds. Closely related to low yields is the problem of pests, diseases and weed infestation. The cassava mealybug (*Phenacoccus manihoti* Mat. Ferr.), the green spider mite (*Mononychellus tanajoa* Bondar), variegated grasshopper (*Zonocercus variegatus* L.), nematodes, mammals, the African cassava mosaic geminiviruses, cassava anthracnose disease, cassava bacterial blight, *Cercospora* spp. and various tuber rots all pose a serious threat to the increased production of cassava (IITA, 1990). In Africa in recent years, the lack of genetic diversity has contributed to the damage caused by the widespread outbreaks of mites and mealybugs, and losses have been severe (Herren, 1981). These types of pest outbreaks have rarely occurred in the Americas (Bellotti *et al.*, 1987), where there is greater variability and adaptability of the crop in the continent of its origin. Research and further introductions of germplasm to Africa should address the problem of limited diversity.

Considerable success has been achieved in the biological control of the cassava mealybug which is the most devastating insect pest of cassava on the continent (Neuenschwander, 1994). There are also good prospects of controlling cassava green mite by biological means (Yaninek, 1994). Stable host plant resistance offers an advantageous and practical long-term solution for controlling cassava pests because it is economical, easy to use and compatible with other control measures (Bellotti and Byrne, 1979; Mahungu and Dixon, 1994). Moreover, there is virtually no danger of contaminating the environment or endangering man or wildlife (Bellotti *et al.*, 1987).

Further introductions of germplasm from South America to Africa is therefore likely to help provide the desired variability and form the basis for developing varieties with appropriate resistance. Also, integrated pest management has a crucial role to play in the control strategy. In subsistence agriculture in which much cassava is grown, there is a reasonably stable equilibrium between pests and host genotypes. Integrated control programmes built around plant resistance are needed to maintain this equilibrium in modern agricultural systems where extensive areas are planted to uniform genetic material (Bellotti and Kawano, 1980). The ultimate aim should therefore be ecologically sustainable cassava plant protection, involving a combination of host plant resistance, biological control and habitat management (see also Yaninek *et al.*, 1994).

Intercropping. In Africa, generally, the common cropping systems largely consist of growing several crops in mixtures. Cassava is grown in association with several other crops in most African countries, as discussed by Nweke (1994). Agricultural research in the developing areas has tended to neglect the complicated mixed cropping systems in favour of research on monocrops, as practised in the temperate regions. Despite the fact that small scale-farmers have failed to accept the recommendations to change to sole-crop farming, such inappropriate research has continued (FAO, 1991). The notion that the practices of subsistence farmers are not worthy of serious study has discouraged work on intercropping. However, this view is slowly giving way to the realisation that intercropping systems are stable and can be made even more so by the application of improved technology (Wien and Smithson, 1979; Gold, 1994).

Marandu (1977) indicated some possible areas where such improvements could be achieved, including the choice of varieties adapted for intercroping, and cropping season duration and the time of planting in relation to individual crop components. Many of the new improved varieties which were selected on the basis of monocrop performance may not necessarily perform well when grown with other species, as shown by Osiru and Hahn (1987). There is therefore the need to breed varieties that are suited for mixed cropping situations. More fundamental research that should be undertaken includes studies on the nutrient needs of individual crops in the mixture and how much of the nutrients the plants are able to extract and return to the soil. Studies are also required on the moisture requirements, shade tolerance/resistance (Doku, 1988) and pests and diseases of crop mixtures.

Adaptation to lowland conditions. Cassava is widely grown under swamp conditions during the dry season in many countries in West, East and Central parts of Africa, particularly to supply fresh leaves, as in Sierra Leone, Guinea, Nigeria, Zaire and Tanzania. The roots are harvested just before the rains and before the fields are completely submerged by water. Most of the improved varieties do not tolerate waterlogged conditions and there is a need to select varieties adapted to swamp conditions. Such work should be accompanied by detailed studies on the physiological responses of the crop to such conditions, particularly when grown primarily for leaves.

Length of growing season. There is a demand from farmers in Sierra Leone for early maturing varieties that can be harvested in three to six months. While the usually long duration of the crop has obvious advantages in some circumstances, there is the need for shorter duration varieties, especially for the hydromorphic areas where the crop is retained for only about six months in the field.

Mealy cooking quality. There is a preference in many parts of Africa for cassava which has a mealy texture when boiled. Indeed, one of the main reasons for the poor adoption of improved varieties in many countries is the lack of this quality. Work has now started at the International Institute of Tropical Agriculture (IITA), Ibadan, and several national institutions, into breeding for varieties with this characteristic and this work should be further strengthened. There is also the need to understand the biochemical basis of mealyness to complement the breeding efforts.

Drought tolerance. Cassava has been widely proclaimed as a crop that is very tolerant to drought, but experience shows that cultivars react differently when subjected to this stress. As cultivation of the crop slowly extends into the semi-arid areas of the continent, there will be need for researchers to screen for drought-tolerant varieties and to study the physiological basis of this phenomenon.

Cassava farming systems. There is still much to learn about the farming systems associated with cassava cultivation and the constraints facing farmers in the various agro-ecological zones in which the crop is cultivated. The application of improved technology must go together with formal studies of the farming system's options and their consequences. Such studies should result in continuous feedback that leads progressively to more relevant research.

Post-harvest technology. Fresh tuberous roots of cassava deteriorate if kept for more than two to three days after harvest, but recently such roots have been kept for some weeks after treatment and storage under special conditions. It is, however, very doubtful if storage under such conditions could gain widespread use in the continent in the immediate future.

About 70% of total cassava production in Africa is processed into a wide range of products including pastes, chips/flour, granules, starch and alcoholic beverages (Nweke, 1994a). Some of these products such as *gari* and flour can be stored for a relatively long time under ambient conditions. Research effort should be directed at developing appropriate technologies for processing cassava into various products and such technologies should aim at removing the drudgery in many of the traditional methods of cassava processing such as peeling and grating.

Cyanogenesis. Cassava contains two glucocides, linarin and lotaustralin, that can be broken down to yield hydrogen cyanide (HCN), which is poisonous. Hydrogen cyanide from cassava has been implicated in the deaths of people who have consumed cassava products and has also been associated with diseases such a goitre, konzo and tropical atoxic neuropathy. Problems with cassava toxicity occur almost exclusively in populations with severe socio-economic deprivation in varied diet and food insecurity (CIAT, 1994).

Bitter cassava has long been associated with high cyanogenic potential, but it is now evident that the relationship between bitterness and cyanogenic potential is complex. Even though there appears to be a broad relationship, there are significant exceptions. The relationship is important for millions of users of cassava as well as for those breeding improved genotypes.

Research work should be intensified to establish the relationship between bitterness/sweetness and cyanogenic potential, as well as the identification and characterisation of the compound(s) responsible for bitterness and the factors that influence it. Also, the influence of the environment and agronomic factors on the cyanogenic potential should be studied.

Training. Success in the cassava research effort depends to a large extent on the development of a cadre of competent African scientists. There is also the need to train more staff for support roles in research. While training will go a long way in enhancing staff performance, retaining qualified people on the job is often difficult because of poor renumeration and other working conditions. There is a need to develop programmes and provide incentives to ensure that young qualified scientists and technicians are fully engaged in productive research.

Technology transfer. Over the last decade, many national cassava research programmes have been successful in breeding new varieties that outyield local clones, but only a relatively small percentage of producers in African countries other than Nigeria are using these improved varieties. The new varieties have largely remained in the experiment stations in some countries, while in others they have not been popular with farmers. Serious effort should be directed at testing new cassava technologies at farm level. This will afford researchers the opportunity to better understand the prevailing farming system in particular areas, the farmers' problems, farmers' technology needs and areas for further research. (See also Otim-Nape *et al.*, 1994).

CONCLUSION

The future of cassava in Africa is very bright. Its satisfactory yield under suboptimal conditions, the prospect of improvement through breeding, and ease of cultivation have made it a crop for the future. The demand for cassava is likely to respond as populations increase, and marketing systems and processing techniques improve (Nweke, 1994).

Africans will increasingly turn to cassava so long as it remains easy to grow, as it is a cheap source of calories and withstands adverse environmental conditions in which other crops fail. Considerable progress will have been made in ensuring food security in the continent if new improved varieties are bred with higher yields and acceptable consumer characteristics so that they are readily adopted by farmers and result in increased cassava production.

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