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Review

Seed constraint to cultivation and productivity of African indigenous leaf vegetables

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Non-availability of improved seeds constitutes a major constraint to the cultivation and productivity of the indigenous leaf vegetables (ILVs) of Africa. Research on African ILVs has focused mainly on the ethnobotany, collection, preservation, and the assessment of food value and chemical composition of the ILVs. No serious breeding and seed production research has been done on the ILVs. This paper examines some factors underlying the lack of interest in the production of ILVs seeds, the problem associated with local seed processing and the way to organize a seed production programme for the ILVs.

Key Words: Seed, indigenous leaf vegetables, cultivation, production

INTRODUCTION

Several authors have documented the importance of indigenous leaf vegetables (ILVs) of Africa, as valuable sources of food, income and traditional medicine (Chweya, 1997; Schippers, 2000; Abukutsa-Onyago, 2003; Adebooye et al., 2003) . Many ILVs are collected in their natural growing habitats as wild species. Of the 150 food-plants commonly consumed by man, 115 are indigenous African species (Kiambi and Atta- krah, 2003). Adebooye et al. (2003) reported a list of twenty-four indigenous leaf vegetables that are eaten in southwest Nigeria only. Several other species have been listed by Okafor (1978, 1983) in Nigeria, Abbiw (1990) in Ghana, Chweya (1997) in Kenya, Rubaihayo (1997) in Uganda, Seck et al. (1997) in Senegal and Okigbo (1977) for the entire tropical Africa. Because of their value as sources of food, some farmers are keen to experiment with the cultivation of some of the ILVs. However, non-availability of improved seeds remains a major constraint to widespread cultivation of ILVs in Africa. Okafor (1997) conducted a field survey and reported that 83.3% of the farmers sampled in Nigeria identified lack of seed and planting material while 91.7% identified seedling mortality and survival as major problems militating against cultivation of ILVs. It must be noted that seedling survival and mortality is a direct effect of poor seed quality and vigour.

The regular release of improved new varieties of routinely cultivated vegetables contributes to the neglect of ILVs thus endangering their continued existence. As the new improved seeds replace old traditional varieties and their wild relatives, future plant breeding raw material embodied in wild species are gradually lost. In very few cases where farmers grow ILVs, farmers' varietal stock that are usually unselected and of poor quality constitutes the source of planting material. The viability of most farmers' seed is usually poor because of the poor farm-level storage conditions that predispose the seeds to rapid deterioration (Schippers, 2000). Poorly handled seeds consequently have low germination percentage and poor vigour.

Currently, seed industry actors operating in Africa mostly promote the production and distribution of vegetable seeds from advanced countries (George, 1999) while seed requirements of Africa's ILVs are met from 'on-farm stored seed' whose quality tend to be below national minimum seed standards. Sustainable production of Africa's ILVs depends on sustainable supply of improved and high quality seeds (George, 1999) as well as strong market demand for ILV products. High quality seed is a product of rigorous research involving varietal breeding, testing and release, seed production under strict pollination control to ensure

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Table 1. Seed yield and sources of seeds for selected high premium ILVs of Africa: A case study of Nigeria.

Indigenous Vegetables	Seed yield (kg/ha)	Sources of farmers' seed	References
Struchium Sparganophora L.	unknown	Grows wild without any human intervention.	Adebooye et al. (2003)
Vernonia amygdalina Del.	unknown	Usually propagated by stem cuttings and seed collected from the wild.	Adebooye et al. (2003)
Abelmoschus callei (L) Moench	600	Farmers' varieties serve as planting material.	Schippers (2000)
Celosia argentea L.	400-700	Few improved varieties available. Farmers' varieties also available.	Schippers (2000), Denton (2004).
Solanecio biafrae	unknown	Farmers' varieties serve as planting material.	Adebooye (2004)
Crassocephalum crepidoides	unknown	Grows in the wild. Few farmers maintain some varieties.	Adebooye et al. (2003)
Celosia cristata L.	300-700	Farmers' varieties serve as planting material.	Okusanya (1980), Denton (2004)
Corchorus olitorius L.	600	Few improved seeds available. Farmers' varieties also available.	Okusanya (1980), Akoroda Akintobi (1983), Oladiran (1986), Onyang (1992)
Hibiscus sabdariffa L.	400-600	Few improved varieties available. Farmers' varieties also available.	Schippers (2000)
Solanum macrocarpon L.	290	Many improved varieties available. Farmers' varieties also serve as planting material.	Bukenya-Ziraba and Bonsu (2004)
Solanum insanum L.	400-500	Farmers' varieties serve as planting material.	Joshua (1978)
Solanum scrabrum Mill	230-250	Farmers' varieties serve as planting material.	Schippers (2000)
Talinum fruitcosum (L) Juss	41-50	Just grows anywhere without human intervention	Adebooye and Opabode (2004)
Telfiairia occidentalis Hook f.	3500	Farmers' varieties serve as planting material.	Adetunji (1997), Schippers (2000), Odiaka and Schippers (2004)

genetic purity of such seeds, and accompanying technology packages associated with harvesting, post-harvest handling and seed vigour testing.

These requirements demand specific types of policy and institutional support structure needed to enhance the development of a seed industry for ILVs. It is also important to overcome the gap in knowledge about production systems and seed yield of many traditional ILVs native to Africa.

METHODS OF SEED COLLECTION

Even in the case of regularly cultivated crops, most African small-scale farmers obtain their seeds for the next cropping season from the remnants of field crops and rarely cultivate plants deliberately to produce seed. Previous studies by Akoroda and Akintobi (1983), among others, have noted this practice. At harvesting of the mature inflorescence, seeds are extracted by crude methods. For example, most farmers extract their own seed of *Corchorus olitorius* L., by beating the dry and mature inflorescence with sticks, followed by winnowing (Akoroda and Akintobi, 1983). This method of processing seed contributes to rapid seed deterioration, adversely affects seed viability and overall seed quality leading to the production of weak seedlings. Also, plants are frequently left in the field for too long, exposing fruits to disease infections. For ILVs such as *C. olitorius*, *Celosia argentea* L., *Amaranthus cruentus* L. and *Abelmoschus callei* L., when fruits are left on the plant for too long, some fully ripe inflorescences will shatter and shed their seeds (Akoroda and Akintobi, 1983; Akoroda, 1988) thereby resulting in wastage. Even though Solanecio biafrae (Olive & Heirne) C. Jeffery is eaten and even offered for sale in southwest Nigeria, it is collected from the wild and reproduced by vines, from generation to generation. There has not been any attempt whatsoever to investigate seed production in this vegetable.

HINDRANCE TO COMMERCIAL ILVS SEED PRODUCTION

Subsistence farmers generally do not take seed production as a sole or major farming activity in southwestern Nigerian because the system and scale of production of ILVs is such that the plants are rarely deliberately cultivated but grow as volunteer crops and in some cases farmers use the carryover seed stock from

previous year for planting. Table 1 shows that majority of the high premium ILVs of southwest Nigeria are still sparingly cultivated using the farmers' varieties, except for *T. occidentalis, C. olitorius* and *C. argentea*, for which few improved varieties have been released for planting. Also, the southwestern Nigeria does not provide large enough market for profitable commercial ILVs seed production, since vegetable farmers easily multiply the ILVs seeds on-farm and as a result have no need to buy seed seasonally. Additionally, the cost of seed production is high (Akoroda and Akintobi, 1983). Notwithstanding these problems, the availability of small-scale profitable ILVs seed production enterprise could stimulate the development and growth of ILVs. Strategic popularization of the ILVs, on the one hand and of home gardening and peri-urban farming on another, based on information about their value as sources of nutrients, could create and sustain good markets for their seeds. Production and multiplication of seeds of different varieties of ILVs will allow farmers and gardeners to choose varieties and species they find most convenient. The overall purpose of ILV seed production activities should be to efficiently produce the best quality seed of improved varieties for farmers and gardeners, and to increase crop production and productivity, per capita farm income and export earnings.

The production and cultivation of ILVs in traditional farming systems, rather than high-input farming systems, would be the most effective strategy through which genetic resources of the species can be conserved (Eyzaguirre, 1995; Iwanaga, 1995; Neuendorf, 1995). The advantage of local seed multiplication is that transportation and packaging costs that constitute bulk of production cost for commercial seed producers are removed (Cromwell, 1994). To facilitate these, agronomic research is needed for developing simple ILVs production technical guidelines for obtaining high quality ILV seeds. The technical guidelines could well serve the advisory and information needs of extension officers, literate farmers and gardeners.

BREEDING AND GENETIC IMPROVEMENT

Genetic improvements leading to the development of improved seed production are key to raising the productivity and promoting the cultivation of ILVs of Africa. To achieve this, breeders must harness naturally occurring variations into development of adapted varieties that combine acceptable attributes (Chweya, 1994). Baidu-Forson et al. (1977) showed how conjoint analysis techniques, based on analysis of data from trait preference surveys, could be used to design modern crop varieties. Similar techniques could readily be applied to design modern ILVs based on trait preference studies. There have been national, regional and international commitments to genetic improvements of ILVs in recent times (Denton and Fajinmi, 1996; Diouf and Guarino, 1997; Kwapata et al., 1997, Adebooye and Opabode, 2004). In Nigeria, genetic improvement of ILVs has been a priority in the research programme of the National Horticultural Research Institute, (NIHORT), Ibadan, Nigeria as well as in some universities' research programmes (Akoroda, 1988; Akoroda, 1986b; Chheda and Fatokun, 1990; Denton and Fajinmi, 1996; Denton, 1997). NIHORT's leading role in research on ILVs and as a gene bank for conservation of ILVs is recognized internationally (Schippers, 2000). For example, breeding of *Abelmoschus esculentum, Corchorus olitorius, Celosia argentea* and *Amaranthus cruentus* have been going on for decades both at horticultural research institutes and some universities in Nigeria and Ghana. Many improved vegetable varieties have been produced for commercial production, although many landraces still exist and are being grown by the local peoples.

At the international level, the United Nations University/Institute for Natural Resources in Africa (UNU-INRA), the International Plant Genetic Resources Institute (IPGRI) and Worldwide Fund for Nature (WWF) are playing active roles in encouraging genetic improvement and conservation of diversity of ILVs in Africa. These organizations give seed money for research to young African scholars who are interested in research on the ILVs of Africa.

Schippers (2000) has listed six steps that should be followed in genetic enhancement of ILVs of Africa:

Extensive collection of germplasm especially from isolated areas and from home gardens.
Screening of the collections with the help of farmers and consumers to identify desirable characteristics. This will be followed by purification of selected materials into varieties and preservation of non-selected as source materials for future breeding research.
Multiplication of seeds of a number of varieties to allow farmers make choices.
Development of new varieties, combining desirable characteristics of many different selections, through crossing.
Agronomic research aimed at identifying and overcoming the major technical constraints facing farmers of indigenous vegetables.
Technical package of guidelines on issues such as nursery, spacing, fertilization, pest and disease control and seed production activities.

CONCLUSION

In a lecture on green and gene revolution as tools for fostering green revolution in Africa, Evenson (2004) noted that yield growth realized to date in Africa has been contributed almost entirely by modern varieties, with little contribution from fertilizer and other inputs. This finding

illustrates the critical role modern seeds play in African agriculture and productivity. No crop cultivar is of value to the farmer unless it is highly productive, meets desired consumer trait requirements, and the seed is available in the right place, at the right time, in adequate quantities and quality at affordable price. Thus, timely multiplication and distribution of improved ILVs is essential if seed is to be used as a vehicle to make science and technology work for poor small scale ILV farmers and contribute towards alleviating poverty and hunger among the rural and urban poor. Officially recognized channels for the multiplication and distribution of improved seed are in place in Nigeria. Public sector seed multiplication and distribution systems are either non-existent or inefficient. Private seed agencies are more efficient and can better service the niche markets. What is required is the development of effective means of improved seed distribution to replace farmer-to farmer seed exchange. To speed up the flow of seed of adapted acceptable improved varieties to farmers, there is a need to form a network between research institutes, public and private seed multiplication agencies, agencies involved in quality control and various nongovernmental organizations interested in various aspects of seed production. This network will identify bottlenecks in the seed production and marketing chain, catalyze or instigate applied and adaptive research and policy changes, which may be required to ensure rapid movement of new cultivars to farmers who need them. This approach will require continued interaction between the various stakeholders.

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