The Potential of Cassava in Optimizing Small-Farm Productivity in Liberia

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ABSTRACT

Cassava is second to rice as the most important food crop in Liberia. Although rice is the staple food, farmers face many problems in achieving high yield and profit. Cassava needs less inputs and investments and gives more yield and economic return, plus its productivity in terms of calories per unit land per unit time is significantly higher than rice and other staple food crops.

Because of the importance of cassava optimizing small-farm productivity in Liberia, a cassava program was initiated at the Central Agricultural Research Institute of the Ministry of Agriculture in 1979 to increase the quantity and to improve the quality of the crop. The program is also motivating the farmers 1) to grow more cassava in their farms, 2) to increase their farm productivity to be self-sufficient in food, and 3) to increase their standard of living. The progress of the program and the importance of cassava and its potential in small-farm productivity in Liberia are discussed in the paper.

Cassava (Manihot esculenta Crantz) is the seventh largest produced staple food in the world (FAO, 1969). It is grown throughout tropical regions and consumed as primary, secondary or supplementary staple. Products from cassava roots, such as industrial starch (including derivatives) and livestock feed, are used increasingly within and outside the tropical belt. World production is about 100 million tons annually from 10 million hectares. Africa produces about 40 million tons from about 5 million hectares (FAO, 1971).

In Liberia, cassava is second to rice as the most important food crop with total annual production of 250,000 tons from an estimated 63,158 hectares of land. It provides Liberia with more than 25% of daily calorie intake. In addition, the leaves supply much needed protein and vitamins in diets of both urban and rural populations.

Cassava has increased in importance as a basal food. One reason is its ability to fill the "hungry gap" especially when rice becomes unavailable. Cassava has been cultivated in Liberia for many years, virtually no attention has been given to improvement of this crop. In view of increasing population demands, high yielding cassava -- even under adverse conditions -- is of major importance. Desirable yield features should encourage the spread of cassava cultivation in Liberia. Future development of cassava in Liberia can significantly contribute to both the economy and improvement of human life and animal production.

Research for Improvement

Realizing the importance and potential of cassava as an energy food during food crises, a cassava improvement program was initiated at the Central Agricultural Research Institute (CARI) of the Ministry of Agriculture in 1979 in close collaboration with the International Institute of Tropical Agricultural (IITA), Ibadan, Nigeria. Recently, financial assistance from the International Development Research Center (IDRC), Ottawa, Canada, has began to operate the program for 3 years.

The program's main objective is to evolve high yielding, good quality, disease and pest resistant/tolerant varieties together with improved cultural practices for high production.

CARI cassava research is at a preliminary stage. However, progress has been made since collaboration with IITA:

Germplasm. Local germplasm materials of cassava were collected nation-wide. Fifty-one accessions were collected and a live germplasm bank established at CARI. Accessions are being evaluated against introduced varieties from IITA. Most local types are disease- and insect- susceptible and have low yield potential. The germplasm bank will be maintained for future plant breeding work.

Varietal improvement. Thousands of cassava genotypes were introduced to CARI from the IITA breeding program for establishment, evaluation and screening. Clonal, preliminary, advanced and uniform yield trials were established with hundreds of high yielding, disease-free cassava clones for selection. This year multi-locational trials were established with three CARI-selected clones at eight locations in three priority counties of Liberia's total of nine counties. Final selection will follow studies under different ecological conditions for adaptation to a wide range of environments before release to farmers. The other six counties will be covered in the future. Results of studies with these three selected clones are in Table 1. Thorough agronomical research (time of planting, time of harvesting for both tuber and leaf, methods of planting, fertilizer use, relations, intercropping) will continually develop sound economical recommendations for farmers in various ecological conditions.

Table 1. Comparison of selected CARI cassava clones against a local check.

Clones	Diseases and Pests CMD	CBB	ANTH	LS	GH	RSM	Yield metric tons/ha	Quality
CARICASS 1	1	1	1	-	0	0	63.7	Excellent
CARICASS 2	1	1	1	-	0	0	51.3	Very good
CARICASS 3	1	1	1	-	0	0	47.3	Good
Local check	4	2	1	+	0	0	20.1	Very good

CMD - cassava mosaic disease; CBB - cassava bacterial blight; ANTH - cassava anthracnose; LS - cercospora leaf spot; GH - grasshoppers; RSM - red spider mite.

Rapid multiplication unit. Establishment of a rapid multiplication unit for cassava has been proposed for CARI. Cassava plants nearing final selection would be multiplied and planting materials distributed to multi-locational trials and to farmers. Each year thousands of cassava genotypes would be introduced to CARI for screening and selection.

Potential Impact

Cassava contributes significantly to the world food supply, being the staple food of about 200 million people in the tropics (Coursey and Haynes, 1970).

Cassava contributes to Liberia's food supply as primary, secondary or supplementary human food, as livestock feed, and as cassava starch or flour incorporated by food industries into products for human consumption.

Cassava's productivity in terms of calories per unit land per unit time is significantly higher than rice and other staple food crops (Vries et al., 1967). Cassava can produce 250 x 10^3 calories/ha/day as compared to 176 x 10^3 for rice, 110 x 10^3 for wheat, 200 x 10^3 for maize, and 114 x 10^3 for sorghum (Coursey and Haynes, 1970). Grain crops subjected to intensive improvement have nearly reached limits of their genetic potential for yield whereas tropical root development is virtually untouched leaving substantial room for improvement (Coursey and Haynes, 1970).

In Liberia cassava can be planted any time. This permits greater flexibility in farmers work schedule. Harvesting may be delayed for several weeks without serious changes in the composition and quality of roots. This flexibility enables farmers to attend the main crop (rice) and use their spare time on cassava. Because cassava roots left in the ground without harvesting for several weeks or months do not spoil, local farmers usually retain cassava plants in the field as security against famine and other unforeseen food shortages.

In some areas of the country a few roots from a single plant are harvested to meet the family's current need while remaining roots are left intact for future use. This admirable suitability of cassava as a subsistence crop is a main reason for its popularity in Liberia.

The comparatively low cost of cassava production is evident in its being one of the cheapest foods in most growing areas. This is attributed to several factors such as low labor requirement, easy cultivation, high productivity, and low investment.

Cassava is valued for at least three outstanding ecological adaptations: drought tolerance, ability to grow in sub-optimal soils, and aggressiveness towards weeds and insect pests. Some cassava varieties grow in regions with as little as 500 mm of annual rainfall; other varieties are adapted to regions with 5,000 mm rain.

Cassava plants need sufficient moisture only in early stages for establishment. Reserves of carbohydrate in the roots enable plants to survive and quickly resume growth when moisture becomes available.

Flexibility of the crop with respect to its moisture needs, enables farmers to raise successful crops of cassava in regions with low annual rainfall inadequate to support cultivation of many cereals. It is considered a safe "risk" crop in areas with erratic rainfall distribution and danger of drought. In some areas, total productivity of land is maximized by raising a crop of cassava after the main rice crop when scanty rain is insufficient for a second cereal crop. This rugged quality of cassava gives it a competitive superiority over cereals and promotes the productive use of agricultural niches presently unsuitable for cereal cultivation (Appan et al., 1970).

It is said that cassava can grow in depleted soils where even many weeds will not grow. However, as in the case of drought tolerance, the eco-physiology of this adaptation has not been adequately investigated. Cassava roots penetrate deeper and tap nutrients from lower soil strata inaccessible to many cultivated annuals (Jones, 1959). Cassava cultivars are capable of growing on soils ranging from a stiff marine clay with a pH of 8 or 9 to sands and loose laterites with a pH of 5 to 5.5 (Rogers, 1965). Ability to grow in sub-optimal soils offers cassava a competitive advantage over other staple food crops. Perhaps this is the most significant aspect in evaluating the importance of this crop in indigenous food production systems.

Cassava does well against weeds if the proper variety is used and adequate soil water and nutrients are available. Within 3 to 4 months after planting, the crop puts up a dense canopy of foliage and weeds are shaded out.

The crop also has potential in food value. It is rich in calories but deficient in protein, fat, and some vitamins and minerals. Cassava roots contain varying concentrations of carbohydrates, lipids, proteins, minerals, vitamins, and water. Their composition is similar to other tropical starchy roots. An estimated average composition of cassava is 60-65% water, 30-35% carbohydrate, 0.2-0.6% ether extract, 1.2% crude protein, and relatively low content of minerals and vitamins (Jones, 1959).

Cassava leaves are high in protein, crude protein ranging from 20.6 to 36% dry weight basis. Seventy-five percent of the crude protein is reportedly true protein and its feeding value is high (Veen, 1938). Cassava leaf protein is as superior as soybean protein (Rogers and Milner, 1963). Possibilities exist of extracting protein from cassava leaves for use as food supplement (Singh, 1964). Fresh cavassa leaves contain appreciable quantities of ascorbic acid, but once picked they lose it fairly rapidly at tropical temperatures. Fresh leaves contain about 352.2 mg/100 gm of ascorbic acid (Raymond et al., 1941). Juice extracted from cooked leaves and vacuum concentrated contain upwards of 2,000 mg ascorbic acid per 100 gm. Leaves also contain carotene, 9746-11136 u/100 gm in fresh leaves and 7172 u/100 gm after cooking. Vitamin A, Vitamin B_1 and Vitamin B_1 are also present in addition to ascorbic acid (Van Veen, 1938).

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