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Evaluation of Macabo Cocoyam Germplasm in Cameroon

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Macabo cocoyam [*Xanthosoma sagittigolium* (L.) Schott], Araceae is an important food crop for more than 400 million people worldwide, especially in the tropics and subtropics. Ethnic groups in Cameroon prepare, process, and consume cocoyams in many forms (Tandehnije 1990). These include: (1) cormels peeled, boiled, and eaten with a vegetable sauce; (2) *ekwan,* a delicacy obtained by tying grated peeled corms (underground stem) or cormels with younger leaves plus some palm oil, fish and crayfish, salt and pepper; (3) *belbach*, a special thick sauce prepared from young tender unopened leaves and tender petioles; (4) *nyeh* bell soup in which the young tender leaves are used as vegetables; (5) *kohki-beans*, cowpea cake prepared by mixing ground cowpea, palm oil, salt and pepper, and young leaves, tying with plantain leaves, and eaten with boiled cormels or plantains; (6) *kohki-corn*, corn cake prepared by mixing ground corn, palm oil, young tender cocoyam leaves, salt and pepper, and tying with plantain leaves; (7) the corms or cormels peeled, boiled, and pounded into futu; (8) cormels transformed into a porridge; and (9) *akwacoco*, a delicacy obtained by grating peeled cormels, mixing with pieces of crayfish, palm oil, salt and pepper, and boiling. In addition, in some locations the large petioles and leaves and some of the roots find widespread use in the local medicinal industry.

For many years, production of macabo cocoyams declined significantly in Cameroon and other cocoyam producing countries, due largely to a root rot disease principally caused by *Pythium myriotylum.* The United States Agency for International Development (USAID) and the Government of the Republic of Cameroon (GRC) funded a Root and Tubers Research Project (ROTREP) in Cameroon with the main objective of developing tolerant/resistant cultivars with acceptable agronomic and sociological characteristics. Assemblage of cocoyam germplasm from different agroecological zones of Cameroon was a major part of the breeding program. Additional accessions were collected from other places like Gabon, Ghana, and Puerto Rico. The root rot disease of macabo cocoyam caused by *Pythium myriotylum* (Steiner 1981; Nzietchueng 1985; Pacumbaba et al. 1992) and dashen mosaic virus (DMV) (Anon. 1991) have been largely responsible for the significant decline of macabo or tannia cocoyam. The crop is widely consumed throughout the tropical regions of the world. In fact, in some places such as the Cameroon, this crop ranks second only to cassava (*Manihot utilisima*) as an important source of energy in daily diets of the people (Lyonga 1980; Onokpise et al. 1992a).

The lack of adequate supply of planting materials associated with the root rot disease is also responsible for the overall low production of cocoyams. Studies on seed production have been undertaken (Alamu 1978; Wilson 1984; Onokpise et al. 1992b), and in vitro plant regeneration of cocoyams have now been demonstrated (Nyochembeng and Garton 1998). Yet the original problems that led to the funding of ROTREP by USAID and GRC, have yet to be resolved. This paper presents preliminary results from several studies whose ultimate objective is the development of cocoyam cultivars with acceptable agronomic and sociological characteristics.

THE GERMPLASM COLLECTION

Between 1986 and 1991, over 300 accessions of cocoyam were assembled from three agroecological zones in Cameroon, from Equatorial Guinea, Gabon, Ghana, Puerto Rico, and Togo, by teams assembled at the Ekona Research Center (Onokpise et al. 1993). Much of this cocoyam population in Cameroon and the rest of the West African Region, are land races of previous introductions especially by the Portuguese. Collections from Puerto Rico were obtained through formal requests sent to scientists working on *X. sagittifolium* in that region. Data was collected on source of planting materials, disease incidence using the Cameroonian National Scoring System(CNSS) (Nzietchueng 1985; Anon. 1991).

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All accessions brought back from the expeditions were initially planted in the project's greenhouse prior to being transplanted to the field. Field evaluation included petiole length, yield, and stand, and disease in incidence evaluated by a scale of 0 (no symptom) to 4 (76–100% yellowing) using Nzietchueng (1985) and Pacumbaba et al. (1992).

Detailed observations have been reported for collections made in Ndian Division of the Southwest Province, in agro-ecological zone I of Cameroon (Onokpise et al. 1993). The high prevalence of root rot disease remains a serious limitation to cocoyam production. Contrary to previously undocumented reports "yellow" cocoyams produced significant amounts of cormels, suggesting resistance to the root rot disease. Cocoyam farmers carried out several cultural practices such as multiple cropping, hill planting, early planting, and early harvesting in order to reduce the disease incidence and its devastating effects on yield. A fungicide, "Ridomil Plus 72," was very effective in controlling the disease, but its cost may be prohibitive to the small scale farmer and the supply is unsteady. A combination of cultural management and fungicidal application could enhance local production until tolerant/resistant cultivars are developed and released by cocoyam breeders. Conventional plant breeding and biotechnology procedures are underway to develop cultivars tolerant or resistant to the disease.

PROTEIN EVALUATION

Tuber protein was determined by the micro-Kjedahl process, and leaf protein involved a block digester method. The LKB horizontal electrophoretic unit and ampholine PAG plates (LKB, Producter, Sweden) were used for electrophoretic characterization. Protein extracts were obtained from fresh cormels by grinding and centrifuging in distilled water and using the supernatant as source of protein extract for electrophoretic identification of accessions. Standard proteins were included in the electrophoretic runs of various accessions. Each electrophoretic run was repeated three to four times. Using the anodic ends of the ampholine PAG plates, isoelectric points were determined and accessions were classified into acidic and alkaline protein types.

Mean tuber proteins in accessions ranged from 2.5% to 9.4%. The mean tuber protein contents were 5.1% (white), 5.2% (yellow), and 5.4% (red) cocoyams. Leaf proteins were significantly higher than tuber proteins and ranged from 11.5% to 25.6% crude protein. Younger leaves had higher protein content than the older ones. Mean protein contents of some of the accessions is shown in Table 1. Crude protein of cocoyam cormels compares favorably with other root and tuber crops such as cassava (1–2%), yams (1.1–2.8%), and sweetpotato (0.95–2.4%), but is lower than taro corms (up to 7%) (Onwueme 1978).

Table 1. Mean protein content (%) of some cocoyam germplasm sources in Cameroon.

Accession	Type	Geographic location of collection	Crude peeled tuber protein (%)
048	Red	Douala, Km 21	7.78a[z]
005	White	Njombe, Km 7	7.20a
XAN 141	Yellow	Njombe	5.01b
037	White	Tombel	4.78b
004	White	Sanje	4.29b
010	White	Bonakanda	4.23b
022	White	Bafia	4.20b
045	Red	Bonaberi	4.14bc
051	Red	Mloboyek	3.85bc
046	Red	Duala Km 10	3.58c
009	White	Upper Bokova	3.55c
041	Red	Yato-17 km to Douala	3.50c
023	White	Banga Bakundu	3.24c
001	White	Bobende	3.18c

[z]Mean separation by Duncan's Multiple range test, 5% level.

The alkaline proteins with isoelectric points of 8.53 and 9.41 corresponded to the standard protein L-lactic-dehydrogenase whose isoelectric points range from 8.30 to 8.55. The acidic proteins with isoelectric points ranging from 4.24 to 4.53, are related to the standard soybean trypsin inhibitor (SBTI), because the banding patterns were found in the region of 1.0 to 1.5 cm, the distance from the anode where the SBTI is usually found during electrofocusing.

FLOWER INDUCTION AND FRUIT FORMATION

Flower induction was initiated by spraying gibberellic acid (GA_3) at 750 ppm, to the cocoyam leaves until the petiole cup was full. More than 700 crosses were made over a five-year period.

Plants flowered 50 to 70 days after GA_3 was applied, and fruits matured in 40 to 60 days. The fruit is dome shape and is made up of a dense cluster of berries. The mean number of berries per fruiting head was 244 while the weight of each head was 16 g. An average of 15 seeds were found in each berry, with 100 seeds weighing 26.6 mg. Thus, a single cocoyam plant producing an average of five inflorescences from which five successful fruits are harvested, can give rise to an average of 20,000 seeds.

Hybridization resulted in the production of more than 10,000 seeds from “white” × “white and “white” × “red” crosses. Virtually no viable seeds were produced from the “white” × “yellow” or “red” × “yellow” crosses perhaps due to ploidy differences.

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