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Research Application Summary

Collection and morphological characterization of cassava landraces in Uganda

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Abstract

On farm conservation by traditional farmers plays a major role in retaining genetic diversity of any crop. Collecting germplasm that had evolved over time on farmers' fields is an important strategy to prevent genetic losses and also to make accessible the genetic resource to breeders and the research community. The aim of this study was to collect cassava landraces from farmers' fields in Eastern, Northern, western, central and southern Uganda and to characterize the collected germplasm using morphological descriptors for ex situ conservation. 200 households were visited and 350 farmer varieties were collected. Morphological data were collected from mature cassava varieties that had been cultivated in the area for the last 20 years and more. During collections, farmers were interviewed using a tool that had been developed to document farmer's knowledge on cassava *in-situ* conservation. 3 root and 11 vegetative descriptors were used for morphological characterization. Data were analyzed based on multivariate analysis and clustering was done with UPGMA method. The results obtained indicated that the collected germplasm fall in 6 morphological groups. No clustering was observed based on agro-ecological zones.

Key words: Conservation, genetic diversity, germplasm, landraces

Résumé

La conservation à la ferme par les agriculteurs traditionnels joue un rôle majeur dans la conservation de la diversité génétique de toute culture. La collecte de matériel génétique dans les champs des agriculteurs, qui a évolué au fil du temps, est une stratégie importante pour prévenir l'érosion génétique et aussi rendre accessible la ressource génétique aux sélectionneurs et la communauté de recherche. Le but de cette étude était de collecter des variétés locales de manioc dans les champs des agriculteurs de l'Est, du Nord, de l'Ouest, du Centre et du Sud de l'Ouganda et de caractériser le matériel génétique ainsi collecté en utilisant des descripteurs morphologiques pour la conservation ex situ. 200 ménages ont été visités et 350 variétés paysannes ont été collectées. Les données morphologiques ont été recueillies à partir des variétés matures de manioc qui avaient été cultivées dans la région depuis 20 ans et plus. Au cours de la collecte, les agriculteurs ont été interrogés à l'aide d'un

outil qui a été mis au point pour documenter les connaissances des agriculteurs sur la conservation in-situ du manioc. Trois descripteurs de racines et 11 descripteurs végétatifs ont été utilisés pour la caractérisation morphologique. Les données ont été analysées en fonction de l'analyse multivariée et le regroupement a été fait avec la méthode UPGMA. Les résultats obtenus indiquent que le matériel génétique collecté appartienne à 6 groupes morphologiques. Aucune classification n'a été observée en relation aux zones agro-écologiques.

Mots clés: Conservation, diversité génétique, matériel génétique, variétés locales

Introduction

Cassava (*Mannihot esculenta* Crantz) is one of the major food crops in the world commonly cultivated in the tropics and subtropics. In Uganda cassava is a staple crop in most areas and also a preferred food security crop by subsistence farmers (FAO, 2011). Cassava can be consumed fresh but for varieties with a high cyanogenic content processing for safe consumption is carried out (OECD 2014). Cassava is known to have low production costs and drought tolerance hence its on-farm conservation is most carried out by farmers who grow and maintain the diversity that exists.

Cassava varieties have got a high level of morphological variability some of which confers adaptability to various agro-ecological zones (OECD 2014). Farmers partly use morphological characteristics and other attributes to distinguish, manage and conserve varieties they grow on farm. Although morphological descriptors might not be very reliable in distinguishing between locally adapted local varieties they do contribute to on-farm selection and conservation (Painting *et al*., 1995). Morphological characterization makes accessible information on the conserved germplasm, for effective use since the value of any conserved germplasm increases as it becomes known and documented (Sudré *et al*., 2010). The aim of this study therefore was to explore cassava germplasm from Uganda and to characterize the collection using morphological descriptors. Understanding the genetic diversity of cassava germplasm will aid its use and management. Morphological characterization will facilitate identification of unique traits that will help in future germplasm improvement.

Methods

Data collection was carried out during a nationwide survey to document farmers' knowledge about old, traditional and unique varieties of cassava. Households were visited randomly or after obtaining information that they possess cassava landraces. For each variety collected morphological data were documented from three cassava plants. Published descriptors from Fukuda *et al.* (2010) were used for data collection. These include; color of fully expanded leaf shape of central lob, color of apical leaves, apical pubescence, petiole color, color of stem exterior, stem epidermis color, stem form, branching habit, shape of plant, flowering, storage root pulp color, storage root surface color, color of outer surface of storage root cortex (Table 1). Mean values were obtained from the three plants characterized for each variety. Cluster Analysis was used to identify groups of objects that are similar (Payne *et*

al., 2011). A dendrogam was obtained by hierarchical cluster analysis using the Euclidean test and group averaging where, the distance between two clusters is calculated as the average distance between all pairs of subjects in the two clusters (Payne *et al*., 2011). Data analysis was conducted using GENSTAT Statistical Software (VSN International, 2011).

Results and discussion

The results obtained indicated that there is variability among cassava varieties grown in Uganda. Petiole color contributed to 14% variability, shape of central lobe 10%, Stem epidermis, and shape of plant, storage root surface color and color of outer surface of storage root cortex contributed to 8% variability. Branching habit and apical pubescence 6%, flowering and stem form 4%, and storage root pulp color contributing to 2%. There was no clustering observed based on agro-ecological zones. All possible phenotypic classes described by Fukuda *et al.* (2010) (Table 1) were observed except for Storage root pulp color where, 2 traits out of 3 were observed. The 14 morphological descriptors used in this study allowed the classification of the 350 farmer varieties into six distinct groups (Fig. 1). The use of molecular markers specifically single-nucleotide polymorphisms (SNP) may allow more detection of differences between genotypes.

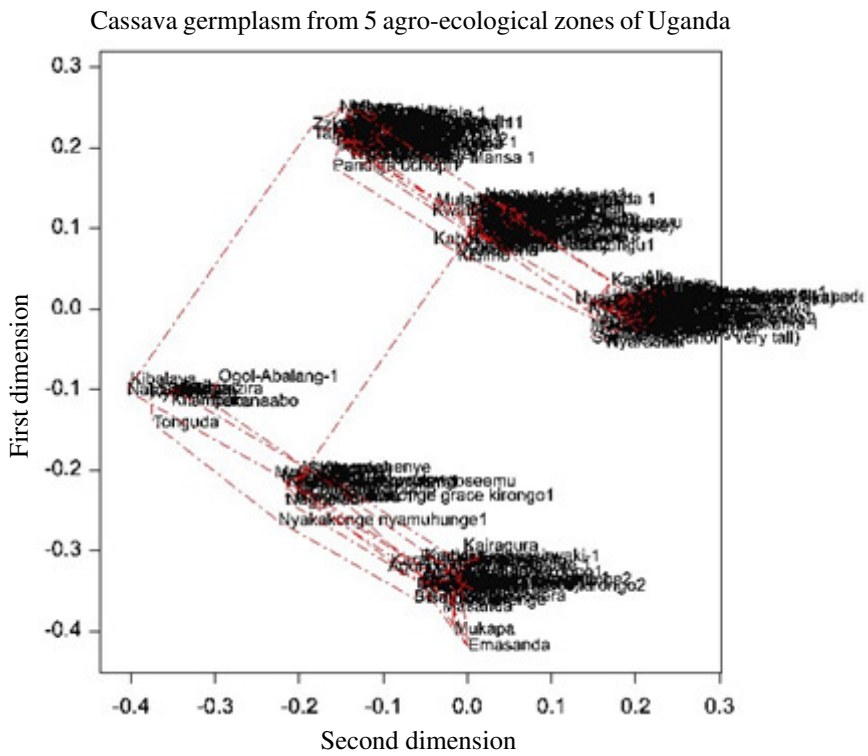

Figure 1. A minimum spanning tree of genetic dissimilarity based on morphological descriptors among 350 farmer varieties collected from Eastern, Northern, Western, Central and Southern Uganda

Table1. Morphological descriptors used to evaluate vegetative parts and roots of cassava collected from Northern, western, central, Eastern and southwestern ecological zones in Uganda

Descriptor	Abbreviation	Phenotypes
Color of fully expanded leaf	CFEL	1=Light green, 2=Dark green, 3=Green-purple, 4=Purple
Shape of central lobe	SCL	1=Oblanceolate, 2=Linear, 3=Elliptic, 4=Pandurate, 5=Lanceolate
Color of apical leaves	CAL	1=Light green, 2=dark green, 3=Purplish 4=green, 5=purple, 6=purplish red
Apical pubescence	AP	1=Sparse, 2=Intermediate, 3=Dense
Petiole color	PC	1=Light green, 2=Dark green, 3=Green with red, 4=Purple, 5=Red, 6=Pink, 7=Purple with green, 8=Purple with red
Color of stem exterior	CSE	1=Silver green, 2=Orange/light brown, 3=Dark brown, 4=Green, 5=Grey, 6=Cream
Stem epidermis color	SEC	1=Orange/light brown, 2=Dark brown, 3=Green, 4=Dark,5=green, 6=Light brown
Stem form	SF	1=Straight, 2=Zigzag
Branching habit	BH	1=Trichomonous, 2=Dichotomous, 3=Erect, 4=Tetrachotomous
Shape of plant	SP	1=Umbrella, 2=Cylindrical, 3=Open, 4=Compact
Flowering	F	1= Absent, 2=Present
Storage root pulp color	SRPC	1=white or cream, 2=Yellow
Storage root surface color	SRSC	1=White 2= Cream, 3=Light brown, 4=Dark brown, 5=Pink
Color of outer surface of storage root cortex	COSSRC	1=White/cream, 2=Yellow, 3=Pink, 4=Purple, 5=Light brown

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