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Research Application Summary

Participatory selection and development of drought tolerant cassava varieties for farmers in marginal areas

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Abstract

Most breeding experiments suffer from the disadvantage that the major stakeholders are not involved in the selection and development of the varieties. This scenario leads to poor adoption and diffusion of the resulting technologies. Participatory plant breeding reduces the chances of developing varieties which, for reasons unknown or overlooked by the breeder, are not acceptable to farmers. Farmers' participation in research and decision making in variety selection enhances adoption. Through participatory variety selection (PVS), farmers also gain skills, information and knowledge about improved varieties. Most previous research in cassava have not involved farmers in the development of the technologies. This research will involve farmers in the participatory selection of farmer preferred cultivars for breeding to improve their Water Use Efficiency (WUE) in drought prone environments of Uganda.

Key words: Drought prone environment, Participatory Variety Selection, Water Use Efficiency, Uganda

Résumé

La plupart d'expériences d'élevage souffrent de l'inconvénient que les principaux intervenants ne sont pas impliqués dans la sélection et le développement des variétés. Ce scénario conduit à une pauvre adoption et diffusion des technologies qui y résultent. La sélection végétale participative réduit les chances de développer des variétés qui, pour des raisons inconnues ou ignorées par le sélectionneur, ne sont pas acceptables pour les agriculteurs. La participation des agriculteurs dans la recherche et la prise de décision dans le choix des variétés améliore l'adoption. Grâce à la sélection variétale participative (PVS), les agriculteurs acquièrent aussi des compétences, des informations et des connaissances sur les variétés améliorées. La plupart des recherches antérieures sur le manioc n'ont pas impliqué les agriculteurs dans le développement des technologies.

Cette recherche permettra de faire participer les agriculteurs à la sélection participative de cultivars préférés des agriculteurs pour l'élevage afin d'améliorer leur économie d'eau potable (WUE) dans des environnements sujettes à la sécheresse.

Mots clés: Environnement sujet à la sécheresse, sélection variétale participative (PVS); économie d'eau potable (WUE)

Background

Cassava is an important food crop for resource poor farmers. However, production of cassava is constrained by many factors including drought stress. As a result of climate change, moisture will likely become increasingly scarce for rain-fed agriculture and consequently, drought stress will become a major environmental factor affecting cassava production. In order to improve cassava yields and avoid losses due to drought stress, breeders should target improved tolerance to water stress.

Breeding for drought tolerance in cassava has been an extremely difficult task due to the high GxE interaction (Cattivelli *et al.*, 2002), the heterozygous nature of the crop, its long growth cycle and poor knowledge of the crop's diversity (Fregene *et al.*, 2001). Molecular breeding through marker assisted selection (MAS) offers a possibility of efficiency and precision in introgression of desired traits and would reduce the generation time.

This research will involve farmers in the participatory selection of farmer preferred cultivars for breeding to improve cassava's water use efficiency (WUE) in water stressed conditions. Candidate genes and metabolic pathways involved in drought tolerance will be identified through functional genomics. This approach will increase our understanding of drought resistance mechanisms and generate markers for strategic improvement of cassava through marker assisted breeding.

Literature Summary

Tolerance to drought is a complex trait and efficiency of phenotypic evaluation for drought improvement is confounded by GxE interaction (Caballos *et al.*, 2004). Currently, molecular breeding in cassava uses genetic linkage mapping by quantitative trait loci (QTL) approach. This has a number of shortcomings in that;

i. it relies on a good genetic linkage map with well saturated or evenly distributed markers;
ii. it involves generating large F_1 population from single crosses; and

iii. the heterozygous nature of cassava makes it difficult to identify parents with good breeding values (Fregene *et al.*, 2001).

An alternative approach to QTL mapping in cassava is to target genes directly through gene expression studies or candidate gene approach (Meuwissen *et al.*, 2001; Hayashi *et al.*, 2004). Such studies have been successfully undertaken in model crop Arabidopsis and genes that respond to drought stress at transcriptional level have been identified (Seki *et al.*, 2002; Shizozaki and Yamaguchi Shinozaki, 2007). Unfortunately, no similar studies on gene expression analysis under drought or drought related stresses have been reported on cassava. In this study, candidate genes associated with drought tolerance in cassava will be identified using Microarray procedure as described by Aharoni and Vasrt (2001).

Study Description

Individual interviews and focus group discussions will be conducted in drought prone cassava growing districts of Uganda (e.g. Katakwi, Kumi, Nakasongola and Buliisa) to identify farmers preferred varieties/cultivars that are considered drought tolerant. Information will also be collected on farmers' indigenous technical knowledge (ITK) on the attributes used to identify/ select germplasm for drought tolerance. The germplasm collected will be evaluated both in the farmers' fields and in a rain-out shades on station at Makerere University Agricultural Research Institute, at Kabanyolo (MUARIK). Genetypes from (I.I.T.A)/CIAT), known to be drought tolerant will be included as checks.

Identification of drought tolerant gene and development of molecular tools for screening cassava germplasm for drought tolerance will be undertaken at Bioscience for East and Central Africa (BeCA) facilities at Nairobi, Kenya. Drought stressed leaf cDNA library will be normalized and constructed from pooled mRNA obtained from the leaf material collected from control treatment (well watered) and stressed plants. RFLP analysis will be used to identify DNA regions of the respective genes of interest in the various treatments.

Research Application

This study will identify candidate genes that will be used to develop drought tolerant cassava varieties.

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