Research Application Summary

Variation in micronutrient content of orange-fleshed sweetpotato varieties grown in different environments

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Abstract

Field experiments were conducted at three locations in Zambia to characterize 15 sweetpotato varieties for tuber yield and micro-nutrient content. Location and variety had significant effect on tuber yield. Marketable yield ranged from 5.22 - 9.69 t/ha with variety Kakamega recording the least yield. AMMI analysis also indicated significant effects of genotype and location for tuber yield. These accounted for 53 and 11% of the differences. The variety x location effect was significant for iron, but not zinc. Varieties Zambezi, K566632, 199062.1 and Mayai had high levels of β-carotene.

Key words: β-carotene, *Ipomoea batatas*, micronutrient malnutrition, Zambia

Résumé

Des expériences sur le terrain ont été conduites à trois endroits en Zambie pour caractériser 15 variétés de patate douce pour le rendement en tubercule. L'endroit et la variété ont eu un effet significatif sur le rendement en tubercule. Le rendement de Markatable s'est étendu de 5.22 à 9.69 t/ha avec la variété Kakamega enregistrant le moindre rendement. L'analyse d'AMMI a également indiqué des effets significatifs de génotype et d'endroit pour le rendement en tubercule. Ceux-ci ont montré 53 et 11% des différences. L'effet d'endroit de la variété X était significatif pour le fer, mais pas le zinc. Les variétés Zambezi, K566632, 199062.1 et Mayai ont eu les niveaux élevés du carotène-β.

Mots clés: Carotène-β, *Ipomoea batatas*, malnutrition du micronutriment, Zambie

Background

Sweetpotato *(Ipomoea batatas)* is one of the most important sources of carbohydrates for small-scale farmers in Zambia and ranks second only to cassava. Promoting orange fleshed sweetpotatoes production and consumption besides providing the carbohydrates, would also supplement diets with essential micronutrients, such as iron and zinc. Unfortunately, appropriate varieties for this type of sweetpotato are not available in Zambia. In order to develop such varieties an initial study was carried out to characterize orange fleshed sweetpotato varieties and determine the yield and genetic variability for micronutrients, as a basis for selection of superior varieties.

Literature Summary

Micronutrient malnutrition affects more than half of the world population, with one third suffering from vitamin and mineral deficiencies (Welch and Graham, 2004; Long *et al.*, 2004; Cichy *et al.*, 2005). Attempts have been made to alleviate micronutrient deficiencies by the use of supplements and food fortification. These strategies unfortunately do not reach all those suffering from deficiency and are not sustainable (Römheld, 1998).

Sweetpotato is an important staple crop in areas in which iron and zinc deficiencies are particularly a problem (Courtney, 2006). It is low in inhibitors (e.g., phytates) and high in promoters (e.g., ascorbic acid), so even a small increase in iron and zinc concentration will pay dividends in the health of the consumers. Sweetpotatoes biofortified with iron and zinc is potentially a powerful tool in the fight against iron and zinc malnutrition. Orange fleshed sweetpotatoes (OFSP) varieties are rich in betacarotene that the body uses to produce vitamin A. According to Kapinga *et al*. (2005), OFSP varieties represent an inexpensive, year-round source of dietary vitamin A to especially poor households in developing countries.

Sweetpotato yields are high per area per unit of time, and yields well even in marginal areas. This makes it an ideal sustainable crop for production in developing countries, where population growth has decreased the amount of arable land per person and increased the use of marginal land for food production (Woolfe, 1992). While yields of sweetpotato are still low in many countries, there is high potential for increasing yield by the introduction of improved clones and more efficient cultivation practices. Moreover, sweetpotato produces two useful foods from the same plant; both the roots and vine tips are used as nutritious food for human and animals (Woolfe, 1992). Presently little is known about the concentration of iron and zinc in sweetpotato. A range of 0.59 ppm to 0.86 ppm (fresh weight) and a level of 0.24 ppm (fresh weight) for iron and zinc, respectively, were given by Woolfe (1992); the USDA gives 0.61 ppm and 0.30 ppm for iron and zinc concentration, respectively (Roboy, 2002).

Study Description

The study was conducted under field conditions in three different locations of Zambia: Mutanda, Kamato and Mansa, during the 2008/09 season. All the three locations are in agroecological region III (Altitude 500-1500 m). Soils in the three locations are all acidic, Mutanda pH 4.5-5.1, Kamato pH 4.5-5.5 and Mansa pH 4.90.

Prior to start of the experiment, fresh soil samples were taken from each experiment from a 20-30 cm depth for characterization. Subsequently, the experiments were laid in a randomized complete block design with three replications at each site. A total of 15 varieties, including 2 local varieties, were used in the experiment. Data were analysed using GenStat computer package and means were separated using the Least Significant Difference (LSD) test at 5% level of significance.

Research Application

The results for marketable yield showed that there were significant differences ($P \leq 0.05$) between locations and varieties. Mansa had mean marketable yield of 5.23 t/ha whereas Mutanda and Kamato averaged 9.69 t/ha and 9.36 t/ha, respectively. Highly significant differences were observed among the sweetpotato varieties: The variety with the lowest marketable yield was Kakamega at 5.23 t/ha.

Non-marketable yield also differed significantly ($P<0.05$) amongst the three locations and amongst the varieties. Interactions were also significant ($P<0.05$). Cultivar Gweri had high non-marketable yield of 3.63 t/ha at Mansa while Kalungwishi had high non-marketable yield of 14.77 t/ha and 5.39 t/ha at Mutanda and Kamato, respectively. There was thus a differential response in non-marketable yield for varieties tested as evidenced by the significant variety x location interactions.

The additive main effects and multiplicative interaction (AMMI) analysis was performed to assess the yield stability of the 15 varieties across the three locations of study. The AMMI analysis of variance for root yield indicated that genotypes and location effects were significant ($P<0.05$) and genotype and locations accounted for 53% and 11% of the treatment sum of squares, respectively.

Harvest index varied significantly ($P<0.05$) between locations**,** varieties and the interactions. Harvest index for location means ranged from 60% at Mansa to 89% at Kamato. Cultivar

199062.1 had a high harvest index (83%) at Mansa while Kalungwishi had a high harvest index of 89% and 97% at Mutanda and Kamato, respectively.

There were significant differences amongst the locations for tuber zinc content while varieties and interactions were significantly different (P<0.05) for iron. Naspot1 and Ukerewe had the highest iron concentration at 11.20 ppm and 8.06 ppm, respectively. Effect of locations, varieties and their interactions for β-carotene and vitamin A concentrations of sweetpotato were significant (P<0.05). Variety Zambezi, K566632, 199062.1 and Mayai produced high mean concentration of β-carotene of 7.82 mg/100g, 7.89 mg/100g, 6.18 mg/100g and 6.52 mg/100g, respectively.

Recommendation

Significant variation in yield was observed with Naspot 1 having the highest yields while Ejumula, Naspot1, Gweri and K135 had wider adaptability across sites. Based on the results obtained, selection for high yielding orange fleshed sweetpotatoes for the varying environments is feasible. However, identification of superior materials in terms of zinc and iron content will require testing larger samples over a number of seasons and preferably over several locations.

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