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Adaptation and stability analysis of sweet potato varieties for low-input systems in Uganda

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Abstract

Sixteen sweet potato varieties were evaluated for fresh storage root yield in 20 trials during 2000–2001 for three seasons in four locations in Uganda. Of the 16 varieties, 11 were developed by farmers and five by a central breeding programme. The behaviour of the varieties was quantified in terms of wide adaptation (genotypic mean across trials), specific adaptation (genotypic predictions for specific locations) and stability (Shukla stability variance). With respect to all three aspects of yield behaviour, farmer varieties performed on average better than the official varieties. The results illustrate the potential that farmer varieties can have in the improvement of sweet potato in Uganda and other regions where high diversity of sweet potato landraces exists.

Key words: *Ipomoea batatas* — farmer varieties — genotype-by-environment interaction — specific adaptation — stability — wide adaptation

Sweet potato is an important low-input crop for many places in sub-Saharan Africa (Ewell and Mutuura 1994, Bashaasha et al. 1995, Kapinga et al. 1995, Tayo 2000). Throughout the region, production of this crop is mainly based on large numbers of landraces (Carey et al. 1998). Many of these varieties have been reported to be relatively low yielding, narrowly adapted, and susceptible to diseases and pests (Bashaasha et al. 1995). For much of sub-Saharan Africa, successful variety selection efforts have relied on the selection of elite varieties from existing farmer's varieties of sweet potato. Examples include the varieties 'Mugande' in Rwanda, 'SPN/O' in Tanzania, Kenya and Uganda, and 'New Kawogo' in Uganda (Ndamage et al. 1992, Mwanga et al. 2001a).

The Ugandan national sweet potato breeding programme develops improved cultivars, and has released selected farmer varieties and bred cultivars following a programme of multilocational and on-farm testing (Mwanga et al. 2001a, 2003). Eleven cultivars have been released by the Ugandan National Agricultural Research Organization to date (Mwanga et al. 2001a, 2003). However, there is continued demand for new varieties to satisfy the needs of farmers for superior varieties with wide adaptation to Ugandan conditions or specific adaptation to certain production regions.

Assessment of wide and specific adaptation and stability play a central role in many breeding programmes. Also, for sweet potato, these concepts seem essential for describing the performance of varieties across environments, as sweet potato has been shown to be very sensitive to environmental changes (Carpena et al. 1982, Janssens 1984; Bacusmo et al. 1988). Wide adaptation is generally ascribed to varieties that do well over large areas. Widely adapted varieties have high mean yields across environments. A variety is said to have specific adaptation if it ranks among the highest yielder at some locations, but not at others. In the definition of Shukla (1972), a stable variety is a variety in which yield varies relatively little around the average yield for that variety, after correction for the average differences that will always exist between environments. Bacusmo et al. (1988) and Manrique and Hermann (2002) employed stability measures in the selection of superior sweet potato varieties for traits such as root yield, total number of roots, β-carotene content and root dry and fresh matter. Manrique and Hermann (2002) reported that none of their high-yielding cultivars had satisfactory stability for total root yield and suggested the need for further study to elucidate the nature of sweet potato root-yield performance in response to varying agro-ecological conditions.

Recent germplasm collections in five districts of north-eastern Uganda identified 188 distinct genotypes (of 206 accessions collected) that were grown by farmers (Abidin and Carey 2001). Of 160 morphologically distinct genotypes, which were investigated in initial on-station trials in 1999/2000, 84 yielded at least 10.6 t/ha (Abidin et al. 2002). Eleven farmer-preferred varieties, of the 84 genotypes with superior yields, were used for further on-farm and multilocation on-station trials. This study was conducted to identify superior cultivars as possible candidates for release and/or parents for hybridization, one of the main sweet potato breeding activities in Uganda (Hakiza et al. 2000, Mwanga et al. 2001b).

The main objective of the present research was to identify the genotypes, which could have wide or specific adaptations in low-input agricultural systems in Uganda. In addition, yield stability was investigated. Because yield is the most important trait our analyses were confined to fresh storage root yield of the genotypes in the study.