Survey and characterisation of sweet potato viruses in South Africa

by

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DECLARATION

I, Mapula Julia Domola, hereby declare that the dissertation/thesis, which I hereby submit for the degree M. Inst Agrar (Plant Protection) at the University of Pretoria, is my own work and has not previously been submitted by me for the degree at this or any other tertiary institution.

M.J. Domola

Dated this 03 day of December 2003.

SUMMARY

Sweet potato (*Ipomoea batatas* Lam.) is a crop which has been used for human consumption in South African rural communities for many years. The crop is widely grown on small-scale, primarily to help ensure the food security and as a cash crop for rural households. The ability of the crop to grow on marginal and degraded soil also adds to its advantages. A baseline survey on production and utilisation of sweet potato by small scale-farmers was conducted during 2001 to 2003 in six provinces of South Africa (Limpopo, Mpumalanga, Eastern Cape, Western Cape, KwaZulu Natal and Northwest). This revealed that farmers mostly harvested enough sweet potato to feed their families but under the small-scale production the yield was very low. During the baseline survey of the current study, sweet potato was ranked the third most important food crop of rural families in South Africa.

Virus diseases have been identified as one of the major constraints to sweet potato production. A survey to determine the incidence of pests and diseases of sweet potatoes grown by small-scale farmers was conducted in seven provinces of South Africa, namely Gauteng, Mpumalanga, Limpopo, KwaZulu Natal, North West, Western and Eastern Cape. Damage caused by insects was found to be more prevalent than any disease in all provinces. Plants showing symptoms of virus diseases were not frequently observed in fields. Representative samples of each province were selected randomly during surveys and cuttings were taken for virus analysis. Samples were indexed to *Ipomoea setosa* Kerr. and serological analysis were carried out aimed at detecting nine viruses, namely sweet potato feathery mottle potyvirus (SPFMV), sweet potato mild mottle ipomovirus (SPMMV), sweet potato latent potyvirus (SPLV), sweet potato chlorotic stunt crinivirus (SPCSV), sweet potato chlorotic fleck potyvirus (SPCFV), sweet potato caulimovirus (SPCaLV), sweet potato mild speckling potyvirus (SPMSV), C-6 virus and cucumber mosaic cucumovirus (CMV). Two other potyviruses, SPV G and SPV II, were later included when the antisera was made available by the Institut für Biochemie und Pflanzenvirologie, Braunschweig, Germany. Three types of enzyme linked immunosorbent assays (ELISA) were conducted: nitrocellulose membrane based enzyme linked immunosorbent assay (NCM-ELISA), triple antibody sandwich ELISA (TAS-ELISA) and double antibody sandwich ELISA (DAS-ELISA), using polyclonal (PAb's) and monoclonal (MAb's) antibodies, kindly supplied by the International

Potato Center (CIP) Lima, Peru and the Institut für Biochemie und Pflanzenvirologie, Braunschweig, Germany. CMV antiserum was obtained from the ARC-Roodeplaat.

Serological analysis showed that viruses are the biggest threat to sweet potato production in South Africa. Nine viruses were identified serologically and approximately 80% of sweet potato cuttings taken from the fields were found to be virus infected. SPFMV was found in 63%, SPMMV in 3% and SPLV in 5% of the samples. Five viruses were found for the first time in South Africa: SPCFV, SPMSV, SPCSV (East and West African strains), SPV II and SPV G. SPV II and SPV G were found in nearly 30% of the samples. Cucumber mosaic virus was found in a single sample. Mixed infections were detected in most samples and only 10% of the samples were infected by a single virus. The effects of virus infection on the yield of nine sweet potato cultivars and advanced breeding lines were studied over two seasons. The plants were infected with two combinations of viruses A) SPFMV, SPV II and SPV G and B) SPFMV, SPMMV, SPV II and SPV G. Healthy plants were infected by grafting to infected cuttings, multiplied and planted randomly in three replicated blocks. Plants from the first trial were kept and planted in the second year to determine the long-term effect of viruses on yield. Average total yield was significantly reduced by between 12 and 22% while the marketable yield was reduced by 21 to 38%. This was mainly caused by the increase in cracking (41-82%). Some cultivars were highly sensitive to virus infection while others showed a degree of tolerance. This study confirmed that cultivars that had been infected for more than one season showed a greater decrease in yield and increase in cracking than newly infected cultivars. This is the first comprehensive study to determine the effect of viruses on sweet potato yield in South Africa.

These findings will contribute to developing programmes aimed at controlling virus diseases that are feasible and more sustainable. It will also be of paramount importance that this valuable information be disseminated among small-scale farmers, so that some of the problems encountered can be minimised.

DEDICATION

I dedicate this work to my grandmother who God has spared to live to see the fruits of her hard work, unending love, sincere moral supports and words of wisdom. To my little girl, Thendo, hoping that this work will be a motivation and inspiration in her future life. Lastly, to my parents and my two siblings Ndivhuho and Happy.

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