

Effectiveness of macropropagation technology in production of disease free banana seedlings in central and eastern Kenya

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Abstract

Banana (*Musa* spp.) is one of the most important food crops that contribute to the food security of the majority small holders in Kenya. However, due to diseases, banana production has not reached its full potential. Fusarium wilt caused by *Fusarium oxysporum* f. sp. *cubense* (Foc); black and yellow sigatoka leaf spot caused by *Mycosphaerella fijiensis* and *Mycosphaerella musicola* respectively, weevils (*Cosmopolites sordidus*) and plant parasitic nematodes have been the major diseases affecting banana seedlings. In addition, banana Xanthomonas wilt (BXW) caused by the bacterium *Xanthomonas vasicola* pv. *musacearum* is a disease that rapidly destroys plantations. Most of these diseases are spread by use of infected planting material. Macropropagation is a cost effective seedling production technology which can be implemented with little capital and skill to provide planting material. The study was carried out to determine the potential of the the technology to produce healthy banana seedlings. From the study, the macropropagation technique has potential for banana seedlings multiplication only if the mother corms were healthy.

Key words: Banana, macropropagation, *Musa* spp., pathogens

Résumé

Le bananier (*Musa* spp.) est l'une des cultures vivrières les plus importantes qui contribuent à la sécurité alimentaire de la majorité des petits agriculteurs au Kenya. Toutefois, à cause des maladies, la production des bananes n'a pas atteint son plein potentiel. La fusariose causée par *Fusarium oxysporum* f. sp. *cubense* (Foc), la tache noire et jaune de sigatoka causée par *Mycosphaerella fijiensis* et *Mycosphaerella musicola* respectivement, les charançons (*Cosmopolites sordidus*) et les nématodes parasites des plantes ont été les principales maladies affectant les semis très jeunes. En outre, le fanage Xanthomonas de la banane (BXW) causé par la bactérie

Xanthomonas vasicola pv. *musacearum* est une maladie qui détruit rapidement les plantations. La plupart de ces maladies se propagent par l'utilisation du matériel de plantation infecté. La macropropagation est une technologie de production des semis à un coût efficace, qui peut être mise en place avec peu de capital et de compétence pour fournir du matériel de plantation. L'étude a été réalisée afin de déterminer le potentiel de la technologie pour produire des semis de bananier sains. D'après l'étude, la technique de macropropagation ne dispose d'un potentiel de multiplication des semis de bananier que si les bulbes-mères étaient sains.

Mots-clés: Banane, macropropagation, *Musa* spp, agents pathogènes.

Background

The banana, *Musa* spp. belongs to the Musaceae family. They originated from South East Asia, a region considered as the primary centre of diversification of the crop and where the earliest domestication occurred (Simmonds, 1962). In East Africa, bananas have evolved into an important zone of secondary genetic diversity for the East African highland bananas (*Musa* EA-AAA) (Smale, 2006). The crop is grown mostly by small scale holders and constitutes a major crop for food, nutrition security and income generation (Wall, 2006). However, commercial cultivation of banana is greatly hindered by biotic and abiotic factors (Seshu Reddy *et al.*, 1998). These include scarcity of high quality seedlings, diseases and pests, lack of agricultural inputs and limited land space for farming. Farmers mostly rely on natural regeneration of existing plants for propagation. These seedlings are likely to carry pests and diseases leading to reduced production. Tissue Culture (TC) is one of the available propagation methods that produce seedlings free from diseases and pests, with genetic purity and uniform growth (Sheela and Ramachandran, 2001). However, adoption of this technology has been low due to high capital investments and subsequent high cost of seedlings. This has led to the plantlets being too expensive for majority of the small holders to acquire. Macropropagation technique can be used as a cost effective method to produce a large number of high quality seedlings. In Kenya, studies have been done to assess the potential and challenges for banana macropropagation as well gauging market response (Mwangi and Muthoni, 2008). However, it has not yet been evaluated whether macropropagation technique can be used to produce seedlings that are free from diseases,

	<p>considering the distribution of pathogens in different localities and the key local varieties that are widely grown by farmers. This study therefore aimed at determining the effectiveness of macropropagation technique to produce disease free banana seedlings in Eastern and Central regions of Kenya.</p>
Study Description	<p>The study was done in Meru Central (1680 Masl), Mitunguu (1071 Masl), Ntharene (1360 Masl), Kerugoya (1340 Masl), Embu East (1265 Masl) and Mathioya (1915 Masl) districts which represent different agroecological zones. Pathogenicity and simulation of corm infection tests were done at Kenyatta University under controlled conditions to assess the efficiency of macropropagation to produce pathogen free banana seedlings. Macropropagation nurseries were set up in the study sites. Selection of corms was done using an established protocol. Pieces from the corms were selected randomly from 10 corms of each variety used for propagation and taken to the laboratory to test for their healthy status. Seedlings that arose from the nurseries were monitored and tested for presence of pathogens.</p>
Research Application	<p>Non-pathogenic endophytes were isolated from 80% of the samples collected from corms used for macropropagation. However, <i>Foc</i> was isolated from only 1% corms. Macropropagation cycle 1 and 2 gave rise to 98% and 100% healthy seedlings, respectively. Simulation of corm infection trials with <i>Foc</i> and BXW showed that macropropagation technique is not capable of eliminating pathogens from corms that are already infected with these pathogens. However, macropropagation technique can be used to produce banana seedlings from corms that were originally healthy. These research findings have been disseminated to agricultural officers and selected farmers within the study area. For the study to have impact, the technology should be disseminated to banana farmers nationwide to improve banana productivity and the life of plantations.</p>
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