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## Banana Improvement Based on Tissue Culture Propagation, Bio-enhancement and Agronomic Management for Sustainable Production

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### Abstract

The propagation of banana using tissue culture techniques has completely changed the banana industry. Firstly, the rapid increase of areas planted with banana in the last two decades has been possible only with this technique. For example, Ecuador, which is now the largest banana exporter in the world, only had 48,000 ha planted with banana in 1985, by 2000, this area had increased to almost 190,000 ha. This increase of 142,000 ha would not have been possible with conventional propagation systems. Secondly, banana producing countries in Central America are severely and regularly affected by hurricanes. Every year, thousands of hectares are destroyed by hurricanes and flooding. Tissue culture techniques allow for these areas to be rapidly replanted. The advantages of using tissue culture plants in comparison to traditional planting materials, such as sucker, bits, or corms are well known: uniformity of a plantation's synchronised ratooning, superior agronomic behaviour and higher production. Furthermore, tissue culture plants are free of nematodes, weevils and some pathogenic fungi, which can be disseminated by suckers. Another breakthrough of this technique is the strong support to the plant-breeding programme. At the present, more than 72 countries benefit from pest and diseases resistant hybrid, and incalculable tons of pesticides have been saved in those countries through the introduction of resistant hybrids. However, this technique does not only have advantages. Somaclonal variation is still a problem. Currently, the majority of commercial tissue culture laboratories have less than 5 % off-type plants, but in some cases, they can reach up to 10 %. Another disadvantage of tissue culture plants is that they are more susceptible to the attack of nematodes, weevils and soil borne pathogens than suckers, as they are produced under sterile conditions in laboratories and are free of beneficial microorganisms that are normally present in field suckers. In order to solve this problem, we are working on the biological enhancement of tissue culture plants with mutualistic endophytic fungi. This involves the inoculation of plants with endophytic fungi that have antagonistic activity towards nematodes and other biotic factors and also a positive effect on plant growth. Currently, we are evaluating these endophytes in five countries in Latin America and we have more than 35 ha planted with inoculated plants. Preliminary results in commercial plantations in Costa Rica indicate that one single inoculation with endophytes has a better nematode control effect than 3 nematicide applications. Studies are being conducted at CATIE, Costa Rica, at IITA, Uganda, and at the University of Bonn, Germany, to elucidate the mechanisms of action of the endophytes.

**Keywords:** Endophytic fungi, nematodes, somaclonal variation, South America