THIRD WORLD BIOTECH

TROPICAL TISSUE CULTURE FOR BETTER BANANAS

MANILA, The Philippines—To many people in developed countries, bananas are nothing more than a fruit used in ice cream desserts or sliced onto cereal for breakfast. But in the tropics—Asia, Africa, Latin America—bananas are more than just good food: They are also the major fruit export. Yet bananas produced for export—mostly on large plantations—constitute only a small percentage of the world's banana crop. In the Philippines, only 20,000 hectares of the more than 300,000 planted with banana are geared toward export production. Thousands of small farmers, whose plots average one hectare, are by far the major suppliers of bananas to the domestic market.

Until now, most research on bananas has been done by and tailored to the needs of the export plantations and not to those of the small farmers. As a result, Philippine plantations yield 40 tons per hectare, while the small farmers manage to produce only about 11 tons.

In 1981, the Canada-based International Development Research Centre (IDRC) decided to fund a major banana research project focusing on the problems and needs of small farmers. Co-sponsored by the Philippine Council for Agriculture and Resource Research and Development, the work is conducted at the University of the Philippines' Los Banos campus (UPLB) and the Bureau of Plant Industry Research Station in Davao, Mindanao.

Research has focused on developing tissue culture methods for storing and propagating bananas. Establishing an *in vitro* germplasm collection at UPLB provides insurance against the destruction that a natural calamity could bring to the *in vivo* (field) germplasm that exists at the Davao station. Moreover, tissue culture yields more plants: Just under 1,000 uniform plantlets can be produced from one banana sucker in about 10 months compared to a single plantlet from the same sucker using conventional propagation methods. This makes tissue culturing cheaper and more convenient for commercial growers.

In addition, tissue-cultured material from a laboratory is more likely to be disease-free than traditional planting material. And tissue culturing can even be used to eliminate disease that may be present in explant material.

Finally, tissue culture represents a boon to international banana research collaboration. The banana sucker or corm (bulb) traditionally used as germ plasm is heavy and often contaminated. This has made scientists reluctant to exchange such material with peers in other countries. Disease-free growing material stored in test tubes would eliminate the risk and much of the expense of such exchanges.

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A young sucker (center), used as the source of explant material for tissue culturing, emerges from the corm of a mature banana tree.

Prior to the research done by Alfinetta Zamora's team at UPLB, no one in the tropics had developed a methodology for tissue culturing banana. UPLB scientists took explant material from the immediate growing point of the plant—located either in the corm or the sucker. They soaked a one-centimeter length of this material for 45 minutes in pure commercial bleach (sodium hypochloride) before cutting it into four pieces—each of which was placed in a flask containing Murashige and Skoog's culture medium, supplemented with coconut water (a growth regulator) and five milligrams per liter of benzyl adenine, which induces shoot growth.

Subculturing took place every 2–3 months. By this time, the saba (a hardy local variety of banana) cultivars had generated about ten shoots. Other varieties, however, fared less well, and averaged only four shoots per flask. Still, this method successfully produced an *in vitro* collection of more than 130 cultivars from the Philippines, Thailand, Malaysia, and Africa. The scientists are expanding the collection to include Latin American varieties, as well.

Because transplanting shoots into fresh medium every 2–3 months raises the risk of variation and the cost of labor, the research team developed a minimum growth protocol to slow down shoot proliferation. The scientists supplemented the shoot medium with 0.01 milligrams per liter of mannitol—a sugar alcohol that counteracts the growth-inducing effects of benzyl adenine. As a result, shoots needed transplantation only every six months. Although this new protocol reduced shoot proliferation and shoot length, it also lowered survival rates. The team is now studying the effect of interspersing a normal growth medium with the minimum growth protocol.

To develop plantlets, shoots are placed in a rooting medium that contains only one milligram per liter of benzyl adenine (higher levels retard rooting). Four weeks later, the plantlets are usually potted out in a coir dust budding mixture made from coconut shavings and hog manure—chosen for their cheap and ready availability in the Philippines.

In field trials, tissue-cultured plants grew faster and flowered as much as 100 days earlier than traditionally propagated plants (which usually flower after 300–400 days). The tissue-cultured plants also produced significantly more suckers (important as sources of new planting material) and bore fruit earlier.

Researchers at the Davao research station have embarked on large-scale field trials of tissue-cultured plantlets. These tests will last three years and involve four varieties and 20,000 to 25,000 plantlets yearly. In addition to determining the field performance of tissue cultured material, the trials will test the feasibility of tissue culturing as a source of planting material for commercial growers. **—Mark Timm**