Beware the potential hazards of tissue culture

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Tissue culture is much talked about as a superior means of propagation with plants guaranteed free from pests and diseases. However, the potential hazards of the technique are not often publicised. Like any method of management, tissue culture has its own set of advantages and disadvantages. These need to be understood so that tissue culture can be used to its best advantage.

Variety mix-ups

This possibility of varietal mix-ups stems largely from the fact that *in vitro* plants of different varieties are not readily identified based on phenotypic characters—the identification number on the jar is what receives the most attention.

Causes of potential mix-ups can include the following:

- Somatic mutations (off types) occurring at the *in vitro* stage.
- Incorrect labelling of *in vitro* plants supplied by the laboratory.
- Mix-ups at deflasking, potting up, or field planting stages.
- Errors in trial plan layouts.

In the early days of tissue culture very high levels of somatic mutations (off-types) caused severe financial hardships to many growers. In Australia, cases of off-type percentages as high as 91% were reported (Daniells and Smith 1993). These days the off-type situation is generally under control as long as multiplication guidelines are adhered to.

The problem of miss-labelling can have serious consequences in situations where the plants are not grown to maturity, in pot experiments for example, making a mockery of research results. Miss-labelling can also result in tissue culture laboratories inadvertently multiplying the wrong variety. Examples exist of major delays in the supply of planting material to growers as a result of such mistakes. This could be particularly serious in a situation where disease resistant varieties are being supplied to stop the spread of diseases. If susceptible varieties slip into the production chain, whole control programmes could be jeopardised.

Susceptibility to pests/diseases

Banana weevil borer

Young tissue-cultured plants in the field are easily damaged by banana weevil borer due to the small growing point and lack of corm reserves. It is necessary to allow sufficient fallow period between crops to prevent carry-over of the pest (6 months minimum) and to pay particular attention to banana weevil borer in nearby blocks.

Burrowing nematodes

Tissue-cultured plants seem to be more readily infested in the field by burrowing nematodes than sucker/bit material. This indicates that the use of clean planting material is only part of the story in controlling nematodes, clean soil is also a necessity.

Figure 1. *Different varieties look more similar at the pot stage - identification depends largely on labelling.*

Figure 2. *Off types such as this dwarf are a regular occurrence with tissue culture. (Tevita Holo MAF, Tonga pictured).*

Fusarium wilt

Studies by Drs. Mike Smith and Ken Pegg of QDPI on Fusarium wilt indicate that tissue culture plants succumb more quickly to the pathogen than plants established from suckers or bits. This may well have been part of the equation leading to huge losses of Cavendish to Fusarium wilt Race 4 in Indonesia some years ago (Buddenhagen 1995).

Virus disease

Studies by French workers (Sarah *et al*. 1990) and observations from Carnarvon, Western Australia indicate that tissue-cultured plants are far more susceptible to infection with cucumber mosaic virus (CMV) than plants derived from suckers/bits. Banana streak virus seems also to infect tissue cultured plants more readily than other forms of planting material (Diekmann and Putter 1996).

Enhanced disease multiplication/dissemination

The "FAO/IPGRI Technical Guidelines for the Safe Movement of *Musa* Germplasm" have been developed in order to prevent the inadvertent spread of pests and diseases with

Figure 3. *QBAN nurseries in Queensland are only accredited if they meet the necessary hygiene standards.*

planting material. However, there are still dangers when planting material is multiplied for local distribution. If the material used for initiation of cultures is infected with virus disease, this can pass unnoticed through tissue culture, with the result that large numbers of infected plants are distributed for planting. Tissue culture thus has the potential to multiply the incidence of virus diseases far more quickly than conventional propagation or vector spread.

Short-cuts at the nursery stage can also result in nematode and Fusarium wilt infection prior to field planting, thus spreading these pathogens to new areas.

Different management requirements

The full potential of tissue culture is often not realized because it is not appreciated that tissue culture plantlets have different field management requirements than conventional planting material.

In Queensland, it has been found necessary to eliminate all suckers in the first 4 months or so after planting otherwise these early suckers attached lower down on the corm lead to a poor first ratoon crop (Daniells and Smith 1994).

It is possible that valuable germplasm has been discarded because of lack of attention to the special requirements of tissue culture plants. For example, Novak's GN - 60 Gy/A (Grande Naine mutant, Novak *et al*. 1990) was apparently discarded by FHIA "because corm formation of the suckers occurred immediately after corm formation of the mother plant, forcing the fruit-bearing plant out of the ground" (Ortiz *et al*. 1995).

What are the solutions?

DNA fingerprinting

Some form of DNA fingerprinting would be of great assistance in checking the identity of plants at an early stage of development. Such techniques need to be made readily available to researchers but it is recognised that cost is likely to be a major constraint.

Expert consultation

Many field trials would benefit greatly from the participation of variety identification experts to confirm the identities of varieties and help sort out mix-ups. Team work can help in this regard.

Improved handling safeguards

Tissue culture laboratories need to ensure that cultures are initiated from virus-free material and must take every precaution to ensure that mix-ups do not occur in the labelling of different varieties.

Figure 4. *Tissue culture has the potential for mass dissemination of virus diseases such as bunchy top pictured.*

Nursery facilities

The correct choice of potting mix, clean irrigation water and proper layout and design of the nursery can help to ensure the health status of tissue culture plants when they reach the field. ■

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