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Cryopreservation of plant species; from protocol development to crop cryobanking

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Classically, plant germplasm is stored through seed at -20°C. Such seed conservation is however not an option for those plant species that are sterile (do not produce viable seeds, like banana), produce only recalcitrant (non-storable) seed (like cocoa) or species for which it is important that specific gene combinations are maintained during propagation (many fruit species such as apple and potato). In such cases, vegetative material needs to be maintained in field or in vitro collections (micro plants grown in test tubes). The ultimate storage method is cryopreservation (or freeze preservation) at ultralow temperatures where biological material is stored in liquid nitrogen (-196°C) or in its vapor phase (-150°C). These temperatures are low enough to arrest all metabolic and physical processes. As such the material can be kept safely for hundreds of years in liquid nitrogen tanks.

Publications on cryopreservation of different plant species are available since the 1980s but the technique was only in a few cases applied to store larger collections. It was only with the development of vitrification based protocols such as droplet vitrification and more recently plate vitrification that cryopreservation is becoming a routine practice in important collections of vegetatively propagated crops like banana, cassava and potato that are stored at the CGIAR (Consultative Group on International Agricultural Research) centres. For example, 905 banana accessions (63% of the in vitro collection) belonging to 30 different genomic banana groups are now safely stored in liquid nitrogen by Bioversity International in Leuven, Belgium.

In this presentation, the state of the art of plant cryopreservation will be presented and the following question will be answered; Is cryopreservation a realistic conservation tool for all crops? Since the development of “generic” cryopreservation protocols are all technical problems solved? How long does it take to develop a suitable cryopreservation protocol for a given plant species?