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Development of an embryo culture manual and an embryo transplantation technique for coconut germplasm movement and seedling production of elite coconut types

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1 Acknowledgments

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2 Executive summary

The replanting of ageing coconut palms in the Asian Pacific region is now a major concern for the producing countries. This replanting will require the collecting and sharing of already existing germplasm between regions or the breeding of new high yielding and locally adapted cultivars. This collection and sharing of coconut germplasm relies on the use of an embryo culture technique which avoids the need to move the bulky fruit and also prevents the transfer of fruit-borne pests and diseases. However, the present embryo culture protocol is inefficient and consequently a new more robust embryo culture protocol is required. This new protocol would also be expected to aid the production of seedlings from the recently identified high value aromatic types and the more well known Kopyor and Makapuno coconut types.

Through ACIAR support, a new embryo culture technique has now been developed for coconut (project HORT/1998/061 - formerly CS/1998/061). The present project aims to produce a manual manuscript about this new technique. A second objective of the present project is to further develop an embryo transplantation technique which may be another way of rapidly producing seedlings of the high value coconut types.

The information generated from the previous ACIAR project (HORT/1998/061 - formerly CS/1998/061) was collected and collated to produce the new embryo culture manual manuscript. This manual manuscript then underwent a series of editing steps to accommodate the views from the partners involved in the original project. The final edited version of the manual manuscript is now available to be published in three different languages (English, Indonesian and Vietnamese) by ACIAR. The manual will find use in many laboratories including those of the Coconut Genetic Network (COGENT) International Coconut Gene banks which are located in the five main coconut-producing regions of the world.

The second part of the present project concerned the improvement of an embryo transplantation technique for the rapid production of seedlings of the high value coconut types. This part of the project took place at the Albay Research Center (ARC) of the Philippines Coconut Authority (PCA) and also involved the provision of some laboratory equipment and staff training at the University of Queensland.

A number of experiments were undertaken at ARC in attempt to improve the previously developed embryo transplantation technique. However, as yet no improvements have resulted in the germination of any of the transplanted nuts. This may relate to the fact that only poor quality fruit were available to do this work. Fruit quality had been significantly reduced by a series of severe typhoons hitting the region during the course of this work. Work is now underway to improve the technique using higher quality fruit.

The main impacts of the project have been for the Filipino project partner (ARC). The capacity of their centre to undertake coconut research has been increased enabling the present work to continue on, with some small amount of national support, after the present project finished. There is now an opportunity for the centre to take the outcomes of the project, particularly those to do with embryo culture, to the next stage of development i.e commercialisation. A pilot study will now need to take place to scale-up the approach, particularly to cater for the high value coconut types such as the aromatic types, Kopyor and Makapuno. At the same time the capacity of the partner country would be significantly improved if a genetic pool of these types of coconut could be established there. The centre could then exhibit to private investors and coconut farmers the commercial potential of the technique. This pilot project would increase the likelihood of the present project (and other previously ACIAR-funded projects) having a higher impact and for that impact to be seen more quickly.

3 Introduction

Coconut (*Cocos nucifera* L.) is the most important palm of the humid tropics. More than 12 million ha of this crop are planted in 90 countries, mainly in Asian Pacific region. The Philippines with 3.2 million ha of coconuts in plantations is the second largest coconut producing country in the world (second to Indonesia, 3.8 million ha). The crop is grown by more than 50 million resource-poor, smallholder farmers world-wide. Coconut is known as 'the tree of life' because of the many items that can be produced from it and their wide use within the local community. In addition to the traditional products of copra, coconut oil and copra meat, coconut has the ability to produce a wide variety of food and environmentally friendly non-food products, which are used domestically or exported. In some Pacific countries, these coconut products are the only source of foreign exchange earnings. Coconut has also been a stabilising factor in the farming systems of marginal and environmentally fragile environments like those found in coastal areas.

Unfortunately, world coconut productivity has been declining for decades and nearly 2/3 of the existing palms are now past their prime and need to be replaced with new, high yielding, locally adapted varieties. This requires a series of high quality breeding programs and these rely upon the availability of appropriate germplasm. At the moment the collecting and movement of coconut germplasm is undertaken using an embryo culture technique as transporting the bulky fruit is impractical and phytosanitary unsafe.

The success of the present embryo culture technique for a range of coconut types, is considered to be unreliable and therefore a new protocol has been developed (ACIAR-funded project - HORT/1998/061) with input from Australia, Indonesia, the Philippines, PNG and Vietnam. This new protocol is more efficient in its ability to produce robust plantlets, which survive planting in soil to give a high percentage of plants established. This new protocol is also applicable to the production of seedlings of the elite coconut types (viz Makapuno, Kopyor and Aromatic), which have a high economic value. However, to date, this new protocol has not been made widely available to all coconut producing countries.

Another important outcome of the earlier project (ACIAR-funded project - HORT/1998/061) was the pioneering work undertaken on embryo transplantation. With such a technique it is now possible to insert into surrogate nuts isolated embryos and nurture them into healthy seedlings. The success rate of such an approach when first developed in Brisbane, however, was low. This was put down to the fact that only poor quality supermarket fruits were available and better results would come if freshly harvested fruit in the producing country were used. Once up and running this new technique could serve as an alternative plant establishment technique to that of embryo culture, which is often tedious and expensive to undertake.