Tropical Tree Crops and Current Research at the Department of Primary Industries, North Queensland©

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INTRODUCTION

The Centre for Wet Tropics Agriculture (CWTA) is located on the Wet Tropical Coast of north-eastern Queensland, approximately 100 km south of Cairns, 60 km north of Tully, and 100 km southeast of Atherton. Climate is wet and tropical, and is one of the dominant driving forces, with an annual rainfall of between 2000 and 4000 mm. The research station has had a long history of service to agriculture, being originally established by the Bureau of Sugar Experimental Stations (BSES) in 1917 for research on sugar.

In 1935, the station became the Bureau of Tropical Agriculture to investigate a range of field and horticultural crops, including soybean, sunflower, tea, rice, maize, sweet potato, jute, and kenaf. Tropical pasture research and species evaluation dominated from the post-war period until 1975 when the first banana research got under way.

Following surrender of the cane assignment in the 1980s, banana research intensified and began the expansion of tropical fruits in the station. Land resources assessment, soil erosion research, and extension became an integral part of the activities.

The CWTA was established in 1995, initially bringing local Department of Primary Industries (DPI) services together in the one facility. Today, the facility accommodates the Departments of Primary Industries and Natural Resources.

Banana and papaya are the major tree fruits under considerable research, with increasing effort into rambutan, mangosteen, and durian research. Cacao research has recently been initiated.

RESEARCH AND DEVELOPMENT

Banana (*Musa* spp). The banana industry worth $240 M per annum is the main horticultural crop grown in the wet tropical coast, with 530 growers on 8460 hectares for the 1999 production period. While agronomic considerations are important, the industry is developing the use of integrated pest management (IPM) by using best management options to manage banana diseases such as yellow Sigatoka, burrowing nematode and insect pests such as banana scab moth, rust thrips, and banana weevil borer. The banana grower benefits from IPM by becoming more aware of the pathogen and pest pressures impacting on their industry and can then target the specific pest or pathogen in an economic way.

The IPM strategies have greater community impact, by reducing the pesticide use by targeting only the damaging pests or pathogens, allowing beneficial organisms to help produce a cleaner, environmentally friendly fruit with high quality market standards.

Banana is largely propagated using “bits”, which are pieces of the corm or underground stem. Between 95% to 98% of the industry utilise this method of

propagation, with the remaining 2% to 5% using tissue-cultured (TC) planting material. Under correct management conditions, TC plantlets can be extremely productive due to the advantages of crop uniformity. Plantlets grown under QBAN accreditation are free of major diseases and pests.

However, bits remain the preferred form of propagation mainly because of cost considerations. TC plantlets cost approximately $2.20 compared to $1.20 for fully prepared (dug, cut, and cleaned) bits. The use of TC plants requires a high degree of planning because plantlets need to be ordered at least 12 to 18 months prior to delivery.

Papaya or Papaw (*Carica papaya*). The papaya industry is valued at $12 million, with the main research areas in breeding and insect pest and disease management. Much effort was put into irrigation and nutrition management in the immediate past.

Seed is the main method used to propagate new papaya or papaw plants. It is relatively quick and straightforward, but because the genetic make-up of seedlings is dependent on the parent plant there can be variation. Where it is important that the new plants are genetically identical to the parent plant vegetative means of propagation including tissue culture are used.

Micropropagation or tissue culture is a technique whereby short nodal sections of stem are placed on artificial growing media and induced to form roots and shoots. Young plantlets are placed on special media in flasks and are grown in a laboratory until large enough for either transplanting or further multiplication. The technique requires a properly designed tissue culture facility for the propagation stages and a high humidity growth chamber for the hardening off of plants once they are removed from the flasks.

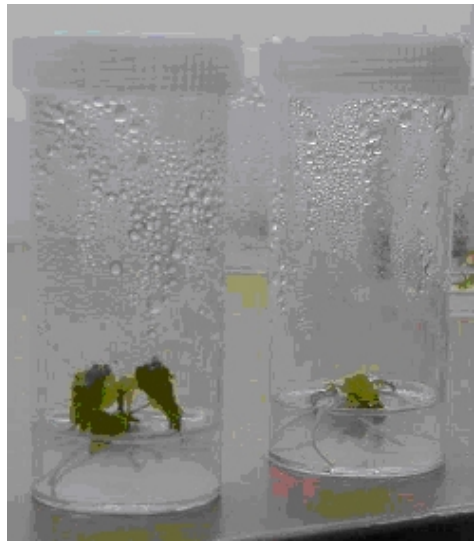

Figure 1. Tissue-cultured papaya plantlets.

This technique requires specialist equipment and skills. There is also a limit in the number of plants that can be multiplied up at any one time with the cutting technique. Furthermore, there is the long time period required for micropropagation techniques. You must be certain of your variety if using this method.

Micropropagation of papaw has not yet been commercialised in Australia and material for existing plantings has been sourced from research facilities. Advantages of micropropagated material include the following:

- All plants derived from the same stock are identical.
- Sex of plant can be selected before planting allowing exact allocation of male plants of dioecious lines or elimination of female plants of bisexual or gynodioecious papayas.
- Ability to multiply up large numbers of identical plants.
- Lower and earlier fruit set.

Figure 2. Papaya plant from cutting method.

The most important points to consider are correct temperatures and prevention of diseases with the cutting technique. Sideshoots from a source plant are propagated in a special cutting propagation house. Papayas have been successfully propagated in South Africa and in south-east Queensland.

Some papaws produce many sideshoots without special treatment. Cutting off the top of the tree can encourage these sideshoots to grow whereas other cultivars may need to be induced to produce sideshoots. The design of your propagation facility will depend on the number of cuttings you plan to propagate.

Rambutan (*Nephelium lappaceum*). Rambutan is a close relative of lychee. The attractive red fruit covered with soft red/green spines is native to Malaysia and Indonesia. Trees have been grown in Australia for the last 20 years and fruits are now more commonly found in our market place. There are 24,000 trees from Daintree to Tully and the industry is valued at $4million. Fruit production in north Queensland occurs from January to April depending on growing location.

The major research and development (R&D) project with rambutans involves an investigation of commercial nutrition and irrigation management. This is a cooperative project with industry and involves the monitoring of leaf and soil levels and nutrient inputs. The project aims to relate nutrition to productivity.

Rambutan propagation is considered to be difficult and is currently limited to one or two commercial propagators. Trees can be approach grafted, however, this is a time-consuming and inefficient form of propagation. The Malaysians developed the modified Forkert bud graft or patch-bud technique. This has proved difficult and beyond the scope of most small-scale-grower propagators. The high cost of planting material has the potential to limit industry expansion.

A small project is under way to investigate rambutan propagation techniques. The project will assess the effects of age of stock and budwood and pre-preparation of budwood as well as graft type (wedge vs. modified forkert).

Mangosteen (*Garcinia mangostana*). Mangosteens are commonly referred to as the “queen of tropical fruits”. Regular visitors to South East Asia will be familiar with this beautiful fruit which varies in size from 80 to 120 g and has delicate white “citrus like” aril surrounded by a hard purple pericarp.

Figure 3. High humidity propagation shelter for assessing different methods of propagation in rambutan.

There are 13,500 trees in north Queensland and the industry is valued at $0.5 million. The industry is expected to rapidly increase in value as trees planted in the last 10 years near fruiting maturity.

The apomictic nature of fruit set means that there are no recognised varieties of mangosteen and hence all production is based on seedling trees. There are a number of important issues which face the industry. The most important of these include the long juvenile period (6 to 8 years), nutrition and irrigation requirements, and fruit quality.

Durian (*Durio zibethinus*). The durian is known as the "king of tropical fruits" and is also found throughout SE Asia although it originated in Indonesia, Peninsula Malaysia, and Borneo. The north Queensland industry consists of approximately 4000 trees valued at $0.2 million/annum.

Current durian R & D includes an Australian Centre for Agricultural Research (ACIAR) project, Management of *Phytophthora* diseases in durian. The project is headed by Melbourne University and involves DPI staff at CWTA and the Northern Territory Department of Primary Industry and Fisheries; Kasetsart University; Thailand; and the Southern Fruit Research Centre, Vietnam.

The principal aims of the project are to study host pathogen environment interactions and epidemiology, develop integrated disease management options for nurseries, orchards, and post-harvest handling and, to demonstrate these options to growers.

Durian is predominantly propagated by approach graft or patch graft and the latter method is reasonably specialised and only successfully carried out by a few

Figure 4. Wedge grafting in durian.

nurseries. At the CWTA we are investigating propagation of durian utilising marcotting. This is not considered a commercially viable method of propagation but is being carried out as a specific requirement of the ACIAR project.

The success rate is generally low (10%) and our investigations at CWTA suggest that a combination of gibberellic acid, 6-benzylamino purine, and naphthalene acetic acid, 500 mg litre^{-1} in lanolin paste applied to the wound prior to bagging with peat will lift the rooting percentage to 70% on the parent tree.

Figure 5. Durian marcott.

Cacao (*Theobroma cacao*). Cocoa is a tropical commodity crop grown principally in low labour cost countries. Increasing demand for cocoa-derived products from Eastern Europe and China combined with falling or stagnant production from traditional growing areas may lead to production shortfalls.

The potential for cocoa in northern Australia has been reviewed as early as 1960. Limited trial work in north Queensland and Northern Territory has demonstrated that promising yields are possible. With irrigation, substantial areas across northern Australia may be well suited to cocoa growing. This includes the coastal area north from Mission Beach to Cape Tribulation in Queensland and significant areas above 16^{o}S in Queensland, Northern territory, and Western Australia.

The cocoa project is being commercially driven by Cadbury Schweppes. It is a feasibility study to investigate potential for commercial cocoa production in northern Australia. Other major partners are Rural Industry Research and Development Corporation, Queensland Department of Primary Industries, Northern Territory Department of Primary Industries and Fisheries, and Agriculture Western Australia.

Stage one of the project is focusing on yield evaluation and quality testing of selected commercial hybrids. The trials are conducted on half to one-hectare plots. Planting layouts and densities, and canopy management are also considered. The second part of the project aims to develop alternative farming systems while another part looks at introducing clonal material for multi-site evaluation.