aggregates are not as efficient as naturally occurring creek bed sands, probably because the man-made sands do not drain as readily.

(i) The selection of the most desirable plant material is necessary; weak or inferior wood affects the rooting percentage quite dramatically.

(j) The inclusion of any soluble material in the irrigation water appears to increase the problems encountered. However, we do include sulphuric acid (98%) at a rate of 25 ppm and polyphosphate 918 at 3 ppm, in the irrigation water to adjust to a pH of approximately 6.5 and to help in the cleaning of the leaves.

All materials that are added to the irrigation water appear to increase the total solids. Therefore we try to apply fertilisers, insecticides, fungicides etc. through the roots as they are less succeptible to damage than leaves. We try to avoid any form of liquid foliage feeding during extremely hot, dry periods. Should foliage feeding become necessary we use weak concentrations of fertilisers and apply them in the evenings on dull days. We water heavily and frequently to prevent the soils drying out but they must drain well.

Cuttings propagated with this inferior water take longer to strike (up to twice as long), the percentage of take is poorer, and the resultant growth slower than those propagated with demineralised water.

POTENTIAL FOR HORTICULTURAL DEVELOPMENT IN THE NORTHERN TERRITORY OF AUSTRALIA

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It is now 150 years since the first documented evidence of incipient horticultural activity in the Northern Territory and, in that time, it has suffered from the vagaries of numerous officials. Horticultural activities have been dampened by a lack of sympathetic government action and a severe lack of technical knowledge of suitable crops.

During the past 12 years, I have become more and more aware of the tropical fruits and their potential in the Northern Territory. With the advent of drip irrigation and a better understanding of tropical techniques (instead of "modifying" southern Australian techniques) even those plants condemned for

having origins in wet zone tropics become distinct probabilities for local cultivation.

Table 1 lists some 40 species encompassing almost 200 fruit cultivars currently growing in Darwin. Most of these have been either introduced, or reintroduced, by the author and his associates in the past 6 years.

Obviously enough, the selection of seeds or propagating material is of prime importance. There are many fruit cultivars growing in the area that are not representative of the species and which do not realise anywhere near the full potential of that species. However I feel that if a cultivar — even a very inferior one, will grow successfully here and crop, no matter how indifferently, then that species should be made subject to as wide a testing as possible, utilising as many clonal sources as are available.

The Litchee (*Litchi chinensis*, syn.: *Nephelium litchee*) and longan (*Euphoria longan, syn.: Nephelium longana*) fruits are two such examples. With litchee several seedling trees of unknown origin have borne fruit of a sort but only after cold, harsh, dry seasons. Marcotts, on the other hand, of the cultivar Kwai Mee, have cropped reasonably well, if inconsistantly, with good sized, well filled fruit in as little as 18 months from establishment. Longan, taking even longer than litchee to bear from seed, is recorded as fruiting, but fruits are almost inedible, with large seed and thin flesh. To my knowledge no clonal material from areas similar to our own has ever been introduced.

The guava (*Psidium guajava*) is well known throughout the tropics. However the usual type is too rank in flavour and aroma, and has too many hard seeds to be a really popular fruit with most Europeans. We have made two distinctly different selections. The first we called "green apple guava", in allusion to the size, shape, colour and vaguely the flavour, all of which resemble the 'Granny Smith' apple. The original plants came from the seed of one fruit, found at Toa-Payoh in Singapore. Seedling variation exists, and we are now producing marcotts of a superior form, named 'Green Jade'. The basic selection has a large (6 to 9cm) round to slightly ovoid fruit, a thin skin and relatively few seeds. The fruit is exceptionally well fleshed and seeds are confined to a small core area. The fruit is palatable when fully formed but green, when the flesh is crisp and apple-like in texture. More conventionally, the fruit is eaten when the skin changes colour to a pale lemon yellow. At this stage the flesh is succulent and very juicy. Although still apple-like in flavour, when dead-ripe a faint, typically "guava" flavour does come through. Fruiting is prompt. Seedlings can begin cropping in as little as 10 to 12 months and, of course,

cuttings and marcotts are correspondingly faster. Four or five flowerings with fruit set are common and our best tree (as far as flowering goes) is seldom without crop all year round.

'Green Jade', our select clone, has much larger fruit than the selection, but produces fewer at each flowering. The fruit does not change colour when ripe (except during the cold, dry season crops in June and July) when a faint colour change is observed. In addition to the large size, the skin is heavily warted and deep emerald green — both features making it an interesting table fruit. The flesh is firm, even when ripe, yet it is every bit as lucious and juicy as fruit from seedling-grown plants of the green apple selection.

Plant size for both the selection and the select cultivar is similar. In all cases, a compact, round crowned tree has developed with thick; blunt ended leaves. The plant is evergreen, or barely deciduous, unlike the species, which has a pronounced leafless period under our conditions. Growth rate is rapid, and mature size (2 to 2.5m usually, and under exceptionally good conditions to 3m) is reached within 12 months.

The other chosen selection of *Psidium guajava* we call "pear guava" — again a reference to the fruit form. This selection is also at odds with the species, but to date no clonal selection has been made. Fruiting occurs in 12 to 18 months from seed and the fruit resembles a large, very juicy 'Packham' pear. It is virtually seedless with as little as 10 seeds or as many as 30 seeds per fruit (the species has hundreds). Ripe fruit colour is a good bright yellow and flesh is creamy white. It is juicier than the green apple selection and larger again. Being pear-shaped the fruit length is in the order of 10 to 12cm. with a base diameter of 6 to 8cm. To date there has been only 2 fruitings per year but this may improve as the plants age.

Instead of the dense, round crown of the green apple selection, or the straggly "no shape" of the species, the pear guava is a tall upright, poplar-like plant. To date, our few (5) specimens have reached 3m and show no sign of slowing down in growth.

With the rising popularity of guava for juice, and to a lesser extent, for canning and in jam making, these two selections and their selected cultivars will create an industry in their own right.

Another species fruiting for the first time since introduction 18 months ago is the bilimbi (*Averrhoa bilimbi*). This fruit is incredibly sour, yet after the initial shock, is very tasty. The aftertaste is reminiscent of the Chinese gooseberry, or Kiwi fruit (*Actinidia chinensis*). The fruit resembles small translucent yellowish-green gerkhins, and are almost all juice. In Sarawak and Malasia they are used in cooking fish, and in some areas

the ripe fruit is added to drinks. I find it an excellent alternative to lime juice. Under our conditions fruiting is continuous and plentiful, even on young plants only 1m high. The plant is evergreen and compact and a very attractive addition to the garden.

Buah kedongdong (*Spondias cytherea*) is fruiting for the first time in Darwin since its introduction just over 2 years ago and, if current indications are correct, crop yields are going to equal, or better those in Asia. Like bilimbi, no active selection has been made, but I feel sure that enormous potential exists for a horticulturist to visit all the fruit growing areas in search of good clones.

One of our more outstanding successes was the jambu ayer, the so-called water apple, *Eugenia aquea*. After sampling the fruit in Java, I was of two minds as to the worth of introducing the species. Fruits were brightly coloured, to be sure, but had no real flavour or, at best, a vague resin-like taste and were very dry textured. I did eventually collect seeds, some from a Denpassar market in Bali and also some from a vendor at Borobodur in Java.

The subsequent plants were not really looked after for as far as I was concerned it was "just" a fruit. Imagine our surprise then, 11 months later, when one tree began cropping. And what a crop! A tree only 1.5m high and every branch had to be propped to prevent breakage under the weight of fruit! The ripe fruit were large for the species, about 4 to 5cm across the base and 3 to 4cm long. They were pear shaped, with a hollow at the base formed by the thickened remains of the sepals. Skin colour is a glossy, brilliant lacquer red, flesh is crisp, juicy, and glistening white. The flavour changes with the season and dry season crops do have the better flavour. In any case, the fruit is far superior to anything I tasted (or have tasted since) in Asia. We describe this jambu as a "kids fruit". The colour is so enticing and the fruit is borne almost continuously, so that it becomes a perfect home garden plant. I doubt if the fruit will keep or carry well so its use may well be limited to home garden and local market distribution. To date all fruit examined (many thousands) have been seedless. Obviously this plant should be the subject of further examination.

The Barbados cherry (*Malpighia glabra*) is another species that has performed extremely well under Darwin conditions, with the dry season flowering giving very large crops of exceptionally fine flavoured fruit. After examination of the many cultivars of this species in the Philippines, however I am convinced that it could become a major plantation fruit in the Northern Territory, where conditions are obviously so good for

growth. Irregular cropping takes place all year round, but the main crop (with all fruit ripening virtually at the one time) does occur from March to June. Interestingly enough, although the seeds are large and well formed, none have ever germinated for us. Unfortunately lack of time has prevented us from researching this phenomenon.

There are other species growing well which give promise of great things to come but have not yet given assessable crops. These include Nanche (*Byrsonema crassifolia*) which fruits exceptionally well in the Kununurra region of Western Australia, the jambolana plum (*Syzigium cumini, syn.: Eugenia jambolana*) and the Bangkok santol (*Sandoricum koetjape*). Nanche is fruiting for the first time in Darwin following its introduction 12 months ago from the Kimberley Research Station, and I am indebted to Allan Skeats for the seed. The present indications are that it will be a worthwhile plant — certainly in flower it is an asset to any garden.

Jambolana plum has shown enormous potential for a shade tree. Growth is dense and rapid and our test plants at age 11 months are already 4.5m high with a similar spread. Some confusion exists as to whether this species is synonymous with *Syzigium cumini*. However I have seen and tasted both, and think the differences are too great for mere varietal variation. The former has large (egg-sized or larger) sweet, juicy fruit in Southern India, where I obtained the seed. The seed source for the latter was from a tall tree; the fruit resembled a peanut pod, (only slightly larger) and the flavour was inferior and sour. To avoid confusion, in our area at least, where both types are available we have utilised the two specific names.

Bangkok santol is a selected clone of *Sandoricum koetjape* (syn. *Sandoricum indicum*). The fruit is 3 to 4 times larger than that of the species and the outer rind is often 1 to 1.5 cm thick. The fruit is in two parts, each complementing the other, and is best eaten in cross-section, so both parts can be taken together. There is a tough yellow skin that is removed before eating, then a pithy, cream coloured rind, that turns pinkish after exposure to the air. This pith has a piercing sour flavour that really sets the palate tingling. The inner, segmented pulp is a translucent grey-white and is almost too sweet, thus off-setting the sourness of the outer portion of the fruit.

The species is extremely variable from seed and obviously any clonal selection must be made by marcott or grafting. Marcotts take easily and are ready for separation in 6 to 8 weeks. To my knowledge, my plant is the only select clone of this species in the Northern Territory and at the time of writing has not yet fruited. Age is just under 4 years and tree height about 5m. The

tree colours up during the dry season and old leaves turn a brilliant liquidamber red before falling. New leaves appear as the old ones fall so the species could be nominally called "evergreen".

In conclusion of this brief list of species I should like to mention the 5 corner or star apple, *Averrhoa carambola*. Seedling variations abound in Darwin and but little selection has occured. There are at least 2 variations of the so-called cultivar 'Siam White' that I know of. Here the fruit is up to 10 times larger than that of the species plants, far less acid in taste and, at maturity, has a creamy-white flesh rather than green or yellow as is more common.

Like its cousin, bilimbi, this fruit needs to be recognised. It travels well, can be ripened after green picking and has a long shelf life. Furthermore, it can be propagated by marcotts (slow, 3 to 4 months) and be in crop in as little as 12 months after establishment.

The scope for the establishment of an exotic fruit industry in the top end of the Northern Territory is enormous. In these days of back loading air freight we are only hours away from enormous markets and freight costs are well within normal consideration.

The greatest problems standing in the way are:

(1) lack of knowledge of the various species and their performance under our conditions, and

(2) lack of suitable, tested clonal material at any price.

We are trying to alleviate problem (1) by active distribution of all new plants as we obtain them. This is not done through official organisations, but rather a loose collective of interested amateurs. While this means that information received may not be 100% accurate it, at least, provides indications of performance under a wide variety of conditions.

Problem (2) is more difficult — while our organisation spends literally thousands of dollars each year in searching out and purchasing new seed we are virtually restricted to seed introduction.

Plant quarantine is strict and it seems that the officers of the department are dedicated to the premise that no plant shall come in alive. I acknowledge the vital necessity of screening and treating incoming plants, but I disagree totally with the techniques currently in use. Few plants, and particularly the exotic fruits, seem able to tolerate methyl bromide fumigation. Until this is changed the introduction of select clonal material from overseas sources remains an expensive and time wasting process.

Table 1. Fruit species currently growing in Darwin, Northern Territory, Australia

Aegle marmelos
Anacardium occidentale
Annona cherimola
Annona glabra
Annona muricata
Annona reticulata
Annona squamosa
Artocarpus heterophyllus
Artocarpus altilis (syn.: *A. incisus*)
Artocarpus integer (syn.: *A.chempeden*)
Averrhoa bilimbi
Averrhoa carambola
Blighia sapida
Borassus flabellifer
Byrsonima crassifolia
Carica papaya
Chrysophyllum cainito
Citrus aurantium
Citrus limon
Citrus maxima (syn.: *C grandis*)
Citrus × *paradisi*
Citrus reticulata
Citrus sinensis
Clausena lansium (syn.: *C wampi*)
Cocos nucifera
Coffea arabica
Coffea liberica
Diospyros discolor
Durio zibethinus
Eugenia aquea
Eugenia grasiliensis (syn.: *E dombeyii*)
Eugenia suborbicularis
Eugenia tierniana
Eugenia uniflora
Euphoria longan (syn.: *Nephelium longan*)
Ficus carica
Garcinia livingstonei
Garcinia mangostana
Garcinia xanthochymus
Litchi chinensis (syn.: *Nephelium litchii*)
Malpighia glabra
Mangifera indica
Manilkara zapota (syn.: *Achras zapota*)
Mimusops brownii
Mimusops elengii
Morus alba
Morus nigra
Murraya koenigii
Musa spp. (several)
Nephelium lappacium
Passiflora edulis (var. flavicarpa)
Passiflora laurifolia
Passiflora quadrangularis
Passiflora seemanii
Persea americana
Phyllanthus acidus
Pithecellobium dulce
Pouteria campechiana
Psidium guajava
Punica granatum
Salacca edulis
Salacca walachiana
Sandorium koetjape
Schleichera oleosa
Solarium hyphorodicum
Spondias cythera
Syzygium cumini (syn.: *Eugenia cumini, E. jambolana*)
Syzygium jambos (syn.: *Eugenia jambos*)
Syzygium malaccensis (syn.: *Eugenia malaccensis*)
Terminalia catappa
Terminalia okari
Ziziphus mauritiana