



## INTERNATIONAL SOCIETY FOR HORTICULTURAL SCIENCE

### Section Tropical and Subtropical Fruits

#### Newsletter No 12 January 2015

Dear Colleagues,

We wish you all a Happy, Healthy and Prosperous New Year 2015

You may be aware that the 29<sup>th</sup> International Horticultural Congress (IHC2014) which was held in Brisbane from 17-22 August 2014 was an outstanding successful event. The Congress was attended by 3400 delegates from more than 100 countries. The program featured 8 plenary lectures, 159 keynote speakers, more than 1200 oral and 1200 poster presentations in 4 plenary sessions and 43 symposia. The Section Tropical and Subtropical Fruits organized IV International Symposium on Papaya, VIII International Pineapple Symposium, International Symposium on Tropical Fruit and International Symposium on Mango during the congress. The Section also organized an evening workshop on Quality Planting Materials. We have many important events in 2015 (please visit Calendar of ISHS events at [www.ishs.org/calendar](http://www.ishs.org/calendar) for details).

We believe you will enjoy reading the e-Newsletter and I will look forward for your comments, suggestions and inputs for the coming issue.

With best wishes,

Dr. Hannah Jaenicke  
Vice-Chair

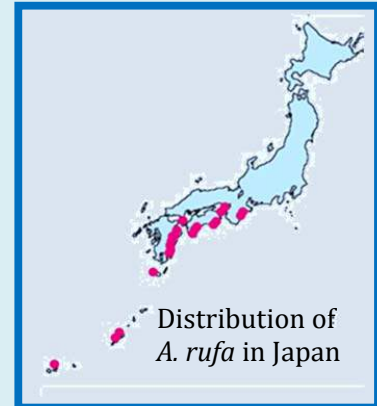
Professor Sisir Mitra  
Chair

Section Tropical and Subtropical Fruits



## Kiwifruit Breeding for Cultivation in Warm Climate by Utilizing Wild *Actinidia* in Japan

Japan consists of four major islands, Hokkaido, Honshu, Shikoku and Kyushu, and southwestern Islands. The total land area is only about 377,900 km<sup>2</sup>, but the archipelago stretches for about 3,000 km from the subarctic to subtropical climate. In this wide range of climates, four species of *Actinidia* occur naturally. Among these, *A. kolomikta*, *A. arguta* and *A. polygama* adapt to cooler conditions in the mountainous regions. In contrast, *A. rufa* called "Shimasarunashi" is found only in the Pacific coastal regions in the southwestern part of Japan. It adapts well to the very warm conditions in Okinawa and southwestern islands under subtropical climate.



Commonly, the leaf shape is ovate or cordate and the petiole is very flexible and highly tolerant to the strong wind. *A. rufa* is dioecious similarly to most kiwifruit. Fruit is much smaller than ordinary kiwifruit (*A. chinensis*). The shape varies, being round, ovoid, cylindrical, and truncate. The skin is commonly glabrous and the flesh is basically dark green. *A. rufa* is very productive when it is sufficiently pollinated under cultivated conditions. The fruit is edible without any bitterness or astringency. Total soluble acid and ascorbic acid content of the juice largely varies among the collections. Protease activity is much less than 'Hayward' kiwifruit. *A. rufa* is diploid and highly cross compatible with diploid *A. chinensis* kiwifruit.

The kiwifruit breeding program commenced in collaboration with Kagawa University and Kagawa Prefecture in 2006. The objectives were, 1) to introduce environmental adaptability such as adaptation to warm winter, tolerance to hot and dry conditions, toughness to strong wind and resistance to bacterial diseases, 2) to increase marketability, such as unique appearance, long storage ability and good shelf life, 3) to meet the consumer demand such as good tasting quality with high nutrition value and convenience for eating.

For this purpose, *A. rufa* was selected as a maternal parent. To improve fruit size and eating quality, *A. rufa* was crossed with diploid *A. chinensis* kiwifruit that has high sugar and low acid contents, yellow flesh and the same ploidy level as *A. rufa*. Interspecific hybridization was done in 2004. Among 2,600 seedlings, 5 superior clones were selected and their performance in the commercial orchards were evaluated for 3 years. Finally, these 5 cultivars 'Kagawa UP-Ki No.1 to No.5' have been registered as "Plant Variety" of MAFF, September, 2014.





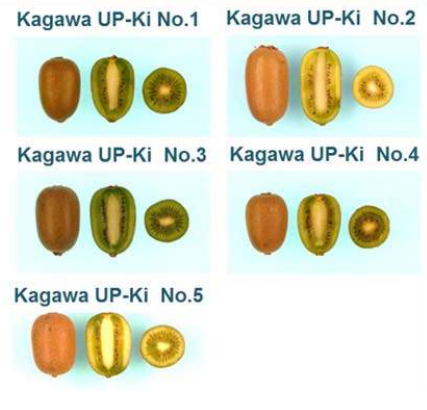
Environmental adaptability of these new cultivars is relatively wide. The leaves are tolerant to high temperature and solar radiation avoiding sunburn. Flexible leaf blade and petiole can stand to the strong wind resulting in the less susceptibility to bacterial flower rot caused by *Pseudomonas syringae*. The chilling requirement for breaking bud dormancy is less than 300 CH.



Fruit size ranges 40-60 g, about half of common kiwifruit. Fruit is oblong with hairless brown skin and green or yellow flesh. Productivity is estimated to be about 40 t/ha. Timing of commercial harvest is from late-October to early-November. The fruits contain 17-20% of total soluble solid and 0.6-0.8% of acid resulting in a well-balanced sweet and sour taste.

Ascorbic acid content ranges 30-60 mg/100 FW, which is equal to satsuma mandarin (33 mg) or strawberry (62 mg). Protease (Actinidin) activity is quite low and irritation in the mouth hardly occurs when eaten. Fruit can be stored for 4 months at low temperature (3°C) with ethylene absorbent.

Now, the fruits of these new cultivars collectively named "SanukiKiwicco®" are commercially available at department stores and fruit shops at major cities in Japan. We are expecting an increase of production of these cultivars in the future.



**Professor Ikuo Kataoka,  
Kagawa University, Miki,  
Kagawa 761-0795  
Japan**

## Breadfruit in the Pacific

Breadfruit (*Artocarpus altilis*), the archetypical Pacific island food tree, is widely cultivated in the Pacific Islands where it is often an integral part of traditional agroforestry systems. Breadfruit can be cooked and eaten at all stages of maturity, is high in carbohydrates and also a good source of minerals and vitamins. In Fiji, the crop can be exported fresh to New Zealand if quarantine treated for fruit flies.

Breadfruit is well adapted to the wet tropics, with optimum conditions being temperatures ranging from 21-32°C, annual rainfall of 1500-2500 mm and adequate drainage (Ragone, 1997, 2006). Breadfruit trees are prone to damage from high winds, however trees are seldom uprooted by cyclones, with damage usually confined to outer branches. Breadfruit requires relatively high levels of rainfall but can survive droughts of 3-4 months after the tree is established (Elevitch and Wilkinson, 2000). It is unlikely that increasing temperatures will have too much impact on breadfruit at least to a 2°C increase; though, if heat stress is accompanied by low rainfall, then fruit drop and smaller fruits are likely to be a problem.

Breadfruit has been identified as a key crop of the future food security of the Pacific islands because of the crop's:

- ability to secure food energy from the atmosphere, thanks to its large leaves and canopy and being relatively undemanding on the soil;
- high tolerance to climate change and climate extremes;
- compatibility to intercropping within agroforestry systems;
- ability to sequester carbon; and
- high yield in biomass that has the potential to be converted into high quality gluten free flour and starch products.

Currently, breadfruit is found in agro-forests, household backyard gardens or around villages. While such cropping systems make a useful contribution to food security for local people, they are unable to make a major contribution to future national food security. Such systems do not efficiently and consistently supply a product of known quality to processors and fresh exporters. The establishment of breadfruit orchards, therefore, is seen as an essential requirement for commercial processing and significant fresh exports.

Globally, the only limited experience with commercial breadfruit orchards is in the small Eastern Caribbean countries of St. Lucia, Barbados, Grenada, Dominica and St. Vincent (Medlicott, 1997). Thus it has been necessary to develop, essentially from scratch, nursery and orchard systems for this "new" commercial fruit tree crop in the Pacific. Basic applied research and extension activities were required in such areas as: planting material selection; propagation and distribution (including commercial private sector nursery development); orchard management practices (including intercropping to ensure financial viability); and post-harvest handling. A major constraint is the limited number of outstanding identified varieties (seedless triploids) from a commercial perspective. Thus there is need to mass propagate these selected varieties to establish orchards with elite planting material.

The establishment of breadfruit orchards has been a key component of the Australian Centre for International Agriculture Research (ACIAR) Project "Developing commercial breadfruit production systems in Pacific Islands" otherwise known as the Pacific Breadfruit Project (PBP). The aim of this four-year project, which began in early 2011, was to assist smallholder farmers to move from opportunist "wild" harvest to growing breadfruit as an orchard crop.

The implementation of the PBP has involved a partnership between Kokosiga Pacific (a Fiji based company), the Fiji Ministry of Agriculture and the Secretariat of Pacific Community (SPC)'s Centre for Pacific Crops and Trees (CePaCT). A proposed second stage of the PBP will expand the focus to



Harvesting breadfruit from wild trees



Harvesting breadfruit from a marcotted orchard tree



Intercropping with pineapples





commercial processing of breadfruit and will involve collaboration with partners in Hawaii, Samoa and Vanuatu.

As of July 2014 a total of 27 farmers in Fiji (planting 1,650 trees) have invested in breadfruit as a commercial crop. All these farmers are located in the western side of Fiji's main island of Viti Levu, in proximity to a quarantine treatment facility for fresh export and are focussing on producing for fresh export to New Zealand. These farmers have planted at least 50 trees (one acre) and are following the recommended package of practices provided by the PBP. The planting target for the completion of PBP Stage 1 (July 2015) is 5,000 trees involving 50 farming households.

A breadfruit tree planted in an orchard is expected to come into full production in four years and reach full production after nine years. However, notably, the first orchards planted under the PBP commenced fruit only 18-months after planting.

The conservative estimate of the average annual yield of marketable fruit is 225 kg per tree. Thus the projected annual production of marketable fruit from these trees is around 1,100 tonnes of marketable fruit. It can be expected that most of this fruit will be exported as fresh fruit. If the orchard up-take by farmers continues at the current rate, the expected output would far exceed fresh export needs in a decade or so. The planting of 20,000 breadfruit trees by the end of the decade would eventually lead to 4,500 tonnes of marketable fruit. If this production was processed into flour or starch it would supply the energy equivalent of around 2,700 tonnes of boiled rice<sup>1</sup>. Fiji currently imports around 25,000 tonnes of rice annually.

## Conclusion

The planting of breadfruit orchards has been identified as a climate change adaptation strategy that is directed at benefiting from the expected increasing comparative advantage of traditional staple food crops. Uptake of breadfruit orchard planting by farmers has been high based on the relatively expected high returns to labour compared with the main alternative of planting sugar cane. However, for the breadfruit orchard development program to realise its full potential, it requires: further refinement of pruning techniques; the continued development of inter-cropping systems; ongoing evaluation of planting material derived from different sources (root suckers, marcots and tissue culture); and the development of commercial enterprises to collect, propagate and distribute planting material.

## Literature Cited

- Dignan Cecily, Barbara Burlingame, Shailesh Kumar, William Aalbersberg 2004. The Pacific Islands food composition tables (second edition).FAO.
- Elevitch, C.R. and K.M. Wilkinson. 2000. Agroforestry Guides for Pacific Islands. Permanent Agriculture Resources, Holualoa, Hawaii.
- McGregor Andrew, Mary Taylor, R. Michael Bourke and Vincent Lebot 2015. Chapter 4: Vulnerability of Staple Food Crops to Climate Change in Taylor, Mary, McGregor, Andrew and Dawson, Brian, (ed.) Vulnerability of Pacific Agriculture and Forestry to Climate of the Pacific Community, Noumea, New Caledonia.
- McGregor Andrew and Anna Fink 2012. Chapter 9: Implications of Climate Change on the Contributions by Agriculture and Forestry to Pacific Island Economies and Communities, in Taylor, Mary, McGregor, Andrew and Dawson, Brian, (ed.) Vulnerability of Pacific Agriculture and Forestry to Climate Change. Secretariat of the Pacific Community, Noumea, New Caledonia.
- Medlicott, A.P. 1997. Postharvest Handling of Breadfruit excerpted from "Product Specifications and Post Harvest Handling of Fruit, Vegetables and Root Crops Exported from the Caribbean. [www.fintac.com/gain/guides/ph/postbrdf.html](http://www.fintac.com/gain/guides/ph/postbrdf.html)
- Ragone, D. 1997. Breadfruit, *Artocarpusaltitilis* (Parkinson) Fosberg. International Plant Genetic Resources Institute, Rome.
- Ragone, D. 2006. *Artocarpusaltitilis* (breadfruit). Pp. 85-100 in Traditional Trees of Pacific Islands: Their culture, environment and use. Edited by C.R. Elevitch. Permanent Agriculture Resources, Holualoa, Hawaii.



Fruiting commences in 18-months with breadfruit trees derived from root suckers at an orchard adjacent to the Nadi international airport



Bale kana variety breadfruit on Taveuni derived from marcots fruit 2 years after planting

Kyle Stice, Andrew McGregor, Livai Tora and Kaitu Erasito  
P.O.Box: 9048, Nadi Airport, Fiji Islands

## Tissue culture papaya- An Australian experience

Papaya (*Carica papaya* L.) is a nutritious fruit and medicinally important crop of the tropics and to a lesser extent of the subtropics. Although not a major world producer, Australia grows enough papaya to supply its own market. Being an island continent and nation, separated by large body of ocean from all other papaya growing regions, Australia enjoys freedom from some of the major diseases of papaya. Much of the papaya production in Australia happens in the Atherton tablelands and coastal areas of Far North Queensland. However, being a large country with major cities and markets (Sydney, Melbourne and Brisbane) a fairway away from the production centre, papaya needs long distance transport in Australia. A lot of the attractive Asian cultivars couldn't stand this particular requirement (long shelf life) apart from the adaptability to Australian climate and soil conditions. Therefore, the Department of Primary Industries, Queensland (DAFF) along with the Horticulture Australia Limited (HAL) embarked on a breeding program that generated many hybrid papaya (Red and Yellow flesh varieties). DAFF selected 6 hybrid lines after careful small scale field evaluation, post harvest assessments and quality testing including taste testing.



Shoot multiplication

DAFF, entrusted Clonal Solutions Australia Pty Ltd (CSA), Walkamin, Queensland, the innovative plant propagation research provider and largest commercial plant tissue culture laboratory in Queensland ([www.clonalsolutions.com.au](http://www.clonalsolutions.com.au)) to generate a few 1000 tissue culture (TC) plantlets of these six selected hybrids for a field trial. DAFF established field trial of these six lines using TC papaya generated by CSA in 2011. Mr Yan Diczbalis and his colleagues at DAFF organised a papaya field day in 2012 to impart awareness about the advantages of tissue culture papaya. Following the participation in that informative field day, which also included a visit to the CSA in Walkamin, some

farmers called up CSA to tissue culture variety 'Solo', a red hybrid papaya 'RB1' and also popular yellow variety '1B' which they have been growing for many years. Irrespective of the papaya varieties grown, farmers in Australia wanted TC papaya to eliminate the need to plant multiple seedlings per spot to create a farm with bisexual papaya, reduce pre-bearing period, achieve flowering at reduced height and extend the period of harvesting the fruits profitably, increase vigour and yield. Very high minimum wage in Australia means huge labour cost for farmers therefore, all the above characteristics are linked to reducing the labour requirement in the farm. The 'Solo' papaya farmer particularly wanted TC papaya to reduce the height at which his seedlings usually bear fruit (120 cm) and this farmer reported that the tissue culture 'Solo' papaya are bearing fruits at an average height of 60 cm! Shorter pre-bearing period (2.5-3.0 months), flowering at reduced height (40-60 cm), greater vigour and yield (2-3 fold in the first year) of TC papaya than seedling papaya have made papaya farming using TC papaya very attractive in Australia



Coppicing papaya



Variety of contaminants at initiation



In vitro rooting



Acclimatisation

Our experience with tissue culture papaya of various lines and varieties is summarised below.

1. Uniform, bisexual plants
2. Shorter pre-bearing period (2.5-3.0 months from planting compared to seedlings) depending on the soil type, management practices and planting season
3. Shorter internodes, larger canopy, greater vigour and higher yield than seedlings
4. Longer harvest period than the seedling derived papaya because fruit production starts earlier and fruits are available at economical picking heights for longer period than the seedling derived



Acclimatised papaya ready to plant




Comparison of tissue culture (Left) vs. seedlings of red papaya (Right): 5 months old

**Dr Puthiyaparambil Josekutty,**

Manager, Tissue Culture Laboratory,  
Clonal Solutions Australia Pty Ltd.,  
Walkamin, QLD 4872, Australia

E mail: [p.josekutty@clonal-solutions.com.au](mailto:p.josekutty@clonal-solutions.com.au)

[www.clonalsolutions.com.au](http://www.clonalsolutions.com.au)



## 4<sup>th</sup> ISHS International Symposium on Plant Genetic Resources: Genetic Resources for Climate Change

The symposium was held during the 29<sup>th</sup> International Horticultural Congress in Brisbane, Australia 18-22 August 2014. There were 18 posters and 32 oral presentations given across the three themes "Utilization of plant genetic resources", "Germplasm conservation strategies and technologies" and "Harnessing the diversity of crop wild relatives". Each theme was introduced by a cross-cutting keynote presentation. In addition, there were two workshops during which participants had the opportunity to discuss additional issues: a workshop on "Global conservation strategies for horticultural crops" was held on Monday 18<sup>th</sup> August with panelists from the Global Crop Diversity Trust, USDA and ACIAR and a workshop on "Strengthening informal seed systems: integrating plant genetic resources conservation within a larger development" was held on Thursday 20 August with panelists representing the private seed/nursery industry and community seed banks. This workshop was held together with the scheduled workshop on "Quality planting material" (convener Sisir Mitra).

The quality of the posters and presentations throughout the symposium was very high and discussion with the participants was lively, despite the time and logistics constraints posed by the tight schedule of the Congress with up to 20 parallel sessions. Despite this competition, the symposium and workshops attracted a good attendance of 30-60 participants in each session, estimated at around 200 individuals overall who participated in the symposium.

The presented activities ranged across the world, with a particular focus on the Pacific, Asia and Africa where the effects of climate change are likely to be most severe. Examples were provided from successful rehabilitation activities after a typhoon to suggestions for more climate-ready genetic resources and laboratory technology to provide vital information to genebank managers and breeders for future plant improvement. Efforts are being taken to increase the genetic diversity of particularly vulnerable resources like root and tuber crops in the Pacific and to establish novel markets to increase interest in more diverse production systems. Important tools are regional and international genebanks, such as that of CePaCT run by SPC serving the Pacific Island countries with a particular focus on providing virus-free planting material of important vegetatively propagated root and tuber crops and AVRDC with a global mandate for vegetables where research is underway for particularly heat-tolerant tomato varieties. For commercially important genetic resources, such as Citrus, increased global networking was suggested. In addition to the important role of public and private genebanks, the increasingly recognized role of farmers as custodians of genetic resources and repositories for future genetic improvement was discussed in several papers.

Whilst the challenges that climate change will pose are huge, especially on vulnerable communities and ecosystems, the presentations during this symposium showed that already significant efforts are taken to address the issue at the level of plant genetic resources. However, more coordinated and collective efforts are needed for more sustainable and focused impact.

*Dr. Hannah Jaenicke,*  
Vice-Chair,  
Section Tropical and Subtropical Fruits,  
ISHS

## FORTHCOMING EVENTS, 2015

Sl. no	Group	Name of Symposium	Symposium Date	Location
1		International Symposium on Guava, Wax apple, Pineapple and Sugar apple	April 8-11, 2015	Kaohsiung City, Chinese Taipei
2		International Symposium on Durian and Other Humid Tropical Fruits	2-4 June 2015	Chantaburi, Thailand
3	Mango	XI International Mango Symposium	September 28-October 2, 2015	Darwin, Australia
4		International Symposium on Valorization, Preservation and Processing of Tropical Fruits and Vegetables	October 18-22, 2015	Port-au-Price, Haiti
5		I International Symposium on Moringa	November 15-18, 2015	Manila, Philippines

