Breadfruit Institute

- The Breadfruit Institute is part of the National Tropical Botanical Garden.
- Created in 2003.
- Headquartered in Hawaii.
- **Mission: To promote the conservation and use of breadfruit for food and reforestation.**

What is Breadfruit?

- Tropical, evergreen tree.
- Moraceae (fig, mulberry) family.
- Produces 350-1000 lb. or more of nutritious food per year (carbohydrates, protein, minerals, vitamins) with minimal inputs of labor or materials.
- Multipurpose tree: food, timber, medicine, animal feed, ecosystem benefits.
- Begins bearing in 3-4 years and productive for decades.
- Grows in many environments.

Breadfruit is Not Jackfruit!

A. heterophyllus

Breadfruit is a member of the genus *Artocarpus*, and distantly related to jackfruit, *A. heterophyllus.*

NTBG Breadfruit Collection - Maui & Kauai, Hawaii

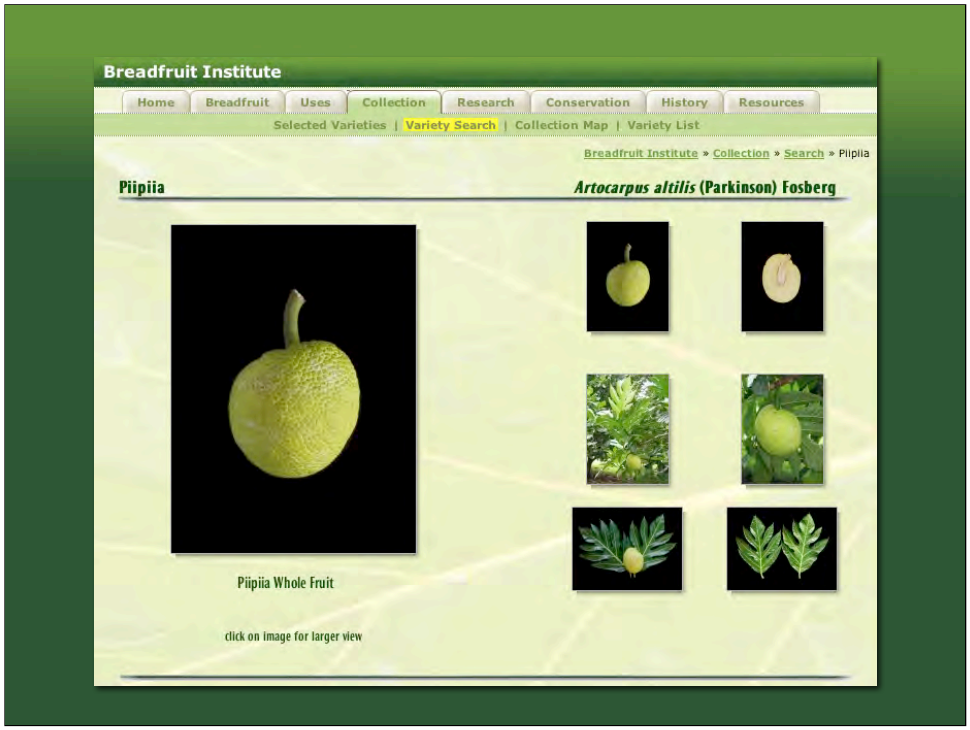
More than 120 varieties from 34 Pacific Islands, Seychelles, Philippines, Indonesia & Honduras.

- Largest collection of breadfruit varieties & species in the world
- More than 120 varieties
- 34 Pacific Islands, Seychelles, & Philippines.

- Incredible resource for conservation, research, and education.
- Most important - resource for food security & sustainable agriculture.

www.breadfruit.org

- Institute is acknowledged international center for information about breadfruit


Breadfruit Institute
Home
Breadfruit
Uses
Collection
Research
Conservation
History
Resources
Selected Varieties | Variety Search | Collection Map | Variety List
Breadfruit Institute » Collection » Search » Piipiia
Piipiia
Artocarpus altilis (Parkinson) Fosberg
Piipiia Whole Fruit
click on image for larger view

www.agroforestry.net/tti/

Breadfruit Production Manuals & Resources

- Production currently small scale, primarily small holder farmers, home gardeners
- A Manual for Growing & Marketing of Breadfruit for Export. 2005. Natures Way Cooperative, Fiji.
- Marketing Profile for Breadfruit. 2009. Diane Ragone. (http://agroforestry.net/scps/).
- The Breadfruit in. Jamaica : a commercial & horticultural perspective. 2009. Webster, Seymour A.

First International Symposium on Breadfruit Research & Development

Nadi, Fiji
April 2007


CHINA
Philippine Sea
PHILIPPINES
FEDERATED STATES OF MICRONESIA
CAROLINE ISLANDS
PALAU
INDONESIA
PAPUA NEW GUINEA
SOLOMON ISLANDS
Coral Sea
AUSTRALIA
Great Australian Bight
Tasman Sea
Indian Ocean
NEW ZEALAND
North Island
South Island
HAWAIIAN ISLANDS
North Pacific Ocean
MARSHALL ISLANDS
KIRIBATI
TUVALU
VANUATU
TONGA
Cook Islands (N.Z.)
French Polynesia (FRANCE)
South Pacific Ocean

Artocarpus camansi Blanco

Breadnut

- This seeded, diploid species is native to Papua New Guinea where it grows wild in alluvial forests in the lowlands. It may also be native to the Philippines and the Moluccas.
- It is grown for its nutritious seeds, similar in flavor and texture to chestnuts. The seeds are high in protein (up to 20%) and a good source of vitamins and minerals. The immature fruit is sliced and cooked as a vegetable.
- Breadnut is the ancestor of breadfruit (*A. altilis*).
- Beginning in the late 1700s, the British and French spread breadnut throughout the tropics and it is now widespread in the Caribbean, Central and South America, Southeast Asia, and parts of Africa, especially West Africa.

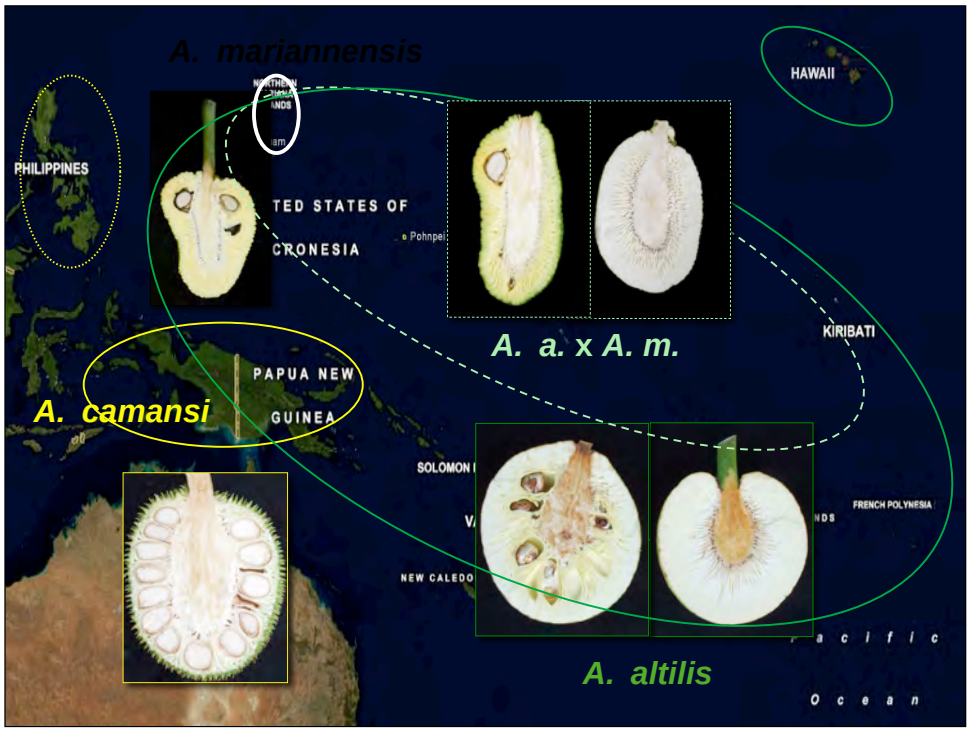
Resources

- http://www.agroforestry.net/tti/#Anchor-Preview-49575
- http://ntbg.org/breadfruit/breadfruit/#camansi

Artocarpus altilis (Parkinson) Fosberg

Breadfruit

- 2-3,000 years of vegetative propagation and human selection have made A. altilis morphologically distinct from breadnut.



Map showing distribution of the breadfruit complex, *Artocarpus camansi* (breadnut), *A. mariannensis* (dugdug/ebiei), *A. altilis* (breadfruit), and *A. mariannensis* x *A. altilis* hybrids in the Pacific Islands.

2-3,000 years of vegetative propagation and human selection have made A. altilis morphologically distinct from breadnut.

Multi-purpose Tree


Timber
• Construction, furniture.
• Canoes.
• Household, ceremonial objects, handicrafts.
• Firewood.
Latex/sap
• Adhesive, caulk.
• Medicine (also leaves, petioles).
Inner bark
• Medicine.
• Bark cloth (tapa).
• Cordage.

Breadfruit Iconography/Symbology

- **Breadfruit has important cultural, spiritual significance to Pacific Islanders.**
- **Left photograph is a statue carved out of breadfruit wood, the Mother Mary is holding baby Jesus, who instead of holding the world, as is typical, is holding a breadfruit, because the breadfruit is the world to the Marquesan people because it was their staple food.**

- **Right - carving of the "Breadfruit Tree Legend" of Palau where there was a magic breadfruit tree with a hollow trunk so that at high tide the water would come through the trunk and bring fish out of the branch. The tree thus provided breadfruit (starchy staple) and fish (protein). Left side of tree people are fighting. Legend says that people became jealous of this tree and during a fight over it cut it down, the water gushed out and the tiny island on which it was located sank beneath the waves.**

- Agroforestry - >100 useful plants, 2000 year old system of sustainable agriculture
- Important for watersheds

Yams & breadfruit typically grown together in agroforestry systems in Micronesia.

Nutritious, easy to grow staple food

Traditional Methods of Cooking Breadfruit

- Pacific islanders did not have pottery or other cooking vessels, so roasting a breadfruit in the open fire is the most common way to cook breadfruit. Early European visitors to the Pacific, after long sea voyages and poor food aboard ship thought the fresh roasted breadfruit smelled and tasted like a loaf of bread because of its doughy texture. Hence the name “breadfruit.”

- HD Video of this cooking method can be viewed at: http://ntbg.org/breadfruit/resources/

Roasted fruit are often pounded, mixed with fresh grated coconut cream, shaped into a flattened, rounded loaf, wrapped in banana leaves and then cooked in the earth oven. Will last for several days. Traditionally called a “porridge.”

Preservation & storage of breadfruit by pit fermentation

- Traditionally, breadfruit was preserved by several methods, the most common and widespread method was pit fermentation in a leaf-lined pit. Now only practiced in a few Micronesian islands.
- Process involves: Mature, firm fruit are harvested, peeled and cut into sections. Washed in fresh water, or if on an atoll island, whole peeled fruit is put into a woven coconut bag and soaked in the lagoon for 2 days. The fruit are placed in a pit lined with banana leaves, and carefully covered with leaves and rocks.
- Process of semi-anerobic fermentation turns fruit into a tart, doughlike mass. Fermented fruit is removed, kneaded, mixed with coconut cream, and baked in traditional earth oven
- Advantages: preserves large harvests, provides food during times of drought, warfare, hurricanes, and provides ‘tart’ addition to a traditionally bland diet.
- Will easily last up to one year and reports of pits with edible ‘mahr’ after 30, even 100 years.

Preservation & storage of breadfruit by drying

Traditionally, breadfruit was preserved by several methods, most common was pit fermentation in a leaf-lined pit. In a few islands, roasted breadfruit was peeled, cut into bite-size pieces and then dried for hours over heated rocks (fire built to heat the rocks). Dried fruit then placed into leaf-lined baskets, stored in cooking house over the fire so smoke would keep insects away. Would last 1-2 years.

Animal Husbandry

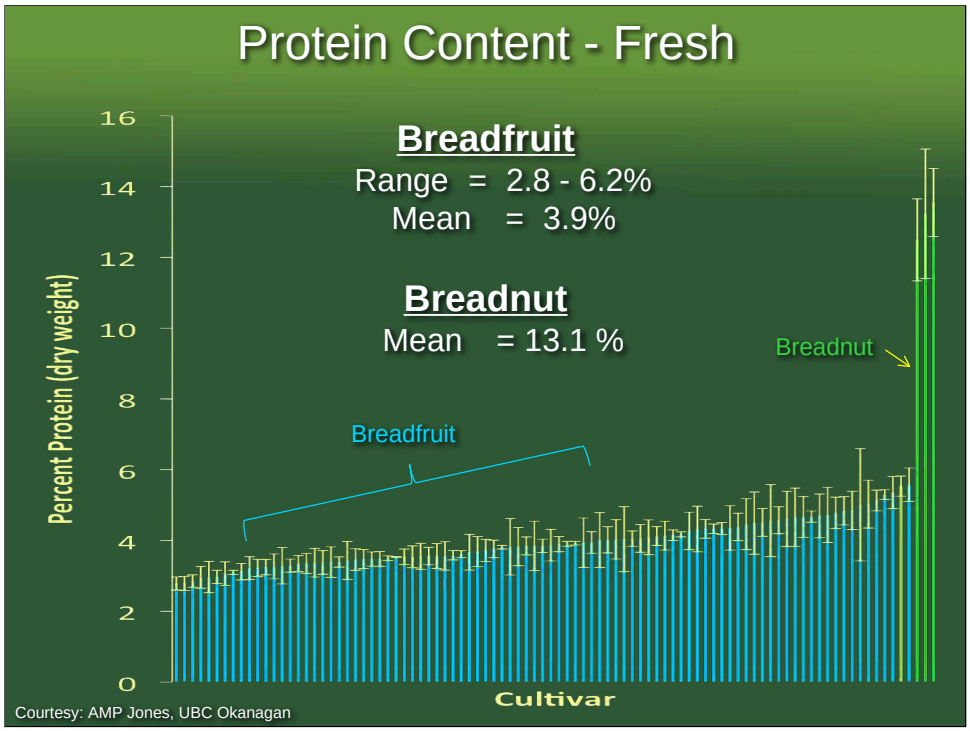
- Fed to pigs, goats, poultry, sheep.
- Also used to fatten fish.

- Peels, cores, damaged/excess fruit used as animal feed. Waste products used to produce protein, fat, and other animal products.

Production & Yields

Crop	Yields (t/ha) dw
Breadfruit*	6.0
Corn	4.0
Rice	4.1
Wheat	2.6
Cassava*	10.0

*100 breadfruit trees/ha (20 t/ha fresh fruit)


Protein Content - Fresh
Breadfruit
Range = 2.8 - 6.2%
Mean = 3.9%
Breadnut
Mean = 13.1 %
Breadnut
Breadfruit
Percent Protein (dry weight)
16
14
12
10
8
6
4
2
0
Cultivar
Courtesy: AMP Jones, UBC Okanagan

Protein content - Flour

Range = 1.8 - 7.6 %
Mean = 3.1 %

Banana & Cassava = 2.8%
Sweet potato = 3.6%
Rice = 7.1%
Cassava = 3.0%

Courtesy: AMP Jones, UBC Okanagan

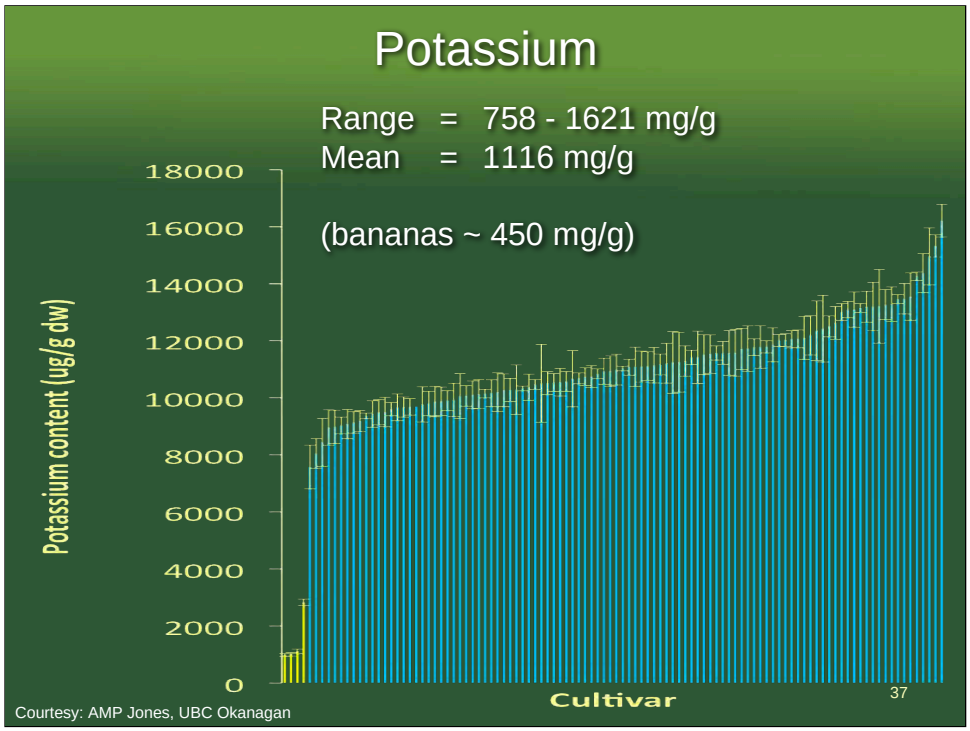
Iron

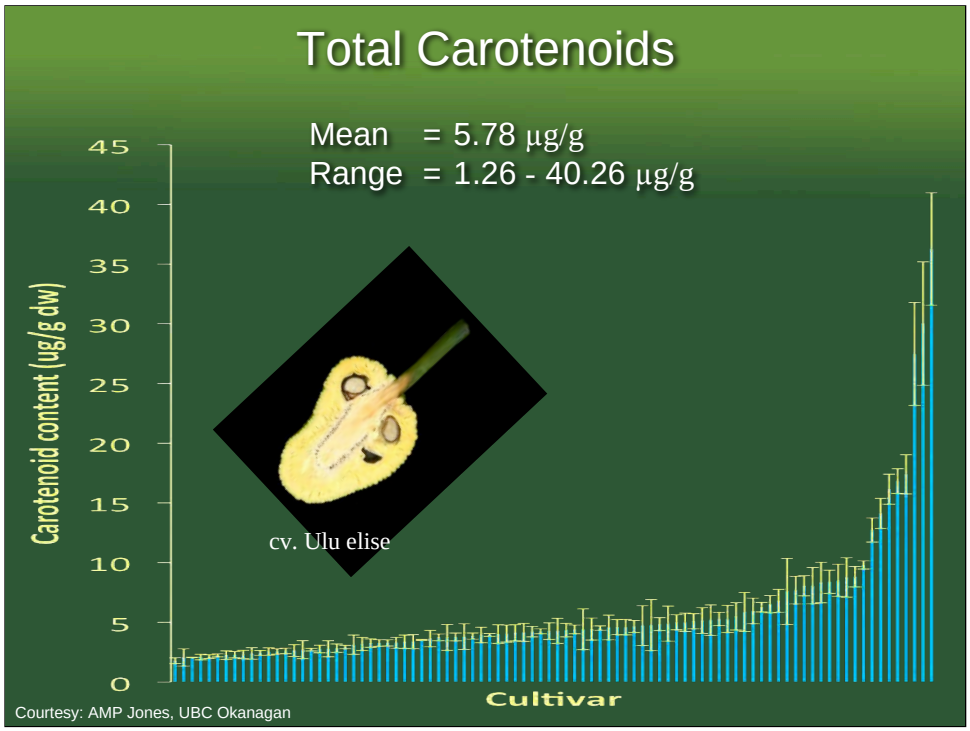
Range = 6.3 - 34.0 µg/g
Mean = 11.9 µg/g

Iron levels approach fortified & whole wheat flours

cv. Meion

Courtesy: AMP Jones, UBC Okanagan


Potassium
Range = 758 - 1621 mg/g
Mean = 1116 mg/g
(bananas ~ 450 mg/g)
Potassium content (ug/g dw)
18000
16000
14000
12000
10000
8000
6000
4000
2000
0
Cultivar
37
Courtesy: AMP Jones, UBC Okanagan


Total Carotenoids
Mean = 5.78 µg/g
Range = 1.26 - 40.26 µg/g
Carotenoid content (ug/g dw)
45
40
35
30
25
20
15
10
5
0
cv. Ulu elise
Cultivar
Courtesy: AMP Jones, UBC Okanagan

Breadfruit as a Source of Mineral Nutrition

Mineral content (% RDA/750g)

Element	Mean	SE	Min	**Max**
Ca	13.3	+/- 0.52	5.9	**44.0**
Co	NA	NA	NA	**NA**
Cu	71.2	+/- 2.05	31.8	**182.6**
Fe	18.6	+/- 0.65	10.4	**46.6**
K	56.5	+/- 0.75	43.4	**90.2**
Mg	75.3	+/- 2.48	51.5	**217.1**
Mn	21.9	+/- 0.85	12.4	**63.1**
Na	4.5	+/- 0.75	1.2	**51.3**
P	44.9	+/- 0.92	30.6	**100.2**
Zn	7.6	+/- 0.47	4.1	**39.4**

Courtesy: AMP Jones, UBC Okanagan

Breadfruit Markets - Fresh Fruit

- Local markets in regions of production.
- Export markets: Caribbean to USA, Canada, United Kingdom; Samoa and Fiji to New Zealand.
- Demand exists from populations of Pacific and Caribbean islanders living in North America, New Zealand, Europe.
- Potential markets for people interested in tropical fruit/vegetable products.

Challenges

- Perishability of fruit, post harvest handling, import restrictions.

Breadfruit is a Versatile Food

- Can be prepared and eaten at all stages of development:
- Small, immature fruit can be sliced and cooked as a vegetable.
- Mature, firm, starchy fruit most typically consumed: can be roasted, baked, boiled, fried, pickled, fermented, frozen, and dried and ground into flour.
- Soft, ripe fruit can be eaten raw, or cooked as a dessert or sweet.

Resources

Recipes are available on the Breadfruit Institute website at:

http://ntbg.org/breadfruit/resources/display/cat/7/

Value-added Products

Fruit

Fries

Canned/frozen slices

Chips

Value-Added Products from Breadfruit

- Breadfruit is perishable, with a short shelf life.
- Development of value-added products suitable to local and export tastes and markets can provide additional income for the small-holder farmer.
- French fries, chips, canned and frozen slices are examples of value-added products.

Flour

- Bread (loaf & flat breads)
- Baby food
- Crackers/biscuits
- Snack foods (extruded)
- Cakes
- Pancakes
- Cereal
- Animal Feed

Breadfruit Flour

- Breadfruit can be sliced or shredded, dried, and ground into flour.
- Breadfruit flour is GLUTEN FREE.
- Can be used as a partial substitute for wheat flour to make breads and other products such as biscuits, cakes, baby food).
- Can be used as the sole flour to make flat breads, pancakes, extruded snacks, etc.
- Skins and core can be dried and processed into nutritious animal feed.

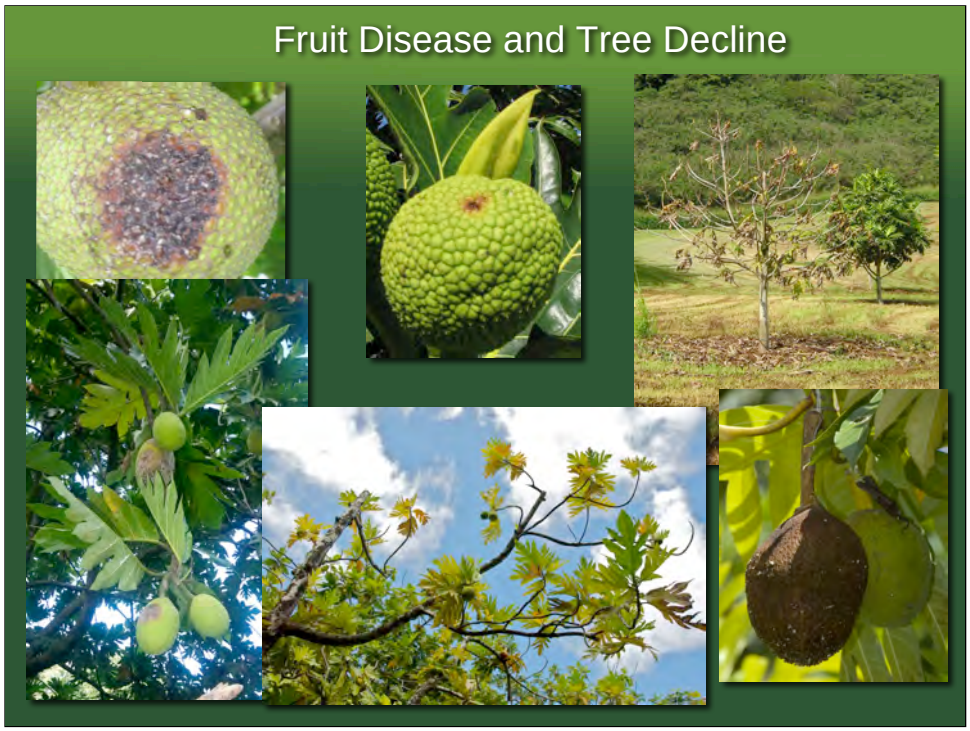
Pruning

Keeping trees pruned to manage height, improve air flow in the orchard and to faciliate ease of harvesting.

Pruned breadnut trees.

Pruned and managed breadfruit trees at National Tropical Botanical Garden, McBryde Garden, Kauai. Trees are six years old.

Mature breadfruit tree, note trunk diameter, pruned yearly after fruiting to keep tree low and manageable in a home garden planting.



In mixed cropping systems, do not plant breadfruit, cacao, and papayas together as they are all susceptible to Phytophthora sp., a serious fungal disease of fruit trees. In Hawaii, Phytophthora is believed to have first infected breadfruit trees from diseased papaya trees.

Poor management of trees, age, fungal diseases, especially Phytophthora and Phellinus noxius, stress, poor drainage with tree roots in standing water can all lead to decline and death of trees

Good management and sanitation practices are essential to controlling breadfruit fruit diseases.

Prompt removal and disposal of infected fruits from tree and ground is a must.

Control of fruit flies.

Tree Management & Care

- Mulching of trees, mixed cropping systems, leguminous ground covers, green manures, animals.

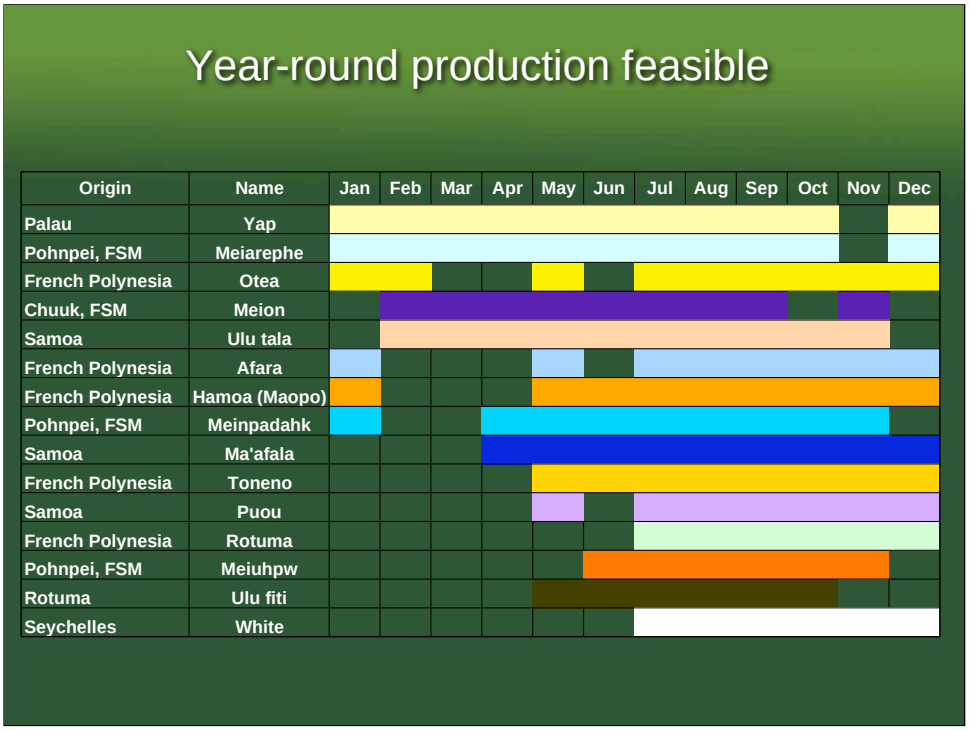
- Incredible diversity of varieties in the National Tropical Botanical Garden's Breadfruit Institute breadfruit collection (repository).
- Some varieties now extinct in their home islands.

Collection-based research

- Morphological evaluation & descriptors.
- Seasonality, yields & production.
- Genetic fingerprinting.
- Nutritional composition.
- *In vitro* propagation.

Research supports curation, conservation and utilization of breadfruit.

Year-round production feasible



Year Round Production of Breadfruit

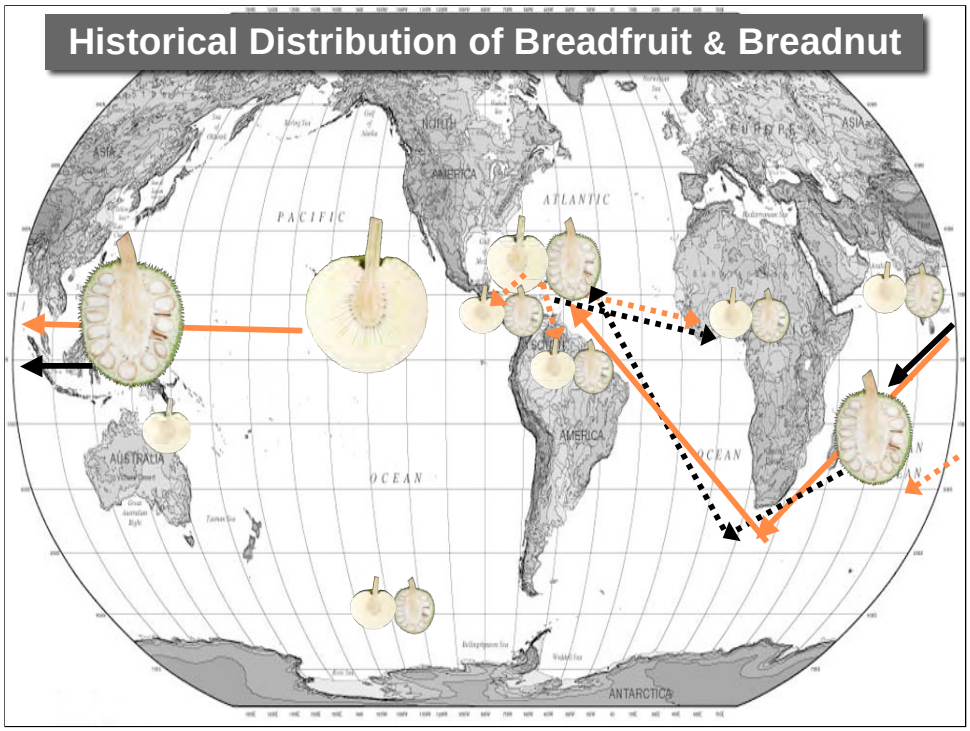
- Year round production of breadfruit is feasible by selection of varieties with overlapping and/or extended seasons.
- Results of 10 year seasonality study conducted on 220 trees at the National Tropical Botanical Garden in Hana, Maui, Hawaii published in Journal of Economic Botany, Fall 2010.

Diversity of Breadfruit (Artocarpus altilis, Moraceae) Seasonality: A Resource for Year-Round Nutrition.

A. Maxwell P. Jones, Susan J. Murch and Diane Ragone

http://www.springerlink.com/content/5429418314x07153/

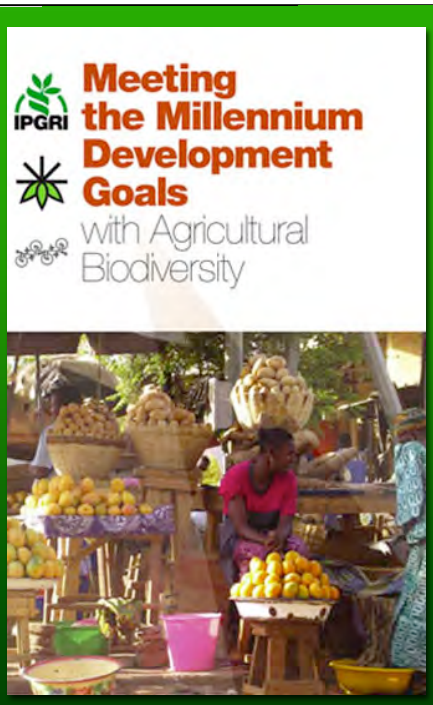
Snapshot of breadfruit diversity in the breadfruit repository at the National Tropical Botanical Garden.



Historical Distribution of Breadfruit and Breadnut

- Breadfruit (*Artocarpus altilis*) introduced from Tahiti to Caribbean by British (Captain Bligh) and from Tonga by French in late 1790s.
- Breadnut (*Artocarpus camansi*) introduced from Philippines to Caribbean via Mauritius by the French in the late 1700s.
- From the Caribbean both seedless breadfruit and seeded breadnut were spread to other tropical regions: Central & South America, Africa, southeast Asia.
- Breadfruit introduced to Queensland, Australia from Polynesia in mid-late 1800s.

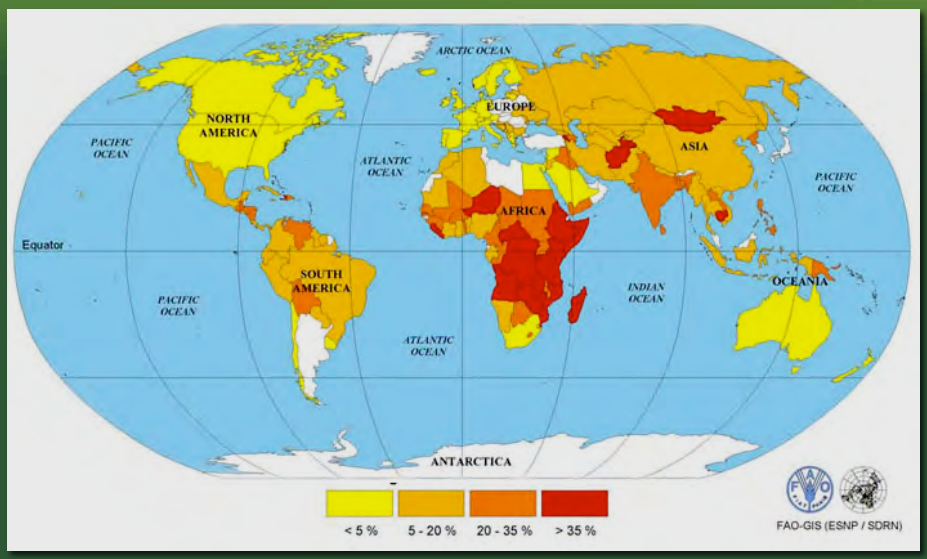
- Our work on breadfruit laid groundwork for Global Breadfruit Initiative to:
- Plant millions of breadfruit trees in tropics.



GOAL 1

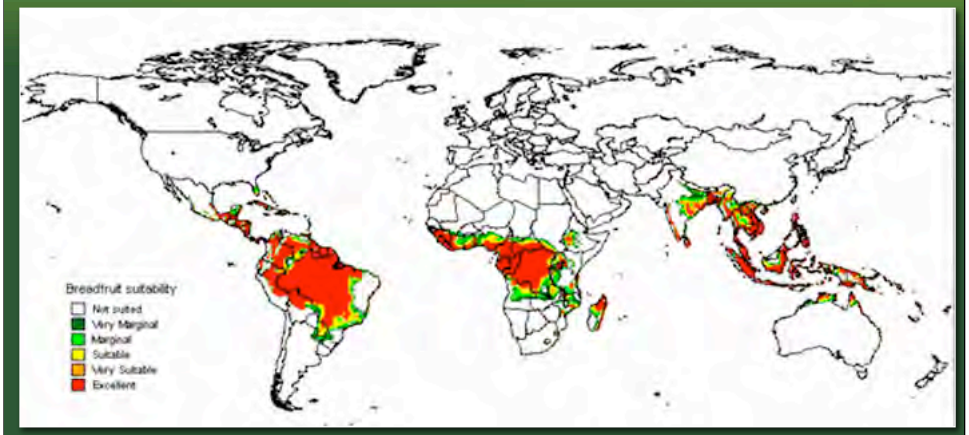
Reduce hunger by 50% by 2015

World Hunger Map



- Every 4 seconds, someone dies of hunger.
- 1 billion undernourished people (FAO).
- More than 80% of the world's hungry live in the tropics.

Breadfruit Growing Areas

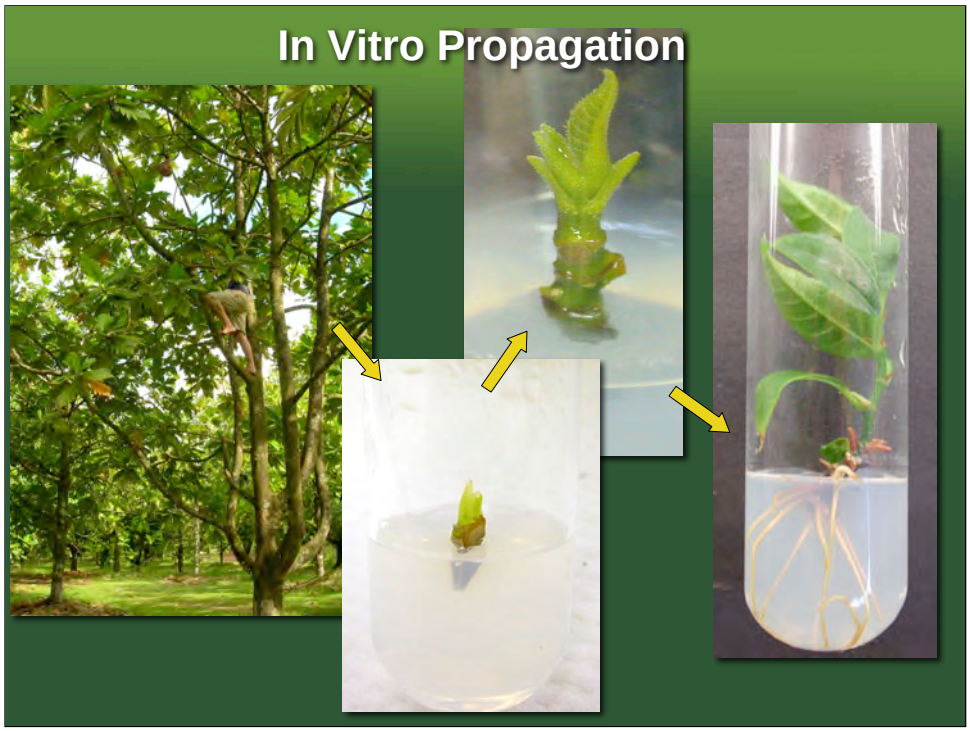


Breadfruit can grow in many areas, especially in Africa, where hunger is a serious issue.

- Food.
- Excellent cash crop, especially for women.
- In Africa, fruits when other traditional crops are not available.
- Watershed protection.
- CO2 reduction.

Why In Vitro Propagation?

- Breadfruit traditionally propagated vegetatively, even seeded varieties.
- Using root suckers or root cuttings.
- Slow, labor intensive, low success rate.
- Removal of roots can be damaging to source ‘mother’ tree.
- Problems with shipping across international borders.



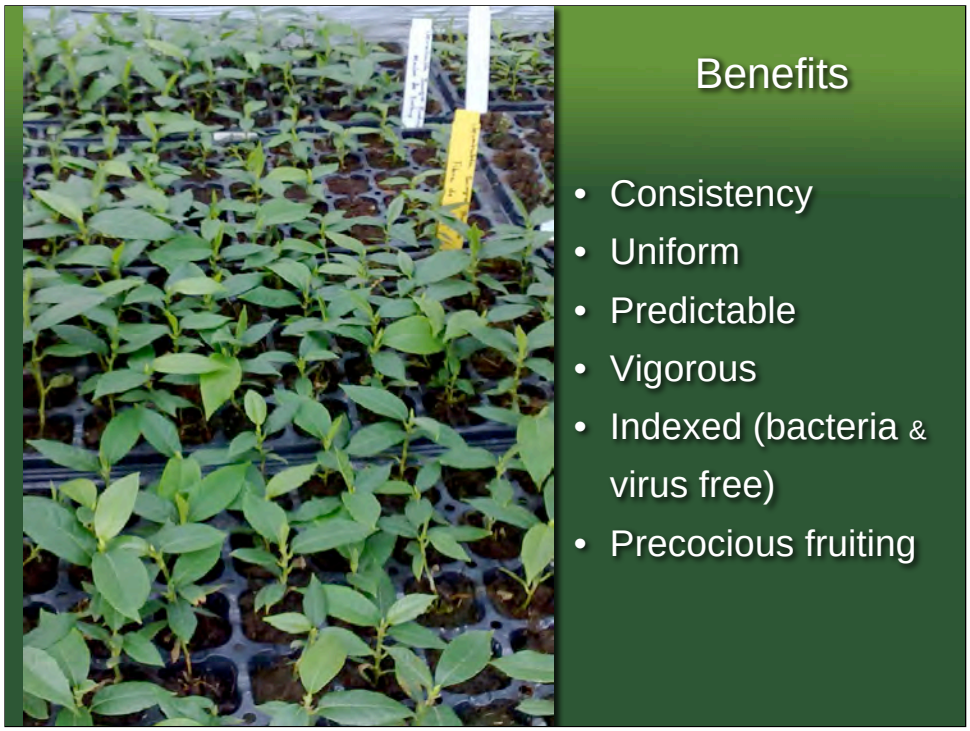
In vitro propagation research

- Process involves harvesting buds from trees (plants) placing them into sterile or aseptic media with nutrients and plant growth hormones to first induce shoot development and then rooting.
- The resulting plant is a clone of the parent/source plant. This is simply a method of vegetative propagation.

In Vitro Propagation Research

Collaborative Research Project with Dr. Susan Murch, Canada Research Chair in Natural Products Chemistry at the University of British Columbia Okanagan

Breadfruit Institute has partnered with a commercial horticultural company, www.globalbreadfruit.com, to make selected varieties of breadfruit available from the NTBG collection.



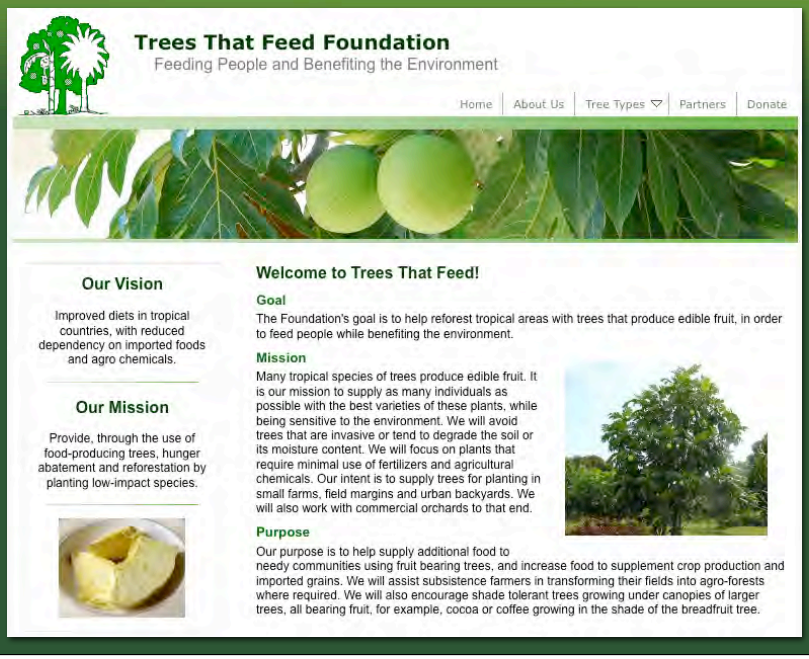
In vitro grown breadfruit plants being weaned in a nursery.

Revolutionary new way to propagate and distribute breadfruit plants

- Vigorous, disease-free plants
- Ready to ship anywhere in the world

In vitro grown trees are fruiting in just 2 years on Kauai, Hawaii. The plugs were ready to be planted in the ground in 6-12 weeks!

JAMAICA



Global Initiative planting project partners include NGOs involved in tree planting projects.

HONDURAS

Sustainable Harvest International

ARN Foundation Goal

•Establish 10 Agroforestry nurseries

•Produce fruit, timber, fiber, plants for biofuel, etc.

•1 million plants per year

Breadfruit

Survey of 500 families showed breadfruit #2 desirable tree (coconut #1)

Especially interested in economic development and income generation (flour)

“ If a man plant 10 breadfruit trees in his life, he would completely fulfill his duty to his own as well as future generations.”

Sir Joseph Banks, 1769

Our goal - grow and use breadfruit so there are no hungry children in the tropics!