# MANGO CULTIVAR EVALUATION PROJECT - PHASE 1



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UNIVERSITY of FLORIDA

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This document was developed using information compiled ruing the National Mango Board-sponsored 2015-2017 research project, Mango Cultivar Evaluation Project - Phase 1.

Editor:
Dr. Jonathan H. Crane, University of Florida
Contributors – Panel Members

- Dr. Ian S.E. Bally, Horticulturist/Breeder, Dept. of Primary Industries, Queensland, Australia at Ian.Bally@daf.qld.gov.au
- Dr. Yuval Cohen, Plant Breeder, The Volcani Institute, Bet-Dagan, Israel at vhyuvalc@volcani.agri.gov.il
- Dr. Jonathan H. Crane, Tropical Fruit Crop Specialist, Univ. of Florida, IFAS, Tropical Research and Education Center, Homestead, Florida at jhcr@ufl.edu
- Dr. Odilo Duarte, Prof., Pan American School of the Americas, Honduras (retired), currently, Consultor en Agronegocios, Perú at odiloduarte@yahoo.com
- Dr. Samuel Salazar-Garcia, Dir., INIFAP (Instituto Nacional de Investigaciones Forestales, Agrícolas y Pecuarias), Tepic-Mazatlán, Mexico at salazar.samuel@inifap.gob.mx
- Dr. Noris Ledesma, Curator, Tropical Fruit Program, Fairchild Tropical Botanical Garden, Miami, Florida at nledesma@fairchildgarden.org
- Dr. Francisco Pinheiro, National Leader, Mango Breeding Program, EMBRAPA, Brazil at pinheiro.neto@cpatsa.embrapa.br
- Mr. Johann du Preez, Manager/Horticulturist, Bavaria Estate, Westfalia, So. Africa at johannd@bavariafruit.co.za
- Dr. Victor Galán Saúco, Research Prof. (retired), Instituto Canario de Investigaciones Agrarias, Canary Islands, Spain at vgalan46@gmail.com

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Photos: Top-row – ‘Southern Blush’, ‘Agam’, ‘Valencia Pride’ and ‘Ataulfo Zafiro’; bottom-row – ‘Calypso’, ‘Noa’, ‘Rapoza’ and ‘Angie’.

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National Mango Board Proposal
Mango Cultivar Evaluation Project - Phase 1

Mango Breeding Review

January 5, 2017

Principal Coordinator: Jonathan H. Crane, Tropical Fruit Crop Specialist
University of Florida, IFAS
Tropical Research and Education Center
18905 S.W. 280 St.
Homestead, FL 33031-3314

**Mango Cultivar Panel**

- Dr. Ian S.E. Bally, Horticulturist/Breeder, Dept. of Primary Industries, Queensland, Australia at Ian.Bally@daf.qld.gov.au
- Dr. Yuval Cohen, Plant Breeder, The Volcani Institute, Bet-Dagan, Israel at vhyuvalc@volcani.agri.gov.il
- Dr. Jonathan H. Crane, Tropical Fruit Crop Specialist, Univ. of Florida, IFAS, Tropical Research and Education Center, Homestead, Florida at jhcr@ufl.edu
- Dr. Odilo Duarte, Prof., Pan American School of the Americas, Honduras (retired), currently, Consultor en Agronegocios, Perú at odiloduarte@yahoo.com
- Dr. Samuel Salazar-Garcia, Dir., INIFAP (Instituto Nacional de Investigaciones Forestales, Agrícolas y Pecuarias), Tepic-Mazatlán, Mexico at salazar.samuel@inifap.gob.mx
- Dr. Noris Ledesma, Curator, Tropical Fruit Program, Fairchild Tropical Botanical Garden, Miami, Florida at nledesma@fairchildgarden.org
- Dr. Francisco Pinheiro, National Leader, Mango Breeding Program, EMBRAPA, Brazil at pinheiro.neto@cpatsa.embrapa.br
- Mr. Johann du Preez, Manager/Horticulturist, Bavaria Estate, Westfalia, So. Africa at johannd@bavariafruit.co.za
- Dr. Victor Galán Saúco, Research Prof. (retired), Instituto Canario de Investigaciones Agrarians, Canary Islands, Spain at vgalan46@gmail.com

**Purpose of project**

Growing, producing, and marketing the right cultivar or cultivars has a critical impact establishing, maintaining and expanding the fresh fruit business in the western hemisphere. The international fresh mango fruit business is no different. Although the major cultivars in the trade, i.e., ‘Tommy Atkins’, ‘Keitt’, ‘Kent’, ‘Haden’ ‘Madame Francis’ and ‘Ataulfo’ possess many of the attributes of successful commercial cultivars, they all have their drawbacks.

- ‘Tommy Atkins’ produces well and adaptable to a wide range of climates. Fruit has moderate anthracnose tolerance, possess a pleasing peel color (orange-yellow ground color with dark red blush), firm pulp, deep yellow pulp color, tolerates hot-water treatment well, and stores and ships well. Drawbacks include fair taste, moderate pulp fiber, and a predisposition for pulp disorders (e.g., soft-nose, jelly-seed, internal breakdown, etc.).
- ‘Keitt’ also produces well, is adaptable to a wide range of climates and possess moderate anthracnose tolerance. The pulp possesses low fiber content and has a sweet, pleasant

flavor, tolerates hot-water treatment, and stores, and ships well. Major drawbacks include large size for some markets, a peel color dominated by green color, and some lenticel spot issues influenced by pre- and postharvest conditions.

- 'Kent' produces moderately well, possess a pleasing peel color (yellow-green ground color with red-crimson blush), pulp is deep-yellow-orange, sweet, rich-flavor and has low fiber content; tolerates hot-water treatment. Drawbacks include susceptibility to anthracnose and some postharvest storage issues (including internal breakdown).
- 'Haden' low to moderate production (depending upon location) and limited climatic adaptability. Beautiful peel color; bright yellow with red blush and large yellow dots. The pulp is firm, deep yellow with a sweet, rich flavor, and moderately fibrous. Drawbacks include relatively low yields or erratic yields, susceptibility to anthracnose and internal breakdown disorders.
- 'Madame Francis' produces moderately well and fills a niche in the market when other cultivars are not available. The pulp has moderate fiber content, orange color, and a rich spicy-sweet aroma; fair to good quality. Drawbacks include sigmoid shape fruit with a greenish to yellowish peel color and periodic lack of fruit availability.
- 'Ataulfo' produces moderately well but appears to have a narrow range in climatic adaptability. Fruit are moderately resistant to anthracnose with a yellow peel and yellow low fiber pulp that is sweet and flavorful. Fruit tolerate hot-water treatment and withstand shipping. This is the marketing breakthrough fruit for introducing yellow-peel colored fruit to the North American and European markets. Drawbacks include postharvest pulp issues if picked immature and/or chilled.

The fresh fruit mango trade in the western hemisphere is expanding and the market seems poised to accept new peel colors, shapes, sizes and flavors. However, establishing sufficient production and marketing of new cultivars can be a daunting task. There are major production, handling-postharvest, transport, and marketing considerations, which need to be worked out as much as possible if a new cultivar is to be successfully introduced. An initial step is for the mango industry to review a range of potential cultivars that have the attributes necessary for commercialization. The purpose of this report is to offer the results of a panel of scientists intimately familiar with mango cultivars and mango growing and handling in an effort to further develop the international mango industry of this continent.

**Importance of mango cultivars**

Given that appropriate cultural practices (e.g., plant nutrient and water management and pest control) are implemented, the four most important parameters for successful commercial production of mango are appropriate environmental conditions, adaptable rootstock, scion cultivar and market acceptance. Under acceptable subtropical and tropical climatic conditions, rootstocks adapted to the soil chemical and biological conditions play a major role in a successful production. If acceptable environmental conditions, and appropriate rootstocks and cultural practices are implemented, the scion cultivar (cultivated-variety) is paramount to successful mango production and marketing.

The criteria for a successful mango cultivar varies somewhat by what part of the mango business considered. Producers require that cultivars come into bearing fruit as soon as possible and have reliable crop yields, moderate to excellent resistance to diseases, insects and pests, possess acceptable fruit quality, and can tolerate postharvest handling and

shipping. In contrast, packers and handlers are more interested in cultivars that tolerate picking and postharvest quarantine treatments, sorting and packing, storage and shipping. Marketers require a year-round fruit supply of blemish-free fruit of acceptable internal and external color, taste, and texture, that ship and store well and that ripen to acceptable eating quality.

**Early commercial mango varieties in the western hemisphere**

The importation of mangos into the U.S. began during the 1800s when fruit from the Caribbean (primarily Cuba and Jamaica) was imported and sold to residents in Key West and the Gulf coast of Florida and eventually to large cities along the U.S. Atlantic seaboard (Wolfe, 1962). Simultaneously, seeds were introduced from Cuba to Florida during the 1840s and 1860s to establish commercial mango plantings. These were mostly polyembryonic criollo types of inferior quality (e.g., 'No. 11', 'Peach', 'Turpentine', and 'Apple'). However, during the late 1880s, small plantings of these were established in-land and along coastal counties from central to south Florida; many of these plantings were killed in the freeze of 1894-1895 (Wolfe, 1962). Beginning in 1885, the first grafted mango trees of superior varieties were imported from India into Florida and from 1889-on additional mango varieties were imported into Florida by the USDA, nursery companies and individuals. One USDA introduction made in 1889, 'Mulgoba' became the first commercial cultivar in Florida. By the early 1900s, sixty Indian mango varieties had been introduced into Florida (Knight and Schnell, 1993). In 1910, a seedling of 'Mulgoba' x 'Turpentine 10' was named 'Haden' and produced fruit of such obvious superior size, color and flavor that it became the basis for the rapid expansion of the Florida mango industry (Knight and Schnell, 1994). From 1912 to 1952 'Haden' was the most important commercial mango in Florida and indeed the U.S.

By 1937, there were over 522-mango variety (and/or seedlings) introductions into the USDA-ARS, Miami from Asia, Africa, Central and South America, the Caribbean and Pacific islands (Knight and Schnell, 1993). These introductions cross-pollinated forming new hybrids and potential new commercial cultivars. Distribution of seeds and seedlings from these introductions were made to other research institutions (e.g., Univ. of Fla.), commercial growers and mango enthusiasts. Interestingly, despite numerous mango introductions, natural crosses of 'Haden' along with a few other named seedling selections e.g., 'Brooks' resulted in major commercial mango cultivars such as 'Tommy Atkins' (? x 'Haden'), 'Keitt' (? x 'Brooks'), and 'Kent' ('Brooks' x 'Haden') (Schnell et al., 2006; Campbell, 1974; Mitchell, 1972; Ledin, 1954).

Today, 'Tommy Atkins', 'Keitt' and 'Kent' dominate the western hemisphere export production and U.S. import mango market (National Mango Board). Other cultivars of significance to the U.S. market include 'Ataulfo' ('Honey') (selected in Mexico), 'Madame Francis' (selected in Haiti) and 'Palmer' and 'Haden' (selected in the U.S.).

**Mango promotion and imports**

During the 1800s, U.S. and Caribbean settlers in Florida were familiar with mangos having grown up eating them. Naturally, interest in growing, importing, and marketing mangos within Florida and to out-of-state customers followed (Wolfe, 1962). As south Florida's population increased from the 1910s-onward interest in commercial production and as a dooryard fruit increased (Kent, 1945). Early promotion of mango consumption in the U.S. was from the efforts of the Florida Mango Forum, which formed in 1938 and disbanded in 2005 (Kent, 1945; JH Crane, personal communication). Over its nearly 70-year history, the forum's commercial and dooryard grower members held festivals in south Florida to promote mango

consumption, evaluated and selected new mango varieties (in conjunction with USDA and Univ. of FL scientists), and provided a forum for educating its members and the public on mango culture (Kent, 1945; Ledin, 1954).

During the late 1960s-early 1980s, the popularity and demand for mangos in the U.S. increased dramatically (from about 7 Mt to over 36 Mt) but the production in Florida could not fill that demand alone nor compete on price (Knight et al., 1984). This lead to a decline in Florida mango production and a steady increase in foreign mango imports; primarily from Mexico. Since the 1970s, the volume of mango imports to the U.S. steadily increased primarily from Mexico, Peru, Ecuador, Brazil, Guatemala, and Haiti (Evans, 2008; Evans and Mendoza, 2009). Likewise, U.S. per capita mango consumption has also increased from 0.25 lbs in 1980 to 2.87 lbs in 2013 (USDA-ERS, 2014). Today, U.S. fresh mango fruit imports are more than 400,000 Mt and valued more than $400 million annually (USDA-ERS, 2016). Beginning in 1999, the commercial mango industries from exporting countries began to organize for the benefit and development of the industry. This lead to the formation of National Mango Board (NMB) in 2004 whose purpose is to promote consumer and foodservice consumption of mango, improve communication within the industry, coordinate a generic marketing program, and to support relevant research and development programs for the industry (NMB, 2017). The NMB promotional programs target consumers in the U.S.A.

**Mango evaluation, selection and breeding**

There are literally thousands of mango varieties (i.e., cultivars, selections, accessions) (Mukherjee, 1953). However, the vast majority are not suitable for large-scale international trade due to production, postharvest, and/or marketing issues. Purposeful mango breeding has only occurred during the past 400 years or so and consisted of selecting superior mangos from chance seedling populations. Today, there is an expectation that the advanced technological and genetic tools, i.e., DNA-marker assisted breeding strategies and gene-editing tools (CRISPR) will speed mango cultivar development (Iyer and Schnell, 2009). This remains to be seen.

Traditional mango breeding is considered difficult and time consuming. This is because trees have a long juvenile period (i.e., seedlings may take four to ten years to flower), hybridization results in unpredictable outcomes, there are high rates of fruit drop (i.e., losing purposeful crosses), there are few zygotic seedlings produced from polyembryonic mango types, and because it takes time to evaluate new selections. Today worldwide most commercial mango cultivars were the result of chance seedlings identified decades to hundreds of years ago. This is especially true of the main commercial mango cultivars (e.g., ‘Tommy Atkins’, ‘Keitt’, ‘Kent’, ‘Ataulfo’) in the Western Hemisphere.

The search for superior mango cultivars probably began 4000 year ago in India, where at least 1000 varieties were recognized (Mukherjee, 1953). The Portuguese and Spaniards introduced Indian and Southeast Asian mangos into the western hemisphere during the 16$^{th}$ century (Mukherjee and Litz, 2009). Mangos were introduced into the West Indies during the mid to late18$^{th}$ century and to Florida in 1861 (Wolfe, 1962). Selection of superior seedlings from chance crosses were made for thousands of years and continues to this day in nearly every tropical and subtropical area of the world (e.g., parts of China, India, Iraq, Israel, Egypt, South Africa, Mexico, Brazil, etc.) (Iyer and Schnell, 2009).

**Modern era mango selection and breeding programs**

The beginnings of modern mango breeding began once the technology to investigate the mechanisms and relationships of genetic inheritance and diversity was far enough developed to generate the necessary information on important tree and fruit characteristics and how they were inherited; probably during the late 1970s and 1980s (Iyers and Schnell, 2009). Interestingly, new selections and cultivars have been developed from breeding programs where genetically desirable parent cultivars can cross naturally and repeated selection is made from a large seedling population and from purposeful controlled pollinations (i.e., either by caging and/or hand pollinations) (Pinto et al., 2004; Dillon et al., 2013; Faleiro et al., 2009). As the science of genomics, bioinformatics and biotechnology progresses, marker assisted selection (MAS) using genetic linkage maps and quantitative trail loci (QTLs) for desirable fruit and tree performance traits will drive to improve breeding efficiency and decrease the time-line for developing superior mango cultivars and rootstocks (Bally et al., 2009; Lavi et al., 2004; Litz, 2004; Krishna and Singh, 2007). Active breeding programs using some combination of biotechnology, bioinformatics and traditional breeding methods occur in nearly all mango-producing regions of the world including India, Mexico, Australia, Israel, South Africa, Brazil, and the U.S. In the near future, development and release of superior mango cultivars will increase.

**Current breeding programs**

***U.S.A.***

USDA-ARS, Miami (https://www.ars.usda.gov/crop-production-and-protection/plant-genetic-resources-genomics-and-genetic-improvement/ and https://www.ars.usda.gov/research/research-programs-by-state/?state=FL&npCode=301)

This agricultural research center has had a long and distinguished mango history and houses over 400 accessions (types of mangos) in its field collections. The main goal of the current mango projects is to develop the genomic tools and data to improve mango breeding efficiency, e.g., identification of mango accessions (plants) with superior disease resistance, develop the necessary genomic data for breeders to enhance marker assisted breeding of mango. To date no new cultivars have been released from this program.

- Project Leader, Dr. David Kuhn, Geneticist (email, David.Kuhn@ars.usda.gov). Title: Conservation, genetic analysis, and utilization of subtropical/tropical fruit crops (including mango), sugarcane, and Miscanthus genetic resources (Proj. No. 6083-21000-022-00-D). The goal of the project is to develop the genetic marker information and genetic linkage maps to identify and map quantitative trail loci (QTLs) to improve plant breeding efficiency and breeding for disease resistance (e.g., anthracnose – the major fruit diseases of mango).

- Project Leader, Dr. David Kuhn, Geneticist. Title: Genetics and genomics of tropical fruit (including mango), sugarcane and grasses (Proj. No. 6038-21000-011-04-S). The goal of this project is to streamline and integrate genetic and phenotypic (observable growth and

stages of growth and development) data with the germplasm (i.e., trees in the field) to improve breeding efficiencies.

- Project Leader, Dr. David Kuhn, Geneticist. Title: Optimization of disease resistance phenotyping methods in cacao, avocado, and mango (Proj. No. 6083-21000-023-08-S). For mango, the goal of this project is to utilize phytopathological screening methods to identify disease resistant mango germplasm (plants) and to phenotype (identify observable plant characters) mango breeding populations that are segregating for anthracnose resistance. All this to improve the efficiency of mango breeding programs.

- Project Leader, Dr. David Kuhn, Geneticist. Title: Genetic mapping, germplasm evaluation and development of genomic tools for mango to accelerate breeding of improved cultivars (Proj. No. 6038-21000-022-07-T). The goal of this project is to develop a detailed genetic map for mango and to screen mango trees (cultivars, varieties, seedlings, and selections) with favorable traits for future breeding.

Fairchild Tropical Botanical Garden (FTBG), Tropical Fruit Program (http://www.fairchildgarden.org/ and http://www.fairchildgarden.org/horticulture/the-fairchild-farm)

The Fairchild Tropical Botanical Garden's Fairchild Farm research and education facility has the largest and most diverse mango collection in the U.S. mainland. Drs. Noris Ledesma, Curator (nledesma@fairchildgarden.org) and Richard Campbell, former Sr. Curator and Dir. of Horticulture Programs (rcampbell@cirulibrothers.com) have over 600 mango accessions (i.e., cultivars, selections) and 12 *Mangifera* species. Recently they have been cage-crossing specific mango cultivars and/or species to develop superior scion and/or rootstock selections.

***Israel***

The Agricultural Research Organization (ARO), The Volcani Institute, Beit Dagan, Israel (http://www.agri.gov.il/en//pages/1023.aspx and http://www.agri.gov.il/people/593.aspx)

Mango breeding in Israel began in 1972 and has resulted in several new cultivars and numbered selections (Tomer, 1997). The Volcani Institute's breeding program has expanded and intensified since the late 1970s and employs a combination of modern molecular technology and traditional breeding (Lavi et al., 1997; Lavi et al., 1998; Lavi et al., 2004; Sherman et al., 2015). Their breeding program has resulted in a number of released cultivars e.g., 'Noa', 'Shelli', 'Maya', 'Omer', 'Agam', and 'Tali' and superior selections (Ahituv, 2016; Lavi, 1996a; Lavi, 1996b).

Contacts – Dr. Uri Lavi-Gefel, Prof. (retired) at ulavi@volcani.agri.gov.il and Dr. Yuval Choen, Prof. at vhyuvalc@volacani.agri.gov.il

### *Australia*

Department of Agriculture, Fisheries and Forestry, Agri-Science Queensland and Commonwealth Scientific and Industrial Research Organization (CISIRO), Australia (https://www.daf.qld.gov.au/ and https://www.csiro.au/)

Australia has had an active mango evaluation, selection and breeding program since the 1960s (Bally et al., 2009a and 2009b; Dillion et al., 2013). The Australian Mango Breeding Program incorporates traditional breeding with modern molecular technology (Bally et al., 2009b; Dillon et al. 2013; Whiley et al., 1993). Their breeding programs have resulted in many released cultivars and selections e.g., 'R2E2', 'Calypso', 'Honeygold', 'NMBP1201' and 'Kensington KRS' (Dillion et al., 2013; Bally et al., 2009b).

Contact – Ian S.E. Bally, Principle Horticulturist at ian.bally@daf.qld.gov.au

### *Brazil*

EMBRAPA, The Brazilian Agricultural Research Corporation, Ministry of Agriculture at Cerrados Research Center, the Semi-arid and Middle-North Research Centers, and the Paulista Agency for Technology and Agribusiness Center and Instituto Agronómico de Campinas (https://www.embrapa.br/en/international and https://www.embrapa.br/en/mandioca-e-fruticultura)

The Brazilian mango selection and breeding program began in the 1970s with the introduction and collection and evaluation of local and introduced mango cultivars (Pinto et al., 2004a and 2004b). The breeding programs employ traditional and modern breeding strategies and have resulted in a relatively large number of new selections and cultivars including 'Alfa', 'Roxa', 'Beta', CPAC 44/86, and CPAC 239/84 (Pinto et al., 2015; Pinto et al., 2009; Pinto et al., 2000; Ribeiro, et al., 2015; Santos et al., 2008; Santos et al., 2010, Santos-Ribeiro et al., 2013).

Contact – Dr. Francisco Pinheiro Neto, National Leader – Mango Breeding Program, EMBRAPA at pinheiro.neto@cpatsa.embrapa.br

### *South Africa*

The Institute for Tropical and Subtropical Crops (ITSC; http://www.arc.agric.za/) and Westfalia Technological Services (WTS formerly Merensky Technological Services) have had mango breeding and selection programs since the 1990s and 1970s, respectively (Cilliers et al., 1996; Human et al., 2009; Human and Rheeder, 2004; Le Lagadec and Köhne, 2004; Le Lagadec et al., 2009). The selection program and breeding programs resulted in a relatively large number of new selections and cultivars including 'Princess', 'Joa', 'Chené', 'Neldica', (Brewer and van Rooyen, 2013; Le Lagadec et al., 2009; Le Lagadec and Köhne, 2004)

Contact – Dr. Stefan Köhne, Gen. Mng R&D, Westfalia Technological Services (http://www.westfaliafruit.com/en-za/Pages/default.aspx), South Africa at

thereseb@westfalia.co.za and Dr. Danielle Le Lagadec, Principle Horticulturist, National Dept. of Agric., Forestries, and Fisheries at http://www.daff.gov.za/daffweb3/Contact-us

***Taiwan and China***

Taiwan has a long history of commercial mango production (1960s) and several institutions have been involved in the selection and breeding of mango cultivars. These include the National Pingtung University of Science and Technology, Pingtung, Taiwan and the Fengshan Tropical Horticulture Experiment Station, Fengshan, Taiwan. Since the 1980s, there has been an active selection and cultivar-breeding program (Shu et al., 2000; Crane et al., 2009). The current selection and breeding program employs traditional and molecular marker assisted techniques. Cultivars selected from their breeding program include 'Jin-hwung' (1980) cultivars released include 'Tainong No. 1' and 'Tainong No. 2' (1985) (Crane et al., 2009).

Commercial mango production on mainland China began during the 1980s (Gao et al., 2011) and since the 1960s several research institutes began mango germplasm collections and selection and breeding programs [e.g., Tropical Crops Genetic Resources Institute, Chinese Academy of Tropical Agriculture Science (CATAS) in Hainan and South Subtropical Crops Research Institute, CATAS, in Guangdong] (Chen, 2013; Wang et al., 2013). Cultivars selected from seedling populations include 'Zhihua', 'Red Ivory', 'Guire 10', and 'Panxi Red'. Cultivars derived from hand-pollinations include 'Guixiang', 'Lupi' and 'Guire 80-17' (Chen, 2013; Gao et al., 2011).

Contact – Taiwan. Dr. Chung-Ruey Yen, Dean. National Pingtung University of Science and Technology (http://mportal.npust.edu.tw/bin/home.php?Lang=en), Pingtung, at yencr@mail.npust.edu.tw and Taiwan Agricultural Research Institute (http://www.tari.gov.tw/english/index.asp), Dr. Wen-Li Lee, Head. Fenghan Tropical Horticultural Experiment Branch, at leewen@fthes-tari.gov.tw

Contact – Hainan. Dr. Aiping Gao, Tropical Crops Genetic Resources Institute (TCGR; http://www.catas.cn/department/pzs/english/about/index.asp), CATAS, Hainan, at aipinggao@126.com and Dr. Yeyan Chen, Dir., TCGR, at chenyy1962@126.com

**Recommendations for advancing "new" cultivars into the markets**

The mango markets of tropical and subtropical Asia are more cultivar diverse and sophisticated than that of North America. This may be due to production areas' proximity to their markets, the great esteem, long associative history and demand for local mangos in Asia. In contrast, the North American and European market for mangos is relatively young, less developed and sophisticated. This may be attributed to the relatively long distance among producers and consumers and less familiarity (history) with mango consumption by these populations.

Until relatively recently, reddish-colored mangos dominated the North American market and only relatively recently has 'Ataulfo' opened up consumers' minds and pallets to the possibilities that mango fruit of other colors are just a delicious as red-types. Changing consumer tastes and demands generally is a slow process. However, with the increased diversity of the North American and European populations there is great opportunity for mango

producers, exporters/importers and consumers to expand the mango fruit diversity available for consumption. There is a range of red, green, yellow and mixed color-peel apple cultivars in the market and this could be duplicated by the mango industry.

**Mango Cultivar Panel —- Findings**

A brief description of each mango cultivar recommended by Panel members, followed by photographs and a list of sources for further documentation. For detailed information on each mango cultivar, please refer to the excel file.

**‘Agam’** is a medium- to large sized fruit (330-520 g; average 450 g), roundish (broad-shaped) with a dark red to scarlet color and numerous yellow dots (lenticels). The pulp is dark orange, firm texture with very low fiber. The fruit has a pleasant aroma and a rich sweet flavor with good to excellent eating quality. Anthracnose tolerance unknown. Tolerant to postharvest handling but unknown tolerance to postharvest quarantined treatment (e.g., hot water treatment). Trees harvested early season. ‘Agam’ is registered in Israel and for information on propagation availability contact the Volcani Center, Israel.





Photo credits: Volcani Research Center

Recommended by Dr. Yuval Cohen

Contact: Dr. Yuval Cohen, Plant Breeder, Volcani Research Institute, Bet-Dagan, Israel at pinheiro.neto@cpatsa.embrapa.br

Further documentation

Ahituv, N. 2016. Mango mania: Israel is an emerging mango superpower. Haaretz News (accessed 3-16-17) [http://www.haaretz.com/israel-news/.premium-1.738736]

Anonymous. 2017. Mango ‘Agam’. The Agricultural Research Organization (ARO), Israel. 2 pages.

Cohen, Y., D. Saada, R. Dor, A. Keinan, and M. Noy. 2016. Set of elite new Israeli mango cultivars. AgroIsrael 2:64-69. [info@agroisrael.net]

**‘Ah Ping’** is a medium- to large sized fruit (300-900 g), oblong-oval shaped fruit with a reddish crimson blush on yellow peel with large dots (lenticels). The pulp is orange colored with very low fiber, sweet with good to excellent eating quality. Postharvest handling and tolerance to quarantine treatments (i.e., hot water and radiation) are unknown. ‘Ah Ping’ is an early season cultivar. The fruit is susceptible to anthracnose. Suitable for fresh market, not evaluated for fresh cut markets. The cultivar readily available for propagation.




Photo credits: www.picssr.com

Recommended by Dr. Victor Galán Saúco

Contact: Dr. Victor Galán Saúco, Research Prof. (retired), Instituto Canario de Investigaciones Agrarias, Canary Islands, Spain at vgalan46@gmail.com

Further documentation

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Torres, AC., D. F. Galván, and V. Galán Saúco. 1997. Guía descriptiva de cultivares de mango. Monografías Técnicas, Dep. De Fruticultura Tropical, Instituto Canario de Investigaciones Agrarias. 73 pages.

**‘Angie’** is a medium size fruit (350-480 g), oval to oblong-shaped fruit with a yellow pink to reddish blush that turns yellow at ripening. The pulp is yellow to orange colored with very low fiber, has a pleasant aroma, is sweet (18-22°Brix) with excellent eating quality. The fruit has excellent anthracnose tolerance and a low incidence of internal breakdown issues. Postharvest handling rated good but reaction to quarantine treatments (i.e., hot water and radiation) are unknown. In Florida, ‘Angie’ trees normally flower in Jan.-Feb. and harvested in May. Suitable for fresh market, not evaluated for fresh cut markets. Cultivar readily available for propagation.






Photo credits: Noris Ledesma© (L), Jonathan Crane© (R)

Recommended by Dr. Noris Ledesma and Dr. Jonathan Crane

Contacts: Dr. Noris Ledesma, Curator, Tropical Fruit Program, Fairchild Tropical Botanical Garden, Miami, Florida at nledesma@fairchildgarden.org and Dr. Jonathan H. Crane, Tropical Fruit Crop Specialist, Univ. of Florida, IFAS, Tropical Research and Education Center, Homestead, Florida at jhcr@ufl.edu

Further documentation

Campbell, R.J. and N. Ledesma. 2015. Mango cultivars with potential for commercial development. Acta Hort. 1075:33-45.

**‘Ataulfo Diamante’** is a small fruit (~271 g), oblong-shaped fruit with a ripe yellow peel. The pulp is golden yellow with no fiber, a pleasant aroma and is sweet (15°Brix) with good to excellent eating quality. The fruit has fair tolerance to anthracnose and a low incidence of internal breakdown issues. Fruit harvested late susceptible to lenticel spot. Postharvest handling and tolerance to hot-water treatment rated good to excellent; excellent tolerance to hydro-cooling and shipping. In Mexico, ‘Ataulfo Diamante’ trees normally flower in October-November and harvested in February-April. Suitable for fresh and fresh cut markets. Cultivar is registered but reported to be readily available for propagation.

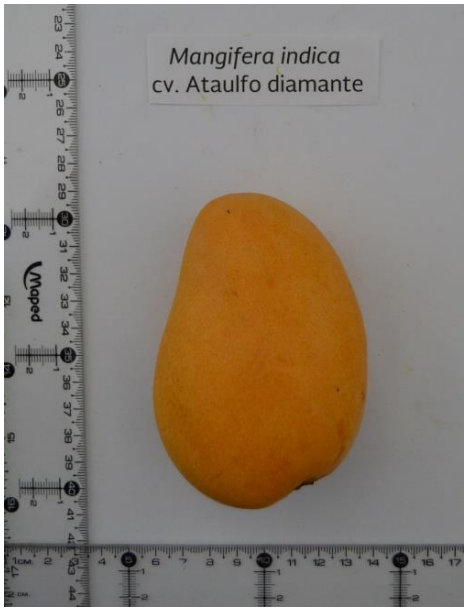



Photo credit: Dr. Alfredo Sandoval©

Recommended by Dr. Víctor Palacio Martínez and Dr. Samuel Salazar-Garcia

Contact: Dr. Samuel Salazar-Garcia, Dir., INIFAP (Instituto Nacional de Investigaciones Forestales, Agrícolas y Pecuarias), Tepic-Mazatlán, Mexico at salazar.samuel@inifap.gob.mx

Further documentation

Marín, A.B., E. Hernández-Castro, A.D. Nava, J.A. Mora-Aguilera, and F.P. Alberto. 2016. Crecimiento de cinco cultivares de mango (*Mangifera indica* L.) con alto potencial productivo en la Costa Chica de Guerrero, México. Revista Tlamati 7(1):31-35.

**‘Ataulfo Zafiro’** is a small fruit (~265 g), oblong-shaped fruit with a ripe yellow peel. The pulp is golden yellow with no fiber, a pleasant aroma and is sweet (13.5°Brix) with good to excellent eating quality. The fruit has fair tolerance to anthracnose and a low incidence of internal breakdown issues. Fruit harvested late susceptible to lenticel spot. Postharvest handling and tolerance to hot-water treatment rated good to excellent; excellent tolerance to hydro-cooling and shipping. In Mexico, ‘Ataulfo Zafiro’ trees normally flower in October-November and harvested in February-April. Suitable for fresh and fresh cut markets. Cultivar is registered but reported to be readily available for propagation.




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Recommended by Dr. Víctor Palacio Martínez and Dr. Samuel Salazar-Garcia

Contact: Dr. Samuel Salazar-Garcia, Dir., INIFAP (Instituto Nacional de Investigaciones Forestales, Agrícolas y Pecuarias), Tepic-Mazatlán, Mexico at salazar.samuel@inifap.gob.mx

Further documentation

Marín, A.B., E. Hernández-Castro, A.D. Nava, J.A. Mora-Aguilera, and F.P. Alberto. 2016. Crecimiento de cinco cultivares de mango (*Mangifera indica* L.) con alto potencial productivo en la Costa Chica de Guerrero, México. Revista Tlamati 7(1):31-35.

**‘Calypso’** is a medium- to large sized fruit (350-570 g), elliptic to round shape with a slight beak; a yellow-pink peel. The pulp is orange, firm with medium-low fiber, and has a sweet rich flavor and mild aroma, good eating quality. The fruit is susceptible to sap burn, has fair tolerance to anthracnose and scab and has a low incidence of internal breakdown issues. General postharvest handling and shelf life rated good and low susceptibility to chilling injury. Tolerance to hot water treatment, forced-air cooling and shipping stress rated as fair, fair and good. Mid- to late season harvest period. Cultivar patented but reported available for propagation.





Photo credits: https://twitter.com/calypsomangoes (L) and http://www.calypsomango. com.au/ find-out/calypso-regions/ (R)

Recommended by Dr. Ian S.E. Bally

Contact: Dr. Ian S.E. Bally, Horticulturist/Breeder, Dept. of Primary Industries, Queensland, Australia at Ian.Bally@daf.qld.gov.au

Further documentation

Anonymous. 2015. Calypso™ (B74). Department of Agriculture and Fisheries, Queensland, Australia. Accessed 6-17-17. https://www.daf.qld.gov.au/plants/fruit-and-vegetables/fruit-and-nuts/mangoes/mango-varieties/b74.

**‘Cavallini’** is a medium fruit (~508 g), oblong-round shaped with a greenish-red mature peel and yellow-red ripe peel. Reported good eating quality. Although registered it is probably available for propagation.





Photo credits: Sr. Juan Mora©

Recommended by Dr. Victor Galán Saúco

Contact: Dr. Victor Galán Saúco, Research Prof. (retired), Instituto Canario de Investigaciones Agrarias, Canary Islands, Spain at vgalan46@gmail.com

Further documentation

Victor Galán, personal communication with notes from Juan Mora, Costa Rica.

**‘Cogshall’** is a medium size fruit (280-500 g), 11-14 cm long, 6.2-8.5 cm dia., oblong with rounded base, yellow-to-yellow-orange peel with crimson blush. The pulp is yellow-orange, low in fiber, with a pleasant aroma and spicy, sweet rich flavor, with good to excellent eating quality. The fruit has fair anthracnose tolerance depending upon production area (climatic conditions). Postharvest handling and tolerance to quarantine treatments (e.g., hot-water treatment) are unknown. ‘Cogshall’ is an early to midseason cultivar. Cultivar readily available for propagation.




Photo credits: Jonathan H. Crane©

Recommended by Dr. Victor Galán Saúco and Dr. Jonathan H. Crane

Contact: Dr. Victor Galán Saúco, Dr. Noris Ledesma, and Dr. Jonathan H. Crane

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**‘Duncan’** is a medium-large sized fruit (450-670 g), 12.5-14.5 cm long and 7-10 cm in dia., oblong shaped with a slightly acute apex, a bright yellow peel and no blush. The pulp is orange, firm with low fiber, and has a mild and sweet pleasant aroma, very good to excellent eating quality. Rough postharvest handling may damage fruit, somewhat susceptible to sap burn, and tolerance to quarantine treatments (e.g., hot-water treatment) are unknown. May be suitable for fresh and fresh-cut markets. Mid-season harvest period. Cultivar readily available for propagation.

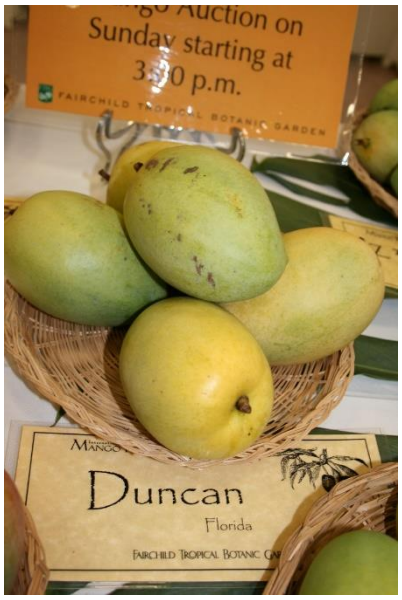



Photo credits: Mark Nickum©

Recommended by Dr. Jonathan H. Crane

Contact: Dr. Jonathan H. Crane, Tropical Fruit Crop Specialist, Univ. of Florida, IFAS, Tropical Research and Education Center, Homestead, Florida at jhcr@ufl.edu and Dr. Noris Ledesma, Curator, Tropical Fruit Program, Fairchild Tropical Botanical Garden, Miami, Florida at nledesma@fairchildgarden.org

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**‘Edward’** is a medium to large sized fruit (~420-620 g), oblong to round-shaped fruit with a ripe green with pink blush peel color. The pulp is yellow-orange, low in fiber, with a mild pleasant aroma and is sweet (14°Brix) with good to excellent eating quality. The fruit has poor to good tolerance to anthracnose depending upon production area (climatic conditions) and a low incidence of internal breakdown issues. Moderately resistant to anthracnose. Low to moderate yields. Postharvest handling and tolerance to hot-water treatment rated good to excellent; excellent tolerance to hydro-cooling and shipping. In Mexico, ‘Edward’ trees normally flower in November and harvested in February-April. In Florida, flower anytime from November to January and harvested in June-July. Cultivar readily available for propagation.







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Recommended by Dr. Alfredo Sandoval Esquivez, Dr. Samuel Salazar García, and Dr. Jonathan Crane

Contacts: Dr. Samuel Salazar-Garcia, Dr. Noris Ledesma, and Dr. Jonathan H. Crane

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**‘Espada Ouro’** is a small fruit (~275 g), 10 cm long and 6.3 cm dia., oblong with a yellow peel. The pulp is yellow-orange, firm with low fiber, and is aromatic with a sweet flavor (20.2° Brix) and of excellent eating quality. Anthracnose tolerance unknown. Postharvest handling tolerance is unknown (i.e., hot water and radiation). ‘Espada Ouro’ typically flowers Feb.-March and harvested in May-June. Not grown commercially at this time but the cultivar readily available.

NO PHOTOGRAPHS AVAILABLE

Recommended by Dr. Francisco Pinheiro

Contact: Dr. Francisco Pinheiro, National Leader, Mango Breeding Program, EMBRAPA, Brazil at pinheiro.neto@cpatsa.embrapa.br

Further documentation

Contact: Dr. Francisco Pinheiro, National Leader, Mango Breeding Program, EMBRAPA, Brazil at pinheiro.neto@cpatsa.embrapa.br

Santos Ribeiro, I.C.N. dos, C.A. F. Santos, F.P.L. Neto. 2013. Morphological characterization of mango (Mangifera indica) accessions based on Brazilian adapted descriptors. J. Agricultural Science and Technology B 3:298-806.

**‘Favo de Mel’** is a small fruit (~330 g), 9 cm long and 7.6 cm dia., roundish with a yellow-orange peel. The pulp is light yellow, firm with very low fiber, and is aromatic with a sweet flavor (21° Brix) and of excellent eating quality. Anthracnose tolerance unknown. Postharvest handling tolerance is unknown (i.e., hot water and radiation). ‘Favo de Mel’ typically flowers Jan.-Feb. and harvested in April-May. Not grown commercially at this time but the cultivar readily available.

NO PHOTOGRAPHS AVAILABLE

Recommended by Dr. Francisco Pinheiro

Contact: Dr. Francisco Pinheiro, National Leader, Mango Breeding Program, EMBRAPA, Brazil at pinheiro.neto@cpatsa.embrapa.br

Further documentation

Santos Ribeiro, I.C.N. dos, C.A. F. Santos, F.P.L. Neto. 2013. Morphological characterization of mango (Mangifera indica) accessions based on Brazilian adapted descriptors. J. Agricultural Science and Technology B 3:298-806.

**‘Gouveia’** is a medium sized fruit (300-450 g), 9.5 to 11.5 cm long and 7 to 9 cm dia., oblong-oval with a greenish-yellow-orange-red peel with large dots (lenticels). The pulp is orange, firm with low fiber, with good to very good eating quality. Anthracnose tolerance unknown. Postharvest handling tolerance is unknown (i.e., storage, hot water and radiation treatment). ‘Gouveia’ typically is a mid-season cultivar. No significant commercial production but the cultivar is readily available.




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Recommended by Dr. Victor Galán Saúco

Contact: Dr. Victor Galán Saúco, Research Prof. (retired), Instituto Canario de Investigaciones Agrarias, Canary Islands, Spain at vgalan46@gmail.com and Dr. Noris Ledesma, Curator, Tropical Fruit Program, Fairchild Tropical Botanical Garden, Miami, Florida at nledesma@fairchildgarden.org

Further documentation

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**‘Harders’** is a medium sized fruit (300-450 g), 9.5-11.5 cm long, 7-10 cm dia., oblong-elliptic shaped with a yellow ground color and red blush, numerous medium sized yellow dots (lenticels). The orange pulp is low fiber, has a pleasant aroma, and is sweet with good to excellent eating quality. Anthracnose tolerance unknown. Postharvest handling is not documented (e.g., storage) and tolerance to quarantine treatments unknown. Harders’ is a mid-season (June-August) cultivar. Cultivar readily available for propagation.

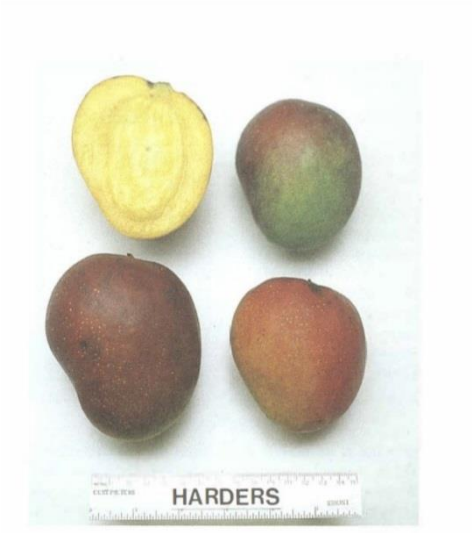



Photo credits: Dr. R.A. Hamilton©

Recommended by Dr. Victor Galán Saúco

Contact: Dr. Victor Galán Saúco, Research Prof. (retired), Instituto Canario de Investigaciones Agrarias, Canary Islands, Spain at vgalan46@gmail.com

Further documentation

Galán Saúco, V. 1999. El cultivo del mango. Gobierno de Canarias and Grupo Mundi-Prensa, Madrid, España. 298 pages.

Hamilton R.A. 1993. Origin and classification of mango varieties in Hawaii. In: Chia CL, Evans DO, editors. 1993. Proceedings, Conference on Mango in Hawaii; March 9-11, 1993; Honolulu, Hawaii. Honolulu (HI): University of Hawaii. p. 28-33.

**‘Isis’** is a large sized fruit (450-870 g), >11.5 cm long and >9 cm dia., oval-irregular with a greenish-yellow-red to yellowish orange peel. The pulp is yellow, firm with very low fiber, moderate sweetness (14°Brix) with slight turpentine flavor and good eating quality. Anthracnose tolerance unknown. Postharvest handling tolerance is unknown (i.e., storage, hot water and radiation treatment). ‘Isis’ typically harvested early to mid-season. No significant commercial production but cultivar readily available.

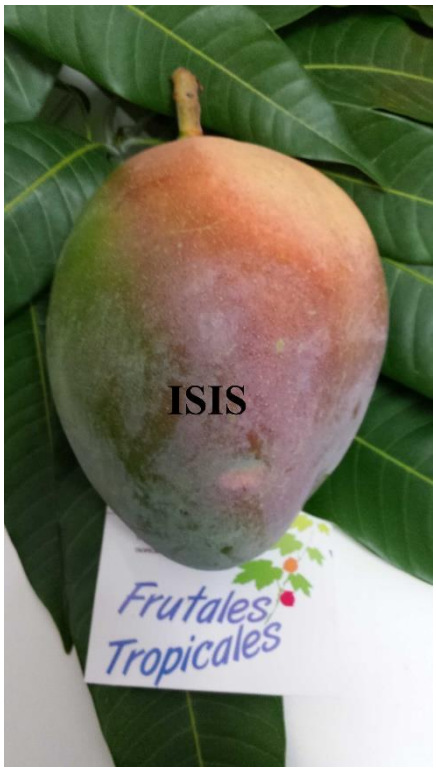





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Recommended by Dr. Victor Galán Saúco

Contact: Dr. Victor Galán Saúco, Research Prof. (retired), Instituto Canario de Investigaciones Agrarias, Canary Islands, Spain at vgalan46@gmail.com

Further documentation

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**‘Kensington Pride’** is a medium to large sized fruit (350-750 g), elliptically shaped with a slight beak; a light green/orange blush at maturity and a yellow peel with dark pink to orange-red blush. The pulp is light orange, firm with low fiber, and has a sweet rich flavor and strong aroma; very good eating quality. The fruit is susceptible sap burn, anthracnose tolerance moderate, susceptible to black spot but has a low incidence of internal breakdown issues. General postharvest handling, tolerance to hot water treatment and shipping stress rated as fair. Tolerance to irradiation, hydrocooling, forced air-cooling, and shipping rated fair to good, good, good to excellent, and poor to fair, respectively. Mid-season harvest period. Cultivar readily available for propagation.





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Recommended by Dr. Ian S.E. Bally

Contact: Dr. Ian S.E. Bally, Dr. Jonathan H. Crane, and Dr. Noris Ledesma

Further documentation


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**‘Maha Chinook’** is a Thai cultivar, small to medium sized fruit (262-435 g), ellipsoid shaped with a slight beak and a yellow-pink peel. The pulp is light orange, firm with very low fiber, and has a sweet distinct flavor and mild aroma; very good eating quality. The fruit is susceptible to sap burn, unknown tolerance to anthracnose, and fair tolerance to scab. General postharvest handling and shelf life rated okay with unknown incidence of internal breakdown. Tolerance to hot water treatment and reaction to forced-air cooling not known. Mid- to late-season harvest period. Cultivar readily available for propagation.





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Recommended by Dr. Ian S.E. Bally

Contacts: Dr. Ian S.E. Bally, Horticulturist/Breeder, Dept. of Primary Industries, Queensland, Australia at Ian.Bally@daf.qld.gov.au and Dr. Noris Ledesma, Curator, Tropical Fruit Program, Fairchild Tropical Botanical Garden, Miami, Florida at nledesma@fairchildgarden.org

Further documentation – see excel file.

**‘Mallika’** is a medium size fruit (280-510 g), oblong-sigmoid shaped fruit with a bright yellow-to-yellow-orange peel. The pulp is orange colored with very low fiber, has a pleasant strong aroma, and is sweet (20-22°Brix) with excellent eating quality. The fruit has good anthracnose tolerance and a low incidence of internal breakdown issues. For optimum fruit quality and postharvest handling, fruit should be picked green and hard and stored at room temperature for 2 to 3 weeks. Normal postharvest handling rated as okay but reaction to hot water treatment is unknown. In Florida, ‘Mallika’ trees normally flower in Jan.-Feb. and harvested in June-July. Cultivar readily available for propagation.





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Recommended by Dr. Noris Ledesma and Dr. Odilo Duarte

Contact: Dr. Noris Ledesma, Curator, Tropical Fruit Program, Fairchild Tropical Botanical Garden, Miami, Florida at nledesma@fairchildgarden.org and Dr. Jonathan H. Crane, Tropical Fruit Crop Specialist, Univ. of Florida, IFAS, Tropical Research and Education Center, Homestead, Florida at jhcr@ufl.edu

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**‘Nam Doc Mai’** is a Thai cultivar with medium size fruit (340-580 g), oblong-sigmoid shaped fruit with blunt apex, and a light green to bright yellow peel and slight pink blush. The pulp is lemon yellow colored with very low fiber, has a pleasant aroma, and has a rich and spicy flavor with excellent eating quality. The fruit has poor to fair anthracnose tolerance, good tolerance to black spot and unknown incidence of internal breakdown issues. Postharvest handling and reaction to hot water quarantine treatment is not known; poor tolerance to irradiation. Mid-season harvest period. Cultivar readily available for propagation.








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Recommended by Dr. Odilo Duarte

Contact: Dr. Odilo Duarte, Prof., Dr. Noris Ledesma and Dr. Jonathan H. Crane

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**NMBP1201** is a small to medium sized fruit (345-530 g), roundish shape with a slight beak; a yellow-red (orange)/dark red peel. The pulp is yellow-orange, soft with very low fiber, and has a sweet rich flavor and mild aroma; excellent eating quality. The fruit is susceptible to sap burn, has poor tolerance to anthracnose, and fair tolerance to scab. General postharvest handling and shelf life rated okay with low incidence of internal breakdown. Fair tolerance to hot water treatment; unknown reaction to forced-air cooling. Mid-season harvest period. Not patented but currently restricted to Australian growers.





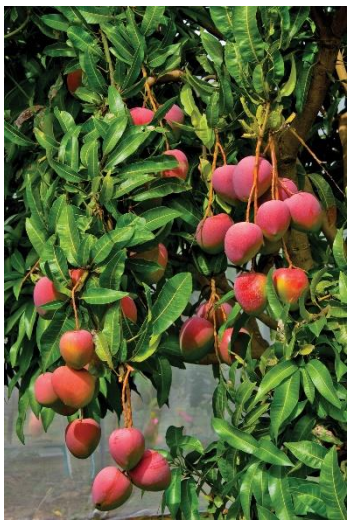


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Contact: Dr. Ian S.E. Bally, Horticulturist/Breeder, Dept. of Primary Industries, Queensland, Australia at Ian.Bally@daf.qld.gov.au

Further documentation

Bally, I.S.E. 2009. New mango hybrid NMBP-1201. [https://www.agric.wa.gov.au/mangoes/new-mango-hybrid-nmbp-1201].

**NMBP1243** is a small to medium to large sized fruit (319-750 g), roundish shape with a slight beak; a yellow-pink-red (orange) peel. The pulp is light orange, medium firm with low fiber, and has a sweet rich flavor and mild to strong aroma; excellent eating quality. The fruit is susceptible to sap burn, has poor tolerance to anthracnose, and fair tolerance to scab. General postharvest handling and shelf life rated okay with low incidence of internal breakdown. Tolerance to hot water treatment and forced-air cooling were rated as good and fair, respectively. Early season harvest period. Not patented but currently restricted to Australian growers.







Photo credits: https://www.agric.wa.gov.au/mangoes/new-mango-hybrid-nmbp-1243

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Contact: Dr. Ian S.E. Bally, Horticulturist/Breeder, Dept. of Primary Industries, Queensland, Australia at Ian.Bally@daf.qld.gov.au

Further documentation – see excel file.

**NMBP4069** is a small to medium sized fruit (325-500 g), roundish shape with a slight beak; a yellow-pink (orange) peel. The pulp is yellow-orange, medium firm with low fiber, and has a sweet rich flavor and mild aroma; excellent eating quality. The fruit is susceptible to sap burn, has poor tolerance to anthracnose, and fair tolerance to scab. General postharvest handling and shelf life rated okay with low incidence of internal breakdown. Tolerance to hot water treatment and forced-air cooling rated as good and fair, respectively. Early, early-mid season harvest period. Not patented but currently restricted to Australian growers.





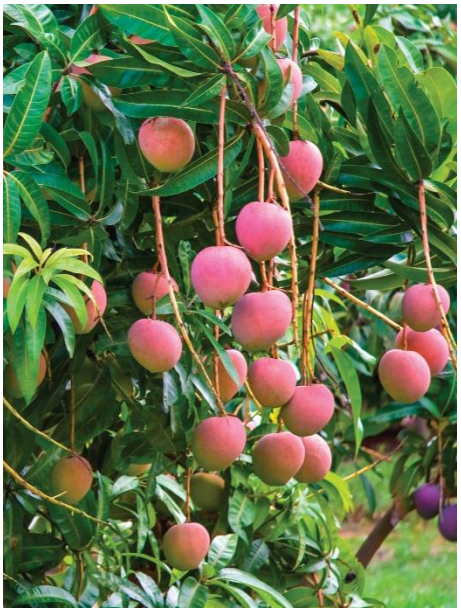


Photo credits: https://www.agric.wa.gov.au/mangoes/new-mango-hybrid-nmbp-4069

Recommended by Dr. Ian S.E. Bally©

Contact: Dr. Ian S.E. Bally, Horticulturist/Breeder, Dept. of Primary Industries, Queensland, Australia at Ian.Bally@daf.qld.gov.au

Further documentation – see excel file.

**‘Noa’** is a large fruit (483-812 g; average 650 g), 13-14 cm long, 9-10 cm dia., broad elliptic-oval shaped with a yellow ground color and large-area with a blend of red, orange, yellow and green color blush, numerous small yellow dots (lenticels). The pulp is medium-orange, firm with low fiber. The fruit has a pleasant aroma, and a rich sweet flavor with good eating quality. Anthracnose tolerance unknown. Tolerant to postharvest handling and shipping; unknown tolerance to postharvest quarantined treatment. Trees harvested mid- to late season. ‘Noa’ is registered in Israel and for information on propagation availability contact the Volcani Center, Israel.





Photo credits: Volcani Research Center

Recommended by Dr. Yuval Cohen

Contact: Dr. Yuval Cohen, Plant Breeder, The Volcani Institute, Bet-Dagan, Israel at vhyuvalc@volcani.agri.gov.il

Further documentation

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Cohen, Y., D. Saada, R. Dor, A. Keinan, and M. Noy. 2016. Set of elite new Israeli mango cultivars. AgroIsrael 2:64-69. [info@agroisrael.net]

**‘Omer’** is a medium-large fruit (average 450 g), oval shaped with a yellow ground color and large-area purple-red blush, numerous small yellow dots (lenticels). The pulp is medium - orange, firm with low fiber. The fruit has a mild, pleasant aroma, and is sweet with a pineapple-like flavor with good eating quality. Anthracnose tolerance unknown. Tolerant to postharvest handling and shipping; unknown tolerance to postharvest quarantined treatment (e.g., hot water treatment). Trees harvested mid- to late season. ‘Omer’ is registered in Israel and for information on propagation availability contact the Volcani Center, Israel.






Photo credits: The Volcani Center (L) and http://haaretz.com (R)

Recommended by Dr. Yuval Cohen

Contact: Dr. Yuval Cohen, Plant Breeder, The Volcani Institute, Bet-Dagan, Israel at vhyuvalc@volcani.agri.gov.il

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Ahituv, N. 2016. Mango mania: Israel is an emerging mango superpower. Haaretz News (accessed 3-16-17) [http://www.haaretz.com/israel-news/.premium-1.738736]

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**‘Orli’** is a medium-sized fruit (410-480 g; average 450 g), roundish (broad-shaped) with yellow ground color and large –area orange and red blush, numerous small yellow dots (lenticels). The pulp is orange, medium to firm texture with low fiber. The fruit has a pleasant aroma and a pleasant sweet-sour flavor with good eating quality. Anthracnose tolerance unknown. Tolerance to postharvest handling and shipping and postharvest quarantined treatments unknown. Trees harvested early to mid-season. ‘Orli’ is registered in Israel and for information on propagation availability contact the Volcani Center, Israel.



Photo credits: The Volcani Research Center

Recommended by Dr. Yuval Cohen

Contact: Dr. Yuval Cohen, Plant Breeder, The Volcani Institute, Bet-Dagan, Israel at vhyuvalc@volcani.agri.gov.il

Further documentation

Ahituv, N. 2016. Mango mania: Israel is an emerging mango superpower. Haaretz News (accessed 3-16-17) [http://www.haaretz.com/israel-news/.premium-1.738736]

Cohen, Y., D. Saada, R. Dor, A. Keinan, and M. Noy. 2016. Set of elite new Israeli mango cultivars. AgroIsrael 2:64-69. [info@agroisrael.net]

**‘Osteen’** is a large fruit (500-760 g), 12-15.5 cm long, 8.5-10.5 cm dia., oblong shaped with yellow-orange color and purple or lavender blush with numerous small white dots (lenticels). The pulp is yellow colored with low fiber, firm, has a mild pleasant aroma, and is sweet with good eating quality. The fruit has fair to good anthracnose tolerance with some susceptibility to internal breakdown issues. Fruit tolerate postharvest handling (e.g., storage) but tolerance to quarantine treatments unknown. Trees harvested in July to early September. Cultivar readily available for propagation.




Photo credit: Mark Nickum©

Recommended by Dr. Victor Galán Saúco

Contact: Dr. Victor Galán Saúco, Research Prof. (retired), Instituto Canario de Investigaciones Agrarias, Canary Islands, Spain at vgalan46@gmail.com and Dr. Noris Ledesma, Curator, Tropical Fruit Program, Fairchild Tropical Botanical Garden, Miami, Florida at nledesma@fairchildgarden.org

Further documentation

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**‘Otts’** is a small to medium fruit (200-350 g), <9.5 cm long, 7-9 cm dia., oval shaped with a yellow ground color and reddish-purple blush, numerous small yellow dots (lenticels). The pulp is orange colored with very low fiber, has a pleasant aroma, and is sweet with good to excellent eating quality. Fruit susceptible to anthracnose. Postharvest handling is not documented (e.g., storage) and tolerance to quarantine treatments unknown. Trees harvested in mid-season. Cultivar readily available for propagation.





Photo credit: P.H.H. Delgado© (L) and G. Mazza© (R)

Recommended by Dr. Victor Galán Saúco

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Galán Saúco, V. 1999. El cultivo del mango. Gobierno de Canarias and Grupo Mundi-Prensa, Madrid, España. 298 pages.

Nelson, S.C. 2008. Mango anthracnose (*Colletotrichum gloeosporioides*). Univ. of Hawai’i at Mánao. 9 pages.

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**‘Papo de Peru 2’** is a small fruit (~160 g), 7.5 cm long and 5.4 cm dia., roundish with a yellow peel. The pulp is yellow-orange, soft with intermediate fiber, and is aromatic with a very sweet flavor (23.1° Brix) and of excellent eating quality. Anthracnose tolerance unknown. Postharvest handling tolerance is unknown (i.e., hot water and radiation). ‘Papo de Peru 2’ typically flowers March-April and harvested in June-July. Not grown commercially at this time but the cultivar readily available.



Photo credit: I.C.N. dos Santos Ribeiro©

Recommended by Dr. Francisco Pinheiro

Further documentation

Contact: Dr. Francisco Pinheiro, National Leader, Mango Breeding Program, EMBRAPA, Brazil at pinheiro.neto@cpatsa.embrapa.br

Santos Ribeiro, I.C.N. dos, C.A. F. Santos, F.P.L. Neto. 2013. Morphological characterization of mango (Mangifera indica) accessions based on Brazilian adapted descriptors. J. Agricultural Science and Technology B 3:298-806.

**‘R2E2’** is a large sized fruit (600-1100 g), elliptic to ovate shape with a slight beak; a yellow-orange-red peel. The pulp is orange, firm with medium-low fiber, and has a sweet flavor and mild aroma; good eating quality. The fruit is moderately susceptible to sap burn, has poor to fair tolerance to anthracnose and scab, and poor tolerance to black spot. General postharvest handling and shelf life good with low incidence of internal breakdown and susceptibility to chilling injury. Tolerance to hot water treatment, forced-air cooling and shipping stress rated as fair. Mid- to late season harvest period. Cultivar readily available for propagation.






Photo credits: www.technologychaoban.com (L) and www.plant.daleysfruit.com.au (R)

Recommended by Dr. Ian S.E. Bally

Contact: Dr. Ian S.E. Bally, Horticulturist/Breeder, Dept. of Primary Industries, Queensland, Australia at Ian.Bally@daf.qld.gov.au

Further documentation

Bally, I., R. Wright, and P. Beal. 2017. R2E2. Queensland Gov. (accessed 12-2017) [https://www.daf.qld.gov.au/plants/fruit-and-vegetables/fruit-and-nuts/mangoes/mango-varieties/r2e2].

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**‘Rapoza’** is a large fruit (650-800 g), oblong shaped with a red blush extending over half the fruit peel. The pulp is yellow, yellow-orange colored with very low fiber, has a pleasant aroma, and is sweet (19-21°Brix) with excellent eating quality. The fruit has fair to good anthracnose tolerance and a low incidence of internal breakdown issues. Postharvest handling rated as good but reaction to hot water treatment is unknown. In Florida, ‘Rapoza’ trees normally flower in Jan.-Feb. and harvested in July-August. Cultivar readily available for propagation.






Photo credit: Jonathan Crane© (L) and https://s3-us-west-1.amazonaws.com/hawaii-com-wp/wp-content/uploads/2015/06/12151300/Makaha-Mangoes-Rapoza.jpg© (R)

Recommended by Dr. Noris Ledesma, Dr. Victor Galán Saúco, Dr. Odilo Duarte, and Dr. Jonathan H. Crane

Contact: Dr. Noris Ledesma, Dr. Victor Galán Saúco, Dr. Odilo Duarte, and Dr. Jonathan H. Crane

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Nelson, S.C. 2008. Mango anthracnose (*Colletotrichum gloeosporioides*). Univ. of Hawai’i at Mánao. 9 pages.

**‘Rosa 2’** is a small fruit (~82 g), 9.6 cm long and 8.2 cm dia., roundish with a pinkish to red peel. The pulp is orange, firm with low fiber, and is moderately aromatic with a sweet flavor (18.8° Brix) and of excellent eating quality. Anthracnose tolerance unknown. Postharvest handling tolerance is unknown (i.e., hot water and radiation). ‘Rosa 2’ typically flowers July-August and harvested in October-November. Not grown commercially at this time and not readily available.

NO PHOTOGRAPH AVAILABLE

Recommended by Dr. Francisco Pinheiro

Further documentation

Contact: Dr. Francisco Pinheiro, National Leader, Mango Breeding Program, EMBRAPA, Brazil at pinheiro.neto@cpatsa.embrapa.br

Santos Ribeiro, I.C.N. dos, C.A. F. Santos, F.P.L. Neto. 2013. Morphological characterization of mango (*Mangifera indica*) accessions based on Brazilian adapted descriptors. J. Agricultural Science and Technology B 3:298-806.

**‘Rosigold’** is a medium fruit (311-400 g), oblong-obovoid shaped and has a yellow peel with pink-orange to crimson-red blush. The pulp is deep orange colored with very low fiber, has a pleasant aroma, and is sweet and rich with very good eating quality. The fruit has fair anthracnose tolerance and the incidence of internal breakdown issues is unknown. Postharvest handling and reactions to quarantine treatments is unknown. Very early harvest season. Cultivar readily available.







Photo credits: Mark Nickum© (L) and Jonathan Crane© (R)

Recommended by Dr. Odilo Duarte

Contacts: Dr. Noris Ledesma, Curator, Tropical Fruit Program, Fairchild Tropical Botanical Garden, Miami, Florida at nledesma@fairchildgarden.org and Dr. Odilo Duarte, Prof., Pan American School of the Americas, Honduras (retired), currently, Consultor en Agronegocios, Perú at odiloduarte@yahoo.com

Further documentation

Campbell, R.J. and N. Ledesma. 2015. Mango cultivars with potential for commercial development. Acta Hort. 1075:33-45.

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**‘Shelly’** is a medium sized fruit (300-700 g), roundish (apple-like) shaped with a yellow ground color and large-area red blush, numerous small yellow dots (lenticels). The pulp is medium to deep yellow, yellow-orange, very firm with low fiber. The fruit has a mild, pleasant aroma, and is sweet with good eating quality. Anthracnose tolerance unknown. Postharvest handling suggests fruit tolerate cold storage, have a long shelf life (up to 30 days) and are less susceptible to postharvest diseases. Tolerance to quarantine treatments unknown (e.g., hot water treatment). Trees harvested mid- to late season. ‘Shelly’ is registered in Israel and under patented agreement with Westfalia, South Africa.

Photo credits: The Volcani Research Center

Recommended by Mr. Johann du Preez and Dr. Yuval Cohen

Contact: Mr. Johann du Preez, Manager/Horticulturist, Bavaria Estate, Westfalia, So. Africa at johannd@bavariafruit.co.za and Dr. Yuval Cohen, Plant Breeder, The Volcani Institute, Bet-Dagan, Israel at vhyuvalc@volcani.agri.gov.il





## Further documentation

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Lavi, U., D. Kaufmann, D. Sharon, S. Gazit, and E. Tomer. 1997. ‘Shelly’: a new mango cultivar. HortScience 32:138.

**‘Southern Blush’** is a medium to large fruit (300-600 g), obovoid (broad) shaped with a yellow ground color and large-area pink blush, numerous small yellow dots (lenticels). The pulp is yellow, firm with low fiber. The fruit has a mild, pleasant aroma, and is sweet with good eating quality. Anthracnose tolerance good. Postharvest handling and quarantine treatment tolerance is unknown. Trees harvested mid- to late season. Cultivar readily available for propagation.





Photo credits: Dr. Jonathan H. Crane©

Recommended by Dr. Jonathan H. Crane

Contacts: Dr. Jonathan H. Crane, Tropical Fruit Crop Specialist, Univ. of Florida, IFAS, Tropical Research and Education Center, Homestead, Florida at jhcr@ufl.edu and Dr. Noris Ledesma, Curator, Tropical Fruit Program, Fairchild Tropical Botanical Garden, Miami, Florida at nledesma@fairchildgarden.org

Further documentation

Pinto, A.C.Q., V.H. Vargas Ramos and N.T.V. Junqueira. 2000. New varieties and hybrid selections from mango hybridization program in central region of Brazil. Acta Hort. 509:207-211.

**‘Tali’** is a medium-sized fruit (average 470 g), roundish (heart-shaped) with orange ground color and red blush, numerous small yellow dots (lenticels). The pulp is dark-orange, firm with low fiber. The fruit has a pleasant aroma and a pleasant sweet-sour flavor with good eating quality. Anthracnose tolerance unknown. Tolerance to postharvest handling and shipping and postharvest quarantined treatments unknown. Trees harvested early season. ‘Tali’ is registered in Israel and for information on propagation availability contact the Volcani Center, Israel.






Photo credits: The Volcani Center

Recommended by Dr. Yuval Cohen

Contact: Dr. Yuval Cohen, Plant Breeder, The Volcani Institute, Bet-Dagan, Israel at vhyuvalc@volcani.agri.gov.il

Further documentation

Ahituv, N. 2016. Mango mania: Israel is an emerging mango superpower. Haaretz News (accessed 3-16-17) [http://www.haaretz.com/israel-news/.premium-1.738736]

Cohen, Y., D. Saada, R. Dor, A. Keinan, and M. Noy. 2016. Set of elite new Israeli mango cultivars. AgroIsrael 2:64-69. [info@agroisrael.net]

**‘Valencia Pride’** is a large fruit (600-900 g), 18-21 cm long, 7.5-10 cm dia., oblong-reniform (kidney) shaped with a yellow ground color and pink to red to crimson blush, numerous large yellow dots (lenticels). The pulp is deep yellow colored with low fiber, has a pleasant aroma, and is sweet with good to excellent eating quality. The fruit has fair anthracnose tolerance with some susceptibility to internal breakdown issues. Postharvest handling is not documented (e.g., storage) and tolerance to quarantine treatments unknown. In Florida, ‘Valencia Pride’ trees harvested in July-August. Cultivar readily available for propagation.






Photo credits: Dr. Jonathan H. Crane©

Recommended by Dr. Victor Galán Saúco

Contacts: Dr. Victor Galán Saúco, Dr. Noris Ledesma, and Dr. Jonathan H. Crane

Further documentation

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**‘Young’** is a large fruit (510-623 g), 11-13 cm long, 9-11 cm dia., obovoid (roundish) shaped with a yellow ground color with a faint pinkish orange blush, numerous yellow dots (lenticels). The pulp is pale yellow to orange colored with low fiber, has a pleasant aroma, and is sweet with good to excellent eating quality. The fruit has fair anthracnose tolerance. Postharvest handling is not documented (e.g., storage) and tolerance to quarantine treatments unknown. ‘Young’ is harvested in June-July. Cultivar readily available for propagation.





Photo credits: Ian Maguire©

Recommended by Dr. Jonathan H. Crane

Contacts: Dr. Jonathan H. Crane, Tropical Fruit Crop Specialist, Univ. of Florida, IFAS, Tropical Research and Education Center, Homestead, Florida at jhcr@ufl.edu and Dr. Noris Ledesma, Curator, Tropical Fruit Program, Fairchild Tropical Botanical Garden, Miami, Florida at nledesma@fairchildgarden.org

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**Recommended cultivars**

Panel members (Table 1) recommended 38 cultivars and numerous criteria were used to select the top five cultivars for further evaluation. Part of the criteria used included the most frequently selected cultivar by Panel Members (Table 2), and peel color, fruit size, and other characteristics described from the cultivar surveys (Table 3). We asked Panel Members to provide their "best" selections and in some cases, these selections may not be readily available for further evaluation at this time. In addition, there was little environmental adaptation and postharvest information for most of these cultivars. This may be attributed to their newness and or the lack of widespread plantings and experience with them. The Panel was not asked for a consensus due to the fact many of these cultivars are not universally familiar or had limited information on which to base a consensus. Therefore, my selection of the top cultivars is based on the survey information provided by these experts, available literature and my view point (Table 3). The survey data-sheets are included in a separate excel file. I suspect NMB members and their organizations will have their own opinions and favorites based on the information provided in this report.

**Top Six**

'Agam' is an early-season fruit developed by the Volcani Institute breeding program. Fruit have an attractive red color, reported to have very good to excellent eating quality and tolerance to postharvest handling; medium sized fruit.

'Angie' is an early-season fruit selected by the Fairchild Tropical Botanical Garden program. Fruit have an attractive bright yellow-red (orange) color and good reported postharvest handling characteristics; medium sized fruit.

'Calypso' is a mid- to late season fruit developed by the Australian Div. of Plant Industry. Fruit have an attractive pink and yellow color and tolerance to postharvest handling; medium- to large fruit.

'Mallika' is a mid-season fruit originating from India. Fruit have a light-orang-yellow color. Interestingly, this fruit should be picked green and hard (immature) and held at moderate temperatures (21-24C) to develop optimum quality; medium sized fruit.

'Rapoza' is a mid- to late season fruit selected in Hawaii. Fruit have an attractive large red blush color, good disease tolerance and low reported internal breakdown issues; large fruit.

'Shelly' is a mid- to late season cultivar developed by the Volcani Institute breeding program. Fruit have an attractive large red blush color and reported long shelf life and good postharvest characteristics; medium sized fruit.

**Others to strongly consider**

'Ataulfo Diamante' and 'Ataulfo Zafiro' are early season fruit selected in Mexico. Very similar to 'Ataulfo' they may provide superior postharvest handling and quarantine treatment tolerance; small fruit size. Potential alternative to 'Ataulfo'.

‘Cogshall’ is an early to mid-season cultivar selected in Florida. Fruit have a yellow-yellow-orange peel and excellent eating quality; medium sized fruit.

‘Maha Chinook’ is a mid- to late season cultivar selected in Thailand. Fruit are ellipsoid shaped with an attractive yellow-pink peel. Reported postharvest handling is okay; small to medium-sized fruit. Potential for Asian-American market niche.

‘Noa’ is a mid- to late season cultivar developed by the Volcani Institute breeding program. Fruit have an attractive multi-colored peel and reported tolerance to postharvest handling; large fruit size.

‘Osteen’ is a mid- to late season cultivar selected in Florida. Fruit are oblong shaped with a reddish-purple peel with reported good postharvest handling characteristics; large sized fruit. Grown commercially in Spain for the European market.

**Fresh Cut Potential**

Most Panel members did not comment nor respond to the fresh cut potential of the fruit they reported on. Relatively few cultivars (e.g., ‘Tommy Atkins’, ‘Keitt’, ‘Kent’, ‘Haden’ and ‘Palmer’) have been evaluated for the fresh cut market (Kader, 2008). Potential criteria fruit suitable for this market include large size (more cubes or slices per fruit, less fruit handled), fruit shape (ease of handling, potential for mechanical cutting), firmness (fiber content, acceptable texture), oxidation potential (low to none is best), flavor, and sweetness. Cultivars to potentially evaluate for the fresh cut market include ‘Edward’, ‘Isis’, ‘Kensington Pride’, Mallika’, ‘Osteen’, ‘Shelly’, ‘Southern Blush’, ‘Tali’, ‘Valencia Pride’ and ‘Young’.

**Potential next steps for the NMB**

The NMB has the option to move to Phase II and Phase III or to stop here anywhere along the line.

Phase 2. Postharvest evaluation. Prior to extensive field-testing each potential cultivar should undergo small-trial postharvest handling and quarantine treatments. This would provide further evidence of commercial suitability for export and import markets.

Purpose: Determine postharvest handling and quarantine treatment tolerance of potential fresh and fresh-cut commercial cultivars.

Process

1. The top-ranked mango cultivars to be harvested and evaluated for:
    a. Reaction to quarantine treatments.
    b. Common postharvest storage temperatures and conditions.
    c. Fruit quality (e.g., color, °Brix, acid content, pulp fiber content, flavor, etc.) after ripening at room temperature for fresh and fresh-cut use.
2. The postharvest and fresh and fresh-cut evaluation data will be compiled and summarized and provided the Mango Board for review.

3. The project investigators will review the information and rank the cultivars for their feasibility and desirability from a postharvest standpoint.
4. The project PIs will provide the NMB their recommendations for mango cultivars that should be tested under orchard conditions for commercialization.

Phase 3. Industry Review and Mango Orchard Testing

Purpose: To increase the number of commercial mango cultivars in the market.
Options:

1. The NMB may want to send a delegation from the board and staff to visit mango collections and/or orchards with the cultivars recommended by the Mango Panel. To view and sample the recommended cultivars.
2. NMB producer members may plant recommended cultivars for private field evaluations.
3. The NMB may desire to establish selected mango cultivars in various production areas to determine their productivity and quality – to determine their production and market potential.

The Phase III project, PI (or PIs) and NMB will suggest cultivars to be tested and suggested criteria for the field evaluation of the cultivars.

**Table 1. Mango selections**

| Panel member | Selections recommended | Comments |
|---|---|---|
| Francisco Pinheiro Lima Neto | *Favo de Mel, Espada Ouro, Papo de Perú, Rosa 2* | Preliminary evaluation, limited information |
| Victor Galán | *Ah Ping, Gouveia, Valencia Pride, Osteen, Harders, Otts, Isis, Cogshall, Rapoza, Cavallini* | Cavallini, minimal information |
| Ian Bally | *Kensington Pride, Calypso, R2E2, NMBP1243, NMBP4069, NMBP1201, Maha Chanook* | NMBP series unavailable |
| Johann du Preez | *Shelly,* Keitt, Kent | Keitt and Kent well known |
| Noris Ledesma | *Mallika, Rapoza, Angie* | |
| Odilo Duarte | *Mallika, Rapoza, Angie, Nam Doc Mai, Rosigold* | |
| Samuel Salazar-Garcóía | *Ataulfo Diamante, Ataulfo Zafiro, Edward* | |
| Yuval Cohen | *Shelly, Omer, Agam, Tali, Noa, Orli* | |
| Jonathan Crane | *Edward, Cogshall, Rapoza, Duncan, Angie, Young, So. Blush, Valencia Pride* | |

| Table 2. Cultivar selection by Panel Members | | |
|---|---|---|
| Cultivar | Number of votes | Whom voted |
| Agam | 1 | Yuval Cohen |
| Ah Ping | 1 | Victor Galán |
| Angie | 3 | Noris Ledesma, Odilo Duarte, Jonathan Crane |
| Ataulfo Diamante | 1 | Samuel Salazar-García |
| Ataulfo Zafiro | 1 | Samuel Salazar-García |
| Calypso | 1 | Ian Bally |
| Cavallini | 1 | Victor Galán |
| Cogshall | 2 | Victor Galán, Jonathan Crane |
| Duncan | 1 | Jonathan Crane |
| Edward | 2 | Samuel Salazar-García, Jonathan Crane |
| Espada Ouro | 1 | Francisco Neto |
| Favo de Mel | 1 | Francisco Neto |
| Gouveia | 1 | Victor Galán |
| Harders | 1 | Victor Galán |
| Isis | 1 | Victor Galán |
| Kensington Pride | 1 | Ian Bally |
| Maha Chanook | 1 | Ian Bally |
| Mallika | 2 | Noris Ledesma, Odilo Duarte |
| Nam Doc Mai | 1 | Odilo Duarte |
| NMBP1243 | 1 | Ian Bally |
| NMBP4069 | 1 | Ian Bally |
| NMBP1201 | 1 | Ian Bally |
| Noa | 1 | Yuval Cohen |
| Omer | 1 | Yuval Cohen |
| Orli | 1 | Yuval Cohen |
| Osteen | 1 | Victor Galán |
| Otts | 1 | Victor Galán |
| Papo de Peru | 1 | Francisco Neto |
| R2E2 | 1 | Ian Bally |
| Rapoza | 4 | Victor Galán, Noris Ledesma, Odilo Duarte, Jonathan Crane |
| Rosa 2 | 1 | Francisco Neto |
| Rosigold | 1 | Odilo Duarte |
| Shelly | 2 | Johann du Preez, Yuval Cohen |
| Southern Blush | 1 | Jonathan Crane |
| Tali | 1 | Yuval Cohen |
| Valencia Pride | 2 | Victor Galán, Jonathan Crane |
| Young | 1 | Jonathan Crane |

| Table 3. Cultivar by peel color, fruit shape and size and overall rating. | | | |
|---|---|---|---|
| Cultivar | General mature peel color | Fruit shape and size[1] | Rating[2] |
| Agam | Dark red | Roundish, medium-large | 1 |
| Ah Ping | Dark red | Oblong-oval, medium-large | 4 |
| Angie | Bright pinkish-orange-red | Oblong-oval, medium | 1 |
| Ataulfo Diamante | Light orange/yellow | Oblong, small | 2 |
| Ataulfo Zafiro | Light orange/yellow | Oblong, small | 2 |
| Calypso | Pink/yellow | Elliptic to round, medium | 1 |
| Cavallini | Green with purple | Oblong-round, medium | NR |
| Cogshall | Yellow-to-yellow-orange | Oblong, small-medium | 2 |
| Duncan | Yellow | Oblong, medium-large | 4 |
| Edward | Pink-yellow | Oblong, medium-large | Already grown, 2 |
| Espada Ouro | Yellow | Oblong, small | NR |
| Favo de Mel | Yellow-orange | Round, small-medium | NR |
| Gouveia | Green-reddish | Oblong, medium | 3 |
| Harders | Green-dull red | Oblong-elliptic, medium | 4 |
| Isis | Green-dull reddish | Oval, large | 3 |
| Kensington Pride | Green-orange | Elliptic, medium-large | 3 |
| Maha Chanook | Yellow-pink | Ellipsoid, small-medium | 2 |
| Mallika | Light orange-yellow | Oblong-sigmoid, medium | 1 |
| Nam Doc Mai | Yellow-pink | Oblong-sigmoid | Already grown, 3 |
| NMBP1243 | Bright orange-red | Round, medium | Unavailable |
| NMBP4069 | Bright orange-red | Round, medium-large | Unavailable |
| NMBP1201 | Bright pink-orange | Round, medium | Unavailable |
| Noa | Yellow-orange-red | Elliptic-oval, large | 2 |
| Omer | Purple-red, yellow | Oval, medium | 3 |
| Orli | Yellow-orange-red | Round, medium | 3 |
| Osteen | Yellow-purple-orange | Oblong, large | 2 |
| Otts | Reddish-purple | Oval, small-medium | 3 |
| Papo de Peru | Yellow | Round, small | NR |
| R2E2 | Yellow-orange | Elliptic-ovate, large | 3 |
| Rapoza | Bright red | Oblong, large | 1 |
| Rosa 2 | Pinkish-red | Roundish, small | NR |
| Rosigold | Yellow-orange | Oblong-obovoid, medium | 3 |
| Shelly | Yellow-red | Round, medium-large | 1 |
| Southern Blush | Yellow-orange-pink | Obovoid, medium-large | 3 |
| Tali | Orange-red | Round, large | 3 |
| Valencia Pride | Yellow-pink | Oblong-reniform, large | 3 |
| Young | Yellow | Obovoid, large | 3 |
| 1, 100-300 g, small; 300-450 g, medium; 450+g, large; 2, 1, highest rating and 5, lowest rating and NR=not rated, insufficient information. | | | |

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