

X Simposio Internacional de Mango

Del 3 al 7 de junio, 2013, Bávaro, Punta Cana, República Dominicana

X International Mango Symposium

June 3 to 7, 2013, Bávaro, Punta Cana, Dominican Republic

El Mango: Oportunidades y Desafíos en el Siglo 21
Mango: Opportunities and Challenges in the 21st Century

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- 10:30AM - Monday June 3, 2013

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P. Amouroux¹, H. Delatte², S. Nibouche², J. Chadœuf³ and F. Normand¹

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Junior Paul and James Chapman

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Traceability pilot project in mango

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Poster Session 7: Postharvest pathology

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Estudio de la descomposición interna de la pulpa y su correlación con los niveles nutricionales foliares (N y Ca) de la planta

Sarmiento, D., Navarro, J., Westendorp, N., Ruiz, V. y Guirado, E.

Sunday June 2, 2013 / Domingo 2 de Junio 2013

02:30 PM - Registration open / Inicio de Registro

Day 1 - Monday June 3, 2013 / Día 1 - Lunes 3 de Junio 2013

09:00 AM - Opening Ceremony / Inauguración

10:30 AM - Monday June 3, 2013

Conference / Conferencia

Proyecto piloto de rastreabilidad en Mango

Teófilo Surriel

Coordinador CEDAF
República Dominicana

Carlos Kupervaser

Consultor Internacional, KYAS, SRL
Argentina

Resumen

En los últimos dos años se estado desarrollando en República Dominicana un proyecto piloto de rastreabilidad en mango con el fin de maximizar la eficiencia y velocidad de los procedimientos actuales de rastreo a lo largo de la cadena de suministro, teniendo como primera etapa la codificación de cajas y pallets para el año 2013. Adicionalmente, brinda certeza, protección y seguridad a los clientes sobre lo que compran y consumen ante posibles contingencias alimentarias. Con la ayuda de KYAS de Argentina se desarrolló el sistema electrónico de rastreabilidad (SER), componente importante del proyecto, el cual está desarrollado íntegramente en ambiente web y permite la interacción de los distintos perfiles de usuarios privados y públicos creando una cadena de valor agregado e interacción permanente que se transforma en una sinergia que potencia la calidad y valor del producto final. El SER brinda la posibilidad de registrar y georeferenciar a todos los productores de mango del país o región, sus fincas y unidades de producción, permitiendo llevar a cabo una rastreabilidad íntegra desde el campo hasta el destino final del producto. El etiquetado y codificado según las normas internacionales públicas y privadas están disponibles para los pequeños y grandes empacadores por igual, permitiendo cumplir las más exigentes normas en ese rubro. El PRA es un esfuerzo del CEDAF con el patrocinio del Departamento de Agricultura de los Estados Unidos (USDA) y el Ministerio de Economía, Planificación y Desarrollo de la República Dominicana, dirigido a mejorar los niveles de competitividad de las exportaciones dominicanas a través de la creación de un proceso eficiente y rápido que posibilite la identificación y monitoreo electrónico de productos entre los miembros de las cadenas productivas.

11:15AM - Intervenciones Especiales

12:00 M - Lunch / Almuerzo

Session 1: World Production

□ 02:00PM - Monday June 3, 2013

Session 1: World Production / Keynote 1-01

Climate change and its probable impact on mango production and cultivation

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Abstract

Climate change is becoming an observed reality, very likely due to the increase of anthropogenic greenhouse gas concentration. Since few decades, several research teams around the world carry out a huge work to model the future climatic change during the 21st century, based on several scenarios of greenhouse gas emission. We have to expect rise in average temperatures, in atmospheric CO² concentration, in soil salinity in some areas, and lower and more irregular rainfall. The climate variability and the frequency of extreme events (scorching heat, heavy rainfall, drought, hurricane) are also expected to rise. Climate change is therefore a great concern for agriculture. The consequences of these changes are expected to be more severe in the tropics and subtropics. Mango is one of the most widely cultivated and popular fruits in these regions for its economic and nutritional values. It is the fifth most cultivated fruit in the world. It is consequently justified to wonder about the impact of climate change on the mango tree and about the consequences on mango production and cultivation. The lack of crop model for mango prevents the prediction of impacts of climate change on the mango tree. They are then assessed on the basis of our current knowledge on the effect of climatic variables on mango tree development and production. In this paper, we describe the effect of climatic variables on processes of agronomical importance for the mango tree: photosynthesis, vegetative and reproductive development, fruit quality. We then review the climate changes predicted for the main areas of mango production and draw the possible consequences for mango cultivation. Finally, we propose some research ways to adapt mango cultivation to climate change in the coming decades, such as cultivar and rootstock selection, and improvement of cultural practices. The interest to develop a mango crop model is discussed.

Keywords: cultural practices, ecophysiology, *Mangifera indica*, rainfall, temperature

☐ **02:40PM** - Monday June 3, 2013

Session 1: World Production / Keynote 1-02

Mango cultivars with potential for commercial development

Richard J. Campbell

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Abstract

Currently the commercial mango industry is dominated by a handful of cultivars adapted to a modern production and handling system. There are many mango cultivars, both traditional and newer selections that have potential for the mango industry of the old and the new world. Cultivars are needed to fill the niche of fresh fruit, mature green and processing industries, as well as for specific requisites of skin color and flavor. Some cultivars can meet multiple niches and should be emphasized to add value to production systems and improve profitability for the grower. We will discuss cultivars that meet the needs of western and eastern markets, which differ substantially in their demands. In terms of any new cultivar there will be a long and difficult transition period for the identification, multiplication and introduction of a new cultivar to the marketplace. There will also be a real need for testing of new cultivars in each production area to facilitate the adaption of new cultivars and to create a pipeline for additional cultivars in the future.

☐ **03:20PM** - Coffee Break / Receso

□ **03:40PM** - Monday June 3, 2013

Session 1: World Production / SI-01

Opportunities for world mango producers in the North American markets

Ernesto Gallo

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Abstract

This paper analyzes millions of observations of the behavior of the mango daily market prices and arrivals, at the wholesale level (limited number of boxes) and at the full container load level in the North American Markets. It compares prices and trends in different markets shipping points, and varieties. The study shows a commodity named “mango” does not exist, because there are different varieties with different prices, season and suppliers. The study analyzes what markets pay more for different sizes and packages. This paper evaluates the different countries supplying North American markets, to define the seasons when the supply is low, or prices are high; it describes the supply of the competitors that new entrant would face in the case of looking for doing business in these markets in a given season. The analysis includes the detailed valuation of the value chain and the marketing bill for the mango business from the exporting countries to the North American Markets. A backward analysis of the value chain helps to define if a firm or supplier will be able to compete in those markets. The paper defines the best seasonal price windows for different varieties and countries. This information is relevant in the investment decision or competitive strategy design for this market.

□ 04:00PM - Monday June 3, 2013

Session 1: World Production / SI-02

National Mango Board's consumer research

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Florida

M. Peele

Director of Industry
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National Mango Board
Florida

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Director of Research
National Mango Board
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Abstract

The National Mango Board's (NMB) mission is to increase the demand of fresh mangos in the United States by conducting promotion, market and production research. Demand is a reflection of consumers' preferences and state of knowledge about a product. Some demand drivers are ingrained in consumers' decision-making processes while others may be more readily changed. To determine scientifically what drives the demand for mangos, potential drivers must be identified and data about household shopping behavior must be accessible. Demand of mangos changes through attracting new consumers to the market (market penetration) and by increasing the amount purchased (market intensity) when a buying decision is made. Statistically almost all of the impact has been on market penetration and very little on market intensity. Since there are nearly 120 million U.S. households, a small gain in market penetration can have a large impact on the total mango demand. Ethnicity is a major demand driver. White non-Hispanics account for nearly 66% of the population and are the least likely group to buy mangos. Given the large white non-Hispanic population and their low levels of consumption, this group is where the most potential for growth in demand lies. Data shows ripeness and quality are the major attributes consumers are concerned when purchasing mangos.

Keywords: Consumer research, fresh mangos, demand, market penetration, market intensity, consumption

M. Peele is the presenter at the X International Mango Symposium, L. Ortega is the corresponding author

☐ **04:20PM** - Monday June 3, 2013

Session 1: World Production / SI-03

Fruit flies harmful to mango in Haiti: host plant range and population fluctuations

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Abstract

In Haiti, the mango crop holds a special place in farms. This fruit plays an important role in terms of self-consumption and more generally contributes to local food security. As an export commodity, its trade generates foreign currency flow in the country and creates jobs especially in periods of production. However, mango exports are limited to less than 5% of local production mainly because of damage caused by fruit flies (Diptera: Tephritidae). These pests attack many cultivated or wild fruit species, including mango, of which cultivar "Francisque" that Haiti mainly exports on the North American market. These quarantine pests are difficult to control and setting up an integrated pest management programs requires a good knowledge of their bio-ecology. This study focuses on the ecology of fruit fly pests of mango in view of an integrated management of their populations. It notably aims at clarifying: (i) the host plant range of two species of *Anastrepha* (*A. obliqua* and *A. suspensa*) and their phenology; (ii) the relative abundance of both fly species on the main host fruits; (iii) the population fluctuations of both species and factors, biotic and abiotic, that influence them; (iv) essential floral or extra-floral resources for fruit flies and their natural enemies provided by wild and cultivated plants inside and around mango plantations. The study focuses on two important mango production areas: one in the Southeast (Jacmel, Cayes-Jacmel, Marigot) and the other in the south (Cayes, Camperrin). As a first step, we conducted a farmer and consumer survey, and we took on a regular basis punctured fruit samples from many host plant species and incubated them in the laboratory until the emergence and identification of adult flies and natural enemies. Moreover, a network of fruit fly traps was set up to record variations in populations of fruit flies in relation with plant diversity, fruit production and abiotic factors. This study provides valuable information on the bio-ecology of fruit flies harmful to mango in Haiti and should contribute to the integrated management of their populations.

☐ **04:40PM** - Poster Session / Sesión de Pósters

☐ **06:00PM** Welcome Coctail/Coctel de Bienvenida

Day 2 - Tuesday June 4, 2013 / Día 2 - Martes 4 de Junio 2013

Session 2: Genetics, breeding and biotechnology

☐ **08:20AM** - Tuesday June 4, 2013

Session 2: Genetics, breeding and biotechnology / Keynote 2-01

Improvement of mango tree architecture and vigor

Ian S. E. Bally and, Natalie L. Dillon

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Mango trees evolved from tropical rainforest as large, terminal bearing, spreading evergreen trees with high rates of annual vegetative growth and relative low productivity. With large tree size, come certain inherent disadvantages to production efficiency. Mango trees are still considered giants when compared to many temperate fruit species. Some of the medium to semi-dwarf cultivars that are grown commercially have overcome some of these disadvantages but there are still enhancements in architecture needed to improve production efficiency. Large mango trees have a relatively low cropping surface area compared to their volume, their canopies become dense and exclude light from much of the foliage making it difficult to manage pests and diseases and to harvest fruit. Labor inputs for pruning and harvest are greater than smaller trees. Tree architecture and vigor can be managed through rootstock interactions although very few have been identified and adopted in mango. Pruning and trellising techniques can be used to adapt the shape of mango trees to improve light interception, pest and disease management and harvest operations. The Australian mango breeding program is breeding for architecture types suited to high density, high productivity production systems. Applied genomic research is identifying dwarfing and other architecture genes in breeding populations the wider mango gene pool that will improve breeders ability to target desired architectural types. This paper will outline the progress of research towards understanding and improving tree architecture in mango.

☐ **09:00AM** - Tuesday June 4, 2013

Session 2: Genetics, breeding and biotechnology / Keynote 2-02

Strategies of breeding and production management of mango (*Mangifera indica* L.) on focus to the dynamic of market

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Abstract

Brazil is one of the largest mango producer countries in the world with area of 72,5 thousand hectares and production of 1,3 million of tones. Nevertheless, the total exported mango from Brazil in 2010 was about 140 thousand tones which is approximately 10% of its total production. The mango supply to the internal and external markets has been diversified from conventional production to the organic one and recently there is a tendency for an increase demand of processed mango. To comply with these demands there is not only a need for the development of the processing industry, but also the improvement of mango cultivars and production management techniques in order to attend the several exigencies of the market. This paper has the objective to suggest to the mango breeders efficient strategies to get and select the so called “ideal mango cultivar” as well as to discuss some efficient management production techniques in order to comply with the request of high production and quality demands of mango as an answer to the dynamic of the international mango market.

Keywords: cultivar evaluation and selection, mango quality, cultural practices.

☐ **09:40AM** - Coffee Break /Receso

□ 10:00AM - Tuesday June 4, 2013

Session 2: Genetics, breeding and biotechnology / S2-01

AFLP and microsatellites genetic divergence analyzes among 103 mango accessions

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Abstract

The genetic relationship among 103 mango accessions of different geographic origins of the Embrapa germplasm collection was estimated based on AFLP and microsatellite markers in order to orient breeding and management of genetic resource of this species to the Brazilian Semi-Arid region. The DNA of the accessions was extracted according to the CTAB protocol. Two UPGMA dendrograms were generated using Jaccard coefficients from distance matrixes based on 50 alleles of 12 microsatellite loci and 157 amplicons obtained from 13 AFLP *EcoRI*/*MseI* primer combinations. The cophenetic values were 0.81 and 0.80 for the AFLP and microsatellite dendrograms, respectively. Four groups were observed in the AFLP dendrogram: 1) Amrapali, Malika, Embrapa-CPAC hybrids and some American varieties forming a group, 2) other built, predominantly, by American varieties, with some inclusions of South African and Brazilian hybrids, 3) a large group composed by Brazilian accessions, with some inclusion of Australian, Indian and American accessions, and 4) a group with some accessions of Espada, Rosa and others of different origins. Three groups were observed in the microsatellite dendrogram: the first group was formed predominantly by foreign accessions, the second group was formed by Brazilian accessions, and the Dashehari accession was isolated from the others. The analyzed accessions presented variability greater than 51% and 30% in the AFLP and microsatellite studies, respectively, suggesting a high genetic variability present in the studied mango germplasm collection. Based on the grouping patterns, the microsatellite study presented a better resolution, since it was possible to separate the Brazilian accessions from foreigner ones. The microsatellite results were the expected one, since mango Brazilian accessions have a long adaptation term, tracking back to the XVI century.

Keywords: *Mangifera indica*, accessions relationship, Brazilian accessions

□ **10:20AM** - Tuesday June 4, 2013

Session 2: Genetics, breeding and biotechnology / S2-02

Molecular characterization of the Banilejo mango (*Mangifera indica* L.) by AFLP analysis

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Abstract

A molecular and morphological characterization was performed on mangoes (*Mangifera indica* L.) of the banilejo type, using AFLP analysis and agro-morphological and flavor characteristics with the final objective of standardizing the variety. Plant material collection was done in three different commercial orchards owned by members of the Dominican Republic mango cluster. These orchards are located in the Peravia Province, 60 kilometers south of the city of Santo Domingo. The analyses were conducted in the laboratories of the Instituto de Innovación en Biotecnología e Industria (IIBI) located at La Isabela, following standard protocols established for these procedures. For the morphological characterization the following parameters were considered: Fruit diameter (DF), Fruit length (LF), Fruit weight (PF), Seed length (LS), Seed weight (PS), Peel weight (PC), Pulp weight (PM) and Brix grade (GB), as % of soluble solids. For the DNA molecular markers the technique of Amplified Fragment Length Polymorphism (AFLP) was used using a pre-designed kit from Invitrogen™ which includes its own working protocol. The conglomerate analysis of AFLP determined the formation of five groups within the 38 samples analyzed showing a great variability between these types of mangoes grown around the Baní area of the Dominican Republic. Based on the data obtained, four individual trees were selected to perform a genetic fingerprinting and to recommend them as source buds for plant propagation of the variety.

Keywords: Mango, morphological characters, molecular markers, AFLP.

□ **10:40AM** - Tuesday June 4, 2013

Session 2: Genetics, breeding and biotechnology / S2-03

The Australian mango fruit genomics initiative

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Abstract

Introduced from trading ships that visited in the late 19th century, ‘Kensington Pride’ has become the iconic Australian cultivar that is still the mainstay of the Australian industry today. Despite its popularity with consumers it has a number of agronomically undesirable characteristics that impact fruit quality and productivity. These include excessive tree vigour, irregular fruit production, short shelf life, inconsistent external colouring, susceptibility to sap burn and some fungal diseases. Maintained in the Australian National Mango Genebank is the largest collection of important mango cultivars and related species in Australia. Many have desirable attributes that when used as breeding parents can contribute to mango tree and fruit quality improvements. Traditional approaches to develop mangoes with improved quality and nutrition, pest and disease resistance and improved tree architecture may take years to lead to the release of a new variety. Like in other horticultural fruit crops such as apple, use of genetic and genomic data to support breeding efforts can achieve mango improvement more rapidly through marker-assisted selection. In Queensland, Australia, a multidisciplinary project involving researchers with expertise in mango breeding, variety selection, physiology, molecular biology, biochemistry, genetics, bioinformatics and food technology are working to generate distinct data sets, each of which provides a great capacity for expediting mango improvement. It is the linking and interactions between these data sets that has the potential to deliver powerful molecular and bioinformatic tools to the mango industry.

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□ **11:00AM** - Tuesday June 4, 2013

Session 2: Genetics, breeding and biotechnology / S2-04

Cloning and expression of flowering related genes in two mango varieties

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Abstract

Flowering is a crucial event in plant's life and influences its commercial value. Mango, an important fruit crop, has critical issues in flowering. Most of the mango cultivars are affected by the problem of alternate bearing but some cultivars do not exhibit this behavior. There are tools to manage flowering in mango by pruning, nutritional management and the use of growth regulators. We initiated a project to identify genes related to flowering in mango and study their functionality. We have identified at least three flowering locus T (FT) like and two terminal flower (TFL) like genes in addition to a Constans (CO) like gene in the mango cultivar Alphonso. Further, to study the expression of these genes we have conducted an experiment using Alphonso (an alternate bearing cultivar) and Ratna (a regular bearing cultivar) with treatment of Paclobutrazol (PBZ) to ensure flowering in treated plants and Gibberellic Acid (GA) to ensure no flowering in treated plants and compared these with untreated plants. All the plants treated with PBZ flowered while none of the plants treated with GA flowered. Expression of CO like gene appeared earlier in PBZ treated plants than in GA treated plants. Expression of one of the FT like gene (MaFT1) was much higher in PBZ treated plants compared to GA treated plants in both the cultivars and paralleled with flowering. This indicated that MaFT1 may be the functional FT in these cultivars. Expression studies of other genes are underway and the results obtained will be discussed in the presentation.

□ **11:20AM** - Tuesday June 4, 2013

Session 2: Genetics, breeding and biotechnology / S2-05

Creating genomic infrastructure for mango breeding

Yuval Cohen¹, Mor Rubinstein², Michal Sharabi², Ada Rozen², Ravit Eshed², Miri Benita¹, Mazal Ish-Shalom¹, David Saada¹, Amir Sherman² and Ron Ophir²

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Abstract

Mango is one of the most important fruit crops in tropical and subtropical regions. The lack of genomic resources for mango limits the ability to integrate high throughput genetic approaches into mango breeding. In order to overcome this hurdle, we have sequenced transcriptomes of Keitt and Tommy-Atkins mango accessions (using a mixture of RNA from different tissues include leaves, inflorescences, flowers and few fruit developmental stages). As a reference we sequence one of the accessions by using 454-GS Titanium technology. For SNP discovery we applied Illumina HiSeq sequencing of the two accessions transcriptomes. Our reference transcriptome includes 41,096 hits in GeneBank non-redundant protein database, suggesting a relatively high coverage of the mango coding sequences. Out of approximately 15,000 SNPs 480 were selected for screening 90 accessions of ARO mango germplasm using Fluidigm platform. The genetic screening results were used to analyze the genetic structure of our germplasm collection, and to create a tool for accession identification. Furthermore, the data will be used for identification of markers associated with important horticultural traits that can be used for marker assisted selection.

☐ **11:40AM** - Tuesday June 4, 2013

Session 2: Genetics, breeding and biotechnology / S2-06

The Israeli mango breeding program and its new cultivars

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Abstract

Mango is one of the most important fruit crop in tropical and subtropical regions throughout the world. The vast majority of mangos are locally consumed. A steady increase in mangos consumption and import to Europe, USA and additional countries has turned mangos from an exotic fruit into a commodity. However, international trade is still based on relatively few cultivars, mostly generated dozens of years ago. For mangos, there is a real need for increased cultivar diversity. The Israeli mango breeding program is focusing on generating new elite mango cultivars, with high fruit qualities, high yields, and long shelf life that will fit the growth conditions of Israel. Our main objectives are generation of very appealing fruits, moderately large, with bright and colorful peels, no fibers, gentle aroma and sweetness and long shelf life. Our breeding strategy is based on “free pollination” of diverse cultivars of our germplasm collection. A number of high quality breeding products were identified, and are being registered as elite cultivars in Israel, Europe as well as additional growing and importing mango countries.

☐ **12:00 M** - Lunch / Almuerzo

□ 02:00PM - Tuesday June 4, 2013

Session 2: Genetics, breeding and biotechnology / S2-07

Three cycles of evaluation among monoembryonic mango progenies in the São Francisco River Valley, Brazil

Francisco Pinheiro Lima Neto^{1}, Carlos Antônio Fernandes Santos¹ and Hilçana Ylka Gonçalves de Albuquerque²*

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Abstract

The goal of this study was to evaluate mango progenies derived from crosses among Tommy Atkins and other three monoembryonic mango varieties - Keitt, Palmer and Van Dyke. The progenies were installed at the Embrapa Semi-Arid Experimental Field Station, located at Juazeiro, Bahia, Brazil. Some fruit characters, important to new mango varieties, such as weight, length, width, soluble solids content (°Brix), acidity content and °Brix/acidity content ratio were evaluated in true hybrids. Putative progenies for all crosses were obtained in 2002 by harvesting fruits from 'Keitt' or 'Palmer' or 'Van Dyke' plants dispersed in 'Tommy Atkins' orchards found in São Francisco Valley, in order to take advantage of natural crosspollination that occurs in the mango species. True progenies were declared based on microsatellite analyses. Management with paclobutrazol, silver nitrate and irrigation were applied to reduce the mango juvenile period. Progenies were evaluated in three successive cycles: 2007-2008, 2009-2010 and 2010-2011. Fruit weight ranged from 151.74 to 1,219.48 g, fruit length ranged from 6.8 to 22.7 cm, fruit width ranged from 4.3 to 12.5 cm, soluble solids content ranged from 9.9 to 27.0°Brix, acid content ranged from 0.06 to 1.34 and the °Brix/acidity content ratio ranged from 10.34 to 234.29. The results showed that natural hybridization among monoembryonic mango varieties generate a great level of genetic variability and also proportionate the identification of progenies with some desirable economic fruit attributes. The adopted strategies were also important to quickly generate and evaluate mango progenies, and should be integrated in mango breeding programs around the world.

Keywords: *Mangifera indica*, hybrids, juvenile period reduction.

□ **02:20PM** - Tuesday June 4, 2013

Session 2: Genetics, breeding and biotechnology / S2-08

Mango breeding in South Africa: challenges and future prospects

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Abstract

The classical breeding of mango cultivars is an inefficient and time consuming process, although most of the current mango cultivars were derived from classical breeding or random selection. The mango breeding program of the Agricultural Research Council's Institute for Tropical and Subtropical Crops (ARC-ITSC) was started during 1990. The strategy at that stage was to select new cultivars mostly acceptable to the consumer in Europe. The criteria for this strategy to be successful were cultivars with a fruit size of more than 300g/fruit and a red external colour. This strategy resulted in the release of cultivars such as 'Heidi', 'Chené' and 'Neldica' and the registration of two others, 'Joa' and 'Crimson Pride'. Since the start of the new millennium the emphasis has changed somewhat. Due to various reasons such as an unfavourable exchange rate at that stage and strong competition from other countries, the aim of the breeding program shifted. The challenge was to find fruit with other characteristics suitable for different markets. Export to other countries with different preferences became a possibility and fruit with a yellow external colour were identified. Promising selections fitting these preferences are selections B2-P33 and C2D2-E12. The South African Governments' emphasis on upliftment of small scale farmers forced another strategy change, i.e. disease tolerant fruit with high yields where fruit size are not so important. Selections from the breeding program matching these characteristics are P3, AM12, 'Nel petite' and G10. The decrease in export since 2004 resulted in the growth of alternative markets such as direct sales, drying, fresh cut, juice and atchar. Selections from the ARC-ITSC's mango breeding are now being evaluated with the specific characteristics for these and other niche markets. Once identified, selections with the potential to perform in these markets are also being evaluated on producer farms in different climatic regions.

Keywords: *Mangifera indica* L., subtropical fruit, cultivar, selection, evaluation.

□ 02:40PM - Tuesday June 4, 2013

Session 2: Genetics, breeding and biotechnology / S2-09

Three cycles of evaluation among ‘Haden’ x ‘Tommy Atkins’ mango progenies in the São Francisco River Valley, Brazil

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Abstract

The goal of this study was to evaluate mango progenies derived from ‘Haden’ x ‘Tommy Atkins’ crosses, installed at the Embrapa Semi-Arid Experimental Field Station, located at Juazeiro, Bahia, Brazil. Some fruit characters, important to new mango varieties, such as weight, length, width, soluble solids content (°Brix), acidity content and °Brix/acidity content ratio were evaluated in true hybrids. ‘Haden’ x ‘Tommy Atkins’ progenies were obtained in 2002 by harvesting fruits from ‘Haden’ plants dispersed in ‘Tommy Atkins’ orchards found in São Francisco Valley, in order to take advantage of natural crosspollination that occurs in the mango species. True ‘Haden’ x ‘Tommy Atkins’ progenies were declared based on microsatellite analyses. Management with paclobutrazol, silver nitrate and irrigation were applied to reduce the mango juvenile period. A hundred and fifty-five progenies were evaluated in three successive cycles: 2007-2008, 2009-2010 and 2010-2011. Fruit weight ranged from 147.39 to 777.62 g, fruit length ranged from 7.3 to 17.7 cm, fruit width ranged from 5.2 to 10.4 cm, soluble solids content ranged from 10.7 to 23.4°Brix, acid content ranged from 0.08 to 1.72 and the °Brix/acidity content ratio ranged from 6.76 to 218.67. The results showed that natural hybridization among Haden x Tommy Atkins mango varieties generate a great level of genetic variability and also proportionate the identification of progenies with some desirable economic fruit attributes. The adopted strategies were also important to quickly generate and evaluate mango progenies, and should be integrated in mango breeding programs around the world.

Keywords: *Mangifera indica*, hybrids, juvenile period reduction.

□ 03:00PM - Tuesday June 4, 2013

Session 2: Genetics, breeding and biotechnology / S2-10

Biodiversity in mango varieties of West Bengal, India: status and prospects for its utilization

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Abstract

Mango, an integral part of horticulture heritage of India, is cultivated under diverse agro-ecologies. It has a heritage of over 4000 years in our country. India, a place of rich mango genetic diversity, is the largest producer of mango with 12.7.5 MT. Considering the significance of subtropical fruits for livelihood, it is imperative to examine the intrinsic value of mango biodiversity and undertake its valuation in the emerging context of environmental issues, ecosystem services and sustainable livelihood options. Mango is also an esteemed fruit crop of the state of West Bengal, occupies the highest area [89.5('000ha)] among fruit crops of the state. West Bengal has a long traditional past with a heritage of large number of varieties planted by Nawababs. The well known 'Raisbag' orchard of Murshidabad district of the state alone was known to have hundred mango varieties of repute. It is believed that more than two hundred mango varieties are still available in West Bengal. We have located and clonally collected 74 varieties. Keeping in view the importance of these traditional varieties, three clonal orchards were established for their conservation, evaluation and utilization. Notable traditional varieties include Safdar Pasand, Rani Pasand, Kishanbhog, Lakshman Bhog, Piarafully, Sarikhas, Saradiminibhog etc. There are many coloured varieties, varieties suitable for processing, suitable to use as fresh fruits and for other commercial purposes. This paper elucidates the status, and prospect of mango germplasm conserved in the University for research and commercial endeavours'.

☐ **03:20PM** - Tuesday June 4, 2013

Session 2: Genetics, breeding and biotechnology / S2-11

Evaluation of indigenous (naati) mango varieties and conservation through diversity parks

M.R. Dinesh, C. Vasugi, K.V. Ravishankar and C. Lavanya

Abstract

Mango is one of the most important fruit crops, valued commercially for its taste and quality. India is the major centre of diversity as far as *Mangifera indica* is concerned. The large varietal wealth has not yet been thoroughly evaluated. Due to rapid industrialization and emphasis on commercial exploitation of few varieties for table as well as processing, large number of local (naati) indigenous varieties is being lost. An attempt was made to collect evaluate and conserve indigenous types (36) in addition to the commercial varieties, locally on farm in two locations at Chittoor, so that these would form as a field genebank at a later date even if the varieties become extinct in farmer's field. The main idea behind conservation in such diversity parks is that these varieties, which have evolved in a particular place, would be conserved *in situ*. Altieri and Merrick (1987) opined that landraces should be preserved for future generations because they harbour diversity of interesting traits for future breeding work and for developing new farming systems and moreover, reflect the cultural identity of certain groups of people. The evaluation carried out showed wide variation among the indigenous types with respect to fruit quality traits. Based on the overall eating quality; varieties were graded as excellent / very good in some of the indigenous types like Lalbaba, Chittithotha, and TSAN6 etc. The molecular characterization carried out showed the diversity among the indigenous types. The conservation of these indigenous varieties *in situ* would help in preserving the diversity present in a particular region with the participation of the farmers.

☐ **03:40PM** - Coffee Break/Receso

□ 04:00PM - Tuesday June 4, 2013

Session 2: Genetics, breeding and biotechnology / S2-12

Characterization of *Mangifera indica* accessions based on Brazilian adapted UPOV descriptors

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Abstract

The goal of this work was to characterize 103 mango accessions of the field Germplasm Bank of Embrapa Semi-arid, located in Juazeiro, Bahia, Brazil, adopting 50 descriptors established by the Brazilian Ministry of Agriculture, Livestock and Supply, to help in the development of new mango cultivars for the Northeast region of Brazil. Four plants were used, with eight adult leaves, eight flowers and 16 fruits being collected per plant, resulting in a total of 32 examples per accession. Characteristics were evaluated from the plant size to the seed embryo. Simple percentages were estimated for all the descriptors and photographs were obtained for some of the descriptors, principally for those related to the fruit. Only the descriptors leaf symmetry and fruit waxiness did not present variation among the accessions. Eight accessions did not present fruits with fibers while others nine accessions presented pulp firmness, which are important characteristics for breeding improvement. The soluble solids content was high, above the 14°Brix, for 95% of the accessions, with Tommy Atkins presenting the lowest value, 12.5°Brix. There was a great diversity for the color of the epidermis ranging from green to red. The accessions Amrapali and Salitre presented a dark orange color for the pulp. The obtained data, the most comprehensive so far in Brazil, can help in the choice of the best parental to develop populations with desirable attributes and also contribute to the protection of mango cultivars in Brazil, according to the descriptors established by Brazilian legislation.

Keywords: Mango, Germplasm Bank, Accessions.

□ 04:20PM - Tuesday June 4, 2013

Session 2: Genetics, breeding and biotechnology / S2-13

Phenotypic divergence among *Mangifera indica* based on agromorphological descriptors

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Abstract

Studies about the genetic divergence among individuals in plant species have been of great value in breeding programs. In this work the genetic diversity of 103 mango accessions were evaluated, based on Brazilian adapted UPOV descriptors, in order to permit selection of adequate genitors for crossings and cultivar development. Only one person applied the descriptors to minimize the difference in personal judgment. For some metric descriptors a numeric value was obtained before converting them to a determined descriptor category. The absence of a given descriptor category was converted to “zero”, while the presence was converted to “one”. The Jacquard index of similarity was adopted to estimate the distance for each individual pair of studied accessions. The matrix of similarity was used for the construction of the dendrogram, according to the Unweighted Pair Group Method with Arithmetic Mean. Averages were estimated for each descriptor for the formed groups. The cophenetic correlation was 0.48. The accessions evaluated presented similarity superior to 24% showing high variability of the accessions. At 0.30 similarity cutoff point four principal groups were formed, where the descriptors of the fruit were the most divergent. The accessions were grouped in the dendrogram independently of their geographic origin. Descriptors related to mature fruits or point of harvest were the most divergent among the four groups, and they could be used to differentiate accessions of different groups. Of special interest is the fruit epidermis color that was different for the four groups. The accessions of groups one and three contrasted to pulp weight and skin color and could be used to develop new mango cultivars.

Keywords: Mango, UPOV, Similarity.

□ 04:40PM - Tuesday June 4, 2013

Session 2: Genetics, breeding and biotechnology / S2-14

Characterization of the Banilejo mango (*Mangifera indica* L.) for the commercial exploitation in the Dominican Republic

Cándida M. Batista, Daysi Martich, Danna de la Rosa

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Abstract

The “Banilejo” mango is one of the most popular native crops in the Dominican Republic in as much as fresh fruit as at the agroindustrial level, also being exported to the ethnic markets in the United States and Europe. It is produced in dispersed plants, organized farms for commercial exploitation not existing (being that these principle zones of production are the provinces of Peravia and San Cristóbal). The fruits present variations in morphological, organoleptic, and cultivated characteristics that make exportation heterogeneous. In order to standardize its commercialization as much as in the local as in the international market, we proceeded to the characterization and evaluation during the years 2005 to 2008 in one single camp of these characteristics for the different selections of the Banilejo mango made since the year 2000 in these two provinces. The materials used, obtained during the asexual multiplication, were identified in accordance with their origins arbitrarily with the following codes: “BN1”, “BN2”, and “BN3” (Banilejos of Najayo, San Cristóbal), “ESC (Escondido, Baní)”, “Baní-2” (both of Baní). The evaluations were performed in the EEFB of IDIAF. The results obtained during the multivariate analysis (MANOVA, Infostat, 2008) demonstrate that “BN2”, “BN3”, and “Baní-1” have similarity between each other in the parameters of plant height, thickness of the cup, and diameter of the cup. “ESC” and “BN1” did not demonstrate statistical differences. In the parameters percentage of flowering and inflorescence with fruits, “BN1” presented the largest averages of 34.4% and 38.2% respectively for the first year of harvest, while in the second year of harvest “ESC” (85% flowering) and “BN1” (49.4% flowering) were the best in amount of inflorescence with fruit. Regarding average fruit weight, the following results were obtained: “Baní-1”, 150.4 g; “Baní-2”, 149.5 g; “BN1”, 189.5 g; “BN2”, 180.4 g; “ESC”, 170.6 g.

Keywords: Mango, crops, *Mangifera indica*

Session 3: Physiology and reproductive biology

☐ 05:00PM - Tuesday June 4, 2013

Session 3: *Physiology and reproductive biology* / S3-01

Reproductive type handle states (*Mangifera indica* L) in central area of Venezuela

Pérez Macias, Mercedes¹; Soto, Enio¹; Puche, Marelía¹; Avilan, Luís².

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Abstract

The transition from the vegetative to the reproductive phase involves changes in the pattern of cell differentiation and morphogenesis of the apical buds, observing afterward, the progressive and orderly appearance of such states reproductive phenology. These floral organs represent a complex array of functionally specialized structures. The evolution of these structures or states called type in reproductive phenology, provides accurate and significantly related to the environment and especially with the seasonal changes that are under perennial species. Today it is essential to build databases that allow storing this information in time using a number system with a uniform coding. None of the above key phenological to date has included in their study a precise description of the mango. In the experimental field of CENIAP, INIA, Venezuela, were analyzed six consecutive flowering observation plots on a total of 20 mango trees, 10 'Haden' and 10 'Edward'. Lossois Aubert, (1972) was used as the basic model reference and also the model of Cabezas *et al.*, (2003) for *Persea americana* Mill. It was established a model that identifies and defines 8 states and 2 major type sub-reproductive stages macroscopically, from bud dormancy until tender fruit, diffuse proposals currently known. It is indicates the annual date of occurrence of the state higher-type, with period climate information, allowing knowledge, measure and infers visual starting date of flowering in the production area.

Keywords: Reproductive phenology, tropical fruits

□ 05:20PM - Tuesday June 4, 2013

Session 3: Physiology and reproductive biology / S3-02

Factors affecting 'Maya' and 'Omer' mango cultivars production in Israeli orchards

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Abstract

The Israeli mango cultivars 'Maya' and 'Omer' are high quality fruits. 'Maya' fruits, which picked as fully mature ("ready to eat"), have a delicious taste and attractive yellow-orange peel colour. 'Omer' fruits are also delicious with a brilliant bright ruby hue peel colour, and the harvested fruits can be maintained at proper low temperatures for up to two months. Therefore fruits from the two cultivars are highly requested at international markets. However, the orchards suffer from low yields of 30 t/ha, compared to other common commercial cultivars. The aim of this work, performed during three consecutive years (2010-2012), was to identify factors affecting 'Maya' and 'Omer' production, in order to develop methods for improvement. Results, from all the conducted experiments, suggested that the moderate temperatures during fruit development, from May to August 2011, is the most important factor which contributed to yield increment of both cultivars: by increasing fruit number per 'Omer' tree (from 170 fruits/tree in 2010 and 2012 to 220 fruits/tree in 2011); and by enlarging 'Maya' fruit weight (from 290 g in 2010 and 2012 to 340 g in 2011). In addition, a positive effect was found between vegetative growth and productivity in both cultivars (more fruits developed on newly growing branches compared to mature branches). Thus, it was suggested that developing methods to reduce temperatures during fruit development, such as shade nets over the trees, and/or increase autumn vegetative growth, by mild pruning or additional irrigation, may improve 'Maya' and 'Omer' production.

Keywords: *Mangifera indica*, productivity, moderate temperatures, autumn vegetative growth

□ 05:40PM - Tuesday June 4, 2013

Session 3: Physiology and reproductive biology / S3-03

Breakthrough in advancing Alphonso mango production season in lateritic rocky areas of Konkan region through manipulation in PBZ application time

M.M. Burondkar¹, Shailendra Rajan², K.K. Upreti³, M.M. Naik¹, P.M. Nigade¹, S. N. Sabale¹

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Abstract

A field trial, aimed at advancing “Alphonso” mango season with manipulation in time of soil application of PBZ (15th May, 15th of June, 15th July and 15th of August), foliar spray of KNO₃ (3% in Aug. and Sept.) along with untreated control, was conducted in RBD, during 2010 to 2012 mango cropping season in red lateritic rocky area along the West coast of India in Konkan region.. Results of individual years as well as pooled of three years revealed that, significantly maximum earliness in flowering time (85.4 days) and with maximum advancement in harvesting time (82.83 days) was recorded in treatment with application of PBZ on 15th May, followed by 15th June application (69 days). However, the maximum flowering (72.230 % and 68.14%) and yield per tree (40.72 and 39.37 kg/tree) was registered by PBZ applied at recommended time i.e. on 15th Aug. followed by 15th July, respectively. The individual fruit weight was recorded maximum in KNO₃ treatment applied foliarly @ 3% in month of Aug. (268g) and Sept.(265.5g), where as T.S.S was higher (19.37 °Brix.) in treatment with application of PBZ on 15th of August. Findings have huge potential to realize about 10 times more price for “Alphonso” mango produced in Feb-March as compared to May harvest.

Day 3 - Wednesday June 5, 2013 /Día 3 - Miércoles 5 de Junio 2013

☐ **08:20AM** - Wednesday June 5, 2013

Session 3: Physiology and reproductive biology / S3-04

Seasonal variations in physiological response of Alphonso mango under Konkan conditions.

M.M.Burondkar, Shailendra Rajan, K. L. Pujari, S. G. Bhave, S. N. Sabale

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Dist: Ratnagiri, Maharashtra, India

Abstract

A research was carried out at Dr. B. S. K. K. V, Dapoli on 25 years old Alphonso mango tree to examine the physiological response of Alphonso mango to the seasonal variation. The physiological parameters such as rate of photosynthesis, leaf water potential and xylem sap flow were analyzed by LICOR-6400, ARIMAD 3000 and Granier's thermal dissipation probe respectively. Result indicated close association between weather parameters and physiological response of mango during all the three seasons namely winter, summer and rainy. Rate of photosynthesis was maximum during October – November and was positively influenced by maximum xylem sap flow and availability of moisture. The photosynthesis during rainy season (June – September) was minimum (ranged between 2.0 – 2.5 $\mu \text{ mol CO}_2 \text{ m}^{-2} \text{ sec}^{-1}$) owing to low sunlight availability (below light saturation point) whereas, during summer photosynthesis was lower (ranged between 4 – 6 $\mu \text{ mol CO}_2 \text{ m}^{-2} \text{ sec}^{-1}$) due to low soil moisture. The highest rate of photosynthesis was observed immediately after rainy season during the second fortnight of October (8.91 $\mu \text{ mol CO}_2 \text{ m}^{-2} \text{ sec}^{-1}$) whereas the maximum xylem sap flow was recorded during September and October (ranged between 20 - 30 kg/hr.). The leaf water potential recorded was highest (-1.9 bar) during the month of March in summer season. It was observed that the annual rainfall had a negative effect on the xylem sap flow, leaf water potential as well as the photosynthesis. The minimum and maximum temperature had shown no distinct effects on either of the aspects.

□ 08:40AM - Wednesday June 5, 2013

Session 3: Physiology and reproductive biology / S3-05

Hydric stress associated to beginning of the mango flowering (*Mangifera indica* L) in the central area of Venezuela

Pérez Macias, Mercedes¹; Soto, Enio¹; Puche, Marelia¹; Gutiérrez, Maria² y Avilan, Luis³.

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Abstract

The beginning of the mango flowering it is rule by environmental factors, genetic expression and the origin of the cultivar; can be promoted by hydric stress, horticultural management and a natural way, by descending of temperature. In the INIA-CENIAP, Venezuela, six consecutive periods of flowering were analyzed in a total of 20 trees of mango of 'Haden' and 'Edward'. The floral phenology was quantified. The intra annual behavior of the historic series was evaluated comparing with the period of the assay. Every 10 days the hydric balances were calculated and also basic wet conditions for each month and year of the assay. The sequence of the dry days in the 30, 60 and 90 days was evaluated previous to the beginning of the visual flowering expression classifying in a arbitrary scale of: low, moderate, severe and much severe. The mayor rainfall are between April and November. In the trial period the atypical climate cycle was not present related with the variability described between 1980-2008. It was observed a maximum of 10 consecutive days with 0 water lamina in the 90 days before the visual of floral expression. The relation E_{Tr}/E_{To} showed values mayor to 0,5 indicating that the water requirement was reached in this biological phase. Environmental signals as the increasing of the number of days with temperatures lower than 20°C in particular, in the months of July and September suggest mayor contribution over the floral mechanism.

Keywords: phenology, fruits crops, water regimes, floral initiation, differentiation

□ 09:00AM - Wednesday June 5, 2013

Session 3: Physiology and reproductive biology / S3-06

Mango (*Mangifera indica* L.) response to deficit irrigation at different phenological stages

A.G. Levin¹, A. Naor¹, M. Noy², C. Love², Y. Gal² and M. Peres¹.

¹Northern R&D-Israel; ²Israeli Extensions Office.

Abstract

In many areas of Israel drought and scarce fresh water resources endanger the sustainability of irrigated agriculture. The application of water below the evapotranspiration requirements is termed deficit irrigation (DI). Very limited research has been carried out worldwide in general, and in Israel, in particular, regarding water deficit irrigation at different phenological stages in mango trees and its consequence from the fruit quantity and quality point of view. The effect of four different irrigation quantities (100% [control], 125%, 75% and 50%) at three different phenological stages (1-fruit set to hardness of the stone; 2-hardness of the stone to harvesting; 3-post harvest) were tested during the period of 2010 to 2012 on Mango trees cv. Keitt in the Jordan valley in Israel. The treatments were tested in five replications in randomized blocks. The years 2010 and 2011 were characterized by medium to high yield (35 and 75 T/ha, respectively) with different climatic conditions (2010 long hot summer with late rain; 2011 shorter mild summer with early rain). In 2010, similar to 2011, no significant difference in fruit production (including fruit number and average fruit size) was found among the treatment for phenological stage 1 and 2. In autumn 2010 and 2012 in the third phenological stage (post harvest) the vegetative growth was directly proportional to the irrigation quantities, in that the vegetative growth was significantly higher in the 125% treatment compared to that of 50%. In the following production year (2011), the yield in the most irrigated treatment (125%) was significantly higher; 38% in comparison to the 50% treatment, mainly as a consequence of larger fruit (30% significant increment in average fruit size) rather than in number (8% non significant increment). However, in 2011 after a heavy fruit production (70T/ha) no significant difference in vegetative growth were observed among the treatments. The year 2012 was characterized by very low production (10-15 T/ha) and as a consequence any significant difference among the treatments could not be associated to the treatment effect. During the three years of the study, the 50% treatment showed significant difference in some of the evaluated physiological parameters (mainly stomata conductivity and maximum daily shrinkage) in respect to the others treatments in all the phenological stages. The 75% treatment was similar in respect to the control (100%) and over-watered treatment (125%) in all the evaluated parameters in the three phenological stages evaluated in this study.

Keywords: yield, fruit size, number of fruit, stomata conductivity, maximum daily shrinkage (MDS).

☐ **09:20AM** - Wednesday June 5, 2013

Session 3: Physiology and reproductive biology / S3-07

Effect of paclobutrazol soil drenching on flowering of mango cv. Mahajanok

Ratthaphol Muengkaew , Peerasak Chaiprasart

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Abstract

The experiment was done in randomized complete block design (RCB). The uniform 10 years old and 4 diameter with 6 replication (1 plant each). Mango tree were selected from the export mango growers at Noen Mapang District, Phitsanulok. Tree pruning and spraying with thiourea 0.5 % (2.5 g/liter) and potassium nitrate (2.5 g/liter) were done for new leaf flushing. After 1 month the mango leaf became immature stage (pasalad leaf). Paclobutrazol soil drenching was applied. They consisted of 30, 60, 90, 120 g and compared with control. The results found that the paclobutrazol application with 120 g showed the highest total nonstructural carbohydrates (TNC) in leaf, shoot and inflorescence. This application also showed early flowering than other treatments after paclobutrazol soil drenching for 50 days and 100 % flowering. But the control treatment showed flower induction later than paclobutrazol treatments for 24-32 days and new leaf flushing approximately 30-40 %. The application of paclobutrazol 30 and 60 g also found that 80-90 % the flower induction and 10% new leaf flushing.

Keyword: total nonstructural carbohydrates (TNC),% flowering, Mango

☐ **09:40AM** - Wednesday June 5, 2013

Session 3: Physiology and reproductive biology / S3-08

Estudio del comportamiento del mango, cv. Keitt, sobre diferentes portainjertos

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Resumen

El cultivo del mango en el sur de España se desarrolla en una estrecha franja costera de las provincias de Málaga y Granada. A pesar de su clima benigno las condiciones climáticas son marginales para el cultivo de esta especie (36° L.N.) provocando que los árboles tenga un escaso desarrollo vegetativo en comparación con el de otras áreas productivas del mundo. Los suelos son, en su mayoría, de origen metamórfico, permeable, neutro y libre de carbonatos. No obstante, ciertas zonas de cultivo presentan suelo con pH superior a 8 y alto contenido de carbonatos. El agua de riego, en general, es de buena calidad con conductividad eléctrica (CE) inferior a 1,2 dS.m⁻¹ y elevados contenidos de HCO₃⁻, Ca²⁺ y Mg⁺². Ocasionalmente, por problemas de intrusión marina en los acuíferos, algunas plantaciones se han regado con aguas de peor calidad. En la búsqueda de un portainjerto vigoroso para nuestras condiciones de cultivo se planteó un ensayo comparativo con una sola variedad (Keitt) sobre cuatro patrones (13/1, Gomera 1, Dasi y Espada).

Se presentan los resultados de 10 años (2002-2012)

Se han estudiado:

- Parámetros de producción: crecimiento vegetativo, productividad, tamaño medio del fruto y periodo de recolección.
- Parámetros de calidad de fruto: color, epidermis, °Brix de la pulpa, descomposición interna, sabor y daños en piel.

☐ **10:00AM** - Coffee Break / Receso

□ **10:20AM** - Wednesday June 5, 2013

Session 3: Physiology and reproductive biology / S3-09

Mango responses to applications of a biostimulant based on amino acids and nutrients

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Miembro de la Sociedad Dominicana de Investigadores Agropecuarios y Forestales, SODIAF

Abstract

Experiments were conducted to determine the effects of a biostimulant formulation containing 5% free amino acids with 1% N and 30% K₂O (AminoQuelant® - K) on fruit set and size of mango 'Banilejo 3'. Beginning at flowering, every three weeks the trees were sprayed with aqueous solutions of the biostimulant at the concentrations of 0 (check), 2, 4, and 6 ml per liter of water. Fruit number and weight increased as spray concentrations increased from 0 to 4 ml per liter. The concentration of soluble solids in the fruit juice also increased as spray concentrations of the biostimulant were increased. These results indicate that under the conditions of this research, this biostimulant may be useful to enhance mango fruit yield and quality.

□ **10:40AM** - Wednesday June 5, 2013

Session 3: Physiology and reproductive biology / S3-10

Potassium nitrate acts to stimulate and concentrate terminal bud development in Nam Doc Mai terminal shoots induced to flower by soil paclobutrazol treatment

¹S.A. Oosthuysen, and ²Bert Desmet

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Abstract

Bearing Nam Doc Mai Si Thong mango trees in a non-irrigated orchard in the Chachoengsao Province, Thailand, were either soil treated in mid-July, 2011, when new terminal shoot development was commencing, with paclobutrazol or were left untreated in this regard. Treated trees were either sprayed or not sprayed with potassium nitrate, potassium nitrate spraying having been carried out to initiate inflorescence development. Potassium nitrate was sprayed on October 10, 20 and 27, and on Nov. 3, 2011. In addition, certain of the potassium nitrate sprayed trees were also sprayed with Ethrel/SOP on Sep. 1 and 8 as a measure to delay bud development from the new shoots arising after paclobutrazol treatment. Terminal bud swell was first noted on Oct. 20. Tree flowering intensity was recorded on Nov. 10, 14 and 24, and on Dec. 8 and 22, 2011. A tensiometer station was set up to monitor soil matric potential during the period of the experiment. Ethrel/SOP treatment had no apparent effect on flowering intensity during the period of flowering evaluation. The trees not treated with paclobutrazol did not produce inflorescences nor new shoots during this period, whereas those that were produced inflorescences during the evaluation period. Flowering intensity in the trees sprayed with potassium nitrate was elevated initially, that is on Nov. 10 and 14. However, flowering intensity of the trees not treated with potassium nitrate was as high as those treated with potassium nitrate on Nov. 24 and later. The results clearly indicate that potassium nitrate acts in stimulating and thereby concentrating terminal bud development to a confined period, and that paclobutrazol acts to induce inflorescence development. New shoots developed on the non treated trees when the trees treated with paclobutrazol only were initiating inflorescences.

□ **11:00AM** - Wednesday June 5, 2013

Session 3: Physiology and reproductive biology / S3-11

The effect of spray application of potassium nitrate, urea, Wuxal Boron, or various growth regulators or mixes thereof on the fruit retention, fruit size distribution and yield of Tommy Atkins, Kent or Heidi mango

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Abstract

The effects of foliar spray application of potassium nitrate, low biuret urea, GA_3 , CPPU, and NAA on fruit retention, average fruit weight and tree fruit yield at harvest were evaluated. Inflorescence pruning during development was also evaluated as a measure to increase fruit retention, size and tree fruit yield. Nutrient spray applications were made while the trees were in flower and growth regulator applications subsequently, just prior to the commencement of fruit drop. Of the treatments applied during flowering, KNO_3 application was the only treatment to noticeably increase fruit retention, individual fruit weight, and tree yield. Positive effects on fruit retention were often negated by negative effects on individual fruit weight. Of the treatments applied after flowering, application of CPPU + GA_3 noticeably increased fruit retention consistently (10 ppm CPPU, 30 ppm GA_3). Fruit size reductions however negated an effect on tree yield. In Tommy Atkins, one 4% spray application of KNO_3 was most effective at full bloom, whereas in Kent and Heidi, two 2% applications were most effective, the first carried out prior to full bloom and the second at full bloom.

□ **11:20AM** - Wednesday June 5, 2013

Session 3: Physiology and reproductive biology / S3-12

Reproductive biology in mango (*Mangifera indica* L.) in a Mediterranean climate

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Abstract

The increase in mango cultivation in the last decades has resulted in the extension of the crop to areas where environmental conditions are not the most favourable for optimal mango development. These effects of the environmental conditions can be even more important during the reproductive phase and, consequently, will have a direct impact on fertilization and yield. In this work, the reproductive biology of mango in the growing area of the Southern Spanish Mediterranean coast was studied using the cultivars 'Osteen', 'Kensington', 'Kent' and 'Keitt'. As a first step, in order to establish the appropriate developmental coordinates during the reproductive phase, phenology was studied from the start of the blooming season to fruit harvest. As a second step, the female and male reproductive structures and the interaction between both was analyzed, with the objective of detecting the reasons behind the low fruit set in mango compared to the initial number of flowers produced. For this, on the one hand, the morphology and development of the main structures in the pistil involved in the interaction with the male gametophytes (stigma, style, *ponticulus* and embryo sac) were analyzed using microscopy techniques. Differences, which could explain the subsequent differential reproductive success observed, were found among flowers. On the other hand, pollen germination and tube growth assays were performed in vitro, in semivivo in the laboratory and in the field allowing the study of pollen tube dynamics and kinetics setting a time for each step of the progamic phase. Finally, a compatibility assay was performed where pollen tube growth was studied in self and cross-pollinated flowers. Although no clear differences were found in pollen tube growth between self and cross pollinations, a paternity analysis with microsatellite markers showed significant differences in outcrossing rate depending on the availability of pollinizer trees. These results suggest that there is a preference for cross-fertilization in mango.

☐ **11:40AM** - Wednesday June 5, 2013

Session 3: Physiology and reproductive biology / S3-13

Effect of methyl jasmonate on red color, qualities and postharvest extending the shelf life of mango fruits cv. Mahajanok

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Abstract

The experiment was done in 5x2 factorial in randomized complete block design (RCB). The first factor was the methyl jasmonate at 20, 40, 80 and 120 ppm of the concentration and the spraying times were 90 days after anthesis compared with non-treated (control). The second factor was the different storage temperatures at 15 and 27°C. Uniform and non-defected mango fruits were harvested at 115 days after anthesis. Chemical and physical properties were determined every 3 days. The results showed that the concentration of methyl jasmonate 80 ppm sprayed mango fruits could be developed of red fruit peel, higher total anthocyanin content than the control. This application also showed firmness of peel, L* values of peel and L* and a* values of pulp were higher than the control. The application of methyl jasmonate 80 ppm showed soluble solids content less than the control. Moreover, all treated and untreated mango fruits kept at 15 and 27 °C. They found that the methyl jasmonate sprayed mango fruits and kept at 15 Co had the shelf life of 18 days. Firmness of peel, L* a* b* values of peel were higher than control. For the mango fruits kept at 27 CO had the shelf life of 9 days. All concentration of methyl jasmonate sprayed mango fruits showed greater total anthocyanin content than the control.

Keyword: Quality, Extending the Shelf Life, Red color, Mango

☐ **12:00M** - Lunch / Almuerzo

Session 4: Horticultural practices

☐ 02:00PM - Wednesday June 5, 2013

Session 4: Horticultural practices / Keynote 4-01

Advantages and disadvantages of cultivating mangoes (*Mangifera indica* L.) under subtropical conditions and potential of greenhouse cultivation of mango

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Abstract

Although the mango is grown mainly in tropical climates, there are significant advantages to cultivating mangoes in the subtropics, where cooler winter temperatures improve flower induction, and both early bearing in younger trees and lower annual growth rates favour high-density planting options. While cold spells can damage vulnerable young trees and sustained low temperatures can provoke alternate bearing phenomena in late season cultivars, the chief disadvantages of cultivating mangoes in the subtropics are the need of avoiding flowering in young trees, the prime cause of premature aging, and the need to control annual flowering so that it coincides with temperatures conducive to good fruit set. Greenhouse cultivation –unheated, in many areas of the subtropics– resolves some of these problems as well as other typically associated with the crop: the higher diurnal temperatures intensify flowering and fruit set, out of season production (particularly early) is feasible, sunburn is largely eliminated, and exclusion of damaging pests becomes possible and easier. These cultivation advantages must be off-set against the initial infrastructure costs as well as the obligatory and timely provision of pollinating insects at flowering time. Prior, in-depth economic studies are thus required in order to ensure that the investment will be profitable in the long term.

Keywords: Flowering, temperature, alternate bearing, pollination, cultural techniques

□ 02:40PM - Wednesday June 5, 2013

Session 4: Horticultural practices / S4-01

Answer of four mango cultivars (*Mangifera indica* L.) to the rehabilitation pruning, to the 5 years of carried out in the south of Havana Cuba

Rafael Jiménez, Fressy Pérez, Domingo Rivero, Felina Martínez, José M. Matamoros, David Zamora y Darío G. Saurd.

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Abstract

The experiment consisted on evaluating the rehabilitation prune on four cultivars of mango Super Haden, Keitt, Haden and Delicioso, grafting on rootstock of white mango on a orchard that was planted in February of 1988 on a soil Ferrasol Rhodic, at a distance of plantation of 10 m x 10 m, the which was destroyed completely by the step of a hurricane Charley in August of 2004. The investigative work was carrying out during 5 years. All the cultural practices were applied in accordance with the technology of production of this cultivation settled down for dry barren land in Cuba. The total area it was of 2.5 ha. In December of the 2004 was carries out the rehabilitation prune to a height of the surface of the soil that oscillate among 0.90 m 1.10 m, to the whole orchard and in April of 2006 was carried out an experiment by making a pruning of formation and topping to a height of 1.70 m from the surface of the soil to conform the structure of the tree, that which was repeated in April of the 2007, but to 2.00 m of height. The analyzed variables were diameter, height and volume of the canopy for the formula $V = 0.5236 hd^2$ (Mandel, 1971) in (m), the production was also evaluated in kg/tree and the productivity kg/volume of the canopy. The utilized analysis was ANOVA of double classification, factorial model. The utilized design was at random of block with four repetitions and 12 tress for treatment, observations of the sprouting, flowering and fructification were also made. The data of the production were transformed in $\sqrt{x} + 1$. When there were significant differences was used the test from Turkey to 5%. The better cultivates were the Super Haden and Keitt and the worse the Delicioso y Haden.

Keyword: Rehabilitation prune, cultivars, years, Cuba

□ 03:00PM - Wednesday June 5, 2013

Session 4: Horticultural practices / S4-02

Use of two forms of the tangential graft without beheading the rootstock in the propagation of the mango (*Mangifera indica* L.) in orchard conditions to the south of the Havana, Cuba

Rafael Jiménez, David Zamora, Fressy Pérez, Narciso N Rodríguez, José M Matamoro, Rubén Tamayo, Domingo Rivero.

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Abstract

Grafting is the most extended method in the world for the vegetative propagation of the mango, given its efficiency and realization easiness. Different types and forms of grafting exist depending on the objectives that are pursued. The practice of this propagation technique is frequently carried out in the nursery stage, but there are occasions that are carried out to make re-grafting and canopy changes in the mature orchard. The objective of the present work consisted on evaluating under field conditions the behaviour of two variants of the technique of side grafting. The experimental work was carried out in the Technological Scientific Unit of Base of Alquizar, in the Technological Unit Scientist of Base Alquizar, located in the south of Havana, belonging to the Institute of Researches in Tropical Fruit. The method used was lateral grafting without decapitating the rootstock covering and without covering completely the bud with the purpose of determining the effectiveness of this technique in the taken of the graft. The results obtained show that full cover of the graft without decapitating the rootstock, gives better taking in comparison with the used traditional graft and its effectiveness to make canopy changes and re-grafting the dead grafts in the field.

Keyword: Propagation, graft, forms, mango

□ 03:20PM - Wednesday June 5, 2013

Session 4: Horticultural practices / S4-03

Handling of the pruning, for the control of the growth in mango orchards (*Mangifera indica* L.) in the first 7 years of planted, associating tropical fruits of growth under, to the south of the Havana, Cuba

Rafael Jiménez, Fressy Pérez, David Zamora, Hugo M. Oliva, José M. Matamoros, Juan Álvarez.

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Abstract

The research was developed on eight cultivars Tommy Atkins, Super Haden, Keitt, Pedro, Kent, Smith, Haden and Delicioso, grafting on rootstock of white mango, Was planted on a soil Ferrasol Rhodic, at a distance of plantation of 6 m x 6 m in the month of June of 2005. All the cultural practices were applied, in accordance with the technology of production of this cultivation settled down in country, the utilized watering was located. The total area was of 2.5 has. They were carried out measures in October from the 2006 up to the 2012, about the growth: perimeter of the trunk and of the graft (cm.) in the height and diameter of the canopy (m) and volume of the canopy for the formula $V = 0.5236 hd^2$ (Mandel, 1971) (m^3); as well as their relationships respectively and of the 2008 to the 2012 was evaluated the yield in kg./tree and t/ha and the productivity in kg/perimeter of the rootstock and in kg/canopy volume. The crop was carried out in the month of June. The utilized design was at random of block, with 5 you reply and 2 treatments (cultivars and prunes), the utilized analysis was ANOVA of double classification, factorial model. They were in associate, tropical fruit growth under of behavior (papaya and guava) in the band in the first year of plantation, to a distance of main cultivation of 1.5 m and 3 m respectively. The data of the production were transformed in $\sqrt{x} + 1$. When there were significant differences was used the test from Tukey to 5%. The cultivars Super Haden and Keitt were the better and the cultivar Kent was the worse, jointly with cultivars them it Haden and Delicioso, not finding interaction cultivarsprunes, by bearing all cultivars good to the handling of the pruning. The use of cultivations in association does profitable to the main cultivation in the first stadiums of the orchard.

Keyword: Handling, prunes, mango, associating, growth under tropical fruits.

☐ **03:40PM** - Wednesday June 5, 2013

Session 4: Horticultural practices / S4-04

Reconversión de cultivo tradicional a cultivo de exportación en un escenario de mercados abiertos

César V. Paniagua

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Resumen

El cultivo de mango para la exportación es una alternativa económicamente factible para el valle de San Juan de la Maguana. La agricultura dominicana con el ejemplo que hemos vivido, debe ser reconvertida y puede ser reconvertida, para desarrollar cultivos de exportación que sean competitivos en el mercado abierto. En 1,200 tareas hemos podido producir un millón de unidades de mangos por año, a partir del 6to. Año que prácticamente no los arrancaban de las manos. El sistema de cultivo asociado es recomendable con frutales para mantener las áreas libres en producción, controlar las malezas, y desarrollar el frutal al mismo tiempo; de esta manera aprovechamos al máximo nuestros recursos naturales: agua, luz y suelo y hacemos una agricultura en armonía con nuestro medio ambiente. Mi experiencia me dice que mientras llega la cosecha promisoriosa fui sembrando de manera intercalada plátanos, yuca, batata, lechosa, maíz, guandul y al final hasta volví a sembrar mis habichuelas. Sin embargo, el gran reto y la más grande oportunidad para el productor tradicional que hoy cultiva mangos de exportación, es haber desarrollado una nueva variedad de pastos conocida como Transvala, que controla la maleza, utiliza eficientemente la luz solar y le da tranquilidad al bolsillo, porque se convierte de un gasto de control de malezas a una inversión de producción de pasto que puede cosechar cada seis meses.

Palabras claves: Mango, Tradicional, Exportación, Mercados Abiertos.

☐ **04:00PM** – Coffee Break / Receso

□ 04:20PM - Wednesday June 5, 2013

Session 4: Horticultural practices / S4-05

Standardization of package of practices for cvs. Alphonso, Ratna, Totapuri mangoes under ultra high density planting (UHDP)

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Abstract

India has the largest area under mango in the world, however, the productivity is the least per ha. The reasons are, most of the orchards have senile trees cultivated by conservative farmers, under rain fed conditions. Poor quality planting materials, low planting density, poor canopy management, failure to use Good Agricultural practices (GAP), rain fed, negligible use of micro irrigation systems (MIS), lack of training and exposure to high-tech productive orchard management etc are other reasons for poor productivity. The research team of Jain Irrigation systems ltd (JISL) has carried out several experiments on young mango trees planted at 3m x 2m (UHDP) using these latest technologies since 2006 in the Experimental mango orchard using differential regime of irrigation water through drip, fertigation using differential doses of fertilizers, canopy management and diseases and pests management as per Global-GAP. Based on the results, the precise packages of practices have been standardized. As a result, the yield of mango fruits of acceptable quality increased two to three folds in cvs. Alphonso, Ratna, Totapuri. The results of the experiments to determine the water, fertilizer requirements, canopy management for getting the targeted yield of quality fruits, the water foot prints and challenges facing mango industry in the country. Various extension methods used to outreach these technologies to farmers such as mobile training program with a specially designed bus, visit by Extension specialists to mango orchards and establishment of demonstration orchards at farmers' field.

□ **04:40PM** - Wednesday June 5, 2013

Session 4: Horticultural practices / S4-06

Integrated mango production in Brazil to enhancing production systems, quality, and safety of fruit

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Abstract

The development and implementation of ecosystem-based technologies in plant protection have been important objectives of the International Organization for Biological Control (IOBC). Integrated Production/Integrated Farming is a system that produces high quality and safe food and other products by using natural resources and regulating mechanisms to replace polluting inputs and to secure sustainable farming. The objectives and principles of Integrated Production (IP) are based in a holistic view of the system, combining strategies such as Integrated Pest Management (IPM), safety, fertilization, and agronomic measures to enhance their effectiveness. It relies on ecosystem regulation, food safety, the importance of animal welfare, and on the preservation of natural resources. The expansion of the mango growing area in Brazil depends on the generation and adaptation of production technologies, as well as on consumer market tendencies that currently require better quality fruit. Brazil needs to adjust itself to agricultural production systems like Integrated Mango Production (IMP) that has the objective economically producing high quality fruit obtained by ecologically safer methods, which minimizes the collateral undesirable effects of the use of pesticides, increasing environmental protection and improving human health. The IMP System in the São Francisco River Valley began in 2000, with the elaboration of an environmental diagnosis of the region followed by the monitoring of insects and diseases, training of technicians and farmers, study of the production chain, and elaboration of data bases and procedures for integrated mango production. This program is based on the integration of scientists, farmers, consultants, and extension people, both from public and private institutions. Research studies are being carried out in order to generate and diffuse new technologies, products, and services that can be adapted to the situation of the Brazilian mango farmers. We collected information on the application of pesticides during crop cycles, using the data recorded in field notebooks of ten parcels of mango, regarding the application of pesticides in 2001 (plots, did not participate of the IMP system) from 2002 to 2009. In the years 2007, 2008 and 2009, all herbicide applications were eliminated. The use of insecticides decreased on average only 31.5% compared to levels applied prior to deployment. The reduction of the application of fungicides has an average of 69.6% and acaricide was 100%. Based on data obtained, it can be stated that the adoption of the Integrated Mango Production gave a considerable reduction in the number of pesticide applications, compared to conventional production system (control).

□ **05:00PM** - Mango Working Group - ISHS

Day 4 -Thursday June 6, 2013 / Día 4 - Jueves 6 de Junio 2013

Session 5: Diseases and Pest control

□ 08:20AM - Thursday June 6, 2013

Session 5: Diseases and Pest control / Keynote 5-01

Características demográficas de *Anastrepha obliqua* (Diptera: Tephritidae), en relación con las plantas de mango en Panamá

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Resumen

El presente trabajo es un compendio de 22 años (1989 – 2010), de evaluaciones de poblaciones de adultos, larvas y pupas de *Anastrepha obliqua*, en relación con las características bióticas y físicas de dos zonas de Panamá, una en la zona baja correspondiente a áreas alteradas por la actividad humana y una segunda correspondiente a una zona protegida como reserva natural. Las evaluaciones de adultos corresponden a capturas de machos y hembras en 82 trampas de proteína hidrolizada, distribuidas a lo largo de una ruta de muestreo de 20 km; las evaluaciones se efectuaron cada 7-10 días y los resultados fueron estandarizados a períodos de un mes. Las plantas soporte de las trampas fueron marcadas, con data correspondiente al “sitio”, fenología de la planta, altura de la trampa y altitud sobre el nivel del mar, la población muestreal correspondió a un total de 28 plantas de mango. La información correspondiente a los frutos fue obtenida durante los primeros años de muestreo en plantas seleccionadas al azar en los sitios de muestreo, los valores obtenidos correspondieron al número total de frutos por planta de mango, algunos frutos fueron seleccionados, marcados y medidos desde su formación hasta el inicio de maduración de plantas de mango “criollo”, se estableció una curva de crecimiento para cada uno de los frutos hasta su maduración, estos frutos fueron seleccionados por parejas, de modo que los frutos “A” quedaron en la planta y los frutos “B” fueron cosechados, los frutos cosechados (“B”), fueron pesados y se determinó el brix en los últimos estados del crecimiento del fruto, los frutos de la serie “A” quedaron en la planta hasta que culminara su proceso de maduración, luego fueron cosechados, pesados, luego se contabilizó el número de frutos infestados, registrándose el número de larvas por fruto. Las larvas obtenidas de los frutos fueron colocadas en frascos

de empupamiento hasta la emergencia de los adultos, determinándose el número de machos, hembras, pupas sanas, pupas parasitadas y los parasitoides obtenidos fueron preservados para su identificación. Para cada año, se registraron valores de precipitación mensual, % de días con lluvia, temperatura max y min diarias, % de humedad del suelo (por período de muestreo). Durante los últimos años (1999 – 2006), se verificó la altura de la planta (con respecto al nivel del suelo de cada sitio), densidad del follaje (abundante, moderado escaso), número de frutos por planta. La información fue analizada mediante diversas pruebas estadísticas relativa a la data obtenida. Los resultados serán presentados en una conferencia ofrecida el República Dominicana, en junio de 2012.

☐ **09:00AM** - Thursday June 6, 2013

Session 5: Diseases and Pest control / Keynote 5-02

Avances y perspectivas para métodos etológicos y de control biológico clásico probados con moscas de las frutas en la República Dominicana

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Resumen

Para dar soporte al sector frutícola, especialmente al del mango, se realizaron desde el 2004 estudios de validación para el trapeo de moscas de las frutas en varias plantaciones de mangos y guayaba en la Región Sur-Central entre Piedra Blanca (Provincia Monseñor Nouel), Hato Damas (San Cristóbal), Ingenio CAEI y Matanzas (ambos en Peravia). Se utilizaron en casi todas las investigaciones las trampas de tipo ‘multicebo’ con base amarilla. Las moscas atrapadas correspondieron en su mayoría a hembras y en mango a *Anastrepha obliqua* (>99%), mientras que en una plantación mixta y en guayaba a *A. suspensa*. Se determinaron áreas con diferentes incidencias de moscas: alta (Hato Damas, con alta pluviometría), intermedia (Ingenio CAEI) y baja (Matanzas, zona árida). En una finca apenas manejada en Hato Damas, los exorbitantes promedios de moscas atrapadas/semana fueron superiores con cebos líquidos (proteína hidrolizada de maíz + 3% borato de sodio (Bórax) o pastillas de levadura *Torula*/Bórax) comparado con los cebos sintéticos secos de Putrescina (Pt) con 1/2 o 1 dispositivo de Acetato de Amonio (AA) o 1 a 2 pastillas de Bicarbonato de Amonio (AB), respectivamente, siendo estos últimos los menos eficientes. No hubo diferencias marcadas entre las diferentes dosis de los cebos secos. En otros estudios, se detectaron diferencias entre productos comerciales de torula de diferentes compañías y se confirmó una correlación positiva entre las capturas y el contenido de Bórax del atrayente, tanto en

proteínas hidrolizadas sintéticas como una nacional de experimentación (LC). Esta última fue mejorada con diferentes niveles de Bórax y comparada en su eficiencia en mango y/o guayaba con diversos atrayentes líquidos comerciales y/o en vía de desarrollo, logrando atrapar números similares de *Anastrepha* spp. como el estándar (Torula/Bórax), superando a algunos atrayentes comerciales y proteínas hidrolizadas líquidas con encimas añadidas. Se seleccionaron dos zonas con alta prevalencia: Hato Damas (HD, Suroeste) y Mata Larga (ML, Noreste) para desarrollar un programa de control biológico clásico con parasitoides exóticos criados en México. En 2005 se liberaron 14,690 (HD) y 2,182 (ML) avispidas, *Doryctobracon areolatus* (Hymenoptera: Braconidae), respectivamente en 20 árboles de *Spondias* spp. u otros hospederos en cada área. Durante tres períodos consecutivos de fructificación hasta Octubre del 2007, se recogieron periódicamente frutos de árboles hospederos. En laboratorios del IDIAF se registraron las cantidades de frutos, pesos, larvas/pupas obtenidas, emergencia de moscas (especie y sexos), parasitoides nativos y exóticos. En 2007, en la zona de HD se recuperaron parasitoides exóticos en 16 de los 18 lugares muestreados con 1.1 a 100% de parasitismo, variando este último en combinación con la especie nativa entre 11.1 y 87.5%. Los exóticos dominaron temporalmente en más del 50% de los lugares muestreados. Emergieron de jobo, ciruela, manzana de oro, guayaba, vinagrillo, carambola, manzana malaya, y almendro tropical. En ML se confirmó el establecimiento de *D. areolatus* recién finalizando el estudio, posiblemente debido a la insuficiente disponibilidad de plantas hospederas de *Anastrepha* durante el año entero y muy inferior cantidad de parasitoides liberados. Se detectaron *D. areolatus* a 6 km (Suroeste), 7 km (Sureste) y 50 km (Noroeste) desde los lugares de liberación más cercanos de HD. Muestreos realizados en una plantación comercial de guayaba y zonas aledañas a HD, indican una diseminación e incremento de parasitismo por *D. areolatus* durante la temporada húmeda y reducción de infestación de frutos. Se discutirán las perspectivas con el parasitoide establecido y futuras acciones para beneficio del sector frutícola.

Palabras claves: *Anastrepha obliqua*, *A. suspensa*, trampas, atrayentes, control biológico clásico, *Doryctobracon areolatus*, hospederos, *Spondias* spp., *Psidium guajava*, *Mangifera indica*.

☐ **09:40AM** - Coffee Break / Receso

□ **10:00AM** - Thursday June 6, 2013

Session 5: Diseases and Pest control / S5-01

Mango malformation disease: etiology, epidemiology and management

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Abstract

Mango malformation disease (MMD) caused by *Fusarium mangiferae* severely affects the crop and is widely distributed in almost all mango-growing regions worldwide. Additional *Fusarium* species have also been reported to cause MMD. Since malformed inflorescences do not bear fruit, MMD is a major constraint to crop production in affected areas. Symptoms of MMD include hypertrophy of young shoots, shorter internodes, dwarfed malformed leaves and an overall tightly bunched appearance of the shoot, while inflorescence malformation include short, thick and branched axes of the inflorescence, larger flowers with increased numbers of male and hermaphroditic flowers that are either sterile or eventually abort. Malformed inflorescences serve as the primary source of inoculum which disseminates passively in the air as conidia are blown or fall from dry malformed inflorescences as dry debris. Conidia land on the foliage and reach the infection site, namely, the apical bud. Conidial germination and infection of apical buds occur at temperatures between 5°C and 37°C accompanied by at least 2 h of wetness. Conidia may be vectored on the body of the bud mite *Aceria mangiferae*. Presence of *A. mangiferae* within the buds assists fungal penetration and increases frequency and severity of infection. Systemic colonization and infection by the fungus was not evident for this host-pathogen interaction, since (i) there was no infection via roots or survival in soil, (ii) there was no continuum of colonization via the vasculature, and, (iii) the pathogen is concentrated within apical and lateral buds, only at but not between the nodes. No effective control methods have been reported to date. The airborne nature of dissemination and infection of buds suggests that protection of buds from infection when inoculum prevails may be a plausible method for disease control from season to season. Field experiments conducted over a number of seasons in different experimental regions indicate that disease severity can be reduced based on sanitation by removing inoculum density within infected panicles and with timely applications of a spray regime.

□ **10:20AM** - Thursday June 6, 2013

Session 5: Diseases and Pest control / S5-02

Effect of vapour heat treatment on occurrence of spongy tissue, fruit fly and stem-end-rot in Alphonso mango fruits

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Abstract

A multidisplinary experiment was conducted for three mango seasons (2009, 2010 and 2011) with an objective to study the effect of exposing Alphonso mango fruits, at different post-harvest intervals to Vapour Heat Treatment (VHT) and Hot Water Treatment (HWT) on occurrence of spongy tissue, infestation of fruit fly, incidence of stem-end-rot and fruit quality. The experiment was conducted in RBD with three replications and seven treatments based on interval between harvesting and VHT treatments. Results indicated that time interval between harvesting and VHT significantly influenced the incidence of spongy tissue in ripe Alphonso mango fruits and was significantly lower from 3rd day onwards (16.40, 14.40, 14.50 and 11.30%). It was observed that VHT treatment after 3 days of harvest of Alphonso mango fruits found most suitable interval, as it had low incidence of spongy tissue (16.40, 14.40, 14.50 and 11.30%), stem end rot without impairing fruit quality and occurrence of fruit fly. Whereas occurrence of spongy tissue was as high as 87.75, 81.50 and 66.60 per cent when fruits was harvested 18hrs, 24hrs and 48 hrs before VHT, respectively with significantly effect on fruit quality. Vapour heat treatments after 3rd day of harvest indicated that significantly low TSS, ascorbic acid, reducing sugar, total sugar, and carotene were observed in VHT after 18 hrs of harvest followed by VHT after 24 hrs of harvest of Alphonso mangoes.

□ **10:40AM** - Thursday June 6, 2013

Session 5: Diseases and Pest control / S5-03

Effect of salts of quitosana in the control of *Colletotrichum gloeosporioides* (Penz.) Penz & Sacc. causal agent of the antracnose in mango

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Abstract

Colletotrichum [gloeosporioides] (Penz.) Penz. & Sacc. fungus, is one of the pathogens that occasions bigger losses during the postharvest of the mango. The use of chemicals, one of the alternatives employed for its control, is a great preoccupation for the consumers and this leads to searching for other not polluting methods that do not generate dangerous residues in the fruits. An example is the use of bioactive products as the quitosan. The objective of this work was to evaluate the effect of the lactate and acetate salts of quitosan in the control of antracnose. The two salts of quitosan (30 %) were tested at concentrations of 5000 mg L⁻¹ and 10000 mg L⁻¹ versus non application of this product (control). *In vitro* effect was determined by the measurement of the diameter of growth of the colonies (cm) within seven days of incubation at 27± 1°C. The conidia concentration (conidiums/ml) and the percentage of the conidia germination at 8 and 24 hours were also measured. The quitosan salts presented antifungic activity against *Colletotrichum*. Both, lactate and acetate of quitosan at 10000 mg L⁻¹ showed a good control of the growth of the colonies with values of 59.87 % and 72.42% of inhibition respectively. Also, both salts produced a reduction of the number of conidia and conidia germination at 8 hours in comparison with the control.

Keywords: salts quitosana, *Colletotrichum gloeosporioides*, control

Palabras Claves: sales de quitosana, *Colletotrichum gloeosporioides*, control

□ **11:00AM** - Thursday June 6, 2013

Session 5: Diseases and Pest control / S5-04

Genetics and biology of the mango Blossom gall midge, *Procontarinia mangiferae*, a pest with highly adaptable life strategies

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Abstract

The development of Integrated Pest Management (IPM) on mango requires the knowledge of the biological cycle of the main pests and of their relationships with the mango tree. Among them, the mango blossom gall midge, *Procontarinia mangiferae* (Felt), is an invasive pest, specific to mango, causing economic damages to inflorescences. The objective of this study was to improve our knowledge of the biology of this species in the subtropical Reunion Island (i) by describing its genetic diversity and ecological abilities to evaluate the determinants of its genetic structure, (ii) by carrying out field and controlled experiments to understand the diapause strategies involved in maintaining populations from one flowering season to another, (iii) by modeling the female dispersion within and between orchards in relation to the mango phenological stages and their flight capacity. Our results showed that *P. mangiferae* was the only species feeding on both inflorescences and young leaves, present all year round at all of the sampled sites on the island, regardless of the climatic and cultural conditions. Secondly, diapause mechanisms allowed a developmental arrest at the 3rd larval instar, lasting between six weeks to more than one year. Thirdly, female gall midges were able to colonize all trees of an orchard from external sources, but they were attracted differently by trees within the orchard in relation to the abundance and the phenology of the susceptible organs. These results illustrated the ecological plasticity of *P. mangiferae*. Consequences of these results to elaborate IPM strategies against the mango blossom gall midge are discussed.

Keywords: Cecidomyiidae, diapause, ecology, dispersion, invasive species, IPM strategies

□ **11:20AM** - Thursday June 6, 2013

Session 5: Diseases and Pest control / S5-05

Uso de sistemas de información geográfica (SIG) para georeferenciación de trampas para el monitoreo de la Mosca de la fruta (*Anastrepha obliqua*), en la provincia de Peravia, República Dominicana

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Resumen

Las plantaciones de mango en República Dominicana son afectadas por la Mosca de las frutas (*Anastrepha obliqua*). Este insecto de color café amarillento, tiene una franja central y dos laterales en el tórax, deposita sus huevos dentro de la fruta en que es incubado, para luego eclosionar sus larvas, las que se alimentan de la pulpa de las frutas, produciendo galerías que provocan la podredumbre del fruto, disminuyendo la calidad e incrementando el costo de exportación. Con el objetivo de controlar las poblaciones de este insecto, se implementó un sistema de monitoreo, con ayuda de los sistemas de información geográfica (SIG), donde se georeferenciaron las trampas a través del sistema de posicionamiento global (GPS) usando el modelo Garmin Map76CSx con precisión de 2 a 5 metros y se levantaron las parcelas de productores usando el globo virtual de Google Earth. Las trampas se ubicaron una por cada 80 tareas, se diseñó un sistema de etiquetas adhesivas para ser colocadas en las trampas a georeferenciar. Para la codificación de las trampas se usó la propuesta por el Ministerio de Agricultura, que incluye: regional, zona, subzona, área, tipo de trampa, cebo, código del productor y número de trampa. Se aplicó un cuestionario con las generales del productor e informaciones de la parcela, que una vez digitalizado fue convertida en base de datos, la cual fue unida a los polígonos de las parcelas por medio del programa ArcMap. Esta base de datos georeferenciada permite la realización de consultas a su base de datos, sobre las generales del productor, tamaño de la finca, variedades sembradas, productividad, sistemas de riego, fuentes de aguas y sistema de producción implementado, ya sea orgánico o tradicional, además permitirá agregar otras informaciones o tablas sobre uso de pesticidas, fertilizantes, etc. Como resultado de este plan se obtuvieron mapas georeferenciados con el número de campo y tareas sembradas.

Palabras clave: GPS, ArcMap

☐ **11:40AM** - Thursday June 6, 2013

Session 5: Diseases and Pest control / S5-06

Comportamiento de *Colletotrichum Gloeosporioides* Penz., desde la poda hasta la floración y la cosecha en una finca de Villa Fundación

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Resumen

Durante el Periodo 2008-2010, se desarrolló en el Proyecto Villa Fundación, una investigación dirigida a evaluar el comportamiento de *Colletotrichum gloeosporioides* Penz, agente de la antracnosis del fruto, desde la poda hasta la cosecha, se desarrolló un estudio en el Proyecto Villa Fundación en la provincia Peravia, durante el período comprendido entre Noviembre del 2008 hasta Junio del 2010. Utilizando como metodología de captura de inóculo, trampas pegajosa, placas de Petri con PDA, recolección de hojas del suelo, así como pedúnculos y frutas dejadas en las plantas después de la cosecha para su posterior análisis en laboratorio. La determinación del comportamiento del hongo en la planta se realizó a través del monitoreo semanal en hojas, flores y frutas. De acuerdo con los resultados obtenidos, en las hojas y ramas que permanecen en debajo de la planta después de la poda, la cantidad de inóculo del hongo es baja, así como su viabilidad después de 48 horas de humedad, mientras que en los pedúnculos y frutos momificados que permanecen en la planta se registra una gran cantidad de inóculo viable después de 24 horas de humedad. Con relación a la presencia del patógeno en el ambiente, 82% de las esporas atrapadas correspondieron a *C. gloeosporioides*. Por otra parte se determinó que la mayor severidad del hongo se registra en la fase de floración.

Palabras claves: antracnosis, monitoreo y mango

☐ **12:00M** - Lunch / Almuerzo

Session 6: Postharvest physiology and technology

☐ **02:00PM** - Thursday June 6, 2013

Session 6: Postharvest physiology and technology / S6-01

Comparative post-harvest study of two mango cultivars growing in Venezuela

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Abstract

Mango is an important crop in Venezuela for domestic consumption in fresh form and industry uses and export purposes at low scale. The aim of this work was to make a comparative study of post-harvest behavior of two mangos cultivars (Sensation and Trementina) growing in Venezuela. Fruits were harvested at physiological maturity and placed in the laboratory at ambient conditions to 25 +/- Celsius degree and 60-70 % relative humidity. Analysis chemicals (total carotenoids, soluble solids, acidity and ratio soluble solids / titratable acidity) and physiological (respiratory activity) were performed. Firmness was determined by a penetrometer ELE-400. Total carotenoids were measured by McCollum method (1953), soluble solids content was determined using a manual refractometer Atago N1. Acidity was measured by AOAC method (1990). Respiratory activity was measured by Nelson that is based on CO² recollection in alkali modified by Guadarrama (1984). Postharvest behavior of two cultivars showed differences. Total carotenoids and soluble solids content were higher in Sensation cultivar. Respiration was higher in Sensation cultivar reaching climacteric peak at eight day after harvest. Trementina cultivar reached its climacteric peak at three day after harvest. Titratable acidity was similar in both cultivars. Results could be indicative of genetic variability in post-harvest behavior of two mango cultivars studied suggesting to consider specific postharvest management for each cultivar.

Keywords: ripening, chemical analyses, *Mangifera indica*

□ **02:20PM** - Thursday June 6, 2013

Session 6: Postharvest physiology and technology / S6-02

Effect of modified atmosphere storage extending the shelf life of mango fruits cv. Nam Dok Mai Sri Tong

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Abstract

Mangifera indica L. cv. Nam Dok Mai Sri Tong is recently one of the most popular exported mango fruits of Thailand. The ripen fruits have fine flesh with the exotic aroma and flavor. However, it has a short shelf life and is susceptible to physiological disorder. Eighty percentage maturity of mango fruits cv Nam Dok Mai Sri Tong were harvested, packed in different plastic bags and kept in temperature storage. The experiment was done by using factorial in randomized complete block design (RCB) 3 replicates (3 fruits each). First factor was the types bagpackage consisted of white ethylene absorbing bag (WEB), green absorbing bag (GEB) and control (no package). Second factor was different storage temperatures consisted 15 and 27 °C. The physiochemical properties were determined every 3 days interval. The results found that the mango fruits kept at 15 and 27 could extend the shelf life for 15 and 6 days respectively due to soluble solid content (SS), titratable acidity (TA), SS/TA, color changes as shown by a* and L* value were higher than other treatments. The shelf life of mango fruits packed without ethylene absorbing bag in both storage temperature were shorter than those kept in both of WEB and GEB. Moreover, all mango fruits packed in WEB and kept at 15 and 27 °C could be extended the shelf life for 24 and 12 days.

Keyword: Modified Atmosphere, mango, shelf life

□ 02:40PM - Thursday June 6, 2013

Session 6: Postharvest physiology and technology / S6-03

Quality attributes of mango fruit (var. Haden, Kent, Palmer and Keitt) stored at ambient and transit temperatures

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Abstract

“Haden”, “Kent”, “Palmer” and “Keitt” mango fruits were harvested green mature, held for 9–21 days at ambient and simulated-transit temperature conditions and evaluated for quality attributes. The objective of this work was to determine the shelf-life and ripening quality of these fruits at both ambient and simulated-transit temperatures and to identify, for each temperature regime, which quality factors limit mango marketability. Shelf-life of Haden, Kent, Palmer and Keitt fruits ripened under ambient conditions was 3.15 days, 4.09 days, 3.16 days and 4.08 days, respectively; and for those that were stored to simulate transit conditions before ripening was 2.91 days, 3.85 days, 2.87 days and 3.92 days, respectively, indicating that Kent and Keitt fruits store better under both ambient and transit conditions. Haden fruits ripened earlier (9.50 days) and Keitt fruits much later (11.01 days). Ripening time was statistically not different among Haden, Kent and Palmer fruits but the time difference between Keitt and Haden was significant ($p < 0.05$). Increased fruit softness, changes in fruit colour and development of decay were the limiting quality factors for all mango fruits stored at both ambient and simulated–transit conditions. Although not objectionable, the highest shrivelling rates were observed in Haden and Palmer fruits with a slight preponderance of the former. Average weight loss was highest (6.50%) for Haden and lowest (4.09%) for Keitt during ripening under ambient conditions. The same trend occurred during ripening after exposure to transit conditions. Prediction of mango fruit shelf-life may not be precise unless the characteristics of the fruit and environmental factors involved are well known. The attributes obtained from the quality evaluations for the different temperature regimes showed that a single quality attribute cannot be used to express loss of quality of mango fruit over the normal physiological range of temperatures.

□ 03:00PM - Thursday June 6, 2013

Session 6: Postharvest physiology and technology / S6-04

Use of the reflectance spectra as a non-destructive indicator of quality, i.e. color, and maturity, i.e. pigment content, of mango fruit

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Abstract

Appearance is the primary factor in quality judgments of fruits and vegetables. Poor coloration of mango peel is an important factor in grade and commercial value reduction, consequently fruits with no green color and no defects often command higher price. Furthermore fruit quality is highly dependent to its maturity stage at harvest, which is more related to chlorophyll content in the peel rather than epidermis coloration because mangoes are generally harvested before any visible color changes. Visible spectra reflectance let to access both pigment content and color coordinate. Therefore this study proposes a methodology to estimate, from visible spectra of mango peel, an indicator both of consumers' perception of fruit quality, thanks to fruit colors distribution, and of fruit maturity stage, thanks to chlorophyll content. This methodology was applied for three cultivars: Tommy Atkins, Kent and Nam Doc Mai. Different color distributions have been observed indicating variable visual perception of these cultivars. Main wavelengths implied in epidermis coloration have been determinate thanks to a partial least square regression. Pigment contents were estimated from reflectance indices thanks to partial least square regression ($r^2 > 0.98$) and compared between studied cultivars. Reflectance measurements in visible region appear to be a practical tool to determinate non-destructively both perception of the fruit appearance by consumers and fruit maturity stage.

□ **03:20PM** - Thursday June 6, 2013

Session 6: Postharvest physiology and technology / S6-05

Changes in the oxidative status of mango in response to temperature. impact on quality

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Abstract

Mango is a fruit of major economic importance produced throughout tropical and subtropical countries. Mangoes generally grow in warm climates (25-35 °C) and fruit may sometimes be exposed to temperatures of above 35 °C. Moreover, fruits within a mango tree are exposed to a wide range of temperature conditions due to their position in the canopy. A significant proportion of the increased mango production is for export markets and for local markets, which include time of storage and transport. In these markets, mangoes are generally harvested at a green mature stage in order to allow time for ripening and market release, and post-harvest techniques are applied to slow down fruit senescence. Fruit senescence can be controlled by regulating the metabolism of the fruit by using cold storage, known to be one of the major means techniques to increase fruit shelf-life. However, plants or fruits acclimate themselves to the limiting environment in which they grow or in which they were stored. The process of acclimating to high or low temperatures involves morphological changes and up- or down-regulation of physiological and biochemical processes, which can be induced by oxidative stress. So, in order to better manage the environmental conditions around mango fruits, we analyzed the effects of high temperature conditions on the tree, through fruit position managing, and of low temperature conditions during storage, on the changes in the oxidative status of the fruit, described by the balance between reactive oxygen species and enzymatic and non enzymatic anti-oxidative systems. Changes in the oxidative status were studied in relation to the final quality of mango cv Cogshall. Total soluble solids, titratable acidity, and the contents in ascorbic acid, total carotenoids and polyphenols were measured according to the temperature effect. A positive effect of temperature was observed on ascorbic acid. Contents in total carotenoids were differently affected by high and low temperatures. The concentration in polyphenol of Cogshall mango was slightly affected by the temperature.

□ **03:40PM** - Coffee Break / Receso - Poster Session / Sesión de Pósters

Session 7: Postharvest pathology

□ 04:20PM - Thursday June 6, 2013

Session 7: Postharvest pathology / S7-01

Prospecting yeasts isolates for biological control agents of postharvest diseases in mango.

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Abstract

The mango fruit production is a very important activity in the São Francisco Valley, however post-harvest pathogens caused heavy losses to production. Most of the infections start in the field and become dormant; their symptoms become evident only in post-harvest, once that complete maturation of the fruits occurs during storage and transport. In this work four strains of yeast previously selected were evaluated about the potential to reduce the incidence of post-harvest diseases when applied as pre-harvest treatment. The experiments were conducted in an organic orchard of the variety Tommy Atkins. The strains L7K, L9, L10 and LF were grown in culture medium SDY for 92h at 28°C in 12h photoperiod. After growth, technical grade preparations (TGP) of the individual strains were produced and, before application, diluted to a field solution containing 10^6 cells mL⁻¹. The treatments were applied one time per week, for two consecutive weeks, spraying the fruit two weeks previously to harvest. The experiment was conducted in a randomized block design with 5 replicates. There were 6 treatments consisting of the TGP containing one of the four yeast strains, one control treatment that received only the TGP, and an absolute control that was free of any application. Twenty fruits were harvested at stage 3 of maturation from each experimental plot, placed in a cardboard box covered with plastic bags and stored in a refrigerated environment at 20°C. The fruits were evaluated for disease incidence and severity for 11 consecutive days. Compared to the control treatments, all TGP containing yeast strains significantly reduced post-harvest rot incidence of mango. Yeasts strains L9 and LF reduced the incidence up to 57.89% and 47.37% respectively. The best results, however, were obtained by treatments containing strains L7K and L10, which showed control efficiency higher than 70%.

Keywords: reduction of incidence, post-harvest diseases, biocontrol, yeast, *Mangifera indica* L.

□ 04:40PM - Thursday June 6, 2013

Session 7: Postharvest pathology / S7-02

Defining optimal dose of a biocontrol agent to postharvest fruit rot in mangoes caused by *Lasiodiplodia theobromae* and *Botryosphaeria dothidea*

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Brazil

Abstract

Mango is the most important fruit crop cultivated in the irrigated areas of the São Francisco Valley (Brazil), reaching an area around 27 thousand hectares and producing almost 600 thousand tons per year. In the last years, heavy losses on fruit production and quality have been caused by *Lasiodiplodia theobromae* and *Botryosphaeria dothidea*, post harvest pathogens able to cause quiescent infections to mango fruits. In this work we evaluated the optimal doses of a yeast strain (L10) previously selected for post-harvest disease control. A technical grade preparation (TGP) containing 10^4 to 10^8 yeast cells mL^{-1} were applied to mangoes previously treated in processing lines of fruit packing houses in the region. The TGP were pulverized at the last stage of fruit processing which were kept in lab environmental conditions for 24 hours. Inoculums of *L. theobromae* e *B. dothidea* were obtained scraping a heavily colonized plates to which was added a solution of Triton X-100 0.01%. Twenty microliter of a conidial suspension containing 10^5 conidia mL^{-1} was applied to wounds artificially produced in fruit skins. After that they were kept in groups of eight fruits in paper boxes and maintained in incubation chamber at $25\text{ }^\circ\text{C}$ (± 2). Disease symptoms evaluations were performed at each 24 hours after treatments measuring the lesions with a digital caliper. The experiment was conducted in a completely randomized design with nine replicates. The yeast strain L10 confirmed control results obtained in previous studies; however optimal dose was highly dependent of the pathogen inoculated. Fruit rot severity produced by *L. theobromae* were effectively reduced (70%) at a dose of 2.0×10^6 cells mL^{-1} , while *B. dothidae* only achieved similar results at a dose of 5.0×10^7 cells mL^{-1} .

Keywords: Yeast, Mango, disease

Session 8: Fruit processing and commercialization

☐ **05:00PM** - Thursday June 6, 2013

Session 8: Fruit processing and commercialization / Keynote 8-01

Postharvest handling of mango under a globally recognized management system for food safety and quality

Reginaldo Báez Sañudo

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Abstract

The acceptance of the mango fruits is dependent of the conditions how the fruits are harvested and handled since harvest to consume. Acceptance is referred to fruit size uniformity, peel ground color, firmness, soluble solids content, and acidity and free of injuries and defects. In this way, the process begin with the harvest and for that, maturity indexes had been developed for most common varieties, determining fruit pulp color, soluble solids content, titratable acidity and pulp firmness. Fruits are transported to packinghouse under adequate conditions of transport and containers. When fruits arrived to packinghouse, fruits phytosanitary condition is evaluated in order to introduce them for process. Fruits selection, washing and classification by size or weight are realized before quarantine treatments are applied. Quarantine treatments are agreed for different markets. Treatments using hot water (46.1°C), vapour, forced hot air or irradiation are realized through a work plan accorded for each country. Subsequently, fruits are stabilized at cool or room temperatures. Some producer realize some special treatments such waxing and after that a second classification before the packing the fruits, palletized, cooled, transported and distributing for the different markets. Retailers handle the fruits under appropriate conditions for the maturity evolution and organoleptic characteristics development. This generic process is recognized and certificated when is demonstrated under a management system in compliance with official norms in the producer and marketer countries in order to protect the population of diseases transmitted by foods. Globally, food consortiums and retailers are grouped in The Food Business Forum, independent network for the consumable goods. This Forum meets retailers, distributors, manufacturers, services suppliers and other interested parties proceeding of 70 countries. One of their activities was the creation of the Global Food Safety Initiative (GFSI) founded during the 2000 year. The main objective of this initiative is encourage convergence between food safety standards, improve the cost efficiency in the food chain and offer an international platform for the interested parties, unique in genre that allows to know the latest practical solutions to manage food safety. GFSI help the food sector to generate consumer confidence during the supply of food. This initiative recognizes the standards that manage food safety, which must comply with three aspects: To have requirements for the food safety management (key

elements), To have requirements for the supply management, in other words, to have a management system for food safety based in the ISO 9000 standards; to have a management system in order to comply with official norms or laws, applying Good Practices (GAP, GMP, GHP) and the HACCP implementation following the codex alimentarius directives. Finally to have a management system for delivery responsibility (trazability and recall) and commercialization of the food. In this way, the amalgam of these criterias had produced a serie of benchmarking and recognised standards by the GFSI such as Safe Quality Foods (SQF), British Retail Consortium (BRC), International Food Standard (IFS), Dutch-HACCP, Food Safety System Certification (FSSC22000), CanadaGAP and standars in benchmarking process such as Dutch-HACCP, PrimusGFS, GlobalGAP y Synergy22000. The standard selected for the implementation and certification will depend of the cost and the client requirement; in some cases in particular the client are sellers of food and owners of some scheme.

Keywords: Postharvest, quarantine, management systems, food safety, quality, GFSI, SQF, BRC, IFS, FSSC22000, PrimusGFS, GlobalGAP, Synergy22000, Codex alimentarius.

□ **05:40PM** - Thursday June 6, 2013

Session 8: Fruit processing and commercialization / S8-01

Haitian mango growers access high value export markets

Junior Paul and James Chapman

Agridev S.A. 14, rue Louverture, Petion-Ville, Hait

Abstract

Mangos are Haiti's largest agricultural export, with over US\$10 million in sales per year. Through it's MYAP, WV has assisted Haitian mango growers to increase marketable produce through post harvest loss reduction measures and encouraged higher and more stable prices through forward contracting between producer groups and mango exporters. Work on improving access to high value, specialty export markets for mangos was begun in 2001, under the USAID-financed Hillside Agricultural Program (HAP). Technical staff in that program, who now work on WV's MYAP through a subcontract to the Haitian firm Agridev, undertook different activities to promote market-led development for resource poor farmers including assistance to access specialty markets (Fair Trade and Certified Organic), Improved post harvest practices and Initiatives to increase production. Through this activities It is clear that there are significant specialty market opportunities which increase the value of production and incentivize resource poor farmers although they involve increased costs in terms of maintaining practices and records to sustain certifications.

□ **06:00PM** Closing Ceremony Technical Presentations

Ceremonia de Clausura Presentación Técnicas

Day 5 - Friday June 7, 2013 / Día 5 - Viernes 7 de junio 2013

06:00AM Field Day - Día de Campo

Poster Session / Sesión de Póster

04:40PM - Monday June 3, 2013 / Lunes 3 de Junio 2013

Poster Session 2: Genetics, breeding and biotechnology

P2-01

Poster Session 2: Genetics, breeding and biotechnology / P2-01

Alternativas de variedades mango para sistemas de producción de la zona central de Venezuela o para exportación

Enio Soto¹; Luis Avilán¹; Emaldi Unai²; Mercedes Perez¹; Margot Rodriguez³ y José Ruiz³.

¹ Investigadores Centro Nacional de Investigaciones Agropecuarias, CENIAP, Instituto Nacional de Investigaciones agrícolas INIA, Maracay, Venezuela, eniosoto@yahoo.com; mercedesmacias@yahoo.com

Resumen

Tradicionalmente en Venezuela la producción de mango para exportación se ha basado en dos cultivares Haden y Tommy Atkins. Desde el punto de vista estratégico no es conveniente basar la producción en poca base genética, es por ello que se proponen otras variedades que pueden ser utilizadas en los sistemas de producción de la zona central de Venezuela o que dediquen el destino de la producción a mercados internacionales. Estas variedades fueron analizadas tomando en cuenta atributos de calidad tales como peso del fruto, porcentaje de pulpa y de semilla, color del fruto, forma del fruto, color de la pulpa, cantidad de fibra. Además se consideró tamaño del árbol, eficiencia productiva y época de floración entre otros. Considerando una escala del 1 al 3 para cada atributo en el cual 3 es adecuado, 2 intermedio y 1 inadecuado los cultivares que presentaron mayores atributos en grado 3 fueron: Irwing, Otts, Palmer, Edward, y Glenn en ese orden. Irwin y Otts sobresalen por tener adecuada forma de fruto con abundantes tonalidades rojizas favorecidas en el mercado internacional y excelente relación pulpa semilla, Palmer y Edward son los frutos más grandes aunque tonalidades amarillas de excelente sabor pero lo desfavorece el tamaño de árbol alto. El cultivar Glenn posee buen tamaño de fruto pero lo desfavorece un poco el porcentaje de pulpa y la forma del fruto poca fibra y muy buen sabor. El árbol es alto al igual que Edward y Palmer.

□ P2-02

Poster Session 2: Genetics, breeding and biotechnology / P2-02

Characterization of Ubá mango accessions from Zona da Mata, Minas Gerais state, Brazil

Girlaine Pereira Oliveira; Dalmo Lopes de Siqueira; Danielle Fabíola Pereira da Silva; Luiz Carlos Chamhum Salomão

Universidade Federal de Viçosa - Departamento de Fitotecnia, Viçosa, Minas Gerais, Brasil

Abstract

The objective of this work was to carry out the physical and chemical characterization of mango 'Ubá' accessions in the Zona da Mata of Minas Gerais, to identify materials of industrial interest. Physiologically mature fruits were harvested and transported to the Laboratory of Analysis of Fruit of the Universidade Federal de Viçosa, where they were washed, treated with fungicide Prochloraz (Sportak 450 EC) at a dose of 49.5g 100L⁻¹ water, for 10 minutes and air dried. After that, they were treated with Ethephon 2-chloroethyl phosphonic acid (Ethrel 240g) at a concentration of 1g ai L⁻¹ together with spreader-sticker Adesil (760g ai L⁻¹ Chemical and Pharmaceutical Nufarm SA) at a concentration of 20mL 100L⁻¹ for 5 minutes and air dried. They were then stored at 20±1°C and relative humidity of 90% until ripening. The fruits that had better characteristics for industrial processing were those from the accessions 7, 11, 16, 17, 21, 26, 28, 47, 48, 53, 54 and 56. The fruit weight, firmness, soluble solids and ascorbic acid are the characteristics that had increased variability in accessions of 'Uba' mango. The genetic variability of the 'Ubá' mango tree, in Visconde do Rio Branco, provides material for future breeding projects and deployment of germplasm collection.

Keywords: *Mangifera indica*, fruit quality, physical and chemical composition.

Poster Session 3: Physiology and reproductive biology

□ P3-01

Poster Session 3: Physiology and reproductive biology / P3-01

Establecimiento del ciclo fenológico de floración del mango en Venezuela: fecha de inicio, intensidad y duración de la floración

Enio Soto

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Resumen

Por su arquitectura, el mango es catalogado como una especie poli-axial con crecimiento no sincronizado de las ramas dentro de un mismo árbol, en el que la producción es influida por el volumen de la cosecha anterior y las condiciones ambientales locales. El desarrollo vegetativo y reproductivo es complejo y difícil de comprender, debido en gran parte, a su composición estructural, a las relaciones que se establecen dentro del árbol, a la multiplicidad de factores que afectan la floración y a la amplia gama de técnicas que son utilizadas para manipularlos. La floración es la fase más importante dentro del ciclo fenológico de los frutales, y su época de aparición está gobernada por factores como las condiciones climatológicas locales, el cultivar y el manejo hortícola. La fenología reproductiva varía de acuerdo al cultivar y la localidad; en general, siendo el mango nativo de Asia tropical (India, Bangladesh y Myanmar (Birmania) entre los 16° y 28° de N), se ha naturalizado en muchas áreas donde se ha introducido, entre los Trópicos de Cáncer y Capricornio, latitudes que van de 20° N a 20° S. La presencia de dos grupos, filipinas (poliembriónica) e indiana (monoembriónica), ha proporcionado cruzamientos naturales y/o artificiales, obteniendo híbridos inter e intra-raciales, produciendo centenares de cultivares, con características diversificadas, en relación con la biología floral. En general, la inflorescencia normal ocurre de enero a marzo en el hemisferio norte y de junio a septiembre en el hemisferio sur. Unos pocos cultivares en la India, florecen dos a tres veces por año, a través de un período extenso, mientras que la mayoría florece solamente una vez al año. Esta floración ocurre por lo general de febrero a abril en el norte de este país y de enero a marzo en el sur, mientras que en el oeste de África se presenta entre enero y febrero. En Venezuela se han reportado, en la zona central, cultivares con floración en los últimos meses del año (septiembre-diciembre) y los primeros meses del siguiente (enero-febrero), variando su extensión de acuerdo al cultivar); así mismo, se ha reportado la floración del mango en los meses de diciembre a febrero en las regiones tropicales de México.

□ P3-02

Poster Session 3: Physiology and reproductive biology / P3-02

Estudios comparativos de ciclos fenológicos en 12 cultivares de mango mantenidos en la Región Central de Venezuela

Enio Soto¹; Mercedes Perez¹ y Luis Avilán¹

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Resumen

La zona central de Venezuela es una de las principales áreas del país dedicadas a la producción de mango tanto para mercado interno como externo. La relación del comportamiento con variables climáticas permite establecer potencialidades de adaptación de diversos cultivares para ser usados como patrón o como copa. Doce cultivares, seis monoembrionicos y seis poliembrionicos fueron estudiados durante 7 años en edad adulta, sembrados a 12 x 12m, en un área clasificada como Bosque seco tropical, suelo franco bajo precipitación unimodal con un ciclo de lluvia de 7 meses, promedio de 1053 mm anuales y temperatura media anual de 25° ubicándose entre mínimas medias de 16° y máximas medias de 34°. Los cultivares monoembrionicos utilizados fueron Amini, Carabao, Haden, Julie, Kent y Palmer; los poliembrionicos fueron: Ceilán, Florigon, Labich, Manzana, Martinica y Rosa. Fueron realizadas mediciones de días de inicio de floración y máximas intensidad de floración, duración de floración, así como cálculo de grados día acumulados (GDA) y caracterización del clima en cada año. No hubo diferencias significativas entre poliembrionicos y monoembrionicos respecto a inicio de floración con valores entre los 192 y 197 días pero dentro de los grupos los monoembrionicos tuvieron diferencias de 86 días entre el mas precoz y mas tardío y de 103 días para el otro grupo. Los cultivares Julie y Labich ubican entre los más tempranos y más larga duración del periodo de floración. Julie y Rosa mostraron los más altos valores de intensidad de floración en promedio en el periodo estudiado. El valor promedio de GDA para inicio de la fase de floración, en los poliembrionicos fue más alto con 2802 sobre 2642 de los monoembrionicos. El cultivar Manzana obtuvo el más alto valor con 3357. Rosa y Florigon, Palmer, Kent. Haden y Julie obtuvieron mayores intensidades de fase de fructificación. En el cuarto ciclo estudiado se obtuvo un efecto negativo en las variables de floración.

□ **P3-03**

Poster Session 3: Physiology and reproductive biology / P3-03

Evolución del contenido de nutrientes en hoja de mango *Mangifera indica*, cv Osteen.

Medina, D.¹; Gómez, R.¹; Guirado, E.²; Hermoso, J.M.²; Sarmiento, D.³

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(3) SAT TROPS. Apdo Correos nº84; 29700 Vélez-Málaga; Málaga (España).

Resumen

Se ha estudiado la evolución del contenido en hojas de mango adulto de los diferentes macro y micro elementos (N, P, K, Ca, Mg, Mn, Fe, Zn, B, Cu) a lo largo de un ciclo vegetativo. El estudio se ha realizado en árboles adultos del cultivar Osteen, variedad mayoritaria en el sur de España. El objetivo de este trabajo es establecer las bases para una correcta fertilización de esta especie, en nuestras condiciones de cultivo. Se han realizado muestreos mensuales durante un año, en tres fincas de similares características de la zona productora de la provincia de Málaga.

□ P3-04

Poster Session 3: Physiology and reproductive biology / P3-04

Extraction and quantification of carotenoids in ‘Cogshall’ mango fruit

Rémy Rosalie¹, Emmanuelle Vulcain²

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² CIRAD, UMR QUALISUD, F-97490, Sainte Clotilde, Ile de La Réunion, France.

Abstract

Mango is well known as a source of health promoting compounds including pro-vitamin A and antioxidant compounds, such as carotenoids. Their extraction and quantification from mango have been studied in past years using a lot of different methods, sometimes involving deleterious steps. In our study, we intended to use low biological hazard solvents, like ethanol and hexane, and low temperature, to extract carotenoids from lyophilized flesh of mango fruit (cv. Cogshall) grown in Reunion island. This methodology was based on previous works made to enhance carotenoid extraction's recoveries from vegetal matrix. Mangoes were harvested at a maturity stage corresponding to the disappearance of the color green and the appearance of yellow first occurred near the apex zone (referred to as the "yellow point"), and stored in controlled chambers for ripening. This method aimed to combine in one extraction a crude and saponified extract analysis. After a single ethanol/hexane extraction, the organic solution was washed, dried and adjusted to 20mL before splitting in three aliquots. One aliquot was for the global quantification of total carotenoids by spectrophotometry, another one was for saponification followed by individual quantification by High Performance Liquid Chromatography, and the last one was for individual quantification by HPLC without saponification. Saponification was carried out by 5% ethanolic KOH at room temperature over a night. Identification and quantification were obtained by comparison between retention times of peaks and commercial standards injections for both crude and saponified extracts. Mango's carotenoid contents were close to the observations made in literature. Major compounds were all-*trans*-violaxanthin, 9-*cis*-violaxanthin (xanthophylls in esterified forms) and all-*trans*- β -carotene, with a content in ripe mango equal to 1 328.8, 894.8 and 982.3 $\mu\text{g } 100\text{g}^{-1}$ of Fresh Matter, respectively. The identity of these three main compounds was also confirmed by previous mass spectroscopy analyzes.

□ P3-05

Poster Session 3: Physiology and reproductive biology / P3-05

Paclobutrazol and tip pruning on the management of mango 'Palmer' in Brazilian semiarid

M. B. Oliveira, M. C. T. Pereira, G. P.

Mizobutsi, V. M. Maia, J. F. Silva, J. A.

A. Oliveira, I. J. S. Costa, S. Nietsche

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Abstract

The paclobutrazol (PBZ), a synthetic plant growth regulator has been applied in mango trees in order to control vegetative growth and induce flowering. The objective of present work was to evaluate the effect of PBZ and tip pruning on flowering, yield and fruit quality of mango trees cultivar 'Palmer' in irrigated conditions of Brazilian semiarid. Uniform trees were selected in a commercial farm located at Jaíba county, Minas Gerais state, Brazil. A randomized complete block design experiment with two methods of pruning and five different doses of PBZ (0, 0.3, 0.6, 0.9 and 1.2 g(a.i.).m⁻¹ PBZ), with four replicates and one plant per plot in a factorial combination was used. The PBZ was dissolved in 2 liters and applied directly on soil. Vegetative growth parameters and reproductive characteristics, fruit quality and yield were evaluated. Differences between treatments were determined with analysis of variance at 5% of probability. Means separation among treatments was performed by Tukey's test and regression models were adjusted. The dose of 0.86 g (a.i) m⁻¹ promoted a significantly reduction in branch length. The different doses of PBZ applied associated with tip pruning produced a significantly flowering. Applying PBZ from 0.3 g(a.i.).m⁻¹ rate increase yield per branch, fruit firmness and reduced fruit length, fruit weight, pH and soluble solids. The fruit yield was not affected by tip pruning and PBZ application. Financial support: Fapemig.

Keywords: *Mangifera indica*, growth regulators, flowering, fruit quality, yield.

□ P3-06

Poster Session 3: Physiology and reproductive biology / P3-06

Mango crop production features under organic compost cultivation in the semiarid region, Brazil

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Abstract

Mango (*Mangifera indica* L.) is one of the most important fruit crops that are cultivated under irrigation at the São Francisco River Valley, in the Brazilian semiarid region. Although there has been achieved a great advance to fruit production in this environment, it relies on technological improvements that require the usage of intensive agricultural practices to soil, such as irrigation, fertilizers application and flowering management of mango tree, it also increased the risks of environmental resources degradation. In this context, an organic crop system perhaps becomes an alternative to guarantee the sustainability of mango crop in the region. However, the organic production has been a great challenge, even higher in tropical soils poor in organic matter. This work aimed to evaluate the effect of different organic compost on soil chemical characteristics, production and quality of mangoes fruit cultivated in an organic system in the Brazilian semiarid region. One long term experiment was implemented and consisted in applying five composts with different compositions and one control treatment (without compost), using a randomized block design. Grafted mango seedlings of the variety Tommy Atkins were planted in 2005 and they received a base fertilization of 40 dm³ of the different composts per plant. The same doses were applied at 2008 and 2009 as complementary fertilization. The treatments applied do not affected significantly fruit production; however they increased quality parameters such as the color of the fruit skin and pulp. Such results corroborate the importance of organic fertilization as a strategy to improve and maintain the plant production and soil quality.

Keywords: *Mangifera indica*, organic fertilizer, soil chemical analysis, fruit color

□ P3-07

Poster Session 3: Physiology and reproductive biology / P3-07

Effect of foliar application of micronutrients (Zinc Sulphate and Boric Acid) on quality characters of mango variety Langra

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Abstract

This experiment was designed to investigate the effect of foliar application of micro-nutrients i.e. Boric acid (H_3BO_3) and Zinc Sulphate ($ZnSO_4$) on the fruit quality characters of Mango (*Mangifera indica* L.) variety Langra. Maximum value for (TSS) Total Soluble Solids (18.50%) was observed in treatment (T_4) 1% H_3BO_3 + 1.2% $ZnSO_4$ followed by (18.25%) in treatment (T_1) 0.8% H_3BO_3 and in treatment (T_6) 1.2% $ZnSO_4$ it was (17.57%) respectively. The maximum Vitamin-C (54.3 mg/100g) was measured in the treatment (T_4) as compared to control (94.7 mg/100g). Maximum Total Sugars (51.08%) were found in (T_5) 1% $ZnSO_4$ as compared to control (45.0%). Whereas, Reducing Sugars were in non-significant range but found highest (19.30%) in (T_1).

Keywords: Mango, *Mangifera indica*, Langra, Fruit quality Characters, Physiochemical analysis, Micro-nutrients, H_3BO_3 , $ZnSO_4$

□ **P3-08**

Poster Session 3: Physiology and reproductive biology / P3-08

Influence of an amino acid formulation on fruit retention of ‘Edward’ mango

José Pablo Morales-Payán

University of Puerto Rico, Mayagüez Campus.

Abstract

Research was conducted to assess the effects of a biostimulant containing 14.4% free amino acids with 7% N (Tecamin Max[®]) on fruit set in ‘Edward’ mango. The biostimulant rates evaluated were 0 (check), 1.5 and 3 liters per hectare. The trees were sprayed to run-off with aqueous solutions of the biostimulant, starting at flowering and repeating the applications at 21-day intervals. Chlorophyll concentration in the leaves tended to increase as the biostimulant rates were higher. Fruit retention was higher when the trees were treated with the rate of 3 liters per hectare, as compared to the 1.5 liters per hectare rate and the check.

□ P3-09

Poster Session 3: Physiology and reproductive biology / P3-09

Growth of 'Parvin' mango in nursery as affected by a soil-applied biostimulant

José Pablo Morales-Payán

University of Puerto Rico, Mayagüez Campus.

Abstract

Nursery experiments were carried out to determine the effects of a biostimulant based on 40% low weight peptides, 5.5% N and 5.5% P₂O₅ (Inicium®) on the growth of 'Parvin' mango. The biostimulant was applied as a soil drench using 150 ml of solution per tree per application, starting 3 weeks after grafting and repeating the application every 2 weeks, for a total of 4 applications. The biostimulant rates evaluated were 0 (control), 1, 2, 3, 4, and 5 ml per liter of water. Gain in shoot height, leaf number, leaf area, and chlorophyll concentration increased as biostimulant rates up to 3 ml per liter of water were used; further increasing biostimulant rates did not result in additional gain in the variables evaluated. Under the conditions of this research, applying this biostimulant at 3 ml per liter four times and with a volume of 150 ml per tree per application was the best treatment to accelerate growth and reduce the time in nursery for 'Parvin' mango.

Poster Session 4: Horticultural practices

□ P4-01

Poster Session 4: Horticultural practices / P4-01

A review of the current Haitian production of mangoes and horticulture practices to increase production and decrease postharvest losses

Brian Flanagan

Cornell University

Abstract

Mangoes have many important roles in Haiti. In particular, mango production in Haiti has the potential to produce economic and environmental benefits across the country, especially in poor rural areas. Any efforts to expand production and decrease postharvest loss must consider the social, and economic context of Haiti to be successful. Haiti is home to more than 150 mango cultivars found throughout the country, with Madame Francique being the cultivar exported, making it the largest export item in Haiti. The majority of mangoes is grown by small scale farmers, which provide them additional income and provides tree cover in an often deforested landscape. But the system of mango production by small scale farmers creates many production and value chain issues because of the scattered system of production. As Haiti looks to increase production there is need for proper orchard planning with small scale land holders based on land tenure, land size and other demands for land uses. There is also a need for uniform and quality Madame Francique plant material with proper rootstock selection and production, along with quality field and nursery grafting. Postharvest methods and investments in infrastructure development are a final topic that will be addressed as it is the key for the produce to reach both export and domestic markets. This poster will look at the current Haitian mango production and will offer recommendations to Haiti's mango production and value chain based on an ongoing review of the situation.

□ **P4-02**

Poster Session 4: Horticultural practices / P4-02

Evaluación del efecto de diferentes fechas de poda de flor en el mango cv. Kent.

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Resumen

Bajo las condiciones de cultivo del mango en el sur de España se ha demostrado que la poda de terminales de brotes en año “*on*”, antes de la plena floración, induce nuevas yemas florales mejorando el cuajado y la posterior cosecha. El presente trabajo se ha llevado a cabo en una parcela de árboles adultos del cv. Kent. Con el objetivo de buscar la mejor fecha de poda para extender la producción de este cultivo hasta principios de noviembre, con mejores precios en el mercado europeo, se han ensayado 3 fechas: finales de febrero (29) - mediados de marzo (14) - finales de marzo (29). Se ha evaluado la floración en dos momentos del ciclo fenológico, así como la productividad media de los árboles y la calidad de los frutos. Los resultados indican que la poda de mediados de marzo fue la que indujo mayor carga floral y productividad.

□ P4-03

Poster Session 4: Horticultural practices / P4-03

Recovery pruning in mango cultivars at Guanare municipality, Portuguesa State

Añez Q., Miguel y Gonzalez, Oswaldo

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Abstract

In order to evaluate the effect of severity pruning on vegetative growth of four mango cultivars, was conducted an experiment at Marfilar, Guanare municipality, Portuguesa State, Venezuela. The plants were 23 years old when was applied a heavy pruning. Experimental design was randomized completely with four treatments (cultivars) and four replicates. The experimental unit formed by one tree. Cultivars were: 'Rubi', 'Harris sdlg', 'Anderson' y 'Glenn'. Variables studied: plant height, medium radio canopy and branches number generated on principal branches of tree. The statistical analysis used was variance analysis for plant height and medium radio canopy and Kruskal-Wallis test non parametric in branches number. Over three years of investigation, was determined similar vegetative growth of cultivars evaluated. The values of plant height for third year varied from 5.91 to 6.80 m, medium radio canopy from 1.99 to 2.93 m and branches number varied from 22.6 to 35.6. Consistently 'Anderson' showed the highest values for three variables studied, it is according to characteristic of vigorous cultivar, about reported in literature revised. To the fourth year after pruning, in the plants evaluated sprouted the first inflorescences (dates not presented). In conclusion, all cultivars showed equal behaviour ($P > 0.05$) to severe pruning applied, in climate and soil of experimental area and agronomic practices used.

Keywords: *Mangifera indica*, vegetative growth, agronomic practices.

□ P4-04

Poster Session 4: Horticultural practices / P4-04

Stock of total organic carbon and total nitrogen in irrigated mango cultivation in the Brazilian semi-arid

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Abstract

The production systems of mango trees in irrigated areas of the Brazilian semi-arid lead to the loss of total organic carbon and, consequently, total nitrogen in the soil and may contribute to the liberation of greenhouse gases to the atmosphere. An experiment with mango trees (*Mangifera indica* L.) cv Kent was implemented testing intercropping with green manure and two soil management systems, leaving the biomass area on the surface or incorporated into the soil. After three years of cropping, the density and total organic carbon values and total nitrogen values in the soil layers were evaluated at 0-5, 5-10, 10-20 and 20-40 cm between or in between the mango tree rows. The stock of total organic carbon and total nitrogen were calculated with a conventional mango orchard as reference and a native forest (Caatinga). In all the layers of the soil, the cultivation of green manure had a positive effect on the carbon stock and nitrogen in relation to the conventional cultivation of mangoes and a negative influence in relation to Caatinga. After examining the layer of 40 cm, it was found that the cultivated mango trees with green manure stocked 24,08 Mg C ha⁻¹ and 4,63 Mg N ha⁻¹ in the soil, while the conventional mango cultivation stocked 12,65 Mg C ha⁻¹ and 2,62 Mg N ha⁻¹ and the Caatinga 35,06 Mg C ha⁻¹ and 4,83 C ha⁻¹. Green manure can be a technological strategy to promote the increase of carbon and nitrogen stock in irrigated areas cultivated with mango trees in the Brazilian semi-arid, mitigating the emissions of CO₂.

Keywords: *Mangifera indica*, green manure, native forest

□ P4-05

Poster Session 4: Horticultural practices / P4-05

Técnicas de manejo del mango, cv. Osteen, en invernadero en el sur de España

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Resumen

En el sur de España, alrededor de 50 ha de mango están cultivadas en invernadero. Las razones para ello son la baja rentabilidad y los altos costes de los cultivos hortícolas en los últimos años, por lo que se aprovechan las estructuras ya existentes. Bajo estas condiciones, la producción de mango se consigue, aproximadamente, tres semanas antes que al aire libre, lo que permite obtener precios más altos en el mercado. También se amplía el periodo de oferta de este fruto en el mercado. Se describen las técnicas de manejo del cultivo, cv. Osteen, mayoritariamente implantado en la zona productora. Asimismo, se comparan los costes de cultivo con el manejo al aire libre. Se han determinado los parámetros fenológicos y productivos del cultivo.

□ P4-06

Poster Session 4: Horticultural practices / P4-06

Green manures in mango 'Kent' orchard

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Abstract

Intensive exploration of soil on Brazilian semi-arid conditions, with mango in irrigated systems, has caused soil degradation and consequently reduced the quality and sustainability of agribusiness in the region. Soil in this region is characterized mostly by sandy texture, organic matter content and water retention low, which is still compromised by climate conditions, high temperatures and insolation, causing serious constraints to agricultural productivity. The present work aimed at studying cropping systems, used as green manure cover, in the orchard establishment of mango 'Kent' by mass quantifying and mineral composition of plant material, resulting from pruning training. Leguminous green manure had some species: *Calopogonium mucunoide*, *Crotalaria juncea*, *Crotalaria spectabilis*, *Canavalia ensiformes*, *Cajanus cajan* L., *Dolichos lablab* L., *Mucuna aterrina*, *Mucuna conchinchinensis*. Non leguminous green manure consisted by species as: *Sesamum indium* L., *Chysantemum peruviamum*, *Ricinus communis* L., *Penissetum americanum* L., *Sorghum vulgare* Pers. Evaluations used three plants per plot with four replications. Green mass resulting from the four training pruning showed that green manure with 75% of leguminous and 25% of non leguminous species increased vigor of the plants in 16.6%, 19.7%, 45.1% and 23.9%, compared to treatment with spontaneous vegetation, respectively. There was no significant difference between treatments in the levels of nitrogen, phosphorus, potassium, calcium and magnesium present in leaves and branches in each of training pruning. Green manure could be reduce orchard establishment time until the beginning of floral induction and production of mango 'Kent'.

Keywords: pruning, orchard establishment, irrigation, organic matter.

□ P4-07

Poster Session 4: Horticultural practices / P4-07

Propagation, grafting and improvement of mango in the U.S. Virgin Islands

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Abstract

Mango (*Mangifera indica* L.) is of great cultural significance and popular fruit crop in the US Virgin Islands. Diseases and pests, high soil pH (caliche), limited land and high cost of management limit the production of mango. Currently, grafted plants of fruit trees including mango are imported from the Puerto Rico and Florida in the USVI. The University of the Virgin Islands Agricultural Experiment Station in collaboration with the Virgin Islands Department of Agriculture investigated propagation and grafting of mango cultivars in three islands. Mango rootstocks collected from the orchards and field grown trees and established in the nursery. Grafting in mango rootstocks was undertaken throughout the three islands in St. Croix, St Thomas and St John. This paper presents results of side veneer and cleft grafting methods in mango rootstocks. Two methods produced positive results. Grafting and propagation of mango locally presents an economical, time saving and beneficial for the local farming community.

Keywords: *Mangifera indica*, rootstock, scion, cleft, side veneer

Poster Session 5: Diseases and Pest control

□ P5-01

Poster Session 5: Diseases and Pest control / P5-01

An investigation into the status and control of mango blossom malformation in South Africa

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Abstract

Mango blossom malformation (MM) is a serious disease in South Africa (SA), causing severe economic losses annually. Current recommendations are to break out the malformed inflorescences as well as three additional nodes of the branch when malformed flowers are clearly visible, but before sporulation occurs. Despite following these recommendations, a high incidence of MM was reported during the past two seasons. The aim of this study was to investigate and evaluate the influence of various management practices by producers on the incidence of malformation, and to develop an integrated strategy for optimum control. In the Hoedspruit production area, the incidence of MM was monitored on different cultivars at four producer sites. In the Nelspruit production area, in a 36 year old Sensation orchard, the effect of inflorescence removal combined with chemical control was investigated. Malformed branches were removed at 300-500mm distance behind malformed blossoms during November. After harvest three treatments were applied, being 1) a control treatment (no further removal of malformed branches), 2) further removal of malformed branches, and 3) further removal of malformed branches followed by a spray of benomyl WP at 0.75g/L. At all sites the number of healthy and malformed inflorescences was counted before inflorescences were removed. Records of all husbandry practices were kept. In the Hoedspruit area removal of the malformed inflorescences lead to a 44.3-80.2% decrease in the prevalence of malformation. It was established that branches were not always broken out by producers according to recommendations, leading to poor control of malformation in certain instances. Results of the incidence of malformation at each of the trial sites will be presented. The study will continue for a further two years and the results will be used to develop a strategy to minimize MM in SA.

Keywords: *Mangifera indica* L., management practices, flowers, inflorescences, benomyl

□ P5-02

Poster Session 5: Diseases and Pest control / P5-02

Antimicrobial effect of chitosan incorporating lactoperoxydase system against mango pathogens

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Abstract

The objective of this study was to evaluate the effects of lactoperoxidase system (LPOS) with or without iodine, incorporated into edible chitosan films. The antifungicidal properties in the *in vitro* inhibition of the mycelia growth of *Phomopsis sp* (RP257) and *in vivo* development (on mango fruit) were studied. This experiment was carried out in CIRAD's laboratories, in Montpellier, using isolates of *Phomopsis sp* (RP257) extracted from mangoes presenting decay symptoms. Lactoperoxydase systems with or without iodine (LPSOI/LPSO incorporated into three concentrations of chitosane (0; 1, 0; 1, 5%) were studied. Antimicrobial effect of chitosane film and synergy between the antimicrobial activity of lactoperoxydase systems and different concentrations of chitosane films obtained were tested on the inhibition of *Phomopsis sp* (RP257). The experiment were realized *in vitro* (PDA medium, film, and measurement of inhibition growth of the pathogen) and *in vivo* (artificial inoculation of fruit and coating with chitosane films added with lactoperoxydase).

□ P5-03

Poster Session 5: Diseases and Pest control / P5-03

Diagnóstico y diversidad de los aislados de *Fusarium* causantes de la malformación del mango en España

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Resumen

La Malformación del Mango (MMD) es una de las enfermedades más importantes que afectan a este cultivo. Varias especies del género *Fusarium* se han descrito como agentes causales de la enfermedad a nivel mundial, como son *Fusarium mangiferae*, *F. sterilihyphosum*, *F. proliferatum*, *F. mexicanum* y *F. tuiense*. La MMD es una enfermedad de reciente introducción en el cultivo de mango de la costa andaluza. Durante cuatro años consecutivos (2009-2012) se realizaron prospecciones en fincas de varias localidades de la Axarquía (Málaga), de las que se aislaron un total de 134 aislados, de los cuales aproximadamente una tercera parte fueron identificados como *F. mangiferae* en base a características morfológicas y a la amplificación por PCR de un fragmento específico de 608 pb. Para la identificación de los restantes aislados, se han secuenciado parcialmente los genes del factor de elongación 1 α y la β -tubulina. La combinación de ambos genes utilizando el programa informático MEGA.5 ha resultado en la agrupación de éstos aislados en un cluster junto a aislados de *Fusarium tuiense*. Tanto los aislados diagnosticados como *F. mangiferae* como los similares a *F. tuiense* han confirmado su papel como agentes causales de esta enfermedad en España, cumpliendo los postulados de Koch en plantas de mango de dos años inoculadas experimentalmente. Para estudiar la heterogeneidad de las poblaciones de *Fusarium* patógenas de mango de la Axarquía se han determinado los Grupos de Compatibilidad Vegetativa (VCG) y las pautas de amplificación mediante ap-PCR. Los resultados indican que la población de aislados del tipo *F. tuiense* pertenecen a un único grupo de compatibilidad vegetativa y presentan un perfil de bandas idéntico lo que sugiere un origen clonal. En el caso de la población de *F. mangiferae* aparecen dos grupos de compatibilidad vegetativa que presentan un patrón de bandas muy similar pero diferenciable, lo que sugiere al menos dos entradas diferentes de esta especie. Para completar este estudio de diversidad se está determinando el mating -type de los aislados mediante ensayos de PCR con los cebadores MAT-1 y MAT-2, y asimismo realizar un diagnóstico concluyente de los posibles *F. tuiense* mediante cruzamientos con aislados fértiles de referencia de esta especie. Este proyecto ha sido financiado por ayudas CICE-Junta de Andalucía, Proyecto de Excelencia P07-AGR-02471, cofinanciado con fondos FEDER (UE). Asimismo ha recibido ayudas de un convenio con SAT-2803 TROPS, Reyes Gutiérrez S.L. y Viveros Brokaw S.L.

□ P5-04

Poster Session 5: Diseases and Pest control / P5-04

Effect of calcium and magnesium silicate under pests management and yield in mango tree cultivar Palmer

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Abstract

The silicon (Si) in agriculture has been used to control pests and for improving the quality of vegetables and fruits. The objective of present study was to evaluate the effect of different doses of silicon, in order to control insects, diseases and mites and promote the increment in yield of mango trees cultivar Palmer under irrigated conditions. The experiment was carried out at commercial farm located in Matias Cardoso county, Minas Gerais state, Brazil. Five different doses of silicon were applied: control (without silicon application) and doses of 400, 800, 1600 and 3200 kg of Agrosilício (commercial product). The application of product was performed directly on soil. The experimental design was in randomized blocks with five treatments, five replicates and one plant per parcel. The following characteristics were evaluated: incidence of pests, physical and chemical characteristics of the soil, chemical analyses of the leaves, vegetative and reproductive characteristics of the plants, physical-chemical characteristics of the fruits and incidence and yield. The results were submitted to variance analysis and regression models were adjusted. Independent of Agrosilício dose applied the maximum incidence of pests was 5%. No significant differences were observed between the characteristics for almost characteristics evaluated. The dose of 2400 kg/ha of Agrosilício promoted significant effects on pH, length and diameter in fruits of mango cultivar Palmer (Financial support: Fapemig).

Keywords: *Mangifera indica*, Silicon

□ P5-05

Poster Session 5: Diseases and Pest control / P5-05

Evaluación de un fungicida y tres extractos orgánicos en el control de Antracnosis (*Colletotrichum gloeosporioides* Penz.) en la poscosecha en mangos de producción convencional y orgánica

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Resumen

Con el objetivo de evaluar la efectividad de cuatro fungicidas orgánicos, en el control de la antracnosis del mango (*Colletotrichum gloeosporioides* Penz.) en la poscosecha, se desarrolló esta investigación en los laboratorios de protección vegetal de la Universidad Autónoma de Santo Domingo (UASD). Se estudio la efectividad de Biolife, Agriol, Coctel orgánico, Aceite de Neem, e Hipoclorito de sodio como testigo relativo. Se utilizó un diseño de bloques completamente al azar (DCA) para cada finca, cinco (5) tratamientos y cuatro (4) repeticiones. Los frutos tratados se almacenaron por 15 días, en una nevera a 12 grados centígrados y humedad relativa promedio de 80%. Después de su retiro de la nevera, los frutos se sometieron a tres (3) evaluaciones (día 1,4 y 6) para evaluar el nivel de deterioro a lo largo del tiempo, bajo condiciones ambientales. Los resultados obtenidos indicaron que no hay diferencias significativas entre los tratamientos de cada finca, pero hay diferencias en la apariencia y deterioro de la fruta en el tiempo (días expuestos a condiciones ambientales) de evaluación. En prueba de control de *Colletotrichum gloeosporioides* a nivel de laboratorio, con los productos señalados; ninguno de los productos orgánicos resultó efectivo para inhibir el desarrollo del hongo a la dosis aplicada.

Palabras claves: antracnosis, poscosecha, fungicidas orgánicos

□ P5-06

Poster Session 5: Diseases and Pest control / P5-06

Infografía de enfermedades del cultivo del mango (*Mangifera indica* L) en la República Dominicana

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Resumen

En República Dominicana se citan numerosos agentes patógenos asociados al cultivo, Ciferri, ya en 1929 reporta la flora criptogámica presente en *Mangifera indica* en la República Dominicana, La lista de enfermedades reportadas por este autor, ha sido actualizada y ampliada por otros investigadores, sin embargo hasta ahora la información se encuentra en diversas publicaciones, de acuerdo con el área de interés de los fitopatólogos del país. Por esta razón el objetivo de este Poster es presentar una colección de imágenes con los síntomas de las enfermedades que oficialmente están reportadas en el país entre las que se encuentran, además de las citadas por Ciferri (1929) *Colletotrichum gloeosporioides* Penz, *Colletotrichum acutatum* J.H. Simmonds, *Elsinoe mangifera* Bitancourt & Jenk, *Pestalotia mangiferae* (Henn.) Steyaert, *Erwinia mangiferae*, (Doige) Bergey, *Xanthomonas campestris*, *Meliola mangiferae* Earle, *Lasiodiplodia theobromae* (Pat.) Griffin & Maubl, *Fusarium decemcellare* C. Brick, *Oidium mangiferae* Berthet. En este poster se presentan otras enfermedades fisiológicas y otras cuyos agentes causales no han sido identificados.

Palabras claves: Mango, enfermedades, República Dominicana

□ P5-07

Poster Session 5: Diseases and Pest control / P5-07

Diseminación de síntomas de la enfermedad de Escoba de bruja en mango (*Mangifera indica*) en la República Dominicana

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Resumen

En el país se observaron síntomas de la malformación de flores y brotes de mango, en plantas dispersas en cultivares criollos y viveros en el período 1998-2000 en algunas provincias de la región Este. En las apariciones de los primeros síntomas se encontraron ácaros, *Aceria* (sin. *Eriophyes*) *mangiferae* Sabed, asociados a los síntomas y reportados en el país en el 1996 (Pellerano & Batista 2000). Varios años después se observaron las plantas de mango con los síntomas en el centro de la ciudad de la Provincia de San Cristóbal, durante 2005-2008 en cultivares criollos de mango 'Largo' y 'Banilejo'. Los síntomas se encontraron más tarde en planta de mango criollo en la carretera de de San Cristóbal – Baní de la región Sur del país. Los síntomas de la enfermedad han extendido y se han encontrado en la Estación Experimental de Frutales Baní del IDIAF en mangos criollos cv. 'Puntica' y 'Banilejo', mostrando síntomas agresivos en cv. 'Puntica' y también se han encontrado a partir del 2008 en varias fincas en la provincia de Azua. Posteriormente se detectó la presencia de *Fusarium* sp. y que mediante la descripción morfológica realizada en los laboratorios de la Estación Experimental de Mata Larga, a través de la cual se identificó en las muestras de San Cristóbal y Baní el patógeno *Fusarium moniliforme* Sheldon. Al igual que Como en otros países como México, Venezuela e Israel se han relacionado otras especies del género *Fusarium* con la enfermedad, por lo que es posible que en el país también existan otras especies involucradas. Además los síntomas han además sido detectados en las provincias: San Juan (San Juan de la Maguana) Santiago Rodríguez, Santiago (Navarrete y La Lomota), Monte Plata (Bayaguana), Azua (Las Cabuyas), Peravia (Villa Sombrero), Santo Domingo (Guerra) y el Distrito Nacional. La presencia de los síntomas avanza, aunque en ninguna localidad se encontró un alto número de plantas afectadas. Establecer una vigilancia a nivel nacional, actualización del estatus y medidas de control son necesarias para evitar de que se transforme en una epidemia como en otros países.

Palabras claves: Malformación floral, enfermedades, mango.

Poster Session 6: Postharvest physiology and technology

□ P6-01

Poster Session 6: Postharvest physiology and technology / P6-01

Ripening and quality of hot water treated mango cv. 'Tommy Atkins' after refrigerated transit period plus seven days under marketing conditions

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Abstract

The present study had the objective of evaluate the effect of hot water quarantine treatment on the postharvest maturation and quality of Tommy Atkins mango fruit after refrigerated eighteen days transit plus seven days at marketing temperature. The experimental design was a completely randomized in a factorial (2 x 3) treated and untreated hot water fruits and three times of evaluation: beginning and ending of eighteen days simulate transit period at 10°C and 90% of relative humidity and after plus seven days at 20°C and 80% of relative humidity to simulate market period. Ten repetitions were used per treatment, with one fruit per plot. The analyzed variables were mass loss, firmness, peel and flesh color (brightness, chromaticity and hue angle), solubles sollids, pH, titrable acidity and ratio soluble solids/tritable acidity. The decrease in acidity, which occurs naturally during ripening of mango fruit, increased after the transit and marketing period, but the reduction in acidity was significantly higher in hot water untreated fruits. These results had a positive influence on the taste of the hot water untreated fruit that had a SS / AT ratio values three times higher than treated fruit at the end of the marketing period. About the Hue angle values, it seems that from the beginning of the experiment, fruit treated with hot water had the skin lighter green than untreated fruit. At the end of the transit period, the skin color of the treated fruit was already much more yellow (Hue = 90°) than untreated fruit. During the marketing period, the fruits of both treatments had reached the yellow color resulting from the rapid chlorophyll pigments degradation and the exposure of the yellow pigments, naturally present in the skin cells. The purity of color (chromaticity) increased in both treatments, both during transport and during the marketing period, however, at the end of the transit period the pulp of untreated fruits already had a yellow color and at the end the marketing period the pulp showed a characteristic orange color of fully ripe fruit. Under the conditions in which the experiment was carried out, it can be concluded that most suitable values of firmness, pH, titrable acidity and the higher soluble solids and ratio soluble solids/tritable acidity and better pulp developed orange color, indicate that the fruits not subjected to hot water treatment have best quality and most appropriate maturity for consumption than fruits submitted to hot water treatment, although these have shown better development of skin color.

Keywords: *Mangifera indica* L., hot water, quarantine treatment, postharvest quality

□ P6-02

Poster Session 6: Postharvest physiology and technology / P6-02

Suitability of South African mango cultivars for agro-processing

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Abstract

Mangoes in South Africa are mainly sold on the local markets as well as being exported. However, during the past six years exports declined and more fruit were supplied towards agro-processing. Currently the total mango production in South Africa can be divided into three sectors, namely processing (73%), local markets (26%) and export (1%). Processed mango products available in the South African market are canned mango slices and pieces in syrup, mango juice, dried mango products and achar, also known as pickled mango. To expand the processing market and to develop new products, a project was initiated to investigate the potential to produce ice cream, sorbet and frozen yoghurts from various mango cultivars. The main aim of the study was to investigate the opportunity for new product development, as well as determining the suitability of various cultivars with regard to above-mentioned products. The suitability of various cultivars with regard to drying was also investigated. The mango cultivars found most suitable for ice cream production and drying were 'Tommy Atkins', 'Joa', 'Crimson Pride', 'Kensington', 'Heidi', 'Sensation', 'Keitt' and 'Kent'. The taste, colour, texture and overall impression of the ice creams and dried mango were evaluated by a sensory panel.

Keywords: *Mangifera indica* L., subtropical fruit, drying, ice cream, sorbet, yoghurt, sensory evaluation

□ **P6-03**

Poster Session 6: Postharvest physiology and technology / P6-06

Traceability pilot project in mango

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Centro para el Desarrollo Agropecuario y Forestal (CEDAF)

Abstract

The Agricultural Traceability Pilot Project (PRA) began in August 2011 with the purpose of assisting the mango supply chains and production under greenhouses to maximize efficiency and speed of current trace procedures along the supply chain, having as first stage the coding of boxes and pallets by 2013. This agreement among commercial Dominican enterprises comprises full traceability processes through labeled products at the time of packaging, as well as information collection and storage, achieving consistency in existing data and allowing the right decision making for businesses. Additionally, it provides certainty, protection and security to customers about what they buy and consume under possible food contingencies. The overall objective of the project is to establish in the Dominican Republic a pilot agricultural traceability system according to local and international requirements. It includes an Electronic Traceability System that has been designed with an architecture that brings together several layers of information related to products which, in addition to making possible the continuous monitoring of the merchandise, offers the possibility of improving systems of business management. The Traceability Pilot Project is a CEDAF effort, sponsored by the United States Department of Agriculture (USDA) and the Ministry of Economy, Planning and Development of the Dominican Republic, aimed to improve competitiveness levels of Dominican exports through the creation of an efficient and fast process that enables the identification and monitoring of products among members of the supply chain.

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Estudio de la descomposición interna de la pulpa y su correlación con los niveles nutricionales foliares (N y Ca) de la planta

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Resumen

Los cultivares estudiados, Tommy Atkins, Osteen, Kent y Keitt, representan el 95%, aproximadamente, de la superficie cultivada de mango en el sur de España. La empresa asociativa TROPS representa el 50 % del sector, englobando a 1200 productores de aguacate y mango. Exporta mango de los citados cultivares a 22 países, siendo la calidad su principal objetivo. La descomposición interna de la pulpa (DIP) es el principal problema fisiológico del fruto en las condiciones de producción del sur peninsular. En trabajos previos realizados en la Estación Experimental “La Mayora” durante más de 15 años, se ha constatado la correlación de esta fisiopatía con altos niveles foliares de nitrógeno y bajos de calcio. El estudio se ha llevado a cabo durante un periodo de 4 años, realizando 1000 análisis foliares y evaluando 5500 frutos, anualmente. La incidencia de DIP se ha determinado en fruto en estado de madurez de consumo. Para la evaluación de la fruta se ha utilizado un método, no destructivo, basado en la tecnología NIR, sistema portátil de análisis para frutas y hortalizas NCS001. Los resultados confirman los obtenidos en trabajos previos, la incidencia de esta fisiopatía está correlacionada positivamente con altos niveles foliares de nitrógeno. La relación N/Ca debe ser ≤ 0.5 , aunque valores de N superiores a 1.6 % en hoja muestran una alta incidencia de DIP, independientemente de los niveles de calcio.