

HIGHLIGHTS OF THE 4TH INTERNATIONAL MANGO SYMPOSIUM

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I want to thank Dr. Chia for his kind invitation and helpful support so that I could participate in this conference. He asked me to summarize the events at the 4th International Mango Symposium that was held at Miami Beach in July, 1992. Planning for that meeting began with an invitation at the close of the 3rd International Mango Symposium in Darwin, Australia, three years ago. The Mango Symposia are sponsored by the Mango Working Group of the International Society for Horticultural Science. The symposium was organized by Dr. Jonathan Crane (Extension Specialist in tropical fruits) at the Tropical Research and Education Center at Homestead. Dr. Bruce Schaffer organized the program.

Overall, there were around 500 participants at the symposium representing around 40 different countries. The symposium included a pre-conference field tour of mango production in Sinaloa, on the west coast of Mexico. It is one of the major exporting areas of mangos to the United States. They primarily export 'Tommy Atkins', 'Haden', and 'Keitt'. Import from Mexico is one of our biggest problems, as far as our small mango-producing area in Homestead is concerned, because of the large volume of fruit that comes into the country.

Seventy-five oral presentations and a number of posters were presented. The subject areas covered world production, plant pathology, physiology, growth and development, taxonomy, breeding and genetics, horticultural practices, postharvest physiology, handling and marketing, entomology, and pesticide regulations. Following are highlights of the conference presentations.

World Production

Asia is the largest producer of mangos in the world, claiming around 62 percent of the world's production. They have a million hectares in production, producing 15.7 million metric tons of fruit per year. These figures include all of India, Pakistan, Southeast Asia, and the Philippines, but by and large, India is the largest major producer. Except for the Philippines, most of these producing areas do not export much fruit. Most is grown for local consumption. In India, for

example, transportation and packing-house systems are crude, and they do not have the infrastructure required to move fruit over large distances. Their primary cultivars are 'Alphonso' and 'Dashahiri'.

The South African mango industry is growing rapidly. They currently produce around 42,000 metric tons of fruit. About 60 percent of that is processed to mango pickle, called atchar. Small fruits are harvested prior to seed coat hardening. Pickers also harvest fruit from the ground, taking them to processing plants where they are chopped, and spices are added to make atchar. The Indian population is quite large in South Africa, so there is a demand for mango pickle. Of the remaining 40 percent of the crop, most (about 30 percent) is distributed within the country and the rest (10 percent) is exported, primarily to Europe. This alternative use of what would otherwise be useless "drops" is quite interesting. I feel it has a tremendous market potential in the U.S. and other countries with ethnic consumers who are used to such spicy condiments.

A general talk by R. L. Brown focused on mango production and trade (Abstracts, IV Intl. Mango Symp., Miami Beach, Florida, July 5-10, 1992, Univ. Florida, IFAS, Trop. Res. & Edu. Cntr., and Intl. Soc. Hort. Sci., p. 4). He was optimistic about expansion of the mango market. The success of commercial mango production depends upon the people involved in mango distribution and the strategies they use to develop markets. In addition, another key element is to provide fruit the year around, as mentioned today by Dr. Kefford. If consumers saw mangos in the store every day – different cultivars, perhaps, and likely from different sources – they would better appreciate what a mango is and could begin to enjoy them as a regular part of their diet.

Plant Pathology

Some of the talks presented information on specific and newly discovered pathogens of mango trees and fruit. One new pathogen discussed by J. Darvas (ibid. p. 11) was *Dothiorella dominicana*, which he feels is an important pathogen currently spreading in South Africa.

Mango malformation is another disease that is rapidly spreading around the world. Caused by the fungus *Fusarium subglutinans*, one effective control measure is simply to prune infected branch tips and burn them. The disease organism attacks small, tender buds, especially those infested with mites or other insects. Growers have successfully limited its initial spread in Homestead in this manner. Similarly, successful control has been achieved in South Africa.

Commonly found in the southern hemisphere, *Xanthomonas compestris* pv. *mangiferaeindicae* (Xcm) causes bacterial black spot of mango. This was a particularly hot topic during the 3rd International Mango Symposium. It is especially prevalent in South Africa and has great potential for continued spread. The talk by O. Pruvost (ibid. p. 24) brought that message home. Any time we ship cuttings that are not sanitized we risk the possibility of spreading disease.

The rest of the pathology session focused primarily on anthracnose problems in mango-growing areas of the world.

Stress Physiology; Growth and Development

K. D. Larson (ibid. p. 40) presented a talk on root flooding and its influence on formation of hypertrophied lenticels in bark above the flooded zone. The authors speculated that these lenticels may be a means of facilitating oxygen diffusion down to oxygen-starved roots in chronically flooded soils. Flooding is a problem in some low-elevation areas of South Florida where urban encroachment is forcing growers to find cheaper land in the Everglades. Although trees are planted in mounded rows, the area is flooded sometimes five or six months of the year. Thus, the roots of these trees may be under water for extended periods. Many are not aware that trees in South Florida are grown in porous limestone rock. In higher areas (about 10 ft above sea level), this rock is ground into a coarse gravel in a grid of trenches with a special scarifying dozier blade similar to some I have seen used on Hawaii to break up lava rock. Trees are planted at the intersections of the trenches. They are planted on raised gravel beds in lower areas (about 4 to 5 ft above sea level) which are prone to flooding as the fresh water lens in the porous rock rises above the surface of the rock during the rainy season. It may flood up to the top of the raised bed itself, so there is an interest in South Florida to better understand flooding and its effects on the physiology of orchard trees.

A. W. Whiley (ibid. p. 54) stressed the importance of low temperature on mango flowering and emphasized the need to consider the genetic background of selections derived from various environmental conditions and its relation to flowering during minimal temperatures. For example, 'Tommy Atkins' was selected in a subtropical environment providing extended periods of chilling temperature to reliably stimulate flowering each year. It, however, does not flower reliably in lower latitudes which do not receive such cool temperatures. 'Carabao' and many other successful cultivars which were selected in the deep tropics may be triggered to flower at higher temperatures than those developed further north.

Water stress has been considered for many years to be a major induction factor of mango flowering. Flowering occurs during the dry season in many areas of tropics; however, results of controlled experiments conducted in Whiley's lab in Australia and concurrently in our lab have demonstrated no direct affect of water stress on flowering. There may, however, be an indirect affect which will be discussed in detail in my other presentation on mango flowering.

E. K. Chacko (ibid. p. 32) presented a talk on the role of immature leaves in mango shoot growth, stressing the importance of certain gibberellins involved in shoot elongation. There are over 80 known gibberellins. Some gibberellins may also inhibit induction (commitment) and/or initiation (commencement) of flowering. Aging of leaves reduces their capacity to produce gibberellins over time. We find that branches with young leaves do not flower even under inductive conditions, and as these leaves age they lose this inhibitory effect. Therefore, one or more of these gibberellins may be involved in inhibition of flowering.

This theme was continued in a talk by R. Nuñez-Elisea (ibid. p. 43), who discussed the influence of gibberellin-synthesis inhibitors on flowering. Soil applications of paclobutrazol can stimulate early and more efficient flowering of mango in tropical areas. This particular report demonstrated that it was not paclobutrazol per se that induced the flowering. Chilling temperatures, in which the trees were residing at the time, were necessary to actually induce flowering. It appears that the paclobutrazol simply reduced the level of a putative inhibitor (a gibberellin?). Thus, by reducing the level of inhibitor we are able to stimulate flowering under marginally inductive

conditions, i.e., conditions where the temperatures are not as low as is normally required to induce flowering.

Factors responsible for seasonal changes and successful pollination rate of mango flowers in Israel was presented by S. Gazit (ibid. p. 36). He showed that even though optimum temperatures for normal flowering may be present at the time flowers are opening, it is the temperatures present during early development of panicles which determines their success. Chilling temperatures during floral development may inhibit pollen germination or survival. A talk by M. Issarakraisila (ibid. p. 64) in the Taxonomy, Genetics, and Breeding session presented information on this subject in more detail. It was reported that sporogenesis (pollen development) is greatly affected by low temperatures, so that even though you might have optimum temperatures at the time that flowering is actually occurring, those flowers which were previously exposed to low temperatures lack viable pollen.

There were more talks on paclobutrazol and its use, especially in relation to stimulation of early flowering. Another two talks concerned chemical and manual thinning of panicles to force a second, delayed flowering flush. Freezing temperatures in subtropical areas can have an important impact on the success of flowering. In such cases there is a desire to delay flowering to avoid early loss of the crop. The strategy is to deblossom or pinch inflorescences, which delays production of flowering panicles by a month or even a month and a half. Abscission of panicles has been successfully achieved using ethephon or hydrogen cyanamid.

Workshops

Several workshops on various topics were held during the evenings. One was "Mango Tree Size Control and Training," in which were discussed approaches to control tree size in orchards. There was a "Mango Genetic Resource Conservation" workshop which discussed the various germplasm reservoirs throughout the world, what is available, and how well they are doing. We have a collection of about 50 trees at the experiment station in Homestead. There is also a collection at the USDA center in Miami. Trees at both locations were severely damaged in Hurricane Andrew. Their survival is uncertain.

There was also an evening workshop on "Diseases of Mango" which mainly focussed on anthracnose, malformation, and postharvest

diseases. I was surprised that bacterial black spot was not discussed in more detail, considering its emphasis in the previous symposium. The main reason may be that fewer Australians, Indians, and South Africans participated this year. These are areas where it is a major problem. It apparently does not occur in the Northern Hemisphere (except perhaps India?), but it seems to me that this is something which we should be aware of and understand before it migrates here.

Field Tour of a Mango Production Area

A field tour conducted during the Symposium showed participants the mango growing area in South Florida, all the way from our high-elevation mangos at ten feet above sea level to our low-elevation mangos at four feet above sea level. Participants were amazed to see mango trees sitting in water and people having at times to harvest some of those with a boat. That turned out to be quite a joke, when in fact they have done just that to avoid getting their feet wet.

Taxonomy, Genetics, and Breeding

Talks were presented on various breeding and genetic studies going on in Brazil, Australia, and Florida. An interesting paper by J. M. Bompard (ibid. p. 60) discussed other mango species with potential commercial importance for breeding into the commercially important *Mangifera indica*.

In more basic areas of study, H. Mathews (ibid. p. 66) demonstrated the use of *Agrobacterium tumefaciens* strains to obtain genetic transformations in mango, which opens the opportunity for genetic engineering. A talk on frequency and characteristics of zygotic seedlings from polyembryonic mango cultivars using isozymes as genetic markers was presented by C. Degani (ibid. p. 61). R. J. Schnell (ibid. p. 68) described use of RAPDtm markers for doing something quite similar at the gene level. He is also trying to map genetic interrelationships among various cultivars and their sources to aid their breeding program.

Horticultural Practices

S. C. Mandhar (ibid. p. 83) reported on development of a mango harvester which snaps off the fruit about two centimeters above the pedicel, therefore reducing the amount of latex sap bleeding on the fruit. It was developed in India where they do not have sophisticated machinery available. The affect of soil temperatures on rooting of cuttings was presented by O. Reuveni

(ibid. p. 88). Four polyembryonic cultivars were studied with variable results. Twenty to thirty degrees was optimum. Temperatures higher than this range inhibited rooting, as did lower temperatures.

A new approach to an old problem was discussed by R. Holmes (ibid. p. 79), who described formation of grower groups in Australia to increase efficiency of their extension programs. He described their success in extending research information to the growers.

Postharvest Physiology and Handling, Food Science, and Marketing

M. C. Lizada (ibid. p. 104) demonstrated that lowered oxygen tension such as one might get in controlled atmosphere storage facilities contributes to internal breakdown of mango fruit.

The basis for differential ripening was described by H. Lazan (ibid. p. 102). He described activities of enzymes actively involved in fruit ripening.

Handling systems to reduce mango sap burn were described by R. Holmes (ibid. p. 98). 'Kensington Pride' is the primary production cultivar in Australia. Sap burn is a particular problem with that cultivar. I have never seen that in any other cultivar. It is, however, an important problem for them.

Entomology

Most talks described various entomological pests that are common in their particular areas. The session began with a description, by J. Sharp (ibid. p. 126), of approved quarantine treatments available for fruit flies, such as hot water dip, steam vapor, quick freeze, radiation, and low temperature. Some of you are actively involved in this already and are familiar with all of these strategies.

Talks by speakers from the West Indies, Israel, Pakistan, Florida, and Costa Rica described various insect pests. J. D. Hansen (ibid. p. 120) reported on control of the mango seed weevil. It was a rather general presentation. The pest is not present in the Americas but it is a problem in many places around the world.

The main meeting ended with evening workshops. One entitled "What is Needed to Improve Research in Practical Aspects of IPM for Mango" focused on integrated pest management as a tool to reduce pesticide use while improving control of pests.

The workshop on flowering physiology of mango discussed environmental influences on flowering such as low temperature, water relations, nutrition, and day length. Indogenous factors influencing flowering, such as a florigenic promoter and inhibitor, were also covered. Discussion of flowering management strategies in tropical and subtropical environments included growth synchronization and use of triazole plant growth retardants such as paclobutrazol.

The last workshop focused on postharvest handling of mangos. The symposium closed with talks on quarantine treatments and pesticide regulations. A major problem, of which many of you are already aware, is the re-registration program currently being conducted by EPA on virtually all pesticides. It is going to be tougher and tougher for minor crops, such as mango, to get clearance for use of certain pesticides. There are people here who are a lot smarter than me that can discuss this issue, but it is a problem which needs to be addressed.

The meeting closed with the decision that the 5th International Mango Symposium be held in 1995 in Israel. I would encourage all of you who are interested in mangos to make plans to attend that meeting.