ISSN: 2581-3749 (online) Advanced Agricultural Research & Technology Journal ▪ Vol. III ▪ Issue 1 ▪ JANUARY 2019
IMC-2018 Special

Proceedings and Recommendations of International Mango Conference (IMC-2018)

N. B. Gokhale*, A. D. Rane, V. K. Patil, P. M. Haldankar, T. Bhattacharyya

The International Mango Conference was held at Vengurle, Dist. Sindhudurg, Maharashtra, India during 8-11th May, 2018. This conference was jointly organized by Inter-disciplinary Society for Advancement of Agricultural Science and Technology (ISASaT) and Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli. The usual precedence of a pompous inaugural ceremony was dropped and the technical sessions began on 8th May, 2018 at 10.00 am by lighting a lamp to spread the knowledge of science. The lamp was lited by Dr. Ping Lu, Chairperson, Mango Working Group, ISHS, Australia, Dr. Víctor Galán Saúco. Research Professor (retired) Instituto Canario de Investigaciones Agrarias, Padma Shri Dr. K. L. Chadha, National Professor on Horticulture, Dr. Tapas Bhattacharyya, Vice Chancelor, Dr. B. S. Konkan Krishi Vidyapeeth, Dapoli, Dr. Shrirang Kadrekar, Former Vice Chancellor, Dr. B. S. Konkan Krishi Vidyapeeth, Dapoli and Dr. N. B. Gokhale, Secretary,

Inter-disciplinary Society for Advancement of Agricultural Science and Technology. Shri. Vijay Sardesai, Minister for Town & Country Planning, Agriculture, Archives & Archaeology, Factories & Boilers, Government of Goa interacted with the delegates at the International Mango Conference.

A total of 11 technical sessions and poster sessions were held at the International Mango Conference. The first session was on World Mango Scenario, which was chaired by Dr. Ping Lu and Co-Chaired by Dr. K. H. Pujari. Dr. Víctor Galán Saúco presented World Mango scenario and expressed the prospects for mango production and market both for fresh and processed mangoes.

It was observed that over 105 countries are involved in mango cultivation, however, the area has not increased but the productivity has increased. Interestingly, mangoes are available throughout the year with Mexico being the world leader in the export of Mango, followed by India, Thailand and Brazil. India's export is fluctuating around 2.2 % to 15.3 % and is supplying mangoes to UK and surrounding countries. USA, European Union, China, Persian Gulf and Canada are the major markets of mango in the world. Markets like Japan, China, the European Union and USA (require irradiation or Hot water treatment) are strict and require phyto-sanitary clearance for fruit fly.

Irwin, Kent, Haden, Palmer, Kent, Tommy Atkins are the major varieties under trade in the world. It was concluded that there is a good prospect for increasing mango production as the demand for processed mango is increasing. A positive trend of price was observed in the top ten markets, except UAE.

The second technical session was on Climate Change, it was chaired by Padmashri Dr. K. L. Chadha and co-chaired by Dr. M. M. Burondkar. Dr. Ping Lu attested the fast pace of climate change due to high green house trapping. Key words of understanding the climate change are effects, consequences, risks, adaptation and mitigation. Global Circulation Model and Regional Circulation Models are widely used in climate change studies. It was suggested that temperature and rainfall are the most important climatic factors for assessing the suitability of a region for mango cultivation. There is a need to develop varieties resilient to extreme climatic conditions in the future. Complete crop prediction model should be developed collaboratively with variables like temperature, drought and salinity.

Dr. Daruni Nephrom also observed that drought, high temperature and intermittent rainfall affected mango

Corresponding author: nbgokhale@rediffmail.com
Dr. N. B. Gokhale is Secretary, ISASaT.
Dr. A. D. Rane is Associate Editor of AARJ.
Dr. V. K. Patil is Councillor of ISASaT.
Dr. P. M. Haldankar is Director of Research, DBSKKV.
Dr. T. Bhattacharyya is former Vice Chancellor of DBSKKV and President, ISASaT.

production in Thailand. The mango production under climate change

scenario can be achieved by adopting cultural practices like use of water stress, root stock, pruning techniques, partial irrigation, manipulation of microclimate through sprinklers, shading of mango trees and plant nutrients and growth regulators management.

Dr. S. Rajan depicted the geographical suitability for any mango variety as a function of climate change and that vegetative and reproductive aberrations are its indicators. The reduction in temperature by 0.7 to 1.0 ºC will reduce the suitable areas and rainfall will also impact the fruit quality and quantity. Studies on phenology response is helpful in identification of resilient germplasm through a network project.

The third technical session was on Genetics and Breeding and was chaired by Dr. K. E. Lawande and co-chaired by Dr. S. G. Bhave. M. Shankaran emphasized on the different methods of mango breeding, germplasm, wild species and local collections for Karnataka for pickle purpose. *M. odorata* is the best species for utilization in mango breeding programmes for imparting abiotic stress resistance. It was also noted that a stone weevil resistant germplasm has also been identified.

Dr. Vidya Gupta highlighted the molecular secrets of Alphanso mango flavour. It was observed that over 85 volatile compounds determine the flavour and aroma in Alphanso mango fruit, moreover, these contents vary with the locations. Lactones and Ketones are the important volatile components and were prominent in accession of Deogad as compared to Dapoli accessions. Further, unsaturated fatty acids were more in Alphonso than in Payari and Kent mango varieties.

Dr. B. R. Salvi briefed the delegates regarding the breeding programme at Dr. B. S. Konkan Krishi Vidyapeeth, Dapoli. It was found that Neelam variety being a regular bearer and M-13-1 are salt tolerant phenotypes. He emphasized on the establishment of half sib and full sib mating designs for a systematic mango breeding programme.

The fourth session was held on Propagation and Natural Resource Management. The chairman of this session was Dr. Barin Ganguli and Co-Chairmen were Dr. Hukum Singh and Dr. D. K. Pal. The crux of Dr. D. K. Pal's findings were the importance of Ca-rich zeolite abundance in Konkan soils. He further emphasized that Zeolite causes uniqueness to red ferruginous soils. Soil orders observed in Konkan and Western Ghats region were Inceptisols, Mollisols and Alfisols. These soils were able to maintain a high levels of base saturation percentage of millions of years. Zeolite soils are important for the farmers as it supports growing of mango in deep soils and contribute to ecosystem services. Dr. T. Bhattacharya supplemented that zeolite also supports mango growth even in hard rocks.

Dr. E. Chakurkar emphasized on the implementation of Integrated Farming System Model for low land holding farmers. This model will be helpful in upland and sloping land in Konkan. It was also discussed that opteine 6 ml per 10 L of water showed better performance for fruit yield. So also weed extract contains growth promoters and is helpful for improving yield in mango.

Dr. S. S. Narkhede stressed upon the importance, multiplication and preservation of Wild Mangoes. He further suggested the need to domesticate the promising wild mango species for breeding and developing superior material.

Dr. S. S. Prabhudesai detailed the relationship between mango fruit quality and micronutrient. He highlighted that balanced nutrition produced best quality mangoes with superior fragrance, colour etc. It was observed that imbalanced nutrition resulted in spongy tissues in mango, especially due to the deficiency of calcium. Finally, L. S. Chavan emphasized that organically grown mango is useful for more economic yield.

The fifth technical session was on agrotechniques for sustainable production which was chaired by Dr. R. T. Gunjate and co-chaired by Dr. B. R. Salvi. Dr. N. Kumar emphasized on the improvement of productivity by canopy management, rejuvenation technology, use of paclobutrazol, high density plantation and holistic management of water and nutrients.

Dr. R. T. Gunjate shared his experience on improved mango production technologies. High density plantation with a density of 266 to 1000 plants $acre^{-1}$ with a 10-20 % pollinizer variety between 5^{th} and 10^{th} row is beneficial for productivity. He also emphasized on rejuvenation of unproductive plantations, regular training and pruning, application of paclobutrazol, adoption of irrigation and suitable water conservation measures. Further, water stress and use bee hives are better for fruit set. It was observed that M 13/1 polyembryonic root stock performed better in saline soils. He further recommended Mango cv Sonpari and Reliance Kesar variety for trial in this region.

Dr. J. C. Rajput highlighted the role of bioproducts

viz. BGA, SWE (BF), AMF, Bacterial extract, SWE (BP gold), Salicylic acid, humic acid, EFF (Hexanal formulation) and irradiated crab chitosan for increasing fruit set, fruit retention, fruit quality, shelf life, plant protection and yield.

Dr. P. M. Haldankar discussed the various ecofriendly technologies like rejuvenation of old and senile mango plants, ringing, girdling and tip prunnning for improving productivity in Alphonso mango. He also recommended to use pre-harvest bagging to obtain quality spotless fruits.

Dr. Prakash Patil emphasized that importance should be given on collection of germplasm, standardization of pruning technology, HDP, chemical regulation for early flowering, more fruit retention and plant protection.

The sixth technical session was held on Plant Protection which was chaired by Dr. S. S. Magar and co-chaired by Dr. A. P. Suryawanshi. Dr. Vikas Jindal emphasized that barcode is the future line to identify the insect species within a short period and is economical. He stressed thatglobally 2,78,582 species are identified and in India around 7,772 species have been barcoded. Cryptic species can also be barcoded and hence there is a need to have a collaborative effort in future.

The seventh technical session was on Post Harvest Management which was chaired by Dr. Zora Singh and co-chaired by Dr. D. P. Waskar and Dr. Vivek Damale. Dr. Zora Singh mentioned the rapid expansion of mango production, its international trade, short shelf life, high chilling injury susceptibility, post-harvest diseases and on the other hand consumer demand is for the best quality produce is the major challenge in extending the storage of life of mango. By retarding ripening process through down regulation of respiration rate and ethylene production.

Post-harvest application of calcium, nitric oxide fumigation, plant growth regulators, shrink wrapping, edible coatings and irradiation has resulted in limited success in extending storage life of mango. Post-harvest application of calcium, nitric oxide fumigation, plant growth regulators, shrink wrapping, edible coatings and irradiation results in limited success in extending storage life in mangoes. The CA storage usually comprising of reduced levels of oxygen and elevated levels of carbon di oxide down regulates metabolic activities in the fruit leading to reduced rate of respiration and ethylene production and its action consequently extends post-harvest life. Further, optimum gas composition in CA required to extend post-harvest life of mango fruit varieties among cultivars and the success of CA storage is also influenced by various pre-harvest factors such as nutrition, disease management and harvest maturity. The gas proportions of O_2 and CO_2 in CA storage varies with the cultivar for extending the shelf life of mango.

Dr. K. H. Pujari maintained that maturity standards of mango vary with variety. Maturity assessed by specific gravity technique is necessary for judging the maturity of Alphonso mango, whereas, heat unit concept in north Indian mango cultivars is to be taken into account to decide the correct harvesting period. Pest in mangoes can be controlled by hot water treatment (47 ºC for 50 min. controlled fruit fly in Kesar and Alphonso), vapour treatment (48 ºC for 10 min controlled fruit fly and stone weevil) and irradiation (400 Gy radiation dose for control of fruit fly in mango).

Dr. N. J. Thakor stated that India contributes to 40 percent of world mango production and shares 15 percent of world trade. Totapuri (47 %) is widely exported from India followed by Alhonso (43 %) and Kesar (11 %).

The eighth technical session was held on Farm Mechanization and it was chaired by Dr. V. M. Mayande and co-chaired by Dr. Y. P. Khandetod. Dr. V. M. Mayande stressed that mango mechanization should be to develop precision and smart machinery with multidisciplinary approach using electronics and software engineering inputs.

Dr. Y. P Khandetod emphasized that there is a need to overcome critical constraints in farm mechanization and future mechanization should be eco-friendly.

The ninth technical session was on TOT and Production Economics. The Chairman of this session was Dr. K. D. Kokate and co-chairman was Dr. P. A. Sawant. Dr. M. B. Magdum focused upon reducing the cost of cultivation, location specific technologies, high density plantation,

rejuvenation of 20 % area annually, use of growth regulators, intercropping, post- harvest management and value addition to double the farmer's income by 2022.

Dr. S. G. Bhave emphasized on the strong linkages of Research-Extension-Farmer-Marketing. It was indicated that market led extension by use of print and electronic media is required.

Dr. P. A. Sawant reviewed the changing role of agriculture extension since the World War II, he also emphasized about multi-dimensional model of agriculture technology transfer for public sector including impact analysis of environment.

The tenth technical session was special session on issues related to mango and was chaired by Dr. Daruni Nephrom and co-chaired by Dr. K. D. Patil. Dr. M. M. Burondkar made a presentation on the cause and mechanism of spongy tissue in mango and underlined the different breeding approaches for developing spongy tissue free alphonso. There are several internal and external factors that are responsible for the occurrence of spongy tissue in mangoes. Spongy tissue is governed by seed germination at maturity, stage of fruit maturity at harvesting and that B stage (14 anna) is the perfect stage for harvesting to get minimum spongy tissue in alphonso. PBZ can reduce the incidence of spongy tissue, which acts as germination inhibitor. Further avoidance of post-harvest exposure to sunlight, handling, storage, shipment and ripening of fruits at comparatively low temperature, transportation of fruits during night hours, avoiding concentrated detergent solution for washing blemish fruits, use of sulphate of potash rather than Muriate of potash as a source of potassium fertilizer.

Dr. Balkrishnan discussed about the genes $MiFT_1$, $MiFT_2$ and $MiFT_3$ responsible in floral induction and repression in mango. $MiFT_1$ and $MiFT_3$ with PBZ are up-regulating the induction of flowering while the application of GA3 flowering is been down regulated.

Mr. Gandhe narrated different missions, projects and schemes for the upliftment of rural community initiated by Tata Trust.

Dr. K. Usha gave presentation on hormone, biosynthesis and signaling done in relation to mango malformation. In Amrapali variety levels of endogenous hormones were observed in different stages of bud development. *Fusarium mangiferae*, caused malformation upto 20-80 percent in this mango variety.

Mr. Sunil Desai emphasized that products (40 %), timing (20 %), mechanical (19 %) and finetuning (20 %) is required for product use efficiency, spraying performance and spraying patterns of agrochemicals in mango.

Mr. Dhake highlighted the involvement of Jain Irrigation Pvt. Ltd. in plastic, tissue culture, food processing, agri. Value chain etc.

The eleventh technical session was on Export and Commercialization and it was chaired by Dr. Víctor Galán Saúco. Shri. Milind Joshi reported that India has an advantage of having long period availability of mango for export, however, Venezuala, Costa Rica and Mexico are the main competitors in the mango export. Infrastructure facilities like irradiation, vapour heat treatment and hot water treatment are installed by MSAMB for supporting export of mango. The protocol of export is unavailable and variable phyto sanitary protocols of importing countries is a constraint in export of mango.

Dr. Bhaskar Savani stressed that 10 prominent varieties from India should be promoted for the export to North America. Irradiation regimes on mango has created confusion and is main hurdle to export of Indian mangoes to America. 70 percent Americans have not tested Indian mangoes and hence there is need to have a National Mango Board to understand and resolve various issues relating to export of mango.

The poster session was held parallely with each technical session and in total 80 posters were displayed in all the eleven themes at the International Mango Conference.

General Recommendations of the Conference

- Exotic mango varieties should be cultivated for world market trade but Indian varieties are good for high quality niche markets.
- Mango has received less importance in climate change studies being tropical crop.
- Inter-regional groups and collaborations are the need of the hour for collection of species and knowledge sharing.
- Complete crop model for Mango in collaboration with various institutes will be a key in mitigating the climate change.
- New varieties development and its adoption has to be propagated at a fast pace.
- Emphasis on germplasm, wild species and local collections.
- Stone weevil resistance germplasm has identified.
- Molecular secrets of Alphonso mango flavour.
- 27 mango varieties evaluated for DNA fingerprinting and metabolites of the flavour.
- Lactone and Ketone are important volatiles in Alphonso and they vary with the location in Konkan region.
- Unsaturated fatty acids are more in Alphonso than Kent and Pairi.
- Projected various breeding methods in mango.

- Neelam as a regular bearer and M-13-1 as a salt tolerant genotype.
- Half sib or full sib mating design be used for studying combining ability.
- Ca-rich zeolites in mango growing soils are important as it has the right properties required for mango cultivation. These zeolite-rich soils are also important for cultivation of other important agricultural cash crops.
- Integrated farming in Mango orchards particularly with livestock like cattle. Chicken, is recommended for sustainable production of mangoes. However, it has to be practices with caution particularly for the safety of the animals being utilized and their impact on the standing trees.
- A wealth of biodiversity pool exists in the natural forests of India including wild mangoes. Some of these biodiversity pools have become endangered. Opportunities for protection of these germplasm for the future particularly wild mangoes should be explored to avoid the 'Death at Birth'.
- There is a great need to preserve the wild mangoes globally also through efforts of collecting them, planting them in orchards, in botanical gardens and carry out information campaign to keep them conserved in the wild. These wild varieties are a great source of salads, pickles and chutneys apart from being a storehouse of gene pool for future mango verities with unique qualities.
- The research on quality of mangoes and micro-nutrient content holds promise.
- Issue of use of biochemicals being promoted by private sector has to be carefully reviewed before being used. It might have an adverse impact.
- For improving mango productivity adoption of high density planting/UHD planting is a must.
- For improving productivity in short time, rejuvenation should be adopted on mission mode.
- Under tropical and subtropical conditions use of paclobutrazol is a essential for profitable mango cultivation.
- There is need to follow training and pruning from the first year of planting.
- For higher mango productivity irrigation of mango needs to be adopted.
- Ringing, girdling and tip pruning are the eco-friendly practices for improving productivity of Alphonso Mango.
- A separate package of practices for mango is required for different mango growing regions with different mango varieties.
- Bar coding can be used as major tool for taxonomic identification of the insect species.
- The diversity indices and species richness is more in mango orchards than cashew orchards.
- The insecticides Thiomethoxam and Acetamiprid can be used for the management of mango hoppers.
- The infection of mango wilt disease is increasing in India and it will be a major disease which will cause economic losses in future. It can be managed by using different IDM techniques.
- A holistic approach to meet market requirements considering mango production technology, post harvest handling including Controlled Atmosphere (CA) storage and supply chain is considered prerequisite for extending storage life of mango.
- Harvesting at optimum maturity and proper post harvest treatments are required to reduce post harvest losses of mango fruits.
- The utilization of mango seed kernel needs to be exploited as it is a good source of antioxidant and other bioactive compounds which have benefits towards human health.
- Location specific technological approach need to be experimented with data base for upscaling through extension agency.
- In mango growing areas, there is a need to develop value chain in consortium mode for the economic benefit of mango growers.
- There is a need to develop innovative ways to foster the delivery services in public private partnership mode including mobile extension.
- Efforts are required for improving the knowledge and adoption of the eco-friendly inputs and practices among the mango growers.
- The investment in mango production is observed to be profitable proposition. It is, therefore, suggested to make efforts for bringing more cultivable waste land under mango plantation.

- Integrated approaches be followed for effective management of spongy tissue *viz*. proper stage of harvesting and adoption of recommendations on use of harvesting fruit at "B" stage (85 % maturity), avoiding post harvest exposure of fruit to sunlight, handling, storage, shipment and ripening of fruits at comparatively low temperature, transportation of fruits during night hours. Avoiding concentrated detergent solution for washing blemish fruit, Use of Sulphate of Potash rather than Murate of Potash as a source of potassium fertilizer. PBZ at perfect stage with perfect dose, paper bag covering for fruits and vapour heat treatment, use of X-ray for screening the spongy tissue and use of one 1-MCP during export of Alphonso mango fruit to different countries.
- $MiFT_1$ and $MiFT_3$ genes with application of PBZ up regulates the flowering in mango.
- A collaborative effort by Tata Trust and Dr. BSKKV, Dapoli to implement various programme for tribal areas in Thane district be undertaken.
- Fusarium mangiferae causes the bud malformation due to decreasing level of GA3 hormones.
- Four keys *viz*, products (40 %), timing 20 %, mechanical (19 %) and fine tuning (20 %) be followed for increase in product use efficiency, spraying performance and spraying patterns of pesticides.
- **Salient Recommendations**
- Complete crop model for Mango in collaboration with various institutes will be a key in mitigating the climate change.
- To conserve wild mango germplasm to avoid the 'Death at Birth'.
- For improving productivity, short time rejuvenation should be adopted on mission mode.
- A holistic approach to meet market requirements considering mango production technology, post harvest handling including Controlled Atmosphere (CA) storage and supply chain is considered prerequisite for extending storage life of mango.
- Locatition specific technological approach for mango are required to be experimented with database for upscaling through extension agency.