



APPPC Workshop on Systems Approach for Management of Fruit Flies on Mango

Date: 19–23 June, 2023 Venue: Fortune Select Exotica, Vashi, Navi Mumbai, India

Workshop Report



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Directorate of Plant Protection, Quarantine & Storage

FOREWORD

The Asia and Pacific Plant Protection Commission (APPPC) workshop on Systems Approach for Management of Fruit Flies on Mango was convened from 19–23 June 2023 in Mumbai, India, with the participation of 36 delegates from 14 countries. The workshop reviewed the status on systems approach for management of fruit fly in mango and its successful implementation in the member countries of APPPC besides having discussions on various provisions under the relevant International Standards for Phytosanitary Measures (ISPMs). The workshop covered pre-harvest integrated plant health management of mango fruit fly, pre-treatment handling of the fruits, post-harvest treatment facilities and orchard field visits. The aspects of record keeping production and export of pest free mango fruits were also dealt in the workshop.

I would like to thank APPPC for giving responsibility to chair the Standing Committee on Integrated Pest Management (IPM) for the current biennium 2023–2024 and to lead and host the Workshop on Systems Approach for Management of Fruit Flies on Mango in Mumbai, India. I am thankful to Hon'ble Ministers for Agriculture & Farmers Welfare; Shri Manoj Ahuja, Secretary, and Dr Pramod Kumar Meherda, Additional Secretary (Plant Protection), Department of Agriculture & Farmers Welfare, Government of India for guidance and financial support for organizing five days' workshop.

I am also grateful to the Hon'ble Minister of State for Agriculture and Farmers Welfare, Government of India, Sushri Shobha Karandlaje and Shri Ashish Kumar Srivastava, Joint Secretary (Plant Protection), Department of Agriculture & Farmers Welfare, Government of India for their august presence in the opening ceremony of the workshop. It is my privilege to convey special thanks Dr Yubak Dhoj GC, Executive Secretary of APPPC and his team for their presence and assistance throughout the workshop and providing financial support to the international participants.

I would also like to thank all the participating National Plant Protection Organizations (NPPOs) (Bangladesh, India, Indonesia, Lao People's Democratic Republic, Malaysia, Nepal, the Philippines, Samoa, Sri Lanka, Thailand, Viet Nam and Bhutan (observer)), Dr Abraham Verghese, Former Director, ICAR-NBAIR; Dr S. N. Sushil, Director, ICAR-NBAIR; Dr Tarun Bajaj, Director, Agricultural and Processed Food Products Export Development Authority (APEDA); Mr Ekram Hussain, President, Exporters Association; Mr Milind Joshi, Dy. General Manager, Maharashtra State Agricultural Marketing Board (MSAMB); Officers of Krishi Vigyan Kendra, Narayangaon, Maharashtra & mango orchard farmers for their support during the workshop and team of NPPO India who has supported in successfully organizing this workshop.

Dr J.P. Singh
Chairperson, Standing Committee on IPM,
Asia Pacific Plant Protection Commission (APPPC)

Summary report

The Asia and Pacific Plant Protection Commission (APPPC) workshop on Systems Approach for Management of Fruit Flies on Mango was convened from 19–23 June 2023 in Mumbai, India, with the participation of 36 delegates from 14 countries (Annex 1), including three participants via virtual means. The workshop reviewed the status on a systems approach for the management of fruit flies on mango and its successful implementation in the member countries of APPPC besides having discussions on various provisions under the relevant International Standards for Phytosanitary Measures (ISPMs). The workshop covered pre-harvest integrated plant health management of mango pests, pre-treatment handling of the fruits, post-harvest treatment facilities and orchard field visits. The aspects of record keeping from production to export of pest-free mango fruits were also dealt with in the workshop. The participants also shared country status reports and case studies indicating the implementation of the systems approach in management of fruit flies on mango, pre-harvest pest management and post-harvest treatment facilities. Dr S. N. Sushil, Director, ICAR-NBAIR, dealt about systems approach concept and relevant ISPMs. The pre-harvest integrated pest management (IPM) practices to be followed for pest-free production of mango were explained in detail by Dr Abraham Verghese, Former Director, ICAR-NBAIR. The packhouse system for export of fresh fruits and vegetables to different destinations in general and for export of mango in particular was dealt in detail. Further, post-harvest phytosanitary treatments, treatment facilities and record keeping in field, packhouses and treatment facilities were also covered during the workshop. The participants were taken on a field trip to mango orchard at Narayangaon, Pune, India, to demonstrate successful adoption of Good Agricultural Practices (GAP) for the management of fruit flies in India. The visits to pack house and treatment facilities displayed the efforts of India in management of fruit flies by development of improved treatment procedures. The workshop concluded with the interactions with stakeholders for the promotion of export in a regionally harmonized manner, and the summary of the workshop was presented by Dr J. P. Singh, Plant Protection Adviser, DPPQS & Chairperson, Standing Committee on IPM, APPPC.

The participants had the following feedback and general suggestions for follow up actions:

All the participants felt topics covered in the workshop were relevant and well-designed covering all the activities involved in a systems approach for the management of fruit flies on mangoes. Speakers delivered their lectures effectively, and visits to mango orchard and treatment facilities were very informative. Participants suggested organizing a similar workshop at least once a year.

1.0 Background

The 32nd session of APPPC was held in Bangkok in November 2022, wherein 75 participants from Asia and the Pacific countries, International Plant Protection Convention (IPPC) Secretariat, Rotterdam Convention Secretariat, APPPC Secretariat, Asian Development Bank (ADB), German Society for International Cooperation (GIZ) and World Bank were participated. The session unanimously elected India as chair of the Standing Committee on IPM for the current biennium 2022–2024 and further decided that India would lead and host the workshop on a systems approach for the management of fruit flies on mango.

Accordingly, the APPPC workshop on a systems approach for the management of fruit flies on mango was held during 19–23 June 2023 in Mumbai with the objective of enhancing the capacity building in implementing a systems approach for managing fruit flies on mango. The workshop included discussions on systems approach for the management of fruit flies on mango, relevant ISPMs, pre-harvest IPM for mango pests, post-harvest phytosanitary treatments, and NPPO case studies, and treatment facilities and orchard visits.

Day I

2.0 Opening ceremony

The workshop was set afloat with lighting of the lamp by the dignitaries present on dais, a devote full act in the Indian tradition which was followed by welcome to all the delegates.



2.1 Welcome address by Dr J. P. Singh, Plant Protection Adviser, DPPQS & Chairperson, Standing Committee on IPM, APPPC

Dr J. P. Singh, Plant Protection Adviser, DPPQS & Chairperson, APPPC IPM Standing Committee in his welcome address expressed his delightedness to host the APPPC workshop on systems approach for management of fruit flies on mango. He has expressed his gratitude to the Hon'ble Union Minister of State for Agriculture & Farmers Welfare, Sushri Shobha Karandlaje for sparing her valuable time for inauguration of the workshop. He thanked the Joint Secretary (Plant Protection) for his continuous guidance and support to organize the workshop and welcomed all the participants. He further, shared the journey of the systems approach implementation in India through farmers registration, adoption of GAP by the farmers, pest monitoring, pre-harvest IPM, processing of harvested fruits at pack house, post-harvest pest proof packaging, phytosanitary treatments for pest free global trade.

2.2 Participant introductions

All the participants of the workshop who attended physically and virtually introduced themselves.

2.3 Address by Dr Yubak Dhoj GC, Executive Secretary, APPPC Secretariat

Dr Yubak Dhoj, Executive Secretary, APPPC secretariat, welcomed all the participants and thanked to the Government of India. He further shared his work experience while serving as an NPPO for Nepal government and currently working in FAO Regional Office for Asia and the Pacific. He thanked all the delegates for attending the workshop and lauded the efforts of Indian NPPO team for organizing the workshop. He also greeted India and Dr J.P.Singh for the Chairmanship of IPM Standing Committee for the current biennium 2023–2024. He praised India for being the largest producers and exporter of mango. He highlighted the importance of management of fruit flies in promoting pest free export of mango and role of a systems approach in fruit fly management. He further said that this capacity development programme would provide the practical measure for managing fruit flies during transboundary movement of agriproduct at international level.

2.4 Address by Dr Tarun Bajaj, Director APEDA

Dr Tarun Bajaj, Director APEDA in his address shared the role of APEDA in mango export facilitation especially on farm registration through mangonet, financial support for pack house and treatment facility to the farmers. He thanked DPPQS and APPPC for organizing such useful workshop.

2.5 Address by Dr S.N. Sushil, Director, ICAR-NBAIR, Bangalore

Dr S. N. Sushil his address highlighted on the importance of systems approach and concern for pest introduction and spread through the export of agriculture commodities. He recalled the efforts taken by the DPPQS, MoA&FW in revoke of ban on export of fresh fruits and vegetables through implementation of pack houses during 2014. He further briefed the successful

implementation of a systems approach in India in line with ISPM and specially recalled the internationally recognized systems approach of Grapenet.

2.6 Address by Sh. Ashish Kumar Shrivastava, Joint Secretary (PP), Ministry of Agriculture & Farmers Welfare (MoA&FW), India

Shri Ashish Kumar Shrivastava, Joint Secretary (PP) briefed on IPPC, APPPC and their role in pest risk mitigation for safe transboundary movement of commodity. He shared his experiences on implementation of systems approaches for mango in India. In this aspect, he further emphasized on the development of systems approaches for all the important agricultural commodities by farm and orchard registration with State Agriculture Department, application of IPM at farmer level, regular monitoring of pest and timely management of pest so that even smaller farmer and marginal farmer can also produce export quality products and take complete benefit of the concept.

2.7 Address by the Chief Guest Hon'ble Minister of State for Agriculture & Farmers Welfare, GoI, Sushri Shobha Karandlaje

In the inaugural speech, Hon'ble Minister, Sushri Shobha Karandlaje has emphasized on the production of pest free as well as residue free fruits and vegetables for getting market access to larger destinations so that farmer's income can be increased. She wished benefit of the workshop would be spread the India's motto of Vasudhaiva Kutumbakam. She further linked the agricultural export/trade, measures to be taken and need to strengthen the working together for export promotion.

Opening Ceremony of the workshop concluded with the Vote of Thanks by Dr S. Gnanasambandan, Joint Director (Plant Quarantine), DPPQS, MoA&FW

3.0 Agenda

3.1 Agenda 1: Summary of workshop objectives and agenda

Dr J. P. Singh, Plant Protection Adviser, DPPQS & Chairman, IPM Standing Committee, presented objectives and agenda to be covered in the five days of the workshop. **Annex 2** (Agenda & timetable) and **Annex 3** (PPT on objectives & agenda)

3.2 Agenda 2: Introduction to system approach and relevant ISPMs

Dr S.N. Sushil, Director, ICAR-NBAIR, Bangalore, delivered lecture on a systems approach concept and related ISPMs He explained basic requirement of a systems approach given in ISPM 14 (*The use of integrated measures in a systems approach for pest risk management*), independent and dependent measures, critical control points, responsibilities of importing and exporting countries and other important aspects. Explained measures suggested in ISPM 14 during pre-planting, pre-harvest, harvest, post-harvest treatment and handling, and transportation and distribution **Annex 4** (PPT on system approach concept and related ISPMs)

3.3 Agenda 3: Successful implementation of systems approach for management of fruit fly in mango

Dr D.K. Nagaraju, Deputy Director, DPPQS, made presentation on the successful implementation of a systems approach for management of fruit fly in mango. He elaborated National Standards and Standard Operating Procedure developed by DPPQS for implementing systems approaches and also role of the NPPO as well as various stakeholders involved in ensuring adoption of systems approach. **Annex 5** (PPT on successful implementation of systems approach for management of fruit flies in mango – An Indian perspective).

3.4 Agenda 4: NPPO case studies – Implementation of systems approaches for management of fruit fly

The participating countries presented their country information and their respective case studies on the successful implementation of systems approaches for management of fruit flies in mango.

Bangladesh – Mr Shahjahan Seraj presented on the plant quarantine network of Bangladesh. He explained about various measures taken to ensure implementation of systems approach in mango. Following field sanitation, cultural management, fruit bagging, pheromone traps are some of the technologies used in the country. Bangladesh has also developed formats for form records on GAP and pest management. He also mentioned about mango fair, special mango train and trainings conducted to boost the export.

Indonesia – Mr Rizky Gunawan Sugeng Purnama shared the countries experience in implementation of a systems approach. Though a systems approach was not completely implemented for exportation of Indonesian fresh mango, it was well-established for other fresh fruit (mangosteen, salacca, dragon fruit). He briefly explained area wide management in controlling fruit fly involving various stakeholders i.e. trap monitoring, use of male annihilation technique (MAT) using methyl eugenol blocks, use of toxic proteins (protein bait/PB), implementation of male sterilization technique (MST) using sterile males and environmental sanitation (crop hygiene).

Lao People's Democratic Republic – Mr Sopha Kham explained about the pests of mango in his country. Fruit wrapping is technique used mainly. He also mentioned the challenges faced in exploring export opportunities.

Malaysia – Mrs Azian Binti Harun explained the network of plant quarantine department in their country. Malaysia is implementing systems approaches – operational work plan for the exportation of Malaysian Jackfruit. She mentioned about various record keeping aspects to ensure pest monitoring. She also said about MyGAP form implemented in Malaysia.

Nepal – Mr Kul Dip Ghimire presented that Nepal needs to strengthen a system approach for mango. However, they have fruit fly management strategies for *Bactrocera minax* on citrus.

Philippines – Ms Glaiza Marie L. Duron presented on the fruit fly species encountered on mango in the Philippines. Fruit bagging, methyl eugenol traps, sanitation and other IPM practices are practiced. She mentioned about importance of quality planting materials and certified nurseries.

Samoa – Mrs Monika Afamasaga gave an oral introduction.

Sri Lanka – Mrs Weliweriya Liyanage Samantha Priyangika explained step by step measures followed to ensure systems approaches to have certified mango grower for export. Sanitation around the field, good water supply and irrigation, record keeping, fertilizer and pesticide application, date of harvesting, details of the place of the parent materials selected, place for discard the crop debris, use of sticky traps to control fruit fly, white fly, leaf minor and other insects, usage of pheromone traps, weed management etc. are some of the management options followed in Sri Lanka. She also mentioned about different species of fruit flies in their country.

Thailand – Ms Sasiprapha Marach explained the comprehensive management options for management of fruit flies in mango in Thailand. The country was following a system approach for management of fruit flies on mango by combining different measures to address pest risk due to fruit flies

Viet Nam – Mr Ngo Quoc Tuan explained the structure of NPPO in their country. He mentioned that as their country lack experience in systems approach implementation, this workshop would help them learning various things.

Day II

3.5 Agenda 5: Pre-harvest integrated pest management for mango fruit flies

Dr Abraham Varghese, Former Director, ICAR-NBAIR, highlighted the importance of GAP in production of pest free mango fruits. He elaborated pre-harvest IPM for mango fruit fly such as push and pull strategies, bait splash, oviposition deterrent with herbal liquid soap and Azadirachtin. Participants has got in depth information about the pheromone traps and its placement, role of cultural practices like water management, quality of water, destruction of fallen fruits and removal of weeds for management of fruit flies, etc. He further suggested to sensitize farmers on large-scale adoption of integrated approach for area wide management of fruit flies (**Annex 6** – PPT on pre-harvest integrated pest management for mango fruit fly)

3.6 Agenda 6: Farmers training, record keeping and institutional support for pest management at farm level

Dr Sunita Pandey, Deputy Director, DPPQS, in her presentation, discussed about institutions involved in capacity building of farmers through training programmes. She elaborated about the support given by DPPQS, State Agriculture Departments and ICAR institutions to famers for pest management at farm level. She further insisted on the importance of record keeping of various aspects like pest reported, fruit flies caught in the traps, details of pesticides used in the

pest management and harvesting information (**Annex 7** – PPT on farmers training, record keeping & institutional support for pest management at farm level).

3.7 Agenda 7: Harvest, pre-treatment processing for mango – de-sapping and other pack house activities

Dr Vasudha Gautam, Deputy Director, DPPQS, explained about the precautions taken during harvesting of the fruits. She elaborated the maturity indices of the mango fruits, harvesting, and handling of fruits post-harvest and pretreatment processing before subjecting to any post-harvest treatments. She further briefed the framework of packhouse and other activities conducted before treatments (**Annex 8** – PPT on harvest, pre-treatment processing for mango – de-sapping and other pack house activities).

3.8 Agenda 8: NPPO case studies – Pre-harvest integrated pest management for mango pests, record keeping and institutional support

The participating countries presented their country information and their respective case studies on pre-harvest IPM for mango pests, record keeping and institutional support.

- Given under agenda 4.

3.9 Agenda 9: Post-harvest treatments – Hot water immersion treatment (HWIT) for mango fruit fly

Mr Gyaneshwer Banchhor, Deputy Director, DPPQS, in his presentation explained about the hot water immersion treatment (HWIT) facilities present in India and detailed operation procedures followed in the treatment. He further highlighted the importance of weight of fruits for deciding the exposure time of the treatment and role of sensors to ensure the correctness of treatment (**Annex 9** - PPT on post-harvest treatments – hot water immersion treatment for mango fruit fly).

3.10 Agenda 10: Post-harvest treatments – Vapour heat treatment (VHT) for mango fruit fly

Dr Brajesh Mishra, Deputy Director, DPPQS, elaborated on the different temperature requirements for export to different countries and explained in detail the operation procedure, role of size of fruits and placement of sensors in ensuring the correctness of the treatment (**Annex 10** – PPT on post-harvest treatments – vapour heat treatment for mango fruit fly).

3.11 Agenda 11: Post-harvest treatments – Irradiation treatment for mango fruit fly

Dr Gnanasambandan, Joint Director, DPPQS, in his presentation, elaborated the procedure of irradiation treatment followed for mango fruits. He also explained the pretreatment processing and packaging of fruits before subjecting to treatment. Further, he presented about the paperwork and precaution to be taken post-treatment (**Annex 11** - PPT on post-harvest treatments – irradiation treatment for mango fruit fly).

3.12 Agenda 11: Record keeping and institutional support at pack house and treatment facilities

Dr Neelam Choudhary, Deputy Director, DPPQS, highlighted the importance of maintaining hygiene in the pack house in reduction of damage to the fruits. She explained the support given by DPPQS, State Agriculture Departments, APEDA and MSAMB for promoting export of mango. She further presented about the importance of record keeping in the pack house in traceability (**Annex 12** – PPT on record keeping & institutional support at pack house & treatment facilities).

3.13 Agenda 13: NPPO case studies – Post-harvest treatments for mango pests including record keeping and institutional support

The participating countries presented their country information and their respective case studies on post-harvest treatments for mango pests including record keeping and institutional support.

Bangladesh – Mr Shahjahan Seraj presented that country have 17 HWIT facilities. The Exportable Mango Production Project is on track to give proper support to the farmer level, like mango production management training to the stakeholders and the supply of mango fruit bags, crates, poly sheets, and record-keeping materials to the farmers.

Indonesia – Mr Rizky Gunawan Sugeng Purnama shared HWIT, VHT and irradiation is under trial stage.

Lao People's Democratic Republic – Mr Sopha Kham informed no such facilities available now.

Malaysia – Yet to develop treatment facilities.

Nepal – Yet to develop treatment facilities. One such facility is under development for citrus fruit fly.

Philippines – Has VHT facilities for treating mangoes at 46 °C for 10 minutes for Japan.

Samoa – Yet to develop treatment facilities

Sri Lanka – Mrs_Weliweriya Liyanage Samantha Priyangika explained VHT, irradiation and liquid phosphine facilities were in trial stage.

Thailand – Ms Sasiprapha Marach explained they have VHT facility and irradiation facilities.

Viet Nam – Mr Ngo Quoc Tuan explained Viet Nam has seven VHT and three irradiation facilities.

Day III

3.14 Agenda 14: Field trip:

The participants visited mango orchards at Village-Narayangaon in Pune district of Maharashtra. The mango orchard belongs to Mr Vitthal Shinde and Kesar variety being cultivated. The farmer followed high density planting using Israel technology of 5×5 m spacing. The farmer is well aware of the GAP in general and IPM in particular.

The participants were also taken to another field of Krishi Vigyan Kendra (KVK), Narayangaon, Pune. KVKs have been functioning as Knowledge and Resource Centre of agricultural technology supporting initiatives of public, private and voluntary sector for improving the agricultural economy of the district and are linking the NARS with extension system and farmers. The KVK scheme is 100 percent financed by the Government of India and the KVKs are sanctioned to Agricultural Universities, ICAR institutes, related Government Departments and Non-Government Organizations (NGOs) working in Agriculture. The participants were made aware of successful adoption of GAP and IPM for the management of fruit flies in India. Scientists of KVK briefed about the guidance given to the farmers during implementation of GAP. They further highlighted about the encouragement given to the farmers for using GAP and IPM to promote the export of pest free and residue free mangoes fruits to different destinations.

Day IV

3.15 Agenda 15 and 16: Visit to pack house, hot water immersion treatment, vapour heat treatment and irradiation facilities

The exposure visits for having hands on experience to different post-harvest treatment facilities viz. HWIT, VHT, and irradiation treatment were arranged during the fourth day of the workshop. The participants had a clear practical knowledge of the treatment plants and the procedures being followed. The phytosanitary inspectors of NPPO-India at the pack house demonstrated the inspection procedures followed for phytosanitary certification. The officers at the pack house briefed about different activities, such as inspection consignment on arrival into the pack house, sorting, grading, surface sterilization, cleaning, post-harvest treatments, drying, packaging, loading of the consignments to the safe transport container, etc.

3.16 Agenda 17: Interaction with stake holders; APEDA, exporter, treatment providers

An interaction of the participants with different stakeholders viz., representatives from State Government, Maharashtra, APEDA, exporters associations, pack house facility owner, treatment providers and Maharashtra State Mango Growers Association and shared their experiences on their respective roles in the entire process of mango cultivation and export.

3.17 Agenda 18: Report preparation, relevant contacts, and next steps

Participants gave their feedback on the workshop.

4.0 Agenda 19: Summary and way forward

Dr J. P. Singh, Plant Protection Adviser, DPPQS & Chairman, IPM Standing Committee, summarized the five days' workshop.

4.1 Recommendations of the workshop and way forward:

- comprehensive guidelines on a system approach for the management of fruit flies on mango in APPPC member countries need to be developed;
- development and evaluation of more cost effective and efficient post-harvest treatments;
- making availability of cost-effective pre-harvest IPM technologies like methyl eugenol traps, bags, food baits, etc.;
- development of short videos for the benefit of farmers and stakeholders in local languages on the GAP, IPM and post-harvest treatments;
- short videos on the post-harvest handling, pack house activities, post treatment handling, transportations, etc. for the benefit of stakeholders;
- extensive list of fruit fly species within the regions and their risk analysis to identify the pests of concern within and outside the region;
- implementation of systems approaches for the management of fruit flies in mango in the member countries;
- exploration of systems approaches in other fresh fruits/products; and
- support and coordination for the regional activities related to the above topics by APPPC.

5.0 Workshop closing

5.1. Closing Address by Dr Yubak Dhoj GC, Executive Secretary, APPPC Secretariat

Dr Yubak Dhoj, in his closing remarks, thanked all participants and congratulated them for making the APPPC workshop on systems approach for the management of fruit flies on mango such a successful one. He expressed heartfelt thankfulness to Dr J. P. Singh and his team for organizing this excellent workshop. Appreciated all the hard work, great efforts, and generous hospitality the team put into organizing this workshop. He opined that all participants learned a lot about a concept and foundation of a systems approach as well as the implementation of fruit fly management measures on mango from the practical aspects through comprehensive presentations from experienced experts of the DPPQS and ICAR India and on-site observation of orchards and treatment facilities. He also opined that, in addition to the experiences and practices in India, we share and exchange experiences and challenges in fruit fly management measures in participating countries, which could be informative for each country, especially for the countries that want to establish the system to explore the international market.

Further, he mentioned that to establish a solid system to control fruit flies it would be important:

- to identify critical control points in a system and decide appropriate management options;
- to evaluate the efficacy of each measure as well as a whole system to meet domestic or international requirements;
- to develop standard operating procedures (SoP) clearly defining critical control points and respective actions that should be taken;
- to train technical officials as well as other human resources related to pre-harvest practices, post-harvest treatment; and
- to raise awareness of stakeholders.

In addition to the above, harmonization and cooperation at the national, regional, and international levels would be essential to achieve respective goals. Each country should analyse and consider existing current gaps between national practices and international requirements to achieve their goal.

He hoped that all participants would take over the knowledge and experience learned throughout the workshop, which would definitely have a significant impact on the capacity development of NPPOs to manage fruit flies appropriately, and it could facilitate agricultural trade while preventing the movement and spread of plant pests.

Workshop ended with vote of thanks by Dr J.P. Singh, Plant Protection Adviser, DPPQS & Chairman, IPM Standing Committee, to the NPPO of participating countries, APPPC secretariat, Dr Yubak and his team. He conveyed special thanks to the Hon'ble Union Minister of State for Agriculture and farmers Welfare Sushri Shobha Karandlaje for inaugurating the workshop, Sh. Manoj Ahuja, Secretary DA&FW, Dr Pramod Kumar Meherda, Additional Secretary (PP) DA&FW and Sh. Ashish Kumar Srivastava, Joint Secretary (PP) DA&FW for guidance and providing financial support for the workshop. Also conveyed his thanks to APEDA, Exporters Association, MSAMB, KVK, and mango orchard farmers to their active support during the workshop and team of NPPO India who has supported in successfully organizing this workshop.

Actionable point for NPPOs:

- NPPOs to formulate guidelines/SoP for implementation of systems approaches for management of mango fruit flies;
- encourage state/local authorities for adoption of systems approaches for the management of fruit flies in mango over the larger area;
- encourage all the stakeholders in the country i.e. NPPO, state and local government authorities, export promotion agencies, treatment providers, pack house facilities, farmers, exporters and transporters to work in synergy for mass adoption of a systems approach;
- making availability of cost-effective pre-harvest IPM technologies like methyl eugenol traps, fruits bags, food baits, etc.;

- preparation of short videos on GAP in mango orchard, post-harvest handling, pack house activities, treatments, post treatment handling, transportations, etc. for the benefit of stakeholders; and
- listing of fruit fly species present in the country showing their distribution and host range.

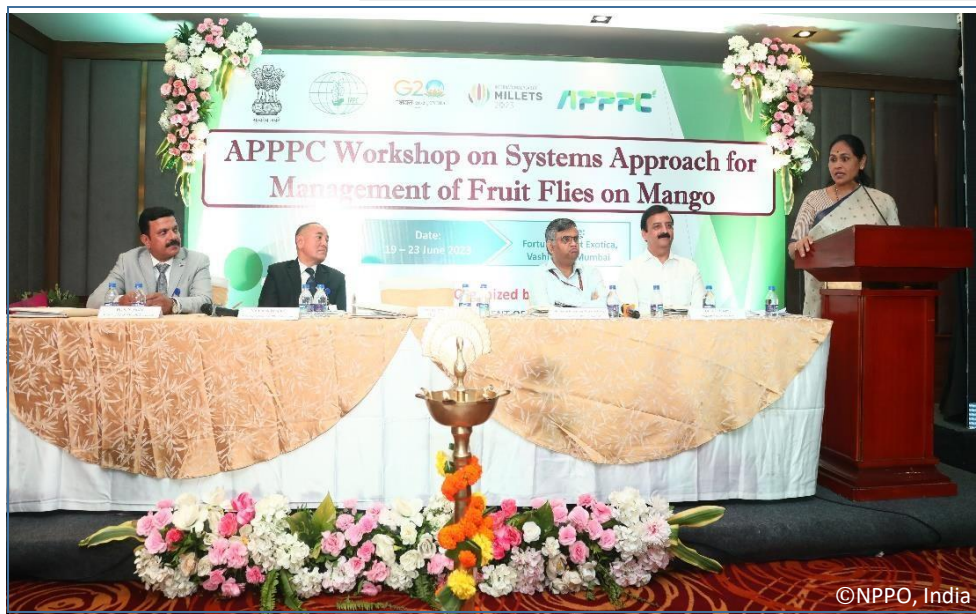
Actionable point for APPPC Secretariat:

- follow up with the NPPOs for above action points and technical support.

Glimpses of the Workshop



Lightening of the lamp by dignitaries and delegates



Address by the Chief Guest Hon'ble Minister of State for Agriculture & Farmers Welfare, GoI, Sushri Shobha Karandlaje



Address by Sh. Ashish Kumar Shrivastava, Joint Secretary (PP)



Address by Dr J. P. Singh, PPA and Chairperson, IPM Standing Committee, APPPC



Address by Dr Yubac Dhoj GC, Executive Secretary, APPPC Secretariat



Address by Dr Tarun Bajaj, Director APEDA



Address by Dr S.N. Sushil, Director, ICAR-NBAIR, Bangalore



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Visit to fields and KVK at Narayangaon, Pune, Maharashtra



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Visit to Hot water, Vapor heat and Irradiation treatment facilities



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Stakeholder's Interaction

List of Participants

APPPC Workshop on Systems Approach for the Management of Fruit Flies on Mango, 19–23 June 2023 in India

Australia

Ms Claire Hollis (Participated Virtually)

Mr Jason Ng (Participated Virtually)

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**APPPC Workshop on Systems Approach for the management of fruit flies on mango
19th to 23rd June, 2023 – Mumbai, India
Provisional Agenda and timetable**

Day One: Monday 19th June – System approach concept

Morning session

08.30-09.30	Registration Hotel Fortune Select Exotica, Vashi, Navi Mumbai	
09.30-11.00	Opening ceremony	<ul style="list-style-type: none"> - Lighting of lamp - Welcome by Bouquet to the dignitaries - Welcome address by Dr J. P. Singh, Plant Protection Adviser, DPPQS & Chairman, Standing Committee, IPM, APPPC - Participant introductions - Address by Dr Tarun Bajaj, Director APEDA - Address by Dr Yubak Dhoj GC, Executive Secretary, APPPC Secretariat - Address by Dr S.N. Sushil, Director, ICAR-NBAIR, Bangalore - Address by Sh. Ashish Kumar Shrivastava, Joint Secretary (PP), Ministry of Agriculture & Farmers Welfare (MoA&FW), India - Address by the Chief Guest Hon'ble Minister of State for Agriculture & Farmers Welfare, GoI, Sushri. Shobha Karandlaje <p style="text-align: center;">Vote of Thanks by Dr S. Gnasambandan, Joint Director (Plant Quarantine), DPPQS, MoA&FW</p> <ul style="list-style-type: none"> - Introduction of workshop facilitators and presenters
11.00-11.30		Tea & Official group photo

11.30-12.00	Opening of workshop Agenda 1	Summary of workshop objectives and agenda - Dr J. P. Singh, PPA, DPPQS & Chairman, Standing Committee, IPM, APPPC
12.00-12.45	Agenda 2	- Introduction to System Approach & relevant ISPMs- Expert presenter -Dr S.N. Sushil, Director, ICAR-NBAIR, Bangalore
12.45-13.00		- Question Answer Session
13.00-14.00	Lunch	

Afternoon session

Session	Agenda item	Speaker
14.00-14.45	Agenda 3	Successful implementation of Systems approach for management of Fruit fly in Mango: An Indian perspective - DrD.K. Nagaraju, Deputy Director (Entomology), DPPQS, MoA&FW
14.45-15.00		Question Answer Session
15.00-15.15	Tea	
15.15-17.00	Agenda 4	NPPO case studies – APPPC countries will be invited to share experiences with implementation of systems approach for management of fruit fly (Five minutes to each participating countries)
19:30	Official welcome dinner hosted by MoA&FW	

Day Two: Tuesday 20th June, 2023 – Pre & Post-harvest Management of fruit flies

Morning session

09.30-10.15	Agenda 5	Pre-harvest Integrated Pest Management for mango fruit fly- Dr Abraham Varghese, Former Director, ICAR-NBAIR
10.15-10.30		Question Answer Session
10.30-10.45	Tea	
10.45-11.05	Agenda 6	Farmers training, Record keeping & institutional support for pest management at farm level- Dr Sunita Pandey, Deputy Director (Entomology), DPPQS, MoA&FW

11.05-11.15		Question Answer Session
11.15-11.30	Agenda 7	Harvest, Pre-treatment processing for mango- de-sapping and other pack house activities- Dr Vasudha Gautam, Deputy Director (Entomology), DPPQS, MoA&FW
11.30-11.40		Question Answer Session
11.40-13.00	Agenda 8	NPPO case studies – APPPC countries will be invited to share experiences with Pre-harvest Integrated Pest Management for mango pests, record keeping & institutional support (Five minutes to each participating countries)
13.00-14.00	Lunch	
14.00-14.30	Agenda 9	Post-harvest treatments- Hot Water Immersion Treatment for mango fruit fly- Sh. Gyaneshwer Banchhor, Deputy Director (Entomology), DPPQS, MoA&FW
14.30-14.35		Question Answer Session
14.35-15.05	Agenda 10	Post-harvest treatments- Vapour Heat Treatment for mango fruit fly- Dr Brajesh Mishra, Deputy Director (Entomology), DPPQS, MoA&FW
15.05-15.10		Question Answer Session
15.10-15.25	Tea	
15.25-16.00	Agenda 11	Post-harvest treatments- Irradiation for mango pests- Dr S. Gnasambandan, Joint Director (Plant Quarantine), DPPQS, MoA&FW
16.00-16.05		Question Answer Session
16.05-16.20	Agenda 12	Record keeping & institutional support at packhouse & treatment facilities- Dr Neelum Chaudhary, Deputy Director (Entomology), DPPQS, MoA&FW
16.20-17.30	Agenda 13	NPPO case studies – Post-harvest treatments for mango pests including record keeping & institutional support (Five minutes to each participating countries)

Day Three: Wednesday 21st June – Field Trip


09.00-17.30	Agenda 14	Field trip (Mango Orchards)
(Lunch will be arranged during field trip)		

Day Four: Thursday 22nd June – Post-harvest treatment facilities

09.00-13.00	Agenda 15	Visit to pack House facility, Hot Water Treatment facility
13.00-14.00	Lunch	
14.00-17.30	Agenda 16	Visit to Vapour Heat Treatment & Irradiation facility

Day Five: Friday 23rd June – Summary and close


Session	Agenda item	Speaker
09.00-10.30	Agenda 17	Interaction with stake holders 1. Sh. U. K. Vats, General Manager (FFV including Fruits and Vegetable Seeds, Floriculture and Market Access issues of the FFV. 2. Sh. Govind Hande, Adviser, Maharashtra Government 3. Sh. Milind Joshi, DGM, MSAMB, Maharashtra 4. Sh. Ekram Hussain Shaikh, Vegetables & Fruits Exporters Association 5. Sh. Chandrakant Mokal, President, Maharashtra State Mango Growers Association
10.30-10.45	Tea	
10.45-11.30	Agenda 18	Report preparation, relevant contacts, and next steps
11.30-12.30	Agenda 19	Presentation on Summary of the Workshop and next actionable point – Dr J. P. Singh, PPA, DPPQS & Chairman, Standing Committee, IPM, APPPC
12.30-13.00	Workshop Closing	- Closing Address by Dr Yubak Dhoj GC, Executive Secretary, APPPC Secretariat
13.00-14.00	Lunch	



APPPC Workshop on Systems Approach for the management of fruit flies on mango


Objectives & Agenda

Dr. J. P. Singh
Plant Protection Adviser
MoA&FW, Government of India




Broader Objectives

- developing NPPOs capacity to implement plant health standards
- facilitating pest free agricultural trade
- strengthening biosecurity capabilities



Objectives of the Workshop

- to promote the consistent interpretation and implementation of System Approach for the management of fruit fly
- harmonisation of implementation by APPPC member countries
- standardize pre-harvest IPM with backward linkage
- routing of harvested fruits through approved integrated pack-houses system having facilities for Hot Water Immersion Treatment or Vapour Heat Treatment or Irradiation



Day One Monday 19th June – System approach concept

Agenda 2

12.00-12.45 Introduction to System Approach & relevant ISPMs- Dr. S.N. Sushil, Director, ICAR-NBAIR, MoA&FW

12.45-13.00 Question Answer Session

Agenda 3

14.00-14.45 Successful implementation of Systems approach for management of Fruit fly in Mango: An Indian perspective – Dr. D. K. Nagaraju, Deputy Director, DPPQS, MoA&FW

14.45-15.00 Question Answer Session

Agenda 4

15.15-17.00 NPPO case studies – APPPC countries will be invited to share experiences with implementation of systems approach for management of fruit fly (Five minutes to each participating countries)



Day Two Tuesday 20th June – Pre & Post-harvest Management of fruit flies

Agenda 5

09.30-10.15 Pre-harvest Integrated Pest Management for mango fruit fly - Dr. Abraham Verghese, Former Director, ICAR-NBAIR, MoA&FW

10.15-10.30 Question Answer Session

Agenda 6

10.45-11.05 Farmers training, Record keeping & institutional support for pest management at farm level – Dr. Sunita Pandey, Deputy Director, DPPQS, MoA&FW

11.05-11.15 Question Answer Session

Agenda 7

11.15-11.30 Harvest, Pre-treatment processing for mango – de-sapping and other pack house activities – Dr. Vasudha Gautam, Deputy Director, DPPQS, MoA&FW

11.30-11.40 Question Answer Session



Agenda 8

11.40-13.00 NPPO case studies – APPPC countries will be invited to share experiences with Pre-harvest Integrated Pest Management for mango pests, record keeping & institutional support (Five minutes to each participating countries)

Agenda 9

14.00-14.30 Post-harvest treatments for mango pests – Hot water Immersion Treatment for mango fruit fly – Gyaneshwer Banchhor, Deputy Director, DPPQS, MoA&FW

14.30-14.35 Question Answer Session

Agenda 10

14.35-15.05 Post-harvest treatments for mango pests – Vapour Heat Treatment for mango fruit fly – Dr. Brajesh Mishra, Deputy Director, DPPQS, MoA&FW

15.05-15.10 Question Answer Session




Agenda 11	
15.25-16.00	Post-harvest treatments for mango pests – Irradiation Treatment for mango fruit fly – Dr. S. Gnanasambandan, Joint Director, DPPQS, MoA&FW
16.00-16.05	Question Answer Session
Agenda 12	
16.05-16.20	Record Keeping & Institutional Support at pack house & treatment facilities – Dr. Neelam Chaudhary, Deputy Director, DPPQS, MoA&FW
Agenda 13	
16.20-17.30	NPPO case studies – Post-harvest treatments for mango pests including record keeping & institutional support (Five minutes to each participating countries)



Day Three Wednesday 21st June – Field Trip	
Agenda 14	
09.00-17.30	Field trip (Mango Orchards)
Day Four Thursday 22nd June - Post – harvest treatment facilities	
Agenda 15 & 16	
09.00-13.00	Visit to pack House facility, Hot Water Treatment facility
14.00-17.30	Visit to Vapour Heat Treatment & Irradiation facility



Day Five Friday 23rd June – Summary and Close	
Agenda 17	
09.00-10.30	Interaction with stake holders; APEDA (Export Promotion Agency), Exporter, Treatment providers
Agenda 18	
10.45-11.30	Report preparation, relevant contacts, and next steps
Agenda 19	
11.30-12.30	Presentation on Summary of the Workshop and next actionable point – Dr. J.P. Singh, Plant Protection Adviser, DPPQS, MoA&FW
Workshop Closing	
12.30-13.00	<input type="checkbox"/> Closing address by Sh. Ashish Kumar Shrivastava, Joint Secretary (PP), DA&FW, MoA&FW <input type="checkbox"/> Closing Address by Dr. Yubak Dhoj GC, Executive Secretary, APPPC Secretariat



Thank you for your kind attention

Source: Singh, J.P. 2023. Objectives & Agenda. Presentation at the APPPC workshop on systems approach for management of fruit flies on mango, 19–23 June 2023. Mumbai.

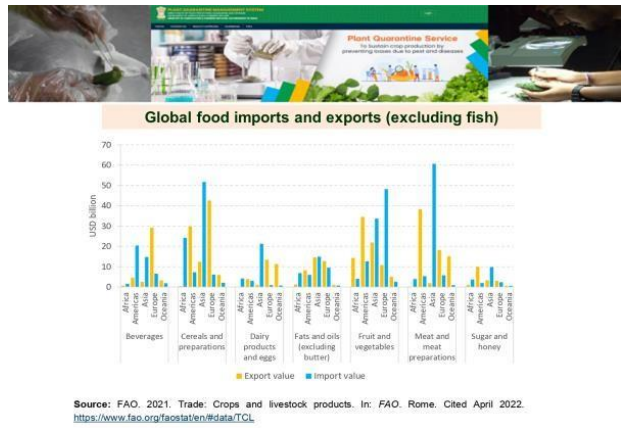
Plant Quarantine Service
To sustain crop production by preventing losses due to pest and diseases

APPPC Workshop on Systems Approach for the management of fruit flies on mango
June 19-23, 2023, Mumbai, India

Introduction to Systems Approach & Relevant ISPMs

Dr. S. N. Sushil
Director
ICAR- National Bureau of Agricultural Insect Resources
Bengaluru-560 024, India
E-mail: director.nbair@icar.gov.in; satya.sushil@icar.gov.in

June 19, 2023



Plant Quarantine Service
To sustain crop production by preventing losses due to pest and diseases

- ❑ In the Asia-Pacific region, transboundary pests and pathogens (TPPs) cause respective losses of **US \$57.6 and US \$43.8 billion/year** in various food crops (Nwilene et al., 2008; Savary et al., 2019, Yubak, 2022).
- ❑ Out of various options of pest risk management, Systems Approach option integrates different measures for pest risk management, at least two of which act independently, in order to meet a predetermined level of protection with its cumulative effect.
- ❑ The current impetus is to increase understanding of Systems Approach and encourage its proper use more widely within the IPPC Community, helping countries prevent the introduction of invasive species and protecting crops and biodiversity, therefore ensuring safe trade of plants and plant products.

ISPMs related to use of Systems Approach in Pest Risk Management

- ISPM 1: Phytosanitary principles for the protection of plants and the application of phytosanitary measures in international trade
- ISPM 5: Glossary of Phytosanitary terms
- ISPM 14: The use of integrated measures in a systems approach for pest risk management
- ISPM 22: Requirements for the establishment of areas of low pest prevalence
- ISPM 24: Guidelines for the determination and recognition of equivalence of phytosanitary measures
- ISPM 29: Recognition of pest free areas and area of low pest prevalence
- ISPM 35: Systems approach for pest risk management of fruit flies
- ISPM 36: Integrated measures for plants for planting
- ISPM 38: International movement of seeds
- ISPM 39: International movement of wood

Systems Approach.....

ISPM 1
Point 2.5: Integrated measures for pest risk management, applied in a defined manner, may provide an alternative to single measures to meet the appropriate level of phytosanitary protection of an importing contracting party.

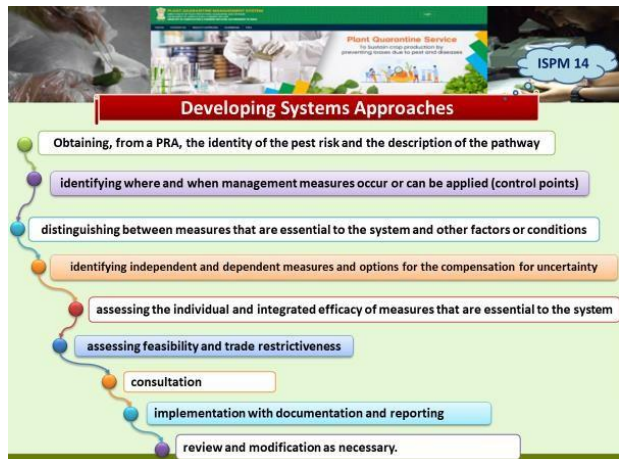
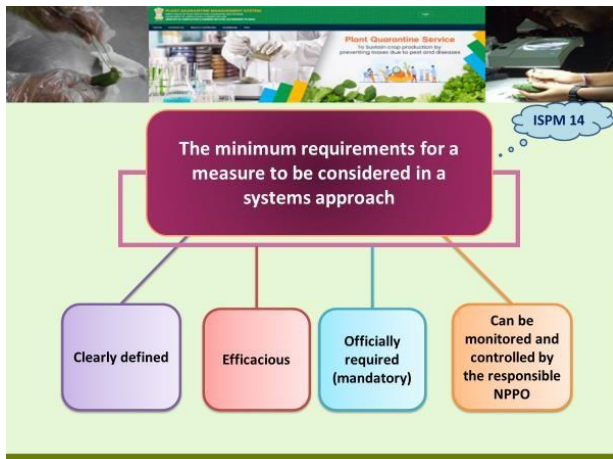
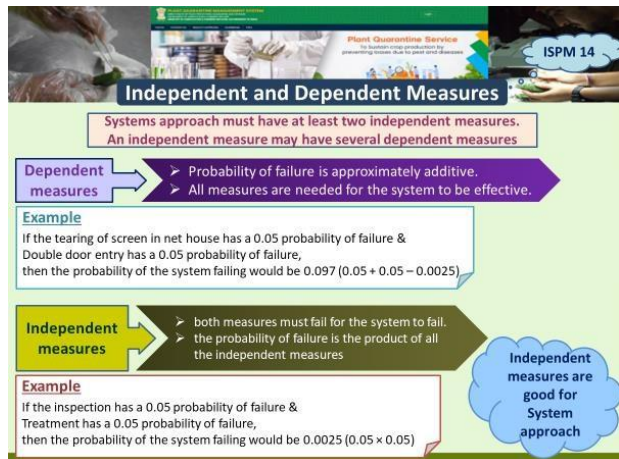
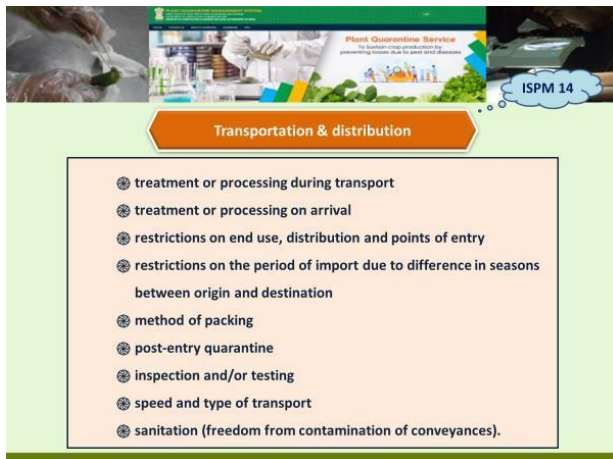
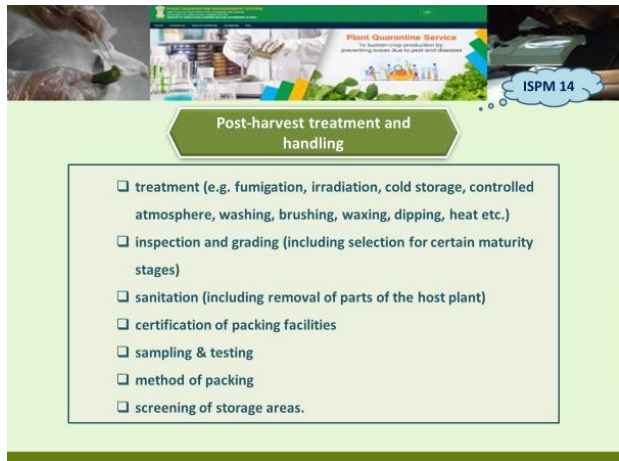
ISPM 5
Definition: A pest risk management option that integrates different measures, at least two of which act independently, with cumulative effect.

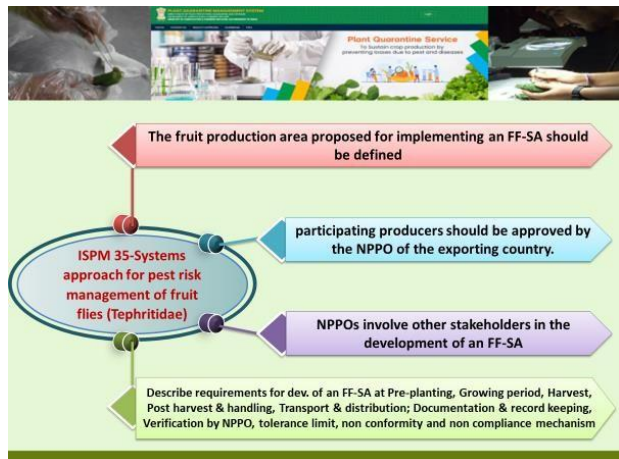
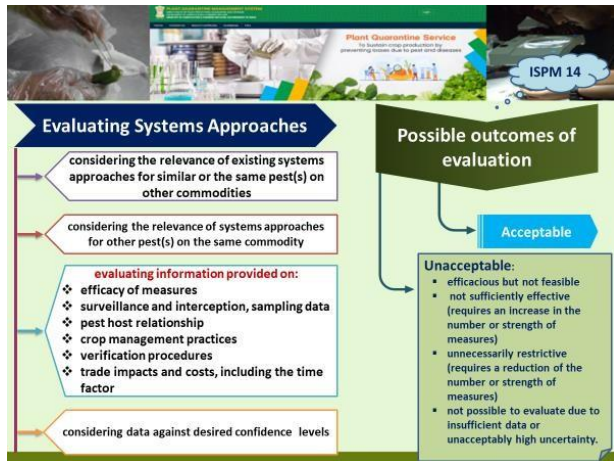
ISPM 14: The application of critical control points system in a systems approach may be useful to identify and evaluate points in a pathway where specified pest risks can be reduced and monitored.

ISPM 14

Characteristics of Systems Approach


- Requires two or more measures that are independent of each other
- Ability to address variability and uncertainty by modifying the number and strength of measures to meet phytosanitary import requirements
- Measures may be applied pre-and/or post-harvest
- Measures applied in the place of production, during the post-harvest period, at the packing house, or during shipment and distribution of the commodity.





Thank you for your kind attention

Source: Sushil, S.N. 2023. Introduction to Systems Approach & Relevant ISPMs. Presentation at the APPPC workshop on systems approach for management of fruit flies on mango, 19–23 June 2023. Mumbai.



APPPC Workshop on Systems Approach for the management of fruit flies on mango

Successful implementation of Systems approach for Management of Fruit fly in mango: An Indian perspective

Dr. D. K. Nagaraju
Deputy Director
MoA&FW, Government of India



- ❑ India successfully implemented System approach in fresh fruits and vegetables
- ❑ Implemented System approach in mango in nine states; Maharashtra, Gujarat, Uttar Pradesh, Karnataka, Andhra Pradesh, Telangana, Tamil Nadu Goa & Bihar
- ❑ Exporting mango with system approach to EU countries, US, Japan, New Zealand, Australia, South Korea, Mauritius, Iran etc.




NPPO

- ✓ Development of guidelines related to farm, packhouse & treatment facility registration in the form of National Standards for Phytosanitary Measures (NSPMs) & Standard Operating Procedures (SOPs)
- ✓ Certification of pack houses, Treatment facilities
- ✓ Development of IPM packages and Good Agricultural practices (GAPs) in coordination with research Institutes.
- ✓ Phytosanitary inspection & certification
- ✓ Pest Surveillance & human resource development in plant protection
- ✓ international co-ordination,

Commerce (APEDA & DGFT)

- Financial & technical support in developing pack house, residue laboratory & treatment facility
- Providing software support for farm registration and maintenance of farm traceability data
- Pack house audit and registration jointly with DPPQS
- Registration of exporter and trade facilitation



ICAR & State Agricultural Universities

- ❑ Research support in the field of pest management
- ❑ Development and Evaluation of IPM package of practices and Good Agricultural Practices.
- ❑ Specialized training to extension officers & lead farmers
- ❑ Pest identification and Surveillance

State Departments

Registration of farmers, Implementation of IPM packages, training to farmers, implementation of GAP

Farmers

Registration with State Government, implementation of GAP, maintenance of record pertaining to pest occurrences and management

Pack houses

Registration with DPPQS & APEDA, follow guidelines, maintenance of traceability record

Treatment providers

Registration with DPPQS, follow guidelines, maintenance of treatment record

Transporters

Pest free transport



National Guidelines

- NSPM-10 Export certification of mango to China
- NSPM-13 Establishment of PFA for mango nut & pulp weevil
- NSPM-14 Establishment of PFA for fruit flies
- NSPM-15 Hot Water Immersion Treatment
- NSPM-20 Vapour Heat Treatment
- NSPM-21 Irridiation facilities

SOPs for fresh fruits and vegetables



Farm registration

Farm registration by State Government and maintenance of pan India record by APEDA

9705 mango growers registered in India

<https://apeda.gov.in/apedawebsite/Grapenet/Hortinet.htm#rules-tab>

HortiNet
Exporting System for Horticulture Products

NETNET-PRODUCTS

- Apple Export Process
- Avocado Export Process
- Banana Export Process
- Cherry Export Process
- Citrus Export Process
- Guava Export Process
- Jackfruit Export Process
- Mango Export Process
- Orange Export Process
- Pineapple Export Process
- Rubbery Export Process
- Tomato Export Process
- Watermelon Export Process

Implementation of GAP

Successfully implemented by farmers with the help of State Government & DPPQS

Good Agricultural Practices (GAP) for management of pest of Mango

Register Orchard with State Horticulture Department

Record Maintenance

1. Status of the Farm
2. Field Fly Monitoring
3. Details of pesticide used
4. Details of Farming

Implementation of GAP

Pre-Harvest Management

- 1. Harvest only mature fruits to the maximum of 100% of the total harvest.
- 2. Harvest fruit along with stem.
- 3. Harvest only mature fruits to the maximum of 100% of the total harvest.
- 4. Harvest fruit along with stem.
- 5. Harvest only mature fruits to the maximum of 100% of the total harvest.

Other practices include: Rain Sprays on tracks using 1000 ml water:50g Jaggery: 100ml of dichlorvos (D.D.C)/Mankote (50 EC), Collect and bury the fallen fruits, Mummify the area under the canopy, and Fruit Ripening.

Implementation of Pack house activities

- > Pack houses registered jointly by DPPQS & APEDA and have yearly compliance audit
- > Pack house have trained manpower for record maintenance, sorting, grading and packing etc.
- > Inward, outward, traceability, rejection and certification records are maintained

Treatment facilities

- > Treatment facilities registered by DPPQS and have yearly compliance audit
- > 21 pack houses registered exclusively for mango with hot water treatment facility
- > 117 for fresh fruits and vegetables (48 with hot water immersion treatment facilities as per NSPM 15)

9 Vapour heat treatment facilities certified

48 facilities for hot water immersion treatment certified

4 Irradiation facilities certified



Phytosanitary inspection & certification

- All the consignments are inspected by authorized PQ inspector and issued PSC through online
- Certified consignment kept separately in the pack house






Certification website




Transport of treated and certified consignment

- Loaded in cleaned & insect proof vehicle
- Sealed at the pack house and de-sealed at airport in presence of PQ official



Thank you for your kind attention


Source: Nagaraju, D.K. 2023. Successful implementation of Systems approach for Management of Fruit fly in mango: An Indian perspective. Presentation at the APPPC workshop on systems approach for management of fruit flies on mango, 19–23 June 2023. Mumbai.

APPPC Workshop on Systems Approach for the management of fruit flies on mango

Pre-harvest Integrated Pest Management for mango fruit flies

Dr. Abraham Verghese
 Former Director, ICAR- National Bureau of Agricultural Insect Resources, Bengaluru, India
 Former Head, Entomology, ICAR-Indian Institute of Horticultural Research, Bengaluru, India
 Editor-in-Chief, Insect Environment

Management of fruit flies



2001

- IPM research at 9 centers with IIHR as main centre: ICAR-DFID (UK)
- Mass rearing standardized

2001 to 2005

- IPM for fruits and cucurbits standardized and validated
- Training for identification of fruit flies

2006

- ICAR approved for national transfer of technology

2023 Pre-harvest Integrated Pest Management for mango pests APPPC Workshop

Management of fruit flies

2010-12

- Improved traps, Alcohol-free, slow release impregnation (Patented)

2012-20

- Commercialization of traps > 28 firms


2014

- We were awarded DBT commercialization award for fruit fly trap (Rs. 2 Lakhs)

Management of fruit flies

2006 to till date

- Improving IPM technology, developing climate resilience for trapping



DBT award from Dr. Harsh Vardhan, Minister of Science and Technology, 2014

2023 Pre-harvest Integrated Pest Management for mango pests APPPC Workshop 4


Management of fruit flies



- Patents obtained for fruit fly management

2023 Pre-harvest Integrated Pest Management for mango pests APPPC Workshop 5

A Special Issue in PMHE



>50 extension folders in 7 languages


2023 Pre-harvest Integrated Pest Management for mango pests APPPC Workshop 4

The first India - UK team that worked on IPM in fruit fly, 2001-2006



2023 Pre-harvest Integrated Pest Management for mango pests APPPC Workshop

IMFFI participants with Dr. G. Kalloo in New Delhi (January 2005)



2023 Pre-harvest Integrated Pest Management for mango pests APPPC Workshop

Mango (*Mangifera indica* L.)

King of fruits, is also our national fruit

More than 50 percent of world production by India.

India tops in the mango production in the world; 21 million metric tons; 55 percent of the world's total production. (2022, National Horticulture Board)

India has the highest collection of mango germplasm

India has excellent IPM strategies for pests including fruit flies; increase by 7 million metric tons

(Verghese and Rashmi, 2014, 2022)



2023 Pre-harvest Integrated Pest Management for mango pests APPCC Workshop

Mango fruit flies used to cause 36-70% loss prior to 2000


It was an export Impediment



2023 Pre-harvest Integrated Pest Management for mango pests APPCC Workshop

Main fruit fly species with horticultural and quarantine implications

There are > a dozen of species



Bactrocera dorsalis – South India

Bactrocera zonata – North India


Bactrocera correcta

Zeugodacus cucurbitae

2023 Pre-harvest Integrated Pest Management for mango pests APPCC Workshop

Fruit fly identification & IPM folder

Identification of common fruit fly pests of fruit crops in India and its management



2023 Pre-harvest Integrated Pest Management for mango pests APPCC Workshop 12

Fruit fly identification & IPM folder



2023 Pre-harvest Integrated Pest Management for mango pests APPCC Workshop 13

Female fruit fly ovipositing



SEM image of fruit fly ovipositor

2023 Pre-harvest Integrated Pest Management for mango pests APPCC Workshop

Fruit fly damage symptoms



2023 Pre-harvest Integrated Pest Management for mango pests APPCC Workshop 15

Good agricultural practices (gap) in relation to IPM of fruit flies

1. Orchard Sanitation.
2. Raking soil below the tree from flowering.
3. Collecting dropped fruits from 50% maturity onwards and putting them into manure pit.
4. Using clean water for irrigation and spraying.

2023 Pre-harvest Integrated Pest Management for mango pests APPCC Workshop


Pre-harvest IPM of fruit flies



Sanitation

2023 Pre-harvest Integrated Pest Management for mango pests APPCC Workshop

Pre-harvest IPM of fruit flies



Fruit fly trap with flies inside

1. Male annihilation using Methyl Eugenol for orchards in plywood block traps with optimum placement numbers and height @ of 10-15 traps per acre.
2. Fruit fly population is affected by high wind velocity, high temperature and rain fall, therefore trap numbers/acre should be modified with expert advice.
3. Traps should be installed from the time of 50 % maturity of fruits.

2023 Pre-harvest Integrated Pest Management for mango pests APPCC Workshop

Pre-harvest IPM of fruit flies




Bait splash
2 to 3 times from 30 days prior to harvest

Jaggery/ Protein hydrolyste 10% bait splash

2023 Pre-harvest Integrated Pest Management for mango pests APPCC Workshop

Pre-harvest IPM of fruit flies



Oviposition deterrents
Herbal liquid soap + Azadirachtin 10000 ppm
3 times 30 days prior to harvest

RESEARCH NOTE
A push-pull strategy for the management of the Oriental Fruit Fly, *Bactrocera dorsalis* (Hendel) in mango
ABRAMAM VERGHESE, RAKSHITHA MOULY, T. S. SHIVANANDA, C. K. SOMAYAJI and K. A. KASHIF

2023 Pre-harvest Integrated Pest Management for mango pests APPCC Workshop

Pre-harvest IPM of fruit flies



Bagging of fruits

2023 Pre-harvest Integrated Pest Management for mango pests APPCC Workshop



Pre and Post Harvest IPM for the Mango Fruit Fly, *Bactrocera dorsalis* (Hendel)
Abramam Verghese*, K. Sreedevi and D. K. Nagaraj

Economic evaluation of the integrated management of the oriental fruit fly *Bactrocera dorsalis* (Diptera: Tephritidae) in mango in India
Abramam Verghese*, P. A. Tashir, John M. Hanchaisree*

Fruit flies of economic significance in India, with special reference to *Bactrocera dorsalis* (Hendel)
Abramam Verghese*, S. S. Mathura, P. D. Karanji Jayaram and John M. Hanchaisree*

Wind speed as an independent variable to forecast the trap catch of the fruit fly (*Bactrocera dorsalis*)
ABRAMAM VERGHESE, S. S. MATHURA, P. D. KARANJI JAYARAM, P. J. SANKARAN, N. S. VITTAL and S. SURESH*

2023 Pre-harvest Integrated Pest Management for mango pests APPCC Workshop 22

Evidence of a random ovipositional strategy by female fruit fly *Bactrocera dorsalis* (Tephritidae: Diptera) with reference to host quantity
Abramam Verghese*, M. S. Uma, P. D. Karanji Jayaram, Ranjita Manjya and Mithila Bhatia

Phenolics as chemical barriers to female fruit fly *Bactrocera dorsalis* (Hendel) in mango
Abramam Verghese*, C. K. Somayaji, S. Shivananda, S. Saravanan and S. V. Krishnamoorthy

Chapter 8 Insect Disinfection and Quarantine
Abramam Verghese
Prasad Bhatia, K. Sreedevi, K. S. Mathura, P. D. Karanji Jayaram, P. J. Sankaran, N. S. Vittal and S. Suresh

2023 Pre-harvest Integrated Pest Management for mango pests APPCC Workshop 23

Promoting export to Japan

Pest free areas identified for *B. caryaea*

PEST FREE AREAS (PFA) OF *Bactrocera caryaea* (Kapur) IN MAJOR MANGO BELTS OF SOUTH INDIA
ABRAMAM VERGHESE, K. SURESH, S. S. MATHURA, D. K. NAGARAJ and S. R. JANITHA MALA

Frank Milliere Haworth (1877-1926): discoverer of the Pest Paper's lure for the fruit flies (Tephritidae: Diptera)
Abramam Verghese, P. J. Sankaran, P. D. Karanji Jayaram and K. Sreedevi

A GLOBE TO IDENTIFICATION OF SOME COMMON FRUIT FLIES (Diptera spp.) (DIPTERA: TEPHRITIDAE; DACTYNOPTERA)
S. S. MATHURA and ABRAMAM VERGHESE*

A FARMER-FRIENDLY TRAP FOR THE MANAGEMENT OF THE FRUIT FLY *Bactrocera* spp. (TEPHRITIDAE: DIPTERA)
ABRAMAM VERGHESE*, S. S. MATHURA, S. R. JANITHA MALA and D. K. NAGARAJ

2023 Pre-harvest Integrated Pest Management for mango pests APPCC Workshop

Potential Invasive Tephritidae

Pest risk analysis surveillance
threatful fruit flies



Bactrocera tryoni



Ceratitis capitata

Eg. *Ceratitis capitata*
Bactrocera tryoni



Bactrocera kandiensis

*Suspicious specimens should
be sent to ICAR-NBAIR*

2023

Pre-harvest Integrated Pest Management for mango pests

APPPC Workshop

Current research undertaken by ICAR, R-IPRS, DBT, GOI

- o Climate resilient traps
- o Female ovipositional deterrent sprays
- o Non insecticidal traps
- o Imparting gallic acid, phenolics etc., resistance, through various breeding technologies

2023

Pre-harvest Integrated Pest Management for mango pests

APPPC Workshop 26

THANK YOU

BLOGS ON FRUIT FLIES AND MANGO PESTS
insectenvironment@gmail.com
<https://insectenvironment.com/>

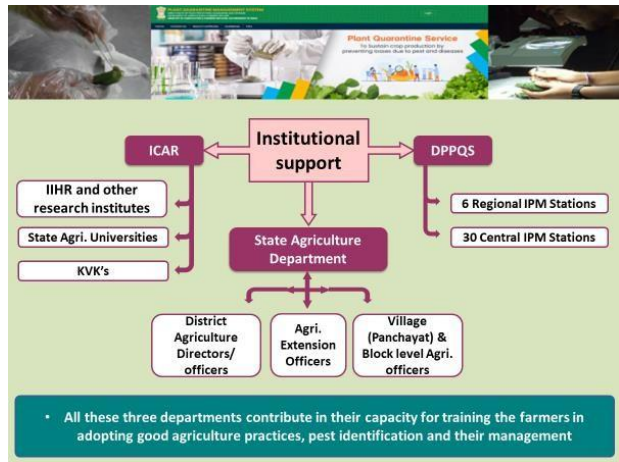
Source: Varghese, A. 2023. Pre-harvest Integrated Pest Management for mango fruit flies. Presentation at the APPPC workshop on systems approach for management of fruit flies on mango, 19–23 June 2023. Mumbai.



APPC Workshop on Systems Approach for the management of fruit flies on mango

Institutional support for Farmers Training, record keeping & pest management at farm level

Dr. Sunita Pandey
Deputy Director
MoA&FW, Government of India




Role of DPPQS- IPM Division

Farmers Training

- Central IPM Centres : 36 Nos.
- Farmer Field Schools
- Season Long training Programme (SLTP)-
- Orientation training programme-
 - ❖ 2 days OTP
 - ❖ 5 days OTP

Pest monitoring & management

- Central IPM Centres monitor pest build up through Pest Surveillance
- Issuance of pest forewarning
- Issuance of advisories.
- Key role in management of pest epidemics
- Trans-boundary pest mgt

Mass production and Field release of Biocontrol agents

Schedule of typical Farmers Field School Training Programme

Week	Activity Schedule	Week	Activity Schedule
1 st	•Inauguration • Introduction to IPM • Pre Evaluation	8 th	•AESA •Identification & Management of pest/diseases/Nutrition disorders •Biological Control measures •Observations of PAR Experiments
2 nd	•Overview of IPM Cultural Practices	9 th	•AESA •Identification & Management of pest/diseases/Nutrition disorders •Biological Control measures •Biopesticides & ITK •Observations of PAR Experiments
3 rd	•Pest Surveillance Methods •Field Walk •Water & Nutrition Management	10 th	•AESA •Demonstration of Fruit fly traps & Fruit bagging •Biopesticides & ITK •Discussion on Harmful effects of Chemical Pesticides
4 th	•P/D Ratio •Mechanical Measures • Weed Management	11 th	•AESA • Safe & Judicious use RC approved pesticides as last option •Advantages of IPM over chemical control •Discussion on Harmful effects of Chemical Pesticides
5 th	•Setting up of Insect Zoo (PAR-I) •Identification of pest/diseases/defenders	12 th	•AESA •Review of Identification of Pests/diseases /defenders/weeds •Review on Management Practices
6 th	•AESA •Management of Major Pests •PAR-II	13 th	•AESA •Review of Identification of Pests/diseases /defenders/weeds •Review on Management Practices
7 th	•AESA •Management of Major Diseases •Observations of PAR Experiments	14 th	•Post Evaluation Planning for next season •Comparison between IPM & Non IPM •Farmers Field Day



Active role of CIPMCs in Management of Mango Fruit Fly



Preparation of Low cost Fruit fly traps in Labs



Demonstration of Fruit fly traps & Bagging during regular FFS & Training Programmes



Explaining about use of Fruit fly trap



Installation of Low cost Fruit fly trap



Regular Survey in Mango Growing areas



Establishment and monitoring of backward linkage for production and procurement of Mango

- Backward linkage system.
- Mangonet
- Standard Operating Procedure for Export Inspection & Phytosanitary Certification of Vegetables & Fruits to European Union countries
- Developed 11 different National Standard for Phytosanitary Measures for pest mitigation
- PoP on mango for export
- Development of Pest free area



Training to the farmers

Some of the management measures suggested at Farm Level

- Collection & destruction of fallen and rotten fruits
- Raking under the tree to expose pupa to sun
- Deep ploughing of orchard after harvest of fruit to expose pupa to sun.
- Conservation of natural enemies
- Early harvesting of mature fruits to avoid fruit fly infestation
- Bagging of fruits
- Installation of Methyl Eugenol Fruit fly traps
- Installation of sticky traps for sucking pest
- Balance use of Nitrogenous fertilizer
- Safe and judicious use of recommended pesticides
- Pre harvest and Post harvest management of Mango

Training to the Farmers

Model Agro-Ecosystem Analysis Chart

1. Yellow sticky traps
 Pest attracted: White flies, aphids, leaf miners
 Crops: Cotton, mustard, vegetable and flowers
 Methodology 1:
 Materials required:
 • Ply wood board or hard board or card board (1.5m X 1.0 ft size)
 • Yellow colour oil paint
 • Glue or white grease
 • Bamboo poles
 • Wire or rope

Fruit fly traps using methyl eugenol

Role of ICAR

- Research in Agriculture including pest management
- Pest identification
- Phytosanitary Services – Testing Export Plants/Planting Material
- Trainings to State Agriculture/ Horticulture extension functionaries for pest identifications and management
- Post Entry Quarantine Inspection

Role of State Government

- Farm Registration for export on Mango net system
- Regular monitoring of pest concerned to Exporting countries
- Training to the farmers for proper plant protection measures
- Advisories and support (financial, plant protection chemicals, equipment's etc.) to the farmers for pest management

Procedure for registration of farmers growing Mango for USA

Submission of application by farmer for registration/renewal

Records in System by concern authority

Issuance of registration certificate by State Ag Authority

A registration number shall be given to each farm upto the plot level. The farm/plot would be allotted a registration number by adopting only the following code format

State Code	District Code	Taluka Code	Product Code	Farm Code	Plot Code
AA	01	01	001	0001	01

Record by registered farmer for "Plot Registration & Field Application Record of all chemicals (insecticides, pesticides and other chemicals)

Permission to the authorized laboratories for sampling for testing purpose.

Record of crop profile by farmer

Submission of declaration to the exporter.

Export of Mangoes to the USA are processed, treated and packed in packhouses recognised by APEDA & NPPO

Visit of Inspection Authority (Agriculture/Horticulture Officer prior to harvesting of the produce.

The state Government shall maintain all the data of requested farmers through database system.

Record Keeping

Pest monitoring at Farm level

MANGONET


Appendix-C

(Farm registration)
 Name of Farm: _____ District: _____
 Village name: _____ Varieties: _____
 Crop: _____
 Register crop area: _____
 Registration number: _____
 Date of registration/ renewal of farm: _____

Export of Mango – Farm Registration with State Agriculture Department

1. Status of the Pests:

Sl. No.	Date of observation (fortnightly)	Crop stage	Name of pest observed	Intensity of the pest	Plant protection measures adopted	Remarks by State Deptt. of Agri./Hort
1.			1.			
			2.			



2. Fruit Fly Monitoring:


Date	Fruit fly catches in traps			Average Fruit Fly per trap	Plant protection measures adopted	Remarks by State Deptt. of Agri./Hort
	T1	T2	T3			

Fruit fly is a major concern -

Guidance to farmers

Regular monitoring
Record maintenance of fruit flies

By DPPQS and State Agriculture
Installation of Traps
Identificatn of fruit flies



3. Details of pesticide used:

Only Registration Committee (RC) approved pesticides to be used

Sl. No.	Date of application	Crop stage	Name of the pesticide	Dose (ml/lit of water)	Quantity of chemical used	Remarks
1.						

➤ Records of Harvesting details of the previous year crop are maintained which helps in deciding the maturity indices of the fruit.




Thank you for your kind attention

ppa@nic.in

Source: Pandey, S. 2023. Institutional support for Farmer Training, record keeping & pest management at farm level. Presentation at the APPPC workshop on systems approach for management of fruit flies on mango, 19–23 June 2023. Mumbai.



APPPC Workshop On Systems Approach For The Management Of Fruit Flies On Mango

Harvest, Pre-treatment Processing & Pack House Activities

Dr. Vasudha Gautam
Deputy Director
MoA&FW, Government of India



Maturity Index

Maturity indices are an indication of the readiness of the fruit for harvest.

Methods of assessing the maturity of mangoes:-

- Shape – flat shoulder at stem end; fullness of cheeks.
- Peel appearance – Fruit should be harvested at light green colour stage of mango peel (for some varieties).
- Pulp color – light creamy yellow pulp.



Harvesting

- Harvest only mature fruits in the morning or evening time of the day to minimize the latex flow.
- Use appropriate harvester, mango harvesters (stalk clippers) to improve the quality and shelf life Traditional 'jerk harvesting' should not be adopted.
- Leave 2-3 cm of the stem (pedicel) attached to divert latex flow away from the fruit.



Post Harvest Handling

- Harvested fruits should be kept in shade to avoid injury caused by prolonged exposure to sun.
- Clean plastic containers lined with soft material like jute or polyurethane should be used.
- Containers with edges and hard body should be avoided to carry the fruits,



Trimming: Long stems left attached on the fruit should be trimmed prior to packing



Inverting freshly de-stemmed fruits on plastic or steel mesh racks, allowing the latex to drip for 30 minutes. These racks are called as desappers....care should be taken that latex would not fall on fruit



Desapping/ Delatexing

Dipping freshly de-stemmed fruits in 1 percent alum solution (one-half kg powdered alum per 50 liters of water) for one minute. Alum enhances coagulation of the latex when fruit are dipped. Plastic crates can be used to hold the fruits during dipping. Allow fruits to dry before packing.



Cleaning and washing of fruit :

- (a) After de-sapping, the fruits should be washed carefully for 2-3 minutes to remove any patches of sap.
- (b) Neutral detergents like Teapol, Sandovit or Indron at 0.1% (1 ml of detergent per litre of water) may be mixed with water to help remove latex (sap).
- (c) During washing, fruits should also be cleaned with soft brushings.
- (d) The washing done with only fresh potable water of temperature lower than that of the fruit.
- (e) It is recommended that the Alphonso mango shall be subject to specific gravity test for removal of fruits affected by the internal disorder (2.5% salt Solu).
- (f) Surface sterilization of mango with hot water fungicidal dipping with Sodium hypochlorite at 200 ppm at 52 degree celsius for 3-4 minutes.





What is pack house?

1. Pack house is a processing unit for ensuring an appropriate standards in export of horticultural produce.
 2. Encouraging exporters to meet the international standards in terms of quality of produce.
 3. Integrated facilities like material handling , holding, pre-inspection, sorting , grading, washing, standard treatment, packaging, stacking, pre-cooling, cold storage, quarantine check etc.
- APEDA Recognition**
- Should have appropriate facilities.
 - Should export through APEDA recognised pack house only.
 - For horticulture produce only viz fresh fruits, vegetables only.



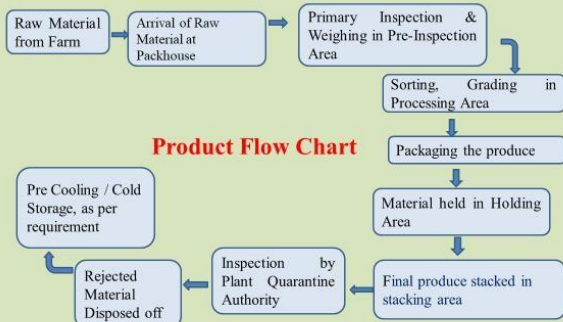
Responsibilities of Pack House

- outflow should be done in uni-directional manner.
- List of the registered farmers should be there.
- Pack house should free from cracks and crevices in floors and walls.
- To provide exclusive area for pre and post plant quarantine inspection.
- To provide separate storage area for finally packed and inspected consignments.
- Keep everything in writing like capacity/ quantum of commodity handled like grading, sorting, packing and PQ inspection.
- To ensure cleanliness of the vehicle used for transporting
- To ensure the disposal of infested material after inspection of each consignment.
- All the personals are well trained about the activities of the pack house
- Packing boxes shall have insect proof mesh on the aeration holes.
- Finally packed boxes after inspection shall be pasted with a sticker "Plant Quarantine Inspected".



Traceability

- Consignment traceability may be track from source material register.
- Document traceability may be track from PQMS on-line system through PSC No.



Thank you for your kind attention


Source: Gautam, V. 2023. Harvest, Pre-Processing & Pack House Activity. Presentation at the APPPC workshop on systems approach for management of fruit flies on mango, 19–23 June 2023. Mumbai.



APPPC Workshop on Systems Approach for the management of fruit flies on mango

Post-harvest treatments for mango fruit fly → Hot Water Immersion Treatment


Gyaneshwer Banchhor
Deputy Director
MoA&FW, Government of India



Hot Water Immersion Treatment

Facility certification by the DPPQS as per National Standard NSPM 15

NSPM 15 and list of certified facility available at <https://pqms.cgg.gov.in/pqms-angular/homeGuidelines>




Presently 49 certified facilities (all Batch type)



Hot Water Immersion Treatment facilities for surface sterilization



Presently 21 certified facilities – Continuous flow type



Hot Water Immersion Treatment

Protocol HWT for EU countries & Australia

S. No.	Fruit size (gms)	Water Temperature Degree Celsius	Duration in Minutes
1.	Up to 500	48	60
2.	501-700	48	75
3.	701-900	48	90



Hot Water Immersion Treatment



Primary Inspection in Holding Area

Fruits Sizing

Pulp Temperature before Dipping



Hot Water Immersion Treatment



Preparation of Crates

Loading crates in tank



Hot Water Immersion Treatment



Dipping & treatment

Temperatures recorded sensors shall not vary by more than 1°C at any given time after the fruit have been immersed for the first 5 minutes of treatment.

Fruit kept at least 10.2 cm (4 inches) below the water surface during the treatment, by use of a flotation barrier.



Hot Water Immersion Treatment



Sensors in the tank

Continuous flow systems - at least 10 per tank for

Batch type - at least two sensors per tank.

Tanks that treat multiple baskets (cages) of fruit there must be at least one sensor per basket position

An automatic temperature recorder (strip chart or data logger) shall be used to record the time and temperature during each treatment.

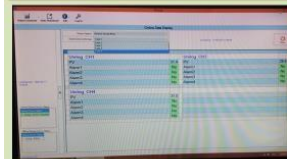


Sensors in the tank

Sensors calibrated against a certified Centigrade glass mercury thermometer



The time interval between prints is for every two minutes.



Sr. No.	Date	Time	C1 (°C)	C1 (°F)	C1 (°C)
185	06-May-17	15:28:52	48.5	48.6	48.6
186	06-May-17	15:30:52	48.1	48.2	48.3
187	06-May-17	15:32:52	48	48.1	48.2
188	06-May-17	15:34:52	48.1	48.2	48.2
189	06-May-17	15:36:52	48.2	48.2	48.3
190	06-May-17	15:38:52	48.2	48.3	48.3
191	06-May-17	15:40:52	48.3	48.3	48.2
192	06-May-17	15:42:52	48.2	48.2	48.2
193	06-May-17	15:44:52	48.3	48.3	48.3
194	06-May-17	15:46:52	48.2	48.2	48.2
195	06-May-17	15:48:52	48.2	48.3	48.2
196	06-May-17	15:50:52	48.3	48.2	48.2
197	06-May-17	15:52:52	48.2	48.1	48.2
198	06-May-17	15:54:52	48.3	48.2	48.3
199	06-May-17	15:56:52	48.2	48.2	48.2
200	06-May-17	15:58:52	48.2	48.3	48.2
201	06-May-17	16:00:52	48.2	48.1	48.2
202	06-May-17	16:02:52	48.1	48.2	48.2
203	06-May-17	16:04:52	48.2	48.2	48.2
204	06-May-17	16:06:52	48.2	48.3	48.2
205	06-May-17	16:08:52	48.3	48.2	48.3
206	06-May-17	16:10:52	48.2	48.2	48.2
207	06-May-17	16:12:52	48.1	48.1	48.1
208	06-May-17	16:14:52	48.3	48.2	48.2
209	06-May-17	16:16:52	48.2	48.3	48.2
210	06-May-17	16:18:52	48.2	48.2	48.2
211	06-May-17	16:20:52	48.2	48.3	48.2
212	06-May-17	16:22:52	48.3	48.3	48.2



Hot Water Immersion Treatment



Unloading

An alarm is required for all batch systems. In order to notify packing house employees that a treatment has been completed for a particular basket (cage).

To avoid "over-cooking".



Hot Water Immersion Treatment



Drying

APPPC Workshop on Systems Approach for the management of fruit flies on mango

Post-harvest treatments for mango fruit fly → Vapour Heat Treatment

Dr. Brajesh Mishra
Deputy Director
MoA&FW, Government of India

Vapour heat Treatment

Facility certification by the DPPQS as per National Standard NSPM 20

NSPM 20 and list of certified facility available at <https://pqms.cgg.gov.in/pqms-angular/homeGuidelines>

Presently 6 certified facilities




Vapour heat Treatment

Treated as per importing country requirement


EU	: 46.5°C for 30 minutes
	47.5°C for 20 minutes
Japan	: 47.5°C for 20 minutes
Australia	: 46.5°C for 30 minutes
	47.5°C for 20 minutes
New Zealand	: 48°C for 20 minutes
Mauritius	: 47.8°C for 20 minutes

Treatment starts when pulp core temperature of the monitored fruits attains

Vapour heat Treatment

Primary inspection

Viping & crate preparation

Vapour heat Treatment

Pre-treatment pulp temp.



Weighing

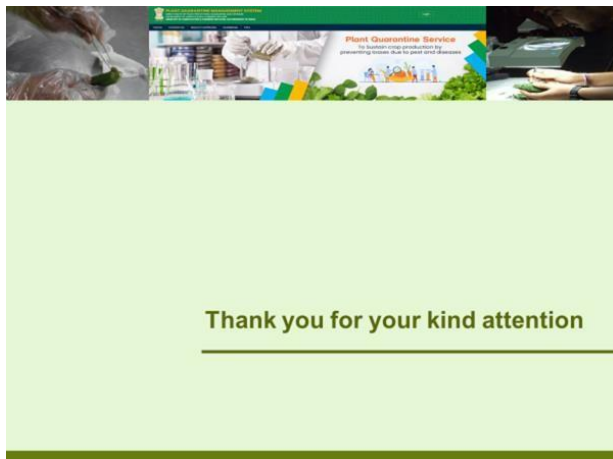



Vapour heat Treatment

Loading from front side

Unloading from rear side




Source: Mishra, B. 2023. Post-harvest treatments – Vapour Heat Treatment. Presentation at the APPPC workshop on systems approach for management of fruit flies on mango, 19–23 June 2023. Mumbai.



APPPC Workshop on Systems Approach for the management of fruit flies on mango


Post-harvest treatments for mango fruit fly → Irradiation Treatment

Dr. S. Gnanasambandan
Joint Director (Plant Quarantine)
MoA&FW, Government of India




Irradiation

- Gamma-ray irradiation uses ionizing radiation to **modify pests' DNA**, making them **sterile**.
- Irradiation does not lead to immediate death of the treated organism.
- Irradiated insects suffer from "**Radiation syndrome**" which means that they absorbed a lethal dose and will die within several days or weeks after treatment.



Symbol showing that fruit has been treated with ionizing radiation




Irradiation

Facility certification by the DPPQS as per National Standard NSPM 21

NSPM 15 and list of certified facility available at <https://pqms.cgg.gov.in/pqms-angular/homeGuidelines>

Presently four certified facilities




Registered Irradiation Facilities as per NSPM-21

Sl. No.	Name of The facility	Address of the facility
1	KRUSHAK Bhabha Atomic Research Centre,	Kotamgaon Road, Lasalgaon, Dist. Nashik – 422306 Email: agrosurg.krushak@gmail.com Contact No.09890501092
2	M's MSAMB Irradiation Treatment Plant,	APMC Market Yard, Sector 19 F. Opposite Dana Bander, Vashi,Navi Mumbai – 400705 Email:msamb@vsnl.com, ifc@msamb.com Tel : 022-27840205/9 ContactNo. 09850228586
3	M's Innova Agri Bio Park Private Limited	Plot No. B – 12, 3rd Phase, KIADB, Industrial Area, MALUR – 563160, Kolar District, (Karnataka) Email : info@innovafoodpark.com Tel : 08151235309
4	M's Gujarat Agro Industries Corporation Ltd,	Survey No. 1024-1025, Balya- Bagodara Highway, Village: Ramnagar, Ta. Balva, District: Ahmedabad-382220, Gujarat E-mail: agrosurg.ahd@gmail.com ContactNo.: 09920684713



Target Pests

Pest Name	Common name	Minimum dose
1. Tephritidae - <i>Bactrocera dorsalis</i>	Oriental Fruit fly	150 Gy
2. Curculionidae - <i>Sterochetus mangiferae</i>	Mango seed weevil	300 Gy





Process Flow IFC

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graph TD
    A[Arrival of Product from Pack house to IFC] --> B[Documents & Registration and Gate Entry at Security]
    B --> C[Application for Irradiation & Concern documents check]
    C --> D[Vehicle Seal check & then Open]
    D --> E[Unload Rows & Moved the Boxes at Holding Area]
    E --> F[Boxes Physical Condition, Ventilation Holes Net check]
    F --> G[Inspection by NPPQ & USDA Official at Holding Room & Sampling]
    G --> H[Withdraw Samples to Inspection room for thorough check]
    H --> I[On Rejection]
    H --> J[After Sampling Acceptance]
    I --> K[Shipment Return to Exporter with Documentation]
    J --> L[Clearance for Processing by NPPQ & USDA Officials]
    L --> M[Irradiation Processing, Dosimetry etc.]
    M --> N[After Completion of Irradiation process Documents, Indian Phyto, USDA Certificate & Treatment Certificate Handover to Exporter]
    N --> O[Product Loading into the Vehicle & Put Seal on the Vehicle by NPPQ & Facility Officials.]
    O --> P[Vehicle Moved to Air Cargo]
    
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Pre-treatment of Irradiation or post Harvest processing of Mangoes for Irradiation



Dipping in Hot water of 45-52 Degree Celsius with Sodium Hypochlorite 50-200 ppm Conc

Washing

Brushing



Drying

Collecting and storing in crates

Packing into Boxes with all trace back details



Verification of packages as per requirement and Unloading of boxes and moved the boxes to Holding area



Sampling process for the preclearance inspection of Mango Export to USA

Sample Size:

- Lot size of 1 to 4 cartons - inspect all cartons; minimum fruit to cut - 10 fruit
- Lot size of 5 to 99 cartons -inspect 5 cartons; minimum fruit to cut - 20 fruit
- Lot size of 100 to 240 cartons -inspect 7 cartons; minimum fruit to cut - 30 fruit
- Lot size of 241 or more cartons - inspect 14 cartons; minimum fruit to cut - 30 fruit



Inspection by NPPO & USDA Official at Holding room and sampling of boxes



Pre clearance Inspection by NPPO and USDA officials



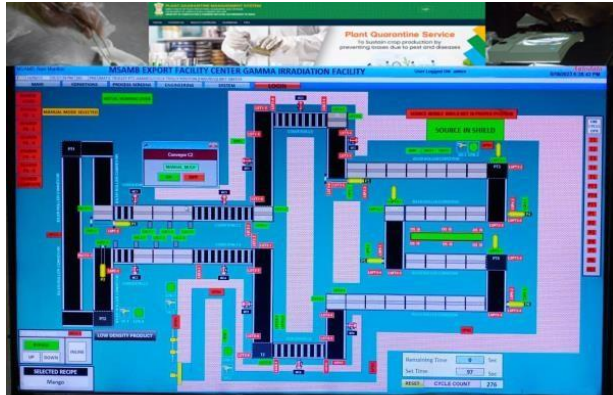
Pre-clearance inspection



If lot Passed in pre-clearance inspection lot will handed over for Irradiation

- Mango boxes are kept in toed boxes for gamma rays exposure
- Cobalt-60 used a source
- Dosimeter used to gamma ray absorption dose
- minimum absorbed dosage of 400 Grays.





Flow of mango fruit through Irradiation Unit



After completion of Irradiation process, Treatment certificate, Phyto sanitary certificate of India and USDA pre clearance certificate will be handover to Exporter.



Product loading into the vehicle and put seal on the vehicle by NPPO and facility officials.



Vehicle seal check



Final packed mango with traceability label received at Irradiation facility



Irradiated Mango Exported during current season from Mumbai Plant:

Sl. No.	Country	No. of Consignments	Qty. (MTS)
1	USA	467	785.270
2	Australia	16	24.185
3	Malaysia	01	0.406
	Total	484	809.861 MTS



Thank you for your kind attention

Source: Gnasambandan, S. 2023. Post-harvest treatments – Irradiation Treatment. Presentation at the APPPC workshop on systems approach for management of fruit flies on mango, 19–23 June 2023. Mumbai.



APPPC Workshop on Systems Approach for the management of fruit flies on mango

Record keeping & Institutional support at pack house & treatment facilities

Dr. Neelam Chaudhary
Deputy Director
MoA&FW, Government of India



Institutional Support

- To promote the export of mango the farmers are encouraged to register their orchards at APEDA through <https://traceability.apeda.gov.in/hortinet/Exporter/ExporterLogin.aspx>
- With the joint efforts of DPPQS, APEDA and MSAMB the Directorate was successful in establishment of pack house facilities which has boosted the export of mango fruits.



- The Directorate has supported the mango growers by standardizing the hot water immersion treatment facility for management of fruit flies.
- APEDA has provided financial support for the post harvest treatment facilities to boost the export of mango.
- The officers of RPQS are always available at the pack house facilities for any assistance regarding the treatment facilities.
- Directorate has also facilitated for joint inspection of mango fruits for export to several countries.



Record Maintenance

1. House Keeping Record:

Keeping the pack house clean and hygienic plays an important role in reducing the reporting of pests at pack house.

The records of sanitation are maintained time to time and the chemicals used for sanitation are regularly inspected.



2. Pest Control Record

Keeping the pest control record of pests such as rodents, flies and termites at the pack house ensures the hygienic condition of pack house and thus less damage to the fruits.

The disinfestation of the pack house is done time to time by authorized disinfectant agents.



3. Outward Registry

All the consignments which are getting entered in the pack house, treated there, inspected and their PSC along with other details such as their exporter and destination are maintained in the outward registry at the packhouse.

4. Treatment Record

Sl. No.	Quarantine No.	Block	Lot No.	Quantity	Plant Part	Treatment	Remarks	Inspector
1	1001	1001	1001	1001	1001	1001	1001	1001
2	1002	1002	1002	1002	1002	1002	1002	1002
3	1003	1003	1003	1003	1003	1003	1003	1003
4	1004	1004	1004	1004	1004	1004	1004	1004
5	1005	1005	1005	1005	1005	1005	1005	1005
6	1006	1006	1006	1006	1006	1006	1006	1006
7	1007	1007	1007	1007	1007	1007	1007	1007
8	1008	1008	1008	1008	1008	1008	1008	1008
9	1009	1009	1009	1009	1009	1009	1009	1009
10	1010	1010	1010	1010	1010	1010	1010	1010

All the treatment data logs are maintained electronically and physically at the facility
Treatment details are recorded in Plant Quarantine Management system by PSC issuing authorities

Thank you for your kind attention

Source: Chaudhary, N. 2023. Record keeping & Institutional support at pack house & treatment facilities. Presentation at the APPPC workshop on systems approach for management of fruit flies on mango, 19–23 June 2023. Mumbai.