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PESTICIDE RESIDUE MANAGEMENT IN MANGO

(*Mangifera indica* L.)

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Preface

India is a home to the best mango varieties available in the world and its cultivation is well suited to the tropical climatic conditions of the country. Export of Indian mangoes is on the rise and the United Arab Emirates is the major consumer of Indian mangoes. Now a days, there is a need for residual analysis most of produce for exports as well as for the internal consumption. This would help us in modifying pre-harvest and post-harvest management practices thereby helping in the quality production of horticultural commodities.

The institute since long addressing the issue of food safety by developing technologies/strategies for production of pesticide free fruits and vegetables such as the organic production protocols, biofertilizers, biopesticides, and microbial formulations, etc. Recently the institute has come-out with the recommendation on Post Harvest Intervals (PHI) for pesticides on mango based on the results of the supervised field trials of pesticides as per the Good Agricultural Practices, which aimed at bringing down the pesticide residue levels within the permitted limit in accordance with international standards. I appreciate the efforts made by the Dr Soudamini Mohapatra, Principal Scientist, Pesticide Residual Laboratory for developing this protocol and brining-out the technical bulletin on pesticide residue management on mango to meet the requirement of mango growers for producing safe and pesticide residue free mangoes. The information provided in this technical bulletin shall be a guide for farmers to produce quality and pesticide free mango fruits for both the domestic and international markets. I also acknowledge the support provided by the technical and contractual staff to carry out the studies.

Place : Bengaluru
Date:

(M.R. DINESH)
Director, ICAR-IIHR

Pesticide Residue Management in Mango (*Mangifera indica* L.)

Mango (*Mangifera indica* L.) is the most important fruit of India and is known as the "King of fruits". India is the home of about 1,000 varieties and ranks first among world's mango producing countries accounting for about 50% of the world's mango production. The fruit is cultivated in the largest area i.e. 2,312 thousand ha and the production is around 15.03 million tons, contributing 40.48% of the total world production of mango. The main mango producing states in India are Uttar Pradesh (23.86%), Andhra Pradesh (22.14%), Karnataka (11.71%), Bihar (8.79%), Gujarat (6.00%) and Tamil Nadu (5.09%). India is also a prominent exporter of fresh mangoes to the world. India exports mango to over 40 countries worldwide. The country has exported 36329.01 MT of fresh mangoes to the world for the worth of Rs. 317.10 crores during the year 2015-16. Major Export destinations are United Arab Emirates, United Kingdom, Saudi Arabia, Nepal, Kuwait, Bangladesh, Bahrain etc. India is also a major exporter of mango pulp in the world. The country has exported 1,28,866.01 MT of mango pulp worth of Rs. 796.17 crores during the year 2015-16.

Mango crop is affected by a number of pests and diseases, the major insect pests of mango are fruit flies, mango hoppers, mealybugs, scale, shoot borer, stem borer, stone weevil, thrips etc. The major diseases of mango are anthracnose, bacterial leaf blight, powdery mildew etc. For controlling these pests and diseases a large number of pesticides are applied to the crop throughout the cropping season. Contact pesticides remain on the surface whereas systemic pesticides are absorbed by the plant tissues. Repeated application of pesticides may lead to build-up of residues leading to residue levels in the harvested produce above the maximum residue limits. Pesticides from soil application, packaging materials, and pack houses may also contaminate the mango fruits. Food safety is a major concern for countries worldwide and it has taken the center stage in the global food trade. The exported mango fruits should not exceed the maximum residue limits of the importing countries.

Maximum residue limits

Pesticides used on food crops may leave residues on these crops. Maximum Residue limits (MRLs) are the upper legal levels of a concentration for pesticide residues in/on food or feed based on good agricultural practices and to ensure the lowest possible consumer exposure. They act as an indicator of the correct use of pesticides, and ensure compliance with legal requirements for low residues on unprocessed food. MRLs are set at low levels to ensure that high-level consumers will not consume more than the acceptable daily intake (ADI) if they eat large quantities of every food type containing the residues at the MRL. Nationally established MRLs for pesticides are based on national conditions and practices. It is possible, therefore, for different countries to set different MRLs for the same pesticide/food commodity combination. It is also possible that a pesticide authorized in one country is not authorized for use in another. These factors can result in unjustified barriers to trade. While exporting mango the MRLs set by the importing country must be adhered to.

Table 1. MRL of pesticides on mango notified in different countries

Pesticide	MRL (mg/kg)					
	EU	UK	India	Australia	Codex	Japan
Acephate	0.01	0.02	-		-	-
Azoxystrobin	0.70	0.20	-	0.50	0.7	1.00
Bifenthrin	0.30	0.30	-	-	-	0.30
Buprofezin	0.10	-	-	0.20	0.10	0.90
Carbendazim	0.50	0.10	2.0	-	5.00	2.00
Chlorpyrifos	0.05	0.05	0.5	0.05	-	0.05
Cypermethrin	0.05	0.05	-	-	0.70	0.03
Deltamethrin	0.05	0.05	-	-	-	0.50
Dicofol	0.02	0.02	5.0	-	-	3.00
Difenoconazole	0.10	-		-	0.07	0.07
Dimethoate	0.02	0.02	2.0	1.00	1.00	1.00
Dinocap	0.02	-	-		-	-
Dithiocarbamates	2.00	-	3.0	7.00	2.00	2.00
Ethefon	0.05	0.05		0.02	-	2.00
Ethion	0.01	0.01	2.0	-	-	0.30
Fenvalerate	1.50	0.02	-	-	-	1.00
Hexaconazole	0.01	0.02	-	-	-	0.07
Imidacloprid	0.20	-	-	-	0.20	1.00
Lambda-cyhalothrin	0.20	0.10	-	-	-	-
Malathion	0.02	-	4.0	-	-	8.00
Monocrotophos	0.01	0.01	1.0	-	-	
Oxydemeton – methyl	0.01	0.02	-	-	-	0.02
Phosphamidon	0.01	0.01	0.2	-	-	0.20
Propiconazole	0.05	0.05	-	-	-	0.05
Pyraclostrobin	0.05	0.05	-	0.10	-	0.05
spirotetramat	0.30	-	-	0.30	0.30	0.30
Tebuconazole	0.10	-	-	-	0.05	0.10
Trifloxystrobin	0.01	0.50	-	-		0.70
Thiamethoxam	0.01	0.50	-	0.07	0.20	0.20
Triadimefon	0.05	0.10	-	-	-	0.05
Triadimenol	0.05	0.10	-	-	-	0.05

Pre-harvest interval (PHI)

PHI is the time gap between the last application and the harvest of the crop to ensure pesticide residue level to remain within the permissible level, i.e. the MRL. It is basically a withholding period to meet the MRL. PHI is crop and pesticide specific. If pesticides are applied on mango at the growth stage of the crop using the recommended dosage and the appropriate PHIs are allowed, the harvested produce will have residues within the specified MRL. PHI of pesticides on mango have been calculated based on the residue data generated from supervised field trials carried out at the experimental field of IIHR, Bengaluru as per GAP. The residue data thus generated and the European Union MRLs of pesticides on mango has been taken into account to calculate the PHI (Table 2).

Table 2 Pre-harvest intervals of pesticides on mango

Pesticide	Pest/ Disease	Dosage Formulation	EU MRL (mg/kg)	Pre-harvest interval (days)
Azoxystrobin 23% SC	Anthracnose, Powdery mildew	1.0 mL/L	0.70	15
*Bifenthrin 10% EC	Hopper	0.5 mL/L	0.30	16
Buprofezin 25%SC	Hopper	1.0 mL/L	0.10	15
Carbendazim 50%WP	Anthracnose, Powdery mildew	1.0 g/L	0.50	60
*Cypermethrin 25%SC	Hopper	1.0 mL/L	0.05	30
*Difenoconazole 25%SC	Stem end rot	0.5 mL/L	0.10	21
Deltamethrin 2.8%EC	Hopper	1.0 mL/L	0.05	30
Dimethoate 30% EC	Mealy bug, Hopper	1.5 g/L	0.02	60
Dinocap 48% EC	Powdery mildew	0.5 mL/L	0.02	30
*Fenvalerate 20% EC	Hopper	1.0 mL/L	1.50	30
Hexaconazole 5% EC	Powdery mildew	1.0 mL/L	0.01	20
Imidacloprid 17.8% SL	Hopper, Scale	0.4 mL/L	0.20	60
Lambda-cyhalothrin 5% EC	Hopper	1.0 mL/L	0.20	15
Malathion50% EC	Mealy scale, Hopper	1.5 mL/L	0.02	25
Oxydemeton–methyl 25% EC	Hopper	1.0 mL/L	0.01	65
Thiamethoxam 25%WG	Hopper, Thrips	0.25 g/L	0.01	48
Combination formulations				
Carbendazim 12% + Mancozeb 63% WP	Powdery mildew, anthracnose, blossom blight	0.11%	0.5+2.0	45
*Beta cyfluthrin 9% + imidacloprid 21%	Powdery mildew	0.025%	0.02+0.2	45
*Spirotetramat 12% + imidacloprid 12%	Hopper, Aphid	0.075%	0.3+0.2	30
*Trifloxystrobin 25% + tebuconazole 50%	Powdery mildew and anthracnose	0.1%	0.01+0.1	45

*Without CIBRC recommendation

Mango production and pesticide residues

Application of pesticides has become a necessity for increasing the mango production. Pesticides applied to crops dissipate due to various physical and chemical parameters, environmental parameters including growth dilution factors. Pesticides applied at the initial stages of fruit growth dissipates due to growth dilution effect. As mango fruits are slow growing in nature application of pesticides towards maturity increases the chances of having residues above the MRL at harvest. The PHIs have been worked out by giving pesticide application at the growth stage of the mango crop (immature fruits). It is not applicable if pesticide application is given to mature mango fruits (fully grown). As a thumb rule NO pesticide application should be given to mango crop 1 month ~~before~~ within harvest.

Residue analysis of pesticides on mango

Pesticide residue analysis in mango is carried out in the Pesticide Residue Laboratory, ICAR-IIHR, Bangalore using the QuEChERS method in conjunction with liquid chromatography mass spectrometry (LC-MS/MS), gas chromatography mass spectrometry GC-MS) and gas chromatography (GC).

QuEChERS Analytical Method

Cut 2 kg mango fruits were into small pieces.
Homogenize in a high volume Robot Coupe homogenizer

↓

Place 15 g sample in 50 mL polypropelene tube

↓

Add 15 mL of 1% acetic acid in HPLC grade acetonitrile

↓

Add 6 g anhydrous magnesium sulphate, 1.5g of sodium acetate, mixed thoroughly by shaking and mix for 2 min using a Vortex mixer.

↓

Centrifuge the tubes at 10,000 rpm for 10 min.

↓

Place 4 mL of the upper acetonitrile extract in 15-mLpolypropelene tube containing 50 mg primary secondary amine (PSA) sorbent and 150 mg anhydrous magnesium sulphate per mL of extract.

↓

Shake the tubes vigorously and mix for 1 min using a Vortex mixer.

Centrifuge at 10,000 rpm for 10 min.

Draw 2 ml acetonitrile extract and pass through 0.2 µm PTFE membrane filters.
Analyze by GC, GC-MS and LC-MS/MS

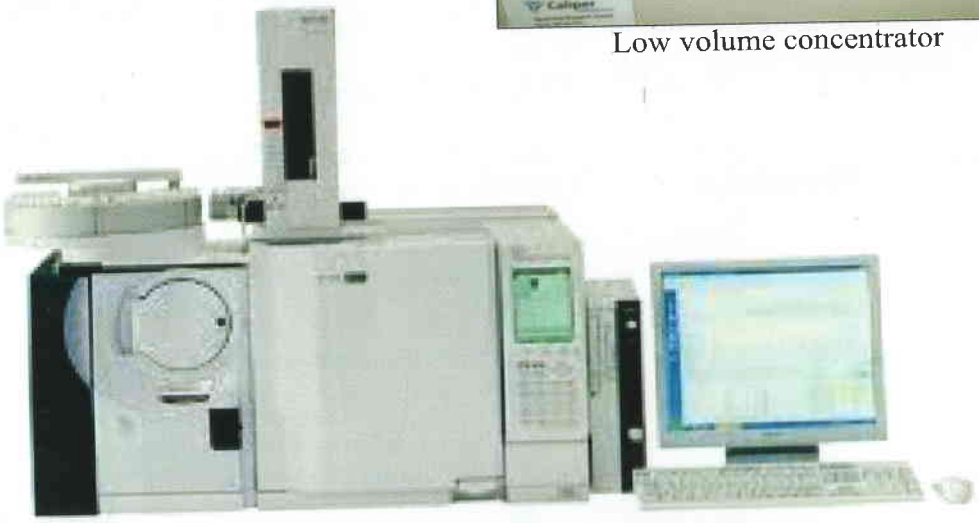
Instruments used for pesticide residue analysis

Robot Coupe homogenizer

Vortex mixer

Centrifuge

Low volume concentrator



Gas Chromatography Mass Spectrometry

Liquid Chromatography Mass Spectrometry

Gas Chromatography

The GLOBALGAP standard

The Global GAP is the internationally recognised set of standards dedicated to Good Agricultural Practices (GAP). It is a standard set to ensure safety of food for the human community. GLOBALGAP is a set of standards designed to apply voluntarily for agriculture production (crop, livestock and fisheries) worldwide. Safe agricultural productions can only ensure safety of the food on the table. The aim of GLOBALGAP is to have sustainable agriculture development in the countries worldwide. Following GLOBALGAP standard is very important as it not only imparts increased acceptability of the product in foreign markets, but also leads to reduced cost of production due to lesser use of pesticides, chemicals, etc.

The requirements of GLOBALGAP

- Record keeping and internal self assessment/inspection
- Site history and site management
- Workers health, safety and welfare
- Waste and pollution management
- Environment and conservation
- Traceability
- Soil and sustainable management.
- Irrigation and fertigation
- Harvesting
- Produce handling

Advantages of Good Agricultural Practice (GAP)

- Good agricultural practices are a set of recommendations that can help improve the quality and safety of the produce grown.
- These guidelines can be adapted/ incorporated into any production system.
- It is knowing, understanding, planning, measuring, recording and managing to achieve the production goals.
- GAP in addition to improving the yield and quality of the products, also has environmental and social dimensions.
- Implementation of GAP would promote optimum utilization of resources such as pesticides, fertilizers, water and eco-friendly agriculture.
- Its social dimension would be to protect the agricultural workers' health from improper use of chemicals and pesticides.
- Crops produced as per good agricultural practices are considered safe for consumption.

Post-harvest application of pesticides

- Use of pesticide should be avoided after harvest of the mango fruits, and non-chemical control method should be adopted.
- Post-harvest pests and diseases should be controlled in the field before harvest of the crop.

Minimize the chances of pesticide residues in harvested mango

- Wash thoroughly under running water before consuming mangoes.
- Wash the produce, even if it is grown organically.
- Peel the fruits whenever possible.
- Wash raw mangoes thoroughly and dry with a clean cloth towel if peel is retained.

References

1.http://www.isoindia.org/iso_Global_GAP.php

2.http://agriexchange.apeda.gov.in/Market%20Profile/one/MANGO.aspx

3.http://ec.europa.eu/food/plant/pesticides/eu-pesticides-database/ public/?event=homepage language=EN

4. Australia New Zealand Food Standards Code – Schedule 20 – Maximum residue limits.htm

5. https://secure.pesticides.gov.uk/MRLs/mrls.asp?page=1

6. http://www.fao.org/fao-who-codexalimentarius/standards/pestres/commodities-detail/en/?c_id=134

7. http://cibrc.nic.in/mup.htm

8. http://www.ncipm.org.in/NCIPMPDFs/Pest_of_Fruit_Final.pdf

9. http://www.m5.ws001.squarestart.ne.jp/foundation/fooddtl.php?f_inq=11600

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Protection to be used while Spraying

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