CODE OF GOOD AGRICULTURAL PRACTICES (GAP) FOR MANGO

PNS/BAFPS 45:2009

EXPLANATORY MANUAL

DEPARTMENT OF AGRICULTURE (DA)
BUREAU OF AGRICULTURE AND FISHERIES STANDARDS (BAFS)

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Explanatory Manual

Code of Good Agricultural Practices (GAP) for Mango (PNS/BAFPS 45:2009)

Department of Agriculture (DA)
Bureau of Agriculture and Fisheries Standards (BAFS)
Quezon City, 2025

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Reader's Guide

This Explanatory Manual (EM) complements the Philippine National Standard (PNS) Code of Good Agricultural Practice (GAP) for Mango (PNS/BAFS 45:2009). The PNS outlines practices for the pre- and post-production of safe and high-quality mangoes intended for domestic and export markets. It provides guidelines on farm location, structure, and maintenance, cultural and farm management, integrated pest management (IPM), and pesticide management to support GAP compliance.

This EM is specifically designed to aid readers in understanding the provisions of the PNS. It is intended for regulatory personnel, industry professionals, and individuals involved in mango production, offering clarity, insights, and practical guidance to encourage the adoption and implementation of PNS requirements.

The content of this EM mirrors the section numbers of the PNS for easy cross-referencing. Explanatory notes, which provide additional explanations and interpretations of PNS provisions, are included to assist readers. These notes are placed inside yellow boxes to distinguish them from the PNS provisions. Furthermore, photographs, images, illustrations, and examples of anecdotal practices are incorporated to clarify the PNS provisions and offer practical insights. Note that this EM presents the minimum requirements as stated in the PNS and does not include additional regulatory requirements beyond the scope of the PNS.

For more updates and detailed information about the PNS and other knowledge products (KPs), readers are encouraged to visit the DA-BAFS website at www.bafs.da.gov.ph or follow the DA-BAFS Facebook page at www.facebook.com/da.bafs.

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Director's Message

I am honored to present to you the Explanatory Manual (EM) for the Philippine National Standard (PNS) Code of Good Agricultural Practices (GAP) for Mango. This Manual represents a collaborative effort among the Department of Agriculture-Bureau of Agriculture and Fisheries Standards (DA-BAFS), the Technical Working Group (TWG), and our dedicated stakeholders who have provided invaluable insights throughout its development.

This Manual was developed to address the need for a harmonized understanding and interpretation of the PNS provisions. It provides detailed explanations, practical examples, images, and illustrations to guide mango producers, PhilGAP inspectors, agricultural extension workers, and other stakeholders in the effective implementation of GAP principles.

I extend my deepest gratitude to the TWG for their dedication and expertise in crafting this Manual. Your commitment has been instrumental in developing a product that empowers our farmers and strengthens our agricultural standards system.

I hope that this Explanatory Manual will serve as a valuable resource in promoting the adoption of GAP principles and ensuring the production of safe, high-quality mangoes. Together, let us work toward a future where sustainable and safe food systems contribute to the growth and prosperity of the agriculture sector.

May this Manual guide and inspire you in your journey toward agricultural excellence.

MARY GRACE R. MANDIGMA, PFT
Officer-in-Charge, Director

List of Acronyms

A.I.	Active ingredient
AMIA	Adaptation and Mitigation Initiative in Agriculture
ASEAN	Association of South East Asian Nations
ATI	Agricultural Training Institute
BAFS	Bureau of Agriculture and Fisheries Standards
BSWM	Bureau of Soils and Water Management
BPI	Bureau of Plant Industry
DA	Department of Agriculture
DAFI	Days after flower induction
DENR	Department of Environment and Natural Resources
DOLE	Department of Labor and Employment
DOST	Department of Science and Technology
EIA	Environmental Impact Assessment
EM	Explanatory Manual
FPA	Fertilizer and Pesticide Authority
FAO	Food and Agriculture Organization
GAP	Good Agricultural Practices
HWT	Hot water treatment
IPM	Integrated Pest Management
ITDI	Industrial Technology Development Institute
MoA	Mode of action
MRL	Maximum Residue Limits
NCCAG	National Color-Coded Agricultural Guide
NCPC	National Crop Protection Center
NSIC	National Seed Industry Council
NSQCS	National Seed Quality Control Services
PAGASA	Philippine Atmospheric, Geophysical and Astronomical Services Administration
PHTRC	Postharvest Horticulture Training and Research Center
PNS	Philippine National Standard
PPE	Personal protective equipment
RFO	Regional Field Office
TWG	Technical Working Group
UPLB	University of the Philippines Los Baños
VHT	Vapor heat treatment

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Foreword

The DA-BAFS Technical Services Division (TSD) generated a Priority List for PNS Promotion for 2024 based on established prioritization criteria. The list included the PNS Code of GAP for Mango (PNS/BAFPS 45:2009) for re-promotion. This Standard covers the practices for pre- and post-production of safe and high-quality mangoes intended for domestic and export markets. This Code provides information on mango farm location, farm structure and maintenance, cultural and farm management, integrated pest management (IPM), and pesticide management geared toward GAP compliance.

To assist the Bureau of Plant Industry (BPI) Food Safety Officers, PhilGAP inspectors, the DA Regional Field Offices, and the Food Safety Compliance Officers, an EM was developed to provide supplementary material to the standard, further clarify specific PNS texts, and provide more details on the minimum requirements.

The TWG, created specifically for the purpose, assisted in completing the EM, given the expressed urgency for this supplementary material to ensure consumer safety and facilitate trade. The TWG consisted of representatives from government agencies, academe, and private sector organizations. The establishment of this TWG was formalized through Special Order (SO) No. 369, series of 2024, which created the TWG for the Development of Knowledge Products of PNS.

To draft this EM, a series of meetings and writeshop were conducted. The photographs and other relevant information gathered during the field data gathering activities in Zambales and Guimaras were incorporated into the supplementary material. The TWG discussed and finalized the draft over a period of one year (February 2024 to February 2025) before it was submitted to DA-BAFS for final editing, proofreading, and layout. The draft EM was also subjected to a pre-testing activity to gather insights from the target users/implementers of the PNS before it was published in its final form.

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Section I

Farm location

1. For existing farms, the following factors may be taken into consideration in evaluating the possible sources of chemical, biological or physical contaminations: prior land use of the farm, its current use and activities of neighboring farms or lands. It should not be a source of contamination (e.g. former mining site or dumpsite).

Explanatory Note:

To evaluate the possible contamination in a farm, a **risk assessment** can be conducted. The following are the basic risk assessment steps:

1. Identification of hazards

Hazards can be identified by:

- observing the site
- learning the history of the site usage
- seeking information from neighbors regarding their activities.

Prior land uses that can be a source of contamination include (ASEAN, 2007):

- storage of animal manure
- intensive animal grazing
- treatment or storage of human sewage, biosolids, or reclaimed water
- dumping of excess chemicals
- treatment with chemicals to control pests
- landfill
- industrial factory

2. Evaluation of risks and implementation of precautionary measures

The sites should be further evaluated through analysis and characterization of the identified contaminants. This involves conducting a **risk analysis**, which is the process of identifying and assessing factors that may jeopardize the success of a project or the safety of a system or environment. In agriculture, it includes evaluating the likelihood of hazards occurring and their potential impact on farm production or income (Food and Agriculture Organization (FAO), n.d.).

Following the risk analysis, **risk characterization** is performed. This step integrates information from hazard identification and exposure assessment to estimate the probability and severity of adverse effects on agricultural systems. It provides a qualitative or quantitative evaluation of the potential risks, considering factors such as the extent of exposure and the sensitivity of the affected entities (US Environmental Protection Agency (EPA), n.d.).

Based on the outcomes of risk characterization, appropriate precautionary measures can be implemented to mitigate identified risks and ensure the safety and productivity of the farm.

After conducting risk characterization, laboratory analysis is necessary to confirm potential contaminants and assess their impact. The following government institutions can provide laboratory services for analyzing contaminants:

DA - Bureau of Plant Industry (BPI) - Plant Product Safety Services Division (PPSSD) and its Satellite Laboratories

Address: 692 San Andres St., Malate, Manila
Contact number: (02) 8524 0708/0779
Email address: ppssdbpi@gmail.com

DA - Bureau of Soils and Water Management (BSWM) and its Regional Laboratories

Address: SRDC Bldg. Elliptical Road corner Visayas Avenue, Diliman, Quezon City
Contact No.: (02) 8529-7640 local 301

DA - Regional Field Office (RFO) - Integrated Laboratory Division

Address and contact number: refer to DA website (da.gov.ph)

Department of Science and Technology (DOST) - Industrial Technology Development Institute (ITDI)

Address: DOST-ITDI Bldg., DOST Cmpd., General Santos Avenue, Bicutan, Taguig City
Contact No.: (632) 86837750 local 2182, (632) 88372071 local 2182

University of the Philippines Los Baños (UPLB)

Address: College, Laguna

- **National Crop Protection Center (NCPC)**
  Contact No.: 09958933931/09310571496
  Email Address: ncpc.uplb@up.edu.ph
- **BIOTECH**
  Contact No.: +63 947 5859 416
  Email Address: biotech.uplb@up.edu.ph

Precautionary measures that can be implemented are based on the evaluated risks. In doing the evaluation, the assistance of local authorities (e.g., local government unit or DA RFO) is valuable. Other sources of useful and relevant information are published research and references.

From the results of the evaluation, the corresponding measure will help eliminate or minimize the hazards and risks identified.

3. Implementation of changes (as appropriate)

Actions are taken based on assessment findings, with the most critical issues given the immediate attention.

4. Monitoring and review

Regular monitoring and review of actions provide the necessary information on the effectiveness of measures or changes made to address the hazards identified and minimize the risks. The routine of reviewing assessments is established even if no major changes occur.

2. Where a significant risk of a chemical, biological or physical hazard is present, remedial measures must be taken and records of such activities are recorded.

Explanatory Note:

Table 1 below shows the possible hazards that may occur in farms and their corresponding remedial measures.

Table 1. Examples of hazards, sources of soil contamination and possible remedial measures

Hazard	Source of soil contamination	Remedial measure
Biological	Animal feces or and human sewage from adjacent lands contaminating the water used for irrigation	Proper sewage system
Chemical	Pesticides or heavy metals present in soil from previous use or from leakage from industrial sites	Phytoremediation

3. When selecting new areas for mango plantation, the following may be used as guide in assessing suitability of the land for mango production. The area should preferably be rich in organic matter and suitable for mango production:

   a) Soil characteristics – well drained soil; pH of 5.5 to 7.5.
   b) Climatic conditions – preferably with distinct wet and dry season; with four (4) months dry period; with the temperature of 22 °C - 34 °C
   c) Elevation –preferably the area should not be higher than 600 meters above sea level

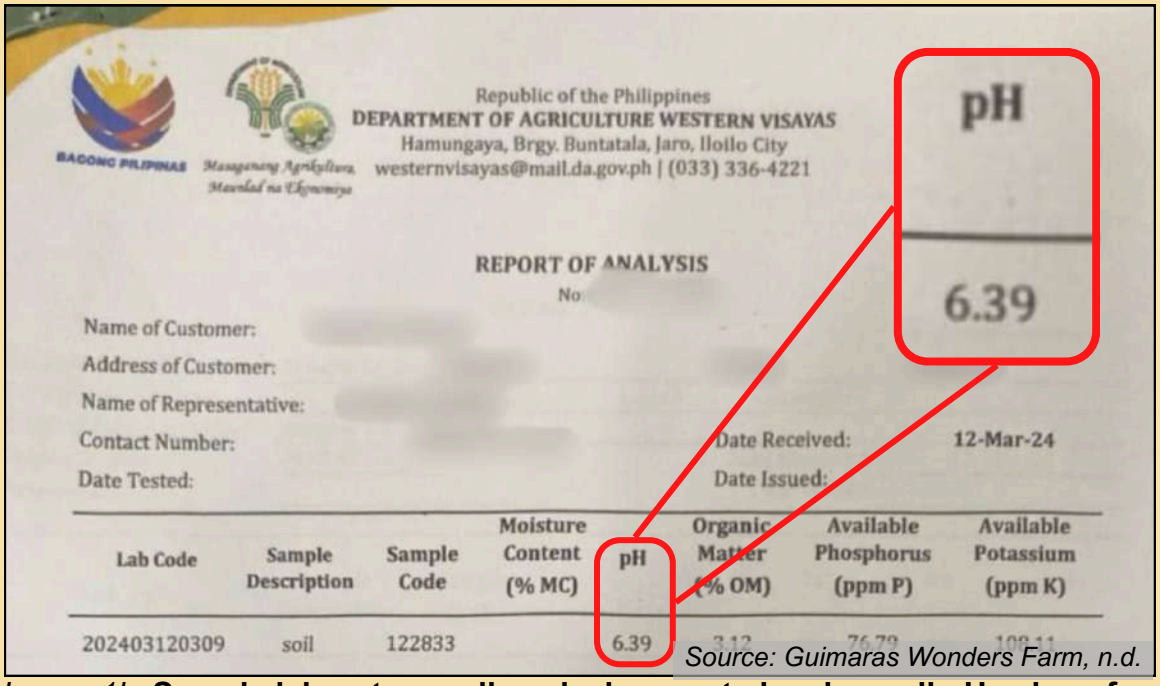
Explanatory Note:

A well-drained soil is essential because mango trees have sensitive roots that are prone to rot in waterlogged conditions. Well-drained soil allows excess water to drain away, preventing root rot and ensuring proper oxygen availability for healthy root growth.

As for the soil pH, the slightly acidic to slightly basic pH range provides optimal nutrient uptake for mango trees. Highly acidic or basic soils can limit the availability of essential nutrients, hindering growth and fruit production (Bally, 2006). Soil pH can be determined using a soil test kit, but for more accurate results, a standard laboratory soil analysis can be done.

Source: BSWM, n.d.

Image 1a. **Determining the soil pH using a soil testing kit**



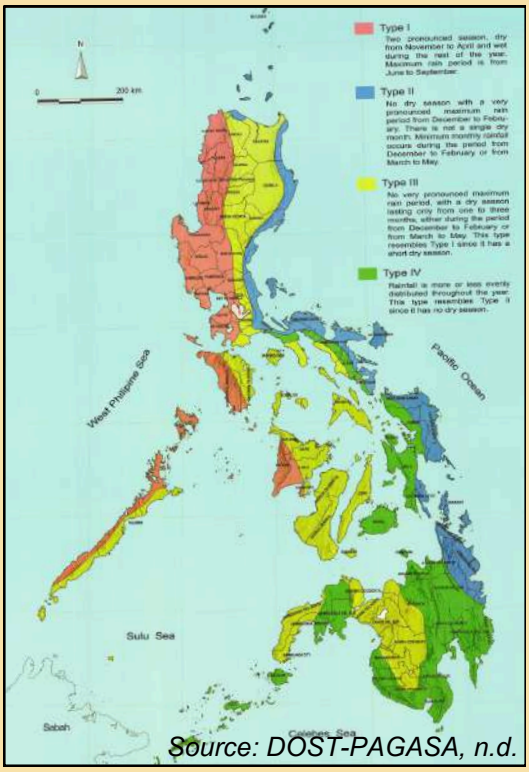
Source: Guimaras Wonders Farm, n.d.

Image 1b. **Sample laboratory soil analysis report showing soil pH value of 6.39 that is within the recommended pH range (*i.e.* pH 5.5-7.5)**

Mango trees need a clear wet and dry season to grow and produce fruit well. During the wet season, the trees produce new flushes/leaves, while the dry season helps them form flowers and improve fruit quality. A long dry period of about 4 months signals the trees to start flowering, which results in better fruit harvests (International Tropical Fruits Network, 2016).

Mango trees are tropical and prefer warm temperatures for optimal growth and fruit development. The temperature range of 22 °C - 34 °C allows for efficient metabolic processes and fruit ripening (Flowerree, n.d.). Mango trees are adapted to warm, low-elevation environments. Higher altitudes can experience cooler temperatures that may not be suitable for optimal growth and fruit production (Bally, 2006).

Climate and weather-related information can be accessed at the DOST - Philippine Atmospheric, Geophysical and Astronomical Services Administration (PAGASA) website: **www.pagasa.dost.gov.ph/information/climate-philippines**



Source: DOST-PAGASA, n.d.

Image 1c. **Climate Map of the Philippines (1951-2010)**

4. A farm land with good drainage and a flat to slightly rolling terrain is ideal for growing mangoes. A farm topography map should be made available showing the location of crop production sites, windbreakers, water resources, irrigation lines, drainage canals and outlets, roads, buildings, storage facilities and other structures.

Explanatory Note:

The farm map helps the farmer identify potential sources of contamination. For example, the storage area for chemicals should not pose a risk to the production, processing, and packing area, the workers, and the neighborhood.

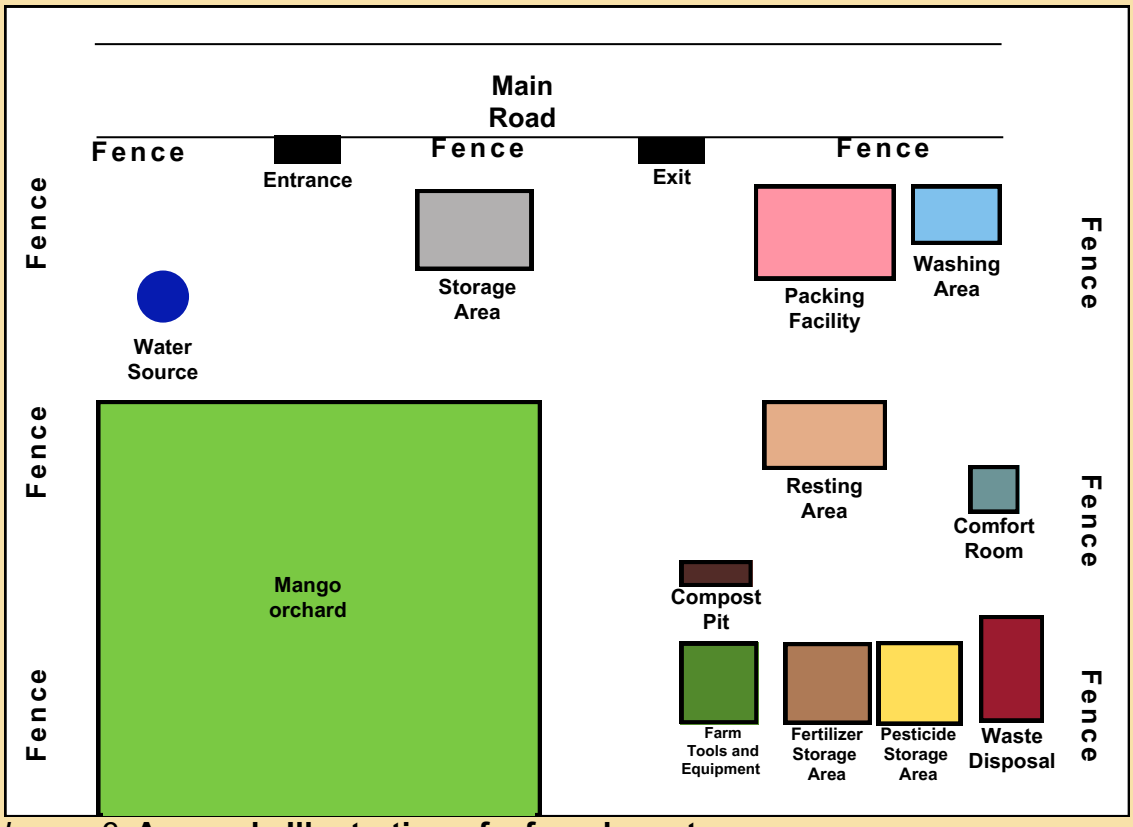


Image 2. **A sample Illustration of a farm layout map**

5. The Bureau of Agricultural Research (BAR) Geographic Information System (GIS)-based maps for mango can also be used as guide as to where to plant mangoes.

Explanatory Note:

In 2017, the DA, through its climate change program, the Adaptation and Mitigation Initiative in Agriculture (AMIA), launched the National Color-Coded Agricultural Guide (NCCAG) Map. This map database can be used for identifying the agricultural areas that are naturally suitable for economically important crops such as mangoes. It overlays data on soil properties, elevation, slope, rainfall pattern, temperature, and climate change-induced multi-hazards.

In 2023, the NCCAG Map Version 2.0 was launched. It now incorporates the latest maps from various authorized mapping agencies, introduces additional layers, and provides users with new interactive features, emphasizing statistical data integration.

The NCCAG Map can be accessed at www.farmersguidemap.da.gov.ph.

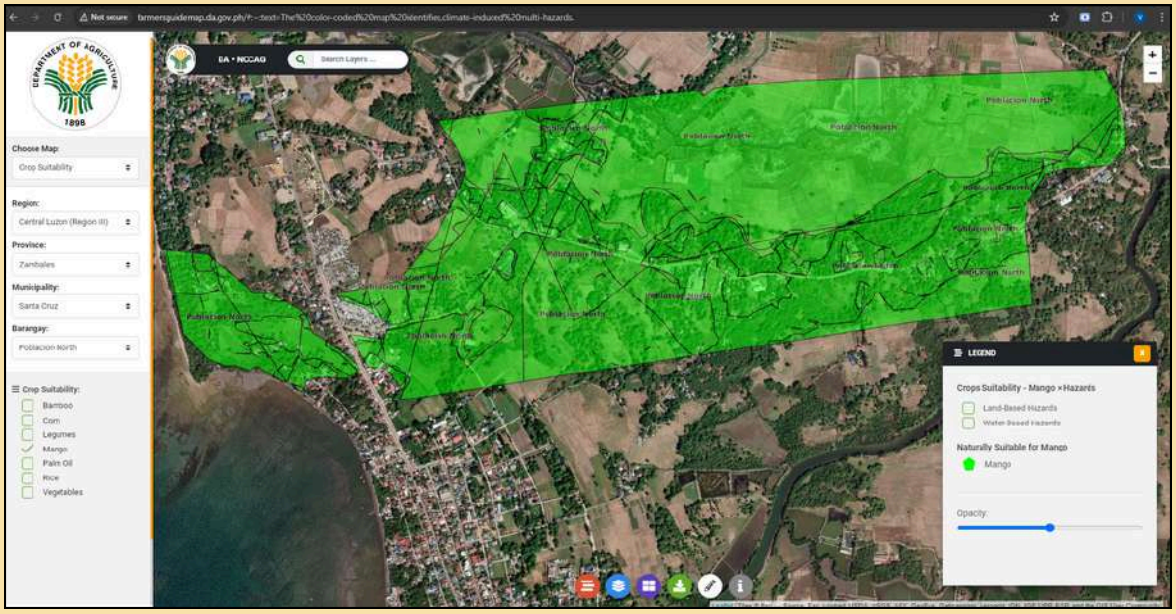


Image 3. **Highlighted areas in the NCCAG crop suitability map shows the areas suitable for commercial-scale mango production**

6. In highly sloping areas which are prone to soil erosion, environmental impact assessment is recommended.

Explanatory Note:

Soil erosion depletes fertile topsoil, reducing agricultural productivity and contributing to sedimentation in water bodies, which can lead to flooding, water pollution, and loss of aquatic habitats. To mitigate these risks, an **Environmental Impact Assessment (EIA)** is required before implementing land-use changes or development projects.

EIA is a systematic process that evaluates the potential environmental effects of a proposed project, identifying preventive and mitigating measures to protect ecosystems and communities (Department of Environment and Natural Resources (DENR), n.d.). In the Philippines, project proponents must engage a **DENR-registered EIA practitioner/consultant** to conduct the assessment and submit an EIA report to the DENR-Environmental Management Bureau (EMB) for review and approval (GreenDev Solutions, n.d.).

As part of erosion control strategies, sustainable land management techniques such as **Sloping Agricultural Land Technology (SALT)** can be implemented. SALT is designed for sloping areas and integrates contour farming, terracing, and cover cropping to minimize soil loss, improve water retention, and enhance farm productivity (ATI, n.d.). By combining EIA with sustainable practices, farmers and land developers can reduce environmental degradation while ensuring long-term agricultural viability.

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Section II

Farm structure and maintenance

Source: Aani Mango Industry Association, n.d.

1. Preferably farm boundaries are enclosed to ensure that there are no stray animals inside the production area, especially during harvesting.

Explanatory Note:

Screens, fences, or walls are often used to keep animals out during important farm tasks like spraying chemicals or harvesting. The method used should match the type of animal and the environment. It is also important to ensure that these methods do not harm other local wildlife (Langley, 2023).

Image 4. **Use of wire fence around the farm**

2. Designated areas or facilities for the working shed of workers and separate sheds for farm implements and equipment should be available. Sheds for farm workers must be provided with adequate and clean comfort rooms.

Explanatory Note:

Aside from toilet facilities, hand-washing facilities should be available and accessible to the workers. The availability of accessible hand-washing facilities and toilets is important for disease prevention, hygiene and sanitation, workplace hygiene, and workers' health and productivity.

The following are important considerations for toilets and hand-washing facilities in the production area or processing area.

- Accessibility means that the facilities are near the workers' work areas and are available at all times. Accessible facilities help lower the chance that workers will relieve themselves in undesignated areas, such as in fields, thereby risking contamination of produce.
- To prevent possible contamination of fields, soil, and irrigation water sources, toilet facilities are properly constructed and located in areas where there is little potential for runoff in the event of heavy rain. This may be determined through proper risk assessment.

- Toilet and hand-washing facilities have a sufficient supply of water, soap, single-use towels, or toilet paper, and a waste container. The wash water is also collected for proper disposal.
- Facilities are operational, adequately ventilated, and regularly cleaned (Lepper et al., n.d.).

Image 5a. **Toilet facility**

Image 5b. **Hand washing area near the farm**

3. Toilet provided for the farm workers must be properly maintained. These should not be close to water sources or in places where rain can wash out contaminants or cause spills.

Explanatory Note:

The disposal of water from toilets and drainage systems is a critical component of sanitation on the farm, as it has an impact on both health and the environment. The following measures minimize health hazards and environmental degradation due to improper disposal of water from toilets and drainage systems:

1. construction of a septic tank;
2. disposal of waste from mobile toilets away from the production area and waterways; and
3. proper maintenance of drainage systems to minimize the risk of flooding and environmental degradation due to stagnant water (Blom, 2015).

4. Storage and packing areas must be kept clean and tidy. Litter and waste materials must be removed immediately from the crop production area. Effective measures (*i.e.* composting) must be taken to dispense of the trash or waste material on the farm.

Explanatory Note:

Biodegradable wastes, such as used fruit bags, leaves, branches, or ripened/ rejected fruits, may be brought to a compost pit for the production of organic compost. Non-biodegradable and recyclable wastes should be placed in properly segregated waste bins.

Image 6. **Vermicompost beds for biodegradable mango farm wastes**

5. Irrigation system should be clean and well-maintained to provide effective delivery of clean water, prevent blockage and backflow.

6. All equipment associated with cultivation, harvesting storage of mangoes should be clean and maintained at optimum operating conditions.

Explanatory Note:

Cleaning removes dirt, dust, and germs from surfaces or objects using soap or detergent, while disinfecting uses chemicals (disinfectants) to kill germs on surfaces and objects (US EPA, 2022).

Equipment and tools should be thoroughly washed after use. Cross-contamination can occur if the same equipment and containers are used for hauling or storing agricultural chemicals, lubricants, oil, cleaning chemicals, plant or other debris, tools, and others (BAFS, 2021).

Image 7. **Clean crates are placed in a separate clean area**

There should be separate cleaning areas for non-hazardous and hazardous equipment to avoid cross-contamination.

7. Adequate areas for waste collection measures and storage for biodegradable and non-biodegradable wastes should be provided. Non-biodegradable wastes should be separated from biodegradable waste materials.

Explanatory Note:

The image below shows a good example of properly segregated, color-coded waste bins.

Image 8. **Properly segragated farm wastes**

8. Domestic and farm animals, except those that will be used for transport, should be excluded from the production site and packing shed during harvesting. Such animals must be on leash to prevent them from entering the production areas especially during harvesting.

Explanatory Note:

The images below show how animals are prevented from entering the farm during spraying and harvesting operations.

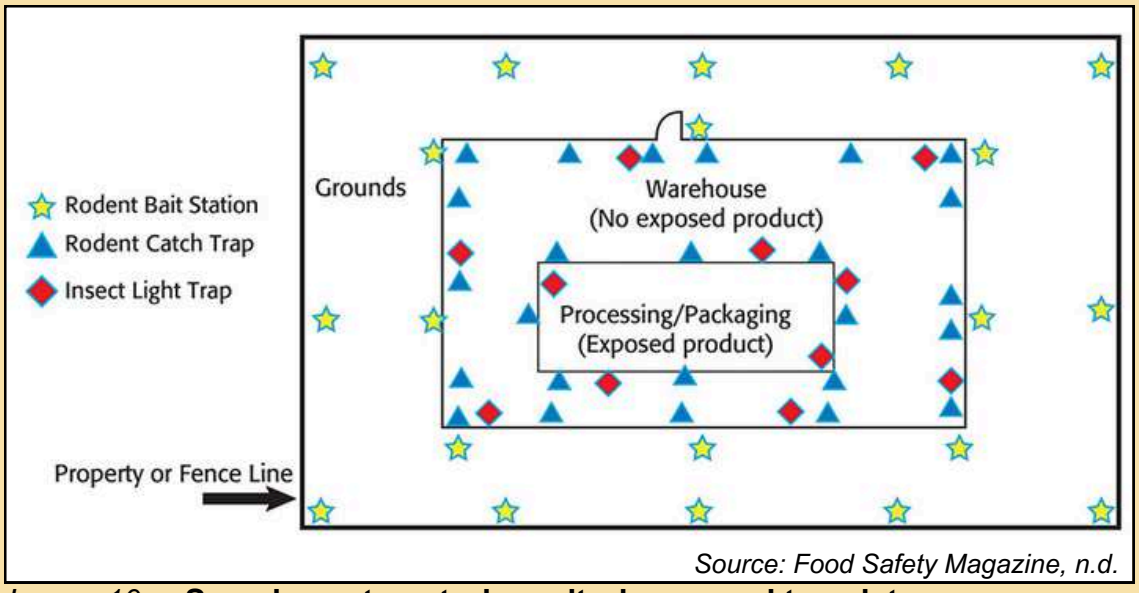
Image 9. **Dos and don't in preventing the entry of animals in farms**

9. When pest control measures such as baits, traps and vermin control are used, the location, date of application and a trained person assigned for the maintenance should be properly recorded.

Explanatory Note:

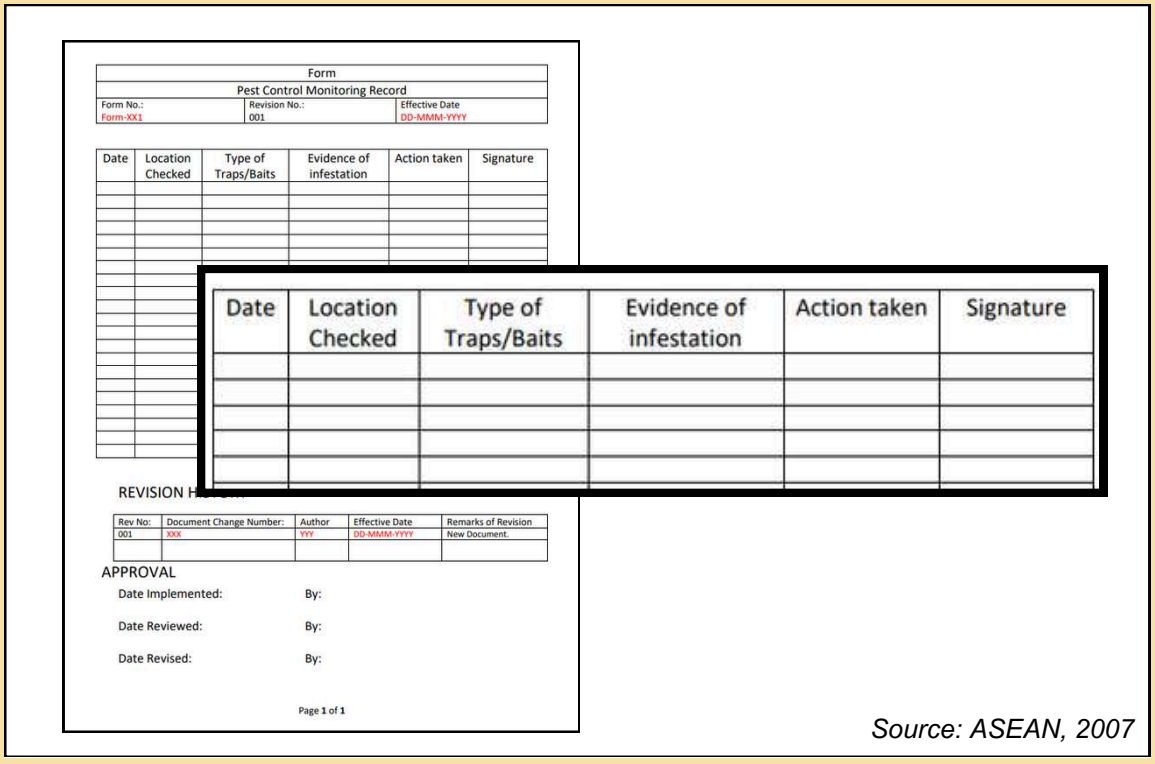
To minimize the risk of chemical contamination, baits and traps used for pest control must be placed and managed carefully. This ensures that chemicals don't accidentally spread onto produce, equipment, containers, or other materials. The exact locations of these baits and traps should be recorded to show that the risk of cross-contamination is adequately controlled (ASEAN, 2007).

The locations can be recorded on a map of the building or structure, and properly recorded on a monitoring sheet. A sample illustration of the map and a monitoring record template can be seen below.



Source: Food Safety Magazine, n.d.

Image 10a. **Sample pest control monitoring record template**



Form

Pest Control Monitoring Record

Form No.:	Revision No.:	Effective Date
Form-XX1	001	DD-MMM-YYYY

Date	Location Checked	Type of Traps/Baits	Evidence of infestation	Action taken	Signature

REVISION H

Rev No:	Document Change Number:	Author	Effective Date	Remarks of Revision
001	XXX	YYY	DD-MMM-YYYY	New Document.

APPROVAL

Date Implemented: By:

Date Reviewed: By:

Date Revised: By:

Page 1 of 1

Source: ASEAN, 2007

Image 10b. **Sample pest control monitoring record template**

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Section III

Cultural management

A. Quality planting materials

1. For the establishment of new farms, it is recommended that cultivars are chosen based on resistance to pest, suitability to the site, yield potential and market preference.

Explanatory Note:

The Bureau of Plant Industry - National Seed Industry Council (BPI-NSIC) issues a **List of Registered Varieties of Crops,** including mangoes that are reliable and superior in field performance.

Selecting planting materials that are resistant to pests and diseases will reduce the need for chemical pesticides and the risk of chemical contamination of the environment. Planting material can be a source of chemical contamination through chemicals used to treat seeds or control pests during nursery production.

The NSIC Registry serves as a reference for farmers, seed producers, and other stakeholders to identify approved and recommended crop varieties that have undergone evaluation and testing for their performance, adaptability, and quality.

The list is available in their database at https://nsic.buplant.da.gov.ph/registry.php/.

The mango trees are tagged accordingly by the BPI-National Seed Quality Control Services (NSQCS). White tags are for parent trees, while red tags are for foundation trees. Planting materials from the certified trees are also tagged individually to establish traceability.

The BPI-NSQCS plant material certification/tagging ensures the quality and genetic purity of NSIC Registered varieties grown by nursery operators/farmers.

Image 11. **NSQCS tags of NSIC-registered Carabao mango strains - a) parent tree; and b) foundation tree**

2. The following are the recommended strains of Carabao mango approved and registered by the National Seed Industry Council (NSIC).

Explanatory Note:

Table 2. List of NSIC-approved and registered carabao mango strains (as of September 2024)

NSIC accession Name and code	Date approved	Contact person/Owner and address
GES 73 PSB 91-Mn	1991	National Mango Crop Research and Development Center (NMCRDC) San Miguel, Jordan, Guimaras
GES 77 PSB 91-Mn	1991	NMCRDC San Miguel, Jordan, Guimaras
GES 84 PSB 91-Mn	1991	NMCRDC San Miguel, Jordan, Guimaras
GES 85 PSB 91-Mn	1991	NMCRDC San Miguel, Jordan, Guimaras
GOLEZ Strain PSB 91-Mn	1991	NMCRDC San Miguel, Jordan, Guimaras
Carabao Lamao # 1 PSB 91-Mn	1991	Institute of Plant Breeding U.P. Los Banos, Laguna
MMSU Gold NSIC 1997 Mn 01	1997	Mariano Marcos State University (MMSU) Batac, Ilocos Norte
Fresco NSIC 2000 Mn 02	2000	Mrs. Preveda G. Fresco Aguilar, San Lorenzo, Guimaras
Talaban NSIC 2000 Mn 03	2002	Mr. Salvio Talaban Aguilar, San Lorenzo, Guimaras

(continued)

NSIC accession Name and code	Date approved	Contact person/Owner and address
Sweet Elena NSIC 2002 Mn 04	2002	Mrs. Nida Malabed Sta. Cruz, Zambales
Tanaleon NSIC 2004 Mn 05	2004	Mr. Dominador T. Tanaleon Camansi, Aguilar, San Lorenzo, Guimaras
Guimaras Super (Galila) NSIC 2004 Mn 06	2004	Mr. Cesar Galila Sitio Ugatan, Brgy. Poblacion, Nueva Valencia, Guimaras
Efondo NSIC 2005 Mn 07	2005	Mr. Marciano M. Efondo Milan, Sibunag, Guimaras
Corcino NSIC 2005 Mn 08	2005	Mr. Roque Corcino 7 Piddig, Ilocos Norte
Prima NSIC 2005 Mn 09	2005	Ms. Prima Franco Sinait, Ilocos Sur
JTA Sweet NSIC 2009 Mn 10	2008	Ma. Luz T. Animas Constancia, San Lorenzo, Guimaras
P-1 King Rodolfo NSIC 2009 Mn 11	2008	Mrs. Hilaria Moselina dela Cruz Sabang, Sta.Cruz, Zambales
BPI Golden Pico NSIC 2017 Mn 12	2017	NMCRDC San Miguel, Jordan, Guimaras
A3 NSIC 2018 Mn 13	2018	Ms. Athene Acayan Abad Zone 1, Panalingan, Iba, Zambales

(continued)

NSIC accession Name and code	Date approved	Contact person/Owner and address
Mangoming' Mango NSIC 2018 Mn 14	2018	Ms. Maria Socorro M. Bodiongan 24 Pittsburgh, Celdran Villages Subd., Barangay Tubod, Iligan City
R3-Lady Rhea NSIC 2019 Mn 15	2019	Ms. Hilaria Moselina dela Cruz/Mr. Jesus Q. dela Cruz Sabang, Sta. Cruz, Zambales
Prince Jesse NSIC 2018 Mn 16	2019	Ms. Hilaria Moselina dela Cruz/Mr. Jesus Q. dela Cruz Sabang, Sta. Cruz, Zambales
Farrales NSIC 2020 Mn 17	2020	Ms. Perla A. Farrales Purok 5, Brgy. Nagbayan, Castellejos, Zambales
BPI Golden Pico NSIC 2017 Mn 12	2017	NMCRDC San Miguel, Jordan, Guimaras
A3 NSIC 2018 Mn 13	2018	Ms. Athene Acayan Abad Zone 1, Panalingan, Iba, Zambales
Mangoming' Mango NSIC 2018 Mn 14	2018	Ms. Maria Socorro M. Bodiongan 24 Pittsburgh, Celdran Villages Subd., Barangay Tubod, Iligan City
R3-Lady Rhea NSIC 2019 Mn 15	2019	Ms. Hilaria Moselina dela Cruz/Mr. Jesus Q. dela Cruz Sabang, Sta. Cruz, Zambales

(continued)

NSIC accession Name and code	Date approved	Contact person/Owner and address
Prince Jesse NSIC 2018 Mn 16	2019	Ms. Hilaria Moselina dela Cruz/Mr. Jesus Q. dela Cruz Sabang, Sta. Cruz, Zambales
Farrales NSIC 2020 Mn 17	2020	Ms. Perla A. Farrales Purok 5, Brgy. Nagbayan, Castellejos, Zambales

3. Scions of these registered varieties/strains can be gathered from the parent trees or from established foundation/scion groves validated and certified by the Bureau of Plant Industry – National Seed Quality Control Services (BPI-NSQCS).

Explanatory Note:

Farmers should source the scions from BPI-registered nurseries. Otherwise, the desired characteristics of the variety cannot be achieved.

Table 3. List of established foundation/scion groves with certified mango trees as sources of quality planting materials (as of September 2024)

Region/ Province	Strain	No. of trees tagged	Contact person/s
DA-ISS 1, Dingras, Ilocos Norte	Lamao #1	27	Ms. Wilma Ibea Station Chief Ms. Myrna Enriquez Agric. 2-HVCC Coordinator
DA-ISS 2, Batac, Ilocos Norte	Lamao #1 GES 77 GES #84	34 2 17	Ms. Wilhelmina Castañeda Station Chief Ms. Alma Ribac Chief, NSQCS Satellite Reg. 1

(continued)

Region/ Province	Strain	No. of trees tagged	Contact person/s
ILIARC-ADP, San Ildefonso, Ilocos Sur	Lamao #1 GES 84	51 15	Dr. Larina G. Zabala OIC, ADP Station Mrs. Visitacion Mendoza Crops Project Leader
MMSU, Batac, Ilocos Norte	MMSU Gold	29	Dr. Gliceria Pascua Professor/Project Leader
DA-ILIARC DMMMSU, Bacnotan, La Union	GES 85	2	Dr. Consuelo N. Belarmino Asst. Manager for Technical Programs Mr. Nestor Blanco Agriculturist II
DA-ISS 3, Sta. Barbara, Pangasinan	Lamao #1 GES 84 GES 77	5 2 3	Mr. Wilfredo Pal-laya Station Chief Dr. Benito Andaya NSQCS Reg. 1 Chief
CVIARC, Ilagan, Isabela	Lamao #1	17	Engr. William Contillo Agriculturist II
CLIARC Lowland Zone, Paraiso, Tarlac City	GES 77	34	Dr. Irene M. Adion Station Chief
Lipa Experiment Station	MMSU Gold GES 84 GES 77	11 10 22	Dr. Gavina Huelgas Chief, LAES

(continued)

Region/ Province	Strain	No. of trees tagged	Contact person/s
BPI--Guimaras NMRDC	GES 85 GES 73 GES 77 GES 84 Lamao # 1 Talaban Fresco	52 42 40 48 12 5 10	Mr. Yondre Yonder OIC, NMRDC
DA-EVIARC, Abuyog, Leyte	GES 73 GES 77 GES 84 GES 85 Galila Talaban Fresco	7 7 5 6 5 5 5	Dr. Carlos dela Cruz Center Chief

4. Grafted seedlings will also be tagged as certified in accredited nurseries if scions are gathered from the certified foundation/scion trees. The Bureau of Plant Industry – Crop Production Division (BPI-CPD) was mandated to do accreditation of plant nurseries.

Explanatory Note:

Formerly, the BPI-CPD handled the accreditation of plant nurseries. However, due to the issuance of the DA Department Circular No. 01 Series of 2020 or the *Guidelines on Plant Nursery Accreditation for Government and Private Plant Nursery Operators and their Nurseries*, the process of plant nursery accreditation was transferred to BPI-NSQCS. The BPI Crop Research Production Support Division (CRPSD) now serves as the training provider on plant nursery establishment.

The BPI regulates the production, distribution, and regulation of breeder, foundation, and registered seeds (Seed Industry Development Act 1992/RA 7308 S. 1992). The list of accredited seed growers or plant nursery operators is available at the BPI website at https://www.buplant.da.gov.ph.

5. A record of the source of the planting materials, the and date of purchase must be kept in the farm.

Explanatory Note:

A record is kept in case problems are encountered during production or postharvest. The record enables the planting material to be traced back to the supplier/nursery to investigate possible causes of the problem. The record can be an entry into a logbook or an official receipt (ASEAN, 2007).

Planting Material Record

Date	Crop	Variety	Supplier (name and address)	Quantity obtained	Location where planted

Modified - Source: ASEAN, 2007

Image 12. **Sample planting material record template**

6. The minimum age of the grafted planting material should be one (1) year old. Overgrown/too old planting materials should not be recommended.

Explanatory Note:

The optimal age for grafted mango planting material is typically around one year, based on the maturity and compatibility of the rootstock and scion. Research indicates that **rootstocks aged between 6 to 12 months** are commonly used for grafting, as they possess a **well-established root system** capable of supporting the scion's growth. This age range ensures that the rootstock has adequate stem thickness, approximately the diameter of a pencil, facilitating a successful graft union (World Agroforestry Centre, n.d.).

Using older rootstocks (>3 years old) is not advisable. As rootstocks age, they may develop deeper root systems and thicker bark, which can impede the grafting process and reduce the likelihood of graft success. Additionally, older rootstocks may exhibit reduced vigor, potentially affecting the growth and productivity of the grafted plant (Yadav et al., 2019).

Structural issues such as "gooseneck" and curling of primary roots can also occur in older rootstocks, leading to weak anchorage and increased susceptibility to being uprooted by strong winds (Yadav et al., 2019).

B. Land preparation

1. For flat to rolling areas not previously planted with agricultural crops, the land is prepared by plowing at least once and harrowing twice. This is done especially if there is an intention of intercropping mangoes with other crops. For steeper areas, practice minimum tillage by clearing about 2 sq.m. for each plant and digging a hole of at least 1/3 cubic m.

Explanatory Note:

The depth/height of the planting hole may be twice the size of the seedling bag.

2. However, if the site will be used solely as a mango plantation, the area where the mangoes will be transplanted should be cleared of weeds before a hole is dug.

Explanatory Note:

Aside from weeds, big stones and stumps are removed before transplanting. Clearing can be done manually in sloping areas or using a tractor in flat areas.

3. Land preparation is best done before the onset of the rainy season.

Explanatory Note:

Areas with stable water sources, land preparation can be done at any time of the year.

C. Design and distance of planting

1. For flat to slightly rolling areas, the ideal lay-out should follow an east-west orientation to maximize exposure of trees to sunlight.

Explanatory Note:

East-west planting orientation allows maximum exposure to sunlight, provided the topography permits this arrangement. Trees may be planted in other orientations if prevailing winds have a negative influence on crop yields (University of Missouri Center for Agroforestry, 2021).

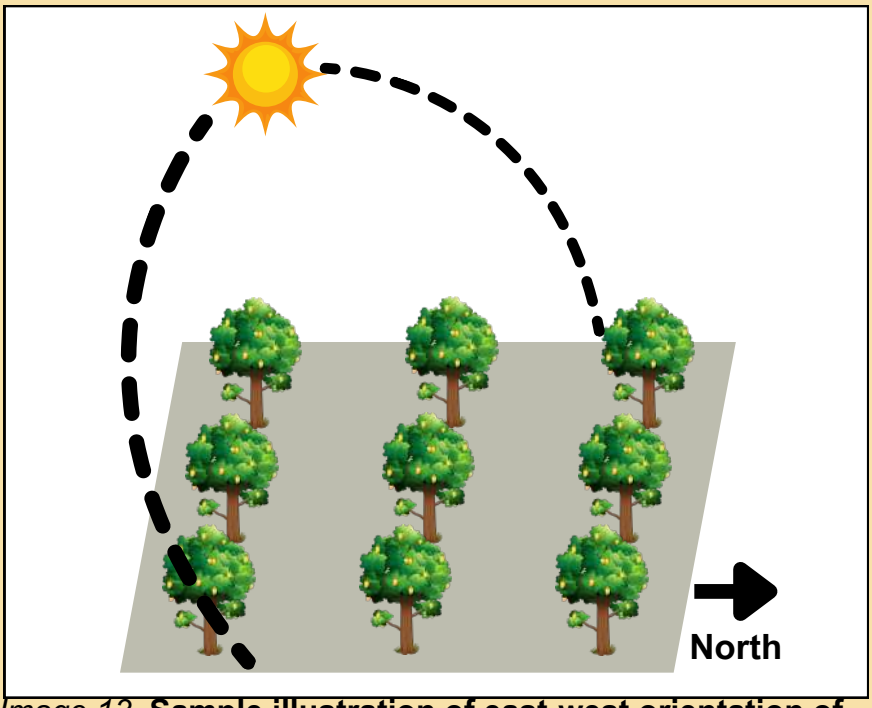


Image 13. **Sample illustration of east-west orientation of planting**

2. In highly sloping areas, contour planting is recommended.

Explanatory Note:

Contour planting prevents erosion by reducing the slope length and the slope angle. Thus, helping the soil absorb rainwater, allowing it to percolate, and preventing runoff (ATI, n.d.).

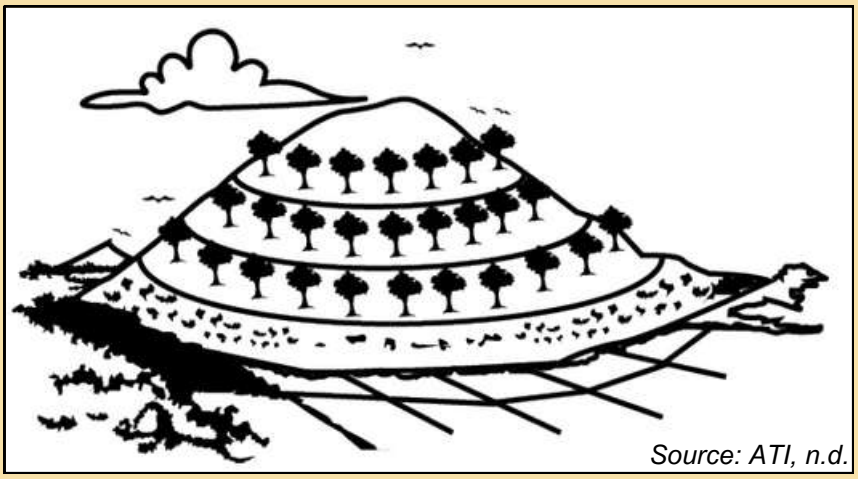


Image 14. **Illustration of contour planted mango trees**

3. The recommended planting distance for carabao mango ranges from 12 m x 12 m to 20 m x 20 m depending on the fertility of the soil and the intended purpose (intercropping).

Explanatory Note:

Planting less than the recommended planting distance can also be done with proper maintenance.

In 1 hectare of land, the following planting distances can be used to grow a certain number of trees using square planting design (Haque & Sakimin, 2022):

- 10m x 10m = 100 trees
- 12m x 12m = 69 trees
- 15m x 15m = 44 trees
- 20m x 20m = 22 trees

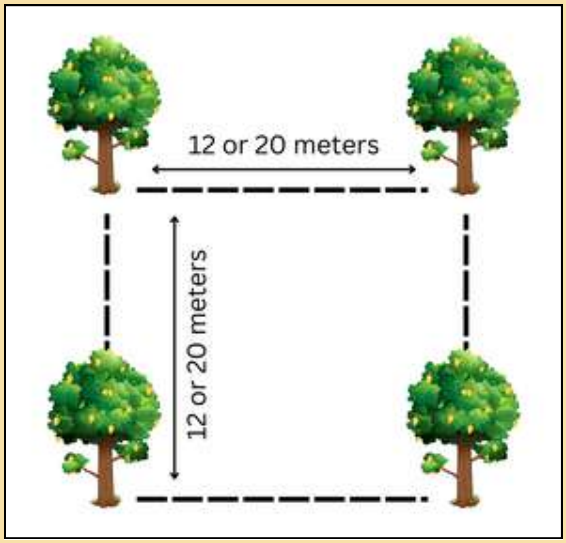


Image 15. **Illustration of the recommended planting distance**

4. The planting design for mangoes may either be square or quincunx. In the latter, a tree is planted in each corner of the square and an additional tree in the center. In the former, one tree is planted in each corner of the square.

Explanatory Note:

Square planting design is easier to maintain and to determine the inventory of trees. Whereas in quincunx, almost double the number of trees can be planted initially (Haque & Sakimin, 2022).

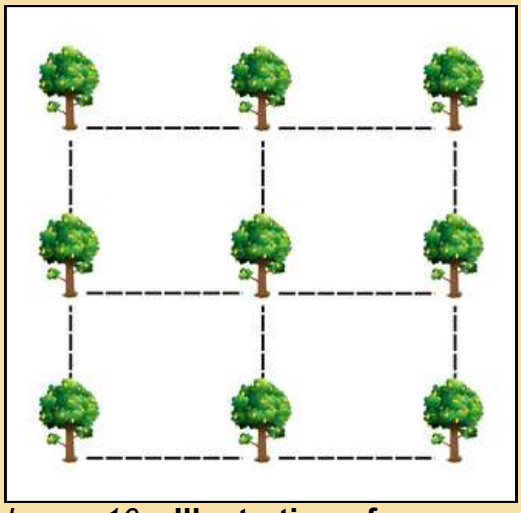


Image 16a. **Illustration of square planting design**

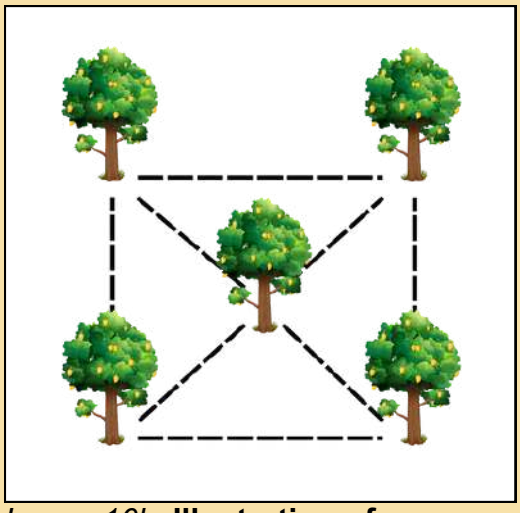


Image 16b. **Illustration of quincunx planting design**

After planting, the individual mango trees may be indexed/tagged with a unique code for proper recording and traceability.

Image 16c. **Mango tree with tag**

D. Cultural management of young trees

Early pruning

1. Formative pruning is done to reduce the height of trees. This is usually done when the tree is about 1 m tall, and the terminal portions are cut/pinched to encourage lateral branching.

2. Three (3) to four (4) branches are allowed to grow to 1 m and then the second cutting or pruning of terminal portions is done until the branches are evenly distributed.

Explanatory Note:

Generally, pruning is not required for young trees except for the removal of disease-infected or insect-infested parts.

Formative pruning is usually done to produce dwarf trees (ATI, n.d.).

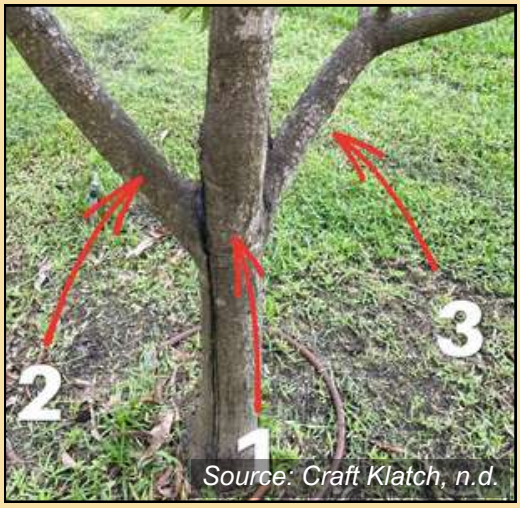


Image 17a. **Three strong branches are maintained**

Image 17b. **Removal of unhealthy parts in young trees**

3. For established young trees, 3-4 year old (at least 3 meter tall), where early pruning is not practiced, the tree is center-pruned to control the height and for proper development of lateral branching. This allows sunlight penetration, air circulation, and facilitates spraying, bagging and harvesting operations.

4. Pruning is suggested to be done during the dry season.

Explanatory Note:

Pruning during the wet season is not recommended since it promotes fungal and microbial growth (Rajput & Rao, 2007). To prevent bacteria and fungi from infecting your newly cut branches, pruning paint (e.g., black paint) may be applied to side branches after the cut regions are dry. This will seal the surface and promote faster healing by holding in water.

In terms of workers' safety, the wet season is not recommended since slipping during pruning activity may occur.

Fertilization

1. Soil and tissue analyses are preferably carried out and used as bases for the amount, kind and timing of fertilizer application. Samples may be sent to the Bureau of Soils and Water Management (BSWM) or to other government accredited or recognized laboratories. Results of such analyses should be kept.

Explanatory Note:

Soil analysis reports provided by the DA-BSWM or by the DA regional or provincial soil laboratories include fertilizer recommendations for effective fertilizer use and increased crop production.

Republic of the Philippines
DEPARTMENT OF AGRICULTURE
Regional Field Office III
Integrated Laboratories Division
REGIONAL SOILS LABORATORY

TEST REPORT

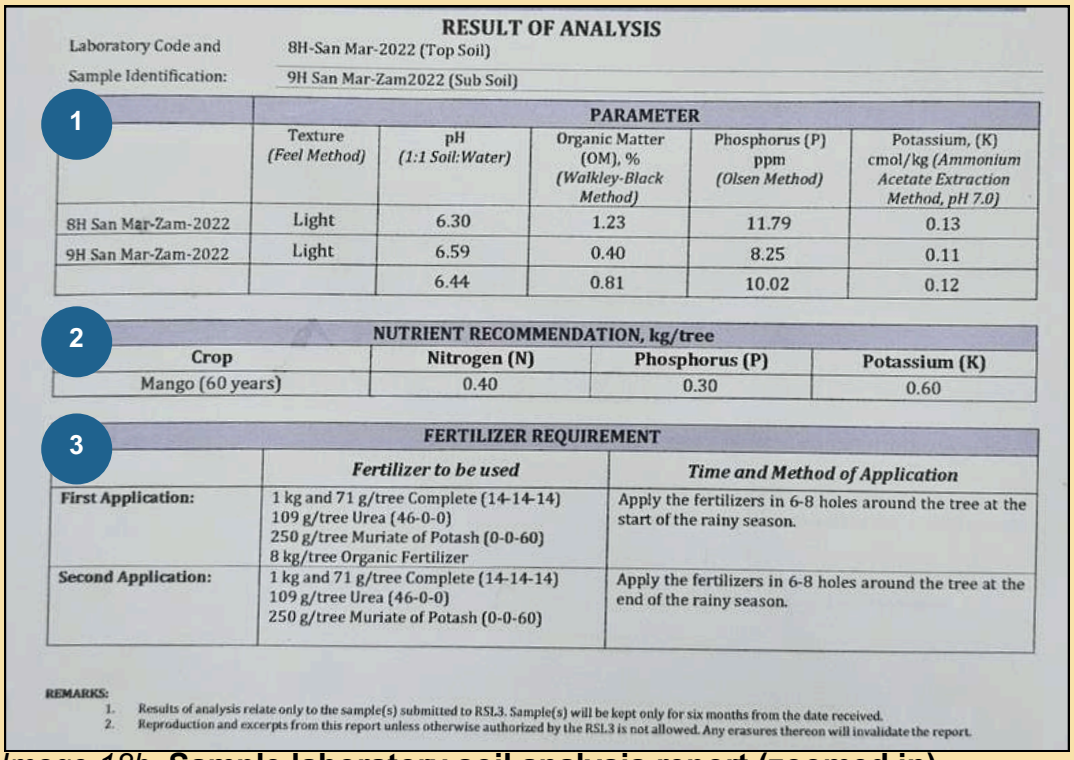
RESULT OF ANALYSIS

PARAMETER

NUTRIENT RECOMMENDATION, kg/tree

FERTILIZER REQUIREMENT

Image 18a. **Sample laboratory soil analysis report (full)**



RESULT OF ANALYSIS

Laboratory Code and Sample Identification: 8H-San Mar-2022 (Top Soil); 9H San Mar-Zam2022 (Sub Soil)

1

	PARAMETER				
	Texture *(Feel Method)*	pH *(1:1 Soil:Water)*	Organic Matter (OM), % *(Walkley-Black Method)*	Phosphorus (P) ppm *(Olsen Method)*	Potassium, (K) cmol/kg *(Ammonium Acetate Extraction Method, pH 7.0)*
8H San Mar-Zam-2022	Light	6.30	1.23	11.79	0.13
9H San Mar-Zam-2022	Light	6.59	0.40	8.25	0.11
		6.44	0.81	10.02	0.12

2

NUTRIENT RECOMMENDATION, kg/tree			
Crop	Nitrogen (N)	Phosphorus (P)	Potassium (K)
Mango (60 years)	0.40	0.30	0.60

3

FERTILIZER REQUIREMENT		
	Fertilizer to be used	*Time and Method of Application*
First Application:	1 kg and 71 g/tree Complete (14-14-14) 109 g/tree Urea (46-0-0) 250 g/tree Muriate of Potash (0-0-60) 8 kg/tree Organic Fertilizer	Apply the fertilizers in 6-8 holes around the tree at the start of the rainy season.
Second Application:	1 kg and 71 g/tree Complete (14-14-14) 109 g/tree Urea (46-0-0) 250 g/tree Muriate of Potash (0-0-60)	Apply the fertilizers in 6-8 holes around the tree at the end of the rainy season.

REMARKS:
1. Results of analysis relate only to the sample(s) submitted to RSL3. Sample(s) will be kept only for six months from the date received.
2. Reproduction and excerpts from this report unless otherwise authorized by the RSL3 is not allowed. Any erasures thereon will invalidate the report.

Image 18b. **Sample laboratory soil analysis report (zoomed in)**

The following parts are generally found in a test report provided by DA soil laboratories:

1. **Actual values per parameter** (*i.e.,* texture, pH, organic matter, phosphorus, and potassium level)
2. **Nutrient recommendation**, which provides the recommended amount (in kg) of nutrients
3. **Fertilizer requirement**, which recommends the amount of fertilizer to be added and how to apply the fertilizers (time and method of application)

Measuring the amount of fertilizer to be used can be done by using common items such as 100g or 1 cup clean containers.

2. In cases where no such analysis are carried out, the following are suggested:

Table 4. Fertilization schedule/program for young trees

Age of the trees (in years)	Fertilization schedule/program (per tree)
1	Split application* of 100 g urea, or 200 g of organic fertilizer** + 100g urea The fertilizer should be placed in the soil near 10 cm the base of the plant. Ring method with soil cover.
2	Split application* of 200 g urea, or 500 g organic fertilizer +200 g urea The fertilizer should be placed about 15 cm away from the trunk. Ring method with soil cover.
3	Split application* of 300 g 14-14-14, or 1 kg - 2 kg organic fertilizer + 300 g 14-14-14 The fertilizer should be placed about 30 cm away from the trunk. Ring method with soil cover.
4	Split application* of 400g 14-14-14, or 2 kg - 3 kg organic fertilizer + 400 g 14-14-14 The fertilizer should be placed about 50cm away from the trunk. Ring method with soil cover.
*1st application – at the onset of the rainy season **2nd application – before the end of the rainy season	

Explanatory Note:

The updated list of registered organic soil amendments can be found on the DA-BAFS website at www.bafs.da.gov.ph.

For registered non-organic soil amendments, the list can be found on the Fertilizer and Pesticide Authority (FPA) website at www.fpa.da.gov.ph.

Irrigation

1. Irrigation is done by manual watering, sprinkler or drip method to keep the base of the plant moist at all times. This promotes rapid growth for bigger canopy or early maturity.

Explanatory Note:

Irrigation can also be done through three other methods (Philippine Mango Seedling Farm Corp., n.d.):

1. **Canal Method** - Preferably done on a flat surface.

2. **Basin Method** - Often used in sloped areas and in younger trees. An excavation-like hole 10 cm deep is dug around 2 m away from the base of the trunk.

3. **Hole Method** - Applicable either in flat or sloped areas. 4-6 holes are dug around the base. The holes must be 20 cm deep and 15 cm wide, and 2m away from the base of the trunk.

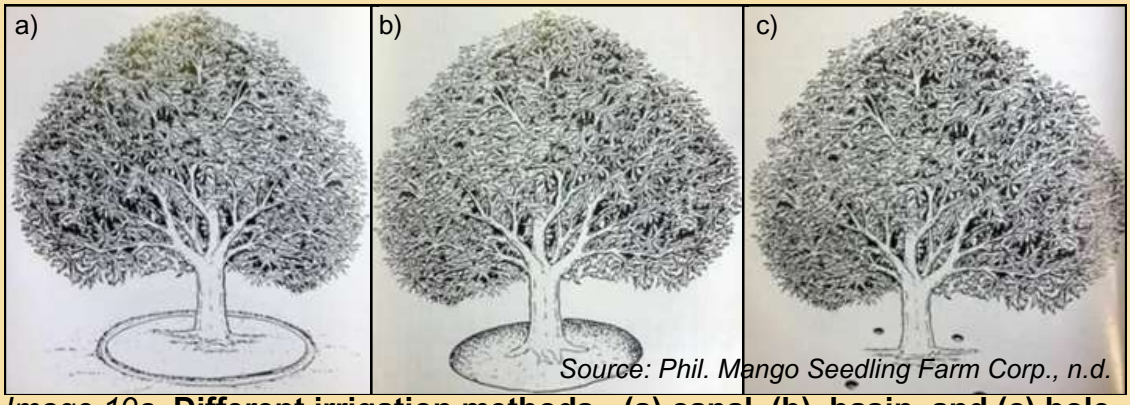


Image 19a. **Different irrigation methods - (a) canal, (b) basin, and (c) hole**

Image 19b. **Canal irrigation of a mango tree**

2. During the dry season, water plants weekly. Saturate with enough water or use about 3 L - 5 L of water per tree.

3. To minimize evaporation, mulching using dry leaves or thick layer of rice hull (10 cm - 15 cm) at the base of the mango tree is recommended. This prevents growth of weeds and serves as source of organic matter.

Explanatory Note:

Mulching materials are placed around the base of the trunk of a 1-5-year-old mango tree, a few inches away from the stem, to prevent pest problems.

Other commonly used mulching materials include rice straws, sugarcane bagasse, chopped weeds and banana stalks (ATI, n.d.).

Image 20. **Mulching of a mango tree**

Inter-cropping

1. The area between the rows of mango trees may be planted with fruit trees, vegetables or legumes best suited to the area and with high demand in the locality.

Explanatory Note:

Cash crops like legumes (e.g., peanuts, mung beans, and cowpeas) improve soil fertility by fixing nitrogen, which benefits mango trees (Hada et al., 2021).

Image 21. **Intercropped eggplant crops**

Short-duration vegetables, such as eggplant, tomatoes, okra, and chili, can be grown and harvested multiple times a year, offering a steady source of income (Kunhamu & Santhoshkumar, 2012). Fruit-bearing trees like calamansi or kamias may also be intercropped, provided their fruiting season does not overlap with the mango harvest.

Additionally, ornamental plants like marigolds and herbs can be cultivated between mango trees. These can serve as trap crops, reducing pest pressure and promoting a healthier orchard ecosystem (Greg, n.d.).

2. Pests affecting these intercrops should likewise be managed properly as they may serve as alternate hosts of insects and diseases.

Explanatory Note:

Papaya and cacao are not recommended for intercropping with mangoes because they are susceptible to anthracnose, a fungal disease that also affects mangoes (Maeda & Nelson, 2014; Takata et al., 2024). Planting these crops together can increase disease pressure, making it harder to control and potentially leading to higher crop losses.

Additionally, papaya is highly attractive to fruit flies, pests that also affect mangoes (ATI, n.d.). Intercropping papaya with mango can lead to increased fruit fly populations, as the pests can easily move between the crops, complicating pest management and increasing the risk of infestations.

Weed control

Weeds compete with mango for nutrients and water. To control weeds, the following are recommended:

a) ring cultivation, about 1m radius from the trunk;
b) inter-row cultivation (plow/tractor);
c) cover cropping with leguminous creeping vines like Tropical Kudzu and Centrocema. These can also be plowed under (green manuring) to provide additional nutrients; and
d) apply herbicides, only when necessary.

Explanatory Note:

Parasitic plants that climb are removed. These plants reduce the mango trees' ability to absorb sunlight and produce food of their own (photosynthesis), and cause the rotting of branches.

Image 22. **Parasitic plants (e.g. *Pyrrosia piloselloides*) being removed**

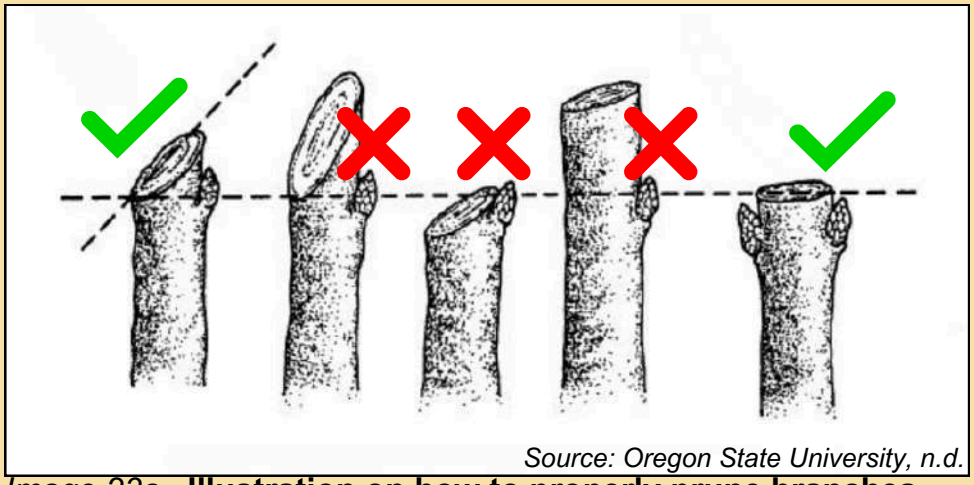
E. Cultural management of bearing trees

Pruning

1. Pruning involves the removal of unnecessary branches such as water sprouts, dried, disease-infected branches and all branches that grow towards the center of the canopy. This is preferably done after harvest.

Explanatory Note:

Twigs and small branches are cut to just beyond a vigorous bud, or at an intersecting branch. When cutting to a bud, choose a bud that is pointing in the direction of new growth. Cut close enough to avoid leaving a stub but not too close to damage the bud (Oregon State University, n.d.).



Source: Oregon State University, n.d.

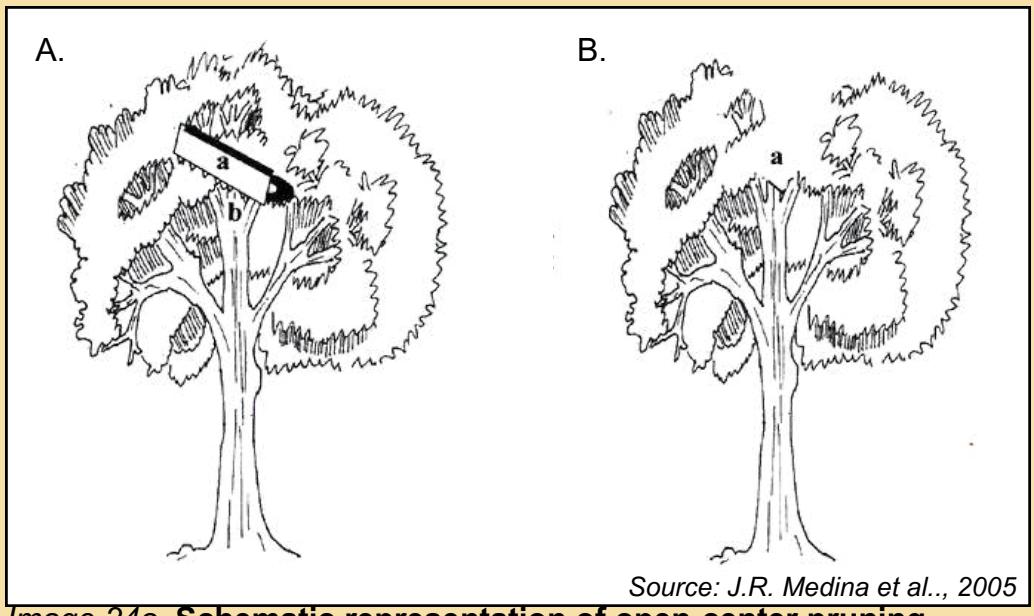
Image 23a. **Illustration on how to properly prune branches**

Image 23b. **Pruning activity done to remove unnecessary branches of bearing trees**

2. To minimize pest infestation, open-center pruning should be practiced.

Explanatory Note:

Open center pruning is done to remove scabs for the control of diseases. It also allows the entry of sunlight, wherein the mango pulp weevil is sensitive to.



Source: J.R. Medina et al.., 2005

Image 24a. **Schematic representation of open-center pruning method. A) Mango tree with whole canopy, (a) pruning saw used to cut topmost branch of the tree, (b) topmost branch of the tree; B) Mango tree with open center canopy, (a) topmost branch of the tree was cut.**

Image 24b. **Mango trees that have undergone open-center pruning**

3. Drastic or radical pruning is the removal of the total canopy or more than 30 % of the canopy and is usually done to rejuvenate unproductive trees.

Fertilization

1. Soil and tissue analysis is recommended before the application of fertilizer. Samples may be sent to the Bureau of Soils and Water Management (BSWM) or to other government accredited or recognized laboratories. Results of analysis should be kept on record.

2. In case soil and leaf analyses are not available, the following fertilization schedule is recommended.

Table 5. Fertilization schedule/program for fruit-bearing trees

Age of the trees (in years)	Fertilization schedule/program (per tree)
5-6	500 g - 1 kg of 14-14-14 or 3 kg - 4 kg of organic fertilizer* + 500 g - 1 kg of 14-14-14
7-8	2 kg of 14-14-14 or 4 kg - 5 kg of organic fertilizer + 2 kg of 14-14-14
9-10	3 kg of 14-14-14 or 5 kg - 6 kg of organic fertilizer + 3 kg of 14-14-14
11-15	5 kg of 14-14-14 or 10 kg of organic fertilizer
16-20	6 kg - 7 kg of 14-14-14 + 12 kg of organic fertilizer
More than 20	10kg of 14-14-14 + 15 kg - 20 kg of organic fertilizer

Explanatory Note:

Fertilizers are applied yearly. Half of the fertilizer is added at the start of the rainy season. The other half is added at the end of the rainy season.

3. The above mentioned fertilizer quantity can be split evenly and applied, one at the start of the rainy season and the remaining towards the end of the rainy season. It can be placed in a shallow canal or in 6-8 holes dug around the tree at a depth of 15 cm - 30 cm and a distance of 2 m and 4 m radius from the trunk. This recommendation is applicable for 10 years and above

Explanatory Note:

Image 25. **Illustration of fertilizer application**

4. At 18-25 days after flower induction and before bagging, foliar fertilizer should be applied as supplement to the soil-applied fertilizer. The foliar fertilizer should have macro and micro nutrients such as zinc, boron, magnesium and calcium.

Explanatory Note:

Foliar fertilizer is applied to the point of drip, which helps retain fruitlets as they develop. This can be combined with insecticides and fungicides or both, depending on the compatibility recommendations stated on the label.

Image 26. **Application of foliar fertilizer**

5. A complete set of records of fertilizer applications must be kept. Information should include fertilizers used, rates (amount/tree) and dates of application as well as the names of applicator/s.

Flower induction and management

Flower induction

1. Prior to spraying, the leaves of trees are checked for attributes of readiness to flower as follows:

   a) The age of the leaves should be at least 7 months from flushing;
   b) leaves are dark green, coppery and brittle; and
   c) buds are prominent and dormant.

Explanatory Note:

Farm records (flushing, flowering, and fruiting) of at least 6 to 8 months can be used as the basis for flower induction.

Image 27. **Flower induction**

2. Nitrate based products (i.e. potassium nitrate, calcium nitrate, sodium nitrate, calcium ammonium nitrate, liquid ammonium nitrate) for use as flower inducers, whether of agricultural grade or formulated products, is recommended.

Explanatory Note:

A mango grower should ensure that the flower inducer applicator using nitrate-based products is licensed by the FPA. For the use of potassium and calcium ammonium nitrate, a special permit from the Philippine National Police (PNP) needs to be secured.

3. Flower inducer is sprayed by wetting the leaves thoroughly with 1 % - 3 % spray concentration. During the rainy months, higher concentrations (2 % - 3 %) of flower inducers should be used; while during the dry months, lower concentrations (1 % - 1.5 %) may be used.

4. If it rains within six hours from spraying, a follow-up spray using a lower concentration (50 % of the initial spray concentration) of flower inducer may be applied.

5. A growth retardant (i.e. paclobutrazol) may also be used to promote early leaf maturation especially in young trees (less than 10 yrs. old) and prepares the trees for early flowering. This is applied as a soil drench.

Explanatory Note:

The recommendations on the label should be strictly followed for the use of growth regulators. The excessive use of growth retardants may hamper the fruit production for a few years.

Flower and fruit management

1. Foliar application of liquid fertilizer at 18-22 days after flower induction (DAFI) may be done to promote flower growth and development.

2. Pollinating insects like blue flies & bees are encouraged by avoiding spraying of insecticide during full bloom (26-38 DAFI). A five percent (5 %) sugar or honey solution is sprayed as spot application to attract pollinators during full bloom.

Explanatory Note:

Colonies of pollinators, such as cultured honey bees, should be transferred to areas far from the spraying activity. After the re-entry period of the sprayed insecticide (refer to the pesticide label), colonies can be returned to their original area.

3. If it rains during full bloom, spray flowers with fungicide immediately after the rain to prevent fungal growth. Fungal growth can also be prevented by gently shaking the branches to remove rainwater deposit on the flower and to remove disease-infected flowers.

4. Mango trees are irrigated weekly, approximately 100 L - 300 L of water per tree per week, to enhance the development of flowers and young fruits and minimize fruit drops. Watering is stopped one (1) month before expected harvesting schedule.

Explanatory Note:

Watering should be stopped before the expected harvesting schedule, as water reduces the sweetness of the fruits.

5. Bagging is recommended at 55 to 60 DAFI, if no infestation is observed. However, if cecid fly and capsid bug infestations are observed, bag should be done 40–45 DAFI.

Explanatory Note:

Close monitoring of developing fruits is done due to the possible occurrence of the cecid fly. The mango fruits are then bagged using fruit protection bags.

Image 28. **Packaging materials used as fruit protection bags - (a) newspaper, and (b) glassine paper**

Proper harvesting

1. Fruits should be harvested upon reaching maturity of 105-130 DAFI. On season harvesting is 105 to 115 DAFI. Off-season harvesting is 120 to 130 DAFI.

Explanatory Note:

The time of harvest varies depending on the fruit's maturity.

In Guimaras Island, a local ordinance (Ordinance No. 2017-003) requiring mango harvesting to be done 115 DAFI is being implemented.

2. Other maturity indices include:

   a) flattening or expansion of shoulders and fullness of cheeks;
   b) presence of “bloom” or powdery deposit on the fruit;
   c) yellow green color near pedicel and yellowing of pulp; and
   d) floatation of fruits in 1 % salt solution (100 g salt/10 L of water). Sinking of 70%-75% of the fruits is an indication that the fruits are already matured

Explanatory Note:

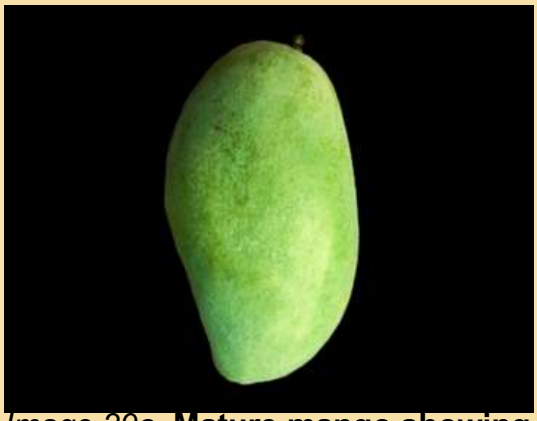


Image 29a. **Mature mango showing expanded shoulders and full cheek**

Image 29b. **Mango flotation test to check mango maturity**

3. Harvesters must wash their hands before harvesting. Good personal hygiene must be practiced to avoid cross-contamination of the produce.

4. The fruits should be harvested between 9:00 AM and 3:00 PM for lesser latex flow. When it rains, harvesting is deferred. Leave about 2.0 cm pedicel on the fruit to minimize latex flow which may burn the fruit. Farmers may use tarpaulin or fish net to catch the fruits which may accidentally fall while harvesting.

Explanatory Note:

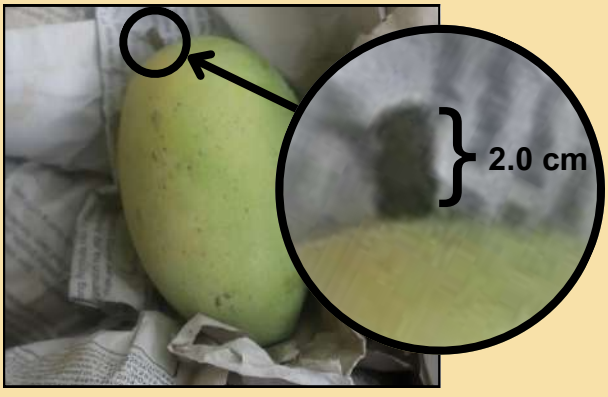


Image 30. **Harvested mango fruit with inset photo showing 2cm pedicel retained**

5. Minimize damage and avoid contamination of fruits with soil, pathogens, fertilizers or other agro-chemicals. Harvested mangoes should not get in contact with the soil in order to avoid microbial contamination.

Explanatory Note:

To prevent contact with dirt and other substances, materials like paper, plastic, or timber can be placed on the ground or floor (ASEAN, 2007).

Image 31. **Harvested mangoes are placed on top of a clean plastic sheet**

6. Harvested fruits should be kept away from direct sunlight and brought immediately to the shade for sorting and other post-harvest activities.

Explanatory Note:

Image 32. **Harvested mangoes are brought to a shaded area for sorting and classifying**

7. Harvesting crates/containers (e.g. bamboo baskets, stackable plastic crates, etc.) should be regularly cleaned and maintained. Unfit harvesting crates/containers should be disposed if it will cause damage to the fruit or will cause contamination.

8. Containers of harvested fruits should be clearly identified with names or codes containing date of harvest, time, block number, and name of harvester/farmer. Record of this information should be kept for traceability.

Explanatory Note:

Image 33. **Harvested mango containers with code/tag**

Proper post-harvest handling

1. Harvested fruits may be sorted/packed on-farm or may be transported to a common packinghouse facility. If transported, fruits hauled carefully in an appropriate container to the packinghouse to minimize mechanical damage. Mango fruits placed in bamboo baskets or “kaings” should be lined with newspapers not banana leaves or other organic material.

Explanatory Note:

Banana leaves are not recommended as a lining material since they produce ethylene, which hastens ripening, and may be a source of fungal contamination.

Image 34. **Harvested mangoes place in crates with newspaper as liners**

2. Fruits to be sorted out should not be placed in direct contact with the soil or the floor of the packinghouse to avoid cross-contamination of the produce.

3. Sorters/packers should wash their hands with soap or detergent before handling the produce. They should also practice good personal hygiene.

Explanatory Note:

To remind workers regarding handwashing, written instructions may be provided and displayed in prominent locations. Instructions are preferably presented in a language that workers can easily understand and in a straightforward manner (BAFS, 2021; ASEAN, 2007).

Image 35. **Written instructions on handwashing posted in a handwashing facility**

4. For packinghouse facilities, the packing room must be from toilet facilities and must be kept clean, tidy, well ventilated and free of foul smell at all times.

Explanatory Note:

There should be a separate designated packing area where the produce is handled, packed, and stored away from oil, grease, and machinery to prevent cross-contamination (BAFS, 2021). Ideally, a packinghouse should have adequate space and a layout that promotes a smooth flow of materials and personnel.

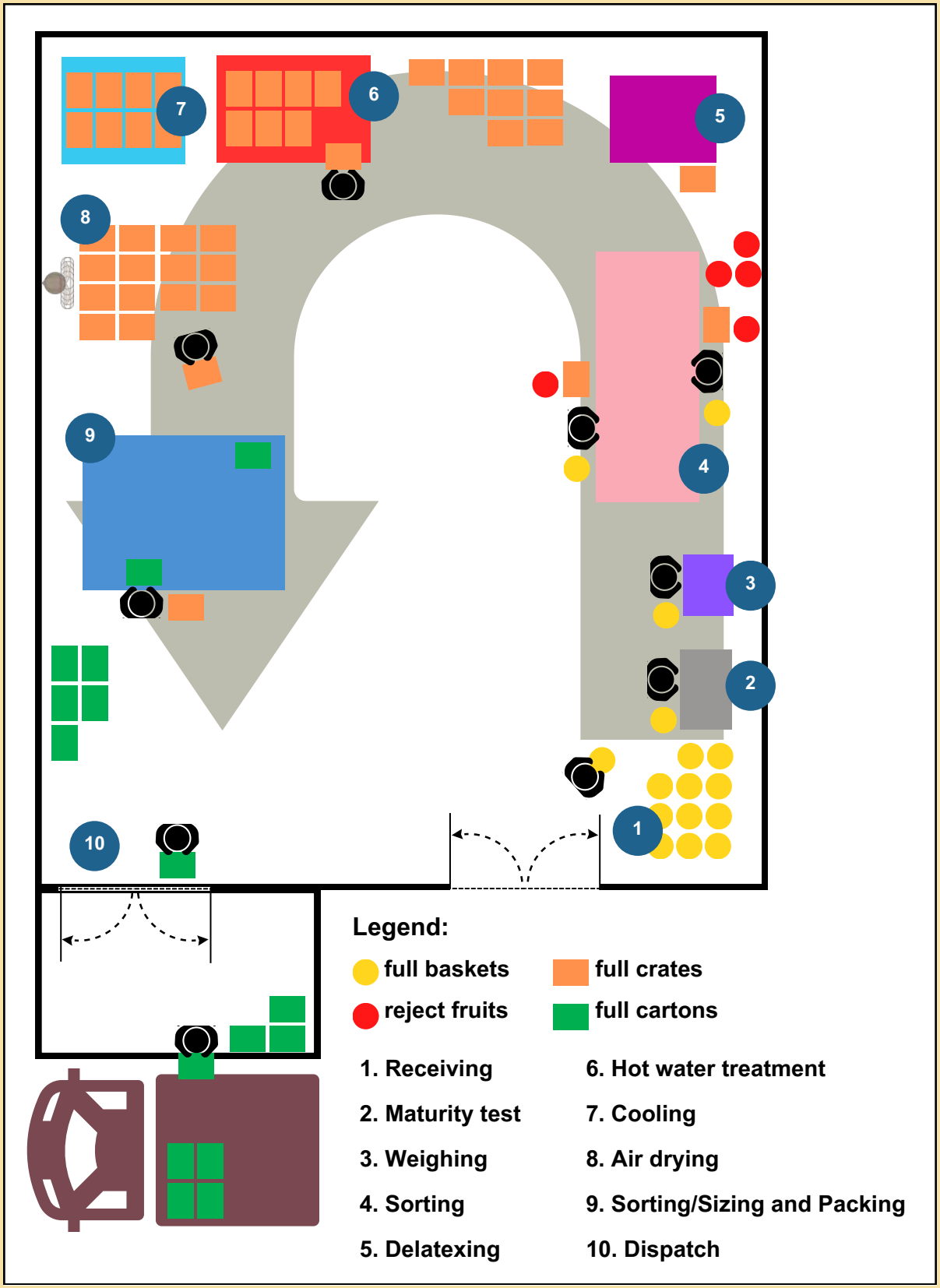


Image 36. **U-type configuration of product flow inside a packinghouse**

5. Mangoes should be sorted according to size and quality (Annex 1 – Revised PNS for Mangoes). Damaged and diseased fruits should be discarded to avoid cross-contamination of the whole lot.

Explanatory Note:

The PNS/BAFS 13:2024 Mangoes — Product Standard — Grading and Classification Standard covers food safety and quality requirements and nutritional composition of mangoes. Images of grades and defects are further illustrated in the Illustrative Guide of the PNS. The latest version of these documents can be downloaded at www.bafs.da.gov.ph.

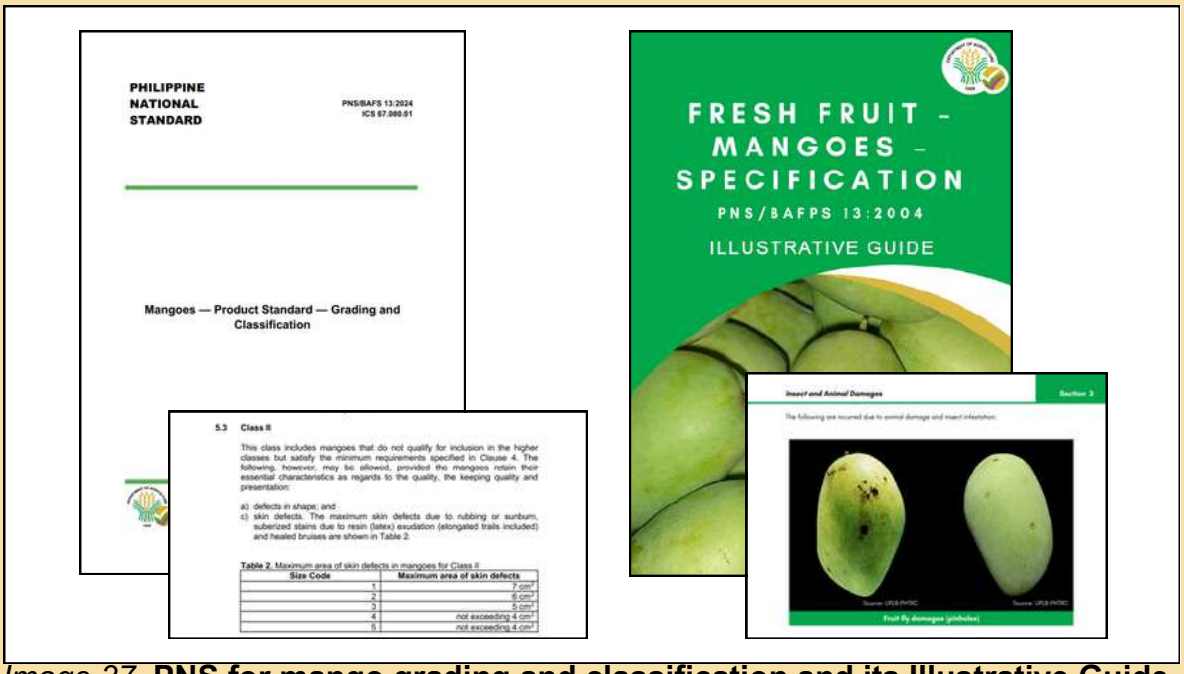


Image 37. **PNS for mango grading and classification and its Illustrative Guide**

6. Sorted and graded mangoes should then be inspected and trimmed of stems connected to the fruits.

Explanatory Note:

Sorted and graded mangoes are inspected by the Quality Assurance officer of the exporter or consolidator/trader of mangoes intended for the local market.

Source: Guimaras Wonders Farm, n.d.

Image 38. **BPI PQS officer sealing box after inspection of export mangoes**

7. The fruits should be washed clean with a mixture of potable water and mild soap. If required by the importing country, the fruits should be subjected to any of the following post-harvest treatments:

   a) Hot water treatment (HWT) – The newly harvested fruits are dipped in hot water (about 52 °C - 55 °C) for about 10 mins. The fruits are then rinsed in cool running water for 10mins (hydro-cooling), air-dried for another 10 mins and packed.

   b) Rapid HWT – The fruits are submerged in hot water (60 °C) for 30 sec to one (1) minute. Hydro-cooling is no longer required.

   c) Extended HWT – The water is allowed to reach the temperature of 48 °C. The fruits are submerged in the water until pulp temperature reaches 46 °C. The pulp temperature is retained for 15 mins (holding temperature). The fruit is air cooled for 15 mins, followed by hydrocooling for another 10 mins - 15 mins, airdried and packed.

   d) Vapor heat treatment (VHT) – Fruits are heated in a chamber with vapor saturated air until the pulp reaches a temperature of 46 °C which is maintained for 10 mins. The chamber is then ventilated to cool.

Explanatory Note:

HWT is a standard procedure for exporting mangoes, and is widely used by growers supplying institutional buyers, such as supermarkets. Processors also apply HWT, especially for mangoes grown during the rainy season.

It is considered a chemical-free method of disease control since no fungicides are added to the water. It also helps remove fresh latex and promotes uniform fruit ripening (Esguerra et al., 2019).

Mangoes are subjected to HWT within 24 hours after harvest.

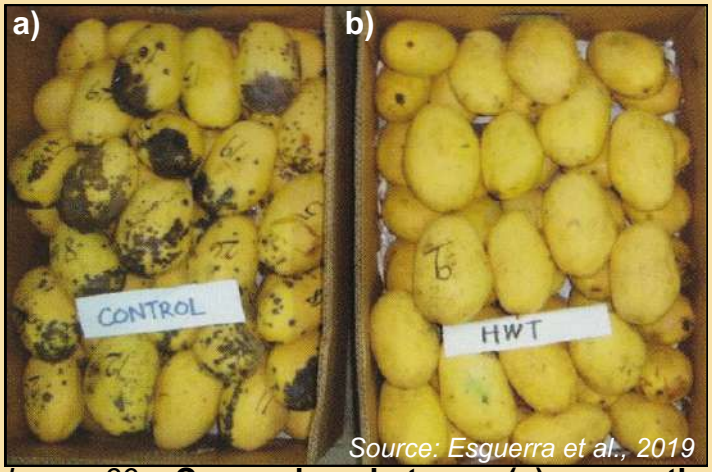


Image 39a. **Comparison between (a) conventional mangoes, and (b) mangoes subjected to HWT**

Image 39b. **HWT used for mangoes**

On the other hand, VHT is used to control fruit flies.

Image 39c. **VHT used for mangoes**

8. Transported fruits should be appropriately labeled for traceability.

Packaging

1. Mangoes which have been sorted, washed and subjected to post-harvest treatment(s) are then packed in suitable packaging containers. For specific packaging requirements of individual countries, the packaging specifications should be mutually agreed upon.

Explanatory Note:

Lightweight cartons or fiberboard boxes are usually used as packaging containers to help minimize freight costs, making air transport viable for mangoes from Visayas and Mindanao to Manila.

For exports to Hong Kong and China, cartons are placed with vertical dividers and layered fruit arrangement separated by newspaper liners to reduce bruising. For Japan exports, fruits are arranged in a single layer with individual cells, ensuring premium quality and minimizing damage during handling (Esguerra et al., 2019).

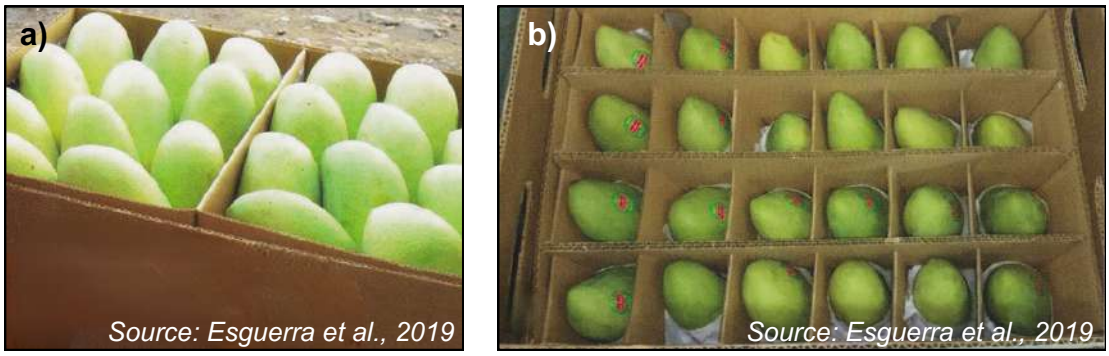


Image 40. **Sample packaging of mangoes for export to (a) Hong Kong, and (b) Japan**

Furthermore, mangoes for export are inspected by plant quarantine officers. Packing materials should be made of materials verified to prevent fruit fly penetration. In case of holes or vents on a package, one of the following conditions should be fulfilled (BPI, 2021):

- Fresh fruits should be covered with wrapping material (if there are holes, they should be covered with nets with a mesh of 1.6mm or less in diameter) before putting them in a package.
- A screen (a mesh should be 1.6 mm or less) should be installed on holes or vents.
- Package or bundled packages should be netted (a mesh should be 1.6 mm or less).

2. Each packaging container must be clearly labeled with the following information:

   a) a mango grower's accreditation code
   b) name of commodity
   c) net weight
   d) batch number and date of packing
   e) name of Plant Quarantine Service (PQS) signing officer
   f) the name "Product of the Philippines"

Explanatory Note:

According to CXS 346-2021 (General standard for the labeling of non-retail containers of foods) and PNS/BAFS 13:2024 (Mangoes - Product Standards - Grading and Classification), each non-retail package shall bear the following information:

1. Name of the food
2. Lot identification
3. Date marking and storage instructions
4. Identification of a non-retail container
5. Name and address
6. Origin of produce
7. Commercial specifications

Image 41. **Sample labelled mango packaging for export**

3. Storage facilities for packaging materials must be kept free from rodents, birds, farm animals, physical and chemical contaminants.

Storage facilities for fruits

1. Storage facilities must be sanitized and free from decaying plant waste and foul smell.

Explanatory Note:

Storage facilities should have double-screened windows, nets and plastic curtains to prevent the entry of mango fruit flies.

2. Packed mangoes may be stored in a cold room (temperature 12 °C - 14 °C; relative humidity 85 % - 95 %) immediately after packing. Refrigeration equipment should be in good working condition with the temperature regularly monitored and recorded.

Explanatory Note:

For export, mangoes must be stored in a cold room to delay ripening. Under optimal conditions, they can be kept for up to two weeks, though ripening accelerates toward the end of this period. While storage can be extended to three weeks, fruits will be in an advanced state of ripeness upon removal, significantly reducing their shelf life (Esguerra et al., 2019).

Improper storage conditions can lead to losses due to microbial growth and excessive moisture loss. Additionally, temperatures below 12°C can cause chilling injury, compromising fruit quality (Esguerra et al., 2019).

3. Cooling equipment must be cleaned and inspected frequently. Maintenance of equipment and use of appropriate sanitary procedures is critical in ensuring the safety of the produce.

Explanatory Note:

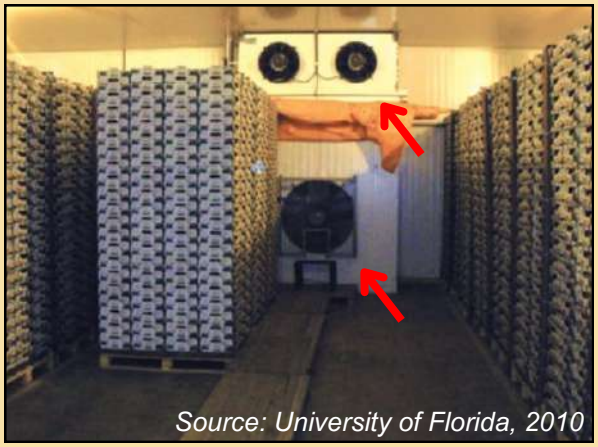


Image 42. **Cooling equipment used for mango storage facility**

Section IV

Integrated pest management

1. Integrated Pest Management (IPM) is an effective and environment-friendly approach to pest management. To control and minimize damage, it combines the use of current and comprehensive information on the life cycles of pests; their interaction with the environment and the available pest control methods, e.g. biological, cultural, varietal selection, and chemical control. Use of chemicals should be on a need basis.

Explanatory Note:

IPM involves a **careful evaluation of various pest control methods and the integration of suitable measures that discourage the growth of the pest population.** It combines biological (e.g., use of resistant varieties and biological control agents), chemical (e.g., pheromones), physical (e.g., removal of pest and breeding sites), and crop-specific (cultural) techniques (e.g., crop rotation, planting of trap crops) to grow healthy crops and limit pesticide usage. **This approach aims to decrease the reliance on pesticides, thus minimizing potential health and environmental risks** (FAO, n.d.).

The following basic steps can be considered for an IPM approach:

1. **Prevent or suppress harmful organism** which can be done through:
   - avoidance of intercropping of crops that are alternate hosts of pests (e.g., fruit fly);
   - use of adequate cultivation techniques like conservation tillage, and pruning, if applicable;
   - where appropriate, use of pest-resistant or tolerant cultivars and registered planting material;
   - implementation of the recommended soil fertilization and water management;
   - prevention of the spread of harmful organisms through field sanitation and hygiene measures such as the removal of infected plants or plant parts, regular cleansing of machinery and equipment, and
   - protection and enhancement of important beneficial organisms through the utilization of refuge inside and outside production sites.

2. **Monitor harmful organisms** through direct counting and visual inspection.

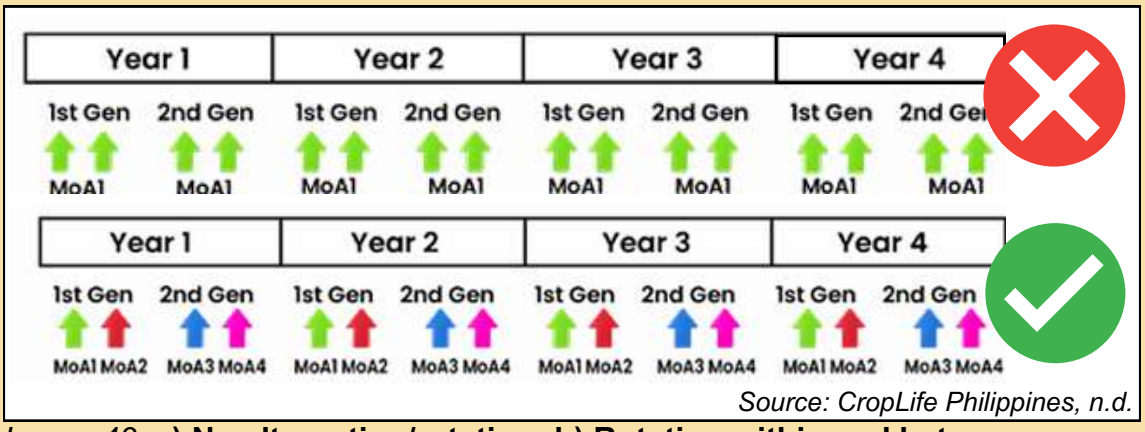
3. **Use pest management inputs based on the results of monitoring**. Priority is given to sustainable physical, and other non-chemical methods.

4. **Apply pesticides as needed**. Choose pesticides as specific as possible for the target pest that is registered for mango, with the least side effects on human health, non-target organisms, and the environment.

Different products belong to different Modes of Action (MoA). Rotating or alternating different products during the cropping season should be done.

This prevents the selection of resistant individuals, thereby prolonging the effective longevity of the product. In rotating insecticide modes of action, there are several principles that need to be followed for the resistance management efforts to succeed.

First, avoid the exclusive use of one MoA throughout a crop cycle for a pest species with multiple generations. The second principle in rotating insecticides MoA is to alternate “windows” or “blocks” with different modes of Action. This is where spray applications are arranged into MoA spray windows of blocks.



Source: CropLife Philippines, n.d.

Image 43. **a) No alternating/rotation; b) Rotation within and between**

5. **Monitor and evaluate the progress** of the applied pest management measures (FAO, n.d.) *(modified)*.

2. Mango trees are susceptible to pest attacks at various stages of development. Flowers and fruits are, however, the most susceptible to major pests.

Explanatory Note:

The list of pest identity, biology, and damage (Annex II) only shows the insect pests and diseases of mango that occur at the stages of flower and fruit development. This does not mean that these pests attack all at the same time. There may be an attack of just one or two major insect pests and disease infections in one crop season, and the rest of the pests, if ever present, may be of minor occurrence. But the major pest population should be properly managed because failure to do so may lead to total crop failure.

3. The following are important factors for a successful implementation of IPM:

a) crop phenology;
b) pest identity, biology and damage;
c) pest/weather monitoring; and
d) pesticide management.

Explanatory Note:

The duration of the stages of development of the panicles, flowers, and fruit from the start of flower induction up to full maturity of fruits is shown in Annex I with corresponding pictures. Mango fruits reach **full maturity at 115 to 130 DAFI**. It is necessary to understand these stages of development because pest management strategies differ according to the stage of panicle, flower, and fruit development.

Another requirement in pest management is a good knowledge of the pest involved. A pest identification tool is provided in Annex II, showing the pictures and descriptions of the insect pests and diseases of mango. These insect pests and diseases causal organisms are often small and difficult to find, but the damage to the affected part of the mango is easily noticeable, and so a description of the damage is also added here, along with the management strategies appropriate for each pest.

For the mango workers and for all those who are already familiar with the insect pests and diseases of mango, a chart for pest monitoring is shown in Annex III. To

use the chart, for example, if the mango tree is at the flowering stage, then monitor for 1 month for the presence of tip borer, leafhoppers, and thrips as indicated in the chart. Apply control or management strategies if needed within the time frame provided in the chart. Refer to Annex II for the management strategies of the pest population. Weather monitoring is also important because rain and typhoons can delay farm operations. It should be noted that more insect problems can be expected during the dry season, and during the wet season, expect more disease problems.

4. The detailed discussion of 3(a) to 3(c) is found in Annex IV, V and VI, respectively of this manual.

***Note:**

Annexes IV, V and VI mentioned in the PNS provision refers to Annexes I, II and III of this EM.

5. An IPM program has been developed to guide the mango growers in the implementation of IPM in their farms. For each month stage of mango development, the pests most likely to attack the tree identified and the corresponding intervention measures are indicated (Table 1).

***Note:**

Table 1 mentioned in the PNS provision refers to Table 6 of this EM.

Explanatory Note:

The guide for an Integrated Pest Program for Mango in Table 6 (Phenological guide for IPM for Mango) can be best understood after familiarizing oneself first with the different stages of mango development, insect pests and diseases, and the management strategies for each pest as found in Annexes I to III.

Table 6. **Phenological guide for integrated pest management (IPM) program for Mango**

Stage/s	Phenology	Illustration	Target pests	IPM interventions
1	Dormant		Scale insects Mealybugs	• Prune to improve light penetration and air circulation • Fertilizer application (soil application)
2	Flushing		Cecid fly Twig cutter Anthracnose	• Spray insecticides and fungicides to protect flush • Apply growth regulator if necessary
7-9	Leaf maturation		Twig cutter	Prune and burn infested twigs

Table 6. (cotinuted)

Stage/s	Phenology	Illustration	Target pests	IPM interventions
Before flower induction			Mango leafhopper	• Light trapping • Field sanitation • Pruning
Flower induction 0 DAFI	Mature buds and leaves		Mango leafhopper	• Monitor percent flushing/flowering • Monitor for pest
1-8 DAFI	Bud break/bud initiation	 Source: Aani Mango Industry Association, n.d.	Mango leafhopper	Prune and burn infested twigs

Table 6. (cotinuted)

Stage/s	Phenology	Illustration	Target pests	IPM interventions
9-12	Bud emergence	 Source: Aani Mango Industry Association, n.d.	Mango leafhopper Tip borer Thrips	• Monitor for pest • Spray insecticide if needed
13-16	Post emergence Bud elongation I		Mango hopper Tip borer Thrips Anthracnose	• Apply foliar fertilizer • Monitor for pest • Spray insecticide and fungicide if needed
17-22	Post emergence Bud elongation II		Mango hopper Tip borer Thrips Mealy bug Anthracnose	• Monitor for pest • Spray insecticide and fungicide if needed

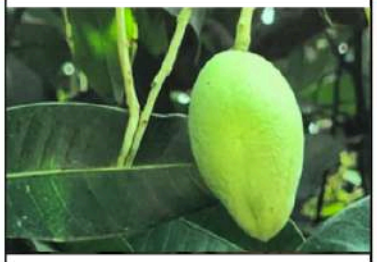
Table 6. (cotinuted)

Stage/s	Phenology	Illustration	Target pests	IPM interventions
23-25	Pre-anthesis		Mango hopper Tip borer Mealy bug	• Apply foliar fertilizer • Monitor for pest • Spray insecticide and fungicide if needed
26-30	Full bloom		Blossom blight	• No insecticide spraying to encourage pollinators • Shaking of branches
31-35	Fruitset (monggo size)		Mango hopper Tip borer Mealy bug Anthracnose Scab	• Monitor for pests • Spray insecticide and fungicide if needed

Table 6. (cotinuted)

Stage/s	Phenology	Illustration	Target pests	IPM interventions
36-42	Fruit development (corn size)		Mango leafhopper Tip borer Mealy bug Anthracnose Scab	Monitor for pests
43-50	Fruit development (marble size)		Tip borer Mealy bug Cecid fly Anthracnose Scab	• Spray insecticide and fungicide if needed • Early bagging for cecid fly control (optional)
51-60	Fruit enlargement (chicken-egg-size)		Mango seed borer *Helopeltis* sp Mealybug Scale insect Mango pulp weevil Anthracnose Scab	• Field sanitation • Before fruit bagging, apply foliar fertilizer • Spray insecticide and fungicide if needed

Table 6. (cotinuted)

Stage/s	Phenology	Illustration	Target pests	IPM interventions
61-90	Fruit enlargement		Mango seed borer *Helopeltis* sp Mealybug Scale insect Anthracnose Scab	• Monitor for fruit pests • Collection and proper disposal of fruit drops • Spray insecticide and fungicide if needed
91-109	Start of maturation		Fruit fly Mealy bug Scale insect Anthracnose Scab	• Monitor for fruit pests • Collection and proper disposal of fruit drops • Spray insecticide and fungicide if needed • Use fruit fly attractants and traps
110-120	Full maturity		Fruit fly Stem-end rot Anthracnose	• Harvesting of fruits based on maturity indices • Hot water treatment (HWT)

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Section V

Pesticide management

Source: CropLife Philippines, n.d.

1. Pesticide management refers to the judicious use of chemical pesticides. It focuses on maximizing the benefits of the chemicals while minimizing its harmful effects. Other means of controlling pests, i.e. biological pesticides, may be used.

2. Pesticides may be classified based on its uses, formulation type, chemical grouping, mode of action, and hazards.

Explanatory Note:

Pesticide classification based on pest controlled (FPA, n.d.):

- Insecticides - insects
- Herbicides – weeds
- Fungicides – fungi
- Nematicides – nematodes
- Molluscicides – snails
- Rodenticides - rodents
- Miticides – mites
- Bactericides – bacteria

Pesticide classification based on formulations (FPA, n.d.):

- Emulsifiable Concentrate (EC) - composed of active ingredient (A.I.), solvent and emulsifier
- Flowable (F) – composed of finely ground A.I. and liquid
- Granule (GR) – composed of A.I., carrier and binder
- Soluble Concentrate (SC) -composed of A.I. and Solvent
- Wettable Powder (WP) – composed of A.I., wetting agent and carrier

Pesticide classification based on effects on pest (FPA, n.d.):

- Anti-feedant
- Attractant
- Defoliant
- Disinfectant
- Growth Regulator
- Semiochemical
- Anti-transpirant
- Chemosterilant
- Dessicant
- Feeding Stimulant
- Repellant
- Synergist

Pesticide classification based on chemical grouping/composition (Kaur et al., 2019):

- Organochlorines
- Organophosphorus
- Carbamates
- Pyrethroids

Pesticide classification based on mode of action/entry (FPA, n.d.):

- **For insects and nematodes (insecticides)**
  - Stomach Poison
  - Contact Poison
  - Systemic Poison
  - Fumigants
- **For weeds (herbicides)**
  - Contact
  - Translocated
- **For fungi (fungicides)**
  - Protectant
  - Curative or eradicative
- **For rodents (rodenticides)**
  - Fumigant
  - Chemosterilant
  - Attractant
  - Repellant

Pesticide classification based on hazard and toxicity (FPA, n.d.):

- **Category I**
  Note: no product in this category is registered for mango, products on this category is only permitted for plantations.

  Warning statement: "*DANGER: This product is highly toxic and may cause death if swallowed, inhaled or absorbed through the skin." Follow directions for use carefully.*"

- **Category II**
  Warning statement: "*WARNING: This product may be harmful if swallowed, inhaled or absorbed through the skin." Follow directions for use carefully.*"

- **Categories III & IV**
  Warning statement: "*Dangerous if not properly used*". Generally, no warning statement is necessary unless the substance is a recognized cause of dermatitis or allergy.

Table 7. Classification of pesticides based on hazard and toxicity (FPA, n.d.)

Category	Signal	Color	Symbol
I	"Danger: Poison"	Red	 Skull and crossbones
II	"Warning: Harmful"	Yellow	 Cross
III	"Caution:"	Blue	-
IV	"Caution:"	Green	-

3. There are specific guidelines in applying GAP to ensure that the use of pesticides in mango production is managed properly. If these are followed judiciously, residues in mango will not exceed the maximum residue limit (MRL) of the pesticide.

Explanatory Note:

MRL is the maximum concentration of a pesticide residue (expressed as mg/kg) recommended by either the Codex Alimentarius Commission or the national competent authority to be legally permitted in or on food commodities. MRLs are based on data on the use of pesticides. Foods derived from commodities that comply with the respective MRLs are intended to be toxicologically acceptable.

Table 8. MRLs of some pesticide A.I.s based on PNS/BAFS 160:2021 Mango – Product Standard – MRLs of Pesticides

A.I.	MRL (mg/kg)	A.I.	MRL (mg/kg)
carbaryl	3.00	cypermethrin	0.03
carbendazim	2.00	glyphosate	0.20
chlorpyrifos	0.05	profenofos	0.05

4. The following are the good agricultural practices (GAP) pertaining to the use of pesticides:

a) Use registered pesticides

Apply only pesticides and other agricultural chemicals e.g. plant growth regulators which have been approved by the Fertilizer Pesticide Authority (FPA).

Explanatory Note:

Mango growers are advised to use FPA-registered products. An FPA registration number can be found on the product label. Avoid using products with labels written in foreign languages other than English. Purchase products only at licensed dealers.

It is advisable to always check the DA-FPA website for updated information and the list of registered pesticides for mango, or contact them through the information below:

FPA Pesticide Regulations Division (PRD)
Address: FPA Building, Bureau of Animal Industry Compound, Diliman, Quezon City
Contact number: (02) 8922-3368
Website: fpa.da.gov.ph

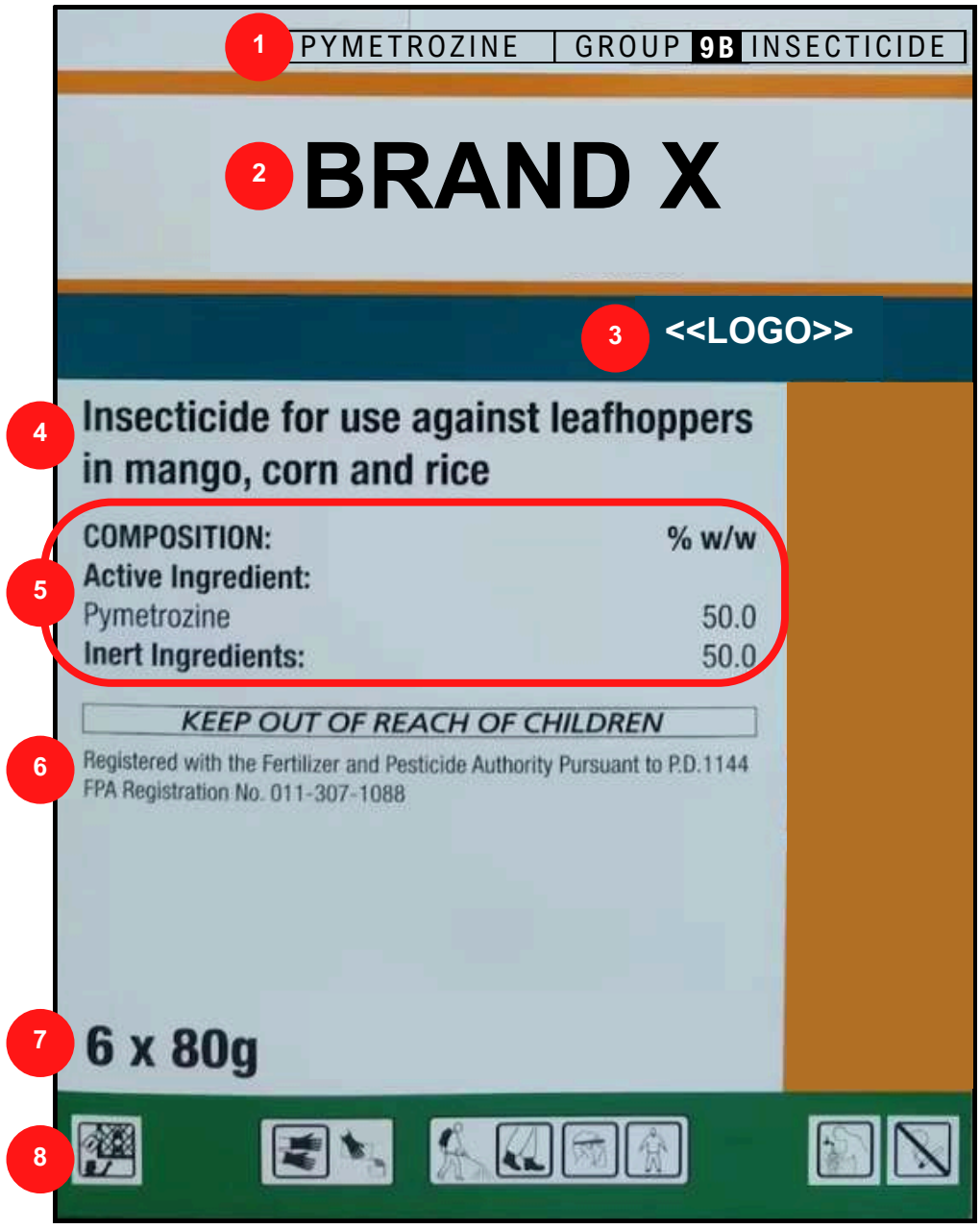
b) Read and follow the label instructions.

It is important to always read and understand the pesticide label to be able to use the product properly. The following information is found on the label:

i. Product information
   1) Active ingredient(s) (a.i.) may be present in several brand names.
   2) Solvent
   3) General use statement – summary of the approved use(s) of the product

Explanatory Note:

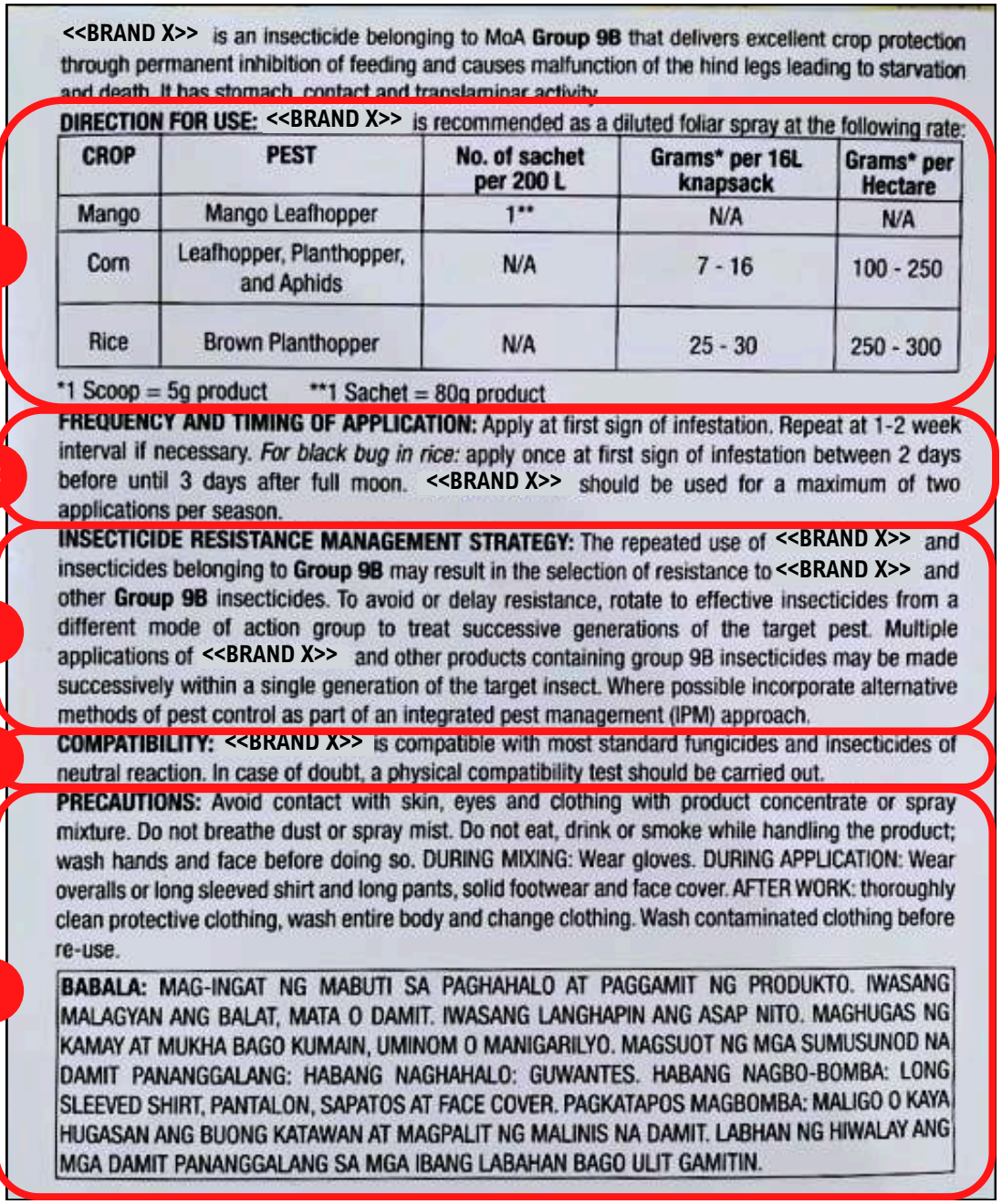
Always read the product label:
1. before buying
2. before mixing
3. before applying/spraying
4. before storing
5. before disposing



Legend:

1. **Mode of Action information box (A.I. + MoA group + type of pesticide)**
2. **Product name**
3. **Manufacturer's logo**
4. **Type of pesticide**
5. **Composition (A.I., inert ingredients, concentration)**
6. **FPA registration**
7. **Weight**
8. **Warning colour band + Pictograms**

Image 44a. **Sample of front packaging label**



<<BRAND X>> is an insecticide belonging to MoA **Group 9B** that delivers excellent crop protection through permanent inhibition of feeding and causes malfunction of the hind legs leading to starvation and death. It has stomach, contact and translaminar activity.

1 **DIRECTION FOR USE:** **<<BRAND X>>** is recommended as a diluted foliar spray at the following rate:

CROP	PEST	No. of sachet per 200 L	Grams* per 16L knapsack	Grams* per Hectare
Mango	Mango Leafhopper	1**	N/A	N/A
Corn	Leafhopper, Planthopper, and Aphids	N/A	7 - 16	100 - 250
Rice	Brown Planthopper	N/A	25 - 30	250 - 300

*1 Scoop = 5g product **1 Sachet = 80g product

2 **FREQUENCY AND TIMING OF APPLICATION:** Apply at first sign of infestation. Repeat at 1-2 week interval if necessary. *For black bug in rice:* apply once at first sign of infestation between 2 days before until 3 days after full moon. **<<BRAND X>>** should be used for a maximum of two applications per season.

3 **INSECTICIDE RESISTANCE MANAGEMENT STRATEGY:** The repeated use of **<<BRAND X>>** and insecticides belonging to **Group 9B** may result in the selection of resistance to **<<BRAND X>>** and other **Group 9B** insecticides. To avoid or delay resistance, rotate to effective insecticides from a different mode of action group to treat successive generations of the target pest. Multiple applications of **<<BRAND X>>** and other products containing group 9B insecticides may be made successively within a single generation of the target insect. Where possible incorporate alternative methods of pest control as part of an integrated pest management (IPM) approach.

4 **COMPATIBILITY:** **<<BRAND X>>** is compatible with most standard fungicides and insecticides of neutral reaction. In case of doubt, a physical compatibility test should be carried out.

PRECAUTIONS: Avoid contact with skin, eyes and clothing with product concentrate or spray mixture. Do not breathe dust or spray mist. Do not eat, drink or smoke while handling the product; wash hands and face before doing so. DURING MIXING: Wear gloves. DURING APPLICATION: Wear overalls or long sleeved shirt and long pants, solid footwear and face cover. AFTER WORK: thoroughly clean protective clothing, wash entire body and change clothing. Wash contaminated clothing before re-use.

5 **BABALA:** MAG-INGAT NG MABUTI SA PAGHAHALO AT PAGGAMIT NG PRODUKTO. IWASANG MALAGYAN ANG BALAT, MATA O DAMIT. IWASANG LANGHAPIN ANG ASAP NITO. MAGHUGAS NG KAMAY AT MUKHA BAGO KUMAIN, UMINOM O MANIGARILYO. MAGSUOT NG MGA SUMUSUNOD NA DAMIT PANANGGALANG: HABANG NAGHAHALO: GUWANTES. HABANG NAGBO-BOMBA: LONG SLEEVED SHIRT, PANTALON, SAPATOS AT FACE COVER. PAGKATAPOS MAGBOMBA: MALIGO O KAYA HUGASAN ANG BUONG KATAWAN AT MAGPALIT NG MALINIS NA DAMIT. LABHAN NG HIWALAY ANG MGA DAMIT PANANGGALANG SA MGA IBANG LABAHAN BAGO ULIT GAMITIN.

Legend:

1. Directions for use

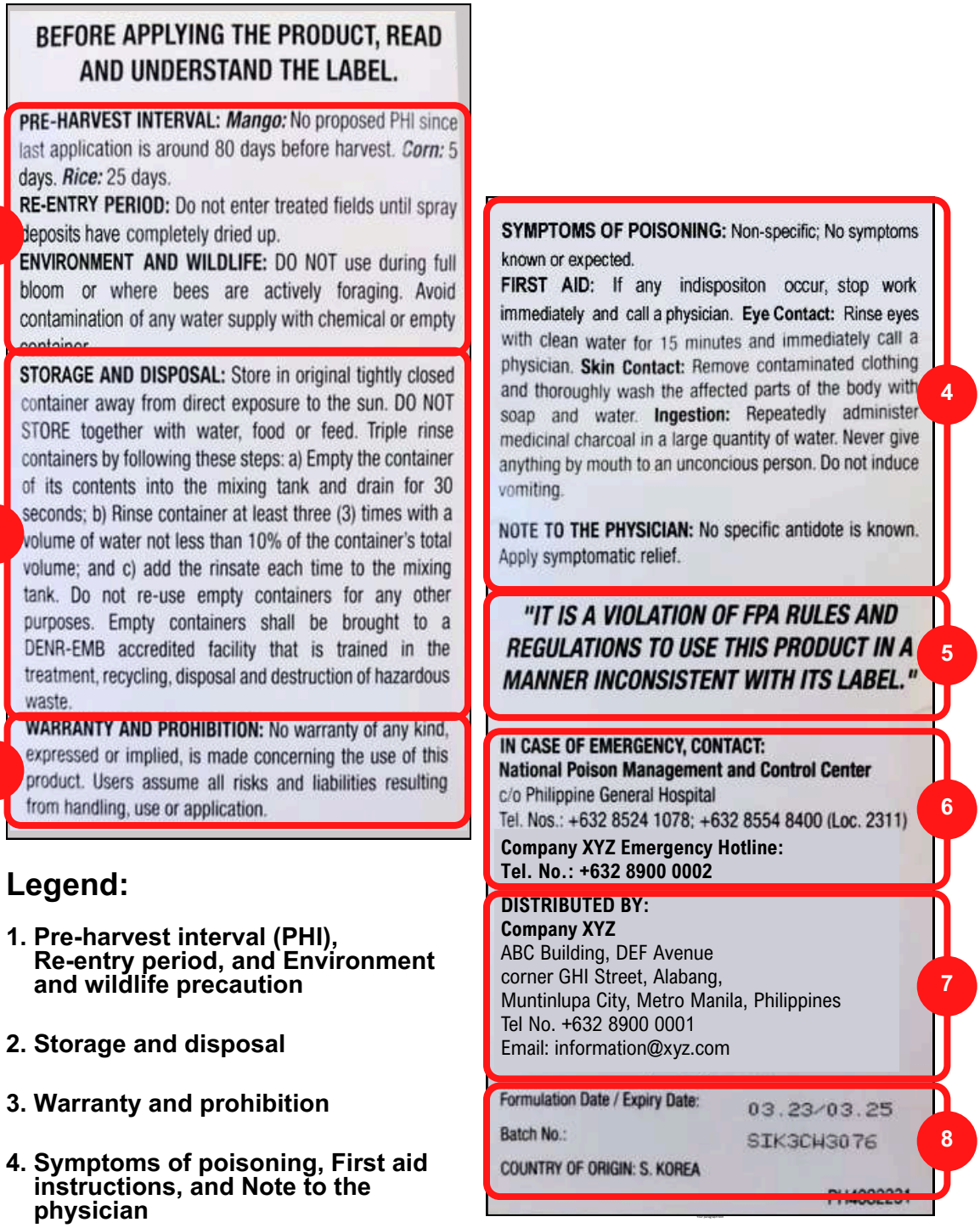
2. Frequency and timing of application

3. Insect resistance management strategy

4. Compatibility

5. Precautions

Image 44b. **Sample of back packaging label**



Legend:

1. **Pre-harvest interval (PHI), Re-entry period, and Environment and wildlife precaution**
2. **Storage and disposal**
3. **Warranty and prohibition**
4. **Symptoms of poisoning, First aid instructions, and Note to the physician**
5. **FPA warning statement**
6. **Emergency numbers**
7. **Manufacturer's information**
8. **Formulation date/Expiry date, Batch number, and Country of origin**

Image 44c. **Sample of side packaging label**

ii. Directions for use
1) Crops
2) Target pests
3) Dosage, frequency and timing of application
4) Pre-harvest interval
   a. PHI refers to the number of days between the last spraying and harvest. It is derived from a supervised pesticide residue trial (SPRT) where the pesticide is applied at the approved rate and the residue level is analyzed.
   b. Each pesticide active ingredient (a.i.) has its own PHI.
   c. If the pesticides are applied following the recommended PHI, pesticide residues even if present would still be at or below the maximum residue limit (MRL).
   d. Mango fruits at harvest should not contain pesticide residue levels exceeding its MRL.

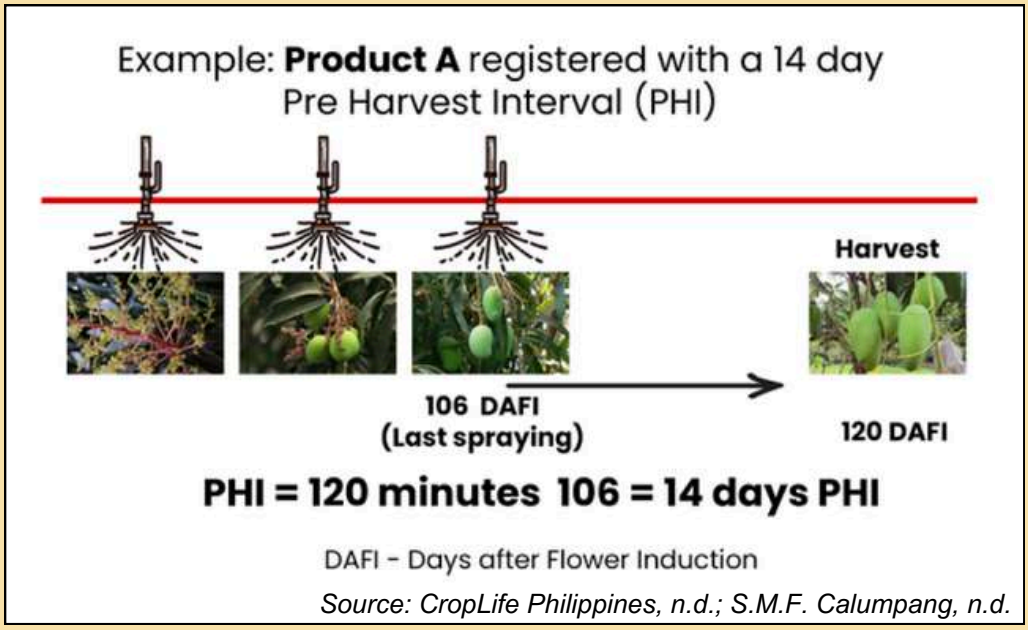
Explanatory Note:

DIRECTIONS FOR USE:

CROP	DISEASES	ml/16L	ml/100L	ml/200L	Last application to harvest–Days
Mango	Anthracnose and Scab	8 to 10	50–60 (1/2 cup)	100 (1 cup)	7

Source: S.M.F. Calumpang, n.d.

Image 45a. **Sample pesticide label information showing the PHI**



Source: CropLife Philippines, n.d.; S.M.F. Calumpang, n.d.

Image 45b. **Example of PHI of a pesticide product**

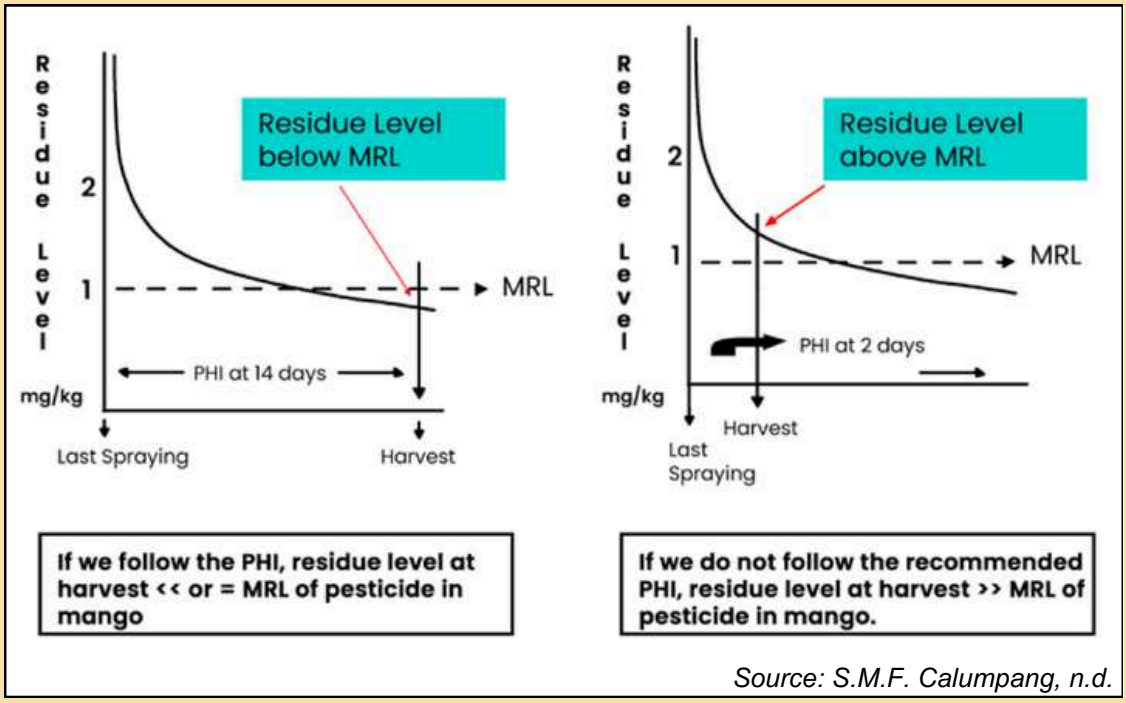


Image 45c. **Comparison of pesticide residue levels when the PHI is followed versus when it is not followed**

5) Re-entry period
   a. It is the length of time to be observed before re-entering the treated area after each application of pesticide.

Explanatory Note:

After pesticide application, the treated area should not be entered within the indicated re-entry period including animals and cultured bees.

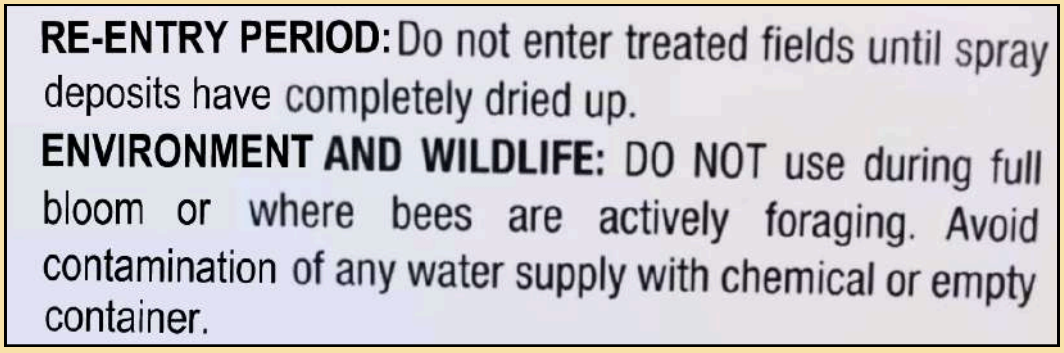
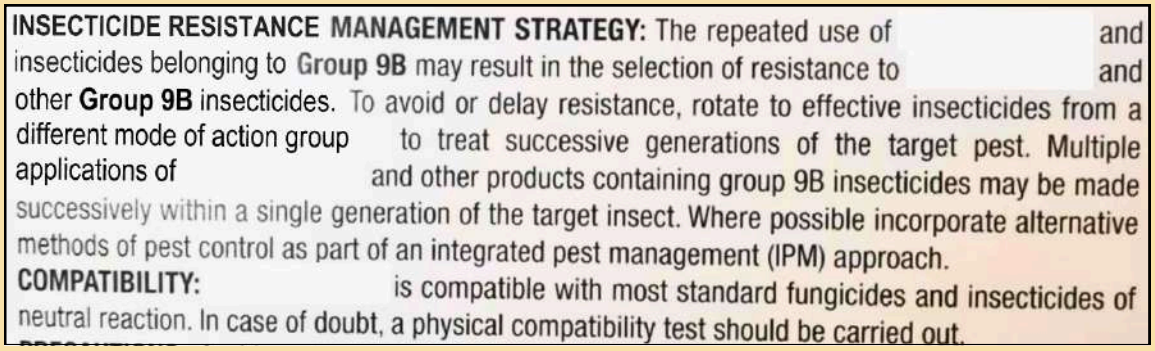


Image 46. **Sample pesticide label showing re-entry period instructions**

6) Compatibility
   a. In tank mixing with other pesticides and related chemicals, check label advice for compatibility.

Explanatory Note:



INSECTICIDE RESISTANCE MANAGEMENT STRATEGY: The repeated use of and insecticides belonging to **Group 9B** may result in the selection of resistance to and other **Group 9B** insecticides. To avoid or delay resistance, rotate to effective insecticides from a different mode of action group to treat successive generations of the target pest. Multiple applications of and other products containing group 9B insecticides may be made successively within a single generation of the target insect. Where possible incorporate alternative methods of pest control as part of an integrated pest management (IPM) approach.
COMPATIBILITY: is compatible with most standard fungicides and insecticides of neutral reaction. In case of doubt, a physical compatibility test should be carried out.

Image 47. **Sample pesticide label showing compatibility and insecticide resistance management strategy**

iii. Pre-cautionary measures

iv. Storage and disposal
   1) Please refer to the advice on the storage and disposal on the label.

v. First aid and medical treatment in case of poisoning

vi. Emergency contact number

Explanatory Note:

In case of emergency, the pesticide label should contain contact numbers of the company and a recognized poison center:

National Poison Management and Control Center - Philippine General Hospital
Hotline numbers: +632 8524 1078; +632 8554 8400 (local 2311)

b) GAP for the proper use and handling

i. Before mixing

1) Keep spraying equipment in good condition. Check sprayer for defects. Maintain a record of maintenance check-up of spraying equipment.
2) Check and repair leaks. Leaky sprayers cause unnecessary waste and risks, so do not use faulty or leaky sprayers.
3) Clean the nozzles with water or a soft-probing device. Never blow into a clogged nozzle.

Explanatory Note:

Calibrating sprayers ensures that the intended volume of spray mixture is distributed to the target area (Michigan State University, 2002).

Here are the steps in the calibration of the sprayer:

1. Determine a 2 x 50 m (100 m^2) area of land.
2. Fill sprayer tank with water.
3. Determine the time it takes to spray uniformly the measured area at a comfortable pace, constant speed and pressure.
4. Repeat Step 3 at least three times and calculate the average time needed to cover 100m^2.
5. Refill tank with water then dispense the spray into a container for the duration of the average time determined previously and get the volume of water.
6. Repeat Step 5 at least 3 times and calculate the average volume of water.

Below is a sample calculation of the calibration of a sprayer:

1. If 4 L were needed to spray 100m^2 :

$$\text{To spray 1 ha} = 4\ \text{L} \times \frac{100\ m^2}{\text{ha}} = 400\ \text{L of spray solution needed}$$

2. Spray load per hectare:

For a knapsack sprayer with 10 L capacity,

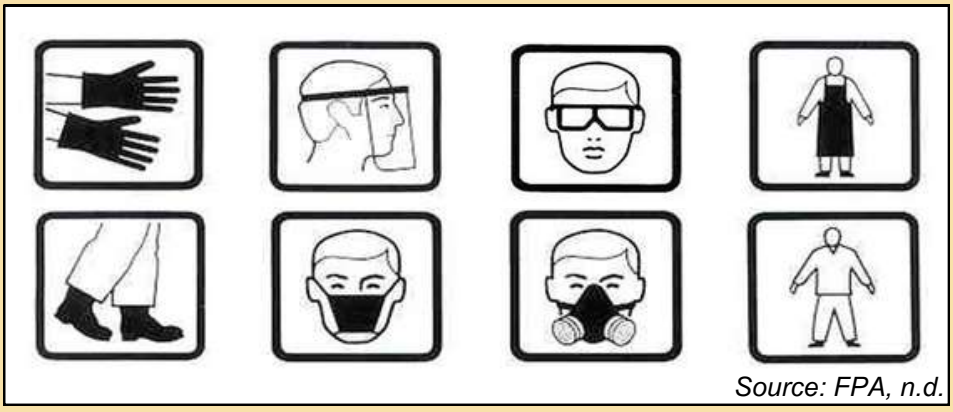
$$= 400\ \text{L} \times \frac{1\ \text{spray load}}{10\ \text{L}}$$

Always check the nozzle, hose, pump, motor, fan belt, and oil/gasoline.

4) For appropriate personal protective equipment (PPEs) to be used, read the product label.

Explanatory Note:

Check pictograms on the label regarding the appropriate PPEs to use.



Source: FPA, n.d.

Image 48. **Sample pictograms on PPEs**

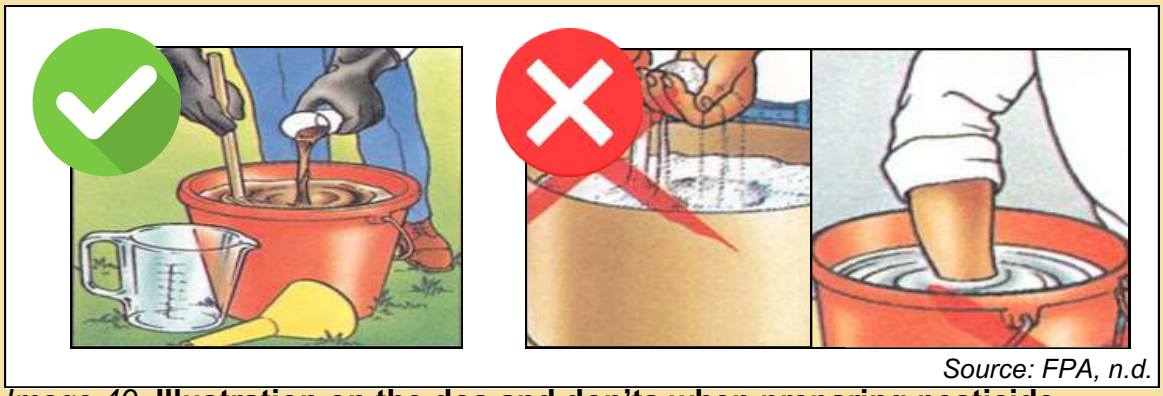
ii. During mixing

1) Use a measuring cup or graduated cylinder in measuring the concentrated formulated pesticide, with care to avoid spillage or hand contamination.
2) Use clean water for mixing pesticides to avoid microbial contamination of the mango fruits.
3) When the contents of the pesticide bottle are used up, rinse the bottle 3 times with water and pour into the last sprayer tank load.
4) Never use your bare hands for mixing.
5) Use appropriate gloves to minimize dermal exposure.

Explanatory Note:

Additional precautions to be observed while mixing/measuring:

- Always wear protective clothing and remember to use the recommended dose.
- Keep children and animals away from the mixing site.
- Use suitable equipment for measuring and mixing - scoops/measuring cups, plastic buckets, steel drums, steel cans, and sticks/paddles.
- Do not mix granules with water. Granules are ready to use and can be applied directly to the soil.



Source: FPA, n.d.

Image 49. **Illustration on the dos and don'ts when preparing pesticide solutions**

iii. During application

1) Pesticide residues are highest in the face area, including the neck and shoulders, so wear the necessary protection.
2) Do not spray against the wind.
3) Spray inner canopy first before spraying the outer canopy.
4) Use a power sprayer with an extended boom such as bamboo pole, to reduce contact with the spray mist and avoid climbing of trees to minimize exposure.
5) To minimize exposure while spraying: wear protective headgear.
6) Maintain a record of spray application indicating information of pesticide used, volume used, area sprayed, and operator.
7) To minimize exposure while spraying: wear protective headgear, cover nose and mouth, wear long-sleeved shirts and long pants, change shirt and headgear when it gets wet with perspiration or spray solution and do not rub face or other body parts with contaminated hands. Do not smoke and eat if your hands are not washed clean after spraying.

Explanatory Note:

To minimize exposure while spraying, wear a cotton long-sleeved shirt and long pants. Cotton absorbs the insecticide, preventing it from entering the skin pores.

The insecticide spray solution will easily enter the skin when polyester shirts and pants are worn. This could lead to pesticide poisoning incidents (Calumpang & Medina, 1996; Calumpang, 2003).

Source: S.M.F. Calumpang, n.d.

Image 50. **Farmer wearing t-shirt as mask**

iv. After spraying

1) Clean spray equipment by flushing the remaining pesticide solution using detergent and clean water.
2) Do not dispose contaminated water or rinsate into waterways.
3) Change working clothes immediately after spraying.
4) Remove gloves last.
5) Wash your hands with soap and water.
6) Do not go home in your working clothes (used in spraying) because the pesticides in the fabric can be absorbed by the skin.
7) Do not hang used clothes to dry for reuse the following day.
8) Soak clothes in water and detergent.
9) Dispose of rinse water properly, taking care not to contaminate water and food sources.
10) Launder working clothes separately from uncontaminated clothes.

Explanatory Note:

Remove and place pesticide-soiled clothing in a separate bag before bringing it home to be laundered.

Separation of laundering of pesticide-soiled clothing with family wash minimizes the exposure of launderers to pesticides by doing the laundry and the transfer of pesticide residue to other clothing.

In the study of Rondl, R. and Schulze, L. (2000), the following were recommended in properly cleaning pesticide-soiled clothing:

- use of chemical-resistant gloves when doing the laundry;
- pre-rinsing to remove pesticide residue from the clothing;
- use pre-treatment products to help remove some pesticides from clothing;
- if feasible, use hot water;
- wash contaminated garments a second time to ensure greater removal of pesticides; and
- hung the garments outside to dry (line drying) to get enough ventilation and sunlight to further remove pesticide residue if present.

d) GAP for storage and disposal

i. Storage

1) Store pesticides in their original labeled containers.
2) Keep pesticides locked in a storeroom and out of children's reach.
3) Keep pesticides out of the kitchen.
4) Do not place pesticide bottles beside bottles of vinegar, oil, soy sauce, etc. Do not place pesticide powders near salt or sugar.
5) Keep pesticides away from fire or open flame, stove or lamps. Liquid formulations may have flammable solvents which can be a fire hazard.
6) Partially used pesticide bottles must be placed inside a thick plastic bag to avoid hand contamination.
7) Do not recycle used bottles as containers for oil, vinegar, soy sauce, and for a any other food and feed stuff.

Explanatory Note:

Pesticide storage cabinets should be secured, locked, and can only be accessed by authorized individuals. It should be placed in a separate structure together with other agricultural inputs.

Image 51a. **Example of a secured and locked pesticide storage cabinet**

Image 51b. **Sample warning sign placed outside a pesticide storage facility**

For small orchards, buy the right amount of pesticides needed to avoid unnecessary storage.

For commercial-scale mango production, observe proper segregation in the storage of crop protection products. Liquid formulations of chemicals must not be stored on shelves above powders.

Return the empty pesticide bottle/container to the dealer. Do not reuse an empty pesticide bottle as a food container.

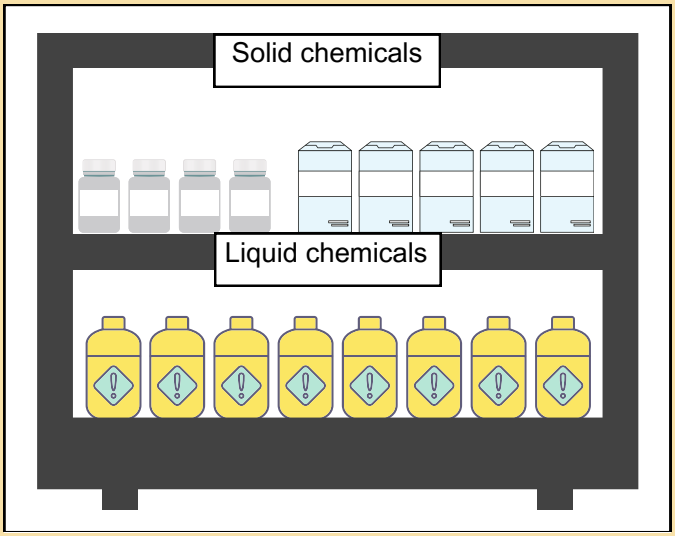


Image 51c. **Illustration on how to properly arrange chemicals (*i.e.* placing the liquid below the powdered/ dry formulations)**

ii. Disposal

1) Dispose of empty pesticide bottles and cartons into a pesticide disposal pit.
2) Dig disposal pit in an area away from people and animals, and far from water sources.
3) Do not burn pesticide containers. The temperature in the burning pile is not high enough to destroy the pesticide left in the containers. It will only spread faster through the hot air generated while burning. This will lead to inhalation problems and in some cases, phytotoxicity in standing crops.

Explanatory Note:

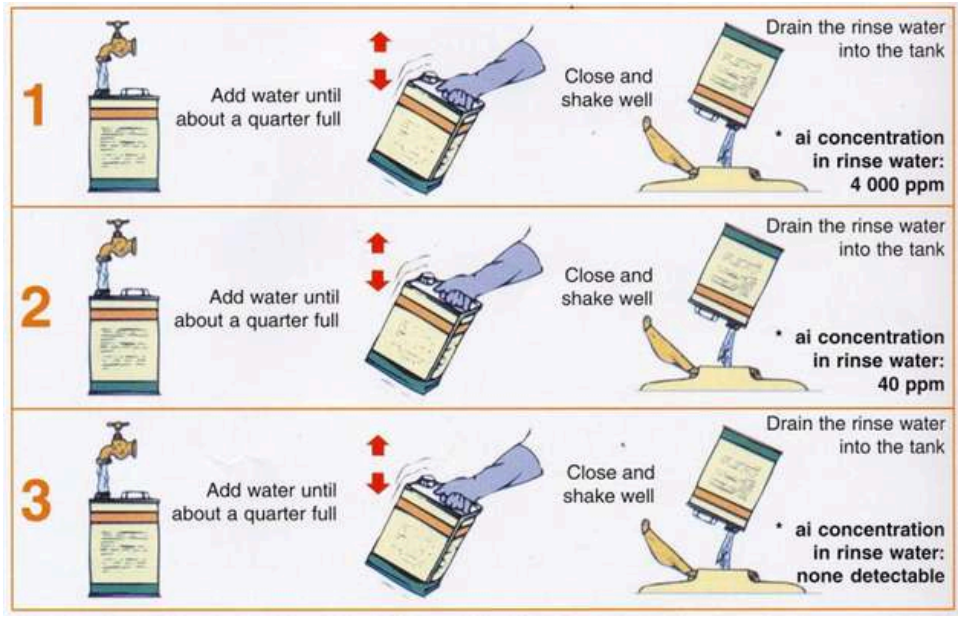
The DA-FPA Pesticide Regulatory Policies and Implementing Guidelines states that the **disposal of empty pesticide containers shall be the shared responsibility** of the pesticide companies, their network of dealers/distributors, the users, local government units, and accredited waste generators/transporters and treatment/ storage/ disposal entities. The Guidelines also provide measures on how to manage empty pesticide containers. Below are a few details lifted from the DA-FPA Guidelines.

The general guidelines in empty container management are as follows:

1. **Rinsing**

   Strictly, all used pesticide containers shall be decontaminated before disposal. Cleaning must be undertaken immediately following the emptying of containers. It must be properly rinsed, and the rinsate must be added to the spray tank as part of the make-up solution. The options that may be adopted are:

   a. **Triple rinsing** is applicable for smallholder farmers who do not have mechanical rinsing equipment. It follows the following stages: a) Empty the container of its contents into the mixing tank and drain for 30 seconds; b) Rinse the container at least three times with a volume of water not less than 10% of the container's total volume; and c) add the rinsate each time to the mixing tank.



Source: FPA, n.d.

Image 52a. **Illustration of the effect of triple rinsing on the decrease on AI concentration**

b. **Pressure rinsing** is applicable for farmers and/or plantation-type operations that have mechanical equipment. The jets of water hit the internal surfaces of the container, removing and dissolving the residues.

Image 52b. **Sample image of spray nozzle used for pressure rinsing**

Whichever method of rinsing is used, the rinsate should be added directly to the spray solution and not thrown elsewhere.

2. **Burying or burning of empty containers or packaging is prohibited.**

3. **Collection of empty containers**

   a. The pesticide dealers are hereby designated as primary collection points of properly rinsed packaging. They are, therefore, mandated to provide properly sealed drums in a secure area on their premises as temporary holding areas where their clients should bring their rinsed containers. The dealers shall maintain a record of the rinsed containers they receive from the company. A report on such should be submitted to the nearest DA-FPA office every quarter.

   b. Thereafter, the pesticide dealers shall bring the collected rinsed pesticide containers to the DENR-EMB-accredited waste generator near their area. The waste generator, which may be the Local Government Units, NGO's or the private sector, must be compliant with the provisions of Republic Act 6969, or the Toxic Substances and Hazardous and Nuclear Waste Control Act and Its Implementing Rules and Regulations. They are required to assign a Pollution Control Officer for this purpose.

   c. Plantation owners are hereby mandated to collect their empty containers. They shall keep a record of empty containers by the company and shall submit such to the nearest DA-FPA office quarterly. They must seek accreditation with DENR-EMB as waste generators and are required to assign a Pollution Control Officer.

e) Insect resistance management

i. Use products according to the recommended dosage. Underdosing quickly affects insect populations with average levels of tolerance, while overdosing kills most of the insect population leaving only those which are tolerant or resistant. This leads to the development of a new generation of insects which are difficult to kill.

ii. Use appropriate, well-maintained equipment to apply insecticides/fungicides. Use recommended water volume and spray pressure in order to obtain optimal coverage of the canopy. Avoid spraying to run-off.

iii. Target the pests at their vulnerable stage, (young instars, larvae) where possible, because these are easier to control than older instars/larvae.

iv. Use appropriate economic thresholds and spray intervals (based on label recommendation).

v. Use alternately products of different modes of action or from different chemical groups such as pyrethroids, carbamates, organophosphates and new generation compounds.

vi. If the efficacy of the product is no longer good, do not reapply the same insecticide/fungicide but change to the one having a different mode of action.

vii. Mix different pesticides. This may offer a short-term solution to resistance problems. However, remember that each product used in the mixture should belong to a different class or mode of action, and is used at the recommended dose.

Explanatory Note:

When mixing pesticides, it is important to check the compatibility statement indicated on the label.

Section VI

Farm management

1. All records must be updated and kept up to two years.

2. Copies of laboratory analysis and certificates that verify compliance with this Code must be filed.

3. Each package/bulk packed produce leaving the farm must be traceable (i.e. date of harvest) to farm sources.

4. Records of lot number must be maintained for all produce leaving the farm.

5. Staff training records must also be maintained.

Explanatory Note:

Records enable tracing back of consignments to investigate possible causes of food safety problems and also provide evidence for auditors and customers that good agricultural practices have been implemented.

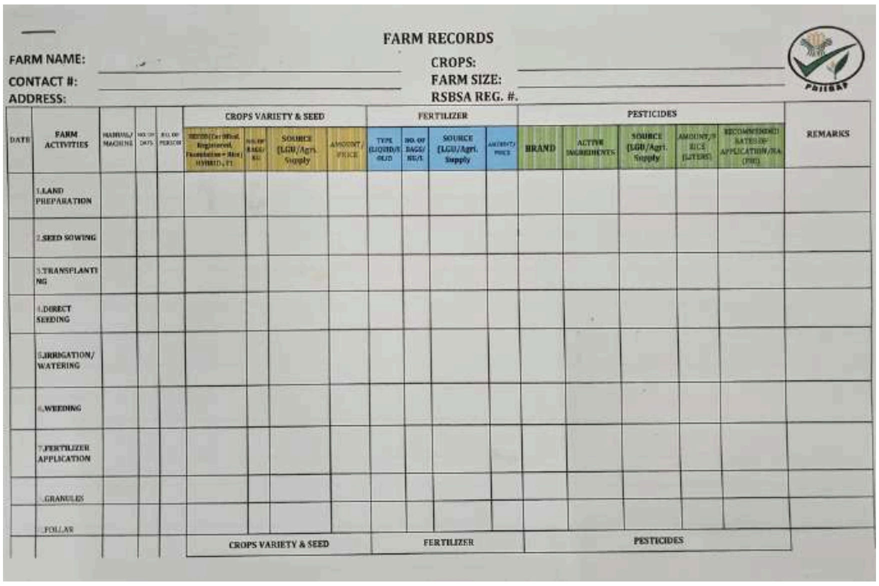


Image 53. **Sample of an actual logbook or record sheet**

Growers and/or packers should always update all relevant information on agricultural activities, such as:

- site of production
- suppliers' information on agricultural inputs
- lot number of agricultural inputs
- irrigation practices
- use of agricultural chemicals
- pest management
- cleaning schedules for indoor establishments, premises, facilities, equipment, and containers

Section VII

Workers health, safety and welfare

1. Working conditions are suitable for workers and protective clothing is supplied where conditions are hazardous to workers.

Explanatory Note:

Images below show the appropriate working clothes based on the farm activity.

Image 54a. **Sample of recommended working clothes in the farm**

Image 54b. **Sample of recommended working clothes in the packinghouse**

2. All farm vehicles, equipment and tools, including electrical and mechanical devices, are adequately guarded and maintained and inspected on a regular basis for potential hazards to users.

3. Safe manual handling practices are followed to minimize the risk of injury from lifting heavy objects and excessive twisting and reaching movements.

Explanatory Note:

Manual handling is an activity requiring force to lift, lower, push, pull, carry, or otherwise move, hold, or restrain any static or moving load. Heavy lifting, work requiring poor posture, and repetitive work can cause back, joint, and muscle problems in workers.

Following safe manual handling practices can help reduce the human requirement to lift excessive weights, bend or twist, exert excessive push/pull forces, adopt uncomfortable postures for long periods, and minimize repetitive work. For international certifications, the following examples of safe practices are recommended:

- Use mechanical aids like slings, hoists, trolleys, wheelbarrows, and conveyors.
- Opt for smaller and lightweight containers, bags, and materials.
- Deliver and place heavy items as close as possible to work areas.
- Substitute manual handling of fertilizer bags with bulk bags and mechanical equipment.
- Adjust bench heights to suit the worker.
- Ensure tools are within easy reach.
- Train workers in safe manual handling practices and encourage prompt injury reports.
- Provide protective clothing and equipment such as gloves (ASEAN, 2007).

4. Where provided by an employer, living quarters are suitable for human habitation and contain basic services and facilities.

Explanatory Note:

Basic services and facilities include adequate sleeping quarters that are not overcrowded and hygienic kitchen facilities, toilets, and hand-washing facilities.

5. The minimum working age shall comply with the country regulations which is more than 15 years of age.

Explanatory Note:

According to Presidential Decree No. 442, the minimum age to work in the Philippines is 15 years old for non-hazardous jobs, and 18 years old for hazardous jobs.

Furthermore, the Department of Labor and Employment (DOLE) Department Order No. 149 Series of 2016 - *Guidelines in Assessing and Determining Hazardous Work in the Employment of Persons Below 18 Years of Age* stipulates that the following mango farming activities are declared hazardous to persons below 18 years of age:

1. Preparatory activities such as clearing of land, plowing, harrowing, irrigating, grafting and cutting

2. Tending activities such as handling, spraying, and application of harmful fertilizers, pesticides, herbicides, and other toxic chemicals, and the loading and carrying of heavy loads
3. Harvesting activities such as cutting and picking, spreading for drying, hauling, burning of the field, sticking and classifying, threshing, loading, and carting of produce
4. Post-harvesting activities such as sacking of products, hauling of products led by animal guide, loading and unloading of packed farm products, sealing and carting of produce for warehousing and transport to market, and all ancillary work such as clearing, cleaning, and recycling of farm waste in its preparation as animal food and other related processes

6. New workers are informed about the risks associated with health and safety when starting at the worksite.

7. Workers have appropriate knowledge or are trained to a level appropriate to their area of responsibility in the following areas:

   a) Operating vehicles, equipment and tools;
   b) Accident and emergency procedures;
   c) Safe use of chemicals; and
   d) Personal hygiene.

Explanatory Note:

To have the necessary knowledge, the training can include instructions on measures that the workers need to follow to prevent or minimize the risk of the hazards to their health and safety. The training may take the form of on-the-job training or formal training sessions. Refresher training and signs in the work area also help in reinforcing instructions for workers.

Image 55. **Certificates of training of farm workers on GAP**

Section VIII

Review of practices

1. All practices are reviewed at least once each year to ensure that they are done correctly and actions are taken to correct any deficiencies identified or if changes occur to environmental regulations.

2. A record is kept to show that all practices have been reviewed and any corrective actions taken are documented.

Explanatory Note:

All practices are reviewed at least once a year, though they do not need to be assessed simultaneously. Ideally, reviews/internal audits should be conducted when the practices are being carried out. For instance, harvesting and post-harvest handling practices should be evaluated during harvest, while pesticide application should be reviewed before the produce is harvested.

Despite best efforts, issues may arise. The review/audit process helps identify any practices that are not being properly implemented. If a problem is found, it should be investigated, corrective actions taken, and measures should be put in place to prevent recurrence. Results are then recorded accordingly (ASEAN, 2007).

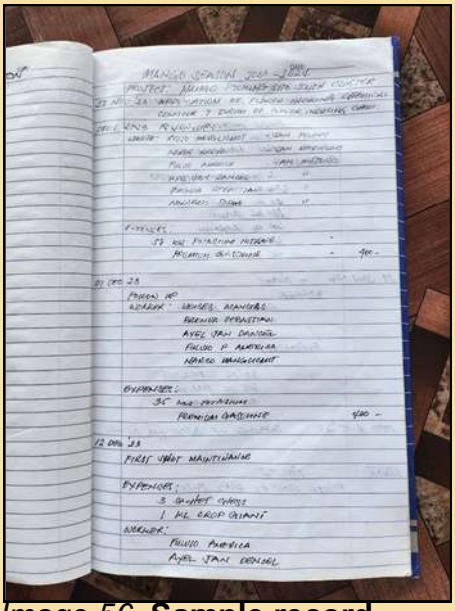


Image 56. **Sample record book showing farming activities**

3. Actions are taken to resolve complaints related to environmental management, and a record is kept of the complaint and actions taken.

Explanatory Note:

Customer or stakeholder complaints related to food safety are thoroughly investigated, and appropriate measures should be taken to address the issue. Complaints may involve the detection of excessive chemical residues, the presence of physical hazards, or illnesses linked to consuming the produce.

All complaints, non-compliances, and corresponding corrective actions taken are documented. This information should be recorded in a logbook or a designated record form for proper tracking and reference (ASEAN, 2007).

Annexes

Annex I
Crop phenology
Stages of panicle development and fruit maturation

 *Source: Aani Mango Industry Association, n.d.*	Bud break (6-8 DAFI)
 *Source: Aani Mango Industry Association, n.d.*	Bud emergence (9-12 DAFI)
	Panicle elongation (13-22 DAFI)
	Pre-anthesis (23-25 DAFI)
	Full-bloom (26-30 DAFI)
	Fruit set (mungbean size) 31-35 DAFI

Annex I (continued)

	Fruit enlargement (corn size) 36-42 DAFI
	Fruit enlargement (marble size) 43-50 DAFI
	Fruit enlargement (chicken-egg size) 51-60 DAFI
	Fruit enlargement 61-90 DAFI
 *Source: Aani Mango Industry Association, n.d.*	Start of maturation 91-109 DAFI
 *Source: Aani Mango Industry Association, n.d.*	Full maturity 110-120 DAFI

Annex II
Pest identity, damage and management*

Part of the Mango Plant	Pests	Disease
Flowers	Mango leafhopper Mango tip/twig borer Mealy bugs Scale insect Mango thrips	Anthracnose Sooty mold
Fruits	Fruits flies Mango seedborer Pulp weevil Mango thrips Mealy bugs Scale insect Capsid bug Cecid fly Ants	Anthracnose Scab Sooty mold Diplodia stem-end rot

**Source: PNS/BAFPS 45:2009 and Presentations of Dr. Louella Lorenzana*

Annex II (continued)

Insects	Damage	Management
Ants Ant infestations in mango trees are encouraged by the presence of scale insects and mealy bugs that produce honeydews, which are ants' excellent food source.  *Source: CropLife Philippines, n.d.*	Ants do not really create harm or damage the tree or fruit, but they can make harvesting very cumbersome because of the painful bites they can inflict on to the farmers/ harvesters.	- Prune the mango tree and remove all unnecessary branches that provide favorable environment for ants. - Control mealy bugs, scale insects and leafhoppers. - Apply insecticides during heavy infestation, particularly directed on the nests.
Capsid bug The adult insect looks like a small rice bug. Its pair of antennae is twice as long as its body. The female adult capsid bug has a black body with an orange thorax. Its eggs are white while young nymphs are red or orange. The bug stays in wild vegetation and is active in the evening. It feeds on developing fruits, up to the size of a chicken egg.  *Source: CropLife Philippines, n.d.*	The bug excretes toxic materials that produce dry, brown irregularly-shaped corky spots on the fruit's skin. These spots are locally known as "kurikong," "saksak walis", "armalite", or "nora-nora" depending on the area or region.	- Bag the fruits at 55 to 60 days after flower induction. - Remove weeds, underbrush shrubs and small trees under the mango canopy as well as infested fruits. - Remove alternate hosts of adult bugs such as cashew, guava and cacao from the orchard. - If infestation is heavy, apply registered insecticides, preferably at night. Prevention: Prune trees after harvesting or before flushing.

Annex II (continued)

Insects	Damage	Management
Fruit Fly The adult fruit fly is almost similar in size to the house fly. It has a light brown body, bright yellow spots on the shoulder and thorax, and has transparent wings. The female fruit fly punctures the peel of a mature fruit and lays eggs on it. Its larvae grow and feed on mango fruits.  *Source: CropLife Philippines, n.d.*	Punctures on the fruit are not readily recognizable. However, after four to five days, soft brownish spots appear, liquid oozes from the spots and the underlying tissue rots. The continuous feeding of the larva and the secondary microbial activity further destroy the fruit making it unsuitable for consumption.	- Collect the infested fruits and bury deep into the soil to prevent the insect from completing its life cycle. - Bag the fruits with appropriate bagging materials such as old newspapers at 55 to 65 days after flower induction or when the fruits are about the size of chicken-egg. - Harvest fruits at mature green stage since fruit flies are attracted to them as soon as their surfaces become yellow. - Do not intercrop with the following fruits trees: guava, papaya, jackfruit, sineguelas and santol since they are also preferred hosts of the fruit flies.
Mango cecid fly Cecid fly is a very small and delicate fly with long legs and antennae, and hairy transparent wings. Its larvae are tiny bright yellow maggots. The adult cecid fly stays on wild vegetation while the larva stays in young mango leaves or fruits.  *Source: CropLife Philippines, n.d.*	The developing larvae cause gall formation in the leaves and round sunken spots on the fruits.	Management: - Prune crowded branches and infested leaves, particularly flushes. - Remove weeds, underbrush shrubs and small trees under the mango canopy. - Collect and dispose the infested fruits properly. Prevention: -Bag fruits at 40 days after flower induction or at marble size or spray registered insecticides up to 55 days after flower induction. -Bag fruits one to three days after insecticide application.

Annex II (continued)

Insects	Damage	Management
Mango Leafhopper Adult mango leafhoppers are wedge-shaped insects which are greyish green or brown. The young leafhoppers or nymphs are very small, wingless and yellowish. They can be found hiding underneath the leaves, main stalk of the panicle and in emerging flowers.  *Source: CropLife Philippines, n.d.*	The nymph and adult mango leafhoppers pierce and suck plant sap resulting in the withering and falling of individual flowers. High hopper infestations results to production of sticky fluid "honey dew" which serves as medium for the growth of sooty mold beneath the leaves, flower buds and panicles. Under severe leafhopper infestation, the entire canopy will turn black.	- Prune all dead branches after harvest to improve light penetration and air circulation. - Do light trapping before flower induction to reduce initial leafhopper population in the field. - Induce early flowering. This can minimize heavy leafhopper infestations that usually occur during the summer months. - Avoid excessive application of fungicides to conserve beneficial fungi that attack the leafhopper. - Apply insecticides only when there are at least three leafhoppers per panicle. Check the presence of mango hopper seven days after flower induction or once flower buds are formed or have elongated.

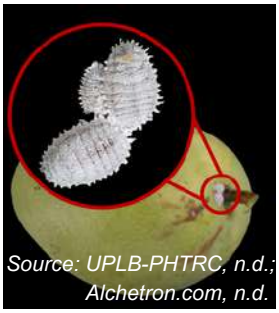
Annex II (continued)

Insects	Damage	Management
Mango pulp weevil The mango pulp weevil is a hard-bodied weevil, usually 6 mm long and brownish black in color. Due to its color and habit, it cannot easily be seen in the tree. Its larvae, which feed on the mango flesh, develop inside the mango fruit. This insect is found only in Southern Palawan but because of its destructive nature, it has placed the island under quarantine. Mangoes from this area are not allowed to be transported or brought out of the province.  *Source: CropLife Philippines, n.d.*	The damage created by the weevil is not visible externally. But inside the fruit, tunnels and discolored pulp are formed due to larval feeding. An adult weevil does not leave the fruit until it falls to the ground and rots.	- Prune the tree, preferably open-center pruning, to allow the sunlight to penetrate the tree canopy. Sunlight kills weevils. - Keep the orchard clean. Remove all weeds, twigs, fallen leaves and other debris under the tree canopy. - Dispose of infected fruits properly by burying the fruits two feet below the ground. - Bag the fruits at 55 to 60 DAFI.

Annex II (continued)

Insects	Damage	Management
Mango seed borer The adult mango seed borer moth is light brown and 16 mm long. The larva is white with red inter-segmental bands.  *Source: L. Chandler, n.d.*	The damage starts when the larva enters the fruit through the apex or the narrow tip area of the fruit. The growing larva feeds on the seed and flesh. Later, the damaged area collapses and the apex bursts. When the seed is totally consumed, the fruit will fall to the ground. A single larva can consume the entire seed in a short period of time.	- Remove infested fruits from the tree to prevent movement of larva from one fruit to another and to minimize damage to other fruits. - Dispose of infected fruits properly to prevent the insect from completing its life cycle. This can be done by burying the fruits two feet below the ground. - Bag the fruits at 55 to 65 DAFI. - Monitor infestation and when necessary, apply insecticide at 50-55 days after flower induction.
Mango thrips Mango thrips are minute, slender-bodied insects and about 4 mm long. When fully developed, the insects have four long, narrow fringed wings. Thrips are sensitive to light.  *Source: CropLife Philippines, n.d.*	Adults and nymphs attack the flowers. They suck the plant sap, which causes the flowers to wither and fall off. They can extend damage to the fruits resulting to scaby appearance locally called “chico-chico”.	- Prune or cut off excess branches to improve aeration and to allow more light to penetrate the canopy. - Spray registered insecticides as a fine mist to protect the upper and lower surfaces of the leaves.

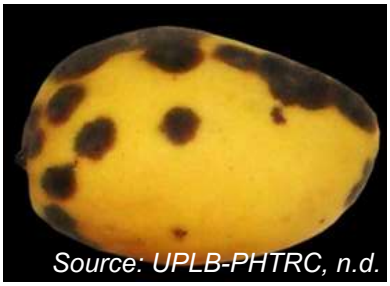
Annex II (continued)

Insects	Damage	Management
Mealy bugs Mealy bugs are small (2 mm long), oval-shaped, soft-bodied insects with white cottony filaments on their body. Male adult mealy bugs have two wings while females are wingless. They are usually found on flushes, flowers and fruits. Mealy bugs have symbiotic relationship with red ants. They excrete sticky fluid called “honeydew”, which serves as food for red ants. The ants protect and transport mealy bugs to the different parts of the tree.  *Source: UPLB-PHTRC, n.d.; Alchetron.com, n.d.*	Mealy bugs suck vital plant sap and affects leaves, flowers and fruits. Affected parts turn yellow, dry-up and eventually, fall-off. The honeydew produced by the mealy bugs promotes growth of sooty molds on leaves, which eventually affects the photosynthetic activity.	- Remove infested fruits from the tree to prevent movement of larva from one fruit to another and to minimize damage to other fruits. - Dispose of infected fruits properly to prevent the insect from completing its life cycle. This can be done by burying the fruits two feet below the ground. - Bag the fruits at 55 to 65 DAFI. - Monitor infestation and when necessary, apply insecticide at 50-55 days after flower induction.
Mango tip borer The adult mango tip borer is a grayish black moth, usually about 8 mm long. Its larva can grow to as long as 10 mm and light-brown to purple in color. It is considered as a serious pest of flowers and young shoots.  *Source: CropLife Philippines, n.d.*	Mango tip borer destroys the flowers from bud emergence to elongation. Its larva bores into the tip of the shoots and developing flowers and feeds on the inner tissues. The affected shoots wilt and terminal parts die while the affected panicles split-open and gradually shed off the flowers.	- Prune and burn the infested parts to prevent the insects from multiplying and spreading. - Spray registered insecticides recommended for tip borer control.

Annex II (continued)

Insects	Damage	Management
Scale insect Scale insects are small (1 mm long), stationary, convex and scale-like organisms.  *Source: CropLife Philippines, n.d.*	High population of scale insects causes the canopy to turn black due to the growth of sooty mold. Since the leaves are covered with sooty mold, photosynthetic or food production activity is reduced considerably. Punctures created by insects on the fruit result in whitish spots which lower the fruit's market value.	- Look for scale insects on leaves, flowers and fruits. Check if infestation is widespread or occurring only in small patches. If infestation is widespread, prune heavily-affected parts before spraying registered insecticide. If it occurs in patches, remove affected parts mechanically. - Check if there are ipil-ipil or kakawate trees nearby. These are alternate hosts of scale insects and serve as a source of infestation. -Destroy the red ants infesting the mango tree because these facilitate the spread of scales from one tree to another.
Twig cutter The larva of twig cutter grows to as long as 18 mm, is colored white and legless. It can be found inside the twigs where it feeds on woody tissue. It pupates inside the twig and will get out only when it has become a fully-grown beetle. The adult twig cutter is a gray-spotted long-horned beetle and around 20 mm long. This insect is very destructive during the dry season, particularly in many growing areas of Central Luzon.  *Source: CropLife Philippines, n.d.*	The twig cutter cuts or girdles the twig before it lays eggs. The infested twig breaks off easily at the point of incision or die. A twig cutter-infested tree is characterized by the presence of dead twigs and leaves on its canopy.	- Prune and burn infested twigs to prevent the development and spread of insects. - Apply insecticide during flushing stage, the time when the adults lay eggs on the twigs.

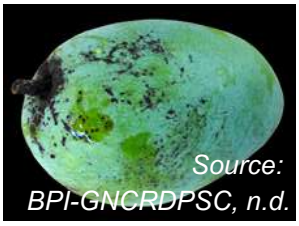
Annex II (continued)

Insects	Damage	Management
Anthracnose Anthracnose is a major post harvest problem of mango fruits and is the most serious fungal disease of mangoes in the Philippines.  *Source: UPLB-PHTRC, n.d.*	Anthracnose causes irregular brown spots on young leaves while mature leaves get distorted with “shotholes” in various shapes and sizes. It also blackens and withers the flowers and produces “blossom blight” while causing brown to black sunken spots on the fruits. Other damage caused by anthracnose: - reduced tree vigor - unproductive terminal branches - withering of flowers - failure to set and retain fruits - rotting of fruits - total crop failure	Field Management - Maintain good light penetration and air circulation in each mango tree. - Collect and burn trash to reduce sources of disease. - Bag fruits using appropriate bagging materials to reduce further field infestation. - Fertilize and irrigate trees to improve tree vigor. - When flushing occurs on rainy days, protect emerging flushes from leaf spots by spraying registered contact fungicides. DO NOT use systemic fungicides. - Apply protectants/systemic fungicides to protect inflorescence against blossom blight and fruit rot infection on developing fruits. Post Harvest Management Subject newly harvested fruits in hot water treatment

Annex II (continued)

Insects	Damage	Management
Scab Scab is a fungal disease which primarily infects young developing fruits. It is prominently seen in panicles and young developing fruits, particularly on the pedicel. The surface of infected fruit has grayish brown spots with dark irregular margin. As the spots enlarge, the surface develops cracks and fissured corky tissues. Heavily infected fruits look like common scab-infected calamansi fruits. Heavier infestations occur during the rainy season.  *Source: BPI-GNCRDPSC, n.d.*	Infected fruits are misshapened with unsightly looking surface, thus are downgraded and have lower market value.	Follow the protection management used against anthracnose. - Use the recommended cultural practice to maintain vigorous and productive trees, which are less prone to diseases. - Maintain good light penetration and air circulation in each mango tree through regular sanitation and pruning. Prune after harvest to increase ventilation and reduce humidity inside the canopy. - Collect and burn trash to reduce sources of diseases. - Bag fruits using appropriate bagging materials to reduce further field infection. - Spray registered fungicides in scab prone areas during the young fruit stage or around 35 to 50 days after flower induction to control the disease.

Annex II (continued)

Insects	Damage	Management
Sooty mold Sooty mold is a fungal disease that grows and obtains nourishment from the honeydew excreted by insects such as leafhoppers, scales and mealy bugs. The disease develops on the leaf surface and on fruit as black velvety covering.  *Source: BPI-GNCRDPSC, n.d.*	The sooty mold on leaves interferes with the photosynthetic activities of the plant. It reduces the tree's vigor and fruit bearing capability and downgrades the fruit's market value.	- Eradicate or manage the population of the honeydew-excreting insects. - Bag clean fruits with appropriate bagging materials. - Practice pruning
Diplodia/ stem -end rot Diplodia stem-end rot is a fungal disease caused by complex fungal organisms. It is characterized by dark lesions developing at the pedicel end of the mango fruits after they are harvested. Under warm and moist conditions, the infected area extends towards the end of the fruit. The fruit turns from dark-brown to purplish black and the tissues become watery and produce unpleasant odor. Diplodia stem-end rot produces soft rot unlike anthracnose which produces hard rot. This disease also infects inflorescence, young developing fruits and terminal branches.  *Source: CropLife Philippines, n.d.*	Stem-end rot causes post-harvest losses due to rotting of fruits. It also reduces tree vigor because of severe drying of twigs and defoliation.	- Remove and burn primary sources of the disease such as dead twigs, barks and other trashes. - Harvest the fruits with about 1 cm to 2 cm of the stalk attached. It was observed that there is a high incidence of stem-end rot on fruits without stalk. - Follow the disease management interventions developed for anthracnose. They are known to substantially reduce incidence of stem-end rot.

**Source: PNS/BAFPS 45:2009 and Presentations of Dr. Louella Lorenzana*

Annex III

Pest and weather monitoring

Legend:

presence of pest/disease

monitor/control

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This Explanatory Manual (EM) serves as a supplementary learning material for the Philippine National Standard (PNS) Code of Good Agricultural Practices (GAP) for Mango. The EM aims to aid stakeholders by promoting uniform understanding and interpretation of the PNS to ensure efficient adoption and implementation of the Standard.

PNS/BAFS 45:2009 was developed to support Filipino farmers and to promote sustainable mango farming.


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