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GOSF
GLOBAL QUALITY
AND STANDARDS PROGRAMME

SIAEP

STANDARD OPERATING PROCEDURES

For Disease Management For Export Quality

Acknowledgements

This document was prepared by Mr Peter Johnson and Mrs Huynh Thi Ngoc Diem. We appreciate the valuable inputs received during the preparation of this document from the following experts and organizations: Mr Le Minh Hung, Mrs Tran Thi Kim Oanh, Mr Ngo Van Binh, Mr Nguyen Vinh Phuc, Sub-Institute of Agricultural Engineering and Post-Harvest Technology (SIAEP), Agro Processing and Market Development Authority (AGROTRADE), Plant Protection Department (PPD), Department of Crop Production, Vietnam Institute of Agricultural and Post-Harvest Technology (VIAEP), Southern Horticultural Research Institute (SOFRI), Vietnam Fruit & Vegetable Association (VINAFRUIT).

This document was prepared under the framework of the project “Increasing quality and standards compliance capacity of Mango value chain in the Mekong River Delta”, which is jointly implemented by the Ministry of Agriculture and Rural Development (MARD) and the United Nations Industrial Development Organization (UNIDO) and funded by Switzerland, through its State Secretariat of Economic Affairs (SECO).

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Acronyms

GAP	Good Agricultural Practices
GlobalG.A.P.	Global Good Agricultural Practice
HACCP	Hazard Analysis and Critical Control Points
HWT	Hot Water Treatment
IDM	Integrated Disease Management
IPM	Integrated Pests Management
MRL	Maximum Residual Limit
MSDS	Material Safety Data Sheets
PPE	Personal Protective Equipment
PUC	Production Unit Code
SER	Stem end rots
SOP	Standard Operating Procedures
VietGAP	Vietnamese Good Agricultural Practices

1. Scope of SOP Document

The scope of this document provides the standard of operating procedures for the management of post-harvest disease in fresh mangoes to meet export requirements to a modern retail system.

This document can be used as training and reference resources for Agricultural Extension Centers, Vietnam Fruit and Vegetable Association, or agricultural students at Universities and Colleges.

2. Key Definitions

GAP (Good Agricultural Practices) are principles and procedures established to ensure a safe and clean production environment, food must ensure that it does not contain pathogens such as biological toxins (bacteria, fungi, viruses, parasites, etc.). microorganisms) and chemicals (pesticide residues, heavy metals, nitrate content), protect the health of producers and consumers as well as protect the environment.

Global G.A.P. (Global Good Agricultural Practice) is a set of technical measures known as good agricultural practices, developed for voluntary application to the production, harvesting, and post-harvest handling of agricultural products, including horticultural crops, livestock, and fisheries, on a global scale.

Integrated Disease Management (IDM) is the practice of using a range of measures to prevent and manage diseases in crops.

The components of an IDM in mango production are:

- Excluding the pathogen.
- Reducing inoculum levels of the pathogen.
- Protecting the host.
- Effective monitoring to determine conditions for disease.
- Inhibiting development.
- Careful application of chemicals with well calibrated equipment.

Sanitation are activities aim at eliminating or reducing the amount of inoculum present in the plant, field or packing house.

Maximum Residual Limit (MRL) is the maximum amount of pesticide residue expected to remain on food products when a pesticide is used according to label directions. The MRL is not a toxicological parameter, but rather a trading standard set by national and international authorities (e.g., Codex Alimentarius) to ensure that residues are controlled in world food trade.

HACCP (Hazard Analysis and Critical Control Points) is a systematic preventive approach to food safety from biological, chemical and physical hazards in production processes that can cause the finished product to be unsafe and designs measures to reduce these risks to a safe level.

MRL (Maximum Residual Limit) is the maximum amount of pesticide residue that is expected to remain on food products when a pesticide is used according to label directions. The MRL is not a toxicological parameter, but rather a trading standard set by national and international authorities (e.g. Codex Alimentarius) to ensure that residues are controlled in world food trade.

MSDS (Material Safety Data Sheets) is a document that contains information on the potential hazards (health, fire, reactivity and environmental) and how to work safely with the chemical product.

PPE (Personal Protective Equipment) Clothing and equipment that is worn or used in order to provide protection against hazardous substances or environments..

PUC (Production Unit Code) is an identification number for a growing area in order to monitor and control production and control harmful organisms; traceability of agricultural products.

SOP (Standard Operating Procedures) is set of step-by-step instructions compiled to help operators carry out routine practices.

VietGAP (Vietnamese Good Agricultural Practices) is a locally developed set of principles, order and procedures to guide organizations and individuals in production, harvesting and post-harvest handling in order to ensure safety, improve product quality, and ensure social welfare, health of producers and consumers; while protecting the environment and traceability of production.

3. Introduction

Disease management is the single biggest limitation for export development of mango. The document is intended to assist the export supply chains from field production to retail in the management of post-harvest disease to meet product specifications and standards, and shelf-life expectations, produced within MRL limits of the importing countries while complying to all regulatory, health, safety and environmental standards.

This document is intended to be read in conjunction with the following SOP documents:

- SOP No.1 Standard Operating Procedures for exported mangoes field practices
- SOP No.2 Standard Operating Procedures for packhouse procedures for mango export
- SOP No.4 Standard Operating Procedures for cool chain management of exported mangoes
- SOP No.5 Standard Operating Procedures for transportation of exported mangoes
- SOP No.6 Standard Operating Procedures for traceability of exported mangoes
- SOP No.7 Standard Operating Procedures for mangoes export market requirements manual

4. Principles of SOP Document

(Description of practice and its influence on quality, shelf-life, compliance in the context of meeting export requirements.)

This document is based on IDM principles

Principle 1: Inoculum Reduction

Practices are targeting to removing and/or minimizing the level of inoculum that is present within a producing orchard, and other critical points in the chain where fruit is exposed to high levels of pathogens. Reducing inoculum levels will lower the infection rates and greatly enhance other additional control methods.

Principle 2: Protecting the Host

With almost all post-harvest pathogens inoculation occurs at the preharvest level. Measures and practices to control the pathogens need starting at this stage to have an effective disease control program. An understanding of disease profiles, varietal resistance, conditions of spread and effective chemical control is necessary to implement good preharvest control practices.

Principle 3: Inhibiting Disease Development

Effective post-harvest control strategy is necessary to enhance the impact of the preharvest control programs. This can come in the form of either a fungicidal and/or fungistatic effect on the disease pathogen.

Principle 4: Storage and Transportation

Disease development is greatly influenced by storage temperature, temperature fluctuations in transport and storage duration.

Principle 5: Ripening Management

Fruit ripening techniques can assist in management of disease development and help maximize the saleable life of the fruit for retailers. This essentially brings the greener fruit forward to a saleable level reducing the presale storage and natural ripening time required.

Principle 6: Compliance and Record Keeping

Compliance and record keeping helps verification of management practices and meet standards, regulations, quality, environment, health and safety.

5. Inoculum Reduction

5.1. Orchard Layout and Planting Material

- Planting varieties must meet the criteria of GAP or Viet GAP.
- The best method to control disease is to keep the inoculum from entering the orchard in the first place.
- Use seed free from diseases and propagation material. Bacterial blackspot can be moved to the orchard from infected plants of budwood.

- Do not transport infected branches, fruits, and work tools into the orchard.
- Do not source material where mango malformation is known to occur.
- Set out orchard to allow adequate access to improve chemical application and reduce plant material being damaged.
- The establishment of windbreaks around the orchard can dramatically reduce the spread and development of bacterial blackspot and mango scab.

5.2. Orchard Sanitation

Removal of diseased material by pruning, including dead or damaged leaves, twigs, branches, flower panicles and old fruit. Including the removal of diseased fruit. All of this material should be not be left on site either removed off site or destroyed.

Clean and sterilize all pruning and other equipment used in the orchard or packing shed.

5.3. Orchard Management

5.3.1. Pruning

Prune trees to remove old leaves, prune to an open up the canopy that will allow good airflow. This will assist in keeping the canopy dryer and allow good spray penetration.

5.3.2. Nutrition and Disease

Good fertilizer management helps encourage new disease free, vegetative growth. Do not use excessive nitrogen applications as this can weaken the cell walls in the fruit making it more vulnerable to disease. Keep nitrogen in the range of 1.0 - 1.5 % “leave concentration”. Ensure calcium soil levels are maintained to at least 1,000 mg/kg, preferably higher this will help improve cell wall strength and natural disease resistance. Maintain boron levels between 50 – 70 ppm “leave concentration” to encourage new root growth assisting in the uptake of calcium.

5.3.3. Harvesting

Clean and sterilize all harvesting equipment regularly.

Do not place harvested fruit on the ground or allow contact with soil.

5.4. Training Requirements

Technical staff, workers and farmers need to be trained in awareness of mango disease and implications of management practices on the reduction of inoculum.

5.5. Records and Documentation

In case of purchase, there must be a record fully documenting the origin of the variety and rootstock. Dossiers on varieties and rootstocks are made according to the form specified in GAP or VietGAP.

Document and maintain records of fertilizer purchases and application rates and timings.

6. Protecting the Host

6.1. Disease Identification and Conditions

Correct identification of the disease is important as the management practices will differ depending upon which disease is dominant.

6.1.1. Key Diseases of Mango in Vietnam Effecting Export Fruit

- Anthracnose (caused by the fungus *Colletotrichum gloeosporioides* Penz.)
- Stem end rots (SER) (caused by *Diplodia natalensis*, *Botryodipodia theobromae*, *Phomopsis spp.*)
- *Alternaria alternata*
- Bacterial blackspot *Xanthomonas campestris pv. Mangiferae*
- Transit rots *Rhizopus stolonifera*

These diseases must be successfully managed for export.

(Identification symptoms, development conditions and prevention measures. Refer to [2, 3 and 6]).

6.1.2. Other Mango Diseases of Minor Importance

- Mango scab (caused by *Elsinoe mangiferae*)

- Frog skin disease (caused by the fungus *Chaetothyrium* sp.)
- Powdery mildew (caused by the fungus *Oidium mangiferae* - disease to plant quarantine).
- Red rust: The disease is caused by an alga called *Cephaleuros virescens* Kunze.
- Pink mold (caused by the fungus *Corticium salmonicolor*).
- Leaf blight disease (caused by the fungus *Macrophoma mangiferae* - disease to plant quarantine).
- Sooty mould (caused by the fungus *Capnodium mangiferae*).
- Crack stem and sap flowed (caused by the fungus *Fusarium solani* combined with *Botryodipodia theobromae*).

These diseases are unlikely to be an issue within the export chain but may influence the skin quality of the fruit. (Identification symptoms, development conditions and prevention measures: Refer to [2, 3 and 6]).

6.2. Varietal Resistance

Some mango cultivars possess moderate resistance to some diseases.

Grow hybrid mango varieties with thick skin such as LD12 (SOFRI), etc.

6.3. Conditions of Spread

- Fungi are spread by wind and water splash, and through the movement of contaminated soil, animals, workers, machinery, tools, seedlings and other plant material. High humidity and warm temperatures will exacerbate the spread, especially when combined with high levels of inoculum.
- Use windbreaks in high wind prone zones.
- Ensure trees have an adequate protectant coverage before significant rain.
- After significant rain it may be necessary to treat with a systemic fungicide.

6.4. Fungicide Treatments

6.4.1. Protectant Fungicides

These fungicides will prevent the disease from developing on the surface of the plant either leaf or fruit. Their effectiveness will depend upon the application method; therefore, good, calibrated spray equipment is essential.

Spray protectant fungicides as a preventative spray, ensuring the developing fruit is well covered. Protective copper sprays can be applied as soon as the flower panicles emerge and continue in two to three weeks until the fruit has grown to half size.

For areas where bacterial blackspot appears ensure all new leaf flushes are protected. Copper protectants with the smallest particle size will give the best coverage.

Calibrate spray equipment so droplet size is small, add wetting agent to the spray mix. Make sure the surface of the leaves is well covered spray till runoff. Spray needs to be penetrated well into the canopy of the tree.

Calibration and effectiveness of spray can be verified with the use of water sensitive paper test strips placed randomly in the canopy of the tree.

6.4.2. Systemic Fungicides

Systemic fungicides are absorbed into the plant. Locally systemic fungicides move within the plant but not far from the site of penetration. Unlike protectant fungicides, systemic fungicides can sometimes be used to suppress the disease after it had infected a plant.

Identify which disease is intended to be controlled, spray at critical development time such as fruit set for SER and after significant rain for anthracnose.

Rotate fungicides from different chemical groups, do not continually spray with the same fungicide. Ensure trees are well covered and the spray is able to penetrate well into the canopy. Add a wetting agent to the spray mix to facilitate good coverage.

6.5. Protective Barriers

Protective bags will provide a barrier around the fruit. This can exclude water from the surface of the fruit reducing the level of anthracnose development. Provided that the bags are attached correctly.

- Pruning fruit: Select regularly growing fruits to carry out fruit wrapping, for Cat Hoa Loc only 1 fruit/stem, Cat Chu for 2-3 fruits/peduncle.
- Bag 30-45 days after flowering.
- Ensure fruit has a good protectant coverage just prior to bagging,
- Ensure bag is closed around fruit peduncle to prevent water from coming into contact with the mango.

*. Do not use bags that are damaged or have holes in them.

6.6. Training Requirements

Farmers, managers, and technicians require training in growing conditions, disease life cycles, disease management methods, chemicals, and applications.

6.7. Records and Documentation

Keep records of spray applications (rates, product, batch number, timing, and weather conditions). Keep record of chemicals stored on farm (product, batch numbers and expiry dates). Record dates of fruit bagging.

7. Inhibiting Disease Development

7.1. Heat Treatment with Hot Water Immersion

Post-harvest Hot water treatment (HWT) can be an effective post-harvest treatment, that will suppress the development of SER, Anthracnose and Alternaria. The level of suppression will depend on several factors such as the level of inoculum, disease profile, temperature of the water and duration of treatment.

* **Batch System:** Fruit is immersed in a hot water bath for 2 - 5 minutes at 52°C.

Ensure that the water is circulating with a pump so that there is an even water temperature, monitor the water temperature constantly, make sure the fruit

is fully submerged for the duration of the treatment. Do not exceed treatment time or temperature. Do not treat fruit harvested in wet weather.

*** Flow Thru System:** Fruit is exposed to a continuous hot water spray at 52°C for 2 - 5 minutes. This is done best in a mechanized packing line.

Monitor the water temperature constantly to ensure the fruit is rotating and a dip that it is forced under the water for the duration of the treatment. Do not exceed treatment time or temperature. Do not treat fruit harvested in wet weather.

7.2. Post-Harvest Chemical Treatment

Hot water treatment efficacy can be greatly enhanced by the addition of post-harvest fungicides.

These options are currently being trialed in Vietnam for registration purposes. Check products permitted status in Vietnam before using. Ensure the chemical is permitted by the importing country

Follow manufacture label for dosage, top up requirements, mixing and safety procedures.

Treatments should be recorded; batches should be identifiable throughout storage and subsequent distribution up to and including point of export. Post-treatment intervals should be complied with. Dispose of waste chemical solutions in accordance with local environmental and safety regulations.

7.3. Packhouse Hygiene

Keep packhouses clean to prevent disease spread, particularly transit rots.

Develop a regularly schedule for cleaning and sterilizing floors, packing lines, equipment and cool rooms, at the end of each working shift.

Remove all old and rotted fruit from the packhouse, especially from the cool rooms.

Sterilize surfaces of tools/ equipment with alcohol at 70% or 200ppm chlorine solution.

7.4. Training Requirements

Employees are trained in the application of HWT, chemical management and packhouse hygiene.

7.5. Documentations and Record Keeping

Keep records of chemical application (rates, product, batch number, etc.).

Keep record of chemicals stored on farm (product, batch numbers and expiry dates).

Cleaning schedules document

8. Chemical Management

8.1. Products and Registrations

Use only permitted registered chemicals, obtained from licensed suppliers according to the list of pesticides allowed to be used and banned from use in Vietnam”.

Some products may not be permitted in the importing country; therefore, they cannot be used on crops designated for export. It is important for the exporter to provide a list of such substances.

8.2. Application of Chemical Interventions

Always use chemicals strictly according to instructions on labels or instructions of competent state agencies.

The label or product information sheet should include the following:

- Warning signage.
- Safety directions.
- Recommendations for additives and warnings of product incompatibilities.
- Storage and mixing instructions.

The following information should be recorded in a spray diary (see also section 8.9):

- Commercial product name.
- Active ingredient.
- Batch number and expiry date.
- Identification of treated zones.
- Application rates and registrations.

Operators should be aware that counterfeit products are circulating in the industry and should only purchase from reputable licensed suppliers.

8.3. Material Safety Data Sheets Requirements

MSDS contain information on the physical, chemical and taxological properties of the compound as well as health effects, precautions and emergency procedures.

An MSDS should be supplied at the point of purchase and kept readily accessible on farm or place where chemicals are being stored and used.

(Refer to Standard: TCCS 20:2010/BVTV. Guidelines for the safe and effective use of pesticide)

8.4. Managing Fungicide Resistance

Some groups of fungicides are at high risk of developing resistance, particularly the case with systemic fungicides; therefore, the growers should:

- Minimize fungicide use is fundamental to resistance management.
- Reduce the inoculum load in the orchard.
- Use protective bagging.
- Use mixtures as combine a protectant (mancozeb or copper) with the at-risk product.
- Rotate sprays of the at-risk products with fungicides from a different chemical group.
- Reduce the number of spray applications per season. Target critical times when disease pressure may be high. Such as fruit set and wet weather conditions.

8.5. Managing MRL's

Check the difference of importing countries MRL differs from Vietnam.

- Chemical applications must be used according to the instructions on the product label.
- Do not exceed spray applications.
- Ensure that spray equipment is correctly calibrated.
- Adhere to withholding periods on label.
- Record all spray applications.

Set up a plan in place to regularly check the implementation of the manufacturing process and take samples to check for chemical residues in the product at an accredited or designated testing laboratory. Analytical results of chemical residues do not exceed the maximum limit according to regulations. Set action levels to ensure product complies with MRL limit at point of sampling for regulatory compliance (typical action limits are 1/3 to 1/2 of the MRL).

8.6. Storage

Chemical storage, arrangement, preservation, use and handling of chemicals are carried out according to the guidelines of the Department of Plant Protection. (Refer to Standard Base: TCCS 20:2010/BVTV. Guidelines for the safe and effective use of pesticide)

8.6.1. Storage Areas

There are regulations to periodically check chemical warehouses to remove expired or banned chemicals. Storage facilities are to be well ventilated and have solid sealed floor with surrounding lip so any spillages can be contained. A spill cleanup kit should be readily available. Storage area should be lockable to prevent unauthorized access. Gasoline, oil and chemical fuels should be stored separately in suitable facilities.

8.6.2. Storage Containers

Check containers regularly for signs of rust or leakage and transfer contents to another container only, if necessary, when replacing the chemical packaging and container, write the full name of the chemical and instructions for use such as the original packaging and container. Never decant chemicals into food or drink containers.

8.6.3. Spill Cleanup Equipment

A clean up kit consists of bin, shovel, broom, absorbent material, e.g., sand, and a bag of hydrated lime.

8.7. Safety Procedures

Use personal protective equipment (PPE) that meets label and MSDS guidelines.

Before opening product, read label for safety of mixture and loading, follow label guidelines, work in well-ventilated areas. Do not stir chemicals with hands or arms. Triple rinse all used containers and equipment.

Read labels of pesticides carefully, wear PPE, check equipment for leaks, avoid eating, drinking, or smoking during mixing, spraying and clean-up operation. Ensure equipment is accurately calibrated, observe weather conditions especially wind speed and direction.

After application clean all equipment, ensure runoff is captured, make people aware of re-entry periods of the sprayed areas.

Dispose of chemicals and packaging according to state regulations.

8.8. Training Requirements

Organize training course(s) for farmer owners, farm workers and extension officers on the basics of IDM, inoculum reduction, identification of high-risk conditions, methods of control, chemical usage, types of chemicals, managing resistance to pesticides, spray calibration, effective application, chemical safety and management of MRL's.

8.9. Documentations and Record Keeping

- Document pest occurrences, observed times, observer.
- Training records
- Keep records of spray applications in a spray diary (date, rates, product, batch number, timing and weather conditions).
- Keep record of chemicals stored on farm (product, batch numbers and expiry dates).
- Keep a copy of MSDS sheets for chemicals being used.

9. Storage and Transportation

9.1. Temperature Management within the Chain

Temperature plays a significant part in the development of disease in export fruit.

Generally lower temperatures will suppress disease development, fluctuation in temperature along the chain will put the fruit under stress and increase disease expression.

Ensure loads mangoes are correctly cooled by the set temperature measured the internal pulp temperature. To avoid breaks in the cool chain, pulp temperature needs to be maintained through the chain. Do not transport fruit at the temperature above 22°C as this will significantly increase disease development.

Ensure the cooling equipment in rooms and transportation are regularly maintained and calibrated and performs adequate cool temperature as the set one.

Monitor loads with pulp temperature checks.

9.2. Long Term Storage (Including Sea Freight)

Fruit with low levels of disease can be stored for up to several weeks under the right conditions.

Long term storage will only work if fruit are correctly treated for disease pre- and post-harvest, generally this will include a post-harvest fungicide treatment.

Storage temperatures are between 5 to 12°C depends on the variants and export markets.

Control environment and modified atmosphere conditions will increase the storage time and suppress disease while in the containers.

After long term storage disease can develop rapidly.

After storage fruit needs to be ripened quickly so the temperature should be rose to 18-22°C and ethylene (C₂H₄) may need to be added to accelerate the process. Further storing of the fruit after long term storage will increase the disease risk.

9.3. Training Requirements

Managers, technicians and key staff members need to be trained in cool chain management and monitoring.

9.4. Documentations and Record Keeping

All activities of storage and transportation documented and recorded.

10. Ripening Management

Correct ripening of fruit will ensure uniformity of ripening across the consignment, this will reduce the storage time necessary to bring the fruit to its display ripeness, thus giving less time for disease to develop.

10.1. Ripening Systems

Fruit ripening is carried out in a suitable temperature controlled room with. Ethylene is introduced through an air pump or catalytic ethylene generator at a concentration of 100 ppm for 36 to 48 hours to activate ripening (the duration will partially depend on customers' requirements), while maintaining CO₂ below 1%. The room temperature for ripening should be maintained between 18 and 22°C (65 to 72°F).

Maturity rooms should be located away from storage areas where products may be damaged by exposure to ethylene. It's important to note that pure ethylene gas is potentially explosive and requires extreme caution and appropriate safety measures when used.

10.2. Storage of Ripened Fruit

After moving mangoes out of the ripening room, randomly selected fruit should be pulled for data collection and recording on the mango evaluation and ripening log. This data log showing the quality conditions of the fruit before and after ripening will be the most valuable tool for fine-tuning the specific mango ripening protocol.

Once ripened, mangoes can be stored at 12-15°C and 90-95% relative humidity for short periods.

10.3. Training Requirements

Organize a training course on management of cool rooms, ventilation and fruit ripening procedures.

10.4. Documentations and Record Keeping

On exposing fruit to ethylene, duration, process and concentrations of ethylene, temperature settings and ventilation procedures are documented and kept in records.

11. Compliance and Record Keeping

11.1. Mandatory Legislative Requirements

11.1.1. Registrations

Producers doing export are required to register a Producer Unit Code (PUC) with PPD. Conditions to be granted PUC are specified in TCCS Industry Standard 774: 2020 / BVTV.

Importing market authorities may require additional conditions to the suppliers, for example direct property registration and inspections.

11.1.2. Standards

Some importing countries such as the EU issue maximum disease standards, usually not exceeding 10% of the consignment.

Some diseases such as bacterial black spot will have quarantine implications and protocols will be applied.

11.2. Customer Requirements

While no regulatory requirements many customers will requires a level of compliance from their suppliers before they purchase their product.

11.2.1. Certifications and Accreditations

Most modern retail markets in importing countries will require Global G.A.P or equivalent HACCP based on accreditation.

Depending on the importing customers, some will accept fewer requirements. This may need a negotiation between the importing customer and local exporter.

11.2.2. Standards

Most modern retailers will require minimum shelf-life standards; therefore, there is very low tolerance to disease in consignments. Exporters need to be aware of their customer requirements and the manage practices accordingly.

11.2.3. Registrations

Some accreditation systems will require the producer to become a registered supplier. This will also require input suppliers to be registered as approved suppliers.

11.2.4. Audits (Internal and External)

Most accreditation systems will require an internal and an external audit. The external audit must be conducted by an approved audit company.

11.3. Occupational Health and Safety

- Assessment of health and safety risks to workers.
- Identify hazards related to workers health and safety.
- Develop guidelines to reduce the indicated hazards.
- Ensure the safety of the worker by providing a safe working equipment, training for workers on safety knowledge in the usage of chemicals and pesticides.

(Refer to: Decree no. 39/2016/NĐ-CP for Detailed provisions on implementation of some articles of occupational safety and sanitation law).

11.4. Environmental Management

Farms must follow local environmental regulations.

Storage, use, handling and disposal of chemicals are under VietGAP guidelines.

Developing an effective documented system is to minimize the risk of contaminating environment including chemical, fertilizer, heavy metal and biological contaminants.

Do not graze livestock that pollute the soil and water resources in the production area. There are measures to treat waste to ensure that it does not pollute the environment and products after harvest.

Develop a waste removal program that meets local regulatory requirements.

Complete records of all above activities.

(Refer to: Law 55/2014/QH13 Environmental protection, Article 69: Environmental protection in agricultural production).

11.5. Training Requirements

Organize training courses for people involved in production on:

- HACCP principles.
- Viet Gap, Global G.A.P, internal auditing.

- Developing risk assessment plans.
- Monitoring, recording and keeping of related documents.

11.6. Record Keeping

11.6.1. Regulatory Requirements

The farm operator is obliged to use any nationally mandated software package for the keeping of farm records, and traceability, to ensure that record keeping is compatible with national data standards. The farm operator will maintain production and process records for one year and made available for inspection by regulatory officials. The farm operator will maintain records in regards to market access requirements such as registrations, inspection and audit results.

11.6.2. Compliance Requirements

The farm will keep all records related to the farming process for VietGAP and/or Global G.A.P. certification (if applicable), including farm layout maps, copies of certificates, chemical and fertilizer application records, risk assessments on food, environment, health and safety hazards internal audits, analysis results of water and fruit, training and traceability. Calibration and internal auditing records are maintained for at least 3 years.

Other document requirements might include fully documenting the origin of varieties and rootstocks purchased.

11.6.3. Other Records and Documentation

Display of clear signs for access areas and written instructions for workers/persons to follow when entering and leaving.

Records of contracts/agreements with packers/exporters.

Productivity data on tree yields, flowering and bagging dates and grade out rates.

Records on pest incisions, dates, monitoring levels and damage observed.

12. Relevant Publications

1. Government of the Socialist Republic of Vietnam, 2016. Decree No. 39/2016/ND-CP detailing the implementation of a number of articles of the Law on occupational safety and health.
2. Plant Protection Department, 2020. Process of setting up and monitoring planting areas. TCCS 774: 2020/BVTV.
3. National Assembly of the Socialist Republic of Vietnam, 2020. Law 72/2020/QH14 on Environmental Protection, Article 61: Environmental protection in agricultural production.

13. References

1. Plant Protection Department, 2010. Guidelines for safe and effective use of plant protection drugs (TCCS 20: 2010 / Pesticide).
2. Lisa Kitinoja and Adel A. Kader, 2003. Techniques for post-harvest handling and storage of small tissues: Technical documents for vegetables and ornamental plants.
3. Misra, A.K. and Pandey, B.K. 2010. Integrated Disease Management Practices in Mango. Pub. CISH, Lucknow, 16 p.
4. Northern Territory Government Department of Resources of Australia, 2010. Pests, beneficials, diseases and disorders of mangoes.
5. Southern Plant Protection Center, 2019. Technical documents: Common pests and diseases on mangoes in Vietnam.
6. Post-harvest Technology Information and Research Center, the University of California, Davis. *Translation by Chu Doan Thanh, Luong Thi Song Van and Nguyen Thi Hanh, p147-148,153-156. Fruit and Vegetable Research Institute, Vietnam.*



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