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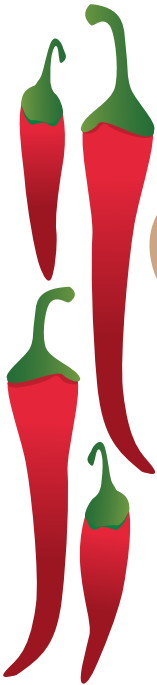
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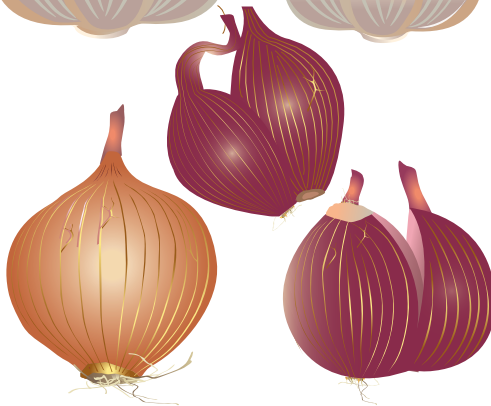
HARVESTING, PACKING HOUSE OPERATIONS, STORAGE AND TRANSPORT OF SPICY VEGETABLES



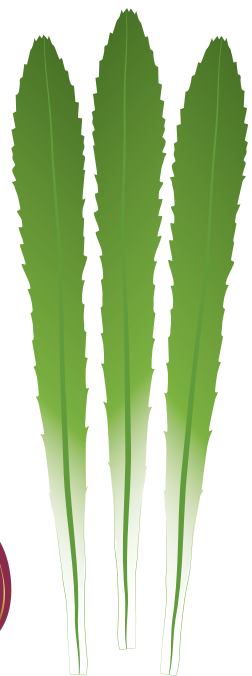
CHILI



GARLIC



PURPLE ONION



ERYNGIUM

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ABBREVIATIONS

ppm	Parts per million
RH	Relative humidity
LDPE	Low density polyethylene
CO ₂	Carbon dioxide
VIAEP R3	Ethylene absorbent created by VIAEP
CIPC	Carbamate - isopropyl N- 3-chlorophenyl
Zineb	Zinc-ethylenebis (dithiocarbamate)
Permethrin 50EC	Active ingredient permethrin 50%
VietGAP	Vietnam Good Agriculture Practice
Deltamethril	Derivative with high light fastness, biodegradable ultrafast
MH	Maleic hydrazide

PREFACE

Under the framework of the Joint Program for Vietnam “UN Support to National Target Programme on New Rural Development” funded by One Plan Fund, the United Nations Industrial Development Organization (UNIDO) aims to support the strengthening of the supply capacity of the fruit and vegetable sector by applying proper technologies along the value chain.

UNIDO and the Vietnam Institute of Agricultural Engineering and Post-harvest Technology (VIAEP) collaborated in the development of a set of four handbooks on Harvesting, Packing House Operations, Storage and Transport of Leafy, Root, Spicy and Fruit Vegetables. The four handbooks give practical information and describe simple low-cost and practical post-harvest technologies.

This handbook covers four spicy vegetables: chili, eryngium, garlic and purple onion.

Spicy vegetables are added to many dishes in the Vietnamese cuisine. Small quantities are used, but they play a very important role as their aromatic esters and mixtures of polyphenols create tasty odours and flavours. These valuable compounds decrease rapidly when poorly harvested and stored. Good care is needed during storage and transportation of spicy vegetables: insects can damage the vegetables and micro-organisms can cause soft and grey rots. Furthermore, spicy vegetables can suffer weight loss because of dehydration.

CHILI

Pre-harvesting

Irrigation should be restricted prior to harvest because high soil moisture encourages fungal growth.

Harvesting



◀ Light green (1)

◀ Deep green (2)

◀ Breaker (3)

◀ Breaker red (4)

◀ Light red (5)

◀ Deep red (6)

Chili is considered ripe when it reaches the “breaker red (4)” stage as shown in the photo to the left.

Chilis are generally harvested weekly. The best harvest time is early morning on dry days.

Chilis are harvested when they have reached the required colour and size and some stem should remain attached. On sunny days chilis should be kept in the shade to avoid getting hot.



Any soft fruit is separated out and sold separately at a lower grade.

Chilis can be put into plastic crates in the field or into smaller plastic buckets, which are later emptied into crates at the side of the field. If necessary, chili is pre-cleaned in the field by gently rubbing the fruit to remove soil and dirt.



Packing house operations

Cleaning: Chili can be washed in clean water or 200-300 ppm chlorinated water. After washing, the fruit must be drained and dried off properly to prevent decay.

Sorting/Grading: Chili are graded by shape, size and colour. Different varieties have their own grades, for example, Class 1, Class 2, etc.



Control of decay and insect damage: To reduce fungal diseases during storage, chili can be soaked in clean hot water at 50-52⁰C for 2 minutes, cooled in cool water then allowed to drain and dry.

Cooling: Cool air at 8-10⁰C and over 90% RH is used to reduce temperature and slow metabolism before packing. Lower air temperature may cause chill injury. Ice can also be used for cooling. The chili must be dry before packing as surface water lets soft rot develop during storage.

Packaging: For the home market, chili is packed in 0.05mm thick LDPE film or mesh bags then placed in bamboo baskets, wooden boxes or plastic containers lined with soft materials.

For the export market chili is normally packed in standard size cartons measuring 20x51x34 cm, each holding about 5kg.



Storage

Ambient storage: Chili can keep well for 2-3 days in a dry, airy place. Above 13⁰C, chili ripens quickly and easily develops rot. Chili should be stored away from sources of ethylene as this increases the rate of ripening and reduces shelf life.

Chilled storage: Chili keeps well for 2-3 weeks at 9-10⁰C and 85-90% RH. Storage below 5⁰C chili causes chilling injury. The signs are surface pitting, surface water, condensation on the surface, decay and lack of color development.

Modified atmosphere storage: Chili can keep for 35 days with a damage rate of 1.5%. Recommended conditions are: 10-11⁰C, 2-2.5% oxygen, 5.5-6.5% CO₂ and approximately 90% RH.

Transport to market place

Normal precautions should be taken. Avoid overloading, ensure ventilation and avoid bumps.

ERYNGIUM

Pre-harvesting

The soil should be kept a little dry to avoid root rot.

Harvesting

Harvest is done in the early dry mornings to avoid hot sunshine that wilts the leaves. The leaves are tied into 1-2 kg bundles.



Packing house operations

Sorting/Grading: Eryngium of the same size is grouped together. Leaves that are poor quality, have insect damage, sunburn, mechanical damaged or not fully developed are rejected.



Cleaning: Stems are trimmed away if necessary. The plants are carefully and gently washed under running water to clean the leaves thoroughly .



Handling: The harvested eryngium is placed in crates and kept in a dry, airy place to drain off and dry. A hand operated centrifuge, shown in the photo below, can be used to spin-dry the leaves faster.



Packaging: Within 3-6 hours after harvest, eryngium should be packed in a 0.03mm thick LDPE bag then placed in plastic crates or cartons. The recommended size is 30×35×40 cm. Stems are placed in the same direction. A small packet of VIAEP's R3 ethylene adsorbent is added at a rate of 3-5 g/kg before sealing the bag.

Storage

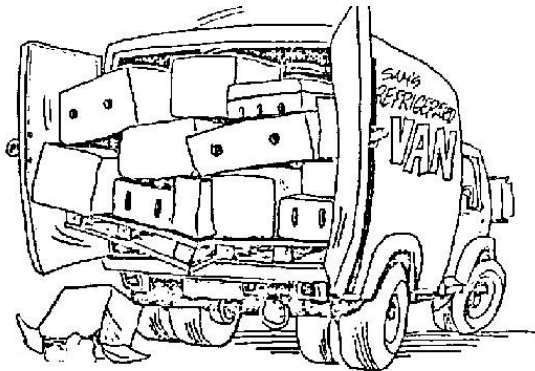
Ambient storage: Eryngium will keep for 2 days when put in a dry, cool, airy place.

Chilled storage: Eryngium will keep for 2-3 weeks at 8-10°C and 90-95% RH in cool store like the one on the right.



Transport to market place

Normal precautions should be taken. Avoid overloading, ensure ventilation and avoid bumps.



GARLIC

Pre-harvesting

15-20 days before harvest, it is recommended to stop watering, and spray a 0.2% solution of CIPC (isopropyl N-(3-chlorophenyl) carbamate) at the rate of 4.2 kg/ha. This should be done in the morning or late afternoon to ensure the chemical has time to be absorbed.

Harvesting

A trowel is used to break clods around the stem to help pull out the whole garlic plant without breaking off or injuring the bulb. The attached soil is removed and the garlic is hung up in a dry, airy place.



Packing house operations

Sorting/Grading: Bulbs are graded by size. It is important that any bulbs with rot and mechanical damage are rejected.

Drying: Garlic is placed on a sheet of canvas or mesh and left until the outer skin and stalk are both dry. In good weather conditions, this takes around 10 days.



Alternatively a mechanical drier can be used to dry garlic in just one day, using air at 35-45⁰C and 60-75 % RH.

Treatment: To control black, dry and green molds, cleaned, dried garlic is hung on a trellis or frame then sprayed with a 0.3% Zineb solution. The garlic is left for 3-4 hours after spraying to absorb the chemical and become dry. A withholding



time of 30 days is compulsory to allow the chemical to reduce to an acceptable level.

Storage

5% permethrin 50 EC solution is used to clean and disinfect the store.

Dry bulbs are tied or bagged in 2-3 kg lots then hung or arranged on a multi-storey rack in a dry, airy place with temperature below

30⁰C. Garlic is checked 3 times a month to remove rotten or damaged bulbs.



Transport to market place

Normal precautions should be taken. Avoid overloading, ensure ventilation and avoid bumps. Keep transport temperature below 30⁰C.



PURPLE ONION

Pre-harvesting

15-20 days before harvest, spicy onions should be sprayed with a 0.2% CIPC solution (isopropyl N-(3-chlorophenyl) carbamate) at the rate of 4.2 kg/ha. This should be done in the morning or late afternoon to ensure the chemical has time to be absorbed.

As per VietGAP standards, irrigation is restricted 7-10 days before harvest to avoid the soil sticking to the bulbs.

Harvesting

Purple onions are harvested around 60-65 days after sowing when two-thirds of the foliage has yellowed. They should be harvested in clear mornings by pulling the whole plant, then drying in the sun for 2-3 days while still in the field. After that, they are piled in bulk and arranged 2-3 layers deep on bamboo or plastic shelves ready for transport to the packing house.



Packing house operations

Sorting/Grading: Good quality bulbs are the same size and color, fully developed, not sprouted and without rot or mechanical damage.



Cleaning: Dirt is brushed or shaken off as necessary. The roots are completely cut off, but without hurting the bulb.

Drying: Purple onions are dried in the sun for 10-15 days. That allows the two outer layers of skin to become dry and tough and give good protection.



Treatment: Purple onions are sprayed evenly wet with 10g/l Deltamethrill solution to control pest and diseases. They are also sprayed with 150 ppm MH (Maleic hydrazic) solution to

minimise sprouting. After spraying, they should be allowed to dry for 3-5 days before packing.

Packaging: Purple onions are commonly tied in 2-3kg bundles or packed in 15-20kg mesh bags. It is important for them to get enough ventilation to avoid high humidity that causes disease.



Storage

The storeroom should be cleaned and disinfected by spraying 5% Permethrin 50 EC solution to control insect pests.

Mesh bags are arranged in rows. If they are piled up, a support stand is necessary.

Purple onions can be stored loose with 2-3 layers on separate multi-shelf stands. They should be stored at 25-30⁰C and 70-75% RH in a clean, dry and airy place.

Bags should be turned periodically, changing their positions from bottom to top, and inside to outside. This reduces the risk of disease caused by high humidity. During storage, purple onion should be checked once a month to remove rotten bulbs.

Transport to market place

Normal precautions should be taken. Avoid overloading, ensure ventilation and avoid bumps.

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