TRAINING MAERIALS

For training of cooperative staff, farmers and farmers' groups

oject: "Strengthen Vietnamese SPS capacities for trade-Improving safety and quality of fresh vegetables through the value chain approach"
MTF/VIE/046/STF (STDF/PG/259)

TECHNICAL GUIDELINES

SAFE VEGETABLE PRODUCTION -

VietGAP APPLICATION

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INTRODUCTION

The Farmer Field School (FFS) is organized in the framework of the project:" Strengthen Vietnamese SPS capacities for trade - Improving safety and quality of fresh vegetables through the value chain approach" (MTF/VIE/046/STF (STDF/PG/259)) funded by the Food and Agricultural Organization (FAO) period 2010 – 2012. With the help of FAO agent, Fruit and Vegetable Research Institute (FAVRI) that implement the project complied booklets, organized the training of trainer (TOT) and Farm Business School for farmers in three provinces Son La, Hung Yen and Lam Dong.

The training program helps to improve good production skills VietGAP for farmers through the Farmer Field Schools. The Farm Business School is considered "learning occurs by doing", and it is held over a growing season.

This book is compiled basing on the researching results and actual production, references and quotations from documents, books and magazines of FAVRI. Besides, the editors also refer to the opinions of each locality through the primary teacher training.

The book is easy to understand and apply. Thus, farmers can use it efficiently in producing, handling and good processing.

In the process of writing and preparing, we hope to receive supporting from readers.

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LESSION 1: TECHNIQUE FOR PLANTING, HARVESTING AND STORING TOMATO IN LAM DONG

Chapter 1: Ecological requirements of tomato plant

1. Temperature

Tomato (*Lycopersicon esculentum L.*) prefers warm weather. The most suitable temperature for germination is 18.5 – 21^{0}C. Extreme temperature will slow the germination, reduce the vitality of seeds and make them become distortion.

Tomato grows well in temperature is 15 – 30 ^{0}C, the critical temperature is 22 – 24^{0}C. The photosynthesis process of leaves will increase when the temperature is 25 – 30^{0}C. As it is higher, the photosynthesis will decrease.

Temperature directly affects the flowering and pollination. The rate of fruit formation is high at 18 – 20^{0}C. When the day temperature is higher than 38^{0}C in 5 – 9 days before or 1 – 3 days after flowering; the night temperature is lower than 25 – 27^{0}C in several days before and after flowering, the vitality of pollen reduces. As a result, the yield is lower.

The formation of fruit color will be affected by temperature. The critical for this is 18 – 24^{0}C. At 24 – 28^{0}C, the fruit is red – dark orange because of the formation of *lycopene* and *carotene*. At 30 – 36^{0}C, *lycopene* is not formed; consequently, fruit is yellow.

2. Light

Light requirement for tomato is high. In nursery, if the light is enough (5000 lux), quality of seedlings is good. They are hard, their leaves are large and they will be planted soon. It is easy for collecting pollen if there is enough sunshine. As a result, fruits grow normally, unity and yield increase.

Chemical components of tomato are impacted of light quality, photoperiod and light intensity. The tomato plants that grown in full light have higher ascorbic acid level than others.

3. Water

Water requirements of tomato are different basing on growth stage. It needs less at first, and more at later. The flowering requires most water. If it is not supplied enough water at this stage, the formation of flowers and fruits decrease.

In some references, we see that the critical of soil humidity is 60 – 65%, and for air humidity is 70 – 80%. The pollen will cracked if humidity is too high (>90%), tomato flowers that are not pollinated will drop. However, dry wind will drop much flowers. Soil and air temperature

depends mostly on rainfall, especially in off – season. Rainfall is the main factor that has influence on growth and development of plant from sowing to harvesting.

4. Soil and nutrients

Plating tomato is easy. However, it should be cultivated on alluvial soil that organic content is greater than or equal 1.5%, pH = 5.5 – 7 (best is 6.5 – 6.8). Soil must be much mud, porous and well-drained.

To harvest 1 ton of tomato, the nutrition requirements are 2.9kg N, 0.4kg P, 4kg K and 0.45kg Mg; and to get 50tons/ha, tomato needs 320kg N, 60kg P_2O_5 and 440kg K_2O. For unlimited tomato, the quantities are 180kg N, 80kg P_2O_5 and 180kg K_2O; for limited tomato, the quantities are 120:80 and 150, correspondingly. In the soil condition in Lam Dong, to get average yield 70tons/ha, the quantities of fertilizer for 1ha are 25tons of manure, 250kg N, 150kg P_2O_5 and 300kg K_2O.

Like others, tomato needs at least 20 nutritious elements for the normal growth and development. Among macronutrients, tomato requires more potassium than nitrogen and phosphorous.

Chapter 2: Seeds, planting technique, harvesting and storing tomato

1. Soil

Tomato is suitable to many types of soil in Lam Dong. Soil for cultivated tomato must have thick cultivated level (>20cm), well-drained, be easy for irrigation, not cultivated Solanaceace family at previous season. The pH must be 6.5 – 6.8.

2. Seeds and seedlings

Seed: high quality, from clear resources, is supplied from reputable agencies and companies. Some varieties are used in Lam Dong as Anna, red-pearl, 386. They are mostly grafted on anti-disease plants (mainly against wilt bacteria, such as, Vimina variety of Southern of Vietnam Academy of Agricultural Science).

Nursery must be fresh, full of sun, and have enough tools for shielding to avoid rain and sun.

Seed handling: this step is not necessary for new seeds. For stored seeds, they must be soaked in warm water (50^0C) in 30 minutes, then, they are soaked in cold water and dried.

Media for nursery: powered soil (alluvial soil or small pieces of dried mud) – decomposed humus or manure – fumigated husk or coir with the rate 1.0: 0.7: 0.3, respectively. Media must be handled by fungicide, pesticide and added more nutrients as 10kg powered lime + 1.0kg Basudin (or Vibam 5H) + 1.0kg Zineb + 1.0kg urea + 1.5kg superphosphate + 1.5kg potassium chloride (in 1000kg media). The media is prepared 10-15 days before using.

Seeds are sown in plastic or foam tray. The density is one seed/box/tray. Then, seeds are covered by media, husk or dried straw (about 10cm). Water is supplied for seeds until they germinate. When the seedlings have 5-6 real leaves (20-25 days after germinating), they are planted. In nursery stage, seedlings are supplied enough water and sprayed pesticides. The seedlings that are weak, diseased must be removed.

Criteria for variety: hard and large stem, small space among leaves, 5-6 real leaves, 10-15cm height and free-diseases.

3. Crop season

Tomato can be cultivated annually in Lam Dong. In dry season (September to March), tomato will give high yield, less pest and disease. In contrast, in rainy season, although the yield is low, the price of tomato is high.

4. Fertilizer and supplements

Fertilizer is used efficiency, in which decomposed organic manure is priority. Do not use fresh manure to water. Besides, micro-organic and bio-organic also are used to supply.

Fertilizers must be allowed in Vietnam.

The amount of fertilizer depends on the type of soil and rainfall. Normally, the amount of fertilizer is 25tons manure + 1.2tons lime + 7kg borate and chemical fertilizer. This quantity is equal to 240kg N – 100kg P_2O_5 – 275kg K_2O (to get 50tons tomato/ha). That pure chemical fertilizer is equal to 400kg urea + 350kg NPK (16-16-8) + 500kg superphosphate + 400kg potassium sulfate.

The table below shows how to apply fertilizer for 1ha of tomato:

Fertilizer	Unit	Quantity	Basal dressing	Top dressing (kg)						
				1st	2nd	3rd	4th	5th	6th	7th
Organic fertilizers	tons	25	25							
Lime	Kg	1200	1200							
Borate	kg	7	7							
NPK(16-16-8)	kg	350		50	50	50	50	50	50	50
Urea	kg	400		150	150	100				
Superphosphate	Kg	500	500							
Potassium sulfate	Kg	400		100	150	150				

Method:

- Basal dressing: fertilizer is applied into canal between two beds. It is mixed with soil and covered 5-7days before planting.
- Top dressing: it is divided into 7 times. Fertilizer is blended to water or it is supplied into hallows that are 10cm from stump. After that, it can be covered by soil and watered.
  - ✓ 1st: 10-15 days after planting
  - ✓ 2nd: 20-25 days after planting (flowering stage)
  - ✓ 3rd: first harvesting
  - ✓ 4th – 7th: 7-10 days after harvesting.

In the growth and development of tomato, some micronutrients can be sprayed onto leaves with the concentration as follow: $CuSO_4$ 0.1%, $ZnSO_4$ 0.1%, $MnSO_4$ 0.3-0.4%. They can be applied several times. Besides, other fertilizers can be applied as Bayfolan (20-30cc/8l), Komic BFC VG (40-50cc/8l), or pure NPK and some chemical components that stimulate growth of plant as Dekamon, Agritonic, Atonic (5-10cc/8l). For some varieties that have long flowering and fruiting, the 3rd top dressing can be divided into 3times and applied every 5-7days.

5. Planting and caring

5.1. Preparing soil and planting

Soil must be ploughed carefully, free-weed, applied lime after plough and exposed to sunlight 7-10days. Before planting, soil must be dug, basal dressing and making beds. In some cases, fungicide and nematodicide are used to prevent some pests in soil. Their application can be updated and used following guidance.

Dry season: the bed is 20cm height and 1.2m width, the canal is 30cm. Plants are cultivated in double in one bed. Rainy season: the bed is 25-30cm height and 80-90cm width, canal is 30cm. Plants are grown in single line.

Plastic cover: the plastic is used to keep moisture for soil. Besides, it can reduce the nutrient erosion, weeds, pests and disease. Instead, a thin layer of straw or dried grass can be used.

Density and planting distance:

Dry season: planting double line, line x line = 70cm, plant x plant = 50cm. Plants are grown as quincunx. Density is 27000 plants/ha.

Rainy season: planting single line, line x line = 1-1.2m, plant x plant = 50-60cm. Density is 18000-20000 plants/ha.

Plants should be grown in cool afternoon, boxes are laid carefully. If grafted tomatoes are planted, soil should not be covered the grafted point. In some field, there is much wind; some old bamboos are used to help plants to stand. Water must be supplied after planting to prevent being wilt. Remember to prepare 10% healthy plants to substitute died and weak ones (7-10 days after planting). They can be grown in field and among plants in line.

5.2.Watering

Water must be clean. Do not use water in dirty pond, waste water or polluted water.

Soil must be kept moisture by supplying enough clean water. After planting, plants must be watered 2-3times/day until they recover; then, the frequency is once per day. Basing on the moisture, water can be given efficiency. The moisture is always 60-70%. In the flowering stage, the moisture for tomato is 70-80%. If water is not supplied enough, the fruits will be drop.

5.3.Cultivating

It is necessary to cultivating 7-10 days after planting. After 20-25 days, cultivating and fertilizing are done to avoid water remained among the lines. Discard pests and disease fruits. In rainy season, old leaves and leaves that near roots must be removed. All of them should be ruined in place that is far from tomato field.

5.4.Making frame and pruning

When the plants are 40-60cm height, frames should be made to help plants distribute evenly on beds; furthermore, it is also easy to care and prevent pest and diseases.

Pruning: the old leaves and leaves that are near roots must be removed. The stems that are lower the first flowers should be discarded, there are only 1-2 stems are remained. This work must be done regularly every 2-3days. When the number of fruits is as required, fruits that formed late should be removed.

6. Preventing weed and diseases

The tomato plant will grow worse if there are many weeds that place for pests and diseases. Weeds can be discarded by mechanical or chemical method. For small farm and less investment, weeds can be removed by hand or cultivation techniques.

6.1.Manual cultivation methods

Tomato can be rotated to other crops as rice, legumes and other upland crops to reduce the transition of pests and diseases.

Some manual methods are used such as discarding the clutch; catching and killing small insects when the density is low; finding and removing plants that are green-wilt.

6.2.Chemical method

Nursery stage: aphids, downy mildew, root rot… must be prevented by high efficient chemical pesticides. Aphids can be used pesticides that contain *Lufenuron* (Match 50EC, Luferon 50EC); downy mildew can be treated by fungicides that have *Cymoxamil* + *Mancozeb* (Xamized 72WP, Jack M9 72WP…); the root rot disease can be treated by fungicides that contain *Metalyxyl* (Validacin 5L, Vida 3SC).

Field stage: field should be observed frequently to find pests and diseases.

Main pests and diseases on tomato in Lam Dong:

Pests

+ Leaf miner (Agromyza): it appears on the growth and development stage, especially when there is sunny.

Morphology: adult is small, black; there is bright small ring on its back. Maggot is tubular in shape; its head is white and small. The maggot eats the epidermis on leaves, creates the zigzag lines and make leaves dry.

Prevention: using Vectimec, Trigard, Polytrin and BT.

+ Fruit borer (*Heliothis armigera*):

Symptoms: when the pests are 1-2ages, they eat buds, tops and flowers. When they are older than 3, they like to eat buds and fruits. They punch fruit and eat inside, wound is ruined by bacteria and fungi; that cause the damages and reducing yield.

Prevention: using Regent, Polytrin, Sherzol, Pegasus, Amate and BT.

+ *Prodenia Litura*: they often eat leaves, flowers and young fruits. They must be treated by Polytrin, Regent, Sherzol, Pegasus, Delfin, Amate, Sucssec, and BT.
+ Aphids and hoppers (*Thrisps spp.*): they suck on stems. They are also leaf curl virus disease agents.
They must be prevented by Supracide, Polytrin, Actara, and Osin…
+ Thrips and whiteflies: they must be treated early to prevent virus diseases by Regent, Confidor, Actara and Osin…
Notes: These chemical pesticides must be used rotation. Do not use one pesticide many times.

Diseases

+ Blight (*phytophthora infestan* (mont) de Bary):
Symptoms: this disease appears when the temperature is 18-20^{0}C and high moisture. The lowest moisture for fungi is 76%, the higher the moisture is, the quicker fungi damages. The suitable condition for this disease is cloudy, dark and rainy. This can damage most parts in tomato plant: stem, leaf, long leaf and fruit.
The lesions are brown and their shapes change in variety types. On the other side of leaves where there are many lesions, there are groups of white brown fungus. They are small at first and become larger and larger. When there are a lot of wounds, leaves are wilt, dark brown and rot.
On stem, the lesions are long stripes, dark-brown or black. They break or make the death woods.
On fruits, the lesions are dark brown, sunken, necrotic edges, and not flat in surface. They appear deeply on flesh.
This disease can spread from potato to tomato.
Prevention:
The remains must be removed from field after harvesting.
Grow tomato in field that is far from potato.
Good seeds that come from free-disease fruits and healthy plants (local tomato).
Supply potassium for tomato plants.
This is typical that cause disease on tomato plants. Farmers should use some chemical fungicides as Boocdo, Zineb, Benlat C, Ridomil, Daconil, Carbendazim, Tilt, Curate and M8. They must be sprayed to prevent disease.
+ Bacterial wilts (*Ralstonia solanacearum*)
Symptoms: this disease damages on all area that grow tomato, especially for growing tomato in many years and for all varieties. The critical condition for this disease is 26-30^{0}C, pH = 6.8-7.2.
The disease grows mostly on high areas. Rotate tomato with rice will decrease the rate of disease more than rotation with upland crops. The bacterial can live in soil in 5-6years and about 6-7 months in organs and seeds. Bacteria cause disease through wounds and spread by water and insects. Bacteria cause disease at any stages and most serious in flowering.
Prevention:

Nowadays, there is not specific pesticide for this disease. The main method is through the farming techniques. The farmer must pay attention to choose good seeds that can resist to disease, handle soil, rotate and gather all remains after harvesting. In some areas that there are a lot of disease plants, it is important to reduce harmfulness by using power or water lime 15-20%. However, Food Plant Research Laboratory, Southern Technical Institute of Agriculture successfully researched the grafted seedlings that are anti-bacterial wilt. This research opens new hope to construct area for growing tomato for processing and exporting.

+ Brown spots (*Alternaria solani*)

Symptoms:

This disease is caused by fungi and damages most tomato in tropical area. Fungi damages stems, leaves, flowers and fruits. The typical symptoms are the brown spots that contain concentric circles on old leaves and dark indentations on stems, even there is wound on fruits. The disease grows rapidly in warm and humid weather.

Prevention:

This disease can be prevented by Integrated Cultivation Management. When the disease grows, farmers should care more and top dressing nitrogen. If necessary, they can use Zineb 0.1%, 0.5kg for 1ha of nursery or 2.0-3.0kg/ha field.

Besides, some other chemical can be sprayed to prevent in early times BellKute 40WP, Daconil, Bavistin, Derosal, Carbenda, Tilt, Boodo, $CuSO_4$ 1%, Validacin, Anvil, Monceren, Diconil 8%, Topsin and Score…

+ Tomato yellow leaf curl virus (TYLCV)

Symptoms:

There are three typical symptoms of tomato leaf curl: yellow top curl, green foliage, yellow flowers.

The first is more common. It can occur when the plants are small until growth and harvest. Thus, it causes huge damages for yield.

When plants have disease, they become smaller and cannot have flower and fruits. Flowers and fruits often do not grow and will drop. The vector is whitefly Bemisia sp. This insect causes damage on many crops: Solanaceace, Fabaceace, Cucubitaceace and others. It also can be transmit through mechanical way when the farmers prune and care.

Prevention:

This disease must be detected early. The disease plants must be removed from field as soon as possible. Besides, the farmers can choose suitable crop season, when the damage is large, they should avoid grow tomato in early and late time.

The vector whitefly can be treated by Confidor, Mosfilan, Actara and Osin… They must be sprayed in turn to avoid resistance.

+ *Rhizoctonia solani spp.*: can be treated by using Anvil, Validacin, Tilt, Monceren and Cu^{2+} chemicals.

Notes: the chemical pesticides above can change over time and market.

These chemical pesticides should be used if necessary. Besides, they are allowed. The quantity of them must be followed guidance of producers.

7. Harvesting

Farmers should not water 20days before harvesting to increase the fruit quality. They must ensure the isolation time after spraying.

When the top of fruit is pink, the fruits can be harvested. While harvesting, the farmers should do carefully to avoid crushing, discard the disease fruits; then all fruits are transported and stored in cold places. They will be stored in packages, carton box and transported to consume places.

8. Post-harvesting

Tomato can be stored at 8-10^{0}C, air moisture 90-95% in 4-7 days. In normal conditions, it can be stored in 2-3 days.

9. Storage and transportation

All transport vehicles must be cleaned before loading container products. To avoid polluted products, tomato cannot be stored with other products. Stored houses and transport vehicles must be disinfected regularly.

Chapter 3: Economic efficiency and safety of VietGAP tomato

1. Production costs (for 1000m^2)

Labor (plough, care) (50labor x 80000VND)	4,000,000VND
Materials and equipment (seeds, fertilizer, pesticides…)	12,000,000VND
Depreciation of greenhouse	6,000,000VND
Total costs	**20,000,000VND**

2. Income and efficiency (for 1000m^2)

Yield: 8,000kg
Price: 3,000VND/kg
Total income: **24,000,000VND**

LESSION 2: TECHNIQUE FOR PLANTING, HARVESTING AND STORING CABBAGE (*Brassica oleracea* L. var. capita)

Chapter 1: Ecological requirements of Cabbage

1. Temperature

The seed of cabbage can germinate at 18-20^{0}C. The critical temperature for the growth of cabbage is 15-20^{0}C. The difference between day and night temperatures is 5^{0}C – at this temperature, the quality of cabbage is the best. At tropical region, this temperature is only in the areas that are higher 800m than the sea level. If the temperature is higher than 25^{0}C, the cabbage still grows normally; however, the quality is not good, the leaves are not in rolls and hard.

Nonetheless, the respond to temperature depends on the characteristics of variety. For early cabbages (KK Cross, T40 (Takii) and Thuy Phong…), the leaves can roll in high temperature as in the Northern of Vietnam.

2. Light

In the winter-spring seasonal crop in the North of Vietnam, the photoperiod is short; thus, cabbage can grow well and give high yield.

3. Water

Moisture: the soil moisture must be 75-80%, the air moisture is 80-90%. If the soil moisture is too high (>90%) in 2-3 days, the roots can be affected.

4. Soil and nutrient

The cabbage likes rich nutrient soil, high content of humus, well-drained, moisture and the pH 6-6.5. It also prefers light and sandy soil, especially backed alluvial annually. To get 80tons cabbage/ha, the plants need 214 kg nitrogen, 79 kg phosphorus and 200kg potassium from soil. This number is equal to supply 610kg urea, 400kg superphosphate and 500kg potassium.

Therefore, to ensure that cabbage can give high yield, it can be supplied basal and top dressing.

Chapter 2: Seeds, planting technique, harvesting and storing cabbage

1. Soil

The farmers should choose the soils that rotate to rice, maize, potato and legumes… The pH value is 6-6.5 and the soil is rich of humus. The field of cabbage must far from waste water sources and industrial zones. Moreover, it is easy to drainage and irrigation.

Soil must be well-prepared, grain, porous. The beds are 1-1.2m width, 0.2-0.25cm height and the canal is 0.2-0.3m. It is better to grow two lines/ bed; the distance between lines is 70cm.

Power lime must spread evenly (100kg/1000m^2) and plough must reach to 20-25cm depth. Soil can be handled by Mocab (20ml/8l) and Sincosin (30ml/8l); they should be watered or sprayed to avoid nematode.

2. Seeds and seedlings

There are different varieties of cabbage, in which the Nova is more common.

Seedlings: can be bought directly from seedling production facilities to ensure the quality requirements.

There are two ways to sow seeds in nursery: sowing directly to soil and sowing to boxes.

The first: Sowing directly to soil:

Soil should be ploughed carefully and free-weed. It can be handled by Mocab (20ml/8l) and Sincosin (30ml/8l); these chemical can be watered or sprayed to avoid nematode. 1ha of cabbage needs 200-250m^2 of nursery. The bed should be 25-30cm height and 80-100cm width.

The quantity of fertilizer used to basal dressing for nursery is 1.5kg manure + 150kg superphosphate + 100kg potassium.

Method: fertilizer can be spread evenly on bed surface, or it can be mixed to soil. After that, soil in canal is taken to cover the bed surface to get 1.5-2.0cm thickness.

The quantity of seeds for 1ha of cabbage is 400-600gram; in contrast, the quantity of seeds for 1m^2 of nursery is 1.5-2.0g.

Sowing method: seeds should be soaked in warm water (about 70^0C) in 20 minutes before sowing. They can be spread evenly on the bed surface, after that, they are covered by a thin layer (5-10cm) of straw or husk and watered. In the 3-5days after sowing, the seeds can be water 1-2times/day; as they germinate, they cannot be watered in 1-2 days. Then, they need be watered every 2 days. When the plants have 2-3 real leaves, disease and distortion plants must be removed. At that time, the distance between plants is 3-4cm. In the nursery stage, the cabbage does not need nitrogen.

There must be have PVC roof to avoid rain and sun, or it had better to sow seeds on greenhouse.

The second method: Sowing on boxes

To save seeds, labors and increase the unity of plants, the farmers should sow seeds on porous or plastic boxes that have size 60 x 45cm and the density is 40 holes for one box.

Materials for making hole contain 40% soil, 30% fumigated husk or decomposed mud and 30% decomposed manure. They are mixed together; straw and waste can be discarded. Then, they are put into boxes and let to the shelves that are 50cm from the ground. They are let in greenhouse that has nylon or plastic roof.

Criteria for good seedlings: round leaf; nodes are closed, large and short. Plants will be grown when they have 5-6 real leaves. The seedlings will be sold after sowing 20-25 days.

3. Seasonal crop

In Lam Dong, cabbage can be grown in all year.

4. Preparing soil, variety, density and planting distance

4.1.Preparing soil

- The garden must be cleaned; all remaining of previous crop season should be removed; lime is spread carefully with 20-25cm depth. The beds are 1.2m width (containing canal), 15cm height (in rainy season) and 5cm height (in dry season).
- There should be good drainage and irrigation system in the garden.

4.2.Density and planting distance

- The density and planting distance can be determined depending on variety. For Nova variety, density is 35000-40000 plants/ha, and the planting distance is 40cm x 50cm.

5. Fertilizer and supplements

The quantity of manure for 1ha cabbage is 30-40m^3. If there is no decomposed manure, the farmers can use bio-organic fertilizer with the quantity is 1-3tons/ha (depend on types of soil).

Power lime: 1000-1500kg

Microbial phosphate: 300kg

Inorganic fertilize N-P-K: 250kg-150kg-200kg

The farmer can use single or complex fertilizer with suitable that quantity above.

Basal dressing:

- All the manure, lime and microbial phosphate, ¼ N, 2/3 P_2O_5, ¼ K_2O are supplied.
- Microbial phosphate can be spread evenly with lime when the farmer handles soil.
- Manure and chemical fertilizer can be supplied into canal. They must be mixed, covered by soil and watered 1 day before planting.

Top dressing:

- 1st: 7-10 days after planting. 1/3 P_2O_5, ¼ N and ¼ K_2O are supplied. They must be mixed together and spread 10-15cm from the root. The fertilizing can be done with weeding. Then, the farmers should water to dissolve fertilizer.
- 2nd: 25-30 days after planting. 1/3 P_2O_5, ¼ N and ¼ K_2O are supplied. They must be mixed together and spread 20cm from the root. The fertilizing can be done with weeding. Then, the farmers should water to dissolve fertilizer.
- 3th: 40-45 days after planting. All the remaining of N and K are supplied. They must be spread between two lines and then water can be applied.

- In the growing stage, some foliar and micronutrient fertilizer can be sprayed.
- When the leaves are roll, the foliar and micronutrient fertilizer should not be used.

6. Watering

The farmers must not use waste water, water from pond or water without processing to supply for plants.

- The plants must be watered after planting, 2times/day in the early morning and late afternoon. They can be watered until plants recover. Then, water can be supplied every 3-5 days depending on the soil moisture.
- The top dressing must be done with weeding, and watering.

When the foliar is large, water can be supplied to canal and it must be irrigated to avoid flooding.

7. Pest and disease prevention

Pests: there are some main pests that damage on cabbage:

Silk worm (*Plutella xylostella*) is considered the most dangerous for cabbage. They grow and damage continuously. They can resist to pesticide easily, so, the farmer must use the Integrated Pest Management. If necessary, they can be treated by chemical pesticides that allowed. The dose of pesticides should follow as in label.

Aphid (*Aphis* sp.): the number of aphid can increase in drought weather. Thus, when caring cabbage, it can be kept in moisture, old leaves can be removed. When the number of aphid increases, they can be treated by safe chemical pesticides that noted appendix. The concentration and dose can be followed as guidance in label.

Pieris rapae and *Spodoptera liture*: these pests can be reduced if the number of silk worm and aphid can be controlled. When the number of them increases, the farmers can use chemical pesticides that are in appendix; otherwise, they can have intercropping among cabbage, rice and other legumes. In one field, they can grow cabbage intercrop to tomato to reduce the damage of pest.

Diseases:

The main diseases that damage on cabbage are: bacterial rot (*Erwinia carotovora* sp.), fungal rot (*selerotioum*), leaf spot disease (*Cereospora* sp.), and anthracnose. These diseases can be reduced by keeping field dry, cleaning, weeding and gathering old and disease leaves.

If necessary, they can be treated by chemical fungicides that are in appendix. However, the concentration and dose of fungicides must be followed as guidance in label.

8. Harvesting

When all leaves are roll, the surface of cabbage is smooth, it can be harvested. At that time, leaves arrange in flat and have white color. These old and disease leaves should be discarded. Cabbages cannot be soaked and crushed.

The yield of cabbage is about 70-80tons/ha.

9. Post-harvesting

The cabbage can be stored at 20^0C, dark and good ventilation condition. At this state, cabbage can be kept in 7-10 days. They must be stored in hole-boxes, mesh-bags. When the temperature is 1^0C, air moisture 95-98%, cabbage can be kept in 2-3 months.

10. Storing and transporting

Transport vehicles must be cleaned before loading container products. Cabbage cannot be stored with other goods to avoid contamination. Storage house and transport vehicles must be disinfected regularly.

LESSION 3: TECHNICAL PLANTING, HARVESTING AND STORING OFF-SEASON TOMATO (*Lycopersicon esculentum* L.)

Chapter 1: Ecological requirements

1. Temperature

Tomato (*Lycopersicon esculentum L.*) prefers warm weather. The most suitable temperature for germination is 18.5 – 21^{0}C. Extreme temperature will slow the germination, reduce the vitality of seeds and make them become distortion.

Tomato grows well in temperature is 15 – 30 ^{0}C, the critical temperature is 22 – 24^{0}C. The photosynthesis process of leaves will increase when the temperature is 25 – 30^{0}C. As it is higher (>35^{0}C), the photosynthesis will decrease.

Day and night temperature affects the vegetative growth of plants. In day time, the plant can grow well at 20 – 25^{0}C; in contrast, the temperature is 13-18^{0}C at night. When the temperature is higher than 35^{0}C, the tomato stop growing; and if the temperature is 10^{0}C in long time, the plants can die. In the vegetative stage, the day and night temperature is about 25^{0}C will increase the formation and development of leaves. The growth rate of stems, buds and roots are well at 26-30^{0}C (in day) and 18-22^{0}C (in night). This relates to maintaining the photosynthesis.

Temperature directly affects the flowering and pollination. The rate of fruit formation is high at 18 – 20^{0}C. When the day temperature is higher than 38^{0}C in 5 – 9 days before or 1 – 3 days after flowering; the night temperature is lower than 25 – 27^{0}C in several days before and after flowering, the vitality of pollen reduces. As a result, the yield is lower.

The formation of fruit color will be affected by temperature. The critical for this is 18 – 24^{0}C. At 24 – 28^{0}C, the fruit is red – dark orange because of the formation of *lycopene* and *carotene*. At 30 – 36^{0}C, *lycopene* is not formed; consequently, fruit is yellow. When the temperature is higher than 40^{0}C, the fruit is green because the mechanism for breaking *chlorophyll* does not work, *carotene* and *lycopene* cannot be formed. Temperature and moisture also are the cause for development of diseases.

2. Light

Light requirement for tomato is high. In nursery, if the light is enough (5000 lux), quality of seedlings is good. They are hard, their leaves are large and they will be planted soon. It is easy for collecting pollen if there is enough sunshine. As a result, fruits grow normally, unity and yield increase.

Chemical components of tomato are impacted of light quality, photoperiod and light intensity. The tomato plants that grown in full light have higher ascorbic acid level than others.

3. Water

Water requirements of tomato are different basing on growth stage. It needs less at first, and more at later. The flowering requires most water. If it is not supplied enough water at this stage, the formation of flowers and fruits decrease.

In some references, we see that the critical of soil humidity is 60 – 65%, and for air humidity is 70 – 80%.

The pollen will cracked if humidity is too high (>90%), tomato flowers that are not pollinated will drop. However, dry wind will drop much flowers. Soil and air temperature depends mostly on rainfall, especially in off – season. Rainfall is the main factor that has influence on growth and development of plant from sowing to harvesting.

4. Soil and nutrients

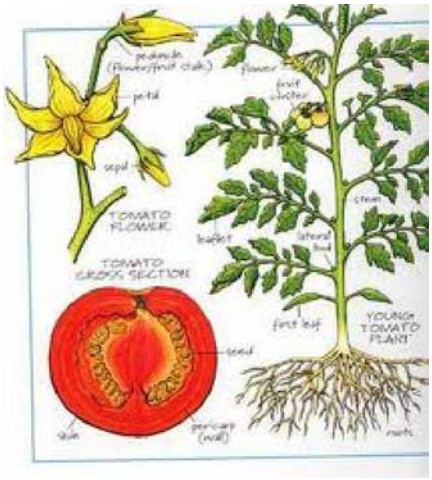
Plating tomato is easy. However, it should be cultivated on alluvial soil that organic content is greater than or equal 1.5%, pH = 5.5 – 7 (best is 6.5 – 6.8). Soil must be much mud, porous and well-drained.

To harvest 1 ton of tomato, the nutrition requirements are 2.9kg N, 0.4kg P, 4kg K and 0.45kg Mg; and to get 50tons/ha, tomato needs 320kg N, 60kg P_2O_5 and 440kg K_2O. For unlimited tomato, the quantities are 180kg N, 80kg P_2O_5 and 180kg K_2O; for limited tomato, the quantities are 120:80 and 150, correspondingly. In the soil condition in Lam Dong, to get average yield 70tons/ha, the quantities of fertilizer for 1ha are 25tons of manure, 250kg N, 150kg P_2O_5 and 300kg K_2O.

Like others, tomato needs at least 20 nutritious elements for the normal growth and development. Among macronutrients, tomato requires more potassium than nitrogen and phosphorous.

Chapter 2: Seeds, planting technique, harvesting and storing off-season tomato

1. Soil



In off-season condition, there is rainy; thus, tomato must be cultivated in high field level, well-drain, easy for drainage and irrigation and do not cultivate Solanaceace in previous crop season. The pH requirement is 6.5-6.8.

2. Seeds and seedlings

Seed: high quality, from clear resources, is supplied from reputable agencies and companies.

The varieties that are used for off-season must have the following characteristics:

- The growth is good, the leaves are dark-green, and leaf surface is thick. Leaves grow semi-limited or unlimited.
- The plant can form fruits at >32^{0}C (without using stimulation chemical). The rate of fruit formation is higher than 60% with the first florescence.
- The fruit is hard, the shell is thick. It cannot be crushed in rainy or sunny weather.
- The fruit ripen uniformly and has red.
- The plant can resist some diseases as: anthracnose, stem rot pythium, downy… or brown spot leaves and grey spot leaves.

Nursery must be fresh, full of sun, and have enough tools for shielding to avoid rain and sun.

Seed handling: this step is not necessary for new seeds. For stored seeds, they must be soaked in warm water (50^{0}C) in 30 minutes, then, they are soaked in cold water and dried.

Media for nursery: powered soil (alluvial soil or small pieces of dried mud) – decomposed humus or manure – fumigated husk or coir with the rate 1.0: 0.7: 0.3, respectively. Media must be handled by fungicide, pesticide and added more nutrients as 10kg powered lime + 1.0kg Basudin (or Vibam 5H) + 1.0kg Zineb + 1.0kg urea + 1.5kg superphosphate + 1.5kg potassium chloride (in 1000kg media). The media is prepared 10-15 days before using.

Seeds are sown in plastic or foam tray with the size 7x10cm. The density is one seed/box/tray. Then, seeds are covered by media, husk or dried straw (about 10cm). Water is supplied for seeds until they germinate. When the seedlings have 5-6 real leaves (20-25 days after germinating), they are

planted. In nursery stage, seedlings are supplied enough water and sprayed pesticides. The seedlings that are weak, diseased must be removed.

Criteria for variety: hard and large stem, small space among leaves, 5-6 real leaves, 10-15cm height and free-diseases.

In off-season condition, the farmers should use the variety tomato that is grafted to aubergine to resist to bacterial wilts and flooding.

3. Crop season

Sowing seeds are done from the beginning of June. Planting is done in July.

4. Fertilizer and supplements

Fertilizer is used efficiency, in which decomposed organic manure is priority. Do not use fresh manure to water. Besides, micro-organic and bio-organic also are used to supply.

The table below shows how to apply fertilizer for 1ha of tomato:

Fertilizer	Unit	Quantity	Basal dressing	Top dressing (kg)			
				1st	2nd	3rd	4th
Organic fertilizers	tons	20-30	20-30	-	-	-	-
N	Kg	160-170	20	20	50-55	40-45	30
P_2O_5	kg	120-150	90-120	30	-	-	-
K_2O	kg	180-200	20		60	60	40-60
Lime	Kg	60-70	60-70				

Methods:

- Basal dressing: the fertilizer is supplied along to canal. It should be mixed and covered by soil.
- Top dressing: can be divided into 4 times. The fertilizer can be dissolved into water and supplied 10cm that far from root. Then, it can be covered and watered again.
  - ✓ 1st: when the plant recover
  - ✓ 2nd: when it flowers first
  - ✓ 3rd: when it form fruits
  - ✓ 4th: after the first harvesting

5. Planting and caring

5.1.Preparing soil and planting

Soil must be ploughed carefully, free-weed, handled by Basudin 10H or Vibam 5H (27kg/ha).

The bed is 35-40cm height and 1.4m width (contain canal), the canal is 30cm.

Plastic cover: the plastic is used to keep moisture for soil. It can be used after bedding and basal dressing.

The plants can be grown into 2lines for one bed with the distance70cm x 40-45cm. Depending on each variety; the density can be 28000-32000plants/ha.

If the farmers grow the grafted tomato, they do not cover the soil over the grafted. After planting, they must use bamboo stick to keep the plant avoid strong wind.

5.2.Watering

The moisture must be 70% compares to field moisture. Water can be supplied into hole or canal. Water must be clean to avoid transmission of disease (especially the bacterial wilts).

5.3.Making frame

One month after planting, the farmers should make frame to help plant stand, fruits cannot touch ground and avoid the damage of pests and diseases. Depending on the growing stage, the frame can have 2-3 levels. The stems can be stick to frames.

5.4.Pruning

The frame can be made one month after planting. Depending on the variety and growing stage, the plant can be pruned. Only 1-2 branches can be kept. The old and disease leaves can also be removed. This work can be done every 2-3 days.

If the tomato is unlimited growth, the top is cut when the numbers of fruits are as required.

If the farmers grow grafted tomato, they must check regularly and discard all the sleep germs of the grafted root.

6. Using nutritional products and chemical for fruiting

In the off-season condition, the tomato needs some nutritional products to enhance the vitality of pollen; thus, the rate of fruit formation can increase. Some nutritional products are used as Botrac, Agrodream. They can be sprayed as guidance from the flowering stage to first harvesting. Besides, some chemical can be used to increase the fruit formation such as CPA, GA3 10-15ppm. They are sprayed to florescence. Notice that, farmers do not let them to touch the growth tops of the tree.

7. Prevention weeds and diseases

If there are many weeds, the tomato does not grow well; moreover, weed is the place for most of pests and diseases. Weed can be treated by mechanical, chemical, handling and cultivation technique methods for small farm with less investment.

Pests:

Green worm infects leaves and flowers

Bollworm infects flowers and fruits

Leaf miner

Diseases:

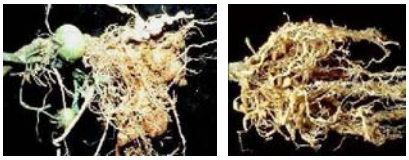
Downy mildew

Anthracnose (*Collectotrichum coccodes*)

Disease by *Slecrotium rolfsii*

Bacterial wilt (*Ralstonia solanacearum*)

Bacterial spots



Disease by root knot nematode (*Meloidogyne incognita*)

Mosaic virus

Yellow leaf curl virus

Some physiology diseases

Ca^{2+} deficiency or distortion of water on tomato


Bad pollination or fruit form in extreme temperature

Too hot weather

7.1.Farming practices

Soil for growing tomato should be rotate to other crops as rice, legumes and upland crops to reduce the transmission of pests and diseases.

Some manual methods are used such as discarding the clutch; catching and killing small insects when the density is low; finding and removing plants that are green-wilt.

7.2.Chemical methods

- Nursery stage: aphids, downy mildew, root rot… must be prevented by high efficient chemical pesticides. Aphids can be used pesticides that contain *Lufenuron* (Match 50EC, Luferon 50EC); downy mildew can be treated by fungicides that have *Cymoxamil* + *Mancozeb* (Xamized 72WP, Jack M9 72WP…); the root rot disease can be treated by fungicides that contain *Metalyxyl* (Validacin 5L, Vida 3SC).
- 1st stage (after planting-branching-flowering): the farmers should check the field regularly to detect pests and diseases. Aphids and thrips can be treated by some chemical pesticides with high safe and efficiency.

Aphids, thrips: can be treated when >20% of total leaves are infected. Some chemical used that contain *Immidacloprid*, *Lufenuron* and *Indoxacab*….

Other pests can be treated when the density is >2 pests/m^2. Some chemical used that have *Permethrin*, *Lufenuron* and *Indoxacab*…

- Medium and last stage of crop season: the farmers should pay attention to thrips, bollworms, green aphids, rock spider and lady buds…

  Some chemical used that have biology sources.

Thrips, red spiders:

When there are more than 50% of total leaves are infected, the farmers should use the chemical that contain *Difenthiuron* (Pegasus 500SC, Pesieu 500SC), *Emamectin benzoate* (Sausto 1.0EC; Rholam 50WP; Tasieu 2WG…) and *Aba mectin*.

Bollworm:

When there are more than 10% of total fruits infected. The farmers should treat these pests by some chemical that have *Matrin* (Marigold 0.36AS, Emaben 0.2EC…); biochemical *Bt*, *Emamectin benzoate* (Sausto 1.0EC, Rholam 50WP, and Tasieu 2WG…).

Green aphids

When the density is more than 40 individuals/m^2 and 15 individuals/m^2 (lady buds), the farmers should use chemical that have *Dinotefuran* (Oshin 20WP, Chat 20WP…), *Thiamenthoxam* (Actara 25WG).

8. Harvesting

Farmers should not water 20days before harvesting to increase the fruit quality. They must ensure the isolation time after spraying.

When the top of fruit is pink, the fruits can be harvested. While harvesting, the farmers should do carefully to avoid crushing, discard the disease fruits; then all fruits are transported and stored in cold places. They will be stored in packages, carton box and transported to consume places.

Chapter 3: Economic efficiency of safe off-season VietGAP tomato

1. **Production costs (for 360m^2)**

- Labor (plough and caring): 50labors x 60000VND = 3,000,000VND
- Material and equipment (seeds, fertilizers, pesticides): 2,500,000VND

Total costs: **5,500,000VND**

2. **Income and efficiency (for 360m^2)**

- Yield: 2,000kg
- Price: 10,000VND

Income: **20,000,000VND**

LESSION 4: FARMING TECHNIQUES, HARVESTING AND STORING CHAYOTE (*Sechium edule*)

Chapter 1: Ecological requirements

1. Temperature

The chayote can grow well at 12-13^{0}C, the difference between day and night temperature is 4-5^{0}C. At this temperature, the chayote can give the best quality for all parts such as stems, leaves, flowers and fruits. If the temperature is higher than 20-23^{0}C, the difference between day and night temperature is less; the chayote does not grow well, much pests and diseases, bad quality for fruits, leaves and stems. If the temperature is higher than 25^{0}C, the chayote stops growing and death.

2. Light

The chayote prefers to the tropical areas that are higher 800m than sea level. At those areas, in the summer (especially in winter-spring crop season in North of Vietnam), the photoperiod is short (8-10hrs/day), it is suitable for growth and development of chayote.

3. Water

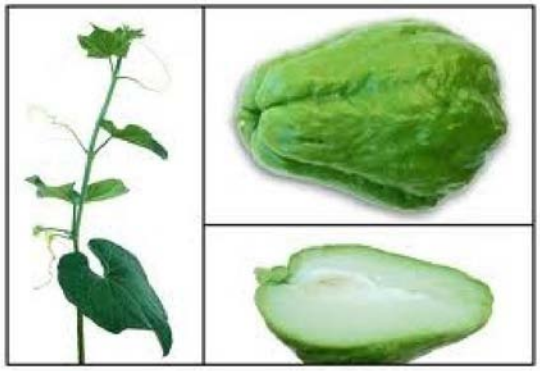
The suitable moisture is 80-85%, air moisture is about 85-95%. If the moisture is higher than 90% in long time, the root system can be affected.

4. Soil and nutrients

The chayote likes rich-nutrient, humus, well-drained soil. The pH value should be 5-6.0. The chayote has large biomass yield, thus, it can be supplied enough nutrients.

Chapter 2: Seeds, planting technique, harvesting and storing chayote

1. Seeds and seedlings



Nowadays, there are two kinds of chayote can be grown in Vietnam: Smooth chayote and Barb chayote.

2. Preparing soil and planting

Power lime can be spread evenly. Holes and beds are made. Their size is determined basing on the farmers' purpose: growing chayote for stems or for fruits.

To get stems: beds are 1.5-2.0m width; holes are 50 x 40cm, the distance between holes is 1.5m. Chayote should be planted in flat land.

To get fruits: the distance among lines is 2-2.5cm; holes are 50 x 40cm, the distance between holes is 2-3m. Holes can be dug along the contours in slope land.

For each hole: the farmer should supply 15-25kg decomposed manure or 1.5-2kg micro-organic fertilizer and 0.2-0.25kg superphosphate a week before planting.

There are two methods to growing chayote in field: growing directly to the soil and growing in boxes.

The 1st method: holes must be supplied fertilizer as basal dressing method, then, they are full of soil. The fruits for growing must be well-germinated, free-disease.

Three fruits can be let into one hole. The distance among fruits is 15-20cm. Fruits are let at three corners of hole. Then, they are covered by soil, plastic cloth to prevent plant.

The 2nd method: seedlings are grown in bags. There must be holes in the bottom of bags to irrigate. The farmer should prepare plastic bags with 12-15cm diameter, 15cm height. The nursery areas must have high level, enough light. Soil is prepared for growing in bags: decomposed soil and decomposed manure are mixed with the rate 3:1. For 1ha of chayote, the farmers should prepare 1600-2500 bags, for 360m^2 they need 60-90 bags. The fruits that well-germinated are grown into bags. When the seedlings have 4-5 real leaves and are 15-20cm height, they can be planted into fields.

For 1ha of chayote, the farmers should prepare 250-360kg of fruits, the density is 1000-1500 plants/ha. To get stems, the fruits needed are 450-500kg, the density is 2000-2500 plants/ha.

3. Seasonal crop

At the area that higher 800m than sea level (as Moc Chau), plants can be grown in January – March. At those areas, the plants can live 2-3 years.

4. Fertilizer and supplements

For 1ha of chayote, the farmers should use 15-20 tons of decomposed manure for basal dressing; otherwise, they can use 1.5-2tons of bio-organic fertilizer

The total quantity of fertilizer for 360m^2 is: 20kg power lime + 500-700 kg decompose manure + 50kg superphosphate + 10kg potassium chloride + 30kg urea.

The dose and method for supplying fertilizer for 1ha of chayote can be shown as following:

Fertilizer	Quantity		Basal dressing (%)	Top dressing (%)				
	(kg /ha)	(kg/sao)		1st	2nd	3rd	4th	5th
Decompose manure/ Bio-organic fertilizer	15.000 - 20.000 1.500 – 2.000	540- 720 55 - 72	100					
Urea	400	30	0	20	30	20	20	10
Superphosphate	250	9	10	20	20	20	20	10
Potassium chloride	130	4,6	0	10	20	30	20	20
Power lime	560	20	100					

- Basal dressing: is done 7 days before planting. Decomposed manure, power lime and 10% of superphosphate can be used for basal dressing.
- There are five times for applying top dressing:

Times	To get fruits	To get stems
1	15-20 days after planting	
2	Start flowering	
3	When plants give fruits	After the first harvesting
4	After the first harvesting	After the 2nd-3rd harvesting
5	After the 2nd-3rd harvesting	After the 8th-10th harvesting

5. Caring and making frame

Caring: at the first stage of planting, the chayote must be kept enough moisture. The farmers should plough and discard all weeds to reduce the number of pests and diseases. When the plants grow and develop well, it can be pruned. The old and diseases leaves must be removed. If the plant is grown by the old stems, the farmers should uncover the soil surface to help them develop new germ when it is 2-3 months.

Making frame: when the plants are 30-40cm height, it is necessary to make frame. It must have flat surface. For chayote that getting stems, the frame should be 40-50 cm height and 1.5-2m width. That helps to harvest more convenient. For the chayote that gives fruits, the frame is 1.8-2.0m height and 1.5-2m width.

6. Watering

- The chayote needs a lot of water. The soil moisture should be 80-85%. The plants cannot resist to flood, so that; the farmers should have well-drainage.
- The farmers must not use the contaminated water to supply for chayote as waste water, water in dirty ponds.

7. Pest and disease prevention

Pests

Some main pests that cause damage on chayote are aphid (*Aphididae*), leaf miner (*Agromyzidae*), red spider (*Tetranychidae*) and thrips (*Thripidae*).

Thrips (*Thripidae*):
They are mostly on vein and suck sap. The wound is often small white spot. When they are in buds, the buds may stop growing, the leaves are curl and easy to drop, and the fruits have scares. There is a light white on stems, leaves and fruits.
Prevention: besides the Integrated Pest Management, the farmers should intercrop, supply enough fertilizer and clean the field. If the density of pests is too high, they can use chemical method.
Some chemical pesticides can be used as Sherpa 25EC 0.15-0.2%, Angun 5WDG (sprayed on two sides of leaves and isolated in 7-10 days); Trebon 10EC 0.1% (isolated in 10 days), Thianmectin 5EC or others that suggested by the Plant Protection agent.

Diseases

- Downy mildew (*Pseudoperonospora cubensis M.C.*)
  The symptoms are mostly on leaves. At first, they are yellow spots and changes into brown when they are old. The formation of spore can be observed at the bottom of the wound in high moisture.
- Powdery mildew (*Erysiphe cichoracearum Sphaerotheca fuligena*)
  The first symptoms are the yellow spots on leaves and stems. On the wound surface, there is white spore. They spread fast and cover all the leaf. At that time, the leaf changes to brown and easily wilt.

Prevention: besides the Integrated Pest Management, the farmers should intercrop, supply enough fertilizer and clean the field. If the density of pests is too high, they can use chemical method.
Some chemical pesticides can be used as Ridomil 72WP (1.5kg/ha), Alliette 80WP (2kg/ha), Anvil 5SC (0.5-1l/ha) and others that suggested by the Plant Protection agent.

8. Harvest and post-harvest

For getting fruits:
The fruits can be harvested 75-90days after planting. They can be harvested by hand one by one to avoid damage to the next generation flowers.

The fruits can be harvested immediately as they grown and every 5-7days. Normally, the fruits can be gotten from April to November. They should be harvested as they are small because of the higher economic value.

The fruits can be stored in 7 days at cool weather 15-20^{0}C and ventilation condition. They are let in hole-boxes. If the temperature is 1-5^{0}C, air moisture is 95-98%, the fruits can be stored in 2 months.

For getting stems:

They can be harvested 3 months after planting. The farmers should use sharp knives or scissors to cut stems. The cut can be 1-1.5cm from the axil. At that time, they also cut some old and disease leaves.

9. Storing and transporting

Transport vehicles must be cleaned before loading container products. Cabbage cannot be stored with other goods to avoid contamination. Storage house and transport vehicles must be disinfected regularly.

Chapter 3: Economic efficiency of producing safe chayote VietGAP

(Unit: VND)

No.	Contents	For getting stems	For getting fruits
I	**Production costs (for 1 sao = 360m^2)**	**3.900.000**	**3.900.000**
	Labor (plough and care): 40 labors x 60.000 VND/labor	2.400.000	2.400.000
	Materials and equipment (seeds, fertilizer and pesticides)	1.500.000	1.500.000
II	**Income and efficiency (for 1 sao = 360m^2)**	**7.000.000**	**6.000.000**
	Yield (kg/sao)	1.400	1.200
	Price	5.000	5.000
III	**Profit**	**3.100.000**	**2.100.000**

LESSION 5: PLANTING TECHNIQUE, HARVESTING AND STORING SMALL FRUIT TOMATO (*Lycopersicon esculentum* L.)

Chapter 1: Ecological requirements

1. Temperature

Tomato (*Lycopersicon esculentum L.*) prefers warm weather. The most suitable temperature for germination is 18.5 – 21^{0}C. Extreme temperature will slow the germination, reduce the vitality of seeds and make them become distortion.

Tomato grows well in temperature is 15 – 30 ^{0}C, the critical temperature is 22 – 24^{0}C. The photosynthesis process of leaves will increase when the temperature is 25 – 30^{0}C. As it is higher (>35^{0}C), the photosynthesis will decrease.

Day and night temperature affects the vegetative growth of plants. In day time, the plant can grow well at 20 – 25^{0}C; in contrast, the temperature is 13-18^{0}C at night. When the temperature is higher than 35^{0}C, the tomato stop growing; and if the temperature is 10^{0}C in long time, the plants can die. In the vegetative stage, the day and night temperature is about 25^{0}C will increase the formation and development of leaves. The growth rate of stems, buds and roots are well at 26-30^{0}C (in day) and 18-22^{0}C (in night). This relates to maintaining the photosynthesis.

Temperature directly affects the flowering and pollination. The rate of fruit formation is high at 18 – 20^{0}C. When the day temperature is higher than 38^{0}C in 5 – 9 days before or 1 – 3 days after flowering; the night temperature is lower than 25 – 27^{0}C in several days before and after flowering, the vitality of pollen reduces. As a result, the yield is lower.

The formation of fruit color will be affected by temperature. The critical for this is 18 – 24^{0}C. At 24 – 28^{0}C, the fruit is red – dark orange because of the formation of *lycopene* and *carotene*. At 30 – 36^{0}C, *lycopene* is not formed; consequently, fruit is yellow. When the temperature is higher than 40^{0}C, the fruit is green because the mechanism for breaking *chlorophyll* does not work, *carotene* and *lycopene* cannot be formed. Temperature and moisture also are the cause for development of diseases.

2. Light

Light requirement for tomato is high. In nursery, if the light is enough (5000 lux), quality of seedlings is good. They are hard, their leaves are large and they will be planted soon. It is easy for collecting pollen if there is enough sunshine. As a result, fruits grow normally, unity and yield increase.

Chemical components of tomato are impacted of light quality, photoperiod and light intensity. The tomato plants that grown in full light have higher ascorbic acid level than others.

3. Water

Water requirements of tomato are different basing on growth stage. It needs less at first, and more at later. The flowering requires most water. If it is not supplied enough water at this stage, the formation of flowers and fruits decrease.

In some references, we see that the critical of soil humidity is 60 – 65%, and for air humidity is 70 – 80%.

The pollen will cracked if humidity is too high (>90%), tomato flowers that are not pollinated will drop. However, dry wind will drop much flowers. Soil and air temperature depends mostly on rainfall, especially in off – season. Rainfall is the main factor that has influence on growth and development of plant from sowing to harvesting.

4. Soil and nutrients

Plating tomato is easy. However, it should be cultivated on alluvial soil that organic content is greater than or equal 1.5%, pH = 5.5 – 7 (best is 6.5 – 6.8). Soil must be much mud, porous and well-drained.

To harvest 1 ton of tomato, the nutrition requirements are 2.9kg N, 0.4kg P, 4kg K and 0.45kg Mg; and to get 50tons/ha, tomato needs 320kg N, 60kg P_2O_5 and 440kg K_2O. For unlimited tomato, the quantities are 180kg N, 80kg P_2O_5 and 180kg K_2O; for limited tomato, the quantities are 120:80 and 150, correspondingly. In Vietnam, the quantities of fertilizer for 1ha are 25tons of manure, 250kg N, 150kg P_2O_5 and 300kg K_2O.

Like others, tomato needs at least 20 nutritious elements for the normal growth and development. Among macronutrients, tomato requires more potassium than nitrogen and phosphorous.

Chapter 2: Seeds, planting techniques, harvesting and storing small fruit tomato

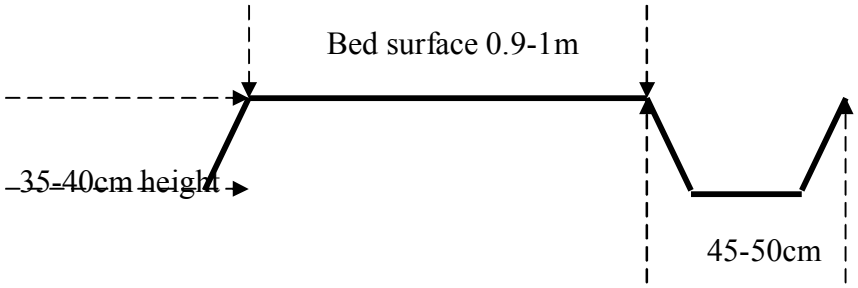
1. **Cropping season**

- Fall-winter season: sowing from August to September.
- Winter season (on season): sowing from the end of September to October.
- Spring-summer season: sowing from 15th December to 25th January.

2. **Soil**

Soil

The soil for planting tomato must be high level, well-drained, easy to irrigate and do not cultivate Solanaceace in previous season. The pH value is 6.5-6.8.



***Preparing soil and planting**:*

The soil must be ploughed carefully, free-weeding and handled by some chemical as Basudin 10H or Vibam 5H (27kg/ha).

The bed is 1.4-1.5m width, 35-40cm height and the canal is 40-50cm width.

The plastic cover should be used to keep the soil moisture.

3. **Seeds and seedlings**

Seeds: Seed: high quality, from clear resources, is supplied from reputable agencies and companies.

Some small fruit tomatoes can be used in market mostly hybrid varieties as Thuy Hong, Trang nong 060, HT 144. Besides, there is pure-bred as VR2 (from FAVRI).

Nursery must be fresh, full of sun, and have enough tools for shielding to avoid rain and sun.

Seed handling: this step is not necessary for new seeds. For stored seeds, they must be soaked in warm water (50^0C) in 30 minutes, then, they are soaked in cold water and dried.

Media for nursery: powered soil (alluvial soil or small pieces of dried mud) – decomposed humus or manure – fumigated husk or coir with the rate 1.0: 0.7: 0.3, respectively. Media must

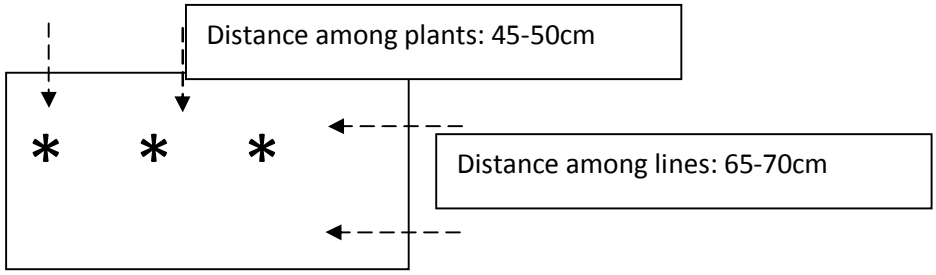
be handled by fungicide, pesticide and added more nutrients as 10kg powered lime + 1.0kg Basudin (or Vibam 5H) + 1.0kg Zineb + 1.0kg urea + 1.5kg superphosphate + 1.5kg potassium chloride (in 1000kg media). The media is prepared 10-15 days before using.

Seeds are sown in plastic or foam tray with the size 7x10cm. The density is one seed/box/tray. Then, seeds are covered by media, husk or dried straw (about 10cm). Water is supplied for seeds until they germinate. When the seedlings have 5-6 real leaves (20-25 days after germinating), they are planted. In nursery stage, seedlings are supplied enough water and sprayed pesticides. The seedlings that are weak, diseased must be removed.

Criteria for variety: hard and large stem, small space among leaves, 5-6 real leaves, 10-15cm height and free-diseases.

4. Density and planting distance

The plants can be grown 2 lines/bed with the distance is 70cm x 45-50cm. Depending on each variety, the density may be 28000-32000 individuals/ha.



If the farmers plant single bed, the bed should be 90-95cm width and the distance between plants is 40cm.

The plants should be grown in cool afternoon and should not be grown too deeply.

5. Fertilizers and supplements

Fertilizer is used efficiency, in which decomposed organic manure is priority. Do not use fresh manure to water. Besides, micro-organic and bio-organic also are used to supply.

The table below shows how to apply fertilizer for 1ha of tomato:

Fertilizer	Unit	Quantity	Basal dressing	Top dressing (kg)			
				1st	2nd	3rd	4th
Organic fertilizers	tons	20-30	20-30	-	-	-	-

N	Kg	120-150	20	20	30-40	30-40	20-30
P_2O_5	kg	100	70	30	-	-	-
K_2O	kg	120-150			40	60	20-50

Methods:

- Basal dressing: the fertilizer is supplied along to canal. It should be mixed and covered by soil.
- Top dressing: can be divided into 4 times. The fertilizer can be dissolved into water and supplied 10cm that far from root. Then, it can be covered and watered again.
  - ✓ 1st: 7-10 days after planting
  - ✓ 2nd: 3-4 weeks after planting
  - ✓ 3rd: 5-6 weeks after planting
  - ✓ 4th: after the first harvesting

The farmers can use complex or NPK fertilizer to supply with the corresponding dose with the pure. Besides supplying to the soil, the farmers can spray to the leaves the macronutrient, medium-nutrient or micronutrient as the guidance of producers.

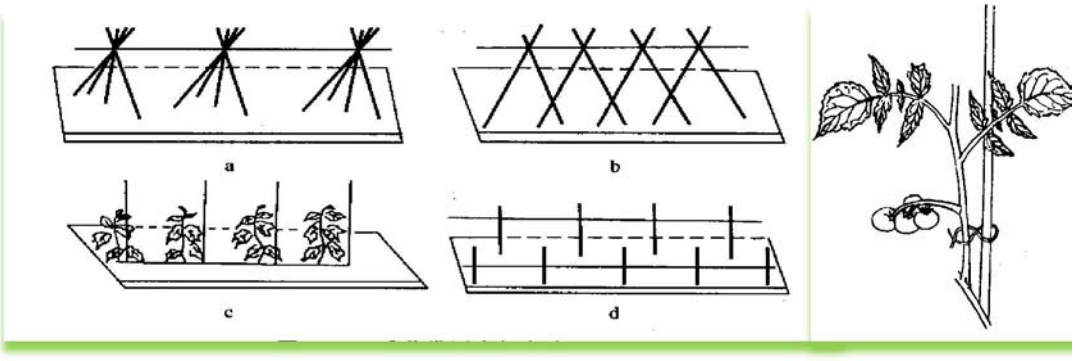
6. Planting and caring

6.1.Watering

The moisture must be 70% compares to field moisture. Water can be supplied into hole or canal. Water must be clean to avoid transmission of disease (especially the bacterial wilts).

6.2.Making frame

One month after planting, the farmers should make frame to help plant stand, fruits cannot touch ground and avoid the damage of pests and diseases. Depending on the growing stage, the frame can have 2-3 levels. The stems can be stick to frames.



6.3.Pruning

The frame can be made one month after planting. Depending on the variety and growing stage, the plant can be pruned. Only 1-2 branches can be kept. The old and disease leaves can also be removed. This work can be done every 2-3 days.

When the number of fruits as required, the late fruits can be removed to ensure the unity. Normally, for small fruit tomato, the number of fruits should be 12-16.

7. Preventing pests and diseases

7.1.Pests

Main pests

Green worm infects leaves and flowers

Bollworm infects flowers and fruits

Leaf miner

- Green worm: the worm is dark green with many light stripes on the back and two wide and dark colors on either side. When the worm is large, it is green and smooth back, the abdominal surface is often light yellow. The immature worm often eats leaves, the mature ones eat fruit.

  Prevention: the farmers should observe regularly to kill the eggs. The old leaves or the leaves near fruits should be removed to spray easily. Some chemical pesticides are used as Minic, Atabron, Baythroid, Selecron, Bt Xentari and Lannate.
- Dark worm: it usually damages the young plants. The farmers can catch them or use Basudin 5G (10G) to kill them.
- Bollworm (Helicoverpa armigera): they lay eggs on leaves. The immature eats leaves and the mature ones eat fruits. The farmers must use pesticides at immature stage. They can use Delfin 32BIU, BT, and Sherpa 25EC. If the plants are infected by aphids, whiteflies or thrips, they can use PT-Pentin 15EC, Bassa 50EC to treat.
- Leaf miner: the adults are small black flies with long wings. They lay eggs on leaves, the immature attack the layer between epidermises; thus, the leaves are dry and reduce the photosynthesis area. They often attack at the beginning of dry season and can resist to pesticides. The farmers can use Ofunack, Fenvalerate, Polytrin, Sumidicin and Trigard to treat them.

7.2.Diseases

Main diseases

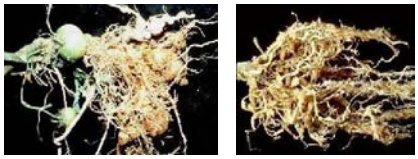
Downy mildew

Anthracnose (*Collectotrichum coccodes*)

Disease by *Slecrotium rolfsii*

Bacterial wilt (*Ralstonia solanacearum*)

Bacterial spots



Disease by root knot nematode (*Meloidogyne incognita*)

Mosaic virus

Yellow leaf curl virus

Some physiological diseases

Ca^{2+} deficiency or distortion of water on tomato


Bad pollination or fruit form in extreme temperature

Too hot weather

- Leaf curl disease: this disease can appear in early season crop, spring-summer season. The disease is caused by virus and it can transmit through aphids, whitefly. This can be treated by removing plant or spraying to kill vectors.
- Downy mildew (*Phytophthora infestans*): the disease can grow in high moisture, low temperature. It can infect in leaves, fruits and stems. The prevention method is to create clean field (pruning stems, leaves…). The farmers can spray Boocdo 1%. Besides, they can use Zineb 80WP, if the damage is large, they can use Ridomil MZ 72WP, Altracol 70WP…
- Bacterial wilts (*Pseudomonus Solanacrearum*): the disease can appear if the moisture is high, warm weather; especially, it appears in early crop season. To prevent it, the farmers should rotate the tomato with rice. When the disease develops, they should not water.
- Spotted leaves: it appears in early crop season when the moisture and temperature are high. It is less dangerous when compared to above diseases. If the damage is large, the farmers can spray Boocdo, Zineb and Mancozeb…

8. Harvesting

Farmers should not water 20days before harvesting to increase the fruit quality. They must ensure the isolation time after spraying.

When the top of fruit is pink, the fruits can be harvested. While harvesting, the farmers should do carefully to avoid crushing, discard the disease fruits; then all fruits are transported and stored in cold places. They will be stored in packages, carton box and transported to consume places.

Chapter 3: Economic efficiency of producing small fruit VietGAP tomato

(Unit: VND)

No.	**Contents**	**Total value**
I	**Production costs (for 1 sao = 360m^2)**	**3.500.000**
	Labor (plough and care): 50 labors x 50.000 VND/labor	2.500.000
	Materials and equipment (seeds, fertilizer and pesticides)	1.000.000
II	**Income and efficiency (for 1 sao = 360m^2)**	**7.000.000**
	Yield (kg/sao)	2.000
	Price	3.500
III	**Profit**	**3.500.000**

LESSION 6: PLANTING TECHNIQUES, HARVESTING AND STORING SMALL FRUIT CUCUMBERS (*Cucumis sativus* L.)

Chapter 1: Ecological requirements

1. Temperature

The cucumber prefers warm weather. The minimum temperature should be 16^0C. At this level, the seeds can germinate after 9-16 days. If the temperature is 21^0C, the seeds can germinate after 5-6 days. However, the seeds can germinate at 12-13^0C. The most suitable temperature for growth and developments of cucumber is 18.5-30^0C. If the temperature is too high in flowering, the vitality of seeds may reduce. If the temperature is 35-40^0C in long time, the plants can die. At 15^0C, the plants will lose the balance between the anabolic and catabolic.

2. Light

Cucumber is short-photoperiod plant. If the photoperiod is short at high latitude, the rate of growth will faster. The plants can flower and form fruit earlier.

3. Water

The cucumber fruit contains 95% of water. Moreover, the leaves are large, and the coefficient evaporation is high; thus, the cucumber needs high moisture. The air moisture is 90-95% and the soil moisture is 85-90%. In the fruit formation, the field must be kept in moisture. Cucumber cannot resist to drought, the fruits will be bitter because of the high concentration of cucurbitacine if it is drought in fruit formation. Besides, the cucumber also cannot resist to flood; therefore, the field must be well-drainage and near the water source.

4. Soil and nutrients

Because the root systems of cucumber do not grow well, the soil for cucumber is harder than other plants in Cucubitaceace. The pH value is 5.5-6. Soil must have light mechanical composition as sandy and loam soils. The cucumber is sensitive to all chemical. To produce 1ton of cucumber, the plant needs 0.8-1.36kg N; 0.27-0.9kg P_2O_5 and 1.36-2.3kg K_2O from soil. The cucumber needs potassium most, and then is nitrogen and phosphorus. The cucumber cannot stand the high concentration of fertilizer but also is sensitive to nutrient deficiency. The organic fertilizer is clearly to increase the yield of cucumbers. Potassium and phosphorus have vital role in the quality of fruits. Nitrogen helps the fruits have nice color.

Chapter 2: Seeds, planting technique, harvesting and storing

1. Soil

The cucumber likes soil that has thick cultivated layer, rich-nutrient, well-drain, and medium mechanical composition. The soil must be well-prepared and free-weeds.

2. Seeds

The cucumber varieties are Marinda (Netherlands), Levina (USA) and Ninja 179 (Thailand).

3. Cropping season

In spring season: sowing from 5th February to 5th March to avoid the cold weather in late spring and Lao wind in early summer. The average temperature is 18-22^{0}C with the maximum is 30^{0}C and minimum is 14^{0}C.

In winter season: sowing from 5th September to 5th October.

When the plants are grown between two rice seasons, they must be sown in tray to take the advantage of cropping season.

4. Fertilizer and sowing

To save the seeds, labors for care at the first stage and increase the unity of plants, the seedlings must be planted in plastic or porous trays. The trays will have size 60 x 45cm and 60 holes.

Materials for a bag are 40% soil + 30% fumigated husk + 30% decomposed manure. They are mixed together, discard dirty things and covered all holes in trays. The trays should be let in shelves that are 50cm from the ground and in the greenhouse.

Seeds are soaked in warm water (35-40^{0}C) in 3hrs, and then they are incubated at 27-30^{0}C. When they crush, they are sown in holes (2seeds/hole) and watered. Then the seedlings must be watered every day and stopped before planting 2-3days.

The quantity of seeds for 1ha is 600-800gram.

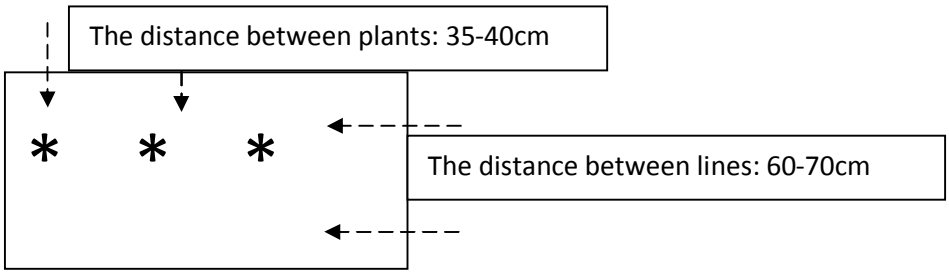
5. Preparing soil and planting

Soil is high level, well-drain and near the water sources. The soil is sandy or light loam soils with the pH value 5.5-6.5. The soil cannot be cultivated Cucurbitaceace in previous 2 crop season.

The soil must be plough carefully because the root systems of cucumber are weak. The beds are 1.2-1.4m width, 0.3m height and the canal is 0.3-0.4m width.
The bed is divided into two lines with the distance is 60-70cm to fertilize.
Planting: the trays can be transported to the field. All the distortion and disease plants can be removed. The strong ones can be grown in the lines. The seedlings should be grown deeply to the soil and watered after planting.

6. Density and distance

For the small fruit cucumber: the distance between individuals is 35-40cm (in winter) and 60-70cm (in spring).



The density is 15000-20000 individuals/ha.

7. Fertilizer

The quantity for 1sao = 360m^2

- Decomposed manure: 0.7-0.8tons (20-25tons/ha)
- Superphosphate: 20kg (560kg/ha)
- Urea: 6-7kg (150-200kg/ha)
- Potassium sulfate: 10kg (270kg/ha)
- In the case that there in not enough manure, the farmers can use micro-biochemical by the industrial factory.

Methods:

- Basal dressing: 100% decomposed manure and phosphorous + 20-30% nitrogen and potassium.
- Top dressing: the remaining can be dissolved in water and supplied every 7-10 days.

8. Watering and basal dressing

The root systems of cucumber cannot grow deeply, thus, the cucumber plants need a lot of water. It must be water from wells or rivers. Before making frame (20-30days after planting), water can be given into canal and then it can be drained. In the fall-winter season, the water can be put into canal. The cucumber needs moisture from the flowering stage, especially from the harvesting fruits to increase the quality. When the water is not enough, the fruits may be bitter and curve.

Besides, the nutrients can be supplied by dissolving phosphorus with manure.

If there is rainy in the basal dressing time, the farmers should use foliar fertilizer as the guidance in label.

9. Caring

When the plants have 5-6 real leaves, the farmers should make frame. The frame is 1.2-1.6m height. They should have 42000-45000 bamboo poles for 1ha of cucumber.

The farmers usually clean the root of plants as discarding weeds, cutting old and disease leaves.

10. Pest and disease prevention

Main pests

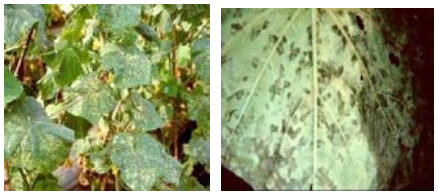
Thrips infect on leaves

Thrips infect on fruits

Green worm with smooth surface

Main diseases

Anthracnose (*Collectotrichum*)



Downy mildew (*Pseudoperonospora cubensis*) Benk and Curt)


Disease caused by *Pythium*, *Rhizoctonia*

Powdery mildew (*Erysiphe cichoracearum*)

Some physiological diseases

Phosphorus deficiency

K^+ deficiency on fruit and leaf

Cu^{2+} deficiency

Fe deficiency

- Thrips: they often are in plants from the seedling stage to flowering and fruit formation. They prefer the young parts in plants. They often damage near vein, downside and make the leaves are curl and yellow. If they are in buds, the buds can grow well; consequently, they are dry and die. The thrips make the fruits drop. Besides, they are also vectors to transmit virus that cause stunt and curl stems.
  When the density of thrips is high, they must be treated by Oncol 20ND, Bassa 50ND, and Pegasus 500SC.
- Red spider: they are small, pink color. They move quickly and are in upside of leaf. They grow well in cloudy, dry and rainy. They suck the leaves and make them change the color from green to light green, brown-green and yellow. At last, they can drop easily.
  There are some chemical to treat red spider as Comite 73EC, Ortus 5SC, Danitol – S50SC and Pegasus 500SC…

- Black aphids: they are small, yellow-green and have sucking mouthpart. They live in young leaves, and flowers. They have two types: wings and no-wings. They suck the sap from plant; as a result, the plant cannot grow. The flowers and fruits can drop if they attack in flowering stage. Besides, they are vectors of mosaic leaves virus.
  They can be treated by Oncol 20ND, Padan 95SP, Bassa 50ND, Pegas 500SC and Sumithion 50EC.
- Green worm: the worm is dark green with many light stripes on the back and two wide and dark colors on either side. When the worm is large, it is green and smooth back, the abdominal surface is often light yellow. The immature worm often eats leaves, the mature ones eat fruit.
  Prevention: the farmers should observe regularly to kill the eggs. The old leaves or the leaves near fruits should be removed to spray easily. Some chemical pesticides are used as Minic, Atabron, Baythroid, Selecron, Bt Xentari and Lannate.
- Leaf miner: the adults are small black flies with long wings. They lay eggs on leaves, the immature attack the layer between epidermises; thus, the leaves are dry and reduce the photosynthesis area. They often attack at the beginning of dry season and can resist to pesticides. The farmers can use Ofunack, Fenvalerate, Polytrin, Sumidicin and Trigard to treat them.

- Downy mildew: the disease caused by fungi. They create the polygon with many edges. At first, they are yellow, and then they are brown. In the morning, on the down side of the leaf, we can see the white filaments.
  It often causes disease in roots and then spread to the apex. If the damage is less, the fruits still form but the quality is not good; if the damage is much, the plant will die. This disease often appears in cloudy and cold weather.
  Prevention: the farmers should use in turn the fungicides as Boocdo 1% and Ridomil…
- Powdery mildew: the disease is mostly on the leaf flat. The disease makes the leaves change from the green to yellow. There is powder on the leaf surface. When the damage is much, the leaves are dry and die.
  Prevention: the farmers can use Anvil 5SC, Bavistin and Belal 5WP and spray them to two sides of leaves.
- Bacterial wilts: this disease make the cucumber become wilt, lose water and die. The leaves are green wilt and there are some nodes on the roots.
  Prevention: the disease plants must be removed from the field. Some chemical can be used as Boocdo 1%, chlorine oxygen.
- Virus diseases: the virus can cause the mosaic on leaves. There are some green and yellow wounds. The apex will be stunted, the leaves are curl and the plants do not grow well. The fruits will be yellow and do not give good quality.

Prevention: these diseases can be detected early and all disease plants must be removed from field. Some pesticides can be used to treat the vector as aphids…

Besides some methods above, the farmers should use chemical method if necessary. However, the dose must be followed the guidance of producers or plant protection agents.

11. Harvesting

Because cucumber can be harvested regularly (1-2times/week), the farmers should not use chemical in the harvested time. After the flowering, they should use bio-pesticides as BT 0.2-0.3%, Delfin WP (32BIU) and Xentar WDG.

The fruits can be harvested at the second flowers. At first, they can be harvested 1 time, and then 2 times/ day. After that, they can be handled and stored in carton boxes.

12. Post-harvesting

The fruits can be stored in 20-30days at cool temperature (<20^0C), good ventilation and dark condition. They must be stored in hole-bags. At 1^0C and air moisture 90-95%, cucumber can be stored in 2-3months.

13. Cleaning

The labors should be trained and given documents for cleaning themselves. The rules for cleaning must be let in places that people can see easily. There should be toilet near the field with well-equipped. The waste must be processed.

14. Processing products

In the post-harvesting stage, the farmers must not use the chemical to processing their products. The fruits must not be cleaned because it can reduce the appearance of products and the time for storing.

15. Storing and transporting

All transport vehicles must be cleaned before loading container products. To avoid polluted products, tomato cannot be stored with other products. Stored houses and transport vehicles must be disinfected regularly.

16. Management and waste processing

Some methods for management and processing the waste must be given from the producing, transporting to storing stage. The producers must record the waste management activities as some samples of waste managing and processing.

Animals at home and farm may cause the contamination for the producing area and water source. Thus, they must be kept in right way to reduce the risks for pollution due to their waste.

17. Labors

17.1.Safety for labors

The person who manage and use chemical must have knowledge about them and recording skill. Groups or people must provide equipment and initial measure and then they must give the labors to the hospital if they are affected by chemical. There must have the guidance for initial measure in the chemical storage. The person who sprays pesticides must have cover clothes. The clothes must be cleaned and not let with pesticides. There must be warning board.

17.2.Working conditions

The house for working must be clean; the density of people is effectively. The working condition must be ensured and suitable to the labors' heath. The labors must be supplied working-clothes. Some materials, tools must be checked regularly to avoid their risks for labors. For lifting some heavy things, there must be guidance.

17.3.Social welfare for labors

The working age must be abided by Vietnamese law. The houses of labors must well-equipped. Salary for labors must be suitable to the Vietnamese labor law.

17.4.Training

Before start working, the labors must know the risks that relate to their health and safe condition. The labors must be trained for some works as following:

- The way to use materials, tools
- Guidance for initial measure of working accidents
- Safety using chemical and cleaning

The producers must keep the record about their labors and other activities in farm.

17.5.Record, record keeping, traceability and recall the products

Groups and people that produce as VietGAP must record and keep all the production diary and diary about using chemical, fertilizer and selling products… They must check and hire other to check for them the production and recording. If it is not as required, they should have methods to repair and it can be record in documents. The record must be detail for each step in VietGAP and kept in production farm. They must be kept at least 2 years or longer. The VietGAP products must be recorded the position and code of the production. The position and code must be record and kept. Bags and boxed for keeping products must have labels to help trace the original. When the producer exports his products, he must record the time, the place that products come and keep record for each product. When he detects the polluted products, he must isolate them and stop delivering. If not, he must notice to his consumers. Then, he must investigate the reasons and have strategies for processing it.

The producers must record the training for labors and other activities in farm.

17.6.Internal checking

Groups or people that produce fruits and vegetables must have the internal check at least every 1 year.

The test must be done followed the assessment tables. When they have finished, they must sign on that table.

The self-assessment of the agents must be kept in record. The VietGAP group or people production must summarize and record the results for the agents as required.

The labor must use the self-assessment VietGAP at least one year.

17.7.Complaints and resolving complaints

The VietGAP group or people must have the complaint samples when the customers ask. In case there is any complaint, they must solve follow the rules and record that complaint and resolving on documents.

Chapter 3: Economic efficiency of safe VietGAP cucumber production

(Unit: VND)

No.	**Contents**	**Total value**
I	**Production costs (for 1 sao = 360m^2)**	**4.500.000**
	Labor (plough and care): 25 labors x 60.000 VND/labor	1.500.000
	Materials and equipment (seeds, fertilizer and pesticides)	3.000.000
II	**Income and efficiency (for 1 sao = 360m^2)**	**10.000.000**
	Yield (kg/sao)	2.000
	Price	5.000
III	**Profit**	**5.500.000**