

Small Scale Vegetable Production with 5 Color Approach, Nutrition Plant Growing, Innovative Gardening and Fruit Tree Growing Facilitator's Manual



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Key objectives of the Manual

1. To support Community facilitators and Mother Groups in Community Mobilization and Participation.
2. To guide community facilitators and Mother Groups in small scale vegetable production practices.
3. To clarify best practices in innovative gardening (vegetables and fruits) including care and preservation.
4. To provide clear guide and ensure sustainability of project activities.

Target Audience and User.

This manual has four modules that support small scale vegetable production, nutrition link with demonstration plots , innovative gardening, nutritious plant and fruit tree growing. The Facilitator's manual is intended to guide community facilitators and strengthen farmer's capacity to produce vegetable on small scale. The manual is also intended to provide capacity to "Mother Groups" to grow vegetable following 5 color approach and learning nutritional knowledge including fruit tree growing and care.

The main learning approach for this manual is to help farmers learn through discussions and practical exercises based on their own farming environment and experience.

MODULE 1: SMALL SCALE VEGETABLE PRODUCTION WITH 5 COLOR APPROACH

SESSION 1: MOBILIZING THE COMMUNITIES

1.1: Contacting the Participants

a) Initial communication with community leaders.

1. Find village level person to contact – Village Tract, HH Household, then Village administrator (check contact list in the data base of the organization or ask the Department of Agriculture for information).
2. Ask an official to attend the meeting to introduce the facilitator and the project
3. Call the village contact person(s) by phone or make a personal visit to arrange the meeting. Check if they have a good communication method with the villagers. **Tell the village administrator we are expecting a minimum of 50% household attendance of the target group or we cannot continue; likewise 50% female attendance is required; otherwise, arrange a second meeting for those who did not attend.**
4. Explain the topic of the proposed visit and arrange a date to visit the village.

b) Confirmation of the meeting.

Call the contact person 2 days before the meeting to confirm the visit; if needed repeat the phone call one day before the meeting as well.

1.2: Mobilization and organizing the Meeting:

Objectives

1. To explain the CDN-ZOA project.
2. To explain the training based on the training manual (aim, target beneficiaries, inputs).

3. To select beneficiaries.

1.2.1: Activity 1: To explain the project model and inputs to all village members present (5 min)

- a) Start with general chatting and local issues before the meeting starts.
- b) Ask the official to welcome the attendees and introduce you, the facilitator.
- c) Explain the agenda topics and the duration of the meeting.
- d) Explain about the RWCP components, the SSVP model, and the provision of a small amount of inputs (on prepared flip charts).
- e) Answer and discuss questions raised by the participants.

1.2.2: Activity 2: To explain the process of training and selection of beneficiaries (5 min)

- a) Explain the training approach and how the beneficiaries will do home gardens/ demonstration plots /fruit tree plantation according to the training manual.
- b) Answer and discuss any questions raised by the participants.
- c) Discuss and confirm who should be the beneficiaries (landless / small land farmers /mothers with children), date, time and place for training. Make sure the time and place are suitable to both men, women, elderly and persons with disabilities.
- d) Put the participant beneficiary selection criteria on flip chart (selection criteria should be set by both project staff and community).
- e) Ask the participants to nominate on a small piece of paper those who they think should attend the training. Assist those who cannot write.
- f) Confirm the list of selected beneficiaries.
- g) Agree on time and place for the training.
- h) Reflect on Mother Group formation, clarify roles and allocate roles together with participants.

SESSION 2: INTRODUCTION AND SELECTION OF VEGETABLE CROPS

Duration: 30 Minutes

Material- Flipchart, markers, tape, Attendance Register form; vinyl.

Objectives:

1. To know each other better and to know the objectives of the training course.
2. To know the 5 vegetable varieties that have been selected and why.
3. To know the criteria for selecting of vegetable varieties.
4. To know the inputs which the project will provide.

2.1: Activity 1: Introduction.

1. Welcome participants to the introductory meeting.
2. Explain the project and objectives of the training to the participants.

2.2: Activity 2: Vegetable crop selection .

1. Write down the selection criteria on flip chart and explain how participants need to consider the selection of vegetable varieties.
2. Explain to the participants crop diversity, various nutrients and its value especially to mothers.
3. Write down the list of varieties that participants selected.

2.2.1: Vegetable varieties Selection Criteria:

Selection of vegetables to grow:

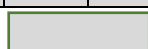
1. Market demand, price and timing of planting and harvest to get the best price.
2. Expected profit by selling the surplus of vegetable produce in home gardens.
3. Family consumption preferences and nutritional value (why we choose 5 color crops in nutrient value point of view).
4. Suitable for seasonal planting calendar (winter, rainy, summer season).
5. Soil type preferences or tolerance e.g. acid, neutral, alkaline.
6. Availability of water near the garden.
7. Crop rotation requirements for soil improvement and disease control.
8.
9.
10.

2.2.2: Calendar of Crops for the Different Seasons Including target crops!

Crops	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept
1. Long-yard Bean												
2. Okra												
3. Onion												
4. Carrot												
5. Chili												
6. Tomato												
7. Egg-plant												
8. White egg-plant												
9. Cabbage												
10. Cauliflower												
11. Broccoli												
12. Radish												
13. Water spinach												

14. Bottle Gourd													
15. Snake Gourd													
16. Ridge Gourd													
17. Bitter Gourd													
18. Cucumber													
19. Water Melon													
20. Pumpkin													
21. Amaranth													
22.													
23.													
24.													

Remarks:



Good growing period



Difficult growing period

2.2.3: Crops Selected and Reasons (10 min)

	Crop	Season	Reasons Why Selected
1	Yard Long Bean	Monsoon & Winter	Good market & price; popular to eat; good nutrition; input availability; suitable for several soil types; good for crop rotation & environment; low risk
2	Bottle Gourd	Monsoon & Winter	Good market & price; popular to eat; input availability; suitable for several soil types; good for crop rotation & environment; low risk
3	Bitter Gourd	Monsoon & Winter	Popular to eat; input availability; suitable for several soil types; good for crop rotation & environment; low risk
4	Carrot	Winter	Good market & price; popular to eat; nutritious; input availability; suitable for several soil types; low risk.
5	Broccoli	Winter	Good market & price; popular to eat; nutritious; input availability; suitable for several soil types; good for crop rotation & environment; low risk
	Yard long bean, winged bean, okra, chilli, tomato, egg-plant, cucumber, bitter gourd, bottle gourd, cabbage, cauliflower, lettuce, water spinach, carrot and broccoli		Good market & price; popular to eat; nutritious; input availability; suitable for several soil types; good for crop rotation & environment; low risk.

SESSION 3: SITE SELECTION, FENCING, MAKING RAISED BED, ESTABLISH NURSERY

Duration: 60 Minutes

Objectives:

1. To be aware of site selection criteria.
2. To know why fencing is important and practical fencing options.
3. To know about the advantages of different cultivation techniques .
4. To know why raised bed is important for vegetable growing.
5. To know how to establish the nursery plants and care practices.

3.1: Activity 1: Site selection

1. Remind the participants that the project is providing the seeds and inputs for a small 20 ft x 3 ft plot for one crop cultivation.
2. Brainstorm the criteria to consider for vegetable growing site selection and write down their ideas on a flip chart.
3. Explain the site selection criteria and write their ideas on a flip chart.

Site selection criteria:

Site selection criteria

1. Easy access from home to enable regular visits.
2. Free from flooding.
3. Near water source.
4. Free of pests or disease contamination from their field and neighbor.
4. Prefer some shade trees but not too much.
5. Suitable size for family consumption and labor availability.
- 6.....
7.
8.
9.

3.2: Activity 2: Fencing

1. Brainstorm why fencing is important and write down their feedback on a flip chart.
2. Ask participants to describe different materials for fencing and list these on a flip chart. Then discuss the advantage and disadvantage of different type of fencing.

Why is fencing important?.

1. To prevent crop damage by animals.
2. To prevent contamination by animals.
3. To protect chemically sprayed areas from children and others entering the field and becoming contaminated.
4. Make a small child proof enclosure for rubbish (old plastic bags, spray containers) and dispose off the rubbish regularly and safely with regard to worker's health and the environment.
5.
6.
7.

3.3: Activity 3: Making raised bed

1. Brainstorm with the group on the question: "Why is it important to make raised beds?" Write down their answers on a flip chart and discuss.
2. Review their answers and discuss their ideas on the importance of raised beds.

Why is it recommended to have raised beds?

It is recommended that farmers have raised beds because:

1. Excess water can initially drain away from the plant reducing the chance of disease and water stress.
2. The excess water that drains into the furrows can slowly soak into the bottom of the bed and move up towards the plant roots. Therefore the excess water is not lost.
3. Roots can grow quickly toward the water in the furrows. Long roots improve the feeding and production of the plant.
4. Nematodes don't like to move up the furrows so the roots are protected in raised beds.....
5.
6.
7.

3.4: Activity 4: Nursery establishment

1. Ask participants why farmers use nursery beds than planting directly to the field.
2. Discuss the advantage and disadvantage of direct seeding and planting from nursery bed.
3. Explain how to establish and maintain a nursery bed .

	Seedlings	Direct Seeding
Amount of seed used	Less	More
Water application	Less amount used	More amount used
Weather/pests effect	Easy to control, low impact	Difficult to control, high impact
Productivity	High productivity, good uniformity in quality	Uneven productivity in plants; lower quality
Crop season in field	Shorter	Longer

3.4.1: Establishing nursery in Seed tray



Raising seedling in seed tray can be placed under shade net prevented from soil borne disease and sucking pest such as thrip.



3.4.2: How to Establish and Maintain a Nursery

TIPS	REASONS
1. Select a raised or slightly sloping secure site close to water source.	Water can run off to prevent flooding. Fencing protects plants from damage. Water is essential for plant growth.

2. Build a table from local materials. Do not put your nursery close to guava or banana plants because these are hosts for insect pests.	Local materials are easy to access and cheap.
3. Put shade cloth or palm leaves on top of the seedling table for 30% shade and protection from rain. Do not cover the sides.	Direct sunlight dries the soil quickly and high temperature stresses the young seedlings. The rain can wash out the seedlings. Too much shade makes long stem weak seedlings while too much light stresses young plants and they do not grow well. Airflow from the sides reduces moisture and disease.
	 <p>Too much shade produces elongated seedlings</p>
4. Put a ring of an ash and oil mixture around the nursery seedbed to prevent ant invasion	Ants can destroy the seedlings
5. Grow seedlings in separate small pots with water drainage holes like a plastic seed tray, bamboo joint, newspaper, or other small homemade containers with holes in the bottom	This reduces competition for light, nutrients and root development area between plants. Plants can also be easily taken out of the pot and transplanted without disturbing fine roots and the plant next to it in the nursery.
6. When the seedling mix is ready, poke a hole in the soil with a sharp stick and plant seeds in the containers about a quarter inch below the surface. Water the soil until it is very wet.	This protects the plant from too much light, and provide a moist surrounding that stimulate root growth. It is also close enough to the air so the plant can breathe and have access to water.

	
<p>7. For seasonal vegetables, stagger your planting in the nursery 2-3 seedlings per week over a number of weeks.</p>	<p>So you grow just enough to eat each week over a number of weeks. Not to have every plant ready for harvest at the same time.</p>
<p>8. Keep the nursery seedlings moist by light watering 2-3 times per day. Make sure the seedlings are not too wet or too dry, just moist. Check for and control pests and diseases, pick up and destroy affected leaves or seedlings.</p>	<p>Plants need water for growth but too much water rot the roots and base of the stems. This attract crop diseases.</p>
<p>9. Seedlings are ready to transplant when there are 3 fully open leaves (do not count the first round leaves)</p>	<p>If seedlings are planted too early they are weak with small root development, while old seedling can develop tangled roots restricting growth.</p>
<p>10. 2 days before transplanting reduce watering to 1 x per day and increase the light exposure</p>	<p>Helps adjust the seedling to life outside the nursery.</p>

SESSION 4: BASAL FERTILIZER AND COMPOST APPLICATION, MULCHING, TRANSPLANTING, DIRECT SEEDING, WATERING, TRELLISING, WEEDING AND THINNING

Duration: 90 Minutes

Objectives:

1. To know how to apply basal fertilizer and compost.
2. To know about mulching.
3. To know how to plant nursery seedlings and seeds directly into the field.
4. To know the water requirements for young plants.
5. To know different methods of trellising.
6. To know the importance of weeding.
7. To know the techniques for thinning.

4.1: Activity 1: Compost application

1. Brainstorm on how to apply basal fertilizer and compost. Write their ideas on a flip chart.

2. Show the participants how to make EM bokashi compost.

How many types of compost do you know?

Two main types are:

- i. Effective Micro-organism (EM) bokashi compost – takes 3 weeks to make.
- ii. Organic waste compost – takes 3-6 months to make.

4.1.1: Making EM bokashi compost

Steps in making Super EM Bokashi

Materials needed

Rice Husk	-	2 bags
Cow Manure	-	2 bags
Rice Bran	-	1 bag
Instant EM	-	1 Liter
Molasses	-	1 Liter
Water	-	40% moisture

Procedure:

1. Find a shady flood free site big enough for your bokashi making. You need to use at least 600 viss of compost for 1 acre.
2. Water the ground thoroughly and make it is wet before making the compost. Dry soil can suck the moisture out of the compost and it will not be successful.
3. Sprinkle the rice husk on the ground, then mix in the cow manure and bran.
4. Mix the EM and molasses together and pour it over the dry material and mix well.
5. Add water enough to wet the soil and make a ball to bring the moisture up to 40%.
6. Cover with black plastic or dark colored tarpaulin to prevent light from reaching the mixture. The micro-organisms do not like the light.
7. Bury the edges of the black plastic or tarpaulin to prevent air getting into the mixture because the micro-organisms work better without air.
8. Add some water every 10 days if the mixture is getting dry.
9. The bokashi should get hot while fermenting and have a grey/white color and sweet smell like beer when ready.
10. The bokashi should be ready after 3 weeks.
11. If you do not use the bokashi immediately, you can store it in bags in a dry cool place for up to 6 months.

4.1.2: How to make Organic Material Waste compost

What to use:

For a good result, include a mixture of old and tough materials ("brown materials") with young and juicy materials ("green materials"). You need about half "browns" and half "greens" by volume. You can adjust this ratio depending on the quantity and quality of the materials you have at hand.

Constructing the heap.

1. Make a base (2m x 2m) of sticks about 30 cm deep in the soil. This will ensure good air circulation and drainage.
2. The heap should be built on a raised soil bed to prevent flooding.
3. Make a heap of organic materials in a series of layers - each layer is about 6" - 10" thick.
4. The first layer should be with coarse and woody materials such as thin sticks or twigs. This will ensure good air circulation and drainage.
5. Add a layer of harder or difficult to compost materials ("browns"), such as rice straw, rice husks or leaves and stems of maize
6. Add animal manure (wet) to cover plant materials.
7. Add the "green" material that is easily composted, such as fresh grass, leaves, vegetables and fruit residues.
8. Ash and urine can then be lightly sprinkled onto these layers, to accelerate the process of decomposition.
9. Repeat all these layers except the first layer of coarse material, until the heap reaches a height of 1 to 1.5 m. The last layer is again green material.

4.2: Activity 2: Mulching

1. Brainstorm with participants – "What is the meaning of mulching?". Write down their ideas on a flip chart.
2. Brainstorm – "Why should the farmers use mulching?"
3. Ask: "What different types of mulching do they know?"

Mulching is the covering of soil with grass or other materials to prevent stress to the plant.



Question: Why should farmers use mulching?

1. To prevent rising of soil temperature that cause stress to the plant and reduce nutrient uptake.
2. To prevent water loss through evaporation.
3. To protect the soil from wind erosion.

4.3: Activity 3: Transplanting seedlings and direct seeding.

1. Transport the seedlings carefully to the field. Select only the healthy seedlings for planting.
2. Make a hole in the mulch and soil bed 2 inches wide and 2 inches deep. Space plant width of the adult plant. If you plant too close, you get thin weak plants and if too wide, weeds can grow fast thereby encroaching on plant nutrients and light.
3. Take the seedling from the pot by the crown of the plant without bending or pressing too hard. Drop the seedling into the hole and **cover the seedling media completely with soil ; do not press** the seedling against the soil and ***do not press*** the soil against the seedling media.

(Try to transplant seedlings after 3:30 pm to avoid dehydration.)

4.4: Activity 4: Trellising.

1. Brainstorm with participants on the question: “Why is trellising important for some crops?” and “Which crops are best suited for trellising?” Write their ideas on a flip chart.
2. Ask them about the different types of trellising they know. Write their ideas on a flip chart.
3. Split participants into groups and ask each group to discuss the advantages and disadvantages of one trellising method per group.

4.5: Activity 5: Weeding

1. Ask participants to **define and discuss the meaning of a weed**. Write their ideas on a flip chart.
2. Show on a flip chart the following answer: “A weed is a plant that is in the wrong place at the wrong time”. For example, a rice plant is a weed in a corn field; corn is a weed in a rice field etc.
3. Brainstorm “Why is weeding important?”

4.6: Activity 6: Thinning

1. Ask participants: “Why is thinning important?” Write their answers on a flip chart (5 minutes)
2. Explain to the participants for proper thinning base on crop and why thinning is important

SESSION 5: SEED SAVING AND SEED STORAGE

Duration: 30 Minutes

Objectives:

- 1- To understand the systemic saving of seeds in proper condition
- 2- To understand how to store the seeds for next season
- 3- To understand the difference between open pollinated seeds and hybrid F1 seeds

5.1: Activity 1: Seed saving

1. Ask the participants how they save the seeds for next season.
2. Ask participants about their experience in growing F1 hybrid seeds and if they saved the hybrid seeds.
3. Explain to the participants about the type of varieties that can be saved and how to save the seeds for future growing systematically.
4. Ask participants how they store the seeds. Write down their ideas on the flip chart.
5. Explain to the participants how seeds should be stored in a proper way.

5.1.1: Seed saving

Vegetable seeds can be saved for sowing in the future season, but not all seeds are suitable for saving. Varieties suitable for seed saving include local varieties that have been grown in one region for a very long time, self-pollinating crops (for example, beans and peas) and open-pollinated varieties of some cross pollinating crops (for example, pepper, cucumber and carrot).

Commercial F1 hybrid varieties are popular among several vegetable growers today. However, the seed of hybrid varieties should not be saved, because the F1 hybrid seed were produced by crossing two different parent varieties. Seed saved from hybrid will either be sterile or the plants of the next generation may show wide variation in the characters, uniformity and maturity.

Open pollinated or Cross Pollinated Plants	Hybrid Packet of Seeds
Open/cross pollinated seeds carry the characteristics of the parent plants, just like a baby carries the characteristics of the mother and father.	Produced in the laboratory by scientists. Farmers cannot produce these seeds with the same characteristics themselves. Need to buy new seeds each year.
Seeds can be kept each year but after 2-3 years their characteristics can differ widely from the parent plants.	If farmers kept hybrid seeds for the next year, the characteristics would not be the same. They would have low germination, low yield and low disease resistance. DO NOT KEEP HYBRID SEEDS FOR THE NEXT CROP.

Ask participants: What are the advantages and disadvantages of open/cross pollinated seed and hybrid seed?" Write their ideas on a flip chart.

	Advantages	Disadvantages
Open/Cross Pollinated seeds	<ol style="list-style-type: none">1. good tolerance/ resistance to local diseases .2. Farmers can produce their own seeds.	<ol style="list-style-type: none">1. Less tolerance/ resistance to imported diseases.2. Low production.
Hybrids seeds	<ol style="list-style-type: none">1. High production and high quality.	<ol style="list-style-type: none">1. Limited access to sellers and farmers have to pay.

	2. Highly resistant to most pests and diseases.	2. Farmers can't keep their own seeds for the next season.
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Seed saving involves selecting suitable plants from which to save seeds, harvesting seeds at the right time, and storing them properly. The seed saving techniques of many common vegetables will be introduced in this manual.

How do you keep seeds pure?. Keep in mind that natural cross pollination can always happen to some extent under a field situation, even in self-pollinating plants. It often occurs when pollen grain stick onto the bodies of insects visiting flowers, and then carry the pollen grains to the next flower they visit.

Isolation in distance : Pure seeds can be produced by leaving enough distance between two or more varieties to prevent cross -pollinating by insects or wind-blown pollen. How far apart among vegetables will be described for each vegetable in the following chapters.

Bagging: When only a small amount of seed is needed, cover the unopened flowers with a paper bag. This is applicable for crops with a high but not 100% rate of self-pollinating , such as pepper and egg-plant. You can also bag the flower of cucurbits, in this case , both male and female flower should be bagged, but hand pollinating is required.

Caging: Cages can be used for vegetables that flower over a long time or to prevent insects from transmitting pollen from two nearby varieties of the same crop. You can use bamboo rods stuck in the ground to make an arched tunnel and covered with nylon mesh. Since the cage will exclude all insects, you may need to hand pollinate the plants to ensure seed set, or you can introduce bees into the cage if they are cross-pollinated species.

5.2: Activity 2: Storage of seeds.

1- Explain how you store the seeds

What is the best way to store the seeds? After saving your seeds, it is important to keep them alive for future use. Newly harvested seeds should not be immediately stored in a plastic bag because the moisture content of the seed is still high and will lead to deterioration .

Before keeping seeds in the storage, seeds should be dried. Keep in mind that seeds are alive- but they breathe very slowly. To keep seed for a long time, keep them under low temperature and low humidity during storage.

Humidity: Seeds will absorb moisture from the storage environment. High humidity level cause seed to increase their respiration rate and use their stored energy. Make sure the seeds are dry enough (seed moisture content should be around 7-8%) before storage, and keep them in an air-tight container, such as a screw-top jar.

Darkness: Exposure to sunlight will shorten the life of seeds. Use dark-color jars or non-transparent containers to protect the seed from sun light. If using clear jars, place them in a paper bags to shield out sunlight.

Temperature: For most vegetable seeds, a temperature below 15 degree Celsius is ideal. You can keep the seeds in air- tight container and place the container in the refrigerator. For short term storage, keep the seeds in a cool and shady dry place.

Most vegetable seed can be safely stored for at least three to five years. Place the seeds in manila envelopes, cloth or mesh bags, plastic containers, or foil envelopes. The best containers are air-tight, such as a sealed glass jar, metal can, or foil envelope. Label each container carefully. Note the name of the line or variety, the year, and any other information you feel is valuable. Store seeds in a cool, dry place.



SESSION 6: PEST AND DISEASE CONTROL

Duration: 60 Minutes

Objectives:

1. To know the main types of pests and diseases in the target crops.
2. To know methods of insect and pest control.
3. To know the proper techniques for mixing and spraying chemical insecticides.

6.1: Activity 1: Insect, pest and disease control.

1. Write on a flip chart the following 5 methods of insect, pest, and disease control: (1) Prevention; (2) Companion planting; (3) Physical/mechanical control; (4) Organic pesticide application; (5) Chemical control (10 min).
2. Form 5 sub-groups, to discuss what they know with regard to one of the control measures per group. (5 min).
3. Invite group leaders to report to the plenary (15 minutes). Write their key ideas on a flip chart.(5 min).

6.1.2: Important note to Participants.

- 1) Use preventative and organic methods of control where possible. Only use chemicals as a last resort because chemicals are dangerous for farmer's health, can be dangerous for consumer's health, and they are also dangerous for the environment.(5 min).
- 2) Learn about the good insects (beneficiary insect) and the bad insects (Pest). Only kill the bad insects.(5 min).
- 3) Recognize the pests and diseases in the crops early and how to control them. (Pest and Disease Handbook)(30 min).

6.2.1: Prevention:

It is a good idea to reduce the chance of insect, pest and disease attack by:

- 1) Crop rotation;
- 2) Sterilizing the soil by burning rice husk on top.
- 3) Disease forms in wet conditions so have enough air ventilation to dry the vegetable leaves.
- 4) Sterilize seeds by treatment with EM or buy chemically treated seeds to protect the seeds from diseases.
- 5) Use disease resistant seeds and varieties.
- 6) Plant at a time of year when there is less disease.
- 7) Transplant only healthy seedlings so they are strong enough to fight diseases and pest attacks.
- 8) Protect plants from extremes: not too hot; not too wet and physical damage from animals.
- 9) Inspect your crops regularly to detect and control problems early, not when it is already too late.
- 10) Remove weeds as they can be hosts for pests and diseases.
- 11) Before sowing, flood the field to drown insects.
- 12) Leave a week between cultivations for the sun to dry the soil and kill some diseases.

6.2.2: Companion planting:

Some plants have natural substances in their roots and flowers that can repel or attract insects. They can also provide nutrients to the plants beside them. Open cupped flowering plants are most attractive to beneficial insects. Examples are; marigold (repellant), sunflower (attractant)

6.2.3: Physical/mechanical control:

In small gardens you can look around each plant and squash the bad insects between your fingers or cut off the disease affected part of the plant. Remember to leave the good insects. Remove and burn the disease affected plants. Also use light and water bucket insect traps.

6.2.4: Organic control:

In small gardens it is better to use only organic control. Some examples are: EM-5, neem extract, fermented plant juice, Fermented Fruit Juice, Tobacco and soap solution.

6.2.5: Chemical control:

Use only as a last resort when pest and disease levels are very high and other methods of control are not working. Remember that chemicals kill both good and bad insects, are dangerous to the environment and your family's health. The main steps for control are:

- 1) Identify the pest or disease and select the chemical suited to control that specific problem
- 2) Buy only as much chemical as you need. It is dangerous to store poisonous chemicals around the house.
- 3) Follow the instructions on the labels on the containers. If you put on too much it is a waste of money and bad for the environment, too little and it will be ineffective.
- 4) Use registered/permitted agro-chemicals only;
- 5) Expired or deteriorated chemicals should not be used;
- 6) Keep children and pregnant women away from agro-chemicals;
- 7) Use protective clothing when using agro-chemicals;
- 8) Wash your body and spraying equipment after chemical application;
- 9) Timely observation and action reduces the amount of agro-chemicals to be used;

- 10) Respect agro-chemical pre harvest interval (PHI);
- 11) Do not enter the crops immediately after applying chemicals;
- 12) Store small amounts of chemical in a sealed container away from children or animals, and larger amounts of chemicals in a separate, lockable, well ventilated shed with hazard warning signs;
- 13) Keep small amounts of chemicals in sealed containers well away from children and animals;
- 14) Store chemicals separately from fertilizers and other inputs;
- 15) Triple wash old chemical containers then make holes in them so no other person uses them;
- 16) Dispose of old containers in a deep hole or at an approved disposal site;

Safe use of chemicals

1. Invite participants to discuss health problems they may have experienced or heard of when using chemical applications on their vegetables
2. In small groups ask them to draw a picture and name the different types of protective gear they should wear to reduce the effect of chemicals on their health (hand out paper for this exercise)
3. Explain that idea of using chemicals is only when the pest/disease incidence has reached the economic threshold. That is, when the cost of spraying is less than the amount of damage. E.g.
4. Spend 20,000 MMK to save 100,000 MMK. That is, you are 80,000 MMK better off. If there are just a few plants infected you do not have to spray the whole crop. Just deal with the individual plants. This saves money, your health and the environment.



SESSION 7: VEGETABLE INTEGRATED PEST MANAGEMENT (IPM)

Duration: 30 Minutes

Objectives

1. To provide knowledge of IPM and to control pests and minimize usage of chemicals.
2. To be aware of organic pesticides to control pests and diseases for vegetables.

Activity

- Explain IPM methodology and how to differentiate beneficial insect from harmful insect
- show how to make organic pesticide or repellent using in-organic products.

7.1: Methodology of IPM

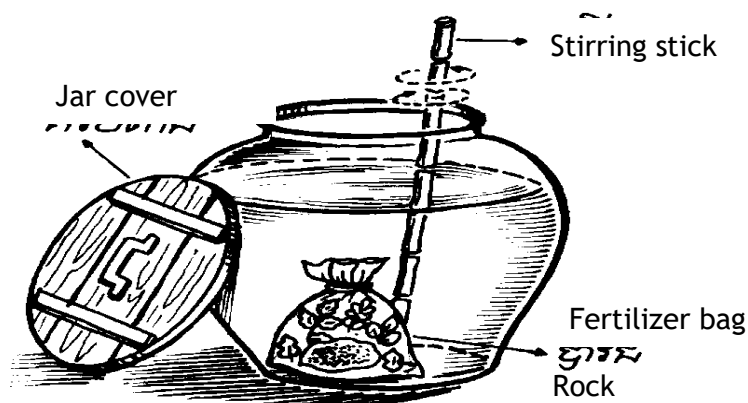
Integrated pest management (IPM) combines a host of practices that keep vegetable crops healthy while minimally impacting on human health, the environment, or profits. IPM requires a knowledge of the crops and associated pests so that general farm practices may be tailored to minimize them, and that control intervention, when necessary, will integrate the most appropriate methods. Growers successfully using IPM combine the following factors:

1. Knowledge of host plants and their associated weeds, pests, and beneficial organisms (including identification, biology, and life cycle).
2. Conduct day-to-day practices to minimize pest problems (such as crop rotation, resistant varieties, composting soil, promotion of beneficial predators, and sanitation).
3. Monitor for pests, symptoms, and beneficial organisms.
4. Chemical use only when pest thresholds are reached.
5. Integrate non-chemical control tactics (mechanical, cultural, biological controls).
6. Keep records of monitoring results.

7.2: Making EM Insect repellent/ foliar fertilizer

How to make organic pesticides

- Put 10 pounds of organic materials (kitchen waste, cow dung, chopped up plant material) and a heavy piece of rock in an open weave bag and put that bag at the bottom of a jar
- Pour 20 liters (or 5 gallons) of water into the jar.
- Cover the jar with a wooden lid to avoid eggs from houseflies and bad smells
- Stir the mixture in the jar twice a day for 2 months until it does not smell so bad
- Apply the pest disease control mixture every 4-5 days during the crop cycle. Dilute with water 1:20 for young plants and 2:20 for older plants



Effective Micro-organisms (EM) Use

- To speed up the fermentation process to only 3 weeks and have a good smell use the Effective Micro-organism (EM) approach
- Combine EM (500ml), molasses (500ml) and 10 pounds of freshly chopped up plant material mixed with 20lt (or 5 gallons) of water in a sealed container to ferment for only 3 weeks to make a liquid organic fertilizer and pest control product.

- Apply the EM pest disease control mixture every 4-5 days during the crop cycle. Dilute with water 1:100 for young plants and 1:20 for older plants

7.3: EM-5 Repellent

Concentrate Alcohol	- 100 Cc
Vinegar	- 100 Cc
Molasses	- 100 Cc
Concentrated EM	- 100 Cc
Water	- 600 Cc

- Put all materials in order in 1 Liter bottle and seal tightly from air.
- Keep it in dark, dry, cool place.
- Start to use as repellent after 2 weeks.
- The rate is 1:500-1:1000 (EM-5: Water) to apply.
- It is not pesticide, just only repellent.
- It can be used for 3 months.

SESSION 8: PRE AND POST-HARVEST CROP CARE

Duration: 60 Minutes

Objective:

1. To know the systematic handling of crop after harvest
2. To know how to maintain the crop for market
3. To reduce the damage or loss from transportation

8.1: Activity 1: Pre and Post-harvest crop care.

8.1.1: The meaning of Pre and Post- Harvest Crop Care.

- 1 Brainstorm with the group on the question: What does Pre and Post-harvest Crop Care mean? Ask participants to give examples. Write their answers on a flip chart. (5 mins)
- 2 Split participants into 6 sub-groups. **Group 1:** Quality Standards; **Group 2:** Harvesting; **Group 3:** Cleaning and Sorting; **Group 4:** Packing; **Group 5:** Transporting; **Group 6:** Storage. Ask them to discuss methods they know under their group heading. Ask the group leaders to write the groups' ideas on a flip chart. (15 minutes)
- 3 Invite group leaders to present their ideas, summarizing the main points on a flip chart. (10 mins)

8.1.2: Pre and post-harvest techniques.

8.1.2.1: Quality Standard

- Produce should meet the standards demanded by the market sellers (suppliers) and consumers. Find out what the standards are, and make sure your produce meet these standards.
- Pre harvest Interval (PHI). If you use chemical spray or animal manure, you should not harvest the crops until 1 or 2 weeks after your last application.
- Fertilizer (both chemical and organic) applications and timing should be kept for each crop.



8.1.2.2: Harvesting

- Quality cannot be improved after harvest. Produce must be harvested at optimum maturity.
- Handle crops carefully. Do not throw them or drop them.
- Harvest during cool morning or evening part of the day.
- Do not harvest in the afternoon.
- Cut stem a quarter inch up from the fruit.
- If wet or humid, dry produce in a shady place.



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8.1.2.3: Cleaning and sorting.

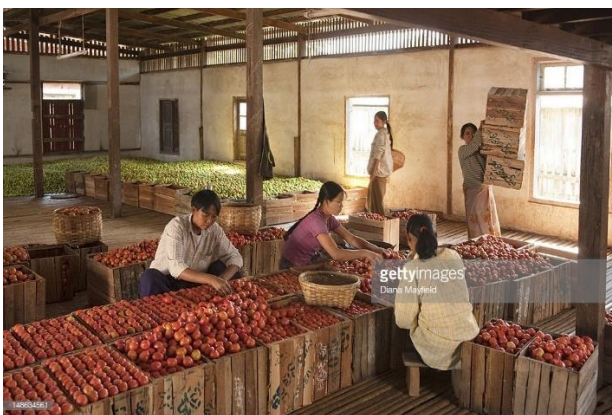
- Pickers should have clean hands free of disease.

- Do not pick and pack produce that has been on the ground. You have to clean it first.
- Spread produce on a flat clean surface to help heat to dissipate before packing.
- Remove leaves, long stems, flower, damaged or disease affected produce.
- Sort into grades according to market requirements.
- If washing produce, make sure it is dry before packaging.



8.1.2.4: Packing

- Put in well ventilated basket or crates using liners such as banana leaves or paper to protect the produce.
- Avoid over filling the crates or baskets and stacking on top of each other unless they fit exactly on top.
- Canvas and polypropylene sacks should be avoided as they restrict ventilation. Wide weave containers that let air circulate are better.



8.1.2.5: Transportation

- Vehicles should have a roof or cover over the produce.
- Vehicle should have separate shelves so produce is not stacked on top of each other.
- Transporters should handle produce carefully.
- Transport quickly after harvest in the cool parts of the day or at night.
- Produce should be kept separate from contaminants like fertilizer, pesticides, animals etc.



8.1.2.6: Storage.

- A wet cloth over a storage basket can reduce the temperature.



SESSION 9: VEGETABLE PRESERVATION

Duration: 30 Minutes

Objectives:

1. To learn the different method of preservation of vegetable
2. To provide knowledge how to maintain nutritional value in vegetable

Activity-

Discuss how vegetables can be preserved in different methods and how this can maintain the nutritional value.

9.1: Methods of preservation

9.1.1: Drying

Simplest processing method; commonly done by sun drying which is slow, weather-dependent and non-hygienic for being subject to microbial contamination and foreign debris.

Dried product is sealed in thick plastic bags (e.g. 100 micron thick polypropylene or polyethylene film) to minimize moisture absorption, and stored in a cool, dark and dry place.

9.1.2: Producing tomato paste

- Tomato paste is a concentrated product with minimum soluble solids of 24%. If refractometer is not available, the desired soluble solids can be determined through viscosity of paste, i.e. sticky on the teaspoon and flows slowly on the paper.
- Good tomato paste is free of seeds, skin residue and other solid parts of fruit, smooth, juicy, not too sticky, without off-color and off-odor.
- Deep red, big-fruited varieties are more desired to facilitate removing unneeded parts and obtain the desired red color.



9.1.3: Producing fermented leafy vegetable

- Fermented vegetable is produced through the action of lactic acid bacteria which convert sugar to acid in the product. It has enhanced nutritional value and improved digestibility.
- Fermentation technique for cabbage and Chinese mustard could yield >20% higher income than that for the fresh-market.



SESSION 10: ESTABLISH DEMONSTRATION PLOTS FOR FIVE COLOR VEGETABLES

Duration: 30 Minutes.

Objectives

1. To know the design for demo plot of 5 color vegetables.
2. To provide the crop management tips for 5 color crops distributed by the project.

Activity

- Show the design of demo plot and discuss with farmers how they can plan for plots
- Provide techniques and crop management tips of 5 color crops .

One vegetable from each group was selected and there were five varieties prioritize by communities to establish for demonstration plot.

Activity 10.1: Design and Site Layout plan for Demonstration plot.

The demonstration plot for five color vegetable growing include five raised beds on which each raised bed (20 ft x 3 ft x 1 ft) has one color vegetable that is nutritious with minerals. The vegetable varieties for five raised beds include; Pumpkin, Radish, Amaranth, Tomato and Eggplant.

Some crops can be grown in seed tray as the seedlings. After getting the seedlings, we have to transplant to beds which are ready to be covered with plastic sheet (Mulch). The aims of mulching is to control weeds, moisture, reduction in the cost of fertilizer, quality produce, reduction in soil compaction and root damage, soil erosion and salinity management. Due to the above benefits, we have to use these materials on each demonstration plot.

10.2: Example of Site Layout plan for Demonstration plot

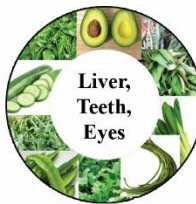
(Raised bed Demonstration plot)



SESSION 11: FIVE COLOR VEGETABLE GROUP

Duration: 60 Minutes.

The picture below shows nutrients and health benefits found in different color of vegetable groups and fruits.(10 min).



Green		<p>Helps keep eyes healthy. Helps keep bones and teeth strong. Helps keep liver healthy. Helps keep skin healthy.</p>
Yellow/Orange		<p>Helps boost immunity. Helps promote growth & development. Helps keep eyes healthy. Helps keep heart healthy.</p>
Red		<p>Helps keep heart healthy. Helps keep bladder healthy. Helps keep memory strong.</p>
White/Brown		<p>Helps keep bones healthy. Helps boost immunity. Helps keep heart healthy.</p>
Purple/Blue		<p>Helps keep brain healthy. Helps keep memory strong. Helps keep heart healthy.</p>

11.1: List of vegetables in five color groups

Table of five color vegetables

Green	Yellow or Orange	Red	White	Purple/ Blue
Long Bean	Pumpkin	Red Capsicum	Cauliflower	Egg plant
Water Spanich	Sweet potato	Tomato	Mushroom	Corn
Cucumber	Carrot	Onion	Wax gourd	Broccoli
Okra	Sweet paper	Roselle fruit	Taro	Cabbage
Mustard	Lemon	Water Melon	Raddish	Plum type
Roselle leaf	Melon	Beetroot	Bottle gourd	Yam (Dioscorea)
Amaranth	Pineapple		Garlic	Sweet Potato
Broccoli	Mango		Potato	
Pea	Corn			
Lime	Orange			
Green bean	Squash			
Cabbage	Grapefruit			
Chines cabbage				
Lettuce				
Green Capsi um				

11.2: Cultivation of Vegetable Crops

11.2.1: Amaranth

Amaranth is a popular leafy vegetable that can be grown throughout the year. The leaves and succulent stems are good sources of iron, calcium, vitamin A and vitamin C. Grain amaranth is a rich source of protein and essential amino acids like lysine, leucine and isoleucine.

Soil requirements Loose, fertile, moist, sandy loam soils are the best.

Preparation of land & Sowing .

- Prepare the land by ploughing or digging followed by levelling.
- Divide the raised bed into three parts.
- Make shallow trenches 30-35 cm wide and, 30 cm apart. Mix well rotten manure with the soil in the trenches.
- Sow the seeds in the first part and cover with a thin layer of soil. Since seeds are very small, mix some dry sand with the seed before sowing to get uniform distribution along the row.
- After 7-10 days, sow in the second part and do the same with the third part 7-10 days later.

- Staggered sowing results in continuous harvesting and regular consumption. Harvesting can start within 25 to 30 days after sowing. Either clip off full grown side leaves or cut the top of the plant to encourage side branching and more leaves.

Water management: The first irrigation is given immediately after sowing. Avoid rapid water flow to prevent washing out the seeds. Irrigate daily unless there are rainy days.

Weed management : Give 4-5 surface digging depending on weed growth. Avoid deep digging. Do not disturb the soil after plants start producing large amount of leaves.

Harvesting: Good yields are possible by cutting the top portion of the plant, and 4-6 cuttings can be enough.

11.2.2: Pumpkin

Pumpkin is an annual warm season crop with branched tendrils. It grows well in loam and sandy loam soils with good drainage. Seeds germinate quickly when temperatures are 25-30°C. Plants require full sunlight. Pumpkin is tolerant to brief drought. However, it is sensitive to frost and not tolerant to wet conditions. Pumpkin is very nutritious including its leaves and seeds which are rich in zinc.

Cultivation instructions

Soak seeds in water for 5-10 hours, wash clean, and cover with a wet towel or napkin in 25-30°C to hasten germination. Fill seedling trays with a medium that drains well, such as peat moss, commercial potting soil, or a potting mix prepared from soil, compost, rice hulls, vermiculite, peat moss and sand. Sow the germinated seeds 2.5 cm deep in the seedling tray. Seedling trays should be placed on benches (avoid touching the ground to prevent infection by soil-borne diseases and vulnerability to flooding). Use 50-60 mesh netting to enclose the nursery, to exclude insect pests.

Transplant the disease-free and strong seedlings when they have 3-4 true leaves into raised beds, which should be prepared with a mixture of compost and NPK fertilizers. Rows should be 2.4-3 m apart, with 1.2-1.5m between plants within rows. Irrigate plants moderately and let them creep on the ground. Apply NPK fertilizer during the growth (3 and 6 weeks after transplanting) and harvesting periods (every 2-3 weeks).

11.2.3: Tomato

Tomatoes grow best under temperatures of 20-27°C. Fruit setting is poor when average temperatures exceed 30°C or fall below 10°C. Tomatoes prefer a well-drained soil because they are sensitive to waterlogging. Tomatoes benefit from crop rotation. Growing tomato after paddy rice reduces the incidence of diseases and nematodes. Avoid planting tomato in a field planted the previous season with tomato, pepper, eggplant, or other solanaceous crops. These crops share some insect pest and disease problems.

Cultivation instruction

Fill the holes of seedling trays with a medium that drains well, such as peat moss, commercial potting soil, or a potting mix prepared from soil, compost, rice hulls, vermiculite, peat moss and sand. Sow 2 seeds per hole and thin the seedlings 2-3 days after the first true leaves appear. Seedling trays should be placed on benches (avoid touching the ground to prevent infection by soilborne diseases and

vulnerability to flooding). Use 50-60 mesh netting to enclose the nursery, to exclude whiteflies and other insect pests.

Transplant vigorous, stocky seedlings when they reach 4- or 5-leaf stage. The seedlings should be thoroughly watered 12-14 hours before transplanting. Transplant the disease-free and strong seedlings into raised beds, which should be prepared with a mixture of compost and NPK fertilizers. Insert the seedling into a hole so the cotyledons appear above the surface. Press soil firmly around the roots, and water around the base of the plant to settle the soil. Recommended plant spacing is 40 cm apart. Irrigate the field as soon as possible after transplanting. Plants should be staked two to three weeks after transplanting. Indeterminate tomatoes should be pruned to allow two main stems to develop. Apply NPK fertilizer during the growth (3 and 6 weeks after transplanting) and harvesting periods (every 2-3 weeks).

11.2.4: Radish

Radish (*Raphanus sativus*) is a member of the cabbage family and grown worldwide. The harvested roots, prized for their pungent taste, come in a wide variety of colors, shapes and sizes. There are two major types. First, there are the biennials of temperate origin that require a cold period for flowering. These include the Japanese, American and European radishes. Second, there are radishes of tropical origin that do not require a cold period for flowering.

Radish grows best in a cool dry climate. Temperatures above 32 °C cause the stigma to drop and the pollen may fail to germinate.

11.2.5: Egg-plant

Eggplant (*Solanum melongena* L.), is a popular vegetable crop grown in the sub-tropics and tropics. It is called brinjal in India and aubergine in Europe.

Climate and soil requirement

Climate: A long growing season of about 120 days is required for successful production. Eggplant is a warm weather plant that grows best under temperatures of 21 ° to 29 °C. It cannot tolerate frost, and the growth of young plants will be retarded if night temperatures are below 16°C. Cool temperatures and cloudiness can reduce fruit set. Eggplant can tolerate drought and excessive rainfall, but struggles to grow when temperatures exceed 30°C. When temperatures and humidity is high, eggplant becomes more vegetative.

Soil: Eggplant prefers a soil that is deep, fertile, well drained, high in organic matter, and has a pH of 5.5 to 6.8. A sandy loam soil is ideal when an early yield is desired. Heavy clay and saturated soils should be avoided due to the build-up of root-rotting diseases.

Selecting a variety

The fruits of eggplant come in a wide array of shapes and colors . Select a variety that is most suitable to your market. Other desirable characteristics for varieties include high productivity, resistance to diseases, early maturity, strong growth habit, and tolerance to heat.

Seedling production: Transplants are usually used to establish a uniform and complete stand of plants. Transplants grown in cells or containers are ideal because they allow field planting without disturbing the root system. Plug trays or containers are filled with a sowing medium such as peat moss, commercial potting soil, or a potting mix prepared from a combination of soil, compost, rice hulls, vermiculite, peat moss and sand. Sterilize the soil mixture by autoclaving or baking at 150 °C for 2 hours.

Transplanting: The ideal transplant is a seedling with three to four true leaves, stocky and disease-free, and without flower buds (Fig. 4). Begin hardening plants six to nine days before transplanting to reduce transplanting shock. Slightly withhold water. Expose seedlings to stronger sunlight by removing the netting. Thoroughly water seedlings 12 to 14 hours before transplanting to the field. Transplanting should be done in the late afternoon or on a cloudy day in order to minimize transplanting shock. Transplant seedlings by digging a hole deep enough to bury a plant so that its first true leaf is just above the soil surface. Press the soil firmly around the root. Irrigate furrows immediately after transplanting. Transplanting can be done manually or by machine (Fig. 5). If transplanting is done by machine, the plug seedling trays must be compatible with the transplanter. The field should be irrigated immediately after transplanting to establish a good root-to soil contact.

Fertilization: Adequate application of manures and fertilizers is very important for successful crop production. Being a long duration crop, eggplant requires a large quantity of fertilizers. Fertilizer rates depend on the soil's fertility, organic matter content, and texture

Mulching: Mulching is recommended to reduce weeds, prevent soil compaction, and conserve soil moisture. Plastic mulch must be laid before transplanting

Irrigation : Irrigation is essential for eggplant cultivation wherever little or no rain is available during the growing season. Irrigation is most critical during the time of flowering and fruit set. A lack of water during this period could lead to the development of blossom and malformed fruit. Reduction of fruit size and yield are also caused by moisture stress.

Weed control : Eggplant is slow to become established and cannot compete with aggressive weeds. Weeds also harbor damaging insects and diseases

Harvesting: Eggplant fruits are harvested once they have reached sufficient size for marketing (usually three to four weeks after flowering). Harvesting is done by hand using a sharp knife or clippers, leaving the calyx attached to the fruit. Harvest once or twice a week.

SESSION 12: NUTRITION

Duration: 60 Minutes.

Objective:

1. To Provide nutritional knowledge to mother groups.
2. To provide knowledge on how nutrition is important to human health.

Activity

- Provide knowledge of how important the nutrition in our body
- Provide knowledge on 5 color for vegetables, fruits and its nutritional value

Activity 12.1: Why is nutrition important?

There are many different types of nutrients, and these different nutrients are found in different foods. We often group foods into separate categories based on the kinds of nutrients that they contain. **There are six main food groups:**

Carbohydrates and fats – energy-giving foods.

Staples	Grains such as rice, wheat, maize, sorghum, teff and products made from grains for example breads; roots and tubers; green bananas
Fats and oils	Butter, cooking oil, coconut oil, sesame oil, nuts such as groundnuts and nut oils, mustard oil, avocado.

Micronutrients – protective foods.

Vegetable	Dark-green, leafy vegetables like kale, spinach, amaranth leaves, cowpea leaves, pumpkin leaves, Swiss chard; other vegetables like tomato, pumpkin, squash, sweet/ hot pepper, onion, carrot, beet root, fresh/ vegetable beans and peas and lettuce.
Fruits	Dark-orange or yellow fruits such as mango and papaya; orange, lemon, banana, guava, passion fruit and peach.

Proteins – body-building foods.

Legumes and nuts	All types of beans, chickpea, cowpea, nuts and seeds.
Animal source foods	Eggs, beef, goat, sheep, chicken, fish, milk, cheese, whey & breastmilk.

12.2: What are the recommended foods to eat?

There is no one single food that is complete and best. In fact, we need to eat from every food group, including a variety of foods throughout the week, in order to get all the types of nutrients that our bodies need.

Our food should be safe: free from all diseases or germs transferred from our hands to the food during harvesting or preparation; or through use of toxic water to irrigate vegetables or use of human feces to fertilize land.

12.3: A good meal should contain:

- A staple food
- Foods that may be made into sauce, stew or relish. These should include:
 - a) legumes and/or foods from animals;
 - b) at least one vegetable;
 - c) some fat or oil (but not too much) to increase the energy and improve taste.
- Fruits eaten with a meal or as a snack
- Plenty of clean water during the day

Avoid drinking black tea or coffee until 1-2 hours after a meal (when food will have left the stomach) as these reduce the absorption of iron from food.

12.4: How can we increase variety in the diet? Encourage families to use:

- Have several food groups at each meal;
- Different vegetables and fruits at different meals because different vegetables and fruits contain varying amounts of the different micronutrients.
- Either legumes or – if possible – meat, poultry, offal or fish daily because these foods are the best sources of iron and zinc (which are often lacking in diets, especially the diets of young children and women).

The foods listed above can provide adequate amounts of all necessary nutrients if consumed based on individual size, age, conditions (pregnant, lactating, sick), and level of activity. While the specific amount of food of these different groups needs to be adapted to each individual, it is important that everyone, regardless of age, eat from all six food groups every day: starchy staples; vegetables; fruits; legumes and nuts; animal source foods; fats and oils. The exception is infants 0-6 months who receive all the nutrients and calories they need from exclusively breastfeeding (no other food or liquid by mouth).

12.5: Nutrition information on local vegetables and fruits.

Which nutrients can be found in vegetables and fruits?

Vegetables and fruits are in general rich in so-called micronutrients, namely vitamins and some minerals.

- Orange colored vegetables and fruits such as carrot, pumpkin, squash, mango and papaya contain beta-carotene (**vitamin A**) which prevents infection and keeps the immune system working properly. It keeps the skin, eyes and lining of the gut and lungs healthy and is needed to see in dim light.
- A good source of **vitamin C** that enhances immunity and prevents diseases is citrus fruits such as oranges and lemons but also kales and sweet pepper. Vitamin C aids the absorption of some forms of iron, destroys harmful molecules (free radicals) in the body and helps to heal wounds.
- Green leafy vegetables are also a good source of **folic acid** which is important to make healthy red blood cells and to prevent abnormalities in the foetus.
- Dark green leafy vegetables contain **iron** which helps in blood formation, namely to make hemoglobin, the protein in red blood cells that carries oxygen to the tissues, to enable the muscles and brain to work properly.

12.6: How can we retain nutrients in the food?

The way we store, prepare and cook our food affects the nutrients in it. For example, some vitamin C and folic acid are lost during cooking. Ways to reduce nutrient losses are:

- Buying or picking vegetables and fruits on the day you use them and storing them in a cool place.
- Cleaning and cutting vegetables and fresh starchy roots immediately before cooking.
- Cooking vegetables in little water or with a stew until just tender; other cooking methods for vegetables that preserve nutrients are stir frying (i.e. frying very quickly over high heat), or sautéing (i.e. cooking in fat or oil in a pan or on a griddle).
- Eating food soon after cooking.

- We absorb the vitamin A in plant foods better when the food is cooked (but not overcooked) and eaten with fat.
- When drying leafy vegetables this should be done under shade, e.g. in a solar drier. Through open sun-drying more carotenes (vitamin A) will be lost.

MODULE 2: NUTRITION PLANTS GROWING

SESSION 1: SPECIAL NUTRIENT PLANTS

Duration: 90 Minutes.

Objectives

1. to provide the other nutritional plants that good for health
2. to provide crop management tips for cultivating the plants

Activity.

- Explain nutritional value of the crops which can be grown easily in communities
- provide the management tips and how to grow successfully of plants in community.

Activity 1.1: Myanmar Name- **Sue Poke**

Scientific Name- (*Acacia pennata*)



Origin: Origin of Sue Poke has not been recorded yet. This plant is found in widespread of Myanmar.

Varieties: There are two varieties- **1**-Small variety and **2**- Large variety

Climatic and Soil Condition :It can thrive in every climate in Myanmar (hilly or low land). It cannot grow well in waterlogged and swamp areas and it dislike silty and clayey soils. It prefers thick top soil layer of a little lateritic, sandy and sandy base. The soil must be well drained.

Land Preparation: Land must be ploughed, harrowed and leveled after rain starts. Rows must be prepared in 40 ft interval.

Planting System: Pits should be about 8 inch depth and 4-6 inch wide on the rows. Pit by pit spacing is 6 ft. Pits are partially filled with compost by mixing natural fertilizer and top soil. Seedlings must be planted in 4 inch depth in prepared soil of pit with upright position for seedlings. Soil must be pressed with hand at the base of plant so as to reduce the moisture.

Fertilizer Application: 1 kg of manure must be applied for one plant and watered enough. After 10 day of transplanting, manure application must be added in November and December.

Care and Management Technique: Shoots emerge after 6 month transplantation in the field. If the shoot become 1 ft length, topping practice must be practiced. The new shoot should be harvested by cutting with one leaf left so that new shoots sprout again. It dislikes heavy topping as soap pod(*Acacia concinna*). If heavy topping, the plant can die. Nevertheless dry and injured branches must be pruned.

Propagation: There are two kinds of propagation methods; 1. Propagation by seed and 2. Propagation by layering. Layering should be done in the month of September. After one month later, layering plant is cut and transplanted to the field. One year old branch with the size of pencil should be selected for layering.

Harvesting and Yield: After 6 months planting, tender shoots can be harvested. It is important to leave one leaf for the next new shoot to grow. Harvesting must be done in a three day interval. 20 year old plants should be replaced and planted again because old plants give lower yields. 400 - 500 Bundles of shoots can be harvested in one time in new planted field of one acre. One bundle contains 2-3 shoots. One batch harvest can yield about 1000- 1500 bundles within a month from February to June. One batch harvest can yield about 1000- 1500 bundles within a month from September to November. July and August are resting periods for next harvest. One batch of harvest for one acre in second year can yield up to 2000 - 3000 bundles. And one batch harvest for one acre can be up to 5000 bundles in third year and next years.

Nutrient component: Vitamine A, B, C, Calcium, Iron, Fibre and Phosphorus.

Health benefit: fever, digestive trouble, and Asthma or Bronchial

1.2: Myanmar Name- **Danthulun**

English Name- Drum Stick

Scientific name-(*Moringa oleifera*)



Introduction

Moringa is a fast-growing tree and tolerates a wide range of environmental conditions. It grows best between 25 to 35°C, but will tolerate up to 48°C in the shade and can survive a light frost. Moringa prefers a well-drained sandy loam or loam soil with full sunlight. Avoid clay soils that become sticky when wet and very hard when dry. Moringa will not survive under prolonged flooding and poor drainage.

Cultivation instructions: Dig a planting pit about 50 cm deep and wide. Compost or manure at the rate of 5 kg per pit can be mixed with top soil before planting seeds. Sow one or two moringa seeds per pit at a depth of 2 cm. The seeds germinate 5-12 days after planting. If two seeds germinate, remove the weaker seedling after they reach about 30 cm. For leaf, pod and seed production, space plants 3-5 m apart. For intensive production of leaves, space plants 10-20 cm within rows 30-50 cm apart.

Moringa grows well in most soils without adding fertilizer. However, for optimum growth and yields, fertilization is recommended at planting time and at least once a year before the rainy season. Dig trenches around the base of the plant (10-20 cm from the base) and apply approximately 300 g of a commercial nitrogen fertilizer per tree, or compost or well decomposed farmyard manure at the rate of 1-2 kg/tree.

For optimal growth, it is advisable to irrigate regularly during the first 3 months after seeding. Once established, moringa rarely needs watering unless persistent wilting is evident. To encourage the development of many branches and pods within easy reach from the ground, prune the apical growing shoot when the tree is 1-2 m high. Thereafter, cut the growing tips of the branches so that the tree will become bushier.

Leaves can be harvested after plants grow 1.5-2m tall, which usually take at least one year. Harvest leaves by snapping leaf stems from branches. Harvesting young shoot tips will promote development of side branches. For making leaf sauces, harvest seedlings, growing tips or young leaves. Older leaves can be stripped from the tough and wiry stems and are more suited for making dried leaf powder.

Moringa trees will flower and fruit annually and in some regions twice annually. Harvest pods when they are young, tender and green, about 1 cm in diameter. Older pods are fibrous and develop a tough shell, but their pulp and immature seeds remain edible until shortly before the ripening process begins. Moringa seeds have no dormancy period, so they can be planted as soon as they are mature and they will retain the ability to germinate for up to one year.

Nutrition and cooking:

Moringa leaves are a good source of proteins, calcium, iron, potassium, and vitamins A, C and E; pods are rich in phosphorous. Leaves can be eaten as salad greens, cooked, or combined with staples such as rice or wheat, pickled or added to curries and soups. Dried leaves can be rubbed into a powder and added to soups or porridge. Young pods can be boiled, steamed, fried or shelled; the immature seeds can be used like peas or fresh beans. Mature seeds can be fried or roasted. Fresh or dried flowers are used for making teas

1.3: Myanmar Name – Hin nu nwe

English Name- Amaranth

Scientific Name-(*Amarantus gargeticus*)

**In which environment does amaranth grow best?**

- Amaranth requires full sun or partial sun and high temperatures and will not perform well at temperatures below 15-18°C.
- The preferred soil type is well-drained sandy/ clayey loam or clay.
- It tolerates drought although during the dry season it needs irrigation about once a week. Without irrigation it starts flowering and stops leaf production.
- It is sensitive to frost, salinity and flooding.

How is amaranth cultivated?

- Grown throughout the year by either directly sowing in beds at a depth of 0.51.0cm in rows 20-30cm apart, or by broadcasting. Note that spacing under shade needs to be wider.

- Thinning is done after 3 weeks when plants have 3-4 true leaves, so that spacing is 20-30cm between rows and 10-15cm from plant-to-plant within rows.

Note- that all plants removed through thinning can already be used as a vegetable!

How is amaranth propagated?

- For seed production, the recommended spacing is 60 cm between rows and 25 cm between plants.
- Cut inflorescence before shattering. To determine if the seed is able to be harvested gently shake or rub the flower heads between your hands to see if the seeds fall readily.

How and when is amaranth harvested?

- Harvesting of leaves is usually done within 35 weeks of sowing, depending on the variety and crop management.
- Once-over: uproot or cut off at ground surface.
- Repeated: cut 50% of foliage and tender stem every 1-2 weeks at 15-20 cm above ground surface until flowering.

What are typical nutritional characteristics of amaranth?

- The leaves are high in iron and vitamin C and medium rich in folic acid and beta-carotene (vitamin A).
- The seed contains 12-15% crude protein and 5-8% oil; seeds are rich in iron and calcium.

1.4: Myanmar Name – Kyet Thahin Ywet

Scientific Name -*Souropus androgynous*



Nutrient components

- Protein
- carbohydrate
- fibre
- Potassium, Calcium, Phosphorus, Iron

- vitamin A, B, C

Health Benefit

- Improve the flow of breast milk for breastfeeding mothers.
- Prevent eye disease
- Improve cell growth, immune system, reproduction, and maintaining healthy skin.
- Supports blood pressure, cardiovascular health, bone strength, and muscle strength.
- Prevention from Anaemia.

1.5: Myanmar Name –Pauk Pan Phyu

Scientific name – *Sesbania grandiflora*



Agricultural Aspect

- fast growing tree.
- tree thrives under full exposure to sunshine.
- is extremely frost sensitive.
- easily propagated by seeds or cuttings.

Nutrient Components

- Iron
- Phosphorus
- Vitamin B1, B2, B9
- Vitamin C
- Selenium
- Amino acids

Health Benefits

- Low blood pressure and help keep arteries flexible

- Support normal fetal development
- Beneficial for skin
- Boosts immunity
- Prevent Alzheimer's disease and migraine and weakness

1.6: Myanmar Name –**Gun Pei**

Scientific Name – ***Besella alba***



Agricultural Aspect

- Adapted to summer, winter and rainy season.
- Easy for propagation by cutting or seeds.
- Grow in poor soil.
- Quick rapid productive growth.
- high yield of green leaves and shoots.

Nutrient Contents

- Iron, Sodium, Magnesium, Calcium, Potassium
- Protein
- Vitamin A, C, D
- Vitamin B-6
- Vitamin B-12

Health Benefits

- body's fluid balance
- helps send nerve impulses, bone and affects muscle function
- good for recovery of diarrhoea

SESSION 2: COMPOST AND MANURE

Duration: 90 Minutes.

Objective

1. to gain the knowledge of how to make organic compost
2. to provide knowledge of organic composting and benefit for environment and human health by using organic

Activity

- Ask farmers how do they make and use compost in their farm and how many methods do they know
- Explain to farmers how to make compost systematically and if possible show the in practical methods

Application and incorporation of compost or manure to soils will increase soil organic matter and certain soil nutrient levels. Both compost and manures are widely used in crop production but differ in how they are used . Composting is when plant tissue or animal waste is broken down into organic matter through heat and microbial action. Composting reduces bulk, stabilizes soluble nutrients, and hastens the formation of humus. Most organic materials (manures, crop residues, leaves, sawdust, etc.) can be composted. Finished composts provide relatively low amounts of readily available nutrients. They vary in their nutrient content depending on the original source of material. Even though most composts don't supply large amounts of nutrients, they help improve soil fertility by increasing OM and by slowly releasing nutrients. Compost should be tested for nutrient content and for organic certification purposes. Manure can supply the nutrients required by crops and replenish nutrients removed from soil during harvest. Since manure contains multiple nutrients, applications should consider not only what is needed for the crop, but also how the ratio of nutrients in manure could affect soil test levels. This ensures adequate nutrient supply and reduces potential for over- or under-application and subsequent buildup or depletion of selected nutrients in the soil. Good manure nutrient management should consider short- and long-term impact on crop nutrient supply and soil resources

2.1: Bokashi Compost (See Module -1)

2.2: Fish Amino Acid

Making Fish Amino Acid (FAA)

2.2.1: What Is FAA?

Fish emulsions have been documented to promote seedling growth , fruiting , and microbe action in the soil . One such emulsion, fish amino acid (FAA), is produced by fermenting fresh fish by-products (bones, head, skin, and other tankage parts) with brown sugar. FAA is used in conjunction with other Natural Farming inputs and applied as either a light foliar mist or a soil drench to maximize uptake and minimize runoff or leaching, providing just enough N to the plant for optimum uptake and the production of chlorophyll to maintain plant health.

2.2.2: How is FAA made?

- 1) Collect fish waste (head, bones, skin, fins, viscera) from deep sea, blue-back fish etc.
- 2) Weigh the fish waste and mix with an equal amount of brown sugar (1:1 ratio by weight) .
- 3) Select a fermentation container (clay jar, plastic cooler) .

- 4) Place a layer of the fish by-product and brown sugar(Molasses) mixture and cover with more brown sugar(Molasses). Continue with alternating layers of the fish by-product mixture and more brown sugar until the container is nearly full , ending with a layer of brown sugar(Molasses). Do not leave any fish exposed.
- 5) Add a needed amount of concentrated EM to accelerate the fermentation process .
- 6) Cover the container with a breathable cloth to keep out insects but allow aeration, and store out of direct sunlight in a cool, well-ventilated location secured from animals.
- 7) After approximately 3 to 5 days, the fish waste will begin to break down and liquefy through fermentation and the osmotic pressure generated by the addition of brown sugar(Molasses). However, the process takes 2 to 6 months to complete, producing mature FAA that is ready to use. FAA, when completely fermented, will have a sweet, slightly fishy odor.
- 8) Decant or pour off only the liquid portion from the fermentation container to use as FAA. The remaining solids can be placed in a compost pile

2.2.3: How Is FAA Used?

- FAA is applied as a source of nitrogen during the early or vegetative stage of development to boost growth and size. Do not apply FAA if plants are at the reproductive stages of their production cycle when flowering or fruiting is desired. FAA is diluted with water (1:1,000) or used in a “cocktail” with other Natural Farming inputs(EM-5, Neem insecticide) and applied as a light foliar spray or soil drench. For leafy vegetables, spray weekly to improve yields, fragrance, and taste . Avoid spray applications during full sunlight hours to prevent foliar burning and evaporation of the solution before the plant has had a chance to absorb it.

2.3: Vermicompost

Vermicomposting is a method of preparing enriched compost with the use of earthworms. It is one of the easiest methods to recycle agricultural wastes and to produce quality compost. Earthworms consume biomass and excrete it in a digested form called worm casts. Worm casts are popularly called as Black gold. The casts are rich in nutrients, growth promoting substances, beneficial soil micro flora and having properties of inhibiting pathogenic microbes.

Vermicompost is stable, fine granular organic manure, which enriches soil quality by improving its physicochemical and biological properties. It is highly useful in raising seedlings and for crop production. Vermicompost is becoming popular as a major component of organic farming system.

There are different species of earthworms viz. *Eisenia foetida* (Red earthworm), *Eudrilus eugeniae* (night crawler), *Perionyx excavatus* etc. Red earthworm is preferred because of its high multiplication rate and thereby converts the organic matter into vermicompost within 45-50 days. Since it is a surface feeder it converts organic materials into vermicompost from top.

2.3.1: Types of vermicomposting

The types of vermicomposting depend upon the amount of production and composting structures. Small-scale vermicomposting is done to meet the personal requirement and farmer can harvest 5-10 tons of vermicompost annually. While, large-scale vermicomposting is done at commercial scale by recycling large quantity of organic waste with the production of more than 50 – 100 tons annually

2.3.2: Methods of vermicomposting

Vermicomposting is done by various methods, among them bed and pit methods are more common.

Bed method : Composting is done on the pucca / kachcha floor by making bed (6x2x2 feet size) of organic mixture. This method is easy to maintain and to practice.

Pit method: Composting is done in the cemented pits of size 5x5x3 feet. The unit is covered with thatch grass or any other locally available materials. This method is not preferred due to poor aeration, water logging at bottom, and more cost of production.

2.3.3: Process of vermicomposting

Following steps are followed for vermicompost preparation .

- Vermicomposting unit should be in a cool, moist and shady site.
- Cow dung and chopped dried leafy materials are mixed in the proportion of 3:1 and are kept for partial decomposition for 15 – 20 days.
- A layer of 15-20 cm of chopped dried leaves/grasses should be kept as bedding material at the bottom of the bed.
- Beds of partially decomposed material of size 6x2x2 feet should be made .
- Each bed should contain 1.5-2.0 ft of raw material and the number of beds can be increased as per raw material availability and requirement.
- Red earthworm (1500-2000) should be released on the upper layer of bed .
- Water should be sprinkled with can immediately after the release of worms.
- Beds should be kept moist by sprinkling of water (daily) and by covering with gunny bags/polythene.
- Bed should be turned once after 30 days for maintaining aeration and for proper decomposition.
- Compost gets ready in 45-50 days .
- The finished product is 3/4th of the raw materials used.

2.3.4: Harvesting:

When raw material is completely decomposed it appears black and granular. Watering should be stopped as compost gets ready. The compost should be kept over a heap of partially decomposed cow dung so that earthworms could migrate to cow dung from compost . After two days compost can be separated and sieved for use. (Note – show practical work on the process of compost making).

MODULE 3 : INNOVATIVE GARDENING

Objectives

1. To understand the different idea of gardening
2. To understand how can the farmers use these idea base on the environment and locally available material to overcome the constraints such as flood, shortage of water.

Activity

- Discussion of different design of gardening and how farmers can use depend on the situation they want to overcome.
- Show practical ways of doing the design if they interested.

The demonstration plot design will be many kinds depending on seasons as well as crops will be changed in demo plots. Depending on the season and weather condition, demo plot design will be green-house, table-garden, container garden and raised bed in the field. Some of the innovative gardening ideas are as below.

Objectives

1. To provide knowledge for different technique of gardening
2. To grow home garden in adapting with situation (flood, heavy rain, limited space etc)

SESSION 1: TABLE GARDEN

Duration: 90 Minutes.



Table garden can be made of bamboo and locally available material. The garden is design for growing crops in high bed and seed tray or other container can be place on top. Lettuce, water green, celery, corianders and other short variety of vegetable can be grown in top. The benefit of the design is good for flood area in monsoon.

(Show practical work including establish seedling in plastic tray)

SESSION 2: SACK AND POLYTHENE BAG GARDEN

Duration: 90 Minutes.



These can be made in various sizes by doubling or tripling polythene or sack layers. To make a bigger sack garden, one can sew different sacks together horizontally and at the edges. Plants can be planted on the sides of the sack. Good soil fertility and drainage should also be ensured.

The materials needed for sack and polythene gardening include:

- Stones (Small to medium sized)
- Sacks and polythene
- Manure or organic compost mixed with top soil
- A round container (about 9-12 inches in diameter) with the top and bottom cut out
- A knife
- A shovel
- Seedlings ready for planting
- A watering can

Steps to follow for sack/polythene gardening

- 1) Place the sack/polythene on an even ground and put a small layer of soil (about 4 inches) at its bottom.
- 2) On top of the soil, insert the round container (with the bottom and top cut out), just in the center of the sack/polythene. In case you are using a smaller sack/polythene, use a 9 inch diameter container. If the size is bigger, for instance when two or more sacks have been sewn together, use a larger container e.g. 12 inch diameter or more.
- 3) Fill the container with stones up to its brim. The stones are meant for drainage and water distribution in the sack/polythene.
- 4) Shovel the soil around the container that you have filled with gravel. When the soil reaches the top of the container, lift the container up slowly, leaving the stones in the center, to create more space for adding gravel. Add more stones in the container. Add more soil around the container.
- 5) Repeat the same process until the sack/polythene is full. Your sack should have the center comprised of gravel/stones only.
- 6) Plant crops on your sack. For instance, you could plant four crops at the top and about eight crops on the side of a sack measuring 2 feet high. Water the crops immediately after planting them.
- 7) Cover the top of the sack with grass to retain water in the sack.

Follow steps 1-7 to make as many bags as you need in your sack garden. Space your sacks in the garden for easy movement when watering your garden. That space also allows the crops on the sides to get enough light for healthy growth.

Always water your sack garden every morning before 9:00am and every evening after 5:00 pm. Pour water through the stones in each sack. You can also pour water on the sides of each sack around the plants.

(Show practical work with plastic or polythene bag)

SESSION 3: CONTAINER AND BOX GARDEN

Duration: 90 Minutes.



Various containers can support vegetable growth e.g. buckets, wooden boxes, pots, jerry cans, plastic bottles and woven baskets. They can be of different shapes and sizes depending on one's preference and the space available.

The materials needed for container and box gardening include

- Any container that can support vegetable growth i.e. can allow at least 25cm depth of soil- for the root system.
- Stones (Small to medium sized)
- Manure or organic compost mixed with top soil
- A knife
- A shovel
- Wood (preferably flat), polythene sheet, a hammer and nails (in case of a wooden box)
- Seedlings ready for planting
- Watering can

Steps to follow when establishing a container garden

- 1) Choose a sunlit area to place the container.
- 2) Place the container on an even ground.
- 3) Put a small layer of stones (about 3-5 inches) at its bottom. This is meant to improve drainage.
- 4) On top of the stones, add good soil that has been mixed with manure up to its brim.
- 5) Plant the desired seedlings in your container.
- 6) Water the crops sufficiently well immediately after planting them.

- 7) You may mulch the soil with grass to retain water in the container.
- 8) Space your containers well for easy movement when watering your garden.

For plastic containers, such as buckets or jerrycans, some holes can be punched at the bottom prior to planting to improve drainage and prevent water logging.

For wooden box gardens, bottomless boxes can be made using wood and nails. An inner lining of polythene should be put before adding soil to maintain moisture within the box while at the same time preventing the wood from easily getting rotten. The box can be a depth of about 1 metre or more.

(Note- Show practical work with some available containers)

SESSION 4: HANGING GARDEN

Duration: 90 Minutes.



This refers to gardens that are suspended in the air or are not directly supported by the ground. This method allows you to grow vegetables e.g. tomatoes without reducing much on the already limited space. It is usually practiced by those who totally lack where to grow vegetables but still have the interest. Different containers e.g. baskets, bottles and buckets can be used.

Steps to follow when establishing a hanging garden

- 1) Start with a small hanging pot, some potting soil, a hook, gardening supplies, and your choice of plants. Opt for resilient and vibrant annual vegetables.
- 2) Clear your balcony and select a good area to hang the garden.
- 3) Drill the hook in the desired spot. Make sure it is well fastened and secure.
- 4) Fill up the container/basket with good loam soil. This should be well manured, not too clayey or too sandy.
- 5) Plant the seedlings you desire to grow and water them sufficiently well. Avoid pouring too much water since all the excess water might drip to the ground in case of the basket.
- 6) Hang up the container/basket on the hook in the desired spot.

(Note- show practical work with plastic bottle or other available material in some hanging place)

MODULE 4: FRUIT TREES GROWING

Objective

1. To provide crop management tips on how to grow fruit tree in communities
2. To provide the knowledge of nutritional value of each trees distributed by project

Activity

- Provide the management tips for how to grow fruit trees in communities
- Provide the nutritional value of fruits distributed by project

CDN-ZOA is promoting 4 varieties of fruits : Pomelo, Jack fruit, Guava (seedless), and Mango (big). All are grafted and high nutrient fruit varieties. Lychee and Papaya are promoted on Demonstration plots including Special nutrient plants.

SESSION 1: CULTIVATION OF POMELO

Duration: 60 Minutes.



1.1: Climatic condition

The most suitable temperatures for pomelo are (15-30) degrees Celsius. Warm days and cool nights are optimal. Lower temperatures will delay ripening, reduce water content, and lead to small size fruits and poor quality. If there is high moisture content in the morning, the fruit will be large with a thin seed coat and fresh fruit. If there is suitable light intensity, fruits will be bright yellow with seed coat. In the case of high light intensity, the fruit will have pale yellow seed coats. Moreover, if pre-ripening fruits are bagged, fruits will have gentle tissue and freshness. Rainfall should be (150 – 200)cm/year. If the plant has a shallow rooting system, there is a risk that the roots will be rotted by flooding.

1.2: Soil conditions

This variety should be grown in silty soils with green manure fertilizer. If it is grown in clay soils, there is need for good drainage. Drainage water should not have high saline content. The ideal soil pH range is 5.5 - 6.0.

1.3: Planting system

Pomelo seedlings should be spaced at 6 meter intervals. Pits should be dug about 3 meters deep and wide and partially filled with compost by mixing natural fertilizer and topsoil. Plant the seedling in the middle of the prepared pits by fitting the soil. Later, we need to water the seedling till it develop new shoots.

1.4: Weed control

Weeding can be done by hand or by machine.

1.5: Irrigation

At the vegetative stage (growth stage), fruit trees will need enough irrigation and water. The same also applies during the flowering stage and fruit setting. The fruit trees will need more water. However, if irrigation keeps slowly and will limited water, flowers and fruits will fall down. This will stop fruit growth. On the other hand, in case of over irrigation, flowers and young fruits will easily fall down. Therefore, firstly, we need to water as just moist and then irrigate slowly daily.

1.6: Harvesting

Usually, pomelo fruits will be ready for harvesting between 5 to 6 months from fruit set.

1.7: Nutrient deficiencies

- When the plants are affected by manganese deficiency, the leaves change to brown color. The change in brown color affect the plants leading to small size fruits and low yields.
- Zinc deficiency appears as small blotches of yellow between green veins on the leaf. With severe deficiency, leaves may become increasingly yellow except for the green veinal areas, and weakness branches. To protect the zinc deficiency, zinc sulfate (2) viss is soluble in water (200)L and then can spray at the beginning of new leaves. If it is sprayed at the flowering period, the flowers will fall off.
- Iron deficiency becomes thin leaves, leaf vines and interveinal areas are slightly darker green. Trees may become partially defoliated before maturity and also new foliage will become the weakness.
- Boron deficiency becomes abnormal leaves and these leaves will change the brown color. There is also symptom on branches such as marrow stem or pith lesions due to the boron deficiency. We can use boron solution for protection.

1.8: Nutrients value

Pomelo is an excellent source of vitamin C, providing 193 percent (116 mg) of your daily recommended needs. You'll also benefit from small amounts of thiamin, riboflavin, niacin, and vitamin B6 when you consume this citrus fruit.

Size 100 g fruit of Pomelo contain the following nutritional amount are as follow water 89.1 g, Energy 38 kcal, Protein 0.76 g, total lipid (fat) 0.04 g, Carbohydrate 9.62g, Fiber (total dietary) 1g, Calcium 6 mg, Iron 0.11, Magnesium 6 mg, Potassium 216 mg, Phosphorus 17 mg, Sodium 1 mg, and Zinc 0.08.

1.9: Benefits for Health:

1. Urinary Tract Infection (UTI):

Increased consumption of Pomelo can help to fight urinary tract infection; a painful bacterial infection of the urinary system. Vitamin C in Pomelo increases the acid level in urine, inhibiting the development of bacteria in the urinary tract.

2. Heart Health:

Pomelo contains high levels of potassium, a mineral required for proper functioning of the heart. Potassium regulates blood pressure level and reduces bad cholesterol in the body. Pomelo juice also helps to clear arterial deposits in the body, thereby reducing the risk of stroke and heart attack.

3. Infection:

Consuming a serving of Pomelo daily can prevent free radicals from attacking the body. It stimulates the antibodies and immune cells to guard the body from bacteria that cause cold, flu, asthma and allergies.

4. Fights Cancer:

The skin of the Pomelo fruit is rich in bioflavonoids, an antioxidant that prevents intestinal, pancreatic and breast cancer. It eliminates excess estrogen from the body, preventing the cancer from spreading. It also contains high amounts of fiber, which protects the body from colon cancer.

SESSION 2: CULTIVATION OF GUAVA

Duration: 60 Minutes



In Guava, there are two types of fruit varieties such as red core and white core. In red core variety, inside of the fruit's tissues are pink / red colors with soft consumption. In white variety, inside tissues are only white color and compact/hardness tissues of fruits.

2.1: Cultivation

Guava are grown on February-March or August-September. One year seedling by directly from seeds or grafting can grow in the field.

Plant spacing will be 15 ft and pits should be done of 3 ft wide and depth will measure the half of seedling. And then, pits will fill with mixture of natural fertilizer (cow dung and compost). As the other inputs/supplements, we can use small amount of N:P:K fertilizers for better growth of the seedlings. When we grow these seedlings, place them in the middle of pits and also water them to till the new shoots grow.

2.2: Weather condition

It is easy to grow. Although these variety can grow in any soil condition, these fruit trees are tolerant to flooding. These varieties are resistant to temperature/heat and drought. But older plants can tolerate drought.

2.3: Care

It is necessary to apply mulch, weed and water. Branches and lateral branches at the bottom of the plants need to be pruned. New branches have higher fruit yields. To protect from fruit flies (pests), fruits should be bagged.

2.4: Fertilizer application

Fertilizer should be applied twice annually first in March and second in October). For one plant, we can use cow dung (compost) 3 bags (1bag = 50kg) and also can use N: P:K about 1 pyi.

2.5: Pests and disease

Fruit flies and aphids will affect this plant. Diseases are wilting, spots, other fungus diseases. To protect against these diseases, we can use Bordeaux-mixture fungus solution bi-weekly

2.6: Harvesting

Trees grown from seeds can be harvested in four to five years. Grafted plants can be harvested within two years. It is possible to get fruit year-round with regular fertilization, irrigation, and drainage. This variety will have high yields for 10 to 15 years. After this period, plants should be replaced.

2.7: Nutrients value and health benefits of Guava.

Guava is a tropical fruit that has either pink , white or yellow flesh with seeds and a green or yellow skin. The fruit can be sour or sweet but is always nutritious, helping you meet your daily requirements for fiber, vitamins and minerals. Guava is a very good source of vitamin C and fiber. One of guava fruits provide 280 percent of the daily value for this nutrient. A guava will also provide you with 15 percent of the daily value for vitamin A and smaller amounts of niacin, vitamin B-6, folate, thiamine and riboflavin.

Macronutrients

One guava fruit contains 45 calories, 1 gram of protein and 10 grams of carbohydrate, including 5 grams of dietary fiber. Dietary fiber helps to keep your digestive tract clean and makes your food more filling. It may also lower your risk for obesity, diabetes, heart disease and high cholesterol.

Vitamins

Guavas are an excellent source of vitamin C, with one fruit providing 280 percent of the daily value for this nutrient. A guava will also provide you with 15 percent of the daily value for vitamin A and smaller amounts of niacin, vitamin B-6, folate, thiamine and riboflavin. Vitamin C is an antioxidant that your body needs for the growth and repair of tissues, and vitamin A is essential for good vision and immune system function and cell division.

Minerals

Although not a great source of minerals, a guava provides 2 percent of the daily value for calcium, magnesium, iron and phosphorus. Calcium helps with muscle and nerve function and strengthens your bones. Magnesium helps keep your bones and your immune system strong and regulates blood pressure and blood sugar levels. Iron is essential for forming red blood cells, and phosphorus helps turn your food into energy and forms proteins in the body for forming new cells and tissues.

SESSION 3: CULTIVATION OF JACKFRUIT

Duration: 60 Minutes



3.1: Environmental Condition

Jackfruit grows well under full sunlight, in temperatures between 16 - 28°C. Required rainfall is 39-94 inches. Although they can grow in all soils, alluvial soils or rich and well drained sandy loam soils are best. Suitable soil pH is 5-7.5. This variety is not drought resistant, and does not tolerate moisture stress or flooding well.

3.2: Land Preparation and digging pits

Clear the growing place and dig pits 3 feet wide and 5 feet deep, spaced 30 feet apart. Refill the pit with a mixture of one part topsoil and three parts soil compost. If we have to use cow dung, it takes about 15 days to till compost.

3.3: Planting

Jackfruit can be planted either directly from seeds or by transplanting seedlings from pots. Seedlings should be transplanted before one year or take out the roots from pots.

3.4: Fertilizer Application

We can apply farm manure about (10) viss yearly.

3.5: Irrigation

Regular irrigation is needed from planting to growth stage. At the flowering and fruiting stages, the plant needs to be watered if there is a drier period.

3.6: Weeding

Weed the surroundings of the plants regularly through at least years 3 to 4. The pulled weeds can be used as mulch at the base of the trees to control moisture and protect the survival of weed seeds.

3.7: Pruning

By pruning we can manage the plant types of direct seedling plants. The benefits of pruning, we can get uniform branches at least 4 - 5 new branches. Moreover, we have to remove disabled branches, disease-infected branches and overlapping branches to get adequate sunlight, good ventilation and to protect against diseases.

3.8: Pest and disease management

Major pests are the shoot borer, pot borer and bud borer. To protect against pests, young fruits should be bagged. Fallen and damaged fruits should be collected and destroyed by ploughing. Fruit rot and stem rot diseases are serious fungal diseases. These disease symptoms can be seen at the panicles and shoots. Affected panicles rot, change to dark color, and then fall down. We can protect against these diseases by removing infected parts.

3.9: Harvesting

Young fruits can be harvested and cooked two to three months after seed ripening. The ripe fruits can be harvested when indicated by the following:

1. A dull, hollow sound is produced when the fruit is tapped with a finger
2. The fruit color changes from green to pale green
3. An aromatic odor develops
4. Fruit spines become well developed and widely spaced.

3.10: Nutrient value and health benefits

Jackfruit has an impressive nutrition profile. It contains a moderate amount of calories, providing 155 in a one-cup (165-gram) serving. Approximately 92% of the calories come from carbs, while the rest come from protein and a small amount of fat.

Furthermore, jackfruit contains some of almost every vitamin and mineral that you need, as well as a decent amount of fiber.

One cup of sliced fruit provides the following nutrients :

- Calories: **155**
- Carbs: **40 grams**
- Fiber: **3 grams**
- Protein: **3 grams**
- Vitamin A: **10%**
- Vitamin C: **18%**
- Riboflavin: **11%**
- Magnesium: **15%**
- Potassium: **14%**
- Copper: **15%**
- Manganese: **16%**

What makes jackfruit unique from other fruits is its protein content. It provides more than 3 grams of protein per cup, compared to 0–1 grams in other similar types of fruit, such as apples and mangoes.

Ways of Preserving Jack Fruit all year round (Jack fruit jam)

Ingredients

- Well ripened jack fruit - 500 g
- Sugar - 350 g
- Citric acid - 1 teaspoon
- Water - as required

Method

- Cut the well ripe jack fruit into small pieces
- Boil the pieces with water and pulp into fine paste
- Add the jack fruit paste and sugar and cook on pan with little water, if required
- Add permitted food colour and citric acid to the mixture. Add one tablespoon of lime juice to the same (optional).
- Stir continuously till jam consistency
- Test for end point using ladle test.



SESSION 4: CULTIVATION OF MANGO

Duration: 60 Minutes



Mango (*Mangifera indica*) is the leading fruit crop of the world and considered to be the king of fruits. Besides delicious taste, excellent flavour and attractive fragrance, it is rich in vitamin A&C. The tree is hardy in nature and requires comparatively low maintenance costs. Mango, all stages of its development can harvest at both in its immature and mature state. Raw fruits are used for making chutney, pickles and juices. The ripe fruits besides being used for desert are also utilised for preparing several products like squashes, syrups, nectars, jams and jellies. The mango kernel also contains 8-10 percent good quality fat which can be used for soap.

4.1: Climate

Mango can be grown under both tropical and sub-tropical climate from sea level to 1400 m altitude, provided there is no high humidity, rain or frost during the flowering period. Places with good rainfall and dry summer are ideal for mango cultivation. It is better to avoid areas with winds and cyclones which may cause flower and fruit shedding and breaking of branches.

4.2: Soil

Mango comes up on a wide range of soils from alluvial to laterite provided they are deep (minimum 6') and well drained. It prefers slightly acidic soils (pH 5.5 to 7.5).

4.3: Varieties

Though there are nearly 1000 varieties of mango in India, only following varieties are grown in different states.

4.5: Propagation

Farmers should always get vegetative propagated, true to type plants from recognized nurseries. Inarching, veneer grafting, side grafting and epicotyl grafting are the popular methods of propagation in mango.

4.6: Planting

Land should be prepared by deep ploughing followed by harrowing and levelling with a gentle slope for good drainage. Spacing varies from 10 m x 10 m, in the dry zones where growth is less, to 12 m x 12 m, in heavy rainfall areas and rich soils where abundant vegetative growth occurs. New dwarf hybrids like can be planted at closer spacing. Pits are filled with original soil mixed with 20-25 kg well rotten FYM, 2.5 kg single super phosphate and 1 kg muriate of potash. One year old healthy, straight growing grafts from reliable sources can be planted at the center of pits along with the ball of the earth intact during rainy season in such a way that the roots are not expanded and the graft union is above the ground level. Plants

should be irrigated immediately after planting. In the initial one or two years, it is advisable to provide some shade to the young plants and also stake to make them grow straight.

4.7: Training and pruning

About one meter from the base on the main trunk should be kept free from branching and the main stem can be allowed thereafter spaced at 20-25 cm apart in such a way that they grow in different directions. Branches which cross over/rub each other may be removed at pencil thickness.

4.8: Fertilizer Application

In general, 170 g urea, 110 g single super phosphate and 115g muriate of potash per plant per year of the age from first to tenth year and thereafter 1.7 kg, 1.1 kg, and 1.15 kg respectively of these fertilizers per plant per year can be applied in two equal split doses (June-July and October). Foliar spray of 3% urea is recommended before flowering in sandy areas.

4.9: Irrigation

Young plants are watered frequently for proper establishment. In case of grown up trees, irrigation at 10 to 15 days interval from fruit set to maturity is beneficial for improving yield. However, irrigation is not recommended for 2-3 months prior to flowering as it is likely to promote vegetative growth at the expense of flowering.

4.10: Plant Protection

Mango is prone to damages by a large number of pests, diseases and disorders. The recommended control measures for most important and common among them are briefed below:

1. **Mango hopper:** Two sprays (at panicles emergency and at pea size of fruits) of carbaryl (0.15%), monocrotophos (0.04%) or phosphamidan (0.05).
2. **Mealy bug:** Ploughing inter spaces in November and dusting 2% methyl parathion @200 g per tree near the trunk and fixing 20 cm wide 400 gauge polythene strips around the trunk with grease applied on the lower edge in January as prophylactic measures and two sprays of monocrotophos (0.04%) at 15 days interval as control are needed.
3. **Powdery mildew:** Two to three sprays of wettable sulphur (0.2%) or Kerathane (0.1%) at 10-15 days interval.
4. **Anthrax:** Two sprays of Baristin (0.1%) at fortnight interval.
5. **Malformation:** One spray of 200 ppm NAA in October followed by deblossoming at bud burst stage in December -January.
6. **Fruit drop:** Regular irrigation during fruit development, timely and effective control of pests and diseases and spraying 20 ppm NAA at pea size of fruits.

4.11: Harvesting and yield

Graft plants start bearing at the age of 3 -4 years (10-20 fruits) to give optimum crop from 10-15th year which continues to increase up to the age of 40 years under good management.

4.12: Post Harvest Management

4.12.1: Storage: Shelf life of mangoes being short (2 to 3 weeks) they are cooled as soon as possible to storage temperature of 13 degree Celsius. A few varieties can withstand storage temperature of 10 degree Celsius. Steps involved in post-harvest handling include preparation, grading, washing, drying, waxing, packing, pre-cooling, palletization and transportation.

4.12.2: Packaging : Mangoes are generally packed in corrugated fiber board boxes 40 cm x 30 cm x 20cm in size. Fruits are packed in single layer 8 to 20 fruits per carton. The boxes should have sufficient number of air holes (about 8% of the surface area) to allow good ventilation. Financial institutions have also formulated mango financing schemes in potential areas for expansion of area under mango. Individual mango development schemes with farm infrastructure facilities like well, pump set, fencing and drip irrigation system etc. have also been considered.

4.13: Nutrient value and health benefits

One cup of mango slices has about 100 calories, almost no fat, and 25 grams of carbohydrates. It's also almost sodium free and has about 3 grams of fiber. Mangos are high in vitamins, potassium, and folate and also add fiber to your diet.

Mangoes are packed with vitamins like A, C, and K. While, good levels of vitamin K are beneficial for our bone health and vitamin A promotes good eye health. Mangoes comprise 36.4 mg of vitamin C, 4.2 microgram of vitamin K and 1082 IU per 100 gm serving. Mango is one of the highest food sources of vitamin C. This vitamin is essential for your immune system.

Mango, It is known that fiber plays an important role for weight loss and mangoes are rich in fibre. There are 1.6 gm of dietary fibers per 100 gm of serving. Consuming mangoes will keep your hunger pangs at bay. But, remember moderation is the key.

One cup of mangoes delivers a day's worth of vitamin C. One cup of diced mango contains:

- ❖ 100 calories
- ❖ 1 gram protein
- ❖ 0.5 grams fat * 25 grams of carbohydrate (24 grams of sugar and 3 grams of fiber)
- ❖ 100 percent of the daily need for vitamin C
- ❖ 35 percent of vitamin A
- ❖ 20 percent of folate
- ❖ 10 percent of vitamin B-6
- ❖ 8 percent of vitamin K and potassium Mangoes also contribute copper, calcium, and iron to the diet as well as antioxidants such as zeaxanthin and beta-carotene

4.14: Ways of Preserving Mango all year round.

4.14.1: METHOD 1: Drying .



1. Get your mango (either by plucking or by buying)
2. Wash very well and then peel that back

3. Mix 8–9 tablespoons of lemon juice (to help retain the mango colour) in 1000 ml/4 cups/68 tablespoons of water
4. Slice the fruit in thin pieces into the mixture from 3 above and allow to soak
5. Preheat your oven to 55 degrees.
6. Set the soaked mango (evenly spaced) on the oven tray and put in the oven for 18 hours, as an alternative, spread the soaked mango out in the sun (Note: the sun must be extremely scorching) till its dry but supple, depending on your taste.
7. Place in a jar or plastic bag
8. Dust off with icing sugar (just enough to stall the tartness of the lemon juice).
9. Seal off and place on the shelf.

Note: best consumed in the first 6 months.

4.14.2: METHOD 2: Soaking in brine

Brine is simply a solution of salt in water, some add preservative to extend its shelf life, but if you are all about team natural, use without preservation. This will last up to a year.



1. Get your mango (either by plucking or by buying)
2. Wash very well
3. Peel the back (optional)
4. Cut into tiny pieces
5. Pour in a glass jar or ceramic container and fill with water such that it covers the mango
6. Add approximately 3 tablespoons of salt.
7. Cover tightly
8. Shake well and allow to sit in the sun for 3 days
9. Drain the soaked mango and spread under the sun for another three days
10. Air dry (inside your house) for at least 10 days
11. Package in a container and place on the shelf.

Note: shake the jar often whilst still under the sun. 3g/0.5 tsp of Potassium metabisulphite can be added as a preservative.

How to make brine water

This procedure is for 5% salt solution.

If you are making 1000ml of water, multiply by 0.05 to get the weight of salt to be used. That's 50g of salt.

4.14.3: METHOD 3: Processing

4.14.3.1: Mango bars



1. Get your fully ripe mango (either by plucking or by buying)
2. Wash properly and peel
3. Cut up into pieces and blend to a smooth paste
4. Add 10 to 15% sugar of the pulp
5. Add 2 tablespoons of lemon juice and a pinch of Potassium metabisulphite to the pulp
6. Heat for three minutes at medium heat and pour into a tray already coated with vegetable oil
7. Set to dry under the sun till a leather consistency is observed
8. Cut into desired shapes and package in plastic bags.

Storage life : about 12 months (with preservative), less than 12 months without preservatives

4.14.3.2: Mango juice



1. Get your fully ripe mango (either by plucking or by buying)
2. Wash properly and peel
3. Cut up into pieces and blend to a smooth paste
4. Into 1000 ml of pulp, add 1000 ml of boiling water, 2 tablespoons of lime and approximately 12 tablespoons of sugar
5. Package in a clean bottle and sterilize in not too hot (like 60–70 degree celsius) water.

6. Allow to cool and store

Storage life : about 12 months

4.14.3.3: Mango jam



1. Get your fully ripe mango (either by plucking or by buying)
2. Wash properly and peel
3. Cut up into pieces and blend to a smooth paste
4. Pour the pulp in a pot and place over the stove (medium heat)
5. Add 60% sugar of weight of the mango prepared
6. Add two spoons of lemon juice and stir continuously
7. Once a jelly like structure begins to form, add another 2 spoons of lemon juice and continue stirring
8. At the stage the gel should be fully formed.
9. Cool and package in clean jars
10. Store.

SESSION5: CULTIVATION OF LYCHEE

Duration: 60 Minutes



5.1: Soil condition

This variety can grow in sandy soil with good fertility.

5.2: Cultivation

Lychee should be grown near rivers and other places with easy access to water. It should be planted between March and April in three foot wide pits, spaced 25 feet apart. Each pit should be filled by mixing compost litters with topsoil in ratio. The seedlings are made by air-layering will plant in each pit and also will do soil compact and then need to watering.

5.3: Fertilizer Application

We need to apply natural fertilizers (cow dung, litter compost, soil compost) with (1) basket for one plant. N:P:K fertilizer can also be used at 0.05 lbs per tree in a five foot diameter circle from the plant bottom.

5.4: Care

We need to care the plants since the young seedlings. We can prune the branches to left (3)ft high of stem. And also will do to get sunlight in the middle of plants. The branches at the upper portion will need to be pruned in winter season.

5.5: Pests and Diseases

Major pests on Lychee trees are mites and bark-eating caterpillars. We can protect against these by spraying a lime-sulphur solution. If some disease symptoms such as leaf spotted disease on the leaves and branches, we can protect by spraying with copper solution.

5.6: Harvesting

To harvest the fruit, allow them to turn red. Remove the fruit from the tree by cutting it from the branch just above the panicle bearing the fruit. When the fruits are stored for a long period, they may dry out, darken, and rot. Therefore, we should pack by using some leaves or moisture control plastic bags.

5.7: Nutrients value and health benefits

Lychee, like citrus fruits, is an excellent source of vitamin-C; 100 g fresh fruits provide 71.5 mg or 119% of daily recommended value. Studies suggest that consumption of fruits rich in vitamin-C helps human body develop resistance against infectious agents and scavenge harmful, pro-inflammatory free radicals.

Further, it is a very good source of B-complex vitamins such as thiamin, niacin, and folates. These vitamins are essential since they function by acting as co-factors to help the body metabolize carbohydrates, protein, and fats.

Lychee also carries many minerals like potassium and copper. Potassium is an important component of cell and body fluids help control heart rate and blood pressure; thus, it offers protection against stroke and coronary heart diseases. Copper required in the production of red blood cells.

The amazing health benefits of lychee fruit are because of its rich nutritional value. Lychee is very rich in Vitamin C, and contains about 72 mg of Vitamin C per 100 grams. It is also rich in copper, phosphorus, and is low in sodium. It provides many B complex Vitamins and is a good source of Fiber too.

SESSION 6: CULTIVATION OF PAPAYA

Duration: 60 Minutes



6.1: Introduction:

The papaya (*Carica papaya*) is one of the important delicious fruit crop grown in the tropical and subtropical parts of the world. It is originated in Mexico and spread to almost all the corners of the tropical world. The papaya is highly productive and interesting crop. It is easy to grow as short duration crop. As a raw fruit, it is used in cooking and some preparations. Its latex is used as a papain in food and medicine industry. Ripe fruit is very delicious containing vitamin A and Carbohydrates.

6.2: Climate:

It requires warm and humid climate without frost. Low temperature affect the fruit and plant growth. Both foliage and fruit get damaged near 0°C. Hence, plants have to be protected by covering with gunny bags under North Indian conditions. It is also very sensitive to water logged conditions.

6.3: Soil

Papaya as a filler is grown from plains to sub mountains areas. It like soils which are well drained, rich in organic matter with near normal pH. Water stagnation for few days can be harmful.

6.4: Propagation

Commercially the papaya is propagated by seeds. The tissue culture technique is limited to research laboratories only. The seeds loose viability in a short period and therefore the seeds should not be stored for more than a season. The seedlings in polybags are prepared. Due care is taken to avoid damping off of the newly germinated and young seedlings. The seedlings become ready for transplanting within 6-8 weeks.

6.5: Planting

Heavy rains, hot air, frost, etc are considered while selecting the season for planting in a particular area. The pits of 30 x 30 x 30 are prepared in already selected and prepared field at the distance of 2.5 to 3 meters distance. The pits are fitted with well-decomposed FYM and NPK mixtures. A care is taken not to disturb the roots while transplanting the seedlings.

6.6: Irrigation

Papaya is very sensitive to water logged conditions. Avoid flooding periodically. Divide the field into segments. Apply light irrigation at 6-7 days interval in summer and 15 to 20 days interval in winter depending on soil condition. If rain is there avoid irrigation. Water should not stay near the stem of plants to prevent color rot.

6.7: Manuring and Fertilization

Papaya needs more nutrition due to its short juvenile period. It prefers soils with good organic matter. Apply 20kg of farm yard manure by mixing with 200g of urea 400g of muriatic of potash in February or March every year per plant.

A very high dose of fertilizers will not recommended .The male plants should not be fertilized at all. The manure and fertilizer mixture should be mixed within a radius of 40cm around the plants.

6.8: Weed Control

Weeding should be done regularly to keep the basins free of weeds when the papaya is planted as filler in orchards. Two hoeing one in February-March and other in July-August are sufficient to check the growth of weeds. No weedicides should be sprayed since papaya is a shallow rooted fruit crop and plants can be damaged.

6.9: Plant Protection

The papaya is susceptible for virus disease, which are spread through insect vector. The rouging off is strictly followed to avoid further spread of the disease, in addition the insecticide sprays are taken against aphids, white flies and other sucking pests. Powdery mildew, downy mildew and stem rot providing wind breaks, well drained conditions to soil avoiding planting papaya after papaya and following a suitable crop rotation keeping the field clean and weed free are some of the measures which will help to keep the papaya crop in good health condition.

6.10: Frost Protection

Papaya is very sensitive to frost due to broad leaves and succulent stem. To save the young papaya plants from winter, the plantation should be done during October or November so that plants could be provided protection easily.

6.11: Harvesting and Fruit Handling

Papaya plants tend to over bear. Fruits are so crowded that they do not get proper space for development. Fruit thinning should be done to get well sized fruits. Proper size is attained after 5-6 months of flowering. Near ripening fruits change color from green to yellowish green. Fruits should be harvested at maturity. After harvesting the fruit should be placed in single layer and covered with straw till ripening. For distant markets it should be packed in baskets by placing straw below and newspaper along with gunny bag above to avoid bruising of fruits.

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