

Sustainable Home Gardening

Training course guide



AVRDC

The World Vegetable Center

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INTRODUCTION

AVRDC-The World Vegetable Center provides training programmes as a part of many of its project activities in South Asia.

This manual provides a structured approach for those seeking to help improve village vegetable production in Odisha.

Although home vegetable gardening is nothing new to most rural households, the introduction of improved practices can make a big difference to the maintenance and productivity of vegetable gardens.

This is important for ensuring a family's stable vegetable supply and for avoiding malnutrition that can be exacerbated by floods and poor seasonal conditions.

PROPOSED USERS OF THIS MANUAL

NGOs: Field level workers who can train farmers/farm women

Farmers: Leading or progressive farmers who act as village training facilitators

Extension workers: Technical staff from state departments and universities

COMPONENTS OF THE MANUAL

This can be used as a single training curriculum manual, or a series of individual training modules. Lesson plans should be altered to suit to the needs of each group.

The manual contains guidelines for trainers and resource persons as well as a local organizer. It includes session plans, suggested training methodologies and participatory approaches, written and video information resources for resource persons and trainees, and evaluation forms for trainer support.

A. GUIDELINES FOR THE TRAINING ORGANISER

While the trainer teaches, it's the organizer who gets everything ready. This includes:

- Identifying the resource persons/trainers who have sufficient experience and skills in the proposed area.
- Preparing the training schedule in advance and communicating with the resource persons.
- Sharing the training modules and methodology with the resource persons.
- Finding out the expected requirements of the resource person (eg. physical facilities, materials, aids) and getting them ready.
- Sending invitations to the resource persons and participants (written or oral) clearly mentioning the schedule and confirm their participation.
- Communicating any rescheduling required well in advance.
- Ensuring that all the items in the training curriculum checklist are in place.
- Following the protocol to make the training programme a good experience for all involved.

B. GUIDELINES FOR THE TRAINER

An effective trainer not only provides new information, but using adult learning principles also builds on the existing skills and understandings of those being trained and develops local resource persons who can train others. A training programme's effectiveness mainly relies on the skills of the trainer, the training approaches used and the support services provided. Its impact is shown in the changes in attitudes and practices leading to adoption of the technologies learnt. The trainer needs to do the following:

- Be well prepared for the training programme. He/she should be well equipped with a knowledge of adult learning principles.
- Be aware of participatory methods to be used in the training.

- Know that an appropriate combination of teaching methods and good resource materials are needed.
- Always design the training lesson plan well in advance.
- Ensure that only a part of the lesson is provided theoretically through an interactive approach, and that this is balanced with practical field work.
- Organise seasonally-appropriate demonstration activities on a primary stakeholder's farm. If a proposed demonstration has no direct relationship with the season, such as the preparation of spray materials, conduct it in a convenient meeting place for the training participants.
- Ensure that all the required materials and equipment are in place before the training starts.
- Have sufficient copies of resource materials for all participants.
- Encourage interaction and the sharing of experiences among the participants.

C. CHECKLIST OF ITEMS FOR THE TRAINING ORGANISER

1. Programme flyer/invitation to be sent to the participants
2. Invitations to the resource persons
3. Training schedule
4. Training module
5. Trainees' resource materials for each session
 - Written material for literate trainees like NGO staff and extension workers
 - Pictorial material for illiterate farmers and farm women

Trainers' resource materials

- Display material during the training – Posters, Charts, Calendars
- Pamphlets/Folders/Leaflets/calendars
- Videos

Monitoring & Evaluation materials

- Pre & Post Test Questionnaire
- Feedback
- Evaluation

D. MODULES FOR EACH TOPIC/LESSON

This manual can be used as a single unit or as five individual training modules on individual topics related to home vegetable gardening. Each module introduces different methodologies to deal with a different topic.

Many of these approaches may be best applied with more educated learners who can then help work with others within their villages.

Localised approaches to reach illiterate adult learners may be developed using this manual as a base.

E. COMMUNICATION MATERIAL (IEC)

Materials required to support the training programme in the form of short videos and hand-outs for different topics are included with this manual. These were field-tested with communities in Odisha in 2015 before their incorporation into this manual.

Field testing of the training videos:

Farm women who viewed a video from one of the lessons said "It seems to be very simple to learn from this short film." Short 2-3 minute videos were played in villages to groups of 15-20 participants, with occasional breaks for face-to-face interaction with the resource persons.

Groups responded well to the content, and the testing showed that the videos for each module could be independently used as a key resource material for both literate and illiterate trainees.

MONITORING & EVALUATION

Training aims to bring about changes in knowledge, attitudes and skills of the learners, with the expectation this will then bring about changes in practice.

Changes in attitude generally need to be assessed over time. Changes in knowledge can

be assessed through a simple test administered before and after the training programme using written or verbal means (more useful with uneducated adult learners).

Skills are improved through demonstration and practice and can be assessed during the programme by involving the learners in practicing the techniques.

A sample test with 5-6 questions has been given at the end of each module. Feedback forms give opportunity to the participants to also comment on the training logistics to help improve future programmes.

The longer term impact of the training on practices can be assessed three months after training. A simple structured questionnaire is provided for this purpose, and this is important for assessing future training needs.

ANNEXURES

Assessment of Change in Knowledge

Used by the training organisers to know the participants' change in knowledge level.

Feedback

Distributed and collected immediately before concluding the training programme.

Consolidation of feedback: To be used by training organiser

Training Evaluation Questionnaire: Given to the participants three months after the training programme.

REFERENCES

[www.avrdc.org /PPT on mature technologies](http://www.avrdc.org/PPT%20on%20mature%20technologies)

http://www.appropedia.org/Bag_gardens

<http://practicalaction.org/floating-gardens-legacies>

<http://www.climatechoices.org.uk/pages/case3.htm>

https://www.youtube.com/watch?v=_JatsIs73RA

https://www.youtube.com/watch?v=bWGRX_cH3oM

avrdc.org/download/publications/manuals/save-your-own-veg-seed.pdf

agridr.in/tnauEAgri/eagri50/GPBR112/pdf/lec17.pdf

<http://howtosaveseeds.com/store.php>

<http://www.extension.umn.edu/garden/yard-garden/vegetables/saving-vegetable-seeds/>

<http://www.timberlinehomestead.com/1043-storing-vegetable-seeds.html>

Managing Vegetable Crops in Home Gardens



OBJECTIVE

To provide knowledge to home gardeners on better crop management practices with the help of field-level workers

BACKGROUND

Field level workers need to be aware of the key technical aspects of home gardening.

Although vegetables are regularly grown in home gardens there is a lack of community knowledge on improved practices.

Home gardens need to be maintained well so as to have an assured vegetable supply throughout the year.

Home gardeners also need to know how to save their seeds to complement supplies that can be bought locally.

DURATION OF THE PROGRAMME

Three days (before, during and after the crop season) with demonstrations of healthy seedling production and harvesting techniques.

MATERIAL REQUIRED:

- Extension literature
- Videos of successful farmers
- Photos/ specimens – pest and disease damage symptoms
- One or more fields of standing crops for sessions 2 & 3



SESSION PLAN

	Topic/ Activity	Duration	Facilitator	Material/ Method	Expected output
	Day 1: Before the season starts (sowing)				
1	Registration	15 min	Training organiser	Format	All the participants attend
2	Introduction	15 min	Training organiser	One or more sentences highlighting of the person's experiences	All participants get to know each other
3	Expectations from participants	15 min	Training organiser	List the expectations on the board & copy onto a chart to verify their fulfilment after the training programme	Facilitator will be able to modify the content to be covered to suit to the expectations of the participants
4	Pre test	10 min	Training organiser	Literates will fill in the questionnaire and others will seek help	Knowing the level of knowledge of the participants will help the facilitator in dealing with the topic
5	Discussion on vegetable cultivation in backyards/ seasonality issues	45 min	Training organiser, Participants	Charts & white board	Participants will be able to analyse their current situation of their home gardens
6	Introduction of improved practices-line sowing, staggered sowing, staking, trellising etc.	60 min	Resource person	Video on line sowing	Participants will gain knowledge on critical interventions to make a difference to their gardening practices.
7	How to do line sowing	60 min	Participants	Demonstration by the participants	Participants will be able to practice the technique
8	Exercise on pest and disease identification	60 min	Resource person	Photographs, Power point presentation, charts, videos	Participants will be able to identify important pests and diseases
9	Integrated Pest Management	30 min	Resource person	PPT on Precautionary measures to be taken	Participants will be able to know how to prevent major infestations
10	Discussion on availability of seeds and marketing of excess produce	30 min	Participants	White Board and plain charts	Participants will know about alternative seed systems
11	Planning for the next lesson	15 min	Training organiser, Participants	-	Participants will be prepared to get more practical knowledge

DAY-2: Field day (fruiting stage of the crop)					
1	Identification of pests and diseases	100 min	Resource person , Participants	A visit to 2 or 3 neighbouring home gardens to look for any prevailing pest problems	Participants will be able to practically identify key pests and diseases.
2	Integrated Pest Management	60 min	Resource person	Photographs of pests & diseases	Participants will learn how to manage existing outbreaks and to prevent further problems.
DAY-3: Field day (at the time of first harvest)					
1	Harvesting and picking	60 min	Resource person	Demonstration- harvesting blades and knives	Participants will be able to know the best way of picking to sustain further production
2	Feedback on crop performance and preferences	30 min	Training Organiser	-	Participants will be able to identify any changes to be made in the cropping pattern for the next season.
3	Post test	10 min	Training Organiser	Questionnaire	Knowledge gained would be clarified by participants

DAY- 1: Sessions 1-5: Introduction, pre-test, demonstration and video

- Introduce participants to each other and conduct a pre-test of participants' knowledge using a standard questionnaire.
- Obtain the expectations of the training programme, asking the participants to list them on the blank flash cards distributed to them.
- Place the cards in a line in one corner of the class-room.
- Initiate a discussion on vegetable cultivation – seasonality/ local demand/ future markets through past experiences- draw a seasonality map on the board involving the participants. Facilitate the discussion and draw conclusions.
- Explain improved practices for all crops recommended for home gardens highlighting the critical interventions using either Powerpoint presentation or Charts, Posters, Photographs etc.
- Layout a potential plan of a home garden.

AMARANTHUS (LEUTIA)

Amaranthus 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 amaranthus 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 seed 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 similarly 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 diggings depending on weed growth. Avoid deep digging. Do not disturb soil after plants start producing large amounts of leaves.

Harvesting

Good yields are possible through cutting the top portion of the plant, and 4-6 cuttings can be obtained.



BASELLA

Basella is grown in the summer and rainy seasons. Low susceptibility to pests and diseases makes Basella suitable for kitchen garden.

Sowing & Planting

- Before sowing, dig the soil and add manure.
- There are three way to sow basella:

1. When grown across the ground, sow seeds in lines 35 cm apart with 30 cm between plants.
2. When grown on a trellis, space them 30 cm x 26 cm apart.
3. Two to three 20- 25 cm long stem cuttings can be placed per pit with a spacing of 20-30 cm within the row and 38 cm between rows.

Harvesting

Avoid waterlogging in the field. Young shoots are first harvested at about 6-8 weeks after emergence and, subsequently at regular intervals for 4-6 months. Repeated harvests of new stems can be made throughout the season.



KANGKONG

Kangkong (kalmi sag or water spinach) is a popular leafy vegetable in south Asia and south-eastern Asia and wild types can be found in swampy land. The leaves and succulent stems are a good source of iron, calcium, magnesium, vitamin A and vitamin C. Improved varieties can be grown from seed in fields throughout the year. These varieties grown from seeds are tastier because they have green, tender and smooth stems.



Sowing and planting

- Sow the seeds in rows spaced 20 cm apart with plants spaced 5 cm apart within the row.
- Water spinach can also be raised from stem cuttings, 30-40 cm long, taken from the young growth just below a node, and planted about 15 cm deep.

Nutrition:

- Regular applications of an organic liquid fertiliser should occur every two weeks or so for best results. Liquid fertilisers are usually diluted before application to the plants.

Harvest

- The first cutting can be done within a month after sowing. Cut the plant close to the ground. Cut young shoots at weekly intervals.
- Do one shallow hoeing after the first harvest to promote growth. More than one harvest can be taken if shoots are cut above ground level, allowing secondary shoots to grow from nodes below the cut.
- Removal of the main shoot stimulates horizontal shoot growth. These new shoots can be harvested in 4-6 weeks, depending on plant vigour and temperature.

ANNUAL MORINGA

Annual moringa grows well in a wide range of soils.

Sowing & Planting

- Planting is done from July to October.
- Seeds can be sown directly into the field as two seeds per pit at a depth of 2 - 3 cm or in poly bags containing potting mixture and transplanted 35 -40 days after emergence.
- For direct planting or transplanting, dig pits 45 cm x 45 cm x 45 cm deep spaced 2.0 m apart. Apply 15 kg of compost or rotted manure per pit after mixing with topsoil. Pinch off the tip of the seedlings when they are about 75 cm high to encourage branching.

Nutrition

- A fertilizer dose of 45:15:30 g NPK per pit may be applied three months after sowing. Apply an additional 45 g of N per pit 6 after sowing months when the crop is bearing.

Pests & Diseases

Hairy caterpillar: Use a flame torch when the caterpillars settle on the tree trunk. Heap ashes around the base of seedlings.

Harvest

- Cut the trees back at a height of 90 cm after the harvest is over. In another four to five months, plants will again be ready for harvest.
- Ratoon crops can be harvested for three years. Apply a dose of 45:15:30 g NPK fertilizer per plant within a week after cutting back along with 25 kg of rotted manure or compost every year.



BITTER GOURD

Bitter gourd requires a moderate warm temperature. It is a good source of vitamin C.

Sowing & Planting

- Plough the field and dig pits 30cm×30cm×30cm in size. Add dried and decomposed manure to the pits just before sowing the seeds. The distance between pits should be 60 cm and 3-4 seeds should be sown per pit. Thin to one seedling when they have four true leaves.
- Form 20 cm high beds during the dry season and 30 cm or higher during the wet season.



Staking & Trellising

Staking & trellising will increase the fruit size and reduce root rot and make spraying and harvesting easier.

Nutrition

- Apply 10 kg of rotted manure per pit and 100g of 6:12:12 NPK per pit as a basal application and 10 g of N per pit 30 days after sowing.

Pests & Diseases

- Fruit fly is the most destructive insect pest of bitter melon. Bury any infested fruits to prevent the build-up of fruit fly populations.

Harvest

- It normally it takes 15–20 days after fruit set or 90 days from planting for fruit to reach a marketable age. However, bitter melon can be harvested at earlier stages depending on the purpose for which it will be used. Fruit should be light green, thick and juicy, and the seeds should be soft and white. Harvest every two to three days using a pair of scissors or a sharp knife to cut the fruit stalk.

Session 6: Introduction of improved practices- line sowing, staggered sowing, staking, and trellising

Start a discussion on methods of sowing with the following points:

- How do you sow leafy vegetable seeds?
- What method do you adopt to sow other seeds?

Before getting into details, play the **video** on line sowing.



<https://goo.gl/bnIOpy>

Ask the participants to describe the important interventions that were shown in the video. Then explain line sowing and staggered sowing, training and pruning in creepers.

NOTES FOR THE RESOURCE PERSON:

Staggered sowing

Divide the raised bed into three parts. Sow seed in rows spaced 25 cm apart in the first part and cover the seed with a thin layer of soil.

After 7-10 days, sow seed in the same way in the second part, and repeat it in the third part after 7-10 days. Repeat this process each month. This staggered sowing results in continuous harvesting of leafy vegetables over a long duration.

Staggered sowing results in continuous harvesting and regular consumption. Harvesting can start within 25-30 days after sowing.

Either clip off full grown side leaves or cut the top of the plant to encourage side branching and more leaves.

Staking & trellising: Explain how this will increase the fruit size and reduce root rot and make spraying and harvesting easier.

Session 7: How to do line sowing

Ask participants to demonstrate line sowing in the prepared field, with the knowledge obtained from watching the video.

Session 8: Exercise on Pest and Disease identification

Divide the participants into four groups. Distribute the photographs of major pests and diseases to each group. Ask them to identify them and note down on charts. Allow each group to explain what they found to other groups after their identification. Verify the names of pests as identified by the participants and discuss the following:

1. Common pests that affect leafy vegetables?
2. Major diseases that cause crop losses?
3. Which ones are more prevalent in your operational area?
4. Regular pests or diseases that discourage farm women from continuing home gardening?

Session 9: Integrated Pest Management

Facilitate open sharing on what the participants know about IPM. Explain IPM methods through charts and posters.

Discuss the IPM approaches that need to be adopted from sowing onwards.

Some points for discussion may be:

- What do the farmers spray when they see thrips in their field?
- If mealy bug is a regular problem in your area, how do farmers try to control it?

Likewise, depending on the situation, try to pose as many questions as possible. Then encourage the group to discuss the best IPM practices that can be adopted to prevent the occurrence of pests/diseases. Announce the date and time well in advance requesting the participants to gather at the field for the next lesson on IPM.

Session 10: Discussion on availability of seed material/ alternatives/ marketing

Facilitate this discussion as a brainstorming session and let the participants share their ideas.

DAY 2: Practical session - Field Day at fruiting stage of the crop

Session 1: Identification of pests & diseases

Ask the participants to collect plant parts infested by disease and pest from their neighbouring home gardens and encourage their identification using local names.

Assist them in identification and explaining findings to the group. Use photographs to identify pests that are not present during the training, but may occur at later stages of the crop.

Session 2: Understanding Integrated Pest Management

Explain the known methods of managing major infestations in that locality. Hand over any available literature for ready reference. Announce the tentative date of the next lesson.

NOTES TO THE RESOURCE PERSON:

Host plant resistance

Select pest/ disease-resistant vegetable varieties for the home garden, if available

Cultural control:

- Modifications of management practices that make the environment less favourable to pest reproduction, dispersal, and/or survival

Clean cultivation and sanitation

- Plant seed beds away from production fields
- Plough, remove or bury crop residues in seed-beds and production fields
- Use netting/ screens while raising the seedlings to prevent pest infestations

Crop rotation

- Related vegetables should not be planted on the same land in succession or rotation
- This discontinues the pest's food source, thereby cutting its life cycle
- Best to rotate crops that are not in the same family, since many pests can feed on more than one kind of related plant

Intercropping / mixed cropping can reduce pest populations

Hand-removal of pests

Removal of infested leaves, fruits and shoots

Coloured sticky traps: Helpful for monitoring pest populations and reducing numbers

- Yellow sticky traps for whiteflies, leaf miners, aphids, thrips, leafhoppers and moths
- Blue sticky traps for legume/bean thrips. The brilliant blue colour attracts thrips and leaf miners



Sticky traps

DAY 3: Practical session- Field Day during first harvest

Session 1: Harvesting & Picking:

- When the participants gather in the home garden where the first harvest was supposed to take place, ask them to explain how they normally pick their produce.
- Demonstrate picking techniques that don't cause any damage to the rest of the plant to encourage further production.
- Talk about staggered harvesting and multiple pickings from leafy vegetables.

Session 2: Feedback on crop performance and preferences

- Analyse the pros and cons of growing vegetables in home gardens with the recommended practices.

- Discuss issues around home gardening like the availability of quality seed, pests and diseases and consumption, and get solutions from the participants themselves.

Session 3 & 4: Post-test & Feedback

- Conduct a post-test using the same questionnaire used at the start to assess knowledge transfer.
- Obtain feedback from each participant regarding the training programme using the format developed for the purpose.
- Prepare individual work plans based on what has been learnt.

PRE- & POST-TEST

(Tick (√) the right answer)

Name of the participant:

1. Sowing at different times is advantageous over the traditional method of sowing at one time.

- **Strongly agree**
- **Agree**
- **Disagree**

2. Basella can be propagated only through seed.

- **Strongly agree**
- **Agree**
- **Disagree**

3. Kangkong cannot be grown easily with stem cuttings.

- **Strongly agree**
- **Agree**
- **Disagree**

4. Line sowing facilitates good crop growth.

- **Strongly agree**
- **Agree**
- **Disagree**

5. Staking & trellising of bitter gourd will;

- **Increase the fruit size**
- **Reduce root rot**
- **Make spraying and harvesting easier**
- **All of the above**
- **Need not be done.**

6. Cutting back the branches in moringa

- **Encourages branching**
- **Is not recommended**
- **Will make the plant dry up**

7. Mention the important IPM approaches in home gardens.

Bag Gardening

OBJECTIVE

To help participants learn how to grow vegetables in bags under flooded field conditions and where there is no land available for vegetable cultivation.

BACKGROUND

Field level workers need to be made aware of the key technical aspects of growing vegetables as a part of home gardening.

Vegetable crops are grown in home gardens and not all houses have sufficient space to grow vegetables.

In areas with flooding and waterlogging problems, open field cultivation is difficult and this can have a big impact on the availability of vegetables to households after floods.



DURATION OF THE PROGRAMME

Six sessions in one day

MATERIALS REQUIRED

- Extension literature
- Video
-

For demonstration

- Coirpith
- Poly bags- 60 cm (wide) x 90 cm (long)
- Coir rope
- Seeds: amaranthus- 20 g, spinach- 20 g, bittergourd- 12 seeds, pumpkin- 8 seeds, chili- 8 seedlings, basella- 8 g

SESSION PLAN:

	Lesson topic	Duration	Facilitator	Materials & methods	Learning outcomes
1	Introduction Pre-test Expectations & Objective	30 min	Training organizer	Blank charts and flash cards	Expectations of participants will help to modify the training content to suit to their needs
2	Introduction to bag garden	45 min	Resource person	Video	Participants can visualize how to make a bag garden
3	Preparation of bag garden	60 min	Participants	Demonstration materials	From the video, participants will be able to make bag garden
4	Establishment of bag garden	30 min	Participants	Demonstration Vegetable Seeds	This enables the participants to practice
5	Do's and Don'ts	30 min	Resource person	Interaction	Participants will be able to analyse what needs to be done and what to avoid
6	Post-test & feedback	30 min	Training organizer	Formats	Knowledge acquired will be known.
7	Preparation of work plan	10 min	Training organizer	Workshop	Each participant will come up with a plan of work

Session 1: Introduction, Pre-test & Expectations and Objectives of the training

1. Start the programme with an introduction of the participants, conduct the pre-test and seek the expectations of the participants about the programme, these will be re-checked at the end.
2. Open up a discussion on seasonal vegetable growing by rural households and their home consumption. Analyse the reasons for differences in consumption, if any.
3. Initiate a discussion on the consumption of vegetables during and after rains and flooding.
4. Give practical ideas about communicating to farmers, which may likely include:
 - As many farmers as possible must be involved during preparation of the bag garden.
 - The bags should be placed at a location where other farmers can see the technique and results
 - Feedback and queries of farmers must be noted down for later use or responses.

Session 2: Introduction and advantages

Play the **video** on 'Bag Gardening' to show how it is done.

In an interactive way, explain the use of bag gardens and their potential value. Facilitate answers from the footage they have seen.

What is bag garden?

Where can it be done?

What are the potential advantages and disadvantages?

Do you think it can be applicable to the areas where you are working?

If yes, how do you wish to use the technique?



<https://goo.gl/XatBc5>

NOTES FOR THE RESOURCE PERSON

BAG/ SACK GARDEN:

Bag or sack gardens are tall sacks filled with soil in which vegetables can be grown.

This term sometimes also used to describe horizontal bag gardens, which are simply bags laid on one side with their upper side cut open so that the bag functions like a pot or trough.

This concept for a small portable garden is good for areas where the gardener is landless or may have to continually relocate, as well as for flood-prone areas where farmers cannot grow any vegetables in the rainy season due to prolonged waterlogging. Sack gardens are also fairly efficient in terms of using water.

THE ADVANTAGES OF USING A BAG GARDEN

We recommend using a mixture of coir pith and cow dung in bags as a medium for growing vegetables.

Coir pith is lightweight and holds water better than soil.

People can easily change the position of bags to a suitable place during wet periods.

Coir pith absorbs water easily and unnecessary water drains out easily.

Coir pith holds moisture for a long time, so there is no need to irrigate the bag daily.

Because of these advantages, farmers can use bag gardens in the *Kharif* to produce vegetables for their household consumption.

Session 3: Preparation of Bag garden

1. Encourage participants to practice the preparation of a bag garden based on their learnings from the video. Use the following step-by-step process to demonstrate the system;
2. Combine coir pith and decomposed cow dung in a 1:1 ratio and mix thoroughly. Pour the mixture into poly bags and water it thoroughly. Compost or decomposed water hyacinth can also be used as a substitute for cow dung.
3. Tie or stitch the open end of the bag with a coir rope to avoid any loss of the mixture and to ensure that the bag can be used for at least two seasons.

Session 4: Establishment of Bag garden

Using the example of five bags per farmer, help the participants to understand the distribution of different species of crops in different bags.

NOTES FOR THE RESOURCE PERSON

Demonstration- How to sow? Sort out three bags for leafy vegetables and two for creepers.

Bags 1,2,3 (leafy vegetables): Place the bags filled with the mixture horizontally and cut slits in the upper sides with the help of a knife or a blade.

Depending on the family preferences, sow either amaranthus (mixed with sand or soil to make it easier to sow) or seeds of spinach in the slits in the three bags. For a continued supply of vegetables, repeat this process after harvesting of the first crop.

Bags 4, 5 (creepers): Place the empty bags vertically. Put a long PVC plastic pipe into the center of the bag and pour pebbles into the pipe. Pack the mixture of coir pith and manure into the bags around the pipe as shown in the picture. Remove the pipe leaving a column of pebbles down the center of the bag in order to ensure percolation of water down the whole depth of the bag and to help excess water drain out.

Make four to five holes in the vertical walls of the bag at a fixed interval. Sow two bitter melon seeds or two pumpkin seeds in each hole at a depth of 1 cm.

Place the bags in a sunny elevated position where they are easy to access and water. The bottom can be cut off a plastic bottle to provide a funnel for easy irrigation into the center of the bag.

Session 5: Do's and don'ts

After completing the demonstration, talk about the care needed in establishing the garden. Help participants to share their ideas, and re-iterate the following points:

- Put the bags in an elevated position or on a bamboo platform where they are unlikely to get waterlogged.
- Do not over-irrigate the bags.
- Do not make too many holes in a bag.
- During heavy rains, place the bags where they will not get waterlogged.
- Do not open the bags fully, to prevent either waterlogging during the rainy season or excessive loss of moisture during hot weather.
- Do not place the bags directly on the ground in an existing vegetable garden.
- Do not move the bags unnecessarily which may lead to them tearing.

Session 6

Post-test and feedback:

In concluding the training programme,

- Conduct a post-test using the same questionnaire given at the start to assess the knowledge transferred.
- Obtain feedback from each participant on the training programme using the format provided.

Session 7

Preparation of work plan

Help the participants prepare their work plans before closing the training programme.



◀ CUT AND SOW SEEDS IN THE SLITS

PEBBLES AT THE CENTER OF THE BAG AND MIXTURE AROUND IT ▶



◀ LEAFY VEGETABLES ON HORIZONTALLY PLACED BAG



PRE- & POST-TEST

(Tick (✓) the right answer)

Name of the participant:

1. Bag or sack gardens are tall sacks filled with soil in which vegetables can be grown.

- **Strongly agree**
- **Agree**
- **Disagree**

2. Bags should not be kept directly on soil.

- **Strongly Agree**
- **Agree**
- **Disagree**

3. Bag gardens help in providing vegetables during flooded conditions.

- **Strongly agree**
- **Agree**
- **Disagree**

4. A mixture of coirpith and compost in a 1:1 ratio has to be used to fill the bags

- **Strongly agree**
- **Agree**
- **Disagree**

5. The filled bags should be left without closing to capture rain water.

- **Strongly agree**
- **Agree**
- **Disagree**



Preparation of Floating Gardens

OBJECTIVES

To help farmers acquire knowledge and skills on cultivating vegetables in floating gardens in flood-affected areas where waterlogging is persistent.

To enable farmers get some benefit from flood-affected lands

BACKGROUND

In the areas where prolonged waterlogging is a problem and fields are frequently flooded, vegetable cultivation cannot be conducted even for home consumption. If water persists in the fields for more than 3-4 months, a cropping season will be lost.



DURATION OF THE TRAINING

Two days. The first lesson is theory with a demonstration of bed preparation and a video. The second lesson is conducted 20-25 days after the first.

MATERIAL REQUIRED

- Flash cards
- Scribbling pads & Pens
- Registration form / sheet
- Pre-test questionnaires
- Feedback forms
- White board markers and duster
- Extension material- printed leaflets, charts, posters

Materials needed for Bed preparation

- Water hyacinth
- Four 9 m long bamboo pieces
- Knife
- Long coir rope
- Fishing net
- Seeds: amaranthus, kangkong, bitter gourd, flat beans, and chili



TRAINING METHODOLOGY

The schedule/lesson plan for the training is as follows:

SESSION PLAN

	Topic/Activity	Duration	Facilitator	Material/Method	Expected output
1	Registration	15 min	Training organiser	Format	All the participants attend
2	Introduction	15 min	Training organiser	Give one or two sentences highlighting each person's experiences	All participants are introduced to each other
3	Expectations from participants	15 min	Training organiser	List the expectations on the board and copy onto a chart to verify their fulfillment after the training programme	The facilitator will be able to modify the content to be covered to suit to the expectations of participants
4	Pre-test	10 min	Training organiser	Literates will fill in the questionnaire and illiterates will ask others write for them	Level of knowledge of the participants will help the facilitator in dealing the topic
4	Introduction to floating gardens, the need and importance	30 min	Resource person/ Trainer	Photographs, Powerpoint presentation, charts	The participants will get to know the importance of cultivation in floating gardens
5	Successful cultivation of floating beds	15 min	Training organiser	Video on floating gardens in Bangladesh	Participants will be able to relate this to their context
6	Demonstration on preparation of a floating bed	60 min	Resource person/ Trainer	Materials needed	Participants will learn bed preparation
7	Benefits and drawbacks of a floating bed	30 min	Resource person/ Trainer	Interaction	Pros and cons will be analysed
8	Summary	15 min	Training organiser	Oral presentation by one participant	All participants will be able to summarize the lesson
9	Sowing into the prepared bed	100 min	Resource person/ Trainer	Demonstration 25 days after bed preparation	Participants will practically learn sowing process.
10	Feedback	10 min	Training organiser	Oral feedback regarding the willingness to try the technology	The training organiser will understand what further support is required

DAY- 1

Session 1: Introduction of participants

After registration, ask the participants to introduce themselves to the group through some good ice-breaking exercises if they are from different locations and don't know each other.

Session 2: Pre-test and expectations

Start the training programme with the pre-test to assess the knowledge level of participants.

Obtain the participants' expectations of the training programme on blank flash cards and display them on one wall of the room. Discuss which of these can be achieved and if possible make suggested changes in the program content.

Allow participants to realize the need for floating gardens, facilitating the discussion on waterlogging conditions in the fields and the inability to grow vegetables for local consumption.

Session 3: Introduction to floating garden

Initiate a discussion on the participants' experiences with floods, their ill effects, damage to the soil and the waste of land and time. List all the probable issues on a white board or chart. Draw a seasonality map to track the period of floods and waterlogging.

Later explain in detail.

- Floating gardens work best in waterlogged areas where still water remains for three to four months. Amaranthus, kangkong, colocasia, chili, bitter melon, okra and leafy vegetables can be cultivated on floating gardens.
- Beds should not be established near running rivers with strong currents or in areas that experience high tides. An abundance of water hyacinth plants nearby is a pre requisite for constructing a floating bed.
- The technology is more adaptable for Kharif gardens and the bed has to be prepared before the rain commences, towards end of May or in first week of June, so long as bamboo is readily available.



- The bamboo frame can be used for two seasons, but water hyacinth needs to be changed after each season. The decomposed water hyacinth can be used as manure.

Session 4: Play videos of "Floating garden in Bangladesh".

After the theoretical explanation, conduct a demonstration in the field to show the preparation of a floating bed. Make sure all the required raw materials are ready on the previous day.



<https://goo.gl/dLtlO6>

Session 5: Demonstration of bed preparation

A minimum water level of 1- 1.3 m is needed to keep the bed afloat.

A layer of water hyacinth is spread on the water surface, and above that a supportive framework is placed (eg. Four long bamboo poles placed along the length and shorter poles across the width). Over this another layer of water hyacinth is spread, ensuring that the leaves of the hyacinth remain inward and the roots outward.

Fishing nets have to be placed above both the layers of water hyacinth to keep the plants intact for a longer period.

The plant material should be smashed up with a bamboo stick or by foot. This process should be repeated until the size of bed reaches 1 m above the water level.

Size of the floating bed

In general the size of the floating bed is 6 m long, 1.5 -2 m wide and 1-1.2 m high.

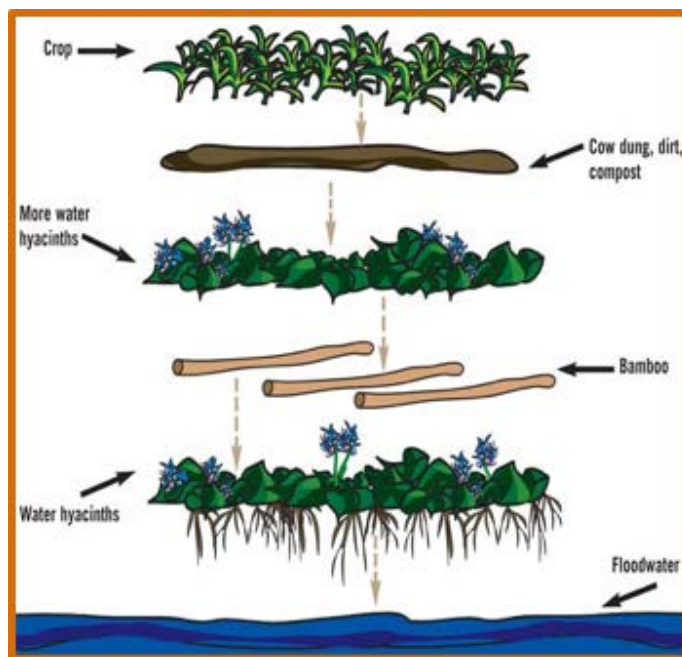
Session 6: Benefits and drawbacks

In an interactive way, discuss the pros and cons of the system, and ensure the following issues are raised;

Benefits: Floating garden beds offer many benefits to farmers. They contribute to the family's food and nutrition security by providing an area to produce vegetables year-round. Farmers gain more space for vegetable cultivation and seedling production in wetlands, and thus become more resilient during monsoons.

Invasive species like water hyacinth are put to good use in floating gardens. As the plants decompose in the beds, water hyacinth contributes nitrogen, phosphorus and potassium at levels comparable to cow manure. This allows farmers to produce well-nourished crops with little or no chemical fertilizer, and minimizes water pollution.

As the water recedes and the land begins to dry, the decomposing beds can be tilled into the soil, adding valuable organic matter and nutrients.



The method works in drier seasons as well. Although water is scarce in the Rabi, farmers can still build and plant floating gardens on lakes and ponds.

Drawbacks: The cost of bamboo varies from place to place, but a bamboo pole 6 m long can cost up to INR 100, and such prices may limit the number of poles a farmer can purchase to construct a sturdy bed. To harvest their floating crops, farmers must enter the water body, which they may not like doing.

Work out the economics of floating beds with the participant group and communicate to the farmers during field visits.

Price for a floating bed (Average) as per the market prices in 2015

Inputs	Required amount (number)	Unit price (Rs.)	Total Price (Rs.)
Bamboos (6 m)	4	80	320
Coir rope	5	15	75
Man power	4	150	600
Total			995

Taking care of a bed

Care and maintenance can be explained as follows:

A floating bed should be tied with a rope to a fixed structure near the water body so that the bed will not float away with the tide.

Do not allow children or animals to walk over the bed, as there may be a chance of falling through if the hyacinth decomposes a lot.

Use the bed for at least for two seasons and note its durability.

DAY-2

Session 7: Sowing

- The bed should be left for 20-25 days for decomposition of the upper layer of water hyacinth, keeping it always wet, by watering twice a day.
- To save time, a layer of decomposed water hyacinth can be applied to the top of the bed. This type of bed can be prepared just 3-4 days prior to seed sowing.
- After the decomposition period, a practical class can be conducted on sowing. A thin layer of soil also has to be spread onto the bed before sowing.

WRAP-UP/SUMMARY

Ask one of the participants to summarize what was learnt. Close the training programme after conducting the post-test, distributing reading material and obtaining feedback.

Work out action plans for the participants to be taken up individually

PRE-& POST-TEST

(Tick (√) the right answer)

Name of the participant:

1. A floating garden contributes to a good vegetable production in waterlogged areas or during floods.

- **Strongly agree**
- **Agree**
- **Disagree**

2. Water hyacinth is the major component of a floating bed.

- **Strongly agree**
- **Agree**
- **Disagree**

3. Bamboo poles form the base of the floating bed, which is tied to a support.

- **Strongly agree**
- **Agree**
- **Disagree**

4. Seeds are sown on the floating bed after it decomposes.

- **Strongly agree**
- **Agree**
- **Disagree**

5. The time required for decomposition of the bed is 10 days.

- **Strongly agree**
- **Agree**
- **Disagree**

Seed Extraction and Storage

OBJECTIVES

- To build awareness and skills in seed collection and storage for home gardeners (your home garden, your seeds)
- To enhance the knowledge of village level extension workers of improved seed production and seed storage practices for kitchen garden crops.

BACKGROUND

- Trainees train home gardeners
- All crops are open pollinated varieties and seeds can be collected and stored for future use
- Seeds are not easily available locally

DURATION OF THE TRAINING

One day – Two sessions (half day each) with demonstration of seed collection, extraction and storage techniques

MATERIAL REQUIRED

- Flash cards
- Scribbling pads and pens
- Registration form/ sheet
- Pre-test questionnaires
- Feedback forms
- White board, markers and duster
- Mature fruit and seedpods from leafy vegetables and fruit vegetables
- Polythene covers
- Label, pencil

Storage materials:

- Glass jar with cap
- Charcoal
- Newspaper / absorbent paper
- Knife
- Mug
- Water

Extension material- printed leaflets, charts, posters



SESSION PLAN

	Topic/Activity	Duration	Facilitator	Material/Method	Expected output
1	Registration	15 min	Training organiser	Format	All the participants attend
2	Introduction	15 min	Training organiser	Provide one or two sentences highlighting each person's experiences	All participants are introduced to each other
3	Expectations from participants	15 min	Training organiser	List the expectations on the board and copy onto a chart to verify their fulfilment after the training programme	The facilitator will be able to modify the content to be covered to suit trainee's expectations
4	Pre-test	10 min	Training organiser	Literates will fill in the questionnaire and others will seek help	The level of knowledge of the participants will help the facilitator in dealing with the topic
5	Discussion on availability of seed for home gardens	30 min	Training organiser, Participants	Charts and white board	Participants will be able to analyse the present situation of their home gardens
6	Introduction to Seed production	30 min	Resource person	Charts/posters	Participants will obtain knowledge on producing their own seed
7	How to extract seeds	45 min	participants	Charts/posters	Participants will be able to understand the concept
8	How to extract seeds	45 min	Training organiser, Participants	Video and demonstration	Participants will be able to demonstrate seed extraction methods
9	Learning safe storage of seed	45 min	Resource person & participants	Demonstration	Participants will know how to store seed carefully
10	Post-test	10 min	Training organiser	Questionnaire	Knowledge gained will be clarified
11	Training feedback	10 min	Training organiser	Format	Future modifications in the training methodology will be possible
12	Wrap-up and summary	15 min	Training organiser	Action plan preparation	Participants will develop a plan put their learning into practice

Sessions 1 & 2: Registration & introduction of participants

After registration, ask the participants to introduce themselves to the group through some good ice-breaking exercises if they are from different locations and don't know each other.

Examples of simple ice-breaking exercises:

My name is?

Go around the group and ask each person to state his/her name and attach an adjective that not only describes a dominant characteristic, but also starts with the same letter of his/her name e.g. generous Geethika, dynamic Dave, beautiful Bhumika, Photogenic Philip etc. Write them down and refer to them by this for the rest of the day.

Someone who?

Form the group into pairs and ask them to get know each other in just a minute. Pose some questions to the group after introducing each other, to which the answer will be given by the partner.

1. Who has the hobby of reading comics?
2. Who has a long hair?
3. Who wishes to holiday at hill resorts?
4. Who likes to travel most of the time?
5. Who loves pets?
6. Whose favourite colour is green?
7. Who seems to be more creative?
8. Who watches horror movies?

The questions can be varied by the coordinator.

Sessions 3 & 4: Pre-test & expectations

Start the training programme with the pre-test to assess the knowledge level of participants.

Obtain participants' expectations of the training programme on blank flash cards and display them on one wall of the room. Discuss which of these can be achieved and if possible make suggested changes in program content.

Facilitate a discussion on present seed collection/ extraction/ storage practices and problems, drawing a problem tree on the board/ chart starting with –

- The main problem of 'home garden sustainability' as the 'trunk'
- Causes for the problem as 'primary branches'
- Further issues that lead into the causes as 'secondary branches' and so on

Link up all the problems & causes showing that they are interlinked. Allow participants to realize the need for seed production and seed storage.

Session 5: Availability of seed for home gardens

Initiate a discussion on the availability of seeds for home gardens, including where they can be obtained, the quality and reliability of supplies using questions such as;

- Where do home gardeners get seed?
- What practices do they have to get seeds in time?
- Do they wish to retain seed for next season?
- If so, how do they do that?
- Are they satisfied with the quality of the seed bought from shops?

Session 6: Introduction to seed production in home gardens

Compare the importance of storing garden seeds to being like storing family jewels.

All crops can produce seeds and can be stored for future use. Like 'Precious family jewels they also need to be saved in a special protected place'. Home garden seeds are equally important and once lost, they are very hard to replace.

Facilitate an open discussion on the pros and cons of producing your own home garden seed.

Organise an interactive session using example left-over plants or fruits for seed production with an emphasis on the following points:

- Select at the right time (mid stage of the crop maturity process)
- Select plants/ fruits/ pods that are free of pests and diseases
- Select during a dry day
- Select from healthy plants and fruits

Session 7: How to produce seeds?

Facilitate a discussion to document the existing community seed production methods.

Discuss the methods of plant propagation using seeds, seedlings and cuttings, using charts, posters and live specimens.

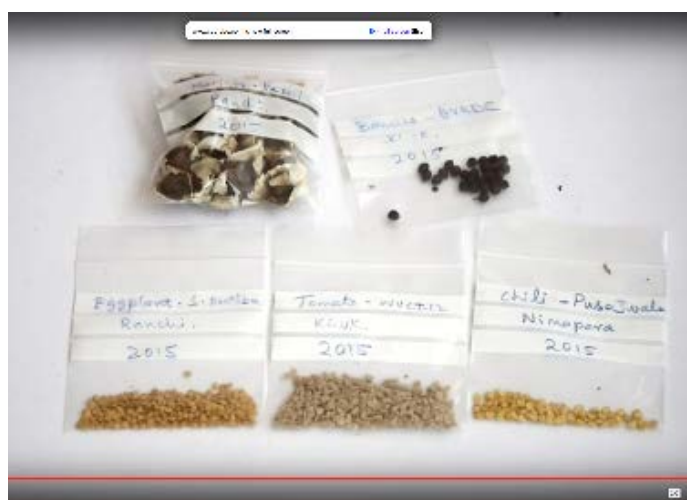
Deal with the principles and concepts of seed production-flowers and their parts, open pollinated varieties vs. hybrids, pollination and fertilization, isolation distances, protection from cross pollination, and specific methods for amaranths and moringa that easily cross-pollinate.

Explain the key points for extraction, drying and storing;

- For leafy vegetables, leaving some plants for seed production after a few leaf harvests
- Shade drying till optimum moisture (well dried seed should be hard to chew)
- Storing in a dry, cool and dark place
- Stored seeds can be used for one to two years
- Seeds may be replaced after three to five years if possible

Session 8: How to extract seeds?

Play the **video** on the extraction of seeds. Pause the video to interact with the participants. Provide some plant and seed samples to the participants and ask them to practice what they have learnt from the video.



<https://goo.gl/17Q1Hy>

Session 9: Learning safe storage of seed

Before showing participants the proper way of storing seed for the future, find out the methods presently adopted by home gardeners for seed storage.

- Do local home gardeners store seed for next season?
- If yes, how is it done?
- Do they have any damage or loss with their present methods of storage?

Then, explain and demonstrate how the extracted seed can be stored.

Encourage participants to discuss and develop a seed storage model that is suited to their situation.

Demonstrate the proper way of storing seed in containers as follows.

- Get a clean jar with a sealable top. Make sure it is dry.
- As a precaution against moisture, put a 1 cm layer of powdered charcoal (dessicant) in the bottom of the jar.
- Place the seeds in an envelope so that they do not get in contact with the charcoal. Place in the jar and close it tightly.
- Periodically check the dessicant. If it feels moist, change it with fresh material.
- The storage jar should be kept in the coolest place in the house, preferably in a frost-free refrigerator.

Explain the use of a pre storage seed test and demonstrate it to the participants.

Mention the point that the packed seeds have to be labelled and kept safe.

NOTES FOR THE RESOURCE PERSON:

Collection and extraction of seed

Tomatoes, Cucumbers and Melons:

Open the fruits and place seeds in a jar. Add a little water to make a soupy mixture.

Leave the jar open at room temperature and allow the mixture to ferment for two to three days. During fermentation, stir occasionally to separate the pulp from the seeds.

After two to three days the seeds should settle to the bottom of the jar and the pulp can be poured off.

Wash the seeds and lay them on absorbent paper; an old newspaper will do. Put them in the sunlight to dry for 2 days.

Squash, Eggplants and Pepper:

Open the fruits. Remove the seeds and wash. Dry them like the tomatoes. Eggplant seed also requires overnight soaking to remove the pulp.



Beans, Okra:

Allow the pods to dry on the plant but pick them before the pods shatter and seeds fall to the ground. Complete the drying process by laying them out under the sun until the pods are hard and dry. The seeds are easily taken from the dry pods.

Seed Storage:

Small seedlots can be stored in polyethylene bags or bottles

Bags thinner than 0.075 mm should not be used, because they are too permeable to moisture vapor.

For recalcitrant seeds which have no dormancy and cannot be stored for long period, the maximum thickness of a storage bag wall is 0.25 mm. Thicker plastics can limit gas exchange because they are impermeable to oxygen and carbon dioxide. There is no maximum thickness for orthodox seeds which are those that can be stored for a long time.

When storing seeds with sharp points or appendages, double bags can be used to reduce the problem of damage to the storage bag.

All orthodox seeds should be stored in moisture-proof, sealed containers with a seed moisture content of 5% to 10%.



Pre-storage seed test

In order to be sure that the seeds to be stored or planted are viable, it is important that a germination test be done before storage or just before planting.

Testing the viability of seeds can be done by placing a number of seeds in a jar or dish with a moist paper towel and allowing them to germinate for 7-10 days. If 80% or more of the seeds germinate, the seeds are good and suitable for either planting or storage.

Sessions 10 & 11: Post-test & feedback

Conduct a post-test using the same questionnaire and obtain feedback about the training programme.

Session 12: Wrap-up

Close the training programme after conducting the post-test, distributing the reading material and obtaining feedback.

Work out individual action plans for the participants.

Follow-up of the training program

Prepare a training report immediately after the programme incorporating any feedback to improve future programs. Follow up with an evaluation of the programme after a given period to know how much of the technology learnt has been applied.

PRE TEST & POST TEST

(Tick (✓) the right answer)

Name of the participant:

1. Home garden plants can be propagated through

- **Seeds**
- **Stem cuttings**
- **Both**

2. To remove the pulp around the seeds of tomato and brinjal,

- **They should be soaked in water**
- **They should be dried in the sun**
- **They should be kept in a cool place**

3. Seeds should be stored to ensure quality and good germination

- **Strongly agree**
- **Agree**
- **Disagree**

4. Seeds can be stored in

- **Bottles**
- **Polythene covers**
- **Both**
- **None**

5. Seeds should be stored in the form of

- **Pods**
- **Seeds**

6. A germination test is needed to test seed viability

- **Strongly agree**
- **Agree**
- **Disagree**

Grafting Techniques for Root Disease Management

OBJECTIVE

To provide knowledge and practice on grafting for root disease management in solanaceous vegetables and also help plantscope with waterlogged conditions.

BACKGROUND

Management of root-borne diseases is easy through the planting of grafted seedlings.

Plants grow healthy and can withstand initial viral infestations.

Plants can survive waterlogged conditions.

DURATION OF THE PROGRAM

Six sessions in one day involving theory and practice

Training material required

- Extension literature
- Video on grafting
- For demo; plants, blade, tube, polythene sheet

NOTES TO THE RESOURCE PERSON

Why graft?

To reduce bacterial wilt disease and other diseases caused by fungal wilt, root knot nematodes and death of the crop due to temporary waterlogging in tomatoes. Organic growers in particular can gain from grafting because growing tomatoes in soil and compost rather than in sterile media often leads to problems with weak roots, as a result of soil-borne pathogens.

Major steps in grafting:

Selecting a Scion

This is the fruiting part of the grafted plant. Any popular and widely grown tomato hybrid/

variety that has the desired fruit characteristics can be used to produce scions for grafting.

Indeterminate varieties should be used in green houses or net houses and determinate or semi indeterminate varieties in open fields.

Selecting rootstock

This is the rooting part of the grafted plant. Select the rootstock based on its potential for resisting soil borne diseases.

To choose the right rootstock, the first step is identifying prevalent pathogens in the area. Fields where solanaceous crops (tomatoes, potatoes, and peppers) have often been grown have recurring problems such as bacterial wilt, verticillium wilt and root-knot nematodes.

Disease resistant eggplants are the best source of rootstock and if the seeds are not available, then use *Solanum torvum* as a rootstock, which is available locally. *Solanum sisymbriifolium* also proved to be a good rootstock.

Raising Root stocks and scion

Both scion and rootstock should have the same stem thickness (diameter) at the time of grafting.

To ensure this, the rootstock has to be sown little earlier than the tomato scion. If wild solanaceous plants like *S. torvum* or *S. sisymbriifolium* are used, they have to sown first as they often have low germination rates and slow growth.

Preparation for grafting:

- A nursery of eggplant rootstocks should be started earlier than the nursery for tomato scions.
- For the nursery media, prepare a mixture of cocopeat and vermicompost in a 1:1 ratio.
- Avoid using soil for the eggplant rootstock nursery to prevent soil borne diseases.
- Select pro trays with 50 or 100 holes and fill them with the nursery mixture.
- Sow the eggplant seeds first.
- Slowly irrigate the seedling trays with a watering can or mug.

- When the germination of eggplant seed is completed, start the sowing of tomato seeds in different trays in the same manner as the eggplant seed was sown.

The seeds for grafting need to be sown two weeks before typical, non-grafted transplanting. This allows the newly grafted seedlings to spend up to one week in the chamber followed by one week under shade or in the greenhouse to re-acclimatize to normal light conditions before they are put into the field.

As germination varies with the variety, sowing times may be altered to grow different cultivars to the same size. In many cases, rootstock varieties take two to five days longer to germinate than the scion.

Before getting into the grafting process, the healing chamber should be constructed and kept ready so that the grafted seedlings can be protected in the chamber without much delay.

Constructing a healing chamber

The purpose of the healing chamber is to protect the scion from water stress. This can be accomplished by slowing the transpiration stream—the movement of water from inside the plant tissue into the atmosphere. The best way to do this is to increase the humidity, decrease light and temperature.

The seedlings resulting from joining a rootstock and scion must reconnect vascular tissues so that water and nutrients can be supplied to the scion from the rootstock. This process occurs in a chamber where humidity, light and temperature can be regulated.

Construction is relatively simple and inexpensive, and selecting a proper place in the farm to locate the chamber plays a critical role. While the grafts are healing in the chamber, they must be kept in 80 to 95 per cent humidity, minimal direct sunlight and a temperature between 24°C and 30°C. The daily temperature variation must remain low, as additional stress can decrease grafting success. The best place for a healing chamber is indoors. Healing chambers can also be maintained inside a greenhouse so long as there

is sufficient shading to keep the grafts from being exposed to excessive heat inside the chamber.

A simple healing chamber consists of a frame covered by polyethylene sheet, which keeps the humidity level high during the healing process. The floor of the chamber should hold water. During the first few days after grafting, an opaqued/black polythene covering is used to keep all light out of the chamber.

Materials required

- PVC pipes, clamps, or wooden sticks or any other suitable material to make the frame can also be used
- Transparent polythene
- Opaque or black polythene
- Wooden stick
- Binder clips
- Water

Construct a frame ideally using 2.5 cm polyvinyl chloride (PVC) piping (or any other available size). The height of the frame should not be so low that it touches the plants or too high to reduce the humidity.

Cover the PVC frame with a layer of clear plastic so that the sides and ends can be easily pulled up to check on the grafts during healing.

Use a wooden stick at the base to make a shallow pool of water which does not touch the seedling tray.

Grafting process

Tomato seedlings are almost always grafted using the 'tube grafting' method in commercial propagation

Tube Grafting Method (Method 1)

Tube Grafting or Japanese Top-Grafting is carried out when the plants are very small and the rootstock and scion can be held together with a 1.5–2 mm tube. This is also called the 'Japanese Grafting Method'. The diameter of the scion and rootstock must be matching. The advantages of this method of grafting are:

- Very good graft union
- Seedlings produced in a short period
- More seedlings can be produced as it requires only local materials.

The disadvantage is:

- The height of the rootstock above the soil is short, so earthing up of the seedlings in the field is not possible as the soil will touch the scion

Materials

- Scion seedlings at a two-true-leaf stage. Target diameter of the grafting site is 1.5 mm.
- Rootstock seedlings at the same leaf stage. Target diameter of grafting site is 1.5 mm.
- Razor blade (used for shaving) works best for this grafting method.
- Grafting tubes/Cycle valve tubes.
- Scissors to cut the valve tubes to the desired length.

Steps

1. Initially, cut the cycle valve tube into 1.5-2 mm long pieces at an angle.
2. Cut the rootstock under the cotyledons at a 30-45 degree or sharper angle. Cutting the rootstock above the cotyledons is not advised as axillary buds may grow out when vigorous rootstocks are used.
3. Prepare the scion with matching stem width cut in the same angle at about 5-10 mm below the cotyledons.
4. Place one tube a half way down on top of the cut end of the scion.
5. Insert the scion and grafting tube onto the rootstock so that the cut surfaces align perfectly.

Transplanting and care of grafted seedlings in the open field.

- The tube need not be taken off as the growing stem applies pressure on it so that it breaks off on its own.
- Plant the grafted plant so that the graft union remains at least 2.5 cm above the soil. This will prevent root formation from the scion.
- Suckers usually develop from the rootstock after grafting and become obvious 6-8 days after



grafting. These suckers should be removed as soon as they emerge.

- Staking of the grafted plants is essential as the earthing up is not possible because of the need to avoid soil contact above the grafted joint to assure protection from soil borne diseases.

Tips for success

For proper healing to take place, the vascular tissue in the rootstock and scion must align so that their tissues can easily grow together, forming a strong union for water and nutrient uptake. An essential component for grafting success is to use rootstock and scion plants that have similar stem diameters. Grafting should take place when the plants are not water stressed. Early in the morning or just after dark are excellent times to graft as transpiration has typically slowed down. Grafting should be done indoors or under some sort of shading. If daytime grafting is essential due to timing and labour concerns, move the plants to a shady area in the morning before transpiration increases to prevent unwanted water stress during the process.

Cleft (v-shaped) grafting method (Method 2)

This technique can be easily practised. This grafting method also has some amount of flexibility in terms of matching the size of the scion and rootstock. As the rootstock shoots will be completely removed, this method has less chance of developing rootstock shoots in the field.

Materials

- Scion seedlings at a two or three-true leaf stage.
- Rootstock seedlings at a two or three-true leaf stage.
- Razor (shaving) blade works the best for this grafting method.
- Grafting clips. Size needs to be selected for matching seedlings.

Steps

1. Using a sharp clean blade, decapitate the rootstock seedling with a horizontal cut approximately at a height of 3-5cm.
2. The decapitated rootstock seedling without any leaves is shown. The foliage of the rootstock seedling is discarded.



3. Bisect the truncated rootstock stem at its widest diameter to a depth of 4 mm.

4. Remove the roots of the scion seedlings with a horizontal cut approximately 5 mm above the cotyledons.

5. Trim the cut surface of the scion seedling to the shape of a wedge with sides approximately 4 mm long. (Alternatively, in the two cut process, two diagonal cuts at an angle of 65 degrees are made to separate the scion from its roots and to form the wedge).

6. Insert the trimmed scion into the vertical slit of the rootstock.

7. Secure the graft with a clip.

Tips

- Selecting matching sizes of scion and rootstock is important in this grafting procedure.
- Trimming leaves from the scion seedling can be beneficial as this can reduce water loss in grafted seedlings. The trimming can be done two to three days before grafting process.
- Grafting clips should also be selected according to the stem size. Clips that are too big cannot hold the grafted union and clips that are too small apply too much pressure and may deform the union.

Healing of graft union

- Move the tray filled with grafted plants for healing for up to 7 days.
- Pour water into the healing chamber. Keep the seedling tray on the wooden sticks above the water. Care should be taken to ensure that the tray should not directly touch the water as it will promote damping off diseases of the seedlings.
- Use black plastic to block all available sunlight from entering the chamber until the leaves of the newly grafted transplants attain normal turgor levels and they no longer show signs of moisture stress.
- Then cover the chamber with black polythene to prevent light penetration. This will help the scion to maintain its stored energy reserves until healing is completed.

- After 24-48 hours, remove the black polythene and allow limited indirect light until the healing process is completed in two more days.
- Four days after grafting, open the transparent polythene for the seedlings to acclimatize to the external environment.
- Two days after this, move the seedlings outside, but keep them under shade for two to three more days and before transplanting in the main field.



SESSION PLAN

	Topic /Activity	Duration	Facilitator	Material/Method	Expected output
1	Introduction, pre test, objective & Expectations	45 min	Training organiser	Use the pre-test format, and ask everyone to introduce themselves with a few highlights of their work	All the participants attend with clear learning expectations to facilitate good content delivery.
2	Introducing Grafting and Materials required, why grafting?	45 min	Training organiser, Participants	Demonstration/ display of materials	Get to know the required materials for grafting
3	Selecting and producing resistant root stocks	30 min	Resource person	Powerpoints	Understanding the importance of producing and using good rootstocks for grafting
4	How to select and produce scion	15 min	Resource person	Powerpoints	Participants will be able to select a good scion
5	Demonstration of grafting process and video play	45 min	Resource person, Participants	Video and demonstration	Participants will be able to demonstrate the grafting technique
6	Demonstration on making of Healing chamber	45 min	Resource person & participants	Demonstration and video	Participants will be able to make their own
7	Post-test and feedback	20 min	Training Organiser	Questionnaire	Knowledge gained will be clarified
8	Wrap-up, summary & work plan preparation	15 min	Training Organiser	Action plan preparation	Participants will develop a plan to help women farmers adopt the technique

Session 1: Introduction, Pre-training test and objective sharing

- Conduct a pre-test using through the structured questionnaire to find out how much the participants know about the subject
- Introduce the participants to each other and tell them about their role in the transfer of technology to farmers.
- Obtain the expectations of the participants regarding the training programme, asking them to list these on the blank flash cards distributed to them.
- Place the cards in a line in one corner of the class-room.
- Explain the objective of the training.
- Initiate a discussion on the regular practices in growing tomatoes and usual nursery raising techniques.
- Gather the participants' experiences on the grafting of Solanaceous crops.

Session 2: Introducing Grafting, why grafting and Materials required

- Explain grafting, root stock & scion as follows:

Grafting is a horticultural technique in which tissues from one plant are inserted into those of another so that the two sets of vascular tissues may join together. The technique is most commonly used in asexual propagation of commercially grown plants for horticulture and agriculture.

Scion is a detached shoot containing buds from a plant which is grafted onto the rootstock. A rootstock is part of a plant from which new above-ground growth can be produced.

- Explain the use of a healing chamber and its importance
- Briefly talk about the care to be taken with the grafted seedlings.

Session 3: Selecting and producing resistant root stocks

Facilitate discussion on the following –

- What are the soil borne diseases of tomato and brinjal in your area?

- How do you think these are transmitted?
- Do you know what constitutes a good rootstock?
- What is a resistant rootstock?
- How can we produce it?
- How to produce rootstock seedlings?

Session 4: How to select and produce a Scion

Explain the following through a Powerpoint presentation

- Criteria for selecting a good scion
- Suitable varieties
- Seedling production

Session 5: Demonstration of the grafting process, and video

Display the **video** and ask the participants to practice the process they saw demonstrated.



<https://goo.gl/UGNKYP>

Session 6: Demonstration of how to make a Healing chamber

Demonstrate how to construct a low cost healing chamber and explain its utilization. Play the video on different types of healing chambers.

Session 7: Post-test & feedback

- After the practice, conduct the post-test with the same questionnaire used at the start to assess the knowledge gained.
- Obtain feedback on improvements to the training process, follow up and further actions.

PRE-TEST & POST-TEST

(Tick (✓) the right answer)

Name of the participant:

1. Grafting is a horticultural technique in which tissues from one plant are inserted into those of another

- **Yes**
- **No**

2. Grafted seedlings are more prone to root-borne diseases.

- **Yes**
- **No**

3. A rootstock is part of a plant from which new above-ground growth can be produced.

- **Strongly agree**
- **Agree**
- **Disagree**

4. Grafted seedlings can be directly transplanted into the field

- **Strongly agree**
- **Agree**
- **Disagree**

5. Grafting also helps the seedlings survive water-logging conditions.

- **Strongly agree**
- **Agree**
- **Disagree**



Annexure 2: Training feedback format

Title of the training :

Name of the participant :

Topic	Question	Response of the participant on On a scale of 1 - 5 (1 = lowest, 5 = highest)			
		Facilitator 1	Facilitator 2	Facilitator 3	Average
Contents	Was the content appropriate?				
	Was it sufficient?				
Reading Materials	Was all the content taught covered in the materials?				
	Were the materials useful?				
Teaching method	Was the teaching method appropriate?				
Trainer/ Facilitator	Was the trainer/ facilitator effective?				
	Did the trainer invite interaction?				
Motivation to learn	Were you motivated to learn the contents?				
	Were you motivated to apply the things learnt?				
Program relevance	Was the program relevant to your needs?				
Level of understanding	Did you understand the content?				
	Can you transfer the contents to others?				
Time and Length	Was the time and length of program appropriate?				
	Was the program timely?				
Facilities	Were the training facilities appropriate and adequate?				
Overall evaluation	What is your overall rating of the program? (1-5) 1. Very poor 2. Poor 3. Average 4. Very Good 5. Excellent				
Planned improvements	How will you apply what you have learned? What additional support or resources do you think you will need? In what topics do you feel confident you can train others, based on what you learned? Do you have any questions or concerns about applying what you learned?				

Annexure 4: Training Evaluation Questionnaire

1. Was the overall training course/programme beneficial to your work? **(Yes, No)**

2. If **"yes"** please explain how it was beneficial.

If **"no"** or **"don't know"** please try to explain why not.

3. Is there any specific knowledge of package of practices and seed production techniques that you have used in your work after the training course/ seminar? **(Yes, No)**

4. If **"yes"** please provide at least one concrete example.

If **"no"** or **"don't know"** please try to explain why not.

5. Have you used the reading materials since you participated in the training course? **(Yes, No)**

6. If yes, please explain what materials you have used and for what purpose.

If **"no"** or **"don't know"** please try to explain why not.

7. Did you incorporate anything else you learned in the training course/ seminar into your work? **(Yes, No)**

8. If **"yes"** please provide at least one concrete example. If **"no"** or **"don't know"** please try to explain why not.

9. Is there anything which has changed your perception, attitude or behavior as a result of the training course/ seminar? **(Yes, No)**

10. If **"yes"** please provide at least one concrete example.

11. What kind of follow up support would help you do your work better?

12. Would you like to attend any training programmes in future? **(Yes, No)**

13. Do you have any recommendation or other comments on the training course/ programme?

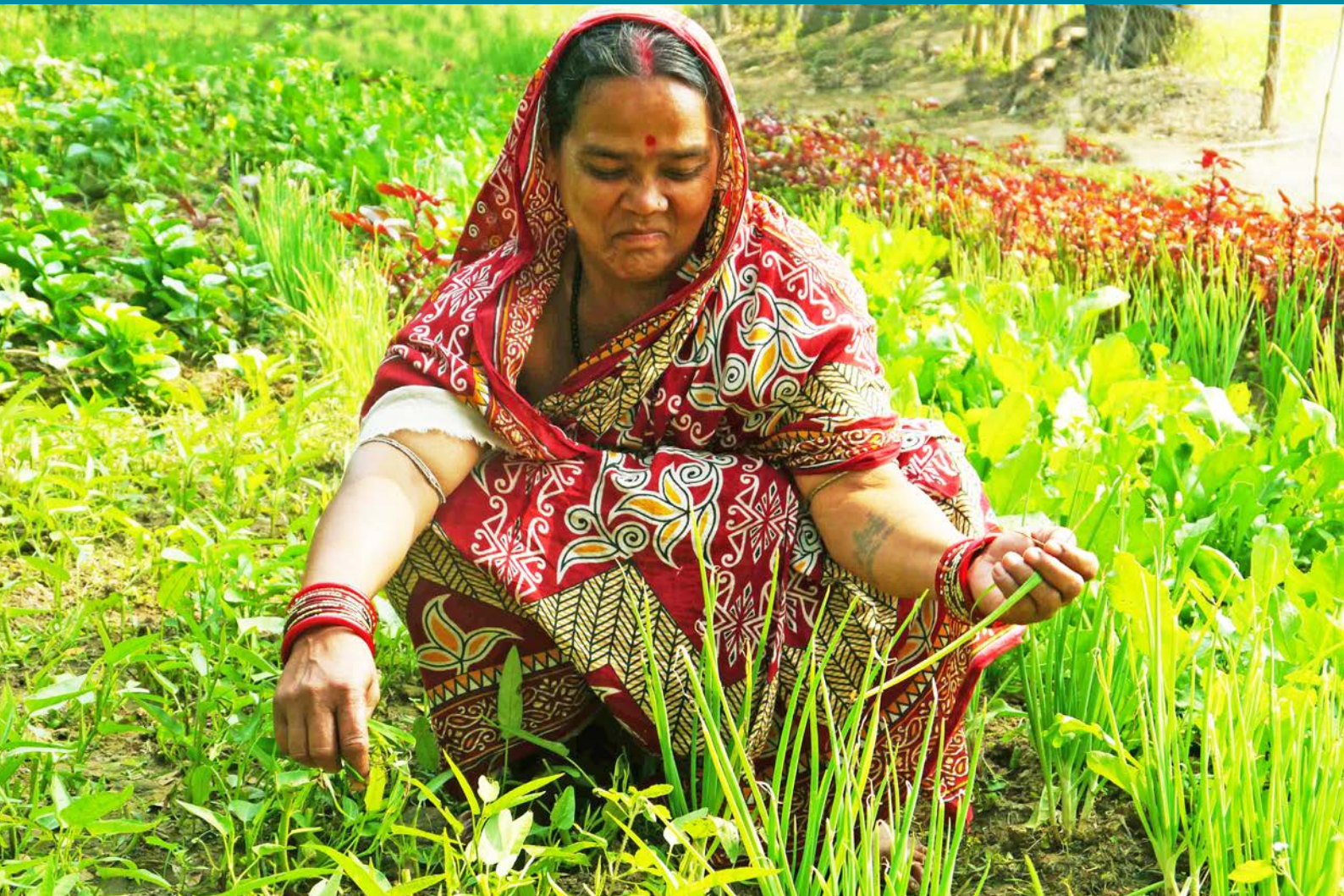
NOTES

AVRDC - South Asia
ICRISAT Campus, Patancheru 502 324
Hyderabad, Telangana, India.

Tel: +91-40-30713755

Fax: +91-40-30713074 / 75

[info-southasia\(at\)worldveg.org](mailto:info-southasia(at)worldveg.org)



Compiled by: PVL Bharathi

Edited by: Warwick Easdown

Contributors: M Ravishankar,
Swarna Sarika, Devender Pal Kaur

Designed by: Sreeram Banda



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