PRACTICAL MANUAL

Organic Farming

HNR 331 3(2+1)

for B.Sc. Horticulture III year II Sem

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Syllabus HNR 331 3(2+1): Raising of vegetable crops organically through nutrient, diseases and pest management, Vermicomposting, Vegetable and ornamental nursery raising, Macro quality analysis, grading, packaging, postharvest management

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PRACTICAL No. 1

Objective: Study about organically vegetable crops raising through nutrient, diseases and pest management

Procedure for land preparation for raising vegetable crops: .....

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Provide proper drainage: .....

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Procedure for direct sowing of different vegetable crops: .....

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Flat beds: .....

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Raised beds: .....

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Ridges: …….....

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Mechanical methods of sowing: ……..

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Manual method of sowing: ……

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Nutrient management: ……

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Management of weeds, diseases and insect-pests at appropriate growth stages: ……

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Optimum irrigation at critical growth stages: .....

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Harvesting at proper stage: .....

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Prepare small area for raising vegetable crops. Keeping in mind the principles of establishing a field, take up manual sowing at proper spacing and depth of any direct seeded vegetable crops. Write the steps in your practical note book as per data sheet.

DATA SHEET

Name of the crop	
Season	
Aspect of the garden	
Slope of the garden	
Date of pre-sown irrigation, if needed	
Plot size	
Size of drainage channel	
Tools/Implements used	
Date of sowing	
Method of sowing (Flat bed/raised bed)	
Seed rate	
Seed treatment (mention the fungicide and rate)	
Organic manures and bio-fertilisers used and quantity applied	
Spacing	
Bio-formulations for insect-pest and disease management applied and its rate	
Bio-herbicides for weed management applied and its rate	
Any other operation	
State your experience	

PRACTICAL No. 2

OBJECTIVE: Study about preparation of bio-formulation for diseases and pest management

Brahmastra (broad spectrum botanical pesticide)

Ingredients required: ……..

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Procedure: .....

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Uses: ……..……

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Neemastra (broad spectrum botanical pesticide)

Ingredients required: .....

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Procedure: ……..

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Uses: ……

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Agneyastra

Ingredients required: .....

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Procedure:.....

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Uses:.....

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Organic Earthen Pot Arkh

Ingredients required: .....

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Procedure:.....

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Uses: .....

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Sanjeevani

Ingredients required:.....

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Procedure:.....

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Uses: .....

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Amrit Dhara

Ingredients required: ……...

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Procedure:…….....

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Uses:.....

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Control of Aphids (Mahu)

Ingredients required:…….....

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Procedure:…….....

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Uses:.....

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Fungal Disease Control

Ingredients required: …….....

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Procedure:…….....

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Uses: ……

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PRACTICAL No. 3

OBJECTIVE: To study about preparation of Vermicompost

Methods of Vermicomposting: .....

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Materials Required:.....

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Commonly used earthworm species: .....

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Basic Characteristics of Earthworm Suitable for Vermicomposting: ……

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Enemies of Earthworm: .....

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Procedure: .....

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Nutritional comparison: .....

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PRACTICAL No. 4

Objective: To study about nursery raising technique for different vegetable crops

Factors to be taken into consideration for raising nursery

Location of the nursery:.....

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Soil: .....

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Procedure for nursery bed preparation: .....

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Seed Sowing in nursery bed: .....

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Quantity of seed and nursery area required for raising seedlings for one hectare area

S.No.	Crop	Seed rate (g/ha)	Nursery area required (m^2)

Use of mulch: .....

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Removal of mulch: .....

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Use of shading nets or polysheets: .....

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Irrigation: .....

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Thinning: .....

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Interculture and weed control: .....

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Plant protection: .....

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Hardening of the plants in the nursery: .....

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Transplanting: .....

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PRACTICAL No 5

OBJECTIVE: To study about ornamental nursery raising

Advantage of raising seedlings in nursery: .....

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Preparation of nursery:

Selection of site.....

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Selection of soil: .....

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Types of nursery bed

a) Flat bed .....

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b) Raised nursery bed .....

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Preparation of raised nursery bed: .....

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Advantage of raised nursery bed: .....

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Media for propagating nursery plants:

1. Soil mixture: .....

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2. Sand .....

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3. Peat.....

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4. Sphagnum moss .....

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5. Vermiculite .....

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Container for propagation and growing young plants:

1. Earthen pots .....

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Tube pot sizes	Height (cm)	Diameter (cm)	Cost per pot (Rs.)
Tube pot			
¼ size pot			
½ size pot			
¾ size pot			
Full size pot			
Tub size pots			

2. Seed pan and seed boxes .....

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3. Polythene bags .....

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4. Plastic pots .....

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Tools and implements for nursery work

Tools and implements	**:**	**Purpose**
Rose can/water can	**:**	
Digging fork	**:**	
Shovel	**:**	
Garden rake	**:**	
Hand trowel	**:**	
Secateur	**:**	
Budding or Grafting knife	**:**	

Potting: ……..

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Pot mixture or potting compost: …….

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Potting procedure: ……

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Repotting: ……

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Repotting procedure: ……

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Experiment No. 6

Objective: To study of determination of total nitrogen from plant sample - Kjeldahl's method.

Materials required: .....

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1. Name the reagents required for the analysis of total nitrogen from plant.

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2. How to digest a plant sample for analysis?

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3. Determine total N from the given sample. Write procedure with calculation.

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General calculations:

- Weight of material digested = 1g = w
- Vol. made after digestion = 100 ml
- Vol. of aliquot taken after digestion = 5ml
- Vol. 0.02N NaOH used for titration of excess sulphuric acid = Y ml
- Vol. of 0.02N sulphuric acid taken in the receiver = X ml
- Vol. of 0.02N sulphuric acid used for actual absorption of ammonia = X-Y ml = T

Total Nitrogen (%) = T x 0.02 x 14 x 100/w x 1000 =

4. What are the precautions needed to be taken while analyzing total N?

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Experiment No. 7

Objective: Determination of crude protein from plant sample

The variation in the N depends on factors like soil type, soil moisture regimes, soil properties like texture, pH, fertility status of the soil etc. total N in the plant samples is one of the most frequent determination made in soil fertility. Common method used for its determination is Kjeldahl's method.

Materials required: ……

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1. Name the reagents required for the analysis of total nitrogen from plant.

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2. How to digest a plant sample for analysis?

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3. Determine total N from the given sample. Write procedure with calculation.

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General calculations:

- Weight of material digested = 1g = w
- Vol. made after digestion = 100 ml
- Vol. of aliquot taken after digestion = 5ml
- Vol. 0.02N NaOH used for titration of excess sulphuric acid = Y ml
- Vol. of 0.02N sulphuric acid taken in the receiver = X ml
- Vol. of 0.02N sulphuric acid used for actual absorption of ammonia = X-Y ml = T

Total Nitrogen (%) = T x 0.02 x 14 x 100/w x 1000 =

Crude protein (%) = N x 6.25 = ???

4. What are the precautions needed to be taken while analyzing total N?

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PRACTICAL No. 8

OBJECTIVE: To study the determination of total phosphorus from plant sample

Materials required: ……..

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1. Name the reagents required for the analysis of total phosphorus from plant.

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2. Determine total P from the given sample. Write procedure with calculation.

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General calculations:

- Weight of plant material taken = 1g
- Volume made = 100 ml
- First dilution = 100 times
- Volume taken for development of colour =
- 5 ml Final volume made = 25ml
- Second dilution = 5 times
- Total dilution = 100 x 5 = 500 times
- Transmittance as read from spectrophotometer = T ppm as read from standard curve against T value = Y ppm of P in the given plant sample = Y x 500 = A

  % P in the given plant sample = A/10000 =

3. What are the precautions needed to be taken while analyzing total P?

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PRACTICAL No. 9

Objective: Determination of total potassium from plant sample

Materials required: ……..

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1. Name the reagents required for the analysis of total potassium from plant.

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2. Determine total K from the given sample. Write procedure with calculation.

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General calculations:

- Weight of plant material taken = 1g
- Volume made = 100ml
- First dilution = 100 times
- Second dilution = 50 times
- Total dilution = 100 x 50 = 5000 times
- Reading shown by flame photometer = A
- ppm of K against A as read from standard curve = Y
- ppm of K in given plant sample = Y x 5000 = B

% K in the given plant sample = B/10000 =

3. What are the precautions needed to be taken while analyzing total K?

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PRACTICAL No 10

Objective: To study about the analysis of amino acids by Ninhydrin test

Materials required: ……..…..

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1. Determine presence of amino acids from the plant sample. Write its procedure.

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2. Write precautions

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PRACTICAL No 11

Objective: Determination of Reducing Sugar by Benedict's test

Materials required: ……..

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Determine presence of reducing sugar from plant product. Write procedure with result observed

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Result:

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Write precautions

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PRACTICAL No. 12

Objective: Analysis of flavonoids using Shinoda method

Materials required: ……..

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Determine presence of flavonoids in the plant product. Write its procedure with result observed.

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Result:

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Write precautions

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PRACTICAL No. 13

OBJECTIVE: Grading and certification of organic produce

Standards of National Program for Organic Production (NPOP)

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Certification process.....

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Steps in organic certification

Receipt of application form.....

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Scrutiny and registration of application:.....

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Inspection and evaluation of the farms and documents.....

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Sampling of soil, water and plant products if necessary:.....

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Issue of certificate to eligible organic farms::.....

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Organic standards.....

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Registration……..

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Certification & Product Labelling……..

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Scope Certificate-.....

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Transaction Certificate--.....

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List of certification agencies in India

No.	Products	Certification Agencies
1.	Floriculture and seeds	
2.	Fruits & Vegetables	
3.	Groundnut/Pulses/ Guargum	
4.	Processed Fruits & Vegetables/ Processed Food Products/Meat products/Cereals preparation/ Misc.	
5.	Preparation Dairy/Poultry/Honey	
6.	Alcoholic Beverages	
7.	Cereals	

PRACTICAL No. 14

OBJECTIVE: Post-harvest handling of organic produce

Describe the post -harvest Management of organic products: ……

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Important practices to maintain the quality of produce: ……

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Post-harvest Storage.....

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.**Room cooling**.....

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Forced-air cooling……

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Hydro- cooling……

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Vacuum cooling……

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Top or liquid icing……

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Enlist the allowed cleaners, disinfectants, sanitizers, and postharvest aides

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PRACTICAL No. 15

OBJECTIVES: Marketing of organic produce

Organic Production and Markets in India:.....

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How to Sell Small Farm Organics: .....

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At Your Farm - Right to the Locals.....

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At the Farmers' Market: ……..

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Start a CSA:……..

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Local Restaurants: ……..

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Smaller Co-Operatives & Grocers.....

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Online:.....

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Enlist the companies which involved in organic product marketing.

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PROCEDURE FOR LAND PREPARATION FOR RAISING VEGETABLE CROPS

- The first step is deep mouldboard ploughing. A field which is not under cultivation should be ploughed to a depth of 30 cm or more *e.g.* a field of native vegetation or pasture grasses must be ploughed deeply to grow vegetables. Deep ploughing promotes complete decomposition of plant material. If there is excessive plant residue in the field, then go for deep ploughing in the fall season. This allows sufficient time for the decomposition of plant residue prior to spring planting.
- Deep ploughing or turning of the soil in the alternate years is sufficient in the fields with continuous cropping unless a large amount of crop residue has been ploughed/turned under.
- Deep chisel point ploughing done in the off years can improve the physical condition of soil by penetrating and breaking compact soil. This is desirable to prevent the formation of a compact soil layer at the depth of the plough blade otherwise it obstruct downward water percolation and normal root development. Sowing of seed directly over chisel marks permits melons, pumpkin and tomato roots to penetrate deeply into the soil profile.
- It is important to avoid ploughing or disking in water saturated soils. To test the proper moisture condition of the soil, compress the soil together in your hand and if the slice disintegrates readily then that indicates the condition to take up land preparation. Therefore, it is important to drain the wet soils before taking up land preparation operation. Taking up operations in wet soils leads to clod development. Clods do not provide well pulverized seed bed. After deep ploughing, disking in two directions should be done for which tandem and/or offset harrows can be used efficiently. If the field has to be furrow irrigated, make rough raised beds using bed lifters. Best height of bed is determined by soil type, intended crop and irrigation method. Raised beds 15-20 cm high ensure good drainage of excessive water, early soil warming, rapid drying of soil surface, improved soil aeration and less chances of soil borne diseases especially in case of heavy soils. Mix farmyard manure or other composts in the field during this operation for proper mixing in the soil.
- If soil moisture is insufficient for planting after bed preparation, preplant irrigation is necessary to replenish moisture to field capacity. Once the soil sufficiently dries, the rough beds should be reworked using a rolling cultivator or a power rotovator. Do not bring soil to powder form. Rotovator mellowing improves the soil structure by breaking up clods and kill weed seedlings which may emerge as a result of the pre-plant irrigation.
- Final seed bed preparation can be done with a bed roller or a sled type shaper. It may be done manually by using spade or hand hoe *etc.* Seed beds are similar to the foundation provided for a building. So, field preparation should be done carefully to harvest good crop. In all these operations greater grower skill comes with experience and working through trials and errors.
- Traditionally, the land preparation is done by using local plough along with leveller driven by the bullocks. For raising vegetables at small scale, spade or any other local implements/tools can be used.
- **Provide proper drainage:** For providing proper drainage, furrows are made both vertical and horizontal at regular intervals. Good drainage is essential to get success in growing vegetables. Drainage not only removes the excess water but also allows the soil to warm up early in the spring, ensures proper aeration and thus favouring proper root growth and development of plants. It also ensures early harvest and more remuneration to the growers along with early planting of next crop.

Procedure for direct sowing of different vegetable crops

- The direct seeded crops are grown on flat beds, raised beds or ridges.
- Prepare raised beds or ridges to a height of 15-20 cm.
- Separate two beds/ridges by making furrow of 30-45 cm width for providing irrigation.
- Leafy vegetables like spinach, mustard, amaranth, coriander, fenugreek *etc.* are sown by broadcasting the seeds. However, the crops sown in the rows grow better than the ones broadcasted.
- Growing of vegetables in rows is advantageous for taking up intercultural operations like hoeing-cum-weeding, fertilizer application, and irrigation along with easy harvesting.
- Apply fertilizers in the rows by mixing it thoroughly with the soil. The seeds should not come in direct contact with fertilizers.
- Treat the seed with fungicide(s) before taking up sowing to minimise the incidence of seed borne diseases.
- Sow the seeds of garden pea, French bean, okra, beet leaf, spinach, cluster bean and cow pea *etc.* directly in the rows.
- Pre-soaking of seeds of pea, French bean and okra in water for overnight before sowing gives better germination. Discard the seeds which float on water surface.
- Sowing of seeds of root vegetables is generally done on ridges but sometimes on flat beds also. Mix seeds of root vegetables or any small seeded vegetables with fine sand to regulate their sowing.
- Pre-germinated seeds of cucurbits also enhance better crop stand.

Mechanical methods of sowing

- Most of the commercial vegetable growers use machine planter to sow the seeds.
- Machines do the sowing operations much better and more rapidly than hand sowing.

- The common seed drills open the furrows, drop the seeds and cover it simultaneously *i.e.* in a single operation.
- These drills can be regulated to sow at various rates and at desired depth.
- By regulating the seed rate through mechanical methods, thinning can be reduced to the minimum.

Manual method of sowing

- Seed sowing by hand is commonly practised in home gardens as well as when the quantity of seed to be sown is less.
- A garden line or marker should be used to provide straight row furrows to do hand sowing.
- The furrows are made with the rake or with the corner of an ordinary hoe or with a heart shaped hoe attached with plough or teeth of a wheel hoe.
- The seed should be distributed uniformly in the furrow.
- The seeds should be covered immediately with the soil by trampling with the help of back of a hoe to prevent loss of soil moisture.

PREPARATION OF BIO-FORMULATION FOR DISEASES AND PEST MANAGEMENT

Coconut- Buttermilk Ghol

Ingredients: Cow buttermilk (*chaanch*) – 5L; Coconut water- 1L; Fruit juice- 1L; Turmeric- 100g; Hing- 20g (It has pesticidal actions)

Method of application

- 1L of this solution diluted with 10L of water before spray.
- Used as a tool for plant protection against fungal disease and insects Brahmastra (broad spectrum botanical pesticide)
- Crush 3 kg neem leaves in 10 L cow urine.
- Crush 2 kg custard apple leaves, 2 kg papaya leaves, 2 kg pomegranate leaves and 2 kg guava leaves in water.
- Mix the two and boil 5 times at same interval till it becomes half.
- Keep for 24 hours, then filter squeeze the extract. This can be stored in bottles for 6 months.
- Dilute 2-2.5 litre of this extract to litre to 100 litre for acre.

Benefits: Useful against sucking pests, pod/fruit borers.

Neemastra (broad spectrum botanical pesticide)

- Crush 5 kg neem leaves in water
- Add 5lit cow urine and 2 kg cow dung
- Ferment for 24 hrs with intermittent stirring
- Filter squeeze the extract and dilute to 100 lit
- Use as foliar spray over one acre
- Useful against sucking pests and mealy bugs

Agneyastra

- Crush 1 kg Ipomea (besaram) leaves, 500 gm hot chilli, 500 gm garlic and 5 kg neem leaves in 10 lit cow urine.
- Boil the suspension 5 times till it becomes half
- Filter squeeze the extract.
- Store in glass or plastic bottles
- 2-3 lit extract diluted to 100 lit is used for one acre.
- Useful against leaf roller, stem/fruit/pod borer

Organic Earthen Pot Arkh

Ingredients: Earthen pot – 1 unit; Indigenous Cow Urine – 5 litres; Neem leaves – 1 kg; Pongamia Leaves – 1 kg; Calotropis Leaves – 1 kg; Jaggery – 50 g

Method of Preparation

- Collect the fresh leaves of Neem, Pongamia and calotropis and crush them
- Mix the Cow urine, cow dung and jaggery properly in the earthen pot.
- Add the crushed leaves to the earthen pot and stir well.
- Cover the mouth of the earthen pot with a clean cloth
- Store it in a shade place for 7-10 days.
- Collect the extract and further add 5 litre of cow urine and again collect the extract every 10 days.

Method of application: For use dilute 20 ml of extract per litre of water and spray the crop or drench the soil in a rose cane for control of disease pests

Sanjeevani

Ingredients: Neem leaves Extract – 250 ml; Desi Cow Urine – 2.5 Litre; Earthen Pot – 1 Unit

Method of Preparation

- Collect the fresh leaves of Neem, extract juice out of it.
- Take an earthen pot and pour the cow urine.
- Pour the neem juice extract and stir well.

The medicine is ready in 1 day.

Method of application: Dilute 50 ml for every litre of water and spray in crop.

Amrit Dhara

Method of Preparation: *Tara Chand Balji Method, Madhya Pradesh*

Add 15 gm peppermint, 15 gm ajawaine, 15 gm kapur and mix well. Spray in 1 acre land.

Benefits: This will protect crops from sucking pests. Control of Aphids (Mahu)

Ingredients: Cow urine: 1L; Fresh cow dung: 2kg; Groundnut cake: 1 kg; Fermented Jaggery: 250 g

Method of application: Mix all the ingredients in 5 litre of water and spray in crops.

Fungal Disease Control

- A mixture of ash (2-3 kg) and 1 liter of castor oil is spread on a seed bed of a size of about 100 m2. The application is repeated 2-3 times at intervals of 7-10 days. This provides protection against soil borne diseases in tobacco nurseries.
- A mixture of 2 kg of turmeric powder and 8 kg wood ash is used as dust over leaves for treatment against powdery mildew.
- Ginger powder at 20 gm/lit of water and sprayed thrice at interval of 15 days can also effectively check the incidence of powdery mildew and other fungal diseases.
- Handful of slaked lime applied at the base of tomato plant can combat damping off disease.
- Cattle and goat urine have fungicidal properties. Two cups of cattle urine with 5ml peppermint oil and 10 lit of water can be used to control fungal diseases on grapes.

PREPARATION OF VERMICOMPOST

Commonly Used Species: *Eisenia foetida, Perionyx excavatus, Eudrilus eugeniae, Lumbricus rubellus, L. terrestris.*

Eudrilus eugenia – African night crawler; Eisenia foetida – Tiger worm; Perionyx excavatus – Indian blue

Maintenance of Base Culture

- For initial multiplication, best substrate is cow dung.
- Base culture should be multiplied on this substrate.
- For any commercial venture, maintenance of seed culture is a must.
- Mixing of cow dung + pieces of banana pseudostem in 1: 1 ratio gives more number of worms due to more multiplication rate.
- One year old semi-decomposed rice straw makes the worm to lay as many cocoons as possible.

Preparation of Vermicompost

- Pit size: 10 m x 1 m x 0.3 m
- In irrigated area and heavy rainfall areas – above ground.
- Drench with chloropyriphos @ 2 ml/lit of H_2O. Leave for one week and then go for filling the pit in the following manner.
- Apply water @ 30 to 60 litres for 16 days. Leave 1000 to 2000 worms of suitable species at about 10-15 cm depth.
- Worm multiplication and compost production will be higher if sugarcane trash, sunflower or bajra residues are used.
- Keep the pit always moist (30-60% moisture) by daily watering (@ 50 lit) during summer or twice a week during rainy season. Provide shade to the pit.
- Vermicompost production is seen after 45 days of leaving worms to the pit. It will be complete in 80-90 days. Residue will be converted to vermicompost (75%).
- To collect / take vermicompost from the pit, leave the pit without watering for about 3 days. Worm will move to deeper layer due to lack of moisture in the upper layer. Take out the compost from the upper layer and sieve the compost and store it in a gunny bag under shade.

FACTORS TO BE TAKEN INTO CONSIDERATION FOR RAISING NURSERY

Vegetable crops are propagated either through seeds or vegetative plant parts. Vegetable crops propagated through seeds are either directly seeded or are transplanted in the field by raising the seedlings in the nursery beds. A nursery could be considered as a location where plants are cared for during the early stages of growth by providing optimum conditions for germination and subsequent growth until they become strong enough for planting in the open field conditions. The seeds of solanaceous vegetables, cole crops, onion *etc.* are first sown in the nursery.

Location of the nursery:

- Nursery should be situated near the main field for transplanting.
- Nursery area should receive sunlight right from morning till evening *i.e.* south-west aspect is most suitable as this aspect is very sunny.
- Area must be free from water stagnation *i.e.* proper drainage must be provided.
- Area should be well protected from stray animals and strong winds.
- The area should be near the water source for continuous supply of good quality water.

Soil

- Soil should have good organic matter.
- Soil texture should be neither too coarse nor too fine.

- Soil should be sufficiently porous and adequately aerated. It should have a fair degree of water holding capacity. Soil pH of nursery bed should be in the range of 6 to 7. Acidic and alkaline soils are not suitable for raising nursery rather, neutral soils are suitable.
- Soil should normally be rich in all essential nutrient elements. Preferably soil testing of nursery area should be done so as to mix additional nutrients accordingly for improving its soil fertility status.

Procedure for nursery bed preparation:

- The soil of the nursery area should be fine and fertile with good water holding capacity. For the preparation of beds, the field should be ploughed and levelled well. Soil should be worked thoroughly to obtain a fine textured soil free of clods and debris.
- Prepare raised beds to facilitate proper drainage of excess water. The level of the bed surface should be made little slanting on the two sides.
- The length of nursery bed should be 3-5 m but it can be increased or decreased according to the availability of land and requirement of plants but the breadth of the beds should not be more than 1.00 -1.2 m and the beds should be 15-20 cm raised from the ground surface.
- The standard size of nursery bed is 3m × 1m × 15 cm.
- A space of 30-45 cm should be left between two beds. This space can be utilized to perform intercultural operations such as weeding, disease and insect-pest management and also for draining out the excess rain water from the nursery beds.
- Add 20-25 kg well rotten farmyard manure in each standard size nursery bed along with 200g single super phosphate and 15-20 g each of fungicides and insecticides such as mancozeb and dusts like methyl parathion.
- The number of nursery beds depends on the particular crop, season and growing area of crop for transplanting.
- The beds should be prepared in the east and west direction and lines/rows for sowing of seeds should be made from north to south direction on the beds.

Seed Sowing in nursery bed

- Treat the seed with bio-fungicides to check the infection of soil borne diseases.
- Make rows at a spacing of 5 cm.
- Sow the seeds at 1 cm depth. The general rule for sowing depth is 2-3 times of the thickness of seed.
- Mix a little of sand in the seed for uniform distribution in the rows and cover it with soil or farmyard manure.
- Avoid broadcasting seeds in the nursery-bed. Thick sowing or sowing with broad casting also leads to increase in an incidence of damping off disease.

Use of mulch

- After sowing, cover the seed bed with a layer of dry grass.
- Apply water over the grass so that seed does not come up on the surface of the bed.
- Mulching maintains the soil moisture and temperature for seed germination.
- It protects the growing seeds/seedlings from direct sunlight and rain drops.
- It protects seeds against bird damage.

Removal of mulch

- Due attention is given to remove the covered mulch from the seedbed.
- After three days of sowing, observe the seed beds daily.
- As and when the white thread like structure is seen above the ground, remove the mulch carefully to avoid any damage to emerging plumules.
- Use of shading nets or polysheets
- After seed germination or during the seedling growth, if there is very high temperature (>30° C), cover the nursery bed with 50% or 60% shading nets (green or green + black coloured) about 60 - 90 cm above ground by providing suitable support.
- During winter season, cover the nursery bed over night with polythene sheet about 60-90 cm above ground by providing suitable support. Remove the sheet in the morning before the temperature rises. This technique protects young seedlings from severe winter frost or low temperature injury.

Watering

- Provide light irrigation to the nursery beds with rose can till the seeds germinate.
- During summers, irrigate the beds twice in a day *i.e.* both morning and evening. During winters, irrigation once in a day is sufficient.
- Keep beds moist but not wet otherwise “damping-off of seedling” may appear. Excess rainwater or irrigated water should be drained out from the nursery bed otherwise plants may die due to excess of water.
- Watering in the beds depends upon the weather condition. If temperature is high, irrigation is applied whereas irrigation is not needed during rainy days.

Thinning

- It is an important operation to remove weak, unhealthy, diseased, insect-pest damaged and densely growing plants from the nursery beds keeping distance of about 0.5 to 1.0 cm from plant to plant.
- The thinning facilitates balanced light and air to each and every plant. It also helps in monitoring the disease and insect pest infestation.

Interculture and weed control

- Timely weeding in nursery is very important to get healthy seedlings. If there are some weeds in the seed bed, remove them manually either by hand or by hand hoe (thin forked *Khurpi*). Pre emergence bio-herbicides can also be sprayed soon after the seed is sown to control the weeds. Cover the soil with mixture of farmyard manure, soil and sand.

Plant protection

- Adoption of plant protection measures in the nursery against the incidence of insect pest and diseases is very important task to get the healthy seedlings.Damping off is a very serious disease affecting seedlings in the nursery. Timely care for controlling diseases and insect-pests is essential.
- If the disease appears after the seed emergence, drench the nursery beds suitable bio-herbicides after germination.
- It will be better to remove and dispose off the affected seedlings from the beds to avoid further spread of pests and diseases.
- Hardening of the plants in the nursery
- Withhold irrigation in the nursery beds 4-5 days before the date of transplanting but on the day of transplanting, first apply water to the nursery beds and then take out the plants for transplanting.
- Hardening should be gradual to prevent or check the growth.
- Warm season crops like tomato, brinjal and chillies cannot withstand severe hardening.
- Hardened plants withstand unfavourable weather conditions like hot day winds or low temperature more efficiently than non-hardened seedlings.
- Transplanting
- After 4-6 weeks of sowing, the plants become 10-15 cm tall and are ready for transplanting.
- Select healthy plants for transplanting and always transplant in the afternoon.
- Fix the plants well in the open field and water them daily till they establish well.

Advantage of raising seedlings in nursery

- It is very convenient to look after the tender seedlings
- It is easy to protect the seedlings from pests and diseases
- Economy of land usage (duration in the main field is reduced)
- Valuable and very small seeds can be raised effectively without any wastage
- Uniform crop stand in the main field can be maintained by selecting healthy, uniform and vigorous seedlings in the nursery itself.

Preparation of nursery

Selection of site

- The nursery area should be nearer to the water source
- Generally, the location should be partially shaded i.e. under the trees. If not, artificial shade is to be provided
- It should be well protected from animals
- Proper drainage facilities should be provided.

Selection of soil: A medium textured, loam (or) sandy loam soil is preferred. Soil should be rich in organic matter. Soil depth should be preferably by 15-25 cm.

Types of nursery bed: a) Flat bed b) Raised nursery bed

Preparation of raised nursery bed: Selected soil should be worked well to break the clods. Weeds, stones and stubbles should be removed. Height of the raised bed should be 10-15 cm with a width of 1m and length may be according to the requirement and conveniences. Two parts of fine red earth, one part of sand and one part of FYM can be incorporated to each bed to improve aeration and fertility of the soil. Before preparing the bed, the soil should be drenched wit 4 % formaldehyde or 0.3 % copper oxy chloride to kill the pathogenic spores in the soil.

Advantage of raised nursery bed

- Water movement will be uniform and drainage of excess water is possible (In the case of flat bed water moves from one end to the other and there is possibility of washing away of seeds).
- Germination percentage of seeds is normally high. Operations like weeding and plant protection measures are easy.

Media for propagating nursery plants: Several materials and combination of different materials are available are media for germinating seeds and rooting cuttings. A good propagating medium should possess the following characters.

- It must be firm and dense to hold the cuttings or seeds in place during rooting or germination.
- It must possess sufficient moisture retaining capacity
- It must be sufficiently porous to permit excess water to drain away and to admit proper aeration
- It must be free from weed seeds, nematodes and pathogens.

Soil mixture: This is the most commonly employed medium for pot plants. It usually consists of red earth, well decomposed cattle manure, leaf mold, river sand and also charcoal in some cases. Soil mixture commonly used for propagation is

Red earth - 2 parts; FYM - 1 part; Sand - 1 part

Sand: It is the most satisfactory medium for rooting of cuttings.

Peat: It consists of the remains of aquatic marsh, bog or swamp vegetation which has been preserved under water in a partially decomposed state. When such peat is derived from sphagnum, hypnum or other mosses, it is known as peat moss. it is used in mixture after breaking them and moistened.

Sphagnum moss: Commercial sphagnum moss is the dehydrated young residue or living portion of acid-bog plants in the genus Sphagnum such as *S. papilliosum*, *S. capillacem* and *S. palustre*. It is generally collected from the tree trunks of the forest species in south Indian hills above 1500m above M.S.L. during rainy period. It is relatively sterile, light in weight and has a very high water-holding capacity. It is the commonly used medium in air layering.

Vermiculite: It is very light in weight and able to absorb large quantities of water. This can be used as a rooting medium for air layering and also in pots for raising certain plants.

Container for propagation and growing young plants

Earthen pots: They are made of burnt porous clay in various sizes to provide requisite amount of soil and root space to different kinds and sizes of plants. They have straight sides and are made wider at the top than at the bottom to hold the greatest bulk of compost where the feeding roots are and also to facilitate easy removal of soil, intact with roots (ball of earth) at the time of planting or repotting. In our county, tube pots of varying sizes are used as follows.

Tube pot sizes	Height (cm)	Diameter (cm)	Cost per pot (Rs.)
Tube pot	20	13	15.00
¼ size pot	18	22	15.00
½ size pot	20	27	30.00
¾ size pot	25	32	50.00
Full size pot	35	35	65.00
Tub size pots	35	50	90.00

Seed pan and seed boxes: Seeds pans are shallow earthen pots about 10 cm high and 35 cm in diameter at the top. They have one large hole for drainage in the centre or 3 holes at equidistant from each other. Seed boxes are made of wood, 40 cm wide and 60 cm long and 10 cm deep, with 6-8 properly spaced holes drilled in the bottom.

Against each of the holes is placed a crock with its concave side down. Some large pieces of crock are put over it and also by the side of this crock, some coarse sand 2 or 3 handfuls are sprinkled on the crock pieces forming a thin layer to prevent fine soil from clogging the drainage. Over this, required soil mixture is added. Very delicate kinds of seeds like Cineraria, Begonia, etc. are best sown in these containers.

Polythene bags: Small polythene bags with holes punched in the bottom for drainage and filled with a porous rooting medium are used for propagation of cuttings like Jasmines, Duranta, Crotons etc. in the mist chamber. Sometimes, young seedlings which are raised in the nursery are subsequently transplanted in these polythene bags and kept there till they attain required growth for transplanting them to the main field (Papaya, Curry leaf etc.).

Plastic pots: Plastic pots, round and square are used to keep mostly indoor plants. They are reusable, light weight, non-porous and they require only little storage space

Tools and implements for nursery work

Rose can/water can	:	This is used for watering the nursery. Fine spray of water should be used for watering nursery of small sized seeds
Digging fork	:	This has prongs of 20 cm long fitted to a wooden handle. This is used for uprooting plants, rooted cuttings, harvesting of tubers etc., without damaging the root system or tubers.
Shovel	:	This is a curved steel plate attached to a wooden handle and used for transferring soil, manure etc.
Garden rake	:	This is used for leveling lands and collecting weeds. The rake consists of a number of nail like projections from a crow bar provided with long handle
Hand trowel	:	This is used as a small tool for making holes for planting seedlings and small plants. This is also useful for removing surface weeds in nursery beds
Secateur	:	This is used for cutting small shoots to regulate shoot growth in fruit trees
Budding or Grafting knife	:	This knife is used for budding and grafting. This has two blades in which one is with ivory edge used for lifting the bark in budding operation.

Potting

Purposes for which plants are potted are

- Preparing plants for sale such as rooted cuttings of grapes
- Growing plants for decoration like crotons
- Growing plants for experimental studies like pot -culture studies
- For using plants as rootstocks in certain grafting methods as in inarching of mango.

Pot mixture or potting compost: It is essential for potting of plants. The pot mixture is prepared by suing various ingredients. The proportion of pot mixtures will vary with different kinds of plants.

- An ideal pot mixture should have an open structure, which allows good drainage and holds sufficient moisture for plant growth and permits excess waster to drain away.
- Should supply adequate nutrient to the plants during all stages of growth
- Should be free from all harmful organisms and toxic minerals and
- Should be light in weight

Potting procedure

- Wet the seedbed before lifting plants. Life with a ball of earth with as much of the root system intact, as possible. Do not pullout seedlings in the hot sun. Do not allow roots or the soil around the roots to dry.
- Fill up pots by putting some crocks first, then a layer of sand (5-8 cm) and finally pot mixture (8-10 cm).
- Place the plant with the ball of earth in the centre upon the layer of pot mixture (Place on one side of pots in the case of root stock plants used in inarching)
- Put pot mixture around the ball of earth, press as you fill up and level off, leaving one inch head space at top. Do not press over the ball of earth. It will break and damage the roots.
- Set the stem of plant at the same height as it was in the seed bed
- Immerse pot with plant in a tub of water gently and keep inside water till air bubbles cease to come out. Remove and place the pot under shade of trees.

Repotting: Repotting is done for changing the soil medium for pot bound plants.

Pot bound condition: When the potted plants are grown for more than one season or one year in pot, the root very soon become a tangled mass and exhaust the entire nutrient in the limited soil, besides being circumscribed in the limited place. This stage is known as pot bound condition.

Repotting procedure

- It is better to west the potted plant 24 hours earlier to facilitate repotting (removal of plant from pot)
- The technique to remove the plant with a ball')f each intact is to keep the right hand palm over the soil, allowing the stem of the plant in between the first fingers and turn the pot upside down holding the pot at the bottom with the left hand and gently knocking the rim of the pot on the edge of table or any other hard surface or even on the bottom edge of another inverted pot. The ball of earth comes out of the pot. If for any reason, it fails to come out, break the pot knocking the sides with a stone or fork and free the soil from it.
- Examine the roots, cut neatly with a secateur, the decayed, dead and dried or twisted roots. Reduce the size of the ball of earth around the roots.
- Place the plant in the new pot at the same height at which it was in the old pot. Fill up pot with fresh pot mixture and immerse in water.

DETERMINATION OF TOTAL NITROGEN FROM PLANT SAMPLE

Equipment and Apparatus Required: Pestle mortar, Distillation flask, pipettes, burette, heater and Whatman No. 1 filter paper

Reagents Required: Conc. H_2SO_4, digestion mixture, NaOH solution, H_2SO_4, methyl red indicator

Procedure:

- Transfer 1g of prepared plant material wrapped in a piece of filter paper, to a 300 ml kjeldahl's digestion flask.
- Add to it 10 g of catalyst mixture and 25-30 ml of concentrated sulphuric acid.
- Mix the contents of the flask by swirling with care not to through the samples on the side.
- Start digesting the contents of the flask on digestion heater for 20-30 min until frothing stops.
- Continue heating until the organic matter is destroyed and the solution is clear light yellow or grey colour. Cool and make the volume 100ml with distilled water.
- Pipette out 10 ml of 0.02N sulphuric acid in a 150 ml conical flask, add 2 -3 drops of methyl red indicator.
- Take 5 ml of aliquot in distillation flask and connect it to the mouth of the distillation flask.
- Now pour 25ml of 45% NaOH in distillation flask through the funnel attached to the distillation apparatus.
- Collect about 30ml the distillate.
- Titrate the excess of 0.02 N sulphuric acid in a conical flask against 0.02N NaOH. The end point is change in colour from pink to yellow.

Precautions

- Prepare reagents carefully
- Handle distillation chamber carefully as it will boil at high temperature
- Titration should be accurate as the amount is very less

DETERMINATION OF CRUDE PROTEIN FROM PLANT SAMPLE

Equipment and Apparatus Required: Pestle mortar, Distillation flask, pipettes, burette, heater and Whatman No. 1 filter paper

Reagents Required: Conc. H_2SO_4, digestion mixture, NaOH solution, H_2SO_4, methyl red indicator

Procedure:

- Transfer 1g of prepared plant material wrapped in a piece of filter paper, to a 300 ml kjeldahl's digestion flask.
- Add to it 10 g of catalyst mixture and 25-30 ml of concentrated sulphuric acid.
- Mix the contents of the flask by swirling with care not to through the samples on the side.
- Start digesting the contents of the flask on digestion heater for 20-30 min until frothing stops.
- Continue heating until the organic matter is destroyed and the solution is clear light yellow or grey colour. Cool and make the volume 100ml with distilled water.
- Pipette out 10 ml of 0.02N sulphuric acid in a 150 ml conical flask, add 2 -3 drops of methyl red indicator.
- Take 5 ml of aliquot in distillation flask and connect it to the mouth of the distillation flask.
- Now pour 25ml of 45% NaOH in distillation flask through the funnel attached to the distillation apparatus.
- Collect about 30ml the distillate.
- Titrate the excess of 0.02 N sulphuric acid in a conical flask against 0.02N NaOH. The end point is change in colour from pink to yellow.

Precautions

- Prepare reagents carefully
- Handle distillation chamber carefully as it will boil at high temperature
- Titration should be accurate as the amount is very less

DETERMINATION OF TOTAL PHOSPHORUS FROM PLANT SAMPLE

Phosphorus is a major component in plant DNA and RNA. Phosphorus is also critical in root development, crop maturity and seed production. Total phosphorus in the plant extract is generally determined by Vanadomolybdo phosphoric yellow colour method in nitric acid system.

Equipment and Apparatus Required: Pestle mortar, Distillation flask, pipettes, burette, heater and Whatman No. 1 filter paper

Reagents Required: 4N Sodium bicarbonate, 6N Hydrochloric acid, 2,4dinitrophenol indicator, Nitric acid – vandate – molybdate reagent, Phosphate standard

Preparation of plant digest

- Wash the samples with distilled water and air dry them or put a filter paper sheet over them to absorb the excess moisture.
- After this initial drying, place the samples in the brown paper bags and place them in hot air oven. Set the temperature of oven at 65^0C and let the samples dry overnight or until all moisture in then is completely lost.
- Take these dry leaf samples and grind them into fine powder or small pieces using a grinder or scissor.
- Take 1 gram leaf sample powder in a kjeldahl/conical flask.
- Prepare a Di-Acid solution of nitric acid and perchloric acid in the 4:1 ratio i.e. 400ml of nitric acid and 100ml of perchloric acid. Add 20 ml of this Di-Acid solution to the kjeldahl/conical flask containing leaf sample powder/pieces. This acid solution is a strong oxidizing agent which will extract all the plant nutrients into an extract form.
- Gently swirl the contents of the conical flask and cover their mouth of the flask. Let the contents of the flask undisturbed for 10-12 hours.
- Put the conical flask on a hot plate and heat the contents of the flask in a well- ventilated place.
- The fumes initially have a light brown colour. As it tends to reach the end point of the heating, the fumes start to get accumulated in the neck of the conical flask which are purely white. At this point stop the heating process.
- The correct proportion of the extract at the end of the heating is about 1-2 ml of the extract.
- After complete cooling of the flask and the extract, collect the extract in a 25 or 50 ml conical flask and makeup the volume to 100 ml with distilled water in a vol. flask. Use this diluted plant extract for further analysis as practiced for soil analysis of K, P, S, Zn etc

Procedure:

- Take 5 ml of plant digest in 25ml volumetric flask.
- Add 1-2 drops of 2-4 dinitrophenol indicator and 4N NaHCO3 solution drop wise till yellow color appears.
- Now add 6N HCl drop wise till yellow color disappears.
- Add 2.0ml of 6N HCl in excess to get required pH of 4.8.
- At this stage add 5ml vanadate molybdate reagent and make up the volume upto 25ml. the colour develops in several minutes and is stable for 2 months at high P concentrations, but at P concentration of 5 ppm it is stable for only 2 weeks.
- Prepare a blank in the similar way. Read the intensity of yellow color formed on a spectrophotometer at a wavelength of 880 nm and make up the volume upto 25ml. the color develops in several minutes and is stable for 2 months at high P concentrations, but at P concentration of 5 ppm it is stable for only 2 weeks.
- Read the intensity of yellow color spectrophotometer at a wavelength of 880 nm.

Precautions

- Carefully handle the digestion and distillation chamber as it is maintained at very high temperature
- Concentrated acids are used, need to be careful while handling

DETERMINATION OF TOTAL POTASSIUM FROM PLANT SAMPLE

For the determination of K, Na, Ca and Mg cations, flame photometer can be used depending on the principle of its excited atoms due to flame and the energy released during the process. Known concentration of standard solutions can be used to prepare standard curve and therefore, sample concentration can be calculated.

Equipment and Apparatus Required: Flame photometer, Pestle mortar, Distillation flask, pipettes, burette, heater and Whatman No. 1 filter paper

Reagents Required: Acid for digestion, Distill water, Potassium standard solutions

Procedure:

1. Digestion of plant samples (1 g) is carried out in digestion chamber using di acid.
2. Take 1 ml of plant extract in 50 ml of volumetric flask.
3. Make the final volume upto 50 ml with distilled water.
4. Now feed the solution to the atomizer assembly of the flame photometer, the galvanometer of which has already been adjusted with the standard K solutions and note down the reading.

Precautions:

- Carefully handle the digestion and distillation chamber as it is maintained at very high temperature
- Concentrated acids are used, need to be careful while handling

ANALYSIS OF AMINO ACIDS BY NINHYDRIN TEST

There is a reaction between an amino group of free amino acid and ninhydrin. Nihydrin is a powerful oxidizing agent and its presence, amino acid undergo oxidative deamination liberating ammonia, CO_2, a corresponding aldehyde and reduced form

of ninhydrin (hydrindatin). The NH_3 formed from an amino group reacts with another molecule of ninhydrin and is reduced product (Hydrindatin) to give a blue colour substance dihydrin (Ruhemanns Complex)

Equipment and Apparatus Required: Water bath, Test tubes, weighing balance, filter paper

Reagents Required: 2% Ninhydrin in acetone, amino acid solution

Procedure:

- Collect plant samples to be analysed. Wash with water, let dry and cut into small pieces.
- Weigh 2 gm of sample and add 10 ml ethanol and mix it. Let it stand for 10 minutes and filtrate it in another flask/ tube
- The filtrate is ready for analysis
- Take 1 ml of plant extract in dry test tube and 1 ml distilled water in another test tubes as a control
- Pour few drops of 2 % ninhydrin in both the tubes. Keep it standing for 5 minutes
- Development of blue or violet colour will indicate presence of protein

Precautions

- Prepare reagents carefully
- Handle water bath carefully

Results:

- Blue colour indicates presence of amino acids

DETERMINATION OF REDUCING SUGAR BY BENEDICT'S TEST

Sodium carbonate makes the environment alkaline. In alkaline condition, aldehydes like glucose are converted to powerful reducing agents like enediols. This product can react with Cu^{2+} ions and forms copper oxide (Cu_2O) which can either be green/yellow/red. Na citrate inhibits the reaction of Copper sulphate and Sodium carbonate to form copper carbonate and sodium sulphate.

Equipment and Apparatus Required: Burner, Test tubes, weighing balance, filter paper**,** pipette, test tube holder

Reagents Required: Benedict's reagent - copper sulphate, sodium citrate, sodium carbonate

Procedure:

- Collect plant samples to be analysed. Wash with water, let dry and cut into small pieces.
- Weigh 2 gm of sample and add 10 ml ethanol and mix it. Let it stand for 10 minutes and filtrate it in another flask/ tube
- The filtrate is ready for analysis
- Using a pipette, take 5 ml of Benedict's reagent and slowly transfer it to test tube
- Take 5 ml of sample extract and add into the test tube with benedict's reagent
- The test tube should be held securely with test holder and heat it in the burner for 2 minutes
- On heating, the sample, the colour changes to green/yellow/red indicating the presence of sugar

Precautions

- Prepare reagents carefully
- Handle test tube carefully while heating
- Titration should be accurate as the amount is very less

Results:

- Check the colour of the solution and interpret the results accordingly
- Green – 0.5 %
- Yellow – 1 %
- Orange – 1.5 %
- Red/Brown – 2 %

ANALYSIS OF FLAVONOIDS USING SHINODA METHOD

Flavonoids are a diverse group of phytonutrients (plant chemicals) found in almost all fruits and vegetables. Along with carotenoids, they are responsible for the vivid colors in fruits and vegetables. The flavonoid which is present in the extract after the addition of Magnesium and conc. HCl, it reduces to the anthocyanin and due to formation of this, the colour of the extract changes to red.

Equipment and Apparatus Required: Pestle mortar, filter paper

Reagents Required: 95 % ethanol, Magnesium ribbon, conc. HCl

Procedure:

- Take any plant material. Dry it and grind it
- Transfer 4 gm of powdered sample in a conical flask
- Add 20 ml 95% ethanol to prepare ethanolic extract
- Shake the conical flask so that ethanol gets mixed properly with plant material
- Cover it with cork and leave it for 30 minutes
- Filter the extract using filter paper
- Take about 2-3 ml of ethanolic extract and transfer it into the test tube
- Add 3-4 drops of conc. HCl
- Add few pieces of Magnesium ribbon into the test tube

- After the addition of conc. HCl and magnesium ribbon, if the colour of the solution changes to pink or purple then it indicates the presence of flavonoids

Precautions

- Carefully filter the extract
- Concentrated acids are used, need to be careful while handling

Results:

- Change in colour of the solution to pink or red indicates the presence of flavonoids

GRADING AND CERTIFICATION OF ORGANIC PRODUCE

Standards of National Program for Organic Production (NPOP)

- The organic certification process in India follows a set of standard guiding principles laid down by National Program for Organic Production (NPOP). They are as follows.
- Conversion of land for Organic Farming must be done.
- All inputs to the farm should be natural.
- No Genetically Modified inputs or Irradiation technology should be used.
- Integrity of all processes (physical, biological, mechanical) must be maintained at all times.
- No contamination from nearby farms or other means must be present.
- Sustainable practices must be followed in the farm.

Certification process: In order to certify a farm, the farmer is typically required to engage in a number of new activities, in addition to normal farming operations: Study the organic standards, which cover in specific detail what is and is not allowed for every aspect of farming, including storage, transport and sale.

Steps in organic certification

Receipt of application form: The farmer intending to get his farm organically certified must apply to the organic certification board. The documents required for applying are duplicate of application form, Pan card, Annual cropping pattern, Field map, General details of the farm, Soil and water analysis report, Chitta (land documents), a written annual production plan must be submitted, detailing everything from seed to sale (seed sources, field and crop locations, fertilization and pest control activities, harvest methods, storage locations etc.)

Scrutiny and registration of application: The application received along with the others farm or field details are verified by the inspector if it meets the requirements then the application is forwarded for the registration. For the registration the farmer must pay a prescribed amount. Once the farm is registered it must be strictly maintained under the organic conditions only.

Inspection and evaluation of the farms and documents: Annual on- farm inspections are required, with a physical tour, examination of records, and an oral interview is done. Record keeping written, day-to-day farming and marketing records maintained and will be checked, the farmers must have covered all activities like biodiversity conservation and buffer zone. The farmer must be viable for inspection at any time. In addition, short notice or surprise inspections can be done by the certification officer.

Sampling of soil, water and plant products if necessary: If the certification officers doubt that the grower has done a mal practice then he has all the right to collect the soil, water and plant sample. Analysis of plant and soil sample will be done and if the results indicate the presence of any chemicals or toxic substance then their certificate will be taken back.

Issue of certificate to eligible organic farms: If the grower has maintained his farm purely under organic condition then a certificate will be given to him assuring others that he is an organic grower. The certificate is online generated, and it takes around six months from date of application.

Organic standards

- Conversion period it is the time required for the conversion of inorganic field to completely organic field. Its two years for annuls and three years for perennials.
- Buffer zone: Area of three-meter square must be left in border of field to separate the organic field from inorganic field. If the organic field is in low regions, then there must be a drench dug to avoid entry of polluted water in the form of runoff to organic field.
- One per cent of area must be covered under the trees to protect the biodiversity and the farm must have a live fencing.
- Selection of crop and variety- The crop must be suitable to the area and season. The seeds used must be organic if such seeds are not available then the farmers can use the commercial seed in the first year and from the consequent year, he must use the seeds that are produced in his farm.
- The crops grown must be divers as it avoids loss to grower.
- Only biodegradable material of microbial, plant or animal origin should be used, minimize nutrient loss is needed and accumulation of heavy metals and other pollutants must be prevented.
- Origin farm must encourage the soil and water conservation.
- Weeds should not be controlled chemical method.
- No use of synthetic growth regulators.

Registration

- Individual farmers- The farmer willing to register a field under organic must be a legal owner of the land and there no limit of area for certification.
- Group- All the members of the group must be within the revenue district and no restriction on the area for certification but numbers of farmers with more than 10 ac of land should be less than 50 per cent of total area of group.

- Corporate bodies- Group of farmers can come together and register as a corporate body. They can produce organically, process and sell but there should be an office setup to monitor the activities.

Certification & Product Labelling: Being able to put the word "organic" on a food product is a valuable marketing advantage in today's consumer market as people have become more health conscious.

Certification is intended to protect consumers from misuse of the term organic, and make buying of organic products an easy task. However, the organic labelling made possible by certification. In India the following certificates and labels are mandate to produce, sell and export any organic produce.

Scope certificate- This is the certificate that is provided by the organic certification agency which ensures that field is maintained organically according to the NPOP standards. The certificate needs to be renewed every year by paying a prescribed fee. Scope certificate contains the following details of the organic grower and the field.

Transaction Certificate- Transaction Certification is an authorization certificate given by APEDA stating that the products or stocks mentioned in transaction certificate has been produced and/or prepared in compliance with the current NSOP/NPOP standards. This certificate shall also be issued to the seller, if the seller provides the required details after the verification by the Organic Certification Inspector and evaluator.

List of certification agencies in India

S. No.	Products	Certification Agencies
1.	Floriculture and seeds	Dept. of Horticulture/DIC/SIA/FSSAI
2.	Fruits & Vegetables	Dept. of Agriculture/Horticulture/ DIC/SIA/FSSAI
3.	Groundnut/Pulses/ Guargum	DIC/SIA/FSSAI/Udyog Aadhaar Memorandum issued by Ministry of MSME
4.	Processed Fruits&Vegetables/ Processed Food Products/Meat products/Cereals preparation/ Misc	FSSAI
5.	Preparation Dairy/Poultry/Honey	FSSAI/EIC/EIA
6.	Alcoholic Beverages	Dept. of Excise Commissioner
7.	Cereals	DIC/ SIA/ FSSAI/Udyog Aadhaar Memorandum issued by Ministry of MSME

POST HARVEST HANDLING OF ORGANIC PRODUCE

Describe the post -harvest Management of organic products: The inherent quality of produce cannot be improved after harvest, only maintained for the expected window of time (shelf life) characteristic of the commodity. Part of what makes for successful postharvest handling is an accurate knowledge of what this window of opportunity is under your specific conditions of production, season, method of handling, and distance to market. Under organic production, growers harvest and market their produce at or near peak ripeness more commonly than in many conventional systems. However, organic production often includes more specialty varieties whose shelf lives and shipping traits are reduced or even inherently poor. As a general approach, the following practices can help you maintain quality:

Important practices to maintain the quality of produce:

- Harvest during the coolest time of day to maintain low product respiration.
- Avoid unnecessary wounding, bruising, crushing, or damage from humans, equipment, or harvest containers.
- Shade the harvested product in the field to keep it cool. By covering harvest bins or totes with a reflective pad, you greatly reduce heat gain from the sun, water loss, and premature senescence.
- If possible, move the harvested product into a cold storage facility or postharvest cooling treatment as soon as possible. For some commodities, such as berries, tender greens, and leafy herbs, one hour in the sun is too long.
- Do not compromise e high quality product by mingling it with damaged, decayed, or decay-prone product in a bulk or packed unit.
- Only use cleaned and, as necessary, sanitized packing or transport containers. These operating principles are important in all operations but carry special importance for many organic producers who have less access to postharvest cooling facilities.

POSTHARVEST STORAGE: Temperature is the single most important tool for maintaining postharvest quality. For products, that are not field-cured or exceptionally durable, the removal of field heat as rapidly as possible is highly desirable. Harvesting cuts a vegetable off from its source of water, but it is still alive and will lose water, and therefore turgor, through respiration. Field heat can accelerate the rate of respiration and with it the rate of quality loss. Proper cooling protects quality and extends both the sensory (taste) and nutritional shelf life of produce. The capacity to cool and store produce gives the grower greater market flexibility. Growers have a tendency to underestimate the refrigeration capacity needed for peak cooling demand. It is often critical that fresh produce rapidly reach the optimal pulp temperature for short-term storage or shipping if it is to maintain its highest visual quality, flavor, texture, and nutritional content. The five most common cooling methods are described below.

Room cooling – an insulated room or mobile container equipped with refrigeration units. Room cooling is slower than other methods. Depending on the commodity, packing unit, and stacking arrangement, the product may cool too slowly to prevent water loss, premature ripening, or decay.

Forced-air cooling – fans used in conjunction with a cooling room to pull cool air through packages of produce. Although the cooling rate depends on the air temperature and the rate of airflow, this method is usually 75 to 90% faster than simple room cooling. Design considerations for a variety of small- and large-scale units are available in Commercial Cooling of Fruit, Vegetables, and Flowers (ANR Publication 21567).

Hydrocooling – showering produce with chilled water to remove heat, and possibly to clean produce at the same time. The use of a disinfectant in the water is essential, and some of the currently permitted products are discussed later in this publication. Hydro-cooling is not appropriate for all produce. Waterproof containers or water-resistant waxed corrugated cartons are required. Currently waxed corrugated cartons have limited recycling or secondary use outlets, and reusable, collapsible plastic containers are gaining popularity. A list of vegetables that are suitable for hydrocooling is available in Postharvest Technology of Horticultural Crops (ANR Publication 3311) as well as in Commercial Cooling of Fruit, Vegetables, and Flowers.

Top or liquid icing – an effective method to cool tolerant commodities, and equally adaptable to small- or large-scale operations. Ice-tolerant vegetables are listed in Postharvest Technology of Horticultural
Crops and in Commercial Cooling of Fruit, Vegetables, and Flowers. It is essential that you ensure that the ice is free of chemical, physical, and biological hazards.

Vacuum cooling – uses a vacuum chamber to cause the water within the plant to evaporate, removing heat from the tissues. This system works well for leafy crops that have a high surface-to-volume ratio, such as lettuce, spinach, and celery. The operator may spray water onto the produce before placing it into the vacuum chamber. As with hydrocooling, proper water disinfection is essential (see Sanitation and Water Disinfection). The high cost of the vacuum chamber system restricts its use to larger operations.

Enlist the allowed cleaners, disinfectants, sanitizers, and postharvest aides

Acetic acid – allowed as a cleanser or sanitizer. The vinegar used as an ingredient must be from an organic source.

Alcohol (ethyl) – allowed as a disinfectant. Alcohol must be from an organic source.

Alcohol (isopropyl) – may be used as a disinfectant under restricted conditions.

Ammonium sanitizers – quaternary ammonium salts are a general example in this category. Quaternary ammonium may be used on non-food-contact surfaces. Its use is prohibited on food contact surfaces, except for specific equipment where alternative sanitizers significantly increase equipment corrosion. Detergent cleaning and rinsing procedures must follow quaternary ammonium application.

Bleach – calcium hypochlorite, sodium hypochlorite, and chlorine dioxide allowed as sanitizers for water and food contact surfaces. In California, product (fresh produce) wash water treated with chlorine compounds as a disinfectant cannot exceed 10 ppm residual chlorine measured downstream of product contact.

Detergents – allowed as equipment cleaners. This category also includes surfactants and wetting agents. Products must be evaluated on a case-by-case basis.

Hydrogen peroxide – allowed as a water and surface disinfectant.

Ozone – considered GRAS (Generally Regarded as Safe) for produce and equipment disinfection. Exposure limits for worker safety apply.

Peroxyacetic acid – Water disinfectant and fruit and vegetable surface disinfectant.

Other aides

Carbon dioxide – permitted for postharvest use in modified- and controlled-atmosphere storage and packaging. For crops that tolerate treatment with elevated CO_2 (≥15%), suppression of decay and control of insect pests can be achieved.

Fumigants – allowed if materials are naturally occurring forms (e.g., heat-vaporized acetic acid). Materials must be from a natural source.

Wax – must not contain any prohibited synthetic substances. Acceptable sources include carnuba or wood-extracted wax. Products that are coated with approved wax must be so indicated on the shipping container.

MARKETING OF ORGANIC PRODUCE

Organic Production and Markets in India: Major organic produces in India include plantation crops i.e. tea, coffee, and cardamom, spices i,e. ginger, turmeric, chillies and cumin, cereals i.e. wheat, rice, jowar, and bajra, pulses i.e. pigeonpea, chickpea, green gram, red gram, and black gram, oilseeds i.e. groundnut, castor, mustard and sesame, fruits i.e. banana, sapota, custard apple and papaya, and vegetables i.e. tomato, brinjal, and other leafy vegetables, besides honey, cotton and sugarcane especially for jiggery. There are three types of organic producers in India – traditional organic growers who grow for their subsistence needs, commercial farmers who have surplus and export their produce through different channels, and private companies which either have their own farms or organize large conversion programmes with growers.

How to Sell Small Farm Organics: Larger organic operations often have an easier time finding buyers than small organic farms. However, it doesn't have to be that way. For one thing, don't ignore typical markets. Even though you're smaller, you can still find some of the same buyers that larger operations find. Secondly, focusing on local customers is a smart bet for smaller organic farms. Below are some ways you can sell organics locally, on a smaller scale.

At Your Farm - Right to the Locals : You can set up a small farm-stand, offer U-pick services or even consider adding a small shop to your property and sell your fresh goods in this manner. Note that if you do sell right at your farm, you have to advertise that you've got farm produce to sell or no one will come to you. Be sure to place contact info and directions on

your farm's website. Consider hanging posters in co-ops and smaller natural grocers or at other local places, such as schools and libraries.

At the Farmers' Market: Farmers' Markets are a perfect place to set up shop year-round. Most areas have at least a few Farmers' Markets and their numbers are growing. Make sure you have an attractive stand and set prices that are reasonable when compared to other sellers. Also, if your local market has a well-known strawberry seller already, well offer another item.

Start a CSA: A CSA can be a lot of work to get started, but can also pay-off if you get a successful CSA running. Community Supported Agriculture (CSA) is a unique local farming system where a farmer will offer “shares” or "subscriptions" of the farm for sale to members of the community. A good CSA system allows for low-cost marketing and may help guarantee a decent percentage of seasonal sales.

Local Restaurants: Restaurants that serve organic food are popping up all over the place. Usually, organic ingredients are harder to source for most food establishments. These restaurants will likely jump at the chance to associate with and buy from a reputable grower year-round. This is a win-win situation, so long as you stay professional and offer great products.

Smaller Co-Operatives & Grocers: Selling to smaller organic retailers works much like selling to organic restaurants. Keep in mind that retail establishments are more likely to be certified organic than a restaurant though and thus have more stringent handling practices. Also, many small co-ops and even larger organic retailers have their own specific organic labeling practices in place. They often want a percentage of products free in order to carry your goods at their store. So, make sure you discuss all the details with a store before selling it to them.

Online: Selling online can be tricky. For one, most people will not buy fresh food online, unless it's in the form of a CSA subscription or grocery delivery system. Both of these are ways you can sell online if you deal with food. If you're a small organic operation that processes crops into value-added goods, you may have a wider online market.