PRACTICAL MANUAL

Principles of Organic Farming

APA 308 2(1+1)

B. Sc. (Agriculture) III Year (VI Semester)

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2020

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Syllabus APA 308 3(2+1):

Visit of organic farms to study the various components and their utilization; preparation of enrich compost, vermicompost, bio-fertilizers/bio-inoculants and their quality analysis; indigenous technology knowledge (ITK) for nutrient, insect, pest disease and weed management; cost of organic production system; post harvest management; quality aspect, grading, packaging and handling.

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PRACTICAL No. 1

OBJECTIVE: Visit of organic farms to study the various components and their utilization

ACTIVITY: Gathering information about farm waste and their decomposition and proper farm planning for establishing organic farm.

Raw materials availability for preparation of organic manures at farm: ……

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Crops grown under organic farming:……

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Limitations and benefits of organic farming: ……

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Precautionary measures: .....

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Take home lesson: .....

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Data sheet

1. Name of the owner : ....
2. Address : ....
3. Date of visit : ....
4. Cropping Season : ....

Name of the crop	Area sown under a particular crop	Date of sowing/ transplanting	Name of the variety/ hybrid	Spacing	Growth stage	Insect-pest & disease incidence	Expected harvest duration (days)	Expected yield (kg.)	Expected income (Rs.)	Remarks

PRACTICAL No. 2

OBJECTIVE: To study preparation of enrich compost

Materials Required: ……

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Initial preparation required:

Shredding:……

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Mixing: ……

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Pit making and filling with substrate ……

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Procedure:……

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Nutritional comparison: ……

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PRACTICAL No. 3

OBJECTIVE: To study preparation of Vermicompost

Commonly used earthworm species: ……

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Preparation of Vermicompost:.....

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Materials Required: ……

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Basic Characteristics of Earthworm Suitable for Vermicomposting: .....

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Enemies of Earthworm: .....

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Use:.....

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PRACTICAL No. 4

OBJECTIVE: To study preparation of bio-fertilizers/bio-inoculants

Stages of development of biofertilizers:……

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Mass production: ……

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Media used for mass culturing: …….. ……

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Carrier materials:.....

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Application methods:.....

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PRACTICAL No. 5

OBJECTIVE: To study the quality analysis of composts

Determination of Moisture percentage of compost: .....

Particle size, smell and color: .....

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Determination of pH: ……

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Determination of electrical conductivity: ……

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Determination of organic matter: ……

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Determination of C: N ratio: ……

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PRACTICAL No. 6

OBJECTIVE: Indigenous technology knowledge (ITK) for nutrient management.

BIJAMRUT

Ingredients required:.....

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Procedure:.....

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JIVAMRUT

Ingredients required: .....

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Procedure:.....

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Uses:.....

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AMRITPANI

Ingredients required: .....

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Procedure: .....

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Uses: .....

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PANCHAGAVYA

Ingredients required: .....

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Procedure: ……

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Uses: ……

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Sanjivak

Ingredients required: ……

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Procedure: ……

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Uses: ……

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Enriched Amrut Ghol

Ingredients required: ……

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Procedure: ……

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Uses: ……

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Amrit Jal

Ingredients required: ……

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Procedure: ……

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Uses: ……

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Bilb Rasayan

Ingredients required: ……

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Procedure: ……

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Uses: ……

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Harad Rasayan

Ingredients required: ……

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Procedure: ……

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Uses: ……

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Pushp Rasayan

Ingredients required: ……

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Procedure: ……

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Uses: ……

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Calcium Arkh

Ingredients required: ……

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Procedure: ……

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Uses: ……

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PRACTICAL No. 7

OBJECTIVE: To study about indigenous technology knowledge (ITK) for insect pest and disease management

Coconut- Buttermilk Ghol

Ingredients required: .....

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Procedure: .....

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Uses: .....

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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. 8

OBJECTIVE: To study about Indigenous technology knowledge (ITK) for weed management

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PRACTICAL No. 9

OBJECTIVE: To study about cost of organic production system

S. No.	Operation/Materials	Inputs	Rate (Rs.)	Cost (Rs.)
1.	Nursery (100 m^2) (a) Nursery preparation			
	(i) One discing by 35 HP Tractor			
	(ii) Two ploughings & plankings by tractor			
	(b) Seed bed preparation			
	(c) Manures (@ 3 kg m^{-2})			
	(d) Seed			
	Soil treatment			
	Seed Treatment			
	(e) Sowing of seeds			
	(f) Plant protection			
	(g) Nursery care (1labour 4 hours day^{-1} for 30 days)			
2.	Field preparation			
	(i) One discing by 35 HP Tractor			
	(ii) Two ploughings & plankings by tractor			
3.	Layout (Manual)			
4.	Uprooting & packing of seedlings			
5.	Seedlings inoculation & transplanting			
6.	Gap filling and establishment of planting materials (5 labour for 5 days)			
7.	Manures			
	(a)			
	(b)			
	(c)			
8.	Weeding (2 manual weeding)			

9.	Hoeing			
10	Irrigation			
	(a) Water charge			
	(b) Labour charge			
11	Plant protection			
	(a)			
	(b)			
	(c) Labour charge			
12	Harvesting, grading and Packing			
13	Land revenue			
14	Interest on working capital			
Total Cost of cultivation (Rs.)				

PRACTICAL No. 10

Objective: Determination of total nitrogen from plant sample

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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PRACTICAL No. 11

OBJECTIVE: Determination of crude protein from plant sample

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. 12

OBJECTIVE: 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.13

OBJECTIVE: Determination of Reducing Sugar by Benedict's test

Materials required:……

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

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Result: ……

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2. Write precautions: ……

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PRACTICAL No 14

OBJECTIVE: Analysis of flavonoids using Shinoda method

Materials required: ……

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

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Result: ……

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2. Write precautions: ……

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PRACTICAL No. 15

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. 16

OBJECTIVE: To understand about the Grading of the organic produce.

Basis of grading:

Soundness:.....

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Firmness: .....

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Cleanliness……

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Size……

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Weight……

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Colour……

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Shape……

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Maturity……

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Diseases……

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Insect: ……

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Damage: ……..……

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Mechanical injury: ……

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PRACTICAL NO.17

OBJECTIVE: To understand about the packaging of the organic produce.

PACKAGING: ……

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Purpose: ……

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Benefits of packaging: ……

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Materials required for packaging: ……

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Organic product packaging materials

Types of packaging: Primary, secondary and tertiary packaging

Primary package: ……

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Examples: ……

Secondary package: ……

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Examples: ……

Tertiary package: ……

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Examples: ……

PREPARATION OF ENRICH COMPOST

Materials Required:

I. **Substrate Two types of organic substrates were used:** Crop residue viz., paddy straw, maize stover, groundnut and soybean stalks and Weed biomass viz., *Ambrossia artimisifolia*, *Eupatorium* spp. and *Ageratum conyzoides*, *Lantana camara*

II. **Slurry:** The slurry consisted of cow dung/ poultry excreta/pig dung, soil and well rotten compost in the ratio of 1:1:0.5. Slurry prepared from 100 l of water containing 35 kg of fresh cow dung/poultry excreta (one month old) /pig dung (one month old), 35 kg dry soil and 17 kg of well rotten compost is enough for a single pit of 3m (L) x 2m (B) x 1 m (D) dimension. Before making slurry, poultry excreta and pig dung are dried under shade, debris removed and lumps broken.

iii. **Mineral additive**: External addition of nutrients such as N, P and S to the substrate hastens the process of composting and improves the quality of compost. Urea, rock phosphate and elemental sulphur are added as mineral additive.

Preparation of PSN compost

(a) Shredding: The dry and hardy substrates (weed biomass & crop residues) are chopped using sharp knife. Although the recommended substrate size for rapid composting is as low as 2.5cm, however about 10 cm size was maintained to reduce the cost of labour.

Shredding why? Reduction in substrate particle size increases the surface area for microbial activity and thus hastens the process of decomposition.

(b) Mixing: The naturally dry crop residues and weed biomass are mixed with green and succulent ones in equal proportions.

Why to mix dry and green substrates? Carbon (C) to nitrogen (N) ratio of the substrate should be around 30:1. Mixing of dry and green substrates in equal proportion helps to bring down the C: N ratio to the desired range

(c) Pit making and filling with substrate: Digging: The pit method of composting was used. Pits of 3m (L) x 2m (B) x 1m (D) dimensions were dug in a location of the farm which is free from water stagnation. With this dimension, each pit can accommodate approximately 3 quintals of mixed substrate. The sides and the bottom of the pit should be made free from cracks and crevices.

Plastering of pit:

- Before filling the pit with substrates, the inner sides and bottom of the pit are plastered using the slurry.
- Plastering with slurry creates a nearly impervious layer.
- It checks seepage loss of nutrients and prevents entry of water from outside. The slurry at the pit bottom also provides an ideal seat for microbial activity.

Pit filling:

- The most critical part of the whole composting process is proper filling of the pit with layers of substrate, slurry and mineral additives.
- It is a multi- step process involving the following activities in sequence:-

Procedure:

Step I: Placing the substrates in layers Approximately 20 cm thick layer of the substrate is placed uniformly on the pit bottom. Care should be taken to avoid too much compaction of the substrate while putting in layers.

Step II: Sprinkling and mixing of slurry. After placing each layer of the substrate, the slurry (cattle dung/poultry droppings/ pig dung+ soil + well rotten compost + water) is sprinkled over each of the layers in sufficient quantity to ensure a coating of the whole substrate with slurry. The slurry acts as a sticker that helps the mineral additives to adhere on the substrate.

Step III: Application of mineral additives immediately after sprinkling of slurry, mineral additives is applied to the substrate layer. As per the protocol, Nitrogen (N) was applied @ 0.5% as urea; Phosphorus (P_2O_5) @ 1.5% as Mussoorie rock phosphate and Sulphur (S) @ 0.5% as elemental Sulphur.

After adding mineral additives, another new layer of substrate is placed in the similar fashion.

Step IV: Step- I to III is repeated in similar fashion till the pit gets filled up with substrate and reaches a height of 1ft above the ground level. The materials inside the pit are moistened with water sufficiently (70% moisture content).

Step V: Plastering of pit top after filling the pit, a dome shape is given to the substrates remaining above the ground level. The pit top is then plastered with a thick layer of the slurry.

Step VI: Turning the substrate after plastering the pit top, the compost pit is kept as such for 20 days.

After 20 days the materials inside the pit is turned manually.

The moisture content of the partially decomposed substrate inside the pit is to be checked and water is added, if necessary, to maintain moisture level of nearly 70%. The pit top should be covered again with slurry. Same process need to be repeated at an interval of 20 days till the completion of composting (till 100-105 days, approximate time of completion of the composting process).

Step VII: Judging the completion of decomposition. The completion of the composting process is marked by a number of indicators-both physical and chemical. These indicators are known as compost maturity and stability indices. As it is not possible for the farmers to evaluate the chemical indices, they have to rely on the physical indicator

Physical indicators to judge the maturity of compost:

- ❖ No more reduction in volume.
- ❖ Conversion of the substrate to a dark brown to black coloured mass.
- ❖ Absence of the pleasant smell, giving way to a soil- like musty odour.
- ❖ Little or no presence of substrate recognizable in original form.
- ❖ Complete cooling down of the compost pile. No more heating upon wetting.
- ❖ Production of a mass- friable and brittle when dry.

Step VIII: Harvesting of matured compost Once composting process is complete, the compost is collected from the pit. Care is taken to avoid scraping of the pit-bottom-soil along with compost as presence of foreign materials like soil deteriorates the quality of the compost.

Step IX: Post harvest processing of compost After collection from the pit, compost is spread under a shade to remove excess moisture and unwanted materials like, stone, pebbles, plastics, metals etc.

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.

BIOFERTILISERS

Mass production: Isolated bacterial cultures were subculture in to nutrientϖ broth The cultures were grown under shaking condition at 30±2°Cϖ The culture incubated until it reaches maximum cellϖ population of 10^{10} to 10^{11} Under optimum condition this population level could beϖ attained within 4-5 days for Rhizobium 5-7 days for Azospirillum and 6-7 days for Azotobacter. The culture obtained in the flask is called Starter cultureϖ For large scale production , inoculum from starter culture isϖ transferred in to large flasks / fermentor and grown until required level of cell count is reached

Media used for mass culturing:

Rhizobium: YEMA (yeast extract mannitol Agar+ congored) Azospirillum:Dobereiners mallic acid broth with Sodium chloride Azatobacter: Waksmanna No.77broth Phosbacteria: Pikovaskys brothᄀ Pseudomonas: Kings B brothᄀ Trichoderma: PDBᄀ Prepare appropriate media for specific to bacterial inoculant in required quantity Inoculated with specific bacterial strain for aseptic condition Incubated at 30±2ºC for 5-7 days in rotary shaker Observe growth of the culture and estimate the population (starter culture) The above the media is prepared in large quantities in fermentor Wednesday, June 14, 2017 Advances in Microbial Biotechnology (1+1) 18 Sterilized and cooled well Media in a fermentor is inoculated with the log phase of culture grown in large flask (usually 1-2 % of inoculum is sufficient) Cells are grown in fermentor by providing aeration & continuous stirring Broth is checked for the population of inoculated organisms Cells are harvested with the population load of 109 cells/ml

Carrier materials: The use of ideal carrier material is necessary for the production of good quality of biofertilizer Ideal carrier material should be Cheaper in cost, Locally available, High organic matter content, No toxic chemical, Water holding capacity of more than 50%, Easy to process.

A : Press mud ; B : Lignite : C: Charcoal : D: Coconut Shell : E: Rice Husk : F: Cellulose Powder : G: Leaf Manure : H: Peat Preparation of inoculants packet Neutralized and sterilized carrier material is spread in a clean, dry, sterile metallic or plastic Bacterial culture drawn from the fermentor is added to the sterilized carrier and mixed well by manual or mechanical mixer Inoculants are packed in a polythene bags sealed with electric sealer

TESTING FOR COMPOST QUALITY

Maturity Testing Set-Up: In order to become valuable compost, your collection of garden and food waste needs oxygen in order to properly decompose. Placing it in your garden while it is undergoing this process will inevitably lead to your compost stealing valuable elements that your plants' roots need, doing more harm than good. To start, divide your compost bins or other containers into two sets of three, four, five, or six. If the Experiment bins produced less germination than the Controls, your compost is immature and will need to give it another month to mature.

Check the Color of Your Compost: Another telltale sign of the quality of your compost is its color and texture. Good compost will be a rich brown or dark brown and crumbly to the touch. It will be dry and crumble between your fingers like coarse sand.

The smell of the Compost: This is perhaps one of the most important methods of knowing the quality of your compost. Your compost should never have a bad or pungent odor. This is one of the easiest traits to test. Your compost should never smell like what you would expect from a pile of decomposing organic materials. When it is properly balanced in its Carbon-to-Nitrogen ratio, compost should simply smell like freshly turned earth. It should never smell like decaying wood or other organic compounds.

Checking the Temperature of Your Compost: Another way to test your own compost at home is by checking the temperature of your mixture. As the microorganisms break down the materials in the container or pile, they and the natural process of all plant, food, and other materials breaking down will generate heat. Your compost pile should exude a moderate amount of heat, meaning it should never be cold or too hot. Temperatures may fluctuate due to the material composition of your compost pile and aeration. Additionally, the ideal size of your compost pile will change depending on whether it's stored within a container, indoors, or outdoors.

Professional Biochemical Compost Test: The last option for testing the quality of your compost is to hire a professional agricultural company to do so. Professional agricultural companies, or even universities offer their services for assessing the biochemical makeup of compost samples.

ITK FOR NUTRIENT MANAGEMENT

BIJAMRITA: Take 20 litres of water, 5 kg of local cow dung, 5 litres of local cow urine, 50 gram lime & handful soil from the bund of farm. Preparation Method: • Take 5 kg local cow dung in a cloth and bound it by tape. Hang this in the 20 litre water up to 12 hours. • Take one-liter water and add 50 gm lime in it, let it stable for a night. • Then next morning, squeeze this bundle of the cow dung in that water thrice continuously, so that all essence of cow dung is accumulated in that water. • Add a handful of soil in that water solution and stir it well. • Finally add 5 litre deshi cow urine or human urine in that solution & add the limewater and stir it well.

Bijamrita Application: Add Bijamrita to the seeds of any crop as a seed treatment: coat them, mix them by hands; dry well and use for sowing. For leguminous seeds, just dip them quickly and let dry.

JIVAMRUT Jeevamrutha is prepared by mixing 10 kg local cow dung with 10 litres cow urine, add 2 kg local jaggery, 2 kg pulse flour and handful of garden soil and the volume made upto 200 litres. Keep the drum in shade covering with wet gunny bag and stir the mixture clockwise thrice a day and incubate.

Uses: Promoting growth and flowering along with acting as a yield enhancer (@5-10% spray with water). Soil fertility enhancer (applied along with irrigation water)

AMRITPANI

Materials Required: The fresh cow dung of Indian breed – 1 kg. Cow urine of Indian breed – 1 liter, Jaiggery – 50 grams (sugarcane juice can be replaced with 2 glasses or raped six bananas), Water – 10 liters.
Preparation method:
Phase 1: Take a container of plastic or wood, add water and jaggery to it and mix it well. Mix fresh cow dung and cow urine in the mixture, stirring the mixture with a wooden stick.
Phase 2: Mix the water again in the mixture and stir it slowly in the same direction and bind the container's face to the clothes.
Phase 3: Amrutpani is ready for use in 4 days, mixed with wooden sticks 3 times a day.
Preparation time: 4 days.
Use:

- Mix one liter of nectar-water with 10 liters of water and use it.
- Use Amritpani to irrigate it every week.
- The root treatment should be done 30 minutes before planting.

- Dried leaves or dried sugarcane leaves are soaked in Amrutpani and used as mulch.
- By giving water to plants using Amrutpani on a weekly basis, Amrutpani keeps the soil alive and enriches nutrients.

PANCHAGAVYA

- Panchagavya ingredients include 5 items from Indian Cow and 4 items from plants. Fresh Cow Dung – 5 kg, Cow Urine (need not be fresh) – 3 liter, Cow Milk boiled and cooled (not refrigerated) – 2 liter, Fresh Cow Curd – 2 liter, Cow Ghee – 500 g,well ripened Bananas – 12, Black organic jaggery dissolved in 3 liters of water (Alternatively use sugarcane juice of the same volume) – 500 gms, Fresh Tender coconut water – 3 liters and Fresh Grape Juice – 2 liter.
- Panchagavya Preparation
- Take a wide mouth plastic, clay or wooden container. Do NOT use a metal container. Make sure its clean and sun dry it for a day or two to sterilize it.
- Mix the cow dung and ghee in the container using a wooden stick. Again do not use any metal here. Stir in clockwise direction in a rhythmic motion. Then stir in anti clockwise direction. Do not mix vigorously. It will kill the beneficial microbes in cow dung.
- Cover the container using thick cloth to protect it from insects. Leave this mixture for three days. Keep it away from direct sunlight and rain. Give it a stir once in the morning and once in the evening. Twelve times in each direction works well.
- On the fourth day slowly stir in all other ingredients. Make sure you are mixing them in while stirring the mixture in a single direction slowly.
- Leave this to ferment for 15 days. Give it a stir once in the morning and once in the evening.
- Your Panchagavya is now ready to use. Store it in a place away from direct sun and rain. Keep it covered and give it a stir two times a day. If you follow these guidelines you can store this concoction up to 2 months.

Sanjivak

Ingredients: Cow urine-100L, Cow dung-100-200kg, Jaggery-500g and Water-300L. Kept for 10 days to ferment
Method of Application: (Diluted 20 times before use)
Along drip irrigation
Foliar spray
To enrich soil with microorganisms for quick residue decomposition.

Enriched Amrut Ghol

Ingredients: Cow urine- 5L; Cow dung- 1kg; Decaying fruits (juice) – 1L; Mixed and kept for 5 days
Method of application: For 1 acre- 20-30L spray
Uses
Soil fertility enhancer (60-100 ltr per litre)
Growth and flowering enhancer (Spray)

Amrit Jal

Cow dung – 1 kg; Cow urine – 1lt, Jaggery – 50 g. These are mixed in earthen pot, then cover with a cloth and tied.
Allow 3 days to decompose, then, it will act as a biofertilizer.
Use: Dose 200ml in 20 ltr water.

Bilb Rasayan

Method of Preparation: *Tara Chand Balji Method, Madhya Pradesh.* Half kg dry Bilb powder or 5kg fresh Bilb dissolve in 20 liter water and then add 1kg jaggery. After one month, add this prepared solution to roots.
Benefits: This will increase potassium in the soil

Pushp Rasayan

Method of Preparation: *Tara Chand Balji Method, Madhya Pradesh.* Add 2kg flowers in 2 litre cow urine and add 2lt water. After 7days, spray in 1acre land.
Benefits: This will increase Boron in the so

Calcium Arkh

Method of Preparation: *Tara Chand Balji Method, Madhya Pradesh*
Add 150 dm dry turmeric clots in 100 gm calcium water, add 50 ml milk. After 4 days take turmeric clots and dry. Then add 1gm turmeric powder/lt water and spray in plants for Calcium
Benefits: This will provide Calcium to the plants

Harad Rasayan

Method of Preparation: Add 2 kg Harad in 10 lt water then add 20 gm fitkari. After 6 days, filter and spray this solution after every 15 days interval.
Benefits: This will increase Iron in the soil

ITK FOR INSECT, PEST AND DISEASE MANAGEMENT

Coconut- Buttermilk Ghol

- 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 squeezes 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

- 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

- 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)

- 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.

ITK FOR WEED MANAGEMENT

- Apply the Neem seeds @ 40 kg / ac as basal to get more yields as compared to the equal quantity of Neem cake to control weed growth.
- Cultivation of sun hemp or daincha helps to control the nut grass (*Cyperus rotundus*) weed.
- Mulching Tree leaves (karanj-pongamia-ponnata) and paddy straw are used as mulch materials. This conserves the soil moisture and simultaneously keeps the soil cool which provides favourable conditions these mulches act as organic matter to enhance the crop effective for weed management
- Common salt is dissolved in water and sprayed in rice fields for controlling major weeds

BEUSHENING IN RICE Practiced in direct -seeded low land rice in Odisha, MP, Bihar, WB, UP to control weeds, optimize crop stand and provide soil aeration. Cross ploughing of young crops 4 to 6 weeks after sowing with a light country plough in 5-10 cm standing water once or twice depending upon the density of weeds and crop stand, if there are too many weeds it is followed by flanking.

Jhum cultivation/Slash & Burn cultivation/Shifting cultivation: Well suited to the heavy rainfall areas of the north east India. The trees are slashed & burned and the seeds are sown only after the 1st rainfall. After cultivating for 2 - 3 years, fields go into fallow. Then, the farmer moves on to the next plot or forest area to protect the soil and allow for buildup of nutrients. Soil erosion is controlled and fertility maintained by constructing contour bunds often May reduce the incidence of soil born diseases.

DETERMINATION OF TOTAL NITROGEN 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.

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:

1. Transfer 1g of prepared plant material wrapped in a piece of filter paper, to a 300 ml kjeldahl's digestion flask.
2. Add to it 10 g of catalyst mixture and 25-30 ml of concentrated sulphuric acid.
3. Mix the contents of the flask by swirling with care not to through the samples on the side.
4. Start digesting the contents of the flask on digestion heater for 20-30 min until frothing stops.
5. 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.
6. Pipette out 10 ml of 0.02N sulphuric acid in a 150 ml conical flask, add 2 -3 drops of methyl red indicator.
7. Take 5 ml of aliquot in distillation flask and connect it to the mouth of the distillation flask.
8. Now pour 25ml of 45% NaOH in distillation flask through the funnel attached to the distillation apparatus.
9. Collect about 30ml the distillate.
10. 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

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.

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 acids 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

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

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

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

POST HARVEST HANDLING OF ORGANIC PRODUCE

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 post harvest quality. 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

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 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. The high cost of the vacuum chamber system restricts its use to larger operations.

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 CO2 (≥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.

ORGANIC PRODUCT PACKAGING MATERIALS

The organic product packaging materials should have minimal adverse environmental impacts and recommend that 'Processors of organic food should avoid unnecessary packaging materials; and organic food should be packaged in reusable, recycled, recyclable and biodegradable packaging whenever possible'.
1. Cardboard and Paper; 2. Plastic 3. Glass 4. Metal

How packaging must protect food from external threats

External environmental conditions	Protective packaging functions
Mechanical shock, vibration and compressive loads	Shock and vibration absorption, compressive strength
Biological factors	Resistance
Gases (O, N, CO_2)	Low permeability (high gas barrier)
Light	Transmission (low or high as required)
Temperature	Thermal conductivity (low or high as required)
Water	Resistance and absorption (high water vapour barrier)