Principles of organic farming
Practical Manual
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Content

Practical-1

Topic- Visit of organic farms to study the various components and their utilization

Aim- To visit an organic farm

Objective- To visit an organic farm for student's exposure and study of various components of the farm.

Introduction: Organic farming is one of the growing issues of modern day agriculture. A visit to organic farm will give knowledge about cultivation practices of different crops organically, its conservation and packaging of products.

Procedure: Study should be planned well ahead and the authority of organic farm should be informed accordingly.

Students should interact to know about modern techniques and technologies and management practices related to organic cultivation of crops following direct conversation and discussion with different scientists. They should get themselves educated on different experiments and their implementations in the field level under a given Agro climatic zones of the state or country.

Important things to know: students should be able to know the basics of the crops and related cultural practices will a head before going to any research station/ farm. The teacher should brief about the research farm to be visited ahead of visit, its importance, objectives and working principles.

Observations: observe each and every component of organic units of the research station/ farm and note down the basic principle and working of the farm.

Date of visit	Organic units	Components used

Conclusion:

Video link: https://youtu.be/tUsR5Fql5I4

Practical -2

Topic- Preparation of enrich compost (NADEP compost)

Aim- To study the different methods of compost preparation

Objective- To prepare compost by NADEP method

Relevant information- The NADEP method of compost making was first invented by a farmer named N. D. Pandharipande (also popularly known as NADEP kaka) of Maharashtra. The process includes the placing of selective layers of different types of compostable organic materials, followed by sealing with mud in a given structure prepared with brick and concrete/ mud. NADEP method is one aerobic method of composting.

Materials required-

i. Required quantity of farm waste, like crop residues, weed, plant leaf, twigs, sugarcane bagasse, husk etc. It should be free from foreign materials like glass, plastic, stone etc.

ii. Cow dung, the slurry from biogas plant can also be used.

iii. Dry ground soil.

iv. Water: as per the condition and types of material.

Procedure:

Pit size- A rectangular brick tank having a size of 3.05 m. (long) × 1.5 m. (wide) × 0.91 (deep) is required for making NADEP compost. Provide sufficient space in between the bricks for good aeration. The size may vary depending upon availability of raw material and demand.

Steps followed

Step I:

First layer: Fill the first layer to a height of 6 inches with farm waste with at least 100-120 kg material.

Second layer: Mix 4 kg of cow dung in 125-150 litres of water (cow dung slurry) and sprinkled on the farm waste and see whether the material is completely wet or not. The amount of water will be more in summer season.

Third layer: Take 60 kg of clean soil and dilute in water and sprinkled over the second layer.

Step II:

i. After completion of first three layers, fill the tank with same series of three layers in same sequence up to one and half foot above the edge of the tank in the shape of a cone.

ii. In a standard sized tank, 11-12 series of layers can be placed easily.

iii. Seal the tank with three inch layer of soil followed by plaster with liquid cow dung slurry. This will prevent cracks.

Step III:

Inspect the heap on regular basis. After a period of 15-20 days, you will notice that the volume of material will be reduced. It is due to degradation by microbial activities.

Open the tank and fill it again layer by layer in same sequence up to one and half foot above the edge of the tank. Once again, plaster it.

Step IV:

In order to maintain the moisture level (about 15-20%) and also to prevent cracking, apply cow dung slurry on the compost heap.

Cover the tank roof to prevent excess evaporation of water.

Character of well decomposed compost: The compost will be ready for use if it feels crumbly and looks like good brown/black in colour.

Observations:

After completion of composting, the compost will be deep brown in colour with a pleasant smell. It should be removed from tank and sieved.

Time in days	**Colour**	**Texture**	**Smell**	**Moisture content (%)**	**Temperature (°C)**

Precaution:

i. The important technique in production of NADEP compost is that the entire tank should be filled in one operation.

ii. Filling should be completed within 24 hours and should never go beyond 48 hours, as this would affect the quality of compost.

iii. At any condition the compost should not be allowed to become dry. If cracks found, it should be promptly filled up with cow dung slurry.

Conclusion:

Video link: https://youtu.be/w0ALj5mw-qM

Practical -3

Topic- Preparation of enrich compost (Coimbatore method)

Aim: To study the different methods of compost making

Objective: To prepare compost by Coimbatore method

Relevant information: This type of composting is done in pits of different sizes depending on the availability of waste material. It is very similar to NADEP method. It consists of layers of waste materials with mixture with organic manures, cow dung and water. Dry crop residue or plant parts are first laid in the pit.

Materials required:

1. Raw material: Any type of crop residue, weeds, dry plant part.

2. Starter materials: Cattle dung and water emulsion prepared by mixing 5-10 kg of cow dung with 2.5-5 litre of water.

3. Additives: Powdered bone meal 0.5-1 kg.

Procedure:

It is moistened with a suspension of cow dung and water and with fine bone meal sprinkled over it uniformly. Similar layers are laid one over another till the material rises 0.75 m. above the ground level. It is finally plastered with wet mud and left undisturbed for 8-10 weeks. Plaster is then removed, material moistened with water, given a turning and made into a rectangular heap under a shade.

It is left undisturbed till its use. This process is called as aerobic and anaerobic decomposition of compost. In this process elementary raw materials are not very well decomposed as in the other methods but organic matter and N contents are well preserved.

Pit size: This method (Manickam, 1967) involves digging a pit of 3.65 m. (long) × 1.8 m. (wide) × 0.91 m. (deep) is prepared for composting.

Steps followed

Step I

First layer: Spread the raw material to a depth of 9 inch and sprinkle water over it with a rose can or pipe until the entire material is moist.

Second layer: Uniformly broadcast about 1 kg of powdered bone meal over it to make a layer.

Third layer: Apply a layer of cow dung slurry with 5-10 litre of water.

Step II

Repeat this process until a heap of 0.75 meter above the ground level is formed.

Plaster the entire exposed surface area of the heap with mud. This will enable a semi aerobic fermentation process which would take place for above 4-6 weeks depending upon the nature of raw materials.

Apply sum amount of old compost as inoculums.

Step III

Observe time to time and apply water when it is necessary.

After 4-6 weeks remove the plaster, turn the material and apply water.

Step IV

Keep the heap open for a week to facilitate aerobic decomposition. Plaster it with a layer of moist clay for anaerobic fermentation. The compost will be ready within 4-5 months period starting from the day of preparation.

Important things:

Layering process is to be continued for about a fortnight.

Apply some old compost as inoculums.

Do not disturb the heap for about a month.

This method saves labour cost, as there is no need of regular turning and watering. That's why it is the cheapest process of composting.

Character of well decomposed compost: The compost will be ready for use if it feels crumbly and looks like good brown/black in colour.

Observations:

Time in days	**Colour**	**Texture**	**Smell**	**Moisture content (%)**	**Temperature (**°C**)**

Conclusion:

Precaution:

1. Handle the implements, other tools very carefully.
2. Wash your body part after completion of work.

Practical -4

Topic- Preparation of enrich compost (Bangalore method)

Aim: To study the different methods of compost making

Objective: To prepare compost by Bangalore method

Relevant information: This method of composting was developed at Bangalore in India in 1939 (FAO, 1980). In this method of composting, dry waste material of 25 cm. thick is spread in a pit and a thick suspension of cow dung in water is sprinkled over for moistening. A thin layer of dry waste is laid over the moistened layer. The pit is filled alternately with dry layers of material and cow dung. It is left exposed without covering for 15 days.

Materials required:

1. Raw materials: Any organic material can be used for composting.

2. Starter/ Inoculation: FYM or mixture of dung, urine and litter or even knight soil.

3. Additives: Bone meal/ oil cake, wood ash.

Procedure:

Prepare a trench of 9.1 m. (long) × 1.8 m. (wide) × 0.91 m. (deep) or in pits of 6.09 m. × 1.8 m. × 0.91 m. size and follow the filling steps.

Step I

First layer:

Broadcast the basic raw materials into the pit to a depth of 25 cm.

Apply 75-110 liter of water depending upon the dryness of material.

Second layer:

Place 5 cm layer of FYM/ preferably a mixture of dung, urine and litter from cattle shed over that. Cover the top with a layer of earth to a thickness of 15 cm.

Third layer:

Make a layer mix with earth or bone meal/ oil cake, wood ash etc. to improve the nutritional value of compost. Continue the filling of the layers till the heap rises over the ground level to a height of 0.5 meter. It may be given a dome- shape structure.

Step II

Keep it as such without any turning for about three months.

Open the heap. It will get a pleasant colour and smell. The compost contains about 1.5 % N, 1 % P_2O_5 with 1.5 % K_2O.

Character of well decomposed compost: The compost will be ready for use if it feels crumbly and looks like good brown/black in colour.

Observations:

Time in days	**Colour**	**Texture**	**Smell**	**Moisture content (%)**	**Temperature (**°C**)**

Conclusion:

Precaution:

1. Handle the implements, other tools very carefully.
2. Wash your body part after completion of work.

Practical -5

Topic- Preparation of enrich compost (Indore compost)

Aim- To study the different methods of compost making

Objective- To prepare compost by Indore method

Relevant information- An important advance in the practice of composting was made at Indore in India by Howard in the mid-1920s. The traditional procedure was systematized into a method of composting now known as the Indore method (FAO, 1980). In this method of composting, organic wastes are spread in the cattle shed to serve as bedding. Urine soaked material along with dung is removed every day and formed into a layer of about 15 cm thick at suitable sites. This method was developed by Howard who worked at The Indian Institute of Plant Industry, Indore.

Materials required:

1. Straw or any other organic farm waste is used as basic raw material.

2. Cow dung, urine, wood ash and soil is used as starter material.

Procedure:

Open a pit with a size of 3.04 m. or more (as convenient) in length, 1.8-2.4 m. width and 0.6-0.9 m. deep.

Steps:

Step I: Placing the material

1. Chop the straw or other waste material and spread it with cattle dung and soil in a ratio of 4:2:1 up to 5 cm layer.

2. Sprinkle water over it.

3. Fill the pit with above materials up to 30 cm height above the ground level

4. Add one more layer of bedding material with wood ash and mud.

5. Provide extra aeration by making artificial holes or opening of 10 cm diameter in each foot length of the pit.

Step II: Turning

Turn the material 3 times for proper aeration and moisture content.

1. First turning- 10-15 days after filling the pit

2. Second turning- 15 days after first turning

3. Third turning- After 2 months of second turning.

Time for decomposition: Under favourable conditions, the decomposition process in the Indore method takes three months, but under adverse conditions it may take longer than six months.

Character of well decomposed compost: The compost will be ready for use if it feels crumbly and looks like good brown/black in colour.

Observations:

Time in days	**Colour**	**Texture**	**Smell**	**Moisture content (%)**	**Temperature (℃)**

Conclusion:

Precaution:

1. Handle the implements, other tools very carefully.
2. Wash your body part after completion of work.

Practical -6

Topic- Preparation of vermicompost

Aim: To study the method of vermicompost making

Objective: To study the preparation and use of vermicompost

Relevant information: Vermicomposting is a method of preparing enrich compost with the use of earthworms. Earthworms accelerate the process of composting, aerate the organic matter and enhances the finished compost with nutrients and enzymes secreted from their digestive tracts. This enriched product is eventually called "worm cast" or **black gold**.

Castings

The expelled manure from worm has a bit of mucus surrounding each granule. This gets hardens on exposing to air. When these granular castings are mixed into soil, the nutrient from compost releases slowly to feed the plant. However, the hardened particles of mucus do not break down easily, thus they help in soil aeration and drainage. Casting is an organic soil conditioner as well as a super natural fertilizer which contents 7 times more P, 11 times more K and 1.5 times more Ca than other composts.

Methods of vermicomposting

Out of various methods, heap/bed and pit method is the most popular methods.

Heap/Bed method

In this method, composting is done in the cemented or over ground floor by making a bed of 1.8 m. × 0.6 m. × 0.6 m. in size. This method is easy to maintain.

Pit method

Here vermicomposting is done in cemented pit with a size of 1.5 m. × 0.9 m. × 0.9 m. This pit is covered with grass or any other local material. This method is not favourable due to poor aeration, water logging at bottom and high cost of production.

Materials required:

1. Earthworm species: *Eisenia foetida*, *Udrilus eugene*, *Perionyx excavates* etc.

2. Raw materials: Crop residues, weed biomass, vegetable waste, dry leaf, waste from agro-industries, bio degradable portion of rural and urban wastes.

3. Cow dung

4. Water

Phases of vermicomposting

Vermicomposting has 3 distinguished phases:

Phase I: Pre-digestion of organic waste on earthworm bed.

Phase II: Collection of earthworms and putting them on pre-digested waste compartment.

Phase III: Storing of vermicompost for proper moisture and growth of micro-organism.

Procedure

i. Prepare a pit or heap according to the requirement or availability of materials.

ii. Select the site near a water source in an unused shady area but should not any water stagnation.

iii. Create 1 inch thick layer of leaves.

iv. Put organic residue layer (finely chaffed material) up to 9 inch thick over the first layer.

v. Create a third layer up to 2 inch with cow dung slurry by mixing equal amount of dung and water.

vi. On 24th day of processing, release 4000 worms in the pit (1 sq. m. - 2000 worms) without disturbing.

vii. Apply water regularly.

viii. The raw material will be turned into vermicompost in the form of worm excreta.

Vermicompost harvesting:

After the vermicompost production, the earthworm present in the tub/small bed may be harvested by trapping method. In the vermibed, before harvesting the compost, small, fresh cow dung ball is made and inserted inside the bed in five or six places. After 24 hours, the cow dung ball is removed. All the worms will be adhered into the ball. Putting the cow dung ball in a bucket of water will separate this adhered worm. The collected worms will be used for next batch of composting. The vermicompost collected is dried, passed through a 3 mm sieve to recover the cocoons, young worms, and unconsumed organic material.

Observations:

Inputs			
Materials	**Quantity**	**Rate (Rs.)**	**Amount (Rs.)**
Cost of vermibed (5year lifespan) and shade			
Cow dung			
Organic residues			
Earthworm			
Miscellaneous items (Gunny bag, packing materials, mesh sieve)			
Labour (filling pits, watering, harvesting and packing)			
Total production cost			
Output			
Vermicompost			
Earthworm			

Gross return		
Net return		
Return per rupee invested		

Conclusion

Precautions:

- The compost pit should be protected from direct sunlight and a suitable temperature has to be maintained.
- Water should be regularly sprayed on the pit in order to maintain the moisture level.
- The worms should be protected from natural predators (ant, bird, rodents etc.).
- Salt, Chilli, Soap, Soap water, Vinegar, Insecticides should be avoided.

Video link: https://youtu.be/w75w5Jzipqc

Practical -7

Topic- Portable method of vermicomposting

Aim: To prepare vermicompost

Objective: To learn the process of vermicomposting in portable bed/ box.

Relevant information: Vermicompost can be produced in any place with shade, high humidity and cool surrounding. In general, fixed structure is required for making vermicompost (pit/heap method). But some low cost portable readymade beds are useful for making vermicompost. In this portable vermicomposting method, HDPE bags, bins or wooden boxes (portable structures) are used for making vermicompost.

Materials required: Vermiworms, HDPE bag (3 m. long× 1.2 m. wide× 0.5 m. high)/bin/ wooden box, cow dung, organic waste (Crop residues, weed biomass, vegetable waste, dry leaf etc.) and water.

Procedure:

- Place the HDPE bag (Rhino vermi bed) in a shady humid area.
- **1st Layer (bottom most):** Place cow dung; green leaves; discarded parts or peelings of vegetables; kitchen wastes; droppings of goats, pigs, etc.
- **2nd Layer:** chopped straw; saw dust (this layer should be dampening with water).
- **3rd Layer:** rice husk; sugarcane bagasse; cotton fibre etc.
- **4th Layer:** papers; scrap of card boards.
- Sprinkle water on the top properly.
- Release earthworm @ 1 kg (around 1000 worms) per bed, after partial decomposition of organic residues (attained in 10-15 days).
- Sprinkle water daily on vermin beds according to the requirements and season to keep them moist.
- Appearance of black granular crumbly vermicompost on the top of the bed indicates maturity of the vermicompost.
- Harvest the vermicompost by scrapping layer wise from the top of the bed and heap under shed.
- Sieve the vermicompost and dry it in shade before storing.

Maturity: The maturity of vermicompost depends on season and types of raw material used for making vermicompost. The mature vermicompost is light in weight and does not emit any foul smell.

Observations to be recorded

Inputs			
Materials	**Quantity**	**Rate (Rs.)**	**Amount (Rs.)**

Total production cost			
Output			
Vermicompost			
Earthworm			
Gross return			
Net return			
Return per rupee invested			
Duration (Days)			

Conclusion:

Ideal Feed for the worms:

Cattle dung; Droppings of Poultry birds; Vegetable wastes.

Cattle dung can be fed as such.

Other dung materials or vegetable wastes are to be mixed with cattle dung for better feed acceptability (generally at 10:1 ratio).

Precautions:

- Salt, Chilli, Soap, Soap water, Vinegar, Insecticides should be avoided.
- Be careful about natural enemies like birds, insects, rodents, etc.
- Metal bodies, rubber and plastics are disliked by earthworms, thus these materials should be discarded.
- Optimum moisture and proper aeration should be maintained.
- The eco-factors should be optimum.

Dose of vermicompost:

- **For Field Crops:** 2-5 tons/ha (at the time of sowing or transplanting of seedlings and after 1 month in between the rows).
- **For Fruit Trees:** 2-10 kg/tree (depending on the age of the tree).
- **For Vegetables and Flowers:** 1-2 tons/ha.

Practical -8

Topic- Identification of bio-fertilizers

Aim: To identify bio-fertilizers

Objective: To study different types of bio-fertilizers and its use.

Relevant information: Bio-fertilizers are the preparations containing living cells of efficient strains of microorganisms that help crop plants in uptake of nutrients by their interactions in the rhizosphere when applied through seed or soil. They accelerate certain microbial processes in the soil which augment the extent of availability of nutrients in a form easily assimilated by plants.

Use of bio-fertilizers is one of the important components of organic farming, as they are cost effective and renewable source of plant nutrients to supplement the chemical fertilizers. Several microorganisms and their association with crop plants are being exploited in the production of bio-fertilizers.

Materials required

Different types of bio-fertilizer, Pen/ pencil, record

Observations:

Sl. no	Bio-fertilizer species	Source of nutrient	Crops	Method of application
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				

Conclusion:

Practical -9

Topic- Preparation of bio-fertilizers/bio-inoculants (*Azolla* multiplication)

Aim: To multiply *Azolla*

Objective: To learn the process of *Azolla* multiplication.

Relevant information: *Azolla* is a free-floating water fern that fixes atmospheric nitrogen in association with nitrogen fixing blue green algae *Anabena azollae*. The agronomic potential of Azolla is quite significant particularly for rice and it is widely used as bio-fertilizer for increasing rice yield. It can fix 40-60 kg N per ha per rice crop.

The common species of *Azolla* are *Azolla microphylla, Azolla pinnata, Azolla nilotica, Azolla maxicana and Azolla rubra.*

Materials required

1. Area- 40 sq. m. (1 cent) for tank construction.
2. Cattle dung 10 kg.
3. Jeevamrutha
4. *Vitex negundo* leaf extract
5. Fresh *Azolla* inoculum 8 kg.

Procedure

i. Select a swamp field and complete ploughing and levelling thoroughly.
ii. Divide the field into small sectors with bunds with a dimension of 20 × 2 m.
iii. Put 10 kg cow dung in 20 L water and mix thoroughly, sprinkle in the field.
iv. Put water in the sector up to a height of 10 cm. and maintain the water level.
v. Apply Jeevamrutha @ 500 ml.
vi. Apply fresh *Azolla* biomass @ 8kg to each plot.
vii. Apply Jeevamrutha on 4^{th} and 8^{th} day after *Azolla* inoculation @ 500 ml.
viii. Apply *Vitex negundo* leaf extract on 7^{th} day after *Azolla* inoculation.
ix. Maintain 10 cm. water level throughout the growing period (2-3 weeks).
x. As soon as Azolla mat begins to float on the water, harvest the *Azolla* by drain out the water and record the biomass.

Uses

Method of inoculation of *Azolla* in rice field

A. Azolla is mainly applied in two ways in rice field. It can be inoculated in rice field before transplanting and incorporated as green manure. This method requires huge quantity of fresh *Azolla*.

B. Azolla may be inoculated after transplanting of rice and grown as ‘dual culture’ with rice and incorporated subsequently.

Observations: Observe every day progress and do accordingly.

Conclusion:

Practical -10

Topic- Preparation of bio-fertilizers/bio-inoculants (Multiplication of Blue Green Algae)

Aim: To study the multiplication technique of Blue Green Algae (BGA)

Objective: To learn the process of Blue Green Algae (BGA) multiplication.

Relevant information: Blue Green Algae (BGA) is a symbiotic association, used as bio-fertilizer which can able to fix atmospheric nitrogen. The most common and important species are *Anabena* and *Nostoc*. Others are *Calothrix* , *Plectoneme* and *Tolypotrix* etc. The amount of nitrogen fixed by these species varies from 15-45 kg per ha. It grows well under wide temperature range from 25°- 45° C. Growth of Blue Green Algae (BGA) increases with bright sunshine hours. A neutral *pH* range is ideal for its growth.

Materials required

i. Fresh BGA inoculum
ii. Cattle dung
iii. Jeevamrutha
iv. Soil
v. Lime
vi. *Vitex negundo* leaf extract
vii. silpauline sheet

Procedure

Pit method

i. Prepare shallow cemented tank of 8.25 m. long × 1.5 m. wide × 0.25 m deep. Place a silpauline sheet over the structure. Silpauline is a polythene tarpaulin which is resistant to the ultra violet radiation in sunlight. Tank size varies depending on the space and material available.
ii. Place 20 kg soil and mix 80 g. Lime with it. Apply Jeevamrutha as a source of nutrient.
iii. Fill water around 6.5 cm depending on the local conditions and evaporation rate.
iv. After the settle down of soil, sprinkle hand full of cow dung and spread culture on the surface of standing water. Keep the whole system under direct sunlight.
v. Add water regularly depending on daily evaporation rate.
vi. When the mass increases (within 15 days of inoculation), allow water to dry up.
vii. Collect dry algae flakes and store it for field use.

Tray method

i. Iron tray of a dimension of 2 m × 2 m × 0.325 m size is standard.
ii. Place a silpauline sheet over it.
iii. Apply 20 kg soil and Jeevamrutha.
iv. Spread 5-10 cm thick layer of Blue Green Algae (BGA) inoculum.

v. Maintain the water level.

vi. A thick mat of Blue Green Algae (BGA) will develop within 7-10 days of inoculation.

vii. Drain out the water and collect dry Blue Green Algae (BGA) flakes for field use.

Use

i. Apply algal flakes @ 10 kg per ha over standing water in rice field before 1 week of transplanting.

ii. Maintain water level in the field.

iii. Apply sodium molybdate if the soil is deficient in P.

Observations

Days to maturity:

Labour requirement:

Yield (kg dry flakes):

Conclusion

Precaution

Do not store BGA materials with chemical fertilizers.

Video link: https://youtu.be/2UDmzSwmCzY

Practical -11

Topic- Quality analysis of compost and vermicompost

Aim: To understand the quality of compost and vermicompost

Objective: To learn the quality analysis of compost, vermicompost.

Relevant information: In recent few decades, dumping of huge quantity of organic wastes from different sources like domestic, agriculture and industrial wastes have caused serious environmental hazards and economic problems. Most of these wastes are either burnt or used for land filling. Burning of organic wastes contributes large amount of Carbon dioxide to the atmosphere that causes environmental pollution. This over all process tremendously leads to destroy the surface soil organic matter, decreases soil microbial population and affects the physical properties of the soil. Proper utilization of organic wastes can not only promote recycling of plant nutrients, it also improves soil health and environmental quality. Utilization of various organic residues such as Kitchen waste, weed wastes, Sewage and sludge, livestock wastes and agricultural wastes by making compost and vermicompost is very important in organic farming. It is very essential to analyze the quality of the compost and vermicompost before use.

Materials required:

pH meter, Electric Conductivity (EC) meter, Hot air oven, aluminium moisture box, digital weight balance, distilled water, 100 ml beaker, mesh sieve, Core sampler, compost and vermicompost sample.

Procedure:

Determination of *pH*: The *pH* of the compost sample is determined as per the procedure described by Chandrabose *et al*., (1988).

- Take 30 gm of air-dry sample and sieve it through 2mm mesh sieve.
- Transfer the fine sample to a clean 100 ml beaker and add 60 ml of distilled water.
- Stir the contents intermittently and the sample suspension just before taking the reading.
- Immerse the electrodes into the beaker and record the meter reading.

Determination of Electrical Conductivity (EC): The electrical conductivity of the test samples was determined as per the procedure outlined by Chandrabose *et al*., (1988). Electrical conductivity is the measurement of total amount of soluble salts present in the sample and is expressed as millisimens/cm (mS/cm).

- Take 5 gm of the experimental sample and add 50 ml of distilled water.
- Stir well and allow the suspension to settle for eight hrs.
- Immerse the electrode of the conductivity cell into the sample solution and record the EC (mS/cm).

Determination of moisture content: Moisture meters give an immediate reading but these are said to lack accuracy. Oven drying provides an accurate method for measuring the moisture content of compost and vermicompost.

- Weigh an empty aluminium moisture box and record the weight (W_1).
- Collect fresh compost/ vermicompost sample and record the weight of compost/ vermicompost+ aluminium moisture box (W_2).
- Put the box (with lid open) in a hot air oven at 105° C for 24 hours.
- Record the weight of dry soil sample+ aluminium moisture box (W_3).
- Calculate the moisture content of compost/vermicompost by using the following formula.

$$\text{Moisture content (\%)} = \frac{W_2\text{-}W_3}{W_3\text{-}W_1} \times 100$$

Determination of bulk density (g/cm^3):

- Record the weight of an empty aluminium moisture box.
- Determine the volume of core ($\pi r^2 h$)
- Drive the core of known volume vertically into the compost and draw sample.
- Collect the sample from the core in aluminium moisture box.
- Keep the moisture box (with lid open) in hot air oven at 105° C for 24 hours.
- Record the weight of dry sample.
- Calculate the bulk density of compost/vermicompost by using the following formula.

$$\text{Bulk density (g/cm}^3\text{)} = \frac{\text{Weight of oven dry sample (g)}}{\text{Volume of sample = volume of core } (\pi r^2 h)}$$

Observations:

Table 11.a Quality analysis of compost

Type of compost	***pH***	**EC (mS/cm)**	**Moisture content (%)**	**Bulk Density (g/cm^3)**	**Colour**

Table 11.b Quality analysis of vermicompost

Sl. No.	**Quality parameters**	**Standards as per FCO**	**Quality of produced vermicompost**
1	Moisture present by weight	15-25	
2	Colour	Dark brown to black	

3	Odor	Absence of foul odor	
4	Particle size	Minimum 90% material should pass through 4.0 mm sieve	
5	Bulk density (g/cm^3)	0.7-0.9	
6	Total organic carbon, present by weight, minimum	18.0	
7	Total nitrogen (as N), present by weight, minimum	1.0	
8	Total phosphate (as P_2O_5), present by weight, minimum	0.8	
9	Total potassium (K_2O), present by weight, minimum	0.8	

Conclusion:

Practical -12

Topic- Indigenous technological knowledge (ITK) for nutrient management

Aim: Preparation of panchagavya, amritpani, Beejamruth, Jeevamruth and liquid manure

Objective: To learn the process of panchagavya, amritpani, Beejamruth and Jeevamruth preparation and its use.

Preparation of panchagavya

Relevant information: Panchagavya is a mixture of different ingredients like cow dung, cow urine, milk, curd, ghee, jaggery, banana, tender coconut water and water. It has miraculous effects and has the potential in encouraging growth and providing immunity of plant system.

Materials required: Cow dung-7 kg, cow urine 10 litres, Ghee-1 kg, fresh cow milk- 3 litres, curd- 2 litres, jiggery-3 kg, well ripe banana- 12 nos, tender coconut water- 3 litres and water- 10 litres.

Procedure:

i. Take a wide mouthed earthen pot.

ii. Take the cow dung and ghee and mix thoroughly together in morning and evening. Keep the container as such for 3 days.

iii. After 3 days mix cow urine and water and keep it for few days.

iv. Stir the mixture twice a day both in morning and evening.

v. Add milk, curd, coconut water, jaggery and banana on 15^{th} day and keep it for another 15 days. Stirring should be done every day.

Application: Apply 30% Panchagavya for all the crops as foliar spray.

Preparation of Amritpani

Relevant information: Amritpani is a liquid manure and also used to improve the soil fertility. 'Amrut' means the drink considered as the 'heavenly drink', that rejuvenates the 'Gods' and has the supremacy to revive the dead.

Materials required: For making 200 litres of Amritpani (for 1 ha land) the following materials are required.

Ghee-250 gm, honey- 500 gm, Fresh cow dung- 10 kg, water- 200 litres and plastic container.

Procedure:

i. Thoroughly blend 10 kg cow dung with 500 gm honey into a creamy paste.

ii. Mix the creamy paste with 250 gm ghee.

iii. Dilute the mixture in 200 litre water.

iv. This mixture thus obtained is Amritpani.

Application:

- Seedling root dip before planting.
- Planting materials of sugarcane, turmeric, ginger etc. should be dipped into Amritpani before planting.
- Mixed with irrigation water for sugarcane.

- Soil application before planting for chilli, tobacco seedlings or fruit tree saplings.

Preparation of Beejamruth

Relevant information: It is a fermented product used as plant growth stimulating elements. It is a rich foundation of beneficial micro-flora that support and excite the plant growth which ultimately improves the vegetative growth and quality of produce.

Materials required: Cow dung-5 kg, cow urine-5 lit., Lime- 50 gm, Soil 50 gm and water 20 lit.

Procedure:

i. Take 5 kg fresh cow dung in a cloth bag. Suspend the cow dung in a water filled container to extract the soluble ingredients of dung.
ii. Dissolve 50 gm lime in 1 litre of water in a separate jar.
iii. Keep the cow dung extract for 12-16 hrs and squeeze the bag.
iv. Add 5 litre cow urine and 50 gm fresh soil into the extract.
v. Add the lime in 20 litre of extract and incubate it for 8-12 hrs.
vi. Filter the content to obtain the perparation

Application: Apply it for seed treatment as soaking 100 kg seed in 20 litre beejamruth. Soak vegetative part like rhizome, stem, root and tuber for 2 minutes before planting.

Preparation of Jeevamruth

Relevant information: It is an organic preparation used as nutrient source.

Materials required: Cow dung-20 kg, cow urine-10 lit., Gram flour- 1 kg, Jaggery- 1 kg, Dry soil-250 gm, water 200 litre, bucket and plastic container.

Procedure:

i. Mix cow dung in a separate bucket with ample water. No clods should be there.
ii. Mix jiggery and gram flour in water each in separate bucket.
iii. Pour cow dung, jiggery solution, gram flour liquid and cow urine in the plastic drum.
iv. Add soil and fill the drum completely with water.
v. Stir it thoroughly.
vi. Keep the solution for 3-6 days in shade depending on temperature

Application: Apply diluted (1:10) Jeevamruth as foliar spray at 15 days interval.

Preparation of liquid manure

Relevant information: Sustainability of crop production depends on efficient and effective management of plant nutrients. During the early part of 20^{th} century, mainly cattle urine was used as liquid manure to fertilize the crops. It is possible to give nutrients directly through foliar application of liquid manure on plant foliage, thus offering the crop a competitive advantage over weeds and also helps the crops to perform in a better way.

Materials required: Fresh cow dung-1.5 kg, Fresh green leaves of Subabul (*Leucaena leucocephala*) and Babul tree (*Acacia nilotica*)- 1.5 kg, cotton bag, plastic drum, water-40 lit.

Procedure:

- Take 1.5 kg fresh cow dung and 1.5 kg fresh green leaves of Subabul (*Leucaena leucocephala*) and Babul tree (*Acacia nilotica*) in a closed mouth cotton bag.
- Place the bag into a plastic drum and add 40 litres of water.
- Place the drum in an open place (with covering the mouth) for about 20 days.
- Stir the solution everyday (preferably at morning hour) with a stick by removing the cover and complete the whole task as early as possible.
- The colour of the liquid will change to light tea liquor after the required time period.
- Dilute the liquid by adding normal water (5 times dilution- total liquid volume will be 200 lit.).
- Apply the liquid manure either on soil surface or through foliar spray.

Nutrient content: The average nutrient content of the liquid manure is 1 % N, 1.8 % P_2O_5 with 2.1 % K_2O.

Conclusion

Video link: https://youtu.be/jn_WJUEIzT0

Practical - 13

Topic- Indigenous technological knowledge (ITK) for insect-pest and disease management

Aim: To know the Indigenous technological knowledge (ITK) for insect-pest and disease management

Objective: To learn the process of preparation and use of different organic pesticides.

Introduction: Indigenous knowledge is the distinct knowledge that human being gained through inheritance from their ancestors. This knowledge bank provides a base for education, agriculture, Healthcare and host of other happenings. Ample of such information spread from generation to generation. Such ITK are still used in agricultural sectors for insect control and disease management.

Insect- pest management:

Control of paddy stem borer

Materials required: a branch of 'Kendu' tree *Coromandel ebody*

Procedure: A branch of Kendu is kept inside the infected hill of rice. Local bird namely 'Bhadua' comes by the attraction of the dibbled kendu branch and sits over it. Whenever the month of stem borer comes out the bird catches and feed on them.

Control of paddy leaf roller with bamboo shoot extract

Materials required: Bamboo shoot 1kg, water 10 litre, broomstick and container

Procedure: Chop bamboo shoot into pieces about half inches size. Soak it in 2-3 litre of water overnight in a container. Drain the water in morning and add 7- 8 litre fresh water.

Uses: apply the mixture by sprinkling over the infected plants by means of broomstick in the morning before 10 a.m.

Ash- paper powder

Procedure:

Sieve plant ash

Grind finely dried pepper

Mix 2 kg of ash with 50 gram of pepper powder

Use: The mixture is used for controlling corn stalk borer. Place a pinch off ash mixture to the tunnel of the plant when pinholes on corn leaves are observed. That amount is sufficient to apply in 0.4 hectare land.

Turmeric extract for insect control

Materials required: turmeric rhizomes- 20 gram, cow urine- 200ml, water 2-3 litre and liquid soap 8-12 ml.

Procedure: Soak the shredded rhizomes in cow urine. Strain it and dilute it in 2 to 3 litre of water. At the liquid soap, stir well and store.

Use: Spray the content either in the early morning times or in the later part of afternoon over the infected plant. It controls aphid, caterpillar, red spider and mites.

Ginger Garlic and Green Chili extract

Materials required: Ginger - 25 gram, garlic - 50 gram, green chilli -25 gram, kerosene oil- 10 ml, liquid soap - 12 ml and water - 3 litre.

Procedure:

i. Soak garlic in kerosene oil overnight.
ii. Grind and make a paste
iii. Add 50 ml water to chilly and make a paste
iv. Prepare the ginger paste
v. Mix all the ingredients and dilute into water and steer it well**.**
vi. Filter it to obtain the distillate and add liquid soap.
vii. Stir well before spray.

Use: Spray the diluted extract on infested plant. It is effective against aphids, armyworm, caterpillars, fruit borer, leaf miner etc.

Disease management

Control of bacterial leaf blight of paddy by cow dung slurry

Ingredients: cow dung and 10 kg, water - 100 litre, fine cloth

Procedure:

i. Add a little bit of water in cow dung and steering oil to make it a thick paste
ii. Step by step at all the cow dung in 100 litre of water by continuous staring.
iii. Filter the dilute true define cloth to obtain a fresh slurry

Use: Spray the dilute over the crop in an interval of 7-8 days depending upon degree of infestation.

Use of citronella extract

Materials required: Grinded leaves and roots of citronella- 50 gram, Water- 2 litre

Procedure: Soak the grounded materials in water for few hours and filter it.

Use: Spray the materials over vegetables like tomato carrot and lettuce for controlling bacterial leaf blight.

Lemon glass, bitter gourd and chilli extract

Materials required: whole plant of lemongrass, chilli pods, bitter gourd leaves, liquid soap- 4 ml, mortar and pestle, strainer and bowl.

Procedure:

i. Smash lemongrass Chilli bitter gourd plant part into mortar and pestle to get the extract
ii. Take 5 - 7 tablespoon of lemongrass, chilli, bitter gourd extract and mix it thoroughly. Filter it in a bowl.
iii. Add the liquid soap for stickiness. Dilute the mixture in 4 litre of water.

Use: Spray in the infected plant in morning. It controls the blast disease of rice.

Turmeric extract for controlling powdery mildew

Materials required: turmeric rhizomes- 20 gram, cow urine- 200 ml water - 2-3 litre, liquid soap - 8-12 ml

Procedure:

Soak the shredded rhizomes in cow urine.

Strain it and dilute it into 2-3 litre of water

Add liquid soap, stir well and store

Use: Spraying should be done either in the early morning times or in the later part of afternoon over the interested plant.

Garlic extract

Materials required: garlic bulb - 2 number, water - 4 Cup, liquid soap, grinder, strainer and bottle.

Procedure:

i. Grind the garlic and mix with water.

ii. Leave the mixture for 24 hours.

iii. After 24 hours add soap and stir well and strain it then store it in bottle

Use: Dilute 1 part of emulsion with 9 part of water and stir it thoroughly before spring. Spray the mixture over infected plant preferably in the morning. It controls black spots, blight, fruit rot, mildew and rusts.

Baking soda

Materials required: baking soda, liquid detergent and water.

Procedure: Take 5 gram of baking soda and few ml of liquid detergent and dissolved in 1 litre water.

Use: Make fresh mixture and spray the mixture over infested plant preferably in the morning. It controls powdery mildew.

Conclusion

Video link: https://youtu.be/gR_WXaC0UO4

Practical - 14

Topic- Indigenous technological knowledge (ITK) for weed management

Aim: To prepare organic extract for weed management

Objective: To learn the process of preparation and use of plant extract and vinegar for weed management.

Preparation of *Parthenium* extract

Introduction: On soaking chopped plant part in water liberates several Chemicals present in the plant body. Once the mixture is boiled the Chemicals totally get diluted in water and regulate the wind infestations.

Materials required: *Parthenium* plant part- 1 kg, water - 10 litre, container

Procedure:

i. Collect freshly growing *Parthenium* with leaves
ii. Keep it under Sun for drying
iii. Chop it into small pieces.
iv. Soak the pieces in water in 1: 10 ratio (1 kg of *Parthenium* pieces in 10 litre of water) in a container for 24 hours at room temperature to prepare *Parthenium* water extract.
v. Collect the *Parthenium* extract by filtering it through a screen.

Use:

i. Boil the extract and reduce the volume by 20 times to prepare concentrated *Parthenium* water extract.
ii. Dilute the extract and spray it as pre emergence herbicide.

Preparation of *Calotropic* extract

Materials required: *Calotropic* plant part - 2 kg, water - 10 litre, container

Procedure:

i. Collect freshly growing *Calotropic* with leaves.
ii. Cut it into small pieces and soak it in water in a container for 24 hours at room temperature.
iii. Boil the extract for 30 minutes and reduce the volume by 20 times to prepare concentrated *Calotropic* water extract.
iv. Dilute the extract in 10 litre water.

Use: Spray it as pre emergence herbicide.

Use of vinegar:

Vinegar (acetic acid) is a non-selective contact herbicide. In general, weed control increases as acetic acid content and application volume increase. Typically, vinegar is less effective in controlling grasses than broadleaf weeds and more effective on annual species than perennial (Webber and Shrefler, 2007c, 2008a, 2008b, 2009b; Webber *et al*., 2009b).

There is also a difference between non-synthetic and synthetic acetic acid and approval for use in organic production. If the material is intended for use on certified organic land, check for approval of your specific product with your organic certifying agency. Vinegar with 10, 15 and 20% acetic acid concentrations can kill weeds effectively.
Precaution: Vinegar with greater than 10% acetic acid can cause severe eye damage or even blindness.

Conclusion

Practical - 15

Topic- Cost of organic production system

Aim: To study the cost of organic production system

Objective: To learn the process of data collection and calculation of cost of production.

Introduction: The organic production system always has some differences with traditional cultivation system. The inputs are also different from traditional crop cultivation as a result the ultimate cost varies. The price of organic product is also very high.

Procedure: Collect all the data related to all inputs required, cost of labour, collection of data and market study for organic produce.

Observations to be recorded: Calculate the cost of cultivation, gross return, net return and calculation of B: C ratio with all collected data.

Sl. No.	Particulars	Operations	Quantity	Rate (Rs.)	Amount (Rs.)
1	Land preparation				
2	Layout				
3	Nursery bed preparation				
4	Seed				
5	Sowing/Planting				
6	Manure/ Compost Bio-fertilizer				
7	Application cost				
8	Weed management	(Cost of organics+ Preparation cost+ Application cost)			
9	Intercultural operation				
10	Plant protection	(Cost of organics+ Preparation cost+ Application cost)			

11	Irrigation charges				
12	Application cost				
13	Harvesting, drying				
14	Threshing, winnowing, bagging and storage				
Total					
Cost of cultivation (Rs.)					
Gross return (Rs.)					
Net return (Rs.)					
B:C ratio					

Conclusion

Practical - 16

Topic- Post harvest management: Quality aspect, grading, packaging and handling of organic produce

Aim: To study the grading, packaging and handling of organic produce

Objective: To learn the process of post harvest management of organic produce, its quality, grading and packaging.

Introduction: principles of organic production may vary from region to region. However, there are certain legal minimum requirements to confirm the product as organic produce. The concept of organic does not end with production only. The organic production system includes:

i. Replenish and maintain soil fertility.

ii. Eliminate the use of toxic and persistent chemical pesticides and fertilizers.

iii. Encourage biological diversity.

Organic food: Organic foods are minimal process to maintain the integrity of the food without artificial ingredients and preservatives

Production: This is the foundation level; planting a seed, nurturing it to the fulfilment of its density as a fruit, root, or seeds and harvest it.

Harvesting: It is one of the most critical aspects in production of Agricultural crop is harvesting. The possibility to spoil the crop and end up receiving a lower return is very acute. This requires knowledge how and when to harvest before it is grown. Many crops require specialized techniques to ensure that they reach market in the right condition.

Processing: Few agricultural harvests are eaten in the natural state but most are cooked. Processing is assumed for many reasons: the earliest was probably for preservation and storage, since many fruits were highly seasonal. Processing is now related with confirming about food safety, especially to limit the growth of micro-organisms that may cause food poisoning as well as deterioration and wastage of food.

Low-temperature, acidification and heat have all been practiced for many years. But progressively other approaches have also been established such as irradiation, vacuum packing and use of low temperature.

Limitations

The difficulties of organic food processing are:

i. The additives permitted for preservation and to improve taste and texture are greatly limited.

ii. The substances used for cleaning and processing machinery are also restricted. The research needs are, therefore, similar to those in production: how to achieve the desired aims with acceptable substances.

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