PRACTICAL MANUAL

Course Title	: **Principles of Organic Farming**
Course No.	: **AGRO – 248 (New)**
Credits	: **2 (1+1)**
Course	: **B.Sc. (Hons.) Agriculture**
Semester	: **IV Semester (New)**

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Experiment No. 1

Visit to Organic Farm to study the various components and their utilization

Objectives :

1) To know the individual components of Organic Farming.
2) To study the various components present on Organic Farm. The major components of organic farming system would include,
3) To visit and introduce various components and their utilization of Organic Farm Research Station

Components of Organic Farming :

The components of organic farming are as follows

1) **Organic manures :** Enrichment of soil with organic matter Organic materials substituted for inorganic fertilizers
   a) FYM
   b) Compost
   c) Vermi-compost
   d) Biogas slurry
   e) Green manuring crops
   f) Bio-fertilizers
   g) Agricultural waste
   h) Industrial waste
2) **Cropping systems :**
   a) Crop rotation
   b) Mixed farming
3) **Bio-fertilizers**
   a) Symbiotic,
   b) Associative symbiotic
   c) Non-symbiotic and
   d) Others
4) **Weed management:** Non chemical weed control measures *viz.*
   a) Cultural practices
   b) Mechanical control measures
   c) Physical practices
   d) Biological means
5) **Pest management:** Use of bio-pesticides for control of insect pests and diseases.
   a) Cultural methods pest management
   b) Physical methods
   c) Bio-agents : Use of botanicals (NSKE, Pongamia, etc) Use of bioagents (Parasites, predators and pathogens)

Table No.1: Nutrient status of some organic manures :

Sr. No.	Category	Source	Nutrient content (%)		
			N	P_2O_5	K_2O
1.	Animal wastes	Cattle dung	0.3-0.4	0.10-0.15	0.15-0.20
		Cattle urine	0.80	0.01-0.12	0.50-0.70
		Sheep and goat dung (mixed)	0.65	0.05	0.03
		Night soil	1.2-1.5	0.8	0.5
		Leather waste	7.0	0.1	0.3
		Hair and wool waste	12.3	0.1	0.3
2.	FYM/Compost	Farm Yard Manure	0.5-1.0	0.15-0.20	0.50-0.60
		Poultry manure	2.87	2.90	2.35
		Town compost	1.5-2.0	1.0	1.5
		Rural compost	0.5-1.0	0.2	0.50
		Water hyacinth compost	2.0	1.0	2.30
3.	Oil cakes	Castor	5.5-5.8	1.8	1.00
		Cotton seed	3.9	1.8	1.60
		Karanja	3.9-4.0	0.9-1.0	1.30
		Neem	5.2	1.0	1.40
		Niger	4.8	1.8	1.30
		Rape seed	5.1	1.8	1.00
		Linseed	5.5	1.4	1.20
		Sunflower	4.8	1.4	1.2
4.	Animal meals	Blood	10-12	1.2	1.00
		Raw bone	3-4	20-25	-
		Steamed bone	1-2	25-30	-
		Fish meal	4-10	3-9	1.80

Table No. 3 : Fertilizer equivalents of some organic manures and biofertilizers

Components	Input level	Fertilizer equivalent of input in terms of yield
FYM	Per tonne	3.6 kg N+P+K (2:1:1)
Green manure (*Sesabania*)	Per tonne	4.4 kg N
Green manure (*Sesbania*)	45 days crop	50-60 kg N for rice
Cowpea intercropped with castor	Legume burried after 6 weeks	30 kg fertilizer on castor
Leucaena loopings	88 kg N in Leucaena 5t/ha	25 kg fertilizer on sorghum
Sugarcane trash	5 t/ha	12 kg N/t
Rice straw + water hyacinth	5 t/ha	20 kg N/t

Experiment No. 2

Study of preparation methods for Enriched Composts

Objectives : To know the procedure for preparation of enriched compost.

Introduction :

Compost :

- Compost is a process by which organic wastes are converted into organic fertilizers by means of biological activities under controlled conditions. It may be **defined as a method of solid waste management.**
- The recycling of waste organic materials as manure for sustaining soil fertility is very important for organic farming systems.
- The primary objectives of composting are to stabilize the putrescible organic matter in raw agricultural / industrial waste to reduce offensive odours, to kill weed seeds and pathogenic organisms and finally to produce a uniform, slow release organic fertilizers which stimulates soil life, improve soil structures, helps plants to tolerate / resists insect pests and diseases.
- Production of organic manures from both rural and urban wastes would not only provide plant nutrient humus but also results in hygienic disposal of the organic waste which otherwise may cause environmental pollution.
- Composting can be made by adopting various methods such as Indore, Bangalore, NADEP, Coimbatore, Synthetic methods, etc.

A. Preparation of Enriched Sugarcane Trash Compost :

- By recycling the cane trash as manure, the productivity of crops can be enhanced besides achieving hygienic disposal of he trash avoiding environmental pollution and deterioration of soil health.
- Dig a pit measuring **9 m x 5 m x 1 m** in a corner of the field.
- Spread a layer of about **500 kg of cane trash.**
- Over this spread about **500 kg of press mud or soil.**
- Over these layers, sprinkle **25 kg of a fertilizer mixture** prepared by mixing rock phosphate and gypsum in the ratio of 2:2.
- These layers should be moistened with **500 litres** of aqueous suspension of **soil, cattle dung and decomposed manure** mixed at the rate of about 5 kg each in 100 litres of water.
- **Repeat** the layers of cane trash, press mud or soil sprinkling with fertilizer mixture and moistening till **10 layers** are laid.
- Over the final layer, spread a layer of press mud or soil to a thickness of **15cm** and cover the heap.
- **Moisten** the heap **once in a week** and allow for decomposition for **3 months.**

- After 3 months, give a **turning** by mixing the layers and re-heaping the materials.
- Continue **moistening** the heap **once in 7-10** days for **2 months.**
- After **5 months,** completely decomposed manure is **ready** for field application.

B. Composting of Pressmud :

It can be done by mixing with **distillery effluent** which is also a rich nutrient source.

- First, the **moisture content** of the press mud is reduced from **75 to 50 %** using **aerotiller.**
- Additives containing materials like
  1. Composted coir pith 5%,
  2. Sugar cane trash 2.5 %,
  3. Water hyacinth 2.5% and
  4. Rock phosphate 2.5 % are mixed with press mud.
- Then **1 tonne** of press mud is **inoculated** with **1.5 liters** of composite culture containing **thermophilic microbes** (*Bacillus* sp. and *Pseudomonas* sp.).
- Above this, **distillery effluent** is added to bring **60% moisture** level.
- Then heap is **reformed** with aerotiller until a temperature of **60-70^{0}C** is reached.
- After **4-5 days,** adding of next dose of **effluent** is done when the moisture content goes **below 50%.**
- Again, the heap is **reformed** with aerotiller.
- Likewise composting of press mud and adding of effluent are continued.
- The addition of **effluent** is about **4000 litres** which is done in **1-2 months.**
- The heap is allowed for **curing** for about **15 days.**
- To the composted materials, **bio fertilizers** viz. *Azotobacter, Azospirillum* and *phosphobacteria* **each at 2 kg/ha** is added at the time of application, which enables N fixation and solubilization of native and added P.

Table : Composition of enriched sugarcane trash compost

Nutrients	Sugarcane trash	Press mud	Sugarcane trash compost
Major nutrients (%)			
Nitrogen (N)	0.50	1.90	1.60
Phosphorus (P)	0.13	1.50	1.10
Potassium (K)	0.40	0.50	0.50
Calcium (Ca)	0.55	3.20	1.00
Magnesium (Mg)	0.30	2.00	0.60

Sulphur (S)	0.12	0.50	0.48
Micro nutrients (ppm)			
Iron (Fe)	360	2440	2710
Manganese (Mn)	110	400	450
Zinc (Zn)	90	260	370
Copper (Cu)	30	130	80
C:N Ratio	**113:1**	**16:1**	**22:1**

C. Enrichment of Compost with microbial inoculants:

- Enrichment of compost using low cost **N fixing** and **Phosphate Solubilising Microbes** is one of the possible ways of improving nutrient status of the product.
- It could be achieved by **introducing microbial inoculants**, which are more efficient than the **native strains** associated with substrate materials.
- Both the nitrogen fixing and phosphate solubilising microbes are more exacting in their **physiological and ecological requirements** and it is difficult to meet these requirements under natural conditions.
- The only alternative is to enhance their inoculums potential in the composting mass. Studies conducted at IARI, New Delhi showed that inoculation with *Azotobacter / Azospirillum* and phosphate solubilising culture in the presence of 1% rock phosphate is a beneficial input to obtain **good quality compost rich in nitrogen (1.8%).**
- The **humus content** was also higher in materials treated with microbial inoculants.

D) Enriched FYM (EFYM)

- FYM is **bulky and low** in major plants nutrients such as **N,P** and **K.** Hence there is a need to improve its quality.
- EFYM is recommended for **rainfed crops** which require **available P** for their **root proliferation** to **withstand** the initial growth stages under **dryland conditions.**
- First **750 Kg** of well decomposed FYM is taken. After **sieving**, the recommended dose of **P** and **K_2O** for the crops to be grown is mixed with the sieved **FYM.**
- The mixture is spread in the form of **heap** and **plastering** is done with **red-earth paste.** This **anaerobic** process is maintained for **30 days.**
- Then, the **nitrogenous fertilizers** recommended for **basal dose** of the crop to be grown is **mixed** and it should be applied immediately before sowing.

Assignment:

1. Draw a neat diagram of NADEP composting method along with labels.

Experiment No. 03
Study of preparation methods for vermi-compost and vermiwash

Objectives

1) To study the preparation method of vermi-compost.
2) To know the procedure for preparation of vermiwash.

Introduction :

- **A novel technique of converting decomposable organic waste in to valuable compost through earthworms is called vermi- compost. It is also rich source of Ca, Mg, Cu, Zn, Fe and Mn.**
- Vermi-compost is a mixture of worm casting (faecal excretions), organic materials including humus, live earth worms, their cocoons and other microorganisms.
- Vermi-compost is complex bio-fertilizer and is not desirable to compare its status as a mere supplier of NPK fertilizers. It is richer than any other type of composts.
- **Vermi-culture means the scientific methods of breeding and raising the earthworms in controlled condition and the by-products is known as vermi-compost.**
- The aim of vermiculture is to create improved conditions artificially so that the earthworms can multiply in the shortest possible time and space.

Types of Earthworms :

There are about **3000** species of earth worms reported throughout the world, among them **509** are available in India. The earthworms are mainly divided in to two groups :

I) **Epigeic** (Surface feeder) group of earthworms are very important in vermicomposting example, ***Eisenia foetida***, *Eudrilus eugenia, Pherionyx excavatus.*

II) **Epianeeic** group of earthworms are feeders on leaf litter in the upper layer of soil surface.

Preparation of Vermi-compost : includes :

i) Selection of earthworms
ii) Selection of enclosure,
iii) Set up for vermi-composting
iv) Application of feed materials
v) Removal of vermi-compost
vi) Care and maintenance of vermi-composting unit.
vii) The vermi-compost can be prepared in wooden boxes, plastic buckets, pits or tanks made of brick or concrete or in heaps.
viii) The **bottom** of the vermi- bed should be lined with **plastic sheets** for provision of **drainage**.

ix) The organic waste materials of different **C:N** ratio and maturity should be arranged in different layers as follows :

a) **Bottom layer**: pebbles or broken bricks to facilitate proper water drainage.

b) **First layer**: Add 5-7 cm thickness layer of slow decomposing materials and cow dung.

c) **Second layer**: half or fully decomposed materials.

d) **Third layer**: Earthworms approximately 100/cu.ft. and cocoons.

e) **Fourth layer**: Kitchen and garden wastes.

f) **Upper layers**: covered with gunny bag.

x) **Bio agents** like *Pseudomonas* and *trichoderma* can be added to improve the **quality** of vermin-compost.

xi) The organic matter is converted into granular amorphous odorless dark brown vermi-compost, which also contains vermi-casts and cocoons.

xii) Before removing the compost, **stop watering**.

xiii) Composts is placed on a plastic sheet or ground in the form of cone under **bright sunshine**, which compels the earth worms to move at the bottom of compost biomass. The recovered earthworms can be used for further vermi-composting.

xiv) The compost may be sieved using 2.0-2.5 mm sieve and stored in polythene bags t retain about 15% moisture in it.

xv) Mature vermi-compost is recommended @ 5 t/ha. It can be used @ 500 g in small fruit plants and 3-4 kg/plants for large trees, whereas for vegetable crops @ 3 kg/10 m^2 area.

Nutrient composition of Vermi-compost : The average nutrient content of vermin-compost is about 1.6 N; 5.04 P; 0.8 K.

Precautions to be taken while vermi-compost preparation:

- Protect the vermi-compost units from bright sunshine and rain water.
- Avoid use excess kitchen wastes which may hasten the growth of earthworms.
- Avoid addition of thick layer of organic wastes.
- The vermi-compost heaps should not be covered with plastic sheets should not be used to cover.
- Maintain optimum moisture level (Dry conditions kill the worms whereas water logging drive them away)
- Prevent the attack of red ants, rats, cats, dogs, hen, cock, birds etc., which may feed the cocoons.

(A) Vermi-composting of Dairy Waste: Biogas slurry & dairy farm waste can be efficiently converted into compost with earthworms, as they consume almost any non-toxic organic waste, including food processing waste, paper & manure.

- Dig a trench of **1.5 m x 1.2 m x 0.3 m**

- **Build some moistened straw, as a bed, to a height of 10 cm.**
- **Over this add 10 cm cow dung / biogas slurry** and pour some water.
- **Introduce about 100 earthworms /cu.ft. in the bed.**
- Over this put 5 cm layer of farm waste and moisten with water.
- Add a 15 cm layer of slurry over this and water it to maintain moisture.
- Allow it to remain for 45 days.
- Mixing and turning using a pitch fork should be done every 15 days. It must be watered regularly.
- After 45 days, stop watering, sieve the compost and store.

(B) Vermi-composting of Sugarcane Bagasse:

- Chop sugarcane bagasse to a size of 10-15 cm
- Dig a pit of 0.6 m x 0.9 m x 0.3m in shade.
- Fill the pit with the chopped sugarcane begasse
- Add a layer of cattle dung, urea and rock phosphate.
- Over this add a layer of top soils.
- Cover the pit. Allow the mixture to decompose for 10-15 days.
- After partial decomposition, add deep burrowing earthworms.
- Cover the pits with gunny bags or by regular watering.
- Maintain sufficient moisture for 4 months.
- Compost shall be ready after this period.

Preperation of Vermiwash :

- Vermiwash is collection of excretory products and mucus secretion of earthworms along with micronutrients from organic molecules.
- It is collected after passage of water through column of earthworm action.
- It is clear, transparent pal yellow colored fluid used for foliar spray.
- An earthen pot of 250 lits capacity is filled with pieces of bricks / stone / pebbles up to 25 cm height from bottom.
- Barrels / bucket / earthen pot can also be used for this set up.
- A hole is made to one side open container to fit a 'T' jointed tube for tap and valve.
- A layer of (30-45 cm thickness) loamy soil is placed.
- Introduce 100 earthworms into moistened soil layer.
- Cow dung paste, organic material, hey is placed on top of soil and gently moistened everyday for 15-30 days till brownish black mask of compost is obtained.
- Container filled with 5 lit water kept on top of barrel after 15-30 days.
- Water from top container is discharged drop by drop continuously overnight.

Assignment :

1) Draw a neat and well labeled diagram of vermi-composting unit (layer wise)
2) Draw a neat sketch of pitch fork.

Experiment No. 04
Study of Bio-fertilizers and Bio-inoculants

Objectives:

1) To get acquainted with various bio-fertilizers
2) To study the various bio-inoculants formulations.

Introduction:

During post green revolution period the Indian Agriculture has become a chemical agriculture in which numerous chemicals like insecticides, nematicides, herbicides and commercial fertilizers are being used in producing crops.

- This has resulted into a major shift in microbial population and whole rhizosphere is getting polluted.
- Nutrient dis-balance, fast depletion in soil fertility and continuous deterioration in physical properties of soil, are some of the added disadvantages of chemical agriculture.
- Bio-fertilizers play an important role in improving soil fertility and thereby boosting crop yields.

Bio-fertilizers are microbial inoculants which are capable in nitrogen fixation, phosphate solubilising and decomposing organic matter at a faster rate.

Besides, the Vesicular Arbuscular Mycorrhizae (VAM) and Plant Growth Promoting Rhizobacteria (PGPR) are also very important microbes which help improving the soil fertility and boosting crop productivity.

Classification of Microbial Inoculants :

The inoculants may be classified into following groups based on their mode of action:

(A) Nitrogen fixers:

(a) **Symbiotic:** These found in symbiosis or in complementarily with legumes i.e. *Rhizobium* inoculants.

(b) **Non symbiotic:** Those which are found associated with cereals, millets and vegetable like :

1) **Bacteria:**

(i) **Aerobic:** These which function in presence of oxygen including *Azotobacter, Azomonas, Azospirillum, Mycobacterium*

(ii) **Anaerobic:** They are capable of functioning in absence of oxygen. *Closterdium, Chlorbium, Chromatium.*

(iii) **Facultative anaerobes :** This may also function in absence of oxygen which includes *Bacillus, Enterobacter, Escherchia, Klebsiella, Rhodospirillum.*

(2) Blue Green algae : These algae are capable of fixing atmospheric nitrogen besides adding organic matter to the soil. This includes *Anabaena, Nostac, Tolypothrix, Anabaeopsis.*

(B) Azilla: It is a primitive free floating water fern, forms a green mat over the water, which often becomes reddish due to accumulation of anthocyanin pigments. It has an algal symbiont (*Anabena azolla*) within a central cavity. *Azolla pinnata* can double its biomass in 3-5 days and assimilate 60-8 Kg N/ha

(C) Phosphate Solubilizing Microbs: Indian soils are poor to medium in available phosphorous status. Only about 25-30 per cent of applied phosphorous becomes available to the crop and the remaining part gets converted on to insoluble / unavailable forms. Hardly 1-2 per cent of applied P is incorporated in to above ground plant parts. These residual or fixed forms o soil phosphates are solubilised and mineralized by a group of heterotrophic microorganism (called as PSM) by producing organic and inorganic acids and phtase enzymes and make them available to crops.PSM include various bacterial, fungal, and actinomycetes forms. They are *Bacillus megatherium, Pseudomonas straita* (bacteria) *Aspergillus acva .Penicillium digitum and Trichoderma spp.* (fungi)

(D) Vesicular – Arbuscular Mycorrhyza (VAM): These organism(fungi) are commonly found in association with agricultural crops, shrubs, most tropical tree species and some temperate tree species. VAM differ from PSM is that the former do not solubilise the insoluble unavailable phosphorous but assimilate phosphorous, zinc and other nutrients from soil for their own need and in addition, translocate them in different forms to the host roots.
VAM increases root absorbing surface and reaches outside the root depletion zones. It directly translocate the nutrients like phosphorous, Zn, Cu, K, Al, Mn, and Mg from the oil to the root cortex and increases the growth of associated plants by producing auxins, antibiotics etc.

(E) Plant Growth Promoting Rhizobacteria (PGPR): They enhance the plant growth indirectly by depriving the harmful microorganisms of (Fe^{3+}) in their energy metabolism via production of extra cellular iron charatora, there by allowing the plants to achieve more of its growth potential. e.g. *Agrobacterium, Azotobacter Bacillus*

(F) Sulphur Solubilizing Microbs.

Types of Inoculum :

There are varieties of formulation both in liquid and solid. The main types currently used for Bio-fertilizers have been classified into

A) dry products (dusts, granules and briquettes) and
B) suspensions (oil or water based and emulsions).

A wider range of formulations with additives are available in market.

I) Dry Inoculum Products :

- These formulations comprise dusts, granules and briquettes, based on particle or aggregate size.
- Dusts based on inert diluents or carriers, normally with low absorbent capacity, these have different particle sizes ranging from 5-20 mm.
- Particles of < 10 mm are hazardous when inhaled, but the smaller particles adhere best on the particles.
- Dusts mainly contain 30% of an organism's in suspension by weight.

II) Granules, Pellets, capsules and briquettes

- Granules are discrete masses 5-10 mm^3 in size
- Pellets are > 10 mm^3, an
- Briquettes are large blacks up to several cubic centimeters
- Like dusts these products contain an inert carrier holding the organisms.
- Carriers include clay minerals, starch polymers and grinded plant residues.
- Soft carriers, e.g. Bentonite, disburse quickly to release the organism. The product can be coated with various materials to slow down or control the rate of release, which also depends on unit size.
- When the carrier forms a protective coat around aggregate of organisms, the unit is termed a capsule.

The concentration of organisms in granules is 20-30 %.

There are three **types of granular formulations:**

i. The organisms are attached to the outer surface of a granular carrier in a rotating drum by a sticker
ii. The organisms are incorporated into a carrier paste or powder which sets as a matrix size being controlled by passing the product through a sieve.
iii. The organisms are sprayed onto a rotating granular carrier without a sticker.

iii) Wettable powders:

This formulations are predominated among all commercial products and comprise charcoal, lignite, vermiculite powders blended with 3% gum to make them stable during storage on the shelf and readily stick with seeds.

Wettable powders are formulated as dry powder mixed in water as a carrier, just before use.

Suspensions (Liquid Formulations):

Liquid bio fertilizers are special liquid formulation containing not only desired microorganisms and their nutrient, but also special cell protctants or substances that encourage formation of resting spores or cysts for longer shelf life and tolerance to adverse conditions.

i) Dormant Aqueous Suspension:

- Several current commercial products available in market following the dormant technology.
- Generally they are using growth suppressants, contaminant suppressant fungicides, insecticide etc. for the long term viability.
- These when applied in crops take prolonged time for reactivation, which is not desirable for short duration crops.

ii) Dormant Oil Suspension:

- Microorganisms can be suspended in oil at higher concentration in various degrees of dehydration and remain viable.
- This formulation delivers organisms in a physiologically dormant state and does not encourage the growth of contaminants during storage.
- The bacteria / fungus has been successfully dried by continuous aeration as a suspension in oil to provide inoculants with shelf lives of several years.

Assignment :

1) Write the various methods of bio fertilizer application.
2) How bio fertilizers are used (recommended dose) for field crops.

Experiment No. 05
Study of Preparation Biodynamic Compost and Cow Pat pit.

Objectives:

1) To know various biodynamic preparations.
2) To study application of biodynamic preparations.

Biodynamic preparations: Basically there are two types of biodynamic preparations i.e. **A) Biodynamic compost preparations** (BD-502 to BD-507) and

B) Biodynamic field sprays (BD-500 and BD-501).

The basic constituents, related planets and main elements with these BD sets (BD-502 to BD-507) are given below

Table: Biodynamic preparations and relations with planets and constituents

BD set	Related planet	Base material	Nutrient composition
BD-500	Moon	Cow horn manure	Ca
BD-501	Sun	Cow horn silica	Si
BD-502	Venus	Fermented flower heads of Yarrow (*Achillea millefolium*) Bhut Kesi , Rojmaari	S, K and N
BD-503	Mars	Fermented Chamomile blossom (*Matricaria chamomilla*) Gul-babunah	Ca, S, K and N
BD-504	Mercury	Whole shoot of stinging nettle with flower (*Urtica dioeca*) fermented in the soil Stinging nettle, Bichchhu buti	Ca, S, K and Fe
BD-505	Moon	Fermented Oak bark (*Querqus robur*) English Oak, mayaphala	Ca
BD-506	Jupiter	Fermented flower heads of Dandelion (*Traxacum officinale*) Dandelion, Dugdhapheni, Lootari,	K and Si
BD-507	Saturn	Valerian flower extract (*Valeriana officinalis*) Indian Valerian, Nakkali jatamasi	P

Biodynamic Compost Heap:

- Biodynamic compost is an effective **soil conditioner** and an immediate source of nutrient for crop.

- Biodynamic compost **heap** can be prepared by using **green leaves and dry leaves.**
- Green leaves (nitrogenous) and dry leaves (carbonaceous) are piled up in alternate layers of 15 to 25 cm thick of **5 m x 2 m x 1.5 m** in size.
- For enriching the compost with different nutrients as per the need, rock phosphate (P), slack lime (Ca), wood ash (K) etc. can also be used.
- Composition of **air, moisture and warmth** is very important in the breakdown and decomposition of the material used.
- BD sets (502 to 507) are incorporated and the heap is **plastered** with mixtures of **dung and clay.**
- Enriched compost get ready in **75 to 100 days** depending upon the temperature maintained.

Biodynamic Liquid Manures and Pesticides:

- Liquid manures are prepared using different materials i.e. **liquid fish manure, liquid seaweed manure and liquid plant manure.**
- The liquid manures are used for the different purposes based upon the quality and composition.
- On an average, preparation of liquid manure takes **8 to 12 weeks** . One litre of liquid manure dissolved in 4 litres of water is used on plant as foliar spray.
- Liquid manures prepared with neem, *Pongamia* (karanj) and *Calotropis(* Rui or ruchki) leaves have **insecticidal and fungicidal** properties.

Biodynamic Field Sprays (BD 500-501):

BD 500:

These are the fundamental biodynamic field spray preparations. Cow horns filled with fresh **cow dung from lactating cow** are buried in **fertile soil.** Horns are buried in **descending moon** during autumn **(October - November)** for incubation during winter. It is taken out in **March-April** during **descending** period and used or **stored in earthen pots** in **dark and cool** place. Its characteristics and applications are mentioned below:

- Regular application for 2 to 3 years improves **soil characteristics.**
- Earthworm activity, porosity, activity of humus forming bacteria, crumb structure, clover nodulation and root penetration are increased.
- The **moisture absorbing capacity** of the soil can be increased at least four fold over the years
- Humus depth can be extended down about **30 cm.**

- Soil pH rises up to a point which is conducive to the support of earthworms in the range of **5.8 to 6.5**
- The soil becomes able to allow the plants to express their natural characteristics.
- Promotes **breathing** of the earth.

Application of BD 500:

- **BD 500 (25 g)** is dissolved in **13.5 litres of water** in plastic bucket by making vortex in clock and anti clock wise for 1 hour in the evening.
- The solution is sprayed with the help of natural brush or with tree twig.
- Spraying of BD-500 is done at the time of field preparation in descending period of the moon.
- Very interesting increase in microbial activity of BD-500 during stirring response has been obtained from **cosmos** and **earth**.
- It should be applied at least twice in a year once in spring and other in autumn.

BD-501:

- It is prepared in **ascending period of moon** by filling cow horn with **silica powder** and buried in **spring (March-April)** after taking out BD-500.
- Within **6 months**, the preparation is ready for use.
- The solution is prepared by dissolving **1 g in 13.5 litres of water.**
- BD-501 is sprayed on the leaves in the form of mist **before sunrise** and the best assemblage in **Moon opposite to Saturn.**
- Its characteristics and applications are mentioned below

Application of BD 501:

- BD-501 is applied (**1g in 13.5 liters of water**) in the **early morning** in **ascending** period of the **moon** once at the beginning of the plant's life (**at the 4 leaf stage**) and again at the **flowering stage or fruit maturation** stage for its maximum effect.
- BD-501 works on the photosynthetic process.
- It strengthens the **quality** of plant product and encourages the **development of fruit and seeds.**
- Due to enhancement of photosynthesis, starch, sugars and cellulose synthesis is improved.
- It also improves the **storage life** of the produce.
- It has been found specific for the control of fungi like **powdery mildew, brown rot, rust, blight etc.**

Cow Pat Pit (CPP):

- It is a biodynamic field preparation and is also called as **Soil Shampoo.**
- CPP is a **strong soil conditioner.**
- It enhances germination, promotes rooting in cutting and grafts, improves oil texture, provides resistance power to plants against pests and diseases, replenishes and rectifies the trace element deficiency.
- CPP is used to **improve soil fertility** before sowing and also as seed treatment and foliar applications.
- The CPP may be prepared **throughout the year.**
- Depending upon the weather and temperature, the preparation will be ready for use in approximately **75 to 90 days.**
- **Soaking 0.5 to 1.0 kg** of CPP in **40 to 50 liters** of water **overnight** and sprinkling over **acre** of land before sowing may improve the **germination and health of the soil.**

Application of CPP:

- Prepare **CPP manure slurry**, sprinkle on **seeds**, mix, dry it in shade and sown
- Dissolve **1 kg of CPP** manure in water,make slurry with **clay**, dip the **seedlings for 5 minutes** and transplant.
- **Dissolve CPP** manure in **pure water** in a food grade plastic bucket or drum, stir in **clock and anti-clockwise** directions making **vortex for 20 minutes.**
- The solution can be sprinkled / spread in the low volume to make bigger droplets on the foliage.
- **Soak CPP** manure **overnight**, dissolve in pure water in a food grade plastic bucket or drum for 20 minutes by making vortex.
- **Sprinkle** the solution by brush / broom / sprayer under low volume spray to make bigger droplets **on the foliage.**
- In quality compost preparations, CPP manure can be used if BD (502-507) preparations are not available.
- Prepare **CPP manure (2 kg) in 5 litres** of pure water for **20 minutes.**
- Pour the solution in different holes in the compost heap and rest over the heap.

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Experiment No. 06
Study of quality analysis of compost and vermi-compost.

Objectives:

1) To get acquainted with various quality parameters of compost and vermi-compost

Introduction :

Quality parameter really depends on the conditions and the input of the two methods. But if all are the same then vermi-composting would give a better compost as the worms will bring more microorganism diversity and vermi-compost will contains more plant growth hormones, traditional compost apparently contains more mineral nutrient.

Comparison between compost and vermi-compost:

- On a large-scale, composting is always a 'thermophilic' process, whereby considerable amounts of heat are produced as a result of the intense microbial activity within the composting mass. This heat can be important for killing pathogens and weed seeds, as well as speeding up the decomposition process.

- "Vermi-composting" can be defined specifically as the biological breakdown (decomposition) of organic wastes, via the joint action of (specialized) earthworms and microorganisms. It is a term that can be used interchangeably with "worm composting".

- The mineral matter content (ash%) is higher in all enriched composts in comparison to conventional compost.
- The total organic carbon and water soluble carbon are lower where as total mineral (NPK) are higher in Enriched Compost and vermi-compost as compared to conventional compost.
- The period of decomposition is (105±10 days) for enriched compost whereas (175±10 days) for conventional compost and (105±10 days) for vermi-compost.
- As regard to biochemical quality of compost, it was found that conventional compost exhibit less amount of total phenol, alkaline and acid phosphotase enzyme activities, but a higher dehydrogenase activity.
- The greater dehydrogenase activity in case of conventional compost is an indicator of partial decomposition of the compost.
- There is no variation in terms of chemical, biological constituents due to method of compost preparation. Although vermi-compost is better than conventional compost.

Parameter*	Garden compost 1	Vermicompost 2
pH	7.80	6.80
EC (mmhos cm^{-1})**	3.60	11.70
Total Kjeldahl nitrogen(%)***	0.80	1.94
Nitrate nitrogen (ppm)****	156.50	902.20
Phosphorous (%)	0.35	0.47
Potassium (%)	0.48	0.70
Calcium (%)	2.27	4.40
Sodium (%)	<0.01	0.02
Magnesium (%)	0.57	0.46
Iron (ppm)	11690.00	7563.00
Zinc (ppm)	128.00	278.00
Manganese (ppm)	414.00	475.00
Copper (ppm)	17.00	27.00
Boron (ppm)	25.00	34.00
Aluminum (ppm)	7380.00	7012.00

Assignment:

1) Describe the physical properties of compost and vermi-compost.

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Experiment No. 07
Study of Crop Residue Management and Green Manuring

Objectives:

1) To study different green manuring crops
2) To study management crop residue

Residue Management:

Crop residues are defined as the non-economic plant parts that are left in the field after harvest and remain that are generated from packing sheds or that are discarded during crop processing.

The greatest potential as a biomass source appears to be from the field residues of corn, wheat, soybean, and grain sorghum and the processing residues of sugarcane (bagasse) and cotton (gin wastes).

An estimated **48 per cent** of the total crop residues produced come from corn and small grains and grasses.

Table: Estimated residue production from common crops

Crop	Residue yield (t/ha)
Corn	5.49
Wheat	2.04
Soybean	1.72
Grain sorghum	3.05
Sugarcane	85.07
Cotton	0.52

Crop residues, however, require preparation, usually consisting of size reduction and drying, before they are suitable for use as a biomass feed stock for conversion to energy.

Two principles **conversion methods** are used:

A. Thermo-chemical, including direction combustion, pyrolysis liquefaction and gasification with air or oxygen and

B. Biological including anaerobic digestion and hydrolysis followed by fermentation.

1.Use of Residues as Mulch:

This is a simple method particularly for recycling of dry and nitrogen poor organic materials. Mulch is applied on the soil surface during first crop period and is incorporated in next crop period. Studies have shown that mulches control weeds, conserve moisture, and increase crop yield and population of beneficial soil micro flora.

Effect of Crop residue:

The effect of crop residues on the soil physical improvement, fertility and crop yields have been widely studies. The crop residues when incorporated in soil and allowed appropriate period of decomposition before planting the beneficiary crops, were found to exert significant influence on soil fertility and crop yield and reduced the does of chemical fertilizers needed to the crops.

Green Manuring:

Crops grown for the purpose of restoring or increasing the organic matter content in the soil are called green manure crops. Their use in cropping system is called Green Manuring were the crop I grown *in situ* or brought from outside and incorporated

Advantages of Leguminous Green Manure Crops:

1. Fix free N from atmosphere
2. Physical condition of the soil is improved by cultivation and incorporation.
3. They are more succulent than the non-legumes and less soil moisture is utilized for their decomposition.
4. They serve as cover crops by their vigourous growth and weeds are smothered e.g. clover, dhaincha and cowpea.

Classification of Green Manure Crops:

Legumes:

Green manure: Dhaincha, Sunnhemp, Kolinji

Green leaf manure: Glyricidia, Cassia, Pongamia

Non legumes :

Green manure: Sunflower, Buck wheat

Green leaf manure: Calotropis, Adathoda, Thespesia.

Table : Seed rate and yield of different green manuring crops :

Green manure crop	Seed rate (kg/ha)	Yield (tonnes/ha)	N fixation (kg/ha)
Cowpea	25-30	8-10	--
Sunnhemp	25-40	16.8	159
Dhaincha	20-25	26.3	185
Sesbania rostrata	30-40	3-5 (as border crop), 24.9 (as pure crop)	219
Glyricidia	375-400 plants/ha	2.5-5.0 kg/plant (2-3 cuttings/year) (2.5-3.5 t/ha)	--
Velvet bean	-	28 (30x20 cm spacing), 40-45 (thick sowing)	255
Sesbania speciosa (Sesbania)	35-50	5-8 (as border crop), 10 (60 days crop), 20 (90 days crop), 50 (120 days crop), 60 (150 days crop)	--
Wild indigo	25-40	3.5-6 (as catch crop), 16.8 (as pure crop)	115
Madras Indigo	25-30	10-12	--
Phillipesara	20-35	19.6	126
Calapogonium mucunoides	8-10	5	--
Ipomea carnea (morning glory)	1800-2000 plants/ha	5-7 kg/plant/lopping 2-3 lopping/year	--
Pongamia	-	100-150 kg/tree/lopping (2 lopping/year) 1-2 tonne/tree/year	--
Neem	--	150-200 kg/tree/lopping (2 lopping/year)	--
Thespesia populnea	-	100-150 kg/tree/lopping (2-3 lopping/year)	--
Lucer (*Medicago sativa*)	5	10-12	--
Cluster bean (*Cymopsis tetragonolobia*	12-15	8-10	--

Stylosanthus hamata	4	8-10	--
Subabul (*Leucena leucophila*	1000-1500 plants	20-25 kg/plant	--
Green gram	15	4-5	--
Black gram	15	4-5	--

Table : Nutrient status of green manure crops

Green manure crop	C:N ratio	N(%)	P(%)	K (%)	Ca (%)
Sunnhemp	44:1	0.89	0.12	0.51	--
Dhaincha	21:1	0.68	0.13	0.40	
Glyricidia	31:1	0.68	0.16	0.30	--
Sesbania	--	0.70	0.14	0.75	--
Kolanji	--	0.79	0.20	0.60	--
Honge	33:1	0.16	0.14	0.49	1.54
Calotropis	--	0.42	0.12	0.67	0.20
Lantana	--	0.88	0.15	0.90	0.61
Cowpea	--	0.71	0.15	0.58	--
Horse gram	--	0.91	0.18	0.65	--
Black gram / Green gram	--	0.82	0.18	0.52	--

Experiment No. 08 and 09
Study of Indigenous Technology Knowledge (ITK) for nutrient, insect, disease and weeds management

Objectives:

1) To know the various ITKs followed in agriculture / organic farming / respective region.
2) To study the utility of various ITKs followed in agriculture / organic farming / respective region.

Introduction :

Indigenous practices in agriculture are organic in nature. They do not cause any damage to the air, water and soil, sage to the human beings and are free from causing environmental pollution. These practices are dynamic because they are region specific, depending upon soil type, rainfall, topography etc. and are often modified by the local farmers. Therefore, indigenous agricultural practices can play a key role in the design of sustainable and eco-friendly agricultural systems, increasing the likelihood that the rural populations will accept, develop and maintain innovations and interventions. It is also suggested that if the modern techniques are integrated with the traditional and indigenous practices, that will alleviate the poverty and result in the prosperity of the country.

IIRR (1996) reported that the indigenous knowledge in agriculture might be classified into different types such as information, practices and technologies,, beliefs, tools, materials experimentation and biological resources, human resources, education and communication.

A) Indigenous Technology Knowledge (ITK) for nutrient / Soil Management:

(1) Stubble Mulching:

Tillage with leaves to the surface of the soil, cloddy should be mulched with crop residues for an effective moisture and soil conservation. Properly mulched soil surface protects soil particles from runoff or drift. Thus, erosion does not take place. The traditional methods of tillage developed for soil (Water) moisture conservation. Locally available materials such as straw and stalks could be used for mulching. Soil loss and runoff from cropped area can be reduced. Mulches improves infiltration rate, increasing termite and biological activity. Mulches have been used to reduce evaporation, increase infiltration, prevent the soil from blowing and washing away, control weeds, improve soil structure and to increase crops yields.

Mulching is a traditional agronomic practice, in which crop waste and leaf litter are used to cover the soil. Mulching is done under the tree i.e. around the tree trunk. Through this method soil moisture is conserved effectively, evaporation loss is also minimized and checks the wed growth.

(2) Sheep Penning:

During non-cropped season or after harvest sheep penning is done with 100 sheep's in the field for about 4-5 days. Every day morning, the place of penning can be changed. So that, the entire field will be covered At the time of penning sheep manure enriches the soil fertility. Wages for sheep penning is Rs. 80 per night. **Existence**: 75 years.

(3) Green Leaf Manuring:

It is the application of green leaf to land, gathered from shrubs and trees growing in waste lands. Green leaf is gathered from all sources by farmers during the rice planting season. Different kinds of shrubs growing on tank bunds, waste lands, field bunds, etc are used. In addition, lopping from trees on the road side and forest area also gathered for use as green leaf manures. Common shrubs and trees useful for this purpose are, Neem, Teak, Karanj and Rui leaves (Calotropis).

(4) Wood / Fly Ash Treatment in Banana Bunches:

The new traditional technology is mixing house hold wood ash with cow urine in a polythene bag and tying it in the bunches after cutting the last flower. In order to get the uniform growth of bunches and more no. of fingers in banana.The combination can be tried are:

i) Urea as such tied in the bunches.
ii) Wood ash + cow urine
iii) Wood ash + panchagavya
iv) Brick chamber, wood ash is more effective when it is tried in the field.

The combinations to get uniform growth of bunches have to be tried in all levels and means to find out the best combinations and then to spread the combination or technology to all the banana farmers. 250 ml of wood ash + cow urine and panchagavya is put as such in the polythene bag and tied in the bunches, the result proved good in all the banana varieties like red banana, rasthali and robusta.

B) Indigenous Technology Knowledge (ITK) for Weed Management :

(1) Country Plough II:

The nature of the ploughing or breaking up the soil performed by this type of plough consists in the opening V-shaped furrow. The depth of furrow

and its width may vary according to the size and set up the working part or plough bottom.

Uses:

1) Opening soil and preparation of seed bed.
2) Covering the manure, spread on the land.
3) Inter cultivating wide spaced crop like cotton, redgram etc.
4) Removing weeds
5) Sowing seeds.

(2) Bose Plough or Melur Plough : This is a simple plough; the slice is twisted slightly and pushed to side. There is a complicated fitting or adjustments. The draft is low and less than that of mould board plough and country plough.

(3) Small Hand Hoe : It is mainly meant for weeding the garden and dryland. It is made up of iron and weighs about 1/4 kg.

i) It is used to uproot the weed completely.
ii) Less weight compared to ordinary hand hoe
iii) No occupational health hazards to farm women.
iv) There is no damage to root of the crop.

Reasons for intervention : Previously used hand hoe weighs more than the modified new one. So, the farm women get tired up quickly. Previously used hand hoe removes the grass and other monocot weeds at top level only. But modified one removes the shrubs completely. **This is the reason behind the intervention.**

4) Weeding tool:

Use : It is used for weeding in groundnut field as well as for earthing up activity. It is also used in other crops like Avarai, Motchai.

(5) Weed Removing Tool: It is an indigenous tool used to remove the weeds (grasses, broad leaved weeds).

(i) It is a less weight tool.
(ii) Easy for handling and operation.
(iii) No or less repairing cost.
(iv) Durability is more.

(6) Dry Land Weeder cum Mulcher:

Generally, weed growth is a menace in dry lands. It affects the crop drastically and reduces the yield. To overcome this weeding at critical stage is

important. Thus Mr. Chinnathambi has developed a design to uproot the weeds and mulching them simultaneously in the field.

(7) Spade Weeder :

It is a type of hand hoe used for weeding in the widely spaced crops like groundnut.

(8) Needle Type Weeder :

It is a type of hand hoe used for weeding in the closely spaced crops like ragi, vegetables etc.

(9) Pick Axe:

It is a tool used to dig the land left while ploughing i.e. corner of the fields. it is also used to remove the interference of the root to the field and used to loosen the soil in hardy surface.

(10) Ragi Weeder :

Used for weeding in ragi fields.

(11) "C" shaped Hook:

Purpose: It is used for pulling the thorn bush after cutting the plant. It will help the farmers from thorn injury.

(12)Indigenous Dryland Cycle Weeder:

It is easy to operate with the help of long handle and the bottom side is fixed with iron plate which is used to remove the dry land weeds.

(C) Indigenous Technology Knowledge (ITK) in Plant Protection (Pests and diseases management):

(1) Cow Urine + Neem Leaf Extract:

- Neem 10 kg
- Cow urine - 8-10 liters

Preparation:

Neem leaves are pounded well and extract is taken. This extract is mixed with 10 litres of cow urine. Neem leaves bunch is taken for applying the extract.

Dosage: 10 liters/acre

Time of application: 30-45 (DAT)

Existence: > 150 years.

(2) Neem cake application:

Five kg neem is taken in gunny bag and kept in the main channel of the rice field. During irrigation, water passes through neem cake and takes essence

from neem cake which will control the root borne diseases and pests. It can be done after transplanting.
Existence: > 25 years.

(3) Cow dung smoking:

Smoking with the help of dried cow dung in one end of the field will reduce the pests in field.

(4) Kerosine + chilly powder spray:

One kg of chilly powder is mixed with one liter of kerosene. This solution is sprayed in rice field. It is done only at the early morning.

(5) Cow urine tonic:

Ingredient: i) Cow urine: 10 liters ii) Neem oil: 2 liters

Preparation:

Cow urine (10 liters) is taken in a mud pod or any container and boiled well until 10 liters cow urine comes to 5 liters i.e. half the quantity. With this neem oil 2 liters and cow urine 5 liters are added. Again the above said contents are boiled well until 12 liters solution comes to 6 liters. After that the boiled solution is cooled.

Dosage: 1 liter per acre (100 ml / 10 liter water)

(6) Plant Growth Promoter:

Ingredients:

Meat (Bone + flesh): 1 kg
Beef (Bone + flesh): 1 kg
Pork (Bone + flesh): 1 kg
Cow urine: 10 litres

Preparation:

Meat (1kg), Beef (1kg) and Pork (1 kg) are boiled well. After boiling, it has to be cooled and cow urine (10 liters) has to be added into it. These contents are kept for fermentation about 10 days. It has to be stirred well daily. After 10 days, the solution is filtered and used as plant growth promoter.

Dosage: Spray 3.5 litres per acre (50 ml/10 litre water).

Additional information:

Meat, Beef, Pork and Cow urine are having rich nutrients. So this kunabum (powder of the said items) is used as plant growth promoter. Unsold /waste flesh can be used for the preparation of the kunabum.

(7) Ginger + Garlic + Chillies + Cow urine (Cotton Boll worm) :

Ingredients:

Ginger: 1/2 kg
Garlic: 1 kg

Green chillies: 1 kg
Cow urine: 10 liters

Preparation:

Ginger (1/2 kg), Garlic (1kg) and Green chllies (1 kg) are pounded well and made into paste. This paste and cow urine (10 liters) are put in to the buried mud pod. Mouth of the mud pot is covered with waste cloth and the contents are allowed for fermentation for about 10 days. To obtain well fermented solution, every day morning it has to be stirred well by using wooden stick. After 10 days, fermented solution is filtered and used for spraying.

Dosage: 3.5 liters per acre (0.5 liter /10 litters water).
Spraying can be done in weekly intervals.
Note: Fresh cow urine should be avoided.

(8) Rice Bran + Neem Oil:
Rice Brown Plant Hooper: *Nilaparvata lugens* (Delphacidae : *Hemiptera*).

Method of control:
Ingredient: Rice bran or husk : 5-10 kg
Neem oil : 1 liter
Procedure:

Above said ingredients are mixed well and sprinkled over the rice crop at early morning i.e. 5-6 a.m. to control Brown Plant Hopper damage. Cost involved for the preparation is around Rs. 50 per acre.

Existence of the practice: More than 50 years.

(9) Pig Manure Smoking:

Pig manure, dried neem and notchi leaves are used to make smoke. This is being followed to repel the pests and disease incidence in rice field.

(10) Graveyard Ash Sprinkling - (Vegetables):
Method I:
Ingredients:
i) Graveyard ash
ii) Cow urine: 10 litres
iii) Turmeric powder: 1/2 kg

Graveyard ash, cow urine, turmeric powder mixed solution is sprayed over the vegetable crop.
Existence : > 125 years

Method II:

In early morning, ash powder is sprinkled in bhendi and brinjal field. It reduces the pest incidence.

(11) (Bird Perch):

i) It is used to control insect in rice field
ii) Square shaped polythene sheets are used.
(iii) Coconut branches are kept in the field randomly.
iv) "T" shaped stick is used for this purpose.
v) Total numbers required: 15 numbers per acre.

(12) Rat control :

- Mud pot is kept upon 3 pegs in which some popped rice are placed. A mud lid is kept beneath with some popped rice. 4 sets of pot are placed in four corners of the field. First rat will come to take the popped rice in mud lid, after that it will go to take the popped rice in mud pot at that time pot is fell on the lid. The rate is trapped and killed.
- Pots are filled with water and buried in the bunds of the field. When rat enter in to the field, it will be trapped and killed.
- By leaving space (nearly 1 feet) in all four sides of field, rat damage will be reduced.
- Cow dung balls are immersed in kerosene and kept in 8-10 places of the field randomly. Odour comes from kerosene and cow dung will control the rate damage.

(13) Bird Scaring :

Among all the growth stages, economic part development is the most important and critical period. During such period, external damages especially by birds are more common and more intensive. Due to such damage farmers face loss in yield. Normally, to avoid such loss happening due to birds, various local bird scaring techniques are being followed by the farmers. Following are some of the techniques which is being followed by farmers in Trichi district. These techniques are highly popular among small and marginal farmers, because it involves low / no cost expenses.

(i) Tying date palm Fronds (leaves):

Dried date palm fronds are tied to the poles which makes sound when wind blows. In an acre nearly 5-10 such fronds (leaves) are tied to a pole and kept sparsely. Thus, by producing sound, birds like sparrows and parrots are scared and the crop is saved from its damage.

(ii) Tying Unused Recordable Tapes:

Unused Recordable tapes are tied across the field in a cress-cross manner and it looks like a net spread over the field. So birds perceive that a net is bring spread to trap them and avoids to land on that field. When light falls on, it the polished sides, reflects the light scares the sparrows, parrots and other birds.

(iii) Tying Polythene sheet:

Polythene sheets / papers are tied to a pole as like that of dried palmya fronds and kept in the field. When wind comes in contact with it, sound is produced and this will scare the birds.

(iv) Beating Drums and Using crackers:

Some time to scare the birds, sound is produced by beating drums or by beating a plate with a stick. Crackers are also fired and thus sound is produced. The disadvantage of this method is, it needs some persons to perform, by firing crackers environmental pollution happens, which is not an encouraging activity.

All the above techniques, uses a simple logic i.e. by producing sound in a way or other, birds are made to scare and thus the crop is protected from damage. Tying polythene sheet is followed both in garden land and wet land crops (Rice). Remaining other three techniques are followed in garden land only (Ragi, Sorghum and Maize).

(14)Seed treatment with cow urine:

One litre of cow urine is required to treat 25 kg of seeds. This treatment prevents the moth damage during storage.

(15) Seed treatment with turmeric and butter milk:

ne kg of turmeric is taken and it is soaked in 2 litres of skimmed butter. It should be pounded well and the extract is used for seed treatment. This can be done in 2 days after harvesting of the rice grains. Treated seeds are dried in shade for 8-10 hours. This will control the storage pest moth and enhance the germination percentage.

(16) Vermi compost:

Raw materials used: FYM, Coconut sheath and Banana sheath.

Vermi tank size: 2.50 x 2.25 x 0.65

Vermi wash tank size: 0.65 x 0.60 x 0.50 m

Vermi Name: *Perionex escavatas.*

The raw materials are hanged once in two months. He collected the vermi tonic from Vermi wash tank at monthly once. Vermi tonic acts as a growth regulator.

The 15 litres of vermi tonic is diluted with 60 liters of water and sprayed in to the field. It reduces the pests and disease incidence. The vermi tonic applied field totally prevented from animal gracing.

(17) Light Trap:

Light trap is used to trap the pest in the rice field. Now a days bulb is used as light source, previously Aricane or lanther light is used as light trap. Lanther is kept on the stool which is in one corner of the field. Below this structure, water and kerosene mixture is kept in a pan. Pests are attracted by light and fall in the pan. Once the pest fall in to the pan, wings get damaged due to kerosene. So it can not fly again. Light trap can be used between 06.00 to 09.00 p.m.

(18) Pest Trap:

A mud pod is filled in with 0.5 liter castor oil and 4 liters of water. It is mixed well and buried up to pot's neck inside the field. This solution creates an odour which attracts the Rhinocerous beetles and root grubs. Thus the incidence of damage to the leaves and economic parts are diverted in to this trap. If sunlight is more, the odour is increased which attracts more insects in to it.

Nearly 40 pots have been buried in this field @ 1 pot per slope i.e. he has made 40 contours with very less slope in which each contours has one pot buried with the solution.

Assignment :

1) Draw a neat well labelled diagram of deshi plough, khurpi, pick axe and c-shaped hook.

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Experiment No. 10
Study the method of preparation and Production cost of *Panchagavya, Beejamrut* and *Jeevamrut* in Organic farming

Objectives:

1) To study method of preparation and Production cost of *Panchagavya, Beejamrut*and *Jeevamru*
2) To know cost of preparation and Production cost of *Panchagavya, Beejamrut*and *Jeevamrut*

Introduction:

In organic management, protection measures are used only in the case of problematic situations. Use of disease free seed stock and resistant varieties is the best option. There is no standard formulation or treatment methodology, available as on today, but farmers use different methods. **Few of such innovative seed treating formulations are as follows:**

* Hot water treatment at 53^0C for 20-30 minutes.
* Cow urine or cow urine-termite mound soil pests
* Beejamrut
* Asphoetida 250 gm in one liter of water for 10 kg seed
* Turmeric rhizome powder mixed with cow urine.
* Panchgavya extract
* Dashparni extract
* *Trichoderma viride* (4gm / kg) or *Pseudomonas flurscens* (10 gm/kg seed)
* Biofertilizers (Rhizobium / Azotobacter + PSB)

A) Panchgavya :

Panchagavya is an organic product having the potential to play the role of promoting growth and providing immunity in plant system.

Preparation of Panchgavya :

- **Mix** fresh cow dung 5 kg, cow urine 3 liters, cow milk 2 liters, curd 2 liter cow butter oil 1 kg
- Ferment for **7 days** with **twice** stirring per day.
- **Dilute** 3 liters of Panchgavya in 100 liters water and spray over soil.
- **20 liters** panchgavya is needed per acre for soil application along with irrigation water.

Preparation cost of Panchgavya :

Sr. No.	Ingredient	Quantity	Cost
1	cow dung	5 kg	
2	cow urine	3 litres	
3	cow milk	2 litres	
5	curd	2 litres	
5	cow butter oil	1 kg	
6	Miscellaneous and labour charges	7 days	
	Total		

Enriched Panchgavya (or Dashagavya) :

Ingredients:

* Cow dung : 5 kg
* Cow urine : 3 litres
* Cow milk : 2 litres
* Curd : 2 litres
* Cow deshi ghee : 1 kg
* Sugarcane juice : 3 litres
* Tender coconut water : 3 litres
* Banana paste : of 12 fruits
* Toddy or grape juince 2 litres

Preparation of Enriched Panchgavya :

- Mix cow dung and ghee in a container and ferment for 3 days with inter mittent stirring.
- Add rest of the ingredients on the fourth day and ferment for 15 days with stirring twice daily.
- The formulation will be ready in 18 days. Sugarcane juice can be replaced with 500 g jaggery in 3 liters water. In case of non-availability of toddy or grape juice 100 g yeast powder mixed with 100 g jaggery and 2 liters of warm water can also be used.
- For foliar spray 3-4 liters enriched panchgavya is diluted with 100 lit water.

Application : For soil application 50 litres panchagavya is sufficient for one ha/ It can also be used for seed treatment.

Beejamurta :

Use of Beejamrutha, a mix of cow dung, cow urine, water, lime and a handful of soil has been given importance in sustainable agriculture since age old days. It is also one such organic product helpful for the plant growth. The beneficial microorganisms present in beejamrutha are known to protect the crop from harmful soil-borne and seed-borne pathogens.

B) Preparation of Beejamurta :

- Put **5 kg fresh cow dung** in a cloth bag and suspend in a container filled with water to extract the soluble ingredients of dung.
- Suspend **50 g lime** in 1 litre water separately.
- After 12-16 hours squeeze the bag to collect extract and add 5 litres cow urine, 50 gm virgin forest soil, lime water and 20 litre water. Incubate for 8-12 hours.
- Filter the contents.
- The filtrate is used for seed treatment.

Preparation cost of Beejamurta :

Sr. No.	Ingredient	Quantity	Cost
1	cow dung	5 kg	
2	lime	50g	
3	cow urine	5 litre	
4	Water	20 liter	
5	Cloth bag	2	
6	containers	2 (small, big)	
7	Virgin forest soil	50 g	
	Miscellaneous and labour charges	2 days	
	Total		

Jivamrut :

Jivamrut is used to increase the microbial population in soil which help in better crop growth.

C) **Preparation of Jivamrut :**

- **Mix** cow dung 10 kg, cow urine 10 litres, jaggary 2 kg, any pulse grain flour 2 kg and Live forest soil 1 kg in 200 litre water.
- Ferment for **5 to 7 days.**
- **Stir** the solution regularly **three** times a day.
- Use in one acre with irrigation water.

Preparation cost of Jivamrut :

Sr. No.	Ingredient	Quentity	Cost
1	cow dung	10 kg	
2	cow urine	10 liter	
3	jaggary	2 Kg	
4	Any pulse grain flour	2 Kg	
5	Live forest soil	1 Kg	
6	Water	200 liter	
7	Miscellaneous and labour charges	7 days	
	Total		

Assignment:

1) Calculate the cost of production of panchgavya for 1 acre

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Experiment No. 11

Study the method of preparation and Production cost of *Dashparni, Neem Seed Kernel extract,* in Organic farming

Objectives:

1) To study method of preparation of *Dashparni, Neem Seed extract,* in Organic farming
2) To know cost of preparation of *Dashparni, Neem Seed extract,* in Organic farming

Introduction: Many organic farmers and NGOs have developed large number of innovative formulations which are effectively used for control of various pests. Although none of these formulations have been subjected to scientific validation but their wide acceptance by farmers speak of their usefulness. Farmers can try these formulations, as they can be prepared on their own farm without the need of any purchases.

Dashparni extract: It is a fermented,100% natural Bio Insecticide to use on the farm for Fruit Orchards, Vegetables etc. Natural pesticide - DASHPARNI ark is Organic pest and **insect repellent.**

Preperation of Dashparni extract:

- Take a **200 Liter** vessel (either plastic drum or similar ones).
- Pour the **Water first.**
- **Submerge** all the 10 different leaves (*Azadirecta indiça* (neem) leaves 5 kg, *Vitex negundo*(Nirgudi) leaves 2 kg, Ghaneri (*Lantana camara*) Leaves 2 kg, papaya (*Carica papaya*) 2 kg, *Tinospora cordifolia* (Gulvel)leaves 2 kg, *Annona squamosa* (Custard apple) leaves 2 kg, *Pongamia pinnata* (Karanja) leaves 2 kg, *Ricinus communis* (Castor) leaves 2 kg, *Nerium indicum* (Kanehari) 2 kg, *Calotropis procera* (Rui/ruchki/mandar)leaves 2 kg) in the water.
- Pour the **Cow Urine** and **Cow Dung** on **top** of the submerged leaves.
- **Mix** them well and leave it for **5 days.**
- On the **Sixth Day,** add **5-7 liters** of water and again mix all the contents in the vessel.
- Ferment for **one month.**
- Shake regularly **three** times a day.
- Extract after crushing and **filtering.**
- The extract can also be stored up to **6 months** and is sufficient for **one acre.**

- The pesticide should be kept in the **shade** and **covered** with a wire mesh or plastic mosquito net to **prevent houseflies from laying eggs and the formation of maggots (worms)** in the solution.
- This is applicable during the **preparation** as well as during the **shelf life** of the pesticide as well
- The pesticide can be stored for **4 months** in good condition.

Application of Dashparni extract:

Spray System - The pesticide can be applied as a foliar spray.

- Dilute **125 ml** of the pesticide with **10 Litres** of water or
- Dilute **2.5 Litres** of the pesticide with **200 Litres** of water for One Acre.

Preparation cost of Dashparni extract:

S.No.	Ingredient Name	Qty in Litres / Kgs / Nos	Cost in Rs.
1	Neem (*Azadirecta indica*) Leaves	5 Kg	
2	Ghaneri (*Lantana camara*) Leaves	2 Kg	
3	Karanj (*Pongamia pinnata*) Leaves	2 Kg	
4	Kanehari /Indian Oleander (*Nerium indicum*) Leaves	2 Kg	
5	Castor/Jetropha (*Ricinus communis*)	2 Kg	
6	Gulvel (*Tinospora cordifolia*) Leaves	2 Kg	
7	Seeta phal / Custard Apple (*Annona squamosa*) Leaves	2 Kg	
8	Rui/Ruchki (*Calotropis procera*) Leaves	2 Kg	
9	Papaya (*Carica papaya*) Leaves	2 Kg	
10	Nirgudi (*Vitex negundo Linn*) Leaves	2 Kg	
11	Cow Urine	5 Liter	
12	Cow Dung	2 Kg	
13	Water	170 Liter	
14	Miscellaneous and labour charges	1 month	
	Total		

Neem Seed Kernel extract

Biopesticides are a good alternative to the synthetic pesticide. Both leaves and fruit of neem plant are known to have bitter taste having fungicidal, insecticidal and nematicidal properties. Azadirachtin, chemically a tetranorterpenoid component of neem acts on the mitotic cells and blocks the microtubule polymerization. Certain activities of genes and proteins are also altered by azadirachtin. As a botanical insecticide azadirachtin is effective against many biological processes. It may cause a reduction in feeding habit, suspend the molting process, larvae and pupae death and also cause sterility in the emerging adults, this all depend on the given dose. Apart from azadirachtin, many other components of neem also have insecticidal properties. Among them are saponins that are found to have antimicrobial activity that inhibits moulds and protecting plant from attack of insects.

Preparation of Neem Seed Kernel extract (NSKE)

- Take required quantity of **neem seed kernel (5 kg)**
- **Grind** the kernels gently to **powder** it
- **Soak** it **overnight** in **10 liter** of water.
- **Stir** with **wooden** plank in the morning till solution becomes **milky white**
- **Filter** through double layer of **muslin cloth.**
- Make up the volume to **100 liter**
- Add **1% detergent** (Make a paste of the detergent and then mix it in the spray solution)
- Mix the spray solution well and use

Care to be taken:

- Collect the Neem fruits during **bearing season** and air-dry them under **shade.**
- Do not use the seeds over **eight months of age.**
- The seeds stored over and above this age **lose their activity** and hence not fit for NSKE preparation.
- Always use **freshly** prepared neem seed kernel extract (NSKE).
- Spray the extract **after 3.30 pm** to get effective results.

Application of NSKE:

- Neem Kernel extracts (500 to 2000 ml) is required per tank (10 liters capacity).

- **3-5 kg** of neem kernel is required for **an acre.**
- **Remove** the outer **seed coat** and use only the kernel.
- If the seeds are **fresh, 3 kg** of kernel is sufficient. If the seeds are **old, 5 kg** are required.
- Pound the kernel gently and tie it loosely with a cotton cloth.
- **Soak** this overnight in a vessel containing 10 liter of water.
- After this, it is **filtered.**
- On filtering, 6-7 liters of extract can be obtained.
- 500-1000 ml of this extract should be diluted with 9 ½ or 9 liters of water.
- Before spraying khadi soap solution @ 10 ml/liters should be added to help the extract stick well to the leaf surface.
- This concentration of the extract can be increased or decreased depending on the intensity of pest attack

Preparation cost of Neem Seed Kernel extract

Sr. No.	Ingredient	Quantity	Cost
1	Neem eed karnel	5 kg	
2	Khadi soap	10 ml/litre	
3	Water	100 liter	
4	Cloth bag	2	
5	Containers	2 (small, big)	
6	Miscellaneous and labour charges	2-5 days	
7			
	Total		

Assignment :

1) Calculate the per liter cost of production for dashparni ark and NSKE

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Experiment No. 12 & 13
Study of Post Harvest Management in Organic Farming

Objectives:

1) To study the post harvest management practices permitted for organically raised crops

Introduction:

Post harvest Management:

The effort to achieve an economic reward through the marketing of organic produce must begin well before harvest.

Critical factor in determining the postharvest performance of any commodity are

1. **Seed selection**
2. **Genetic traits**
3. **Environmental factors**
4. **Cultural practices**

Planning for postharvest food safety should be included in any crop management plan.

Good Agricultural Practices (GAP) need to be developed and formalized for each crop and specific production field to minimize the risk of a variety of hazards or contaminants:

a) Chemical (e.g., heavy metals carryover),
b) Physical (e.g., sand and soil, wood, plastic or metal shards), and
c) Biological (e.g., Salmonella, Listeria, mycotoxins).

- Prior land use
- Adjacent land use
- Water source and method of application
- Fertilizer choice (such as the use of manure), compost management
- Equipment maintenance
- Field sanitation
- Movement of workers between different operations
- Personal hygiene
- Domestic animal and wildlife activities, and
- other factors have the potential to adversely impact food safety. It is worth noting that many elements of a GAP plan are likely to be incorporated into the existing organic crop management program and activities. Programs in place to ensure produce quality may be directly applicable to food safety with minor modifications. The application of

food safety programs, in turn, has been shown to directly benefit postharvest quality.

Post harvest storage :

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

1) **Room cooling** – an insulated room or mobile container equipped with refrigeration units. Room cooling is slower than other methods.

2) **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. Hydrocooling is not appropriate for all produce.

3) **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.

4) **Vacuum cooling** – uses a vacuum chamber to cause the water within the plant to evaporate, removing heat from the tissues.

5) **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.

Cleaners, Sanitizers and Disinfectants : A partial list of allowed cleaners, disinfectants, sanitizers, and postharvest aides follows.

1. Acetic acid – allowed as a cleanser or sanitizer. The vinegar used as an ingredient must be from an organic source.
2. Alcohol (ethyl) – allowed as a disinfectant. Alcohol must be from an organic source.
3. Alcohol (isopropyl) – may be used as a disinfectant under restricted conditions.
4. Ammonium sanitizers – quaternary ammonium salts are a general example in this category.
5. 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.
6. Detergent cleaning and rinsing procedures must follow quaternary ammonium application.

Assignment :

1. Write down the information regarding the permitted chemical used for post harvest management of organically raised crops

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Experiment No. 14 & 15
Study of quality Aspects: Grading, Packing and Handling

Objectives:

1) To study general principals, recommendations and standards of grading packing and handling of organic products.

Introduction:

Quality : The quality indicated by the grade designation shall be as mentioned in the National Programme for Organic Production notified by the Director General of Foreign Trade, Ministry of Commerce and Industry, Government of India,

A) Grading :

"Certification mark" means the **grade designation mark** as specified in the Schedule;

Grade designation: The grade designation shall be written or stated as "Agmark India Organic".

Grade Designation Mark : The grade designation mark shall consist of Agmark India Organic Insignia consisting of a design incorporating the certificate of authorisation number, name of the commodity and grade designation (Agmark India Organic), resembling the design as set out in Schedule, and wherever required, any other grade designation

B) Packaging :

General Principles : Ecologically sound materials should be used for the packaging of organic products.

Recommendations : Packaging materials that affect the organic nature of the contents should be avoided. Use of PVC materials is prohibited. Laminates and aluminum should be avoided. Recycling and reusable systems shall be used wherever possible. Biodegradable packaging materials shall be used.

Material used for packaging shall be ecofriendly. Unnecessary packaging material should be avoided. Recycling and reusable systems should be used. Packaging material should be biodegradable. Material used for packaging should not contaminate the food.

Standards :

.1 The materials used must not affect the organoleptic character of the product or transmit to it any substances in quantities that may be harmful to human health.

Method of packing:

(1) Certified organic agricultural produce shall be packed in accordance with the provisions made in the National Programme for Organic Production as published in the said notification and such packing may be done in gunny bags or jute bags, cloth bags or other suitable eco-friendly packages which shall be clean, sound, free from insects, fungal infestation and the packing material shall be of food grade quality as permitted under the Prevention of Food Adulteration Rules, 1955.

(2) Only approved additives under the National Programme for Organic Production as published in the said notification shall be used in manufacturing the packaging films used for packaging of organic foodstuff.

(3) The materials used shall not affect the organoleptic character of the product or transmit to it any substances in quantities that may be harmful to human health.

(4) Containers and packaging material shall be made of substances which are safe and suitable for their intended use and they should not impart any toxic substance or undesirable odour or flavour to the produce.

(5) Certified Organic Agricultural Produce shall be packed in pack sizes as per the instructions issued by the Agricultural Marketing Adviser from time to time.

(6) Each package shall contain Certified Organic Agricultural Produce of the same type and of the same grade designation or standards.

(7) Graded material of small pack sizes of the same lot or batch and grade may be packed in a master container with complete details thereon along with grade designation mark.

(8) Each package shall be securely closed and sealed in a manner approved by the Agricultural Marketing Adviser.

C) Handling:-

General Principles : Any handling and processing of organic products should be optimized to maintain the quality and integrity of the product and directed towards minimizing the development of pests and diseases.

Recommendations : Processing and handling of organic products should be done separately in time or from place from handling and processing of non organic products.

Pollution sources shall be identified and contamination avoided.

Flavoring extracts shall be obtained from food (preferably organic) by means of physical processes.

Standards

1. Organic products shall be protected from co-mingling with non-organic products.
2. All products shall be adequately identified through the whole process.
3. The certification programme shall set standards to prevent and control pollutants and contaminants.
4. Organic and non-organic products shall not be stored and transported together except when labelled or physically separated.
5. Certification programme shall regulate the means and measures to be allowed or recommended for decontamination, cleaning or disinfection of all facilities where organic products are kept, handled, processed or stored.
6. Besides storage at ambient temperature, the following special conditions of storage are permitted :
   a) Controlled atmosphere
   b) Cooling
   c) Freezing
   d) Drying
   e) Humidity regulation

   Ethylene gas is permitted for ripening.

Assignment:

1. Write down the information regarding Grading, Packaging and Handling for post harvest storage of organically raised crops

Experiment No. 16

Visit to Bio-Control Laboratory, Bio-fertilizer and Vermi-compost Unit

Objectives:

1) To visit and study the metods and procedures followed at respective laboratories.

1)Bio-control Laboratory

1. Bio-control is exercised in a wide range of area and safe
2. Application of biotic agents is easy
3. The biotic agents survive in nature till the pest is prevalent
4. Farmers does not require any special treatment procedure.
5. No waiting period for harvesting
6. Biological agent's viz. baculoviruses, Parasitoids and predators may be multiplied at farmer's level.

2) Bio-fertilizers Unit :

The bio-fertilizers being cheap and eco-friendly source of nutrients for the variety of crops. The bio-fertilizers or microbial fertilizers or more appropriately microbial inoculants are preparation containing live or latent cells of efficient strain of nitrogen fixing microorganisms used for seed or soil application with the objective of increasing the number of such microorganisms in soil or used for seed or soil application with the objective of increasing the number of such microorganisms in soil or Rhizosphere and consequently improve the extent of microbiologically fixed nitrogen for plant growth.

3) Vermicompost unit :

Vermicompost is the excreta of Earthworm which is rich in humans. Earth warm eats cow dung or FYM along with farm waste and passes it through their body & in the process convert it into vermicompost.

Assignment:

1. Visit to nearby Bio-Control Laboratory, Bio-fertilizer and Vermi-composting Unit and Write down the information regarding it.