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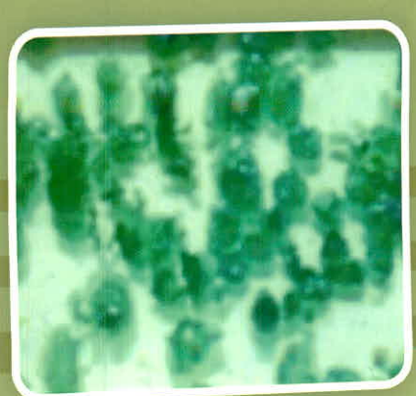
PRACTICAL MANUAL ON ORGANIC FARMING

Sunil Kumar, S.K. Jha, M.C. Bhambri and G.P. Banjara






Depatment of Agronomy
College of Agriculture
INDIRA GANDHI KRISHI VISHWAVIDYALAYA

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FOREWORD

Organic farming is not new to Indian farming community. Several forms of organic farming are being successfully practiced in diverse climate, particularly in rain fed, tribal, mountains and hill areas of the country. Among all farming systems, organic farming is gaining momentum among farmers, entrepreneurs, policy makers and agricultural scientists for varied reasons such as it minimizes the dependence on chemical inputs (fertilizer, pesticides and other agro-chemicals) thus safeguard to improve quality of resources and environment and provides an opportunity to increase rural employment. In a bid to boost organic farming in state, Chhattisgarh government, launched an "Organic Farming Mission" in districts of Bastar, Bilaspur and Ambikapur. It is therefore, essential that the student of agriculture have a good understanding of the organic farming. The teaching in organic farming needs to be more practically oriented and students should be well aware of basic practical concept in transforming the knowledge into action. In view of this, the publication of ***Practical Manual on Organic farming*** by Sunil Kumar, S.K. Jha, M.C. Bhambri and G.P. Banjara, Department of Agronomy, COA, IGKV, Raipur is a most welcome and timely efforts to help the students. It gives me an immense pleasure in bringing out such a useful practical manual on behalf of College of Agriculture, Raipur. I hope, this manual would be extremely useful to students not only in practical but in field of teaching as well.

(S.S. Rao)

PREFACE

Increase in population make compulsion to stabilize agricultural production, but to increase it further in sustainable manner. Natural balance needs to be maintained at all cost for existence of life and environment. The green revolution utilizing chemicals (fertilizers, pesticides, growth promoting hormones etc.) intensively has impaired the health of soil and environment. They are not only hazardous to the consumers but also adversely affect the ecological balance. Organic agriculture in the system, which is in concern with the best use of natural recourses and maintains their balance without polluting soil, water and air. This manual has been developed with the aim of providing guidance, a framework, relevant information and tools to undergraduate students in subject related to the practical knowledge on organic farming technologies through exercises on college field as well as at farmers' field. The description have been classified in a point wise serial order and efforts have been made to collect latest information from several standard books, research magzines and agricultural websites to include all important points and details in a concise and lucid way so that slight practice on the parts of the students will considerably add to their comprehension. We owe a deep debt of gratitude to Dr. S.K. Patil, Hon'ble Vice-Chancellor, IGKV Raipur for his constant encouragement and affectionate guidance. We extent our heartiest thanks to Dr. J.S. Urkurkar, Director of Research, IGKV and Dr. S.S. Rao, Dean, College of Agriculture, Raipur for his valuable guidance useful suggestions and unceasing interest. I am very much thankful to Dr. A. L. Rathore, Professor & Head, Agronomy, for his regular guidance, valuable suggestions and thoughtful ideas during preparation of this manuscript.We would like to convey our cordial thanks to shri sandeep Navrang, Shri Premlal sahu and shri Phool chand Kanwar, Who have directly and indirectly helped us to preparation of this manual. With great pleasure we acknowledge the counsel, encouragement and eulogistic supports by staff members of department for their fruitful and endless efforts.

We hope this manual will cover all the contents of practical course of Agro 322/Agro 222 Organic Farming and furnish all the material related to this course. All necessary precautions have taken to prepare the text free of mistakes but if you come across with any of such mistakes; it would be cordially invited to improve it in future.

Sunil Kumar
S.K. JHA
M.C. Bhambri
G.P. Banjara

CONTENTS

EXERCISE 1 : FIELD VISIT TO AN ORGANIC FARM

Introduction

We already know, that an organic farm has different segments like crops, trees, livestock, cattle shed, compost yard, storehouse and farm office situated at convenient locations. All these components make a complementary association with each other. Buffer zone is another important requirement of an organic farm. This is created at an appropriate place in the farm to prevent or minimize the unintended contamination by prohibited substances or organisms called contaminants. The organic farmer should undertake all the farm activities in accordance with the prescribed norms and standards. A field visit to an organic farm will provide first hand experience of observing an organic farm, facilitate discussion with the organic farmer on farm design, farm practices, marketing and difficulties involved in organic farming. We should record all these information and reproduce in the form of a report along with our views and suggestions.

Objectives

The objectives of this practical exercise are to :

Layout and components of an organic farm,

State of organic crops grown; implements and livestock in the organic farm;

Problems faced by organic farmers, and opportunities for organic produce.

Principle

The basic principle of undertaking a field visit to an organic farm is "seeing is believing". Information collected personally from the operator will motivate and guide us on the organic farming. While visiting the farm and discussing with the farmer, we should observe the compliance of the organic norms and standards and adherence of the farmer to the concepts of organic farming.

i) **Requirements:** While making a study trip to an organic farm, we need the following requiritments:

1) An organic farm
2) **Vehicle:** Vehicle for taking the learners to the chosen organic farming sites.
3) **Field Notebook:** Notebook for recording field observation, experiences and useful informations.
4) **Camera:** Camera for taking photographs of organic farm, organic farmers and other components.

Steps

First we should take the appointment from the farmer to ensure his availability at the farm during our visit. We should earmark our activities as mentioned below:

(a) Planning

- Purpose of the visit.
- Gather all possible information about the farmer and the farm to be visited.
- Ensure that the time is convenient to us as will as to the farmer.

(B) Preparation for the study trip

- Have prior appointment.

- Confirm the vehicle for the visit and arrange for other requirements like food packets, refreshment, *etc.*

(C) Conduction

- Be punctual.
- Discuss with the farmer about different aspects of organic farming practices.
- Praise the farmer for the good work done.
- Record the details of the observations of the visit.

Observations and Results

We should record all the relevant observations of the farm in the following table. This table should be annexed with our final report.

Farm Inventory

1)	Name of the Farmer				
2)	Address				
3)	Experience in Organic Farming				Years
4)	Land Area				Acres
	Details	Wet Land	Garden Land	Dry Land	Total
a	Owned				
b	Leased in				
c	Leased out				
d	Operational area				
5)	Soil type (brief description)				
6a)	Irrigation Source		Area Irrigated		% Total Area
	(i). Canal				
	(ii). Tank				
	(iii). Well				
b)	Water Availability (Period)				
	(iv). Canal		From	To	
	(v). Tank		From	To	
	(vi). Well		From	To	
7)	Farm Tank, Implements and Machinery				
	Description		Numbers		Present Value (Rs.)
a)	Wooden plough				
b)	Iron Plough				
c)	Puddler				
d)	Trampler				
e)	Leveling board				

f)	Seed drill		
g)	Harrows		
h)	Intercultivators		
i)	Cart		
j)	Electric motor		
k)	Pump set		
l)	Oil engine		
m)	Others if any, specify		
8)	livestock		
	Description	Numbers	Present Value (Rs.)
	Drought animals		
	Milch animals		
	Dry buffaloes		
	Heifers		
	Calves		
	Goats & Sheep		
	Poultry		
	Others if any, specify		
9)	Cropping pattern		

	Season	Crop	variety	Yield per acre
i.				
ii.				
iii.				

10) Expenditures & Net Profit (Rs.) in organic farm during previous year

Source	Income	Expenditure	Net Profit	Remarks
Agriculture				
Livestock				
Other enterprises				
			Total	

11 Problems Experienced in Organic Farming and Suggestions to Overcome them

	Item	Problem	Farmer's Suggestions
	Soil Fertility		
	Labour		
	Credit Availability		
	Inputs being used:		
	Organic seeds/ Planting materials		
	Organic manure		
	Bio-fertilizers		
	Botanical pesticides		
	Crop management practices		
	Water management		

	Livestock management		
	Machinery/ implements		
	Produce storage		
	Marketing		
	Training & Extension services		
	Others, if any, specify		
12	**Draw a sketch of the physical layout of the organic farm**		

Precautions

- Avoid any deviations from the objectives of the visit.
- Ask only relevant questions with due consideration of the famers time and convenience.
- Seek clarification for the doubts that may benefit our colleague.
- Do not ask questions in a formal way rather make a discussion with the farmer.

EXERCISE 2 - SEED AND SEEDLING TREATMENTS WITH BIO-FERTILIZERS

Introduction

Bio-fertilizers are low cost, renewable sources of plant nutrients which supplement chemical fertilizers. These are nothing but selected strains of beneficial soil microorganisms cultured in the laboratory and packed in a suitable carrier. They can be used either for seed treatment or soil application. Bio-fertilizers generate plant nutrients like nitrogen and phosphorous through their activities in the soil or rhizosphere and make available to plants in a gradual manner. However, bio-fertilizer is most commonly referred to the use of soil microorganisms to increase the availability and uptake of mineral nutrients for plants. Bio-fertilizers like Rhizobia, Phosphobacteria, Azosprillum, Azatobactor etc., are utilized for seed treatment.

Use of Bio-fertilizers and microbial cultures

Bio-fertilizers *viz* Rhizobium, Azotobacter, Azospirillum, PSB and VAM *etc.* have been found to be very effective tools of fertility management and biological nutrient mobilization. Recently customized consortia of such bio-fertilizer organisms, better adapted to local climatic conditions have also been developed and are available commercially. Efficiency of such microbial formulations is much higher under no-chemical use situations, therefore, application of such inputs need to be ensured under all cropping situations.

Types of Biofertilizers

The following types of bio fertilizers are available to the farmers in India.

S. No.	Groups	Examples
N2 fixing Bio-fertilizers		
1.	Free-living	Azotobacter, Beijerinkia, Clostridium, Klebsiella, Anabaena, Nostoc,
2.	Symbiotic	Rhizobium, Frankia, *Anabaena azollae*
3.	Associative Symbiotic	Azospirillum
P Solubilizing Bio-fertilizers		
1.	Bacteria	*Bacillus megaterium var. phosphaticum, Bacillus subtilis Bacillus circulans, Pseudomonas striata*
2.	Fungi	*Penicillium sp, Aspergillus awamori*
P Mobilizing Bio-fertilizers		
1.	Arbuscular mycorrhiza	*Glomus sp., Gigaspora sp., Acaulospora s p., Scutellospora sp. & Sclerocystis sp.*
2.	Ectomycorrhiza	*Laccaria sp., Pisolithus sp., Boletus sp., Amanita sp.*
3.	Ericoid mycorrhizae	*Pezizella ericae*
4.	Orchid mycorrhiza	*Rhizoctonia solani*
Bio-fertilizers for Micro nutrients		
1.	Silicate and Zinc solubilizers	*Bacillus sp.*
Plant Growth Promoting Rhizobacteria		
1.	Pseudomonas	*Pseudomonas fluorescens*

Rhizobium

- Rhizobium lives in the root hairs of the legumes by forming nodules
- The name Rhizobium was established by Frank in 1889.
- This genus has seven distinct species based on "Cross Inoculation Group Concept".
- More than twenty cross-inoculations groups have been established so far.
- A new classification has been established for Rhizobium.
- That is 'slow growing rhizobia' known as Bradyrhizobium and the other group is 'fast growing rhizobia' called Rhizobium. Still this classification is discretely not distinguishable because the bacteria of one group may infect to another group.

Rhizobium

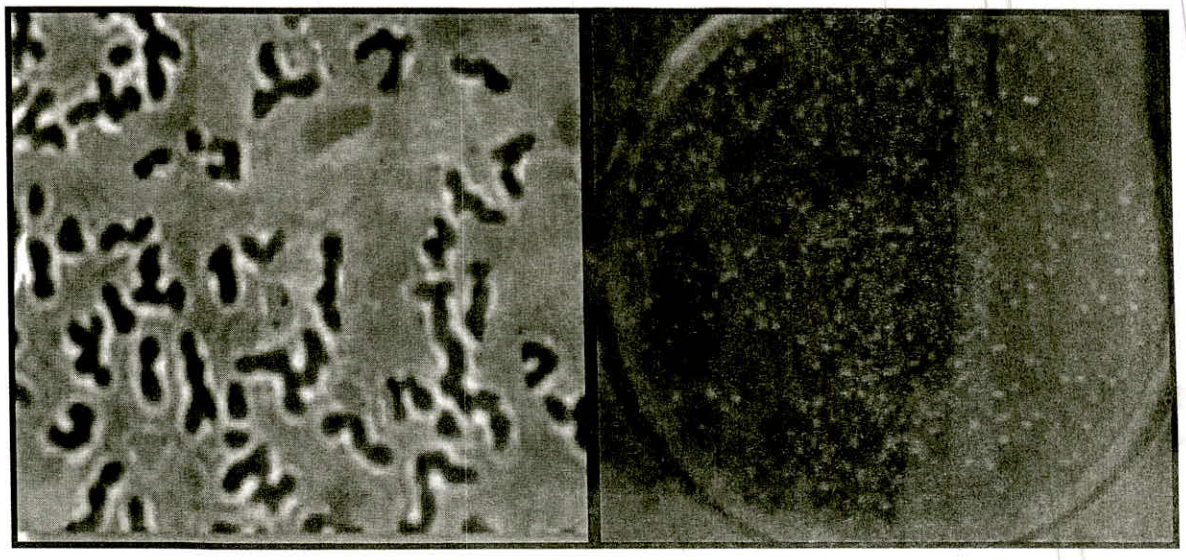
Bacteria in root

Bacteria in root

Legume

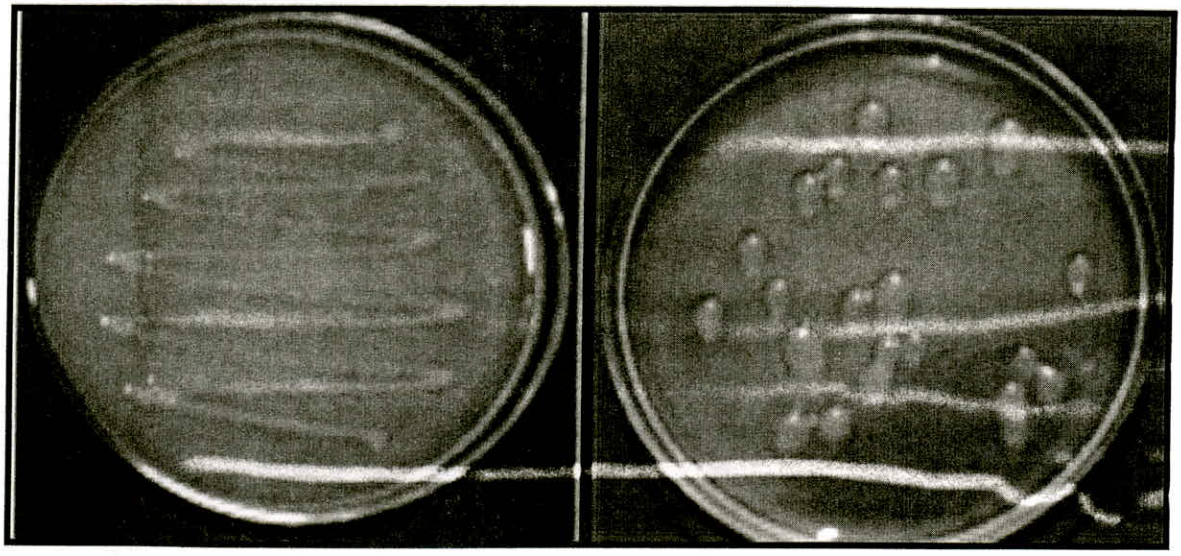
Azospirillum

Azospirillum species establish an association with many plants particularly with C4 plants such as maize, sorghum, sugarcane, etc. It is the most common organism and can form associative symbiosis on a large variety of plants. Azospirillum is recognized as a dominant soil microbe.



Azotobactor

- Azotobactor is a heterotrophic free living nitrogen fixing bacteria present in alkaline and neutral soils.
- Azotobactor chrococcum is the most commonly occurring species in arable soils of India.
- Apart from its ability to fix atmospheric nitrogen in soils, it can also synthesize growth promoting substances viz., auxins, gibberellins and also to some extent the vitamins.
- Many strains of Azotobactor also exhibit fungicidal properties against certain species of fungus.
- Response of Azotobactor has been seen in rice, maize, cotton, sugarcane, pearl millet, vegetables and some plantation crops.



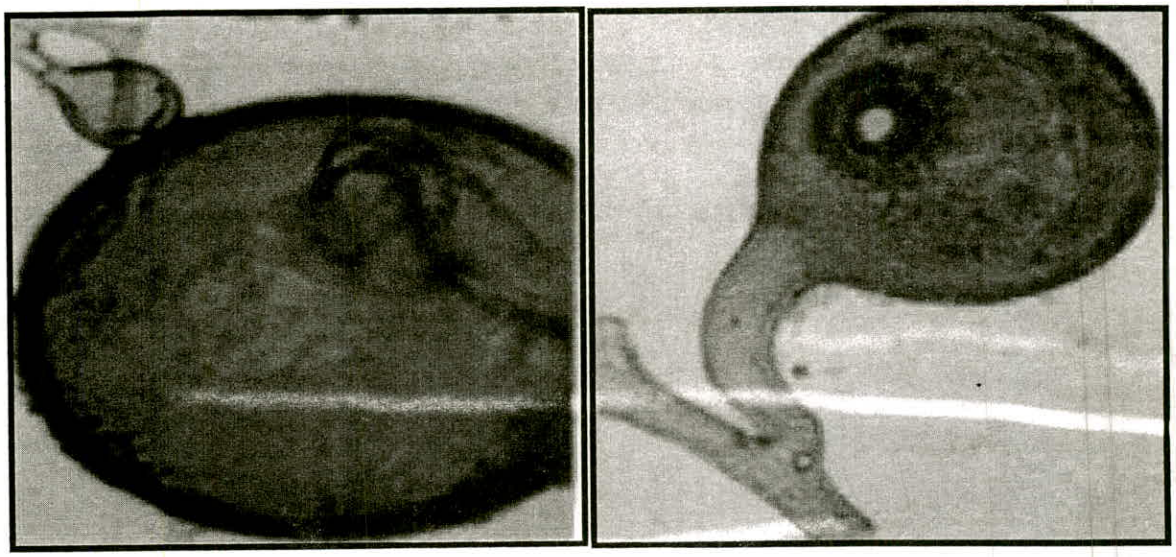
Acetobactor

- Acetobactor diazotrophicus is a newly discovered nitrogen fixing bacteria associated with sugarcane crop.
- This bacterium belongs to the alpha group of proteobacteria.
- It was isolated from leaf, root, bud and stem samples of sugarcane.
- Acetobator is located in apoplastic fluid of sugarcane stem and to some extent in xylem vessels.
- It is an acid and high salt tolerant and sucrose loving bacteria which can fix up to 200 kg nitrogen per hectare.

Vesicular Arbuscular Mycorrhiza (VAM)

- The term mycorrhiza was taken from Greek language meaning 'fungus root'. This term was coined by Frank in 1885
- As indicated above, the mycorrhiza is a mutualistic association between fungal mycelia and plant roots.
- VAM is an endotrophic (live inside) mycorrhiza formed by aseptated phycomycetous fungi.
- VAM helps in nutrient transfer mainly of phosphorus, zinc and sulfur.

- They also mobilize different nutrients like Cu (copper), K (potassium), Al (aluminum), Mn (manganese), Fe (iron) and Mg (magnesium) from the soil to the plant roots.
- They possess vesicles (sac like structure) for storage of nutrients and arbuscular for funneling them into root system.



Mechanism of Action

- The VAM forms an association with plant roots.
- It penetrates in the root cortex and spreads around the roots of the plant.
- As the name indicates, they possess sac like structure called vesicles which stores phosphorus as phospholipids.
- The other structure called arbuscule helps bringing the distant nutrients to the vesicles and root.

Actions of Mycorrhiza

- Enhances the feeding areas of the plant root is as the hyphae spreads around the roots.
- Mobilizes the nutrients from distance to root.
- Stores the nutrients (sp. phosphorus).
- Removes the toxic chemicals (example: phenolic) which otherwise hinder nutrient availability.
- Provide protection against other fungi and nematodes

Phasphorus Solublizing Bacteria (PSB)

Pseudomonas and Bacillus bacteria, Penicilium, Trichoderma and Aspergillus fungus. Oxalic, lactic, malic, citric and tartaric acid.

Advantages of bio-fertilizers

- Sustain soil health
- Supplement chemical fertilizers.
- Replace 25-30% chemical fertilizers

- Increase the grain yields by 10-40%.
- Decompose plant residues, and stabilize C:N ratio of soil
- Improve texture, structure and water holding capacity of soil
- No adverse effect on plant growth and soil fertility.
- Stimulates plant growth by secreting growth hormones.
- Solubilize and mobilize nutrients
- Eco-friendly, non-pollutants and cost effective method
- They form an important association with other soil microbes and help in nutrient supply.
- Fixes atmospheric nitrogen.
- Increase availability or uptake of nutrients through solubilization or increased absorption.
- They are cheap, hence, reduced cost of cultivation.
- Improves soil properties and sustaining soil fertility lead to soil enrichment.
- Build up soil fertility in the long term.

Objectives

The objective of this experiment is to acquire skill and proficiency in seed treatment with bio-fertilizers.

Principle

The basic principle of seed treatment is to coat the seeds with bio-fertilizer inoculums. When the treated seeds germinate, the micro-organisms establish themselves in the plant root zone and fixes atmospheric nitrogen, solubilize phosphorus and enhance availability of nutrients in rhizosphere so it helps in increasing the nutrient availability to the crop.

b) Requirements

1) **Containers:** A broad mouthed container for mixing.
2) **Stick or Rod:** Wooden sticks or metal rods of around 60 cm length are needed for stirring the seeds.
3) Bio-fertilizer

Method of application

Bio-fertilizers can be applied to different crops and plants by three different ways.

1. **Seed treatment**

   Suspend 200 g each of nitrogen fixing and PSB in 300-400 ml of water and mix thoroughly. Pour this slurry on 10 to 12 kg of seed and mix by hands, till all the seeds are uniformly coated. Dry the treated seeds in shade and sow immediately. For acidic and alkaline soils it is always advisable to use 1 kg of slacked lime or gypsum powder respectively for coating the wet bio-fertilizer treated seeds.

2. **Seedling root dip treatment**

   Suspend 1 to 2 kg each of nitrogen fixing and PSB into just sufficient quantity of water (5-10 lit Azotobacter /Azospirillum depending upon the quantity of seedlings required to be planted in one acre). Dip the roots of seedlings in this suspension for 20-30 min before transplanting. In case of paddy make a sufficient size bed (2mt x 1.5mt x 0.15mt) in the field, fill it with 5 cm of water and suspend 2 kg each of and PSB and mix Azospirillum thoroughly. Now dip the roots of seedlings in this bed for 8-12

hours (overnight) and then transplant.

3. **Soil treatment:**

For soil treatment depending upon the total number of plants/ha, 5-10 kg of PSB and 5-10 kg of Azotobacter/Azospirillum are required for one ha. Mix two types of bio-fertilizers in 5-10 litres of water separately and sprinkle this suspension on two separate heaps of 125-250 kg of compost. Mix the two heaps separately and leave for incubation overnight. After 12 hours, mix the two heaps together. For acidic soils mix 67-70 kg lime with this mixture. In plantation crops apply this mixture at the root zones by dibbling.

In some field crops the mixture is broadcast evenly in the moist field and mixed with soil just before sowing. In sugarcane the bio-fertilizer manure is to be applied in furrows near the root zone, after 30-40 days of planting and covered with soil. In potato it is to be applied after 20 days of planting or at the time of earthing-up operations. In case of sugarcane and potato, if setts/tubers are not treated with plant protection chemicals then bio-fertilizer compost mixture can be applied in furrows immediately before planting.

Observation and Results

The treated and untreated seeds are sown separately in prepared seed- beds. Record the germination percentage and time taken to initiate the germination under both the conditions. Also record the plant growth parameters (leaf colour intensity, tiller number and length, plant height etc.) under both the conditions.

Precautions

The following care should be taken while treating the seeds with bio-fertilizers:

- The rice gruel should not be hot.
- The treated seeds should be dried only in the shade.
- Ensure uniform coating of the culture over the seeds.
- The treated seeds should not be treated with any chemical.
- Ensure that the bacterial culture is well within the expiry date.
- The treated seeds should not be used for consumption.
- Store bio-fertilizer packets in cool and dry place away from direct sunlight and heat.
- Use right combination of bio-fertilizers, if required.
- Rhizobium is crop specific, so use in specified crop.
- While purchasing , ensure that each packet is provided with necessary information like name of the product, name of the crop for which it is recommended, name and address of the manufacturer, date of manufacture and date of expiry, batch number and instructions for their use.

Please Remember

- Bio-fertilizers are live product and require care in storage.
- For best result, use both nitrogenous and phosphatic bio-fertilizers simultaneously.

EXERCISE NO 3 - MASS PRODUCTION AND FIELD APPLICATION OF AZOLLA

Introduction

Azolla an aquatic fern is regarded as "Live Nitrogen Manufacturing Factory" because, it harbors nitrogen fixing Cyanobacteria. Azolla has been extensively used both as bio-fertilizer and green manuring for rice cultivation in the South East Asian countries. More than 50 % nitrogen can be supplemented when Azolla dual cropped with rice. Azolla is a free-floating water fern that floats in water and fixes atmospheric nitrogen in association with nitrogen fixing blue green alga Anabaena azollae. Azolla fronds consist of sporophyte with a floating rhizome and small overlapping bi-lobed leaves and roots.

Rice growing areas in South East Asia and other third world countries have recently been evincing increased interest in the use of the symbiotic N2 fixing water fern Azolla either as an alternate nitrogen sources or as a supplement to commercial nitrogen fertilizers. Azolla is used as bio-fertilizer for wetland rice and it is known to contribute 40-60 kg N/ha per rice crop. The common species of Azolla are *A. microphylla, A. filiculoides, A. pinnata, A. caroliniana, A. nilotica, A. rubraand and A. mexicana.*

Composition of Azolla

Azolla is rich in proteins, essential amino acids and vitamin A, vitamin B12, beta carotene. It also contains growth promoting substances and minerals like Ca, Fe, K, Cu and Mg. The composition on dry weight basis is given below.

Proteins 25- 30 %, Minerals 10- 15 % , Amino acids and other bioactive substances -7-10 %, , Carbohydrates - 4-10 %, Lipids 3-6 % , Cellulose 10-20 %, Carbon - 43%, N-5-30 %, P-0.5 %, K-0.25-5% , Ca -0.45-1.25 %, Mg - 0.25 - 0.5 % , S- 0.2-75 %, Si - 0.15-3.5 %

Uses of Azolla

- Azolla is a good manure.
- It is rich in protein and contains 25- 30% on dry weight basis.
- It is a nutritious food for animals like pig, fish, duck, rabbit, poultry and livestock.
- Low lignin and high protein content enables easy digestion of Azolla by livestock.
- 1.5-2 kg Azolla/ day combined with regular feed will help to increase milk production in animals by 15%.
- Azolla as a feed improves the weight of broiler chicken and enhance the egg production in layers.
- Azolla acts as biological herbicides reducing the availability of sunlight to weeds there by reducing their growth.
- Azolla can be used in biogas production.
- Azolla helps in nutrient assimilation and absorbs nutrients from water and make it available to crops.

Objectives

The objective of this exercise is to acquire skill and proficiency in mass production and application of azolla in the field.

Principle

Azolla is a free-floating water fern that floats in water and fixes atmospheric nitrogen in association with nitrogen fixing blue green alga Anabaena azollae. Azolla fronds consist of sporophyte with a floating rhizome and small overlapping bi-lobed leaves and roots. The important factor in using Azolla as a bio-fertilizer for rice crop is its quick decomposition in soil and efficient availability of its nitrogen to rice. Azolla mineralizes organic matter rapidly and its nitrogen is available to the rice crop in very short period.

Method of Mass Production of Azolla

A. Mass multiplication of Azolla under field conditions

A simple Azolla nursery method for large scale multiplication of Azolla in the field has been evolved for easy adoption by the farmers.

Requierments/Materials

One cent (40 sq. m) area plot, Cattle dung, Single super phosphate, Furadan and fresh Azolla inoculum

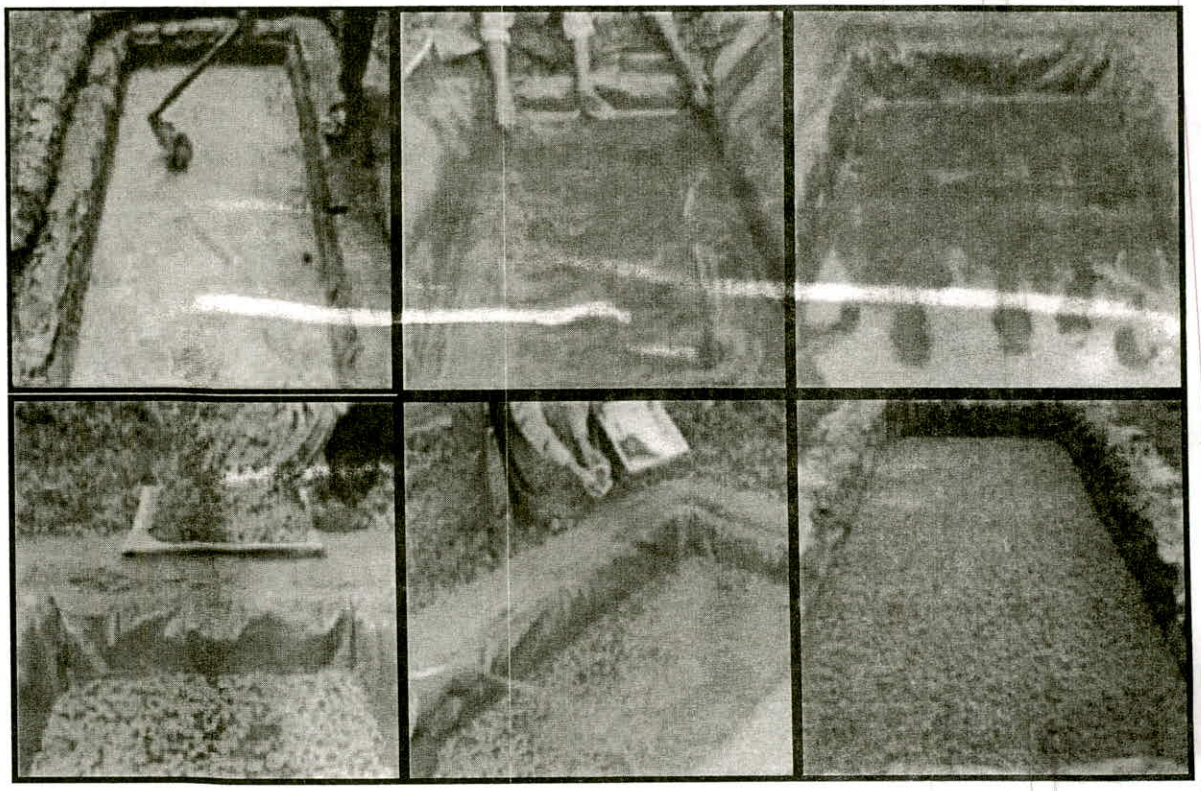


Fig: Mass multiplication of

Procedure

- Select a wetland field and prepare thoroughly and level uniformly.
- Mark the field into one cent plots (20 x 2m) by providing suitable bunds and irrigation channels.
- Maintain water level to a height of 10 cm.
- Mix 10 kg of cattle dung in 20 litres of water and sprinkle in the field.

- Apply 100 g super phosphate as basal dose.
- Inoculate fresh Azolla biomass @ 8 kg to each plot.
- Apply super phosphate @ 100 g as top dressing fertilizer on 4th and 8th day after Azolla inoculation.
- Apply carbofuran (furadan) granules @ 100 g/plot on 7th day after Azolla inoculation.
- Maintain the water level at 10 cm height throughout the growth period of two or three weeks.

B. Method of inoculation of Azolla to rice crop

The Azolla biofertilizer may be applied in two ways for the wetland paddy. In the first method, fresh Azolla biomass is inoculated in the paddy field before transplanting and incorporated as green manure. This method requires huge quantity of fresh Azolla. In the other method, Azolla may be inoculated after transplanting rice and grown as dual culture with rice and incorporated subsequently.

Fig: field method for Azolla multiplication

Application of Azolla

a. Azolla biomass incorporation as green manure for rice crop

- Collect the fresh azolla biomass from the Azolla nursery plot.
- Prepare the wetland well and maintain water just enough for easy incorporation.

- Apply fresh Azolla biomass (15 t ha^{-1}) to the main field and incorporate the Azolla by using implements or tractor.

b. Azolla inoculation as dual crop for rice

- Select a transplanted rice field.
- Collect fresh Azolla inoculum from Azolla nursery.
- Broadcast the fresh Azolla in the transplanted rice field on 7th day after planting (500 kg / ha).
- Maintain water level at 5-7.5cm.
- Note the growth of Azolla mat four weeks after transplanting and incorporate the Azolla biomass by using implements or tranctor or during inter-cultivation practices.
- A second bloom of Azolla will develop 8 weeks after transplanting which may be incorporated again.
- By the two incorporations, 20-25 tonnes of Azolla can be incorporated in one hectare rice field.

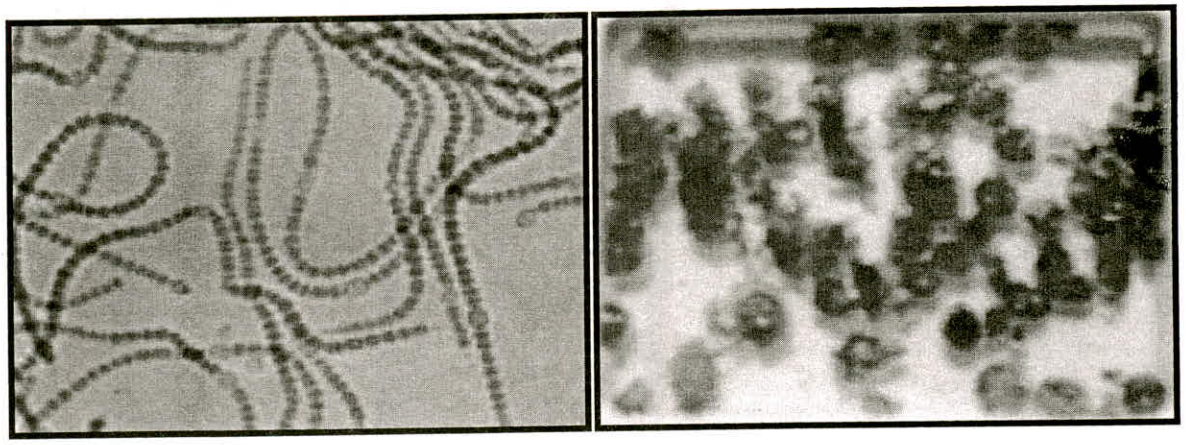
Observations and Results

Azolla mat floating on the plot. Harvest the Azolla, drain the water and record the biomass.

EXCERSISE 4 - MASS PRODUCTION AND FIELD APPLICATION OF BLUE GREEN ALGAE (BGA)

Introduction

The Blue-green algae are small organisms and can be seen under the microscope as a single cell or large accumulation of cells (colonies) or strings of cells (trichomes). They have a similar external appearance to that of algae and azolla growing in a pond and their requirements for light, nutrients and carbon dioxide are also similar. Cyanobacteria is the scientific name for blue-green algae, or "pond scum." The first recognized species were blue-green in colour, which is how the algae got their name. Species identified since range in colour from olive-green to red. Blue-green algae, like true algae, make up a portion of the phytoplankton in many water bodies. However, blue-green algae are generally not eaten by other aquatic organisms, and thus are not an important part of the food chain. True algae (e.g., green algae) are very important to the food chain. They are known as "primary producers", a name given to living organisms that can convert sunlight and inorganic chemicals into usable energy for other living organisms.



Objectives

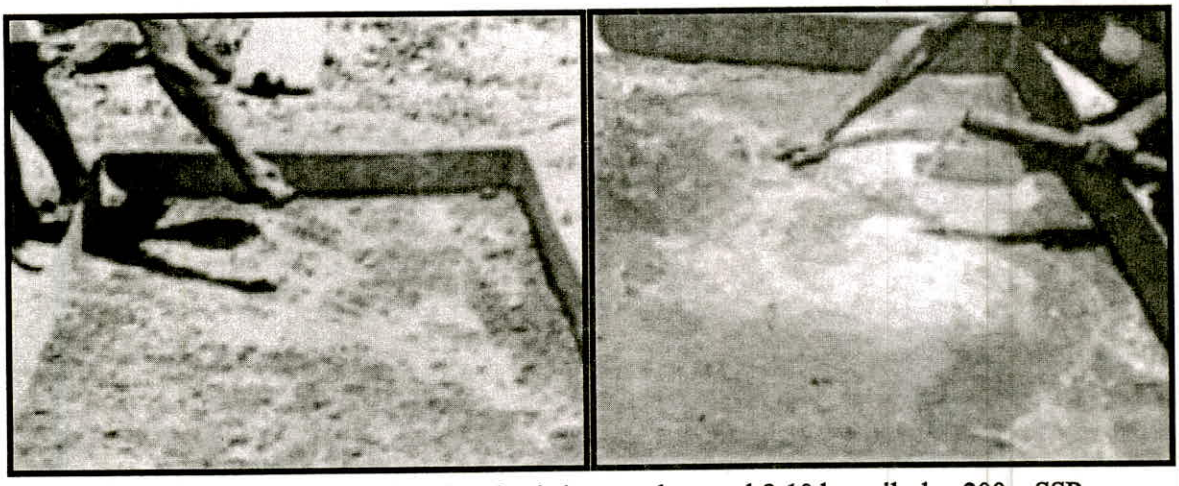
The objective of this exercise is to acquire skill and proficiency in mass production and application of BGA in the rice field.

Principle

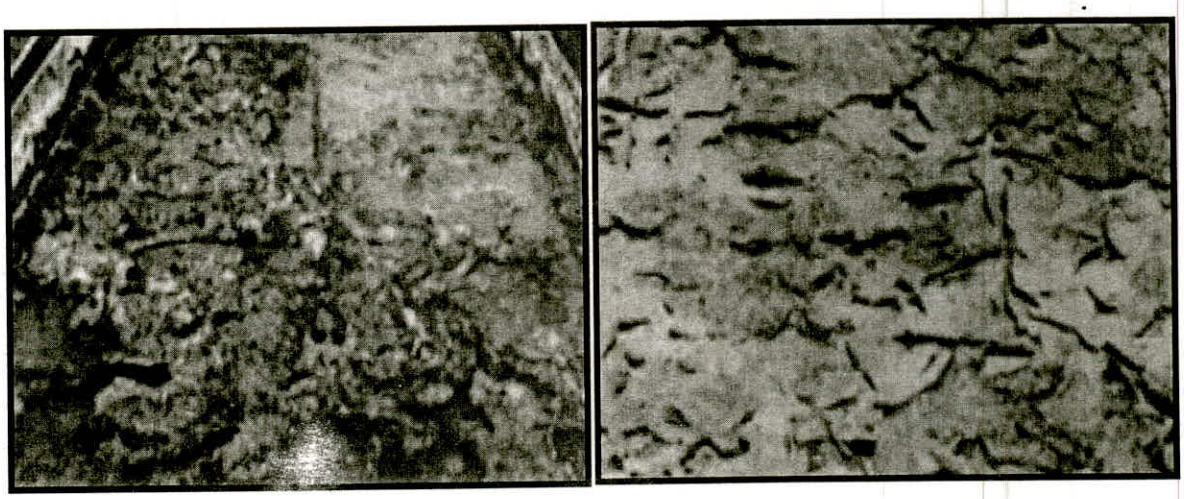
Cyanobacteria (BGA) can be found in almost every conceivable environment. Blue green algae are photosynthetic Cyanobacteria and promote the growth of lowland paddy by supplying fixed nitrogen through exudation. Cyanobacteria include unicellular and colonial form. Colonies form filaments, sheets, hollow balls. Filaments differentiate into vegetative cells, heterocysts and resistant spores. Heterocyst is the site of nitrogen fixation. Heterocyst fix nitrogen into ammonia and nitrate. Nitrate and ammonia are absorbed by plants.

Mass production of BGA culture

The blue green algal inoculum may be produced by several methods viz., in tubs, galvanized trays, small pits and also in field conditions. However, the large-scale production is advisable under field condition which is easily adopted by farmers.



Shallow trays (2m x 1m) of galvanized sheet and spread 8-10 kg soil plus 200 g SSP
Add water (5-15cm), Sprinkle algal culture and expose to sunlight



Thick algal mat forms at 15 days and allow water to evaporate
Collect dry algal flakes and make into powder and pack in polybags

Field application of BGA

- BGA application @ 10 kg/ha one week after rice transplantation contribute 25 - 30 kg N /ha /season with a yield enhancement of 10-15 percent
- Besides fixing nitrogen, these algae excrete vitamins and hormones, which may also contribute to the growth of rice plants and also enhance soil fertility.
- BGA strains used for bio-fertilizer are *Anabaena variabilis ,Nostoc muscorum, Aulosira fertilissima and Tolypothrix tenuis.*

EXERCISE 5 - METHODS OF COMPOST PREPARATION IN ORGANIC FARMING

Introduction

In organic farming, composts are prepared at the farm using crop residues, dung, bedding and urine of animals and other farm wastes. Composting is a process by which organic wastes are decomposed and converted into simple organic fertilizers by means of biological activity under controlled conditions. So that it can be handled, stored and/or applied to the land without adversely affecting the environment. It is an important technique for recycling organic (agricultural/industrial) wastes and for improving the quality and quantity of organic manures.

Nutrient profile of Compost:

S. No.	Parameters	Quantity
1.	Organic matter	70 %
2.	pH	7.5
3.	Organic carbon	33.11%
4.	Nitrogen	1.82 %
5.	Phosphorus	1.29 %
6.	Potassium	1.25 %
7.	Fe (ppm)	1019
8.	Mn (ppm)	111
9.	Cu (ppm)	180
10.	Zn (ppm)	280

Advantages of Compost

1. Compost improves the quality of soil, and for this reason it is considered as a soil conditioner.
2. It contains a variety of the basic nutrients required for healthy growth of plants.
3. In addition to, nitrogen, phosphorous, and potassium, certain micronutrients viz. manganese, copper, iron, and zinc also found in compost which helps them to control diseases and insects.
4. Compost improves the structure and texture of the soil enable them to retain nutrients, moisture, and air for the betterment and growth of plants.

Objectives

After completing this exercise, we will learn scientific way to prepare a good quality compost

Principles of composting

Composts are prepared with the help of microbes, these microbes, bring down the C : N ratio to the level of 20:1 of the organic matter. They convert the complex materials into simple and easily available forms. For example: the protein is broken down in the form of amino acids and further into nitrogen. Composting is a self heating, thermophilic and aerobic biological process which occurs naturally in heaps of bio-degradable organic matter such as manure, moist hay and straw. This bio-degradation process is carried out by different kinds of heterotrophytic microorganisms, bacteria, fungi, actinomycities and protozoa,

which derive their energy and carbon requirements from the decomposition of carbonaceous materials.

Under aerobic conditions, heterotrophic organisms derive energy from the decomposition of organic matter, resulting in the production of CO_2, humic substances and release of available nutrients. In this process the following reactions are likely to occur:

$$(CH_2O)X+XO_2 \longrightarrow XCO_2 + XH_2O + \text{energy}$$

Sugars, cellulose, hemicellulose, lignins, proteins

$$\text{Organic N} \longrightarrow NH_3 \longrightarrow NO_2 \longrightarrow NO_3$$

$$\text{Organic S} + XO \longrightarrow SO_4$$

$$\text{Organic Phosphate} \longrightarrow H_3PO_4 \longrightarrow Ca(HPO_4)_2$$

(phytin, lecithin)

Under anaerobic conditions, microorganisms break down organic materials by a process of reduction in the absence of O2. First, special group of acid producing bacteria and facultative heterotrophs degrade organic matter into fatty acids, aldehydes and alcohols. Then a group of bacteria convert the intermediate products to methane, NH_3 and H_2.

$$CH_2O + O2 \longrightarrow CH_3COOH \longrightarrow CH_4 + CO_2$$

$$\text{Organic N} \longrightarrow NH_3$$

b) Requirements

Animal dung, crop residues, green leguminous leaves, gunny bag, pebbles, pits, open space, buckets, drum and spade.

Methods for composting of agricultural wastes

1. Indore method
2. Activated compost
3. Bangalore method
4. NADEP compost
5. Coimbatore method
6. Windrow composting (leaf compost)
7. Accelerated composting and enrichment
8. Vermicomposting
9. Phospho-composting
10. Reinforced compost from sugarcane trash and press mud
11. Enriched FYM
12. Weed composting

Enriched Farmyard manure

Farmyard Manure is one of the oldest manure used by the farmers in growing crops because of its easy availability and presence of all the nutrients required by the plants. FYM refers to the decomposed

mixture of dung and urine of farm animals along with their litter and left over material from roughages or fodder fed to the cattle. On an average well decomposed farmyard manure contains 0.5% N, 0.2% P_2O_5 and 0.5% K_2O.

a) Pit Method

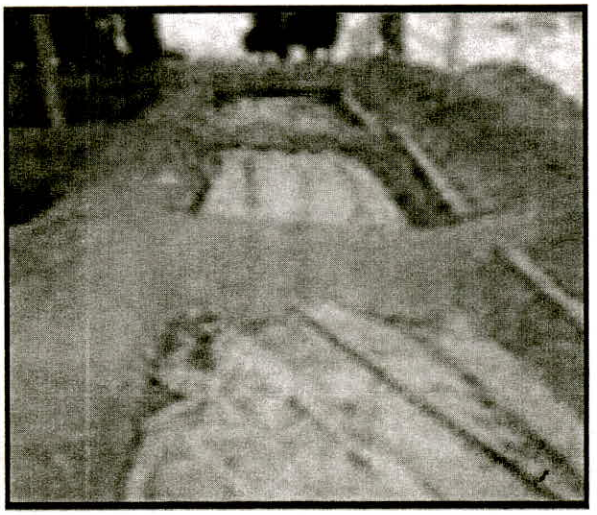
- Dig a pit with the help of spade in an open shaded place. The pit should have a dimension of 6 m long, 2 m wide and 1 m deep. (The whole trench may be divided into 1 m sections).
- Chop up all the available organic residues (green and dried) into convenient size and blend the green residues with dried.
- While filling the pits, first place the sand and small gravels at the bottom of the pit.
- Place 30-45 cm thickness agro-waste as second layer and spray dung slurry. This practice should be repeated till the pit is filled up to a height of 0.5 m above ground surface.
- Then the top of the heap is rounded-off to the shape of a dome and plastered with the mixture of earth and cow dung slurry. The plastering conserves nitrogen and moisture and also prevents fly nuisance.
- You may fill only one section at a time and fill the next section while turning. This process is repeated till the material is out from the pit. This method is called parallel pit method.
- Maintain sufficient moisture 5 5-60% in the pits by spraying water at a regular interval.
- The manure became ready after about 150 to 180 days of plastering. Usually 10-12 tones of FYM obtained/pit or every animal gives out about 5 to 6 tones of FYM /year.

b) Trench Method

This method is also called as Dr. C. N. Acharya method and Banglore method. In this method trenches of 6 to 8 m length, 1.5 to 2 m width and 1 to 1.25 m depth are prepared. Mixture of dung and urine soaked litter is deposited in layers in these trenches until it becomes 50 cm above the ground layer. Now it is covered with 50 cm deep soil or wood ash- soil layer and then plastered by mud paste. Manure becomes ready for use after about 150 - 160 days of plastering. This method saves labour cost because there is no need of turning and regular sprinkling of water.

Method of filling the composting trench

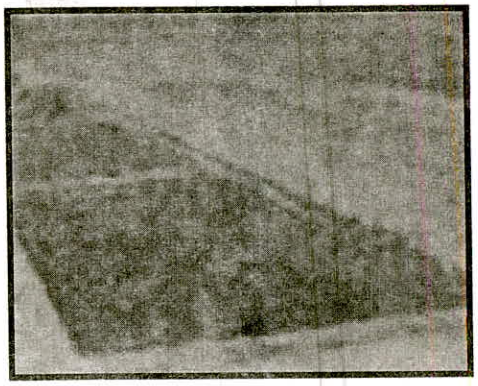
- Spread the moist farm refuse at the bottom of the pit up to one inch.
- Then, spread two inch of cattle dung and urinated mud followed by 1 or 2 inch layer of soil
- This heap is made up to 1.5-2.0 feet above the ground level following above process.
- Finally the heap is covered with 1 inch thick mud.



c) **Heap Method :**

Most commonly used by the farmers. Every day sweepings, cow dung and litter are collected and heaped at any fixed place. After about 6 to 9 months, the rotten manure is used. According to an estimate, about 30 to 35% nitrogen 20 to 25% phosphorus & 4-6% potassium are lost during preparation of manure due to leaching, washing and volatilization.

Indore method of compost preparation



This method was developed by A. Howard and Y. D. Wad at the Institute of Plant industry, Indore, India.

Size of the pit

Breadth - 6-8 feet

Depth - 2-3 feet (not more than 3 feet)

Length - 10 feet or more as per requirement

Raw material

Mix plant residues, weeds, sugarcane leaves, grass, wood ashes, bran, animal dung, wood ashes, water and urine soaked mud

Filling the composting pits

- First of all, spread dry wastes with cattle dung and soil in ratio of 4:2:1 up to 2 inch layer in Composting pit afterwards, sprinkle the water over the materials.
- Pit is filled with above materials up to 1 foot above the ground level.
- One more layer of bedding material with wood ash and urinated mud should be added.
- **Turning:** The material is turned three times for proper aeration and moisture.

  First turning: 10-15 days after filling the pits.

  Second turning : 15 days after first turning.

  Third turning : After 2 month of second turning

NADEP method of compost preparation

This method facilitates a lot of composting through minimum use of cattle dung. In this method, the decomposition process takes place aerobically.

Steps for NADEP Method of Composting

Selection of site

The tank should be located near cattle shed or farm site.

Size of pit

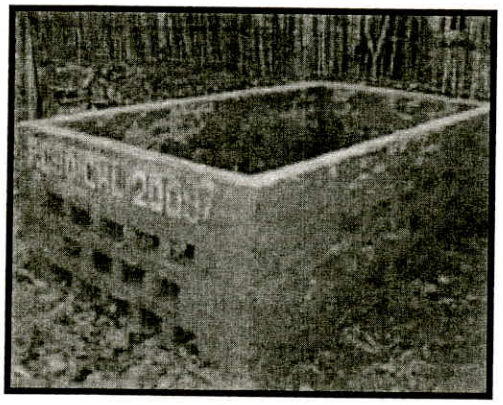
The tank should be 10' ×6' ×3'in size and prepared with 9' inch thick wall. Proper blocks and holes of 7 inches should be left on all the four side of the tank wall for the circulation of air. Plastering of inner wall and floor of the tank should be done by mixture of dung and mud.

Materials Required

S. No.	Material	Quantity (Kg)
1.	Farm residues	1400 -1500
2.	Cattle dung	90 - 100
3.	Dry sieved soil	1750
4.	Water	1500 -2000 litre

Method of filling tank

Slurry made of cow dung and water should be sprinkled on the floor and the walls of tank. The filling of tank follows these steps:



First layer: Plant residues are spread evenly in layer up to 6 inches (10-100 Kg) in tank.

Second layer: 4-5 Kg cattle dung or gobber gas-slurry in 125 to 150 litres of water should be apply on the first layer.

Third layer: 50-60 kg sieved soil added on the second layer of tank In this way, the tank is filled layer by layer up to 1.5 feet above the brick level of tank. Filled tank should be covered and sealed by 3 inch layer of soil (300-400Kg). It should also be pastered with a mixture of dung and soil.

Second Filling

- At this stage, the process of the first filling is repeated and again sealed with paste of mud & dung.
- After 20 days, the plant residue contracts and goes down in the tank by 20-25 inches.
- Periodically the paste of cattle dung and water should be sprinkle to maintain 15-20% moisture.

Observation and Results

Compost is considered ready when it is free flowing and having dark brown colour. The free flow characteristic is obtained when the moisture level is between 15 to 25 per cent.

Benefits of Compost

1. Compost improves the quality of soil, and for this reason it is considered as a soil conditioner.
2. It contains a variety of the basic nutrients required for healthy growth of plants.
3. In addition to, nitrogen, phosphorous, and potassium, certain micronutrients viz. manganese, copper, iron, and zinc are also found in compost which helps them to control diseases and insects.
4. Compost improves the structure and texture of the soil enable them to retain nutrients, moisture, and air for the betterment and growth and plants.

Precautions

- Avoid use of any ingredient in compost preparation which is not in accordance to the NPOP guidlines.
- Too much and too less water application in the pit should be avoided.
- While turning, remove any concrete particles, if seen in the pit. Also remove any hardened plant part.

EXCERSISE 6 - APPLICATION AND METHOD OF VERMICOMPOST PREPARATIONS

Introduction

Vermicompost is the production of compost using earthworms. The earthworm eats the organic residues, digest it and excrete in the form of pellets. The earthworm excreta are called worm cast. The vermicompost is a nutrient rich compost and helps better plant growth and crop yield. Vermicomposting is better than ordinary composting in many aspects e.g. it takes 3 months for the complete decomposition of wastes whereas other takes 5 - 6 months and foul smell is not there in vermicompost.

Nutritive value of vermicompost

The nutrients content in vermicompost vary depending on the waste materials that is being used for compost preparation. If the waste materials are heterogeneous there will be wide range of nutrients available in the compost. If the waste materials are homogenous there will be only certain nutrients are available. The common available nutrients in vermicompost is as follows

Organic carbon	:	9.5 - 17.98%
Nitrogen	:	0.5 - 1.50%
Phosphorous	:	0.1 - 0.30%
Potassium	:	0.15 - 0.56%
Sodium	:	0.06 - 0.30%
Calcium and Magnesium	:	22.67 to 47.60 meq/100g
Copper	:	2 - 9.50 mg kg-1
Iron	:	2 - 9.30 mg kg-1
Zinc	:	5.70 - 11.50 mg kg-1
Sulphur	:	128 - 548 mg kg-1

Advantages of vermicompost

- Vermicompost is rich in all essential plant nutrients.
- Provides excellent effect on overall plant growth, encourages the growth of new
- shoots / leaves and improves the quality and shelf life of the produce.
- Vermicompost is free flowing, easy to apply, handle and store and does not have bad odour.
- It improves soil structure, texture, aeration, and water holding capacity and prevents soil erosion.
- Vermicompost is rich in beneficial micro flora such as a fixers, P- solubilizers, cellulose decomposing micro-flora etc in addition to improve soil environment.
- Vermicompost contains earthworm cocoons and increases the population and activity of earthworm in the soil.
- It neutralizes the soil rection.
- It prevents nutrient losses and increases the use efficiency of chemical fertilizers.
- Vermicompost is free from pathogens, toxic elements, weed seeds etc.

- Vermicompost minimizes the incidence of pest and diseases.
- It enhances the decomposition of organic matter in soil.
- It contains valuable vitamins, enzymes and hormones like auxins, gibberellins etc.

Objectives

- To identify the earthworm species suitable for vermicomposting; and
- To prepare a good quality vermicompost.

Principle

While the earthworms eat and digest, the organic matters get churned and blended with the different gastric juices and other secretions. During this process, the complex compounds get simplified. The vermicompost also contains the vitamins, enzymes and plant growth promoting, substances.

Requirements

Earthworm, Organic residues, Animal dung, Source of water, Buckets and water sprayer, Rakes and Concrete floor under shade.

Temperature and moisture

For *Eudrillus euginae* species the moisture content should be 60 - 70 % at 27 ± 2°C. Water logging is not desirable for its growth and development.

Shelter

Cannot be practiced in open ground, have to be protected from excess moisture and direct sunlight.

Aeration

Earthworms require good aeration for their growth, reproduction and composting activities since vermicomposting is chiefly an aerobic process.

pH and feeding materials

Earthworms are very sensitive to acidic, alkaline soils and strong odour, pungent materials etc. So avoid materials like chilly, spicy and other acidic food materials such as lemon, garlic, greasy/ waxy / oily food etc.

Enemies

Rodents, ants, lizards, birds, snakes, centipedes etc cut the worms. So various precautions against these enemies should be taken.

Procedure

Pre-digestion

Before inoculation (application of earthworm), the organic matter should be pre-digested. During pre-digestion, the temperature inside the heap goes down due to dissipation of heat. By the time the partially decomposed matter is fed to the earthworm, it does not heat up again. The organic residues should be chopped and shredded properly into small pieces and blended with dung slurry. This mixture is left for one month to digest.

Steps

Here, we shall describe the vermicompost production using pit method.

a) Construct a pit of 3.0 x 2.0 x 1.0 m size (Lx W x D) over ground surface using bricks. Make an opening in the bottom of the pit.

b) Fill first layer of sand or sandy soil at a height of 5- 6 cm to drain excess water.

c) Spread paddy straw as a second layer (30 cm) for aeration.

d) Place 15 to 30 days old dung at a thickness of 20-30 cm as third layer.

e) Then place pre-digested material as fourth layer of the about 50 cm.

f) Inoculate earthworms @1000 worms per square meter area or 1.0 kg earthworms in 100 kg of organic matter.

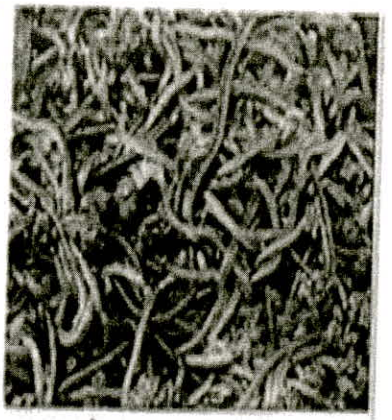
g) Water is sprayed and bed should be covered by gunny bag. Maintain 50-60% moisture by intermittent water spraying.

1. Selection of proper species

For vermicompost production, the surface dwelling earthworm alone should be used. The earthworm, which lives below the soil, is not suitable for vermicompost production. The African earthworm (*Eudrillus engenial*), Red worms (*Eisenia foetida*) and composting worm (*Peronyx excavatus*) are promising worms used for vermicompost production. All the three worms can be mixed together for vermicompost production. The African worm (*Eudrillus eugenial*) is preferred over other two types, because it produces higher production of vermicompost in short period of time and more young ones in the composting period.

Eisenia foetida

Eudrilus eugeniae

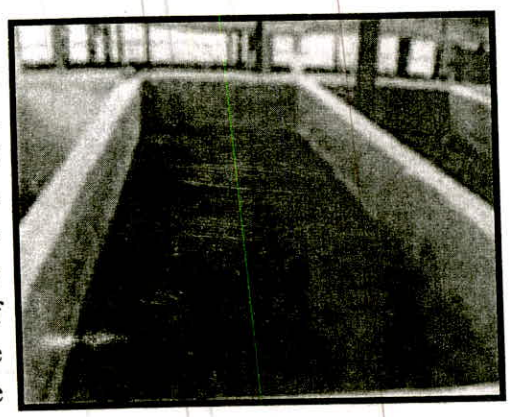


Perionyx excavatus

Selection of site for vermicompost production

Vermicompost can be produced in any place with shade, high humidity and cool. Abandoned cattle shed or poultry shed or unused buildings can be used. If it is to be produced in open area, shady place is selected. A thatched roof may be provided to protect the process from direct sunlight and rain. The waste heaped for vermicompost production should be covered with moist gunny bags.

Containers for vermicompost production



A cement tub may be constructed to a height of 2½ feet and a breadth of 3 feet. The length may be fixed to any level depending upon the size of the room. The bottom of the tub is made to slope like structure to drain the excess water from vermicompost unit. A small sump is necessary to collect the drain water. In another option over the hand floor, hollow blocks / bricks may be arranged in compartment to a height of one feet, breadth of 3 feet and length to a desired level to have quick harvest. In this method, moisture assessment will be very easy. No excess water will be drained. Vermicompost can also be prepared in wooden boxes, plastic buckets or in any containers with a drain hole at the bottom.

Vermiculture bed

Vermiculture bed or worm bed (3 cm) can be prepared by placing after saw dust or husk or coir waste or sugarcane trash in the bottom of tub / container. A layer of fine sand (3 cm) should be spread over the culture bed followed by a layer of garden soil (3 cm). All layers must be moistened with water.

Worm Food

Compost worms are big eaters. Under ideal conditions, they are able to consume in excess of their body weight each day, although the general rule-of-thumb is ½ of their body weight per day. They will eat almost anything organic (that is, of plant or animal origin), but they definitely prefer some foods to others. Manures are the most commonly used worm feedstock, with dairy and beef manures generally considered the best natural food for Eisenia.

Selection for vermicompost production

Cattle dung (except pig, poultry and goat), farm wastes, crop residues, vegetable market waste, flower market waste, agro industrial waste, fruit market waste and all other bio degradable waste are suitable for vermicompost production. The cattle dung should be dried in open sunlight before used for vermicompost production. All other waste should be predigested with cow dung for twenty days before put into vermibed for composting.

Putting the waste in the container

The predigested waste material should be mixed with 30% cattle dung either by weight or volume. The mixed waste is placed into the tub / container upto brim. The moisture level should be maintained at 60%. Over this material, the selected earthworm is placed uniformly. For one-meter length, one-meter breadth and 0.5-meter height, 1 kg of worm (1000 Nos.) is required. There is no necessity that earthworm should be put inside the waste. Earthworm will move inside on its own.

Watering the vermibed

Daily watering is not required for vermibed. But 60% moisture should be maintained throughout the period. If necessity arises, water should be sprinkled over the bed rather than pouring the water. Watering should be stopped before the harvest of vermicompost.

Harvesting vermicompost

In the tub method of composting, the castings formed on the top layer are collected periodically. The collection may be carried out once in a week. With hand the casting will be scooped out and put in a shady place as heap like structure. The harvesting of casting should be limited up to earthworm presence on top layer. This periodical harvesting is necessary for free flow and retain the compost quality. Other wise the finished compost get compacted when watering is done. In small bed type of vermicomposting method, periodical harvesting is not required. Since the height of the waste material heaped is around 1 foot, the produced vermicompost will be harvested after the process is over.

x) **Harvesting earthworm**

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.

Storing and packing of vermicompost

The harvested vermicompost should be stored in dark, cool place. It should have minimum 40% moisture. Sunlight should not fall over the composted material. It will lead to loss of moisture and nutrient content. It is advocated that the harvested composted material is openly stored rather than packed in over sac. Packing can be done at the time of selling. If it is stored in open place, periodical sprinkling of water may be done to maintain moisture level and also to maintain beneficial microbial population. If the necessity comes to store the material, laminated over sac is used for packing. This will minimize the moisture evaporation loss. Vermicompost can be stored for one year without loss of its quality, if the moisture is maintained at 40% level.

iii) **Observation and results**

When the vermicompost is ready, it looks dark brown in colour and free flowing. The material is converted into granules. Note down the time taken for reaching to this stage.

iv) Precautions

The following precautions have to be followed while preparing the vermicompost:

- The African species of earthworms, *Eisenia foetida and Eudrilus eugenae* are ideal for the preparation of vermicompost.
- Only plant-based materials such as grass, leaves or vegetable peelings should be used in preparing vermicompost.
- Materials of animal origin such as eggshells, meat, bone, chicken droppings, etc., are not suitable for preparing vermicompost.
- Gliricidia loppings and tobacco leaves are not suitable for rearing earthworms.
- The earthworms should be protected against birds, termites, ants and rats.
- Adequate moisture should be maintained during the process. Either stagnant, water or lack of moisture could kill the earthworms.
- The vermicompost should be removed from the bed at a regular interval and replaced by fresh waste materials.

EXERCISE 7 - GREEN MANAURING: A BASIC COMPONENT OF ORGANIC FARMING

Introduction

A green manure is a crop grown to improve the soil. Although they may generate a profit, in most cases their sole purpose is to benefit subsequent crops. Once grown, they are usually incorporated into the soil shortly before sowing the next cash crop. With rising nitrogen fertiliser prices and an ever-increasing requirement to farm in an environmentally sustainable way, green manures are fast becoming a viable way to cut input costs, add fertility and improve the soil. There is a wide variety of green manures to choose from including clovers, lucerns, mustards and grasses. Legumes (such as clover) are very popular as they fix nitrogen. However, other species offer benefits such as improved soil structure and weed suppression. 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 systems is called 'green manuring' where the crop is grown in situ or brought from outside and incorporated. Green leaf manuring consists of gathering green biomass from nearby location and adding it to the soil. In both, the organic material should be incorporated into the soil while they are moderately young for easy and rapid decomposition.

The aim of green manuring is to add nitrogen to the companion or succeeding crop and to add to or sustain organic matter in the soil. Green manure crops absorb nutrients from the lower layers of soils and leave them in the soil surface layer when ploughed in, for use by the succeeding crops

Advantages of green manuring

a) Green manuring has a positive influence on the physical and chemical properties of the soil.
b) It helps to maintain the organic matter status of arable soils.
c) Green manure serves as a source of food and energy for the soil microbial population which multiplies rapidly in the presence of easily decomposable organic matter.
d) The enhanced activities of soil organisms not only cause rapid decomposition of the green manure but also result in the release of plant nutrients in available forms for use by the crops.
e) Green manuring improves aeration in the rice soils by stimulating the activities of surface film of algae and bacteria.
f) Many green manure crops have additional use as sources of food, feed and fuel.

Objective

To develop skills and knowledge on green manure crops and green manuring

Classification of green manures:

It can be mainly classified into two groups *viz.*, legumes and non-legumes and further two groups in each *viz.*, green manure and green leaf manure

Green manures			
Legumes		Non -legumes	
Green manure	Green leaf manure	Green manure	Green leaf manure
Dhiancha	Gliricidia	Sunflower	Calotropis
Sunhemp	Cassia	Buck wheat	Adachoda
Kolinji	*Pongamen glabra*		Thespesia

Legumes

a) Fix free nitrogen from the atmosphere

b) Physical condition of the soil is improved by cultivation and incorporation.

c) They are more succulent than the non-legumes and less soil moisture is utilized for their decomposition

d) They serve as cover crops by their vigorous growth and weeds are smothered e.g. clover, dhaincha and cowpea.

Non-legumes

a) Free nitrogen is not fixed by non-legumes except in specific plants which have root nodules produced by bactreria or fungi, e.g. Casuarina, elasagnus and cycas.

b) They are not as succulent as legumes and hence require more soil moisture and time for decomposition Green manures work best when mixed with legumes and non-legumes. That way you get the nitrogen fixing benefit from the legumes, but also you maximize the fast growth of the expansive root development and tall foliage height that is characteristic of grasses and grains.

Important Green Manure Crops

***Sesbania aculeata* (Dhaincha)**

It is a quick growing succulent green manure crop. It adapts itself to varying conditions of soil and climate. It can be grown even under adverse conditions of drought, water logging, salinity, etc. It comes up even in alkaline soils and corrects alkalinity if grown repeatedly for four to five years. Ample of bacterial nodules are formed in on the roots. The plant has a soft stem. It makes good growth in two to four months and produces abundant green matter ranging from 10 to 20 tonnes per hectare, depending upon the age at harvest Recommended seed rate is 20 to 25 kg/ha. Though higher seed rate help in producing plants with thin stem. The stem gets woody and fibrous after three months of growth.

As a pure crop, 25 to 30 kg/ha seeds are sown and the plants ploughed in for single crop rice. Though the initial growth is slow, it picks up fast and grows vigorously by later.

Sesbania rostrata

It is an aquatic leguminous crop which has nodules both on the stem and roots. It was introduced in India in the 1980 from the International Rice Research Institute, Philippines. It is a tropical legume which thrives well under flooded and waterlogged conditions, it gives ten times more nodules than most of the legumes. This can be grown either prior to rice crop or in between two rice crops. Though naturally propagated by seeds, seedlings and root stem cuttings can also be used as planting material.

The normal seed rate is 30 to 40 kg/ha. To get early, uniform germination and vigorous seedlings, seeds have to be scarified with concentrated sulphuric acid for 1.5 minutes. Summer (April-July) is the best season for getting higher biomass and better seed production. The photosensitive nature of this crop (short day) restricts its usage during winter. Intercropping one row of 30 days old seedlings for every 1.5 meter in rice fields could produce three to five tonnes of biomass in 30 days after transplanting. Rice yields are not affected due to intercropping.

***Crotalaria juncea* (Sunhemp)**

It is very quick growing green manure-cum-fibre crop. It comes up well in loamy and heavy soils. This crop can be cut even when it is 45 days old. It does not withstand heavy irrigation or continuous water logging. There are a number of varieties varying in duration ranging from 75 to 150 days. The general appearance of the crop is greyish to greenish. The tall, robust and late duration varieties are used for fibre extraction also. The seed rate is 25 to 40 kg/ha and the yield of green matter may vary ranging from 12,000 to 25,000 kg/ha depending upon the environmental conditions and duration of the crop.

EXERCISE 8 - INDIGENOUS TECHNOLOGY FOR NUTRIENT MANAGEMENT IN ORGANIC FARMING

Introduction

Many alternatives of nutrient management are being used by farmers of different states in organic farming. Few important and widely used formulations are given below:

Objectives

To develop skill in preparation and methodology of various ITKs liquid formulations used in organic farming.

Principle

Different indigenous technologies or liquid formulations are used by farmers to enhance crop growth and productivity in organic farming. Many of them indigenous formulations are immediate responsive to correct nutrient deficiencies by direct supplying of nutrients in safe way or enhancing the availability of nutrient by increasing microbial population and activity in the soil. Some ITK liquid formulation act as a plant tonic to strengthening the health of crops.

A. Vermiwash

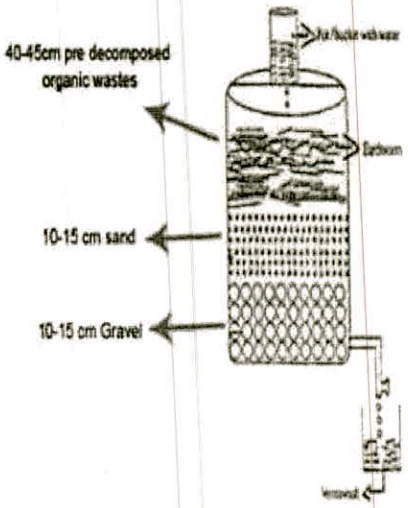
Vermiwash is an extract obtained after pouring the water through a column of earthworm. It is in fact a bathwater of the earthworm. It is highly rich in nutrient content and useful for foliar application. It is a liquid manure obtained from earthworms and is used as a foliar spray. It contains plant growth hormones like auxins and cytokinins apart from nitrogen, phosphorus, potash and other micro-nutrients.

Requirements

Earthen pot, Earthworm, Water, Vermicompost and Plastic net

Methods of preparation

1. Select one sufficiently large container made of concrete or plastic bucket or earthen pot.
2. Drill a hole at the base of the container to fix a tab to it.
3. A base layer of gravel or broken small pieces of bricks are placed to a height of 10-15 cm.
4. Above the gravel layer another layer of coarse sand of 1-15 cm is put.
5. On the coarse sand layer place 40-45 cm pre-decomposed organic wastes and moistens the different layer by using water.
6. Introduce about 2000 number of earthworms into the container.
7. To get vermiwash continuously suspend a mud pot or a small bucket with some holes. Cotton wicks/or bamboo sticks are placed in the holes so that water can trickle down.
8. Fill the container with 4-5 litre water everyday.
9. After 10 days vermiwash starts forming in the container.
10. Everyday about 3-4 litre of vermiwash can be collected.



Applications

1. Dilute 1 litre of vermiwash with 4-5 litres of water and spray as foliar spray during the late evening hours.
2. A mixture of vermiwash (1 liter) with cow urine (1 liter) in 10 litres of water acts as bio-pesticide and liquid manure.

Benefits

It acts as a plant tonic and help to reduce many plant diseases.

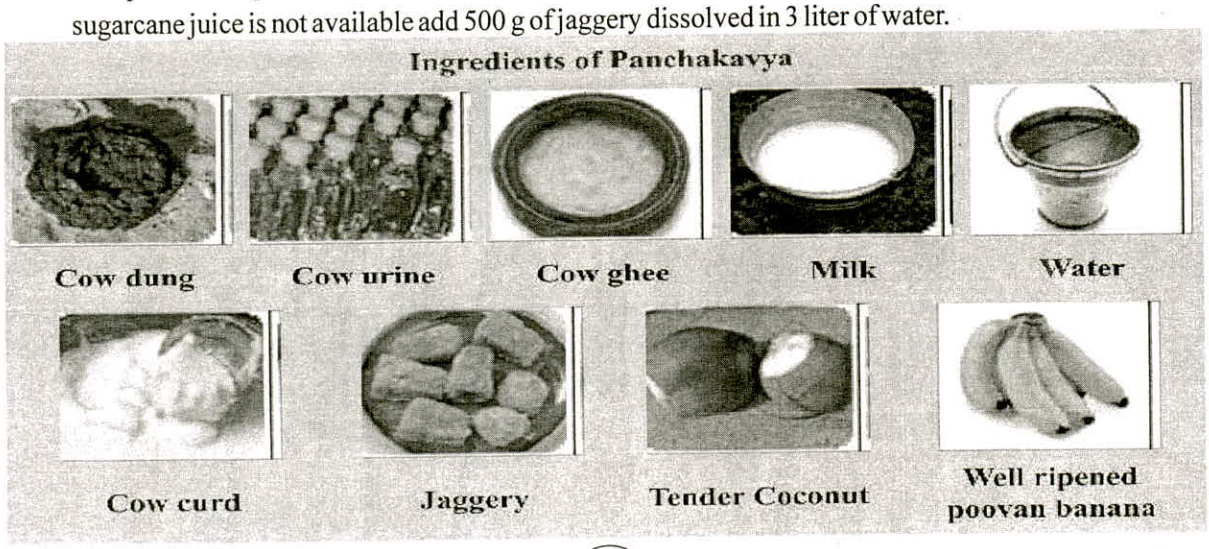
B. Panchagavya

Panchagavya, an organic product has the potential to play the role of promoting growth and providing immunity in plant system. Panchagavya consists of nine products viz. cow dung, cow urine, milk, curd, jaggery, ghee, banana, tender coconut and water. When suitably mixed and used, these have miraculous effects.

- Cow dung - 7 kg and Cow ghee - 1 kg
- Mix the above two ingredients thoroughly both in morning and evening hours and keep it for 3 days
- Cow Urine - 10 liters and Water - 10 liters
- After 3 days mix cow urine and water and keep it for 15 days with regular mixing both in morning and evening hours. After 15 days mix the following and panchagavya will be ready after 30 days.
- Cow milk - 3 litres, Cow curd - 2 litres, tender coconut water - 3 litres, Jaggery - 3 kg and well ripened banana - 12 nos.

2. Preparation

All the above items can be added to a wide mouthed mud pot, concrete tank or plastic cane as per the above order. The container should be kept open under shade. The content is to be stirred twice a day both in morning and evening. The Panchagavya stock solution will be ready after 30 days. (Care should be taken not to mix buffalo products). The products of local breeds of cow is said to have potency than exotic breeds. It 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 in the solution. If sugarcane juice is not available add 500 g of jaggery dissolved in 3 liter of water.



Recommended dosage

Spray system

3% solution was found to be most effectives as compared to the higher and lower concentrations investigated. Three litres of Panchagavya to every 100 litres of water is ideal for all crops. The power sprayers of 10 litres capacity may need 300 ml/tank. When sprayed with power sprayer, sediments are to be filtered and when sprayed with hand operated sprayers, the nozzle with higher pore size has to be used.

Flow system

The solution of Panchagavya can be mixed with irrigation water at 50 litres per hectare either through drip irrigation or flow irrigation

Seed/seedling treatment

3% solution of Panchagavya can be used to soak the seeds or dip the seedlings before planting. Soaking for 20 minutes is sufficient. Rhizomes of Turmeric, Ginger and sets of Sugarcane can be soaked for 30 minutes before planting.

Seed storage

3% of Panchagavya solution can be used to dip the seeds before drying and storing them.

Periodicity

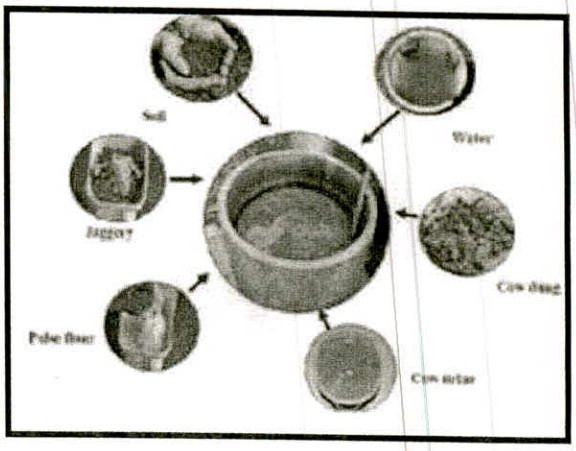
Pre flowering	:	Once in 15 days, two sprays depending upon duration of crops
Flowering and pod setting	:	Once in 10 days, two sprays
Fruit/Pod maturation stage	:	Once during pod maturation

C. Jivamrutha

Jivamrutha is a solution prepared by the farmer with the help of Komiyam, Fresh Deshi Cow Dung, Jaggery, Flour of pulses dissolved in adequate water. Such a solution is permitted to achieve adequate level of fermentation over a period of four to five days. During this period the microbial activity in the solution multiplies several times. Application of this solution on a regular interval of 7 days increases the microbial activity in the soil and brings back the lost humus. The increased microbial activity and humus in the soil will mobilise and make available the different macro and micro nutrients in the soil and enable the plants to uptake them efficiently.

Preparation of Jivamrutha

200 litres of water 10 Kilos of fresh Deshi Cow Dung 5 to 10 litres of aged Deshi Cow Komeyum (Cow Urine) 2 Kilograms of Jaggery 2 Kilograms of Pulse flour and 100 grams of soil from your farm land, mix them well in any vessel or tank except copper vessel. Cover the mouth with a cloth to permit release of methane. Stir the solution thrice a day. Keep it under shade in a cool and dry place. Continue the process for 4 days. Now Jiva-Amrutha is ready for use. Filter the solution if you have to make foliar application



Application of Jivamrutha

Soil application:

First method of application is for increasing the humus of the soil. For this you need to apply 200 litres to 400 litres per acre of this solution when you water your field, For soil application you need not filter the prepared solution, You must apply this solution within 4 to 5 days of preparation of the solution.

Foliar application:

It can be apply to all types of crops through the foliar way in addition to soil application. For foliar application, you need to filter the prepared solution. You need to dilute the prepared solution and spray the same during evening hours or during the first hour of sunrise

Take 100 litres of water and add 5 litres of the filtered Jivamrutha and mix the same well and spray the same and drench the plant completely 30 days after sowing of the seeds; 30 days after this first foliar application, take 150 litres of water add 10 litres of Jivaamrutha and spray the same to drench the plants completely; 30 days after the second application, take 200 litres of water and add 20 litres of Jivaamrutham and spray the same to drench the plants completely; At the time of maturity take 200 liters of water and 5 litres of sour buttermilk and stir the solution well and drench the plants completely.

D. Amritpani

Mix 10 kg cow dung with 500 g honey and mix thoroughly to form a creamy paste. Add 250 g of cow desi ghee and mix at high speed. Dilute with 200 litres water. Sprinkle this suspension in one acre over soil or with irrigation water. After 30 days apply second dose in between the row of plants or through irrigation water.

E. Sanjivak

Mix 100 kg cow dung, 100 litres of cow urine and 500 g jaggary in 300 litres of water in a 500-litres closed drum. Ferment for 10 days. Dilute with 20 times water and sprinkle in one acre either as soil spray or along with irrigation water.

EXERCISE 9 - WEED MANAGEMENT PRACTICES IN ORGANIC FARMING

Introduction

Weed is any plant that is hazard, nuisance, or causes injury to human, animals, or desired crops. The weeds are silent robbers of resources.

Weeds can deprive the crops for	as weeds contain ---------- than crops
47% of N	2.0 times more N
42% of P_2O_5	1.5 times more P_2O_5
56% of K_2O	3.5 times more K_2O
39% of Ca	7.5 times more Ca
24% of Mg	3.0 times more Mg

Objectives

To study and demonstrate different weed management practices used under organic farming

Principle

In order to prevent the accumulation of chemical residues in the soil to a dangerous level and to prevent shift in weed population, it is necessary to find out the alternative weed management techniques leading to minimum loss in crop production and least disturbance to the ecosystem.

Weed management methods

Weed management practices are used in organic farming classified in mainly three categories

- Cultural methods
- Mechanical methods
- Biological methods

A. Cultural methods of weed management

These methods are less expensive and less dangerous to adjoining crops and orchards.

- Tillage
- Stale seed bed
- Sanitation
- Crop/variety selection
- Selection of seeds
- Seeding rate
- Row spacing
- Delayed or early seeding

- Water Management
- Adequate and localized resource application
- Crop rotation
- Inter-cropping
- Green manure & cover crops
- Mulching

Tillage

Ploughing, cultivating and harrowing make possible weed control before sowing the crop because 75% seed bank of weeds are found in upper 5 cm of soil, this weed seeds are destroyed by tillage/summer deep ploughing practices. New types of minimum tillage implements that cut and incorporate residues and ridge the soil in one operation are strongly advocated for organic agriculture. The role of tillage in weed control consists of:

1. Facilitating the germination of weed seeds, which can, then, be easily destroyed by mechanical means;
2. Bringing the roots or stolons to the soil surface where they will dry out under the sunlight
3. Repeated cultivation, thus depleting the food reserve of the plant
4. Uprooting or smothering the weeds with soil

Stale seed bed

A stale seedbed is one where initial one or two flushes of weeds are destroyed before planting of a crop. This is achieved by soaking a well prepared field with either irrigation or rain and allowing the seeds to germinate. At this stage a shallow tillage used to destroy the dense flush of young weed seedlings. This may be followed immediately by sowing a desired crop.

Sanitation

Ensure that boundary, bunds and irrigation channels of field must be clean or free from weeds to prevent coming of weed seeds from above area to the field so it is necessary to keep clean and weed free field and nearby area.

Selection of seed material

Selection of good/certified seed material by the farmer is a pre-requisite for keeping the weed free condition.

Crop/variety selection

Some of the crops or varieties grow quickly and produce canopy early resulting in shading and thus suppress weed growth. Crop vary in their capacity of suppressing the weed growth. Maize has the highest weed suppressing ability (92%) compared to other crops. Semi-tall rice variety 'Kalinga-3' is superior to smoother weeds than dwarf cultivars.

Seeding rate

It is common practice in organic farming to exceed the recommended rates of seeding by up to 25% to allow for losses during cultivation. Higher seed rates, closer crop spacing and use of improved/recommended varieties that emerge quickly and that have a thick and full canopy can have more competitive architecture. Some crops such as forage crops are able to compete successfully with weeds. Traditional method of sowing for thick stand could combat with weeds.

Row spacing

Closer crop spacing increase planting density and provide less space to weeds for growth, in this way weeds are also managed in organic farming.

Delayed or early seeding

Crop should be either sown as early as possible to get a head start on weeds so that crop can maintain its growth or planted later so as to eliminate the germinated weeds prior to crop growth. Sowing of early or delay of crop also influenced weeds population and growth such as wild oat reduced in 10-15 days delayed sowing of main crop.

Water Management

Under upland conditions, frequent irrigation facilitates weed growth. Intermittent wetting and drying promote weed growth. However, continuous flooding suppresses the weed growth. Flooding is a common practice in rice cultivation for weed control. However, it is not efficiently used for controlling weeds in other crops.

Cropping systems

- The important principles in designing organic farming systems are to maximize diversity and soil coverage. A succession of different crops facilitates weed control. The following principles may be followed for effective weed control:-
- Rotation of competitive crops (e.g. forage grass or maize) and non-competitive crops (e.g. cotton or pulses)
- Use of weed suppressing crops as cover crops
- Use of catch crop or trap crop
- Many of semi-dwarf traditional wheat varieties are much competitive than dwarf wheat varieties.
- Black gram varieties T-9, M-2 were found tolerant to parasitic weeds Cuscuta spp.
- Intercropping of weed-smothering crops like cowpea was found effective in controlling weeds in many wide spaced crops.

Inter-cropping

Intercropping suppresses weeds better than sole cropping and thus provide an opportunity to utilize crops themselves as tools for weed management.

- Smother crops reduce weed intensity by shading. Short duration pulses ; green gram ; cowpea and soybean crops are used as a smother crop and manage weeds effectively
- Velvet bean & cow pea - good weed suppression crops can be grown in rotation during fallow period, off- season winter period and simultaneously during part or all of the life cycle of cash crop.

Crop Rotation

Parasitic weeds, as well as the crop associated weeds, can be discouraged by adopting well-conceived crop rotations. For example a grassy weed like *Phalaris minor* can be easily discouraged by replacing wheat with a forage crop in alternate years. Trap / catch crop - reduce parasitic weed seed quantity in the soil. The trap crops are induce germination of parasitic weeds but not get parasitized, whereas catch crops are induce germination of parasitic weeds but get parasitized. Important trap crops are sunflower, cowpea, groundnut and castor for Striga weed and linseed, sunhemp and sesamum for Orobanche.

Mulching

Thick mulches of straw or compost and dark coloured plastic mulch can smother perennial weeds and prevent the germination of annual weeds. These methods are expensive and therefore used only in relatively high return crops.

B. Mechanical weed management

Mechanical weed management practices are safe to environment and user. Mechanical weed practices like hoeing and hand weeding are the oldest agricultural operations and still forms a considerable part in weed management in farming community/agriculture. This method almost removes all type of weed species to the satisfactory level depending upon labour efficiency and type of implement used. Now a days different types of hand weeders, mechanical power operated weeders are available to control the noxious weed in crop land in spite of that some new mechanical weed control equipment like infra weeder, thermal control equipment are also used in developing countries

Infra - weeder - uses infrared heat

- Propane: Fuelled ceramic heating element develops temperature up to 1000^{0}C applies inferred radiation to weeds
- Due to infrared heat application close proximity is essential between heat elements and target species
- Use of this equipment is slower than herbicide application
- Second application is required for matured weeds

Thermal control equipment: Coagulation of proteins and bursting of protoplasm due to expansion

- Directed flaming
- Hot water
- Steam
- Microwave
- Ultraviolet radiation

Soil Solarization

Katan and coworkers, 1976 in Israel developed soil solarization techniques. Organic farmers can sterilize their soils through solarization during summers. In this process, a clear plastic film (100-125 gauges thick) is placed over an area after it has been tilled and tightly sealed with soil at the edges. Solarization works through the heat created under the plastic film, which becomes intense enough to kill weed seeds or kill the activated germination weed seeds.

In Indian conditions, May month recorded significantly lower weed density with thin Transparent Poly Ethylene (25 m) with soil solarization for 45 days. Not all weed species are susceptible to high soil temperatures. Winter and summer annuals susceptible, perennial weeds show differential response. Hard seeded annual weeds and perennials with buried vegetative organs are not easily controlled by solarization. Perennial grass weeds were killed by solarization. Field bindweed *(Convolvulus arvensis)* re-grow after treatment. Transparent plastic is more efficient than black in heating soil using solar radiation.

C. Biological Control of weeds

- Available in nature
- Fear of attacking crop plants

- Phytophagous insects - useful option for perennial ecosystem

Some promising examples

Eupatorium odorata - Leaf eating caterpillar

Parthenium - *Zygogramma bicolorata*

Factors in successful biological control

1. Host specificity: the host specific insects do not attack a desirable plant/crop. They are highly discriminatory in their choice of food.
2. Ability to kill the weed or prevent its reproduction/feeding habit.
3. High ability to disperse successfully and to locate its host plant.
4. Bio-agent hardiness: good adaptation to the weed host and the environmental conditions in which the weed is infesting
5. easy multiplication: reproductive capacity at a rate sufficient to maintain control of host

Bio-herbicides

Active ingredient is a living organism. Most commonly used microorganism is fungi (myco herbicide). Fungal pathogens are regard as to be the only group of microorganism with potential for the classical biological control of weeds. These organisms have been defined as Mycoherbicides. A good mycoherbicide should possess the characteristics of culturable in artificial media, capable of abundant spore production, stable in storage, genetically stable, effective under field conditions, tolerant to temperature variations and compatible with other chemicals/cultural practices.

Popular mycoherbicides used in organic farming

Mycoherbicides	Trade name	Country	Weed controlled
Collectotrichom gloeosphoroides	Collego/ Biomal	USA/ Canada	*Aeschynomene spp.*
Collectotrichom gloeosphoroides	LUBOA 2	China	*Cuscuta spp.*
Cercospora rodmanii	ABG 5003	USA	*Eichhornia spp.*
Phytophthora palmivora	Devine	USA	*Morrenia odorata*
Alternaria cassiae	CASET	USA	*Cassia obustifolia*
Fusarium lateritium	Velgo	-	*Abutilon theophrasti*
Xanthomonas campestris	Camperico	USA	-
Streptomyces spp.	Methoxyphenone	USA	-

Fungus	Parasitic weed	Host plant
Fusarium nygamai and *F. semitectum* 5-10 g/kg of soil	Striga	Sorghum, pearl millet, sugarcane, maize, ragi
Fusarium oxysporum	Orobanche	Tobacco, brinjal, tomato
Collectotrichom gloeosphoroides LUBOA 2 mycoherbicide	Cuscuta	Lucerne, blackgram, greengram, onion, chillies sugarcane and ornamental crops
Insects		
Gall formers: *Smicronyx* spp. Leaf feeder: *Junonia* spp.	Striga	Sorghum, pearl millet, sugarcane, maize, ragi
Fly: *Sipha maidis, Aphis tabae,*	Orobanche	Tobacco, brinjal, tomato
--	Cuscuta	Lucerne, chillies, sugarcane

Use of phytotoxins as herbicides

Several plant secondary metabolites (allelo-chemicals) as well as fungal and microbial toxins possess good herbicidal activity. Some of the naturally occurring compounds that exhibit promising herbicidal activity are given below:

Natural Phytotoxins	Source
• **Microbial source**	
Bialophos	*Streptomyces hygroscopicus*
Herbicidins	*Streptomyces saganonensis*
Anisomycin	*Streptomyces sp.*
Cercosporin	*Cercospora sp.*
• **Plant source**	
Caffeine	Coffee plant
Dhurrin	Sorghum plant
Alldown	Citiric acid + garlic + acetic acid
Matran II	Clove oil
Xpress	Thyme and clove oil

EXERCISE 10 - PEST AND DISEASE MANAGEMENT IN ORGANIC FARMING

Introduction

Pesticides of course have played a commendable role in increasing our food production and protecting us against disease vectors. However, sole reliance on pesticides has created several problems in the environment. Adverse effects of pesticides prompted scientists to look for environment friendly methods of pest control. In organic farming, different methods of pest control such as resistant varieties, cultural methods, physical methods, natural enemies and pesticides are integrated to suppress pest population without jeopardizing other components of the environment.

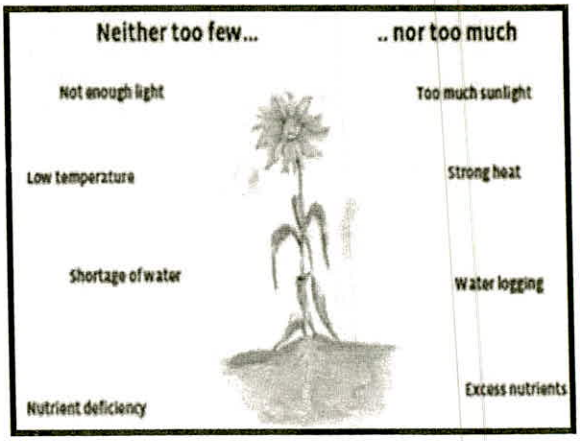
Harmful effects of indiscriminate pesticide use

- Harmful effects on non-target organisms
- Development of pest resistance against pesticides
- Pest outbreaks and resurgences
- Toxic residues in food
- Contamination of soil, water and air
- Health hazards

Objectives

To study and demonstration of different ecofriendly options to manage pest and diseases of crops in organic farming.

Principle



Pest and disease management consists of a range of activities that support each other. Most management practices are long-term activities that aim at preventing pests and diseases from affecting a crop. The general approach in organic agriculture to deal with the causes of a problem rather than treating the symptoms also applies for pest and diseases. Therefore, management is of a much higher priority than control. A healthy plant is less vulnerable to pest and disease infestation. Therefore, a major aim for the organic farmer is to create conditions which keep a plant healthy. This exercise describes preventive practices, as well as control practices using biological, mechanical control and natural pesticides. The interaction between living organisms and their environment is crucial for a plant's health.

Methods

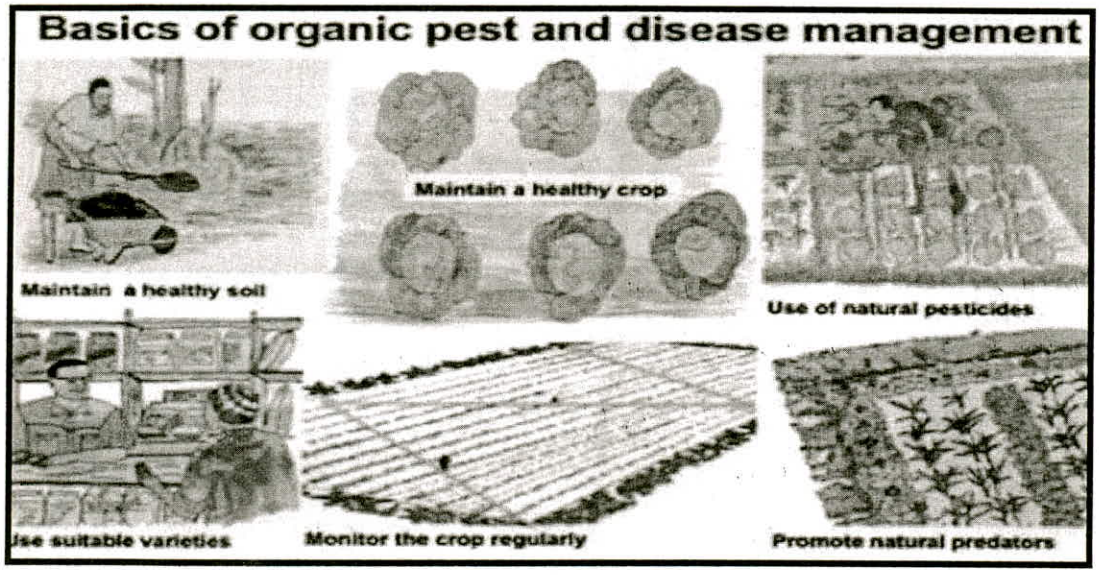
- Prevention practices and monitoring
- Curative practices

ORGANIC FARMING

I. Prevention practices and monitoring

Knowledge about plant health and pest and disease ecology helps the farmer to choose effective preventive crop protection measures. This can be accomplished through the right timing of management practices, a suitable combination of different methods, or the choice of a selective method. Some important preventive crop protection measures are the following ones:

- Cultural Methods
- Monitoring
- Inducing plant Resistance



Cultural Methods

Selection of adapted and resistant varieties

Choose varieties which are well adapted to the local environmental conditions, as it allows them to grow healthy and makes them stronger against infections of pests and diseases.

Selection of clean seed and planting material

Use safe and clean seeds which have been inspected for pathogens and weeds at all stages of production. Use planting material from safe and recognized sources.

Use of suitable cropping systems

Mixed cropping systems: can limit pest and disease pressure as the pest has less host plants to feed on and more beneficial insect life in a diverse system. Crop rotation: reduces the chances of soil borne diseases and increases soil fertility.

Use of balanced nutrient management

Moderate fertilization: steady growth makes a plant less vulnerable to infection. Too much fertilization may result in salt damage to roots, opening the way for secondary infections. Balanced potassium supply contributes to the prevention of fungi and bacterial infections

Use of good water management

No water logging: causes stress to the plant, which encourages pathogens infections. Avoid water on the foliage, as water borne disease spread with droplets and fungal disease germinate in water.

Conservation and promotion of natural enemies

Provide an ideal habitat for natural enemies to grow and reproduce. Avoid using products which harm natural enemies.

Selection of optimum planting time and spacing

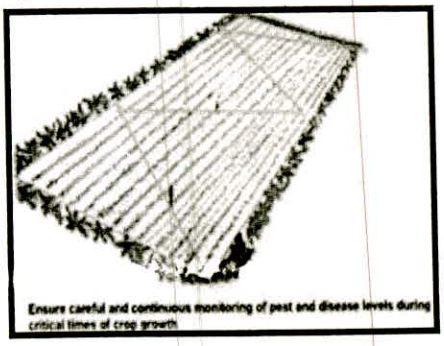
Most pests or diseases attack the plant only in a certain life stage; therefore it's crucial that this vulnerable life stage doesn't correspond with the period of high pest density and thus that the optimal planting time is chosen. Sufficient distance between the plants reduces the spread of a disease. Good aeration of the plants allows leaves to dry off faster, which hinders pathogen development and infection.

Use of proper sanitation measures:

Remove infected plant parts (leaves, fruits) from the ground to prevent the disease from spreading. Eliminate residues of infected plants after harvesting.

B. Monitoring

Regular monitoring of pests, diseases and weeds is the basis for effective management. The most common pattern in pest and disease scouting programs involves walking along a predetermined zigzag or M-shaped route through a field. This pattern is commonly used because it is easy to teach, convenient to use, and ensures that all regions of the field are visited.



Ensure careful and continuous monitoring of pest and disease levels during critical times of crop growth

C. Inducing plant resistance

Organic management and control of diseases is based strongly on strengthening the plant with the aim of enhancing its self-defense and thereby preventing the outbreak of the disease. One typical expression of induced resistance is the thickening of cell walls of the plant, which interferes with pathogen entering the cell. Another is the dying of the infested cell walls, which causes the pathogen to die also, and thus reduce its spread.

There are several resistance-inducing substances that can be prepared by the farmers themselves. Some are plant extracts made from efeu (*Hedera helix*), rhubarb (*Rheum rhabarbarum*), or giant knotweed (*Reynoutria sachalinensis*).

Compost teas and herbal teas are tools that can be made on the farm to enhance crop health and fertility, and to inoculate the leaves and roots with soluble nutrients, beneficial microorganisms, and beneficial metabolites (products that aid in the growth and development of plants).

Compost extract is a fertilizer, but it also can induce plant resistance. For its preparation, mature compost is mixed with water at a ratio of 1:5 to 1:8 (vol/vol: one liter of compost for every 5 to 8 liter of water) and well stirred before it is left to ferment for 3-7 days. One spoonful of molasses can be added per liter of liquid, because this enhance the development of the microorganisms. The fermentation site should be shaded and safe from the rain. After the fermentation period and before the application, the extract is well stirred, then filtered and diluted at a ratio of 1:5 to 1:10.

Plant extracts can be obtained from stinging nettle, horsetail, comfrey, clover, seaweed and others, alone or mixed with marine by-products such as fish waste or fishmeal. Dilution of 1:10 or 1:5 are used as foliar spray or soil drench.

As a general rule it is recommended to apply compost extracts or teas every 7 to 10 days to prevent diseases from developing and as a way to enhance soil microorganisms.

Beejamrutha

It is used for seed treatment and enhance the resistivity of crop seeds to pathogens.

Composition: Water 20 liters, Desi cow dung 5 kg, Desi cow urine 5 liters , One handful of soil from the surface of field and lime 50 grams

Preparation of Bijamrita

- ★ Take 5 Kg Local Cow Dung in a cloth and bind it by tape. Dip this in the 20 Liter water up to 12 hours.
- ★ Take one liter water and add 50 gram lime in it, let it stabilize for a night
- ★ Then next morning, squeeze this bundle of the cow dung in that water thrice continuously, so that all essence of cow dung will accumulate in that water.
- ★ Then add a handful of soil in that water solution and stir it well.
- ★ Then add 5 liter local cow urine or human urine in that solution and add the lime water and stir it well.

II. Curative methods

- ★ Mechanical Methods
- ★ Biological control
- ★ Natural Pesticides

A. Mechanical Control

Mass- trapping of pests is an additional control measure. They often can easily be built with cheap material. Some examples include:

Light traps can be used to catch moths such as armyworms, cutworms, stem borers and other night flying insects. Light traps are more efficient when placed soon after the adult moths start to emerge but before they start laying eggs.

Colour and water traps can be used to monitor adult thrips. In some cases thrips can even be reduced by mass trapping with coloured (blue, yellow or white) sticky traps or water traps in the nursery or field. The colour spectrum of the boards is important for the efficacy of the sticky traps. Bright colours attract more thrips than darker ones.

Water traps should be at least 6 cm deep with a surface area of 250 to 500 cm2, and preferably round, with the water level about 2 cm below the rim. A few drops of detergent added to the water ensure that thrips sink and do not drift to the edges and escape. Replace or add water regularly.

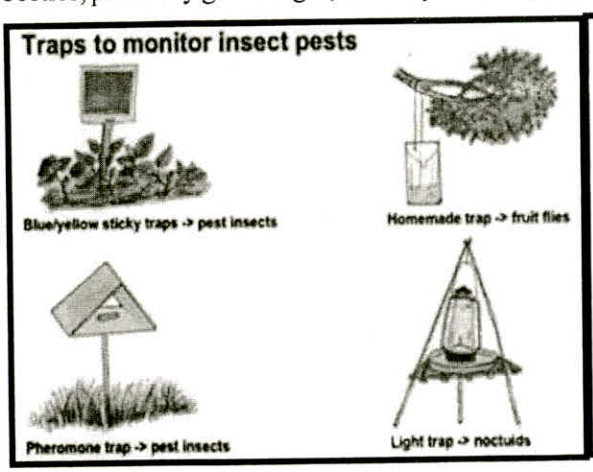
Yellow sticky traps can be used to control whiteflies, aphids and leaf mining flies. Yellow plastic gallon containers mounted upside down on sticks coated with transparent car grease or used motor oil, is one such trap. These should be placed in and around the field at about 10 cm above the foliage. Clean and re-oil when traps are covered with flies. To use, place 2 to 5 yellow sticky cards per 500 m^2 field area. Replace traps at least once a week. To make your own sticky trap, spread petroleum jelly or used motor oil on yellow painted plywood (size 30 cm x 30 cm). Place traps near the plants but faraway enough to prevent the leaves from

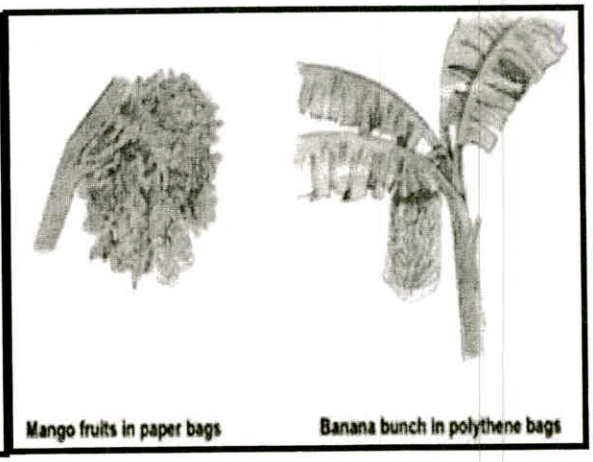
sticking to the board.

Ø **Fruit bagging** prevents fruit flies from laying eggs on the fruits. In addition, the bag provides physical protection from mechanical injuries (scars and scratches). Although laborious, it is cheap, safe and gives a more reliable estimate of the projected harvest. Bagging works well with melon, bitter gourd, mango, guava, star fruit, avocadoes and banana (plastic bags used).

B. Biological control

Biological control is the use of natural enemies to manage populations of pests (such as ladybird beetles, predatory gall midges, hoverfly larvae against aphids and psyllids) and diseases.

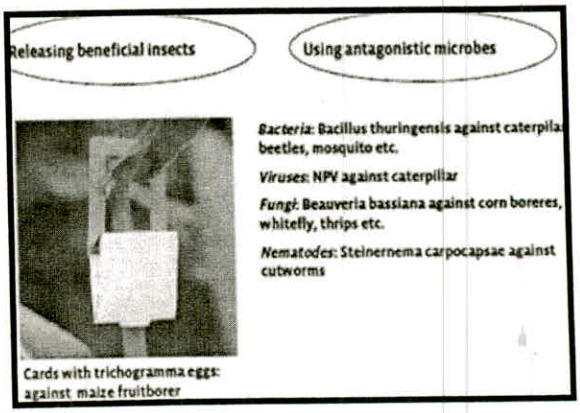




Releasing natural enemies

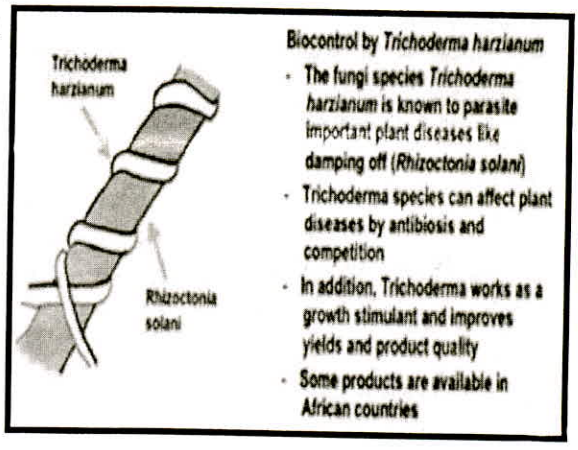
Natural enemies that kill or suppress pests or diseases are often fungi or bacteria. They are called antagonists or referred to as microbial insecticides or bio-pesticides. Some commonly used antagonistic microbes are:

Bacteria such as *Bacillusi thuringiensis* (Bt). Bt has been available as a commercial microbial insecticide since the 1960s. Different types of Bt are available for the control of caterpillars and beetles in vegetables and other agricultural crops, and for mosquito and black fly control. The best-known biocontrol agent used in field crops is the bacteria *Bacillus thuringiensis* var. *kurstaki* and *Bacillus thuringiensis.* var. *aizawai* against diverse lepidopteran pests, and the Bacillus *thuringiensis* var *israeliensis* against mosquitoes. *Bacillus thuringiensis* var *kurstaki* can be used against different pests (African armyworm, African bollworm, bean armyworm, beet armyworm, cabbage webworm, cabbage moth, cabbage looper, cotton leafworm, diamondback moth, giant looper, green looper, spiny bollworm, spotted bollworm, pod borers, tomato looper).



Viruses such as NPV (nuclearpolyhedrosis virus), effective for control of several cater-pillar pest species. Every insect species, however, requires a specific NPV-species. An example: The armyworm *Spodoptera exigua* is a major problem in shallot production in Indonesia. Since experiments showed that SeNPV (NPV specific for S. exigua) provided better control than insecticides, farmers have adopted this control method.

Fungi that kill insects, such as *Beauveria bassiana*. Different strains of this fungus are commercially available. For example: strain Bb 147 is used for control of corn borers (*Ostrinia nubilalis* and O. *furnacaiis*) in maize, strain GHA is used against whitefly, thrips, aphids and mealybugs in vegetables and ornamentals. Several species of fungi can occur naturally in ecosystems. For example, aphids can be killed by a green or white coloured fungus during humid weather.



Fungi that work against plant-pathogens. Some examples include: *Trichoderma* spp., widely used in Asia for prevention of soil-borne diseases such as damping-off and root rots in vegetables. Some *Trichogramma* species against the African bollworm are bred in some laboratories in Africa against lepidopteran pests and aphids. A successful introduction of the neo tropical parasitoid Apoanagyrus lopezi against the cassava mealy bug (*Phenacoccus manihoti*) caused a satisfactory reduction of P. manihoti in most farmers' fields in Africa.

>>> Entomopathogenic nematodes against different weevil species (e.g. *Steinernema carpocapsae, Heterorhabditis bacteriophora*) and to control soil insects like cutworms (*Agrotis* spp.) in vegetables.

C. Natural pesticides

Some plants contain components that are toxic to insects. When extracted from the plants and applied on infested crops, these components are called botanical pesticides or botanicals. The use of plant extracts to control pests is not new. Most botanical pesticides are contact, respiratory, or stomach poisons. Therefore, they are not very selective, but target a broad range of insects. Furthermore, botanical pesticides are generally highly bio-degradable, so that they become inactive within hours or a few days. This reduces again the negative impact on beneficial organisms and they are relatively environmentally safe compared to chemical pesticides. It's a common practice under many traditional agricultural systems. Some commonly used botanicals are:

Neem

Neem derived from the neem tree (*Azadiracta indica*) of arid tropical regions, contains several insecticidal compounds. The main active ingredient is azadiractin, which both deters and kills many species of caterpillars, thrips and whitefly. Both seeds and leaves can be used to prepare the neem solution. Neem seeds contain a higher amount of neem oil, but leaves are available all year. A neem solution looses its effectiveness within about 8 hours after preparation, and when exposed to direct sunlight. It is most effective to apply neem in the evening, directly after preparation.

Neem has a very good repelling effect on diamondback moth (*Plutella xylostella*). Weight 30 g neem

kernels (that is the seed of which the seed coat has been removed) and mix it in 1 litre of water and leave that overnight. The next morning, filter the solution through a fine cloth and use it immediately for spraying. It should not be further diluted.

Neem cake (ground neem seed or neem kernel powder) has also a considerable potential as a fertilizer and at the same time it will hinder nematode attacks of the crop roots (e.g. tomato). Put neem cake in the planting pit (200g per m^2) and mix it with substrate. The neem cake will repel and even kill nematodes and other root pests. Insecticidal agents (azadirachtin) will be translocate to above-ground parts of the plant and help to get rid of pests there.

Neem seed kernel extract (NSKE)

It is prepared by soakeing 5 kg of powdered neem seed kernel (in a muslin cloth bag) in 100 lit, of water for 8 hrs. Then the muslin cloth bag is removed after through shaking. The extrect should be mixed with 100 ml teepol (adhesive). 500 littre. of the extract is required for 1 ha.

Neem oil solution:

It is prepared by mixing 3 litre. of neem oil to 100 litre. of water with 100 ml of teepol. The milky solution formed os used for spray.

Neem cake

Powdered neem cake is directly applied to the field at the time of last ploughing. The quantity applied is 150 kg/ha.

Neem cake extract:

Ten kg of powdered neem cake is taken in a muslin cloth bag and soaked in 100 lit. of water for 8 hrs. Then the bag is removed after through shaking. The extract is mixed with 100 ml of teepol. For spraying 1.0 ha 500 lit of extract is required.

Pyrethrum

Pyrethrum is a daisy-like Chrysanthemum. Pyrethrins are insecticidal chemicals extracted from the dried pyrethrum flower. The flower heads are processed into a powder to make a dust. This dust can be used directly or infused into water to make a spray. Pyrethrins cause immediate paralysis to most insects. Low doses do not kill but have a 'knock down' effect but stronger doses kill. Pyrethrins break down very quickly in sunlight so they should be stored in darkness. Both highly alkaline and highly acid conditions speed up degradation so pyrethrins should not be mixed with lime or soap solutions. To make liquid pyrethrum extract (mix 20g pyrethrum powder with 10 l water), For best effects this should be applied in the evening.

Karayat (*Andrographis paniculata*) 3 to 5 % or baryar (*Sida spinosa*) 5 %

For preparation of these extracts, one of the above mentioned plants is taken and cut into small pieces excluding roots. One kg of this is mixed with four litres of water and placed in a mud pot. This is boiled and reduced to one litre. On cooling, 500 ml of this extract is mixed with 100 ml of soap solution and 9.4 litres of water and sprayed on the top.

Chilli/pepper

Chillies and capsicum pepper have both repellent and insecticidal effects. To make the chilli extract grind 200 grams of chillies into a fine dust, boil it in 4 litres water, add another 4 litres of water and a few drops of liquid soap. This mixture can be sprayed against aphids, ants, small caterpillars and snails.

Garlic

Garlic has anti-feedant (insect stop feeding), insecticidal, nematicidal and repellent properties. Garlic is reportedly effective against a wide range of insects at different stages in their life cycle (egg, larvae, adult). This includes ants, aphids, armyworms, diamondback moth, whitefly, wireworm and termites. Garlic is non-selective, has a broad-spectrum effect and can kill beneficial insects as well. Therefore, it should be used with caution. To make the garlic extract, grind or chop 100 grams garlic into 0.5 litre water. Allow mixture to stand for 24 hours, add 0.5 litre of water and stir in liquid soap. Dilute at 1:20 with water and spray in the evening. To improve efficacy, chilli extract can be added.

There are many other extracts of plants known to have insecticidal effects like tobacco (*Nicotiana tabacum*), yellow root (*Xanthorhiza simplicissima*), fish bean (*Tephrosia vogelii*), violet tree (*Securidaca longepedunculata*), and nasturtium (Nasturtium trapaeolum) which are traditionally used to control pests. Chillies, chives, garlic, coriander, nasturtium, spearmint and marigold are plants known to have a repellent effect on different pest insects (aphids, moths, root flies, etc.) and can be grown as intercrop or at the border of crop fields. Marigold is especially known to deter root nematodes, while neem cake is known to deter mice.

Agniastra (Agni Missile)

Agniastra foliar spray used to control pest like leaf roller, stem borer, fruit borer, pod borer.

Preparation of Agniastra (Agni Missile)

* Take a pot.
* Add 10 liter Local Cow Urine in it.
* Then add 1 Kg Tobacco by crushing it in the Urine.
* Crush 500 gram of Green Chili & add it in Urine.
* Crush 500 Gram Local Garlic & add it in the Urine.
* Add 5 Kg Neem leaves pulp.
* Then boil this solution well 5 hours continuously.
* Let this solution to ferment for 24 Hrs.
* Filter this by cloth.
* Spray (2 ltrs in 100 ltrs of water)

Neemastra (Neem Missile)

Spray Neemastra as it is on the plants for controlling sucking pests & Mealy Bug.

Preparation of Neemastra (Neem Missile)

* Take 100 liter Water.
* Add 5 liter Local Cow Urine in it.
* Add 5 Kg Local Cow Dung in it.
* Crush 5 Kg of Neem Leaves & add this Neem pulp in this water.
* Let this solution to ferment for 24 Hrs.
* Stir this solution twice a day by any stick.
* Filter this by cloth.

Bramhastra (Bramha Missile)

Spray Bramhastra on the trees to control all the sucking pests, pod borer, fruit borer etc.

Preparation of Bramhastra (Bramha Missile)

* Take a pot.
* Add 10 liter Local Cow Urine in it.
* Crush 3 Kg of Neem Leaves & add this Neem pulp in this water.
* Then Add 2 Kg pulps of Sitafal (Custard apple) leaves, 2 Kg pulps of Papaya leaves, 2 Kg Pomegranate leaves pulp, 2 Kg of Guava (Jam, Peru) leaves pulps, 2 Kg Lantena Camera leaves pulp & 2 Kg White Datura leaves pulp in it. (Use Lantana Camera and Datura leaves if available)
* Then boil this solution for 5 hours. Filter this by cloth.
* Let this solution to ferment for 24 Hrs.
* For spraying take this medicine Bramhastra 2 liter in the 100 liter water.

Besides extractions of plants, there are some other natural pesticides, which are allowed in organic farming. Some examples are:

* Soft soap solutions; against aphids and other sucking insects,
* Light mineral oil; against various insect pests (harms natural enemies!),
* Sulphur; against spider mites (harms natural enemies!). The acaricidal effect of sulphur is best at temperatures above 12° C. However, sulphur has the potential to cause plant injury in dry hot weather (above 32° C).
* Plant ashes; Wood ashes from fire places can be efficient against ants, leaf miners, stem borers, termites and potato moths. Ash should be dusted directly on pest colonies and infested plant parts. The ash will dehydrate the soft bodied pests. Wood ashes are often used when storing grains to deter storage pests such as weevils.

Practices used for disease control:

Sulphur is mostly used against plant diseases like powdery mildew, downy mildew and other diseases. The key to its efficacy is that it prevents spore germination. For this reason, it must be applied prior to disease development for effective results. Sulphur can be applied as a dust or in liquid form. It is not compatible with other pesticides. Lime-sulphur is formed when lime is added to sulphur to help it penetrate plant tissue.

Bordeaux mixture (Copper sulphate and lime) has been successfully used for over 150 years, on fruits, vegetables and ornamentals. Unlike sulphur, Bordeaux mixture is both fungicidal and bactericidal. As such, it can be effectively used against diseases such as leaf spots caused by bacteria or fungi, powdery mildew, downy mildew and various anthracnose pathogens. Mix 90 grams of blue copper sulphate with 4.5 litres of water (in a non-metallic container). In another non-metallic container, mix 125 grams of slaked lime with of water. Stir both, mix both solutions, and stir again. This formulation was developed in recognition of the fact that copper, like sulphur, is phytotoxic and that the level of toxicity is related to the age of plant tissue being treated. Do not apply Bordeaux mixture to corn or sorghum, which are described as copper-sensitive plants.

Acidic clays have a fungicidal effect due to aluminium oxide or aluminium sulphate as active agents.

They are used as an alternative to copper products but, are often less efficient.

Milk has also been used against blights, mildew, mosaic viruses and other fungal and viral diseases. Spraying every 10 days with a mixture of 1 litre of milk to 10 to 15 litres of water is effective.

Baking soda has been used to control mildew and rust diseases on plants. Spray with a mixture of 100 grams of baking or washing soda with 50 grams of soft soap. Dilute with 2 litres of water.

Many plant extracts are known to have fungicidal effects. Onion and garlic are effective against many diseases such as mildew and fungal and bacterial diseases. Mexican and African marigold act as a crop strengthener to help potatoes, beans, tomatoes and peas resist fungal diseases such as mildew. The leaves of papaya (Carica papaya) and sweet basil have a general fungicidal effect. Many other plant species are known to have fungicidal effects.

Control of stored grain insects

* Mixing the dried leaves of neem with seeds while storing them.
* Mixing the dried leaves of Nirgundi (*Vitex negundo*) with seeds while storing them.
* Storing the seeds after mixing with Karanja (*Pongamia pinnata*) leaves.
* Mixing 1 kg. of bach (*Acorus calamus*) powder with 50kg. of grains for storage even for one year.
* While storing the seeds of food crops, they are filled in a container to its 3/4" height, covered with a rough cloth on which leaves of neem, Karanja and Nirgundi i are placed to the remaining volume and finally covered with sand up to its mouth.
* Grains are filled in earthen pot to its 3/4" height and the remaining volume with dried cow dung. Then the cow dung is set on fire and mouth of the pot is tightly covered so that fire puts off and carbon monoxide formed inside kills the pests.
* Pulses and food grains are stored in gunny bags, which are previously wet with 10% salt solution and dried, in order to avoid storage pest attack.
* Generally seeds stored with their outer coat/shell escape from storage pests.
* Drying seeds and grains of all the crops on the new moon day before storing to avoid pest attack.

EXERCISE 11 - ORGANIC CERTIFICATION PROCEDURE

Introduction

It is a certification process for producers of organic food and other organic agricultural products. In general, any business directly involved in food production can be certified, including seed suppliers, farmers, food processors, retailers and restaurants. Requirements vary from country to country, and generally involve a set of production standards for growing, storage, processing, packaging and shipping that include:

- Avoidance of synthetic chemical inputs (e.g. fertilizer, pesticides, antibiotics, food additives, etc.) and genetically modified organisms;
- Use of farmland that has been free from chemicals for a number of years (often, three or more);
- Keeping detailed written production and sales records (audit trail);
- Maintaining strict physical separation of organic products from non-certified products; under-going periodic on-site inspections.
- In some countries, certification is overseen by the government, and commercial use of the term organic is legally restricted. Certified organic producers are also subject to the same agricultural, food safety and other government regulations that apply to non-certified producers.

Objectives of certification

Organic certification addresses a growing worldwide demand for organic food. It is intended to assure quality and prevent fraud. For organic producers, certification identifies suppliers of products approved for use in certified operations. For consumers, "certified organic" serves as a product assurance, similar to "low fat", "100% whole wheat", or "no artificial preservatives". Certification is essentially aimed at regulating and facilitating the sale of organic products to consumers. Individual certification bodies have their own service marks, which can act as branding to consumers-a certifier may promote the high consumer recognition value of its logo as a marketing advantage to producers. Most certification bodies operate organic standards that meet the National government's minimum requirements.

The certification process

In order to certify a farm, the farmer is typically required to engage in a number of new activities, in addition to normal farming operations:

- Study the organic standards, which cover in specific detail what is and is not allowed for every aspect of farming, including storage, transport and sale.
- **Compliance** - farm facilities and production methods must comply with the standards, which may involve modifying facilities, sourcing and changing suppliers, etc.
- **Documentation** - extensive paperwork is required, detailing farm history and current set-up, and usually including results of soil and water tests.
- **Planning** - a written annual production plan must be submitted, detailing everything from seed to sale: seed sources, field and crop locations, fertilization and pest control activities, harvest methods, storage locations, etc.

- **Inspection -** annual on-farm inspections are required, with a physical tour, examination of records, and an oral interview.
- **Fee -** A fee is to be paid by the grower to the certification body for annual surveillance and for facilitating a mark which is acceptable in the market as symbol of quality.
- **Record-**keeping - written, day-to-day farming and marketing records, covering all activities, must be available for inspection at any time. In addition, short-notice or surprise inspections can be made, and specific tests (e.g. soil, water, plant tissue) may be requested. For first-time farm certification, the soil must meet basic requirements of being free from use of prohibited substances (synthetic chemicals, etc.) for a numbers of years. A conventional farm must adhere to organic standards for this period, often, three years. This is known as being in transition. Transitional crops are not considered fully organic. A farm already growing without chemicals may be certified without this delay. Certification for operations other than farms is similar. The focus is on ingredients and other inputs, and processing and handling conditions. A transport company would be required to detail the use and maintenance of its vehicles, storage facilities, containers, and so forth. A restaurant would have its premises inspected and its suppliers verified as certified organic.

Certification and Product Labelling

Being able to put the word "organic" on a food product is a valuable marketing advantage in today's consumer market. Certification is intended to protect consumers from misuse of the term, and make buying organics easy. However, the organic labelling made possible by certification itself usually requires explanation. In many countries organic legislation defines three levels of organics. Products made entirely with certified organic ingredients and methods can be labelled "100% organic". Products with 95% organic ingredients can use the word "organic". Both may also display organic seal. A third category, containing a minimum of 70% organic ingredients, can be labelled "made with organic ingredients". In addition, products may also display the logo of the certification body that approved them. Products made with less than 70% organic ingredients cannot advertise this information to consumers and can only mention this fact in the product's ingredient statement.

Certification around the world

In some countries, organic standards are formulated and overseen by the government. The United States, the European Union and Japan have comprehensive organic legislation, and the term "organic" may be used only by certified producers. In countries without organic laws, government guidelines may or may not exist, while certification is handled by non-profit organizations and private companies.

- EU countries acquired comprehensive organic legislation with the implementation of the EU-Eco-regulation 1992.
- In the United Kingdom, organic certification is handled by a number of organizations, All the certifying bodies are subject to the regulations of the UK Register of Organic Food Standards (UKROFS), which itself is bound by EU legislation.
- US Department of Agriculture (USDA).
- In Canada, the government has published a national organic standard, but it is a guideline only; legislation is in process. Certification is provided by private sector organizations. In Quebec,

provincial legislation provides government oversight of organic certification within the province, through the Quebec Accreditation Board.

- In Japan, the Japanese Agricultural Standard (JAS) was fully implemented as law in April, 2001.
- In Australia, the Australian Quarantine and Inspection Service (AQIS) is the controlling body for organic certification. The largest certifier of organic products is Australian Certified Organic.
- In China, the China Green Food Development Center
- In India, Agricultural Processed Foods Export Development Authority (APEDA) under Ministry of Commerce is the controlling body for organic certification for export. Till date there are no domestic standards for organic produce within India. Currently 11 certification agencies have been authorized to undertake certification process under National Programme for Organic Production (NPOP).
- There are also international certification bodies, including members of the International Federation of Organic Agriculture Movements (IFOAM), the Organic Crop Improvement Association (OCIA), and Ecocert. Where formal agreements do not exist between countries, organic product for export is often certified by agencies from the importing countries, who may establish permanent foreign offices for this purpose. In 2006, India's organic certification process under NPOP has been granted equivalence with European Union. It has also been recognized for conformity assessment by USDA's NOP.

Organic logos of some of the countries are given below:

Certification system in India

In India, there are two accreditation systems for authorizing certification and inspection agencies for organic certification. National Programme on organic production (NPOP) promoted by Ministry of Commerce is core agency which governs and defines the standards and implementing procedures. National Accreditation Body (NAB) is the apex decision making body. Certification and inspection agencies accredited by NAB are authorized to undertake certification process. The NPOP notified under FTDR act and controlled by Agricultural Processed Foods Export Development Authority (APEDA) looks after the requirement of export while NPOP notified under APGMC act and controlled by Agriculture Marketing Advisor, Directorate of Marketing and Inspection looks after domestic certification. Currently 20 certification agencies have been authorized to undertake certification process Details of the system are available at www.apeda.com/npop. In 2006, India's organic certification process under NPOP has been granted equivalence with Europien Union and Switzerland. It has also been recognized for conformity assessment by USDA's NOP.

Certification Procedure in brief

- Application to the certification agency in the prescribed format with necessary details of farm and process.
- Screening of application by certification agency and if necessary further details/clarification required by agency
- Cost estimate including certification charge, inspection charge, reporting cost, laboratory charges etc and acceptance of cost by the farmer/producer
- Signing of agreement between farmer/producer and certification agency
- Certification agency asks for cropping/production/cultivation/ processing plan and provide copy of the standards to the farmer/producer to follow
- Inspection is carried out at one or more than one time
- If required surprise inspection can also be done. In case of doubt the inspection team can also draw plant/soil/raw material/ input/product sample for laboratory analysis.
- Inspection report/(s) submitted to the certification committee
- Certification agency asks for final payment
- Certification is granted after final payment is made
- Grower/producer can sale his produce with Certification Mark (India Organic Logo)

National Standards for Organic Production (NSOP)

National Standards for Organic Production are grouped under following six categories:

1) Conversion
2) Crop production
3) Animal husbandry
4) Food processing and handling
5) Labeling
6) Storage and transport

Standard requirements for crop production, food processing and handling are listed below:

1. Conversion Requirements

The time between the start of organic management and cultivation of crops or animal husbandry is known as the conversion period. All standard requirements should be met during conversion period. Full conversion period is not required where organic farming practices are already in use.

2. Crop Production

2.1 Choice of crops and varieties - All seeds and planting materials should be certified organic. If certified organic seed or planting material is not available then chemically untreated conventional material can be used. Use of genetically engineered seeds, pollen, transgenic plants are not allowed.

2.2 Duration of conversion period - The minimum conversion period for plant products, produced annually is 12 months prior to the start of the production cycle. For perennial plants (excluding pastures and meadows) the conversion period is 18 months from the date of starting organic management. Depending upon the past use of the land and ecological situations, the certification agency can extend or reduce the minimum conversion period.

2.3 Fertilization policy - Biodegradable material of plant or animal origin produced on organic farms should form the basis of the fertilization policy. Fertilization management should minimize nutrient losses, avoid accumulation of heavy metals and maintain the soil pH. Emphasis should be given to generate and use own onfarm organic fertilizers. Brought in fertilizers of biological origin should be supplementary and not a replacement. Over manuring should be avoided. Manures containing human excreta should not be used on vegetation for human consumption.

2.4 Pest disease and weed management including growth regulators - Weeds, pests and diseases should be controlled preferably by preventive cultural techniques. Botanical pesticides prepared at farm from local plants, animals and microorganisms are allowed. Use of synthetic chemicals such as fungicides, insecticides, herbicides, synthetic growth regulators and dyes are prohibited. Use of genetically engineered organisms or products is prohibited.

2.5 Soil and Water conservation - Soil and water resources should be handled in a sustainable manner to avoid erosion, salination, excessive and improper use of water and the pollution of surface and ground water. Cleaning of land by burning (e.g. slash and burn and straw burning) should be restricted. Clearing of primary forest for agriculture (jhuming or shifting cultivation) is strictly prohibited.

3. Collection of non-cultivated material of plant origin and honey

Wild harvested products shall only be certified organic, if derived from a stable and sustainable growth environment and the harvesting shall not exceed the sustainable yield of the ecosystem and should not threaten the existence of plant or animal species. The collection area should not be exposed to prohibited substances and should be at an appropriate distance from conventional farming, human habitation, and places of pollution and contamination.

4. Food processing and handling

Organic products shall be protected from co-mingling with nonorganic products, and shall be adequately identified through the whole process. Certification programme shall regulate the means and measures to be allowed or recommended for decontamination, clearing or disinfection of all facilities where organic

products are kept, handled, processed or stored. Besides storage at ambient temperature the following special conditions of storage are permitted. Controlled atmosphere, cooling, freezing, drying and humidity regulation.

Pest and disease control - For pest management and control following measures shall be used in order of priority Preventive methods such as disruption, and elimination of habitat and access to

facilities. Other methods of pest control are: Mechanical, physical and biological methods. Permitted pesticidal substances as per the standards and other substances used in traps. Irradiation is prohibited. Direct or indirect contact between organic products and prohibited substances (such as pesticides) should not be there.

5. Packaging

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 shall not contaminate the food.

6. Labelling

When the full standard requirements are met, the product can be sold as "Organic". On proper certification by certification agency "India Organic" logo can also be used on the product.

7. Storage and transport

Products integrity should be maintained during storage and transportation of organic products. Organic products must be protected from co-mingling with non-organic products and must be protected all times from contact with the materials and substances not permitted for use in organic farming.

Certification system in Chhattisgarh:

In Chhattisgarh, the CGCERT is the controlling body for organic certification.

i. Applicant shall first contact directly through e-mail/postal letter to CGCERT and request for application form for the required scope of certification.

ii. CGCERT shall send / provide the requested application form to the applicant within fifteen days of the receipt of request. The application form consists of application for scope of certification, annual plan format and last three years history format.

iii. The applicant will have to submit his/ her application form within three month of the issue of the application. CGCERT shall acknowledge the receipt of the application form. During screening, if it is found that the application is incomplete, the applicant shall be requested to provide necessary and missing documents for registration.

iv. After receipt of the application, the administrative department of CGCERT shall screen and check the completeness of the application.

v. If the application is found appropriate, then CGCERT shall assign a registration number to the operator in a prescribed format & a fee estimate and a contract form between CGCERT & the Operator shall be sent to the operator.

vi. Applicant will have to deposit 75% of the certification fees either in cash or by Demand Draft in favour of CEO CGCERT, Raipur within 30 days of the date of registration. The balance 25% of fees shall be paid by the operator within fifteen days of the last date of announced inspection. The operator shall

send the signed contract to CGCERT in which they agree to comply with the NPOP standards, allow inspection and provide updated information to CGCERT back along with the 75% of the fees.

Some Accredited Inspection and Certification Agencies in India

Indian Organic Certification Agency (INDOCERT) Mr. Mathew Sebastian
Executive Director Thottumugham P.O.
Aluva-683 105 Cochin, (Kerala)
Telefex:0484-2630908-09/2620943
Email: MethewSebastian@indocert.org

Uttranchal State Organic Certification Agency (USOCA)
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EXERCISE 12- QUALITY ANALYSIS OF MANURES, COMPOSTS AND BIOFERTILIZERS

Introduction

The collection of features and characteristics of a product that contribute to its ability to meet given requirements is known as quality. In other words every application should have all the requirements justified and apart from this it must be user-friendly to the customer/end user, so as to produce absolute customer satisfaction. Hence the value is also an integral part of the quality. Today the goals of quality control are largely driven by consumer concerns and preferences.

There are three views for describing the overall quality of a product. First is the view of the manufacturer, who is primarily concerned with the design, engineering, and manufacturing processes involved in fabricating the product. Quality is measured by the degree of conformation to predetermined specifications and standards, and deviations from these standards can lead to poor quality and low reliability. Second is the view of the consumer or user. To consumers, a high-quality product is that which will satisfy their preferences and expectations. This consideration can include a number of characteristics, some of which contribute little or nothing to the functionality of the product but are significant in providing customer satisfaction. A third view relating to quality is to consider the product itself as a system and to incorporate those characteristics that pertain directly to the operation and functionality of the product. This approach should include overlap of the manufacturer and customer views.

Quality control

Quality control (QC) is the collection of methods and techniques for ensuring that a product or service is produced and delivered according to given requirements. This includes the development of specifications and standards, performance measures, and tracking procedures, and corrective actions to maintain control.

The data collection and analysis functions for quality control involve statistical sampling, estimation of parameters, and construction of various control charts for monitoring the processes in making products. This area of quality control is formally known as statistical process control (SPC) and, along with acceptance sampling, represents the traditional perception of quality management. Statistical process control focuses primarily on the conformance element of quality, and to somewhat less extent on operating performance and durability.

The inspection, analysis, and other relevant actions taken to provide control over what is being done, manufactured, or fabricated, so that a desirable level of quality is achieved and maintained. The assessment of product compliance with stated requirements. Quality control should be independent from production.

Quality of Biofertilizer

Quality of biofertilizer is one of the most important factors resulting in their success or failure and acceptance or rejection by end-user, the farmers. Basically, quality is meaning the number of selected microorganism in the active form per gram or milliliter biofertilizer. Quality standards are available only Rhizobium for in different countries. Specifications of biofertilizer are differ from country to country and maybe contain parameters like the microbial density at the time of manufacture, microbial density at the

time of expiry, the expiry period, the permissible contamination, the pH, the moisture, the microbial strain, and the carrier. Quality has to be controlled at various stage of production (during mother culture stage, carrier selection, broth culture stage, mixing of broth and culture, packing and storage). Main parameters of

Physico-chemical test

Test	Procedure	Optimum ISI Standard	Remark
pH	Inoculant : Distilled Water suspension (1:2.5) be measured for pH in pH meter.	6.5 to 7.5	Lower pH indicates gross contamination qualitatively. This test could be performed to check contamination at broth culture laval
Mesh Size	To be passed through 100 mesh sieve	>100	Higher mesh size is extremely desired.
Moisture content	(10 gm.inoculant-wt.) of desired sample at 80^0C over night ----------x 10 100	45 – 50	Moisutre below 25% and above 75 % is determental survival of micro-organism

In order to monitor the quality of biofertilizer packets being supplied to the farming community, quality has to be controlled at various stage of production (during mother culture stage, carrier selection, broth culture stage, mixing of broth and culture, packing and storage) so that the farmers are not cheated at the hand of substandard producers, quality control centers. Regional quality control centre has been established by the National Centre for Organic Farming, Ghaziabad where free quality control services are rendered by analyzing biofertilizer packets, sent by different state government departments of Madhya Pradesh, Chattisgarh, Gujrat and Rajasthan and Daman & Diu.

Biochemical tests

Test	Procedure	Desired Characteristic
GPA reaction	Diluted culture is plated on GPA - medium (9) and incubated at $(28\pm1)^0$ C	Positive growth indicates gross contamination.
BTB reaction	Diluted culture is plated on BTB – plate (9) and incubated at $(28\pm1)^0$ C	Yellow coloration (rather than blue coloration) indicates gross contamination.
Congo red reaction	Diluted culture is plated on Cryma - plate (9) and incubated at $(28\pm1)^0$ C	Adsorption or mixed reaction indicates gross contamination.

Proposed standard specifications of PSM and Azospirillum:

S.No.	Parameter	PSM	Azospirillum
1.	Base	Carrier (Lignite/Charcoal)	Carrier (Lignite/Charcoal)
2.	Carrier	>100 micron	>100 micron
3.	pH	6.5 to 7.5	7.0 to 8.0
4.	Moisture	35 to 40%	35 to 40%
5.	Viable count at manufacture	10^7/g carrier	10^7/g carrier
6.	Viable count at expiry	10^7/g carrier	10^7/g carrier
7.	Level of contaminant	Nil at 10^4 dilution	Nil at 10^4 dilution
8.	Growth in Pikovskaya medium	+ve	-
9.	Growth in S.S. Malate medium	-	+ve
10.	P.Solubilisation zone	1mm	-
11.	Pellicle formation	-	+ve
12.	Shelf life	6 months	6 months
13.	P. Solubilization	30 to 50%	-
14.	N-fixation	-	15 mg/g of malic acid

Existing ISI standards specifications of rhizobium and azotobacter

S.No	Parameter	Rhizobium	Azotobacter
1.	Base	Carrier based	Carrier based
2.	Cell number at the time of manufacture	10^8/g carrier	10^7/g carrier
3.	Cell number at the time of expiry	10^7/g carrier	10^6 /g carrier
4.	Expiry period	Six months from the date of manufacture	Six months from the date of manufacture
5.	Permissible level of contaminant	No contaminant at 10^5 dilution	No contaminant at 10^5dilution
6.	pH	6.0-7.5	6.5-7.5
7.	Strain	Should be checked serologically	-
8.	Carrier	Should pass through 150 - 212 micron sieve (IS-72 to 100 mesh)	Should pass through 106 micron IS sieve
9.	Nodulation test	Should be positive	-
10.	Nitrogen fixation	Above 20 mg per gm of glucose	Not less than 10 mg of sucrose

Procedures for quality control of biofertilizer

Rhizobium: Quality checks on biofertilizer can be divided into three parts:

1. Mother culture test
2. Broth test
3. Peat test

2.1.1. Mother culture test

Rhizobium: Before producing biofertilizer, the mother culture should be checked on the following:

1Growth

2Purity

3Gram stain

Growth: By streaking a mother culture on yeast mannitol + congo red agar (YMA) plates, checking the growth of rhizobia. Fast growing rhizobia colonies will appear in 3-5 days, and a slow growing rhizobia will appear in 5-7 days.

Purity: Check purity by streaking culture on glucose peptone agar plate, and incubate for 24 hours at 30 C. No growth or poor growth should be obtained on GP. Check purity by streaking culture on glucose peptone agar plate, and incubate for 24 hours at 30 C. No growth or poor growth should be obtained on GPA. Good growth and color changes can be expected from contaminants.

Gram stain: A loop of mother culture is checked by Gram staining. Rhizobial cell is Gram negative, retains safranin color. Cells should appear red and not violet when observed under the microscope.

Compost Quality

Compost quality can be determined through laboratory tests. Good compost is characterized by a low moisture content, black to dark brown colour, earthy odour, high tilth (due to texture and particle size), and consistent and stable nutrient concentrations. Age, storage conditions and raw materials will also affect the final quality of the product.

The standards are based on four criteria: product safety and quality, maturity, foreign matter, and trace elements and pathogens. There is little variation between standards, and they all adhere to the same standard for product safety.

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Soybean-Onion
NM2
75% N organic +
10% VW & 10% CU