textures and quality with every alternative method and timing of ploughing and tillage with possible addition of natural fertilizers at various times, with every possible planting and harvesting date, under varied conditions of residue removal and destruction, crop rotation, intercropping, with pretreatments like flooding and lastly, under weather conditions that lack extremes that are unpredictable and never follow the same pattern twice.

4.2 Resistance

Plant resistance is also included in the definition of biological control. Plant breeders have had many successes in production varieties resistant to disease and occasionally to insets, although not so far weeds. Resistance to soil pathogens may also be provided by the use of resistant root stocks and grafting. Recent research has shown that plant can locally accumulate antimicrobial compounds (Phytoalexins) in response to invasion by disease.

Crop	***Tolerant/Resistant variety***	***Pest/Disease***
Cotton	(a) LK-861, NI-1280, Kanchana (b) H-8, NHH-44, NHH-390,L-603 (c) Narasimha	White fly Jassids Helicoverpa
Groundnut	(a) ICGS-11, ICGS-44,Vemana (b) ICGS-10, ICGS-4	Bud rot Root rot

4.3 Growing Trap Crop

Crop plants more preferred by the pest for egg laying and feeding are grown as trap crops on the bunds of the main crop or one row after every 10 rows.

Crop	*Pest*	*Trap crop*
Cotton, Groundnut	*Spodoptera*	Castor, sunflower
Cotton, Chickpea	*Helicoverpa*	Marigold
Pigeonpea	*Helicoverpa*	Marigold
Sesamum	Red hairy caterpillar	Cowpea
Green gram	Red hairy caterpillar	Sunnhemp

Removal and destruction of egg masses and small caterpillar from trap crop.

4.4 Monitoring Pest Population

(a) Pheromone traps
(b) Light traps**:** Use one light trap for five hectare area

4.5 Erecting Bird Perches

Bird perches help in attracting birds, keep water in a small bowl and spread cooked yellow rice to attract insectivorous birds.

4.6 Releasing Parasites and Predators

For management of boll worm of cotton, egg-larval parasites viz., *Trichogamma sp.* and *Chelonus sp.* and predators viz. crysopa were found effective. For the control of pyrilla, *Epiricania melanoleuca* and for top borer and stem borer *Trichodermma chelonis* and *Trichodermma japonicum* should be released in sugarcane field.

4.7 Biological Chemicals

Another definition of biological control is the use of natural chemical. The identification of natural chemicals and subsequent formation of their derivatives can open new areas of pest control. Chemicals which do not kill the insects, but either attract, repel modify their usual behavior, may also be regarded as biological control agents. Behavior modifying chemicals which reduce mating frequency or release large number of sterile insects, control pests biological by reducing their numbers.

Pest	*Biochemical*	*Action*
Spodoptera, Helicoverpa Leaf folder, all defoliator and sucking pest.	Control by neem oil	Azadirection active ingredient act as a repellent and antifident
White fly, Aphids, Jassids, Helicoverpa	Tobacco decocting (Not be used more than two times)	Nicotine Sulphate acts as a contact poison and fumigants.

4.8 Biological Disease Control

A major success in plant disease control has been the discovery. Development and marketing of *Agrobacterium rediobacterium* for the prevention of crown gall caused by *Agrobacterium temufaciens.* When root pruned seedlings are dipped in liquid suspensions of *A. radiobacter*, crown galls do not develop on the newly planted seedlings even in fields infested with *A. temufaciens*. Trichogramma has potential as a preventive agent against *Sclerotium* and *Rhizoctonia.*

4.9 Bioherbicides

Bioherbicides are biological control agents applied in similar ways as chemical to control weeds. The active ingredient in a bio-herbicide is a living organism, mostly a micro organism. A herbicide made of mycelia fragments or spore of fungi is called mycoherbicide. Commercial bioherbicides first appeared in the market in the USA in the early 1980's with the release product "Devine" in 1981 and "Collego" in 1982.

The Bureau of Plant Pathology of the division of plant industry in Gainsville, Florida has developed the use of *Phytophthora palmivora* for the control of milk weed vine in citrus orchards.

Aeschynomene virginica, a leguminous weed in rice, can be effectively controlled by collecting *Trichum gloeosporidis* Sp. *Aeschynomene*.

4.10 Bio-insecticides

Biological control of insects by microorganisms has been the subject of most research and development efforts in the past and is consequently the most successful aspect of biological control. At present 3000 organisms have been reported to cause disease in insects. In viruses, two most important subgroups are (i) Nuclear Polyhedrosis Viruses (NPV) (ii) Granulosis virus (GV). In Bacteria, *Bacillus thuringiensis* (BT) is known to infect of the caterpillars and few beetle grubs. *Bacillus thuringiensis* has been commercially available for the last 30 years. Improvements in the strain and formulations have led to a substantial in the market size for the control of over 100 insect species. A new strain of *B. thuringiensis* var. *israclienesis* available for control of mosquitoes including Anopheles.

that a “holistic approach Involving Integrated Nutrient Management **(INM)**, Integrated Pest Management **(IPM)**, enhanced input use efficiency and adoption of region-specific promising **cropping system** would be the best organic farming strategy for India”. To begin with, the practice of organic farming should be foe low volume, high value crops like spices, medicinal plants, fruits and vegetables. The NAAS has also emphasized the need for intensive research on **soil fertility** and plant health management and on issues relating to microbial contamination of food arising from the use of **farm yard manures**.

3.3 GLOBAL SCENARIO OF ORGNIC FARMING

The negative effects of modern chemical based farming system were first experienced by those countries, which introduce it initially. So, naturally, it was in those countries organic farming was adopted in relatively large scales. There are very large organizations promoting the organic farming movement in European countries, America, Australia etc. These organizations, for example, the International Federation of Organic Agriculture Movements **(IFOAM)** and Greenpeace have studied the problems of the chemical farming methods and compared the benefits accruing to the organic farming with the former. Organic farming movements have since spread to Asia and Africa too.

3.3.1 PRE – WORLD WAR II

Organic Agriculture (as opposed to conventional) began more or less simultaneously in Central Europe and India. The British botanist **Sir Albert Howard** is often referred to as the **father of modern organic agriculture.** From 1905 to 1924, he worked as an agricultural adviser in Pusa, Bengal, where he documented traditional Indian farming practices and came to regard them as superior to his conventional agriculture science. His research and further development of these methods is recorded in his writings, notably, his 1940 book, An Agricultural Testament, which influenced many scientist and farmers of the day.

In Germany, **Rudolf Steiner’s** development, **bio-dynamic agriculture**, was probably the first comprehensive organic farming system. This began with a lecture series Steiner presented at a farm in Koberwitz (now in Poland) in 1924.

In 1909, American agronomist **FH King** toured China, Korea and Japan, studying traditional fertilization, tillage and general farming practice. He published his findings in Farmers of Forty Centuries (1911, Courier Dover Publication). King foresaw a “World movement for the introduction of new and improved methods” of agriculture and in late years his book became an important organic reference.

The term **organic farming** was coined by **Lord Northbourne** in his book Look to the Land (written in 1939, published 1940). From his conception of “the farm as organism”, described a holistic, ecologically balanced approach to farming.

In 1939, influenced by Sir Albert Howard’s work, Lady Eve Balfour launched Haughley Experiment on farmland in England. It was the first scientific, side – by – side

CHAPTER :5
NUTRIENT MANAGEMENT IN ORGANIC FARMING

Introduction

In order to realize the potential of production systems on a sustained basis, efficient management of resources is crucial (essential). A successful farming system relies on the management of organic matter to enhance physico-chemical and biological properties of the soil. The effects of soil organic matter are dynamic as it is a source of gradual release of essential plant nutrients; improves soil structure, its drainage, aeration and water holding capacity (WHC); improves soil buffer capacity; influence the solubility of minerals and serves as a source of energy for the development of micro-organisms.

According to a conservative estimate, around 600 to 700 m t of agricultural waste is available in the country but it is not managed properly. We must convert waste into wealth by converting this biomass into energy, nutrient to starved soil and fuel to farmers. India produces about 1800 m t of animal dung per annum. Even if ⅔ of the dung is used for biogas generation, it is expected to yield about 440 m t/ annum of manure, which is equivalent to 2.90 m t N, 2.75 mt P_2O_5 and 1.89 m t K_2O.

CONCEPT AND DEFINITION OF INM

The concept of biological INM is the continuous improvement of soil productivity on long-term basis through appropriate use of organic manures, green manures, BGA, biofertilizers and other biological derived materials and their scientific management for optimum growth, yield and quality of crops and intensive cropping systems in specific agro-ecological situations.

Definition of Biological INM

According to Sanchaz (1994). It should relay on biological processes by adapting germplasm to adverse soil conditions, enhancing soil biological activity and optimizing nutrient, cycling to minimize external inputs and maximize the efficiency of their use.

It can also be defined as "a system for approaching the soil nutrient management which maintain soil health, soil fertility, sustaining agricultural productivity and improving farmers profitability through effective, judicious and intensive use of biological based nutrient management resources". The resources are biofertilizers, organic manures green manuring, crop rotation, N-fixing organisms, mycorrhizae, PSM etc.

Role of different sources for biological INM

4.1 ORGANIC MANURES

Term 'manure' was used originally for denoting materials like cattle manure and other bulky natural substances that were applied to land, with the object of increasing the production of crops. Therefore, manures are defined as the plant and animal wastes which are used as sources of plant nutrients.

Urine is normally low in phosphorus and high in potash, where as about equal parts of nitrogen may be excreted in faeces and urine of the cattle. Hence the manure in which the proportion of the urine was allowed to drain away would be relatively low in N and K. Poultry manure is very important for organic farming due to there will be no loss of urine, since both liquid & solid portions are excreted together.

Fresh poultry manure creates local alkalinity, it may hamper the standing crop. Therefore, it is recommended to preserve the excreta at least for six months with suitable amendments and appropriate microbes.

ADVANTAGES OF MANURING

- ⇒ Manures supply plant nutrients including micro nutrients
- ⇒ They improve soil physical properties
- ⇒ Increase nutrient availability
- ⇒ Provide food for soil micro organisms

The droppings of sheep and goat contain higher nutrients than FYM and compost. On an average, the manure contains 3% N, 1% P_2O_5 & 2%K_2O). It is applied to the field in two ways- i) Sweeping of sheep and goat sheds are placed in pits for decomposition and it is applied later to the field. ii) Sheep penning- wherein sheep and goats are allowed to stay over night in the field and urine and faecal matter is added to soil.

A.7 POULTRY MANURE

Poultry manure can supply higher N and P to the soil than other bulky organic manures. The average nutrient content is 2.87% N, 2.93% P_2O_5 & 2.35% K_2O.

A.8 GREEN MANURING

Green un-decomposed plant material used as manure is called green manure. By growing green manure crops (usually leguminous crops) are grown in the field and incorporating it in its green stage in the same field is called green manuring. It adds organic matter and nitrogen to the soil. On an average green manuring gives 60-80 kg N/ha.

(B) Concentrated organic manures

These have required in small quantities and contain higher nutrients as compared to bulky organic manures. The most commonly used are oil cakes, fish meal, meat meal, blood meal, horn & hoof meal, bird guano, raw bone meal etc. which act a good source of organic manures for organic farming system.

B.1 OIL CAKES

Oil cakes are generally grouped into two groups, viz., *edible* oil cakes suitable for feeding the cattle and other domestic animals and *non-edible* oil cakes exclusively used as manure due to their higher content of plant nutrients. It has been estimated that India produced about 2.5 million tones of oil cakes annually

Non-edible oil cakes are used as manure especially for horticultural crops. Nutrient present in oil cakes, after mineralization, are made available to crops 7-10 days after application. Oil seed cakes need to be well powdered before application for even distribution and quicker decomposition. **Neem cake** acts as **Nitrification Inhibitor**.

Average nutrient content of different oil cakes

Oil cakes	Per cent composition		
	N%	P%	K%
Edible oil cakes (feed for livestock)			
Safflower (decorticated)	7.9	2.2	1.9
Groundnut	7.3	1.5	1.3
Cotton seed (decorticated)	6.5	2.9	2.2
Non-edible oil cakes (not fed to livestock)			
Safflower (un-decorticated)	4.9	1.4	1.2
Cotton seed (un-decorticated)	3.9	1.8	1.6
Caster	4.3	1.8	1.3
Neem	5.2	1.0	1.4

B.2 FISH MEAL

Sea food canning industries are present in almost all coastal states of India, Fishes which is not preferred for table purposes due to their small size, bonny nature and poor taste can be converted into very good organic manure. The fish is dried, powdered and filled in bags. It contains average nutrients are 4-10, 3-9 & 0.3-1.5 NPK. These manures are highly suitable for fruit orchards and plantation crops.

B.3 MEAT MEAL

An adult animal can provide 35 to 45 kg of meat after slaughter or death. It contains 8-9% N and 7% P_2O_5.

B.4 BLOOD MEAL

5. The organic carbon in vermicompost releases the nutrients slowly and steadily into the system and enables the plant to absorb these nutrients.
6. The multifarious effects of vermicompost influence the growth and yield of crops.
7. Earthworm can minimize the pollution hazards caused by organic waste by enhancing waste degradation.

APPLICATION OF VERMICOMPOST

In orchards the dose depends on the age of the tree. It can be used @ 500 g in small fruit plants and 3 – 4 kg/tree whereas for vegetable crops @ 3 kg/10 m^2 area. For general use in agriculture, vermicompost should be applied @ 5 t/ha. Vermicompost is mixed with equal quantity of dried cow dung and used as broadcast when seedlings are 12-15 cm height and water should be sprinkled.

4.3 GREEN MANURING

4.3.1 Definition : Crops grown for the purpose of restoring or increasing the organic matter content in the soil are called *green manure crops* while there green undecomposed plant material used as manure is called *green manure*. Their use in cropping system is generally referred as *green manuring*. It is obtained in two ways-either by grown *in situ* or brought from out site. In both ways, the organic material should be worked into the soil while they are fairly young for easy and rapid decomposition.

i) *In situ green manuring*: Growing of green manure crops in the field and incorporating it in its green stage in the same field (i.e. *in situ*) is termed as *green manuring*.

ii) *Green leaf manuring*: is the application of green leaves and twigs of trees, shrubs and herbs collected from nearby location and adding to the soil. Forest tree leaves are the main source of green leaf manuring. Legumes are usually utilized as green manure crops as they fix atmospheric nitrogen in the root/stem nodules through symbiotic association.

4.3.2 ADVANTAGES OF GREEN MANURING

1. It adds organic matter to the soil. This stimulates the activity of soil micro organisms
2. Green manuring concentrates plant nutrient in the surface layer of the soil
3. It improves the structure of soil by deep rooting system
4. It facilitates the penetration of rain water, thus decreasing run off & soil erosion.
5. It holds plant nutrients that would other wise be lost by leaching (eg.N)
6. It increases the availability of certain plant nutrients like P,Ca,K,Mg & Fe.
7. It checks weed growth by quick initial growth
8. It aid in reclamation of sodic soils by release of organic acids.

DESIRABLE CHARACTERISTICS FOR GREEN MANURE CROPS

The criteria for which green manure crops are selected should have following characters,

It should be high biomass production
It should be deep rooting system
It should be leguminous family
It should be fast initial growth
It should be more leafy than woody
It should be low C/N ratio
It should be non-host for crop related pathogens
It should be easy and abundant seed producer
It should be useful for 'by-products'

4.3 RECYCLING OF ORGANIC RESIDUES

A variety of organic residues include crop residues in the form of straw, husk, forest litter; animal wastes like dung urine, bones etc., guano, city or household residues, oil cakes, bye products of food and sugar industries, pond silt, marine wastes, sea weeds and human habitation wastes. There are two major components of crop residues available, i. e.

CHAPTER: 9
CERTIFICATION AND ACCREDITATION PROCESS OF ORGANIC PRODUCT

Introduction

India with its varied agro-climatic conditions and agricultural biodiversity offers tremendous scope for production and export of a wide range of organic products having great demand in a number of developed countries. Ministry of Commerce, Government of India launched the National Programme for Organic Production (NPOP) in 2000 to ensure the well-directed development of organic agriculture. Subsequently various components of NPOP, viz., (i) National standards for production, processing, labeling, storage and transport of organic products, (ii) Systems, criteria and procedures for accreditation of certification and inspection programmes by certification and inspection programmes by certification agencies to facilitate certification, (iii) A national Organic Logo India Organic to be used on certified organic products have been notifies. Agricultural and Processed Food Products Export Development Authority (APEDA) was entrusted with the coordination work of NPOP.

Organic trade is also a rapidly growing reality. A wide variety of organic products are sold world wide and the demand is growing rapidly in Europe, US, Japan and Australia. India is already exporting a range of organic products like tea, spices, coffee, coconut, cotton, rice etc. Even the domestic market is growing though it is still very small.

Certified organic products are those which have been produced, stored, processed, handled and marketed in accordance with precise technical specifications (standards) and certified as "organic" by a certification body. Once conformity with organic standards has been verified by a certification body, the product is afforded a label. This label will differ depending on the certification body but can be taken as an assurance that the essential elements constituting an "organic" product have been met from the farm to the market. It is important to note that an organic label applies to the production process ensuring that the product has been produced, processed and handled in an ecologically sound manner. The organic label is therefore a production process claim as opposed to a product quality claim.

What is organic certification?

Certification is the procedure by which a third party gives written assurance that a product, process or service conforms to specified requirements. Certification in organic farming in simple terms refers to the process of verification and authentication by an independent body that certain products have been produced, processed and or marketed in accordance with certain standards. A certification body does this through a set of procedures established for the purpose. This involves physical inspection of the production location, conditions, verification of records, interviews with the personnel involved and when required subjecting the samples to laboratory analysis.

3.	Indian organic certification agency (INDOCERT)	Thottumugham, P.O. Aluva- 683105 Cochin, Kerala State Ph. 0484-2630909	9.	LACON	Mithradham Chunangardi
4.	Skal inspection and certification agency	Mahalaxmi Layout, No. 191, 1st Main Road, Bangalore 560086	10	International Resource for fair trade (IRFD)	Sona Udyog Unit No. 7, Parsi Panchayat Road, Andheri (E), Mumbai 400069 Ph. 022-28235246
5.	IMO Control Pvt. Ltd.	26, 17th Main HAL, 2nd A Stage, Bangalore 560008, Ph. 080-25285883	11	One Cert Asia	Agarsen farm Vatika, Road off Ton Rd., Jaipur Rajasthan
6.	Ecocert International	54 A, Kanchan Nagar, Nakshetrawadi, Aurangabad 413002, Ph. 0240-2376336	12	National Organic Certification Association (NOCA)	Pune

ACCREDITATION

Accreditation is a process in which certification of competency, authority or credibility is presented. Organisations that issue credentials or certify third parties against official standards are themselves formally credited by accreditation bodies (such as UKAS); hence they are sometimes known as "accredited certification bodies". Accreditation process ensures that their certification practices are acceptable, typically meaning that they are competent to test and certify third parties, behave ethically and employ suitable quality assurance.

In India, as per the National Programme for Organic Production (NPOP), an accreditation refers registration by the accreditation agency for certifying agency for certifying organic farms, products and processes as per the guidelines of the National Accreditation Policy and Programme for Organic Product.

The NPOP programme in context of Indian accreditation scenario, defined the function of accreditation agencies like:

1. Prescribe the package of practices for organic products in their respective schedule.
2. Undertake accreditation of inspection and certifying agencies who will conduct inspection and certify products as having been produced in accordance with NPOP.
3. Monitor inspection made by the accredited inspection agencies.
4. Lay down inspection procedures.
5. Advise the National steering Committee on organic Production.
6. Accept accredited certification programme if such programme confirm to National Standard.
7. Accreditation agencies shall evolve accreditation criteria for inspection and /or certifying agencies and programme drawn up by such agencies for their respective area of operation and products.
8. Accreditation agencies shall prepare an operating manual to assist accredited agencies to abide by such a manual must contain appropriate directions, documentation formats and basic agency and farm records for monitoring and authentication of adherence to the organic production programme.

Practical Manual

Principles of Organic Farming

(Agron. 6.10)

Sixth Semester
Polytechnic in Agriculture
Navsari Agricultural University, Bharuch

PRACTICAL 2: GREEN MANURING FOR ORGANIC FARMING

Green manuring can be defined as a practice of ploughing or turning into the soil un-decomposed green plant tissues for improving physical structure as well as soil fertility. Green manure is the principal supplementary means of adding organic matter to the soil. The green-manure crop supplies organic matter as well as additional nitrogen, particularly if it is a legume crop, due to its ability to fix nitrogen from the air with the help of its root nodule bacteria. Green manure crop should be incorporated in to the soil before flowering stage.

The practice of green manuring is performed in different ways according to suitable soil and climatic conditions of a particular area. Broadly the practice of green manuring in India can be divided into two types

1. Green manuring in situ: In this system, green manure crops are grown and buried in the same field, which is to be green manured, either as pure crop or an intercrop with the main crop. The former system is followed in the northern India while latter is common in the central and eastern India.

2. Green leaf manuring: Green leaf manuring refers to turning into the soil green leaves and tender green twigs collected from shrubs and trees grown on bunds, wastelands and nearby forest areas. This system is generally followed in the central India.

An ideal green manure crop should possess the following desired characteristics:

1. It should be a legume with good nodular growth habit indicative of rapid nitrogen fixation under even unfavorable soil conditions.
2. It should have little water requirements for it's own growth and should be capable of making a good stand on poor and exhausted soils.
3. It should have a deep root system, which can be open the sub-soil and tap lower regions for plant nutrients.
4. The plant should be of a leafy habit capable of producing heavy tender growth early in its life cycle.
5. It should contain large quantities of non-fibrous tissues of rapid decomposability containing fair percent of moisture and nitrogen.
6. It should be fast initial growth with more leafy than woody
7. It should be low C/N ratio

Advantages of the Green manuring

Following are the some of the advantages of the green manuring

1. As they decompose rapidly, it is easy to retain the organic matter in the soil.
2. Green manures improve both physical and chemical properties of the soil.
3. They provide energy to microbes.
4. They provide nutrients to the standing crop and also to the next crop.
5. Addition of green manure crops to the soil, acts as mulch and prevent soil erosion.
6. Leaching of nutrients in light soils can be prevented by addition of green manure.
7. Cultivating green manure crops can control weeds.
8. Majority of green manure crops being legumes, use of nitrogenous fertilizers can be minimized.
9. It increases the availability of certain plant nutrients like phosphorus (P_2O_5), calcium, potassium, magnesium and iron.

Disadvantages of the green manuring

Every coin has got a head and a tail and it is the case with the green manuring. Some disadvantages are also associated with green manuring. When the proper technique of green manuring is not followed or when weather conditions become

PRACTICAL 3: PREPARATION OF ENRICH COMPOST AND VERMICOMPOST

Farm Yard Manure (FYM) is an organic form of fertilizer prepared by decomposition of animal dung, urine and cattle shed wastes. It is the most common organic manure used by farmers of India.

Limitations with traditional method

Procedures followed by farmers in India for utilization of FYM are very crude and far away from modern methods with respect to principle and procedure. The common practice followed by the farmers is to throw cattle dung and other farm and household refuse on roadside or into pits specially dug for manure pit. The dung added to the pit is not uniformly mixed with the urine and litter. Lumps of dung remain as such for a longer period. Large part of urine is lost both in cattle shed and in the pit. There is enormous loss of nutrients from manure heaps and pits which reduce the quality of FYM. Hence, follow certain guidelines for the production of stable, matured and enriched quality of FYM.

What is enriched compost?

The enrichment of compost with nutrients and beneficial organisms like *Azotobactor*, *Azospirillum* or PSB is called enriched compost.

Nutrient Enrichment

- ✓ Feed the cattle with nitrogen rich feed materials like pulse stubbles and green manures.
- ✓ Add phosphates like rock phosphate or SSP @1-2% of the total mass of dung materials to prevent loss of N and enhance N fixation in the trench itself and enrich the manure with P.
- ✓ For K enrichment adds wood ash.
- ✓ Add bio- inoculants like *Azotobacter* and PSB culture @ 250 g per section one month after filling in order to enrich the FYM with these important micro- organisms.

Enrichment of compost with Biofertilizers:

- ✓ N-fixing bacteria-*Azotobacter*, *Azospirillum* each 2 kg/tone if solid, 1 litre/tone if liquid.
- ✓ P-solubilizing bacteria-*Bacillus polymixaetc* - 4 kg/tone if solid, 2 litres/tone if liquid.
- ✓ K-Mobilizing bacteria-*Fraturia aurantia* 4kg/tone if solid, 2 litres/tone if liquid.

Enrichment of compost with Bio-Agents:

Bio-Control agents like *Trichoderma viride*, *Pseudomonas fluorescenceat* the rate of 2 kg/tone of each if solid, 500 ml/tone if liquid form.

Composting :

The process of decomposing organic waste is called composting and the end product of the decomposed material is called compost.

The collected organic refuse may be of rural and urban origin and may include straw, leaves, paddy husk, ground nut husk, sugarcane trash, bagasses, cattle dung, urine, crop residues, city garbage, night soil, sewage, kitchen and vegetable wastes, hedge clippings, water hyacinth and all other residues counting organic matter. During composting under thermophilic and mesophilic condition, heaps or pits are required adequate moisture and aeration. The final product is brown to black colored humified material which on addition to soil replenishes plant nutrients, maintains soil organic matter content and helps in

WHC, disease resistance and better plant growth. AMF saves 25-50 kg P/ha in addition increase the yield up to 10-12%.

f. Growth promoting substance erecting micro organisms.

The specific strain of plant growth promoting rhizobacteria (PGPR) could colonize roots of crops like potato, beet root, apple and legumes. They enhance plant growth indirectly by depriving the harmful micro organisms. PGPR belong to many genera including *Agrobacterium, Arthrobacter, Azotobacter, bacillus, Pseudomonas, cellublomonas, Rhizobium* etc.

General recommendations of bio-fertilizers for different crops

1. For pulses such as Greengram, Black gram, Pigeonpea, Cowpea, kidney bean etc. and legume oil seeds such as groundnut and soyabean use *Rhizobium* + PSB 200 gm each per 10 kg of seed as seed treatment.
2. Non legume crops such as pearlmillet, wheat, sorghum maize, cotton, etc. use *Azotobacter* + PSB 200 gm each per 10 kg of seed as seed treatment.
3. Vegetables crops like tomato, brinjal, chilli, cabbage, cauliflower etc. use *Azotobacter/Azospirillum* + PSB, 1 kg each as seedling root dip.
4. Low land transplanted paddy *Azospirillum* + PSB 2 kg each/acre as seeding root dip for 8-10 hrs.
5. For sugarcane crop, use *Acetobacter* + PSB 4 kg each/acre as seed set dipping.

METHOD OF APPLICATION

Seed treatment

Suspend 200 gm N bio-fertilizer and 200 gms Phosphotika in 300-400 ml of water and mix thoroughly. Mix this paste with 10 kg seeds and dry in shade. Sow immediately.

Seedling root dip

For vegetables 1 kg recommended bio-fertilizers is mixed in sufficient quantity of water. Dip the roots of seedlings in this suspension for 30-40 min before transplanting.

For paddy make a bed in the field and fill it with water. Mix bio-fertilizers in water and dip the roots of seedlings for 8-10 hrs.

Soil treatment

Mix 4 kg each of recommended bio-fertilizers in 200 kg of compost, make moist and leave it overnight. Apply this mixture in the soil at the time of sowing or planting.

PRECAUTIONS

- ✓ Store bio-fertilizer packets in cool and dry place away from direct sunlight and heat
- ✓ *Rhizobium* is crop specific, so use in specified crop
- ✓ Do not mix with chemicals
- ✓ Use the packet before expiry, only on the specified crop, by the recommended method.

PRACTICAL 6: NON CHEMICAL APPROACH FOR INSECT, PEST, DISEASE AND WEED MANAGEMENT

In organic agriculture, incidence of insect and disease attacks can be reduced by sound cultural practices and biological approaches. These practices are region and crop specific.

A. CULTURAL PRACTICES : The cultural methods are the traditional practices followed by farmers for modulating crop growth through selection of seed varieties, appropriate time of sowing and maintenance of specific plant population density for altering the microclimate.

1. Crop rotation : Rotating the crop belonging to one family with one of a different family helps to reduce pest incidence to a large extent. Rotating groundnut with maize will reduce the attack of white grubs. Rotating pigeon pea or chickpea with other non-leguminous crop helps to control fusarium wilt and nematode problems.

2. Trap crops : Insects are strongly attracted by certain plants and when these are sown in the field or along the border, they will gather on them rather than on the main crop. Later they can easily be destroyed. Mustard is a trap crop along with cabbage for the control of diamond back moths, aphids and leaf webbers. The African marigold is a good trap crop for the American bollworm and it also attracts the adults of leaf miners to lay eggs on its leaves. Maize plants are a trap crop to attract fruit flies which are a pest in vegetable cultivation and the cotton bollworm *Helicoverpa armigera*.

3. Intercropping : Intercropping generally has positive effects in terms of reducing the occurrence of insect pests. Insects find it difficult to locate host plants as the visual and chemical stimuli for the host plants are not so strong and the aromatic odour of other plants can disrupt the insects' ability to locate such host plants. Intercropping also interferes with the population development and survival of insect pests. For example, cabbage along with carrot or tomato is an important intercrop combination to effectively manage diamond back moth. Sowing cowpea as intercrop with groundnut minimizes leaf miner infestation. Green gram intercropped with sugarcane reduces the incidence of sugarcane early shoot borer. Growing short-duration pulses like black gram, cowpea, soybean and green gram as intercrops in cotton, increases the effectiveness of natural predators like coccinellids, syrphids, trichogrammatids, etc.

4.Use of resistant / tolerant varieties : Genotypes showing tolerance and resistance to insect pests and diseases are to be selected for sowing. Plants have sophisticated mechanisms to protect themselves from attacks by insects. Certain genotypes act as deterrents and antifeedants and some encourage the predators of pests. There should be a constant watch to update such genotypes in the region. A number of resistant varieties are available for every crop from all agro climatic zones.

B. BIOLOGICAL APPROACHES : Biological approaches to pest management comprise the use of:

- plants or botanicals
- microbial pesticides
- biocontrol by insects
- biorationals

1. Botanicals : The plant kingdom is a rich storehouse of biologically active compounds. Various plant products have been in use for many centuries in India to minimize losses in crops and grain storage.

A large database of plant species that possess pest-controlling insecticidal, antifeedant, repellant, attractant and growth inhibiting properties exists in every village. Some of the plants widely used in the preparation of botanical pesticides are *Anona*

PRACTICAL 8: POST HARVEST MANAGEMENT: QUALITY ASPECT, GRADING, PACKAGING AND HANDLING

Processing

Processing of organic food products and handling should be optimized to maintain the development of pest and diseases. Processing and handling of organic products should be done separately in time or place from handling and processing of non-organic products.

Processing of organic fresh produce requires cleaning, grading followed by peeling, stoning or slicing. At this stage fruits and some vegetable such as onion and peppers are ready for freezing, but most vegetables need to be blanched with hot water or steam at 80^{O}C to 100 ^{o}C to inactivate enzymes that could otherwise lead to a loss in vitamin C and flavour. Fruit can be coated in sugar or in syrup that contains an antioxidant like ascorbic acid. Coating retards browning, avoids the cooked tests after defrosting and increases product quality. The products may be packaged before or after freezing.

The following techniques are adopted for processing.

1. **Freezing :**

Freezing is quite often applied to vegetables but rarely used for fruits, as they do not handle it well. Nutritional quality is maintained when the product is sold from colour, odour and taste are retained well by freezing. The degree of freezing depends on the duration of storage eg.

Practical storage life of frozen products

Products	**Practical storage life (Month)**		
	-18^{o}C	**-25^{o}C**	**-30^{o}C**
Fruits in sugar	12	18	24
Cauli flower	15	24	<24
Carrots	18	24	<24
Potatoes	24	<24	<24

2. Drying :

Drying facilitates for easy transportation and storage of fruits. Dried vegetables are produced in low quantities for the local market but can be useful for soup mixes. The major risks with dried products are microbiological attack and physiological deterioration which leads to browing, loss of vitamins and the development of off-flavours.

3. Water content :

Dry fruit products have a water content of 8 to 12 % and dry vegetable around 7%. Under these conditions, there are no microbiological problems during storage of the products.

4. Additives and processing aids:

Permitted processing aids helps to retain quality of dry produce, such as ascorbic acid, citric acid, tartaric acid, which resulting in low pH, it limits the development of micro organisms and browing. The product is treated by dipping in or spraying with acids or lemon juice. Salt can be used for drying.

5. Blanching :

A brief period at high temperature destroys most of micro organisms and inactivates eazymes which promote browning and degradation i.e.

Fruits /Vegetables	**Process**
Banana	Boiling water for 5 min
Mango, Papaya	Hot water (56^{o}C) for 1 min

Types of Biofertilizers: There are two types of bio-fertilizers.

1. Symbiotic N-fixation: These are *Rhizobium* culture of various strains which multiply in roots of suitable legumes and fix nitrogen symbiotically.

Rhizobium: It is the most widely used bio-fertilizers, which colonizes the roots of specific legumes to form tumours like growth called root nodules and these nodules act as factories of ammonia production.

2. Asymbiotic N-fixation: This includes *Azotobacter*, *Azospirillium*, BGA, Azolla and Mycorrhizae, which also fixes atmospheric N in suitable soil medium.

Mycorrhizae: Mycorrhizae are the symbiotic association of fungi with roots of Vascular plants. The main advantage of Mycorrhizae to the host plants is facilitating an increased phosphorous uptake. In many cases the Mycorrhizae have been shown to markedly improve the growth of plants. In India, the beneficial effects of Vascular-Arbuscular Mycorrhizae (VAM) have been observed in fruit crops like citrus, papaya and litchi.

6. Bio-pesticide

Bio-pesticides are natural plant products that belong to the so-called secondary metabolites. Botanical insecticides are ecologically and environmentally safer generally affect the behaviour and physiology of insects rather than killing them. Neem (*Azadirachta indica*) has justifiably received the maximum attention. All parts of the Neem tree possess insecticidal property but seed kernel is most active.

7. Vermicompost

It is organic manure produced by the activity of earthworms. It is a method of making compost with the use of earthworms that generally live in soil, eat biomass and excrete it in digested form. It is generally estimated that 1800 worms which is an ideal population for one sq. meter can feed on 80 tones of humus per year. These are rich in macro and micronutrients, vitamins, growth hormones and immobilized microflora. The average nutrient content of vermicompost is much higher than that of FYM. Application of vermicompost facilitates easy availability of essential plant nutrients to crop.