INTRODUCTION, CONCEPT AND RELEVANCE IN PRESENT CONTEXT

Introduction:

Green revolution technologies such as greater use of synthetic agro chemicals like fertilizers and pesticides, adoption of nutrient responsive, high-yielding varieties of crops, greater exploitation of irrigation potentials etc… has boosted the production out put in most of cases. Without proper choice and continues use of these high energy inputs is leading to decline in production and productivity of various crops as well as deterioration of soil health and environments. The most unfortunate impact on Green Revaluation Technology (GRT) on Indian Agriculture is as follows:

1. Change in soil reaction
2. Development of nutrient imbalance /deficiencies
3. Damage the soil flora and fauna
4. Reduce the earth worm activity
5. Reduction in soil humus / organic matter
6. Change in atmospheric composition
7. Reduction in productivity
8. Reduction in quality of the produce
9. Destruction of soil structure, aeration and water holding capacity
10. Breeding more powerful and resistant pests and diseases

All these problems of GRT lead to not only reduction in productivity but also deterioration of soil health as well as natural eco-system. Moreover, to day the rural economy is now facing a challenge of over dependence on synthetic inputs and day by day it change in price of these inputs. Further, Indian Agriculture will face the market competition due to globalization of trade as per World Trade Organization (WTO). Thus apart from quantity, quality will be the important factor. Such as Agriculture gave birth to various new concepts of farming such as organic farming, natural farming, bio-dynamic Agriculture, do-nothing agriculture, eco-farming etc.

The essential concept of the these practices is "Give back to nature", where the philosophy is to feed the soil rather them the crop to maintain the soil health. Therefore, for sustaining healthy ecosystem, there is need for adoption of an alternatives farming system like organic farming.

Concept of organic farming

The basic concepts behind organic farming are:

1. It concentrates on building up the biological fertility of the soil so that the crops take the nutrients they need from steady turnover within the soil nutrients produced in this way and are released in harmony with the need of the plants.
2. Control of pests, diseases and weeds is achieved largely by the development of an ecological balance within the system and by the use of bio-pesticides and various cultural techniques such as crop rotation, mixed cropping and cultivation.
3. Organic farmers recycle all wastes and manures within a farm, but the export of the products from the farm results in a steady drain of nutrients.

4. Enhancement of the environment in such a way that wild life flourishes.

In a situation where conservation of energy and resources is considered to be important community or country would make every effort to recycles to all urban and industrial wastes back to agriculture and thus the system would be requiring only a small inputs of new resources to "Top Up" soil fertility.

Definition of organic farming

Many scientists at different levels have elaborated the concept of organic farming; the important descriptions are as follows;

Lampkin (1990) Organic farming is a production system which avoids or largely excludes the use of synthetic compounded fertilizers, pesticides, growth regulators and live stock feed additives.

Koferi (1992) (Korean organic farming environment Research Institute) It is the farming method by which we never use compound chemical fertilizers, agricultural chemicals, pesticides, growth hormones and uses natural sources such as organic matters, minerals, and microbes.

According to national organic standards board of the U.S. defines organic farming as an ecological production management system that promotes and enhances bio diversity, biological cycles and soil biological activity.

Organic farming refers to organically grown crops which are not exposed to any chemicals right from the stage of seed treatments to the final post harvest handling and processing (Pathak & Ram, 2003).

Organic farming relies on crop rotation, crop residues, animal manures, legumes, green manures, off-farming organic wastes, agricultural cultivation, mineral bearing rocks and aspect of biological pest control to maintain soil productivity and tilth to supply plant nutrients and also to control insects, weeds and other pests (Lamkin-1990). In a broader sense it includes biofertilizers, bio diversity and biotechnology.

Area under organic farming in % of total agricultural area in important countries (2003)

Country	% of Cultivated Area	Country	% of Cultivated Area
Austria	11.30	Australia	2.31
Switzerland	9.70	France	1.40
Italy	7.94	USA	0.23
Denmark	6.51	Japan	0.10
Sweden	6.30	China	0.06
United Kingdom	3.96	India	0.03
Germany	3.70		

FAI, New Delhi, Bhattacharyya and Gehlot (2004)

India represents only 0.03% area (43000 ha) out of total cultivated (143 Million ha) area.

History of Organic farming

Traditional farming (of many kinds) was the original type of agriculture, and has been practiced for thousands of years. Forest gardening, a traditional food production system that dates from prehistoric times, is thought to be the world's oldest and most resilient agroecosystem.

Artificial fertilizers had been created during the 18th century, initially with superphosphates and then ammonia-based fertilizers mass-produced using the HaberBosch process developed during World War I. These early fertilizers were cheap, powerful, and easy to transport in bulk. Similar advances occurred in chemical pesticides in the 1940s, leading to the decade being referred to as the 'pesticide era'. But these new agricultural techniques, while beneficial in the short term, had serious longer term side effects such as soil compaction, soil erosion, and declines in overall soil fertility, along with health concerns about toxic chemicals entering the food supply.

Soil biology scientists began in the late 1800s and early 1900s to develop theories on how new advancements in biological science could be used in agriculture as a way to remedy these side effects, while still maintaining higher production.

In Central Europe **Rudolf Steine**r, who's *Lectures on Agriculture* were published in 1925 created biodynamic agriculture, an early version of what we now call organic agriculture. Steiner was motivated by spiritual rather than scientific considerations.

In the late 1930s and early 1940s **Sir Albert Howard** and his wife Gabrielle Howard, both accomplished botanists, developed organic agriculture. The Howards were influenced by their experiences with traditional farming methods in India, biodynamic, and their formal scientific education. **Sir Albert Howard** is widely considered the **"father of organic farming",** because he was the first to apply scientific knowledge and principles to these various traditional and more natural methods

In the United States another founder of organic agriculture was **J.I. Rodale**. In the 1940s he founded both a working organic farm for trials and experimentation, The Rodale Institute, and founded the Rodale Press to teach and advocate organic to the wider public.

Further work was done by **Lady Eve Balfour** in the United Kingdom, and many others across the world.

There is some controversy on where the term "organic" as it applies to agriculture first derived. One side claims term 'organic agriculture' was coined by **Lord Northbourne,** an agriculturalist influenced by Steiner's biodynamic approach, in 1940.

Increasing environmental awareness in the general population in modern times has transformed the originally supply-driven organic movement to a demand-driven one. Premium prices and some government subsidies attracted farmers. In the developing world, many producers farm according to traditional methods that are comparable to organic farming, but not certified, and that may not include the latest scientific advancements in organic agriculture. In other cases, farmers in the developing world have converted to modern organic methods for economic reasons

Need & scope of organic farming

- Increase in awareness and health consciousness
- Global consumers are increasingly looking for organic food, which is considered safe, and hazard free.
- The global prices of organic food are more lucrative and remunerative.
- The potential of organic farming is signified by the fact that the farm sector has abundant organic nutrient resources like livestock, water, crop residue, aquatic weeds, forest litter, urban, rural solid wastes and agro industries, bio-products.
- India offers tremendous scope for organic farming as it has local market potential for organic products

Importance of Organic Farming

The agriculture today in the country is hampered by erosion of natural resources viz., land, water, biodiversity, fast declining soil fertility and use efficiency of inputs, such as water, fertilizer and energy. Demographic pressure accelerates the former and the faulty agronomic practices account for the latter problems. The modern agriculture with its potential takes the country out of the food trap and to reach an era of self sufficiency in food grain production.

The present day for self sufficiency in food grain production may not last longer unless we develop a sustainable agricultural system which maintains and /or improves soil fertility and productivity with greater acceptance of biological principles so as to assure adequate/more food production in future. Besides plants are more prone to pest and diseases in intensive agriculture, use of chemicals can have residues on the produce, in the soil and in ground water. With more of purchased inputs cost of production is also mounting up. Pesticides use in paddy, cotton and vegetables which occupy less than 30 per cent of total area account for more than 80 per cent of the chemicals used.

Organic farming practices that reduces the pressure on land, water and bio-diversity without adverse effects on agricultural production and nutritive value of food comprise, judicious use of organic manure, viz. farm yard manure, compost, crop resides, Vermicompost etc. integrated is an efficient nutrient management practices, cropping systems, conjunctive use of rain, tank and under ground water, integrated pest management and conservation of genetic

resources. Among them, soil fertility is give top attention due to its dynamic action with various physical, chemical and biological properties. Besides this, following advantages derived from organic farming**: Advantages of organic farming**

- Nutrition - Improved soil health makes food dramatically superior in mineral content
- Poison-free - Free of contamination with health harming chemicals like pesticides, fungicides and herbicides.
- Food tastes better
- Food keeps longer - can be stored longer
- Disease and pest resistance - because of healthy plants
- Weed competitiveness - Healthier crops able to compete
- Lower input costs - No costly chemicals used, nutrients are created in-situ (in the farm)
- Drought resistance
- More profitable - Due to greater food value of organic produce consumers are willing to pay premium prices

Advantages

1. Organic manures produce optimal conditions in the soil for high yields and good quality crops.
2. They supply all the nutrients required by the plant (NPK, secondary and micronutrients).
3. They improve plant growth and physiological activities of plants.
4. They improve the soil physical properties such as granulation and tilth, giving good aeration, easy root penetration and improved water holding capacity. The fibrous portion of the organic matter with its high carbon content promotes soil aggregation to improve the permeability and aeration of clay soils while its ability to absorb moisture helps in the granulation of sandy soils and improves their water holding capacity. The carbon in the organic matter is the source of energy for microbes which helps in aggregation.
5. They improve the soil chemical properties such as supply and retention of soil nutrients and promote favourable chemical reactions.
6. They reduce the need for purchased inputs.
7. Most of the organic manures are wastes or byproducts which on accumulation may lead to pollution. By way of utilizing them for organic farming, pollution is minimized.
8. Organic fertilizers are considered as complete plant food. Organic matter restores the pH of the soil which may become acidic due to continuous application of chemical fertilizers.
9. Organically grown crops are believed to provide healthier and nutritionally superior food for man and animals than those grown with commercial fertilizers.
10. Organically grown plants are more resistant to disease and insects and hence only a few chemical sprays or other protective treatments are required.
11. There is an increasing consumer demand for agricultural produces which are free of toxic chemical residues. In developed countries, consumers are willing to pay more for organic foods.
12. Organic farming helps to avoid chain reaction in the environment from chemical sprays and dusts.

13. Organic farming helps to prevent environmental degradation and can be used to regenerate degraded areas.
14. Since the basic aim is diversification of crops, much more secure income can be obtained than to rely on only one crop or enterprise.

Objectives of Organic Farming

The objectives of organic agriculture have been expressed in the standard document of the International Federation of Organic Agriculture Movement (IFOAM) as follows**:**

1. To produce food of high nutritional quality in sufficient quantity.
2. To work with natural systems rather than seeking to dominate them.
3. To encourage and enhance the biological cycles within farming system involving microorganisms, soil flora and fauna, plants and animals.
4. To maintain and increase the long term fertility of soils.
5. To use, as far as possible, renewable resources in locally organized agricultural systems.
6. To work as much as possible, within a closed system with regard to organic matter and nutrient elements.
7. To given all livestock, conditions of life that allow them to perform all aspects of their innate behavior.
8. To avoid all forms of pollution that result from agricultural techniques.
9. To maintain the genetic diversity of the agricultural system and its surroundings, including the protection of plant and wildlife habitats.
10. To allow agricultural producers for adequate return and satisfaction from their work including a safe working environment.
11. To consider the wider, social and ecological impact of the farming system.

1.8 Essential Characteristics of Organic Farming

The most important characteristics are as follows**:**

1. Maximal but sustainable use of local resources.
2. Minimal use of purchased inputs, only as complementary to local resources.
3. Ensuring the basic biological functions of soil-water-nutrients-human continuum.
4. Maintaining a diversity of plant and animal species as a basis for ecological balance and economic stability.
5. Creating an attractive overall landscape which given satisfaction to the local people.
6. Increasing crop and animal intensity in the form of polycultures, agroforestry systems, integrated crop/livestock systems etc to minimize risks.

Principles (International Federation of Organic Agriculture Movements - IFOAM, 1972)

1. To produce food of high quality in sufficient quantity.
2. To interact in a constructive and life-enhancing way with natural systems and cycles.
3. To consider the wider social and ecological impact of the organic production and processing systems.

4. To encourage and enhance biological cycles within the farming system, involving micro-organisms, soil flora and fauna, plants and animals.
5. To maintain and increase the long-term fertility of soils.
6. To maintain the genetic diversity of the production system and its surroundings, including the protection of wildlife habitats.
7. To promote the healthy use and proper care of water, water resources and all life therein.
8. To use, as far as possible, renewable resources in locally organized production systems.
9. To give all livestock conditions of life with due consideration for the basic aspects of their innate behaviour.
10. To minimize all forms of pollution.
11. To allow every one involved in organic production and processing a quality of life which meets their basic needs and allows an adequate return and satisfaction from their work, including a safe working environment.
12. To progress towards an entire production, processing, and distribution chain which is both socially just and ecologically responsible.

Key Principle in Organic Farming Systems

Organic agriculture systems are based on three strongly interrelated principles under autonomous ecosystems management: mixed farming, crop rotation and organic cycle optimization. The common understanding of agricultural production in all types of organic agriculture is managing the production capacity of an agro-ecosystem. The process of extreme specialization propagated by the green revolution led to the destruction of mixed and diversified farming and ecological buffer systems. The function of this autonomous ecosystem management is to meet the need for food and fibers on the local ecological carrying capacity.

1.9.1. Mixed Farming

In organic agriculture systems, one strives for appropriate diversification, which ideally means mixed farming, or the integration of crop and livestock production on the farm. In this way, cyclic processes and interactions in the agro-ecosystem can be optimized, like using crop residues in animal husbandry and manure for crop production. Diversification of species biotypes and land use as a means to optimize the stability of the agro-ecosystem is another way to indicate the mixed farming concept. The synergistic concept among plants, animals, soil and bio-sphere support this idea.

1.9.2. Crop Rotation

Within the mixed farm setting, crop rotation takes place as the second principle of organic agriculture. Besides the classical rotation involving one crop per field per season, inter cropping, mixed cropping and relay cropping are other options to optimize interactions. In addition to plant functions, other important advantages such as weed suppression, reduction in soil-borne insects and diseases, complimentary nutrient supply, nutrient catching and soil covering can be mentioned.

1.9.3. Organic Cycle Optimization

Each field, farm, or region contains a given quantity of nutrients. Management should be used in such a way that optimal use is made of this finite amount.

(i) This means that the nutrients should be recycled and used a number of times in different forms.

(ii) Care should be taken that only a minimum amount of nutrients actually leave the system so that "import" of nutrients can be restricted.

The quantity of nutrients available to plants and animals can be increased within the system by activating the **edaphon**, resulting in increased weathering of parent material.

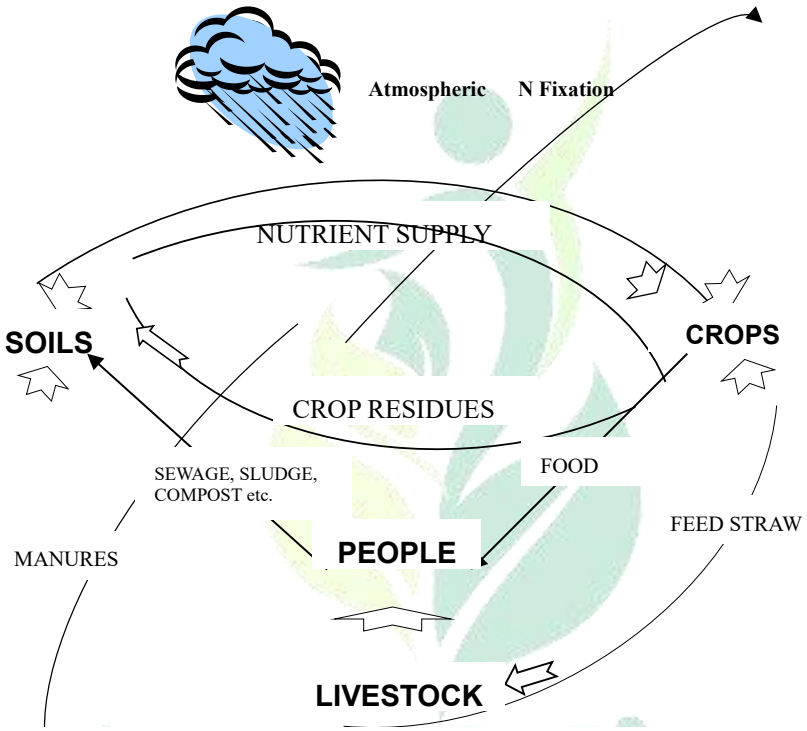


Fig.1. Organic Cycle of an organic farming system

1.10 Organic farming in India : Relevance in present context

- In India, only 30% of total cultivable area is covered with fertilizer, where irrigation facilities are available and in the remaining 70% of arable land, which is mainly rainfed, negligible amount of fertilizers is being used. Farmers in these areas often use organic manure as a source of nutrients are readily available either in their own farm or in their locality.
- The North Eastern Hills of India provides considerable opportunity (18 million hectare) for organic farming due to least utilization of chemical inputs, which can be exploited for organic production.

- India is an exporting country and does not import any organic products. The main market for exported products is the European union. Recently India has applied to be included on the "EU-Third-Country-List", another growing market is USA.
- There has been plenty of policy emphasis on organic farming and trade in the recent years in India.
- The 10th five-year plan emphasizes promotion and encouragement to organic farming in India with the use of organic waste, IPM and INM.
- Even 9th five-year plan had emphasized the promotion of organic produce in plantation crops, spices and condiments with the use of organic & bio-inputs.
- There are many states and private agencies involved in promotion of organic farming in India. These include- various ministries and department of the government at the central and state levels such as;
    - Universities and Research centers
    - Non Govt. organizations (NGO)
    - Eco farms
    - Certification bodies like INDOCERT, ECOCERT, SKAL and APOF etc.

The central and state governments have also identified *Agri-Export Zone* for agricultural exports in general and organic products in some states:

- ✓ In Uttar Pradesh and Uttaranchal the Diversified Agriculture Support Project (DASP) is promoted for organic farming.
- ✓ In Bangalore & Nilgiris; with 50 outlets in south India helps for supply the organic products from small growers.
- ✓ IRFT (International Recourses for Fairer Trade) based in Mumbai, procures organic cotton and agro products to sell them to Indian & foreign buyers to help the rural poors.
- ✓ Ion Exchange, Mumbai, a private company is engaged for export and domestic marketing of organic products in India.
- ✓ In Himachal Pradesh; the net incomes per hectare from organic farming was found to be 2-3 times higher both in case of maize and wheat due to higher production and also for higher price were obtained by organic produce.
- ✓ In Haryana; net returns was higher (2-3 times) in basmati rice, soybeans, arhar and wheat because of 25 to 30 % price premium on organic produce and lower cost of production and marketing.
- ✓ In Maharashtra; popularization of organic cotton production was due to high cost benefit ratio of organic cotton 1:1.63 as against 1:1.47 for conventional cotton.
- ✓ In Gujarat; organic production of chickoo, banana and coconut had higher profitability (Naik, 2001).
- ✓ In Karnataka; groundnut, jowar, cotton, coconut and banana were grown as organic. The major problems faced by organic farmers were found to be initial lower yields, no price incentives, no separate markets for organic produce, besides lack of and high costs of certification (Singh, 2003). **Disadvantages of organic farming**

- Productivity - Low productivity is often reported as the quantum nutrient used comparatively lower.
- Labour intensive - Cultivation requires more labour especially for weed control

- Skill - requires considerable skill to farm organically Ex. Choice of alternatives for control of pests
- Lack of convenience in management compared to easier management like fertilizer application in conventional methods

Synonyms of organic farming

Eco-farming
Biological farming
Bio-dynamic farming
Macrobiotic agriculture

Eco-farming

- Farming in relation to ecosystem.
- It has the potential for introducing mutually reinforcing ecological approaches to food production.
- It aims at the maintenance of soil chemically, biologically and physically the way nature would do it left alone.
- Soil would then take proper care of plants growing on it.
- ***Feed the soil, not the plant*** is the watchword and slogan of ecological farming.

Biological farming

Farming in relation to biological diversity.

Biodynamic farming

1.11. Constraints / Limitations of organic farming in India

1. **Small holding**: The average size of an operational holding is 1.57 ha and further decreasing gradually due to population pressure.
2. **Poor infrastructure facilities**: i.e. lack of sufficient soil testing laboratories.
3. Lack of technological knowledge, lack of knowledge for use of bio-fertilizers, biopesticides, bio-control, IPM and INM etc.
4. Organic farming takes four years for a farmer to free his land completely stopping the use of chemical as nutrients & crop savers.
5. The neighbouring farmers do not well co-operate regarding use of fertilizer, pesticides, weedicides etc.
6. Decrease in production of high yielding crops like rice, wheat which needs high fertility status to get potential yield.
7. The competitive uses of organic materials such as dung-cakes for domestic cook fuel in villages and bagasse as fuel in sugar factories & villages.
8. Wheat & rice straws are disposed off by burning, instead of return to the soil.
9. Dung, slurry & pig manure and other waste used directly in the field (without compositing), which damage the crop & pollute the ground water.
10. Most of organic material are bulky in nature, hence very difficult to store, carry and use.
11. Sewage, sludge contains pathogens and, some of them survive more than six months, which may hazard the human life and prove fatal for the animal .

12. City garbage contains un-decomposed materials such as metal, plastic, glass, stones, needles etc. which causes many problems,
13. Bio control agents are available only for few selected insect pests.
14. Complicated organic certification process and also high cost of certification.
15. High price expectations, delayed delivery, quality restrictions, lack of certification & marketing net work are the major problems for organic producers.
16. Major Indian and multinational companies are not interested in bio pesticides, also dealer's interest in chemical pesticides.

1.12 Natural Farming v/s Organic Farming

Conventional Farming v/s Organic Farming	
Conventional Farming	*Organic Farming*
i. It is based on *economical* orientation, heavy mechanization, specialization and dis-appropriate development of enterprises with unstable market oriented programme.	**i.** It is based on *ecological* orientation, efficient input use efficiency, diversification and balanced enterprise combination with stability.
ii. Supplementing nutrients through fertilizers, weed control by herbicides, plant protection measures by chemicals and rarely combination with livestock.	**ii.** Cycle of nutrients within the farm, weed control by crop rotation and cultural practices, plant protection by non-polluting substances and better combination of livestock.
iii. Based on philosophy of to feed the crop/ plants.	**iii.** 'Feed the soil not to the plant' is the watch word and slogan of organic farming.
iv. Production is not integrated into environment but extract more through technical manipulation, excessive fertilization and no correction of nutrient imbalances.	**iv.** Production is integrated into environment, balanced conditions for plants and animals and deficiencies need to be corrected.
v.Low input**:** output ratio with considerable pollution.	**v.**High input**:** output ratio with no pollution.
vi. Economic motivation of natural resources without considering principles of natural up gradation.	**vi.** Maximum consideration of all natural resources through adopting holistic approaches.

CHAPTER-2
ORGANIC PRODUCTION REQUIREMENT

Organic farming is a concept for following the rule of nature. It is also operates on the natural principles of sustainability. Soil is one of the most important natural resources, which needs proper management for organic production requirement. For doing so, one should rely on organic techniques like crop rotation, using natural manures and green manures, no addition of synthetic substances, proper management of air and water, providing drainage, following integrated pest control, using biological methods of disease and pest control. Using traps, use

of predators, increasing the population of beneficial plants and animals, addition of organic material in the soil, using legume, use of bio fertilizers, modifying cropping systems, use of cover crops, catch crops and establish proper soil-crop-animalhuman being system. Such a system should follow an integrated system approach so as to make the entire production system biologically active, ecologically sound and economically viable. In short locally available natural material should be used to increase soil productivity by improving soil environment.

Details of crop production for conversion to organic system:-

1. **Landscape :**
   - Use of local soil flora and fauna around the fields suited to the region should be encouraged.
   - Actions that affected the bio-diversify should be restricted as far as possible.
2. **Soil And Water Conservation**
   - Relevant measures should be taken to prevent soil erosion, conservation of water, prevent both excess and improper use of water and pollution of ground as well as surface water
   - Relevant measures should be taken to prevent salinization.
   - Cleaning of land by burning of organic matter should be restricted to the absolute minimum
3. **Choice of crops and variety**
   - Seeds and planting materials should be purchased from traditional/ certified organic production
   - Seed treatment should be made with permissible products
   - When certified organic seed not available, chemically untreated seed conventional materials may be used
   - New crop seed and plant material treated with synthetic pesticides, chemicals, related or micro waved can only be allowed in regions where organic agriculture is in the early stage
   - Use of genetically engineered seeds, transgenic plants should not allowed
4. **Crop rotations**
   - Certifying programmes should set minimum standards for crop rotations on arable land, taking into account the nature of the crop, presence of weeds and local conditions
   - Certifying programmes can accept intercropping as part of crop rotation programmes, considering the variations in cropping length of different crops
5. **Manurial Policy**
   - Manurial policy should include green manure, leaf litter and vermincomposting
   - Manure containing human faeces or untreated sewage should not be used on vegetables produced for human consumption

- Any organic wastes should be applied in their natural composition and should not be rendered more soluble by chemical treatments
- All the materials should be in accordance with the standards
- All synthetic nitrogenous fertilizers including urea should be excluded
- Organic farm should have manurial policy to include inputs based on microbial, plants or animal origin, provided they do not have adverse effects on the soil and local ecology

6. Pests, diseases and weed management

- Products of traditional nature, preferably prepared at the farm from local plants, animals and micro-organisms should be used
- Both physical and thermic methods are permitted
- Thermic sterilization of soil is allowed to combat both pests and diseases, whenever necessary
- All the synthetic herbicides, fungicides, pesticides should be strictly prohibited

7. Plant growth regulators

- All synthetic products like growth regulators, dyes should not be used
- Products of traditional nature, preferably prepared at the farm from local plants, animals and microorganisms should be used

CHAPTER -3

BIOLOGICAL INTENSIVE NUTRIENT MANAGEMENT

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.

The use of biological inputs such as N-fixing bacteria , mycorrhiza or soil fauna as a means of enhancing the endemic biological activities are the means of biological sioil management. Direct management is also achieved by the use of organic matter inputs, for the purpose of providing feeding materials to biological populations. Management techniques such as tillage and fertilization also influence the activity of the biota by improving the physical and chemical environment of the soil.

According to a conservative estimate, around 600 to 700 mt 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 t of animal dung per annum. Even if ⅔ of the dung is used for biogas generation, it is expected to yield about 440 MT/ annum of manure, which is equivalent to
2.90 t N, 2.75 t P_2O_5 and 1.89 t K_2O.

CONCEPT AND DEFINITION OF BIOLOGICAL 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 agroecological situations.

Definition of Biological INM

According to Sanchaz (1994), we 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 of 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

3.1 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
- Provide buffering action in soil reaction
- Improve soil tilth, aeration and WHC of the soil

On the basis of concentration of nutrients, manures can be grouped into two categories-

3.1 (A) ***Bulky organic manures***

Contain small percentage of nutrients and they applied in large quantities like FYM, compost, green manure, biogas slurry, night soil, sewage and sludge, poultry manure, sheep & goat manure, animal waste, crop residue etc.

A.1 FARM YARD MANURE (FYM)

Most commonly used organic manure in India. It refers to the decomposed mixture of dung and urine of farm animals along with litter and left over materials from roughages or fodder fed to the animals. It contains 0.5% N, 0.2% P_2O_5 and 0.5% K_2O. Urine contains 1% N and 1.35% K_2O. *Litter is the straw, peat, sawdust and dry leaves used as bedding material for farm animals and birds.* The N present in urine is mostly in the form of urea which is subjected to volatilization losses. Chemical preservatives are used to reduce losses and enrich FYM e.g. gypsum, kainite and super phosphate. These preservatives absorb urine and prevent volatilization loss of urea and also add nutrients.

A.2 COMPOST

Compost means 'a product obtained by the controlled decomposition of organic wastes (*composting*), finally used as organic manure'. Composting is the process of reducing animal and vegetable refuse (except dung) to a quickly utilizable condition for improving and maintaining soil fertility. The final well decomposed manure having lower C: N ratio is termed as 'compost'. The recycling of organic materials by biological decomposition as manure is very important for organic farming as it kills weed seeds, pathogenic organisms, and dispose off agricultural / industrial wastes to produce a uniform, slow release organic fertilizer which stimulates soils life, improve soil structure and control insect-pests and diseases. Compost contains 0.5-0.15-0.5 N,P,K, respectively.

A.3 BIOGAS SLURRY

Instead of directly using the animal dung for composting it can be used for production of biogas by feeding through Biogas Plants. It contains (1–1.8% N, 0.4–0.9% P_2O_5 and 0.61% K_2O) due to low volatilization losses of ammonia.

A.4 NIGHT SOIL (Poudrette)

Night soil is human excreta, both solid and liquid. It contains 5.5% N, 4% P_2O_5 and 2% K_2O. The dehydration of night soil, as such or after admixture with absorbing materials like soil, ash, charcoal and sawdust produces a poudrette that can be used easily as manure.

Poudrette contains about 1.32% N, 2.8% P_2O_5 and 4.1% K_2O.

A.5 SEWAGE AND SLUDGE

1.1.1 The solid portion in the sewage (human excreta + water) is called *sludge* and liquid portion is *sewage water*. It can be recycled for crop fertilization, irrigation to the crop, aquaculture production, application to forest land, biogas production and land reclamation. It was estimated that total waste generated by 217 million people in urban areas is 39 mt/ year (2001). The total NPK content of this would be 2.5 lac tone of N, 2.6 lac tone of P and 2.6 lac tone of K. Both the components are separated and are given a preliminary fermentation and oxidation treatments to reduce bacterial contamination and offensive smell, otherwise soil quickly becomes "**sewage sick"** owing to the mechanical clogging by colloidal matter in the sewage and the development of anaerobic organisms which not only reduce the nitrate already present in the soil but also produce alkalinity. These defects can be removed by thoroughly aerating the sewage in the settling tank by blowing air through it. The sludge that settles at the bottom in this process is called "**activated sludge"** (3.6% N, 2% P_2O_5 & 1% K_2O).

A.6 SHEEP & GOAT MANURE

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 fecal 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	2.20	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

Blood manure contain about **13-20%N**, rich in **Iron** and its application gives a deep rich colour to foliage,.

B.5 HORN & HOOF MEAL

A healthy animal can give about 3 to 4 kg of horn and hoof. These materials are dried, powdered, bagged and marketed as manure. It contains 13% N.

B.6 GUANO (Bird / Fish)

The excreta and dead remains of the bird is called *bird guano* (11-14% N & 2-3% P_2O_5) and the refuse left over after the extraction of oil from the fish in factories, dried in cemented yards and used as manure is called as *fish guano* (7% N & 8% P_2O_5).

B.7 RAW BONE MEAL - An excellent source of organic phosphorus. It contains 3 to 4% N and 20 to 25% P_2O_5.

3.2 VERMICOMPOSTING

Definition: The process of composting organic wastes through domesticated earthworms under controlled conditions is vermicomposting.

Earthworms have tremendous ability to compost all biodegradable materials. Waste subjected to earthworm consumption decompose 2 to 5 times faster than in conventional composting. During composting the wastes are deodorized, pathogenic micro-organisms are destroyed and 40 to 60 % volume reduction in organic wastes take place. It is estimated that the earthworms feed about 4 to 5 time their own weight of material daily.

Earthworms bears both male and female reproductive organs. However, two worms are needed for successful copulation. The self fertilization does not occur generally in the earthworms. Fertilization take place in the egg case or cocoon.

Earthworm species such as Eisenia foetida, Eudrilus eugeniae, lumbricus rubellus, L. mauritee and perionix excavatus have been recommended for vermiculture technology. Vermicompost is the compost which is prepared by earthworms. It is a mixture of worm casting (faecal excretions) organic materials including humus, live earthworms, their cocoons and other micro organisms.

Vermiculture : It is the process of rearing and breeding of earthworms in controlled condition and presently it is known as earthworm biotechnology. It is estimated that 1800 worms which is an ideal population for one sq. meter can feed on 80 tonnes of humus per year. Faecal matter or excretions of earthworms is known as vermin cast. Vermi wash is a liquid fertilizer collected after the passage of water through a column of worm activation, which is useful for foliar spray. It may be diluted with water before use. It can also be diluted with 10% urine of cow. The average nutrient content of vermicompost is about 0.5 to 0.9- 0.1 to 0.2- 0.67 % N,P,K respectively.

3.2.1 TYPES OF EARTHWORMS

There are about 3000 species of earthworms reported in the world. Among them 509 species are available in India. Some of the important species used for vermicomposting are

Eisenia foetida, Eudrilus Eugenia, Lampito mauritii, Pherionyx excavatus, Octochaetoma serrata, etc. These earthworms are mainly divided into two groups viz., i) ***Epigeic*** (Surface feeder) - which feeds at or near the soil surface, mainly on plant litter, dead roots and other plant debris. For example *Eisenia foetida, Eudrilus Eugenia, Lampito mauritii, Pherionyx excavatus, Octochaetoma serrata* etc. are very important for vermicomposting.
ii) ***Endogeic*** (Geophagus/humus feeder) – which feeds deeper beneath the soil surface, ingesting large quantity of organically rich soil. Not suitable for vermicomposting.

3.2.2 CHARACTERISTICS OF COMPOST WORMS

The following are the basic characteristics of earthworm species suitable for vermicomposting:

i) The worms should have feeding preference and adaptability to wide range of organic materials. ii) It should be efficient converter of plant/animal biomass to body proteins.
iii) It should be tolerant to diseases, wide adaptability to environmental factors and have least inactivity period.
iv) It should have high consumption, digestion and assimilation rates v) The worms should produce large number of cocoons.
vi) Growth rate, maturity from young one to adult stage should be fast.
vii) The worms should feed near the surface of organic matter.

3.2.3. **VERMIWASH – A liquid manure**: It is a transparent pale yellow coloured fluid collected after the passage of water through a column of worm action **or** it a collection of excretory products and mucus secretions of earthworm along with nutrients from the soil organic molecules. It is very useful as a foliar spray to enhance the plant growth and yield and to check development of diseases.

3.2.4 BENEFITS OF VERMICOMPOST

1. When added to clay soil, loosens the soil and provides the passage for the entry of air.
2. The mucus associated with it being hygroscopic, absorbs water and prevents water logging and improves water holding capacity.
3. In the vermicompost, some of the secretions of worms and the associated microbes act as growth promoter along with other nutrients.
4. It improves physical, chemecal and biological properties of soil in the long run on repeated application
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.

3.2.5 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.

3.3 GREEN MANURING

3.3.1 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.

3.3.2. 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 improve 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.

3.3.3 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’

3.4 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. *harvest refuse* (straw, stubbles, haulm of different crops) and *process wastes* (nut shell, oilcakes and cobs of maize, bajra and sorghum). *Crop residues* are defined as 'the non-economic plant parts that are left in the field after harvest and remains that are generated from packing sheds or that are discarded during crop processing'. The *benefits* of proper organic residue recycling are that they supply essential plant nutrients, improve soil properties, protect the soil from erosion hazards, reducing residue accumulation at the sites they produced, providing employment as well as income to many, enhancing environmental qualities and illustrate that man is not a waste generator but also its wise utiliser/ manager.

3.4.1 METHODS OF RECYCLING

Organic residues can be recycled in soil by different methods like incorporation, burning, surface mulching, composting etc.

a. ***Incorporation*** - The crop residues like maize, rice, sorghum, wheat straw can be directly applied to the field and ploughed in the soil before the rainy season has beneficial effect on soil properties. Farm wastes can be ploughed in the soil ((0-20 cm layer). After harvesting of cotton, sugarcane, sorghum etc. can be incorporated into the soil by use of rotavator implements which directly adding small pieces of crop residues in the soil.

b. ***Burning*** - A large quantity of sugarcane trash, cotton stalks, caster stalks etc are available and many farmers burn them in the field. It is not advisable practice as burning kills the soil fauna and flora, increases losses of N, C, S and possibly some other nutrients in volatilization and results in unfavorable soil conditions. Although burning releases Ca, Mg and k from crop residues but increases the potential loss due to leaching and erosion.

c. ***Surface mulching*** – One unique and simple way of profitable recycling the crop residues is their use as surface mulching materials. Mulches are thermo insulators, have smother effect on weeds, protect the soil from rain drop impact, reduce salinisation and barriers to vapour transfer thus conserve soil moisture. It is also beneficial for soil micro organisms and on degradation adds organic matter to the soil.

d. ***Composting*** – As discussed earlier compost is the stabilized and sanitized product of composting which is beneficial to soil health and plant growth. A huge quantity of crop wastes/residues and animal wastes are always available on a farm. Properly recycled, these residues form excellent compost in one to six months, depending upon the composting process used. The important methods of composting are NADEP compost, vermicompost, sugarcane trash compost, obnoxious weed compost and recycling of pond silt accumulation alone or by enriching composting units.

3.5 BIO-FERTILIZERS (*Microbial inoculants*)

The atmosphere over an hectare of land consists of 80,000 tones of N. Though atmospheric N is present in sufficient quantity (80%), it is not available to plants since it exists in inert form. Biological nitrogen fixation is the conversion of atmospheric N

by living organisms into forms that plants can use. This process is carried out by a group of bacteria and algae which fix atmospheric Nitrogen (N_2) in to assimilable forms of nitrogen (NH_3)

It can be defined as bio-fertilizers or microbial inoculants are preparations containing live or latent cell of efficient strain of N-fixing or P-solubilizing micro organisms used for seed or soil application with the objectives of increasing the numbers of such micro organisms in the soil or rhizosphere and consequently improve the extent of microbiologically fixed N for plant growth.

3.5:1 Use of bio-fertilizers

Azospirilum is applied as seed treatment or soil application in crop like rice, sugarcane, pulses, soybean and vegetables. It increase in root length, top dry weight, root dry weight, total leaf area and yield were reported. The inoculants like nitroplus (legume inoculants) and VAM (*Vesicular Arbuscular Micorrhizae*) are also effective for crop yield improvement. The *Bacillus* sp. and *pseudomonas* sp. are help full in synthesizing the insoluble form of phosphorus. The combined application of phosphobacteria, rock phosphate and FYM to commercial crops have greatly unhanced biomass production, uptake of nutrients and yield .

3.5.2 Enrichment of compost with microbial inoculants.

Compost prepared by traditional method is usually low in nutrients and there is need to improved its quality. Enrichment of compost using low cost nitrogen fixing and phosphate solubilizing microbes is one of the possible way of improving nutrient status of the soil. It could be achieved by introducing microbial inoculants, which are more efficient than the native strains associated with substrate materials. Both the nitrogen fixing and phosphate solubilizing microbes are more exacting in their physiological and ecological requirements. The only alternative is to enhance their inoculum potential in the composting mass.

3.5.3 Benefits of bio- fertilizers in organic farming

- Bio-fertilizers are eco-friendly and do not have any ill effect on soil health and environment.
- They reduce the pressure on non-renewable nutrient sources/fertilizer.
- Their formulations are cheap and have easy application methods.
- They also stimulate plant growth due to excretion of various growth hormones.
- They reduce the incidence of certain disease, pathogen and increase disease resistance.
- The economic benefits to cost ratio of bio-fertilizers is always higher.
- They improve the productivity of waste land and low land by enriching the soil.

3.5.4 Types of Bio-fertilizers

a. Biological N fixing micro organisms
b. Phosphate solubilizing and mobilizing micro-organisms
c. Potash solubilizing micro-organisms
d. Sulphur mobilizing micro-organisms
e. Arbuscular mycorrhizal fungi
f. Growth promoting substance excreting micro-organisms

a. Biological N-fixing micro-organisms

Biological N-fixing micro-organisms heps in reduction of atmospheric N_2 to NH_3. The N-fixing organisms such as Rhizobium spp. which live in symbiotic association with roots of leguminous vegetables, forming nodules and free living fixers Azotobacter spp. and Azospirillum spp. Which live in association with root system of crop plants. There are two types of rhizobia; (i) the slow growing Bradyrhizobium and (ii) the fast growing Rhizobium. Azospirillum fix N from 10 to 40 kg/ha and saves N fertilizer inputs by 25 to 30%. Azotobacter inoculation saves N fertilizer by 10 to 20% **a.1: Rhizobium and bradyrhizobium**

They symbiolically fix N with leguminous plants increasing the amount of available N for uptake by plants. The quantum of N fixation ranges from 50-300 kg N/ha/crop under most optimum conditions. i.e. cow pea 80-85 kg/ha, Red gram 168-200 kg/ha, G.nut 50-60 kg/ha & lucerne 100-300 kg/ha can fix symbiotically N by legume crop root nodules. An increase in yield about 10-20 % has been observed in pulses treated with Rhizobium.

a.2: Azola

Azola symbiotically can fix 30-100 kg N /ha & increase in yield up to 10-25% and also survive at high temperature in flooded rice crop. **a.3: Azotobacter**

Azotobacter us a free living aerobic N-fixing bacteria can fix 10-25 kg N/ha/season in cereals. 50% of N requirement of crop can be reduced through Azotobacter inoculation along with FYM. A. *chroococcum* is the dominant spices in arable soils. Vegetable crop such as tomato, brinjal and cabbage responded better to Azotobacter inoculation than other crops. **a.4: Azospirillum**

Azospirillum inoculation helps to fix nitrogen from 15 to 40 kg/ha. It is useful in cereals for better vegetative growth and also saving inputs of nitrogenous fertilizers by 25-30 %

A:5 Beijerinckia :

Its production is high in acidic soils. B. idica is a common species. It is generally present in the rhizosphere of plantation crops such as coconut, arecanut, cashewnut, cocoa and pepper.

b. Phosphate solubilizing and mobilizing micro-organism.

Several soil bacteria particularly pseudomonas straita and Bacillus polymixa and fungi Aspergillus awamori and penicilium spp. poses the ability to bring insoluble phosphates into soluble forms by secreting organic acids. Arbuscular mycorrhizal fungi (AMF) are also responsible for converting fixed Phosphorus into available phosphorus through inoculation of efficient strains of AMF, 25 to 50 % of P fertilizer can be saved. **c. Potash solubilizing micro-organisms**

The bacterium, *Frateuria aurantia* was isolated from banana plant from Orissa soil. These bacteria have solubilizing power of 90% within 22 days when the mineral source of K is in fixed form. These bacteria were tested on banana and paddy which increased the yield by 20 & 25%, respectively. It can be used as soil application for all types of crops @ 2.5 kg/ha. It can be mixed with @ 200-500 kg FYM in furrows before sowing. The bacterium can save up to 50-60 % of cost of K fertilizer. **d. Sulphur mobilizing micro organisms.**

Sulphur present as insoluble sulphur form at 30-35 cm deep in soil and are associated with oxides of iron and aluminium. *Acetobacter pasteurianus* helps in converting this nonusable form to usable form. The use of 625 g/ha of A. pasteurianus influenced the levels of

sulphur in crops like vegetables, cabbage, turnip, onion etc. **e. Arbuscular mycorrhizal fungi (AMF)**

AMF improve plant growth through better uptake of nutrient like P, Zn, Cu etc. and make the plant root more resistant to pathogens, improve soil texture, 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.

CHAPTER – 4
SOIL IMPROVEMENT AND AMENDMENTS

Introduction

Conversion from conventional to more sustainable organic farming systems improves the practices such as replacing chemical fertilizers with organic amendments. However; it requires fine tuning with nature. Organic amendments increase or maintain soil fertility and biological activity.

Transition to organic farming system can not be done quickly. To increase soil humus it needs careful and sustained management of organic matter. Humus can not be brought from out side. It has to be created within the soil by action of soil microorganisms in presences of adequate soil organic matter.

To sustain the life in soil, several techniques are involved including conservation of soil and moisture, maintenance of soil organic matter, prevent loss of soil nutrients, adopting tillage practices suited to the local condition, maintain mulching, cover crops and supply of adequate quantity of FYM or compost to improve soil texture and structure. Various soil building practices are explained as under;

4.1 Soil improvement:

The following soil improvement practices can be necessary for development:-

- Deepening of top soil (deep ploughing, ridging, breaking up of soil crust)
- Soil layer mixing
- Sub soil breaking
- Improvement of soil texture and soil structure (Stone or rock removal, organic matter addition)
- Irrigation with quality water (Sprinkle, furrow irrigation)

4.2 Addition of mineral amendment

- Dolomite
- Lime
- Rock phosphate/Guano phosphate
- Gypsum
- Zeolite

4.3 Elimination of excessive salts

- Inundation (flooding): Salts are dissolved in the water and leached down in the deeper layer of the soil.

4.4 Organic matter management

In organic farming soil is fed and not to the crop. The soil has to hold the organic matter and create condition for the micro-organisms to work on it to release the nutrient as per the need of the plants. For maintenance of organic matter may be done by adopting following practices:-

- Composting – use of live stock and human waste, crop residue, weeds, tree waste, sewage and sludge.
- Crop rotation – Follow the pulses after cereals.
- Mixed /Inter cropping- Grow the crops by mixing different seeds or row ratio should be maintained of different crops. i.e. bajara : tur :: 2:1, Ground nut: tur :: 3:1
- Green manuring : Grow the sun hemp and dhaincha as green manuring crops.
- Cover cropping: Legume crops should be sown
- Organic mulching: Use of byproducts of different crops for mulching.
- Agro industries waste: use of oil cakes, paddy husk, bran, bagasse, press mud, saw dust, fruit and vegetable wastes, tea and tobacco wastes, coir and cotton wastes.

Importance of organic matter:

The organic matter incorporated into the soil becomes available as energy and material sources for feeding by various soil organisms. The activated and diversified soil microorganisms decompose and reproduce various organic and inorganic substances. Many of these substances are beneficial to crops as nutrients and growth regulating substances. Some of the organic substances bound soil particles to form soil aggregates. The aggregated and structured soils provide favourable habitats for various micro flora and fauna and also important for retention and transmission of water, air and heat. Such diversified biological community also suppresses the disease causing organisms/pathogens. Good structured and aggregated soil also improves water holding capacity and air permeability. These changes improve root development of the crops and increase the yield and quality.

Organic matter also useful for reclamation of salt affected soils. It counteracts the unfavorable effect of exchangeable sodium. The decomposition of manure and plant residues liberates carbon dioxide and organic acid which help to dissolve any insoluble calcium salts in soil solution and neutralize alkali present. Rock phosphate application provides favourable effect in building up the soil structure.

By adopting soil building practices, nitrogen comes from a variety of sources, including composts, organic amendments, green manuring plants and soil organisms. The decomposition of these materials increases organic matter and improves structure of soil. It may reduce loss of nitrogen by increased cation and anion exchange capacities, extensive root systems and

biomass. The weeds are managed to maintain as low as do not cause a significant reduction of crop growth, because it becomes an important part of a system as N reserves.

Fresh organic matter has a break down rate of 50 – 80 % after the first year of application. Stable humus break down very slowly that is 2-5 % a year. This means that the fresh organic matter contributes to the nutrient availability and the moisture availability of the soil but it does little to improve the structure of the soil. The soil structure may improve by the stable humus.

CHAPTER-5

INTEGRATED DISEASE AND PEST MANAGEMENT, USE OF BIO CONTROL AGENTS, BIO PESTICIDES, PHEROMONES, TRAP CROPS, BIRD PERCHES.

Introduction:-

The use of synthetic chemicals to manage pests has a number of disadvantages which cause environmental pollution, phytotoxicity, ground water contamination and adversely affect the soil and its biotic environment. Indiscriminate use of synthetic pesticides resulted in insecticide resistance, resurgence and accumulation of pesticide residues in food, fruits and vegetables.

Integrated pest management measures are either preventive or curative. Control of insect pest relies on understanding of the pest life cycle, behavior and ecology. It involves natural enemies, host resistance and cultural practices.

A. CULTURAL METHODS

Cultural control is just a modification or manipulation of the environment to the disfavour of pests by disrupting their reproductive cycles, eliminating their foods, destroying their weed hosts or making the environment more favourable for predators, parasitoids and antagonists. The important cultural practices suitable for organic production to reduce the severity of insects, pests and diseases are as follows.

1. **Tillage operation :-**

   Plowing or hoeing helps to expose stages of soil inhabiting insects to sun or predatory birds. Earthing up of soil in sugarcane reduces seedling borer infestation.

2. **Field and plant sanitation: -**

   Regular removal of weeds, pest-affected plant parts, crop stubbles and their destruction will eliminate the sources of infestation of the diseases and pests. Distraction of bored shoots and fruits of brinjal, okra prevents further build up of the pest population. Many virus diseases like leaf curl, bud and stem rot of tomato, groundnut and sun flower can be minimized by uprooting the infected plants.

3. **Crop rotation :**

   Growing of a non host crop after a host crop of the pest will break the breeding cycle of pest species and reduce their population. Like wise, crop rotation prevents the build up of plant pathogen in soil.

4. **Growing of pest resistant varieties** :

Certain varieties of crops are less damage or less infested than other by insects. The resistant varieties have physical and physiological features, which enable to avoid pest attacks. i.e.

Crop	Tolerant / Resistant variety	Pest/Disease
Cotton	L.K.861, Kanchana	White fly
	L-603, L-604,	Jassids
	Narsimha	Helicoverpa
Groundnut	Vemana, Tirupathi, ICGS-11	Bud rot
	Kadiri, ICGS-10	Leaf spot
	ICGV-86325	Multiple resistant to pests & diseases
Red gram	ICPL-332 (Abhaya)	Pod borer
Castor	JI-144	Capsule borer

5. Trap cropping

Some crops are more preferred by the pests for feeding and egg laying are grown as trap crops on the bunds of the main crop or 1 row after 10 rows. Removal and destruction of egg masses and small larvae from trap crop reduce the pest population i.e.

Crop	Pest	Trap crop
Cotton, Groundnut	Spodoptera	Castor, sunflower
Cotton, chickpea, pigeonpea	Helicoverpa	Merigold
Sesamum	Red hairy cater pillar	Cowpea
Green gram	Red hairy cater pillar	Sunn hemp

6. **Water management** :

Flooding of field whenever possible; kills root grubs, termites and soil borne plant pathogens. Draining of water for a few days in paddy fields supprss brown plant hopper population

7. **Adjusting time of sowing** :

The simultaneous sowing of crops in a locality helps in reducing pest damage. Many a times early sown crops escape pest attack i.e. Jowar crop sown before the end of June months usually escapes attack by shootfly.

B. MECHANICAL METHODS :

Hand picking of egg masses, gregarious larvae and sluggish/ lazy adults and their distruction helps in reducing of pest population

1. **Use of phenomones and light traps** : sex pheromones are mostly emitted by female insects to attract the male insect for matting. Such chemical compounds can be prepared in the laboratory and make available as lures for use in traps. These pheromones & also light traps attract the insects in large numbers to the traps, where they get trapped and killed.

Pheromones are non toxic, species specific, safe to other organisms, plants and environment. Generally at least 5 traps/ha are recommended for monitoring for each pest species.

2. **Use of yellow sticky traps** :
   It is used to monitor aphids and white fly.
3. **Erecting bird perchase** :
   Bird perches helps in attracting birds, keep water in small bowl and spread cooked yellow rice to attract insectivorous birds.
4. **Soil solarization** :
   Soil solarization by mulching the soil with polythene cover for 3-4 weeks during summer months results in killing of soil borne pathogens and weed seeds.
5. **Use of nylon net**
   Growing of vegetable nurcery under nylon net drastically reduces pest population and virus/ mycoplasma diseases by preventing the entry of vectors.
6. **Hot water treatment** :
   For the control of nematode problem in planting stock of banana suckers soaked in hot water for 25 minits at 55^0C temperature.

BIOLOGICAL METHODS

Biological control means "The utilization of any living organisms for the control of insect-pests, diseases and weeds. This means use of any biotic agent for minimizing the pest population either directly or indirectly. Conservation of these biotic agents in the field or multiplying in the laboratory and releasing in the fields is called biological control.

ADVANTAGES OF BIOLOGICAL CONTROL

1. Bio-control is exercised in a wide range of area and it is safe for human as well as animal health.
2. Application of biotic agent is easy and possible even in inaccessible areas like forests, tall trees, podns, rivers, lakes, revines etc.
3. The bio agents survive in nature till the pests is prevalent and self perpetuating in nature.
4. There is no need for any special equipments like sprayer, duster except for some microbial preparation
5. No waiting period is required for harvesting of the crops.
6. Biological agents like parasitoids and predators, etc may be multiplied at farmer's level.
7. This method is very economical ones the method is developed, it is usually free of charges for the farmers.

Some of the important bio-control agents are,

1. **Predators:** The predators are feeding several of the insect-pests during their life cycle and hold a key role in minimizing pest population under field conditions. The common predators are birds, spiders, dragonflies, ladybird

beetles, ground beetles, ants, chrysoperla etc; are helps to control sucking pests, pod borer eggs and larvae i.e.

Sr. No.	Predators	Pest controlled
1.	Chrysoperla	Soft body insects like aphids, White hay, leaf hoppers, thrips etc.
2.	lady bird beetle	Aphids, mealy bugs
3.	Spiders	Insects

2. **Parasitoids**: These insects are always require passing at least one stage of their life cycle inside the host. The tiny adults of parasitoids search for the host eggs and parasitise them, i.e. they lay their own eggs within the egg of the pests. On haching, the parasitoid larva feed on the embryonic content of egg. Thus kill only one host insect during their life. However, due to their high multiplication rate they are of vital importance in the bio-control agents. For ex.

Crop	Pest	Parasitoids	Dosage/ha
Cotton	Boll warms	*Trichograma chilonis*	1,50,000
Sugarcane	Early shoot borer, stock borer	--"--	50,000
Paddy, Maize	stem borer	*T. japonicum*	50,000

3. **Biological chemicals :**

The pesticides derived from living organisms are biopesticides. These products are more selective, eco-friendly and leave no toxic residues in the environment. The Identification of natural chemicals open new era of pest control. These chemicals do not kill the insects, but either attract, repel or modify their usual behaviour. Behaviour modifying chemicals which reduce matting frequency or release large numbers of sterile insects, control pests biologically by reducing their numbers.

Biochemical	Pests	Action
1. Nim oil	Grass hopper, leaf minor, white flies, scales, mealy bugs pod borer, moth etc.	Azadiractin acts as a repellent antifident (Azadirecta indica)
2. Nicotin sulphate	White flies, Aphids, Jassids, Helicoverpa	Nicotin sulphate acts as a contact poison and fumigant
3.Pyrethrum/ pyrethrins	Ants, aphids, fliees, ticks	The trade name pyrenone is a contact poison act as pyrethroids
4. Limonene	Pests of pet animals such as fleas, lice, mites, ticks etc.	Trade name d-limonene and linalool extracted from orange or citrus fruit- peels act as contact and fumigant

4. **Microbial insecticides**: These products are obtained from micro organisms such as bacterium, soil borne actinomytes and fungal pathogens. The insecticidal crystal proteins produced by the bacterium, *Bacillus thuringiensis kurstaki* are effective against lepidopterous pest species. These toxins are very specific in their action, easily biodegradable and being stomach poisons, safe for non-target organisms they are as follows.

No.	Bio control agent	Crop	Pest/ disease	Remarks
1.	Trichoderma harzianum Trichoderma viridae	Tomato, chille, Brinjal, G.nut	Root rot, stem rot, blight, damping-off, wilt, nematodes	Fungal antagonists, soil treatment
2.	Pseudomonas florescenes	Banana Tomato Potato Chilli	Wilt Wilt, white rot Tuber rot Fruit rot Die back	Sucker Treatment Soil treatment Seed treatment Seed & Seedling treatment
3.	Bacillus thurengensis	Cotton Cabbage, Tomato, Gram etc.	Lepidopterous pests	Foliar application
4.	Verticillum lecanii	Cotton, Vegetable crops	Aphid, whitefly	--"--
5.	Beauveria bassiana	Gram, Tobacco Cotton tomato	Pod borer, cater pillar, thmps aphids, mealybugs	Spray application
6.	Nuclear polyhedrosis viruses (NPV) Granylosis Viruses (GV)	Chickpea, Maize, sunflower pigeon pea	Heliothis spodoptera	Spray the extraction of 250 crushed larve/ha

5. **Mineral Insecticides**

Sulphur : Sulphur is the oldest known pesticide & currently it is used. It can be used as dust, wettable powder, paste or liquid for control powdery mildews, rusts, leaf blight etc. Sulphur damage the plants, when it is applied in hot (above 90^0 F) and dry weather. Do not use sulphur where recently oil compound have been sprayed, it reacts with the oils to make a more phytotoxic combination.

CHAPTER-6

WEED MANAGEMENT

Introduction:

Increased use of herbicides have resulted many problems. The environment safely has been doubted with increased pollution hazards. That apart, weed species are developing resistance to chemical toxicants. In India, continuous use of isoproturan in wheat crop has resulted in the development of resistance in *phalaris minor*. More over there is also problem of resurgence of weeds. In organic farming weeds can be managed by the following methods;

A: Preventive methods:

Preventive method of weed control include use of weed free crop seeds, weed free manure, clear equipments and elimination of weed infestation in and around irrigation channels and cultivated fields.

B: Cultural methods :

Smother crops are highly competitive with the weed species infesting an area for light, nutrients and moisture. The crops such as barley, millet, sorghum, alfalfa, clover, cowpea, susbania, sunflower etc. creating problems. Other cultural methods are sowing of cover crops, crop rotation, line sowing, maintaining optimum plant population, drip irrigation etc. which reduces weed problems.

C: Mechanical methods:

This method includes such practices as hand weeding, hoeing, moving, flooding, mulching, burning and tilling the soil for the reduction of weeds.

D: Soil solarization:

This is an eco-friendly technology used tokill weed seeds in soil. It involves mulching of soil with clear plastic films so as to trap the solar heat in the surface soil. The resultant temperature increase would be lethal to soil pathogens, nematodes and weeds. This method can be use where air temperature goes up to 45 ^{0}C during summer months. It is efficient in weed where bright sun light is available for about 4-6 weeks.

E: Biological methods

This method involves utilization of natural enemies for the control of certain weeds. This can be achived by direct or indirect action of biological control agents. In direct action, firstly the bio control agent bores into plant, weakens its structure which leading to its collapse and consumes as food and destroys the vital plant parts. In indirect action the bio control agent reserves the competitive ability of weed over other plants and enhances the condition favorable for plant pathogens.

E_1: INSECTS:

For bio-control of weeds, the insect selected should specifically attack on the targeted weed without harming the other plants.

S.N.	Weed species	Bio-agent	Remarks
1.	Prickly pear cactus	*Cactoblastis cactorum*	By leaf feeding beetle

2.	Water hyacinth	*N.bruchi*	By leaf eating grass hopper
3.	Parsitic weed Orobanche 'sp.	Fusarium oxysporium fungus and fly (sipha maidis) & Aphis table insects	Fungus & Insects both are used

E_2 : PLANT PATHOGENS

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. This technique holds promise because reduced quantities of spores are needed, when seedlings are small and emerging

Mycoherbicide	Fungus used	Weed controlled
De vine	Phytophthora palmivora	Milk weed vine
Velgo	Colletotrichum coccodes	Velvet leaf
Collego	F.sp. aeschynonene	Northen joint vetch

F: Allelopathy :

Inter-weed-competition determined by allelopathy can be manipulated in the natural control of weeds. Natural compounds released by some platns inhibit or prevent the grouth of nearby plants. Merigold flowering plant is found to suppress the growth of parthenium. Thistle exudation inhibits the growth of oats. Wheat, oats & peas suppress the growth of *Chenopodium album*. The crop residues from alfalfa, sunflower, wheat, corn and soybean are toxic to weeds.

CHAPTER-7

QUALITY CONSIDERATIONS, CERTIFICATION, LABELING AND ACCREDITATION PROCESSORS

Introduction:

In order to assure the consumer that a product is produced organically, a kind of quality control is needed. The organic quality is based on standards, inspection, certification and accreditation. All organic food is produced and handled according to strict rules called "Organic standards". These standards cover all aspects of food production from animal walfare and wide life conservation, to not allowing artificial food additives. All organic farms are visited at least once in a year by a certifying Inspector to check that standards are being met. Organic standards do not define a quality status, but can be measured in the final products (e.g. quantify of pesticides residues, heavy metals etc.) They define the way of production (e.g. no chemical pesticides and fertilizer are used). There are organic standards on the national as well as international level. For certification, the standards of the target market or importing country are relevant. Certain private labels such as Naturland, Demeter, Codex, IFOAM, Bio Issue, Soil association have additional requirement on top of their national and international standards.

Quality considerations

For the maintenance of quality for organic product, certification is an important prerequisite for the acceptability of organic products or foods as organic by Government Regulatory Authorities, exporters, importers, as well as consumers across the world.

It is necessary to verify the validity of the claims of the farmers about the organic foods and of middleman as well as good processors that their produce for sale is organically grown and processed. For the organic produced foods are assessed through various techniques such as Kirlian photography, microbiological tests, bio-chemical tests etc. for which there is need for perfect production system having specific standards have to be promoted for adoption by the farmers and food processing Entrepreneurs.

- Organic certification exists to provide consumers with the assurance that claims made by sellers of organic product have substance in fact "Certified organic" gives surety that products were produced and or processed under conditions required by National standards or International standards for organic production.
- The farming unit for organic production was to be supervised and inspected at frequent intervals and at different stages of production before certification in order to ensure quality and authenticity.
- The certification agency has to be adopt very reliable methods such as; ○ Soil test ○ Water quality tests ○ Food quality tests
- Once the produce is certified as ORGANIC, the producer or the processor are entitled the symbol.
- It is necessary to keep the records of all management practices and materials used in organic production for five years.

Certification:

Certification for organic farm is an essential pre-requisite for marketing their produce, especially in the international markets. This is done mainly to ensure genuineness of organically farm products reaching the market and consumer. The certificate issued by an accredited agency is the attestation of the organic method of production of the products.

"Certified organic refers to agricultural products that have been grown and processed according to uniform standards, verified by independent state or private organizations accredited by the standard setting organization". Certification includes inspection of farm, fields and processing facilities. Farm practices inspected such as long-term soil management, buffering between organic farms and any neighboring conventional farms, product labeling and record keeping are being followed.

A certification committee decides whether certification may be granted or not and then the agency issues approval of denial or certificate. Certificate is given for current years harvest only and hence annual certification is required.

Types of certification

World wide, inspection and certifications of organic foods is carried out by two sets of guidelines and norms namely (i) Statutory certification norms & (ii) Voluntary/ Civil certification norms.

(i) Statutory certification norms : It includes legal guidelines set by Government, which is related to certification of organic produce, regulatory governing import of organic foods, rules regarding equivalence between countries etc.

(ii) Voluntary/ Civil certification Norms : The Norms are stricter then statutory certification norms. It includes National and International agency and association such as Soil Association of U.K., Organic Growers Association in various countries etc.

The most highly accepted voluntory certifications are from agencies like CODEX, IFOAM, Natural land, Demeter and Soil association etc.

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°C to 100 °C to inactivate enzimes 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 :**

Freering 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 freering. The degree of freezing depends on the duration of storage eg.

Practical storage life of frozen products

Products	Practical storage life (M ɔnth)		
	-18°C	-25°C	-30°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. Solt can be used for drying. The salt adids in dehydration and anti-microbial activity.

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°C) for 1 min
Cabbage	Boiling water 3 min
Carrot	Boiling water 4-6 min

6. **Rapid Drying** :

Sun drying is mostly used for organic fruits such as figs, bananas etc, but there is risk to quality and the difficulty of maintaining a high degree of sanitation. Hence a rapid drying is followed.

Drying condition, moisture content and storage life of food products.

Fruits/ vegetable	**Drying temp (°C)**	**Moisture content (%)**	**Storage life (Month)**
Mango	55	14	6
Banana	55	12	6
Tomato	55	6	6
Onion	50-55	5	3-12

Labeling :-

The label should convey clear and accurate information on the organic status of the product. The labels for organic products should be distinquishable by different coloured labels. The details like name of the product, quality of the product, name and address of the producer name of the certification agency, certification, lot number etc. are to be given in the label. for example;

Information required on the label

Crop	**OG (Organic Ginger)**
Country	I (India)
Field No.	05
Date of harvest	32 (1st Feb.)
Year	2009
Lot No.	OG I 05 32 2009

Lot No. is helpful in tracking back the product particularly field number in which it is grown in case of contamination. Lot number should include the crop, country, field number, date of harvest and production year.

Packing :

For packing, recycling and re usable materials like clean jute bags should be used. Use of biodegradable materials can also be used. Un necessary packaging material should be avoided. Various types of packaging materials are used for packing such as bamboo baskets, gunny bags, card board, paper, glass, metal, wooden box, plastic crates and ventilated corrugated fibre board (CFB) box for safe handling.

CHAPTER-8
STANDARDS AND ACCREDITATION FOR ORGANIC FARMING

I. Standards For Organic Farming

Standards refers the rules of the production for organic agriculture. They determine the production process within the ecological and social environment through, which the product emerges. Some of the standards are as follows :

1. **IFOAM Basic standards :**

   The basic standards for organic production and processing (IBS) of the International Federation of Organic Agriculture Movement (IFOAM) were first published in 1980. The IFOAM basic standards define how organic products are grown, produced, processed and handled. The IFOAM basic standards provide a frame work for certification bodies and standard setting organizations world wide to develop their own certification standards and can not be used for certification on their own. Certification standards should take into account specific local conditions and provide more specific requirements than the IFOAM basic standards. Producer and processors that are sell organic products are expected to work within, and be certified by certification bodies, using standards that meet or exceed the requirement of the IBS.

2. **The Codex Alimentarius:**

   The Codex Alimentarius Commission, a joint FAO/WHO Food Standard Program, began in 1991 elaborating guidelines for the production, processing, labeling and marketing of organically produced food. In June 1999 first the plant production and in July 2001 the animal production was approved by the Codex Commission. The requirements in these Codex guidelines are in line with IFOAM & EU regulation for organic food.

3. **The European Union (EU) Council Regulation**

   The EU regulation came into force in 1993. The EU Regulation on organic production lays down minimum rules governing the production, processing and import of organic products, including inspection procedures, labelling and marketing for the whole of Europe. Each European country is responsible for enforcement and for its own monitoring and inspection system. In Feb-2000 the EU Commission introduced a Logo for organic products. The products which possessed 95 % of the ingredients are organic and then the logo may be used for organic products. Such products are eligible for process, package and label as organic products in the EU or on import from countries with an equivalent inspection system.

4. **Indian National Standards for organic production (NSOP):**

In India, standards for organic agriculture were announced in may 2001 and the National Programme on Organic Production (NPOP) is administered by APEDA using the IFOAM Basic Standards (2000) under the Ministry of Commerce. Definite principles, basic standards, documentation, inspection and certification guidelines are approved by the National

Standards Committee constituted by the members of IFOAM in India. Certain responsibilities to define details are delegated to the accredited certification bodies.

As per the national accreditation policy, all the certifying agencies operating in India are to obtain accreditation from any one of the accrediting agency appointed by the Government of India, viz., Spices Board (Kochi), Coffee Board (Banglore), Tea Board (Kalakatta), Coconut Development Board (Kochi), Cocoa & Cashewnut Board and APEDA (New Delhi). Indian standards are compulsory for organic products to be exported and also for domestic market.

II. Accreditation:

Accreditation is a procedure by which an authoritive body gives a formal recognition that a body or a person is competent to carry out specific tasks. Authorized bodies regularly evaluate certification programmes and check their proper functioning according to certain criteria. In case certification body complies with the criteria, they accredit the certification programme.

Position of accreditation in India

National programme for organic production (NPOP) programme in context of Indian accreditation scenario, defined the functions of accreditation agencies are as follows.

1. To accredite the products, which inspected and certified by certifying agency as having been produced as per NPOP programme\
2. To monitor inspections made by the accredited inspection agencies
3. To lay down inspection procedures
4. To advise the national stirring committee on organic production
5. To accept accredited certification programmes if it is confirm to National Standards
6. To prepare an operation manual to assist accredited agencies
7. To implement the certification programmes will be identified by the accredited agency.

Accreditation regulation announced in may-2001, these makes it mandatory that all certification bodies whether international or foreign operating in the country must be accredited by an accreditation agency.

The regulations also make a provision for export import and local trade of organic products, However, currently only the exports of organic products come under govt. regulations. Thus an agricultural product can only be exported as an organic product if it is certified by a certification body duly accredited by APEDA. Organic crop production, organic animal production, organic processing operations, forestry and wild products are the products covered under accreditation.

ACCREDITED INSPECTION/ CERTIFYING AGENCIES.

1. Association For Promotion of Organic Farming-Banglore
2. Bioinspecta- swizerland
3. Ecocert International-Germany
4. Indian Organic Certification Agency (INDOCERT)- Cochin
5. IMO control private limited- Banglore
6. LACONGM BH,-Germany

Branch office in India

1. Mr. Arun Rast, International Resources for Fair Trade Andheri (E) Mumbai

2. Dr. Prabha Mahale- Gurgaon, Hariyana
3. Prof. Dr. K.K. Krishnamurthi, President-ISCOP, Rasi building-Tamil Nadu
4. SKAL Internation (Nether land)
Contect Person : Mr. Narayan Upadhayay, Monarch chamber- Banglore

CHAPTER-9

MARKETING AND EXPORT OF ORGANIC FOOD PRODUCTS

Scope for organic foods:

To become organic, a farmer or operator must be registered with one of the certification bodies and the land/animals have to be converted foe organic farming. It is the responsibility of the certification body to inspect the operator or food producer on a regular basis to ensure that the producer is complying with organic standards.

In recent years organic farming experienced a tremendous growth in many countries. Organic agriculture is currently practiced in more than 120 countries. It is estimated that world wide about 17 millions hectares are managed organically. The share of land area under organic management is highest in some European countries due to the increased consumer awareness of health and environmental issues. The developing countries such as china, India, Philippines, Shrilanka and Uganda are also gaining importance of organic agriculture.

The world wide markets for organic foods are expanding, with three major markets are Europe, United states and Japan, which recording annual growth rates of 15% to 30% for the last five years. According to International Trade Caentre (ITC) projections the organic market size in the year 2010 would be around US $ 46 billion in the European Union, US $ 45 billion in the united states and US $ 11 billion in Japan, according to SOEL survey (2005).

The highest number of organic farms (1,20,000) in Mexico, followed by Indonesia (45,000), Italy (44043), Brazil (14003) and India (5147).

Important organic food products

The main product desired by Euopean, American and Asian contries are tea, coffee & cocoa; grains, pulses and seeds; vegetable oils and fats; edible nuts, spices and herbs; dried fruits, fruit juices and concentrates, sugar and honey.

1. **Tea** : Tea is trades as black tea, green tea, 0olong tea and instant tea.
   Black Tea : Fully fermented tea
   Green tea : Fermentation is suppressed by deactivating enzymes and the leaves retain green colour
   0olong : Partly (Earlier stage) fermented tea. **Instant tea:** Low quality tea
2. **Coffee :** The important varieties of coffee are Arabica & Robusta

Sr. No.	Information	Arabica	Robusta
1.	Share of world prodn	70%	30%
2.	Yield/ha	30% less than Robusta	30% higher than Arabica
3.	Price	30% more than Robusta	30% lower
4.	Site requirement	High sites	Lower sites
5.	Climate requirement	Fluctuation in annual rainfall and temperature	Steady high rainfall and temperature

6.	Main producer	Latin America East Africa	Asia, Africa
7.	Caffeine content	0.6-1.5%	2.0-2.7%
8.	Disease & pest	Susceptible to berry borer & coffee rust	Resistant

Source : FiBL, 2002

3. **Cocoa** : With its strong and fine flavour the Criollo group produces the highest cocoa quality.
4. **Grains :** USA and Canada dominate the market for organic commodity grain products (e.g. wheat, maize & barely) and opportunities for exporters in developing countries.
5. **Pulses :** It includes kidney beens chickpea, horsebean. Trade is small, but important for export from developing countries.
6. **Vegetable oil & fat :** Soya oil, plam oil, coconut oil are important for export from developing countries
7. **Edible nuts :** Groundnut, coconut, cashewnut, walnut and almonds are important for the European trade
8. **Spices & herbs :** The main international trade for spices & herbs is "dried and in crude fonm, (85%) cleaned but not further processed. Other form is crushed or ground spices, essential oils etc.
9. **Fruits :** Apple, orange, banana, fig, mango, papaya, peach, pear, vine fruits, pineapple and dry fruits and other fruits.
10. **Fruit juices and concentrates :** Fruit juices are orange, apple, pineaple and grape fruits are used.
11. **Sugar and molasis :** Sugar produced from sugarcane & sugar beet. A by-product of the can & beat, sugar refining process is molasses, which is used as a raw material for antibiotics, baker's yeast, rum, alcohol and animal feed.
12. **Honey : Five types; These are :**

a. **Acacia :**
b. **Orange blossom :**
c. **Buckwheat :**
d. **Lotus :**
e. **Clover :** Most widely produced & well known type honey**.**

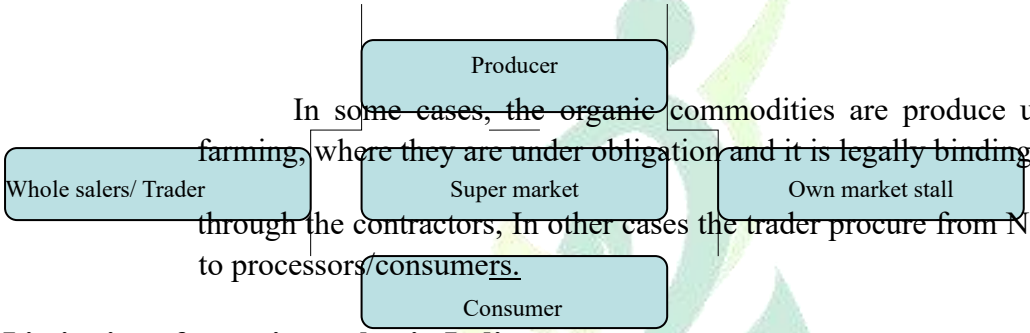
Key characteristics of organic market :

1. **Strong market growth** : The market for organic products will continue to grow in the coming years according to ITC projections, the organic market size in 2010 is estimated to grow multifold to US $ 100 billion in the key market of Eu, USA, & Japn.

2. **Growth in world export from tropical origin :** All tropical products of fruits, vegetables, cereals and other commodities (Tea cottea, cocoa) are produced in the developing countries of Asia, Latin America and Africa. These products are likely to see strong growth in organic exports to Eu, USA & Japan. Non-tropical organic

products are produced in the developed countries and consumed in their own market and hence less likely to offer for export to developing countries like India.

3. **Price premium and consumer behavior :** Prices of organic products are vary with the time and also from one market to another within a region. Most consumers are aware of the advantages of organic farming and are willing to pay certain price premium ranges between 35-100%.
4. **Distribution channels :**
   To day in the developed countries have fastest distribution channels for organic products. Large multinational companies have also their own organic products trading channels. In most of the cases, organic products are brought from the country of produce. After processed and packaged in the country of import and then sold through supper market or specially stores. It is as follows.



In some cases, the organic commodities are produce under contract farming, where they are under obligation and it is legally binding to sell through the contractors, In other cases the trader procure from NGOS and sold to processors/consumers.

Limitation of organic market in India:

Many of the constraints have been identified in the marketing of organic produce. These are as follows :

1. Inadequate knowledge of the package of practices for organic production
2. Farmers do not know where to sell, and consumer do not know where to get genuine organic productS
3. Organic market is limited and supply is inconsistent
4. Low demand of domestic market & less premium prices.
5. Due to high charges for certification and registration farmers are not willing to grow crops organically
6. Lack of consumer awareness on the benefit of organic produce
7. The quality supply is not ensured
8. Inadequate facility of shipment for export
9. Time consuming and complicated paper work, while dealing with export authority
10. Inadequate efforts to develop domestic market

Strategy to be taken for market improvement:

1. Development of package of practices for various crops of organic products.

2. Development of rural market or "haat" where the arrangement for farmers to consumers direct selling can be made.
3. Development of home- delivery system like door to door selling
4. Registration to consumers wanting supply of organic foods.
5. Marketing of organic products through Khadi board or NGOoutlets.
6. Involvement of some NGOs like Rotary clubs, Lions clubs, ladies associations for publicity.
7. Formation of association of organic producer
8. Adequate publicity through meetings, Invitation letters, attractive Leaflets, audiovisual publicity, advertisements, field days, participation in fairs and regular publications.

Organic market in India:

The organic market in India is valued at Rs. 100 crore (US$ 20 millions). Organically produced items like tea, coffee, spices fruits and vegetables, cotton, pulses, cereals and oilseeds are getting higher demand from developed contries like USA, UK and Japan.

The present growth rate in domestic organic market is 35% and it is anticipated to grow by 50% by 2010. The potential share of organic produce in the domestic market is 56%. At present, area under organic cultivation in India is around 2.5 million hectare.

Recently, International competence centre for organic agriculture (ICCOA), Banglore in collaboration with Genus A.B., India and FiBL, witserland surveyed the market demand for organic food in India. The report was published in 2006 for eight metro cities in India.

The results revealed that total market potential for organic foods in India is estimated at Rs. 2300 crores. The current market value of the organic demad is estimated at Rs. 1450 crore. Out of this, Rs. 560 crore is accessible immediately through modern retail.

Sr. No.	Metro	Accessible potential Rs. In crore	Market potential Rs. In crore
1.	Mumbay	148	586
2.	Delhi	112	223
3.	Chennai	84	150
4.	Banglore	69	128
5.	Culcutta	57	154
6.	Hyderabad	33	74
7.	Ahmedabad	30	78
8.	Pune	28	58
	Total	**562**	**1452**

Export market for organic products:

The global market for organic food is expected to touch US $ 100 billion by 2010. The major share of growth promises to come from Europe (US $ 46 billion), USA (US $ 45 billion) and Japan (US $ 11 billion). The current (2006) world market for organic food is estimated at US $ 31 billion with an annual growth rate of about 20-30%. This market share of organic food over conventional food is only 1% of the total sale.

India has already made invasion into the world organic market in certain key sectors such as tea, coffee, spices, fruits and vegetables (mainly, semi processed pineapple, fozen and dried banana), cotton, cereals (mainly basmati rice), dried nuts, oilseeds sesame, pulses and sugarcane to the following countries.

Europe	:	Netherlands, United kingdom, Germany, Belgium Sweden, Switzerland, France, Italy, Spain
North America	:	USA, Canada
Middle East Asia	:	Saudi Arabia, UAE
Asia	:	Japan, Singapor
Australia	:	Australia, Newzeeland
Africa	:	South Africa

The current (2005) status of organic export from India is as bellow:

- Total production : 1,19,656 tons of seedling
  16,57,000 nos. of cuttings
  2,64,000 litters of effective micro organisms
- Total quantity exported : 6792 tons
- Total value of export : Rs. 7123 lakh
- Total area under certified organic cultivations : 25,08,826 ha (This includes wild herb collection from forest area of MP & UP of 24,32,500 ha)

- No. of items exported : 31 Nos.

Lesson Plan
B.Sc. (Horticulture)

Semester:-V (New) **Course No. H/Agro-351**
Course Title: - Organic Farming **Credits: - 2(1+1)**

Sr. No.	Lectures	Topic
1	1	**Introduction** Preamble, Effects of green revolution, Sustainability of resources, Need of switch to organic farming, use of organic sources in nutrient management, plant protection, different systems of farming synonymous of organic farming **Relevance in present contest** Present scenario, area under cultivation, food grain production, demand, scope in crops production, Institutes related to organic farming
	2	**Concept** Meaning, different efforts regarding organic farming at National and International level, Definition, Components

	3	**Advantages and Disadvantages of organic farming** Organic matter production requirement-source ,its utilization
2	4	**Biological Intensive Nutrient Management** Meaning, Need, Components, Advantages or Benefits of BINM
3	5	**Organic manures** Soil fertility and productivity, Importance of organic manures, Classification of organic manures, **FYM,Compost** Definition,classification,advantages,methods of preparations, rate and time of application
	6	**Vermicompost** Earthworms and plant growth, Advantages of Vermicompost, Nutrient composition, Effect on soil and crops, Species of earthworm, composting material, Requirement for vermicomposting, procedure.
	7	**Green manuring** Meaning, Definition,Types,Classification,examples,criteria of selection of green manuring, advantages ,limitation, disadvantages
4	8	**Biofertilizers** Definition, Use of biofertilizers, component of organic farming, Advantages, classification of biofertilizers, examples
5	**9**	**Recycling of Organic Residue** Organic residue availability,residue,Its management,Recycling,Benefits of organic residues, Crop residues, Agro-Industrial wastes Methods of recycling Factors affecting recycling of organic residues Limitations of recycling of organic residues
6	**10**	**Soil Improvement and amendments** Need of soil improvement, Practices followed for soil improvement, Meaning,benefits,examples
7	**11**	**Integrated weed management** Methods of weed control, Concept, Definition, Components, Advantages, limitation, examples.
	12	**Integrated pest management** Methods of pest control, Concept, definition, components, Advantages, limitation, examples.
	13	**Integrated disease management**

		Methods of disease control, Concept, definition, components, Advantages, limitation, examples.
8	**14**	**Use of bio-control agents** Meaning,advantages,predators,parasitoides, examples of bio-agents
9	**15**	**Bio-herbicides** Definition,examples,Bacterial,Viral and Fungal insecticides, mode of action, commercial formulations
	16	**Pheromones** Meaning, use in pest control, Types/example, Advantages
		Trap crops Meaning,definition,advantages,examples
		Bird perches Meaning,Advantages,use in pest control
10	**17**	**Quality consideration** Standards **Accreditation** Meanig,Agencies for accreditation,function,process
	18	**Certification** Meaning,agencies,process of certification **Labeling** Meaning, advantages of labeling, content on label, logo
	18	**Marketing and Export** Commodities, agencies involved, constraints, scope