Course Code 678

ORGANIC GROWER

NSQF LEVEL 4

NATIONAL INSTITUTE OF OPEN SCHOOLING
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A Word With You

A Word with You

Dear Learner, Welcome to the National Institute of Open Schooling (NIOS)! By enrolling with this Institution, you have become part of the family of the world's largest Open Schooling System. As a learner of the NIOS Vocational Programme, I am confident that you will enjoy studying and will benefit from this very unique system of learning. The course "Organic Grower" (NSQF compliant level 4), comprising of theory and practical components and is intended to provide you self-confidence and a new avenue to the future.

The use of chemicals (pesticides, fertilizers, etc.) has significantly enhanced agricultural production since the Green Revolution. However, the overuse of chemicals has a negative effect on crop output. Production was significantly lowered by natural resources including plant yielding capacity, subsurface water, and soil fertility. Additionally, it is consistently seen that a plot of land needs more chemicals as the years go by. This has highlighted the necessity of supporting large-scale organic farming and raising public awareness of the dangerous effects of chemical fertilizers. In light of the aforementioned information, NIOS is launching a specialized course for the benefit of the general public involved in organic farming.

This programme is designated for the youths of rural and semi urban areas like you, who are willing to make their career in the Organic Agriculture sector. After completing this course you will acquire the competencies to cultivate organic crops as per the package of practices recommended for a particular agronomic climate zone, planning & preparation for organic crops, Seed treatment, Crop wise organic nutrient and Cow – Urine based preparation, rainfall pattern and climatic conditions to achieve the organic yields as per the genetic potential of a given variety and sell the produce as per the competitive market prices without distress sale. After completing this course you will be able to work independently, bear risk, upgrade skills and make decisions pertaining to work area. Sincere efforts have been made to present the matter in a very simple manner for your easy understanding.

We are confident that this course will prove to be beneficial to you. We look forward to any comments and suggestions from you for further improvement. Since this is a practical oriented subject you will have to depend on the study centers also for getting empowered in the Organic Farming Methodologies. We wish you all the best in your future career.

Course Team

National Institute of Open Schooling (NIOS)

How to use the Study Material

Congratulations! You have accepted the challenge to be a self-learner. NIOS is with you at every step and has developed the material in Organic Grower with the help of a team of experts, keeping you in mind. A format supporting independent learning has been followed. If you follow the instructions given, then you will be able to get the best out of this material. The relevant icons used in the material will guide you. These icons have been explained below for your convenience.

Title: will give a clear indication of the contents within. Do read it.

Introduction: This will introduce you to the lesson linking it to the previous one.

Objectives: These are statements that explain what you are expected to learn from the lesson. The objectives will also help you to check what you have learnt after you have gone through the lesson. Do read them.

Notes: Each page carries empty space in the side margins, for you to write important points or make notes.

Intext Questions: Very short answer self check questions are asked after every section, the answers to which are given at the end of the lesson. These will help you to check your progress. Do solve them. Successful completion will allow you to decide whether to proceed further or go back and learn again.

What You Have Learnt: This is the summary of the main points of the lesson. It will help in recapitulation and revision. You are welcome to add your own points to it also.

Terminal Exercise: These are long and short questions that provide an opportunity to practice for a clear understanding of the whole topic.

Answers to Intext Questions: These will help you to know how correctly you have answered the questions.

www **Web site:** These websites provide extended learning. Necessary information has been included in the content and you may refer to these for more information.

NSQF (National Skill Qualification Framework)

The National Skills Qualifications Framework (NSQF) is a competency-based framework that organizes all qualifications according to a series of levels of knowledge, skills and aptitude. These levels, graded from one to ten, are defined in terms of learning outcomes which the learner must possess regardless of whether they are obtained through formal, non-formal or informal learning. The learning will enable the learner to acquire desired competency levels, transit to the job market and, at an opportune time, return for acquiring additional skills to further upgrade their competencies.

NSQF Level

Each level of NSQF is associated with a set of descriptors made up of five outcome statements, which describe in general terms, the minimum knowledge, skills and attributes that a learner needs to acquire in order to be certified for that level. Each level of the NSQF is described by a statement of learning outcomes in five domains, known as level descriptors. These five domains are Process, Professional knowledge, Professional skill, Core skill and Responsibility.

NOS (National Occupational Standards)

NOS define the measurable performance outcomes required from an individual engaged in a particular task. They list down what an individual performing task should know and also do. These standards can form benchmarks for various education and training programs and recruitment range of HRM practice. Just as each job role may require the performance of a number of tasks, the combination of all the NOSs corresponding to these tasks would form the Qualification Pack (QP) for that job role. The NOSs and QP for each job role corresponding to each level of the NSQF are being formulated by the concerned Sector Skill Councils (SSCs).

Course "*Organic Grower*" is based on the following National Occupational Standards (NOS) for "*Organic Grower*" formulated by Agriculture sector Skill Council of India:

1. Undertake planning for organic farming AGR/N1201 (v2.0)
2. Carry out seed selection and treatment under organic farming AGR/N1202 (v2.0)
3. Carry out soil nutrient management under organic farming AGR/N1203 (v2.0)
4. Carry out weed management in an organic farm AGR/N1204 (v2.0)
5. Carry out irrigation management in an organic farm AGR/N1205 (v2.0)
6. Integrated pest and disease management in an organic farm AGR/N1206 (v2.0)
7. Carry out harvest and post-harvest management in an organic farm AGR/N1207 (v2.0)
8. Undertake quality assurance and certification in organic farming AGR/N1208 (v2.0)
9. Undertake business of organic farming AGR/N1209 (v2.0)
10. Maintain health and safety at the workplace AGR/N9903 (v4.0)
11. Employability Skills DGT/VSQ/N0102 (v1.0)

For more information about NSQF and NOS, kindly browse in the mentioned websites:

https://nsdcindia.org/; http://www.asci-india.com/National%20Occupation%20Standards.php

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* The Employability Skill Workbook (60 hrs) for this course has been adopted from Directorate General of Training (DGT). To access the workbook QR code is given at page no. 273

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INTRODUCTION TO THE ROLE OF AN ORGANIC FARMING

Agriculture has played a crucial role in forming human history, culture, and economy all across the world, from the beginning of agriculture in ancient Mesopotamia to the contemporary, technologically sophisticated farming methods. The current status of agriculture is a complex and dynamic one. On the one hand, agriculture has made great strides in recent decades, increasing yields and productivity to feed a growing global population. On the other hand, agriculture is facing several challenges, including climate change, water scarcity, and environmental degradation.

Organic farming is a sustainable and environment-friendly approach to agriculture that prioritizes the health of the soil, the well-being of plants and animals, and the overall ecological balance. It involves a set of guidelines and procedures intended to reduce the use of synthetic pesticides, encourage biodiversity, and improve the long-term health and productivity of agricultural systems. Practices such as crop rotation, cover cropping, and composting are used to improve soil health. Genetically modified organisms (GMOs) are not allowed to be used in organic farming for either agricultural production or animal husbandry. Organic seeds and breeds are preferred to maintain genetic diversity. It aims to minimize environmental impacts by reducing water and energy consumption, conserving natural resources, and mitigating soil erosion and pollution.

OBJECTIVES

After reading this lesson, you will be able to:

- acquaint to the present scenario of Indian Agriculture;

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- appraise ill effects of present agriculture and solutions;
- describe the basic concept of different types of organic farming;
- familiarize yourself with the core principles that underpin organic farming; and
- investigate the various components integral to organic farming and their practical application in agricultural practices.

1.1 CONCEPT AND DEFINITION OF ORGANIC FARMING

Organic farming is a farming system that seeks to work in harmony with nature, and being followed from ancient time in India. It recognizes the interconnections of all components in the agricultural ecosystem and aims to create a balanced and regenerative system. Organic farmers aim to enhance and maintain the health of the soil, promote biodiversity, minimize pollution, and prioritize the well-being of both plants and animals. This approach focuses on long-term sustainability, promoting resilience against pests and diseases, and producing high-quality, nutritious, and safe food. Organic farming often promotes local and community-based food systems, reducing the carbon footprint associated with food transportation and supporting local economies.

1.1.1 Definitions of Organic Farming

Organic farming has been defined differently but the description offered by **Lampkin (1990)** appears to be most the comprehensive one covering all essential features. As per this description, Organic Agriculture is a production system which avoids or largely excludes the use of synthetic compounded fertilizers, pesticides, growth regulators and livestock feed additives. To the maximum extent feasible, the organic farming system relies on crop rotations, crop residues, animal manures, legumes, green manures, off-farming organic wastes and aspects of biological pest control to maintain soil productivity and tilth, to supply plant nutrients and control insects, weeds and other pests. The concept of soil as a living system that develops the activities of beneficial organisms is central to this definition. Some important definitions of organic farming have been suggested by various organizations and are given here:

USDA Definition: Organic farming is a system which avoids or largely excludes the use of synthetic inputs e.g., fertilizers, pesticides, hormones, feed additives etc. and to the maximum extent feasible rely upon crop rotations, crop residues, animal manures, off-farm organic waste, mineral grade rock additives and biological system of nutrient mobilization and plant protection.

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FAO Definition: Organic Agriculture is a unique production management system which promotes and enhances agro-ecosystem health, including biodiversity, biological cycles and soil biological activity, and this is accomplished by using on-farm agronomic, biological and mechanical methods in exclusion of all synthetic off-farm inputs.

IFOAM Definition: Organic Agriculture is a production system that sustains the health of soils, ecosystems and people. It relies on ecological processes, biodiversity and cycles adapted to local conditions, rather than the use of inputs with adverse effects. Organic agriculture combines tradition, innovation and science to benefit the shared environment and promote fair relationships and a good quality of life for all involved.

Definition under National Program for Organic Production (NPOP): Organic agriculture is a system of farm design and management to create an ecosystem, which can achieve sustainable productivity without the use of artificial external inputs such as chemicals, fertilizers and pesticides.

Definition suggested by Task Force on Organic Agriculture (2014): Organic agriculture is a unique production management system which promotes and enhances agro-ecosystem health, including biodiversity, biological cycle's and soil biological activity. This is accomplished by using on-farm agronomic, biological and mechanical methods in exclusion of all synthetic off-farm inputs.

INTEXT QUESTIONS 1.1

Fill in the blanks:

1. NPOP stands for .....
2. GMO stands for .....

1.1.2 AIMS of Organic Farming

The principal aim of organic farming is to establish and maintain a harmonious and interdependent relationship between soil-plant, plant-animal and animal soil systems to create a sustainable agro-ecological system based on local resources. Organic farming uses environment-friendly methods of crop and livestock production, without the use of synthetic fertilizers, growth hormones, growth-enhancing antibiotics, synthetic pesticides or gene manipulation. As per IFOAM (2002), organic farming should be based on the following aims:

- To produce high quality food in sufficient quantity.

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- To interact in a constructive and life-enhancing way with natural systems and cycles.
- To consider the wider social and ecological impact of organic production and processing systems.
- To encourage and enhance biological cycles within the farming system, involving microorganisms, soil flora and fauna, plants and animals.
- To develop a valuable and sustainable aquatic ecosystem.
- To maintain and increase long-term fertility of soils.
- To maintain the genetic diversity of the production system and its surroundings, including the protection of plant and wild life habitats.
- To promote the healthy use and proper care of water resources and all life the rein.
- To use, as far as possible, renewable resources in locally organized production systems.
- To create harmonious balance between crop production and animal husbandry.
- To give all livestock conditions of life with due consideration for the basic aspects of their innate behavior.
- To minimize all forms of pollution.
- To process organic products using renewable resources.
- To produce fully biodegradable organic products.
- To produce textiles which are long lasting and of good quality.
- To allow everyone 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.
- To progress towards an entire production, processing and distribution chain which is both socially just and ecologically responsible

1.1.3 Principles of Organic Farming

International Federation for Agriculture Movements (IFOAM) has codified the principles of organic agriculture during 2005. These principles are now the roots from which organic agriculture is growing and developing. These principles while emphasizing on core issues of health, ecology, fairness and care also elaborate the contribution that organic agriculture can make to the world and a vision to improve entire agriculture in a global context.

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IFOAM's four principles of organic agriculture:

- The principle of health
- The principle of ecology
- The principle of fairness
- The principle of care

Principle of Health

Organic farming should sustain and enhance the health of soil, plant, animal, human and planet as one and indivisible. Health is the wholeness and integrity of living systems ensuring maintenance of physical, mental, social and ecological well-being. Immunity, resilience and regeneration are key characteristics of health. The role of organic agriculture, whether in farming, processing, distribution, or consumption, is to sustain and enhance the health of ecosystems and organisms from the smallest microorganism in the soil to human beings. In particular, organic agriculture is intended to produce high quality, nutritious food that contributes to preventive health care and well-being and to achieve this it prohibits the use of chemical fertilizers, pesticides, hormones, synthetic drugs and antibiotics and chemical food additives directly or indirectly in the entire food production chain.

Principle of Ecology

Organic farming should be based on living ecological systems and cycles, work with them, emulate them and help sustain them. It states that production is to be based on ecological processes and recycling. Nourishment and well-being are achieved through the ecology of the specific production environment. For example, in the case of crops this is the living soil; for animals it is the farm ecosystem; for fish and marine organisms, the aquatic environment. Organic Farming, pastoral and wild harvest systems should fit the cycles and ecological balances in nature. These cycles are universal but their operation is site-specific. Organic management must be adapted to local conditions, ecology, culture and scale. To maintain and improve environmental quality and conserve resources, input use policy must rely on reuse, recycling and efficient management of materials and energy.

Principle of Fairness

Organic farming should build on relationships that ensure fairness with regard to the common environment and life opportunities. Equity, respect, justice and stewardship of the shared world, both among people and in their relations to other

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living beings, is the foundation for ensuring fairness. This principle emphasizes that those involved in organic farming should conduct human relationships in a manner that ensures fairness at all levels and to all parties -farmers, workers, processors, distributors, traders and consumers. This principle also insists that animals should be provided with the conditions and opportunities of life that accord with their physiology, natural behavior and well-being. Natural and environmental resources that are used for production and consumption should be managed in a way that is socially and ecologically just and should be held in trust for future generations. Fairness requires systems of production, distribution and trade that are open and equitable and account for real environmental and social costs.

Principle of Care

Organic farming should be managed in a precautionary and responsible manner to protect the health and well-being of current and future generations and the environment. It is a living and dynamic system that responds to internal and external demands and conditions. Practitioners of organic agriculture can enhance efficiency and increase productivity, but this should not be at the cost of health and well-being of any living form including human. Consequently, new technologies need to be assessed and existing methods reviewed. Given the incomplete understanding of ecosystems and agriculture, care must be taken.

This principle states that precaution and responsibility are the key concerns in management, development and technology choices in organic agriculture. Science is necessary to ensure that organic agriculture is healthy, safe and ecologically sound. However, scientific knowledge alone is not sufficient. Practical experience, accumulated wisdom and traditional and indigenous knowledge offer valid solutions tested by time. Organic agriculture should prevent significant risks by adopting appropriate technologies and rejecting unpredictable ones, such as genetic engineering. Decisions should reflect the values and needs of all who might be affected, through transparent and participatory processes.

INTEXT QUESTIONS 1.2

True or false:

1. Organic farming practices allow to use of synthetic fertilizers, growth hormones, growth-enhancing antibiotics, synthetic pesticides or gene manipulation.
2. Four principles of organic agriculture includes health, ecology, fairness and care.

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1.2 DIFFERENT TYPES OF FARMING

1.2.1 Organic Farming in India

Organic cultivation not new in India. The term organic farming was first used by lord north Bourne in the book of 'Look of the Land'. Organic agriculture in India started long back 1900 by Sir Albert Howard a British agronomist, in local village of the north India. Organic farming first coined by north Bourne in 1946. The state of Sikkim and Uttaranchal declared organic state.

Why organic farming is necessary?

- It is a sustainable and eco-friendly technology.
- It improves quality, shelf life and nutritive value of the farm produce.
- It encourages sustainable livelihood of the producers as well as safeguards consumers health.
- It improves the physical, chemical and biological health of the soil.
- Promotes healthy use of the natural resources and minimizes all forms of the pollution.
- It enhances and sustains biological diversity within the system.

Key characteristics of organic farming:

- Relies primarily on local, renewable resources.
- Makes efficient use of solar energy and the production potential of biological systems.
- Maintains the fertility of the soil.
- Maximizes recycling of plant nutrients and organic matter.
- Does not use organisms or substances foreign to nature.
- Maintains diversity in the production system as well as the agricultural landscape.
- Gives farm animal's life conditions that correspond to their ecological role and allow them a natural behaviour.
- Careful attention to the impact of the farming system on the wider environment and the conservation of wildlife and natural habitats.

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INTEXT QUESTIONS 1.3

Fill in the blank:

1. Certified cultivated organic area (ha) is highest ..... in India,
2. Total organic area in India is ..... ha.
3. Organic agriculture in India started long back 1900 by ..... a British agronomist.
4. The state of ..... and ..... declared organic state.

1.2.2 Natural Farming

Natural Farming is a type of sustainable farming. In natural farming all the inputs prepared from natural materials, it observes the law of the Nature, and respects the rights of crops and livestock (Fig 1.1).

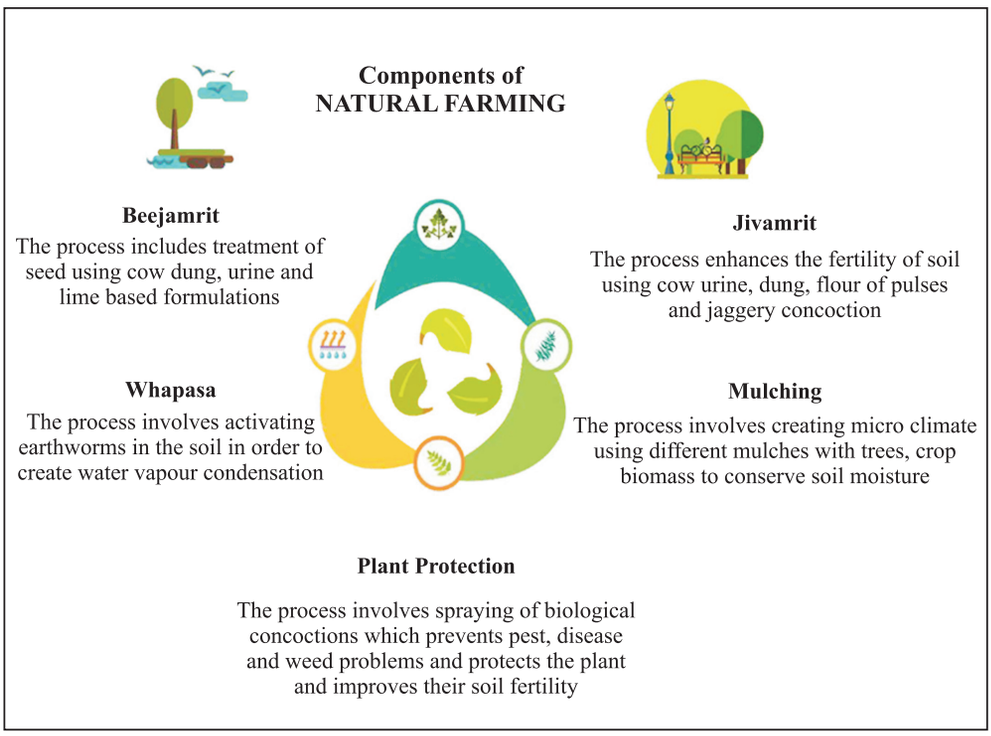

Fig. 1.1: Components of Natural Farming

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1.2.3 What is Permaculture?

Permaculture is a system of agricultural and social design principles centred around simulating or directly utilizing the patterns and features observed in natural ecosystems. Inspired by Masanobu Fukuoka's natural farming philosophy (Fig.1.2).

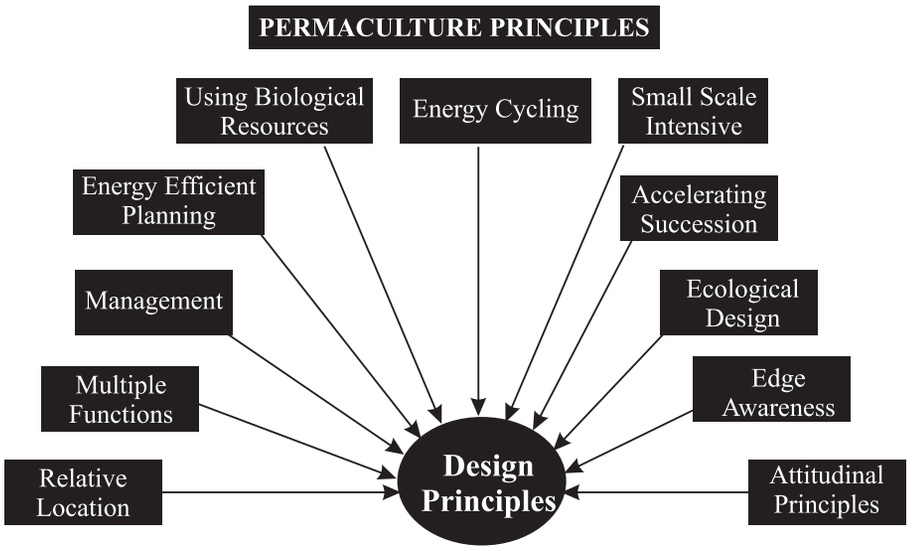

Fig.1.2: Principles of Permaculture

1.2.4 Biodynamic Farming

Biodynamics, derived from two Greek words, bios (life) and dynamos (energy), "Biodynamics refers to a 'working with the energies which create and maintain life".

It is a method of farming that aims to treat the farm as a living system which interacts with the environment, to build healthy living soil, and to produce food that nourishes, vitalises and helps to develop humanity (Fig. 1.3).

The bio-dynamic idea of the farm as an 'organism' or living entity

Advantage of Biodynamic Farming

1. Production of top-quality fruits and vegetables, with strong flavours and high levels of nutrients.
2. Yields always above the average level.
3. No chemical used for grain, fruit and vegetables.
4. Little trouble with livestock and plant diseases.

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5. No spreading of insect pests, and no great economic damage due to their presence.
6. The important criterion is to sustain the fertility of a farm that lasts for future.

Practical Application of Biodynamic Farming

1. Walk around your land each day, with all its aspects.
2. Establish environmental control.
3. Introduce soil-protecting crop rotations and cover crops.
4. Improve soil cultivation practices.
5. Introduce green manuring, carefully ploughed or dug under.
6. Use mulching wherever possible.

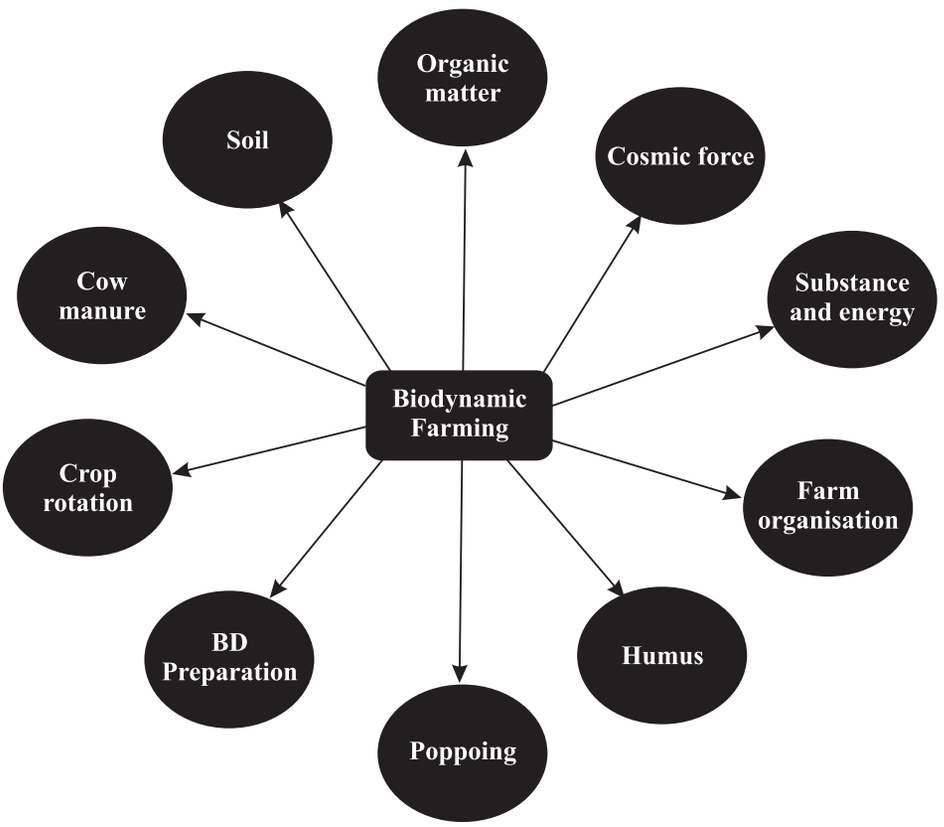

Fig. 1.3: Principle of Biodynamic Farming

1.2.5 Homa Farming

There is no specific agricultural practice associated with homa farming, but the farm and household it is practiced in, is energized and "awakened". The ash that

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results from the puja is used to energize composts, plants, animals, etc. Homa Organic Farming is holistic healing for agriculture and can be used in conjunction with any good organic farming system. It is extremely inexpensive and simple to undertake but requires discipline and regularity.

INTEXT QUESTIONS 1.4

True and False:

1. Natural Farming makes all inputs from natural materials. (T/F)
2. In Natural farming instead of using toxic chemicals, we use light, alcohol, aroma, poisonous plant and so forth to control pests. (T/F)
3. The term organic farming was first used by lord north Bourne in the book of 'Look of the Land. (T/F)
4. Biodynamics refers to a 'working with the energies which create and maintain life. (T/F)

1.3 COMPONENTS OF ORGANIC FARMING

The components of organic farming include:

I. Soil Management:

- Crop rotation: Alternating the types of crops grown in a particular field from season to season to prevent soil depletion and pest build-up.
- Cover cropping: Planting cover crops, such as legumes or grasses, to protect and improve soil quality during fallow periods.
- Compost and organic matter: Adding organic materials like compost, manure, and plant residues to enhance soil fertility and structure (Fig 1.4).

II. Pest and Disease Management:

- Biological control: Encouraging natural predators and beneficial organisms to control pests and diseases.
- Crop diversity: Growing a variety of crops to reduce the risk of pest and disease outbreaks.
- Trap crops and companion planting: Using specific plants to attract pests away from cash crops or pairing crops that have mutually beneficial effects.

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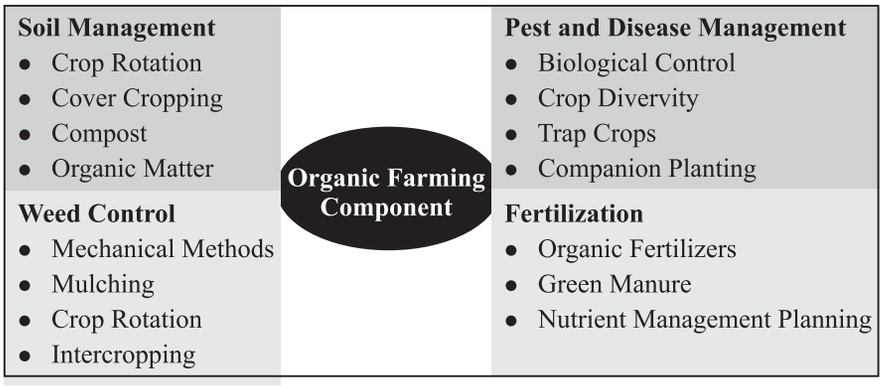

Fig. 1.4: Component of Organic Farming

III. Weed Control:

- Mechanical methods: Using tools like plows, harrows, and hand-weeding to control weeds.
- Mulching: Covering the soil with organic materials like straw, hay, or wood chips to suppress weed growth.
- Crop rotation and intercropping: Combining different crops in a way that disrupts weed growth patterns.

IV. Fertilization:

- Organic fertilizers: Using natural sources of nutrients, such as compost, manure, bone meal, and fish emulsion.
- Green manure: Growing specific crops that are later incorporated into the soil to release nutrients.
- Nutrient management planning: Carefully managing nutrient inputs to avoid over-application and nutrient runoff.

V. Non-GMO and Chemical-Free:

- Avoiding genetically modified organisms (GMOs) in crop production.
- Eliminating the use of synthetic pesticides and herbicides.

VI. Animal Welfare:

- Raising livestock in humane conditions with access to pasture and proper care.
- Avoiding the use of growth-promoting hormones and antibiotics as routine treatments.

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VII. Sustainable Practices:

- Water conservation and management to reduce irrigation and protect water quality.
- Energy-efficient practices in farming operations.
- Biodiversity conservation by maintaining natural habitats on the farm.

1.4 STATUS OF ORGANIC FARMING

In 2021, organic agricultural land accounted for 1.6 percent of the total global agricultural land. Notably, Australia held the largest share of organic agricultural land with 35.7 million hectares, followed by Argentina with 4.1 million hectares, and France with 2.8 million hectares. The number of organic producers worldwide in 2021 was nearly 3.7 million, and over 91 percent of these producers were distributed across Asia, Africa, and Europe. India stood out as the country with the highest number of organic producers, boasting 1.6 million, and it had an organic land area of 2.66 million hectares. Furthermore, the Indian organic market is poised for significant growth, expected to achieve a Compound Annual Growth Rate (CAGR) of approximately 20.5 percent during the forecast period spanning 2021 to 2026.

1.5 SCOPE AND NEED OF ORGANIC FARMING

Organic farming is an agricultural approach that relies on sustainable practices such as green manure, compost, biological pest control, and crop rotation to cultivate crops and raise livestock. This eco-conscious farming system emphasizes the responsible management of resources to preserve biodiversity and maintain ecological equilibrium. Key components of organic farming include the utilization of green manure, cover crops, animal manure, and crop rotation to disrupt the proliferation of pests and diseases, enhance soil fertility, and optimize soil's biological vitality.

1.6 INSTITUTIONS/ORGANIZATIONS INVOLVED IN ORGANIC FARMING

Organic farming involves various institutions and organizations at different levels, from international bodies to local certification agencies. Here are some of the key institutions and organizations involved in promoting and regulating organic farming:

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1. **International Federation of Organic Agriculture Movements (IFOAM):** IFOAM is a global umbrella organization for the organic agriculture movement. It sets international standards and provides a platform for organic farmers and organizations to collaborate and share knowledge.

2. **Research and Educational Institutions:** Universities and research organizations conduct studies and offer education in the field of organic farming. The Organic Farming Research Foundation (OFRF) is an example of an organization focused on research in this area.

3. **Consumer Advocacy Groups:** Organizations like the Organic Consumers Association (OCA) work to promote organic products and advocate for transparency and ethical practices in the organic industry.

4. **Local and State Agricultural Departments:** These government agencies often play a role in regulating and supporting organic farming practices at the local and state levels.

5. **Non-Governmental Organizations (NGOs):** Various NGOs, such as the Organic Farming Association of India (OFAI), work to promote and support organic farming in specific regions or countries.

6. **Codex Alimentarius Commission:** The Codex Alimentarius Commission (CAC) is an international food standards body established jointly by the Food and Agriculture organization (FAO) and the World Health Organization (WHO) in May 1963 with the objective of protecting consumer's health and ensuring fair practices in food trade.

WHAT YOU HAVE LEARNT

Let us recapitulate and enlist the salient points that you have learnt through this:

- Organic farming is an agricultural approach that focuses on cultivating crops and raising livestock using natural processes, avoiding synthetic pesticides and fertilizers.
- Organic farming aims to promote ecological balance, minimize external inputs and sustainably manage natural resources.
- Organic farming has a history dating back to the early 20th century, with various movements and pioneers advocating chemical-free farming.
- Organic farming has seen substantial growth globally, with increased consumer demand for organic products.

Notes

- In 2021-22, total food grain production was estimated at 315.7 million tones (MT).
- It is the second-largest producer of rice, wheat, sugarcane, cotton and groundnuts, as well as the second-largest fruit and vegetable producer.
- Organic farming encourages sustainable livelihood of the producers as well as safeguards consumer's health.
- Natural Farming makes all inputs from natural materials, observes the law of the nature, and respects the rights of crops and livestock.
- Permaculture is a system of agricultural and social design principles centred around simulating or directly utilizing the patterns and features observed in natural ecosystems.

TERMINAL EXERCISE

1. What is the basic concept of organic farming and its importance in agriculture?
2. Enlist the different aims and principles of organic farming.
4. Elaborate the different components of organic farming.
5. What is the status of organic farming in the world and India?
6. Enlist the different institution and organisation involved in organic farming.

ANSWERS TO INTEXT QUESTIONS

1.1

1. National program for organic production
2. Genetically modified organism

1.2

1. False
2. True

1.3

1. Madhya Pradesh
2. 600000
3. Sir Albert Howard
4. Sikkim and Uttaranchal

Notes

1.4

1. True 2. True 3. True 4. True

Key Learning Outcomes

Learner will be able to:

- Identify the principles and components of organic farming.
- Analyze the chronological development of organic farming and involved institution.
- Suggest the various type of farming.

Notes

2

PLANNING AND PREPARATION FOR ORGANIC FARMING

In the previous lesson we have learnt about Introduction to the role of an Organic Grower. In this lesson we will learn about planning & preparation for organic farming, Organic farming helps for a reduction in the use of synthetic pesticides, herbicides, and fertilizers. This protects the environment, wildlife and human health as well as promotes ecosystem services. Organic farming practices focus on building and maintaining healthy soil through practices like crop rotation, composting, and the use of green manures. These methods enhance soil fertility, water retention, and microbial diversity, leading to healthier and more productive soil in the long term. By avoiding the use of chemical pesticides, organic farmers help to preserve beneficial insects, birds, and other wildlife that play essential roles in maintaining ecological balance. Organic farming practices also contribute to better water quality as they reduce the risk of chemical run-off and leaching into water bodies. This protects aquatic ecosystems and ensures safer drinking water for communities. Consumers choose organic products because they believe they are healthier and free from harmful residues. Organic fruits, vegetables, and other crops are typically grown without synthetic pesticides and herbicides, making them a preferred option for those concerned about potential health risks associated with chemical residues. Transitioning from conventional farming to organic farming requires careful planning and preparation.

OBJECTIVES

After reading this lesson, you will be able to:

- identify the prior information about organic farming practices, principles, regulations and certification processes;

Notes

- understand the current farm setup, including soil quality, water availability, infrastructure, and existing crops or livestock;
- describe the feasibility of transitioning to organic farming based on your resources, land size, and market demand for organic products;
- understand the conversion period which is required to convert conventional farms to organic farms;
- determine the soil test for nutrient levels and pH, and make necessary amendments using organic-approved fertilizers or natural mineral sources;
- identify the implement a crop rotation plan to prevent disease and nutrient depletion; and
- understand the demand for organic products in your locality. Identify potential buyers, such as local markets, grocery stores, restaurants, or direct-to-consumer sales.

2.1 PLAN FOR ORGANIC FARMING

Since the Organic Farming is System based therefore selection of the crop and cropping pattern is based upon the local conditions and risk assessment after a thorough analysis of land properties, possible diseases and pests (i.e. infection pressure), soil characteristics, geographic allocation, possible source of contamination and past history of the farm. Marketability of the produce has due importance for success if any Organic Production Programme (Fig. 2.1).

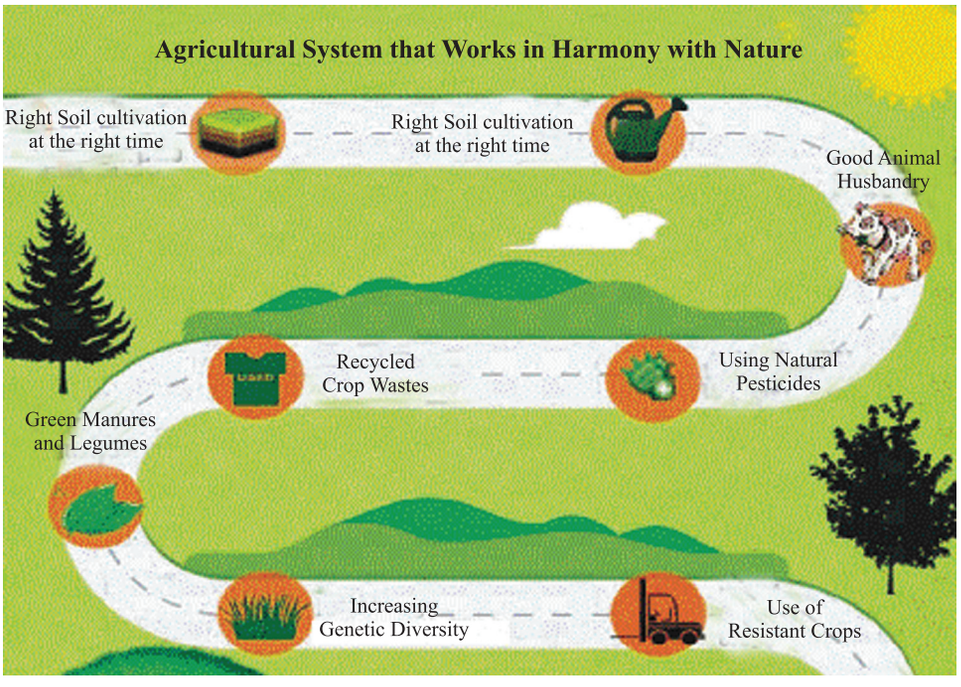


Fig. 2.1: Plan for Organic Farming

Notes

2.2 SELECTION OF FIELD AND CONVERSION PERIOD

When selecting a field for conversion or determining its suitability for a specific purpose, it is essential to consider various factors. Here is an analysis of the field that covers the above mentioned aspects:

(a) Farm characteristics

- **Size:** Determine the total area of the farm, as it influences the scale and type of farming operations.
- **Plots and crops distribution:** Identify the arrangement of different plots and their respective crops. This helps in understanding the farm layout and rotation patterns.
- **Types of crops, trees, and animals:** Take note of the specific crops and their varieties grown on the farm. Additionally, consider any trees or animals integrated into the farm system, such as agroforestry or livestock.

(b) Soil Analysis

- **Soil structure:** Assess the soil's physical properties, including texture, drainage, and compaction. This information helps to determine the suitability for various crops and management practices.
- **Nutrients level:** Conduct soil test to determine the level of essential nutrients such as nitrogen, phosphorus, potassium, and micronutrients. This data aids in formulating appropriate fertilization strategies.
- **Organic matter content:** Measure the soil organic matter content, as it affects fertility, water-holding capacity, and overall soil health.
- **Erosion level:** Evaluate the potential for soil erosion and assess the effectiveness of erosion control measures.
- **Soil contamination:** Investigate whether the soil has been contaminated by pollutants or heavy metals, which can impact crop growth and food safety.

(c) Climate

- **Rainfall distribution and quantity:** Analyze the historical rainfall patterns, including the distribution throughout the year and annual precipitation levels. This helps in planning irrigation and crop selection.
- **Temperatures:** Consider the average temperatures, seasonal variations, and extremes, as different crops have specific temperature requirements.

Notes

- **Frost risks:** Determine the occurrence and severity of frost events, particularly during critical crop stages, to assess their impact on plant growth.
- **Humidity:** Understand the relative humidity levels, as high humidity can increase disease pressure and affect crop growth.

(d) Organic matter sources and management

- Identify potential sources of organic matter, such as manures, compost, cover crops, or crop residues. These sources contribute to soil fertility and structure.
- Assess the current management practices related to organic matter, including incorporation methods and application rates, to optimize nutrient cycling and soil health.

(e) Presence of animal housing systems and/or machinery

- Determine if there are animal housing systems, such as barns or shelters, and evaluate their potential impact on soil and water quality.
- Consider the presence of machinery and equipment, assessing their suitability for the desired farming practices and potential limitations.

(f) Limiting factors

- **Capital:** Evaluate the financial resources available for investment in infrastructure, equipment, and inputs.
- **Labor:** Assess the availability of skilled labour for farm operations and management.
- **Market access:** Consider proximity to markets, transportation infrastructure, and potential marketing channels for the farm's produce.

By analyzing these factors, you can make informed decisions regarding the selection of a field and determine the necessary steps for its conversion or optimal use.

2.2.1 Conversion Period

According to organic farming standards, farmers are required to follow organic practices for a minimum of three years before they can harvest and sell organic products. This period is known as the conversion or transition period. During this time, farmers need to adhere to organic farming guidelines and avoid the use of prohibited inputs such as synthetic fertilizers, pesticides, and genetically modified organisms.

Notes

To manage the financial risks associated with the conversion period, farmers can adopt a gradual field-by-field conversion approach. This means implementing conventional and transitional practices in the same year on different fields until the entire farm is converted to organic. This strategy allows farmers to continue generating income from conventional practices while gradually transitioning to organic methods.

For fields that are newly acquired or previously managed conventionally, the length of the conversion period depends on the type of crops grown. In the case of seasonal and annual crops, the conversion period should be at least 24 months from the last date of using prohibited inputs or from the date of taking the organic pledge, whichever is later. However, for perennial and permanent crops, the conversion period should be a minimum of 36 months under the same conditions.

The conversion period is essential to ensure that organic farms meet the organic standards and provide consumers with reliable organic products. It allows for the elimination of residual synthetic inputs and the restoration of soil health and biodiversity through organic practices.

When selecting crops for conversion to organic farming, farmers should consider the following criteria:

1. **Self-sufficiency and family needs:** Organic farmers should prioritize growing enough food to meet their family needs. This ensures food security and reduces reliance on external sources.
2. **Market potential:** Organic farmers may also choose to grow crops for the market to generate income for other family needs. Selecting crops with good market potential can help generate additional revenue.
3. **Soil fertility improvement:** It is important for organic farmers to grow crops that contribute to the improvement of soil fertility. Some crops, such as legumes, have the ability to fix nitrogen in the soil, enhancing its fertility and reducing the need for synthetic fertilizers.
4. **Pasture grass and legumes for livestock:** If farmers keep livestock, they should grow pasture grass and legumes to provide fodder for their animals. These crops can contribute to the overall sustainability and productivity of the farm.
5. **Low risk of failure:** Farmers should select crops that have a low risk of failure to minimize losses. Crops like maize, sorghum, millet, beans, and peas are often suitable for conversion to organic farming because they have relatively low production costs, moderate nutrient demands, and are resilient against pests and diseases.

Notes

6. **Storable crops for domestic markets:** Traditional crops that can be stored for longer periods are advantageous for organic farmers as they can be sold in domestic markets even after the harvest season. This helps in generating income throughout the year.

7. **Consideration of crop sensitivity:** High-value short-term crops, such as most vegetables, are more delicate to grow and are highly susceptible to pest and disease attacks. Therefore, unless the farmer can sustain some losses in the harvest, these crops should not be grown on a larger scale.

By considering these criteria, organic farmers can make decisions about crop selection during the conversion process, balancing their family needs, market potential, soil fertility improvement, livestock requirements and risk management.

INTEXT QUESTIONS 2.1

Fill in the blanks:

1. Conversion period for annual crops is ..... and perennial crops is .....

2. A transition period required from conversion of conventional farm to organic farm is known as .....

2.3 SELECTION OF CROPS AND VARIETIES

1. **All seeds and plant material shall be certified organic:** This means that only seeds and plant material produced according to organic standards should be used. Organic certification ensures that the seeds and plants have been grown without synthetic pesticides, fertilizers, or genetic engineering.

2. **Species and varieties cultivated shall be adapted to the soil and climatic conditions and be resistant to pests and diseases:** It is important to select crops and varieties that are well-suited to the specific soil and climatic conditions of the farm. Additionally, choosing varieties with natural resistance to pests and diseases can reduce the need for chemical interventions.

3. **Genetic diversity shall be taken into consideration in the choice of varieties:** Maintaining genetic diversity is important for long-term sustainability and resilience in agriculture. By selecting a diverse range of crop varieties, farmers can reduce the risks associated with disease outbreaks, climate variability, and other environmental factors.

Notes

4. **When organic seed and plant materials are available, they shall be used:** Organic farmers should prioritize the use of certified organic seeds and plant materials whenever they are accessible. Using organic seeds ensures that the entire production process remains organic from start to finish.

5. **When certified organic seed and plant materials are not available, chemically untreated conventional seed and plant material shall be used:** In situations where organic seeds are not readily available, farmers may opt for chemically untreated conventional seeds. While not organic, these seeds have not been treated with synthetic chemicals, such as pesticides or fungicides.

6. **The use of genetically engineered seeds, transgenic plants, or plant material is prohibited:** Organic farming prohibits the use of genetically engineered (GE) seeds or transgenic plants. This includes crops that have been genetically modified using biotechnology methods. Organic standards focus on natural breeding techniques and the preservation of genetic integrity.

Following these guidelines ensures that organic farmers prioritize to choose organic, adapted, diverse, and non-genetically engineered seeds and plant materials, supporting sustainable and environment friendly agricultural practices.

2.4 SEED TREATMENT AND SOWING

Using healthy seeds and planting materials, as well as selecting robust and improved cultivars, can have a significant impact on crop production in organic farming. Here is some information on seed treatment and sowing practices for organic farming:

1. **Seed Selection:** When choosing seeds for organic farming, it's advisable to select locally-adapted varieties. These varieties should be well-suited to the local climate, soil conditions, and pests/diseases prevalent in the area. Locally-adapted seeds often exhibit better resilience and productivity in their specific environment.
2. **Organic Certification:** Ensure that the seeds you choose are certified organic. Organic certification guarantees that the seeds have been produced without the use of synthetic chemicals, genetically modified organisms (GMOs), and other prohibited substances, in accordance with organic standards.
3. **Seed Treatment:** Organic seed treatment involves the use of natural methods to protect seeds from diseases and pests. Some common organic seed treatment options include:

Notes

(a) **Hot Water Treatment:** This method involves soaking seeds in hot water to eliminate certain seed-borne pathogens.

(b) **Biological seed treatment:** Beneficial microorganisms, such as rhizobacteria or mycorrhizal fungi, can be applied to seeds to enhance their resistance to diseases, improve nutrient uptake, and promote plant growth.

(c) **Neem Seed Treatment:** Neem oil or neem cake can be used as a natural seed treatment to control insect pests and fungal diseases.

(d) **Bio-priming:** Seeds can be primed with beneficial microorganisms or plant extracts to enhance germination, seedling vigour, and disease resistance.

4. **Sowing Practices:** When sowing the treated seeds, follow these organic farming practices:

(a) **Seed Spacing and Depth:** Follow the recommended spacing and planting depth for the specific crop to ensure proper seed germination and plant growth.

(b) **Crop Rotation:** Rotate crops to reduce the build-up of pests and diseases in the soil. This practice helps to maintain soil health and fertility.

(c) **Organic Soil Amendments:** Use organic fertilizers, compost, and other natural soil amendments to improve soil fertility and provide essential nutrients to the crops.

(d) **Weed Management:** Employ organic weed control methods such as mulching, hand weeding, or mechanical cultivation to manage weeds without the use of synthetic herbicides.

Remember, organic farming practices prioritize natural and sustainable approaches to ensure environmental health, biodiversity, and long-term productivity.

2.5 STRATEGIES OF NUTRIENT, WATER, PEST AND DISEASE MANAGEMENT

2.5.1 Nutrient Management

These are some strategies for nutrient management in organic farming:

1. **Emphasize the use of biodegradable materials:** Organic farms should focus on utilizing biodegradable materials of microbial, plant, or animal origin to maintain or enhance soil fertility and biological activity.

Notes

2. **Minimize nutrient losses:** Proper fertilization management techniques should be employed to minimize nutrient losses from the farm. This includes avoiding excessive application of nutrients and preventing the accumulation of heavy metals and other pollutants in the soil.

3. **Supplement with non-synthetic mineral and biofertilizers:** Non-synthetic mineral fertilizers and biofertilizers of biological origin can be used as supplementary inputs for nutrient recycling. However, they should not replace the primary emphasis on nutrient recycling through organic materials.

4. **Maintain desired pH levels:** Organic farmers should strive to maintain the desired pH levels in the soil, as different crops have specific pH requirements for optimal growth. Soil amendments can be used to adjust the pH if necessary.

5. **Limitations on nutrient inputs:** The certification program for organic farming should establish limitations on the total amount of biodegradable materials brought onto the farm, taking into consideration of local conditions and crop-specific requirements.

6. **Prevent over manuring in animal runs:** Procedures should be implemented to prevent animal runs from becoming over-manured, especially in situations where there is a risk of pollution. Proper management practices, such as proper waste management and rotational grazing, can help prevent the overloading of nutrients in specific areas.

7. **Optimize fertility management practices:** Before permission is granted for the use of mineral fertilizers, organic farmers should demonstrate that other fertility management practices, such as crop rotation, cover cropping, and composting, have been optimized to ensure efficient nutrient utilization.

8. **Avoid manures containing human excreta:** Manures containing human excreta (faeces and urine) should not be permitted in organic farming to minimize the risk of transmitting pests, parasites, and infectious agents.

9. **Natural composition of mineral fertilizers:** Mineral fertilizers should be applied in their natural composition and should not be chemically treated to render them more soluble. Exceptions may be granted by the certification program, but these exceptions should not include nitrogen-containing mineral fertilizers.

10. **Restrictions on certain inputs:** The certification program should establish restrictions on the use of inputs such as mineral potassium, magnesium fertilizers, trace elements, manures, and fertilizers with high heavy metal

Notes

content or other unwanted substances. Synthetic nitrogenous fertilizers are prohibited in organic farming.

These strategies aim to promote sustainable nutrient management practices in organic farming, maintaining soil fertility, minimizing environmental impact, and ensuring compliance with organic certification standards.

2.5.2 Water Management

It's important to note that water management strategies may vary depending on the specific climatic conditions, crop types, and farm locations. Organic farmers should adapt these strategies to their specific contexts while adhering to sustainable and environment-friendly practices.

1. **Irrigation Techniques:** Organic farmers should employ efficient irrigation techniques to minimize water usage. Drip irrigation, for example, delivers water directly to the plant roots, reducing water loss through evaporation and runoff. Other methods such as furrow or sprinkler irrigation can also be used effectively with proper management.

2. **Mulching:** Mulching is the practice of covering the soil surface with organic materials such as straw, hay, or compost. This helps to retain soil moisture by reducing evaporation, minimizing weed growth, and improving soil structure. Mulching also reduces erosion and runoff, thus conserving water resources.

3. **Crop Rotation and Cover Crops:** Implementing crop rotation and cover cropping practices can improve soil health and water retention. Different crops have varying water requirements, so rotating crops can help to prevent excessive water usage. Cover crops, such as legumes or grasses, can enhance soil fertility, prevent soil erosion, and increase water infiltration.

4. **Water Harvesting and Conservation:** Organic farmers can implement water harvesting techniques to capture and store rainwater for irrigation purposes. This can include installing rain barrels, constructing ponds or reservoirs, or using swales and contour ploughing to retain water on the land. Conservation practices like terracing or contour farming can also help prevent water runoff and soil erosion.

5. **Soil Management:** Maintaining healthy soil is crucial for water management. Organic farmers should focus on building organic matter content in the soil through practices like composting, green manure, and organic amendments. Improved soil structure allows for better water infiltration and retention, reducing the need for excessive irrigation.

Notes

6. **Monitoring and Record-Keeping:** Regular monitoring of soil moisture levels and water usage can help organic farmers optimize irrigation schedules and identify areas of improvement. Keeping detailed records of water inputs and outputs, crop yields, and soil conditions can assist in identifying trends and making decisions regarding water management.

7. **Education and Training:** Providing education and training to organic farmers on water management techniques is essential. This can include workshops, seminars, or resources that emphasize sustainable water practices, such as proper irrigation scheduling, water-saving techniques, and the importance of soil health in water retention.

2.5.3 Pest, Disease and Weed Management

Pest, disease, and weed management in organic production systems prioritize the use of natural methods and preventive measures to minimize losses. Here are the key points related to pest, disease, and weed management in organic farming:

1. **Emphasis on Balanced Fertilization and Adaptation:** Organic farming systems focus on maintaining soil fertility through balanced fertilization programs. This helps crops and varieties to adapt well to the environment and promotes natural growth and development.

2. **Preventive Cultural Techniques:** Organic farmers employ various preventive cultural techniques to limit the development of weeds, pests, and diseases. These techniques include implementing suitable crop rotations, using green manures, early and pre-drilling seedbed preparations, mulching, mechanical control methods, and disrupting pest development cycles. Certification programs ensure that measures are in place to prevent the transmission of pests, parasites, and infectious agents.

3. **Ecological Pest Management:** Organic farming encourages understanding and disruption of the ecological needs of pests. Natural enemies of pests and diseases, such as beneficial insects, are protected and encouraged through proper habitat management, such as creating hedges and nesting sites. The aim is to establish an ecological equilibrium that maintains a balance in the pest-predator cycle.

4. **Use of Farm-Prepared Products:** Organic farmers are allowed to prepare products for pest, disease, and weed management using local plants, animals, and microorganisms. However, the certification program evaluates these products to ensure they do not jeopardize the ecosystem or the quality of organic products.

Notes

5. **Thermic Weed Control and Physical Methods:** Organic farming permits the use of thermic weed control methods (such as heat treatment) and physical methods for managing pests, diseases, and weeds.

6. **Restricted Use of Soil Sterilization:** Thermic sterilization of soils to combat pests and diseases is restricted to situations where proper soil rotation or renewal is not feasible. The certification program evaluates such cases on a case-by-case basis.

7. **Equipment Cleaning:** All equipment used in organically managed areas must be properly cleaned and free from residues of synthetic chemicals or substances used in conventional farming systems.

8. **Prohibition of Synthetic Pesticides:** The use of synthetic herbicides, fungicides, growth regulators, synthetic dyes, insecticides, and other synthetic pesticides is prohibited in organic farming. which meet organic standards, are permitted for plant pest and disease control. Producers must keep documentary evidence of the need to use these products.

9. **Evaluation of Commercial Inputs:** Commercial products used as inputs in organic farming must undergo evaluation before they are approved for use.

10. **Prohibition of Genetically Engineered Organisms:** The use of genetically engineered organisms or products is strictly prohibited in organic farming.

These guidelines aim to promote sustainable and environmentally friendly approaches to managing pests, diseases, and weeds in organic production systems.

2.6 CROP ROTATION, INTER-CROPPING, CROPPING SYSTEM, AGRO-FORESTRY, INTEGRATED FARMING SYSTEM

2.6.1 Crop Rotation

Crop rotation is an essential practice in organic production systems as it helps to maintain soil health, control pests and diseases, manage nutrient levels, and improve overall crop productivity (Table 2.1). Here's a general guidelines on crop rotation for organic production:

1. **Diversify Crop Types:** Incorporate a variety of crops into your rotation plan. Include cash crops, cover crops, legumes, and root crops to achieve a balanced rotation that provides various benefits to the soil.

2. **Group Crops by Families:** Arrange crops into different groups based on their botanical families. Avoid planting crops from the same family successively in the same field, as they often share similar pest and disease vulnerabilities.

Notes

3. **Consider Nutrient Needs:** Different crops have varying nutrient requirements. Rotating crops with contrasting nutrient needs helps prevent nutrient imbalances and depletion. For example, following a nitrogen-demanding crop like corn with a legume such as soybeans can replenish soil nitrogen naturally.

4. **Include Cover Crops:** Integrate cover crops into your rotation plan. Cover crops improve soil structure, suppress weeds, prevent erosion, and add organic matter to the soil when incorporated. Select cover crops based on their ability to address specific soil health needs.

5. **Break Pest and Disease Cycles:** Crop rotation disrupts pest and disease life cycles by interrupting their host availability. Avoid planting crops susceptible to the same pests or diseases successively. For example, rotate solanaceous crops like tomatoes with non-solanaceous crops like grains or legumes to prevent soil-borne diseases.

6. **Manage Weed Pressure:** Crop rotation can help manage weeds by disrupting their life cycles. Weeds that thrive in one crop may struggle to compete in another. Additionally, certain crops, like cover crops with dense foliage, can smother weeds effectively.

7. **Plan Rotation Sequences:** Develop a multi-year rotation sequence that balances the benefits mentioned above. A common approach is a three- to five-year rotation, but the specific sequence will depend on your farm's goals, climate, and specific crop requirements.

8. **Monitor and Adapt:** Keep track of the performance and health of your crops and soils throughout the rotation cycle. Monitor yields, pest and disease incidences, and soil nutrient levels. Based on observations, make adjustments to optimize the rotation plan for future seasons.

2.6.2 Intercropping

Intercropping is a common practice in organic farming where two or more different crops are grown together on the same piece of land. The main objective of intercropping is to maximize the benefits from the land by diversifying production. However, to ensure successful intercropping, special attention must be paid to avoid competition between the crops for light, nutrients, and water (Fig. 2.2) and (Table 2.1.). The following are some principles and types of intercropping:

2.6.2.1 Principles of Intercropping

1. **Complementary Effects:** The crops grown together should have complementary effects rather than competing for resources.

Notes

2. **Duration and Growth Habits:** The subsidiary crop should have a shorter duration and faster growth habits to utilize the early slow-growing period of the main crop. It should be harvested when the main crop starts growing.
3. **Similar Agronomic Practices:** The component crops should have similar agronomic practices to simplify management.
4. **Cover Crops:** Erect growing crops should be intercropped with cover crops to reduce erosion and weed population.
5. **Different Root Depth:** The component crops should have different root depths to utilize resources from different soil depths.
6. **Plant Population:** Maintain a standard population for the main crop, while adjusting the plant population of subsidiary crops based on the situation.
7. **Pest and Disease Management:** Avoid choosing component crops that are susceptible to the same pests, diseases, pathogens, or parasites.
8. **Simple and Profitable:** The planting method and management should be simple, time-efficient, economical, and profitable.

2.6.2.2 Types of Intercropping

1. **Mixed Intercropping:** Plants are completely mixed in the available space without distinct rows, reducing competition for solar radiation.
2. **Alternate Row Intercropping:** Two or more plant species are cultivated in separate alternate rows, minimizing competition for light when crops have different canopy arrangements.
3. **Relay Intercropping:** Planting the second crop before harvesting the first crop. The second crop is planted during the reproductive stage of the first crop but before its harvest, taking advantage of the shading effect during germination.
4. **Strip Intercropping:** Several rows of one plant species are alternated with several rows of another plant species.
5. **Parallel Intercropping:** Growing different crops with zero competition, such as black gram/green gram and maize.
6. **Companion Intercropping:** Producing intercrops that yield equal to solid planting, such as mustard/potato/onion and sugarcane.
7. **Multi-storeyed Intercropping:** Growing crops of different heights, such as coconut, black pepper, cocoa, and pineapple.

Notes

8. **Synergistic Intercropping:** Achieving higher yields for both crops compared to pure crops on a unit area basis. There are two types: additive series (crop husbandry according to main crop) and replacement series (both crops are component crops).

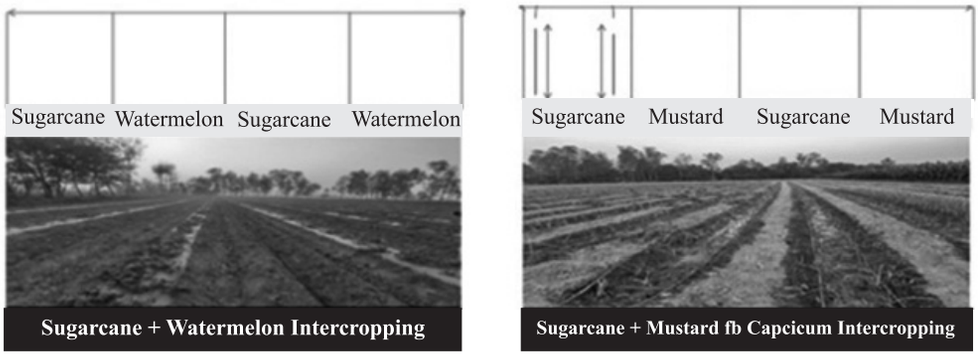


Fig 2.2: Intercropping

2.6.2.3 Advantages of Intercropping

1. **Efficient Nutrient Use:** Nutrients from different soil layers are evenly utilized.

   Nitrogen Fixation: Legume crops in intercropping systems can efficiently fix atmospheric nitrogen.

2. **Micro-Nutrient Availability:** Leaf shading and decomposition reduce the chances of micro-nutrient deficiency.

3. **Increased Biomass Production:** Total biomass production per unit area and time is increased.

4. **Utilization of Limited Space:** Farmers can produce multiple agricultural commodities from a limited space.

5. **Higher Profitability:** Profit per unit area becomes higher due to diversified production.

6. **Fodder Value:** Intercropping legume and non-legume fodder increases the quantity and quality of fodder.

7. **Reduced Marketing Risks:** Intercropping provides yields in instalments, reducing the risks associated with marketing.

8. **Year-round Employment:** Intercropping offers continuous employment and utilization of labour, machinery, and power throughout the year.

Notes

9. **Soil Conservation:** Intercropping helps in soil conservation by reducing erosion.

10. **Insurance against Crop Failure:** Intercropping provides insurance against crop failure as the failure of one crop may be compensated by the success of the other.

Table 2.1: Crop Rotations and Intercropping

S.N.	Main crop	Crop rotations	Intercropping
1.	Cotton	Cotton-Gram Cotton-Wheat Cotton-Potato	Cotton + Soyabean Cotton+ Urad/Moong
2.	Paddy	Paddy-potato–soybean Paddy-gram Paddy–wheat-green gram Paddy–berseem	
3.	Sugarcane	Maize-Sugarcane Wheat-Maize (2nd year) Maize-Wheat-Sugarcane rotation (3rd year)	Sugarcane+Methi/Pea/lentil +Wheat
4.	Maize/Millets	Maize/Millets-Wheat–Moong	Maize/Millets+Soybean Moong/Urad/Arhar
5.	Gram	Paddy-Gram-Moong	Gram+Mustard
6.	Pea	Paddy-Pea	Pea+Maize/Millets
7.	Groundnut	Maize-Moong-Gram Moong–Groundnut_wheat	
8	Potato	Paddy-Potato Maize-Potato-Tomato	
9	Tomato	Maize-Cabbage-Tomato Maize-cauliower-Okra	Cauliower Tomato+Chili Tomato+Cauliower
10	Okra	Dhaincha (Sesbania)-Potato– Okra	Okra+RadishOkra+Pumpkin

INTEXT QUESTIONS 2.2

Fill in the Blanks;

1. Growing two or more crop species simultaneously in the same field is known as .....

2. Planting the second crop before harvesting the first crop is known as .....

Notes

2.6.3 Cropping System

A cropping system for organic production aims to optimize agricultural practices while adhering to organic principles and regulations. It involves a holistic approach to farming that focuses on maintaining soil health, biodiversity, and ecological balance. Here are some key components and considerations for designing a cropping system within an organic production system:

1. **Crop Rotation:** Implementing a diverse crop rotation plan is crucial in organic farming. It helps to break pest and disease cycles, improves soil fertility, and reduces weed pressure. Rotate crops based on their nutrient requirements, growth habits, and pest vulnerabilities.

2. **Cover Crops:** Utilize cover crops during fallow periods to protect and enrich the soil. These crops can suppress weeds, prevent erosion, add organic matter, fix nitrogen, and enhance soil structure. Common cover crops include legumes (e.g., clover, vetch), grasses (e.g., rye, oats), and brassicas (e.g., mustard, radish).

3. **Companion Planting:** Take advantage of companion planting to create mutually beneficial relationships between different crops. Certain plants can attract beneficial insects, repel pests, provide shade or support, or enhance nutrient uptake. For example, planting marigolds alongside tomatoes can deter nematodes.

4. **Intercropping:** Intercropping involves growing two or more crop species simultaneously in the same field. Combining compatible plants can optimize space utilization, reduce pest pressure, and enhance nutrient cycling. For instance, growing corn and beans together benefits both crops, as the beans fix nitrogen, which benefits corn growth.

5. **Polyculture Systems:** Implement polyculture systems that mimic natural ecosystems by growing multiple crops in a mixed and diversified manner. This approach promotes ecological resilience, reduces disease risk, encourages biodiversity, and enhances ecosystem services. Agroforestry systems and permaculture design principles are often applied in polyculture systems.

6. **Pest and Disease Management:** Focus on preventive measures and biological controls to manage pests and diseases. Integrated Pest Management (IPM) techniques include using beneficial insects, traps, physical barriers, crop rotation, and resistant varieties. Organic-approved pesticides and herbicides may be used as a last resort.

Notes

7. **Soil Management:** Adopt practices that improve soil health and fertility. This includes incorporating organic matter through composting, mulching, and green manures. Minimize soil disturbance through reduced tillage or no-till practices to preserve soil structure, moisture retention, and microbial activity.

8. **Water Management:** Implement efficient irrigation techniques, such as drip irrigation or precision sprinklers, to minimize water use and optimize plant health. Implementing water-saving strategies like mulching and soil moisture monitoring can also help conserve water resources.

9. **Nutrient Management:** Organic fertilizers derived from natural sources, such as compost, manure, and organic amendments, should be used to meet crop nutrient requirements. Regular soil testing helps to determine nutrient deficiencies and guides appropriate amendments.

10. **Weed Control:** Weed management in organic systems relies on cultural practices, such as crop rotation, cover crops, and mulching, to suppress weed growth. Manual methods like hand weeding or mechanical tools are preferred over herbicides.

Remember that the design and implementation of a cropping system may vary based on local climate, soil conditions, available resources, and specific crop requirements. It is important to adapt these practices to suit your specific organic production system while complying with organic certification standards and regulations in your region.

2.6.4 Agroforestry

Agroforestry is a sustainable land-use system that combines the cultivation of trees or woody perennials with agricultural crops or livestock (Fig 2.3). It is a holistic approach that integrates ecological principles into farming practices, promoting biodiversity, soil conservation, and sustainable production. When agroforestry is used in conjunction with organic farming methods, it can enhance the benefits and sustainability of the overall production system. Here are some ways in which agroforestry can contribute to an organic production system:

1. **Biodiversity and ecosystem services:** Agroforestry systems increase biodiversity by providing habitats for a variety of plant and animal species. The presence of trees in agroforestry systems supports beneficial insects, birds, and other wildlife, which can help in control of pests and improve pollination. Trees also contribute to the overall health of the ecosystem by enhancing nutrient cycling, improving soil structure, and reducing erosion.

Notes

2. **Nutrient cycling and soil fertility:** Agroforestry systems utilize the natural processes of nutrient cycling and organic matter decomposition. The leaf litter from trees provides a continuous supply of organic matter, which enriches the soil and improves its fertility. The deep root systems of trees also help to capture nutrients from deeper soil layers and make them available to crops, reducing the need for synthetic fertilizers in organic production.

3. **Microclimate regulation:** The presence of trees in agroforestry systems creates a microclimate that can benefit crop growth. Trees provide shade, reducing temperature extremes and preventing excessive evaporation of soil moisture. They can also act as windbreaks, protecting crops from strong winds and reducing water loss through transpiration.

4. **Pest and disease management:** Agroforestry systems can contribute to natural pest and disease management in organic production. By increasing biodiversity and creating habitat for beneficial insects and predators, agroforestry can help control pest populations. Some tree species also have natural repellent properties or attract pest-deterrent species, which can help reduce the incidence of pests and diseases in adjacent crops.

5. **Diversification and income generation:** Agroforestry systems offer opportunities for diversification and additional income streams in organic farming. Farmers can grow a mix of trees, crops, and livestock, allowing for a wider range of products to be harvested and sold. For example, fruits, nuts, timber, medicinal plants, and non-timber forest products can be integrated into the system, providing economic benefits and enhancing the resilience of the farm.

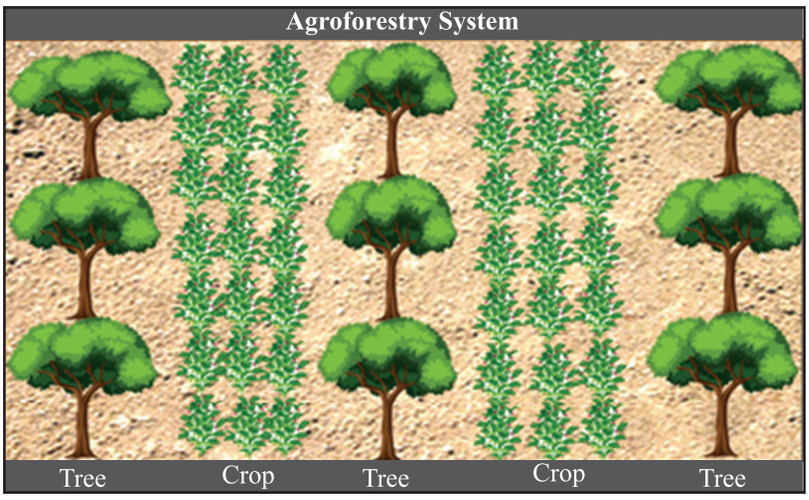


Fig 2.3: Agroforestry System

Notes

It is important to note that successful implementation of agroforestry for organic production requires careful planning and management. Factors such as tree selection, spacing, and management practices need to be considered to ensure compatibility between the trees and crops, and to optimize the benefits of the system.

Overall, agroforestry can be a valuable component of an organic production system, contributing to sustainability, resilience, and increased productivity while promoting biodiversity and environmental conservation**.**

INTEXT QUESTIONS 2.3

Fill in the Blanks:

1. A sustainable land-use system that combines the cultivation of trees or woody perennials with agricultural crops or livestock is known as .....
2. Factors such as ....., ... and ..... need to be considered to ensure compatibility between the trees and crops

2.6.5 Integrated Farming System

An Integrated Farming System (IFS) is a holistic approach to farming that combines multiple agricultural enterprises within a single farm to achieve economic viability, environmental sustainability, and social well-being. It aims to maximize the utilization of resources, minimize waste, and create a balanced and diversified farming system. Here are some advantages and benefits of implementing an Integrated Farming System:

1. **Enhanced Productivity:** By integrating various farming enterprises, IFS can increase overall productivity. For example, the by-products or waste from one enterprise can be utilized as inputs for another enterprise, creating a synergistic relationship and maximizing resource utilization.
2. **Increased Profitability:** IFS focuses on reducing production costs by minimizing external inputs and utilizing on-farm resources effectively. This can lead to improved profitability for farmers by reducing dependence on expensive inputs and increasing returns from multiple enterprises.
3. **Environmental Sustainability:** IFS promotes sustainable agricultural practices by reducing reliance on synthetic inputs such as fertilizers and pesticides. By incorporating natural processes and minimizing chemical usage, it helps preserve soil fertility, water quality, and biodiversity, contributing to long-term environmental sustainability.

Notes

4. **Balanced Food Production:** An IFS can provide a diverse range of agricultural products, including crops, livestock, poultry, fish, and agroforestry products. This allows farmers to meet the nutritional needs of their households and communities through a balanced and varied diet.
5. **Environmental Safety:** By minimizing the use of synthetic chemicals and adopting ecological pest management strategies, IFS reduces the risk of environmental pollution and contamination of soil, water, and air. It promotes the use of organic and natural inputs, enhancing the safety and quality of farm products.
6. **Resource Recycling:** IFS emphasizes the efficient use of resources within the farming system. Recycling organic waste, crop residues, and by-products as inputs for other enterprises reduces waste generation and improves resource efficiency.
7. **Income Year-Round:** Integrating different enterprises with varied production cycles and harvest times can provide a more stable and continuous income throughout the year. This helps farmers mitigate seasonal income fluctuations and enhance their economic resilience.
8. **Risk Minimization:** IFS reduces the risks associated with relying solely on a single enterprise. By diversifying production, farmers can spread their risks and mitigate the impact of market fluctuations, climate variability, and pest or disease outbreaks.

Implementing an Integrated Farming System (Fig. 2.4) requires careful planning, an understanding local conditions, and an appropriate selection of compatible

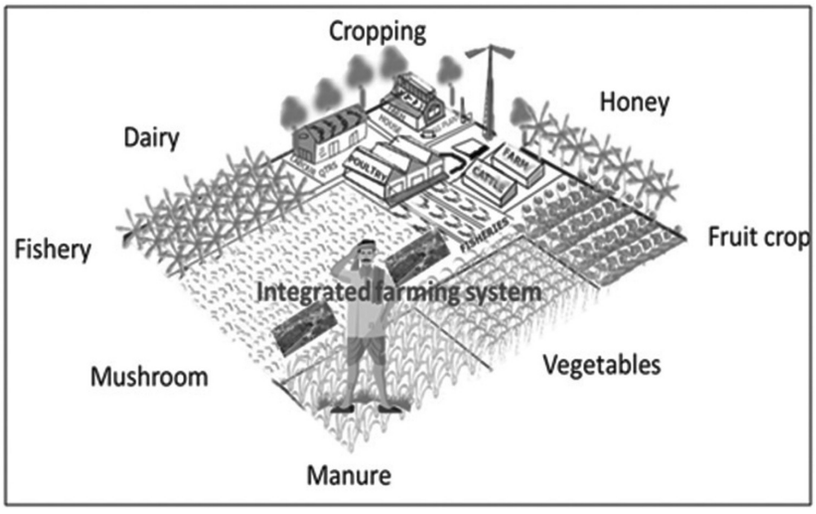


Fig 2.4: Integrated Farming System

Notes

enterprises. It offers a sustainable and efficient approach to agriculture that can improve livelihoods, promote food security, and contribute to environmental conservation.

INTEXT QUESTIONS 2.4

1. ..... is a holistic approach to farming that combines multiple agricultural enterprises within a single farm to achieve economic viability, environmental sustainability, and social well-being.

2. IFS can provide a diverse range of agricultural products, including ....., ..., ..., ... and .....

2.7 POST-HARVEST MANAGEMENT

Post-harvest management in organic production systems involves various practices aimed at maintaining the quality and shelf life of organic produce while adhering to the principles of organic farming. Here are some key aspects of post-harvest management in organic production:

1. **Harvesting:** Harvesting should be done at the appropriate stage of crop maturity to ensure maximum quality and nutritional value. Care should be taken to minimize damage to the produce during harvesting, such as using sharp tools and gentle handling.
2. **Cleaning and Sorting:** Organic produce should be cleaned to remove dirt, debris, and any external contaminants. Sorting helps to separate damaged, diseased, or immature produce from the marketable ones.
3. **Packaging:** Organic products should be packaged using materials that comply with organic standards. The packaging should protect the produce from physical damage, maintain proper ventilation, and prevent contamination. Avoiding the use of synthetic packaging materials is crucial in organic systems.
4. **Temperature and Humidity Control:** Controlling temperature and humidity levels is crucial for maintaining the quality and shelf life of organic produce. Proper storage facilities, such as refrigeration or controlled atmosphere storage, can help to slow down the deterioration process and extend the shelf life of perishable organic products.
5. **Pest and Disease Management:** Organic post-harvest management emphasizes the use of non-synthetic methods for pest and disease control. This may include physical methods such as sanitation, heat treatment, and

Notes

cold storage, as well as the use of organic-approved biopesticides and natural predators.

6. **Handling and Transportation:** Proper handling and transportation practices are essential to minimize damage and maintain product quality. It is important to prevent bruising, crushing, or excessive shaking during transportation to prevent spoilage.
7. **Quality Testing and Certification:** Organic produce may undergo quality testing to ensure compliance with organic standards. Organic certification bodies may conduct inspections and audits to verify that post-harvest management practices align with organic regulations.
8. **Value-Added Processing:** Organic products can undergo value-added processing, such as washing, drying, juicing, or canning, to extend their shelf life and increase their market value. It is important to use organic-approved processing methods and ingredients to maintain organic integrity.

Overall, post-harvest management in organic production systems focuses on preserving the quality, nutritional value, and organic integrity of the product from harvest to consumer, while minimizing waste and environmental impact. It involves a combination of good agricultural practices, proper storage and handling, and adherence to organic certification standards.

WHAT YOU HAVE LEARNT

Let us recapitulate and enlist the salient points that you have learnt through this lesson.

- Transitioning from conventional farming to organic farming requires careful planning and preparation.
- The conversion period for organic farming is three years, during which we must adhere to organic farming practices without using synthetic chemicals.
- Rotate different plant families to minimize pest and weed pressure while maintaining soil health, biodiversity, and ecological balance.
- Intercropping is a common practice in organic farming where two or more different crops are grown together on the same piece of land.
- Agroforestry is a sustainable land-use system that combines the cultivation of trees or woody perennials with agricultural crops or livestock.
- The farming system approach is considered as resource management strategy to achieve economic and sustained productivity that meets the diverse requirements of the farm household while preserving the resource base and maintaining a high level of environmental quality.

- Post-harvest management practices mainly aimed at maintaining the quality and shelf life of organic produce while adhering to the principles of organic farming.

TERMINAL EXERCISE

1. What is conversion period?
2. What are the criteria for conversion of conventional to organic farm?
3. What is intercropping and its importance?
4. What do you mean by agroforestry and its classification?
5. Explain the integrated farming system and its importance.

ANSWERS TO INTEXT QUESTIONS

2.1

1. 24 Months and 36 months
2. Conversion period

2.2

1. Intercropping
2. Relay Cropping

2.3

1. Agroforestry
2. Tree selection, spacing, and management practices

2.4

1. Integrated farming system
2. Crops, livestock, poultry, fish, and agroforestry products

Key Learning Outcomes

Learner will be able to:

- Understand the crop planning during conversion period
- Basic understanding in crop rotation, agroforestry, integrated farming system

Notes

3

SEED SELECTION AND TREATMENT UNDER ORGANIC FARMING

In the previous lesson we have learnt about planning and preparation for Organic Farming. In this lesson we will learn about Seed Selection and Treatment Under Organic Farming. Seed selection and treatment are vital aspects of organic farming, which aims to produce food in a way that is environmentally friendly and sustainable. In organic farming, choosing the right seeds is crucial. Farmers often select heirloom and open-pollinated varieties because these seeds are well-adapted to local conditions and tend to be more resilient against pests and diseases. This approach not only helps in maintaining biodiversity but also reduces the need for chemical pesticides. Seed treatment in organic farming involves natural methods to enhance seed health and germination. For example, farmers may use microbial inoculants, which are beneficial bacteria and fungi that promote strong root development and improve nutrient absorption. Additionally, organic coatings made from natural materials can protect seeds from diseases and pests without using synthetic chemicals. These practices support soil health and contribute to a balanced ecosystem. By focusing on natural methods of seed selection and treatment, organic farmers work to create a sustainable agricultural system that can withstand challenges like climate change and environmental degradation. Overall, understanding these concepts helps learners appreciate the importance of organic farming in promoting healthy food production and protecting our planet for future generations.

OBJECTIVES

After reading this lesson, you will be able to:

- identify the cropping system and types of cropping system;

Notes

- understand the organic practices for seed treatment;
- identify the selection of seed variety–insect pest resistant, non-genetically modified etc.; and
- understand the seed treatment.

3.1 CROPPING SYSTEM AND PRACTICE FOR SEED TREATMENT

A cropping pattern refers to the proportion of land under cultivation of various crops at different points of your time. This indicates the time and arrangement of crops during a particular acreage. Changing cropping pattern would cause:

- Change within the proportion of land under different crops.
- Change in space sequence and time of crops

The average rainfall, temperature, climate, technology and the types of soil used for agriculture, mostly determines the cropping pattern in India. The different patterns of cropping are practiced to obtain the maximum yield.

3.1.1 Types of Cropping Pattern

The major cropping pattern types include the following;

Mono Cropping: Growing one agricultural species at a time in agricultural land is the meaning of monocropping. Monocropping can reduce the fertility of the soil and destroy its structure of the soil. Chemical fertilizers are required to upgrade production. This practice allows the spread of pests and diseases.

Advantages of Mono Cropping

- Simplicity
- Results in higher yields
- Lowers the amount of extra land required
- It is efficient and more profitable to the farmer
- Destroys soil nutrients
- Results in the use of harmful chemicals
- Pollutes groundwater supplies
- Adversely acts and alters the natural ecosystem

Notes

Disadvantages of Mono Cropping

- Destroys soil nutrients
- Results in the use of harmful chemicals
- Pollutes groundwater supplies
- Adversely acts and alters the natural ecosystem
- Destroys the overall soil's degradation and erosion
- Requires lots of water to irrigate
- Uses a lot of fossil fuel energy

Mixed Cropping: Mixed Cropping is the simultaneous cultivation of two or more crops on an area of land that is equivalent to both. For instance, mixed cropping is the practice of producing wheat and gram on the same amount of land at the same time. The application of this technique reduces the likelihood that one of the crops would fail and oers protection against crop failure caused by unusual weather. The crops that are grown together should have a different maturation time and different water requirements.

Advantages of Mixed Cropping:

- The crop yield increases.
- The pest infestation is minimized.
- Reduction in the risk of crop failure.
- The soil is utilized properly.
- More than one variety of crops can be harvested at the same time.

Disadvantages of Mixed Cropping:

- Applying fertilisers to individual crops is very difficult.
- Spraying pesticides to individual crops is difficult.
- Harvesting and threshing of crops separately are not possible.

Inter Cropping: Intercropping is the practice of growing quite one crop on an equivalent time during a definite row pattern. After one row of the most crops, three rows of intercrops are often grown. This increase productivity per unit area.

Notes

INTEXT QUESTIONS 3.1

A. Multiple Choice Questions:

1. Crop grown to protect the main crop from vagaries of nature and also to render support to the crop is called as-

   (a) Trap crop (b) cover crop

   (c) Nurse crop (d) Inter crop

2. Quincunx system of planting used for

   (a) Fruits (b) Vegetables

   (c) Cereals (d) Oilseed

3. Advantages of monoculture

   (a) Results in higher yields

   (b) Destroys soil nutrients

   (c) Pollutes ground water supplies

   (d) Requires lots of water to irrigate

3.2 ORGANIC SEED TREATMENTS

Organic seed treatments involve natural methods to improve seed health and germination without synthetic chemicals. Techniques include applying beneficial microbes, natural coatings for protection, and methods like hot water treatments to eliminate pathogens. These treatments promote strong plant growth, enhance resilience to pests, and support the principles of sustainable agriculture. The purpose of any seed treatment is to improve seed performance in one or more of the following ways:

1. Eradicate seed borne pathogens or protect from soil borne pathogens,
2. Optimize ease of handling and accuracy of planting (reduce gaps in stand or the need for thinning of seedlings, particularly when mechanical planters are used)
3. Improve germination rates.

Notes

Priming

Primed seed has absorbed just enough water to dissolve germination inhibitors and activate the early stages of germination. Primed seed is therefore in a suspended state of growth, so it germinates faster and more uniformly over a broader temperature range, reducing the likelihood of very thick or thin plant stands. Priming results in earlier seedling establishment, which can aid in fending of the attack of damping-o pathogens to which germinating seedlings are particularly vulnerable. Priming is usually performed in conjunction with a pelleting process to protect the primed seed, which has a shortened life expectancy.

Pelleting

A seed pellet is a coating, usually of clay mixed with other inerts that streamlines the size, shape, and uniformity of a small, non-round seed such as those of lettuce, carrots, onions, and many herbs and owers. Pelleting results in easier, safer, and more accurate mechanical seeding, thus reducing gaps in the field and the need for labor-intensive thinning. Ideally, the pelleting materials are somewhat permeable to oxygen and absorb water quickly so that the pellet splits immediately upon hydration. Conventional pelleting techniques using synthetic inert materials are not approved for organic use, but there are now several pelleting materials on the market that are approved for use on organic farms

3.3 PROCESS OF SEED TREATMENT

The concept of seed treatment involves the use of biological or chemical agents to control or contain primary soil and seed borne infestation of insects and diseases which affects crop productivity and crop production (Table 3.1).

Seed Treatment plays an important role in protecting the seeds and seedlings from seed and soil borne diseases and insect pests affecting crop emergence and its growth.

Seed treatment is a term that describes both products and processes. The usages of specific products and specific techniques can improve the growth environment for the seed, seedlings and young plants. Seed treatment complexity ranges from a basic dressing to coating and pelleting.

(a) **Seed Dressing**: This is the most common method of seed treatment. The seed is dressed with either a dry formulation or wet treated with a slurry or liquid formulation. Dressings can be applied at both farm and industries. Low cost earthen pots can be used for mixing pesticides with seed or seed can be spread on a polythene sheet and required quantity of chemical can be sprinkled on seed lot and mixed mechanically by the farmers.

Notes

(b) **Seed Coating**: A special binder is used with a formulation to enhance adherence to the seed. Coating requires advanced treatment technology, by the industry.

(c) **Seed Pelleting**: The most sophisticated Seed Treatment Technology, resulting in changing physical shape of a seed to enhance palatability and handling. Pelleting requires specialized application machinery and techniques and is the most expensive application.

Recommendation of Seed Treatment for Major Crops

Table 3.1: Recommendation of Seed Treatment for Major Crops

S. No.	Name of Crop	Pest/Disease	Seed Treatment	Remarks
1.	Sugarcane	Root rot, wilt	Carbendazim (0.1%) Trichoderma spp. 4-6 gm/kg. seed	For seed dressing metal seed dresser/ earthern pots or polythene bags are used.
2.	Maize	Soil & seed borne disease	Trichodermaviride, T. harzianium 4g/kg seed	–do–
3.	Groundnut	Stem rot, Seed rot, Seedling rot	Soil application of caster cake @ 1000 kg/ha or Neem cake. Seed treatment Trichodermaviride @4gm/kg seed.	–do–
		White grubs	Chlorpyriphos/ Quinalphos @2.5 to 12 ml/kg seed	
4.	Cotton	Soil & Seed	Acid delenting should be followed before sowing @ one litre commercial H_2SO_4 for 10 kg. Seed. Trichodermaspp 4gm/kg seed. Captan 3g/kg seed Carben-dazim 2g/kg seed	–do–
		Black arm	Streptocycline 0.01% dipping of seeds	–do–

Notes

S. No.	Name of Crop	Pest/Disease	Seed Treatment	Remarks
5.	Rice	Root rotdisease & otherinsects/ pests	Trichoderma 5-10 gm/kg. seed (before transplanting) Chloropyriphos 30gm/ 10 kg seed.	–do–
		Rootknot nematode	Seed soaking in 0.2% of monocrotophos for 6 hours	–do–
		White tip nematode	Seed soaking in 0.2% solution of monocro-tophos	–do–

Chemical seed Treatment

Seed Health: It is an important attribute of quality seed. Though a seed lot that meets high standards of germination, vigour and purity if it is contaminated with seed borne pathogens and insect pests, may be useless to farmers because it may result in severe yield loss or even crop loss in an entire area. Benefits of the insecticidal and fungicidal treatments:

- Prevents the spread of plant diseases
- It protects the seed from seed rot and seedling blights.
- It improves the seed germination
- It provides protection from storage insects.
- It controls the soil insects

INTEXT QUESTIONS 3.2

True and False:

1. Is seed dressing a widely used method for seed treatment? (T/F)
2. Is Carbendazim effective against root rot and wilt in sugarcane? (T/F)

3.4 SEED SELECTION AND TREATMENT

- Identify suitable main crop and its companion crops depending upon the suitability of climate and season

Notes

- Plan for multi-crop planting as intercrops, mixed crop, relay crop or trap crop
- Keep rotation cycle in mind
- Plan for sowing or planting methodology
- Select pest and disease resistant varieties suiting to the given agro-climatic and soil situations
- Ensure that seed or planting material is not genetically modified
- Identify vendors for authentic organic seed procurement, if not available on-farm
- Understand the organic practices for seed treatment
- Identify various bio-inputs that could be used for seed treatment
- Chalk out seed/ planting material treatment plan
- Bio inputs such as biofertilizers, bio-pesticides
- On-farm made seed protecting aids such as Bijamrit
- -farm botanical or organically acceptable chemical alternatives
- Identify vendors of authentic organic seed treatment inputs
- Prepare bio-inputs for seed treatment in farm: Bijamruth, botanical alternatives etc.
- Implement seed treatment process appropriately
- Understand acceptable chemical alternatives, their procurement and use

By following these steps for seed selection and treatment, organic farmers can enhance crop health and productivity while adhering to sustainable practices. Let me know if you need more information on any specific step!

For an Instance, We will Take a Chilly Crop

Organic farming is a crop production method respecting the rules of the nature. It maximizes the use of on farm resources and minimizes the use of o-farm resources. It is a farming system that seeks to avoid the use of chemical fertilizers and pesticides. In organic farming, entire system i.e. plant, animal, soil, water and micro-organisms are to be protected.

Climate

Chilli requires a warm and humid climate for its best growth and dry weather during the maturation of fruits. A temperature ranging from 20-25°C is ideal for chilli. In chilli fruit development adversely aected at temperatures of 37°C or more.

Notes

Heavy rainfall leads poor fruit set and in association with high humidity leads to rotting of fruits. High temperature & low relative humidity increases the transpiration during owering resulting in shedding of buds, owers and small fruits.

Land Preparation

Land is prepared to a fine tilth by thorough ploughing / digging. Two to three ploughing are done to bring the soil to fine tilth. Stones and gravel are to be removed. In case of direct sowing, three to four ploughing are undertaken and sowing is done along with the last ploughing. The soil can be treated with Azatobacter or Azospirillum @ 1-1.25 kg mixed with 50 kg of FYM and broadcasted in the field. Farm Yard manure @ 4-6 t and 1-2 t of vermicompost can be added per acre.

Planting Material

Chilli is propagated by seeds. For raising nurseries, seeds of high yielding varieties with tolerance to pests and diseases may be used. They should be carefully selected from certified organic farms or from own seed plot which is raised organically. Seeds should not be treated with any chemical fungicides or pesticides.

3.5 BIO-FERTILIZERS - METHODS OF APPLICATION

Applying bio-fertilizers to seeds can enhance their growth and health. Here are several effective methods for seed application using bio-fertilizers**:**

- **Seed Treatment**: Suspend 200 gm N biofertilizer and 200 gm Phosphotika in 300-400 ml of water and mix thoroughly. Mix this paste with 10 kg seeds & dry in shade. Sowing is done immediately.
- **Seedlings Root Dip**: 1 kg each of two biofertilizers is mixed in sufficient quantity of water. Dip the roots of seedlings in this suspension for 30-40 min before transplanting.
- **Soil Treatment**: Mix 4 kg each of biofertilizers in 200 kg of compost and leave it overnight. Apply this mixture in the soil at the time of sowing or planting.

However, it is always beneficial to adopt indigenous practices for seed treatment, wherever possible. The seeds may be treated with Trichoderma and Psuedomonas sp. @ 10 g per kg of seed to prevent incidence of seedling rot in the nursery. 400 g of seeds would be sufficient for raising nursery for transplantation in an area of acre. Biological seed treatment with antagonistic Pseudomonas uorescens improves the seed quality parameters under laboratory conditions and drastically reduces the bacterial wilt incidence under field conditions.

Notes

WHAT YOU HAVE LEARNT

Let us recapitulate and enlist the salient points that you have learnt through this:

- Importance of choosing high-quality, disease-free organic seeds that are suitable for local conditions.
- Introduce beneficial microorganisms to enhance growth.
- Apply organic materials for protection and nutrient enhancement.
- Use heat water treatment to eliminate pathogens.
- Seed treatments contribute to better soil health by fostering beneficial microbial activity.
- Treated seeds tend to have higher germination rates and stronger early growth, leading to healthier plants.
- Proper seed selection and treatment practices contribute to the sustainability and resilience of agricultural systems.
- Understanding local pests, diseases, and environmental factors is crucial for effective seed selection and treatment.
- Sharing knowledge and practices within communities helps promote organic farming and sustainable agriculture

TERMINAL EXERCISE

1. Write a note on Crop Selection and seed treatment on any agriculture crop.
2. Explain the term Priming of seed
3. Describe Intercropping and Mixed cropping with their Advantages.
4. Briefly explain the process of seed treatment

ANSWERS TO INTEXT QUESTIONS

3.1

1. (c) 2. (b) 3. (a)

3.2

1. True 2. True

Notes

Key Learning Outcomes

Learner will be able to:

- Illustrate the different types of cropping system.
- Identify the organic practices for seed treatment.
- Identify methodology for preparation of inputs for carrying out treatment under organic farming.
- Analyze the quantity of process of applying seed treatment.

Notes

4

NUTRIENT MANAGEMENT

In the previous lesson we have learnt about planning and preparation for Organic Farming. In this lesson we will learn about different aspects of nutrient management. Nutrient management in organic farming is a critical aspect of sustainable agriculture that focuses on maintaining soil fertility and plant health using organic and natural methods. Organic farming seeks to minimise synthetic chemicals and relies on practices promoting soil health and biological diversity. Organic matter, like crop residues and cover crops, should be returned to the soil to enhance nutrient cycling. Organic fertilizers like compost, animal manure, bone meal, and seaweed extracts provide essential nutrients in a form that is slowly released, reducing the risk of nutrient runoff and leaching. Organic farming encourages the development of beneficial soil microorganisms and mycorrhizal fungi that assist in nutrient uptake by plants. Effective nutrient management is essential for achieving higher productivity with healthy and nutritious crops.

OBJECTIVES

After reading this lesson, you will be able to:

- understand the negative impact of chemical fertilizers;
- identify the soil physical, chemical and biological properties;
- identify the different sources of nutrients under the organic production system; and
- understand the use of green manure and biofertilizer in organic nutrient management.

Notes

4.1 PROBLEMS ASSOCIATED WITH CHEMICAL FERTILIZERS

While chemical fertilizers have played a significant role in improving agricultural productivity, they are also associated with several problems. Here are some of the issues commonly associated with chemical fertilizers:

Environmental Pollution: Chemical fertilizers often contain high levels of nitrogen, phosphorus, and potassium, which can leach into water bodies such as rivers, lakes and groundwater. This nutrient runoff can lead to water pollution, causing eutrophication, algal blooms and the death of aquatic organisms.

Soil Degradation: Continuous and excessive use of chemical fertilizers can degrade the soil quality over time. These fertilizers primarily provide macronutrients, neglecting the supply of micronutrients and organic matter necessary for maintaining soil health and fertility. As a result, the soil becomes more compacted, loses its ability to retain water and nutrients, and becomes prone to erosion.

Loss of Biodiversity: The excessive use of chemical fertilizers can disrupt the natural balance of ecosystems, leading to a decline in biodiversity. The high nutrient levels promote the growth of aggressive and fast-growing plant species, which can out compete native plants. This disrupts habitats and reduces the diversity of plant and animal species in the affected areas.

Health Risks: Chemical fertilizers can pose health risks to farmers, agricultural workers, and consumers. Prolonged exposure to these fertilizers, especially during their application, can cause respiratory problems, skin irritations, and other health issues. Additionally, chemical residues from fertilizers can accumulate in food crops, potentially impacting human health when consumed.

Nutrient Imbalance: Chemical fertilizers often focus on supplying a limited set of nutrients, primarily nitrogen, phosphorus, and potassium. However, plants require a balanced mix of macro and micronutrients for optimal growth and development. Overreliance on chemical fertilizers without considering the overall nutrient balance can lead to nutrient deficiencies or imbalances in the soil, negatively affecting plant health.

Dependency and Cost: Continued reliance on chemical fertilizers can create a dependency on external inputs, as they do not contribute to long-term soil fertility. Farmers may become reliant on these fertilizers, leading to increased costs for purchasing and applying them. This can be particularly burdensome for small-scale farmers with limited financial resources.

To address these problems, sustainable and environment friendly alternatives such as organic fertilizers, crop rotation, cover cropping, and precision farming techniques are being increasingly advocated to promote soil health, reduce environmental impacts, and ensure long-term agricultural sustainability.

4.2 SOIL FERTILITY PARAMETERS

Soil fertility is the ability of soil to provide essential nutrients and favourable conditions for plant growth. It is influenced by a combination of physical, chemical and biological properties. Here are the main parameters that affect soil fertility in each of these categories:

4.2.1 Physical Properties

Soil Texture: Refers to the relative proportions of sand, silt, and clay particles in the soil. Different textures have varying water-holding capacity, drainage, and aeration characteristics.

Soil Structure: The arrangement of soil particles into aggregates or clumps. Good soil structure allows for root penetration, water movement, and air exchange (Fig. 4.1).

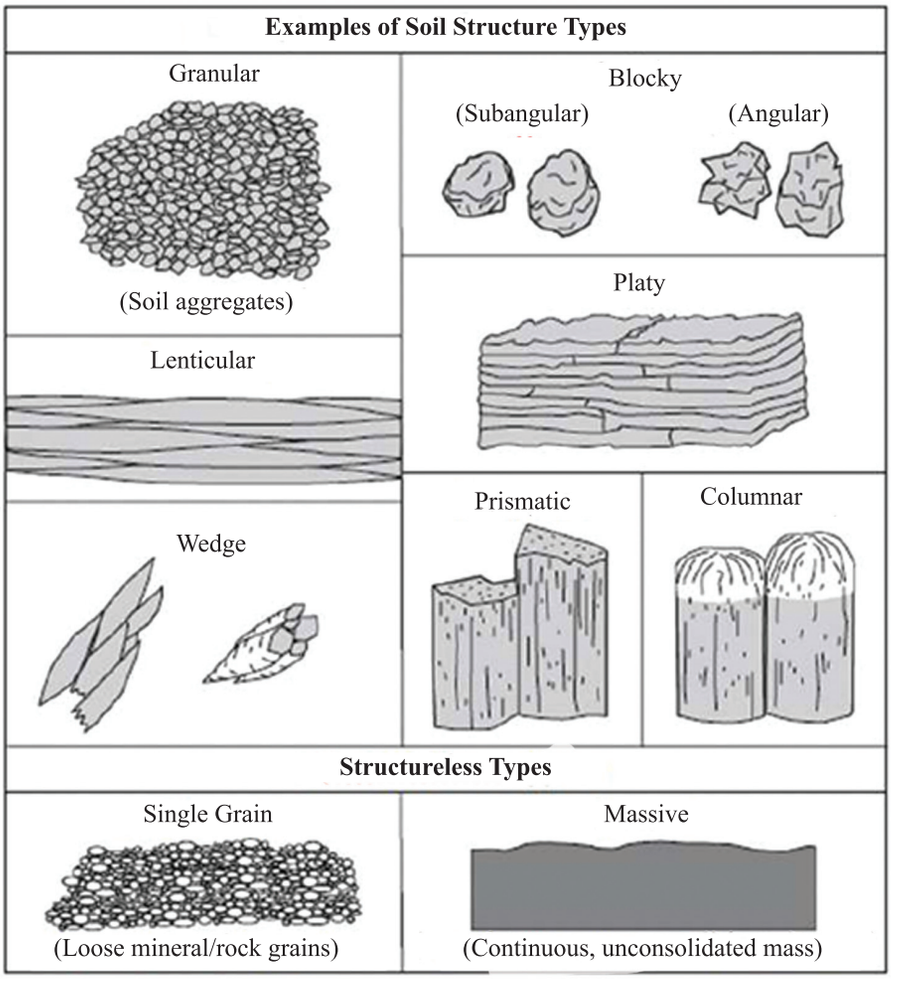


Fig. 4.1: Soil Structure Types

Notes

Soil Porosity: The presence of open spaces or pores between soil particles. Porosity affects water infiltration, root growth, and gas exchange in the soil.

Soil Moisture: The amount of water present in the soil. It is essential for nutrient uptake by plants and biochemical processes within the soil.

Soil Permeability: Soil permeability is a broad term used to define the ability of the soil for transmitting water. It is important to understand the water dynamics and the water balance of the soil and it must be known for accurate management of irrigation. It is determined partly by texture, with sandy soils having high permeability as compared to clay soils and it can be altered by soil management (Fig. 4.2).

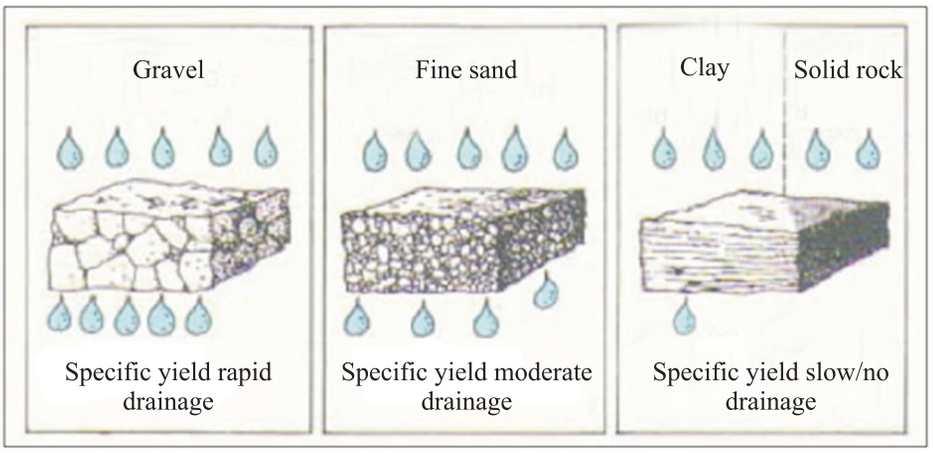


Fig. 4.2: Soil Permeability

4.2.2 Chemical Properties

Soil pH: The measure of soil acidity or alkalinity. pH affects nutrient availability to plants, as different nutrients are more accessible at specific pH ranges.

Nutrient Content: The concentration of essential plant nutrients in the soil, including macronutrients (e.g., nitrogen, phosphorus, potassium) and micronutrients (e.g., iron, zinc, copper).

Cation Exchange Capacity (CEC): The soil's ability to retain and exchange cations (positively charged ions). CEC influences nutrient retention and availability to plants.

Organic Matter Content: The amount of decomposed plant and animal materials in the soil. Organic matter improves soil structure, water-holding capacity, nutrient retention, and microbial activity.

Notes

4.2.3 Biological Properties

Soil Microorganisms: The presence and activity of bacteria, fungi, protozoa, and other microorganisms in the soil. They play vital roles in nutrient cycling, organic matter decomposition, and disease suppression.

Soil Fauna: The diverse range of animals living in the soil, such as earthworms, nematodes, and insects. They contribute to nutrient cycling, aeration, and soil structure improvement.

Soil Enzymes: Biological catalysts produced by microorganisms and plants. Enzymes break down organic matter and nutrients, facilitating their availability to plants.

Soil Biodiversity: The variety of plant species, microorganisms, and animals present in the soil ecosystem. A diverse soil ecosystem is more resilient and productive.

It is important to assess and manage these parameters to maintain and improve soil fertility for sustainable agricultural practices and optimal plant growth.

INTEXT QUESTIONS 4.1

Fill in the Blanks:

1. The relative proportions of sand, silt, and clay particles in the soil is called .....
2. The soil's ability to retain and exchange cations is called .....

4.3 SOURCES OF NUTRIENTS

These are various sources of nutrients commonly used in agriculture:

Legumes: Legumes such as lentils, peas, beans, and chickpeas are excellent sources of nitrogen as they form a symbiotic relationship with nitrogen-fixing bacteria. These bacteria convert atmospheric nitrogen into a form that plants can use, thereby enriching the soil with nitrogen. Different legume crops have specific rhizobium bacteria which is listed in (Table 4.1).

Notes

Table 4.1: List of crop-specific rhizobium bacteria sp.

S No.	Rhizobium sp.	Legume crops
1.	*Rhizobium leguminosarum*	*Pisum sativum* (Pea), *Viciafaba* (Broad bean), *Lens esculenta* (lentil)
2.	*Rhizobium phaseoli*	*Phaseolus vulgaris*
3.	*Rhizobium trifolii*	*Trifolium sp*. (red clover, white clover)
4.	*Rhizobium melilotii*	Melilotus, Medicago, Trigonella
5.	*Rhizobium lupini*	*Lupinus ornithopus*
6.	*Rhizobium japonicum*	*Glycine max* (Soybean)
7.	*Rhizobium sp.*	*Vigna ungiculata* (Cowpea), *Vigna radiata* (Mung bean) *Arachis hypogea* (Groundnut), *Cajanas cajan* (Red gram), *Cicer arietinum* (Chickpea), *Crotalaria juncea*, *Sesbania* sp.

Crop residues: Crop residues like stalks, leaves, and husks left after harvest can be incorporated into the soil as organic matter. As they decompose, they release nutrients and improve soil structure. Crop residues and their nutrient content is listed in the table below (Table 4.2):

Table 4.2: Crop residues and their nutrient content

S. No.	Crop	Nutrient content in crop residues		
		N%	P%	K%
1.	Rice	0.45–0.49	0.089–0.104	1.45–1.51
2.	Wheat	0.48	0.16	1.18
3.	Maize	0.52	0.18	1.35
4.	Sorghum	0.52	0.23	1.34
5.	Pearlmillet	0.45	0.16	1.14
6.	Redgram	0.74	0.28	0.89
7.	Lentil	1.96	0.20	1.14
8.	Groundnut	1.6	0.23	1.37
9.	Soybean	1.93	0.14	1.84
10.	Mustard	0.55–0.65	0.25–0.32	0.39–0.41
11.	Sunflower	0.55–0.58	0.18–0.22	1.70–1.79
12.	Sugarcane	0.4	0.18	1.28
13.	Cotton	0.86	0.30	0.92
14.	Banana	0.47	0.062	3.84

Notes

Mulching: Mulching involves covering the soil surface with a layer of organic materials like straw, hay, or grass clippings. As the mulch breaks down, it adds organic matter to the soil and releases nutrients slowly over time. Mulching have several benefits:

- **Conservation of Moisture**: Mulching helps retain soil moisture by reducing evaporation. The layer of mulch acts as a barrier, preventing water from evaporating quickly from the soil surface. This is especially beneficial during hot and dry periods, as it reduces the frequency of watering and helps plants withstand drought conditions.
- **Weed Control**: Mulch acts as a natural weed suppressant by blocking sunlight and inhibiting weed seed germination. It creates a physical barrier that hampers weed growth, reducing the need for manual weeding or the use of herbicides.
- **Soil Temperature Regulation**: Mulch helps regulate soil temperatures by providing insulation. During hot weather, it keeps the soil cooler, protecting plant roots from excessive heat. In colder seasons, it acts as an insulating layer, preventing rapid temperature fluctuations and protecting plants from frost damage.
- **Nutrient Enrichment**: Organic mulches, such as compost, straw, or shredded leaves, gradually break down over time. As they decompose, they release essential nutrients into the soil, enriching it and improving overall soil fertility. This benefits plant growth and development.
- **Erosion Control**: Mulching helps prevent soil erosion caused by wind and water. The layer of mulch protects the soil surface, reducing the impact of heavy rain or strong winds, which can displace or wash away topsoil.
- **Improved Soil Structure**: Over time, mulch can enhance soil structure by promoting the activity of earthworms and beneficial soil microorganisms. As the organic mulch breaks down, it improves soil texture, aeration, and drainage, leading to healthier root systems.

Green manure: Green manure refers to the practice of growing specific crops, such as clover, rye, or vetch, and then incorporating them into the soil while they are still green and actively growing. Green manure crops improve soil fertility by adding organic matter and nutrients when they decompose. Practice of ploughing or turning in to the soil un decomposed green plant tissues for the purpose of improving a physical condition as well as the fertility of the soil.

Notes

Criteria for green manure crop

- Capacity to fix atmospheric N in good amounts in symbiosis with microorganisms
- Excellent vegetative growth (heavy foliage)
- Succulent vegetation with limited fibrous material
- Deep root system to open the soil-for recycling of nutrients
- Short duration with maximum and faster vegetative growth

Green manure crops:

I. Sunn hemp (*Crotalaria juncea*)

- It is a unique crop possessing, fibre, fodder and green manurial value with the nutrient composition of 2.3 % N, 0.2 % P and 1.4 %K (Fig. 4.1a).
- It can be raised successfully under irrigated or dry conditions.
- It can be grown on medium fertile soils.
- Seed rate is 45 kg ha^{-1}.
- Green matter yield 9-17 tonnes ha^{-1}.

II. Daincha (*Sesbania aculeata*)

- It is an erect growing deep-rooted crop and useful to open soil and improve drainage in heavy soils (Fig. 4.1b).
- Nutrient composition (%): [3.5N, 0.3P and 1.0K]
- This crop can be grown on heavy soils
- Seed rate 30 kg ha^{-1}
- Yield 5 tonnes ha^{-1}
- Seeds require scarification (light pounding with sand) for easy germination.

III. Indigo (*Indigofera tinctoria*)

- Drought-resistant crop with a slow growth rate and deep roots (Fig. 4.1c).
- It is not relished by cattle.
- Can be grown in fruit gardens and plantations during non-monsoon season.

- Seed rate is 20 kg ha^{-1}
- Yield is 5 tonnes ha^{-1}

IV. Wild indigo (*Tephrosia purpurea*)

- It works well on hard, coarse gravelly soils and poor soils.
- It's also utilized as green leaf manure.
- Suitable for unirrigated orchards like mango, sapota, etc.
- Nutrient composition (%): 1.8 N , 0.1 P and 0.3 K

V. Pillipesara (*Phaseolus trilobes*)

- Popular green manure crop for black and alluvial soils
- It has good ratooning capacity
- The crop could be incorporated in to the soil after two cuttings for fodder
- Yield : 3-5 tonnes ha^{-1}
- Seed rate: 35 kg ha^{-1}
- Chemical composition (%): 3 N, 0.1 P and 0.3 K

VI. Horse gram (*Dolichus biflorus*) or *Macrotyloma uniflorum*

- It is suitable as green manure crop for poor and hard soils (Fig. 4.3d).
- It can also withstand drought.
- Seed rate is 35 kg ha^{-1}
- Yield as green matter - 3.5 tonnes ha^{-1}

Fig. 4.1(a): Sunn hemp (*Crotalaria juncea*)

Fig. 4.1(b): Daincha (*Sesbania aculeata*)

Fig. 4.1(c): Indigo
(*Indigofera tinctoria*)

Fig. 4.1(d): Horse gram
(*Dolichos biflorus*)

Fig. 4.1: Different types of green manure crops

Compost: Compost is prepared by decomposing organic materials like food scraps, yard waste, and manure in a controlled manner. It is rich in nutrients and can be added to soil to enhance fertility and improve the soil structure. Different type of compost and their nutrient contents are listed (Table 4.3) below:

Table 4.3: List of compost and their nutrient content (%)

S No.	Name of manure/compost	N%	P_2O_5%	K_2O%
1.	Town compost	1.4	1.0	1.4
2.	Night soil	5.5	4.0	2.0
3.	Poudrette (dehydrated night soil)	1.32	2.0	1.0
4.	Activated sludge	3.0-6.0	2.0	1.0
5.	Poultry manure	3.0	2.6	1.4
6.	Sheep and goat manure	3.0	1.0	2.0
7.	Sunn hemp (*Crotalaria juncea)* Green Manure	2.3	0.2	1.4
8.	Daincha (*Sesbania aculeata*) Green manure	3.5	0.3	1.0

Biofertilizers: Biofertilizers are substances containing living microorganisms that enhance plant growth and nutrient availability in the soil. These microorganisms include bacteria, fungi and algae, which can fix atmospheric nitrogen, solubilize phosphorus, enhance nutrient uptake, and promote plant growth through various mechanisms. Here are some common types of biofertilizers (Fig. 4.4).

(i) **Nitrogen-fixing biofertilizers:** These contain bacteria capable of converting atmospheric nitrogen (N) into a usable form, such as ammonia (NH_3) or nitrate (NO_3). Examples include *Rhizobium, Azotobacter*, and *Azospirillum*.

(ii) **Phosphate-solubilizing biofertilizers**: These contain microorganisms that can convert insoluble forms of phosphorus (P) in the soil into soluble forms, making it easier for plants to absorb. Phosphorus-solubilizing bacteria, such as *Bacillus spp.* and *Pseudomonas spp*., are commonly used.

(iii) **Potash-mobilizing biofertilizers**: These biofertilizers contain microorganisms that enhance the availability of potassium (K) in the soil by converting insoluble forms into soluble ones. Certain bacteria and fungi can facilitate the release of potassium from minerals, making it accessible to plants.

(iv) **Plant growth-promoting rhizobacteria (PGPR)**: These biofertilizers include beneficial bacteria that colonize the root zone of plants and promote growth through various mechanisms. They can produce plant hormones, solubilize nutrients, protect plants from pathogens, and enhance nutrient uptake.

(v) **Mycorrhizal biofertilizers**: These contain fungi called mycorrhizae that form symbiotic relationships with plant roots. Mycorrhizal fungi extend the root system, increase nutrient and water absorption, and improve plant tolerance to environmental stresses.

Biofertilizers offer several advantages over chemical fertilizers. They are environment friendly, promote sustainable agriculture, reduce the need for synthetic fertilizers, improve soil health, and enhance plant growth. However, their effectiveness can vary depending on environmental conditions, soil type, and crop species, so proper application and management are crucial for optimal results.

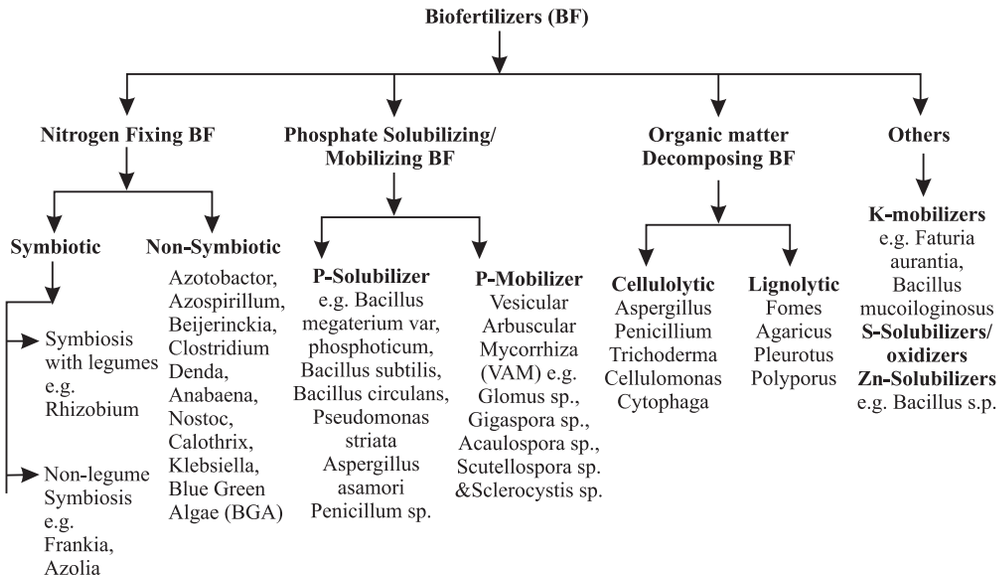


Fig. 4.4: Biofertilizers and their Classification

Notes

Oilseed cakes: Oilseed cakes, such as neem cake, castor cake, or sesame cake, are by-products obtained after extracting oil from oilseeds. These cakes are rich in nutrients and can be used as organic fertilizers to provide essential minerals and organic matter to the soil (Table 4.4).

Table 4.4: List of oilcakes and their nutrient content

S. No.	Oilcakes	N%	P_2O_5%	K_2O%
1.	Castor cake	5.5-5.8	1.8-1.9	1.0-1.1
2.	Mahua Cake	2.5-2.6	1.8-1.9	1.8-1.9
3.	Karanj Cake	3.9-4.0	0.9-1.0	1.3-1.4
4.	Neem Cake	5.2-5.3	1.0-1.1	1.4-1.5
5.	Safflower cake (undecorticated)	4.8-4.9	1.4-1.5	1.2-1.3
6.	Cotton Seed (decorticated)	6.4-6.5	2.8-2.9	2.1-2.2
7.	Cotton Seed (Undecorticated)	3.9-4.0	1.8-1.9	1.6-1.7
8.	Groundnut cake	7.0-7.2	1.5-1.6	1.3-1.4
9.	Linseed cake	5.5-5.6	1.1-1.5	1.2-1.3
10.	Niger cake	4.7-4.8	1.8-1.9	1.1-1.3
11.	Rapseed cake	5.1-5.2	1.8-1.9	1.1-1.3
12.	Seasame/Till cake	6.2-6.3	2.0-2.1	1.2-1.3
13.	Coconut cake	3.0-3.2	1.8-1.9	1.7-1.8

Cow urine and dung-based preparations: Cow urine and dung are used in traditional farming practices as natural fertilizers and soil amendments. They are rich in organic matter, nitrogen, phosphorus and potassium, which contribute to soil fertility. It is important to note that while cow urine and dung-based compost can be a valuable source of organic matter and nutrients, its effectiveness may vary depending on factors such as the quality of the initial materials, the composting process, and the specific crop or plant requirements. It is also necessary to consider the potential presence of pathogens or contaminants in the raw materials, so proper handling and hygiene measures should be followed during the composting process. Here's how the process typically works:

(a) **Collection**: Cow urine and dung are collected from cattle, usually from dairy farms or areas where cows are kept.

(b) **Mixing:** The urine and dung are combined in a container or pit and thoroughly mixed to ensure uniformity.

(c) **Decomposition:** The mixture is allowed to decompose over a period of time, typically several weeks to a few months. During this process, microbial activity breaks down the organic matter in the dung and urine, converting it into nutrient rich compost.

(d) **Turning:** The compost pile is periodically turned or mixed to provide oxygen and facilitate the decomposition process. This helps to accelerate the breakdown of organic matter and prevent odor or pest problems.

(e) **Curing**: Once the composting process is complete, the compost is left to cure or mature for a few weeks to several months. This allows any remaining undecomposed materials to break down further and ensures the compost is stable and ready for use.

(f) **Application**: The cow urine and dung-based compost can then be applied to plants, gardens, or agricultural fields as a natural fertilizer. It enriches the soil with essential nutrients, improves soil structure, and enhances microbial activity, leading to healthier plant growth and increased crop yields.

It's important to note that the choice of nutrient sources depends on the specific crop requirements, soil conditions, and farming practices. Farmers often use a combination of these nutrient sources to maintain soil fertility and promote healthy plant growth.

Beejamrit: Beejamrit is an ancient, sustainable agriculture technique. It is used for seeds, seedlings or any planting material. It is eûective in protecting young roots from fungus.

Beejamrit is a fermented microbial solution, with loads of plant-beneficial microbes, and is applied as seed treatment. It is expected that the beneficial microbes would colonize the roots and leaves of the germinating seeds and help in the healthy growth of the plants.

Inputs needed: 5 kg cow dung, 5 litre cow urine, 50 gram lime, 1kg bund soil, 20 litre water (for 100 kg seed)

Preparation of Beejamrit

Step 1: Take 5 kg cow dung in a cloth and bind it using tape. Hang the cloth in 20 litre water for up to 12 hours.

Step 2: Simultaneously, take one litre water and add 50 gram lime in it, keep stable for overnight.

Step 3: Next morning, continuously squeeze the bundle in the water thrice, so that all the essence of cow dung is mixed in the water.

Notes

Step 4: Add handful of soil, approximately 1 kg in the water solution and stir well.

Step 5: Add 5 litre desi cow urine in the solution and limewater, and stir it well.

Application as a seed treatment: Add Beejamrit to the seeds of any crop; coat them, mixing by hand; dry them well and use them for sowing. For leguminous seeds, which may have thin seed coats, just dip them quickly and let them dry.

Jeevamrit: Jivamrit acts as a biostimulant by promoting the activity of microorganisms in the soil and also the activity of phyllospheric microorganisms when spayed on foliage. It acts like a primer for microbial activity, and also increases the population of native earthworms.

Inputs Needed: 10 kg of fresh cow dung, 5-10 litre cow urine, 50 gram lime, 2 kg jaggery, 2 kg pulses' ûour 1 kg uncontaminated soil and 200 litres water

Preparation of Jivamrit: The materials should be mixed in 200 litre water and stirred well. The mixture should then be allowed to ferment for 48 hours in shade. It should be stirred by a wooden stick twice, once in the morning and once in the evening. This process is to be continued for 5-7 days. The ready solution should be applied on the crops

Application of Jivamrit: This mixture should be applied every fortnight. It should be either sprayed directly on the crops or mixed with irrigation water. In the case of fruit plants, it should be applied on individual plants. The mixture can be stored for up to 15 days. (**Source** – Niti Aayog)

INTEXT QUESTIONS 4.2

Fill in the blanks:

1. *Rhizobium* ..... bacteria responsible for fixing atmospheric nitrogen in pea crops
2. Nutrient content in maize residue N% ....., P_2O_5% ..... and K_2O% .....
3. Nutrient content in sugarcane residue N% ....., P_2O_5% ..... and K_2O% .....
4. Covering the soil surface with a layer of organic materials like straw, hay, or grass clippings is called .....

Notes

5. ..... is practice of ploughing or turning in to the soil un decomposed green plant tissues for the purpose of improving a physical condition as well as the fertility of the soil.

6. ..... are substances containing living microorganisms that enhance plant growth and nutrient availability in the soil

4.4 CROP WISE NUTRIENT RECOMMENDATIONS THROUGH VARIOUS SOURCES

Crop nutrient recommendations can vary based on factors such as crop type, soil conditions, climate, and specific nutrient needs. Here are some common sources and methods for determining crop-wise nutrient recommendations:

Soil Testing: Soil testing is a widely used method to determine nutrient levels and pH in the soil. It helps to identify nutrient deficiencies or imbalances. Soil testing laboratories provide recommendations based on the results, suggesting the appropriate amount of nutrients to apply to achieve optimal crop growth.

Agricultural Extension Services: Agricultural extension services, typically provided by government agencies or universities, offer guidance to farmers on various agricultural practices, including nutrient management. They often conduct research and provide specific nutrient recommendations based on local conditions and crop requirements.

Fertilizer Guides: Many countries have published fertilizer guides or manuals that provide crop-wise nutrient recommendations. These guides are based on extensive research and field trials specific to the region. They typically provide information on nutrient requirements, application rates, and timings for different crops.

Crop Nutrient Demand Models: Crop nutrient demand models use mathematical algorithms to estimate crop nutrient requirements based on factors such as yield goals, crop type, soil characteristics, and environmental conditions. These models help determine the optimal nutrient rates for achieving desired crop yields.

Professional Agronomists and Consultants: Agronomists and agricultural consultants are experts in crop production and nutrient management. They provide personalized recommendations based on field observations, soil tests, and crop-specific requirements. They consider various factors and help farmers to develop customized nutrient management plans.

It is important to note that nutrient recommendations may vary depending on the region and specific conditions. Local expertise and up-to-date information are crucial in determining the most accurate and appropriate nutrient recommendations for a particular crop.

WHAT YOU HAVE LEARNT

Notes

Let us recapitulate and enlist the salient points that you have learnt through this lessons:

- Chemical fertilizers have played a significant role in improving agricultural productivity, but they are also associated with several problems like environmental pollution, soil degradation, loss of biodiversity, health risks, nutrient imbalance, higher cost.
- Soil fertility is the ability of soil to provide essential nutrients and favorable conditions for plant growth. It is influenced by a combination of physical, chemical, and biological properties.
- Soil physical properties includes soil texture, structure, porosity and moisture
- Soil chemical properties include soil pH, nutrient content, CEC, organic matter content and soil biological properties includes soil microorganisms, soilfauna, soilenzymes, soil biodiversity.
- Legumes such as lentils, peas, beans, and chickpeas are excellent sources of nitrogen as they form a symbiotic relationship with nitrogen-fixing bacteria.
- Crop residues like stalks, leaves, and husks left after harvest can be incorporated into the soil as organic matter and release nutrients.
- Mulching involves covering the soil surface with a layer of organic materials like straw, hay, or grass clippings. As the mulch breaks down, it adds organic matter to the soil and releases nutrients slowly over time.
- Green manure crops improve soil fertility by adding organic matter and nutrients when they decompose
- Biofertilizers are substances containing living microorganisms that enhance plant growth and nutrient availability in the soil
- Oilseed cakes, such as neem cake, castor cake, or sesame cake are rich in nutrients and can be used as organic fertilizers.

TERMINAL EXERCISE

1. What is the negative impact of chemical fertilizers?
2. What are soil chemical physical and biological soil properties?

3. Enlist different sources of nutrients in organic farming.
4. What do you mean by bio fertilizers and their classification?
5. What are the green manures and their importance?

ANSWERS TO INTEXT QUESTIONS

4.1

1. Soil Texture
2. Cation Exchange Capacity

4.2

1. *R. leguminoserum*
2. 0.52, 0.18 and 1.35
3. 0.4, 0.18 and 1.28
4. Mulching
5. Green manuring
6. Biofertilizers

SUGGESTED ACTIVITY

Activity 1. Enlist the name of crop residues and their nutrient content

Name of the crop	N (%)	P (%)	K (%)

By doing this activity student will learn the promotion of nutrients in the crop residue.

Notes

Activity 2. Enlist the name of different green manure crops and their nutrient composition

Name of the green manure crop	N (%)	P (%)	K (%)

By doing this activity student can understand the importance of green manuring in nutrient management of the crops.

Key Learning Outcomes

Learner will be able to:

- Identify the nutrient management in organic farming.
- Identify the negative impact of chemical fertilizers.

Notes

5

WEED MANAGEMENT

In the previous lesson, we have learnt about how to use organic fertilizer and manure in organic field. In this lesson, we are going to discuss about how weeds may be a serious issue for farmers. Weed is a plant growing out of place and time.They interfere with agricultural processes, which lower the production and quality of produce. They successfully compete with the beneficial and desired organic crop plants for space, nutrients, sunlight, and water. Weeds are thought to generally reduce agricultural productivity by 5% in the majority of industrialized nations, 10% in less developed nations, and 25% in the least developed nations. Weeds cause larger yield losses in India than other pests and illnesses do. Weeds cause higher yield losses in India than other pests and illnesses combined. Organic weed control is an approach to weed removal and prevention that does not involve the use of synthetic chemicals and weed killers called herbicides. Some organic weed control strategies are cultural and mechanical methods, focusing on prevention and crop rotation. We can manage weed in several ways such as through careful planning and planting and using mulches. In organic farming, chemical herbicides cannot be used. So, weeding can be done only manually. Cultural practices such as tillage, flooding, mulching can be used to manage the weeds. Also, the biological (pathogens) process can be used to manage the loss due to weeds. When the ground is fallow, a cover crop can be planted to suppress the weeds. In this lesson, we will discuss in detail about weed management in organic farming.

OBJECTIVES

After reading this lesson you will be able to**:**

- demonstrate the different weeds;
- explain the characteristics of weed;

Notes

- explain the harmful and beneficial effects of weeds;
- understand the biology and ecology of different weed species; and
- apply the biological & cultural practices for management of weed.

5.1 WEED AND THEIR CHARACTERISTICS

Weed: A plant that grows where it is not desired and is considered undesirable in an area is called a weed.

Weed Characteristics

- Weeds grow quickly from seed and can reproduce when they are small and young.
- Weeds may have dual mode of reproduction. Most weeds are angiosperms & reproduce by seeds as well as vegetative propagules.
- Weeds frequently enhance one another; however, self-pollination is not required.
- If a weed is hybridized, it is done so by wind or unknown floral visitors.
- Weeds frequently develop seeds that have the same size and form as crop seeds, making physical separation challenging and aiding in man-made spread.
- Weeds are highly adapted to over-crowding.
- Some weeds have similar morphology, growth and appearance as that of some crops.
- Certain perennial weeds provide many seed flushes year, with seed production occurring as long as growth conditions allow.
- Every weed plant has the capacity to yield a significant quantity of seeds in a variety of environmental circumstances.
- Numerous weeds have developed unique strategies for both long- and short-range seed dissemination.
- Weeds are highly persistent in nature and hardy to tolerate adverse climate.
- Perennial weeds are able to survive environmental stress because of their strong roots and other vegetative portions, which contain huge food reserves.
- Weeds can compete using unique strategies, such as rosette formation, climbing growth, and allelopathy, and they have a high ability to struggle for nutrients, light, and water.

Notes

5.2 WEED BIOLOGY AND ECOLOGY

5.2.1 Weed Biology

Weed biology is the study of how weed species and weed communities/vegetation are established, grow, reproduce, and go through their life cycles. Weed biology is an integrated science that aims to use and improve weeds' beneficial properties while minimizing their unfavorable ones.

(a) Weed type based on Life Cycle: Weeds are categorised as annuals, biennials, or perennials based on their life cycle.

Annuals

Annuals require less than a year to grow from seed to maturity. Bases on the season weeds may be classified as summer, rainy, and winter annuals. Summer annuals germinate during the summer season if there is good moisture in soil, otherwise, late in the season when there are splashes of rainfall. Rainy annuals germinate during wet season where there is ample moisture in soil. Winter annuals are plants that sprout in the autumn, mature, produce flowers and seeds, overwinter as seedlings or rosettes, and eventually die in the spring or early summer.

Example: *Commelina benghalesis, Boerhavia erecta and Chenopodium album, etc.* (Fig. 5.1).

Fig. 5.1: Examples of Annual Weed

Biennials

Biennials often go through their entire life cycle in two years. In their first year, seeds develop form a tap root and a terminal bunch of leaves. The plant over winters in this stage. The weed develops a flower stem, seeds, and dies in its second year. The wild carrot and evening primrose are some examples of biennial weeds.

Example: *The Alternanthera echinata, Daucus carota and Evening primerose* are the biennials weed (Fig. 5.2).

Fig. 5.2: Examples of Biennial Weed

Perennials

Plants that have the ability to sprout from their roots, rhizomes, or tubers after a time of hibernation are known as perennial weeds. These plants can live for more than two years.

Example: *C. arvense, Sonchus arvensis* and *Elymus repens (common couch grass*) etc. (Fig. 5.3).

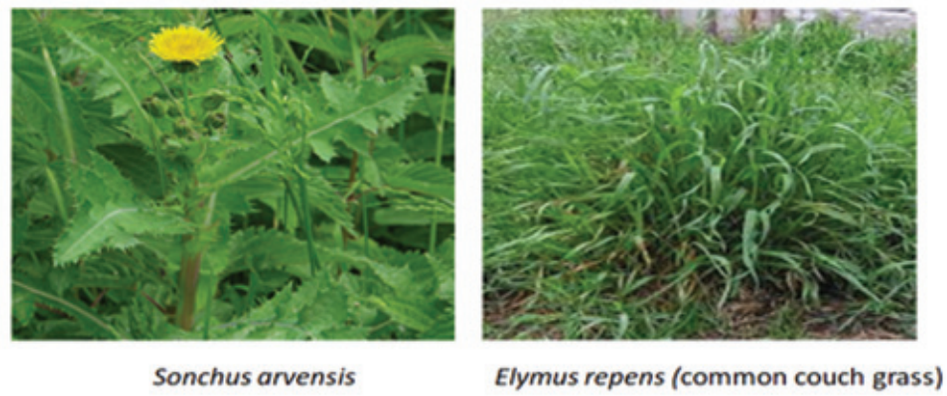


Fig. 5.3: Examples of Perennials Weed

(b) Weed types based on Growth Pattern

Weeds are categorised as rushes, sedges, grasses, and broadleaf weeds based on their growth characteristics.

Broad leaf

Broadleaf weeds are annual, biennial or perennial plants which generally have two seed leaves (cotyledons) emerging upon germination. The flowers often have distinct petals, while the leaves typically have a branching network of veins.

Notes

Grasses

Plants that are grass can be annual or perennial. Typically, their leaves are upright, slender, and have parallel veins. Grasses feature circular cross sections, jointed stems, and hollow internodes in most cases.

Sedges

Sedges are a broad class of grass-like perennial (very rarely annual) plants that are often found in moist, soils with low drainage. Sedge stems are solid, triangular-shaped, and unjointed.

Rushes

Rushes are annual or perennial plants similar in appearance to sedges with grass-like tufted leaves common at the plant base. Rush stems lack joints, have a circular cross section, and hollow. This plant, like the sedge, grows in open fields and forests as well as in wet or poorly drained places.

(c) Weed types based on Method of Propagation

Based on reproductive strategy weeds are classified as weeds reproduced by seed and vegetative propagules.

Propagation by Seed

Sexual reproduction is the process of reproducing from seeds. To fertilise an egg, male reproductive cells are required, usually in the form of pollen. A flower's egg is pollinated, resulting in a seed that can grow into a new plant. Seed production varies greatly among and within weed species in part due to environmental variability between years, competition from neighboring plants, and genetic variability.

Little and abundant seeds are created by sexual reproduction. While perennial weeds rely less on this mechanism for their survival, annual and biennial weeds rely heavily on seed production as their only source of multiplication. For instance, curly dock frequently produces more than 30,000 seeds per plant, yet Canada thistle has been known to yield as few as 680 seeds per plant.

Vegetatively Propagated

Vegetative organs like stems, roots, or leaves give rise to new plants during vegetative (asexual) reproduction. Perennial weeds frequently have underground stems (rhizomes), aboveground stems (stolons), bulbs, corms, and tubers as adaptations of these organs. Although relatively small structures can produce a

Notes

new plant, vegetative structures often do not survive as long in the soil as can seeds. As profuse as seed production, vegetative reproduction is also possible.

5.2.2 Weed Ecology

The study of a weed's interaction or relationship with its surroundings, which includes both abiotic and biotic elements, is known as weed ecology. Ecology studies the growth traits and adaptations that allow weeds to withstand environmental changes. In order to maintain weed-free monocrop or multi-crop cultures and change crop husbandry practices, man has a significant impact on the environment. For effective weed control, the study on both biology and ecology of a weed species are important.

Weed seedbank

Weed seed can survive in the soil for many years after being buried, and weed vegetative tissue can travel considerable distances to infest new areas. The weed seedbank has an extensive library of weed species and ecotypes in any given place that are ready to sprout when the right signal is given. These species and ecotypes are adaptable to a wide range of environmental circumstances.

Seed Dormancy

Dormancy is a state of seeds and buds in which they are alive but not germinated. If all weed seeds were to germinate at one time, their seedlings could be destroyed. Millions of weed seeds can be stored in the soil during dormancy, which permits them to proliferate in bursts over years. The proverbial "One year seeding, seven years weeding" by old gardeners is highly relevant in this situation. Indeed, it has been discovered that weed seeds remain viable even after being buried in soil for 20 to 80 years.

INTEXT QUESTIONS 5.1

State true and false:

1. One year Seeding seven years weeding. (T/F)
2. Environment include only non-living organism. (T/F)
3. Sedge stems are triangular in cross section, solid, and not jointed. (T/F)
4. *Alternanthera echinata* and *Daucus carota* are example of annual. (T/F)

Notes

5.3 LOSSES DUE TO WEEDS

Reduction in Crop Yield

The output of agriculture is negatively impacted by weeds. In India, yield losses from diseases, pests, and other pests account for 20%, 30%, and 5% of total yield losses, respectively. Weeds represent a serious threat to crop productivity. The majority of these weeds self-sow, and because of their quicker rate of development during the early phases of crop growth, they serve as competitor, (Table 5.1).

Table 5.1: Losses caused by weeds in some of the important crops

Crop	Reduction in yields due to weeds (%)	Crop	Reduction in yield due to weeds (%)
Rice	41.6	Groundnut	33.8
Wheat	16.0	Sugarcane	34.2
Maize	39.8	Sugar beet	70.3
Millets	29.5	Carrot	47.5
Soybean	30.1	Cotton	72.5
Gram	11.5	Onion	68.0
Pea	32.9	Potato	20.2

Crop yields are decreased by weeds because they compete with crops for resources including water, soil, nutrients, light, and space. According to an estimate, weeds can prevent crops from absorbing 47% N, 42% P, 50% K, 39% Ca, and 24% Mg.

Weeds as reservoirs of pests and diseases

The community of organisms in a certain area includes weeds. As a result, several animals use them as food, and they are also prone to various parasites and diseases themselves. They might, however, act as significant reservoirs or alternative hosts of pests and illnesses because of their intimate relationship with crops. Weeds also act as alternate hosts that harbour insects, pests, diseases and other microorganisms (Table 5.2).

Table 5.2: Alternate hosts of some of the pest and diseases

Crop	Pest	Alternate host
Sweet potato	*Sweet potato weevil*	*Convolvulus arvensis*
Potato	*Stalk borer, beetles and cut worms*	*Chenopodium album*

Notes

Ill Effect on Human and Animals

Certain weeds discharge toxins into the soil that can harm crops, people, and animals (Table 5.3).

Table 5.3: Health problems caused by weeds to humans

Health Problem	Weed
Hay fever and Asthma (allergic diseases)	Pollen of *Ambrosia* and *Franseria* sp.
Dermatitis	*Parthenium, Ambrosia*
Itching and Inflammation	*Utrica sp.*
African sleeping sickness	Brush weeds
Malaria, encephalitis and filaria caused by mosquito	Aquatic weeds like *Pistia lanceolata, Salvinia auriculata.*

Interference in Crop Handling

Some weeds can make using agricultural equipment more difficult, costly and even impossible.

Poor ploughing performance results from a *Cynadon dactylon* infestation that is severe.

Loss in Crop Quality

A crop should be discarded if it includes weed seeds, particularly if it is being cultivated for seed. For instance, the size and shape of wild oat weed seeds are comparable to those of crops like barley and wheat, hence their mixing may result in rejection for use as seeds. It is unacceptable for toxic weed seeds to contaminate crops, as this drives up crop cleaning expenses. The leafy vegetables, cereals crops, and oilseed crops etc. much suffers due to weed problem as the leafy weed mixture spoil the economic value.

Reduction in Land Value

The land's value could decrease if it is heavily infested with perennial weeds that make it unsuitable for farming. Due to a serious infestation of nutgrass (*Cyperus rotundus*) and other perennial grasses, thousands of hectares of arable land in India's rice-growing regions have been left uncultivated or abandoned.

Limitation of Crop Choice

The growth of a certain crop is restricted when some weeds exhibit significant infestation. The growth of sorghum or sugarcane may be restricted by the heavy infestation of parasitic weeds like *Striga lutea* or red witchweed.

Notes

Loss of Human Efficiency

Through discomfort in the body caused on by allergies and poisoning, weeds lower human productivity. Itching is caused on by weeds like congress grass (*Parthenium hysterophorus*). Thorny weeds like *Solanum spp*. limit farm employees' ability to perform farm tasks like applying fertilizer, taking precautions against insects and diseases, irrigating the land, harvesting crops, etc.

Problems due to Aquatic Weeds

The water flow is restricted by the aquatic weeds that develop along irrigation canals, channels, and streams. Weed barrier reduces water flow velocity, increases water stagnation, and can result in excessive siltation and decreased carrying capacity. Unwanted insects like mosquitoes have places to lay eggs that are created by aquatic plants. By inhibiting fishing, swimming, boating, hunting, and navigation on streams and canals, they lessen the value of recreational activities.

Other Problems

Not just crop plants, but also play areas, road sides, etc., are troubled by weeds. Many playgrounds have *Alternanthera echinata* and *Tribulus terresstris*, which disturbs players and visitors.

INTEXT QUESTIONS 5.2

Fill in the blank

1. Pollen of ..... causes hay fever and Asthma (allergic diseases).
2. *Chenopodium album* is an alternate host of .....
3. Weed Causes yield losses in sugar beet is .....
4. In India, yield losses due to weeds are more than ..... those from pest 30% and diseases 20%.

5.4 WEED CONTROL IN ORGANIC FARMING

Weed control includes many techniques used to limit weed infestation and minimize competition (Table 5.4).

There are two broad methods of weed control:

1. Preventive methods

Notes

2. Curative methods

   (i) Eradication

   (ii) Control measures (Mechanical, Cultural, Biological, and Chemical)

Table 5.4: Weed Control Methods in Organic Farming

Weed Control Methods in Organic Farming			
Preventive Method	**Curative Method**		
	Eradication	**Control Measures**	
		Mechanical	**Cultural**
i. Sowing of weed free clean seeds. ii. Use of clean implements. iii. Removal of weed along the canal and irrigation channel iv. Care in transplanting of seedling / plantlets. v. Use of well rotten manure vi. Avoiding passing of cattle from weed infested area. vii. Crop management practices. viii. Enforcement of Weed Laws. ix. Quarantine Laws x. Use of pre-emergence herbicides.		i. Hoeing, ii. Hand weeding iii. Digging iv. Mowing v. Burning vi. Mulching	i. Selection of crop, ii. Crop rotation, iii. Use of compost or manure, iv. Allowing the land to fallow, v. Pre-sowing irrigation, vi. Sowing time, vii. Orientation of sowing/ transplanting

5.4.1 Preventive Method

Prevention of introduction and spread of weeds in an entirely new locality is termed as preventive method. It is essential to know that how weeds disseminate. By taking following measures, weed spread can be prevented from entering into a new locality.

Notes

Sowing of weed free clean seed: One good way that weeds spread is through infected seed. The crop seed becomes difficult to distinguish from the weed seed. To illustrate, cruciferous crops such as mustard, radish, cauliflower, cabbage, broccoli, and so forth are nicely combined with Satyanashi (*argemone mexicana*) seed. It is best to throw away such tainted seeds before sowing.

Use of clean implements: While operating agricultural implements like cultivator, harrow, and seed drill etc. in weed infested field, care must be taken that multiplication part of weed like rhizome, bulb, tubers, and stem is not being carried along. The farming tools need to be well cleaned. These should only then be applied to other fields. This aids in preventing the weeds from spreading.

Removal of weeds along canal and irrigation channel: Seed from weeds travels through water to get to the field. It is essential to remove weeds that are growing alongside irrigation channels or canals.

Care in transplanting of seedling/plantlets: Many horticultural plants like all transplanted vegetables, flowers, and fruits are transplanted in the field with soil attached to their root. Infestation of soil with weed may contaminate a new field.

Use of well rotten manure: Seeds of weeds are fairly viable. Hirankhuri (*Convolvulus arvensis*) hirankhuri seeds can survive for up to 50 years. The viable lifespan of Doob (*Cynodon dactylon*) and Motha (*Cyperus rotundus*) seeds is two and five years, respectively. Usually, cow excrement is heaped to make manure. Wherever manure is put in the field, seed does not lose its viability if the heaping time is brief. Therefore, use only well-rotten manure.

Avoiding passing of cattle from weed infested area: Weed seed spreads when cattle are allowed to pass through a newly opened field after grazing in an area infected with weeds. After exiting the animal's alimentary canal, the weed seeds emerge through its excrement, where they germinate and grow into weed. Certain weed seeds adhere to the skin and legs of animals, enabling them to be carried to another location where they germinate and emerge as weeds.

Crop management practices: All such practices which favor the growth of main crop only disfavor the growth of weed. The following management practices have smothering effect on weed and must find place in crop land to prevent weed spread:

- Weed establishment is prevented by appropriate crop rotation.
- Increased plant density per unit area suppresses weed development.
- Fertiliser should only be positioned correctly in the seed's root zone to promote crop growth. The weeds' growth is inhibited, and they are deprived of nutrition.

Notes

- Fast and vigorous growing varieties by virtue of their larger leaf canopy cause smothering effect on the growth of weed. Such crops should receive preference to prevent spread of the weed.

Enforcement of weed Laws: In India, many noxious weeds grow in the fields and pose great economic and health hazard. Noxious weeds are those perennial weeds which are reproduced by seeds, stem, roots, and other reproductive parts as well and are very difficult to control. *Parthenium hysterophorus, Striga* sp., *Cyperus rotundus*, *Cynodon dactylon* etc. noxious weeds that grow in many horticultural crops. In India, no weed laws are in force except in Karnataka where Parthenium has been declared as a noxious weed.

Quarantine Laws: Laws pertaining to quarantine place limits on the transportation of agricultural products. The Parthenium and Argemone, which are commonly seen in vegetable and flower fields, might not have reached India if there had been sufficient quarantine regulations. By appropriately implementing and monitoring quarantine, it is crucial to establish separation between the new region and the weed-infested area.

Use of pre-emergence herbicides: Herbicides which are used before the emergence of weeds either before or after planting of crop, is a good preventive measure for preventing weed infestation. Such herbicides either inhibit seed germination or kill young seedlings before they get established.

5.4.2 Curative Method

5.4.2.1 Eradication

Eradication means elimination of weeds after they have become established in an area and control methods are adopted where prevention and eradication have failed, so control measure as a rule eradicate the weeds and make it possible to raise the crops in spite of their presence. Practical weed removal is aided by ongoing management techniques implemented over a number of years. Eradication is impractical, yet it might be able to get rid of some weeds that are restricting their spread if it is done extensively.

5.4.2.2 Control Measures

Methods of weed control: Methods of weed control can be decided by the habits of weed which concern with life cycle and methods of propagation by the habitat which mean magnitude of the problem.

Notes

Physical/Mechanical methods of weed control

(a) Prevention from spread

(b) Destruction of top growth

(c) Destruction of underground part

(d) Destruction of weed seeds in the soil

(a) Preventing from Spread

- **Use of Clean Seed:** When planting, only pure, certified seeds should be utilised. The majority of seeds are contaminated, which contributes to the weeds' yearly spread. A law prohibiting the sale of uncertified seeds ought to be implemented. Preventing the growth of seeds in adjacent waste areas and weed-contaminated areas. Seeds from weeds that grow in ditches, roadside vegetation, fences, waste sites, and other places are transferred to nearby farmed fields. It is important to appropriately manage these regions to stop the growth of weed seeds.

(b) Destruction of Weed Growth

- **Hand pulling:** Hand pulling removes weeds by uprooting them entirely, best done when soil is moist. Regularly check and dispose of weeds properly.
- **Hand hoeing:** Hand hoeing disrupts weeds by cutting roots and stems near the soil surface, preventing regrowth. Best used on shallow-rooted weeds.
- **Tillage:** Practical, oldest and widely practiced method. If timely practiced, it prevents the seed production. It is effective in perennial weeds. It is followed for crops grown in lines. Frequent tillage destroys the soil structure and thus is less favourable for growth. It is important in seed bed preparation of field crops but restricted in orchards.
- **Blind tillage:** It means tillage of the soil after seeding the crop, either before the crop plants are up or while they are in the early stages of growth. Used in most of the crops and cereals. Various types of harrows are used in field even though seedlings of crop plants are not above the ground and repeated until plants are well advanced. This process results in increasing the grain yields.
- **Ploughing:** It means helps in burying of annual, biennial and perennial weeds. Ploughing is practiced before the seeding of crops and top growth of the weeds is checked by it. Deep ploughing in summer is effective in exposing the roots to the sun rays and killing them.

- **Mowing:** It means removing the top growth of weeds growing in lawn/road side and exhausting them to death. Repeated mowing prevents seed production and also starve the underground parts. It may require 1-3 years to control tall and perennial weeds by repeated and frequent cutting. Best time is when the underground root reserves are at the lowest level. Mowing removes apical dominance and repeated cutting hastens food depletion and death of the plant. Effective in tall growing plants. It favours short growing weeds plants by removing competition.
- **Harrowing:** Harrowing disturbs the soil surface to uproot and bury weeds, effectively targeting shallow-rooted plants and preventing their regrowth.
- **Disking:** Disking successfully disrupts weed growth and seedbeds by breaking up the soil and uprooting weeds through cutting and turning the soil.
- **Spudding:** Spud is a tool with a long chisel like blade designed especially for the removal of weeds from the lawns without disturbing the soil.
- **Burning:** Burning eliminates noxious plants such as cuscuta (dodder). It damages the soil and destroys the beneficial vegetation as well.
- **Pasturing and Grazing:** Continued grazing of the tops of the weeds by animals prevents seed formation and ultimately exhausts the underground parts. Grazing should be allowed in a controlled manner to allow grazing on a limited area so that all weeds are grazed and not the tasty ones.

(c) Destruction of Underground Parts:

- **Hand Digging:** Digging by hand is a costly method of removing subsurface components like roots and rhizomes. It is used in limited areas when unwanted weeds need to be eliminated.
- **Summer Fallow:** Continuous clearing of the land throughout summer without growing a crop. Effective if top growth of the weeds is removed at regular intervals to starve the roots. Fields may be ploughed, or disked. Employed in dry farming areas where crop depends on monsoon. It helps in the absorption of precipitation by the soil and in the retention of absorbed moisture.

(d) Destruction of Weed Seeds in the Soil:

Some of the weed seeds remain buried in the soil for years without losing their viability and come up and produce new crops. Steps should be taken to destroy the weeds and to clean the fields.

- **Deep Ploughing:** When deep ploughing is done in the summer, weed seeds that are buried below become visible. These weed seeds are forced to germinate, and once they emerge, controlling them is simple.

Notes

- **Harrowing and Shallow Cultivation:** These techniques can be harmful when seed beds are being prepared because they cause a large number of seeds to germinate.

5.4.2.3 Cropping and Cultural Method

Important cultural practices are:

Crop rotation: Many weeds are highly productive and can become a problem if the same crop is planted year after year. For many weeds, crop rotation or habitat modification disrupts their regular life cycle. Crop rotation should be done every 3–5 years. e.g:

(i) 1st year: Clean cultivated or tall crops- sugarcane and maize.

(ii) 2nd year: Grain crops like wheat, barley etc.

(iii) 3rd year: Grass land (used for pasture)

Crop competition: Simplest method of weed control. Weeds are strong competitors. They take the lion's share of the plant nutrients. For every one kg of weed growth, soil produces about one pound less of crop. Thick crops strongly compete for nutrients by weeds. Most common smother crops are *Sorghum* (fodder), Clovers, Lucerne, Soybean, cowpeas and Sunnhemp. Fodder crops are smothering as their frequent cuttings destroy the top growth of weeds before they set seeds. Smother crop weakens the underground parts of the weeds and they are easily killed by the cultivation that fellows.

Mulching: Straw mulching is practiced to check weed growth. Paper mulch is used in pineapple field (but is expensive).

Clean cultivation: It results in removal of the tops of perennial weeds and it gradually weakens and destroys their underground parts. Cultivation must be thorough and at short intervals so that surface growth of weeds is checked. The removal of surface growth results in non-manufacturing of food to replenish (feed) the roots. Implements used for row cultivation:

(i) Spike tooth harrow: It uproot the germinating weed seedlings, break soil crust and stir the soil up to 1-5 cm depth. It is made of 23 cm long steel pegs (or spikes) fix on a frame. It is a commercial method of controlling weed seedlings in maize, cotton, soybeans, groundnut and grain sorghum. It can be used any time after planting the crop till the crop plants are 7-10 cm tall. It does not injure crop seedlings.

(ii) Spring-tine harrows: Similar to a spike tooth harrow, but with elliptical spring-like tines and sharp, triangular free ends, the spring tooth harrow is used to agitate dirt up to a depth of 7.5 cm.

Notes

(iii) **Rotary hoe cultivator:** It is made up of two gang pairs/groups of hoe wheels or spiders one placed behind the other within each gang. There are row units with space within them to save the rows of crop seedlings. It is a tool pulled by a tractor that actively moves dirt to push weeds aside. It is used to eradicate weeds and grasses that are just starting to germinate in the rows as well as those that are growing near immature crop plants.

(iv) **Wheel hoe:** It is comprises of wheel, two handle and a tine with reversible shovel or a three-prong fork or rake as its cutting tool. It is manually operating weeding tool suitable for weeding small vegetable garden.

(v) **Blade-harrow (Bakkhar):** It is bullock drawn, row cultivator implement. With a length of 30-95 cm and a width of 5–6 cm, its cutting instrument resembles the sweep of a cultivator. The weeds are chopped 7.5–10 cm below the surface and left as mulch on the soil. used on dense black soil.

(vi) **Cultivator (horse hoe):** It is efficient row weeding implement. These vary in size from single row five lined cultivators to multiline tractor drawn cultivators capable of weeding several crop grown at a time. This can cover several hectares area in a day with a bullock drawn five lined cultivators. In wide row crops, used for interrow weeding. The cutting instrument on its tines is a shovel or a sweep. Roots up to 7–10 cm below the surface are chopped off. They keep the weeds in check that have grown. More effective at the time when weeds are in the seedling stage.

(vii) **Rice rotary weeder:** It is used for paddy crop. They are single or double row weeder. It is operated manually. They are able to operate across and parallel to the crop rows. One man can weed around one hectare of rice in twelve hours with a single row rotary rice weeder.

5.4.3 Biological Control

Biological control involves the use of living organisms, such as insects, disease organisms, fish that consume herbivorous plants, snails, or even competing plants to suppress weeds. Weeds cannot be completely eliminated with the biological control method, although their population can be decreased. Not all weeds can be effectively controlled with this strategy. The most ideal targets for biological control are introduced weeds.

Characteristics of bio-agent:

- The bio-agent must feed or affect only one host and no other useful plants.
- It must be free of predators or parasites.

Notes

- It needs to be able to quickly adjust to its surroundings.
- The bio-agent needs to have the ability to locate itself within the host.
- It must have the ability to either directly or indirectly eradicate the weed or at the very least stop it from reproducing.
- It must possess reproductive capacity sufficient to overtake the increase of its host species, without too much delay.

(a) Merits:

- Least detrimental to the ecosystem
- No residual effect.
- Significantly less expensive and more durable than expected
- Harmless to non-targeted plants and safer to use.

(b) Demerits:

- Multiplication is costlier
- Very slow control
- Success of control is very limited
- There are currently very few host-specific bioagents on the market.

Mode of Action

Differential growth habits, competitive ability of crops and varieties prevent weed establishment e.g. Groundnut, Cowpea are fast growing, hence, good weed suppresser.

Outstanding and feasible examples of biological weed control

- Larvae of *Coctoblastis cactorum*, a moth borer, control prickly pear *Opuntia sp.* The larvae tunnel through the plants and destroy it.
- *Dactylopius indicus* and *D. tomentosus*, two cochineal insects, are in charge of it in India.
- The larvae of *Crocidosema lantana*, a moth that burrows into blossoms and stems and consumes flowers and fruits, are responsible for controlling *lantana camara*.
- *Cuscuta* spp. is controlled by *Melanagromyza obtusa, Cyperus rotundus* - *Bactra verutana* a moth borer.

Notes

- *Ludwigia perennis* is completely denuded by *Altica cynanea* (steel blue beetle).
- Herbivorous fish Tilapia controls algae. Common carp, a non-herbivorous fish controls sub-merged aquatic weed. It is apparently due to uprooting of plants while in search of food.
- Submerged weeds are preferred by snails.

Bio-Herbicides/Myco-herbicides:

Bio-herbicides are weeds that are targeted with plant diseases with the expectation that they will kill the plants. Similar to post-emergence herbicides, these are native pathogens that are artificially cultivated and sprayed on target weeds every season, especially in agricultural settings. More use has been made of fungal pathogens of weeds than of bacterial, viral, or nematode pathogens since the latter cannot actively infiltrate the host and must instead find a natural opening or vectors to infect plants.

Here the specific fungal spores or their fermentation product is sprayed against the targeted weeds. Some registered myco-herbicides (Table 5.5).

Table 5.5: Registered myco-herbicides

No	Product	Bio-agent	Target weed	Crop
1.	DeVine	*Phyto phthora palmivora*	Strangle vine (*Morreniaodorata*)	Citrus groves
2.	Collego	*Colletotrichum gloeosporoides*	Joint vetch (*Aeschyomonevirginica*)	Rice, soybean
3.	Bipolaris	*Bipolaris sorghicola*	Jhonson grass (*Sorghum halepense*)	Rice and Wheat
4.	Biolophos	*Steptomyceshy groscopicus*	Non-specific, general vegetation	
5.	Biomal		*Malva pusilla*	Row crops
6.	Bio Chon		*Prunus serotina*	Forests
7.	Emmalocera sp.	*Echinochloa sp*	Rice and Wheat	
8.	Tripose		*Echinochloa sp*	Rice and Wheat
9.	Uromyces rumicis	*Rumex sp*	Rice and Wheat	
10.	Gastrophysa		*Rumex sp*	Rice and Wheat
11.	Bactra verutana	*Cyperus rotundus*	Rice and Wheat	

Notes

INTEXT QUESTION 5.3

State true and false:

1. Sowing of weed free clean seed and use of clean implements are preventive method of weed control (T/F)

2. The seed of hirankhuri (*Convolvulus arvensis*) remain viable for as long as 50 years. (T/F)

3. Eradication and control measures are curative method of weed control. (T/F)

4. Crop rotation, crop competition and mulching are cropping and cultural method of weed control (T/F)

WHAT YOU HAVE LEARNT

Let us recapitulate and enlist the salient points that you have learnt through this lesson:

- Weed is a plant growing out of place and time.
- In India, yield losses due to weeds are more than 45% those from pest 30% and diseases 20% and other pests 5%.
- In organic farming, chemical herbicides cannot be used. So, weeding can be done only manually/mechanically.
- Cultural practices such as tillage, flooding, mulching can be used to manage the weeds.
- Biological (pathogen) process can be used to manage the loss due to weeds.
- Each weed plant is capable of producing large number of seeds per plant and seed is produced over a wide range of environmental conditions.
- Annuals complete their life cycle from seed in less than one year.
- Biennials generally complete their life cycle over two years.
- Perennial weeds live for more than two years.
- Weed ecology is the study of the interaction or relationship between a weed and its environment.

TERMINAL EXERCISE

1. What is weed? Write the Characteristics of weed.
2. Discuss the weed biology and ecology.
3. What are the different types of methods of weed control?
4. Write the three examples of biological weed control.
5. What are the differences between Preventive and Curativemethod?

ANSWER TO INTEXT QUESTIONS

5.1

1. True
2. False
3. True
4. False

5.2

1. *Ambrosia* and *Franseria* sp.
2. Stalk borer.
3. 70 %.
4. 45%

5.2

1. True
2. True
3. True
4. True

Key Learning Outcomes

Learner will be able to:

- Explain the different weeds associated with crops.
- Identity the harmful effects of weeds.
- Identity the conventional and biological method of weed control.

Notes

Notes

6

WATER MANAGEMENT

In the previous lesson, we have learnt about weed and their characteristics and various type of management options. Now, in this lesson, we will understand the basic and essential resource for life on earth is water. It is essential to human life in many ways, including its use as drinking water, sanitation as well as its use in agriculture, business, and ecosystem upkeep. However, the impacts of climate change, coupled with the rising needs of a fast-expanding global population, have put enormous pressure on water resources which, lead to water shortage, pollution, and thus, there is urgent need for effective water management.

Water management refers to a variety of procedures and tactics used to guarantee the conservation, preservation, and sustainable use of this priceless resource.

The main problems associated with water are lack of supply, over use, inefficient usage, contamination, and poor infrastructure. A comprehensive and integrated strategy that incorporates technical break throughs, legislative frameworks, public involvement, and education is needed to address these difficulties.

Additionally, water management is not exclusive to a particular industry or organisation. Governments, communities, businesses, the agriculture sector, and environmental organizations must work together and coordinate. We can only manage water resources sustainably for both the current and future generations via group efforts and a shared commitment.

In this lesson, we will delve deeper into the intricacies of water management. We will look at the numerous methods and approaches used to deal with problems relating to water, such as integrated water resource management, watershed management, rainwater harvesting, and water pollution control. We can strive towards a future in which everyone has access to clean, usable water while preserving the vitality and resilience of our planet by comprehending these ideas and supporting sustainable water management practices.

Notes

OBJECTIVES

After reading this lesson thoroughly, you will be able to:

- explain the importance of water management in agriculture;
- explain the water requirement of different crops;
- maintain quality of irrigation water in agriculture;
- identify the efficient methods of irrigation;
- determine the when to irrigate the crops; and
- understand the importance of drainage.

6.1 WATER REQUIREMENT

The term "water requirement" describes how much water is required for the creation, upkeep, and growth of plants or crops. In managing irrigation systems and agricultural practices, it is very important aspect. Several factors, decide the quantity of water required (Fig. 6.1):

Crop type

Depending on genetic makeup, physiological processes, and growth patterns, various crops have different water needs.

Growth stage

Water needs change depending on stage of crop development such as germination, vegetative growth, flowering and fruiting. Flowering and fruiting are two phases that frequently require more water than other stages.

Climate

The amount of water that crops need to grow depends on factors such as temperature, humidity, sun radiation, and wind speed. Due to increased evapotranspiration rates, high temperature and low humidity can increase the water demand.

Fertility

Fertility of soil is influenced by the texture, structure, and amount of organic matter in the soil, which also affect drainage and nutrient availability. The amount of water that crops need can be affected by several factors related to soil fertility.

Notes

Plant density

The number of plants in a given area can influence the amount of water needed. Competition for water increased due to dense plant populations and it may necessitate additional irrigation.

Cultural practices

Agricultural practices, such as irrigation, mulching and crop management strategies can affect the amount of water that crops use. Water management strategies and effective irrigation methods can help to maximize water use.

It is important for the farmers and agricultural professionals to consider these factors and adapt their irrigation strategies accordingly to meet the specific water need of different crops (Fig. 6.1). Proper water management practices are crucial for water conservation, optimal crop production and sustainable agriculture.

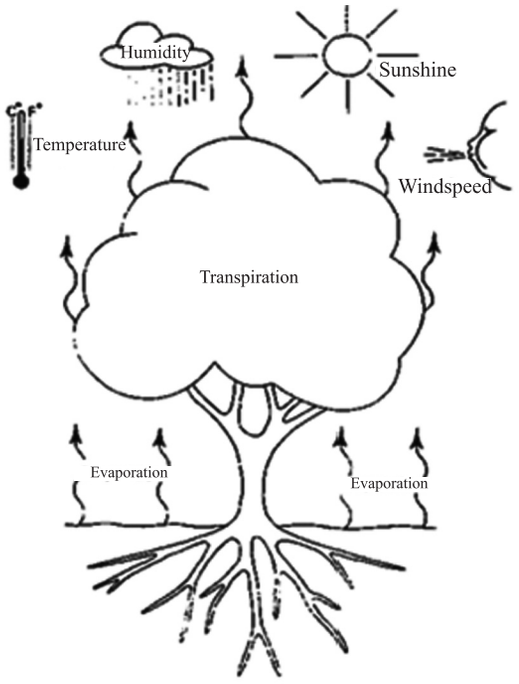


Fig. 6.1: Factor Influencing Crop Water Requirement

(**Source:** fao.org)

6.2 QUALITY OF IRRIGATION WATER

The appropriateness of water for irrigation is referred to as irrigation water quality. It includes physical, chemical, and biological properties of water that may have an impact on plant development and soil quality. Because it may directly affect

Notes

agricultural output and long-term sustainability, quality of irrigation water is crucial.

The quality of irrigation water is influenced by the following essential elements.

pH

The pH of water affect the solubility of minerals in the soil and the availability of nutrients. For optimum growth and development, most of the crops prefer a pH range of 6 to 7.5.

Salinity

The amount of dissolved salts in water is referred to as salinity. High salt concentrations can hinder the intake of water and resulted in water stress, which can have a detrimental effect on plant development. Typically, electrical conductivity (EC) units are used to assess salinity.

Total Dissolved Solids

Total Dissolved Solids (TDS) is a unit used to describe how much inorganic and organic material has been dissolved in water. High TDS levels may be a sign of salts, minerals, or other dissolved substances that might be harmful to soil fertility and crops.

Specific ions

The presence of certain ions in irrigation water, such as sodium (Na^+), chloride (Cl^-), calcium (Ca^{2+}), magnesium (Mg^{2+}), and bicarbonate (HCO^{3-}), can affect the soil's structure, the availability of nutrients, and the health of the plants. For instance, too much salt can damage the soil and inhibit crop development.

Suspended solids

Suspended solids are any particles or organic substances that are suspended in water. Uneven water distribution can result from excessive suspended particles, which can also impede water infiltration and clog irrigation systems.

Irrigation water may contaminated with a variety of diseases causing organisms such as bacteria, viruses, and also heavy metals and toxins (such as pesticides, heavy metals), which can be hazardous to the environment, human health, and crop quality.

It is important for farmers and agricultural professionals to regularly assess the quality of irrigation water to make decisions regarding irrigation practices, crop

Notes

selection, and water treatment, if necessary. Water testing laboratories can provide detailed analysis of water samples, helping to determine its suitability for irrigation purposes and identify any necessary remedial measures.

INTEXT QUESTIONS 6.1

State True or False:

1. High evapotranspiration rates, high temperatures and low humidity can raise the water demand. (T/F)
2. Fertility of soil is not influenced by the texture, structure, and amount of organic matter in the soil. (T/F)
3. Irrigation, mulching, and crop management strategies are not agricultural practices. (T/F)
4. For optimum development, most crops prefer a pH range of 6 to 7.5. (T/F)
5. Electrical conductivity (EC) units are used to assess salinity. (T/F)

6.3 IRRIGATION SCHEDULING

Irrigation scheduling is the practice of deciding when and how much water should be given to crops or plants in order to efficiently satisfy their water requirements. It entails taking into account a variety of elements such as plant type, growth stage, soil conditions, weather patterns, and water availability. Irrigation scheduling that is helps to optimize water consumption, preserve resources, and encourage healthy plant development.

There are several methods and tools available for irrigation scheduling as follows:

Soil Moisture-Based Scheduling

This approach uses soil moisture levels to determine when watering is required. Soil moisture sensors or probes can be used to monitor moisture content in the root zone at various depth. Irrigation should be provided when soil moisture falls below a specific threshold.

Evapotranspiration (ET)-Based Scheduling

ET is the combined process of water evaporation from the soil surface and plant transpiration. ET-based scheduling calculate the amount of water lost due to

Notes

evaporation and adjusts the irrigation need appropriately. ET rates are calculated using weather variables like as temperature, humidity, wind speed, and sun radiation. Commonly used methods include reference ET (ET_0) utilizing the Penman-Monteith equation and crop-specific ET coefficients (Kc).

Crop Coefficient (Kc) Method

This approach determines water requirements based on crop growth stage by using crop-specific coefficients. To compute the crop's actual ET, Kc values are multiplied by the reference ET_0. Kc values differ based on crop type and development stage (e.g., early, mid-season, and late).

Water Budgeting

This method involves calculating agricultural water requirements depending on crop type, development stage, climatic conditions, and soil properties. Irrigation timing may be calculated to maintain an ideal water balance by taking these elements into consideration and accounting for the effective rainfall received.

Plant-Based Scheduling

Some sophisticated systems include plant-based sensors, such as leaf temperature or stomatal conductance, to detect plant water stress directly. These readings can show when plants are deficient in water and need to be irrigated.

Here's how soil moisture-based scheduling typically works:

1. Soil Moisture Sensors
2. Threshold Determination
3. Monitoring and Decision Making
4. Irrigation Application
5. Monitoring and Adjustments

6.3.1 Soil Moisture Sensors

Soil moisture sensors are devices that detect the amount of moisture in the soil. They give vital information regarding plant root zone water availability, allowing for improved irrigation management and water saving.

There are several types of soil moisture sensors available, each of which uses a different technology to monitor soil moisture. Some examples of commonly used sensors are:

Notes

Tensiometers

These sensors indirectly detect soil moisture by measuring the tension or suction required to remove water from the soil (Fig. 6.2).

Capacitance sensors detect the dielectric constant of the soil, which is impacted by its moisture content.

Fig. 6.2: Tensiometer

Source: https://www.sdec-france.com/

Time Domain Reflectometry (TDR) Sensors

TDR sensors employ electromagnetic pulses to monitor the dielectric characteristics of soil, which are used to calculate soil moisture (Fig. 6.3).

Frequency Domain Reflectometry (FDR) Sensors

FDR sensor is a soil sensor based on the frequency domain reflectometry method. By transmitting a high-frequency signal into the soil and analyzing the properties of the returned signal, it is able to ascertain the moisture content of the soil.

Notes

6.3.2 Steps of using Sensor for Monitoring Soil Moisture

Like TDR sensors, FDR sensors monitor soil moisture by analyzing the soil's electrical impedance.

Installation

Soil moisture sensors are frequently put at various depth in the root zone of plants. To capture the soil moisture profile, many sensors at different depth might be deployed. To provide reliable measurements, the sensors should be placed in representative parts of the field.

Data Collection

Soil moisture sensors collect data in real-time on soil moisture levels. Data can be acquired manually by physically visiting sensors or automatically by using telemetry systems that communicate data wirelessly.

Calibration

For soil moisture sensors, calibration is often necessary to create a connection between the measured signal and the actual soil moisture content. Calibration is required because the electrical characteristics of the soil might change, and various soil types can affect sensor readings differently. Calibration can be accomplished using laboratory measurements or through field-specific calibration procedures.

Interpretation

Soil moisture sensor results are commonly represented as volumetric water content (VWC) or as a percentage of the soil's maximum water-holding capacity. Based on established thresholds, this data assists in determining when irrigation is required. To improve irrigation scheduling decisions, sensor data can be combined with other environmental elements like as weather data.

6.3.3 Advantages of Soil Moisture Sensors Precision Irrigation

Using soil moisture sensors, irrigation may be delivered just when needed, preventing over watering or under watering.

- **Water Conservation:** Sensors assist optimize water consumption and decrease water waste by delivering correct information about soil moisture.
- **Plant health and output:** By providing enough water availability, maintaining ideal soil moisture levels increases plant health, growth, and agricultural output.

Notes

- Soil moisture sensors help with optimal resource allocation since they may be linked with automated irrigation systems for accurate water distribution.

6.3.4 Plant-based Scheduling

Plant-based scheduling, also known as plant-based irrigation or plant-based monitoring, is an irrigation scheduling method that directly analyses plants water demands based on their physiological reactions to water stress. Instead of relying merely on soil moisture readings or evapotranspiration estimates, plant-based scheduling considers the plants real water requirements. The following is an overview of plant-based scheduling:

6.3.4.1 Plant Water Stress Indicators

Plant-based scheduling involves tracking certain plant water stress indicators or parameters. These indicators represent plant physiological reactions to water scarcity or abundance. Some examples of regularly used indicators are:

6.3.4.2 Leaf Stomatal Conductance

Stomatal conductance is a measure of how quickly leaf stomata open and close in response to water availability. Water stress is indicated by decreased stomatal conductivity (Fig. 6.3).

Fig 6.3: Leaf Stomatal Conductance

Source: https://edaphic.com.au/

Notes

6.3.4.3 Leaf Temperature:

When plants are stressed by water, their leaves may become hotter owing to decreased transpiration.

6.3.4.4 Leaf Water Potential

Leaf Water Potential is a measurement of the water status inside plant tissues. Water stress is indicated by a decrease in leaf water potential.

6.3.4.5 Chlorophyll Fluorescence

Measuring chlorophyll fluorescence can offer insight into plant photosynthetic efficiency, which can be impacted by water stress.

INTEXT QUESTIONS 6.2

Fill in the blank:

1. ..... is the practice of deciding when and how much water should be given to crops.
2. ..... is the combined process of water evaporation from the soil surface and plant transpiration.
3. Tensiometers indirectly detect soil moisture by measuring the ..... required to remove water from the soil.
4. When plants are stressed by water, their leaves may become ..... owing to decreased transpiration.
5. Stomatal conductance is a measure of how quickly leaf stomata ..... and ..... in response to water availability.

6.4 IRRIGATION METHODS

6.4.1 Surface Irrigation

There are various irrigation methods available, each with its advantages, disadvantages, and suitability for different crops, soils, and climatic conditions. Here are some commonly used irrigation methods (Fig. 6.4).

- **Flood Irrigation:** Flood irrigation involves flooding the entire field with water. This procedure is easy and inexpensive however, it might result in water loss due to evaporation or runoff.

Notes

- **Furrow Irrigation:** Furrow Irrigation is the process of building channels or furrows along agricultural rows and filling them with water. It is appropriate for row crops and orchards.
- **Border Irrigation:** This type of irrigation employs elevated borders or ridges to keep water in certain locations. Water is applied at the top end of the border and flows along the length via gravity.

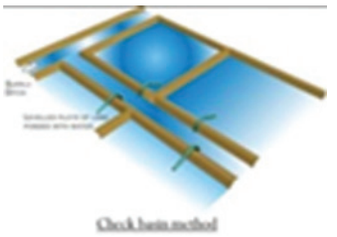
Complete Flooding	Partial Flooding
 Wild Flood Irrigation	 Furrow Irrigation
 Border Irrigation	 Basin and Ring
 Check Basin	 Surge Irrigation

Fig 6.4. Different surface irrigation methods

Source: https://optimizeias.com/

6.4.2 Sprinkler Irrigation

- **Overhead Sprinkler:** This approach distributes water across the field by employing sprinkler heads positioned on risers. As simulated rainfall, water is sprayed into the air and falls on the plants. Sprinkler irrigation distributes water well but is susceptible to wind drift and evaporation.
- **Irrigation using a Centre Pivot:** A center pivot system consists of a central pivot point with sprinklers installed on a long arm that rotates in a circular motion. This technique is frequently utilized in large-scale agricultural areas.

- **Lateral Move Irrigation:** Lateral move irrigation systems are similar to center pivot irrigation systems in that they travel laterally over the field rather than revolving around a fixed point. They are appropriate for rectangular fields.

6.4.3 Drip Irrigation

A network of tiny tubes or emitters feeds water straight to the plant root zone. It conserves water by reducing evaporation and runoff. Row crops, orchards, vineyards, and garden landscapes all benefit from drip irrigation (Fig.6.5).

Micro-Sprinklers: Similar to sprinkler irrigation, micro-sprinklers function at lower flow rates and offer localised watering. They are appropriate for use in orchards, vineyards, and other high-value crops.

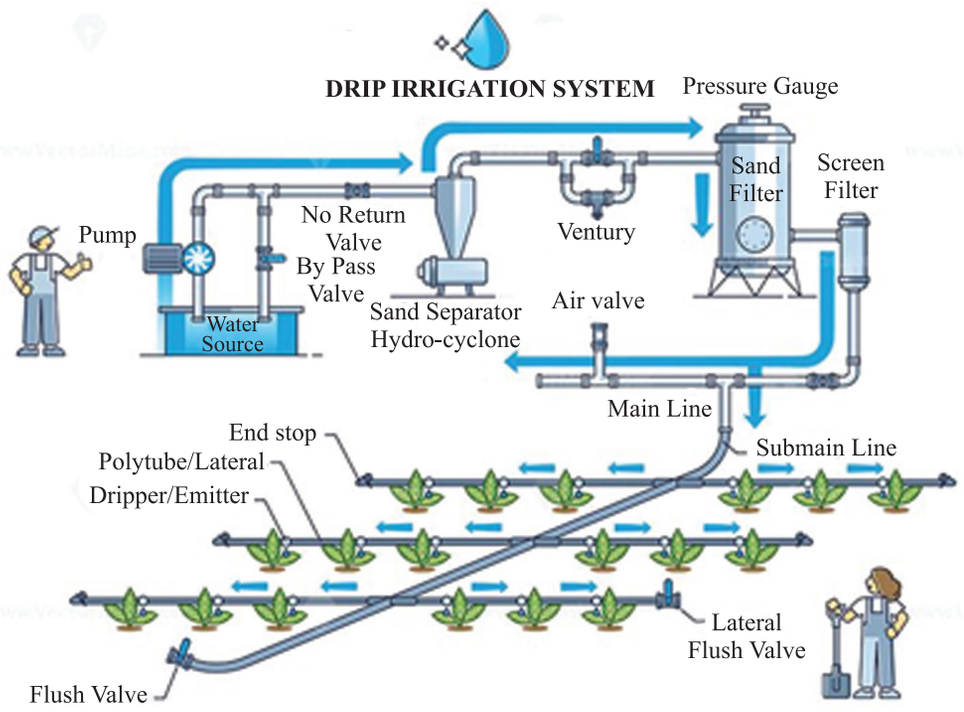


Fig 6.5. Drip irrigation systems

Source: https://in.pinterest.com/

6.4.4 Subsurface Irrigation

Subsurface Drip Irrigation (SDI) is a method of providing water directly to plant roots by installing drip irrigation lines beneath the soil surface. This technology lowers water loss due to evaporation and has the potential to increase water usage efficiency.

Notes

6.4.5 Aeroponics and Hydroponics

Hydroponics is a soil less cultivation technique in which plants grow in nutrient-rich water solutions. Water is usually recirculated to reduce water use.

An aeroponic system exposes plant roots to a thin mist or aerosol of nutritional solution. It offers high quantities of oxygen to the roots while using less water than other approaches.

6.4.6 Other Techniques

- **Hand-watering with buckets:** Hoses, or watering cans is an example of manual irrigation. It is typically utilised in tiny gardens or regions where other techniques of irrigation are impractical.
- **Syphon Irrigation:** Syphon irrigation distributes water across a field using gravity and syphon tubes. Although it is a low-cost solution, it necessitates proper water management.
- **Boom Irrigation:** To distribute water to crops, a moveable boom fitted with sprinklers is used. It is frequently used in greenhouses and nurseries.

INTEXT QUESTIONS 6.3

Fill in the blank:

1. Furrow is appropriate for .....
2. In sprinkler irrigation water is sprayed into ..... and ..... on the plants.
3. ..... technique is frequently utilised for irrigation in large-scale agricultural areas.
4. Water is applied in tiny tubes or emitters feeds water straight to the plant root zone. This irrigation system is called .....
5. ..... is a soil less cultivation technique in which plants grow in nutrient-rich water solutions.

6.5 WATER USE EFFICIENCYIN AGRICULTURE

In agriculture, water use efficiency (WUE) refers to the amount of crop yield or biomass generated per unit of water utilized. It is a measure of how efficiently

Notes

water is used to fulfil crop water demands and maximize yield. Improving water usage efficiency is critical for sustainable agriculture, especially in areas where water is scarce or irrigation is required.

Here is some essential requirement for agricultural water usage efficiency:

6.5.1 Irrigation Management

Implementing irrigation scheduling methods such as soil moisture-based or plant-based scheduling helps optimise the timing and amount of water supplied, decreasing water wastage and preventing over- or under-irrigation.

6.5.2 Soil Management

Soil conservation and organic matter management increase soil structure, water-holding capacity, and infiltration rates, lowering water loss and improving plant access to water.

6.5.3 Mulching

Mulching with organic materials or plastic films conserves soil moisture, suppresses weed development, and reduces evaporation from the soil surface.

6.5.4 Crop Management and Selection

Selecting crop types or cultivars that are well suited to local conditions, such as drought-tolerant or water-efficient kinds, can help to improve water usage efficiency.

6.5.5 Crop Rotation and Diversification

Crop rotation and diversification practices can enhance water usage efficiency by interrupting disease and pest cycles, lowering water demand for specific crops, and increasing nutrient intake.

6.5.6 Crop Management Techniques

Proper fertilizer management, pest and disease control, and proper planting densities all lead to healthier plant development, less water stress, and increased water usage efficiency.

6.5.7 Innovation and Technology

Improved Irrigation Technologies; By providing real-time data and permitting precise control over irrigation applications, improved irrigation technologies such as precision irrigation systems, sensor-based irrigation, or remote monitoring systems assist to optimize water consumption.

Notes

6.5.8 Genetic Improvement

Developing crop varieties with increased water-use efficiency features can lead to more efficient water utilisation and higher yields in water-stressed environment.

6.5.9 Water Recycling and Conservation

Water recycling or reuse technologies, such as collecting and processing irrigation runoff or tail water, can assist to maximise water availability for agricultural use.

6.5.10 Water Conservation Techniques

Water conservation techniques such as contour farming, terracing, or water harvesting techniques can successfully catch and store water, minimising dependence on external water sources.

6.5.11 Training and Education

Educating and teaching farmers on effective irrigation techniques, good water management, and best agricultural practices will help them comprehend water usage efficiency and encourage the adoption of water-saving measures.

6.6 DRAINAGE

In agriculture, drainage refers to the control of surplus water in the soil in order to preserve ideal soil conditions for crop development. Improving soil aeration, reducing waterlogging, managing salt, and fostering healthy root growth all require proper drainage. Here are some important characteristics of agricultural drainage:

- **Surface Drainage:** Surface Ditches; Building open ditches or channels directs surplus surface water away from the field, reducing water collection and increasing surface drainage (Fig. 6.6).

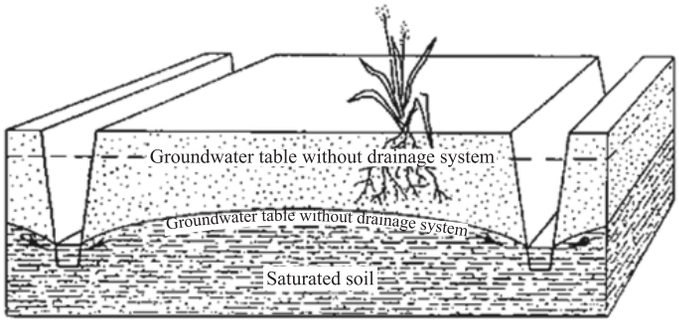


Fig. 6.6: Drainage system

Source: https://www.google.com/

Notes

Contour farming is contouring the soil into ridges and furrows to slow down water flow, prevent erosion, and promote adequate surface drainage.

- **Subsurface Drainage:** Tile Drainage; using perforated pipes, often known as tile drains, to install sub-surface drainage systems which helps to lower the water table and remove surplus water from the soil profile. This strategy is especially beneficial in locations with high water tables or poorly drained soils.
- **Drainage Trenches:** By creating a conduit for surplus water to flow away from the root zone, drainage trenches or gravel-filled trenches can enhance subsurface drainage.

6.6.1 Advantages of Proper Drainage

- **Improved Soil Aeration:** Proper drainage allows air to enter into the soil, encouraging root respiration and nutrient absorption.
- **Waterlogging Prevention:** Excessive water in the root zone can cause waterlogging, which reduces oxygen availability and has a negative influence on plant growth. Waterlogging and other difficulties are avoided with proper drainage.
- **Control of Salinity:** Proper drainage aids in the management of soil salinity by draining away excess salts from the root zone, reducing salt buildup and crop harm.
- **Improved Soil Structure:** Drainage helps to enhance soil structure by avoiding compaction, increasing root penetration, and facilitating greater water infiltration.

6.6.2 Drainage Planning and Design

- **Site study:** It is critical for constructing an effective drainage system to conduct a full study of the site, including soil type, topography, water table depth, and local climatic variables.
- **Drainage System Design:** When designing a drainage system, consider parameters such as field slope, spacing and depth of drains or trenches, outlet location, and total drainage capacity required to manage surplus water properly.
- **Assistance from a Professional:** Working with drainage professional or agricultural engineers may give invaluable assistance in planning and installing a drainage system that is adapted to the individual site requirements.

Notes

WHAT YOU HAVE LEARNT

Let us recapitulate and enlist the salient points that you have learnt in this lesson.

- Water management refers to a variety of procedures and tactics used to guarantee the conservation, preservation, and sustainable use of this priceless resource.
- The term "water requirement" describes how much water is required for the creation, upkeep, and growth of plants or crops.
- Crop type, growth stage, climate, fertility, plant density and cultural practices are several factors can affect how much need of water for different crops.
- For optimum development, most crops prefer a pH range of 6 to 7.5.
- The amount of dissolved salts in water is referred to as salinity.
- Total dissolved solids (TDS) is a unit used to describe how much inorganic and organic material has been dissolved in water.
- Suspended solids are any particles or organic substances that are suspended in water.
- Irrigation scheduling is the practice of deciding when and how much water should be given to crops or plants in order to efficiently satisfy their water requirements.
- Tensiometers sensors indirectly detect soil moisture by measuring the tension or suction required to remove water from the soil.
- Stomatal conductance is a measure of how quickly leaf stomata open and close in response to water availability.
- Flood irrigation involves flooding the entire field with water.
- Furrow Irrigation is the process of building channels or furrows along agricultural rows and filling them with water.
- Sprinkler irrigation distributes water well but is susceptible to wind drift and evaporation.
- Drip Irrigation is a network of tiny tubes or emitters feeds water straight to the plant root zone.

Notes

TERMINAL EXERCISE

1. What is water requirement? Explain the different factors affecting it.
2. What are different essential elements that affects the water quality?
3. What is irrigation scheduling? List different methods of irrigation scheduling.
4. Write short notes on
   (a) Tensiometer
   (b) TDR
   (c) FDR
5. What are different methods of irrigation?
6. Difference between sprinkler and drip irrigation.
7. What is water use efficiency? Explain the factors affecting the water use efficiency.
8. What is drainage? Explain the different type of drainage.

ANSWER TO INTEXT QUESTIONS

6.1

1. T 2. F 3. F 4. T 5. T

6.2

1. Irrigation scheduling
2. Evapotranspiration (ET)
3. Tension or suction required
4. Hotter
5. Open and Close

6.3

1. Row crops and orchards
2. The air and falls
3. Centre Pivot
4. Drip irrigation.
5. Hydroponics

Notes

Key Learning Outcomes

Learner will be able to:

- List the crop wise water requirement.
- Describe the irrigation water quality parameters
- Explain the factors and methods of irrigation scheduling.
- Describe the different method of irrigation.
- Demonstrate different methods of irrigation.
- Demonstrate drip irrigation model in different crops.
- Measure the water requirement and water use efficiency in different crops.

Notes

7

CROP DISEASE MANAGEMENT

In the previous lesson, we have learnt about water management strategies used in organic farming. In this lesson, we will discuss about the disease and their management. Crop diseases are ailments that affect plants, specifically those that we cultivate for food, such as fruits, vegetables, grains, and other crops. Just like humans and animals, plants can also fall ill and suffer from various health issues. These diseases can be caused by a variety of factors, including bacteria, viruses, fungi, and even environmental conditions. These diseases can reduce crop yields, diminish the quality of produce, and even lead to complete crop failure.

Common crop diseases include fungal infections like powdery mildew and rust, viral infections like mosaic viruses, and bacterial infections such as bacterial blight. Farmers and agricultural scientists work tirelessly to prevent and manage crop diseases. Early detection and accurate diagnosis of crop diseases are crucial for effective management. Farmers and experts closely monitor their crops for any signs of disease, including abnormal growth, discoloration, wilting, or the presence of pests. By identifying the specific disease causing the problem, appropriate control measures can be implemented, such as using fungicides, insecticides, or bio control agents.

OBJECTIVES

After reading this lesson, you will be able to:

- identify the various diseases of crop;
- determine the losses due to diseases;
- understand the crop diseases; and
- explain the various type of pathogens.

Notes

7.1 LOSSES DUE DISEASES

Crop diseases pose a significant threat to agricultural productivity and can result in substantial losses in crop yields and quality.

Yield Losses: Crop diseases can cause significant reductions in crop yields, leading to economic losses for farmers. According to the Food and Agriculture Organization (FAO) of the United Nations, yield losses due to crop diseases can range from 10% to 100% (FAO, 2016). The severity of the disease, the susceptibility of the crop variety, and the effectiveness of disease management practices all play a role in determining the extent of yield losses. For example, studies conducted on wheat rust, a fungal disease, have shown that susceptible varieties can suffer yield losses of up to 50% (FAO, 2017). Similarly, other diseases like late blight in potato and blast in rice have been known to cause substantial yield reductions if not properly managed Fig. 7.1.

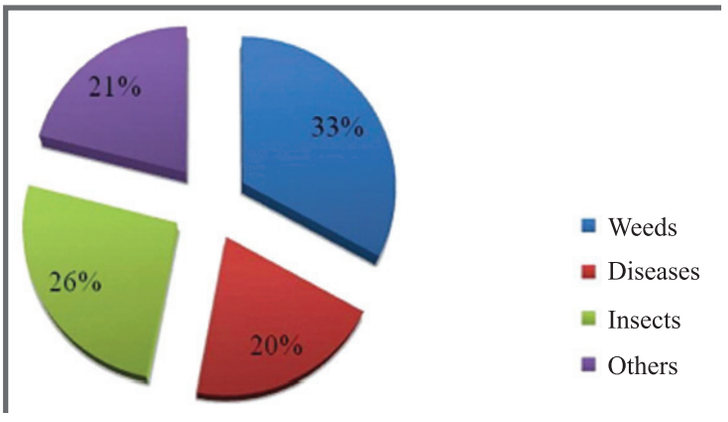


Fig. 7.1: Crop Yield Losses due to Pests and Diseases

(**Source:** Directorate of Weed Research, Jabalpur)

- **Quality Losses:** Crop diseases can also affect the quality of agricultural produce, rendering it unsuitable for consumption or market sale. Diseases can cause physical damage to crops, resulting in deformities, discoloration, or rot. Fungal diseases like powdery mildew and fruit rot can significantly reduce the market value of fruits and vegetables. Moreover, diseases can also impact the nutritional content of crops, compromising their overall quality. For example, some diseases can cause nutrient deficiencies or alter the composition of essential compounds in plants, leading to inferior quality produce (Agrios, 2005).

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- **Economic Impact:** The economic impact of crop diseases extends beyond the individual farmer. When crop yields are diminished, the supply of agricultural products decreases, leading to potential price increases in the market. Higher food prices can affect consumers, particularly those with limited resources, and can lead to food insecurity and reduced access to nutritious food. Furthermore, the losses incurred by farmers due to crop diseases can have long-term consequences for their livelihoods. Reduced incomes can hamper investment in farm improvements, equipment, and technology, hindering overall agricultural development (FAO, 2016).
- **Environmental Consequences:** Crop diseases can also have environmental implications. In some cases, the management of diseases involves the application of chemical pesticides and fungicides. These chemical inputs can have adverse effects on the environment, such as soil and water contamination and the potential harm to non-target organisms. Additionally, disease outbreaks can lead to the loss of biodiversity in agricultural ecosystems. Reduced genetic diversity in crops makes them more susceptible to disease outbreaks in the future. Farmers may do this by using control techniques or disease-resistant crop types.
- **Examples of Serious Diseases that Lead to Famines:**
  - **Irish famine (1845)** – Late blight of potato by *Phytophthora infestans* destroyed million hectares of potato fields thus people switched over to other food crops.
  - **Bengal famine** – *Bipolaris oryzae* (1942), West Bengal, India; Coffee rust – *Hemileia vastatrix* (1868), Srilanka
  - **Wheat rust** – *Puccinia graminis f.sp.tritici* (1940), U.S.A; Southern corn leaf blight – *Helmintho sporium maydis,* U.S.A.

INTEXT QUESTIONS 7.1

Fill in the blank:

1. What portion of crop yield loss due to diseases is .....
2. Irish famine come in the year of .....
3. Bengal famine in the rice come in the year of .....
4. Application of chemical pesticide major causes .....

Notes

7.2 TYPES OF PATHOGENS CAUSING DISEASES

Crop diseases are caused by various types of pathogens that infect plants and adversely affect agricultural productivity (Fig 7.2). Understanding these pathogens is essential for effective disease management strategies.

1. Fungi
2. Bacteria
3. Fastidious vascular bacteria
4. Mollicutes (Phytoplasma and Spiro plasma)
5. Viruses
6. Viroids
7. Algae
8. Flagellated protozoans.

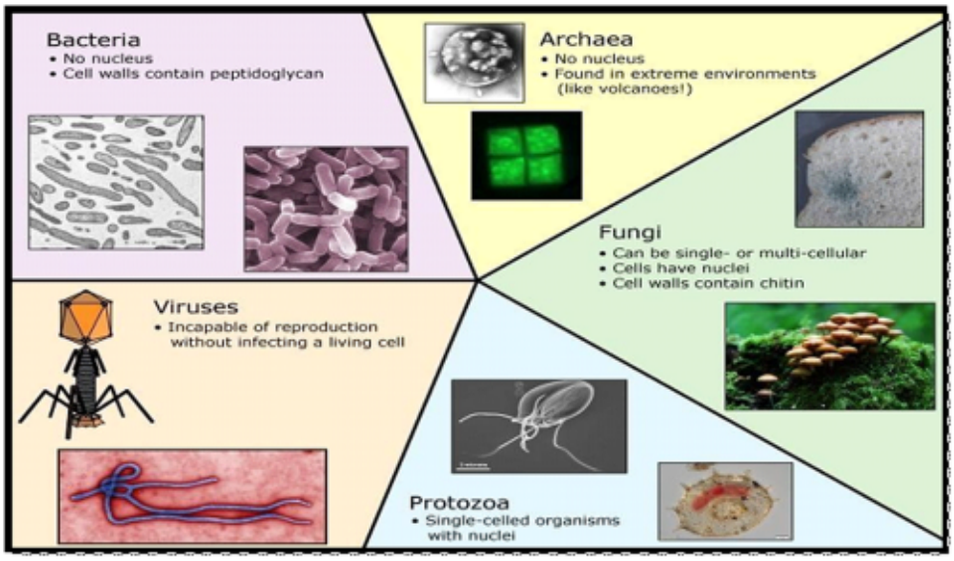


Fig. 7.2: Different Types of Pathogens

Source: by Michael Gerhardt

Fungi: Fungi are eukaryotic, spore bearing, achlorophyllous organisms that generally, reproduce sexually and asexually and who's filamentous, branched somatic structures are typically surrounded by cell walls consisting chitin or cellulose or both with many organic molecules.

Notes

Bacteria: Bacteria are extremely minute, rigid, essentially unicellular organisms free of true chlorophyll and generally devoid of any photosynthetic pigment, most commonly multiplying asexually by simple transverse fission, the resulting cell, being of equal or nearly equal in size.

(i) Fastidious vascular bacteria (FVB) are also known as Rickettsia-like organisms (RLO). Fastidious vascular bacteria are like bacteria in most respects but are obligate parasites or cannot be grown on routine bacteriological media.

(ii) Mollicutes (phytoplasma and Spiro plasma):

Phytoplasma: Phytoplasmas are pleomorphic, wall less prokaryotic microorganisms, that can infect plants and cannot yet to be grown in culture.

Spiroplasma: Spiroplasmas are helical, wallless prokaryotic microorganisms that are present in phloem of disease plants, often helical in culture and are thought to be a kind of mycoplasma and can be cultured on artificial medium.

(i) Virus: A sub-microscopic, obligate parasite consisting of nucleic acid and protein that multiplies only intracellularly and is potentially pathogenic.

(ii) Viroid: Small, low molecular weight ribonucleic acids (RNA) that can infect plant cells, replicate themselves and cause disease in plants.

(iii) Algae: Algae are eukaryotic, photosynthetic, uni or multicellular organisms, containing chlorophyll and a few algae, mainly green algae, cause plant diseases.

(iv) Flagellated protozoans: Protozoa are microscopic, non- photosynthetic, eukaryotic and flagellate, motile, single celled animals.

7.3 MAJOR DISEASES OF IMPORTANT CROPS

The list of major diseases of important crops are given in (Table 7.1).

Table 7.1: Major Diseases of Important Crops, Fruits and Vegetables

Crop groups	Crops	Diseases	Symptoms
Cereals	Rice	Bacterial Blight (Fig. 7.3)	Water-soaked lesions on leaves, yellowing, wilting
		Rice Blast	Gray to white lesions with dark borders on leaves and panicles
		Sheath Blight	Brown lesions on sheaths, rotting of the collar region

Crop groups	Crops	Diseases	Symptoms
		Rice Tungro Disease	Stunted growth, yellowing and rolling of leaves
	Wheat	Wheat Rust	Reddish-brown pustules on leaves, reduced grain quality
		Fusarium Head Blight	Tan to brown lesions on spikelets, shriveled kernels
		Powdery Mildew	White powdery patches on leaves, stunted growth
		Septoria Leaf Spot	Tan to grayish spots with dark borders on leaves
	Maize	Maize Rust	Rust-colored pustules on leaves, reduced grain quality
		Gray Leaf Spot	Grayish lesions with dark borders on leaves
		Maize Streak Virus	Yellow streaks and mottling on leaves
		Fusarium Ear Rot	Discoloured and rotted kernels, mold growth
	Sorghum	Anthracnose	Sunken lesions on stems, leaves, and grains
		Grain Mold	Moldy and discolored grains, reduced quality
		Charcoal Rot	Black discoloration of internal tissues, wilting
	Pearl millet	Ergot	Hard, dark fungal bodies replacing grain kernels
Pulses	Pigeon Pea	Wilt	Wilting, yellowing of leaves, drying of plant
		Sterility Mosaic Virus	Stunted growth, mosaic pattern on leaves
		Phytophthora Blight	Water-soaked lesions, rotting of stem and pods
	Black Gram	Yellow Mosaic Virus (Fig. 7.4)	Yellowing, mosaic pattern on leaves, stunted growth
		Anthracnose	Dark, sunken lesions on stems, leaves, and pods

Notes

Crop groups	Crops	Diseases	Symptoms
		Rhizoctonia Root Rot	Rotting of roots, wilting, stunted growth
	Green Gram	Leaf Curl Virus	Curling, yellowing of leaves, reduced growth
		Cercospora Leaf Spot	Circular spots with gray centers on leaves
		Rust	Rust-colored pustules on leaves, reduced yield
	Gram	Ascochyta Blight	Brown lesions with concentric rings on
Oilseeds	Mustard	Alternaria Blight	Dark brown lesions on leaves, stem cankers
		White Rust	White powdery patches on leaves, reduced yield
		Sclerotinia Rot	Water-soaked lesions, white cottony growth on stems
	Sunflower	Phoma Black Stem	Dark lesions on stem, wilting, premature senescence
		Downy Mildew	Yellow patches on leaves, downy growth on the underside
		Head Rot	Rotting of flower heads, gray mold
	Soybean	Soybean Rust	Rust-colored pustules on leaves, reduced yield
		Sudden Death Syndrome	Wilting, yellowing of leaves, root rot
		Phytophthora Root Rot	Wilting, brown lesions on roots, reduced yield
	Groundnut	Late Leaf Spot	Circular lesions with dark centers on leaves
		Early Leaf Spot	Small brown lesions with yellow halos on leaves
		Rust	Rust-colored pustules on leaves, reduced yield
	Sesame	Fusarium Wilt	Wilting, yellowing of leaves, vascular discoloration

Crop groups	Crops	Diseases	Symptoms
		Charcoal Rot	Black discoloration of internal tissues, wilting
		Alternaria Leaf Spot	Brown spots with concentric rings on leaves
Fruits	Mango	Anthracnose	Dark, sunken lesions on fruits, rotting
		Powdery Mildew	White powdery patches on leaves, fruits
		Bacterial Black Spot	Dark, raised lesions on fruits, oozing of sap
	Apple	Apple Scab	Dark, scaly lesions on leaves, fruits, and twigs
		Fire Blight	Wilting, blackening of blossoms, cankers on branches
		Cedar Apple Rust	Orange lesions on leaves and fruits, spore-producing structures
	Litchi	Litchi Downy Blight	Brown lesions on leaves, shoot dieback
		Litchi Leaf Curl	Curling, yellowing of leaves, stunted growth
		Litchi Fruit Rot	Rotting, blackening of fruits, foul odor
	Guava	Guava Wilt	Wilting, yellowing of leaves, drying of plant
		Anthracnose	Dark, sunken lesions on stems, leaves, and fruits
Potato		Late Blight (Fig 7.5)	Dark, water-soaked lesions on leaves, rotting of tubers
		Bacterial Wilt	Wilting, yellowing of leaves, bacterial ooze from stems
		Early Blight	Brown lesions with concentric rings on leaves
		Blackleg	Black lesions on stems, rotting of tubers
Tomato		Tomato Leaf Curl Virus	Curling, yellowing of leaves, stunted growth

Notes

Crop groups	Crops	Diseases	Symptoms
Brinjal		Early Blight	Brown lesions with concentric rings on leaves
		Late Blight	Dark, water-soaked lesions on leaves, rotting of fruits
		Fusarium Wilt	Wilting, yellowing of leaves, vascular discoloration
		Bacterial Wilt	Wilting, yellowing of leaves, bacterial ooze from stems
		Leaf Spot	Brown lesions with concentric rings on leaves
		Anthracnose	Dark, sunken lesions on stems, leaves, and fruits
Cucurbits		Downy Mildew	Yellow patches on leaves, downy growth on the underside
		Powdery Mildew	White powdery patches on leaves, stunted growth
		Cucumber mosaic Virus	Mosaic pattern on leaves, stunted growth
		Fusarium Wilt	Wilting, yellowing of leaves, vascular discoloration
		Gummy Stem Blight	Dark lesions on stems, gumming, wilting

Fig. 7.3: Bacterial Leaf Blight of Rice

Fig. 7.4: Yellow Mosaic Virus

Fig. 7.5: Potato Blight

7.4 PRINCIPLES OF PLANT DISEASE MANAGEMENT

1. **Avoidance:** Avoiding disease by planting at times when, or in areas where, inoculum is ineffective due to environmental conditions, or is rare or absent.
2. **Exclusion of inoculum:** Preventing the inoculum from entering or establishing in the field or area where it does not exist.
3. **Eradication:** Reducing, in activating, eliminating or destroying inoculum at the source, either from a region or from an individual plant in which it is already established.
4. **Protection:** Preventing infection by creating a chemical toxic barrier between the plant surface and the pathogen.
5. **Disease resistance (Immunization)**: Preventing infection or reducing effect of infection by managing the host through improvement of resistance in it by genetic manipulation or by chemical therapy.

Notes

7.5 DISEASE CONTROL MEASURES

Disease control measures are essential for managing and preventing the spread of plant diseases. Implementing effective control strategies can help farmers and gardeners protect their crops and ensure healthy yields. This section outlines various disease control measures and provides practical guidelines for their implementation.

- **Cultural Practices:** Cultural practices play a significant role in disease control. These practices include proper crop rotation, maintaining plant spacing, providing adequate nutrition, practicing good irrigation management, and implementing timely weed control. By creating favorable growing conditions and minimizing stress on plants, cultural practices help enhance their natural defense mechanisms against diseases.

- **Sanitation:** Maintaining good sanitation practices is crucial for disease control. It involves removing and destroying diseased plant parts, such as leaves, stems, and fruits, to prevent the spread of pathogens. Proper disposal of infected plant material reduces the chances of disease recurrence. Additionally, cleaning and disinfecting tools and equipment after each use helps prevent cross-contamination.

- **Seed Treatment:** Treating seeds with appropriate fungicides or disinfectants can help eliminate seed borne pathogens and protect emerging seedlings from diseases. Seed treatments are particularly useful for controlling soil borne diseases and those caused by fungi or bacteria that survive on or within the seed. It is important to follow recommended application rates and methods for seed treatments.

- **Biological Control:** Biological control involves the use of beneficial organisms, such as predatory insects, parasitic nematodes, or microorganisms, to suppress plant pathogens. These organisms either directly attack the pathogens or stimulate the plant's natural defense mechanisms. Biological control methods are environmentally friendly and can be integrated with other disease control measures for sustainable management.

- **Integrated Disease Management:** Integrated disease management (IDM) combines multiple control measures to create a comprehensive and sustainable approach. IDM involves the integration of cultural practices, biological control, tailored to specific crop-disease systems. Regular monitoring and disease surveillance are crucial for timely interventions and effective IDM implementation (Fig. 7.6).

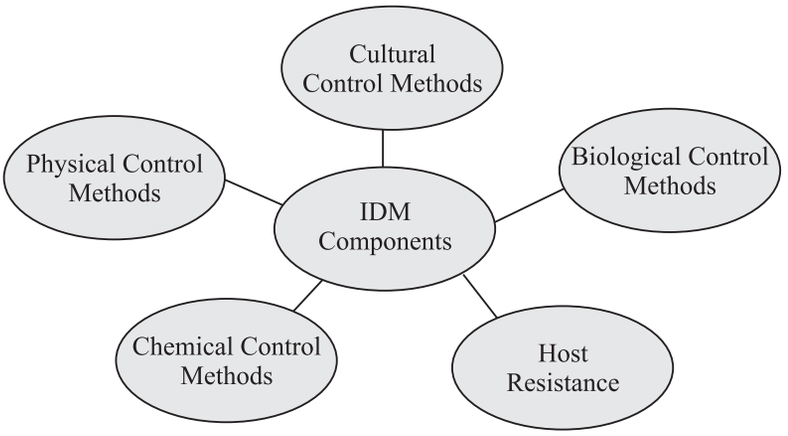


Fig. 7.6: Components of IDM

- **Indigenous Technical Knowledge (ITK):** It is referred to the traditional knowledge and practices that have been developed and passed down through generations within local communities. These knowledge systems often hold valuable insights and solutions for managing crop diseases.

  Indigenous communities have cultivated traditional crop varieties that have evolved and adapted to local environments over time. These varieties often possess inherent resistance or tolerance to specific diseases prevalent in the region. Farmers have observed and selected plants with desirable traits, such as disease resistance, and saved their seeds for future plantings. Preserving and utilizing traditional crop varieties can contribute to disease management by maintaining genetic diversity and resilience.

  Indigenous communities have developed a wealth of knowledge about medicinal plants and their applications. Some traditional herbal and botanical preparations have proven effective in managing crop diseases. Decoctions, extracts, or fermented preparations made from specific plants are used as foliar sprays or soil amendments to control diseases. These preparations may have anti microbial, antifungal, or insect-repellent properties, providing natural alternatives to synthetic chemical treatments.

INTEXT QUESTIONS 7.2

Fill in the blank:

1. Diseases causing agent in plants called as .....

Notes

2. Mildew disease caused by .....
3. Crop rotation help to decrease crop disease .....
4. 33% crop loss by disease .....

WHAT YOU HAVE LEARNT

Let us recapitulate the important points we have learned in this lesson:

- I understand about disease of plants. How disease affect the plant.
- I also understand disease causing agents, and losses due to disease.
- Irish famine (1845) due to Late blight of potato caused by *Phytophthora infestans.*
- Bengal famine caused by *Bipolaris oryzae in* West Bengal.
- India Coffee rust caused by *Hemileia vastatrix.*
- Wheat rust caused by *Puccinia graminis f.sp.tritici.*

TERMINAL EXERCISE

1. What is integrated disease management?
2. List the name of pathogen and their management in rice?
3. List the name of pathogen and their management in Pulses?
4. List the name of pathogen and their management in Fruits?
5. What are principals of disease management?
6. Describe different type of disease-causing agents.

ANSWR TO INTEXT QUESTIONS

7.1

1. 20% 2. 1845 3. 1940 4. Environmental pollution

Notes

7.2

1. Pathogen Powdery 2. Fungus 3. YES 4. NO

SUGGESTED ACTIVITY

- To visit the nearest agriculture farm and observe the disease affected part of plant.
- Collect the samples and analyse the disease.

Key Learning Outcomes

Learner will be able to:

- Describe the natural enemies of disease.
- List the different crop diseases.
- Identify different diseases.

Notes

8

INSECTS AND PEST MANAGEMENT

In the previous lesson, we have learnt about disease management strategies used in organic farming. In this lesson, we will discuss about the insects and pest management. Insects are valuable to all as they are found everywhere and on almost anything. They have an enormous range of forms and life cycles. They are the most diverse animals and are the most abundant and unusual. They account for roughly 80% of all animal life on Earth.

The term "pest control" simply describes how an area of crop is managed properly to keep pests out. Reduced contact between a pest and a host or the impact of those contacts are the goals of preventive control techniques where as, methods of curative control make an effort to eliminate some or all of the pests co existing with the host.

The principles of exclusion, avoidance, protection, and eradication are used in both techniques, whether in the form of physical, cultural, mechanical or biological control. In this lesson, we shall learn about pests, insects as pests, how they damage crops and result in yield loss, different kinds of beneficial and harmful insects and the various control measures which can be adopted for pest management.

OBJECTIVES

After reading this lesson you will be able to:

- identify the harmful and beneficial insects associated with crop;
- determine the losses due to insects and pests;
- identify the important insects of crops, fruits & vegetables.;

Notes

- explain the different insect control measures like cultural, mechanical and biological; and
- describe the cow urine-based inputs for insect management.

8.1 INTRODUCTION AND MEANING OF PESTS AND INSECTS

8.1.1 Meaning of Pests

Pests are an integral component of the natural environment system. These are organisms whose activities damage crops and affect their production. The word pest has been derived from the French word *Peste* and the Latin term *Pestis* which means plague or contagious disease.

A pest is an organism which harms man or his property significantly or is likely to do so (Woods, 1976). Pests are defined as organisms that harm cultivated plants or plant products or render them unfit for human consumption. They spread disease, cause destruction and reduce yields. It includes invertebrates such as insects, nematodes, snails, slugs, mites, etc. and vertebrates like rats, birds, bacteria, virus etc. A pest is any living thing that is unwelcome to have around due to some unpleasant characteristic, they are destructive, uncomfortable, or detrimental in some manner.

Main Characteristics

- These are organisms, invertebrate or vertebrate.
- They are numerous in numbers.
- They harm plant growth and affect yields.
- They cause destruction and value depreciation of plant yields resulting in economic damage to humans.

8.2 INSECT AS PESTS

The phylum Arthropoda of the animal kingdom lack a backbone and are known for possessing jointed legs, compound eyes, a tough exoskeleton, and a segmented body that is organised into bigger units called tagma (plural: tagmata). The majority have one or two sets of wings as well as two antennae. These are small organisms with a body made up of three main parts, head, thorax, and abdomen. The mouthparts and sensory organs like the eyes and antennae are located in the head. Three pairs of legs and, if present, up to two pairs of wings are among the locomotory appendages found on the thorax. The majority of the digestive tract, along with internal and external reproductive organs, are located in the abdomen.

Notes

Usually, they have three pairs of legs and an exoskeleton, which is a tough outer layer similar to a shell. An estimated 900,000 species of insects exist, however not even most of them have been properly identified and recorded.

While some insects are helpful to humans, others can be dangerous. It is important to know and distinguish between insects that are harmful or could cause harm and those that are either beneficial or have no bearing on human welfare. Those insects that harm humans in any way, spread diseases, or damage plants or their yields are called insect pests. Specifically, only those whose populations exceed a predetermined economic threshold by producing economic harm are classified as pests.

8.3 BENEFICIAL AND HARMFUL INSECTS

Insects play a crucial role in our environment and in maintaining the ecosystem as they are involved in various significant tasks viz. pollination, soil aeration, and feeding on harmful pests, thus regulating their growth. They are the ideal economic instrument for a variety of industries, including food, cosmetics, agriculture, pharmaceutical etc., with a favourable economic impact on human livelihoods and economic progress.

Certain insects consume decaying organic materials and recycle the nutrients into the soil as scavengers. Beetles are an example. Also, insects are decomposers and they contribute to the development of a fertile top layer of soil that supports the growth of plants and other species. Insects like ants and beetles create tunnels in the ground that help channel water, which explains why the term "burrowing bug" is applied to them so frequently. Bees, wasps, ants, and other plant pollinators aid in fertilising flowering plants by pollinating them. Certain harmful insects, such as caterpillars and aphids that eat on plants and inhibit their growth, are preyed upon by pest controller insects, like praying mantises.

Economically, insects appeared to be extremely important to both nature and humanity. As a result, they and their products are promoted for a variety of reasons. For instance, people cultivate honey and honey wax from honeybees (*Apis species*), and silk from silkworms is used widely to design and create attractive clothing. Silk from silkworms is also beneficial for the skin and useful for regulating body temperature. Additionally, insects are useful in the food industry. They are abundant in vitamins, minerals, dietary fibre, riboflavin, and nutrients like protein. Insects have been processed by the food industry into foods including flour, energy bars, pasta, and snacks. Numerous insects, such as crickets, locusts, houseflies, mealworms, ants, and mantises, are mass-produced for human consumption.

Notes

Humanity has benefited from many insect-derived products. Apitoxin and melittin, which are produced by honeybees, are known to reduce pain and swelling brought on by conditions such as rheumatoid arthritis, multiple sclerosis, and more. Alloferons, defensin, and other antimicrobial peptides (AMP) are obtained from insects like ants and wasps and aid in the prevention of bacterial, fungal, and viral diseases. Angiotensin-converting enzyme (ACE) inhibitors, which are found in insects including silkworms (*Bombyx mori*), mealworms (*Tenebrio molitor*), and leaf worms (*Spodoptera littoralis*), among others, have been found in insects. Fibroin and sericin, two proteins produced during the creation of silkworm cocoons, promote wound healing while simultaneously reducing obesity by boosting fat metabolism. A fatty acid derived from beetles called cantharidin is used to treat cutaneous warts and as a cancer-fighting agent that targets diseased cells.

Shellac, a resin made from the *Lacciferlacca* lac insect, is frequently used in products like eyeliner, mascara, nail polish remover, and hair spray. It has been demonstrated that essential oils from crickets, locusts, and spider flies are used in cosmetic products to enhance skin hydration, cellular healing, and rejuvenation. Since ancient times, beeswax and honey have been used as cosmetics to soften, hydrate, and cure skin tissue. Products like face washes, face scrubs, lip balms, and hair conditioners all include them.

Insects' two most significant contributions to improved crop quality and productivity are pollination and pest control. Ladybird beetles, lacewings, syrphid flies, and many others are pest-control insects. As they assist in reducing the insect population and protect the crops from their attack, they are economically significant for crop production. Bees, wasps, butterflies, moths, and other pollinator insects consume nectar from a variety of flowers and pollinate the plants as a result, assisting in plant fertilisation.

Many insects, never the less, can have a negative impact on both people and the environment. Insect-related problems pose a serious danger to agriculture. Caterpillars, grasshoppers, and locusts are harmful insect pests that consume the stems, leaves, buds, flowers, seeds, and fruits of agricultural crops. Locusts occasionally form large plagues of several million, which can seriously harm crops and result in famine occurrences. Other insects, such as thrips, and weevils, feed on plant sap, which can have an impact on plant growth and development and increase the risk of disease. One of the most damaging insect pests is the little sap-sucking insect known as the aphid. Other insects that act as vectors for specific viruses include whiteflies, thrips, mealybugs, plant hoppers, grasshoppers, scales, and a few beetles. Some viruses can survive for weeks or months and even replicate in the insects that carry them.

Notes

Insects can also harm a diversity of items that are stored, including wool, feathers, cigars, and tools. When locust swarms attack the crop, they cause harm to the entire crop in all the fields in the region.

Ants, cockroaches, termites, and silverfish are a few domestic pests that harm our home furnishings as well as our food, books, and wooden windows and doors. Furs, feathers, and carpets could all be destroyed by carpet beetles and cloth moths.

Numerous insects live as endoparasites, such as bolt-fly larvae in sheep, while others are ectoparasites like lice, fleas, bugs, and mosquitoes that afflict domestic animals. Several insects spread diseases are vectors and act as secondary hosts of the pathogen. For example, the malarial parasite "*Plasmodium*" is spread from one person to another by Anopheles mosquitoes, Aedes mosquitoes transmit yellow fever and dengue among people.

Some Insect Pests of Plants/Crops

Do you know every insect has its scientific name and it is written in an Italic form as well as the species is written in only small letters? What is the meaning of a host plant?

Host plant means the plant on which the insect pest preys. Here are mentioned some insect pests with their host plants.

SN	Common Name	Scientific Name	Host Plants
1.	Cotton bollworm	*Helicoverpa armigera*	*Gossypium* (Cotton), *Cicer arietinum* (Chickpea)
2.	Tobacco whitefly	*Bemisia tabaci*	*Solanum, Lycopersicum* (Tomato), *Gossypium* (Cotton)
3.	Two-spotted spider mite	*Tetranychus urticae*	*Solanum lycopersicum* (Tomato), *Phaseolus vulgaris* (common bean)
4.	Diamondback moth	*Plutella xylostella*	*Brassica oleracea* (Cabbage), *Brassica*
5.	Taro caterpillar	*Spodoptera litura*	*Glycine max* (Soybean), *Arachis hypogaea* (Peanut)
6.	Red flour beetle	*Tribolium castaneum*	*Triticum* (Wheat)
7.	Green peach aphid	*Myzus persicae*	*Solanum tuberosum (potato)*, *Capsicum annuum* (Bell pepper)
8.	Fall armyworm	*Spodoptera frugiperda*	*Zea mays* (maize), *Gossypium* (Cotton)
9.	Cotton aphid	*Aphis gossypii*	*Gossypium* (Cotton)
10.	Brown planthopper	*Nilaparvata lugens*	*Oryza* (Rice)

Notes

INTEXT QUESTIONS 8.1

1. Why some insects are called pests?
2. Insects have ..... pairs of legs.
3. The reproductive organs in insects are located on .....
4. The insect body is made up of three main parts, ..., ..., and .....
5. ..... is a burrowing bug.
6. Insects that help in fertilizing flowering plants by pollinating are termed .....
7. ..... is useful in regulating body temperature.
8. The scientific name of the silkworm is .....
9. A fatty acid derived from ..... called cantharidin is used as a cancer-fighting agent.

8.4 LOSSES DUE TO INSECTS

As we have discussed earlier that some insects are harmful and they damage crop yields that's why they are called pests. Now, do you know how crop losses are caused, and what are the ways to estimate the losses?

Well, pest's havoc on crops has been documented since the beginning of civilization. Since they may consume different types of plants and crops, insects pose a severe threat to agriculture as well. The majority of insects eat vegetation. Many insects use plant sap or cell contents as a food source. Bees are obligate symbionts of flower nectar and pollen. Numerous moths, butterflies, beetles, and flies have larvae that dwell in or on plants.

Several insect species can cause long-term harm to crops, domesticated animals, and people if they are not controlled. Insect pests reduce food and cash crop yields by 15% to 20% on average. Insect pest losses have decreased globally from the post-green revolution era to the beginning of the twenty-first century, from 13.6% to 10.8%. Crop losses in India have decreased from 23.3% after the green revolution to 15.7% right now. Indian agriculture today experiences an annual loss of roughly 36 billion US dollars, which has a significant negative impact on the country's economy.

Notes

Pest-related losses can be divided into potential and actual losses. Potential losses are those that happen with similar intensity to well-protected crop-producing systems when there is no physical, biological, or chemical crop protection. On the other hand, actual losses are those that never the less happen despite the use of crop protection practices. The percentage of potential losses avoided is used to rate crop protection practices. Primary and secondary losses, as well as direct and indirect losses, are included in the loss categories. Primary crop losses are those brought on by pest and disease damage in a particular year, while secondary crop losses are those brought on by the unfavorable effects of pests and diseases in a prior year.

8.5 HOW INSECTS CAUSE PLANT DAMAGE

Let's discuss how insects harm plants. What is the process and what are the ways? Insects can damage the plants in many ways. They can

(i) Attack directly and cut the plants' roots, stems, and leaves.

(ii) Consume various plant tissues or cell sap.

(iii) Even make holes in the plant's stem and fruits and affect the crop's health resulting in lower production.

Insects can also seriously damage crops by spreading diseases indirectly. Insect pests that spread plant diseases are termed vectors. Typically, they spread bacterial, fungal, or viral infections.

Plant parts like flowers, leaves, stalks, and roots are all edible to insects. The infected sections are really eaten by the chewing insects. Leaf beetles, flea beetles, and immature caterpillars are a few examples of insects that feed by nibbling on leaves. Various weevils, bigger caterpillars, grasshoppers, and katydids are frequently responsible for the irregular scratches found along the edges of leaves. The presence of leaf cutter bees is indicated by perfectly semi-circular cut leaf pieces. Mining is the term for feeding totally within leaves. Among beetles, flies, sawflies, and moths are leaf miners.

Insects that exclusively consume plant tissue for growth include root weevils and root maggots, whereas other species, primarily white grubs, consume both roots and soil organic matter.

Borers, which eat internally as larvae, commonly devour stems. Long-horned beetles also known as round headed borers, metallic wood-boring beetles also known as flathead borers, engraving beetles, clearwing moths, and a few other less common moths are significant borers.

Notes

Sucking insects harm plants by removing cell contents like thrips or sap like aphids, leaf hoppers, scales, etc. These sucking insects occasionally inject saliva into plants. This secretion has the potential to destroy plants, trigger the formation of galls, as with gall aphids, or kill a section of a leaf, as with leafhopper "burn." Insects that feed by sucking excrete extra sugar water as honeydew, which is disgustingly sticky and promotes the development of sooty mould.

The possibility of transmitting plant disease organisms increases when sucking mouth parts are inserted into plants. Aster yellows and Peach X-disease are caused by mycoplasma-like organisms that can be spread by sucking insects like leafhoppers that move between plants. Plants are infected with viruses by aphids and leafhoppers. Some insects destroy the plants by removing them to set their eggs. Cicadas stand out among them because they can seriously harm tree limbs during their peak emergence years. By laying their eggs in stems, tree crickets have the potential to disperse disease-causing agents.

8.6 CROP LOSSES DUE TO INSECT

Crop losses evaluations provide a concise comparison of the potential yield of a healthy crop and the actual yield of a diseased crop, assisting in determining the need for an intervention, frequently in terms of cost. Estimation of crop losses due to the intervention of insects is very crucial in pest management strategies. It is useful in the following manners:

- In the determination of the economic status for an identified pest species.
- In order to determine the pest's economic threshold and damage levels.
- To assess the crop's or a variety's response to pests.
- To calculate the efficiency of the controls.
- Assisting in the allocation of funds for plant protection research and extension.
- Assisting in setting priorities based on the relative relevance of certain pests.

Studies on the biology of the pest provide preliminary data about the harm caused by specific insects. The degree of loss and the amount of damage caused by various insect stages are worked out. For insects that consume leaves, this method is highly practical. However, because it takes time, it is challenging to apply this method over a large field.

The yield of individual plants can be compared by measuring the yield of each plant in the same field, comparing the average yield of healthy plants with the plants displaying various levels of infestation, and estimating the yield loss. The information acquired in this way can also be used to establish the relationship between infection

Notes

level and yield based on the productivity of individual plants. For the assessment of agricultural losses in various crops (Fig. 8.1), this method has been modified in various ways.

Calculating the crop yield per unit area in several fields with various levels of infestation gives a comparison of the yields in various areas. To calculate the yield loss, a correlation between crop yield and infestation level is calculated. This method can be used to estimate crop loss caused by various pests over a broader area, however, the yield may also be impacted by the soil's heterogeneity.

It is possible to manipulate natural enemies in a small area, where the yield is compared to an area without natural enemies and the pest is managed by introducing natural enemies into the field. By removing or harming plant parts, a pest injury is reproduced through the simulation of damage technique. However, the simulated damage might not always be equal to the harm an insect would do.

Crop/Pest	Yield loss (%)	Crop/Pest	Yield loss (%)
TOMATO		**CABBAGE**	
Fruit borer (*Helicoverpa armigera*)	24-65	DBM (*Plutella xylostella*)	17-99
Brinjal		Cabbage caterpillar (*Peiris brasicae*)	69
Fruit and shoot borer (*Leucinodes orbonalis*)	11-93	Cabbage leaf webber (*Crocidolomia binotalis*)	28-51
CHILLIES		Cabbage borer (*Hellula undalis*)	30-58
Thrips (*Scirothrips dorsalis*)	12-90	**CUCURBITS**	
Mites (*Polyphagotarsonemus latus*)	34	Fruitfly (*Bactrocera cucurbitae*)	
OKRA		Bitter gourd	60-80
Fruit borer (*H. armigera*)	22	Cucumber	20-39
Leafhopper (*Amrasca biguttula biguttula*)	54-66	Ivy gourds	63
Whitefly (*Bemisia tabaci*)	54	Muskmelon	76-100
Shoot and fruit borer (*Earias vittella*)	23-54	Snake gourd Sponge gourd	63 50
Average loss: 40%			

Source: Shivalingaswamy *et al., (2002)* Rai, *Integrated Pest Management for Vegetable Crops*

Fig. 8.1: Yield Losses due to Major Insect Pest in Vegetables in India

Notes

INTEXT QUESTIONS 8.2

1. Insects use plant ..... as a food source.
2. Indian agriculture today experiences an annual loss of roughly .....
3. Two types of Pest-related losses are ..... and .....
4. Insect pests that spread plant diseases are termed .....
5. What parts of plants are edible to insects?
6. Caterpillars feed on .....
7. ..... is the term for feeding totally within leaves.
8. Sucking insects inject ..... into plants.
9. How is yield loss calculated?

8.7 MAJOR INSECTS OF IMPORTANT CROPS, FRUITS AND VEGETABLE

Do you know which insects commonly cause damage to crops, fruits or vegetables?

A growing understanding of the harm caused by insects and their role in the spread of disease to animals, plants, and people emphasises the importance of correctly classifying these pests and learning more about their dietary preferences so that they can be managed in time.

Important Insects of Vegetables

Aphid: Soft-bodied, 1-3 mm-long aphids come in green, grey, or black colours. Aphids, which are most frequently observed in spring and autumn, can have wings or be wingless and move slowly in most cases. Aphids gather in groups at the tips of the branches, sucking the plant's sap and weakening it. Additionally, aphids can carry viruses that significantly lower yields and quality (Fig. 8.2).

Fig. 8.2: Aphids

Notes

Caterpillars: Typically, moths or butterflies' larval stages are represented by caterpillars. They typically have long, cylindrical bodies that range in length from 10 to 50 mm and are hairless. Caterpillars can eat roots, flowers, fruits, leaves, stalks, and stems. The leaves of most vegetables will be attacked by looper, cluster, and woolly bear caterpillars (Fig. 8.3). The leaves of the Brassica family, which includes broccoli, cabbage, kale, and cauliflower, can suffer significant harm from the green caterpillars of the huge cabbage white butterfly and the little diamond-back (cabbage) moth.

Fig. 8.3: Caterpillar

Cutworms: Cutworms spend the day hiding in the soil and at night they destroy plants. They cause base-level damage to immature seedling stems, which leads to plant collapse (Fig. 8.4).

Fig. 8.4: Cutworm

Grasshoppers and locusts: Grasshoppers and locusts, which are capable of killing all plants, occasionally come as summer plagues. They are quite difficult to manage since they would not take to baits until all the greenery has been consumed (Fig. 8.5).

Notes

Fig. 8.5: Grasshopper

Thrips: Insects with a torpedo shape, thrips can be yellow, green, grey, or black and measure 1-2 mm long. White streaks appear on the plants as a result of thrips sucking the sap from leaves, fruit, and flowers (Fig. 8.6).

Fig. 8.6: Thrips

Weevils: Some weevil species, including the garden and vegetable weevils, are pests. Asparagus stems and leaves, beets, carrots, parsnips, peas, potatoes, rhubarb, silverbeet and spinach are all may be attacked at night by the 10 mm adults. Carrot, potato, and sweet potato tubers may be penetrated by 12 mm larvae. Plants are more vulnerable when there is a water shortage (Fig. 8.7).

Fig. 8.7: Weevil

Notes

White flies: White flies are little, 1.5-2.0 mm sap-sucking insects that can harm both outdoor and greenhouse-grown vegetables. Damage is more severe in the spring and autumn. When disturbed, the adults, which resemble little moths, take to the air in great numbers. Young stages resemble scale insects more because they lack wings (Fig. 8.8).

Fig. 8.8: Whiteflies

Mites: In contrast to insects, which have six legs, mites have eight legs, and at less than 1mm in size, they are significantly smaller than most insects. As sap-suckers, mites can cause harm to plants that ranges from stippling on the leaves to bronzing of the stems and foliage. The 10 mm adults may target asparagus, bee troot, carrots, parsnips, peas, potatoes, rhubarb, and silverbeet stems and leaves at night (Fig. 8.9).

Fig. 8.9: Mites

Insect of Fruits

Fruits are an integral component of our food. It offers a variety of macro and micronutrients that are vital to our well-being. Do you know how insects damage fruits and make them unhealthy or unconsumable for human beings?

Apple maggot: The most significant insect pest of Minnesota-grown apples. It is active from early July until September. From late July through early August, activity peaks. An adult fly is 1/4 inch long (Fig. 8.10).

Notes

Fig. 8.10: The apple maggot *(Rhagoletis pomonella)*

Mealy Bug: Host Fruits: Pomegranate, Citrus fruits and Mango.

The mealy bug, a group of white insects found on the lower side of older plants, causes the leaves to yellow and dry out. The bodies of adults are round, delicate, tiny, and covered with white mealy wax (Fig. 8.11).

Fig. 8.11: Mealy Bug

Rhizome weevil: The grub kills opening pipes and causes the outer leaves to wither. Grubs eat through the rhizome and kill the plants. Grub has a red head and is a podous and yellowish white. Adult weevils are black in colour. Host Fruits: Banana (Fig. 8.12).

Fig. 8.12: Rhizome weevil

Notes

Stem girdler: Grubs and adults make vine branches droop before the entire thing succumbs. The adult's elytrons are each grey with a white spot in the middle, and it is medium in size. Host Fruits: Grapevine (Fig. 8.13).

Fig. 8.13: Stem girdler

INTEXT QUESTIONS 8.3

1. Aphids are most frequently observed in ..... and .....
2. Larval stage of butterflies is .....
3. Cutworms generally damage ..... stems.
4. Grasshoppers and locusts come as .....
5. ..... suck the sap from leaves, fruit, and flowers.
6. Asparagus stems are attacked by .....
7. Miteshave ..... legs
8. What do you mean by a host plant?
9. The apple maggot is active from early ..... until .....
10. The bodies of ..... are covered with white mealy wax.
11. Match the following

A. Green peach aphid	1. *Gossypium*
B. Cotton aphid	2. *Triticum*
C. Brown planthopper	3. *Solanum tuberosum*
D. Red flour beetle	4. *Oryza*

Notes

8.8 PRINCIPLES OF INSECT MANAGEMENT

We discussed that if pests are controlled and managed in time resulting in an improvement in crop yield. You will agree that pest management should be initiated in time for better results. Have you ever considered the many approaches to pest management and their potential applications?

According to Klass and Schwartz (1985), there are about 600 species of insects, 1,800 species of plants, and several species of fungi and nematodes that are regarded as major pests in agriculture. Therefore, understanding management principles is essential for cultivating plants in the presence of a number of damaging insects in the environment (Fig. 8.14).

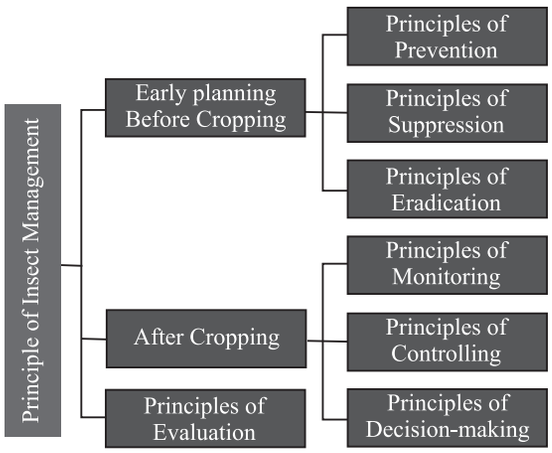


Fig. 8.14: Principles of Insect Management

You should know that to control a pest, following principles should be applied. The pest management includes any one or combination of following.

1. Principles of Prevention

Keeping a pest from becoming a problem is prevention for which various preventive measures are employed. Prevention is basically concerned with preventing harm. It is the process of preventing exposure from damage, avoiding or reducing risk factors, evaluating the risk which cannot be avoided and adapting to technical progress.

2. Principles of Suppression

The purpose of suppression is to minimize the pest population. It is the process of reducing the numbers of pest or managing their damage to an acceptable level by force or using strategies.

Notes

3. Principles of Eradication

It includes destroying the entire population of the pest. For example, the eradication of an entire termite colony from the field before cropping. All the above three principles (4.1-4.3) are employed before cropping, in the early stage of planning for cropping where as the principles 4.4 to 4.7 are used after planting.

4. Principles of Monitoring

This comes after planting when the crops are in the growing stage. It is an act of observing the crop and maintaining a record. It helps in identifying any issue and its potential for damage. Regular and keen monitoring of crops is very essential to identify any risk of harm at the initial stage.

5. Principles of Controlling

Controlling is a listing and adopting of possible control measures in a particular context so that anticipated damage can be minimized. It is a method to keep harmful insects below the threshold level for adequate economic gain.

6. Principles of Decision-making

Decision-making is choosing an action from the different control measures that will give the best results. It is the procedure for selecting options by determining the measures, acquiring data, weighing potential solutions, and making a choice.

7. Principles of Evaluation

The principle of evaluation means determining the value of strategies adopted for insect management or the product of that process. Evaluation is the process related to reviewing and judging for betterment and improvement. It is the reflection of users on their activities related to the goal of minimizing the damage caused by insect pests.

INTEXT QUESTIONS 8.4

1. What is the purpose of suppression?
2. The principle of ..... includes destroying the entire population of the pest.
3. What do you mean by the principle of evaluation?
4. The method to keep harmful insects below the threshold level for adequate economic gain comes under the principle of .....

Notes

8.9 INSECTS CONTROL MEASURES

It's likely that you observed some people standing on farms. Do you know why these are kept on farms? Let us discuss various control measures which can be employed for pest management.

(i) Cultural

You might be aware that cultural control measures include traditional methods of pest management. Cultural control refers to the control of insect populations by using agricultural methods. It is the process of making environments unfavorable for the growth of pests. It includes certain changes in the normal cropping practices for better production. For thousands of years, cultural techniques were the main tools used to control pests in agriculture. In earlier times, crop variety selection, crop rotation, adjusting planting dates, and other cultural practices were used to control insect pests and diseases (Fig. 8.15).

(a) Crop rotation: The same crops being grown in the same location year after year can promote the development of pests and diseases. Pest management may be aided by certain crop rotation techniques. Crop rotation is the annual switching of the crops produced in a field, interrupting the life cycle of insects by putting them in a non-host environment. Rotations can successfully kill insects that have a long-life cycle, and a small range of potential hosts and are generally stationary at particular developmental stages. Such pests are cut off from their food source by a rotation system that switches up the crops. Examples include maize rootworms, white grubs, and wireworms. A typical four-year rotation would have a cycle of cereal and root crops, along with a cycle of beans and maize may interrupt by a fallow period where no crops are grown.

(b) Location or situation: It includes strategies of a careful selection of different crops that will be planted next to one another to lessen pest damage. For instance, planting onions on either side of a row of carrots can help keep carrot flies away.

(c) Timing: To keep the infesting stage of a pest apart from the susceptible stage of the host, changes in planting or harvesting times are used. Changing the schedule of planting or harvesting to avoid damaging insect infestations. Hessian fly damage, for instance, may be avoided by postponing the planting of autumn wheat seedlings**.**

(d) Soil tillage: Many pests spend a portion of their lives in the soil as larvae or pupae. When the soil is dry, ploughing or digging might expose the pest, which

will then dry out and perish in the sun or be removed by hand, birds, or other predators. Additionally, ploughing has the ability to drive pests deep into the earth, where they will be unable to survive.

(e) Culture of cleanliness: The most popular defenses against vegetable and field crop insects are crop residue removal, plant disposal, and chaff stack removal. Also eliminating or destroying diseased plants and those that support insect growth.

(f) Trap Crop: To serve as a "trap," small plantings of a susceptible or favoured crop are made available near the main crop. The insect pests are typically trapped by this method and are destroyed.

(g) Water management: Suffocating insects with water is a direct pest control method. Indirect pest control involves altering the plant's general health.

(h) Use of plant species that are resistant: Crops can develop resistance to insects for a variety of reasons, including non-preference, antibiosis, and tolerance. Insect choice for a particular host plant is influenced by factors like color, light reflection, surface structure, and chemical causes like taste and odor. Using resistant cultivars has advantages such as a cumulative and enduring effect that frequently eliminates insect damage within a few seasons.

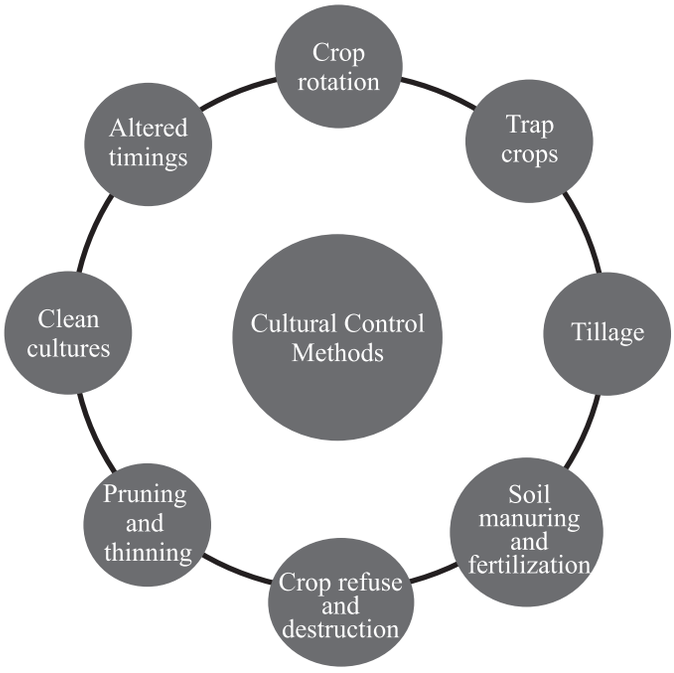


Fig. 8.15: Cultural Control Methods

Notes

Fig. 8.16: Trapcrops

Source: https://gms.ctahr.hawaii.edu/gs/handler/getmedia.ashx?moid=67204&dt=3&g=12

Fig. 8.17: Pruning

Source: https://starpestcontroluae.com/blog/prevention-and-cultural-methods-for-pest-management/

(ii) Mechanical

You might have observed various types of traps being used in farms. Also, you have noticed insect-capturing equipment kept in shops or malls. By remembering those, try to differentiate their types. The management and control of pests by the use of physical barriers like fences, barriers, or electrical wires is known as mechanical pest control. One aspect of mechanical control approaches is the whole or partial

Notes

mechanical removal of plants. Examples include harvesting, shredding, mowing, rototilling, rotovating, and chaining.

Mechanical control is the process of reducing insect populations using tools that directly impact them or significantly change their physical surroundings. In contrast to standard farming practices, mechanical controls involve unique physical actions. Insect management techniques that are common include hand-picking, shingling, and trapping. Other mechanical solutions include screens, barriers, sticky bands, and shade apparatuses, while drags and hopper-dozers are specialized tools for capturing or crushing pests. Large, colored boards covered with glue or oil serve as fly traps. The board's bright coloring draws the flies, they land on it and perish after becoming enmeshed in glue or oil.

A common example is using light-trapping (Fig. 8.18) equipment to destroy insects. The flying insects that are attracted to light traps that are set up at night include brown rice plant hoppers, rice black bugs, rice stem borers, mosquitoes, armyworms, cutworms, chafer beetles, green rice leaf hoppers, rice gall midges, moths, and tomato hornworms.

Fig. 8.18: Light-Trapping Equipment

Source: https://entomology.unl.edu/fldcrops/lightrap

Notes

(iii) Biological techniques and Bio-Agents

You must have heard that biological control is better than chemical control. Have you ever thought about why it is so? What are the agents that are involved and how are they involved in controlling the pest?

Biological control is a technique that employs other living things to manage pests. Pests that harm crops are controlled by predators, biopesticides, bio-repellents, and biofertilizers. It can be described as the impact of viruses, parasites, or predators on a population of hosts or prey, resulting in a lowering population level. Biological control, as opposed to natural enemies and control, generally refers to human operations (Fig. 8.19).

The use of biological control in crop pest management has a long history. In China and Yemen, predatory ant colonies were utilized to manage pest caterpillar and beetle populations. Permanence, safety, and economy are three of the many advantages of biological control.

The three basic categories of conventional biological control are:

- Exotic parasite, predator, and pathogen species introduction;
- Preservation of predators and parasites, and
- Enhancement of predators and parasites

Another method used in the biological management of insects is the use of insect pathogens, such as fungi, bacteria, and viruses. It should be underlined that natural enemies ought to be able to contribute to the majority of agricultural ecosystems.

Many pest situations are not appropriate for biological controls. It takes some time for the parasites and/or predators to proliferate in large enough numbers to control the pest. Other technical challenges include choosing which parasites or predators to use, deciding whether to use more than one parasite species at once, figuring out how to get rid of secondary parasites that prey on the beneficial form, and deciding whether a continuous liberation programme might be feasible.

Some of the biological control methods are (Fig. 8.19):

- **Beneficial agents:** These are organisms that are employed to reduce crop pests and weeds, such as pest predators, parasites, and invertebrates that feed on weeds.
- **Biochemical agents:** Substances in this group include hormones, plant regulators, semio-chemicals, and enzymes.

Notes

- **Semio-chemicals:** These include pheromones, allomones, kairomones, and other compounds produced either naturally or artificially that alter insect behaviour and obstruct reproduction resulting in the management of pests.
- **Provision of natural enemies' habitat:** This is the process of growing crops and/or creating wild vegetative habitats to supply food, nectar, non-pest arthropods, and shelter for crop pests' natural predators.
- **Increasing resistance of host plant:** Genetic resistance of the host plant can be increased through plant breeding or genetic engineering which helps in making the plants stronger and reducing damage from insects.
- **Process of sterile male:** To prevent reproduction in the pest population, the male of the pest species is created with inactive or no sperm.
- **Microbial agents:** Microorganisms like bacteria, viruses and fungi or their byproducts can be used to manage pests.

Bacillus thuringiensis (Bt) is a bacterium that is used to manage a wide range of insect, caterpillar, and larval pests in agriculture; the kurstaki and aizawai strains of Bt are the most often employed types. In order to provide them host-plant resistance to specific insect pests, several new varieties of maize also incorporate genes derived from natural sources and genes made by the soil bacterium Bt.

Bioagent	Dose	Target pest
Trichogramma brassiliensis	2,50,000 parasitized eggs/ha (Inundative release) 50,000 parasitized eggs/ha (Weekly inoculative release)	Okra shoot and fruit borer Tomato fruit borer
Chrysoperla zastrowi arabica	50,000 first instar larvae/ha (weekly release)	Okra aphid Cabbage aphid
HNPV	250 LE/ha (10 days interval)	Tomato fruit borer
SNPV	250 LE/ha (10 days interval)	*Spodoptera litura*
Bacillus thuringiensis	500 g ai/ha (10 days interval)	Diamondback mothShoöt and fruit borer of brinjal and okra, Tomato fruit borer
Kairomones	**Effect**	**Natural enemies**
Tricosane	Preconditioning and reinforcing agent	Chrysopid (Increased predation)
Alpha-Tryptophan	Ovipositional attractant Singh (2001)	Chrysopid, Trichogramma, Coccinellid (Increased oviposition)

Source: Rai, Integrated Pest Management for Vegetable Crops; https://agricoop.nic.in

Fig. 8.19: Bio Control Agents used in Vegetables Crops

Notes

(iv) Cow-Urine dung-based inputs

Do you know which natural pesticide is available in nature abundantly but is less explored by researchers for its efficiency in pest management? Yes, you can use cow urine and dung as pesticides it has many benefits. In our traditional knowledge, it has been mentioned nicely.

Cow urine is a unique product having several applications. It has numerous advantageous qualities, especially in agriculture. One of the most important aspects is that it is readily available and environmentally beneficial. Cow urine has countless medicinal benefits that can treat a variety of severe plant diseases. It is very useful as a biopesticide. It is a rich source of disinfectant and prophylactic properties. Cow urine, therefore, could be an effective tool to address pest and disease control. Cow urine has antibacterial, antifungal, and antiviral properties.

Its uses are proven to enhance the resistance of plants against a wide range of plant pathogens like mycoplasma, viruses, bacteria, fungi, nematodes and insects causing diseases and damage to cultivated plants.

It can be sprayed on crop as a foliar spray using its 10% solution. It is an aid in the management of plant diseases. Because cow urine contains anti-microbial qualities, it is diluted with water and applied to the soil to prevent some soil-borne infections. Insect attacks can be avoided by using it as an organic insecticide. (For10% solution, 100 ml cow urine is diluted with 1 lit of water).

Due to the high concentration of urea, which is poisonous to the majority of pests and insects, it act as a biopesticide. Additionally, because of its strong pungent odour, most pests and insects which are attracted due to fragrance and nectar get repelled, protecting the plants from damage. Its abilities as a pesticide have been used to protect plants. Usually, it is combined with cow dung, plant parts or products. Cow urine is considered a possible biopesticide as its bio constituents have a negative impact on the growth and survival of insects.

Several different types of microorganisms with unique characteristics can be found in cow dung. Utilising cow dung microorganisms can make a substantial contribution to sustainable agriculture. One of the world's abundant bioresources that are still not being completely used is cow dung. The bioremediation of environmental pollutants can be facilitated by an understanding of the processes by which cow dung bacteria break down hydrocarbons. Pathogenic microorganisms that are vulnerable can be killed or have their growth inhibited by microbial products or their derivatives.

Microorganisms in cow dung are antagonistic to one another, and cow dung as a whole has antibacterial properties. Cow dung has antibacterial and preventative,

Notes

or prophylactic, qualities. The bacteria that cause sickness and putrefaction is eliminated by it.

The usage of the five cow-derived products collectively known as panchgavya–milk, ghee, curd, dung, and urine–in the preparation of various herbal medicines lends credence to their therapeutic powers. Ayurveda also mentions the immune stimulatory, immune modulatory, and anti-inflammatory properties of panchagavya.

Cow dung contains *Eupenicillium bovifimosum*, which produces the chemicals CK2108A and CK2801B, which have strong antifungal properties. A heat-stable, mainly hydrophobic antimicrobial compound with a substantial antibacterial action against pathogenic Gram-negative bacteria was discovered to be produced by one isolated strain of Enterococcus faecal is V24.

Integrated control is the management of insect populations by the use of all appropriate strategies in a manner that is compatible and keeps damage to a minimum (Fig. 8.20). It is an ecological strategy that minimises negative consequences while also preventing economic harm.

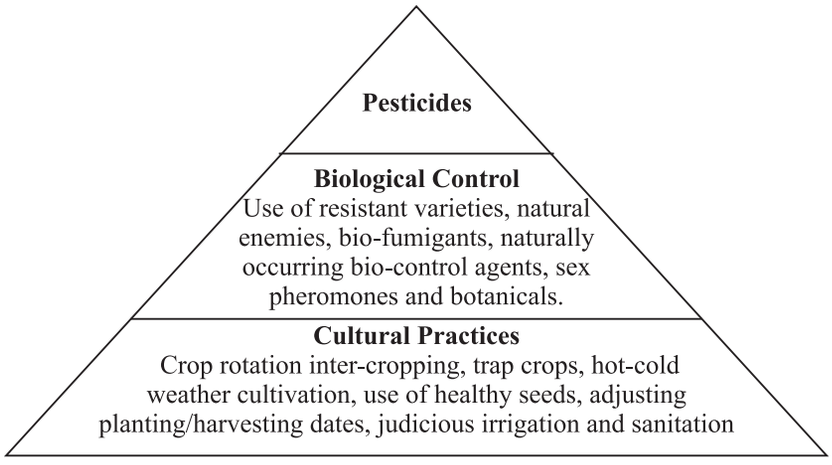


Fig. 8.20. IPM Technology for Pest Management in Vegetables

Source: Rai, A.B., Integrated Pest Management for Vegetable Crops; *https://agricoop.nic.in*

INTEXT QUESTIONS 8.5

1. Traditional methods of pest management are called ..... method.
2. The process of making environments unfavorable for the growth of pests is ..... method.

Notes

3. Annual switching of the crops is produced in a field is called .....
4. Suffocating insects with ..... is a direct pest control method.
5. Hand-picking is a type of ..... technique for insect management.
6. Some female insects create ..... that attracts males.
7. The technique that employs other living things to manage pests is called .....
8. What is use of 10% solution of cow urine?
9. What is panchgavya?
10. Due to the high concentration of ..... cow urine is poisonous to the majority of pests and insects.
11. Match the following:

A.	Semio-chemicals	1.	Plant regulators
B.	Biochemical	2.	Cow urine
C.	Beneficial agents	3.	Viruses
D.	Microbial agents	4.	Kairomones
E.	Biopesticide	5.	Parasites

WHAT YOU HAVE LEARNT:

Let us recapitulate and enlist the salient points that you have learnt through this lesson:

- Insects are the most diverse animals and are the most abundant and unusual. They play a crucial role in our environment and in maintaining the ecosystem, they are extremely important to both nature and humanity.
- A pest is any living thing that is unwelcome to have around due to some unpleasant characteristic; they are destructive, uncomfortable, or detrimental in some manner.
- Many insects have a negative impact on both people and the environment. They can cause long-term harm to crops, domesticated animals, and people if they are not controlled.

Notes

- Insect pests reduce food and cash crop yields by 15% to 20% on average. Indian agriculture today experiences an annual loss of roughly 36 billion US dollars, which has a significant negative impact on the country's economy.
- Insects can damage plants in many ways. They can attack directly and cut the plants' roots, stems, and leaves, consume various plant tissues or cell sap or make holes in the plant's stem and fruits and affect the crop's health resulting in lower production.
- Plants' flowers, leaves, stalks, and roots are all edible to insects. Sucking insects harm plants by removing cell contents like thrips or sap like aphids, leafhoppers, scales, etc.
- To calculate the yield loss, a correlation between crop yield and infestation level is calculated.
- Every insect pest has a host plant/s. Some important insect pests of vegetables are Aphids, Caterpillars, Cutworms, Grasshoppers and locusts, Thrips, Weevils, Whiteflies, Mites etc.
- Some insect pests of fruits are apple maggots, mealy bugs, rhizome weevils, stem girdlers etc.
- There are a few principles of pest management, such as principles of prevention, suppression, eradication, monitoring, controlling, decision-making and evaluation which can be used in combination also.
- Various control measures can be employed for pest management viz. cultural, mechanical, biological techniques and bioagents.
- The usage of the five cow-derived products collectively known as panchgavya – milk, ghee, curd, dung, and urine.
- Cow urine and dung could be an effective tool to address pest and disease control. They have countless medicinal benefits that can treat a variety of severe plant diseases.
- Cow urine is a rich source of disinfectant and prophylactic properties. It has antibacterial, antifungal, and antiviral properties. It is very useful as a biopesticide.
- Microorganisms in cow dung are antagonistic to one another, and it has antibacterial and preventative, or prophylactic, qualities.
- Integrated control is the management of insect populations by the use of all appropriate strategies in a manner that is compatible and keeps damage to a minimum.

Notes

TERMINAL EXERCISES

1. How insects are harmful to the plants? Explain with examples.
2. What do you understand by pests? Discuss with examples.
3. How losses due to insects can be calculated?
4. Describe the important insects of crops, fruits & vegetables.
5. Describe the various principles of insect management.
6. Explain the different cultural, mechanical and biological insect control measures.
7. Describe how cow urine dung is helpful for insect management.

ANSWERS TO INTEXT QUESTIONS:

8.1

1. Insects are called pests because they damage crop yields and cause economic harm.
2. three
3. Abdomen
4. head, thorax, and abdomen
5. Ant or Beetle
6. pollinators
7. silkworms
8. *Bombyx mori*
9. Beetles

8.2

1. Sap
2. 36 billion
3. potential and actual losses.
4. Vectors
5. Plants' flowers, leaves, stalks, and roots are all edible to insects.
6. Leaves
7. Mining
8. Saliva
9. To calculate the yield loss, a correlation between crop yield and infestation level is calculated.

Notes

8.3

1. spring autumn
2. Caterpillars
3. seedling
4. plagues.
5. Thrips
6. Weevils
7. eight
8. Host plant means the plant on which the insect pest preys
9. July September
10. *Mealy Bug*
11. Match the following

A.	*Green peach aphid*	1.	*Solanum tuberosum*
B.	*Cotton aphid*	2.	*Gossypium*
C.	*Brown planthopper*	3.	*Oryza*
D.	*Red flour beetle*	4.	*Triticum*

8.4

1. The purpose of suppression is to minimize the pest population
2. Eradication
3. The principle of evaluation means determining the value of strategies adopted for insect management.
4. Controlling

8.5

1. Cultural
2. Cultural/Agricultural
3. Crop rotation
4. Water
5. Mechanical
6. Pheromone
7. Biological control
8. For 10% solution, 100 ml cow urine is diluted with 1 lit of water
9. The five cow-derived products collectively known as panchgavya—milk, ghee, curd, dung, and urine.
10. Urea

Notes

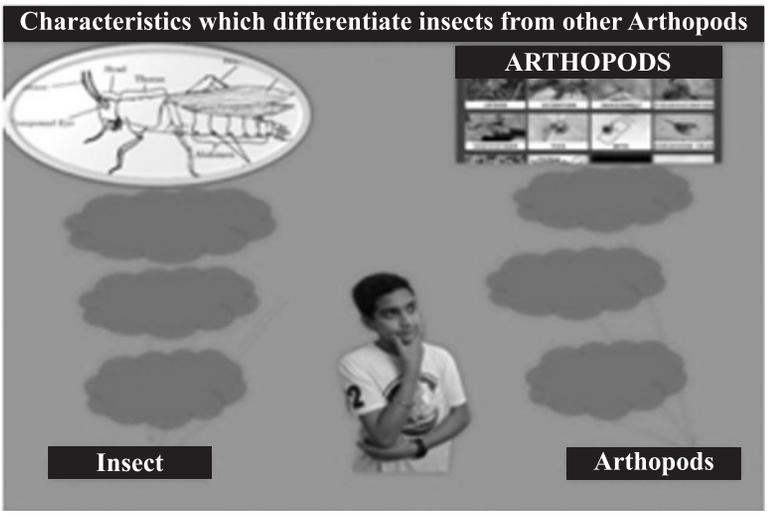
11. Match the following:

A.	Semio-chemicals	1.	Kairomones
B.	Biochemical	2.	Plant growth regulators
C.	Beneficial agents	3.	Parasites
D.	Microbial agents	4.	Viruses
E.	Biopesticide	5.	Cow urine

SUGGESTED ACTIVITY

Activity 1: List the characteristics of pests.

Activity 2: Meaning of Pests & Insects



I. Insects are arthropods, why?

II. Enlist the characteristics which differentiate insects from other arthropods.

By performing these activities, you will able to identify insects as a member of Arthropods and how insects are different from other arthropods.

Do you know which insects are beneficial and harmful? Let us discuss them.

Activity 3: List the harmful and beneficial insects associated with crop.

Enlist the insects associated with crops and classify them on the basis of their nature as harmful and beneficial.

Notes

S. No.	Insects associated with crops	Harmful	Beneficial

This activity will help you to distinguish between harmful and beneficial insects.

Activity 4: Pests & Insects Damage

I. List the ways insects can damage plants/crops.

By doing this activity, you will be able to describe how insects damage any plant

Activity 5: Estimation of losses due to insects**.**

I. In a plot area of 10 square meters, 100 plants have been plotted out of which, 18 plants are 50% damaged by insects and 8 plants are more than 75% damaged. The remaining plants are healthier. Calculate the individual plant Yield, compare the average yield of healthy plants and estimate the yield loss of the area.


100 plants
18 plants – 50% damaged
8 plants – 75% damaged
10 sqm

This activity will develop in you the skills to estimate crop loss which is necessary for planning control measures.

Notes

Activity 6: Describe the important insects of vegetables**.**

I. Collect the insect pests of some vegetables and describe their characteristics.

By doing this, you will be able to identify the insects which damage vegetables.

Activity 7: Describe the important insects of crops**.**

I. Prepare a chart of insect pests (with scientific names and season-wise) that attack crops.

S. No.	Insect	Scientific Name	Host Plant/s	Season

This activity will help you identify important insects and their seasonal activities which damage crops.

Activity 8: Describe the important insects of fruits.

- Identification of various insect pests that damage fruits.
- Prepare a report on the life cycle of insect pests.

By doing these activities, you will be able to identify the insects which damage fruits and also you will be able to describe the life cycle of those insects.

Activity 9: Describe the important insects of crops**.**

- List the principles you find most appropriate in ascending order based on your opinion. Explain which principle you will follow for your garden and why**.**

This activity will develop in you the skill of identifying crop loss and planning for control measures.

Activity 10: Explain the different cultural insect control measures.

- Prepare a list indicating which cultural control measure is most appropriate for specific crops.

Notes

Activity 11: Explain the different mechanical insect control measures**.**

- Search in the fields where mechanical control measures have been adopted, take photos and prepare a collage

Activity 12: Explain the different biological insect control measures**.**

- Collect the photos of biological control agents and describe their characteristics.

The activities from 5.1 to 5.3 will assist you in developing the skill of identifying and applying different control measures.

Activity 13: Demonstrate the production of cow urine-based input for insect control.

- Prepare a 10% solution of cow urine. Use this solution for two months in an area of your garden, observe the difference in the growth of plants in the area where it has been applied and not applied and report.
- Search a panchagavya product and describe its properties. Also, discuss how it has been described in Ayurveda.

These activities will assist you in realising the importance of cow urine-based products for insect control. These will develop the skill of demonstrating cow urine-based products. You will be able to evaluate the effect of using cow urine-based products on crop yields.

Key Learning Outcomes

Learner will be able to:

- Identify the different insects affecting the crop.
- Demonstrate the use of bioagents.
- Demonstrate the production of cow urine-based input for insect control.

Notes

9

HARVESTING, POST HARVEST MANAGEMENT AND VALUE ADDITION

In the previous lesson, we have learnt about the insects and pest management. In this lesson, we will learn about harvesting, post-harvest management and value addition of organic products. In organic farming, the emphasis on adhering to organic standards and avoiding synthetic chemicals or non-organic inputs is crucial throughout the harvesting, post-harvest management, and value addition processes. Organic certification bodies provide guidelines and regulations that organic farmers must follow to maintain the organic integrity and certification status of their produce. By focusing on proper harvesting techniques, effective post-harvest management, and value addition, farmers can maximize the value of their produce, reduce losses, meet consumer demands, and contribute to the overall sustainability and profitability of the agricultural sector.

OBJECTIVES

After reading this lesson, you will be able to:

- understand the importance of proper timing for harvest in organic farming and identify signs of maturity in different crops;
- identify the various steps in the processing and handling of organic produce;
- explain the suitable storage techniques and precautions during the storage and transportation of different organic crops;
- understand the eco-friendly packaging materials and design principles for organic products, as well as proper labelling requirements; and
- list the various techniques to add value to organic produce.

Notes

9.1 PROPER TIME OF HARVESTING

Do you ever wonder how the food we buy at the store is so clean and neat? Well, farmers use different methods to harvest the crops when they are ready. Gathering whole plants or valuable portions from the field as they reach maturity is referred to as "harvesting." In the past, people used a tool called a sickle to cut the plants. Nowadays, farmers use machines called harvesters, which can cut the crops. When a harvester is combined with other machines that remove the grains from the plants and clean them, it's called a combine harvester.

9.1.1 Timing of Harvest

Proper timing for harvest in organic farming is crucial to ensure optimal quality, flavour, and nutritional value of crops. Each crop has an ideal time to be harvested, depending on factors like the type of crop, cultivar, the weather, and the market demand. By harvesting at the right time, post harvest storage problems can be reduced and yield losses can be avoided. Crops that are harvested too early may not be fully developed, resulting in reduced yield and quality. On the other hand, delaying the harvest can lead to over-ripening, loss of nutrients, and vulnerability to pests. Farmers need to monitor their crops closely and use their knowledge to determine the best time for harvesting. Crop maturity and harvesting depends on several factors, such as the season, the crop variety, the maturity period, and the climate, therefore maturity symptoms are useful indicators for time of the harvest (Table 1). It is also important to be careful during the harvesting process to avoid damage of the crops.

Table 9.1: Criteria for Harvesting of Crops

Crop	Criteria for harvesting
Rice	32 days after flowering
	Green grains not more than 4 to 9 percent
	Percentage of milky grains less than one percent
	Moisture content of grains less than 20 per cent
Sorghum	40 days after flowering
	Grain moisture content less than 28 per cent
Pearl millet	28 to 35 days after flowering
Maize	Less than 22 to 25 per cent moisture in grain
	Husk colour turns pale brown
	25 to 30 days after tasselling

Notes

Wheat	About 15 per cent moisture in grain
	Grains in hard dough stage
Sugarcane	The ratio of brix between top and bottom part of cane nearly one
	Brix 18 to 20 per cent
Redgram	35-40 days after flowering
	80-85 per cent of pods turn brown
Blackgram and Greengram	Pods turn brown or black
Cotton	Bolls fully opened

Source: Reddy T.Y and Reddy G.H.S. 2014. Principles of Agronomy (eds. 4th). Kalyani Publishers. Pp. 450.

When it comes to harvesting organic produce, there are a few extra things to keep in mind. Regular care must be taken to harvest each crop at its best maturity stage while keeping in mind its intended market. It is a good practice to harvest early in the day and keep the harvested produce in the shade as much as possible. Also, it is important to remove field heat from the produce quickly. Remember, organic crops may have different characteristics compared to conventionally grown ones, so it is important to consider their specific needs and handle them accordingly to maintain their quality. To maintain the quality of organic produce, here are some general practices to follow:

1. Harvest during the coolest time of the day.
2. Use clean harvesting tools and avoid contact with non-organic substances.
3. Cool the harvested produce quickly to slow down the natural aging process. This can help to extend its shelf life.
4. Treat the produce gently during harvesting to avoid bruising, crushing or damage, as organic crops may be more delicate.
5. To keep the harvested produce cool, provide shade for it in the field. Harvest containers can be protected from the sun's heat, water loss, and early senescence by covering them with reflective pads.
6. If possible, place the harvested product as quickly as possible into a cold storage facility.
7. Never mix high-quality products with products that are broken, decayed, or likely to deteriorate in a bulk or packed unit.

Notes

8. When harvesting underground crops like potatoes, onions, radishes, carrots, and beetroot, it is important to take care and avoid damaging the produce with digging tools.

9. Make sure to use clean and, if needed, sanitized packing or transport containers.

9.2 METHODS OF HARVESTING

1. **Manual harvesting or hand harvesting:** Hand harvesting is a technique where people pick the economic part of crops by hand. Hand harvesting is a common method in organic farming, especially for fruits, vegetables, and delicate crops. It is important to handle the plants carefully to avoid damage and maintain quality.

2. **Harvesting with hand tools:** Crops are harvested by farmers using a few tools like knife, gandasa, small sickle, etc.

3. **Machine harvesting:** It involves using modern harvesters to gather large amounts of grains. These machines can cut the crops, separate the grain from the straw, clean the grain, and transport it in storage tanks.

9.3 THRESHING

Threshing is the process of separating the grain from the chaff or fruits/seeds after the crops are harvested. Threshing can be done by hand or by using machines. Before threshing, it is important to make sure that the crop is properly dried to reduce moisture. This helps prevent molds growth and makes threshing more efficient.

In organic farming, traditional techniques are frequently applied for small-scale crop threshing. To separate the grains or seeds, the harvested crop is beaten against a hard surface, such as a wooden post or threshing floor. For larger-scale organic farming, mechanical threshing equipment such as threshers or power thresher (Fig. 9.1) can be used. It is important to choose equipment that is suitable for organic farming and minimizes damage to the crop. It is necessary to clean the threshing area and equipment like tractors, labour, or animals involved in the threshing process and remove any non-organic crop parts or varieties. This ensures that the organic produce remains free from contamination.

Before threshing, it is important to ensure that seeds and plant materials are properly dry. You can check their moisture content by squeezing a handful of them. If the seeds and plant materials do not give or feel firm in your hand, they are dry.

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However, if they can be squeezed or feel moist, it means they are not yet dry. To make the threshing process easier, you can strip the seeds from the plant by hand before threshing. This helps to minimize the amount of material that needs to be dried. By doing so, you can save time and effort in the drying and threshing process.

Fig. 9.1: Power Thresher

Source: https://www.dawn.com/news/1554093

9.4 WINNOWING

Once the threshing is complete, the next step is winnowing, separate the grains or seeds from the chaff and other plant debris. Winnowing is a process where the threshed material is thrown into the air. As it is tossed, the wind blows away the lighter chaff, while the heavier grains or seeds fall back into a container for collection. The wind carries away the lighter husks, while the heavier grains fall down. This helps to separate the desired grains or seeds from the unwanted plant debris by utilizing the natural movement of the wind (Fig: 9.2).

Fig. 9.2: Winnowing

Notes

INTEXT QUESTIONS 9.1

Tick the right option/s

1. Why proper timing for harvest is crucial in organic farming?

   (a) To increase yield losses

   (b) To maximize post-harvest storage problems

   (c) To maintain quality, flavor, and nutritional value of crops

   (d) To reduce eco-friendly packaging materials

2. What is the purpose of cooling the harvested produce quickly in organic farming?

   (a) To slow down the natural aging process and extend shelf life

   (b) To increase the natural aging process and reduce shelf life

   (c) To maintain field heat and speed up spoilage

   (d) To reduce the nutritional value of the produce

True or false

1. Threshing is the process of separating the grain from the chaff or fruits/seeds after the crops are harvested.
2. Mechanical threshing equipment is not suitable for organic farming as it may damage the crop.
3. Combine harvester cut, thresh, and clean the grains in single operation.
4. For harvesting of wheat crop moisture content in grains should be more than 15%.

9.5 PROCESSING AND POST-HARVEST HANDLING

The way we handle crops after harvesting is crucial for preserving their quality, freshness, and nutritional value. How we process the food strongly impacts its overall quality, including its nutritional content and safety. Organic food is expected to have high nutritional and natural quality. To maintain these qualities, organic food under goes minimal processing to preserve its natural properties and nutritional value that originated from farming practices. Organic food processors

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adhere to strict regulations on permitted materials and take extra precautions to prevent contamination from non-organic substances. When handling and processing organic products, it is important to prioritize maintaining product quality and integrity while minimizing the risk of pests and diseases.

Processing methods in organic food should primarily rely on mechanized, physical, and biological processes. It is crucial to ensure that the essential quality of organic ingredients is preserved at every stage of processing. The selection of processing methods should aim to minimize the use of additives and processing aids. Recommended processing techniques include mechanical and physical processes, biological methods, smoking, extraction, precipitation, and filtration. These approaches help maintain the integrity and natural properties of organic ingredients while minimizing the need for additional substances during processing. To ensure the processing of organic produce align with organic standards, the following principles should also be followed (Fig. 9.3):

1. **Separate processing:** Processing and handling of organic products should be conducted separately, either in different times or locations, from the processing and handling of non-organic products. This helps to prevent cross-contamination and ensures the organic integrity of the products.

2. **Equipment cleaning:** All processing equipment and machinery must be thoroughly cleaned and free from contamination before being used for organic processing. This ensures that the organic produce remains free from non-organic substances.

3. **Contamination-free equipment:** Processing equipment and filtration aids should be free from contamination and should not introduce any substances that could compromise the organic integrity of the products.

4. **Pest and disease control:** Processing and handling practices should be optimized to minimize the development of pests and diseases. This can include implementing proper sanitation measures, maintaining hygienic conditions, and employing organic pest control methods to safeguard the organic products.

5. **Minimal processing:** Organic foods are minimally processed, free from artificial ingredients, flavours, colours, and synthetic preservatives, to preserve their integrity. However, the use of ethylene gas for ripening is permitted within organic standards.

6. **Non-GMOs policy:** The use of genetically modified organisms (GMOs) is prohibited in the production and processing of certified organic products.

Notes

This ensures that organic foods remain free from genetically engineered modifications.

7. **No irradiation:** Irradiation, a process that uses ionizing radiation to treat food, is not allowed in organic production and processing. This restriction helps maintain the natural state and properties of organic products.

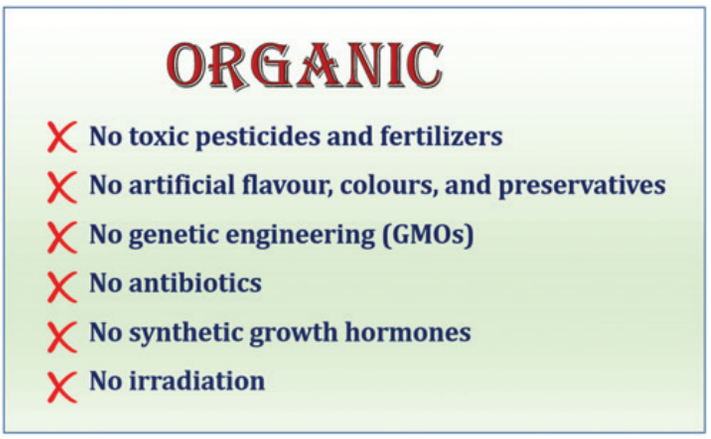

Fig. 9.3: Banned substances in the processing of organic produce.

8. **Authorized organic processes:** Organic processing involves employing simple processes such as cooking, baking, curing, heating, drying, mixing, grinding, churning, separating, extracting, cutting, fermenting, distilling, preserving, dehydrating, freezing, chilling, or other similar manufacturing methods for food products. These processes are permitted within organic standards.

9. **Pollution prevention:** It is important to identify pollution sources during processing and take necessary measures to avoid contamination. This includes implementing appropriate waste management practices, ensuring proper sanitation and hygiene, and preventing the introduction of pollutants that could compromise the organic nature of the products.

By following these practices, organic processors can ensure that the processing methods used align with organic standards and maintain the organic quality, authenticity, and purity of the final products.

9.5.1 Steps of Processing and Post-harvest Handling

The post-harvest handling process consists of several steps to maintain the quality of perishable fresh produce.

Notes

1. **Pre-cooling:** The first step is cooling, which is crucial in preserving the desirable quality of the produce. Pre-cooling, specifically, plays a vital role in removing field heat from freshly harvested crops. By rapidly lowering the temperature of the produce, pre-cooling slows down metabolism and reduces deterioration, ensuring that the produce remains fresh and in a saleable condition. This step is performed immediately after harvest to minimize spoilage and preserve the quality of the produce during transportation and storage.

   Methods for pre-cooling

   There are seven primary methods of pre-cooling fresh produce:

   (i) **Room cooling**: This method involves placing the produce in containers, such as boxes (wooden, fibreboard or plastic) or bulk containers, in a cold room where they are exposed to cold air. Room cooling is relatively slow and is typically used for small amounts of produce or those that do not deteriorate rapidly.

   (ii) **Forced-air cooling**: Forced-air cooling is a modification of room cooling and is designed for products that require rapid removal of field-heat immediately after the harvest. It involves exposing packages of produce to higher air pressure on one side, forcing the cooling air through the individual containers. Specific stacking patterns and baffling are used to ensure effective cooling.

   (iii) **Hydro-cooling**: Hydro-cooling utilizes chilled or cold water to lower the temperature of produce. It can be achieved through flooding, spraying, or immersing the product in chilled water. Hydro-cooling is commonly used for produce that can tolerate water exposure and is often suitable for crops that require washing as part of their market preparation.

   (iv) **Ice cooling**: In ice cooling, crushed or granular ice is used to cool the produce. The ice is either packed around produce in cartons or sacks, or made into a slurry with water and injected into waxed cartons. Ice cooling helps maintain product moisture during the cooling process and can also keep the temperature low during short transportation durations and therefore refrigerated transportation may not be necessary for short transport duration.

   (v) **Vacuum cooling**: Vacuum cooling rapidly cools horticultural produce by evaporating moisture from the product. The pressure is reduced to the point where water boils at a low temperature, encouraging efficient evaporation and cooling.

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(vi) **Cryogenic cooling**: Cryogenic pre-cooling involves using the latent heat of evaporation from liquid nitrogen or solid CO_2 (dry ice) to achieve very low temperature of -196 and -78°C, respectively. The produce is conveyed through a tunnel where the liquid nitrogen or solid CO_2 evaporates, effectively cooling the product.

(vii) **Evaporative cooling**: Evaporative cooling is a cost-effective method that works best in low-humidity environments. Dry air is drawn through moist padding or a fine mist of water, and then passed through vented containers of produce. As the water evaporates, it absorbs heat from the air, thus lowering the temperature of the produce. Effective evaporative cooling requires incoming air with relative humidity below 65 percent.

2. **Washing and Cleaning:** Before fresh fruits and vegetables are brought to the market, it is essential to clean them by removing soil, dust, adhering debris, and insects etc. This process helps improve their visual appeal and hygiene. Washing should be done using fresh water, ensuring that the water itself is clean and uncontaminated.

3. **Sorting and Grading:** Sorting involves removing fruits and vegetables that are unsuitable for market or storage due to factors such as mechanical injuries, insects, diseases, immaturity, over-maturity, or miss hapen appearance. This step helps prevent secondary contamination and reduce losses by separating damaged produce from healthy ones. Sorting can take place either at the farm level or in pack-houses, where sensory quality parameters are considered.

   Grading refers to categorizing vegetables and fruits into different grades based on criteria such as size, shape, colour, volume, firmness, cleanliness, maturity, and freedom from foreign matter, diseases, insect damage, or mechanical injuries. The produce is separated into two or more grades to fetch higher prices in the market. Grading plays a crucial role in ensuring consistent quality, facilitating market transactions, and enhancing consumer satisfaction by providing products that meet their expectations. The objectives of grading include obtaining better prices, differentiating market values, adapting to global market requirements, facilitating packing and transportation, and increasing shelf life.

   Advantages of sorting and grading:

   - Avoidance of selling price losses by eliminating substandard products.
   - Increased marketing efficiency by facilitating buying and selling without personal selection.
   - Setting reasonable prices for graded products.

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- Reduction of packing and transportation costs by avoiding mixing different grades.
- Preservation of the quality and value of diseased and defective specimens, which can be sold at higher prices.
- Fairness for both buyers and sellers through standardized grading.
- Ease of purchase for consumers, as properly graded vegetables and fruits can be chosen without inspection.
- Grading plays a crucial role in ensuring consistent quality, facilitating market transactions, and enhancing consumer satisfaction by providing products that meet their expectations.

4. **Curing:** Curing is an essential step for extending the shelf life of roots and tubers during long-term storage. It is particularly beneficial for hardy vegetables like potatoes, sweet potatoes, yams, and certain tropical vegetables with poorly developed cuticles. These vegetables are susceptible to mechanical damage during harvesting and handling. Curing involves subjecting them to intermediate to high temperatures and high relative humidity, which helps reduce water loss and promotes the development of a protective layer (periderm) over cut, broken, or skinned surfaces. This process aids in wound restoration and minimizes potential spoilage.

5. **Packaging:** The right way to package fresh produce can help reduce waste since it shields the produce from pathological degeneration, unwanted physiological changes, theft, dirt, and mechanical damage while it is being transported, stored, and marketed. Prior to packaging, the commodities should be carefully supervised and sorted to ensure uniform quality. Packaging itself cannot improve the quality of the produce, but it plays a vital role in maintaining its quality throughout the journey. It is important to use ecologically sound materials for packaging organic products and strive for minimal adverse environmental impacts. Whenever possible, organic food should be packaged in reusable, recyclable, and biodegradable materials. Various packaging options are available, including bamboo baskets, gunny bags, cardboard, paper, glass, metal, wooden boxes, plastic crates, and ventilated corrugated fiberboard (CFB) boxes, to ensure safe handling and preservation of the produce.

   When selecting packaging materials for organic produce, following points should be kept in mind:

   - Avoid packaging materials that compromise the organic nature of the contents. This means ensuring that the materials used are in line with organic standards and do not contain prohibited substances.

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- The packaging materials should not affect the sensory qualities (organoleptic character) of the product or introduce any substances that could be harmful to human health.
- Prohibited materials, such as PVC (polyvinyl chloride), should not be used in organic packaging.
- Laminates and aluminium should be avoided, as they may not be environmentally friendly or compatible with organic principles.
- Whenever possible, prioritize packaging systems that promote recycling and reusability. This helps to reduce waste and minimize the environmental impact.
- Choose biodegradable packaging materials that are capable of naturally breaking down over time, reducing their impact on the environment.

By taking these considerations into account, organic producers can ensure that the packaging materials used align with organic standards and contribute to the overall sustainability and integrity of their organic products.

6. **Labelling:** In the case of organic produce, labelling plays a crucial role in conveying clear and accurate information about the organic status of the product. By ensuring accurate and informative labelling, organic producers can provide transparency to consumers and build trust in their organic products. Here are some key factors for labelling organic products:

- The label should clearly indicate that the product is organic, and it should be distinguishable by using different coloured labels or logos specific to organic products.
- The label should include essential details such as the name of the product, the quality of the product, the name and address of the producer, the name of the certification agency, certification status, and lot number.
- Additional information that may be included on the label can vary depending on local regulations and consumer preferences. This can include information about the organic farming practices used, any specific certifications or standards met, and relevant nutritional information.
- The label should be designed in a way that is visually appealing and easy to read, allowing consumers to quickly identify the organic status of the product and understand its key attributes.

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- It is important to comply with labelling requirements specific to the region or country where the product is being sold, including any organic certification logos or marks that may be mandatory.
- When all the requirements of the organic standards are met, the product should be labelled as "produce of organic agriculture" or a similar description.
- Product labels should provide information about the processing procedures involved in the production of the organic product.
- All components of additives and processing aids used in the product should be declared on the label.
- Labelling for mixed products:
  - If a minimum of 95% of the ingredients are of certified organic origin, the product can be labelled as "certified organic" and should carry the certification program's logo.
  - If less than 95% but not less than 70% of the ingredients are of certified organic origin, the product cannot be labelled as "organic." However, statements like "made with organic ingredients" can be used on the principal display, provided the proportion of organic ingredients is clearly stated.
  - If less than 70% of the ingredients are of certified organic origin, the product cannot be called "organic." The indication that an ingredient is organic may appear in the ingredients list.
- Added water and salt should not be included in the percentage calculations of organic ingredients.
- Labels for in-conversion products, which are products transitioning to organic production, should be clearly distinguishable from labels for fully organic products.
- Organic products should not be labelled as "GE" or "GM" (genetic engineering or genetic modification) free. Any reference to genetic engineering on product labels should be limited to the production method.
- Ingredients or products derived from wild production should be declared as such on the label.

Notes

INTEXT QUESTIONS 9.2

Tick the right option/s:

1. Grading of fruits and vegetables is done for
   (a) Better price (b) Increase shelf life
   (b) Facilitate packaging (d) All above
2. Packaging innovations is one of the practices of
   (a) Threshing (b) Pest management
   (c) Value addition (d) Precooling

Fill in the blanks

1. The process of cutting and gathering of economic part of plant is called .....
2. When all the requirements of organic standards are met, the product should be labelled as .....

True or false:

1. GMOs are prohibited in organic farming.
2. Precooling improves quality and shelf life of produce.

9.6 STORAGE AND TRANSPORT

Proper storage and transport are crucial in maintaining the quality and shelf life of organic produce. Here are some important points to consider:

9.6.1 Temperature Control

Temperature plays a vital role in preserving the quality of harvested crops. Organic produce should be stored at appropriate temperature levels to slow down the ripening process and minimize spoilage. It's important to know the ideal storage temperature for each type of product because different crops have different temperature requirements.

9.6.2 Humidity Control

Proper humidity levels should be maintained during storage to prevent excess moisture or drying out of organic produce. This helps in preserving texture, flavour, and overall quality. Some crops require high humidity levels, while others need lower humidity conditions.

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9.6.3 Ventilation

Good airflow and ventilation are important to prevent the build-up of heat, moisture, and ethylene gas, which can accelerate the deterioration of organic produce. Adequate ventilation helps to maintain a fresh and favourable storage environment.

9.6.4 Light Exposure

Light exposure should be minimized during storage, as it can lead to quality deterioration and loss of nutrients in organic produce. Darkness is preferred for most fruits and vegetables to maintain their colour, flavour, and nutritional value.

9.6.5 Hygiene and Pest Control

Before storing organic produce, it is important to thoroughly clean the storage structures, including bins, containers, and warehouses. Remove any debris, old grain, or residues that may harbour insects or pathogens. Cleaning should be done regularly to maintain a hygienic environment. Implement physical barriers such as screens, nets, or mesh to prevent the entry of pests into storage structures. Seal any gaps or openings that pests could use as entry points. Natural plant extracts with insecticidal properties can be used to spray the storage structures, including the floor, walls, and vacant spaces. These extracts can help kill or repel insects and reduce the risk of infestation. However, it is important to use approved organic insecticides and follow proper application guidelines. Explore the use of natural enemies, such as predatory insects or beneficial microorganisms, for pest control. These biological control agents can help manage pests in an organic and environmentally friendly manner. In some cases, fumigation with carbon dioxide gas may be practiced to control insect pests in the warehouse. Carbon dioxide is a natural and non-toxic gas that can help eliminate pests. However, it is important to follow safety guidelines and regulations for fumigation. Overall, integrated pest management (IPM) techniques should be employed to minimize the use of synthetic pesticides and promote sustainable pest management.

9.6.6 Inspection and Monitoring

Regular inspection of stored organic produce is necessary to identify any signs of pest activity or quality deterioration. Monitor for pests such as insects, rodents, or fungi. Promptly remove and discard any infested or damaged produce to prevent the spread of pests.

9.6.7 Documentation and Record-keeping

Maintain records of pest management activities, including monitoring, pest identification, and control measures implemented. This documentation can help track the effectiveness of pest management strategies and assist in future decision-making.

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9.6.8 Preventing Cross-contamination

It is crucial to avoid mixing newly harvested grain with old grain or other contaminated material. Even small amounts of infested grain or residues can lead to the spread of insects and pests. Each batch of organic produce should be stored separately to prevent cross-contamination.

9.6.9 Disinfection of Bags

Bags used for storing organic produce should be disinfected to eliminate any potential insect infestations. Ultraviolet radiation treatment or dipping the bags in boiling water can be effective methods. After disinfection, ensure that the bags are thoroughly dried before use.

9.6.10 Selection of Storage Method

The choice of storage method depends on the specific requirements of the organic produce and the target market. Options include cold storage facilities, controlled atmosphere storage, refrigerated transport, and specialized packaging. It's important to consider the specific needs of each crop and select the most suitable storage method accordingly. Use suitable storage containers, such as clean bins, crates, or packaging materials, to protect organic produce from damage and contamination.

9.6.11 Precooling

Precooling, which is the rapid cooling of harvested produce soon after harvest, is particularly important for fruits and vegetables. It helps to remove field heat and reduce deterioration. Proper precooling methods should be employed to cool the produce quickly and efficiently before storage or transport. There is a range of cooling techniques available.

(i) **Air-cooling:** This method involves supplying cold fresh air to bulk or packaged products. Traditional storage methods, such as pits or caves, utilize the cool and constant temperatures below ground. Another approach is to use night air to lower the temperature of a well-insulated cool store, which is then sealed during the daytime.

(ii) **Forced-air-cooling:** This technique involves building parallel stacks of palletized cartons in a refrigerated cold room. A small fan creates a flow of air through the ventilation slots in each carton, resulting in more rapid and even cooling compared to air-cooling. However, it is not as fast as hydro-cooling or vacuum-cooling.

(iii) **Hydro-cooling:** Hydro-cooling entails immersing produce in cold water to achieve rapid and uniform cooling. However, it requires proper drying of the

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product surface afterward to avoid issues such as disease transmission and weight loss due to dehydration. Hydro-cooling may not be applicable to all types of packaging, particularly cartons.

(iv) **Vacuum-cooling:** Vacuum-cooling is effective for leafy greens. The products are placed in a chilled vacuum chamber, and as air is removed, the water in the produce evaporates and cools the tissue. This process rapidly decreases the temperature. Vacuum-cooling is capital-intensive but yields quick results.

Organic farmers also adhere to following specific storage guidelines to maintain the organic integrity of their produce.

- Organic products must be protected from co-mingling with non-organic products at all times.
- Organic products should not come into contact with materials or substances that are not permitted for use in organic farming and handling.
- Storage and transportation of organic and inorganic products together should be avoided unless they are properly packed, labelled, and physically separated to prevent contamination or co-mingling.
- Synthetic preservatives, chemicals, fumigants, and storage aids are prohibited. However, controlled temperature, cooling, freezing, drying, humidity control through mechanical means, and fumigation with nitrogen or carbon dioxide gas are allowed.
- Ethylene gas can be used for ripening organic produce.
- Prohibited practices such as container fumigation, irradiation/ionization, and the use of vehicles that may cause contamination with pathogenic or toxic substances, such as soil, animals, manures, fertilizers, or chemicals, should be avoided.
- During transport, measures should be taken to ensure that the organic grain remains enclosed and there is no exchange with non-organic crops unless the transport is between two organically registered sites.

It is important to note that organic crops can generally be stored using the same methods as conventional crops. However, there may be slightly higher storage losses in organic crops due to the absence of pesticides and sprout suppressants. Good organic husbandry techniques and storing undamaged, healthy crops can help avoid specific pest and disease problems. Overall, implementing appropriate cooling and storage techniques, regardless of whether the crops are organic or conventional, can help maintain the quality and shelf life of harvested produce.

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9.7. VALUE ADDITION

Value addition in organic farming refers to the process of enhancing the value, marketability, and consumer appeal of organic products through various methods and techniques. It enhances the economic potential of the produce and extends its shelf life. Here are some common value addition practices in organic farming:

9.7.1 Processing

Organic crops can be processed into a wide range of value-added products, such as juices, sauces, jams, pickles, dried fruits, herbal teas, oils, flours, and baked goods. Processing helps to extend the shelf life of organic produce, create convenient and ready-to-use products, and add value through flavour enhancement and product diversity.

9.7.2 Packaging Innovation

Innovative and eco-friendly packaging solutions can be adopted for organic products. Using sustainable packaging materials and designs that are recyclable, biodegradable, or compostable aligns with organic principles and addresses consumer preferences for environmentally conscious products. Eye-catching and informative packaging can also help differentiate organic products in the market.

9.7.3 Branding and Labelling

Developing a strong organic brand and incorporating clear and attractive labelling is essential for value addition. Prominently displaying organic certification logos, highlighting organic attributes, and providing relevant information about the product's origin, production methods, and quality can enhance consumer trust and promote the value of organic products.

9.7.4 Quality Control and Assurance

Implementing strict quality control measures throughout the production and processing stages is crucial for value addition. Adhering to organic standards, maintaining consistent product quality, and conducting regular testing and certification helps to ensure that organic products meet consumer expectations and command higher market value.

9.7.5 Market Diversification

Exploring and targeting niche markets can increase the value of organic products. This can include supplying to specialty stores, organic food markets, farmers' markets, restaurants, hotels, and catering services that cater to health-conscious

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consumers seeking organic options. Direct-to-consumer sales through online platforms and community-supported agriculture (CSA) programs can also provide opportunities for market diversification.

9.7.6 Collaboration and Partnerships

Collaborating with other value chain actors such as processors, food artisans, chefs, and retailers can lead to innovative product development, shared marketing initiatives, and increased market reach. Developing unique organic product lines or collaborating on recipe development and product promotion can add value and differentiate organic offerings in the market.

9.7.7 Education and Awareness

Educating consumers about the benefits of organic farming and the value of organic products is essential for market development and value addition. Engaging in consumer awareness campaigns, participating in organic trade fairs and exhibitions, conducting farm visits, and providing product information and recipes can help build consumer loyalty and create demand for organic products.

By implementing these value addition strategies, organic farmers can enhance the market value and profitability of their products, meet consumer demands for organic and sustainable options, and contribute to the growth and sustainability of organic farming practices.

INTEXT QUESTIONS 9.3

Tick the right option:

1. Which of the following factors is NOT crucial for maintaining the quality of organic produce during storage and transport?

   (a) Temperature control (b) Humidity control

   (c) Sunlight exposure (d) Ventilation

2. What is the purpose of precooling harvested produce?

   (a) To remove field heat

   (b) To increase ethylene gas concentration

   (c) To promote ripening

   (d) To dehydrate the produce

Notes

3. Which of the following is an example of value addition in organic farming?
   (a) Using synthetic preservatives
   (b) Vacuum-cooling harvested produce
   (c) Making pickles
   (d) Fumigating storage containers with pesticides

WHAT YOU HAVE LEARNT

Let us recapitulate and enlist the salient points that you have learnt through this lesson:

- Harvesting of crops should be done at appropriate time which improves quality and shelf life of organic produce. Harvesting tools should be clean properly before use.
- Post-harvest handling practices such as pre-cooling, washing, cleaning, sorting, grading, curing, packaging and transport are very much crucial for preserve the quality, freshness and nutritional value in organic farming.
- Toxic pesticides, fertilizers, artificial flavours, colour, preservatives, genetic engineering and irradiation are strictly prohibited in organic farming.
- Packaging material in organic farming should be eco-friendly in nature and fully biodegradable. Polyvinyl chloride (PVC), laminates and aluminium should be avoided.
- Produce should be store in clean and pest free storage structure. Chemical pesticides should be restricted during storage of produce.
- Value addition is important to get more benefit, which can be done by pre-cooling, packaging innovations, branding, labelling and market diversification.

TERMINAL EXERCISES

1. Why harvesting time is important in organic production system? What precautions you will take during harvesting and threshing in organic farming?
2. Explain basic principles of processing in organic farming.
3. Define grading. What are the different advantages of sorting and grading?
4. Point out the basic steps during storage of organic produce.
5. What is value addition? enlist common value addition practices in organic farming.

ANSWERS TO INTEX QUESTIONS

9.1

Tick the right options

1. (c) 2. (a)

True or false

1. True 2. False 3. True 4. False

9.2

Tick the right options

1. (d) 2. (c)

Fill in the blanks

1. harvesting 2. produce of organic agriculture

True or false

1. True 2. True

9.3

Tick the right options

1. (c) 2. (a) 3. (c)

Key Learning Outcomes

Learner will be able to:

- Understand the harvest for different crops for improving quality, nutritional value and shelf life in organic farming.
- Identify the nutritional and natural quality of organic produce by adopting post-harvest management practices.
- Understand the basic standards of organic farming during harvesting and post-harvest handling.
- Understand the return, marketability, and consumer appeal of organic products through various methods and techniques of value addition.

Notes

10

QUALITY ASSURANCE AND CERTIFICATION

In the previous lesson, we have learnt about harvesting, post-harvest management, and value addition of organic products. In this lesson, we will learn about quality assurance and certification. Quality assurance and certification play a vital role in organic farming to ensure that organic agricultural practices are followed and organic products meet the required standards. Certification in organic farming provides credibility and transparency to consumers, ensuring that organic products meet specific standards and have been produced using environment friendly and sustainable practices. It increases consumer confidence, fosters the expansion of the organic industry, and makes entry to organic markets easier.

OBJECTIVES

After reading this lesson, you will be able to:

- identify the significance of organic certification;
- understand the procedure for obtaining organic certification;
- explain the organic certification system in India; and
- identify the significance of record keeping in organic farming.

10.1 QUALITY ASSURANCE IN ORGANIC FARMING

Assurance of quality in organic farming is crucial to ensure that organic agricultural practices are employed correctly and that organic products meet the necessary standards. Several measures are taken to maintain quality throughout the entire organic farming process, from production to certification. Here are some key components of quality assurance in organic farming:

Notes

- Organic farming follows specific standards and guidelines established by regulatory bodies such as the National Program for Organic Production (NPOP) and the Participatory Guarantee System for India (PGS-India).
- Documentation and record-keeping to maintain detailed records and documentation of their farming practices.
- Organic farming relies on the use of organic inputs, such as organic fertilizers, compost, and natural pest control methods.
- Regular soil and water testing is an essential part of quality assurance in organic farming.
- Implementing practices such as crop rotation, companion planting, habitat diversification, and the use of beneficial insects to maintain a balanced ecosystem and minimize pest pressure.
- Regular monitoring and timely intervention are crucial to prevent and manage pest and disease outbreaks.
- Organic farms undergo regular inspections by authorized certification bodies to verify compliance with organic standards.
- Maintaining traceability throughout the supply chain.
- Organic products are labelled with appropriate certification logos or labels, indicating their organic status. This helps consumers identify and choose genuine organic products, while also facilitating transparency and accountability in the organic market.

By implementing these measures, quality assurance in organic farming ensures that organic agricultural practices are followed diligently and organic products meet the required standards for authenticity and sustainability. It enhances consumer trust in organic products and contributes to the overall growth and development of the organic farming sector in India.

INTEXT QUESTIONS 10.1

True or false:

1. Organic farming encourages the use of synthetic fertilizers and pesticides.
2. Organic certification is only relevant for crops and does not apply to livestock or animal products.

Notes

10.2 QUALITY STANDARDS OF VARIOUS ORGANIC PRODUCTS

India follows the National Standards for Organic Production (NSOP), established by the NPOP. The NPOP has established standards and guidelines that organic farmers in India must adhere to obtain organic certification. These standards specify the guidelines and requirements for organic farming, including the use of organic inputs, soil fertility management, pest and disease control, livestock management, and fibre & textile processing, and labelling. This helps to maintain the integrity of organic products and provides assurance to the consumers about the authenticity of organic claims.

For Crop production: Under the NSOP, organic farmers in India are required to develop an organic crop production plan as part of the certification process. This plan serves as a comprehensive guide to ensure that organic practices are followed consistently. The crop production plan typically includes the following components:

- **Description of Crops:** The plan should provide a detailed description of the crops being grown in the production cycle, including the main crop and any intercrops. This description should consider the agro-climatic seasons and the suitability of crops for specific periods.
- **Practices and Procedures:** The plan should outline the specific practices and procedures that will be employed throughout the crop production cycle. This may include information on seed selection, soil preparation, irrigation methods, weed management, pest and disease control strategies, and harvest techniques. These practices and procedures should align with organic farming principles and the NSOP guidelines.
- **Inputs used:** A comprehensive list of inputs used in crop production should be included in the plan. This list should specify the composition of the inputs, the frequency of usage, application rates, and the source of commercial availability. Inputs may include organic fertilizers, compost, biopesticides, and other permissible substances as specified by the NSOP.
- **Organic planting material:** The plan should indicate the source of organic planting material, such as seeds and seedlings. Organic farmers are required to use organic or untreated planting material to maintain the organic integrity of their crops. The plan should provide details on the procurement and use of such materials.
- **Monitoring practices:** The plan should describe the monitoring practices and procedures that will be implemented to verify the effective implementation

Notes

of the organic crop production plan. This could involve doing routine observations, evaluations, and inspections to make sure organic standards are being followed and to deal with any problems or deviations.

- **Prevention of Contamination:** To prevent commingling and contamination of organic production units, the plan should outline the management practices and physical barriers that will be established. This may involve maintaining buffer zones, implementing measures to avoid cross-pollination, and preventing contact with prohibited substances or conventional farming practices.
- **Record-keeping System:** The plan should describe the record-keeping system that will be implemented to comply with the requirements of organic certification. This includes maintaining detailed records of farming activities, inputs used, pest and disease management, crop rotation, and other relevant information. These records serve as evidence of compliance and can be audited during the certification process.

Conversion period: The conversion period is an interim phase aimed at establishing an organic management system and building soil fertility. It is the period during which a conventional farm or agricultural land transitions to organic farming practices before it can be certified as organic. The primary objective of the conversion period is to ensure that the land and farming practices align with organic standards and that any residual synthetic chemicals or substances are eliminated from the soil and environment. Although the conversion period may not always be sufficient to fully improve soil fertility and restore the ecosystem balance, it serves as a starting point for implementing the necessary actions to achieve these goals. Plant products can be certified organic when they meet the requirements outlined in the national standards after a conversion period of at least two years before sowing. In the case of perennial crops, excluding grassland, the conversion period extends to at least three years before the first harvest of products. During the conversion period, farmers are required to adopt organic farming practices and refrain from using synthetic fertilizers, pesticides, and other prohibited substances. They begin implementing organic methods such as organic inputs, crop rotation, and composting to improve soil fertility and manage pests and diseases. This phase also focuses on restoring the balance of the ecosystem through biodiversity conservation and resource preservation. It's important to note that products grown during the conversion period cannot be labeled or sold as certified organic. Certification as organic can only be obtained once the conversion period has been completed, and the land and farming practices have been audited and certified by authorized bodies. The conversion period plays a crucial role in ensuring the integrity of organic products and promoting sustainable agricultural practices.

Notes

- The goal of organic farming is to improve the ecosystem, and the certification program sets guidelines and requirements to support biodiversity and conservation of the natural world on a minimum percentage of the farm.
- Every seed and plant material used in organic farming needs to have an organic certification. Genetic diversity is considered when selecting varieties. In cases where certified organic seeds and plants are not available, chemically untreated conventional seeds and plants may be used. The use of genetically engineered seeds, transgenic plants, or plant materials is strictly prohibited.
- In situations where the entire farm is not converted to organic, the certification program ensures that the organic and conventional parts of the farm remain separate and inspectable. There should be no switching back and forth between organic and conventional management for converted land and animals.
- Organic farming emphasizes the use of biodegradable materials of microbial, plant, or animal origin produced on organic farms to enhance soil fertility and biological activity. Non-synthetic mineral fertilizers and brought-in bio-fertilizers of biological origin are considered supplementary and should not replace nutrient recycling.
- Applying mineral fertilizers in their natural state is recommended for organic farming; chemical treatment to improve solubility is not necessary. It is not allowed to use manures that contain human excreta (poop and urine).
- Weeds, pests, and diseases are managed in organic farming through preventive cultural techniques that maintain a balanced nutrient management program. This includes suitable rotations, green manures, early and pre-drilling seedbed preparations, mulching, mechanical control, and disruption of pest development cycles. On-farm preparations made from local plants, animals, and microorganisms are allowed for pest, disease, and weed management. Physical methods for pest, disease, and weed management are also permitted.
- The use of synthetic herbicides, fungicides, growth regulators, synthetic dyes, insecticides, and other pesticides is strictly prohibited in organic farming.
- Measures are implemented to minimize contamination from external sources and within the farm. Buffer zones are maintained to prevent contamination from adjacent conventional farms. The size of the buffer zone should be sufficient to prevent unintended contact with prohibited substances applied to neighboring conventional land areas or farms.

Notes

- When using protected structures, plastic mulches, fleeces, insect netting, and silage wrapping, only products based on polyethylene, polypropylene, or other polycarbonates are allowed. These materials must be removed from the soil after use and should not be burned on the farmland. The use of polychloride-based products is prohibited.

By developing a comprehensive organic crop production plan that covers these aspects, farmers can ensure that their farming practices align with the NSOP guidelines and facilitate the certification process. The plan provides a roadmap for maintaining the organic integrity of the crops and helps ensure transparency and accountability in organic farming operations.

For animal husbandry

- The certification program ensures that the management of the animal environment considers the behavioral needs of the animals. It provides sufficient space for free movement, access to fresh air, and natural daylight according to the specific needs of the animals. Adequate facilities are provided to allow animals to exhibit natural behaviors in accordance with their biological and ethological requirements.
- All animals are granted access to open air and/or grazing, considering the type of animals and the season, taking into account their age and condition. Exceptions may be allowed in areas where feeding animals with fresh fodder is a more sustainable use of land resources than grazing, as long as animal welfare is not compromised.
- Landless animal husbandry systems are prohibited, as cage-free practices for poultry and rabbits. Herd animals are not kept individually, ensuring social interaction and natural group dynamics.
- When calculating feed inputs, the feed produced on the farm during the first year of organic management may be considered organic. However, this feed is exclusively for animals being reared within the farm unit and cannot be sold or marketed as organic. The preference is given to feed produced on the farm in accordance with national organic standards rather than conventionally grown or brought-in feeds.
- Animal products can be labelled and sold as "products of organic agriculture" only after the farm or relevant part of it has undergone a conversion period of at least twelve months. This ensures that the organic animal production standards have been met for the appropriate duration before marketing the products as organic.

Notes

- In situations where organic livestock is not available, the certification program permits the use of conventional animals within certain age limits. These age limits are as follows:
  - o 2-day-old chickens for meat production
  - o 18-week-old hens for egg production
  - o 2-week-old poultry for any other purposes
  - o Piglets up to six weeks old and after weaning
  - o Calves up to 4 weeks old, provided they have received colostrum and are fed a diet primarily consisting of full milk.
- The certification program ensures that breeding systems in organic agriculture are based on breeds capable of natural copulation and birthing. The use of embryo transfer procedures is prohibited, however artificial insemination is accepted.
- Organic farming strongly prohibits the use of genetically modified animals or breeds.
- To promote self-sufficiency and regional cooperation, the majority (at least more than 50%) of the feed given to farm animals should come from the farm unit itself or be produced in collaboration with other organic farms in the region.
- The following substances or products are prohibited from being included or added to animal feed:
  - o Artificial stimulants or growth boosters, artificial appetizers.
  - o Preservatives (unless used as a processing aid) and artificial coloring agents.
  - o Urea and pure amino acids.
  - o Farm animal by-products (such as abattoir waste), droppings, dung, or any type of manure, even if technologically processed.
  - o Feed subjected to solvent extraction (e.g., hexane) or the addition of other chemical agents.
  - o Organisms or goods created from them through genetic engineering.
- Bacteria, fungi, enzymes, by-products of the food industry (e.g., molasses), and plant-based products are permissible in animal feed. Fodder preservatives can also be used.

Notes

- In the treatment of illnesses, the well-being of the animals is the primary consideration. Conventional veterinary medicines are allowed only when no other justifiable alternative is available.
- Detailed records must be maintained for each animal, herd, or batch, and made available to the accredited certification body for inspection and verification. These records include parent details, source and purchase details, animal details, breeding details, feeding details, health care details (including vaccinations, medications, veterinarian prescriptions, and withdrawal periods), production details, sale details, and any other relevant information.

For bee keeping

- Hives should be located in organically managed fields and/or wild natural areas.
- Hives must be kept away from fields or areas where chemical pesticides and herbicides are used.
- The main building material for bee hives should be natural resources. It is strictly prohibited to utilize building materials that could be harmful.
- In unfavorable conditions, bees may be fed with feed from organic sources if necessary.
- Feeding should only occur after the last harvest, before a season when no natural foraging feed is available.
- Natural products like propolis, wax, and plant oils can be used within the hives.
- When working with bees, such as during harvest, repellents containing prohibited substances must not be used.
- The use of veterinary medicine is not permitted in beekeeping practices.
- Physical treatments, such as steam or direct flame, can be used for apiary disinfection.
- The destruction of male brood is allowed only in cases where the colony is infested by Varroa destructor, a common bee parasite.
- These guidelines ensure that organic beekeeping practices prioritize the use of natural materials, avoid chemical contamination, and promote the well-being and health of the bees.

Notes

- The operator of an organic beekeeping operation is required to maintain detailed and up-to-date records of the following:
  - Breeding and/or origins of bees.
  - Registration information for any bee purchases.
  - The health plan implemented for disease prevention, injury management, and reproductive issues.
  - Administration of all treatments and medicines, including information on quarantine periods and identification of treated hives.
  - Details of the feed provided to the bees and the sources of feedstuffs.
  - Documentation of stock movements within the unit and hive movements within designated forage areas as indicated on maps.
  - Extraction, processing, and storage records for all bee products.

These measures collectively contribute to quality assurance in organic farming in India, ensuring that organic products are produced and marketed in compliance with established standards.

10.3 CERTIFICATION

Organic certification is an important aspect of the organic farming industry. It is a process of certification that verifies and confirms that the production and processing of organic food and agricultural products meet specific organic standards. This certification is applicable to various entities involved in the organic food supply chain, including seed suppliers, farmers, food processors, retailers, and restaurants.Organic farmers and producers in India need to obtain certification from accredited certification bodies. These bodies assess and verify compliance with organic farming standards and issue organic certificates. The Agricultural and Processed Food Products Export Development Authority (APEDA) and the National Program for Organic Production (NPOP) are the two main certification agencies responsible for organic certification in India.These certification bodies evaluate the practices and processes of organic farmers and producers against the established organic standards. They conduct on-site inspections, review documentation, and ensure that the necessary requirements are met. If the assessment confirms compliance with the organic standards, the certification bodies issue organic certificates to the respective farmers or producers.

10.3.1 Purpose of Organic Certification

Organic certification serves several important purposes and provides numerous benefits for both producers and consumers. Here are some key reasons why organic certification is necessary:

Notes

(i) **Assurance of Organic Integrity:** Organic certification provides assurance to consumers that the organic products they purchase meet specific standards and have been produced according to recognized organic principles. Certification ensures that organic claims are backed by a credible and independent verification process.

(ii) **Compliance with Organic Standards:** Organic certification ensures that farmers and producers adhere to strict organic standards set by certification bodies or government regulations. It verifies that the farming practices, inputs used, and processing methods comply with the defined organic requirements.

(iii) **Consumer Confidence and Trust:** Organic certification helps build trust and confidence among consumers. The certification label or logo on a product assures consumers that it has undergone rigorous inspections, audits, and testing to meet organic standards. It provides transparency and credibility, enabling consumers to make informed choices.

(iv) **Environmental Protection:** Organic certification promotes environment-friendly farming practices. Organic farming emphasizes the use of natural fertilizers, pest management through biological controls, and the conservation of soil health. Certification encourages farmers to adopt sustainable practices that reduce pollution, preserve biodiversity, and protect ecosystems.

(v) **Health and Safety:** Organic certification prohibits the use of synthetic chemicals such as pesticides, herbicides, and genetically modified organisms (GMOs). By choosing organic-certified products, consumers can reduce their exposure to potentially harmful chemicals, promoting better health and well-being.

(vi) **Market Access and Premium Prices:** Organic certification opens up access to domestic and international markets for organic producers. Many retailers, distributors, and importers require organic certification as a prerequisite for sourcing organic products. Certification enables farmers to command premium prices for their organic produce and enhances the market opportunities.

(vii) **Traceability and Transparency:** Organic certification includes comprehensive record-keeping and traceability systems. It enables the tracking of products from farm to market, ensuring transparency and accountability throughout the supply chain. This traceability helps in maintaining the integrity of organic products and mitigating the risk of fraud or misrepresentation.

Notes

(viii) **Support for Farmers and Rural Development:** Organic certification programs often provide technical assistance, training, and capacity-building initiatives to farmers. Certification helps farmers adopt sustainable practices, improve productivity, and access premium markets. It contributes to rural development, farmer livelihoods, and the overall growth of the organic sector.

Overall, organic certification plays a crucial role in maintaining the integrity of organic products, protecting the environment, ensuring consumer trust, and supporting sustainable agriculture. It benefits producers, consumers, and the wider society by promoting healthier and more sustainable food systems.

10.3.2 Organic Certification in India

At present in India two types of certification system exists namely: 1. Third Party certification (NPOP) system which is governed by APEDA, Ministry of Commerce which is mainly focused for export purpose and 2. PGS-INDIA certification system. Both the programmes (NPOP and PGS-India) are independent of each other and products certified under one system cannot be processed or labelled under another system. While NPOP certified products can be traded in export and in domestic market including imports, PGS-India certified products can be traded only in domestic market.

1. Third Party certification (NPOP) system

The NPOP certification system in India is a comprehensive process certification that ensures compliance with organic standards throughout the entire production, processing, handling, storage, and transport chain. This includes a thorough examination of cultivation practices, land management, input usage, machinery usage, pest management, post-harvest practices, animal rearing practices, welfare of animals, avoidance of synthetic feed additives and hormones, and limited usage of allopathic drugs and antibiotics in animal products. NPOP certification is obtained through a third-party certification process. Independent organizations, known as Accredited Certification Bodies, review and inspect the production and processing facilities to ensure compliance with organic standards. The certification process includes document review and on-site physical inspection. When a product is certified under the NPOP system, it can be labelled with the "India Organics" logo (Fig. 10.1). This logo signifies that the product has met the organic standards set by NPOP. In addition to the "India Organics" logo, the product labelling will also include the name and logo of the Accredited Certification Body, as well as the Accreditation Number. This provides transparency and allows consumers to verify the certification details and authenticity of the organic product. NPOP certification is recognized at both domestic and international level.

Fig. 10.1: Logo of Organic Standard "India Organic"

Key aspects of NPOP certification:

Standards and guidelines: NPOP has developed a set of standards and guidelines that organic producers must adhere to in order to obtain certification. Several facets of organic farming are covered by these standards, such as managing soil fertility, controlling pests and diseases, procuring seeds, managing livestock, handling after harvest, and processing.

Accredited certification bodies (ACBs): NPOP operates through a system of Accredited Certification Bodies (ACBs) that are authorized to conduct inspections, audits, and certification of organic farms and products. ACBs are independent third-party organizations that have been accredited by the National Accreditation Body (NAB) as per the requirements of NPOP.

Inspection and certification process: Farmers or producers seeking NPOP certification must undergo a rigorous inspection and certification process. Trained inspectors from the ACB visit the farm or facility to assess compliance with NPOP standards. They evaluate farming practices, inputs used, record-keeping systems, and other relevant factors. If the farm or facility meets the organic standards, the ACB grants NPOP certification.

Annual renewal: NPOP certification is valid for a specific period, typically one year. Organic producers need to renew their certification annually by undergoing inspections, audits, and compliance assessments. This process ensures that certified organic farms and products continue to meet the NPOP standards over time.

India organics label: Products that meet NPOP standards and are certified by authorized ACBs can display the "India Organics" label on their packaging. This label provides assurance to consumers that the product has been certified as organic under the NPOP certification program.

Notes

2. Participatory Guarantee System (PGS)-India

The PGS-India organic certification system was launched in 2011 by the Department of Agriculture and Cooperation & Farmers Welfare, Government of India, is an alternative organic certification system that operates alongside the NPOP certification in India. PGS is a locally focused and participatory approach to certification, primarily intended for small-scale organic farmers who are primarily engaged in local markets. PGS is an alternative, decentralized organic certification system that involves the active participation of farmers and consumers. It promotes local-level certification through a process of peer inspections and mutual trust. PGS certification is typically used by small-scale farmers, farmer groups, and local communities. The third party certification bears high fees and more documentation, as a result small and marginal farmers are not able to offer for certification. To make it more easy, affordable and simplest system of certification which can be accessible by more number of small and marginal farmers to adopt certification and further sale in domestic market.

Key features of the PGS:

Participatory approach: PGS involves the active participation of farmers and relevant stakeholders in the certification process. It promotes mutual trust and knowledge exchange among farmers, consumers, and local communities. The certification decisions are made collectively through a participatory approach, which may include farm visits, group meetings, and peer evaluations.

Localized certification: PGS certification is focused on local markets and consumers. It aims to establish trust between farmers and consumers within a specific locality or community. The emphasis is on building strong relationships and transparency in the supply chain, fostering direct connections between producers and consumers.

Capacity building: PGS promotes farmer empowerment and capacity building. Farmers are encouraged to develop their understanding of organic farming practices, compliance with organic standards, and record-keeping. They receive training and support to improve their farming techniques and knowledge of organic principles.

On-site inspections: PGS certification involves on-site inspections conducted by trained local farmers or members of the certification body. These inspectors assess compliance with organic standards and ensure that the farming practices align with organic principles. The inspections focus on maintaining the ecological balance, biodiversity, and natural resource conservation.

Notes

Certification process: The certification process under PGS typically involves self-assessment by farmers, peer reviews, on-site inspections, and regular meetings to discuss and verify compliance. The group of participating farmers collectively decides on the certification of each member based on adherence to organic practices.

Domestic market focus: Unlike NPOP certification, PGS certification is primarily intended for the domestic market. PGS-certified products bear a specific logo or label that indicates their certification under the PGS system. However, these products cannot be labelled as "India Organics" or carry the NPOP certification mark.

10.3.3. Procedure for Obtaining Organic Farming Certification

The procedure for obtaining organic farming certification involves several steps. Here is an overview of the process:

(i) Before applying for organic farming certification, the farmer must ensure that their farm conforms to the standards set out by the National Programme for Organic Production (NPOP). This includes meeting requirements related to soil management, crop production, livestock management, record-keeping, and other relevant aspects.

(ii) The farmer or producer submits an application to the certification agency in the prescribed format, providing necessary farm and process details.

(iii) The certification agency screens the application and may seek further details or clarification if needed.

(iv) The certification agency provides a cost estimate to the farmer or producer, which includes certification charges, inspection charges, travel costs, reporting costs, laboratory charges, etc.

(v) The farmer or producer accepts the cost estimate and agrees to proceed with the certification process.

(vi) A formal agreement is signed between the farmer or producer and the certification agency.

(vii) The certification agency requests the farmer or producer to provide a cropping/production/cultivation/processing plan. The agency also supplies a copy of the organic standards for the farmer or producer to follow.

(viii) The certification agency raises an invoice for the initial fee and requests the farmer or producer to make the payment.

(ix) The certification agency determines the inspection schedule, which may involve one or multiple visits to the farm or production facility. Unannounced

Notes

inspections may also be conducted if required. Samples of plants, soil, raw materials, inputs, or products may be collected for laboratory analysis if necessary.

(x) The inspection team submits the inspection report(s) to the certification committee for evaluation.

(xi) The certification agency requests the farmer or producer to make the final payment for the certification process.

(xii) Upon completion of the process and compliance with the organic standards, the certification is granted to the farmer or producer.

(xiii) The producer or operator submits an application for obtaining a license to use the India Organic Logo.

(xiv) The certification body grants the license to use the India Organic Logo.

(xv) The farmer or producer can release the certified organic stock for sale, prominently displaying the Certification Mark and India Organic Logo on the packaging.

It's important to note that the certification procedure may vary slightly depending on the specific certification agency and their guidelines. Farmers and producers should follow the instructions provided by the certification agency they are applying to for organic farming certification.

INTEXT QUESTIONS 10.2

Tick the right options

1. What is the purpose of organic certification?
   (a) To increase the cost of organic products
   (b) To promote sustainable farming practices
   (c) To discourage consumers from purchasing organic products
   (d) To limit the availability of organic products
2. Which organization sets the standards for organic certification in India?
   (a) International Organization for Standardization (ISO)
   (b) Food Safety and Standards Authority of India (FSSAI)
   (c) National Programme for Organic Production (NPOP)
   (d) Organic Farmers Association (OFA)

Notes

10.4 RECORD MAINTENANCE

Record maintenance is an essential component of organic farming certification in India. It involves keeping detailed and accurate records of various aspects of your organic farming operations. Maintaining comprehensive records helps demonstrate compliance with organic standards and facilitates the certification process. Following records should be maintained:

Land Records

- Proof of ownership or lease agreement for the land used for organic farming.
- Details of land size, location, and boundaries.

Crop/Livestock Management Records

- Crop rotation plans and schedules.
- Seed sourcing records, including the type, variety, and source of seeds.
- Details of organic fertilizers and amendments used, such as compost, manure, or green manure.
- Pest and disease management records, including monitoring, prevention, and control measures.
- Irrigation schedules and water management practices.
- Livestock management records, including feeding practices, housing, and health management.

Input Records

- Records of organic inputs purchased, such as manures, soil amendments, and pest control products.
- Invoices or receipts from suppliers, indicating the product name, source, quantity, and date of purchase.
- Certification or verification documents for purchased organic inputs.

Harvest and Post-harvest Records

- Dates of harvest for each crop.
- Yield records, including weight or quantity of harvested produce.

Notes

- Post-harvest handling practices, including storage conditions and transportation details.
- Processing methods, if applicable, with records of any processing agents or additives used.

Inspection and Certification Records

- Inspection reports from accredited certification bodies.
- Correspondence with the certification agency, including application forms, fee receipts, and communication regarding the certification process.
- Documentation of any non-compliance issues identified during inspections and actions taken to rectify them.

Sales and Transaction Records

- Sales invoices, receipts, or other documents showing the movement of organic products.
- Records of transactions, including the buyer's name, quantity sold, date of sale, and price.

It is important to maintain these records in an organized and easily retrievable manner. Each record should be accurate, complete, and up-to-date. Additionally, it is advisable to keep digital or physical copies of the records to ensure their security and accessibility.The records should be retained for a specified period, typically for at least five years, as per the requirements of the certification body or regulatory authorities. These records serve as evidence of compliance during inspections and can also be helpful for internal audits and continuous improvement of organic farming practices.

INTEXT QUESTIONS 10.3

1. What does NPOP stand for in the context of organic certification in India?

   (a) National Policy for Organic Production

   (b) National Programme for Organic Promotion

   (c) National Programme for Organic Processing

   (d) National Programme for Organic Production

Notes

2. Which of the following is NOT a requirement for organic farming certification?

   (a) Use of chemical fertilizers and pesticides

   (b) Crop rotation and soil fertility management

   (c) Prohibition of genetically modified organisms (GMOs)

   (d) Protection of biodiversity and wildlife

3. What does the "India Organics" logo signify on certified organic products?

   (a) High nutritional value

   (b) Environmental friendliness

   (c) Compliance with Indian organic standards

   (d) Lower cost compared to non-organic products

True or false:

4. The "India Organics" logo can be used on products that meet the organic standards in India.
5. The National Programme for Organic Production (NPOP) sets the standards for organic certification in India.
6. The Participatory Guarantee System for India (PGS-India) organic certification system was launched in the year 2001.

WHAT YOU HAVE LEARNT

Let us recapitulate and enlist the salient points that you have learnt through this lessons:

- Organic certification is a process that ensures agricultural products are produced according to specific organic standards.
- In India, the National Programme for Organic Production (NPOP) sets the standards for organic certification.
- Organic certification involves a rigorous inspection and certification process, including field verification, record-keeping assessment, and compliance evaluation.
- Organic certification is typically valid for a specific period and requires annual renewal through inspections and audits.

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- The "India Organics" logo on certified organic products signifies compliance with Indian organic standards and provides assurance to consumers about the organic authenticity of the product.
- Record maintenance is a crucial aspect of organic certification, and farmers need to maintain comprehensive records of their farming practices, inputs used, inspections, and sales transactions.
- Organic certification supports the growth of organic agriculture, promotes consumer trust in organic products, and contributes to the overall sustainability of the agricultural sector.

TERMINAL EXERCISE

1. What do you mean by Quality assurance and certification?
2. What is the significance of quality assurance and certification in organic farming?
3. Discuss the key features of the PGS certification.
4. Define conversion period. Explain its importance.
5. Justify "Record maintenance is an essential component of organic farming certification in India".

ANSWERS TO INTEXT QUESTIONS

10.1 True or false

(a) False (b) False

10.2 Tick the right options

1. (b) 2. (c)

10.3 Tick the right options

1. (d) 2. (a) 3. (c)

True or false

4. True 5. True 6. False

Notes

SUGGESTED ACTIVITIES

Activity 1: Prepare the flow chart of the process involved in the organic product certification

By performing this activity, you will be able to understand the organic product certification process.

Activity 2: Prepare the sketch of "India Organic"

By performing this activity, you will be able to understand about the "India Organic".

Key Learning Outcomes

Learner will be able to:

- Describe the certification process.
- Identify the guarantee system of certification.
- Explain the third party certification.
- List the records to be maintained for organic certification.
- List the different accrediting agencies.

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11

ORGANIC FARMING BUSINESS

In the previous lesson we have learnt about quality assurance and certification for organic farming. In this lesson we will learn about different aspects of organic farming business. For centuries, people have been engaged in the exchange of goods and services to meet their daily needs. This system is known as the barter system, and it was very common till date. Since no one can produce everything, they need, people would exchange goods or services they produced with others. This whole process is called marketing and the place where these processes take place is called a market. Markets can be big, like covering the whole world or a country, or smaller like a region, state, city, or even just right at someone's doorstep. In today's modern world, there are even virtual markets where people can trade using special websites or apps.

A market is a place where people come together to buy and sell goods and services. While some trades can happen by exchanging goods, most markets work by sellers offering their products or services in exchange for money. Marketing is all about getting people interested in what a company is selling. It involves market research, understanding what customers like, and figuring out the best ways to make products available and promote them. Marketing includes many different things like creating and improving products, deciding how to sell and distribute them, making sales, and advertising. Marketing is important for businesses because it helps people learn about their products, get interested in them, and decide to buy them. It also involves making plans to keep customers interested and to stay ahead of competitors. In this lesson, we will learn some important basics about marketing and how to plan for a successful business.

OBJECTIVES

After reading this lesson, you will be able to:

- understand the economics of organic farming;

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- identify the different types of marketing and marketing platforms;
- understand the linkages between consumer and producer;
- understand the farmer producer organizations (FPOs); and
- understand the project for credit management.

11.1 ECONOMICS OF ORGANIC FARMING

The economics of organic farming, which is a subset of agricultural economics, covers the entire process and impacts of organic farming in terms of human society, social costs, opportunity costs, unwanted consequences, information asymmetries, and economies of scale. Although the scope of economics is broad, agricultural economics primarily focuses on maximizing production and increasing efficiency at the farm level. Economics takes an anthropocentric approach to the evaluation of the natural world, such that it is considered beneficial only to the extent that it is valued by people and increases profit. Some organizations such as the European Union give substantial grants to organic farming, as these countries seek to promote less water use, less water contamination, less soil erosion, less carbon emissions, more biodiversity, and other such benefits. Attention should be paid to those obtained from organic farming. Traditional organic farming is labor- and knowledge-intensive, while modern farming is capital-intensive, requiring more energy and manufacturing inputs. The profitability of organic farming depends on many factors. First, organic farming does not use artificial fertilizers and pesticides, which can be costly. In addition, organic food currently fetches a much better price than conventionally grown crops, meaning that organic farmers often get a higher return on their produce.

The price premium of organic food is an important factor in the economic viability of organic farming. In the year 2013, 100% price premium was received on organic vegetables and 57% price premium on organic fruits. These percentages are based on wholesale prices of fruits and vegetables, available through the United States Department of Agriculture's Economic Research Service. Price premiums exist not only for organic versus non-organic crops, but can also occur for the place where the product is sold: farmers' markets, grocery stores, or wholesale to restaurants. Direct selling at farmers' markets is more profitable for many producers, as farmers receive the full added value, although it is also the most time-consuming and labor-intensive method. Recent years have seen some signs of reduction in the organic price premium, which reduces the economic benefits for farmers to adopt or maintain organic production methods. Data from 22 years of research conducted at the Rodale Institute found that based on current yields and

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production costs associated with organic farming in the US, only a 10% price premium is necessary to match conventional farming. A separate study found that only a 5–7% price premium was needed to break even with conventional methods on a global scale. Without the price premium, the profitability of farmers gets mixed. Organic food is not only profitable for markets and supermarkets, but it is also sold at a higher price than non-organic food.

11.2 MARKETING AND ITS TYPES

It includes activities like advertising, selling, and delivering products to customers or other businesses. The main goal of marketing is to show your target people that how your offerings can meet their needs and solve their problems. Marketing can be divided into two main types: offline and digital. Offline marketing means using traditional methods like TV, radio, and newspapers to advertise. Digital marketing, on the other hand, refers to any kind of advertising that happens online. Both offline and digital marketing work together to make sure your message reaches the right people. This is important because the more someone sees your advertisement, the more likely they are to buy what you are selling.

There are several types of marketing, but we will focus on the 7 most common ones:

- **Outbound Marketing:** This type involves sending your message directly to your audience instead of attracting them to your website. It is more about selling a product or service rather than educating people about your business. An example is advertising on billboards.
- **Direct Mail Marketing:** It means sending mail directly to your target audience's addresses. It often targets people in a specific area rather than a specific demographic. For instance, receiving coupons from a local restaurant or shop.
- **Stealth Marketing:** This method aims to market to people without them realizing it. Companies achieve this through product placement in movies, TV shows, or videos. They make their brand visible without directly advertising to you.
- **Public Relations (PR) Marketing:** This type focuses on getting your business name out there. It involves creating press releases about updates, such as promotions, expansions, or new products, and sending them to news stations or websites.

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- **Partner Marketing:** It involves partnering with another business and promoting each other's products. By doing so, you can attract the loyal customers of the other business. When there is trust between the two businesses, their customers are likely to trust you as well.
- **Brand Marketing:** This type aims to make your business recognizable to your target audience. It establishes a specific tone, image, and message for your brand. Companies like Coca-Cola and Apple have successfully used brand marketing to attract customers based on their personalities and values.
- **Pillar-Based Marketing (PBM):** This is a newer digital marketing approach. It focuses on creating content that answers your audience's important questions. By positioning your business as an authority in your field, you encourage your audience to take action. For example, if you want to rank for content marketing, you might write about different marketing types, content marketing certifications, and steps for effective content marketing.

11.3 MARKETING PLATFORMS AND THEIR TYPES

Just having products is not enough. It is also important to have places and tools that help consumers to get the products they need. A marketing platform is a tool that connects businesses and consumers, and it helps to create awareness, engagement, and a sense of community. The main purpose of a good marketing platform is to help companies build relationships with their customers. Another important goal is to help companies turn potential customers into actual buyers by providing them with the products or services they need. A marketing platform also allows companies to target specific individuals and personalize marketing messages just for them.

Importance of Marketing Platforms

- **Guiding the buyer's journey:** Marketing platforms help businesses understand where their customers are in the process of making a purchase. This knowledge allows companies to provide the correct information and support at each stage, guiding customers towards completing the sale.
- **Allowing for growth and scalability:** Marketing platforms enable businesses to expand their reach and target new markets. They help increase brand awareness and drive sales, which leads to business growth and increased revenue.
- **Attracting technology users:** Many consumers now use digital marketing channels like email and social media platforms. They rely on mobile technology

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to research and purchase products. By having a strong presence on these platforms, businesses can attract and engage with tech-savvy consumers who prefer online interactions over physical store visits.

- **Creating technological leverage:** Marketing platforms leverage the power of technology, especially artificial intelligence (AI). AI advancements allow marketers to reach consumers through digital channels, target specific groups, provide personalized experiences, and enhance the overall effectiveness of marketing campaigns.

11.3.1 Types of Marketing Platforms

(i) Traditional Marketing Platforms

(ii) Digital Marketing Platforms

(iii) Content Marketing Platforms

(iv) Email Marketing Platforms

(v) Social Media Marketing Platforms

(vi) Customer Relationship Management (CRM) Platforms

(vii) Marketing Resource Management (MRM) Platforms

(viii) Digital Asset Management (DAM) Platforms

(ix) Marketing Work Management (MWM) Platforms

- **Traditional Marketing Platforms**: These are physical mediums that help you raise brand awareness and engage with your target audience offline. Examples include SMS, billboards, flyers, print ads, direct mail, and radio/ television broadcasts.

- **Digital Marketing Platforms: A** digital marketing platform is a Comprehensive tool that use technology to support various online marketing functions. They help with customer retention, performance measurement, campaign optimization, and brand communications. Example: Marketo.

- **Content Marketing Platforms**: Content marketing platforms are tools that streamline and manage content marketing processes from end to end. They help to strategize, create, distribute, and promote content to provide value to your audience and strengthen your brand. Example: Percolate.

- **Email Marketing Platforms: Email** is one of the most cost-effective means of promoting your brand, engaging your audiences, and generating sales. They offer features like template design, list segmentation, personalization, A/B testing, scheduling, performance tracking, and automation. Example: Active Campaign.

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- **Social Media Marketing Platforms**: Tools that assist social media marketers in creating content, managing communities, scheduling posts, listening to social conversations, monitoring campaigns, advertising, collaboration, and improving audience engagement. Example: Hootsuite.
- **Customer Relationship Management (CRM) Platforms**: Tools for tracking customer data and interactions to create personalized experiences and build better relationships. They centralize customer information, enabling real-time analysis and tailored services. Example: Zoho CRM.
- **Marketing Resource Management (MRM) Platforms**: Support marketers in planning, organizing, optimizing, and executing marketing tasks and initiatives. They help to distribute resources, manage projects, and ensure successful execution. Example: Wrike.
- **Digital Asset Management (DAM) Platforms**: Centralized platforms for organizing and accessing digital assets, such as videos, photos, audio files, and graphics. They facilitate easy search and retrieval of assets. Example: Canto.
- **Marketing Work Management (MWM) Platforms**: How do you manage resources, facilitate communication, collaborate on projects, and structure your work day-to-day to ensure you reach your goals without exceeding the deadline or budget limit? With the help of marketing work management platforms, of course. MWM platforms help in managing resources, communication, collaboration, and structuring day-to-day marketing work. They offer features like budgeting, project management, task assignments, workflow automation, team communication, and time tracking. Example: Co-Schedule Marketing Suite.

11.4 CONSUMERS-PRODUCER LINKAGES

Market linkage is about connecting farmers and producers more directly with markets and consumers. It involves various activities such as identifying farmers' products and connecting them with buyers, facilitating contracts with buyers, promoting good agricultural practices, and enhancing farmer entrepreneurship. One important way to connect consumers with producers is through marketing channels. A marketing channel is a group of people, organizations, and activities that work together to transfer goods from the producer to the consumer. The goal of a marketing channel is to create a connection between the producer and potential customers.

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For physical products, there are four basic types of marketing channels:

- **Direct selling: Where** products are directly sold to consumers by the producers without involving intermediaries.
- **Selling through intermediaries**: Where Products are manufactured by the producers and then sold to customers through intermediaries like agents, brokers, wholesalers, and retailers.
- **Dual distribution: Where** producers use multiple channels to sell products. They may sell directly to customers while also working with wholesalers and retailers who have their own distribution networks.
- **Reverse marketing**: Where products move from the customer back to the manufacturer or producer. This includes activities like recycling and product recalls. By understanding these marketing channels, producers can choose the most suitable approach to reach their customers and ensure their products to reach the intended market (Fig. 11.1).

Marketing channels often vary according to the type of produce. Agricultural products, being more diverse in nature, have different marketing channels as per their need and characteristics.

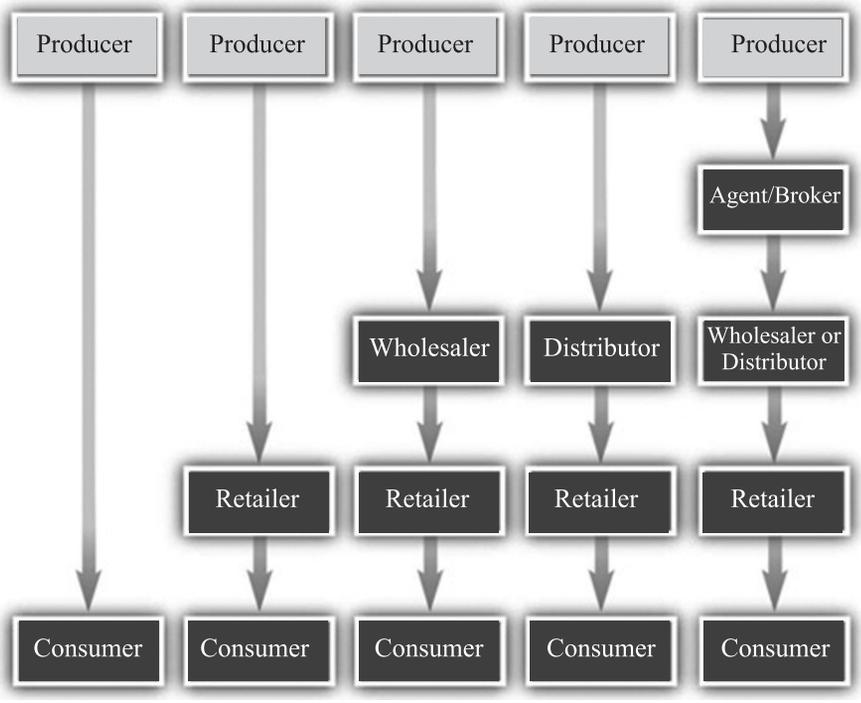

Fig. 11.1: Different Marketing Channels linking Producers to Consumers

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11.5 FARMER PRODUCER ORGANISATIONS (FPOS)

Farmer Producer Organisations (FPOs) are groups of primary producers like farmers, fishermen, rural artisans, and craftsmen who come together to conduct their business more efficiently and share profits or benefits among themselves. These organizations can take different legal forms, such as producer companies, cooperative societies, or institutions specifically for primary producers.

The term "Producer Organization" (PO) is a general name for these kinds of organizations, whether they deal with agricultural or non-farm products, artisans, and so on. When farmers form a group and become members of an organization, it is called a Farmer Producer Organization (FPO). The Small Farmers' Agribusiness Consortium (SFAC) provides support and promotes these FPOs.

11.5.1 Concept of FPO

The concept behind FPOs is that farmers join together and register themselves under the Indian Companies Act. The Small Farmers' Agribusiness Consortium (SFAC), under the Department of Agriculture and Cooperation, Ministry of Agriculture, Government of India, helps the state governments in establishing and supporting Farmer Producer Organizations (FPOs). The main goal is to make farmers more competitive and provide them with better opportunities in the market. FPOs carry out various activities such as supplying seeds, fertilizers, and machinery, establishing market connections, providing training and networking opportunities, and offering financial and technical advice to farmers.

11.5.2 Formation and Functioning of FPOs

- FPOs are formed and also promoted at the State/Cluster level through Cluster-Based Business Organizations (CBBOs)
- "One District One Product"- promotes specialization and better marketing, export, branding and even processing by the FPOs.
- Initially, the minimum number of members in FPO is 100 in North East and hilly regions and 300 in plain areas.
- Project guidance, data compilation, maintenance through integrated portal, information management, and monitoring are provided by a National Project Management Agency (NPMA) at SFAC.
- Loans can be availed by the states or UTs at a concessional rate of interest under Agri-Market Infrastructure Fund (AMIF). It is approved for setting up in NABARD in order to develop the agriculture and allied sector marketing and infrastructure.

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- Initial training will be provided by CBBOs and regular trainings will be conducted for the smooth running of the FPOs.
- Aspirational districts will be given priority for the formation of FPOs. At least one FPO will be there in each block of the aspirational districts.

Why FPO is necessary for farmers?

Farmers in India face a lot of adversities and hardships which is why FPOs are essential. Some of the reasons why FPOs are needed for farmers are enlisted below:

- Almost 86% of the farmers in India are small and marginal farmers and thus have a very small landholding of less than 1.1 hectares.
- Due to the high process of good quality seeds, these farmers are unable to avail them.
- There is a high demand for good fertilizers, manures and biocides owing to the depleting soil quality.
- Lack of proper irrigation facilities.
- Less or no accessibility to large scale mechanisation of agriculture.
- Being economically poor, farmers face a lot of challenges in marketing, thereby depend on the local traders and middlemen for selling their products. This forces the farmers to sell their produce in very low rates.
- Lack of capital also forces farmers to borrow money for initiating production process.

FPOs help in the collectivization of such small, marginal and landless farmers in order to give them the collective strength to deal with such issues.

11.5.3 Aim of Farmer Producers' Organisation

- Ensure better income through their own organisational setup.
- To gain the benefit of economies of scale through aggregation.
- Eliminates the intermediaries in the process of marketing thereby increasing the producer's share in consumer's rupee.
- Farmers will have better bargaining powers as they will be the bulk buyers of produce and bulk suppliers of inputs.

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INTEXT QUESTIONS 11.1

Fill in the blanks:

1. ..... is the way your business shows your target audience how your products or services can solve their problems.
2. ..... is providing support to the FPOs.
3. Percolate is a ..... marketing platform.
4. NABARD stands for .....
5. When producers sell the products directly to consumers, it is called ..... marketing.

11.6 EXPORTING OF PRODUCTS

When a product or service is produced in one country but sold in another, the process is known as export. Exports occur on a large scale between different nations and are one of the oldest forms of economic engagements in the world.

11.6.1 The Export Process

Countries partner with other countries to understand the demands for various products. Countries do not manufacture goods blindly for an international transaction. Instead, the export process starts after receiving an order from the other country. The exporting country must often receive proper clearance from their home country to export goods; this is often done by obtaining an export license or meeting other country-specific requirements.

Several financial matters are settled upfront in the export process. If applicable, then first the exporter may seek a letter of credit from the importer. This establishes the exporters' faith in the transaction and that they will receive compensation once the good is exported. Even the exchange rate is fixed between the exporters and importers as there will be differences in the currencies of the home and foreign countries. This is the point where an invoice is issued and the sale is finalized.

As the order is prepared, formal documents are gathered including a permit issued by the customers department, financial documents such as a bill of lading and shipping documents are prepared, and shipment advance information. These documents are remitted to the seller; of primary importance is the shipment advance which notifies the importer how goods will be transmitted.

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11.6.2 Trade Barriers and Other Limitations

Any government law, policy, practice, or regulation designed to protect domestic products from foreign competition is known as a trade barrier. Government-imposed policies and measures are the most common foreign trade barriers. They prevent or restrict the international exchange of goods and services.

Some other limitations of export are:

1. High costs due to the fact that companies allocate a good number of resources to researching foreign markets and studying the demands and regulations for exports.
2. Companies that deal in export are at a higher financial risk, Payment collection methods are more complex and take much longer than domestic transactions.

Advantages and Disadvantages of Exports

Advantages

- Higher revenue due to greater economic activity
- Better efficiency in production
- Greater innovation and R & D by working with foreign experts
- Reduces operational risk

Disadvantages

- High transportation charges
- Smaller firms may not be able to export due to a lack of knowledge and resources
- Devaluation of currencies may result in exchange risk
- Unknown political or geographical risks may hinder the export process.

INTEXT QUESTIONS 11.2

State true or false:

1. China is the largest exporter in the world.
2. Tariffs are not a type of trade barrier.
3. Petroleum products are the highest exported products from India
4. In dual marketing, producers do not sell the products directly to the consumers.

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11.7 BUSINESS PLANNING

Business is any activity or enterprise that yields profit. It is the practice of making one's livelihood by producing, buying, or selling products. A business plan is a document that defines in detail a company's objectives and how it plans to achieve its goals. A business plan lays out a written road map for the firm from marketing, financial, and operational standpoints. Both start-ups and established companies use business plans.

The Key Elements of a Business Plan

Before writing down the business plan, it is essential to do some preliminary work. You should know what are the elements and what should go into the business plan.

Here are the key elements of a good business plan:

(i) **Executive Summary**: This is the most helpful part of the business plan. It gives the first impression of your business. It states the goals of your business and gives a clear picture of the strategies to be undertaken in the business plan. It acts as the first guide to the readers.

(ii) **Business Description**: Explains the size and structure of the firm along with its position in the market. It removes any confusion from the entire process. It details the different products and services offered by the company. It also states the details of the establishment of the company and highlights the USP of the products and services in comparison to the other competitors.

(iii) **Market Analysis**: This is an important feature in a business plan as analysis of the market helps to determine the current position of the firm and its scope for future expansions. It helps in evaluating the different aspects viz investments, marketing, distribution and even combating the competition.

(iv) **Operations and Management**: This element of a business plan shows the ways in which the firm can deliver better and superior products at affordable rates in less time as compared to others. This is like a statement of purpose of the business firm. It explains to customers about the uniqueness of the firm.

(v) **Financial Plan**: This is the most important element of the business plan. It is mainly addressed to the sponsors and investors. Usually, firms maintain reports to reveal their financial policies and market analysis. Even, a 5-year financial report is required to track the past profits and performances of the firm. The financial plan draws out the current business strategies, future projections, and the total estimated worth of the firm.

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What Are the 7 Steps of a Business Plan?

The following are the seven steps required for a business plan:

- Conduct Research
- Set a goal
- Create a profile for the company
- Describe the company in detail
- Make a plan of marketing beforehand
- Be willing to make changes to your plan as per the target audience
- Incorporate your motivation

11.7.1 Some Common Types of Business Plans

There are many types of business plans. But the 5 most important types of business plans are enlisted below:

(i) **Start-up plan:** As the name suggests, this is a documentation of the plans, structure, and objections of a new business establishment. The products and services to be produced in a firm are described here along with the staff management and market analysis. Even a detailed financial statement is attached so that the investors can evaluate the viability of the business set-up.

(ii) **Feasibility plan:** It evaluates the prospective customers of the company's products or services. It also tells about the profit or loss that the venture may face in the future. It details and forecasts about the sales of the product in the market, the duration to yield results and the profit margin.

(iii) **Expansion Plan: This** plan is particularly made when the company decides to expand its production or its structure. It enlists the basic steps and guidelines for internal and external growth of the company. It helps the firm to analyse the activities like resource allocation for increased production, financial investments, employment of extra staff, and much more.

(iv) **Operations Plan: Also**, known as annual plan, the operations plan details the daily activities and strategies that need to be followed by the company to achieve the targets. It even outlines the roles and responsibilities of various departments and employees in the business firm.

(v) **Strategic Plan: This** plan is the foundation of establishing a business. With the help of SWOT analysis, this plan can be drafted accurately. The internal strategies of a company may be documented and the strengths, weaknesses, opportunities, and threats can be categorized and evaluated so that to develop means for optimizing profits.

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11.7.2 Swot Analysis

SWOT analysis is a strategic planning and strategic management technique used to help a person or organization identify Strengths, Weaknesses, Opportunities, and Threats related to business competition or project planning. A template of SWOT analysis is given below (Fig. 11.2):

STRENGTHS	WEAKNESSES
• What do we do well? • What do our customers say we do well? • What is our unique selling proposition? • Do we have strong brand awareness? • Customer loyalty? • Supplier, distributor, influencer relationships? • What proprietary or unique assets do we have? • What skills do we have that our competitors don't? • Strong capital? • Do our profit margins compare to industry benchmarks?	• Where can we improve? • What do our customers frequently complain about? • Which objections are hard to address? • Are we new or not well known? • Do we have any limitations in distribution? • Are our resources and equipment outdated or old? • Are we lacking in staff, skills, or training? • Do we suffere from cash flow problems? Debt? • Are our profit margins smaller than industry benchmarks?
OPPORTUNITIES	**THREATS**
• Do our competitors have any weaknesses we could benefit from? • Target market growing or shifting in our favour? • Is there an untapped pain point or niche market? • Are there upcoming events we could benefit from? • Are there geographic expansion opportunities? • Are there potential new sources of financing? • Industry or economic trends that could benefit us? • Social or political trends that could benefit us? • Any new technology that could benefit us?	• New competitors or expansion in existing competitors? • Is our target market shrinking or shifting? • Could any indirect competitors become direct competitors? • Industry or economic trends that could work against us? • Social or political trends that could work against us? • Any new technology that could work against us?

Fig. 11.2: SWOT analysis

11.8 PROJECT PREPARATION FOR CREDIT MANAGEMENT

A project is a temporary job or task that is different from the regular work of a business. It could be anything from creating a website to moving offices or doing complex statistical analysis. Some businesses are even entirely based on projects. Project management is a way for businesses to plan, organize, manage, and complete specific tasks, objectives, or goals. It helps businesses in many ways.

Here are some benefits of good project management:

- Reduce the chances of project failure: With proper project management, the likelihood of a project failing or not meeting its goals is reduced.
- Ensures a minimum level of quality: Project management ensures that the work produced meets a certain level of quality and standards.

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- Ensures that outcomes meet expectations: By managing the project effectively, the end results are more likely to meet the expectations of the stakeholders involved.
- Increases project and business efficiency: Good project management helps streamline processes and make them more efficient, benefiting both the project and the overall business.
- Simplifies the project with a single point of contact: Having a project manager as a single point of contact makes the entire project easier to manage and coordinate.
- Encourages consistent communication: Effective project management promotes regular and clear communication among staff members and suppliers, ensuring everyone is on the same page.
- Manages costs, timelines, and resources within budget: Project management helps keep track of the project's budget, timeline, and resources, ensuring they stay within the planned limits.

11.8.1 The Project Cycle

All projects use 5 basic elements according to the size and complexity of the project. They are enlisted below (Fig. 11.3).

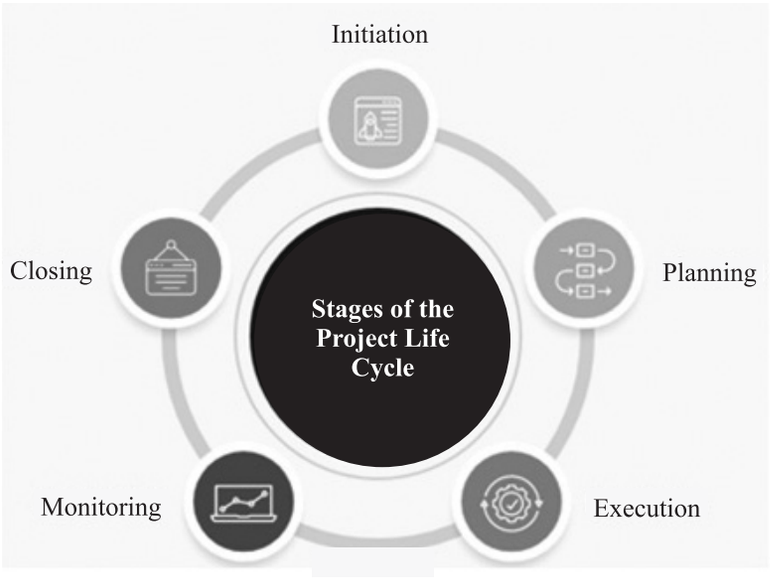

Fig. 11.3: Project Cycle

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Initiation

The beginning of a project starts with something called a Project Mandate, which is a document that briefly explains the purpose of the project and gives permission to spend money on starting it. During the initiation stage, we figure out what needs to be done and how to do it with the resources we have. We write all this information in a document called a Project Initiation Document (PID) or project definition.

Planning and development

After the initiation stage, we move on to planning and development. During this phase, we create a more detailed plan for the project. We specify exactly what needs to be done, who will do it, and when it will be done. The main focus is to make sure we manage our time, money, and resources effectively. This helps us create a project plan and schedule.

Production and implementation

Once the planning is done, we start the production and implementation stage. This is when we put our project plan into action. We start working on the project and produce any necessary deliverables according to the plan we made.

Monitoring and controlling

Throughout the project, we need to keep an eye on how things are progressing. We monitor the project's progress and control any issues that come up during the day-to-day work. We compare the actual progress to what we expected based on the project plan and any quality measurements we have in place.

Closing

The last phase of a project is called closing. This is when we formally accept the work that has been done and bring the project to an end. Closing doesn't necessarily mean the project was successful; it just means it has reached its final point. If a project fails, we also close it at this stage.

11.9 GOVERNMENT SCHEMES TO PROMOTE ORGANIC FARMING IN INDIA

Government of India provides assistance to promote organic farming across the country through various schemes.

1. Traditional Agricultural Development Scheme (PKVY)

Paramparagat Krishi Vikas Yojana promotes cluster based organic farming with PGS (Participatory Guarantee System) certification. Cluster formation, training, certification and marketing are supported under the scheme. 50,000 per hectare/3

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years is provided, of which 62 percent (Rs. 31,000) is given to a farmer as incentive for organic inputs.

2. Mission Organic Value Chain Development for North Eastern Region (MOVCDNER)

The scheme promotes third party certified organic farming of specific crops of the North East region through Farmer Producer Organizations (FPOs) with a focus on exports. Farmers are given assistance of Rs 25,000 per hectare for three years for organic manure and other inputs including bio-fertilizers. The scheme also provides assistance up to Rs 2 crore for formation of FPOs, capacity building, post-harvest infrastructure.

3. Capital Investment Subsidy Scheme (CISS)

Under Soil Health Management Scheme Under this scheme, assistance up to a maximum of Rs 190 lakh per unit (3000 total TPA capacity per year) is provided to the state government, government agencies for setting up mechanized fruit and vegetable market waste, agricultural waste compost production unit. , Similarly, assistance up to 33 per cent of the cost limit up to Rs 63 lakh per unit is provided as capital investment for individuals and private agencies.

4. National Mission on Oilseeds and Palm Oil (NMOOP)

Financial assistance on 50 percent grant under the mission is Rs. 300 per hectare is being provided for various components including biofertilizers, supply of rhizobium culture, phosphate solubilizing bacteria (PSB), zinc solubilizing bacteria (ZSB), azatobacter, mycorrhiza and vermicompost.

5. National Food Security Mission (NFSM)

Financial assistance is provided at 50 per cent of the cost limited to Rs. 300 per hectare for promotion of bio-fertilizers (Rhizobium/PSB) under NFSM. According to international resource data from Research Institute of Organic Agriculture (FiBL) and International Federation of Organic Agriculture Movements (IFOAM) Statistics 2020, India ranks 9th in terms of certified agricultural land with 1.94 million hectares (2018-19).

WHAT YOU HAVE LEARNT

Let us recapitulate and enlist the salient points that you have learnt through this lesson:

- Market is a place where buyers and sellers exchange goods and services overtime.

Notes

- Marketing refers to activities a company undertakes to promote the buying or selling of a product or service. Marketing includes advertising, selling, and delivering products to consumers or other businesses.
- One of the important ways of linking the consumers with the producers is through marketing channels. A marketing channel is a set of people, organizations, and activities that work together to transfer goods (products and services) from the point of origin to the point of consumption.
- Farmer Producer Organisation is one type of PO where the members are farmers. Small Farmers' Agribusiness Consortium (SFAC) is providing support for promotion of FPOs. PO is a generic name for an organization of producers of any produce, e.g., agricultural, non-farm products, artisan products, etc.
- Export refers to a product or service produced in one country but sold to a buyer abroad.
- A business plan is a document that defines in detail a company's objectives and how it plans to achieve its goals.
- Project management provides businesses with a method of planning, organising, managing and executing a specific task, objective or set of goals.
- Government schemes to promote organic farming in India.

TERMINAL EXERCISES

1. What is marketing? What are the different types of marketing and marketing platforms?
2. How are producers and consumers linked in a market? Justify your answer with an example.
3. Is FPO important for farmers? If yes, how?
4. Define export. What are the limitations of exporting a product?
5. Write short notes on:
   (a) SWOT analysis
   (b) Project cycle

ANSWERS TO INTEXT QUESTIONS

Notes

11.1

1. Marketing
2. Small Farmers' Agribusiness Consortium (SFAC)
3. Content
4. National Bank for Agriculture and Rural Development
5. Direct

11.2

1. True 2. False 3. True 4. False

SUGGESTED ACTIVITY

Activity 1. Identify some popular marketing platforms and categorize them into different types

Name of the Platform	Type
Canto	Digital Asset Management (DAM) Platforms

Activity 2: Draw different marketing channels for food grains, pulses, oilseeds, and milk.

Key Learning Outcomes

Learner will be able to:

- Identify the different types of marketing platforms.
- Carry out the essential requirements of a business plan.
- Carry out the process of exporting organic products.
- Identify the different Government schemes to promote organic farming in India.

Notes

12

HYGIENE AND CLEANLINESS

In the previous lesson we have learnt about Organic Farming Business for Organic Farming. In this lesson we will learn about different aspects of hygiene and cleanliness**.** In organic farming, hygiene and cleanliness are essential to maintain crop health and prevent contamination. This includes regularly cleaning tools, equipment, and storage areas to prevent the spread of pests and diseases. Farmers also avoid synthetic chemicals, emphasizing natural sanitation practices like composting, crop rotation, and proper waste disposal to ensure a safe and clean growing environment**.** Personal hygiene in organic farming is essential to ensure food safety and worker health. Farmers should wash hands frequently, especially before handling crops, and wear clean, appropriate clothing to avoid contaminating produce. Proper hygiene practices also help prevent the spread of diseases and pests within the farm environment**.** Cleanliness around the workplace in organic farming is essential to prevent contamination of crops, tools, and equipment. Regularly cleaning tools, removing weeds, and properly disposing of organic waste help maintain a healthy environment. This reduces pest and disease risks, promoting a safer and more productive organic farming system.

OBJECTIVES

After reading this lesson, you will be able to:

- state the process for maintaining good hygienic practices at workplace;
- discuss the work place sanitization norms including distancing from sick people;
- identify the importance of workplace safety;
- explain the know about of PPE equipment/kit;

- perform the cleaning, disinfection and pest control measures;
- describe the importance of drainage and waste disposal around workplace; and
- identify the importance of labeling and risk assessment practices in workplace.

12.1 HYGIENE AT WORK PLACE

As the saying goes, 'healthy mind resides in a healthy body. 'Every human is concerned about his/her health as well as of respective family members. However, considering the importance of hygiene at workplace is also required to be discussed.

Have you ever thrown away snacks/chocolate packet in open considering no one is watching you? Have you ever thrown away the empty water bottle from bus window in an open highway? Have you ever split in open public places? Have you ever thrown the scrap outside the devoted dustbin?

If you have not done all this then you are onright path of maintaining cleanliness in the environment and if you have done so then you need to rethink about your choices.

Our country is also conscious on maintaining the cleanliness drive and has started 'clean India (Swachh Bharat)' initiative during 2014. Point was to aware every citizen of country towards his/her responsibility to the nature. Similar goes with maintaining hygiene at personal level and then at professional level.

12.1.1 Proper Hygiene at Office is Essential for a Healthy Work Atmosphere

Imagine working in a cabin or cubicle full of sprawling papers, files, spilled food, stench, water all around, muddy foot prints and dust everywhere. It surely brings a frown and shuddertous. This and much more prevail at most offices, where cleanliness is totally neglected. Here are some clean lines tips that will help maintain a fresh office environment:

12.1.2 Personal Hygiene

Start your day with a toothbrush and toothpaste alongwith a clean bath, followed by a set of ironed clothes. Perfumes and deodorants must be use dinalimit.While you pack your lunch boxes and laptop bags before rushing to work,don't forget to putinyour deodorant.

Wearing the same clothes without washing them will cause foul odour which will trouble you as well as your colleagues. Another aspect to remember is to cover

Notes

your mouth with a handkerchief if you cough or sneeze. Otherwise, it can be do ne through bend elbow. Do not remove your shoes at work–Socks since all the dirt passes in the air making it unhealthy to breathe. Cleanliness and hygiene should be considered for the entire premises. We normally spend a majority of our time in our office. A company's administration panel should ensure that every corner of your office is cleaned on a daily basis. All the employees should maintain proper hygiene too. The people work in a ground you form a part of your environment. Having the entire building or complex clean will react well for yourself and those dropping by, into your office. Personal grooming and clean lines are your very first step to a clean atmosphere.

INTEXT QUESTIONS 12.1

Fill in the Blanks:

1. Proper hygiene at office is essential for a healthy ..... .
2. Swachh Bharat Mission came in the year ..... .
3. Hand wash is mandatory before ..... .

12.1.3 Keep your Work Space Clean

Look around your cubicle or desk and make sure you keep everything in its place. Invest in an air cleaner and purifier as it keeps the air in a office clean and fresh. Air Cleaners Help To Eliminate Any Bad Odour. If your office is carpeted, make sure it is vacuumed once in two days at least. We ensure the entire seat our work place. When you eat at work, use a mat so that you don't spill anything on your desk or on the oor. Once you finish with your meal, close your lunch box tight. Also, wipe your desk before you begin our work again. If you order as nack or food from an eatery, discard the boxes, wrappers and tissues as soon as you are done with it. Make sure every corner of your office has a dustbin with alidso that no ies amount upon the garbage. This will also keep the smell of food away. If you come across any one littering the office, you may clean it up your self or suggest him/her to use the waste paper baskets.

12.1.4 Washroom Sanitation

Clean toilets should be maintained at every workplace. It is a basic necessity for every employee. When you use the washroom, do not make it wet. After you are done with the toilet seat, lift it up so that the water drains o automatically. Don't forget to ush. It can be rather disgusting to find remains of waste in the pots and used tissues all over the toilet. Especially for female employees' washroom close bin dustbin should be kept along with maintenance of all related sanitary measures.

Throw your used ones in the bin. Many a times, the waste baskets inside the washrooms are overfull and ignored. Have someone to discard the rubbish in a garbage dump every single day and wash the dustbin often. The extra tissue hanging from the tissue roll should be rolled back so that it looks tidy. Exhaust fans are good to absorb the odour. Fixing a freshener inside is an excellent option too. If you carry out these practices before leaving the washroom, it will be a pleasant visit for the next person going in (Fig. 12.1).

Fig. 12.1: Useful Signs for Maintaining Work Place Hygiene

Workplace mandatory hygiene signs have been proven to have shown an increase in employee hygiene standards. These signs should be placed in clear view of workers preparing food in the kitchens, and for those taking a bathroom break in the toilets.

Proper hand hygiene protocols should be strictly followed. Employee/ food handlers shall thoroughly wash and sanitize hands and change into clean uniform before entering the food premise. Hands should be washed for at least 40 to 60 seconds using water (preferably hot water) and soap. Hands should be dried with clean towel or air dryers. It is ideal to use food operated or elbow press taps. In case of a manual tap, it should be sanitized after each use (Fig. 12.2).

Hands shall be washed:

- Before starting work
- After coughing, sneezing or blowing nose
- Before/after touching face or hair
- Before handling cooked or ready-to-eat food
- After handling or preparing raw food
- After handling waste

- After cleaning duties
- After using the toilet
- After eating, drinking or smoking
- After handling money or paper (such as bill, indent, forms, etc.)
- After touching surfaces such as door knobs, walls, windows, doors, keyboards, steering wheel, etc.
- After removal of Personal Protective Equipment (PPE) such as gloves, face covers, etc.

This should preferably be followed with sanitising of hands for at least 20 seconds (with 70% alcohol- based sanitizer or an equivalent). If soap and running water are not immediately available, provide alcohol-based hand rubs containing 70% alcohol (Fig.12.2).

How to Wash Your Hand

Fig. 12.2: Simple Steps for Hand Washing

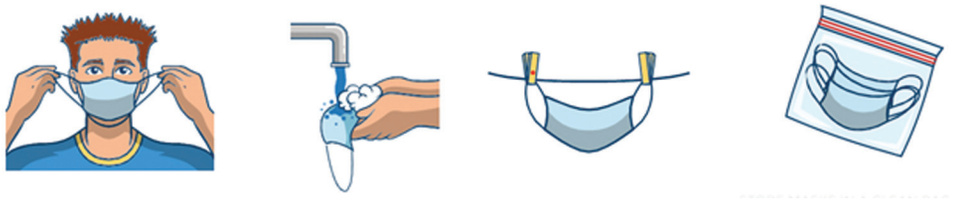
Steps to PuEng on a Clean reusable masks

12.1.5 Safety Measures to Protect Staû and Others

- Review the guidelines and recommendations by any state or local regulations for warehousing.
- Create a Covid-19 workplace health and safety plan by identifying an onsite workplace coordinator who will be responsible for COVID-19 assessment and control.
- Implement exible sick leave and supportive policies and practices.
- Consider conducting daily in-person health checks (e.g., symptom and/or temperature screening) of employees on scheduled workdays.
- Modify the alignment of workstations where feasible. For example, redesign workstations so workers can be at least six feet apart and are not facing each other.

Notes

- Close or limit access to common areas where employees are likely to congregate and interact, such as break rooms, parking lots, and in entrance/ exit areas.
- Place hand washing stations or hand sanitizers with at least 60% alcohol in multiple locations throughout the workplace for workers.
- Reduce the number of sta on-site at one time by increasing the number of shifts, staggering shifts, decreasing the overlap between shifts, and increasing facility hours of operation.
- Provide cleaning materials and conduct targeted and more frequent cleaning of frequently touched surfaces (benches, stands, conveyors, lift assist machines, oors, forklifts, pallet jacks, skids, totes, carts, box cutters, conveyor rollers, ladders, packaging equipment, tablets, phones, paperwork, merchandise, countertops, doorknobs, toilets, tables, light switches, phones, faucets, sinks, keyboards, etc.) (Fig.12.3).



Remove mask carefully holding the straps

Wash mask with detergent and warm water

Let mask dry completely

Store masks in a clea bag or plastic container

Fig.12.3: Putting on a Mask with Proper Hygiene

- Post signs and reminders at entrances and in strategic places providing instruction on social distancing, hand hygiene, use of cloth face coverings or masks, and cough and sneeze etiquette. Signs should be accessible for people with disabilities, easy to understand, and may include signs for non-English speakers, as needed (Fig.12.4).

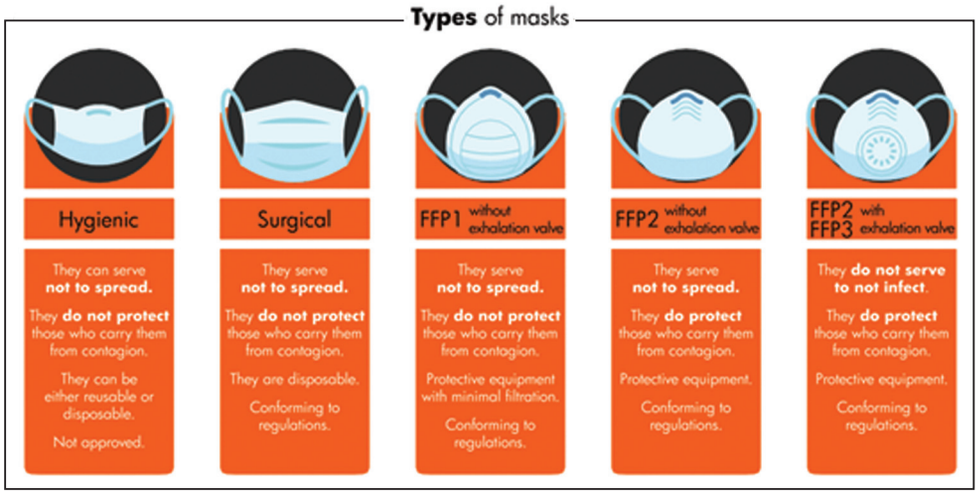


Fig 12.4: Deferent Types of Masks and Related Information on their Uses

INTEXT QUESTION 12.2

Multiple Choice Questions:

1. PPE stands for

   (i) Personal Protective Equipment

   (ii) Protective Personal Equipment

   (iii) Progressive Personal Equipment

   (iv) Personal Progressive Equipment

2. COVID is a well-known pandemic which has firstly hi the world on?

   (i) 2019 (ii) 2020 (iii) 2021 (iv) 2022

3. Which of the following is not a good option for face protection?

   (i) Homemade cloth mask (ii) Clinical mask

   (iii) N95 mask (iv) None of the above

Notes

12.2 CLEANLINESS AROUND THE WORKPLACE

Maintaining cleanliness around the workplace in organic farming is crucial for promoting a healthy environment and ensuring sustainable practices. Regularly cleaning tools, equipment, and storage areas prevents contamination of organic produce and minimizes the spread of pests and diseases. Additionally, an organized and tidy workspace enhances productivity and reflects a commitment to quality and safety in organic farming operations.

12.2.1 Importance of Workplace Safety Checklists

Cleanliness around the workplace is important not only for making good impression but also for maintaining overall productivity in the organization. This is highly important phase for any organization to ensure customer satisfaction as well as keeping office environment safe, reducing the chances of potential hazards and accidents (Fig. 12.5).

Fig12.5: Various Characteristics of Maintaining Work Place Check Lists

12.2.2 Workplace Safety Inspection Checklists

Here are a few examples of items included on the self-inspection for general industry checklist:

- Employer posting of safety guidelines in a public and visible place
- Record-keeping of safety permits, occupational injuries and employee training records

Notes

- Safety and health program existence, consistency and participation
- Medical services and first aid availability, proximity and response
- Fire protection guidelines for alarms, hydrants, facilities and entry ways
- PPE and clothing, such as gloves, aprons, safety glasses, goggles and hard hats
- General work environment sanitation, debris mitigation, hazard removal and waste management
- Walkway clearance, surface management, elevation measurement and bridge compliance
- Floor and wall openings
- Stairs and stairways
- Exit clearance
- Portable ladders
- Hand tools and equipment
- Power-operated tools and equipment
- Compressors and receivers
- Hazardous chemical exposures and handling practices
- Noise management
- Electrical

12.2.3 Protective Equipment (PPE) Inspection

The PPE safety inspection check list contains items that relate to work place compliance in providing, maintaining, using and updating equipment that can protect employees from occupational hazards. Professionals across many industries can use the PPE check list to identify hazards and find protective equipment solutions to support employee safety (Fig 12.6).

Here area few examples of the items covered by the PPE inspection check list:

- Hazard analysis performance and updating
- Eye protection standards
- Ventilation

Notes

- Hazardous waste management
- Noise level monitoring and hearing conservation
- Documentation guidelines for noise exposure
- Hearing protective equipment availability
- Respiratory risk identification
- Respirator availability, use and storage
- Medical qualifications for employee PPE
- Fall protection equipment
- Foot protection equipment

Fig. 12.6: PPE kit

12.2.4 Cleaning and Disinfection

Cleaning is the removal of foreign material (e.g., soil, and organic material) from objects and is normally accomplished using water with detergents or enzymatic products. Thorough cleaning is required before high-level disinfection and sterilization.

Notes

Cleaning is done manually in use areas without mechanical units (e.g., ultrasonic cleaners or washer- disinfectors) or for fragile or difficult-to-clean instruments. With manual cleaning, the two essential components are friction and uidics.

The most common types of mechanical or automatic cleaners are ultrasonic cleaners, washer- decontaminators, washer-disinfectors, and washer-sterilizers.

Methods of Disinfection

Chemical Disinfectants

- Alcohol
- Chlorine and chlorine compounds
- Formaldehyde
- Glutaraldehyde
- Hydrogen peroxide
- Lodophors
- Ortho-phthalaldehyde (OPA)
- Peracetic acid
- Peracetic acid and hydrogen peroxide
- Phenolics
- Quaternary ammonium compounds

Master sanitation schedule shall be maintained for overall facility through checklists which includes:

- Areas, items of equipment and utensils to be cleaned;
- Responsibility for particular tasks;
- Cleaning method and frequency of cleaning; and
- Monitoring arrangements for checking eectiveness of cleaning.
- Person responsible for cleaning.
- Persons responsible for monitoring & verification of eectiveness of cleaning.
- In case of any deviation what correction & corrective actions being taken.
- Where ever chances of microbial risk with product air count & swab test being recommended.

Cleaning procedure should generally involve:

- Removing gross visible debris from surfaces.
- Applying a detergent solution to loosen soil and bacterial film (cleaning)
- Rinsing with water (hot water where possible) to remove loosened soil and residues of detergent.
- Dry cleaning or other appropriate methods for removing and collecting residues and debris
- Where necessary, cleaning should be followed by disinfection with subsequent rinsing.

12.2.5 Pest Control System

In organic farming, pest control systems prioritize natural methods to manage pest populations without synthetic chemicals. Techniques include biological control using beneficial insects, cultural practices like crop rotation and intercropping, and the application of organic-approved pesticides. This holistic approach aims to maintain ecological balance, protect biodiversity, and ensure sustainable crop production (Fig. 12.7).

Fig. 12.7: General Depiction of Pest Control Measures

Source:*https://www.*ef*acility.in/pes*t-c*ontrol-system/*

General Requirements

- The organization shall have a nominated pest control technician to manage pest control activities and/or deal with external pest management agency.
- Pest control program shall identify target pests and address plans, methods, schedules and control procedures.
- Program shall include a list of chemicals which are approved for use in specified areas.
- Eective sanitation and Hygiene, inspection of incoming materials and monitoring can minimize pest infestation and thereby limit the need for pesticides.

INTEXT QUESTIONS 12.3

Multiple Choice Questions:

1. Which of the following statement is true about cleaning?

   (a) It is the removal of foreign material

   (b) It can be manual as well as automatic

   (c) Both of the above

   (d) None of the above

2. Which of the following is/are comes under risk assessment and management?

   (a) Risk identification (b) Risk analysis

   (c) Risk evaluation (d) All of the above

3. Which of the following statement is true about product labelling?

   (a) All incoming, in-process and finished products shall be suitably identified for product identification

   (b) All packaged food products shall carry a label and requisite information as per provisions of Food Safety and Standards Act, 2006

   (c) Lot identification shall be done to facilitate traceability, product recall, effective stock rotation

   (d) All of the above

Notes

12.2.6 Preventing Access

Preventing access to organic farming fields is crucial for maintaining crop integrity and minimizing contamination. This can be achieved through the use of physical barriers such as fences and gates, as well as clear sign age to deter unauthorized entry. Additionally, implementing regular monitoring and employing security measures can help protect the farm from pests, diseases, and potential chemical exposure.

- Buildings shall be kept in good condition to minimize pest activity and to eliminate potential breeding sites. Holes, drains and other places where pests are likely to gain access shall be sealed.
- Windows, doors and ventilation openings shall be designed to minimize pest entry.
- Harbourage and Infestation
- Storage practices shall be designed to minimize the availability of food and water to pests.
- Ingredients and materials shall be stored above the ground and away from walls.
- Where outside space is used for storage, stored items shall be protected from weather or pest damage (e.g., bird droppings).
- Any Potential pest harbourage such as burrows, undergrowth, old & unused equipment shall be removed.

12.2.7 Drainage and Waste Disposal

Effective drainage and waste disposal are critical in organic farming to prevent water logging and contamination. Proper drainage systems channel excess water away, protecting crops and soil health, while composting organic waste and recycling materials reduce pollution and enhance soil fertility. Proper waste disposal is vital to maintain soil health and prevent contamination. Organic farmers should compost plant residues, animal manure, and other biodegradable materials, returning nutrients to the soil. Non-biodegradable waste should be minimized and recycled whenever possible, ensuring a sustainable farming practice that adheres to organic standards. Thoughtful waste management also supports sustainability by minimizing chemical runoff and maintaining an eco-friendly environment (Fig. 12.8).

1. All health supplement/ Nutraceuticals waste and other waste materials shall be removed from time to time from the places where health supplement/ Nutraceuticals is handled, or processed or packed.

Notes

2. A refuse bin shall be placed in all appropriate places with a proper cover and shall be emptied regularly. The design of the refuse bin shall be such that no hand touch is required. This avoids cross contamination chances. They shall be washed daily with a disinfectant and dried before next use.

3. Adequate drainage and waste disposal systems and facilities shall be designed and constructed so that the risk of contaminating health supplement/ Nutraceuticals or potable water supply is avoided.

4. Drains shall be designed to meet expected ow loads, constructed so as to prevent accumulation or back ow of waste water. Drains should be located so that they can be easily and effectively cleaned and inspected.

5. Drains shall be equipped with appropriate traps to effectively capture contaminants.

Fig. 12.8: General Depiction of Different Types of Waste Disposal Facilities

12.2.8 Product Information and Labelling

1. All packaged food products shall carry a label and requisite information as per provisions of Food Safety and Standards Act, 2006 and Regulations made there under so as to ensure that adequate and accessible information is available to each person in the food chain to enable them to handle, store, process, prepare and display the food products safely and correctly and that the lot or batch can be easily traced and recalled if necessary. This should also include information that identifies food allergens in the product as ingredients or where cross contamination cannot be excluded as per FSS (Packaging & Labelling) Regulations, 2011, if applicable (Fig. 10.9).

2. All incoming, in-process and finished products shall be suitably identified for product identification, stage of processing, inspection and test status etc. so as to avoid their in advertent use. Lot identifications hall be done to facilitate traceability, product recall, effective stock rotation etc..

Notes

Fig. 12.9: General Description of Labelling Present in the Product

12.2.9 Risk Assessment and Management in Organizations

Risk happens across all the organizations whether it is public, private or semi government. The process of assessing, monitoring, and responding to the risks in order to reduce their impact is achieved through the implementation of a risk management framework.

Fig. 12.10: Risk Assessment and Management Process in the Organizations

Notes

Risk management framework is a basic conceptual structure used to address the risks faced by an organization.

A basic internal control risk management framework for any organization would essentially consist of the following broad steps (Fig. 12.10):

- Risk identification
- Risk prioritization
- Risk mitigation
- Implementation of mitigation plans
- Review and monitoring of mitigation plans

INTEXT QUESTIONS 12.4

True or False:

1. Risk happens across all the organizations whether it is public, private or semi government.
2. Drains shall be equipped with appropriate traps to effectively capture contaminants.
3. Work place safety leads to overall productivity.

WHAT YOU HAVE LEARNT

Let us recapitulate and enlist the salient points that you have learnt through this lesson:

- Maintaining good personal health is essential for effective performance in organic farming.
- Regular hand washing, proper grooming, and appropriate work attire are critical to prevent the spread of contaminants.
- Staying fit through regular exercise and a balanced diet enhances productivity and stamina needed for farming tasks.
- Adhering to safety standards and using personal protective equipment (PPE) is crucial to mitigate risks associated with farming activities.

Notes

- Regular health screenings help identify and address potential health issues early, ensuring a healthier workforce.
- Supporting mental well-being through stress management resources contributes to a more productive and harmonious workplace.
- Keeping the workplace clean and organized is vital for safety, health, and overall productivity.
- Informing designated authorities about injuries and infectious diseases is essential for quick intervention and maintaining workplace safety.
- Understanding and adhering to health and safety regulations protects both employees and the organization from legal liabilities.
- Hygiene and cleanliness are integral to sustainable organic farming practices, ensuring the health of both workers and the environment.

TERMINAL EXERCISE

1. Why do you think that personal hygiene is mandatory?
2. How you can keep safety checks and measures to adopt COVID related measures with in the organizations?
3. Mention about deferent types off ace masks and their usage guidelines?
4. Write about workplace safety inspection check list and its importance?
5. Explain deferent methods of disinfection in the organizations?
6. Write about risk assessment and management in the organizations?

ANSWERS TO INTEXT QUESTIONS

12.1

1. work atmosphere
2. 2nd October 2014
3. Before eating food

12.2

1. (i)
2. (i)
3. (ii)

Notes

12.3

1. (c) 2. (a) 3. (b)

12.4

1. T 2. T 3. T

Key Learning Outcomes

Learner will be able to:

- Explain the requirements of personal health, hygiene and fitness at work.
- Illustrate the common health-related guidelines laid down by the organizations/Government at the workplace.
- Identify the importance of good housekeeping at the workplace.
- Identify the importance of informing the designated authority on personal health issues related to injuries and infectious diseases.

Notes

13

HEALTH AND SAFETY ISSUES

In the previous lesson, we learnt about marketing of organic products and entrepreneurship development. This lesson will highlight the importance of promoting not only physical health but also mental and emotional well-being while adhering to legal requirements and best practices. The well-being of worker as well as the general performance of a business depend greatly on health and safety in the workplace. Addressing health and safety concerns has evolved into a basic obligation for both farmers and workers in today's dynamic and changing work environments. To guarantee a safe and secure workplace, reduce accidents, and foster a culture of well-being, understanding of and management of these concerns are crucial.

Further more, a thorough awareness of health and safety concerns is necessary due to the growing nature of work, including the influence of technology, remote work, and the changing global scene. In order to safeguard their most important resource – their employees – organizations must adapt and put proactive measures in place to reduce risks and promote a culture of health and safety.

OBJECTIVES

After reading this lesson you will be able to:

- understand the maintain a clean and efficient work place;
- identify the noxious effects of compost, bio-pesticides, parasites and predators;
- understand the safety measures during application of organic manures, bio-pesticides, parasites and predators;
- explain the appropriate emergency procedures – first aid; and
- explain the safety measures for different culture operations.

Notes

13.1 MAINTAIN A CLEAN AND EFFICIENT WORK PLACE

Farmers and workers both share responsibilities for maintaining health and safety in the workplace. The important steps listed below will help to guarantee a secure and healthy workplace (Fig. 13.1).

- **Construct a health and safety policy:** Start by drafting a thorough health and safety policy that explains the farm owner's dedication to provide a secure environment. All workers should be informed of this policy, which should be thoroughly recorded.
- **Risk evaluation:** Conducting routine risk assessments will help you find possible workplace risks. To find possible hazard sources, this entails assessing the physical environment, tools, procedures, and tasks.
- **Education and training:** Workers should get in-depth instruction on safety practices, emergency procedures, and equipment usage. Ensure that workers are aware of the dangers involved with their activities and how to reduce them.
- **Obtaining safety equipment:** Ascertain that every piece of required safety gear, including personal protective equipment (PPE), fire extinguishers, first aid kits, and safety signs, is accessible and in excellent working order.
- **Safety procedures at work:** Set up and enforce safe working procedures. Encourage workers to report events, near-misses, or risky situations. Encourage an environment of honesty and responsibility.
- **Emergency action program:** Create and distribute an emergency action plan that addresses a range of potential situations, such as fires, accidents, natural disasters, and medical crises.
- **Inspections and upkeep on a regular basis:** To detect and address possible dangers, perform routine inspections and maintenance on machinery, equipment, and facilities. Set up these maintenance and inspection chores in advance.
- **Ergonomics:** To lower the risk of musculoskeletal problems and encourage healthy posture at work, think about ergonomics. Workers training and ergonomics equipment should be provided.
- **Stress and mental health:** By encouraging work-life balance, providing counselling or worker support programs, and eradicating sources of workplace stress, Stress and mental health issues are things you can manage.

- **Adherence to regulations:** Keep abreast of and adhere to all relevant health and safety laws and guidelines imposed by regional authorities and organizations focused on a particular sector.
- **Communication:** Maintain open lines of communication about matters of health and safety. Encourage staff to share their problems and ideas for change.
- **Research and reporting:** To identify the underlying causes of accidents or events and stop recurrences, conduct a comprehensive investigation. As required by law, note and report these instances.
- **Managerial and supervisory training:** Give managers and supervisors training so they are knowledgeable about health and safety procedures and can set a good example.
- **Constant development:** The enhancement of health and safety should be continuous. As new hazards arise or as your workplace changes, periodically evaluate and update your policies and procedures.
- **Workers participation:** Include workers in health and safety decision-making processes. They are frequently the ones who know the hazards they confront on a daily basis.
- **Auditing and performance evaluation:** To evaluate the success of your health and safety initiatives, conduct routine audits and performance assessments.

Fig. 13.1: Healthy Workplace for Farming

Source: Getty Images/iStockphoto

Notes

INTEXT QUESTIONS 13.1

True and false

1. All workers should be informed of safety policy (T/F)
2. Conducting routine risk assessments will not help you find possible workplace risks. (T/F)
3. Personal protective equipment is full form of PPE. (T/F)
4. Encourage staff to share their problems and ideas for change will help in safety of work place. (T/F)
5. Workers are frequently the ones who know the hazards they confront on a daily basis. (T/F)

13.2 NOXIOUS EFFECTS

13.2.1 Noxious Effects of Compost

The creation of nutrient-rich soil amendments through the recycling of organic wastes is widely seen as being advantageous and sustainable. However, in some circumstances, composting might have some negative impacts. It's critical to comprehend these possible problems and how to address them:

Odor: Compost piles may release offensive scents, especially if they are not well maintained. Ammonia, sulphur, and other pungent substances can be produced during the decomposition process. Residents close by may find these smells bothersome and file complaints as a result.

Pathogens and pathogen regrowth: Compost occasionally contains dangerous pathogens like *Salmonella* and *E. coli*. These pathogens may persist and provide a concern if the compost is applied to crops or used in gardens if the compost pile does not achieve a high enough temperature throughout the composting process.

Pests and vermin: Rats, mice, flies, and other pests are drawn to compost piles. These pests may even spread illnesses and constitute a nuisance.

Chemical contaminants: Chemical pollutants, such as pesticides or herbicides, can linger in compost and endanger plants or the environment if they are present in the materials that are added to the compost.

Concerns about air quality: Poorly maintained and unaerated compost piles can create dust and particle matter that may have an impact on the air we breathe. This is particularly important for commercial or large-scale composting operations.

Notes

Soil imbalance: Compost overuse can cause soil imbalance, especially if it contains a lot of organic matter. This can hinder plant development by affecting soil nutrient and water retention levels.

Contamination of leachate: If compost heaps are not correctly maintained, leachate (liquid discharge from the compost) might possibly include excessive quantities of nutrients and organic waste, polluting groundwater and surface water.

13.2.2 Noxious Effects of Biopesticide

Compared to chemical pesticides, biopesticides are thought to be more ecologically benign; yet, depending on their use and application, they may still have certain negative impacts. It's critical to comprehend the possible hazards and disadvantages of using biopesticides:

Non-target effects: Biopesticides, like chemical pesticides, may affect non-target organisms such as beneficial insects, birds, or wildlife. For example, some biopesticides can harm pollinators like bees if not applied carefully.

Residue buildup: Biopesticide residue buildup is a possibility, much like with chemical pesticide residues, on crops or in the environment. If used too often, these residues can build up and can harm both the ecology and human health.

Resistance development: Similar to conventional pesticides, some pests may eventually develop a resistance to biopesticides. This may result in decreased efficacy and the requirement for further pest control measures.

Environmental persistence: Although biopesticides are often less environmentally persistent than chemical pesticides, some of them can nevertheless survive and build up over time if applied frequently, which might have long-term ecological implications.

Allergenic and toxic reactions: Some persons may react negatively to the active components of biopesticides due to allergies or sensitivities. These interactions are nevertheless possible, while being less frequent than with chemical pesticides.

Off-target drift: During application, biopesticides may stray from the intended region, potentially harming nearby crops, waterways, or other delicate areas.

Challenges with regulation and certification: In certain areas, biopesticide regulation and certification may be less strict or well-established than it is for conventional pesticides. Variations in product quality and safety may result from this.

Notes

13.2.3 Noxious Effects of Parasites

Disease transmission: Parasites can serve as vectors for various diseases in both wildlife and human populations. For example, ticks and mosquitoes can transmit diseases such as malaria, Lyme disease, and West Nile virus.

Reduced host fitness: Parasites can weaken their host organisms, causing a decline in their overall health and fitness. This can result in reduced reproductive success and survival.

Immuno suppression: Some parasites can suppress the immune system of their hosts, making them more susceptible to secondary infections and diseases.

Behavioural changes: Parasites have the ability to modify their hosts' behavior, leading to altered feeding, reproductive, or migratory patterns, which can negatively impact host populations and ecosystems.

13.2.4 Noxious Effects of Predators

Population decline: In some cases, predators can exert strong pressure on prey species, leading to population declines or even local extinctions of those prey populations.

Alteration of ecosystem structure: The presence of certain predators can lead to shifts in ecosystem structure and composition. Overgrazing or predation by large predators can alter vegetation and affect other species in the food chain.

Human-wildlife conflict: Predators in close proximity to human populations can cause conflicts, including attacks on livestock and pets, which can lead to retaliatory killings of predators.

Disease vectors: Some predators can serve as vectors for diseases. For example, ticks that infest certain predators can transmit diseases to both the predators and, in some cases, humans.

INTEXT QUESTIONS 13.2

Fill in the blank:

1. ..... and ..... pungent substances can be produced during the decomposition process.
2. Compost occasionally contains dangerous pathogens like ..... and .....
3. Non-Target effect of biopesticide happen on pollinators like .....

Notes

4. Ticks and mosquitoes can transmit diseases such as ....., ..., and .....

5. Predation by large predators can alter vegetation and affect other species in the .....

13.3 SAFETY MEASURES

13.3.1 Minimise Noxious Effect of Compost

- To minimize odor issues, regularly turn the compost pile to increase aeration, balance the carbon-to-nitrogen ratio, and avoid adding foul-smelling materials like diseased or rotting food scraps.
- Ensure that your compost reaches the appropriate temperature (ideally 131-170°F or 55-77°C) for an extended period to kill off potential pathogens. Avoid composting materials like pet waste and diseased plant material.
- Use a closed or covered composting system to deter pests. Avoid adding meat, dairy, or other highly attractive food scraps to the compost pile.
- Be cautious about what materials you add to your compost pile. Avoid adding materials that have been treated with chemical pesticides or herbicides.
- Properly manage the compost pile by turning it regularly and using appropriate aeration techniques. Large-scale composting operations may need additional equipment to manage air quality.
- Ensure that you use compost as a soil amendment in appropriate quantities and in combination with other soil amendments to maintain soil balance.
- Use a system to collect and manage leachate, or place the compost pile on an impermeable surface with proper drainage to prevent leachate from entering water sources (Fig. 13.2).

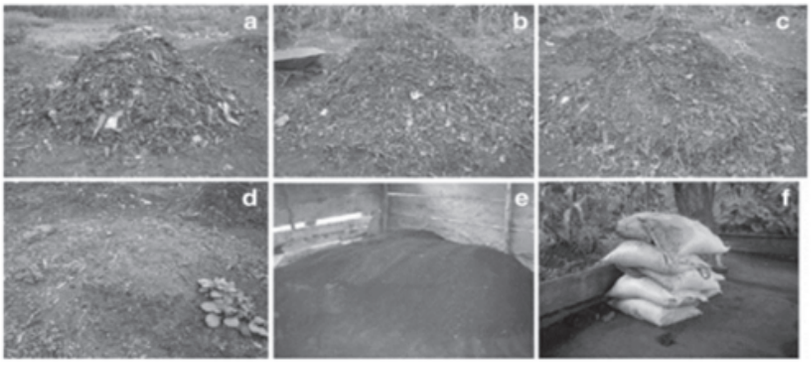


Fig. 13.2: Different Stage of Composting

Notes

13.3.2 Minimise Noxious Effects of Biopesticide

- Careful application methods, including targeted spraying and timing that minimizes harm to non-target species, can help reduce these effects. Following recommended guidelines for biopesticide use is essential.
- Rotating different biopesticides with different modes of action can help delay resistance development. Integrated pest management (IPM) strategies that combine various pest control methods, including biopesticides, can be effective.
- Use biopesticides judiciously and consider their persistence characteristics when selecting products. Monitoring environmental impacts and adjusting usage accordingly is important.
- Use appropriate personal protective equipment when handling and applying biopesticides. Follow safety guidelines provided by the manufacturer.
- Ensure that application equipment is properly calibrated and that wind speed and direction are taken into account to minimize drift. Follow label instructions for application.
- Choose biopesticides that have been approved by relevant regulatory authorities and adhere to established certification standards. Verify the credentials and reputation of the manufacturer or supplier.

13.3.3 Minimise Noxious Effects of Parasites

- Disease management strategies, such as vaccination, use of insect repellents, and habitat modification to reduce vector breeding sites, can help mitigate the risk of disease transmission.
- Enhanced host health through proper nutrition, disease management, and habitat restoration can mitigate the impact of parasites.
- Monitoring host populations and providing veterinary care or medical treatment in the case of domesticated animals can help to reduce immuno suppression.
- Understanding and studying these behavioral changes can help to develop strategies to mitigate their impact, such as habitat management.

13.3.4 Minimise Noxious Effects of Predators

- Predation management strategies may be necessary to protect endangered species or maintain ecological balance.

Notes

- Ecosystem management, habitat restoration, and controlled predator populations can help to mitigate such effects.
- Implementing strategies such as improved animal husbandry practices, predator deterrents, and community education can help to reduce human-wildlife conflicts.
- Disease management strategies, such as tick control measures, can help to mitigate the risk of disease transmission.

INTEXT QUESTIONS 13.3

Fill in the blank:

1. For composting appropriate temperature ..... or ..... is required to kill off potential pathogens.
2. IPM stands for .....
3. ..... is important to reduce vector breeding sites.

13.4 APPROPRIATE EMERGENCY PROCEDURES–FIRST AID

The urgent treatment given to an ill or injured individual is known as first aid. It could be the only care a person requires in some circumstances. In other cases, first aid is a means of keeping a person alive and preventing their condition from getting worse until paramedics arrive or until they are transferred to the hospital (Fig. 13.3).

Getting formal first-aid training is the greatest approach to get ready for these situations. You can learn some simple life-saving techniques in the meanwhile.

This article discusses how to administer first aid in ten different scenarios and how to determine whether more treatment is required.

Fig. 13.3: Basic Tools for First Aids

Source: https://dattmedi.com/blog/understanding-the-basics-of-first-aid/

Notes

13.4.1 The First Aid ABCs

The ABC rule of first aid applies if a person is unconscious or unresponsive: airway, breathing, and circulation.

Airway: The first thing you should do if someone isn't breathing is to open up their airway. When someone's airway has been opened but they are still not breathing, give them rescue breathing.

Keep the person's blood flowing by using chest compressions while performing rescue breathing. Check the pulse if the person is not responding but is breathing. Do chest compressions if their heart has stopped.

13.4.2 First Aid for a Stopped Heart

One of the most crucial emergency medical techniques a person may know is cardiopulmonary resuscitation (CPR) (Fig. 13.4).

A person may pass away if their heart stops beating. CPR and/or the use of an Automated External Defibrillator (AED) may be able to preserve a person's life while they are experiencing cardiac arrest.

Many public spaces and companies have AEDs on hand. Even if you have no experience, using these first aid tools is simple.

What to Do?

- If you think someone is in cardiac arrest, there are four steps you can take to help them,
- Identify a close individual. "Make eye contact."
- Start doing chest compressions to the assistance recipient. Push down quickly and forcefully in the middle of the person's chest with both of your hands.
- Allow their chest to naturally rise up after compressions. Pops or cracks may be audible; this is typical.
- Continue until someone with greater experience shows up.
- If you have training in CPR, you are able to provide rescue breathing and chest compressions.
- Utilize an AED if one is available.
- Do not delay performing chest compressions in order to find an AED, though.
- Give someone else the task of locating the gadget and bringing it to you if at all feasible.

Notes

Fig. 13.4: Cardiopulmonary Resuscitation (CPR)

13.4.3 First Aid for Bleeding

There are a few fundamentals about how blood functions that will be useful for you to know if someone is hurt and bleeding.

You can gauge the severity of the injury from the color and flow of the blood exiting the body:

Capillaries: The tiniest blood vessels, or capillaries, seem to drip while someone is bleeding. Usually, bleeding of this nature ends on its own.

Veins: Blood that flows steadily and has a dark red hue is probably coming from the veins. Mild to severe bleeding can occur with this type of hemorrhage.

Arteries: The biggest blood vessels and the ones that carry the most oxygen are the arteries. They will bleed bright crimson if they are damaged. With this type of bleeding, blood loss can happen extremely quickly.

What to Do?

While it is important to stop bleeding, begin with the ABCs of first aid.

The subsequent actions are:

- If you have disposable gloves, put them on or wash your hands. This will shield you against contagious illnesses that can be transmitted through a person's blood, such as viral hepatitis and HIV/AIDS.

Notes

- Water-rinse the wound.
- Use gauze or a fabric to cover the wound, such as a towel, blanket, or piece of clothing.
- To block the flow of blood and promote clotting (when blood spontaneously hardens to reduce blood loss), apply direct pressure.
- If you can, raise the area of the body that is bleeding above the person's head.
- If the cloth gets wet, do not remove it. The clotting process will be hampered by removing the top layer, increasing blood loss. Instead, if more layers are required, add them.

13.4.4 First Aid for Choking

When food or an item blocks a person's windpipe (trachea), they might choke. It is a grave incident that has the potential to cause unconsciousness or perhaps death.

Signs of choking include:

- Gagging, gasping, or wheezing
- Inability to talk or make noise
- Turning blue in the face
- Grabbing at the throat
- Waving arms
- Looking panicked

What to Do?

Here are the steps:

- Stand behind the person and lean them slightly forward.
- Put your arms around their waist.
- Clench your fist and place it between their belly button (navel) and rib cage.
- Grab your fist with your other hand.
- Pull your clenched fist sharply backward and upward under the person's rib cage in five quick thrusts.
- Repeat until the object is coughed up.

For someone who is obese or pregnant, perform the thrusts around the chest instead of the abdomen.

Notes

13.4.5 First Aid for Burns

The first step to treating a burn is to stop the burning process.

This might mean:

- Cleaning up chemicals
- Turning off electricity
- Cooling heat with running water
- Covering up or taking a person inside out of the sun

A burn's severity is determined by its size and depth in the skin:

First-degree burn: First-degree burns only harm the skin's surface layer and result in redness and oedema. It's regarded as a small burn.

Second-degree burn: This type of burn results in blistering, redness, and oedema and damages two layers of skin. If a burn is more than 3 inches broad, on the face, hands, feet, genitalia, buttocks, or over a significant joint, it is classified as a large burn.

Third-degree burns: These burns impact the deeper skin layers and result in white or blackened, often numb, skin. It is always regarded as a serious burn.

First-degree burn:

For burns that are not an emergency, you can take these first aid steps:

- Flush the burned area with cool running water for several minutes. Do not use ice.
- Apply a light gauze bandage. If the burn is minor, you can put on an ointment, like aloe vera, before you cover it.
- Take Motrin (ibuprofen) or Tylenol (acetaminophen) for pain relief if you need it.
- Avoid breaking any blisters that develop.

13.4.6 First Aid for Blisters

Blisters protect damaged skin while it heals.

Some blisters need to be treated and others don't. Whether you need to treat a blister depends on how bad it is and your overall health.

Notes

What to Do?

Here are the first-aid steps to take for a more serious blister:

- Wash your hands.
- Sterilize a needle with alcohol.
- Make small holes at the edge of the blister.
- Gently push out the fluid.
- Apply antibiotic ointment.
- Put on a bandage.
- If possible, take steps to protect the area from further rubbing or pressure.

13.4.7 First Aid for a Broken Bone or Fracture

Any injury to your limbs, hands, and feet needs to be treated as a broken bone until an X-ray can be done.

What to Do?

- The person is bleeding a lot, is unresponsive, is not breathing, or has more than one injury.
- You think a person has a fracture or other serious injury in their spinal column, head, hip, pelvis, or thigh. In this case, do not move the person.
- A broken bone is poking through the skin (open or compound fracture).
- The area below an injured joint feels cold and clammy or looks bluish.
- You cannot keep the injury from moving well enough to transport the person.

13.4.8 First Aid for Bee Stings

Bee stings can hurt a lot but are only a minor problem for many people. However, for people who are allergic to bee venom, a sting can be deadly.

Signs of an allergic reaction to a sting include:

- Swelling away from the area that was stung
- Flushing
- Hives (raised, large red or skin-colored bumps)
- Itching
- Signs of anaphylaxis

Notes

What to Do?

Get the stinger out immediately. This will prevent additional venom from getting into the person. To remove a stinger, it is best to use a straight-edged object such as a credit card to scrape the stinger out of the skin. Avoid squeezing the venom sac with tweezers or your fingers, as this can inject venom into the skin.

- Wash the area with soap and water.
- Use a cold pack to help with the swelling at the site; however, do not apply ice directly to the skin.
- Use an allergy medication or antihistamine (like Benadryl) to reduce swelling and itching.
- Use Tylenol (acetaminophen) or Advil (ibuprofen) for pain.

13.4.9 First Aid Kit List

A basic first-aid kit should contain:

- Adhesive bandages in multiple sizes and shapes
- Gauze pads in multiple sizes
- Compress dressings
- Adhesive cloth tape
- A roll of gauze
- Latex gloves
- Antiseptic wipes
- Antibiotic ointment
- Hydrocortisone ointment
- A breathing barrier for performing CPR
- An instant cold compress
- Baby aspirin
- Tweezers
- An oral thermometer
- An emergency blanket

Notes

INTEXT QUESTIONS 13.4

True and false:

1. The ABC rule of first aid applies if a person is unconscious or unresponsive: airway, breathing, and circulation. (T/F)
2. CPR stands for cardiopulmonary resuscitation. (T/F)
3. AED stands for automated external defibrillator. (T/F)
4. Blood that flows steadily and has a dark red hue is probably coming from the veins. (T/F)

WHAT YOU HAVE LEARNT

Let us recapitulate and enlist the salient points that you have learnt through this lesson:

- Employers and workers both share responsibilities for maintaining health and safety in the workplace.
- All workers should be informed of this policy, which should be thoroughly recorded.
- Workers should get in-depth instruction on safety practices, emergency procedures, and equipment usage.
- Emergency Action Program is needed forsuch as fires, accidents, natural disasters, and medical crises.
- Workers Participation is needed for health and safety decision-making processes.
- Noxious effects of compost are odor, pathogens and pathogen regrowth, pests and vermin, chemical contaminants, concerns about air quality, soil imbalance and contamination of leachate.
- Biopesticides, like chemical pesticides, may affect non-target organisms such as beneficial insects, birds, or wildlife.
- Noxious effects of parasites are disease transmission, reduced host fitness, immuno suppression, and behavioral changes.

Notes

- Noxious effects of predators are population decline, alteration of ecosystem structure, human-wildlife conflict, and disease vectors.
- Use a closed or covered composting system to deter pests. Avoid adding meat, dairy, or other highly attractive food scraps to the compost pile.
- Be cautious about what materials you add to your compost pile. Avoid adding materials that have been treated with chemical pesticides or herbicides.
- Properly manage the compost pile by turning it regularly and using appropriate aeration techniques.
- Ensure that application equipment is properly calibrated and that wind speed and direction are considered to minimize drift.
- Disease management strategies are such as vaccination, use of insect repellents, and habitat modification to reduce vector breeding sites, can help mitigate the risk of disease transmission.
- One of the most crucial emergency medical techniques a person may know is cardiopulmonary resuscitation (CPR).
- The biggest blood vessels and the ones that carry the most oxygen are the arteries.
- Signs of choking include aregagging, gasping, or wheezing, inability to talk or make noise, turning blue in the face, grabbing at the throat, waving arms, looking panicked.

TERMINAL EXERCISE

1. How can we maintain a clean & efficient work place?
2. What is different noxious effect of compost?
3. What are the non-target effects?
4. List out 5 major noxious effect of parasites and predators.
5. How to manage noxious effect of compost?
6. What is first aid ABCs?
7. What to do when heart stopped?
8. What are signs of choking?
9. Write the name of the articles in first aid kit.

Notes

ANSWER OF INTEXT QUESTIONS

13.1

1. True 2. False 3. True 4. True 5. True

13.2

1. Ammonia and sulfur
2. *Salmonella* and *E. coli*
3. Bees
4. Malaria, Lyme disease, and West Nile virus.
5. Food chain.

13.3

1. 131-170°F or 55-77°C
2. Integrated pest management.
3. Habitat modification

13.4

1. True 2. True 3. True 4. True

Key Learning Outcomes

Learner will be able to:

- State the measures that can be taken to prevent accidents and damages at the workplace
- State common health and safety guidelines to be followed at the workplace
- Explain the common first aids for common problem associated with workplace.

Notes

14

EMPLOYABILITY SKILLS

In the last lesson, we studied about health & safety issues while working on farms and in industry. In this lesson, we will study- how to get good employable skills so that we can work in industries? Employability refers to a person's ability to get and keep a job. It includes the abilities, knowledge, attitudes, and personal characteristics that make people appealing to employers and boost their chances of getting and keeping a job. Employability is critical in today's competitive job market for both job seekers and those who are currently employed, as it determines career progression, job security, and overall professional success.

Employability is not exclusively determined by academic credentials or technological expertise. It also includes a variety of transferrable talents, known as "soft skills," such as communication, teamwork, problem-solving, flexibility and leadership. Employers place a high value on these abilities because they contribute to an individual's capacity to collaborate successfully with others, deal with obstacles, and continually learn and grow in a quickly changing work environment.

Further more, a person's motivation to learn and acquire new abilities, as well as their ability to effectively promote themselves to employers, impact employability. This includes creating an eye-catching resume, emphasizing relevant experiences, and presenting oneself confidently during interviews. Having a professional network, participating in continuous learning opportunities and remaining alert with all industry advancements are critical to improving employability.

Employability has evolved in recent years to include a focus on entrepreneurial skills and a desire to take initiative. Employers are increasingly looking for people who can think creatively, spot possibilities and bring unique ideas to their organizations. This entrepreneurial mentality exhibits a proactive attitude towards work as well as the capacity to adapt to new difficulties and possibilities.

Notes

OBJECTIVES

After reading this lesson you will be able to:

- understand the consumers' and business people's legal rights;
- describe how communication works in a business setting; and
- identify the critical processes involved in creating goals.

14.1 CONSTITUTIONAL VALUES-CITIZENSHIP

Citizenship principles are established in the Indian Constitution (Fig. 14.1), notably in Part II (Citizenship) and Part III (Fundamental Rights). These ideals emphasize equality, liberty, justice and dignity for all citizens. Here are some major constitutional ideals of Indian citizenship:

- **Equality:** The Constitution ensures equality for all people, regardless of caste, religion, gender or place of birth. The equality principle assures that every citizen is treated equally and given equal legal opportunities and protection.
- **Liberty:** Indian citizens have the right to personal freedoms and liberties. Individual liberties such as freedom of speech and expression, freedom of religion, freedom of movement, and the right to life and personal liberty are all protected by the Constitution.
- **Justice:** The values of social, economic, and political justice are promoted by the Indian Constitution. It assures citizens access to a fair and impartial legal system, as well as their protection against discrimination, exploitation and arbitrary acts.
- **Dignity:** The Constitution recognises every citizen's inherent dignity and value. It outlaws all forms of inhuman or humiliating treatment and guarantees that citizens are treated with dignity and respect.
- **Sovereignty and patriotism:** The Indian Constitution supports the country's sovereignty and expects citizens to be loyal to the country. It emphasises the value of patriotism and citizens' responsibility to contribute to the country's well-being and prosperity. India is a secular country, and the Constitution encourages religious tolerance and respect for all religions. It protects citizens' right to practice and promote their faith while ensuring communal peace and an inclusive atmosphere.

- **Social Justice:** The Constitution emphasises the importance of social justice and supports the values of equality, non-discrimination, and affirmative action in order to help under privileged and marginalised members of society. It seeks to bridge social and economic gaps and foster a fairer society.

Fig. 14.1: Constitution of India

Source: https://www.jatinverma.org/

These constitutional concepts of citizenship serve as the foundation for Indian citizens' rights, obligations, and responsibilities. They embody the democratic and inclusive values upon which the Indian country is established, and they influence the operation of the government as well as people' relationships with the state.

14.2 BECOME A PROFESSIONAL IN 21ST CENTURY

To flourish in a fast-changing environment, becoming a professional in the twenty-first century necessitates a mix of knowledge, skills and flexibility. Here are some suggestions to help you become a professional in the twenty-first century (Fig. 14.2).

- **Determine your passions and goals:** Consider your hobbies, values, and long-term work goals. Determine your areas of interest and make specific goals for your career growth.
- **Continuous learning:** Adopt a philosophy of lifelong learning. Maintain your curiosity and aggressively seek opportunities to gain new information and abilities. Keep up to speed on industry developments and breakthroughs, and consider formal education, online courses, workshops, and conferences as learning opportunities.
- **Develop transferable talents:** Focus on establishing transferable talents that are highly appreciated across sectors in addition to specialised knowledge. Communication, critical thinking, problem solving, flexibility, teamwork,

Notes

leadership, and technology literacy are among them. These abilities will boost your employability and assist you negotiate a variety of job contexts.

Fig. 14.2: Professional in 21st Century

Source: https://www.ict360.com/

- **Embrace technology:** Technology is important in the contemporary workplace. Keep up with technological advances, improve your digital literacy, and learn how to use technology to boost your productivity, communication, and problem-solving skills.
- **Develop a professional network:** Make significant connections with professionals in your field of interest. Attend industry events, join professional organisations, and participate in online and offline networking opportunities. Mentorship, direction, and future job possibilities may all be obtained through a strong professional network.
- **Gain practical experience:** Look for internships, part-time employment or volunteer opportunities in the sector you want to work in. Practical experience not only improves your abilities but also gives essential insights into the workplace and aids in the development of a professional track record.

- **Create a professional brand:** Establish a professional internet presence using platforms such as LinkedIn. Display your abilities, expertise and accomplishments. For every opportunity, develop an engaging resume and cover letter that highlights your special selling point.
- **Adaptability and resilience:** The workplace of the twenty-first century is marked by fast change and instability. Increase your adaptability, flexibility, and resilience. To stay ahead in your area, be open to new challenges, embrace change, and always learn and improve.
- **Recognise the value of diversity and inclusion in the workplace:** Recognise the value of diversity and develop cultural knowledge, promote inclusion, and learn to collaborate with individuals from all backgrounds.
- **Professional ethics:** Maintain high ethical standards in your professional interactions. In your relationships with co-workers, clients, and stakeholders, demonstrate integrity, honesty, and responsibility.

14.3 BASIC ENGLISH SKILLS

For various reasons, basic English abilities are critical to employability. Here are some significant points emphasising the significance of English abilities in the workplace:

- **Communication:** English is often considered as the global business and communication language. English proficiency allows for successful communication with colleagues, clients and stakeholders from various backgrounds. It promotes clear and succinct articulation of ideas, instructions and information in the workplace, creating improved cooperation, collaboration and comprehension.
- **Job applications and interviews:** Fluency in desired language is required for job applications and interviews, particularly in international corporations or sectors with a global presence. A well-written resume and cover letter show professionalism and attention to detail. The ability to explain concepts and reply convincingly during interviews increases your chances of impressing potential employers.

  Effective communication becomes increasingly vital as people advance in their jobs. It is frequently required for managerial or leadership positions where workers are expected to successfully communicate with teams, clients and senior management. Strong communication abilities can lead to more senior roles and professional prospects.

Notes

- **Global workforce:** Many businesses operate in world-wide marketplaces and have varied teams made up of people from various language backgrounds. Within such organisations, English is used as a common language for communication. Employees who are fluent in English can navigate and contribute successfully in a global workforce.

  English is the major language used in many professional materials, such as books, journals, research papers, and online learning platforms. Individuals with strong English abilities may access and exploit these resources for ongoing learning, professional growth, and staying current on industry trends.

- **Customer service and client relations:** Interacting with English-speaking consumers or clients is wide spread in areas such as hospitality, tourism, and customer service. Employees with strong English abilities may provide outstanding customer service, answer enquiries, and create relationships with clients, increasing customer satisfaction and the company's reputation.

- **International assignments and travel:** English proficiency is especially important for people who work on international assignments, travel for business, or work in expatriate jobs. It promotes successful partnerships and corporate interactions by enabling efficient communication and adaption in foreign contexts.

  It is vital to highlight that basic English abilities serve as a foundation, while advanced English proficiency can improve employability and career prospects even more. Employers frequently favour individuals with high English communication skills because they are perceived as more adaptive, globally competent, and capable of contributing successfully in a varied and interconnected environment.

14.4 CAREER DEVELOPMENT AND GOAL SETTING

Career development and goal planning are critical procedures that help people prepare for and accomplish their professional goals. Here are some strategies to support your goal-setting and career development (Fig. 14.3).

- **Self-assessment:** To begin, consider your hobbies, values, strengths, and limitations. Consider your interests, talents and what inspires you. Consider your long-term professional objectives and ambitions. Understanding yourself will assist you in aligning your employment options with your values and skills.

Notes

Fig. 14.3: Career Development and Goal Setting

Source: https://www.chemeketa.edu/

- **Investigate job options:** Conduct study and look at numerous job options that match your interests and ambitions. Learn about various sectors, career positions, and the necessary skills and requirements. To obtain direct knowledge and insights into various occupations, seek out informative interviews, work shadowing or internships.
- **Set SMART goals:** Specific, Measurable, Achievable, Relevant, and Time-bound goals. Define particular professional goals that are both reasonable and feasible. Instead of declaring, "I want to work in marketing," a SMART goal may be, "I want to secure a marketing coordinator position within the next two years in a consumer goods company."

Notes

- **Create a career plan:** Make a thorough career plan outlining the measures you need to follow to reach your goals. Divide your long-term ambitions into smaller, more manageable benchmarks. Determine what talents, knowledge, or experiences you will need to gain along the road. Set deadlines for completing each milestone.
- **Develop your skills and knowledge:** Identifying the abilities and knowledge essential for your preferred professional path. Determine whether any more credentials, certifications, or degrees are required. Look for ways to improve your skills, such as online courses, workshops, seminars, or mentoring programmes. To remain competitive in your chosen sector, you must constantly update and improve your abilities.
- **Networking and mentorship:** Create a professional network of connections in your chosen sector. Attend industry events, join professional organisations, and network with others on networks such as LinkedIn. Seek for mentoring from seasoned professionals who can offer direction, advice, and support throughout your career.
- **Gain relevant experience:** Look for internships, part-time work, or volunteer activities that will allow you to gain hands-on experience in your chosen industry. Practical experience is important for acquiring sector-specific skills and generating contacts in your chosen field.
- **Review and adjust:** Review and reassess your professional objectives and success on a regular basis. Adjust your career strategy as required to reflect changing circumstances or new possibilities that occur. Continue to be versatile and open to new opportunities.
- **Seek feedback:** To acquire insights into your strengths and places for progress, seek feedback from mentors, supervisors or trustworthy co-workers. Use constructive comments to advance your professional development.
- **Milestones should be evaluated and celebrated:** Regularly assess how well you're doing in achieving your objectives. Celebrate your accomplishments and milestones along the road to keep motivated and cheerful.

Keep in mind that professional growth and goal-setting are continual activities. As your interests and circumstances change, examine and adjust your objectives on a regular basis. To effectively manage your job path, you must be proactive, motivated, and open to learning.

Notes

INTEXT QUESTIONS 14.1

1. The Constitution ensures equality for all people, regardless of caste, religion, gender, or place of birth. (T/F)
2. The Constitution emphasises the importance of social justice and supports the values of equality, non-discrimination, and affirmative action in order to help underprivileged and marginalised members of society. (T/F)
3. Technology is important in the contemporary workplace. (T/F)
4. English is used as a common language for communication at global workforce. (T/F)
5. Self-Assessment begin with consider your hobbies, values, strengths, and limitations. (T/F)

14.5 COMMUNICATION SKILLS

Improving communication skills is critical for employability since good communication is important in many facets of the job. Here are some things you can do to improve your communication skills (Fig. 14.3).

Develop active listening skills by paying close attention to the speaker, keeping eye contact, and avoiding distractions. To display your interest, concentrate on understanding the material being delivered, asking clarifying questions and providing relevant comments.

- **Improve your verbal communication:** Take note of your public speaking abilities. Practice utilizing proper tone and loudness, as well as clarity and articulation. When interacting with diverse audiences, use succinct and organised language, avoiding jargon or complicated terminology. To enhance your delivery, practice speaking in front of a mirror or with a trusted buddy on a regular basis. Non-verbal signals, such as body language, facial emotions, and gestures, have a substantial influence on communication. Keep an open and positive body posture, keep eye contact, and utilise suitable hand motions to reinforce your message.
- **Improve your written communication:** In professional contexts, written communication is vital. Practice grammar, sentence structure, and vocabulary to improve your writing abilities. Examine your written communication for clarity, conciseness, and organisation, whether it's in emails, reports, or other written materials.

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- **Develop your presentation skills:** Giving presentations is a typical responsibility in many organisations. Develop your presenting abilities by rationally arranging your topic, effectively employing visual aids, and engaging the audience via your delivery. To find areas for development, practice in front of a small group or video recording yourself.
- **Develop empathy and emotional intelligence:** Understanding and empathising with the viewpoints and feelings of others is essential for effective communication. Actively listening, observing non-verbal signs, and responding empathetically to people will help you develop your emotional intelligence. This promotes greater professional ties and understanding.

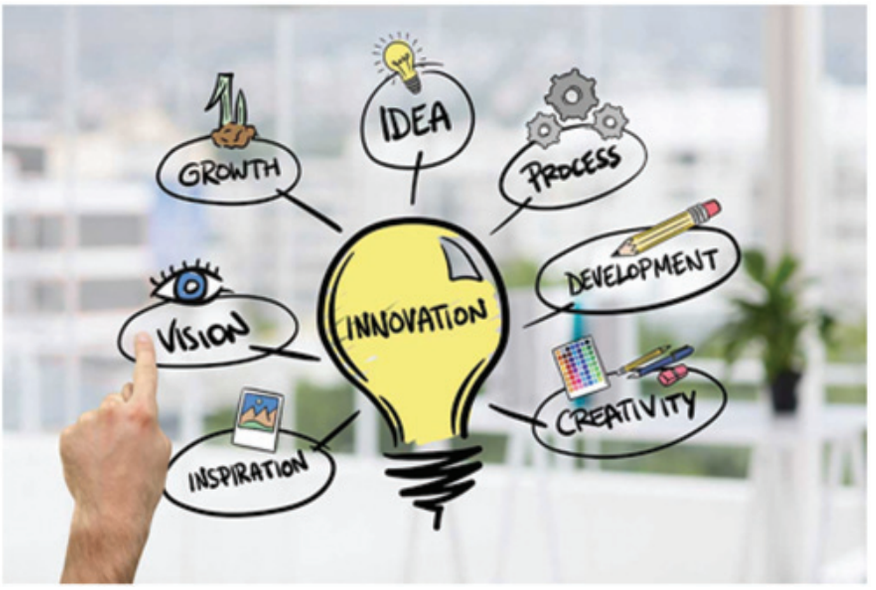

Fig. 14.4: Creative or Innovative

Source: https://blog.webit.org/

- **Seek feedback:** Actively seek feedback on your communication abilities from co-workers, bosses or mentors. Request specific areas for improvement and actively implement their ideas.
- **Continuous learning:** Stay update on communication trends and approaches by reading books, articles, or using internet resources. Attend courses or training sessions aimed at improving communication skills. Maintain your curiosity and look for opportunities to learn and improve your communication skills.
- **Participate in group activities:** Participate in group activities or team initiatives that need teamwork and efficient communication. This allows you

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to practice working with varied people, actively providing ideas, and constructively resolving problems.

- **Develop confidence:** Confidence is essential for good communication. Before significant talks or presentations, practice and prepare thoroughly. Make use of positive self-talk and visualization strategies, and look for opportunities to practice your communication abilities in a variety of circumstances.

Keep in mind that strengthening communication skills requires time and practice. Be patient with yourself and commit to continuous improvement. You improve your employability and become a more successful and impactful professional by always honing your communication skills.

14.6. DIVERSITY AND INCLUSION

Diversity and inclusion contribute significantly to employability by establishing a more inclusive and equitable work environment. Here are a few examples of how diversity and inclusion affect employability.

- **Access to a broader talent pool:** Organisations may tap into a bigger talent pool by embracing diversity and inclusion practices. Employers boost their chances of discovering highly talented employees with unique experiences and ideas by aggressively pursuing applicants from varied backgrounds, including those of different races, genders, ages, abilities, and cultural viewpoints.
- **Innovation and creativity: A** varied and inclusive workforce brings together people from various backgrounds, viewpoints, and ways of thinking. This variety of views promotes organisational innovation and creativity. When people from different backgrounds work together, they bring a broad set of ideas, problem-solving methodologies, and insights to the table, resulting in more inventive solutions and a competitive edge in the market.
- **Improved decision-making:** Diverse opinions and view points are encouraged to be heard in inclusive work settings. When employees from varied backgrounds are given a place at the table and their ideas are appreciated, better decisions are made. Diverse views aid in the identification of blind spots, the testing of assumptions, and the consideration of a larger variety of considerations, resulting in better informed and successful decision-making.
- **Enhanced problem-solving and adaptability:** Employees in inclusive work settings are more likely to collaborate and work together. When various

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people work together to solve challenges, they bring a variety of talents, expertise, and experience to the table. This collective diversity of abilities and viewpoints helps organisations to more successfully manage difficult issues and adapt to changing market conditions.

- **Increased employee engagement and retention:** Employee engagement and work satisfaction increase when they feel included, appreciated, and valued for their unique contributions. Inclusive environments foster a sense of belonging and psychological safety, allowing employees to be their true selves at work. This good work atmosphere increases employee retention, decreases turnover, and attracts top talent looking for inclusive environments.
- **Expanded market reach and customer satisfaction:** Organisations that are diverse and inclusive are better able to comprehend and serve a wide range of customers. Companies may produce goods, services, and marketing tactics that appeal to a wider spectrum of customers by reflecting the diversity of their customers. As a result, consumer happiness and loyalty rise.
- **Reputation and employer branding:** Organisations that prioritise diversity and inclusion are more likely to have a favourable reputation and effective employer branding. They are viewed as progressive, socially responsible and appealing to job searchers who appreciate diversity and inclusive workplaces. This reputation can assist the organisation to acquire top people and boost its overall competitiveness.

14.7 FINANCIAL AND LEGAL LITERACY

14.7.1 Financial Literacy

Financial literacy is important for employment because it provides individuals with the information and skills needed to handle their finances successfully. Here are among the most significant ways that financial literacy affects employability (Fig. 14.5).

- **Budgeting and money management:** Financial literacy teaches people the significance of budgeting and how to manage their income and spending. Individuals may better manage their personal finances by learning how to develop a budget, analyse costs, and make educated financial decisions. This includes living within their means, saving money, and avoiding debt. These abilities are required for individuals to exhibit financial responsibility and stability, which employers strongly respect.

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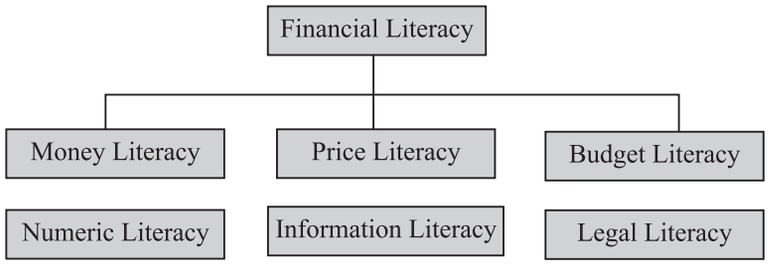

Fig. 14.5: Flow Chart of Financial Literacy

- **Salary negotiation and benefit optimization:** Financial literacy enables people to properly negotiate their salary and grasp the worth of employee perks. Individuals who understand industry norms, the cost of living and the effect of perks such as health insurance, retirement plans and stock options may make educated judgements during job interviews and maximise their remuneration packages. Individuals with this understanding may fight for fair and competitive remuneration, which is critical for financial stability and overall job satisfaction.

- **Debt management and credit worthiness:** Financial literacy teaches people how to handle debt responsibly and keep excellent credit. Understanding topics like interest rates, credit ratings, and debt repayment plans enables people to make educated decisions about borrowing money, using credit cards, and repaying loans. Individuals improve their financial stability and raise their chances of being perceived as trustworthy and responsible by future employers by efficiently managing their debt and keeping good credit.

- **Entrepreneurship and financial decision-making:** Financial literacy is especially crucial for people who want to be entrepreneurs or establish their own firms. It teaches the information and skills required to manage firm finances, such as budgeting, cash flow management, financial forecasting, and capital access. Financial literacy enables entrepreneurs to make solid financial decisions, reduce risks, and handle the financial hurdles of beginning and sustaining a firm.

- **Job mobility and professional development:** Financial literacy may help with job mobility and career progression. Individuals may have the confidence to explore new employment prospects, negotiate higher compensation, or engage in professional growth when they understand their financial condition and make educated judgements. Individuals with financial literacy are better able to make smart job choices and take advantage of opportunities that correspond with their financial goals.

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14.7.2 Legal Literacy

Legal literacy, or an individual's grasp of legal rights, obligations, and processes, is important for employment. Here are some of the most important ways that legal knowledge affects employability (Fig. 14.6).

- **Employment rights and protections:** Legal literacy enables individuals to understand their employment rights and protections. Individuals can exercise their rights and fight for fair treatment in the workplace if they are aware of labour laws, employment contracts, minimum wage requirements, working hour limitations, and anti-discrimination legislation. This awareness aids individuals in navigating job relationships, effectively resolving disagreements and protecting themselves from potential workplace breaches.

Fig. 14.6: Legal literacy an effective tool to control violence

Source: https://twocircles.net/

- **Compliance and ethical behaviour:** Legal literacy fosters a corporate culture of compliance and ethical behaviour. Individuals who are knowledgeable of the rules and regulations that govern their sector are more likely to adhere to ethical standards, avoid unlawful acts, and make judgements that are in accordance with legal requirements. Employers appreciate individuals who display a strong dedication to legal and ethical behaviour since it adds to a healthy work environment and the organization's reputation.

- **Contract negotiation and comprehension:** Legal literacy helps people to understand employment contracts and other legal agreements connected to their jobs. Individuals may negotiate favourable terms and ensure their rights are protected by understanding the terms, conditions and duties specified in

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contracts. This expertise is especially useful for those in management or executive roles who may be engaged in contract negotiations or have control of contractual agreements.

- **Intellectual property protection:** Legal literacy is essential for those who work in areas that include intellectual property, such as technology, media, or creative industries. Individuals who understand copyright, trademarks, patents, and trade secrets are better able to preserve their intellectual property rights. This awareness enables employees to respect and protect intellectual property rights, adding to the organization's overall competitiveness and success.
- **Workplace health and safety rules:** Legal literacy involves understanding workplace health and safety standards. Understanding safety regulations, danger identification, and reporting processes aids in maintaining a safe workplace and preventing workplace accidents or injuries. Employers appreciate workers that prioritize workplace safety and contribute to a positive culture.
- **Dispute resolution and legal recourse:** Legal literacy provides persons with an understanding of legal procedures and dispute resolution possibilities. When workplace problems emerge, employees who understand their legal choices, such as mediation, arbitration, or litigation, may make educated judgements about seeking legal redress if necessary. This awareness enables individuals to safeguard their rights and seek legal solutions.
- **Compliance with regulatory requirements:** Legal literacy is especially crucial in regulated businesses where specific rules and regulations must be followed. Finance, healthcare, and environmental services are examples of such industries. Individuals who are familiar with industry-specific legislation can help to ensure compliance, mitigate risks, and prevent legal ramifications for themselves and their organisations.

INTEXT QUESTIONS 14.2

Fill in the blank:

1. Develop **.....** skills by paying close attention to the speaker, keeping eye contact and avoiding distractions.
2. Budgeting, money management, salary negotiation and benefit optimisation are come under **.....**

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3. Employment rights, protections, compliance and ethical behaviour are come under .....
4. Social media helpful for community development, ..., and .....
5. Legal literacy is essential for those who work in areas of ....., ... or .....

14.8 ESSENTIAL DIGITAL SKILLS

Nowadays, people in a wide range of fields and professions find it increasingly necessary to have specific digital abilities. The following are some fundamental digital abilities that are helpful in many situations:

- **Basic computer literacy:** Basic computer literacy refers to the ability to use computers, navigate an operating system, use a web browser, organise files and directories and perform simple troubleshooting.
- **Internet navigation and search:** Internet navigation and search are essential for discovering pertinent information and making the most of online resources. These skills include how to conduct efficient online searches, assessing the reliability of sources, and moving around websites and web pages.
- **Email communication:** Email remains the primary means of personal and professional communication. Effective communication requires a variety of abilities, including the ability to write and send emails, manage email accounts, organise folders, and comprehend email etiquette.
- **Digital Security and Privacy:** Securing digital identities and preserving privacy online requires an understanding of the fundamentals of online security, such as password management, spotting phishing scams, and securing personal information.
- **Online collaboration and communication tools:** Effective teamwork and distant collaboration need the use of digital collaboration tools, including as video conferencing platforms, project management software, shared document editing tools, and instant messaging programmes.
- **Digital research and information evaluation:** It is crucial for academic endeavours, professional research, and decision-making to be able to quickly obtain information from digital sources, critically assess its veracity and credibility and synthesise pertinent data.

- **Digital creativity and content creation:** This skill can improve one's capacity to articulate ideas, captivate audiences, and effectively communicate in the digital sphere. These skills include graphic design, photo and video editing, audio production, and basic coding.
- **Data literacy and analysis:** As data become more accessible, it is becoming increasingly important to be able to comprehend, examine, and evaluate data sets. Making educated decisions and spotting patterns and trends can be aided by knowledge of data visualisation, data analysis software and fundamental statistical ideas.
- **Social media management:** It's helpful for community development, marketing, and personal branding to be familiar with the various social media platforms, understand social media strategies, and effectively engage and interact with audiences.
- **Adaptability and Continuous Learning:** It's critical to have the capacity to adjust to new technologies, platforms, and tools in the quick-changing digital environment. Growing personally and professionally requires adopting an attitude of life long learning, remaining current on trends and being open to learning new digital skills.

14.9 ENTREPRENEURSHIP

The process of locating, developing, and pursuing possibilities to launch a new company or endeavour is referred to as entrepreneurship. It involves people – known as entrepreneurs – who take risks and invest money to create novel concepts, goods or services in an effort to create economic value.

Entrepreneurship encompasses several key elements:

- **Innovation and creativity:** Entrepreneurs frequently identify and launch new concepts, goods or services to fill gaps in the market or address issues already in existence. They use their ingenuity to build original solutions and advertise them.
- **Risk-taking:** Taking measured risks is a key component of entrepreneurship. Even though they are aware that success is not guaranteed, entrepreneurs are eager to put their time, effort, and money into new endeavours. They welcome ambiguity and are equipped to deal with difficulties and setbacks.
- **Opportunity recognition:** Entrepreneurs have a strong eye for spotting business possibilities. They notice patterns, gaps, and new demands, and they

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think of methods to take advantage of those possibilities by adding value to their offerings.

- **Business planning and execution:** Entrepreneurs frequently identify and launch new concepts, goods, or services to fill gaps in the market or address issues already in existence. They use their ingenuity to build original solutions and advertise them.
- **Resource management:** Successful business people effectively manage resources including money, people and time. They effectively allocate resources, seek funding or investment as necessary and take well-informed decisions to maximise their business operations.
- **Building networks and relationships:** Successful business people recognise the value of developing networks and relationships. To obtain knowledge, access resources, and form cooperative relationships, they interact with mentors, business experts, possible partners and clients.
- **Adaptability and resilience:** Entrepreneurship necessitates the capacity to adjust to shifting market conditions, technical developments, and consumer expectations. To remain competitive, entrepreneurs must be resilient in the face of difficulties, learn from mistakes, and adapt their plans as necessary.
- **Scaling and growth:** Over time, entrepreneurs want to see their businesses expand. They create plans for growing their business, gaining more clients, and breaking into new markets. To promote growth, this may entail bringing on new personnel, looking for additional funds or putting new technology into place.

14.10 CUSTOMER SERVICE

Customer service refers to the support and assistance provided to customers before, during, and after their interaction with a product, service or organization. It involves addressing customer inquiries, resolving issues or complaints, and ensuring customer satisfaction.

Effective customer service is crucial for building and maintaining strong relationships with customers. It encompasses various elements:

(i) Communication

(ii) Knowledge and expertise

(iii) Problem solving

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(iv) Empathy and understanding

(v) Timeliness

(vi) Personalization

(vii) Continuous improvement

(viii) Positive attitude

14.11 GETTING READY FOR APPRENTICESHIP AND JOBS

Preparing for apprenticeships and jobs involves several important steps to increase your chances of success. Here are some key considerations:

(i) Identify your interests and goals

(ii) Research apprenticeships and job opportunities

(iii) Build relevant skills and knowledge

(iv) Create a professional resume

(v) Prepare a compelling cover letter

(vi) Enhance your interview skills

(vii) Network and seek guidance

(viii) Stay updated and persistent

WHAT YOU HAVE LEARNT

Let us recapitulate and enlist the salient points that you have learnt in this lesson.

- Citizenship principles are established in the Indian Constitution, notably in Part II (Citizenship) and Part III (Fundamental Rights).
- Equality, Liberty, Justice, Dignity, Sovereignty and Patriotism, Social Justice are some major constitutional ideals of Indian citizenship
- Continuous learning, determine your passions and goals, develop transferable talents, embrace technology, develop a professional network, gain practical experience, create a professional brand, adaptability and resilience and professional ethics are required become a professional in 21st century.
- English is often considered as the global business and communication language.

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- English fluency is frequently required for job applications and interviews, particularly in international corporations or sectors with a global presence.
- SMART goals mean Specific, Measurable, Achievable, Relevant, and Time-bound goals.
- Global businesses operate in worldwide marketplaces and have varied teams made up of people from various language backgrounds.
- Self-Assessment begin, consider your hobbies, values, strengths, and limitations. Consider your interests, talents, and what inspires you.
- Financial literacy is important for employment because it provides individuals with the information and skills needed to handle their finances successfully.
- Financial literacy teaches people the significance of budgeting and how to manage their income and spending.
- Legal literacy enables individuals to understand their employment rights and protections.

TERMINAL EXERCISE

1. What are Constitutional Values-citizenship? Explain major constitutional ideals of Indian citizenship.
2. What suggestions are required to become a professional in 21st century?
3. What is role of English to become a global professional?
4. How you can decide your career and goal?
5. How to improve communication skill to become a good professional?
6. What is financial and legal literacy? Explain it.
7. Role of digital education in professionalism?
8. What is entrepreneurship and its elements?

ANSWER TO INTEXT QUESTIONS

14.1

1. T 2. T 3. T 4. T 5. T

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14.2

1. Active listening
2. Financial literacy
3. Legal literacy
4. Marketing, and personal branding.
5. Technology, media, or creative industries.

Key Learning Outcomes

Learner will be able to:

- Discuss the Employability Skills required for jobs in various industries
- Discuss importance of relevant 21st century skills.
- Describe the benefits of continuous learning.
- Show how to use basic English sentences for everyday conversation in different contexts, in person and over the telephone.
- Write a short note/paragraph/letter/e-mail using basic English.
- Create a professional Curriculum Vitae (CV).
- Discuss the significance of maintaining hygiene and confidence during an interview.

Or

To access Employability Skill Workbook, Scan the below QR code or open given link:

LEARN EMPLOYABILITY SKILLS ONLINE

Scan to Learn!

Visit : **www.bharatskills.gov.in** or
https://www.skillindiadigital.gov.in