Skill India
कौशल भारत-कुशल भारत

सत्यमेव जयते
GOVERNMENT OF INDIA
MINISTRY OF SKILL DEVELOPMENT
& ENTREPRENEURSHIP

N·S·D·C
National
Skill Development
Corporation
Transforming the skill landscape

SCPwD
दिव्यांग व्यक्तियों के लिए कौशल परिषद्
Skill Council for Persons with Disability

ASCI
Agriculture Skill Council of India

Participant Handbook



Sector
Agriculture

Sub-Sector
Agriculture Crop Production

Occupation
Landscaping, Gardening and Urban Farming

Reference ID: **AGR/Q0801,** Version **3.0**

SCPwD Reference ID: **PWD/AGR/Q0801,** Version **3.0**

NSQF **Level 4**

Gardener

Scan this QR to access eBook

https://eskillindia.org/Home/handbook/128

Published by

Agriculture Skill Council of India
6thFloor, GNG Building, Plot No.10
Sector - 44, Gurugram - 122004, Haryana, India
Email: info@asci-india.com
website: www.asci-india.com
Phone: 0124-4670029, 4814673, 4814659

Second Edition, December 2022

This book is sponsored by Agriculture Skill Council of India (ASCI)
Under Creative Commons Licence: CC BY-NC-SA:

Attribution-ShareAlike: CC BY-NC-SA:



This license allows reusers to distribute, remix, adapt, and build upon the material in any medium or format for non commercial purposes only, and only so long as attribution is given to the creator. If you remix, adapt, or build upon the material, you must license the modified material under identical terms.

Disclaimer

The information contained herein has been obtained from sources reliable to Agriculture Skill Council of India (ASCI) . ASCI disclaims all warranties to the accuracy, completeness or adequacy of such information. Agriculture Skill Council of India shall have no liability for errors, omissions, or inadequacies, in the information contained herein, or for interpretations thereof. Every effort has been made to trace the owners of the copyright material included in the book. The publishers would be grateful for any omissions brought to their notice for acknowledgements in future editions of the book. No entity in Agriculture Skill Council of India shall be responsible for any loss whatsoever, sustained by any person who relies on this material. All pictures shown are for illustration purpose only. The coded boxes in the book called Quick Response Code (QR code) will help to access the e resources linked to the content. These QR codes are generated from links and you tube video resources available on Internet for knowledge enhancement on the topic and are not created by ASCI. Embedding of the link or QR code in the content should not be assumed endorsementofany kind.

Agriculture Skill Council of India is not responsible for the views expressed or content or reliability of linked videos. ASCI cannot guarantee that these links/QR codes will work all time as we have no controlover availability of linked pages.



Note: SCPwD
SCPwD has borrowed the qualification of Gardener from ASCI which is approved by NCVET in the 15th meeting of NSQC on 27th January 2022 (Link of MOM
https://ncvet.gov.in/sites/default/files/MoM%20of%20The%2015th%20meeting%20of%20%20NSQC.pdf
And uploaded on NQR WWW.nqr.gov.in The book caters to the job role aligned to the following disabilities as per the NQR codes mentioned below.
For LD- 2022/PWD/SCPWD/05511
For SHI- 2022/PWD/SCPWD/05512
For LV- 2022/PWD/SCPWD/05513



> Skilling is building a better India. If we have to move India towards development then Skill Development should be our mission.

Shri Narendra Modi
Prime Minister of India

Skill India
कौशल भारत - कुशल भारत

ASCI
Agriculture Skill Council of India

N•S•D•C
National Skill Development Corporation
Transforming the skill landscape

Certificate

COMPLIANCE TO QUALIFICATION PACK- NATIONAL OCCUPATIONAL STANDARDS

is hereby issued by the

AGRICULTURE SKILL COUNCIL OF INDIA

for

SKILLING CONTENT: PARTICIPANT HANDBOOK

Complying to National Occupational Standards of Job Role/ Qualification Pack: **'Gardener'** QP No. **'AGR/Q0801 NSQF Level 4'**

Date of Issuance : March 18th, 2021

Valid Up to* : March 18th, 2026

*Valid up to the next review date of the Qualification Pack or the 'Valid up to' date mentioned above (whichever is earlier)

Authorised Signatory
(Agriculture Skill Council of India)

Acknowledgements

We are thankful to all organizations and individuals who have helped us in preparation of this participant handbook. We also wish to extend our gratitude to all those who reviewed the content and provided valuable inputs for improving quality, coherence and content presentation of chapters. This handbook will lead to successful roll out the skill development initiatives, helping greatly our stakeholders particularly trainees, trainers and assessors etc. We acknowledge all resources, research institutes, journals from which reference material has been collated and compiled for use in skill ecosystem.

It is expected that this publication would meet the complete requirements of QP/NOS based training delivery. We welcome the suggestions from users, industry experts and other stakeholders for any improvement in future.

About this book

This skilling content is mapped to Model Curriculum of Qualification Pack. This is an NSQF level - 4 course and is designed to help participants learn about the process of planning and setting up a garden. The individual undertaking this course will ensure that the quality of seedlings are maintained during its handling, storage and transplanting in the garden. This complete book is divided into 9 modules and subsequently into respective units covering the undermentioned compulsory NOS:

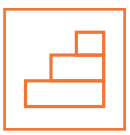
- AGR/N0801: Raise saplings in the nursery for transplanting in the garden
- AGR/N0802: Prepare a plan to set up the garden
- AGR/N0803: Set up the garden as per the plan
- AGR/N0842: Carry out maintenance of the garden
- AGR/N9918: Communicate effectively at the workplace
- AGR/N9903: Maintain health and safety at the workplace
- AGR/N0843: Design, set up and maintain a rooftop garden

To access MSDE Upgraded Employability Skills, click here:
https://eskillindia.org/NewEmployability

To enhance learning, URLs and QR codes of freely available learning materials are also provided at the end of related modules/ units. The book also contains a few Exercises to facilitate formative assessments. Hence, the participant will be able to enhance his/her knowledge and required skills under the guidance of the trainer with the help of this handbook.

Symbols Used


Key Learning Outcomes


Steps


Tips


Notes


Unit Objectives


Exercise

Table of Contents

S.No.	Modules and Units	Page No.
1.	**Introduction**	**1**
	Unit 1.1 - Introduction to Gardening	4
2.	**Propagation of Plants in a Nursery (AGR/N0801)**	**12**
	Unit 2.1 - Nursery Management	15
	Unit 2.2 - Propagation Techniques	31
3.	**Preparation for SeEng up the Garden (AGR/N0802)**	**43**
	Unit 3.1 - Components of Garden	46
	Unit 3.2 - Types of Garden	53
	Unit 3.3 - Design and Layout of Gardens	66
4.	**Process of Establishing the Garden (AGR/N0803)**	**76**
	Unit 4.1 - Features of Garden	79
	Unit 4.2 - Field Preparation	86
	Unit 4.3 - Soil and Soil Management	90
5.	**Maintenance of the Garden (AGR/N0842)**	**96**
	Unit 5.1- Pest & Disease Management	99
	Unit 5.2 - Training, Pruning and Other Operations	115
6.	**Effective Communication at the Workplace (AGR/N9918)**	**123**
	Unit 6.1 - Verbal and Non-Verbal Communication	126
7.	**Hygiene and Cleanliness (AGR/N9903)**	**142**
	Unit 7.1 - Hygiene and Workplace Housekeeping	145
8.	**Safety and Emergency Procedures (AGR/N9903)**	**155**
	Unit 8.1 - Emergency Procedures and First Aid	158
9.	**Process of Designing, SeEng Up and Maintaining a Rooftop (AGR/N0843)**	**175**
	Unit 9.1 - Rooftop Gardening	178



Skill India
कौशल भारत-कुशल भारत

सत्यमेव जयते
GOVERNMENT OF INDIA
MINISTRY OF SKILL DEVELOPMENT
& ENTREPRENEURSHIP

N·S·D·C
National
Skill Development
Corporation
Transforming the skill landscape

ASCI
Agriculture Skill Council of India

1. Introduction

Unit 1.1 - Introduction to Gardening



Terminal Outcomes

By the end of this module, participants will be able to:

1. State the role and responsibilities of a Gardener.

Key Learning Outcomes

By the end of this module, participants will be able to:

1. Describe the size and scope of the agriculture industry and its subsectors.
2. Discuss the role and responsibilities of a Gardener.
3. Identify various employment opportunities for a Gardener.

UNIT 1.1: Introduction to Gardening

Unit Objectives

By the end of this unit, participants will be able to:

1. Describe the size and scope of the agriculture industry and its sub-sectors.
2. Discuss the role and responsibilities of a Gardener.
3. Identify various employment opportunities for a Gardener.

1.1.1 Size and Scope of Agriculture Industry and its Sub-Sectors

India is an agrarian country and major part of its population depends on agriculture for the livelihood.

Farming systems often consist of a range of interdependent gathering, production and post-harvest processes, so that, besides farming, rural household livelihoods can encompass various activities in other key agricultural sub-sectors including livestock, agro-forestry and fishing and aquaculture. India accounts for 2.4% of the world's geographical area and 4% of its water resources, but has to support 17% of the world's human population and 15% of the livestock.

Therefore, in order to cater continuous food demand keeping in view the existing limited resources reflects the importance of agriculture and its related sub-sectors.

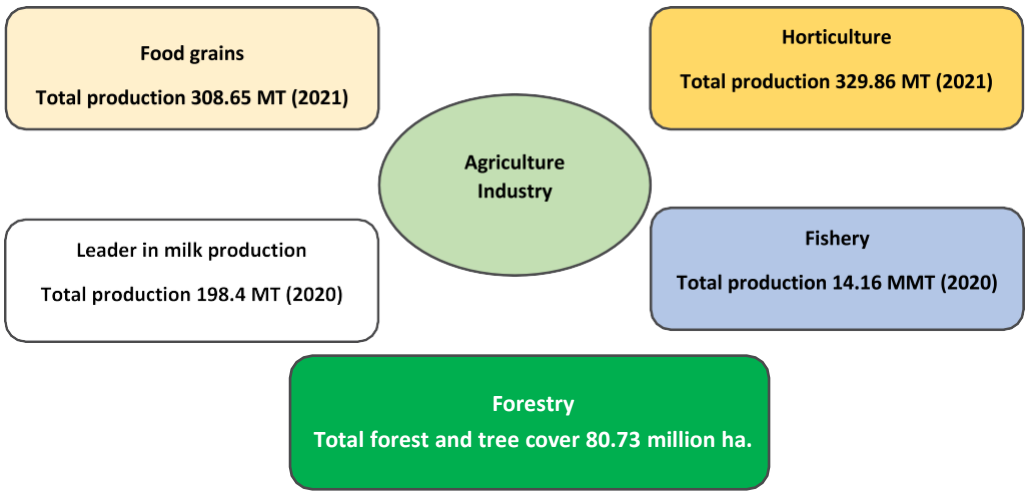


Fig. 1.1.1 Indian agriculture sector along with few sub-sectors[1]

[1]*Source:Data compiled from various articles, Ministry of Agriculture Farmers Welfare Annual Report*

As depicted in the aforementioned picture, India has achieved significant growth over the past years in terms of food grain production and horticulture production. India is the leader in milk production worldwide and having good production rate as compared to previous years. Fishery sector has also given importance and achieving good growth in the present time. India comprises about 24.56 percent of the geographical area of the country and area under forest is also increasing despite industrialization and other challenges.

In terms of global standing, India is the largest producer of spices, pulses, milk, tea, cashew and jute and the second largest producer of wheat, rice, fruits and vegetables, sugarcane, cotton and oilseeds. India is currently the world's fourth-largest producer of agrochemicals. India had the livestock population of around 535.8 million, which translated about 31% of the world livestock population during the year 2019.

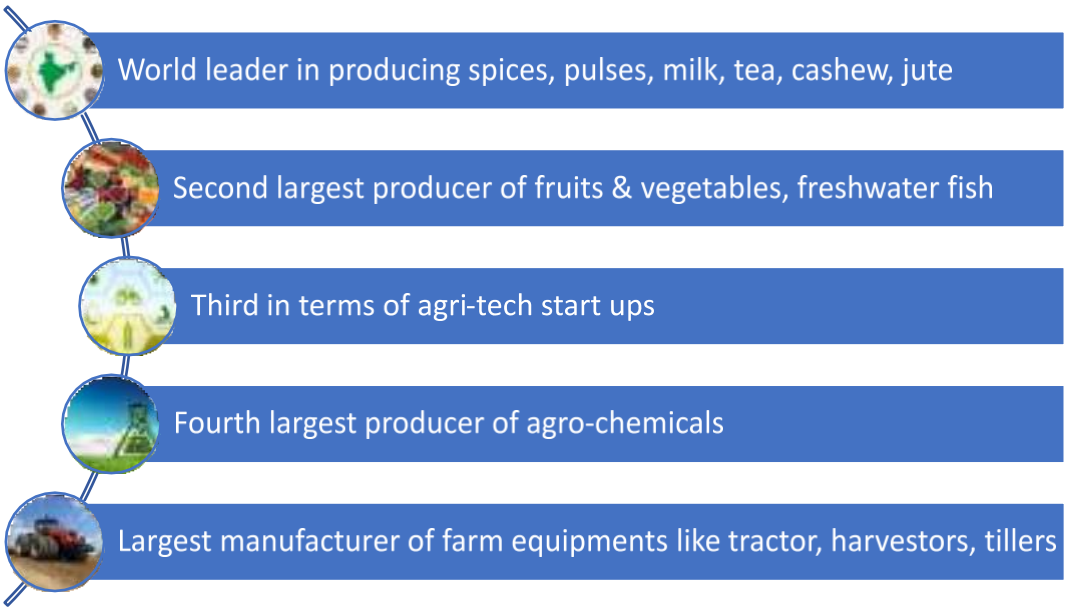


Fig. 1.1.2 Factual representation of India's position globally

Growth rate of agriculture sectors and sub-sectors in past few years have indicated a continuous decline in the share towards Gross Value Added (GVA) from 18.2 percent in 2014-15 to 16.0 percent in 2018-19. Falling share of agriculture and allied sectors in GVA is an expected outcome in a fast growing and structurally changing economy.

Year	Total Economy	Agri and Allied Sector	Crops	Livestock	Forestry & Logging	Fishing
2014-15	7.2	-0.2	-3.7	7.4	1.9	7.5
2015-16	8.0	0.6	-2.9	7.5	1.7	9.7
2016-17	7.9	6.3	5.0	9.9	1.4	10.0
2017-18	6.9	5.0	3.8	7.0	2.1	11.9
2018-19	6.8	2.7	-	-	-	-

Table 1.1.1 Share of agriculture and sub-sectors in total GVA of the economy[2]

[2]*Source:Central Statistics Office, Ministry of Statistics and Programme Implementation, GoI*

1.1.2 Gardening

Gardening is the practice of growing and cultivating plants as part of horticulture. In gardens, ornamental plants are often grown for their flowers, foliage, or overall appearance; useful plants, such as root vegetables, leaf vegetables, fruits, and herbs, are grown for consumption, for use as dyes, or for medicinal or cosmetic use. Gardening is considered to be a relaxing activity for many people.

Gardening ranges in scale from fruit orchards, to long boulevard plantings with one or more different types of shrubs, trees, and herbaceous plants, to residential yards including lawns and foundation plantings, to plants in large or small containers grown inside or outside. Gardening may be very specialized, with only one type of plant grown, or involve a large number of different plants in mixed plantings. It involves an active participation in the growing of plants, and tends to be labor-intensive, which differentiates it from farming or forestry.

Comparison with farming

Gardening for beauty is likely nearly as old as farming for food, however for most of history for the majority of people there was no real distinction since the need for food and other useful product trumped other concerns. Small-scale, subsistence agriculture (called hoe-farming) is largely indistinguishable from gardening. A patch of potatoes grown by a peruvian peasant or an Irish smallholder for personal use could be described as either a garden or a farm. Gardening for average people evolved as a separate discipline, more concerned with aesthetics and recreation, under the influence of the pleasure gardens of the wealthy. Meanwhile, farming has evolved (In developed countries) in the direction of commercialization, economies of scale, and monocropping.



Fig 1.1.3 Farming vis-a-vis- gardening

In respect to its food producing purpose, gardening is distinguished from farming chiefly by scale and intent. Farming occurs on a larger scale, and with the production of salable goods as a major motivation. Gardening is done on a smaller scale, primarily for pleasure and to produce goods for the gardener's own family or community. There is some overlap between the terms, particularly in that some moderate-sized vegetable growing concerns, often called market gardening, can fit in either category.

Planting in a garden

The key distinction between gardening and farming is essentially one of scale; gardening can be a hobby or an income supplement, but farming is generally understood as a full-time or commercial activity, usually involving more land and quite different practices. One distinction is that gardening is labor-intensive and employs very little infrastructural capital, sometimes no more than a few tools, e.g. A spade, hoe, basket and watering can. By contrast, larger-scale farming often involves irrigation systems, chemical fertilizers and harvesters or at least ladders, e.g. To reach up into fruit trees. However, this distinction is becoming blurred with the increasing use of power tools in even small gardens.

Due to labor intensity and aesthetic motivations, gardening is very often much more productive per unit of land than farming. The term precision agriculture is sometimes used to describe gardening using intermediate technology (more than tools, less than harvesters), especially of organic varieties. Gardening is effectively scaled up to feed entire villages of over 100 people from specialized plots. A variant is the community garden which offers plots to urban dwellers; see further in allotment (gardening).

Importance

Flowers have been considered as the symbol of grace and elegance and a feast for our eyes. Flowers are given as a birthday presents, wedding gifts or while meeting sick people and even at funerals. Most hindu ladies adhere their; hair style with flowers i.e. *Gajara* and veni and it is one of the important floral ornament which will and grace to their beauty. All the people irrespective of their origin, race, sex and cadre love flowers. Generally, flowers are offered by devotees in temple, gurudwara, church and masjids- flowers are used as a floral decoration. Even dried flowers are also used in flower craft or arrangement of garlands and bouquets are prepared and offered to welcome the dignitaries. When cut flowers are used for vase decoration, that will be a marvelous piece of indoor decoration. Importance of flowers is not restricted to the beautification, decoration or preparation of gajra, garland, veni or bouquets but also have the industrial importance too. Some flowers like rose, jasmines, tuberose, kevda, bakul are used for extraction of essential oils which is base for preparation of perfumes, scents or attar. From rose gulkand, rose water etc. Products are also prepared.

Scope

There is a good scope for commercial floriculture. The important factors which decide the scope for commercial floriculture are soil, climate, labour. Transport and market. All most all big cities are developing very speedily to accommodate this fast growing population, cement concrete, jungle is also developing at the some rate and thus peoples are now realizing the importance of open space, parks and garden for relaxation, peace of mind, recreation and unpolluted air. Thus, to meet out all these problems bio-aesthetic planning is essential, which runs hand in hand with town planning. In modem life floriculture garden in the country yard is an integral part of the modern life and thus ornamental plants has find a pride of place in home gardening. As far as flower trade is concerned i.e. For cut flowers and loose flowers, it is growing very well in our state because these cut flowers are used for vase decoration and now-a-days there is a craze for indoor decoration. As far as loose flowers are concerned these are mainly used for preparation of gajara, veni, garland and bouquets and thus demand of flowers for these purpose is unending. Thus, taking into consideration the different points i.e.

Bio-aesthetic planning, floral garden, indoor decoration, social functions and religious functions the demand for floricultural plants is increasing day by day and to meet out the same there is a good scope for growing and raising of ornamental or floricultural plants. When flower trade is concerned; different flowers like rose, chrysanthemum, gladiolus, tuberose are demanded in the market as cut flowers. While aster, gaillardia, marigold, chrysanthemum, jasmines, tager nerium as loose flowers.

Aesthetic Value

The aesthetic value is an expression of a variety of (combined) sensations when people experience the landscape. These sensations relate to harmony, diversity and beauty, the assessment of which is also dependent on many other factors related to the observer's background (previous experiences, knowledge, age, cultural background, etc.), as well as to environmental conditions (weather, uniqueness of the landscape, landscape type, etc.)

Cost of growing a garden

To calculate the true cost to start a garden and maintain it throughout the year, add together the following

- Cost of plants or seeds
- Cost to provide nutrient rich soil (manure, fertilizer, worms)
- Cost to protect and structure plants (cages, coverings, fences)
- Cost to water plants
- Cost of tools and accessories (tiller, gloves, spade)
- Cost to disease management

1.1.3 Role and Responsibilities of a Gardener

Gardener in the agriculture industry is a very important job role related to landscaping and gardening activity, in Hindi it is commonly known as 'Mali'.

The responsibilities of a gardener is :

- To raise the saplings in the nursery for transplanting in the garden.
- To perform various activities required to prepare for setting up the garden.
- Plan and set up a garden as per requirement of the client.
- To carry out maintenance of the garden.



Fig 1.1.4 Illustration of gardener role

1.1.4 Employment Opportunities

There are large numbers of different areas of gardener that you can enter into and become an expert over the years. The greatest employment/ self employment opportunities in this profession are that you can try something new every time throughout your career.

Some of the promising work as a gardener are:

- Landscaping supervisor
- Plant nursery and garden manager
- Sales manager
- Garden supervisor
- Heritage gardener
- Garden caretaker

Exercise

A. Fill in the Blanks

1. Gardening is the practice of growing and cultivating plants as part of_____.
2. In respect to its food producing purpose, gardening is distinguished from farming chiefly by_____.
3. The important factors which decide the scope for commercial floriculture are_____.

B. State Whether True or False (T/F)

1. When flower trade is concerned; different flowers like rose, chrysanthemum, gladiolus, tuberose are demanded in the market as cut flowers. ☐
2. Gardener in Hindi commonly known as 'mali'. ☐
3. As far as flower trade is concerned i.e. For cut flowers and loose flowers, it is gradually declining. ☐

Notes

Scan the QR Code to watch the related videos

https://www.youtube.com/watch?v=nSa_ey9Q7oI

Introduction to Gardening - Basics of Gardening



Skill India
कौशल भारत-कुशल भारत

सत्यमेव जयते
GOVERNMENT OF INDIA
MINISTRY OF SKILL DEVELOPMENT
& ENTREPRENEURSHIP

N·S·D·C
National
Skill Development
Corporation
Transforming the skill landscape

ASCI
Agriculture Skill Council of India

2. Propagation of Plants in a Nursery

Unit 2.1 - Nursery Management

Unit 2.2 - Propagation Techniques



AGR/N0801

Terminal Outcomes

By the end of this module, participants will be able to:

1. Describe different methods of plant propagation.
2. Demonstrate the process of propagating plants through different propagation methods.

Key Learning Outcomes

By the end of this module, participants will be able to:

Theory – Key Learning Outcomes	Practical – Key Learning Outcomes
1. List different types of plants grown in gardens according to the season. 2. Describe different methods of propagating plants in a nursery. 3. List various inputs required for propagating plants in a nursery. 4. Describe the process of preparing a nursery bed and seedbed. 5. Describe the process of constructing framed structures such as poly-tunnels, hardening chamber, mist chamber for plant propagation.	1. Demonstrate the process of preparing the nursery bed. 2. Demonstrate the process of preparing farmyard manure or compost. 3. Demonstrate the use of relevant nursery tools and equipment. 4. Show how to sort out and treat the seeds before sowing them. 5. Demonstrate the process of preparing the raised, level or sunken seedbed. 6. Show how to acclimatise the saplings before transplanting them. 7. Demonstrate the process of propagating plants through cutting, root division, layering, and budding methods. 8. Prepare a sample record of nursery operations.

UNIT 2.1: Nursery Management

Unit Objectives

By the end of this unit, participants will be able to:

1. Establish physical infrastructure – shade house, mist chamber, irrigation system
2. Explain nursery management practices
3. List types of nurseries
4. Prepare seed beds
5. Transplant seedlings
6. Take up potting of seedlings
7. Explain basic botany for garden crops
8. Identify tools and implements for nursery work
9. Demonstrate cleanliness in nursery by sweeping trashes and pulling out dead plant parts etc.

2.1.1 Nursery Management

Physical Infrastructure

Shade house

A Shade house is a structure enclosed by agro nets or any other woven material to allow required sunlight, moisture and air to pass through the gaps. It creates an appropriate micro climate conducive to the plant growth. It is also referred as shade net house or net house.

Uses of shade house:

- Helps in cultivation of flower plants, foliage plants, medicinal plants, vegetables and spices.
- Used for fruit and vegetable nurseries as well as for raising of forest species etc.
- Helps in quality drying of various agro products.
- Used to protect against pest attack.
- Protects from natural weather disturbances such as wind, rain, hail and frost.
- Used in production of graft saplings and reducing its mortality during hot summer days.
- Used for hardening tissue culture plant-lets.

Planning for a Shade House

1. Site selection

A shade house should be located in such a way that it is well connected with market for input supplies and sale of its produces. This structure should be constructed away from buildings and trees, so also away from industrial or vehicular pollutants. The site should be free from drainage problem. There should be provision of electricity and good quality water. However, wind breakers may be located 30m away from the structure.

2. Orientation

There are mainly two criteria for shade house orientation. They are the uniformity of light intensity in the shade house and wind direction. Single span structure may be oriented either in east-west or north-south direction but multi splan structure should be oriented in north-south direction to ensure uniform light intensity.

3. Structural materials

A shade house structure composed of two basic components i.e. frame and cladding material. The shade house frame provides support for cladding material and designed to protect against wind, rain and crop load. The shade house mild steel (ms) angle frame lasts up to 20 to 25 years, if anti rust treatment is done at regular interval, whereas bamboo structure can last up to 3 years. The agro shade net lasts for 3 to 5 years depending on the climatic condition. Shade nets are available in different colours with wide range of shade percentages viz. 25%, 30%, 35%, 50%, 60%, 75% and 90%.

Shade House Design

As shown in the figure1.5 inch, steel pipes have been used as vertical to hold the structure while 1 inch pipes are used for everything else. Flats are used for trellis structure. In hind sight, flats could be replaced with 1 inch pipe from strength and aesthetics point of view. It would have cost only a little extra. Here is the list of materials we used to build the shade house.

- 1.5 inch steel pipe (2mm thickness) – 3 pieces of 20 ft length each
- 1 inch steel pipe (1mm thickness) – 14 pieces of 18 ft length each
- 1 inch flat – 7 pieces of 18ft each
- 75% shade net cloth – 400sqft
- UV resistant plastic wire
- Paint and primer



Fig 2.1.1 Concept design of shade house[3]

Steps

Build Shade House

1. As a first step the outer vertical poles are cut to size and erected. They are supported on either the walls or the false pillar posts. A small square rod was first drilled into the wall at an angle of 20-30 degrees to the ground. This angle helps the rod stay put inside the wall. Then the 2 inch steel pipes were soldered to these rods.



Fig 2.1.2 Step 1- Shade house construction[4]

2. Next measurements are taken for the triangular trusses. Each of the three trusses are fabricated from the 1 inch steel pipe to measurement and marked. Then they are soldered on to the vertical posts. The inner verticals are then erected and soldered onto the trusses. A few flats were also soldered on to the verticals for extra support and to create permanent trellis structure.



Fig 2.1.3 Step 2- Measurements

[3]*Source:http://organicterrace.in/blog/how-to-build-shade-house/*
[4]*Source:https://discuss.farmnest.com/t/shadenet-house-construction/1452*

3. And finally the horizontal bars (1 inch pipe) are laid down on top and soldered to the top of the trusses. These connect the three trusses to each other.

After the structure is ready, clean up the pipes using sand paper and cloth and paint it for protection. After the paint is dry, the shade cloth is laid on top of the structure and was fastened using fishing net wire. The fishing net wire used are UV ray protected. So it would not easily disintegrate in heat and would hold on for much longer than normal plastic wires.



Fig 2.1.4 Step 3- Laying down bars

4. To give it extra protection from wind may tie with coconut fiber ropes going across the shade cloth from one side to the other. This is necessary as our place is very windy. In case you don't get so much wind you do not really have to do this.



Fig 2.1.5 Step 4 - Wind security

Mist chamber

Nursery plants propagated by cuttings are grown in mist chambers. In mist chamber, Relative humidity is maintained artificially at high level with the help of mist installations, which spray water under pressure. Fog formation induces rooting and acclimatization. High relative humidity facilitates better root initiation and cooling effect prevents the cutting from drying out.



Fig 2.1.6 Mist chamber

This method results in faster rooting of the cuttings, create optimum micro climate for better root initiation and development and higher success rate in propagation of hard wood cuttings. Temperature and humidity control in the mist chamber is effected through automated control systems.

Irrigation Systems

Drip irrigation system applies water in low volumes uniformly along with the fertilizers onto or into the soil near the plant root zone. This involves several components. These are the network of pipes (main line, sub mains, laterals), emitting device called as drippers or emitters, control head consisting of pumps, filters and fertigation units; and other accessories such as valves, gages etc. The main line delivers water from water source with the help of pumping device or elevated water tank to the sub main and the sub mains to the laterals. The emitters which are attached to the laterals deliver water onto or into the soil for irrigation. Emitters are the end device of the drip irrigation system.

The components of the drip irrigation system are classified into following principal categories:

1. Pump and prime mover

The pressure necessary to force water through the components of the system including fertilizer tank, filter unit, mainline, sub main, laterals and provide at the emitters at the desired pressure is obtained by a pump of suitable capacity or the overhead water tank located at suitable elevation.

2. Water source

Water sources such as river, lake, reservoir/tank, well, canal water supply or connection to a public commercial or cooperative water supply network can be used. Drip irrigation is a pressurized irrigation technology in which water is delivered from these sources by increasing its internal energy (pressure) by pumping.

3. **Pipe network**
   Mainline, sub mains and manifolds (feeder pipes) and laterals.

4. **EmiEng devices**
   Emitters or drippers or the laterals integrated with drippers/emitters and line source with drippers.

5. **Control devices**
   Valves, flow meters, pressure and flow regulators, automation equipment, backflow preventers, vacuum and air release valves, etc.

6. **Filtration devices**
   Removal of suspended materials in the water. Media, screen and disc filters.

7. **Chemical injectors**
   For application of plant nutrients and water treatment agents along with the irrigation water. Pressurized tank, venture injector, injection pump.

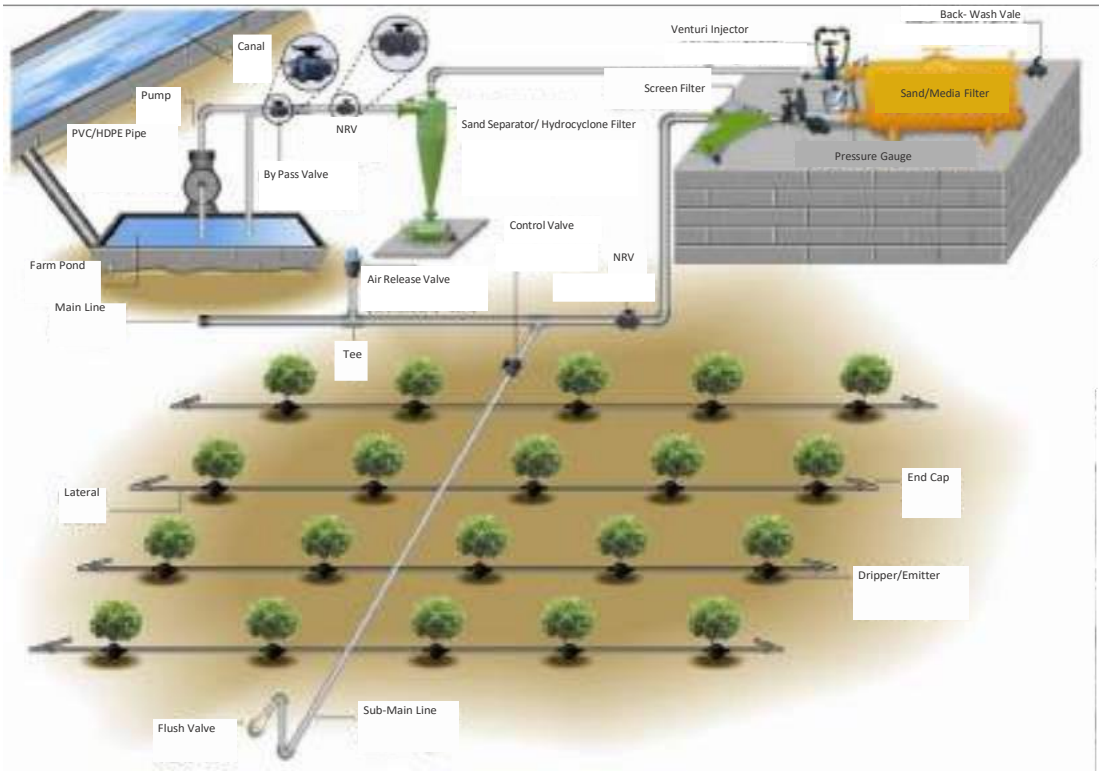


Fig 2.1.7 Layout of drip irrigation system[5]

[5]*Source:https://vikaspedia.in/agriculture/agri-inputs/farm-machinary/drip-irrigation-system*

A good Nursery is a prerequisite for landscaping or hor culture as a whole. All the good quality forest trees, fruit trees, shrubs and other ornamental plants are propagated from their Mother plant in nurseries. (A mother plant is many years old plant which has best of the traits available in its species). A nursery is said to be a good nursery when it has good quality plants and which is propagated from mother plants that have good root system and good scion (i.e. the shoot system).



Fig 2.1.8 Nursery management

Types of Nurseries

Depending upon the type of plants propagated and developed, various types of nurseries are made such as:-

1. **Seasonal flower nursery**

   Nurseries where annual flowers are developed from seeds and seedlings. These are based on different seasons like summer annuals and winter annuals and have a life cycle of six months or one year.



Fig 2.1.9 Seasonal flower nursery

2. **Tree nurseries**

   Tree nurseries are those where tree plants are propagated and developed for sale. It includes fruit trees, forest trees, medicinal trees, plants etc. Mostly trees are propagated vegetatively through cutting, grafting and budding. Fruit nurseries are very important to develop good grafted varieties of fruit trees, root stocks and scion.



Fig 2.1.10 Tree nursery

3. **Vegetable nurseries**

   Vegetable nursery is important to develop annual and perennial vegetable seedling like tomatoes, cauliflower, chilies, drumsticks, cucumber, beans etc. Since vegetables are staple to India, these nurseries propagate vegetable seedlings on very big scale through seeds.



Fig 2.1.11 Vegetable nurseries

4. **Herb nurseries**

   Herb nurseries include herb plants, medicinal plants, culinary herbs and aroma plants. With increase in awareness among general public regarding the benefits of herbs, natural source of medicines and ayurveda, herb gardens are flourishing at a greater speed.



Fig 2.1.12 Herb nursery

   To support the increasing demand herbs are propagated either vegetatively through seeds. Many plants are also propagated through micro propagation.

Many propagated in herb nurseries are:

- Basils
- Citronella
- Lemon grass
- Lettuce
- Aloe-vera
- Mint
- Rosemary
- Stevia, etc.

5. Tissue culture and polyhouse nurseries

- With increase in demand of certain plants commercially, they are propagated through micro propagation or tissue culture.

Example: Banana, Papaya, Gerbera etc. Through tissue culture, millions of plants, tree seedlings can be propagated in very less space. In such Hi-tech nurseries hardening of tissue cultured plants is done by keeping them in shade nets and poly houses. These poly houses and shade nets have the ability to provide high humidity, modify temperature and prevent the plants from direct sunlight. All the shade loving plants that are grown in adverse climatic conditions make use of shade nets and poly houses respectively. Based on the sale of plants, a nursery can either be whole sale nursery or a retail nursery.



Fig 2.1.13 Tissue culture



Fig 2.1.14 Polyhouse

- **Wholesale nursery:** Plants which are sold for commercial purpose in huge amounts at very reasonable rates are known as wholesale nursery. In wholesale nursery, the quantity of every variety available is more.
- **Retail nursery:** Plants which are available to general public at a fixed cost higher than wholesale nursery but are available in small quantity. In retail nursery, number of varieties of plants are more than their quantity unlike wholesale nursery.



Fig 2.1.15 Wholesale nursery



Fig 2.1.16 Retail nursery

6. Prerequisites for a good nursery

- **Good site:** For nursery the site selected should have few things available like ample amount of good quality water with good drainage facility. Also since nurseries are used for propagation, it should have some sort of natural shade or provided proper artificial shade through shade nets. The soil at the site of nursery should be rich in organic matter, should have proper texture i.e. not too clayey or not too sandy.



Fig 2.1.17 Site and beds in the nursery[6]

[6]*Source:https://agritech.tnau.ac.in/horticulture/horti_pcrops_coconut_nursery.html*

7. Beds in the nursery

All the seedlings are prepared from different types of propagations are carried out in beds especially of approximately dimension 5m in length and 1m in width under shade net. Beds can be either raised beds or flat beds. Raised beds are generally raised to a height of 6 to 8 inches.

The soil used to prepare beds should be of very fine quality and hence is prepared by mixing proportionately sand, clayey soil and compost in the ratio of 1:2:1. Also soil should be well treated with pesticides like formaldehyde and chlorpyrifos.



Fig 2.1.18 Nursery bed with bean seedlings (Kate Russell)[7]

These raised beds have a good drainage property. During monsoon they don't get water logged and the excess water runs off. Raised beds assure uniform availability of water to the propagating plants and hence high germination percentage. Other field activities like weeding is very easily done. Other type of Beds made in nurseries are flat beds of size 5m x 1m. Use of raised bed or flat beds depends upon type of propagation of plants carried out in the shade net. Similarly depending upon the type of propagation, different growing mediums are prepared.

8. Growing medium

A growing medium is a mixture of soil, sand, peat moss or cocopeat, vermiculite, pearlite and compost. These constituents are mixed in different proportions to form appropriate growing medium.

Example for propagation of plants: Clay soil + sand + compost is mixed in the ratio of 2:1:1. A growing medium is good for propagation if it has following characterise:

- Adequately porous for proper drainage of excess water, however should possess high moisture retaining capacity as well for rooting and germination.
- The medium should be free from unwanted seeds of weeds, nematodes and other pathogens.
- The medium should be strong enough to hold the cutting in position during rooting and germination.
- Various containers are used in the nurseries for propagating plants.



Fig 2.1.19 Compost vs soil[8]

[7]*Source:https://www.thedailygarden.us/garden-word-of-the-day/nursery-beds*
[8]*Source:https://www.gardeningchannel.com/compost-vs-soil-differences/*

Seedbed

A seedbed, also known as a seedling bed, is the soil environment in which seeds are planted. It frequently includes not only soil but also a specially prepared cold frame, hotbed, or raised bed used to grow seedlings into larger young plants in a controlled environment before transplanting them into a garden or field. A seedling bed is used to increase the number of seeds that germinate.

Soil type

A seedbed's soil should be loose and smooth, with no large lumps. These characteristics are required so that seeds can be planted easily and at a specific depth for optimal germination. Large lumps and an uneven surface would cause the planting depth to be erratic. Many types of seedlings require loose soil with little rocky content in order to grow their roots.

Preparation of Seedbed

The preparation of a seedbed may include:

- The removal of debris. Insect eggs and disease spores are often found in plant debris and so this is removed from the plot. Stones and larger debris will also physically prevent the seedlings from growing.
- Levelling. The site will has been levelled for even drainage.
- The soil is being broken up. Digging will break up compacted soil. This allows air and water to enter the seedling and helps it penetrate the soil. Smaller seeds necessitate a more refined soil structure. Using a rake, the surface of the soil can be broken down into a fine granular structure.
- Soil enhancement - Organic matter, such as compost or peat, can be used to improve soil structure.
- Fertilizing. Fertilizer can be used to adjust the soil's nitrate and phosphate levels. If the soil is lacking in micronutrients, these can also be added.
- The seedlings can be left to mature into adult plants.



Fig 2.1.20 Seedbed[9]

[9]*Source:https://en.wikipedia.org/wiki/Seedbed*

- **Terracotas pots:** These pots are made up of natural earth and are finely porous to allow the plant inside the pot to respire and keeps the plant cool during very hot weather. Mostly annual flowers are prepared in terracottas pots like marigold, salvia, petunia, dahlia, chrysanthemum etc.



Terracotta pots

- **Seed Pan:** Seed pan are also made up of terracottas pots with a centre hole to allow drainage. Seed pans are approx. 4 to 5 inches deep and 14" inches diameter. These are used for growing seeds and prepare seedlings. On the same lines are made seed boxes which are made up of cardboard of dimensions like 18" in width and 24" in length.



Seed pan

- **Polythene bags:** Another very common containers used to propagate cutting, grafting etc. are punctured poly bags. Holes in the poly bags are made for adequate drainage. The rooting medium in the poly bags is generally lettie porous to allow the faster new roots develop and establish faster.



Polythene bag

- **Plastic trays:** Plastic trays are mostly used for growing seedling from seeds. Vegetable seedlings, flower seedlings etc. are grown in the pockets of these trays filled with a medium of coco peat and vermiculite and pearlite. These are very portable and easy to transport from one place to another. Since we can shift the trays and prevent them from adverse climatic conditions, the germination percentage is almost 100%.



Plastic trays

Fig 2.1.21 Containers for propagating seeds/ nursery plants

Tools and Implements for Nursery Work

Axes, crow bar, wheel barrows, boxes, plastic buckets, watering cans, wire cutters, digging forks, hammer, nails, hoes, hand pruning knives, budding knives, respiratory masks, sprayers, saws, scissors, secateurs, budding and grafting knives, budding and grafting tape, germination trays, khurpis, iron pan, spade, forks, etc.

Some of the tools are described as under:

1. **Water Can:** Rain like small droplets fall from water can when water is poured over small seedlings, cuttings and nursery plants. Water can with a funnel helps in uniform water spread without damaging the tender.



Water Can

2. **Digging Fork**: This has prongs of 20 cm long fitted to a wooden handle. This is used for uprooting plants, rooted cuttings, harvesting of tubers etc., without damaging the root system or tubers.



Digging Fork

3. **Shovel**: This is a curved steel plate attached to a wooden handle and used for transferring soil, manure etc.

4. **Garden Rake**: This is used for levelling lands and collecting weeds. The rake consists of a number of nail like projections from a crow bar provided with long handle.

5. **Hand Trowel:** This is used as a small tool for making holes for planting seedlings and small plants. This is also useful for removing surface weeds in nursery beds.

6. **Secateurs:** This is used for cutting small shoots to regulate shoot growth in fruit trees.

7. **Budding or Grafting knife:** This knife is used for budding and grafting. This has two blades in which one is with ivory edge used for lifting the bark in budding operation.



Fig 2.1.22 Tools for nursery work

Garden tools maintenance of tools and equipments:

- Maintaining nursery tools is important to prevent their wear and tear, increase their life and prepare the tools for next me use. There are few basic points to be remembered and executed in order to add more years to any garden tool and equipment and its proper functioning.

Remove the soil and planting material from the tool after use:

Tools used for digging mud like tromel, spade, rake, hoe, weeder etc. and tools used for cutting, pruning, like shears, loppers, scateurs etc. should be made free of soil and planting material attached to their metal parts. Dried mud should be scratched off and small amount of dead leaves / chlorophyll on the blades should be removed after.

- **Dry wet tools:** After washing the tools, the should be to dry completely before storage. This will prevent rusting of tools for wooden parts of the tool, rubbing of linseed oil once in two months will help. Preserve them for long.
- **Wipe the tool:** After drying the tool, it should be wiped all over with a dry cloth and spray any penetrating oil like WD40 over the metal parts. This is important for proper functioning of the tool. Once the seedlings in the beds have strengthened, seedlings are prepared from seeds and hardening of cultured seedlings is done, a proper maintenance and take care of the nursery is very important. Proper hygiene and cleanliness is very important to keep the nursery plants free from pests and deceases. Nursery management includes all the opera ons from raising healthy seedlings to transplanting and repotting of the small plants and seedlings either for commercial sale or for transplanting in fields.

Field Operations Important in Nursery Management

- **PoEng the seedlings:** Using the appropriate growing medium i.e. a mixture of soil + cocopeat + compost + vermiculite in the ratio of 2:1:1 is to grow the seedlings or transplanting the seedlings from trays in the pots timely is very important. Potting done in off seasons does not lead to healthy plant propagation and development.

- **Manuring & Irrigation:** Young plants need heavy feeding for healthy growth. Frequent but light manuring or fertilizer sprays is more effective than drenching the beds with nutrients at once. Generally in beds sufficient amount of compost is added in the beginning, however top feeding of nutrients NPK and DAP has added benefits. Bavisting is generally added along the roots after transplantation of seedlings to avoid root decay and help in vigorous growth of root system. Irrigating timely during the evening hours or early morning using water Can or hose pipe with funnel at low pressure is ideal. High pressure of water can damage the tender stems of the seedlings.
- **Plant protection:** Keen observation on attack of different pests and diseases is required. If the mother plants are infected, the propagated plants will be infected also. Necessary control measures should be taken immediately on observation.

1. Damping Off: Damping off is a decease caused in seedlings due to water logging followed by fungal or bacterial infection. In damping off the seedlings are decayed from the neck region of the root and stem. This disease is most common in nurseries. Hence proper precautions should be taken while raising the seedlings in nurseries like:

- Growing healthy and disinfected seeds.
- Treating the cuttings with fungicide for healthy root development.
- Ensure well drained seed beds and avoid over irrigation and water logging by raising beds and using proper decomposed compost and disinfected growing medium.
- Keep a check of nitrogen fertilizer and avoid its excessive.
- Exposing the soil to sun in summers and avoiding growing of same seedlings year after year in the same soil to avoid problem of pathogens like nematodes.
- Planting the seeds and transplanting seedlings when the soil temperature is congenial and not cold.
- Maintaining proper sanitation and cleanliness in the nursery by removing and discarding dead and diseased plants.
- **Disinfection of seeds:** Seeds are treated with formaldehyde before sowing to prevent it from fungal infestation while germinating. Disinfection of seeds is also done by hot water treatment.

- **Soil treatment:** Soil is the breeding ground for many fungi, bacteria, nematodes and other insects and pests. Hence it is very important to treat soil and enhance healthy growth of nursery plants. Soil can be treated by solarization or exposure to sun using chemicals like formaldehyde, Redomil etc.

Common diseases besides damping off are:

a). Powery mildew
b). Yellow vein mosaic
c). Leaf spot and
d). bacterial blight etc.

- **Weed control:** Seedlings are heavy feeder and compete with weed for food nutrients and water can lead to their unhealthy growth and development. Weeds are generally controlled manually using mulch and weedicides , like basaline and round up.
- **Control of temperature:** Nursery plants are at tender stage and very sensitive to extreme heat and cold. For their fast growth, temperature is regulated and controlled by developing shade nets, poly houses and green house.

Commercial Management

- The ultimate target of growing nursery plants is to sell and generate revenue. Commercial management includes opera on like proper packaging, sale management. Seedlings are generally packed in cartons to avoid damage to them during transportation. Exotic plants developed are packed either in carton or wooden boxes after being wrapped in plastic bags to avoid shaking of plant root ball from its position and safe travel. Sales management includes proper marketing of the products and catering to the demands.

Transplant seedlings

1. Individual Pots

- Fill 3- to 4-inch-diameter pots two-thirds full with sterile potting soil. Water the soil until it's evenly moist. Allow the excess water to drain from the bottom drainage holes in the containers before transplanting.
- Scoop the seedlings from the growing tray with a small spoon, taking care not to damage the roots. Set each seedling in a prepared pot.
- Support the seedling upright by its topmost leaves. Fill in around it with potting soil, gently firming the soil with your fingertips. Plant the seedling so it's growing at the same depth it was at previously.
- Water the soil lightly to settle it. Set the re-potted seedlings in an area that receives six or more hours of daily sun. Water them when the soil surface begins to dry.

2. Garden

- Set the seedlings outdoors in a protected area with bright, indirect sun after frost danger has passed. Gradually increase the seedlings' exposure to the sun over a week-long period, bring them indoors if frost is expected. This process hardens plants so they can better adjust to outdoor conditions.
- Dig a planting hole for each seedling in a prepared garden bed after hardening the plants. Make the holes the same depth as the seedling pots but twice as wide. Space the holes appropriately for the plant varieties.
- Turn each pot on its side and slide the seedling out into hand. Hold it gently by the root ball. Set a seedling in each prepared hole so it's at the same depth it was growing at previously.
- Fill in the hole around the roots with soil, firming it lightly in place. Water the seedlings immediately after planting so the top 6 inches of soil is moist and settles around the roots.

Take up hardening of seedlings

Hardening is the process of exposing transplants (seedlings) gradually to outdoor conditions. It enables transplants to withstand the changes in environmental conditions they will face when planted outside in the garden. It encourages a change from soft, succulent growth to a firmer, harder growth.

Basic Botany for Garden Crops

Plant morphology

Shoot System

Stem:

- Node
- Internode

Buds:

- Apical bud
- Apical meristem (growing point)
- Axillary Bud (lateral bud)

Leaf:

- Blade
- Petiole
- Stipule

Simple Leaf

Compound Leaf: Pinnate or Palmate

Leaf arrangement (at each node):

- Alternate
- Opposite
- Whorled

Root System

- Primary root or tap root
- Lateral (branch) root
- Adventitious root

Vascular Tissues:

- Xylem (wood): water movement phloem (Inner bark): Food movement
- Cork (outer bark)

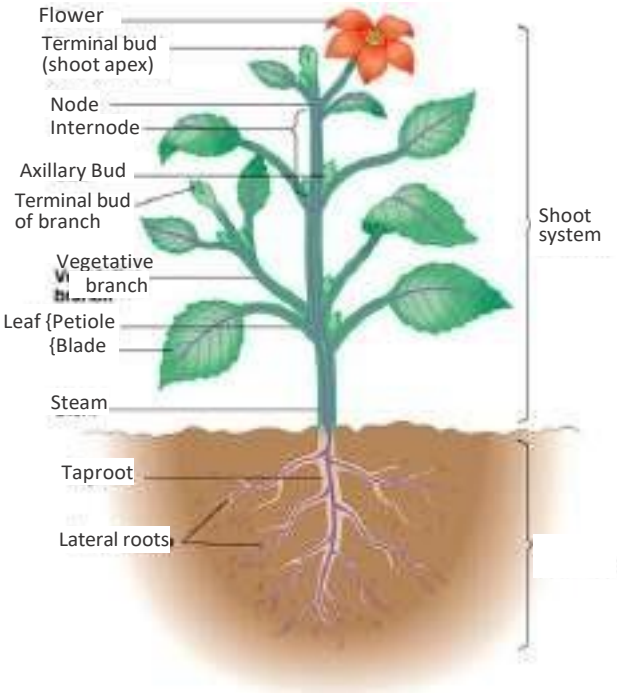


Fig. 2.1.23 Plant morphology

Plant Growth

- Embryo
- Germination
- Seedling

Primary growth (elongation)

Secondary growth (thickening):

- Vascular cork cambium (Cork)
- Cambium (Wood & Bark)

Leaf Classification

Simple leaf patern

Simple leaves are whole, undivided leaves growing from a bud on the stem. The node is the place on the stem where the leaves are attached. You will always find a bud at a node, which is the growing point.

Compound leaf paterns

Compound leaves are divided into leaflets, growing from one axillary bud on the stem.



Fig. 2.1.24 Simple leaf pattern

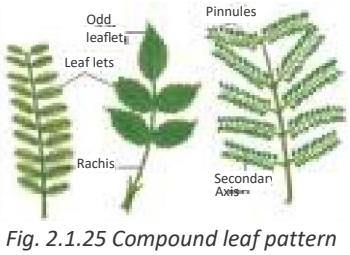


Fig. 2.1.25 Compound leaf pattern

Leaf arrangement

Nodes can have one leaf or many leaves, often in the following arrangements:

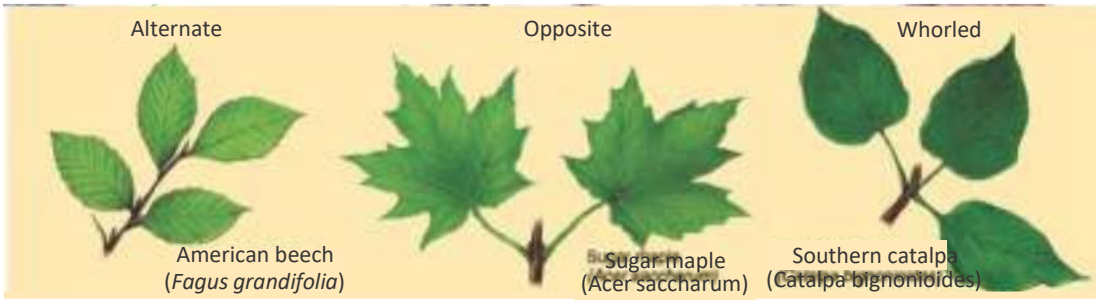


Fig. 2.1.26 Leaf arrangement[10]

[10]*Source:https://slideplayer.com/slide/7960437/*

Tips

To Garden Always Neat and Clean:

1. Organize garden shed

- Keep your shed organized, with all tools neatly ordered, sharpened and ready for use.
- Equipment will be preserved much better than if it was just left lying around in the garden.

2. Keep a close eye on plants

- Every plant in the garden forms part of an entire ecosystem and they all affect one another. For example, when one tree suffers from a disease, it can spread to nearby plants. It becomes a slippery slope, and if the disease is left untreated, the whole garden may soon not be not in a fit state to flourish. So keep a watchful eye on each and every plant to ensure that your garden is always healthy and looks good.

3. Keep trash or debris away from garden

- Trash, dead leaves, or plant debris are ideal shields for pesky insects like fleas.
- Insects love to live in shadowy and highly humid areas as they cannot reproduce well under strong sunlight. So, cleaning should be done.
- In addition, fallen fruits are favorable food sources for the parasites. Rake them up and use them on the compost pile.

4. Remove weeds

- To keep garden neat and tidy, clear away any weeds that pop up.

Exercise

A. Short Questions

Q.1. List out the tools/ equipments required for the nursery management.

Q.2. List out types of nurseries.

2. Fill in the Blanks

1. Plants which are sold for commercial purpose in huge amounts at very reasonable rates are known as_____.
2. Raised beds assure uniform availability of_____to the propagating plants and hence high germination percentage.
3. Nursery plants are tender and very sensitive to extreme_____.

Notes

Scan the QR Code to watch the related videos

https://www.youtube.com/watch?v=Q_vnDbUsmHg&list=PLekJC5v4LQiapihi5HXBnjasuGVMmfmus&index=10

Tools of Gardening

https://www.youtube.com/watch?v=Y6BgWWPFGss

Nursery Production & Management

UNIT 2.2: Propagation Techniques

Unit Objectives

By the end of this unit, participants will be able to:

1. List different types of plants grown in gardens according to the season.
2. Describe different methods of propagating plants in a nursery.

2.2.1 Plant Propagation Techniques

Propagating plants is an inexpensive and easy way to get new plants from plants you already have. This asexual means of reproduction produces a plant that is genetically identical to its parent. There are a variety of plant propagation tools and methods; from taking cuttings to layering to dividing and more. The technique you select will depend on the type of plant you wish to propagate and the amount of me and effort you want to put into it.

Rooting Media

The putting soil, or medium in which a plant grows, must be of good quality. It should be porous for root area on and drainage, but also capable of nutrient retention and water. For a plant to form a new root system, it must have a ready moisture supply at the cut surface. Oxygen is required for all living cells. The coarse-textured media choices often meet these requirements. Most commercially prepared mixes are termed artificial, which means they contain no soil. The basic ingredients of such a mix are sphagnum peat moss and vermiculite, both of which are generally free of diseases, weed seeds, and insects. Rooting media for asexual propagation should be clean and sterile. Cuttings are not susceptible to damping-off, but they are cacked by other fungi and bacteria which may come along in the medium. Most commercially prepared media are clean when purchased. The media should be low in fertilizer. Excessive fertility will damage or inhibit new roots. High-quality artificial mixes some times contain slow-release fertilizers. Coarse perlite alone can be used to start some cuttings. This doesn't hold much water for long, but it is finel for rooting cuttings of cactus-type plants which would ordinarily rot in higher moisture media. Coarse vermiculite alone has excellent water-holding capacity and aeration, but may dry out rapidly via. Evapora on if not covered in some way. A mix of 50% peat moss and 50% perlite favors good aeration. An equal mix of peat moss, vermiculite, and perlite is also good and favors moisture retention. Plain water can be used to propagate some cuttings. This is possible and actually works quite well for some species which root easily. It certainly provides the needed moisture, but if the water is not changed on a weekly basis, it will become stagnant, oxygen deficient, and inhibitory to rooting. Furthermore, roots produced in 100% water are different from those produced in solid media; they may undergo greater transplant shock with a greater incidence of death. So, it is not the most desirable method for most plants, but certainly feasible.

Rooting enhancement conditions once you've selected the right medium, your first priority is to get roots produced as quickly as possible. The consequences of slow rooting may be death because the cutting must rely on its limited water reserves. Water is required for major chemical reactions in plants which will be shut down in its absence. Even though the exposed cells on the cut surface of the cutting ordinarily transport water throughout the plant, they are not equipped to adequately absorb it from the medium.

This can only be done in most plants by roots, and par cularly root hairs. Root hairs are ny, single cell projections from the root ends or ps. Make sure the medium is moist prior to inserting cuttings. If not completely moist, then the surface which has cut, may contact the dry pocket and have its own water absorbed by the medium component. Try to keep both the air and medium temperature.

Higher temperatures enhance growth, but excessively high temperatures do not allow for photosynthesis to keep up with food breakdown in normal cell energy use (respiration). You can buy electric heating pads to put beneath containers holding cuttings to maintain a constant temperature. But not direct light. An east window is fine but a west window is too warm and a south facing window too bright. North is too dim. One way to provide good environmental conditions for asexual propagation by cuttings is through the use of a mist bed. This system sprays a fine mist of water over the cuttings once every few minutes, and the me is adjustable. It should only be on during the day, as nigh time opera on would keep the medium too wet and encourage rooting. Misting inhibits transpiration and forces the plant to conserve water while it forms new roots. If a mist system is unavailable, one can be imitated in a small propagation tray in the home. Choose an appropriate medium, moisten it, and place it in a tray. Place the tray in a perforated or slits clear plastic bag. This increases the relative humidity and inhibits water loss by the plant and medium, yet allows air circulation. Tug gently at the cuttings after 2-3 weeks to test for rooting and transplant to individual pots when roots resist your tugs. Dig them out, do not pull them out! different plants require different rooting times, so do not expect them all to root at the same time.

CuEngs

Many types of plants, both woody and herbaceous, are frequently propagated by cuttings. A cutting is a vegetative plant part which is severed from the parent plant in order to regenerate itself, thereby forming a whole new plant. Take cuttings with a sharp blade to reduce injury to the parent plant. Dip the cutting tool in rubbing alcohol or a mixture of one part bleach to nine parts water to prevent transmitting diseases from infected plant parts to healthy ones. Remove flowers and flower buds to allow the cutting to use its energy and stored carbohydrates for root and shoot forma on rather than fruit and seed production. With large-leaved cuttings (i.e., Rhododendron) and limited space in the propagation container, trimming up to half the leaf length can improve efficiency, as well as light and air circulation for all the cuttings. To hasten rooting, increase the number of roots, or to obtain uniform rooting (except on some, fleshy stems), use a rooting hormone, preferably one containing a fungicide. Prevent possible contamination of the en re supply of rooting hormone by putting some hormone in a separate container for dipping cuttings. Discard this hormone after all the cuttings are treated. Place stem and leaf cuttings in bright, indirect light. Root cuttings can be kept in the dark un l new shoots appear.

Stems **CuEngs**

Numerous plant species are propagated by stem cuttings. Most can be taken throughout summer and fall, but stem cuttings of some woody plants root better if taken in the fall or in the dormant season. Success with herbaceous plants is generally enhanced when done in the spring; these plants are actively growing then, and more apt to root quickly on their own. There are several different types of stem cuttings depending on the part of the stem needed. At least one node (the point on a stem where leaves are attached and buds form) should be below the media surface. Although some plants root at internodes (the space between nodes), others only root at nodal tissue.

Tip cuEngs

Detach a 2- to 6-inch piece of stem, including the terminal bud. Make the cut just below a node. Remove lower leaves that would touch or be below the medium. Dip the stem in rooting hormone if desired. Gently tap the end of the cutting to remove excess hormone. Make a hole in the medium with a pencil or pot label, and insert the cutting deeply enough into the media to support itself.



Fig 2.2.1 Tip cuttings

Medial cuEngs(also stem-section cuEngs)

Make the first cut just above a node, and the second cut just below a node 2 to 6 inches down the stem. Prepare and insert the cutting as you would a tip cutting. Be sure to position right side up. Buds are always above leaves. Make sure the cutting is inserted base down.



Fig 2.2.2 Medial cuttings

- **Cane cuEngs**: Cut cane-like stems into sec ons containing one or two eyes, or nodes. Dust ends with fungicide or activated charcoal. Allow to dry several hours. Lay horizontally with about half of the cutting below the media surface, eye facing upward. Cane cuttings are usually potted when roots and new shoots appear, but new shoots from dracaena and croton are often cut off and rerooted in sand.



Fig 2.2.3 Cane cuttings

- **Single Eye:** The eye refers to the bud which emerges at the axil of the leaf at each node. This is used for plants with alternate leaves when space or stock material are limited. Cut the stem about 1/2 inch above and 1/2 inch below a node. Place the cutting horizontally or vertically in the medium with the node just touching the surface.



Fig 2.2.4 Single eye

- **Double Eye:** This is used for plants with opposite leaves when space or stock material is limited. Cut the stem about 1/2 inch above and 1/2 inch below the same node. Insert the cutting vertically in the medium with the node just touching the surface.



Fig 2.2.5 Double eye

- **Heel cuEng:** The eye refers to the bud which emerges at the axil of the leaf at each node. This is used for plants with alternate leaves when space or stock material are limited. Cut the stem about 1/2 inch above and 1/2 inch below a node. Place the cutting horizontally or vertically in the medium with the node just touching the surface.



Fig 2.2.6 Heel cutting

- **Leaf CuEngs:** Leaf cuttings are used almost exclusively for a few indoor plants. Leaves of most plants will either produce a few roots but no plant, or just decay.



Fig 2.2.7 Leaf cuttings

- **Whole leaf with petiole:** Detach the leaf and up to 11/2 inches of pe ole. Insert the lower end of the pe ole into the medium. One or more new plants will form at the base of the petiole. The leaf may be severed from the new plants when they have their own roots, and the pe ole can be reused. Example: African violet).



Fig 2.2.8 Whole leaf with petiole

- **Whole leaf without petiole**: This is used for plants with sessile leaves (no stalk or pe ole). Insert the cutting vertically into the medium. A new plant will form from the axillary bud. The leaf may be removed when the new plant has its own roots. (Example: donkey's tail).



Fig 2.2.9 Leaf propagation

- **Split vein:** Detach a leaf from the stock plant. Slit its veins on the lower leaf surface. Lay the cutting, lower side down, on the medium. New plants will form at each cut. If the leaf tends to curl up, hold it in place by covering the margins with the rooting medium. (Example: Rex begonia).



Fig 2.2.10 Split vein

- **Leaf sections:** This method is frequently used with snake plant and fibrous rooted begonias. Cut begonia leaves into wedges with at least one vein. Lay leaves flat on the medium. A new plant will arise at the vein. Cut snake plant leaves into 2-inch sec ons. Consistently make the lower cut slanted and the upper cut straight so you can tell which is the top. Insert the cutting vertically. Roots will form fairly soon, and eventually a new plant will appear at the base of the cutting. These and other succulent cuttings will rot if kept too moist. (Note that with variegated snake plant, the new shoot will develop from cells that do not display the variegation.)



Fig 2.2.11 Leaf sections

- **Root CuEngs:** Root cuttings are usually taken from 2- to 3-year-old plants during their dormant season when they have a large carbohydrate supply. Root cuttings of some species produce new shoots, which then form their own root systems, while root cuttings of other plants develop root systems before producing new shoots.

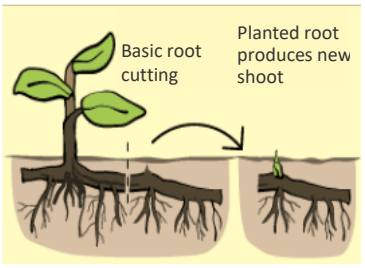


Fig 2.2.12 Root cuttings

- **Plants with large roots:** Make a straight top cut. Make a slanted cut 2 to 6 inches below the first cut. Store about 3 weeks in moist sawdust, peat moss, or sand at 40°F. Remove from storage. Insert the cutting vertically with the top approximately level with the surface of the rooting medium. This method is often used outdoors.
(Example: horse radish).

- **Plants with small roots:** Take 1- to 2-inch sec ons of roots. Insert the cuttings horizontally about 1/2 inch below the medium surface. This method is usually used indoors or in a hotbed. (Example: bleeding heart).

- **Layering:** Stems still attached to their parent plants may form roots where they touch a roo ng medium. Severed from the parent plant, the rooted stem becomes a new plant. This method of vegetative propagation, called layering, promotes a high success rate because it prevents the water stress and carbohydrate shortage that plague cuttings. Some plants layer themselves naturally, but some times plant propagators assist the process. Layering may be enhanced by wounding one side of the stem or by bending it very sharply. The rooting medium should always provide aeration and a constant supply of moisture.

- **Tip layering:** Dig a hole 3 to 4 inches deep. Insert the shoot tip and cover it with soil. The tip grows downward first, then bends sharply and grows upward. Roots form at the bend, and the recurved tip becomes a new plant. Remove the tip layer and plant it in the early spring or late fall.
  Examples: purple and black raspberries, trailing blackberries.

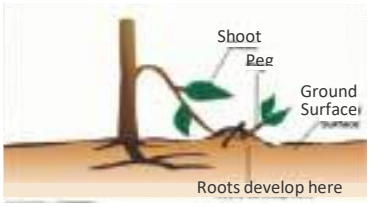


Fig 2.2.13 Tip layering

- **Simple layering:** Bend the stem to the ground. Cover part of it with soil, leaving the last 6 to 12 inches exposed. Bend the tip into a vertical position and stake in place. The sharp bend will often induce rooting, but wounding the lower side of the branch or loosening the bark by twisting the stem may help.
  Examples: forsythia, honeysuckle.


Fig 2.2.14 Simple layering

- **Compound layering:** This method works for plants with flexible stems. Bend the stem to the rooting medium as for simple layering, but alternately cover and expose stem sections. Wound the lower side of the stem sec ons to be covered.
  Examples: pothos and heart-leaf philodendron.


Fig 2.2.15 Compound layering

- **Mound (stool) layering:** Mound (stool) layering is to cut the back of the plant to 1 inch above the ground in dormant season. Mound soil over emerging shoots in the spring for enhancing their rooting.
  Examples: gooseberries, apple rootstocks.


Fig 2.2.16 Mound (Stool) layering

- **Air layering:** Air layering generally used to propagate few of thick stem indoor plants and /or to rejuvenate them when it becomes leggy. Slit the stem just below a node.

- **Plants to propagate layering:** Tip purple and black raspberries, trailing blackberries simple forsythia, honeysuckle, spider


Fig 2.2.17 Air layering

plant, mostvine-types plants (philodendron, grape ivy, devils ivy, swedish ivy, etc.). Compound heartleaf philodendron, pothos Mound gooseberries, apple rootstocks, air layering plants with rigid stems such as dieffenbachia, ficus, rubber plant, aralia, croton.

- **Division:** Propagation from the following plant parts can be considered a medication of layering, as the new plants form before they are detached from their parent plants.


Fig 2.2.18 Division layering

- **Stolons and runners:** The stolons and runners. A stolon is horizontal, often a fleshy stem that can be rooted, then producing new shoots where it touches the medium. A runner is slender stem which originates in a leaf axil and grows along the ground or downward from the hanging basket results in producing a new plant. Plants which produce runners or stolons, propagated by severing the new plants from their parent stems. Plantlets at the tips of runners may berooted while still attached to the parent, or detached and placed in a rooting medium.
  Examples: strawberry, spider plant.



Fig 2.2.19 Stolons and runners

- **Offsets:** Plants with a roasted stem often reproduce by forming new shoots at their base or in leaf axils. Sever the new shoots from the parent plant after they have developed their own root system. Unrooted offsets of some species may be removed and placed in a rooting medium. Some of these must be cut off, while others may be simply litted off the parent stem.
  Examples: date palm, haworthia, bromeliads, many caption.



Fig 2.2.20 Offset

- **Separation:** Separation is a term applied to a form of propagation by which plants that produce bulbs or corms multiply.



Fig 2.2.21 Separation

- **Bulbs:** New bulbs beside the originally planted bulb. Separate the bulb clumps every 3 to 5 years for the largest blooms and to increase the bulb population. Dig up clump after the leaves have withered. Gently pull the bulbs apart and replant them immediately so their roots can begin to develop. Small or new bulbs may not flower for initial 2 or 3 years, but large ones should bloom in the first year.
  Examples: narcissus and tulip.

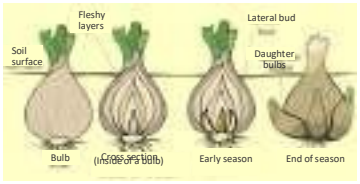


Fig 2.2.22 Bulbs

- **Corms:** A new corm forms on the top of old corm, and tiny cormels form around the large corm. As the leaves wither, dig up corms and allow them to dry in indirect light for 2 or 3 weeks. Cormels are to be removed and then gently separate new corm from the old corm. Dust all the new corms with fungicide and store in a cool place un l they planted.
  Examples: crocus, gladiolus.



Fig 2.2.23 Corms

- **Crowns:** The crowns plants which are more than one rooted crown should be divided and the crowns to be planted separately. If the stems aren't joined, then gently pull the plants apart. If crowns are united by the horizontal stems, then cut the stems and roots with a sharp knife to minimize any kind of injury. The divisions of some outdoor plants should be dusted with a fungicide before it is replanted.
  Examples: snake plant, iris, prayer plant, day lilies.



Fig 2.2.24 Crowns

- **Division:** Stolons/Runners strawberry, begonia, spider plant
- **Offsets:** date palm, haworthia, bromeliads, cacti and succulents.
- **Bulb:** tulip, narcissus, hyacinth, amaryllis, lilies.
- **Corm:** crocus, gladiolus, freesia
- **Crowns:** sansevieria, iris, prayer plant, day lilies, boston fern, cast iron plant, peace lily.

Asexual Propagation of Perennials Division

Most perennials left in the same place for more than 3 years are likely to be overgrown, overcrowded, have dead or unsightly centers, and need basic fertilizer and soil amendments. The center of the clump will grow poorly, if at all, and the flowers will be sparse. The clump will deplete the fertility of the soil as the plant crowds itself. To divide the mature clumps of perennials, select only vigorous side shoots from the outer part of the clump. Discard the center of the clump. Divide the plant into clumps of three to five shoots each. Be careful not to over-divide; too small a clump will not give much color the first year after replanting. Dividing of the perennials when plants are dormant which is exactly before the new season of growth, or in the fall so it can become established before the ground freezes.

- Dividing of the stagger plant so as the whole garden would not be redone at the same me; good rota on will yield a good display of flowers each year. It is suggested not to put all the divisions back into the same space that contained the original plant. That would place too many plants in a given area. Give extra plants to friends, plant them elsewhere in the yard, or discard them.

CuEngs

Many plants can be propagated from either tip or root cuttings. Generally, tip cuttings are easier to propagate than root cuttings. Select second growth of dianthus, candying, and phlox for cuttings. Make tip cuttings 3 to 6 inches long. Treat the base of the cutting with a roots mulant. Leave all foliage on the cutting except the part that will be below the soil line. Insert one cutting per peat pot. Place peat pots of tip cuttings in a lightly shaded place. Cover with a sheet of clear plastic. Check regularly to make sure the cuttings do not dry out. When cuttings do not pull easily out of the soil, they have begun to root. Make holes in the plastic sheet to increase the exposure of the cuttings to the air. This will harden the cuttings. Every few days, enlarge the holes or make new ones. Make root cuttings of phlox, baby's breath, and oriental poppy. Dig the plants in late summer after they have bloomed. Select pencil-sized roots; cut them into 4-inch sections. Put each piece in a peat pot. Prepare a tray of peat pots as for seeds, except the soil mix should be 2 parts sand, 1 part soil, and 1 part peat moss. Water thoroughly.

Budding

- Budding is of propagation where one bud is crated in the root stock to form shoots in future.

There are different types of budding:-

- T-Budding – Since in this method a T-shaped cut is made to insert a bud, it is known as T-budding. It is also known as shield budding.

1. Steps of T-Budding:

- A healthy root stock is taken and 12-15 inches above the ground a horizontal cut of 1-2 cm (approx.) is made.
- From the middle of this horizontal cut a ver cal cut is made down of approx 2-2.5 cm.
- A bud is removed from the desired shoot of mother plant. This bud is of the similar size as that of the cut made in the root stock.

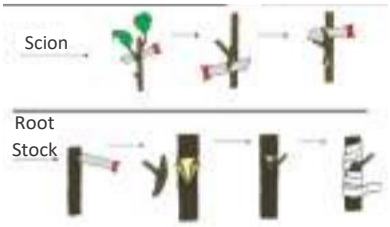


Fig 2.2.25 T- budding

For removing the bud, a horizontal is given above and below the bud at a distance of approx. 2 cm.

- Using a budding knife, this bud is sliced along with the wood.
- This bud is then inserted in the T-shaped cut of the root stock by lifting the flaps to from a bud union.
- This bud union is then tied / shielded with a piece of polythene stip joining the two components firmly together leaving the bud exposed as shown in the figure.

Patch Budding

- In this type of budding a rectangular patch of about (1-1.5) cm vide and 2.5 cm long is removed from the root stock. This patch is transferred to root stock and is fixed there. Then, it is immediately tied with polythene strip.

Chip budding

- In this method, bud from the shoot is removed such that it matches the cuts made in the root stock. Then, the chip with a bud is fixed into the cut. The bud, at last, is tied with a polythene strip.

Grafting

In this method, two plants are joined together such that they unite and continue their growth as a single plant. Various types of grafting are:

- **Tongue grafting:** A long slanting cut of about 4-5 cm is made on the root stock. Another downward cut approx. 1/3rd from the top is made. The scion having 2-3 buds is fitted with the root stock, which is then wrapped with polythene strip.



Fig 2.2.26 Tongue grafting

- **Cleft Grafting:** In this method, stock upto 8 cm thick is grafted. The root stock which is to be grafted is cut and split in the middle down about 4 cm. The bud s ck is then trimmed.

- **Approach Grafting:** Since root stock is approached to the scion, while it is still attached to the mother plant, this method is known as approach grafting. A slice of bark along with a piece of wood is removed from the stock and scion. They are then tied together with polythene strip for the union. The union completes in about 2-3 months. A cut is made to the shoot about half way through its thickness. It is also known as inarching.

- **Veneer grafting:** In this method, a veneer downward cut is made on the root stock at about 15-20 cm high from the ground. At its base, a short inward cut is made to make way into the first cut to remove a piece of wood bark. The scion prepared is then tied into the root stock and tied with polythene strip.

- **Runner:** Runners are special organs which develop from the crown of the plant and spread horizontally like in strawberries. These runners can be detached from the plant and transplanted to develop a new plant. In short, they reproduce the plant with the same trait.



Fig 2.2.27 Runner

- **Sucker:** Sucker is a type of shoot which develops on a plant below the ground. These scions are then separated from the mother plant and transplanted. Sucker forma on takes place in fruit plants like pear, banana etc.

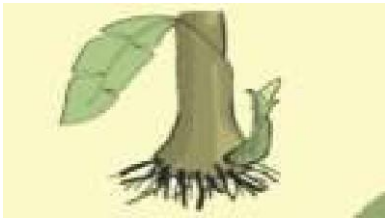


Fig 2.2.28 Sucker

- **Tissue Culture:** It is a technique wherein millions of plants are propagated in laboratories using small propagating material from the mother plant. These progenies developed through. Tissue Culture are true to type and mostly disease – free. In later stages, the small plants developed in laboratories are transferred to poly houses for hardening and then to the shade houses for further development and sale.

Advantages

- Used to conserve rare species.
- Plants in large numbers for commercial purpose can be produced.
- Gives you true to type varieties.

2.2.2 Some Other Operations

Use of Plastics in Nursery

Nurseries have been using plastics in the form of soil solarisation, nursery bags, portrays, plug trays, crates, hanging baskets, sprayers, mini & micro sprinklers, drip irrigation system with foggers & misters, low tunnel, shade net house, greenhouse etc. to develop quality seedlings, saplings, hardening of tissue culture plants and grafts.

Advantages-

- Use of plastics media helps to produce quality seedlings, grafts and plants.
- Better & early germination with less mortality.
- Enable round the year nursery of different crops.
- Helps to raise early & healthy saplings for off-season crops.
- Easy to handle, store, transplant and transport.
- Reduces labour costs.
- Intensity of sunlight.

Types of plants grown in gardens according to the season:

Seasons	Plants
1. SPRING	• Weigela • Crocus • Daffodil • Hyacinths • Primrose • Forsythia
2. SUMMER	• Sweet Alyssum • Lantana • Canna • Portulaca • Salvia • Caladium
3. AUTUMN	• Cyclamen • Winter Aconite • Pansy • Heather • Aster • Dahlia
4. WINTER	• Antirrhinum • Aster • Aster • Clarkia • Dianthus • Statice

Table 2.2.1 Flowering plants for different seasons

Exercise

A. Short Questions

Q.1. Demonstrate T-Budding.

Q.2. List types of layering.

B. Match the Following:

1. Offsets a). Tulip
2. Bulb b). Gladiolus
3. Corm c). Iris
4. Crowns d). Date palm

Notes

Scan the QR Code to watch the related videos

https://www.youtube.com/watch?v=WHiv1OvXGcI

How to Propagate Plants



Skill India
कौशल भारत-कुशल भारत

सत्यमेव जयते
GOVERNMENT OF INDIA
MINISTRY OF SKILL DEVELOPMENT
& ENTREPRENEURSHIP

N·S·D·C
National
Skill Development
Corporation
Transforming the skill landscape

ASCI
Agriculture Skill Council of India

3. Preparation for SeEng Up the Garden

Unit 3.1 - Components of Garden

Unit 3.2 - Types of Garden

Unit 3.3 - Design and Layout of Gardens



AGR/N0802

Terminal Outcomes

By the end of this module, participants will be able to:

1. Describe the process of planning a garden.
2. List various resources required for setting up a garden.

Key Learning Outcomes

By the end of this module, participants will be able to:

Theory – Key Learning Outcomes	Practical – Key Learning Outcomes
1. Describe the process of assessing the soil and climate characteristics at a proposed site to establish suitability for planting a garden. 2. Describe the process of coordinating with an authorised lab to identify the soil's micro and macro-nutrient requirements. 3. List a variety of materials required for setting up a garden. 4. List various trees, plants, shrubs, grass, hedges and edges used for setting up a garden. 5. Describe the process of preparing a layout for setting up a garden. 6. Describe basic practices related to maintaining the record of purchase and payments. 7. Describe the basic accounting and inventory management practices.	1. Demonstrate the process of assessing various parameters required for setting up the garden. 2. Demonstrate the process of applying the necessary treatment to improve the soil's fertility. 3. Prepare a sample layout for setting up a garden. 4. Prepare a sample list of various materials and resources required for establishing a garden.

UNIT 3.1: Components of Garden

Unit Objectives

By the end of this unit, participants will be able to:

1. List a variety of materials required for setting up a garden.
2. List various trees, plants, shrubs, grass, hedges and edges used for setting up a garden.
3. Describe the process of assessing the soil and climate characteristics at a proposed site to establish suitability for planting a garden.
4. Describe the process of coordinating with an authorised lab to identify the soil's micro and macro-nutrient requirements.

3.1.1 Components of Garden

Bushes and shrubs listed by scientific, botanical or latin name.

S.No.	Shrubs	Botanical	Key Characteristics
1.	Tecoma	*Tecoma capensis*	Orange flowers
2.	Pili Kaner	*Yellow Oleander / Cascabela Thevetia*	Yellow Flower
3.	Kaner (safed)	*Nerium oleander*	White flower
4.	Bougainvillea	*Bougainvillea Dwarf*	Man coloures
5.	Caesalpinia	*Caesalpinia pulcherrima*	Yellow and orange flowers
6.	Ixora	*Ixora*	Red and Pink flowers
7.	Tecoma gaudi Chaudi	*Techoma*	Yellow flowers
8.	China Rose	*Hibiscus chinesis*	Multiple colour flowers
9.	Rose		
10.	Ficus black	*Ficus blackeana*	Thick foliage
11.	Ficus benjamina	*Ficus benjamina*	Yellow colored thick foliage
12.	Ficus starlight	*Ficus starlight*	Variegated foliage
13.	Jasmine	*Jasminum*	Fragrant bloom

Table 3.1.1 List of common shrubs with their characters

S.No.	Common Name	Botanical Name	Purpose
1.	Murraya	*Murraya paniculata*	Boundary / Fragrant flower
2.	Bougainvillea	*Bougainvillea glabra*	Flowers / Wall /Border
3.	Ficus Panda	*Ficus retusa*	Hardy / Border
4.	Ficus starlight	*Ficus. benjamina*	Border/leaves variegated
5.	TMC	*Caesalpinia pulcherrima*	Border and flowers
6.	Hibiscus	*Tabernaemontana divaricata*	Border and flowering
7.	Heena	*Lawsonia inermis*	Boundary / Border
8.	Enermi	*Clerodendrum inerme*	Boundary / Border
9.	Tecoma gaudi Chaudi	*Tecoma gaudichaudi*	Screening / Wall
10.	Honeysuckle	*Tecoma capensis*	Screening/Wall

Table 3.1.2 Purpose of shrubs and trees in landscaping

S.No.	Common Name
1.	Lal ghas
2.	Duranta golden
3.	Duranta variegated
4.	Wedelia
5.	Red elanthra
6.	Green elanthra
7.	Black grass
8.	Marigold

Table 3.1.3 A list of plants generally used for making edges

S.No.	Common Name	Botanical Name
1.	Gulmohar	*Delonix regia*
2.	Amaltas	*Cassia fistula*
3.	Jacranda	*Jacaranda mimosifolia*
4.	Cotton silk tree	*Bombax*
5.	Royal Palm	*Roystonea regia*
6.	Ankohan	*Cassia modusa*
7.	Kachnar	*Bauhinia variegata*

Table 3.1.4 A list of avenue trees

3.1.2 Climate and Soil Assessment

All around the world, plants have evolved and have adapted over time to the environment, whether it be temperate or tropical, wet or dry, loamy or rocky, sunny or shady. Plants that were unable to find a niche died out and disappeared. These days, we incorporate plants into our gardens from many cultures and climatic zones. Even though we make an effort to include native plants in our designs, we are aware that even they have a rich past. It is possible that native people, animals, water, wind, and even centuries before may have carried their seeds to the area. Each species of plant has a range of favourable conditions in which it will flourish, other conditions in which it will merely survive, and particular restrictions that will result in its demise in unfavourable circumstances.

Temperature

Plant survival is influenced by temperature. Knowing the temperature in your garden will help you identify the many plant species that can grow there, especially those that often have a lifespan of longer than a year.

The climate in your area, including the dates of the first and last frosts, as well as the particular exposure of your garden, all affect its conditions. If you give tropical plants warmth in the winter or cold to plants from temperate areas in the winter, plants can be cultivated outside their normal climate. When choosing your plants, take into account their endurance to both heat and cold.

Seasons

While some places are consistently hot or cold throughout the year, others are pleasant or moderate most of the time, which experiences hot summers and very frigid winters. In some areas, winters are damp while summers are extremely dry. Some are subject to change from year to year. Despite the fact that we are powerless to change the local weather, we may nevertheless choose plants that are suited to it by observing its patterns.

Microclimate

Every garden contains sections that are exposed to the elements in varying degrees. They are referred to as microclimates. There are generally multiple microclimates on a small deck. In comparison to other areas of the same deck, the area closest to the house may receive more reflected light if it faces west or more shadow if it faces north. Differences are considerably more obvious in larger areas.

Some plants may blossom earlier or later in the season in these particular niches, or they may be more susceptible to freezing or overheating. Buildings with south-facing slopes or sides typically have longer than the surrounding locations. A week or two earlier than those in a cooler area of the garden, spring flowers may bloom there. Even though a south-facing space may be comfortable on sunny winter days, some plants may not be able to withstand the sudden decrease in temperature from a bright winter day to a chilly night. For plants that are only moderately hardy or those that are prone to drying out in the winter, the cooler, shadier, north-facing exposure is preferable.

Soil Assessment

There are four primary functions for the garden soil in which plants thrive. It provides food, water, and air to the roots as well as aiding in holding the plant upright thanks to its structural support. Some soils can already serve these functions and only require minor modification. They are referred to as loam soils and are made up of a variety of organic matter and soil particles. Organic debris is broken down by helpful microbes creating nutrient-rich, textured soil. You won't need to treat a garden that has lush, fertile soil.

However, it's probable that you'll need to enhance one or more of your soil's characteristics. For instance, soil that contains a substantial amount of clay (at or above 25 percent) is composed of rock particles that are so small and closely spaced that little airflow is permitted. Because clay retains more moisture, it needs less watering in the summer and takes longer to dry in the spring. All that is needed to enrich it and increase the likelihood of luxuriant growth is the addition of compost and, on sometimes, a small amount of fertiliser. Composting is crucial. To prevent the soil from being overly thick and insufficiently aerated, it helps break up clay.

Larger rock fragments can be found in sandy soil. In sandy soil, there is a lot of air present, yet water rushes straight through, often taking nutrients too quickly and drying up right after a storm. This means that the gardener may need to add whatever the plants require in rainy climates. The ratio of sand, silt, and clay in your garden soil must be just correct.

Identifying the Garden Soil's

Texture Sand, silt, and clay make up garden soil, and they must all be present in the proper proportions for plants to thrive.

There are a few methods for identifying the type of soil you are working with.

- Simply squeeze some slightly moist soil in your hand for a quick test.
- Clay soils hold their shape and create a tight lump.
- When probed, loam soils break up into smaller pieces. Sandy soils are completely unconformable.

Additionally, you can examine your soil's texture in a water-filled jar:

- Select a Sample of soil from the garden that is eight inches deep and close to the surface.
- Dry it, then grind it into tiny grains and thoroughly combine.
- A quart glass jar should have a layer of one inch (just over a cup) of powdered dishwasher detergent in it. (Detergent for the dishwasher won't bubble up.)
- Fill the jar with water until it is two thirds full.

- Shake the jar vigorously for a minute, tipping it upside down as necessary to remove all the soil, and then place it somewhere it can remain undisturbed, such a counter.
- Mark the jar's level of settled particles with a crayon or wax pencil after one minute has passed. That's sand. Set a four-hour alarm, and when it goes off, mark the next level, which represents how much silt has accumulated.
- The clay will gradually settle over the course of the following day or two, enabling you to take the precise measurement. These metrics reflect your soil's relative proportions of sand, silt, and clay.

Plants in your garden receive nourishment from organic materials. To find out how to evaluate the organic content of your garden soil, keep reading.

Analysing the organic content of the soil

Topsoil is richer than subsoil in the natural world. In contrast to the subsoil below, which can mostly be clay or sand, topsoil is the dark brown layer of soil that is at the surface and is the result of years and years of organic matter breaking down. The soil is given life by organic materials.

Each soil requires organic matter to maintain its texture and usability as well as to provide the nutrients needed for strong plant growth. It is made of materials that come from weeds, fallen logs, twigs, animal droppings, leaves, and other once-living sources.

Growing plants like to have their roots in the dark, rich layer created by the breakdown of leaves and other organic waste in the forest. Earthworms and helpful microbes break down organic matter into simpler chemicals that plants can use as food.

While commercial fertilisers can be used in areas with minimal organic matter to supply the essential compounds, they do not address soil texture and it might be challenging to add all the trace minerals that organic matter naturally provides. By adding a lot of organic matter in the form of compost, wood chips, various mulches, chopped leaves, and animal manures, you may ensure good soil quality, texture, and quantity.

Coordinating with an authorised lab to identify the soil's micro and macro-nutrient requirements

The soil provides nitrogen, phosphorus, potassium, calcium, magnesium, and sulphur in relatively large amounts; these are commonly referred to as macronutrients. The soil provides iron, manganese, boron, molybdenum, copper, zinc, chlorine, and cobalt in trace amounts, which are known as micronutrients.

Method of conducting soil testing

- Collect soil sample from various parts of the garden.
- Mix the collected soil and take out a sample from it.
- With proper packaging send the soil to an authorised laboratory for soil testing.
- According to the test results, make amendments into the soil to increase the soil fertility and productivity.

Exercise

A. Short Questions

Q.1. List components of garden and write short note on them.

Q.2. List at least two plants generally used for topiaries.

B. Fill in the Blanks

1. When a group of shrubs are planted together in a group, then collectively these shrubs are known as a_____.
2. When we grow plants close enough to form a dense fence or boundary which is thick and full of foliage, it is known as a_____.
3. A row of trees planted all along, both sides of road are known as_____.
4. Those plants which have a soft stem and are unable to stand straight without a support are known as_____.
5. _____gardens are uneven landscaped or asymmetrical gardens, resembling closely to natural gardens.
6. _____gardens are a very well planned gardens with neatly trimmed and shaped hedges and shrubs perfectly pruned borders and manicured topiaries.

Notes

Scan the QR Code to watch the related videos

https://www.youtube.com/watch?v=OcOiEFelPx0&list=PLekJC5v4LQiapihi5HXBnjasuGVMmfmus&index=3

Identification of Ornamental Plants

UNIT 3.2: Types of Garden

Unit Objectives

By the end of this unit, participants will be able to:

1. Describe landscaping and types of garden.
2. Describe basic practices related to maintaining the record of purchase and payments.
3. Describe the basic accounting and inventory management practices.

3.2.1 Landscaping: Types of Garden

Landscaping

1. Landscaping of Home
2. Landscaping of Institute
3. Landscaping of Industry

1. Landscaping of Home

There are many people who think that landscape gardening relates to only gardening in large public parks or palaces of the rich. Landscaping as it is done for larger estates or public parks can also be implemented in a tasteful and artistic way for a small home ground, though on a smaller scale. The term "small" is a misleading 'one so far as it relates to gardens. The simplest definitive or "small", as suggested by some authors quite appropriately, is an area which can be effectively managed and maintained physically as well as financially by the owner and his family with occasional hired labour for such hard work as digging, mowing, and shearing of hedges. Here, ways will be suggested for landscaping only small residential houses. For larger estates, a combination of landscaping effects suggested for parks and home landscaping may be followed.

There are some basic guidelines for a home landscape. But personal preference plays a considerable role in developing a home garden. The home including its surroundings should be an outward expression of the inner personality and individuality of the owner. Often a common mistake is made by many to copy a successful competitor of a garden competition or a neighbour. This may not suit your own home for various reasons. For example, location aspect of your own garden may be quite different compared to the one which you want to copy. It is advisable to think a lot before even a single digging work starts. It is a matter of great regret that in our country sometimes we spend a fortune in decorating the interior of the house to make it attractive but ignore the outside compound.

- **Making a Plan:** Before any actual garden work is undertaken a master plan has to be prepared according to a scale (1:15 or 1:20) in which all the features such as house wall, drive-way, paths, flower beds, shrubbery, etc., are plotted. The shaded areas due to large tree canopy or the building itself has to be marked on the plan. A plan prepared on a printed graph paper is of great help. The plan thus prepared should be studied again and again keeping in view what shape a plant will take in the long run. It is frequently observed that people attracted by the graceful form of a young Araucaria cookii, plant this in the centre of a lawn or near the house possess the gigantic form and height it will attain after some years.

Perhaps the owner of the house will cut this tree when overgrown or it may be retained to the detriment of other plants growing below it. Either way, this is not a good planning. Perhaps, one way of satisfying the urge of a garden lover to grow such beautiful trees in a small compound, is to grow them large concrete tubs and bury the tub growing the tree in the appropriate place, thus giving the impression that the plant has actually been grown on the ground. When this attains a considerable height, say 3-6 m, the tree along with the pot should be lifted and given to someone who can afford to use such a grown-up tree. But it is better not to include such controversial items. If the garden area is sufficiently large, this can be divided into three areas.

- **Approach or Public Area:** This is the area from the street side extending to the entrance of the house. The area may be small or quite large depending upon where the building is situated. The aim is to harmonize or blend the surroundings with the house proper. The approach area should not be overcrowded with large trees. It is better to have doorway or "Foundation" plantings with low rowing shrubs and evergreens. Floribunda and miniature roses are also suitable for foundation planting provided sufficient sun, at least during the morning hours, is available.



Fig 3.2.1 Floribunda rose

It is important to note that planting in front of the house should neither obscure it nor cut off light and air nor block the windows thus obstructing view of the garden from indoors.

Big trees, if space permits, can go in the backyard but should not be overcrowded in the front. But a few low-growing trees can be accommodated at the appropriate places as next to entrance, if space is available or somewhere in the front lawn. An open spacious lawn with some annuals (cut-and-come again zinnias, salvias, and petunias) or herbaceous perennials (chrysanthemum, Canna, and Impatiens in shade) can be planned in addition to the foundation plantings.



Fig 3.2.2 Impatiens balsamina



Fig 3.2.3 Zinnia

- **Work or Service Area:** The work or service area can be convenient, orderly and attractive. Wherever feasible this and the living area should be situated at the back of the house as these need seclusion or privacy. This area includes the kitchen garden, compost bin, nursery, tool shed, and garage. Some people like to include the children's swings and the slide in this portion as the children can be kept under surveillance from the kitchen. This should be separated from view by planting a thick hedge or a row of bushy shrubs, as this is considered as the shabbiest part in any garden.



Fig 3.2.4 Service area

- **Private garden area or living area:** This is generally termed as the outdoor living area, where people sit out in the winter to enjoy the sun or rest in the summer under an arbour or shade of tree. This area should be easily approachable and visible from the living (drawing-room) or dining-room, screened from unsightly objects and for privacy. In the western countries people prefer a terrace and this is the place where it should come. There should be some shaded sitting spot such as a tree or arbour with garden benches.
Landscaping can help you effectively cover your outdoors thereby helping you block unpleasant views from outsiders or your own neighbors. Building huge walls to achieve this would be undesirable when the same can be achieved beautifully through landscaping.

Garden benches offer a real opportunity to add utility, color and beauty to the landscape. Comfortable and attractive items are now available in a wide variety of low maintenance outdoor furniture. Outdoor furniture must be large enough to be practical and must be in scale with its surroundings. Built-in furniture has the added value of being permanently in place and enhancing the overall design. Occasionally the surface of a retaining wall or raised planter can serve as a seating area.



Fig 3.2.5 Playing area

The living terrace is the most usual place for outdoor furniture. A wide stretch of lawn with shrub border or few annual beds or a rose garden can also be included in this section. A tennis court or a play area has to be included here, if there is enough room.

But before actual planning one has to first decide what one wants for one's house. A choice has to be made from the following. Whether the garden is needed (a) as an outdoor having room with a long stretch of lawn and terrace (b) as a fenced-in playground (c) as a show piece with collection of exotic and rare plants or (d) a yielder of vegetables and fruits or cut flowers for the house is to be determined first. Some may like to add to the list a large tree for shade or trees to attract birds. It is to be considered first what should be the major theme of the garden.

If somebody is fascinated with flowers, the borders are to be planned wide to fulfill his desire. People fond of vegetables and fruit may like to reserve the major portion of the area for this purpose with possibly a little area left around the house for a pleasure garden. But, if the garden is desired as a place for outdoor living, a vast expanse of lawn with minimum of beds and borders has to be planned. Some novices may like to combine the good qualities of all these themes and incorporate in his garden. This is bound to create a mess of everything and the ultimate result will be a garden good for nothing.

Many people advise not to include any pool or formal rock garden or the kind in a home garden. But there is no harm if a formal or informal 1i1y pool can fit in with the overall design, with or without a fountain or a rock garden. A statue or sun dial can also be well fitted in some spacious compounds.



Fig 3.2.6 Lily pool

Some Points to Ponder

In designing a house some more thinking is necessary. To keep down maintenance cost and time, an untrimmed hedge should be preferred over trimmed one, open lawns and shrubs need less attention than annual flower beds. If the beds and borders in a lawn are edged with stone or brick no hand-clipping of grass will be required. A pool needs to be cleaned occasionally and one should ponder twice before including this in the plan.

The water outlets in the garden should be fixed at appropriate places so that the hoses are not dragged to long distances. The above suggestions are for reducing the labour cost which is especially relevant in industrially advanced countries where labour is costly. Fortunately in India, labour is not so costly' and one can include one or two features needing help of manual labour.

To create privacy, trees, hedges, shrubs, fences, or creepers trained on wire-mesh structure supported by angle iron or G.I. pipe pillars can be grown. Trees are used when height is needed, otherwise hedges and other types of screens should be preferred.

Lighting is needed in the light special1y for terrace area and paths. The same electricity points can be utilized for running an electric lawn mower.



Fig 3.2.7 Electric lawn mower

How to Proceed

When everything has been decided, it is time to tentatively select the plants needed. The different features are then drawn on the paper with a pencil so that this can be erased if alterations are to be made. After thorough study and several additions and omissions a plan is finalized. For an experienced man, this would not be much of a problem. But a novice must visit the neighbours and see some of the local parks to know what can be grown. The first thing is to select the materials for the basic framework such as background, screens, trees needed for shade, the doorway and the corner of the house. To this the features needed for effects and beauty as for example plants for foundation planting, flower beds, specimen shrubs or trees are added.

After everything is finalized on paper these are put into practice on the ground with the help of split-bamboo stakes and rubber hose. The trees are represented by bamboo stakes, while the beds and borders can be plotted by bending a rubber hose in the desired pattern, Paths, hedge, or screen area can also be marked with stakes. When everything is plotted the design is studied again and last-minute changes are effected if required. After this, digging and planting work are started according to plan. Before implementing the plan some compounds may need a little dressing-up like cleaning, levelling and tidying-up.

Salvaging an Old Garden

If a property has been purchased which already had some garden, it is to be studied whether the old garden can be re-made. This is a complicated job which has its advantages and disadvantages. It is often difficult to adjust some existing features into the new plan. The aim is to incorporate in the new design every interesting existing feature and remove others not needed. A bird bath, water garden and terraces should be retained and improved upon. The remaking process has to be completed slowly after watching every feature carefully and evaluating their utility in the new design.



Fig 3.2.8 Water garden

Problems and solutions

Often it so happens that a double-storey house has a one-storey garage attached at one side of the building thus disturbing the whole balance. The solution in correcting this imbalance lies in planting tall trees with rounded canopy along the garage end. It is also important to select the proper plants near the house to soften and broaden the view of the house. A medium tree with low-branching habit and with a rounded or little oval-shaped top is planted near the corner with some low-growing shrubs planted around it. Trees such as silver oak, *Amherstia nobilis, Cassia nodosa, Dillenia indica, Gulmohar, Magnolia grandiflora and Saraca indica* can be used for this purpose. If the tree selected is deciduous in nature the evergreen shrubs below should form the contrast. For a two-storey house, a high branching rounded canopy tree such as *Anthocephalus cadamba, Erythropsis colorata, Michelia champaca, and Polyalthia.* Longifolia should be planted farthest from the corner of the house and in between a fairly large second tree or shrub is planted, besides some other low-growing shrubs.



Fig 3.2.9 Amherstia nobilis



Fig 3.2.10 Gulmohar



Fig 3.2.11 Michelia champaca

A doorway near the house needs special attention as this is the place which receives maximum attention from a visitor. Depending upon the approach a doorway can be planted informally, formally, or in a semi-informal pattern. It can be arranged with a garden-type design consisting of an ornamental shade or flowering tree perennial and annual flowers, climbing roses, some bulbs such as Zephyranthes, Amaryllis and daffodils (for temperate regions). Where it is not possible to plant the annual and perennial flowers in ground these can be put in tubs and arranged artistically. An ornamental light post, an urn or an artistically shaped boulder will be an object of interest when placed near the shade tree or in an appropriate corner. A bed of roses can also be a spot of beauty provided it receives the morning sun. Symmetrical plants with pyramidal form such as Thuja, Juniperus chinensis, and Cupressus macrocarpa are preferred by many near the doorway for a formal treatment.

If a plot is rectangular in shape, where the length is far greater than the breadth, the best way to develop such plot will be to divide the whole area into a series of garden compartments enclosed by hedges with continuous walk of gravel paving or grass connecting each segment with the other. But some people may prefer to have long stretches of open lawn, when this arrangement will not do. In such cases the plot should at least be subdivided into two segments as too much of a rectangular land with narrow width is not pleasing to the eye. Many people inherit irregular-shaped plots specially those who are allotted the corner plots. It is far more difficult to plan a garden for such plots compared to a rectangular or a square plot. Inept handling may ruin such plots but a man with imagination and artistic sense can develop a garden which will be far more interesting than a garden in a regular shaped plot.

Such plots should receive informal treatments. An irregular-shaped corner may be tackled by constructing an informal lily pool. Similarly beds and borders should be shaped irregularly according to the contour of the plot. It may be far more convenient to develop a rock garden in a shapeless corner than to have a lawn or flower bed. It may be wise not to have formal paths of any kind; instead, the various areas may be reached by stepping-stones placed in artistically-curved fashion over the grass. These are only a few suggestions. Much depends on the imagination and tact of the man doing the job on the spot as the situation demands.

Plans for very small compounds

What we have so far discussed suits the plots which are relatively large. For very small plots which cannot be divided into different segments such as public area, living area, and work area, one has to depend upon one's own imagination to landscape such plots. But it should be remembered that the majority of the flowering plants and Calcutta doob do not flourish well in a shaded place. For such plots situated under shade it is wise to put shade loving foliage plants and flowering plants preferring semi-shade such as Impatiens sultanii, geranium, day lily and footfall lily. Otherwise, a lawn planted with a few specimen shrubs or roses or one or two small beds of flowering annuals will be more than sufficient for small compounds situated in the open. In all probability it will not be possible to have any large tree in such compounds.



Fig 3.2.12 Impatiens sultanii



Fig 3.2.13 Geranium

What we have discussed so far are some possibilities and nothing is sacrosanct. One can use one's own imagination to alter one plan or other. Actually landscape design has a wide flexibility and the same plot can be landscaped in two or more different ways. Moreover, opinion varies between one landscape designers to another and hence, the controversy whether a design is perfect will never end. But the basic theories must be followed and mistakes such as overcrowding, monotony and placing of plants in wrong situations (e.g., a sun-loving plant placed under the shade of a tree) should be avoided. Once the design is decided, the different features such as paths, walls, pools, lawn are constructed as per the procedures suggested in this book. The basic necessities such as irrigation and drainage should also be taken care of.

Trees suitable for small gardens

While selecting trees for the home garden the following questions must be answered. First of all, why the tree is needed? Is it for a background or corner planting to frame the house; whether this is needed for shade for sitting or for the terrace and if so, whether grass will grow under shade? Once the questions are answered, the right type of tree has to be selected. Enough room has to be left for the tree to grow.



Fig 3.2.14 Bauhinia purpurea

As for example, a 25 x 50 m plot has room only for a large shade tree and two to three small flowering trees. Shallow rooted trees such as Millingtonia hortensis should not be planted as they are surface feeders and may be uprooted by storms.

Bottle brush is suitable for many situations. Tecoma argentea is a wonderful flowering tree for home gardens around bangalore. The following trees are also suitable for planting in the home grounds: *mimusops elengi, gliricidia maculata, cochlospermum gossypium, cassia fistula, and cassia spectabilis.*



Fig 3.2.15 Cassia fistula



Fig 3.2.16 Cassia spectabilis

Some shrubs may be grown as specimens in the lawn. A few suggested shrubs are *ixora singaporensis, brya ebenus, sophora tomentosa, mussaenda philippica, azalea, cotoneaster horizontalis* and rhododendrons in different species. The last three are suitable for temperate climates. For shrubbery border a list of shrubs may be made from the chapter on ornamental and flowering shrubs, depending upon situation.



Fig 3.2.17 Ixora singaporensis



Fig 3.2.18 Mussaenda philippica

Landscaping a Country Home

A villager in India may not need a sophisticated garden as has been discussed in the foregoing pages. However, a countryman will need as much privacy as a city dweller. A village home has to be planned with more utility items. A villager would like to grow more vegetables and fruit for his family consumption and consequently more area should be earmarked for this purpose. But a shade tree or two and some area reserved for children's playground is definitely needed. Some utility flowering trees such as *Michelia Champaca, Plumeria acutifolia* and shrubs such as hibiscus rosa-sinensis, tabernaemontana coronaria, barleria, and jasmines yielding flowers for worshipping and hair decoration should be included for planting.



Fig 3.2.19 Michelia champaca



Fig 3.2.20 Hibiscus rosa-sinensis



Fig 3.2.21 Tabernaemontana coronaria



Fig 3.2.22 Barleria cristata

The common flowering annuals such as marigold, zinnia, balsam, and sunflower can be grown for beauty and cut flowers for various purposes.

2. Landscaping of Institute

A planned and properly landscaped school building will be different in appearance and beauty than unplanned one. Moreover a good garden in the campus inculcated aesthetic sense to our younger generation.

The general recommendations is to plant large trees in the school compound in the periphery of the school campus, along the rear and wings, a thick belt of large shady trees should be planted to bring down noise and cut down dust and storms. This plantation will also help keep down severe heat and cold. The front should be planted with medium-sized flowering trees for beauty. The trees should not completely obstruct the view of the building from outside. For enhancing the scenic beauty it is also suggested to plant a row of flowering trees, with different blooming seasons, in front of the large trees along the periphery. It is difficult to give any general recommendation regarding the types of such trees, as this will vary according to the architectural design, situation and climate. The object is to provide beauty and comfort depending on convenience.

The roads and paths are to be formally planted with medium to tall flowering plants. Before planting provision should be made for overhead wiring and sewerage so that these do not interface with the avenue planting. Where the electric wires limit the choice of avenue trees, small flowering trees such as cochlospermum gossypium, callistemon lanceolatus, bauhinia variegata, and tecoma argentea can be planted. The trees should be planted in pure avenues.



Fig 3.2.23 Bauhinia variegata



Fig 3.2.24 Callistemon lanceolatus

A lawn looks nice in an educational institution, but is very difficult to maintain. The playground can be planted with lawn, if this can be maintained or should be left bare.

A thickly planted belt of eucalyptus for peripheral planting is considered ideal. Silver oak, Polyalthia and Samanea saman are also suitable for this purpose. *Cassia fistula, Tecoma argentea, Erythrina indica, Lagerstroemia flos-reginae and Bauhinia variegata* are suitable for planting in the front and in the front row of the border planting.



Fig 3.2.25 Lagerstroemia flos-reginae



Fig 3.2.26 Cassia fistula

The roads and paths are to be formally planted with medium to tall flowering plants. Before planting provision should be make for overhead wiring and sewage so that these do not interfere with the avenue planting. Shrubs play an important part in the school landscaping. Shrub borders round parks or playgrounds is very effective and can replace hedges as the maintenance is minimum. A lawn look nice in an educational institution but it is very difficult to maintain. A bougainvillea creeper trained over the wall of the building can change the whole look. Similarly, a Bignonia venusta supported against a wall also looks beautiful. A creeper climbing with their rootlets such as Ficus repens, Tecoma radicans can also be trained over some stone or brick wall. Besides an ornamental or a landscape garden, universities and colleges can also maintain a botanical garden or a student garden, where the plants are arranged in groups, family wise so that such gardens become educative.

3. Landscaping of Industry

In modern times, a factory should not become a place of only machinery, dust, pollution and noise, but should also be provided with nicely laid-out parks and gardens. This is not only needed from the point of beautification, but also to fight pollution and dust. The factories may be broadly categorized into two groups. The first group comprises comparatively neat factories such as a plywood factory or a fruit processing plant which emit less dust and other polluting materials. The second group consists of factories such as cement, steel, fertilizer, etc. which emit a lot of dust, smoke, and harmful chemicals. The primary aim in a factory garden will be to plant trees to arrest the drifting dust and smoke and to cut down noise.

Another important aim is to provide ample shade and coolness so that the workers get a respite under the coolness of trees from the hostile hot interior of the factory. Moreover the trees bend down the temperature in the factory premises to a considerable extent. The places where garden can be laid in the factory area are canteen, rest-shed, hospital, administrative building etc.

It is interesting to note that well landscaped offices tend to have lower cases of absenteeism and job shifting. It has also been found that employees serving in offices featuring colorful landscaped entrances show better productivity.

The reason for this can be attributed to the basic fact that humans have a fundamental desire to keep contact with nature. Our perception and moods are highly influenced by the colors we see in and around us Tall and hardy trees such as Casurarina equisetifloia, Eucalyptus, Polyalthia logifolia and Silver oak should be planted all around or in the direction of the winds to stop the spread rows of plants planted in a staggering manner bring down the noise from the factory to the surroundings outside this barrier.



Fig 3.2.27 Polyalthia logifolia

Moreover, in a well-planted factory, the trees bring down the zone may be created by afforestation between the factory and its residential colony. Afforestation can be done with hardy ornamentals such as Acacia auriculiformis, Casuarina equisetifolia, Dalbergia sisso, and some other shade trees. Besides planting of trees, a factory area can also be beautified with rockeries, statues water pools or lakes, fountains, etc. Bougainvillea should be used freely to beautify a factory area.

Root zone process is a german technology to treat industrial and domestic waste water economically, efficiently and naturally. Three integrated compounds are essential to this system. They are the reeds, the reed bed and the microbial organisms.

Run the contaminated water under the root zone and the reed beds treat the water. The out coming water is clear, odourless and free from contamination which can be used for gardening and farming.

Landscaping can hugely enhance the sales appeal of a property thereby increasing the overall property value. The factors that seem to contribute in increasing the property values include greenery, walkways, arches, patios, decks and ponds.
Thus there is vast scope for the development of industrial and institutional landscapes. Such landscapes should aim to improve the aesthetic beauty of the place and reduce the pollution.

Physical and psychic utility

Owing to the seat bound office jobs, there is hardly and physical activity in our lives. This lack of exercise has lead to a number of health hazards. Roof garden system of vegetable cultivation provides an alternative to people living in all kinds of dwellings – individual houses, flats, or apartments. A family can tend the garden as a team. This can be a healthy family time to interact and talk, while doing a useful activity from the point of health and economy. This physical exercise helps us to forget the tensions of office and our minds can freshen up.

With the passage of time, the traditional joint family system is breaking up in India and most of the families are fragmenting into nuclear families on account of struggle for money and job strains. In families where grand parents are a part, the older generation feels left out. With a roof garden at home, even the old people can participate and feel one of the group and work rather than feeling left out. Thus having a garden is not only a physical or monitory need but a psychological too.

3.2.2 Record and Inventory Maintenance

A well-organized purchase order procedure keeps things moving. It also provides an audit trail that you can use to track expenses and settle disputes if necessary.

Best Practices in Purchase Order Management

- Provide Written Instructions
- Examine Your Purchase Orders
- Purchase Order Process Automation
- Construct Conditional Routing Rules
- Utilize Vendor Databases
- Connect to Document Management Systems

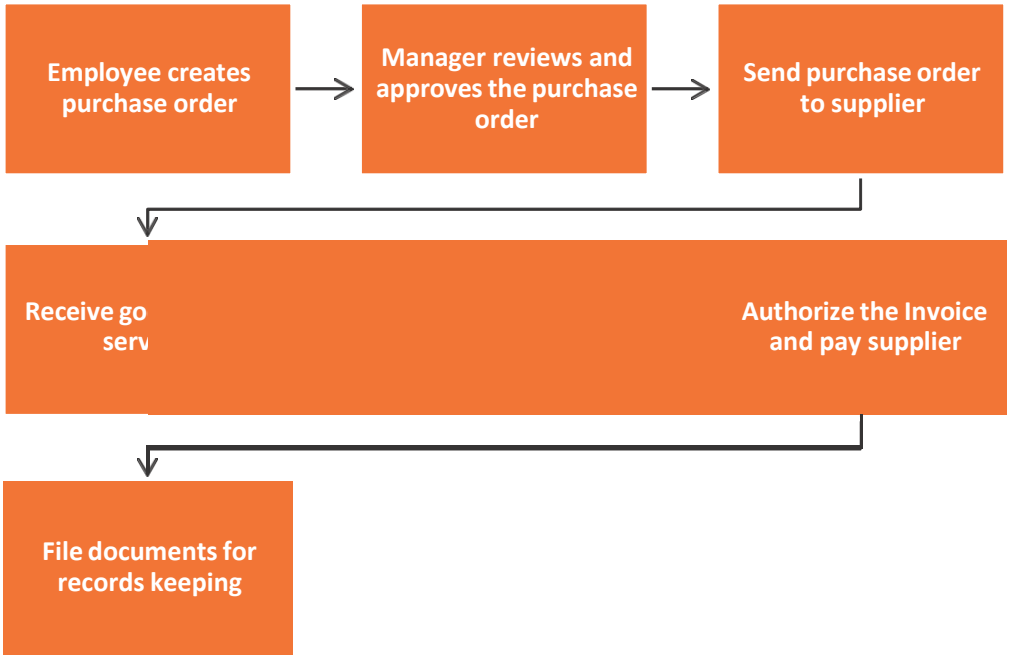


Fig 3.2.28 Purchase to record keeping

Basics of Accounting

The practise of recording and reporting on business transactions is known as accounting. The resulting data is an important feedback loop for management, allowing them to see how well a business is performing in comparison to expectations. The discussion of accounting fundamentals that follows will provide you with a solid foundation from which to understand how an accounting system works and how it is used to generate financial reports.

To begin, there must be a logical approach to record keeping. This entails creating accounts in which financial data is stored. Accounts are divided into the following categories:

- **Assets:** These are items that have been purchased or acquired but have not yet been consumed. Accounts receivable and inventory are two examples.
- **Liabilities:** These are business obligations that must be paid at a later date. Accounts payable and loans payable are two examples.

- **Equity:** This is assets less liabilities and represents the ownership interest of the business's owners. Common stock and preferred stock are two examples.
- **Revenue:** This is the amount that customers are charged in exchange for the delivery of goods or the provision of services.
- **Expenses:** This represents the total amount of assets consumed during the measurement period. Rent and wage expenses are two examples.

Inventory management process

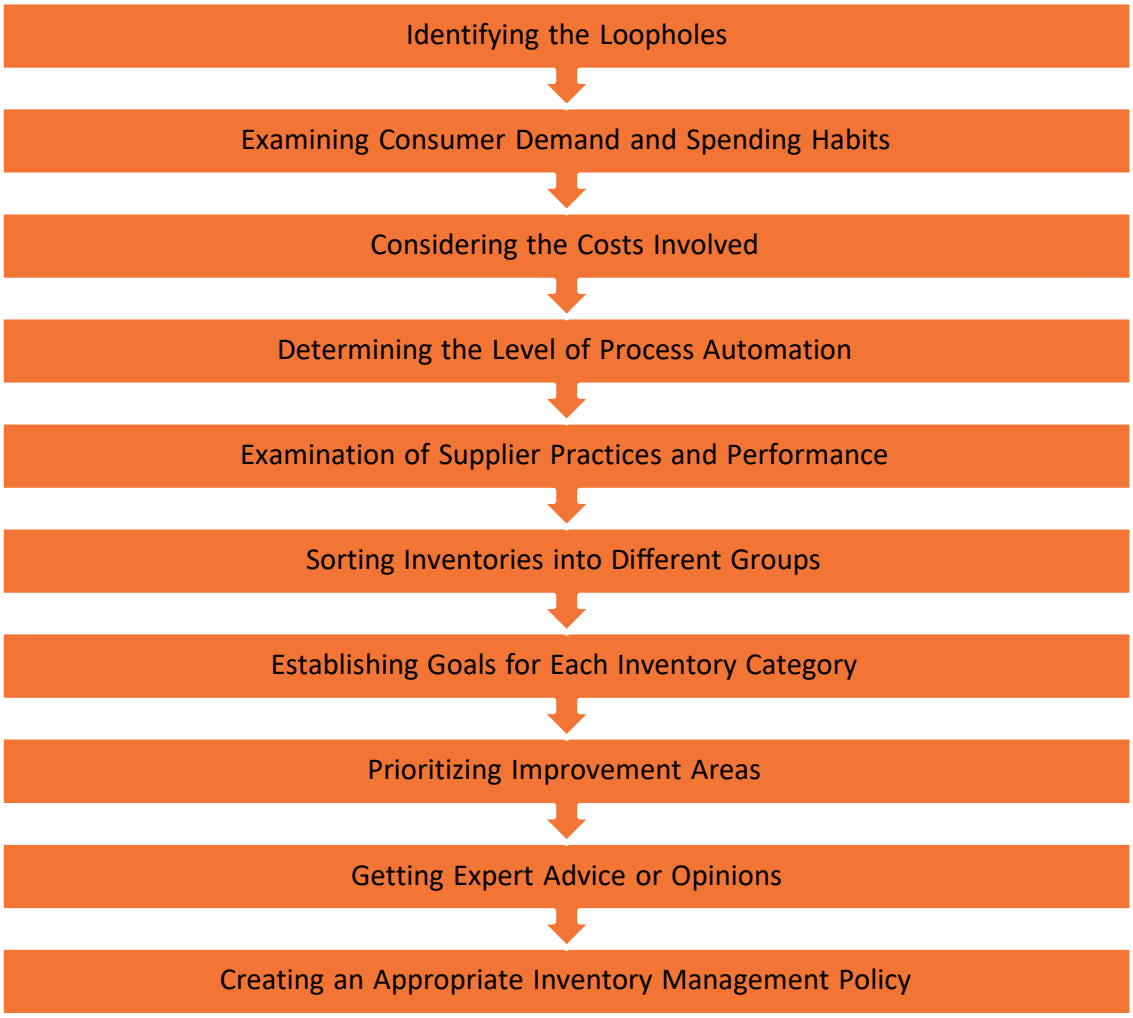


Fig 3.2.29 Inventory management process

Exercise

Q.1. List out all types of garden.

Q.2. List out major flowers used for landscaping.

Notes

Scan the QR Code to watch the related videos

https://www.youtube.com/watch?v=2DED2nRPZUQ

Types of Gardens

UNIT 3.3: Design and Layout of Gardens

Unit Objectives

By the end of this unit, participants will be able to:

1. Describe the process of preparing a layout for setting up a garden.

3.3.1 Garden Design

1. Garden design

Garden design is an arrangement of various garden components like trees, shrubs, ground covers, rocks, water body, fountains, pathways, gazebos, topiaries etc. in and around the buildings in such a way that it looks unique, beau ful and serves the purpose for which it is being made. Example - Children's park, residence, vegetable garden, farmhouse etc.

2. Layout of a garden

Layout of a garden is a plan or a drawing made to explain a gardener, a contractor or any layman that which component or feature of the garden is to be placed while developing it on the ground. A layout helps to understand at what distance various trees, shrubs, topiaries, hedges, ground covers etc. are to be planted, thus helping to determine the exact quantities of various plants required. Similarly, a layout plan also makes it easier to understand the exact position of various buildings, pathways, gazebos and other concrete features, thus helping in proper positioning of plants on the ground.

Process of making a design

Designing process begins with examining the site, taking inputs from the customer, understand their requirements, analyse whether the garden is for a commercial purpose or residential purpose. Once all the requirements and inputs are noted, then a preliminary design is made and with repeated consultations with the customer, a concept drawing is finalized.

The concept drawing illustrates various species of plants selected, different features that are a part of the drawing like gazebo, swimming pool, fencing, hedges etc. Followed by the concept drawing, there are different working drawings made which illustrates every element of the landscape design in detail. As a example working drawing of irrigation will include a complete layout of all the pipelines layed for various uses and where are the hydrants, bends, outgoing pipes, supply lines etc. Other working drawing can be of lights, planting plan of plants, hard scape like pathway, water harvesting tank under the ground etc.

Site examination of the site means understanding the details of the existing property on which a garden has to be developed. Suppose, a client has a requirement of a front lawn. Then while examining the site, we shall see what are the existing features in the property like location of the house, its entrance, big trees, parking area etc. Out of all these which are to be kept and which all features can undergo change or can be removed.

While examining the site it is also important to study the scenic beauty and directions as in north, west, east and south. Sun movement and directions tells us about the shady and sunny regions according to which the placement of shade loving and sun loving plants is decided. In case the property has many structures, then the measurements of the structures and distances between them is also obtained. While examining the site various aspects like different elevations, direction of the slope, soil texture, fertility are also noted.

List of items to be observed while examining a site (Checklist) :

- Existing trees
- Existing shrubs
- Location of building
- Other plantation
- Walkways and roads
- Other structures on the property
- Irrigation and electrical lines above and under the ground
- Property markings
- Soil texture and fertility
- Views to be hidden or screened
- Style of the house

Client / Customer Inputs

Taking inputs from the customers and understanding their needs and requirement is one of the most important aspects of garden design. It is important to learn about their taste, likes and dislikes in a garden space, any particular or specific requirements or utility of place that they wish to have.

List of items to be asked by customer:

- Choice / selection of plant varieties.
- Preference of type of a garden – formal / informal.
- Public and private area.
- Kids area.
- Vegetable / Herb garden.
- Lights.
- Fruit trees or only ornamental plants.
- Flower beds for annual flowers.
- Gazebo or pergola requirement or any other sting area.
- Size of gatherings for party purpose.
- Other utility areas.
- Pet space.
- Fences.
- Areas to be screened.
- Desirable views if any.

Once all the objectives are listed in order to design the landscape garden, then a program is made. In this program we decide what items are to be brought from outside and what all things are to be from the existing property. This is done so that the land could be made clear of unwanted items and further preparations of planing plan can be carried out.

Type of Drawings

After collecting the details of the site and noting down the customer's inputs and concerns, the process of making the drawing starts.

1. Rough sketch

While examining the site, penning down the location of buildings, big trees, roads, driveway, measurements and distance between different structures are roughly noted on the paper in the form of a rough sketch.

2. Concept drawing

Keeping in mind all the likes and dislikes of the customer and various challenges, a concept drawing is made. The concept drawing involves the artistic creativity of the architecture and with repeated interaction with the customers, the final layout of the garden is designed, showing various trees, hedges, shrubs, ground covers, structures, buildings, water body etc.



Fig 3.3.1 Garden designing

In short the concept drawing is a plan showing how the garden will appear from top putting all the elements together.

- **Working drawing:** Besides plants, there are few more sec ons that are very important to understand and incorporate in the final design and is described in detail in the working drawing. Therefore working drawing is a detailed and an elaborate drawing plan along with the keys of every sec on separately.

- **Example:** A working drawing of an irrigation plan will include layout of pipes, quantity of pipes, the bends and turns, excavation depth to bury the pipes, hydrant points, types of hydrants, sprinklers, details of water harvesting if any etc. Similarly working drawing of lightings will include all the details of lights such as layout of electrical lines, joints, types of lights, generator, power house required etc.

Principles of Designing

All the designs are inspired by nature and various elements of nature like mountains, hills, river, forests, deserts, fire, waterfalls etc. Thus one can say that designing a garden is an empt to create a mini nature in a small place.

While designing a garden, few important things should be kept in mind.

They are:-

- **Background:** Background of a garden can be a wall, screening of shrubs, climbers covered wall, tall trees or manicured hedges etc.

- **Contrast:** Use of different colours, textures, sizes and forms of plants help in creating a varia on and break monotony.

  Example:- Use of three different colour foliage shrubs of different sizes in 3res.

- **Proportion:** Looking at the relative size of the structures in the property, the landscape is designed.
  Example: A vast lawn around a medium sized swimming pool or a small hedge all around a gazebo. Imagine how would small randomly planted plants In a big yard would look like?



Fig 3.3.2 Proportion gardening

- **Balance:** A garden design looks beau ful when balanced in terms of quantity of plants, number of features, colour combine on and forms of plants.
  Example: One of the main principles of Mughal styles of garden is balancing. Same type and number of trees and same shaped shrubs on either side of the imaginary centre line are planted. Similarly non-symmetrically but similar group of plants are put together without overcrowding the place to design an informal garden.



Fig 3.2.3 Garden designing - balance

- **Rhythm:** When we repeat plants at an interval it adds continuity and rhythm. Arranging various components and elements of a garden in a pattern makes a garden look harmonious such as using geometric shapes and curves in a garden is eye appealing. All these ways are used to bring rhythm to a garden design.
  Example: Random plant ons of shrubs in a garden in various shapes and sizes makes a garden appear non-harmonious. Similarly putting all the features like fountain, topiary, flowers, water body, bridge, gazebo, pergola, lawn, tall trees etc. in a small garden will appear complex and stressed. However when the same components are planted and nicely bordered with a round hedge makes it look pleasant.



Fig 3.3.4 Non rhythmic gardening



Fig 3.3.5 Rhythmic gardening

- **Variety:** Plantation of different varieties of same or different plants makes a garden look interesting and unique. Use of different varieties of plants and flowers breaks the monotony and adds lots of colour, form and texture to a garden.



Fig 3.3.6 Garden designing with different varieties

Elements and Principles

The design process begins by determining the needs and desires of the user and the conditions of the site. With this information, the designer then organizes the plants and hardscape materials, which are collectively referred to as the features. The features can be physically described by the visual qualities of line, form, colour, texture, and visual weight—the elements of design. The principles are the fundamental concepts of composition—proportion, order, repetition, and unity—that serve as guidelines to arrange or organize the features to create an aesthetically pleasing or beautiful landscape. Knowledge of the elements and principles of design is essential to designing a landscape and working through the design process. This publication describes each of the elements and explains the principles and their application.

Elements of Design

- **Line:** Line in the landscape is created by the edge between two materials, the outline or silhouette of a form, or a long linear feature. Lines are a powerful tool for the designer because they can be used to create an infinite variety of shapes and forms, and they control movement of the eye and the body. Landscape designers use lines to create patterns, develop spaces, create forms, control movement, establish dominance, and create a cohesive theme in a landscape.



Fig 3.3.7 Lines in the landscape[11]

- **Landscape lines are created several ways:** When two different materials meet on the ground plane, such as the edge of a brick patio meeting an expanse of green turf; or when the edge of an object is visible or contrasts with a background, such as the outline of a tree against the sky; or by the placement of a material in a line, such as a fence. Figure shows common landscape lines, including bedlines, hardscape lines, path lines, sod lines, and fence lines.
- **Properties of lines:** The properties of lines determine how people respond to the landscape, both emotionally and physically.
- **Straight lines:** Straight lines are structural and forceful; they create a formal character, are usually associated with a symmetrical design, and lead the eye directly to a focal point. Diagonal lines are straight lines with an intentional direction. Straight lines are most often found in hardscape edges and material.
- **Curved lines:** Curved lines create an informal, natural, relaxed character that is associated more with nature and asymmetrical balance. Curved lines move the eye at a slower pace and add mystery to the space by creating hidden views.
- **Vertical lines:** Vertical lines move the eye up, making a space feel larger. An upward line can emphasize a feature and has a feeling of activity or movement. Vertical lines in the landscape include tall, narrow plant material, such as trees, or tall structures, such as an arbor or a bird house on a pole.
- **Horizontal lines:** Horizontal lines move the eye along the ground plane and can make a space feel larger. Low lines are more subdued and create a feeling of rest or repose. Horizontal lines can spatially divide a space or tie a space together. Low lines are created by low garden walls, walkways, and short hedges.

[11]*Source:https://www.gardeningchannel.com/compost-vs-soil-differences/*

Form: Shape is created by an outline that encloses a space, and form is the three-dimensional mass of that shape. Form is found in both hardscape and plants, and it is typically the dominant visual element that spatially organizes the landscape and often determines the style of the garden. The form of structures, plant beds, and garden ornaments also determines the overall form theme of the garden. Formal, geometric forms include circles, squares, and polygons. Informal, naturalistic forms include meandering lines, organic edges, and fragmented edges. Plants create form in the garden through their outlines or silhouettes, but form can also be defined by a void or negative space between plants.

Geometric Forms

Circular form: Circles can be full circles, or they can be divided into half circles or circle segments and combined with lines to create arcs and tangents. Shows the use of circle segments for hardscape and lawn panels. Circles can also be stretched into ovals and ellipses for more variety and interest. Circles are a strong design form because the eye is always drawn to the center, which can be used to emphasize a focal point or connect other forms.

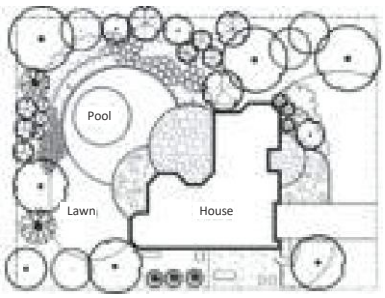


Fig 3.3.8 Circular forms in hardscape and lawn panels

Square form

Squares are used for a variety of features, including stepping stones, bricks, tiles, and timber structures, because they are an easy form to work with for construction. The square form can also be segmented and used repeatedly to create a grid pattern. Unlike circles, squares are stronger on the edges, which can be lined up or overlapped to create unique patterns and more complex forms.

Irregular polygons

Polygons are many-sided forms with straight edges. Triangles, for example, are three-sided polygons. The angled edges of polygons can make interesting shapes, but they should be used cautiously because the forms can become complex; simplicity is best.

Naturalistic Forms

Meandering lines

Meandering lines often mimic the natural course of rivers or streams and can be described as smooth lines with deeply curved undulations. Meandering lines work well for pathways, plant bedlines, and dry stream beds. Meandering lines can add interest and mystery to a garden by leading viewers around corners to discover new views and spaces.

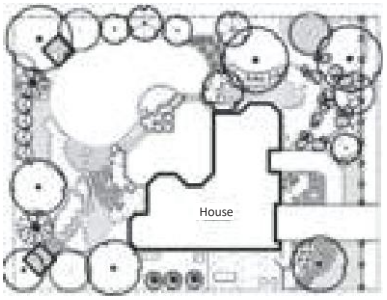


Fig 3.3.9 Meandering lines in the andscape

Organic edges

Organic edges mimic the edges of natural material, such as foliage, plant forms, and rocks, and can be described as rough and irregular. Organic lines can be found in rock gardens and along dry creek beds or purposely created on hardscape edges.

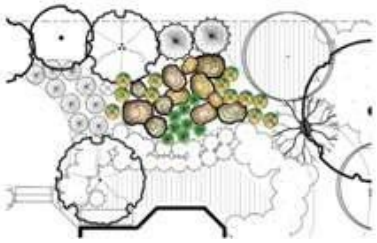


Fig 3.3.10 Organic edges: Irregular edge of rock garden

Fragmented edges

Fragmented edges resemble broken pieces scattered from the edge, such as stones or pavers, and are often used to create a gradually disappearing edge on patios or walkways.

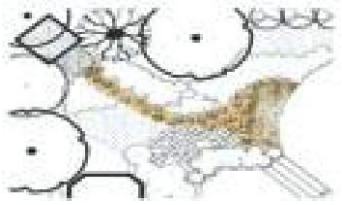


Fig 3.3.11 Fragmented edges: stepping stones in pathway

Plant Forms

Form is the most enduring quality of a plant. Common plant forms are well established and standardized, as form is the most consistent and recognizable characteristic of plants. Form can also be created through the massing of plants, where the overall mass creates a different form than an individual plant. A strong form that contrasts with the rest of the composition will have greater emphasis within the composition. A highly contrasting form must be used with care—one or two work well as a focal point, but too many create chaos. Natural plant forms, rather than over-trimmed forms, should establish the bulk of the composition.

Tree forms

Common tree forms include round, columnar, oval, pyramidal, vase shaped, and weeping. Different tree forms are used for visual appeal, but the form is also important for function. Creating a shady area in the garden requires a round or oval tree, while a screen usually requires a more columnar or pyramidal form, and a weeping tree form makes a good focal point.

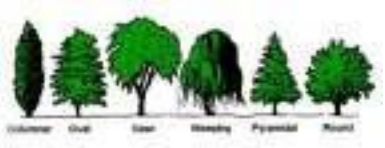


Fig 3.3.12 Tree forms

Shrub forms

Shrub forms include upright, vase shaped, arching, mounding, rounded, spiky, cascading, and irregular. Choosing shrub forms often depends on whether the shrub will be used in a mass or as a single specimen. Mounding and spreading shrubs look best in a mass, and cascading and vase-shaped shrubs do well as specimen plants.

Groundcover forms

Groundcover forms include matting, spreading, clumping, sprawling, and short spikes. Almost all ground covers look better in masses because they are typically small, ground-hugging plants that have very little impact as individual plants.

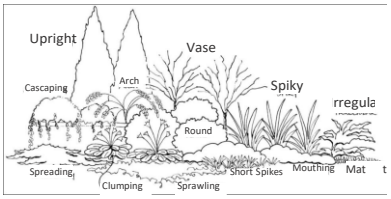


Fig 3.3.13 Shrub and groundcover forms

1. Texture

Texture refers to how coarse or fine the surface of the plant or hardscape material feels and/or looks. Texture is used to provide variety, interest, and contrast. The plant's foliage, flowers, bark, and overall branching pattern all have texture. The size and shape of the leaves often determines the perceived texture of the plant. A plant can generally be described as having a coarse, medium, or fine texture.

2. Coarse texture

Plant characteristics that create coarse texture include large leaves; leaves with very irregular edges; bold, deep veins; variegated colors; thick twigs and branches; leaves and twigs with spines or thorns; and bold, thick, and/ or irregular forms.

3. Fine texture

Characteristics that create fine texture include small foliage; thin, strappy leaves (grasses) or tall, thin stems; tiny, dense twigs and small branches; long stems (vines); and small, delicate flowers. They are often described as wispy and light or with a sprawling, vining form. Fine-textured plants sometimes have a stronger form because the small individual leaves are densely packed (e.g., boxwoods) to create a solid edge.

4. Medium texture

Most plants are medium texture, in that they cannot be described as having either coarse or fine texture. They are characterized by medium-sized leaves with simple shapes and smooth edges. The average-sized branches are not densely spaced nor widely spaced, and the overall form is typically rounded or mounding.

Proportion

Relative proportion is the size of an object in relation to other objects. Absolute proportion is the scale or size of an object. An important absolute scale in design is the human scale (size of the human body) because the size of other objects is considered relative to humans. Plant material, garden structures, and ornaments should be considered relative to human scale.

Exercise

A. Short Questions

Q. 1. Write a note on the garden designing.

Q.2. Write a note on the principles of designing garden.

B. Fill in the Blanks

1. Designing process begins with_____.
2. All the designs are inspired by nature and various elements of_____.
3. Garden Design is an arrangement of various garden components like_____.

Notes



Skill India
कौशल भारत-कुशल भारत

सत्यमेव जयते
GOVERNMENT OF INDIA
MINISTRY OF SKILL DEVELOPMENT
& ENTREPRENEURSHIP

N·S·D·C
National
Skill Development
Corporation
Transforming the skill landscape

ASCI
Agriculture Skill Council of India

4. Process of Establishing the Garden

Unit 4.1 - Features of garden

Unit 4.2 - Field Preparation

Unit 4.3 - Soil and Soil Management



AGR/N0803

Terminal Outcomes

By the end of this module, participants will be able to:

1. Describe the process of planting a garden.
2. Demonstrate the process of preparing the field for planting.
3. Demonstrate the process of setting up various garden features, and irrigation and fertigation systems.

Key Learning Outcomes

By the end of this module, participants will be able to:

Theory – Key Learning Outcomes	Practical – Key Learning Outcomes
1. Describe the process of preparing the field for planting. 2. Identify various materials used for treating garden soil. 3. Describe the process of planting various types of trees, plants, shrubs, hedges and edges. 4. Describe the process of preparing a flower bed. 5. Describe the process of installing different types of irrigation systems. 6. List different garden features and describe their installation process. 7. Explain the benefits of resource optimisation.	1. Demonstrate the process of preparing the field for planting. 2. Demonstrate the process of planting trees, plants, shrubs, grass, hedges, edges, vegetables and fruit plants. 3. Show how to apply fertilizers, manure and mulch. 4. Demonstrate the process of setting up different types of irrigation system such as drip irrigation, sprinkler irrigation, subsurface irrigation. 5. Demonstrate the process of installing a fertigation system. 6. Show how to set up various garden features such as walkways, statues, and fountain. 7. Demonstrate the process of preparing a flower bed.

UNIT 4.1: Features of Garden

Unit Objectives

By the end of this unit, participants will be able to:

1. List different garden features and describe their installation process.
2. Describe the process of planting various types of trees, plants, shrubs, hedges and edges.
3. Describe the process of installing different types of irrigation systems.
4. Describe the process of preparing a flower bed.
5. Explain the benefits of resource optimisation.

4.1.1 Features of Garden

Simplicity

Simplicity here means reducing chaos and complexity. Too many species of plants, quantity of plants, garden accessories, statues, fountains can make a garden look crowded and messy. Different garden components should be added in a garden only to make it elegant.

Components of garden

To create a look of a mini nature, a garden should have some components. These components have different characters, which add value to a basic garden and enhances its beauty.

Few garden components are described below:-



Fig 4.1.1 Components of garden - Lawn

- **Lawn:** A lawn is an area where grass is grown as a green carpet for a landscape and is the basic feature of any garden. It serves to enhance the beauty of the garden, be it larger or smaller. Proper lawn maintenance plays a crucial part in any landscape design. A beautiful well maintained lawn can make the entire landscape look good, whereas a lawn that is not maintained can completely ruin it's beauty. The lawn not only harmonizes with a decor of the drawing room, but also sets of a suitable background for a specimen tree or a shrub, as well as for colourful beds and borders.



Fig 4.1.2 Components of gardening - Shubbery

- **Shrubbery:** When a group of shrubs are planted together in a group, then collectively these shrubs are known as a shrubbery. Now shrubbery can be a mixed shrubbery or it can be a pure shrubbery. A mixed shrubbery includes a group of different species of shrubs. The varia on in the species may be based on flower colours, foliage colour or texture, height of shrubs, fragrance etc.

- **Hedges:** When we grow plants close enough to form a dense fence or boundary which is thick and full of foliage, it is known as a hedge. Generally we use different types of shrubs to make a hedge. A hedge can be maintained at a tall height to screen optician unwanted sight or it can be maintained at a short height to form boundaries. Hedges are generally well trimmed in different shapes, continuous and full of foliage from ground level. If the shrubs used for making hedge is flowering then the flowers are enjoyed during the flowering season and neatly manicured during rest of the season.



Fig 4.1.3 Garden components - hedges

- **Edges:** Edges are live borders made of mostly herbaceous plants, that are fast growing and short in height. Edges are used for bordering purpose around different structures like gazebos, swimming pool, house entrance etc. They are also used to separate pathways, driveways and walkways. Edges can be perennial or seasonal in nature. Perennial edges are made of mostly plants that have foliage beauty or have coloured or variegated leaves. Seasonal edges are annuals generally grown during winters and summers for colourful flowers.



Fig 4.1.4 Garden components - Hedges

- **Avenue trees:** A row of trees planted all along, both sides of road are known as avenue trees. Generally avenue plantations are done to provide shade on pathways. To make avenue plantation look beau ful foliage beauty, colour of flowers, season of flowering and spread are some characteristics taken into consideration, while selecting avenue trees. Although, avenue trees can be of any origin, however it should be kept in mind that since trees live for years together hence preferably they should be indigenous in nature.

Example:-

- A row of *Gulmohar* and *Cassia fistula* as avenue trees makes a beautiful combina on of yellow and orange colour flowers when in bloom.



Fig 4.1.5 Garden components - Avenue trees

- **Topiaries:** Topiary is an art of training plants into beautiful shapes and figures. This component of garden design adds attractive feature and are generally planted on a mound in groups.

Plants generally used for topiaries are:-

- Ficus retusa
- Ficus panda
- Casurina
- Bottle brush



Fig 4.1.6 Garden components - topiaries

- **Rockery:** Rockery is an attempt to portray a mini mountain or hilly terrain in a very small area of a garden. A rockery is an assemble of big rocks and boulders, grasses, bushes and plants coming out of crevices representing a natural hilly landscape. Rockery is generally made on an elevated area to enhance its presence.
  A lot of agave, cactus varieties, ferns, grasses, perennial flowering ground covers are mostly used while making a rockery.



Fig 4.1.7 Garden components - Rockery

- **Ground covers:** The main purpose of the ground cover is to cover a reasonable amount of ground area with closely planted herbaceous plants and hide the earth. Ground covers are trimmed severely and frequently to almost ground level like a carpet. Some mes ground covers are also planted in a patterns using different coloured ground covers to give an attractive artitics look from a distance.

Different types of ground cover plants:

- Red Iresine
- Red elanthera
- Golden duranta
- Duranta variegated
- Wedelia
- Black grass



Fig 4.1.8 Garden components - Ground covers

- **Climbers and creepers:** Those plants which have a soft stem and are unable to stand straight without a support are known as climbers. They are raised against a support like walls, pergolas, gazebos or any trellis structure or arches. Beautiful flowering and fragrant climbers form an important component of a garden design because it can be climbed at any height on any support for desired shapes and patterns in shorter period of me than other plants.

Different types of climbers / creepers are:

- Alamanda – colourful flowers
- Bignonia Venesta – Orange bloom in winters
- Bougainvillea – flowers round the year
- Vernonia – foliage beauty
- Ficus repens – low maintenance
- Morning glory – flower purple
- Madhu Malti – flowering in bunches of pink flower



Fig 4.1.9 Climbers and creepers

4.1.2 Irrigation System

Types of Irrigation System

Sprinkler irrigation: In this system of irrigation, water is sprayed through a nozzle in small droplets like rain over the plants. Sprinklers head and nozzles also come separately that can be attached directly to the hose pipe used. These sprinklers also come as pop ups which are laid under the ground and with automatic provision, these nozzles come out and sprinkle water.

Sprinkler Irrigation has advantages like:

- Fertigation - Adding fertilizers in water tank and giving it to plants while irrigating.
- Uniform spread of water over the crops.
- More absorption and less wastage of water.

Drip Irrigation

In drip irrigation, PVC pipes and LLDPE pipes are laid all along the plantation. Every pipe has a hole or drippler at equal intervals from where water comes out drop by drop and falls in the root zone.

Drip irrigation has a lot of advantages:

- Saves a lot of water.
- Fertigation.
- Better yield and growth of plant.

Flooding: In flooding water is provided to plants through hose pipes. Water runs openly in the plants. A lot of water gets wasted during flooding.

Sprayers

- No matter how well the sprayer is designed and equipped, even if it is new, all sprayers wear out and deteriorate.
- All parts should be inspected. Worn out, broken and damaged parts should be replaced.
- These costs are nominal, compared with the value of the chemicals to be used. The nozzle is the most neglected, precision component of sprayer.
- If nozzle is worn out and delivers a 10 % overdose, chemical wastage in a couple of hours would cover the cost of a new one.
- A detailed instruction book giving simple advice and illustrated drawing of component and assemblies are provided with each new sprayer.
- To avoid guess work and waste of time, it is necessary to specify correct name and code number of the part specified in the manual. Parts that are likely to be needed should be kept in stock.
- Extra time should be devoted to the sprayer at the end of the spraying season, before it is kept in the store.
- Sprayer should be cleaned thoroughly, since residual chemical if left over for several months will corrode parts of sprayer. Filters and Nozzles should also be cleaned thoroughly.
- Corroded parts should be painted. The pump should be greased and operating / moving parts should be well oiled.
- Sprayer should be well maintained during the spraying season.
- Checking and preparation should commence well before the beginning of the season.

- It is of paramount importance to clean both inside and outside of sprayer after each day's work, even if the same chemical is being used the next day.
- Sprayer should be lubricated thoroughly and regularly, especially all moving parts, before starting the work.

Duster

- Rotary dusters are provided with an agitator, which stirs the powder and releases it evenly through the discharge vent.
- The blower sucks the dust or powder from the hopper through the connecting pipe, and pushes it out forcefully to achieve efficient dispersal.
- The operator carries the duster by means of one or two shoulder straps, and holds the lance in his left hand cranking the handle with his right.

4.1.3 Flower Beds

Flower Beds: Seasonal flowers add a lot of colours to the garden (have a soft appearance). They are planted as borders or in different shaped planting beds. To add character to a garden, either same variety can be of annuals planted in one bed or can be given an asserted look with annuals of different colours, height and texture.

Name of Seasonals:

- Petunia
- Zinnia
- Marigold
- Antirrhinum
- Pansy
- Salvia



Fig 4.1.10 Floer beds

Flower Beds: Seasonal flowers add a lot of colours to the garden (have a soft appearance). They are planted as borders or in different shaped planting beds. To add character to a garden, either same variety can be of annuals planted in one bed or can be given an asserted look with annuals of different colours, height and texture.

Steps to make a flower bed

- Choose and mark a location.
- Remove all weeds and grass.
- Edge the garden bed.
- Select and place the flower plants.
- Cover with mulch.
- Irrigate the flower bed.

Walkways & Pathways: Walkways and pathways in the garden are made with different materials like pavers, concrete, natural stones, cement and bricks. They take definite amount of space for walking and prevent lawn and plants from getting damaged.



Fig 4.1.11 Walkways & pathways

4.1.4 Resource Optimization

Resource optimization is the set of processes and methods to match the available resources (human, machinery, financial) with the needs of the organization in order to achieve established goals. Optimization consists in achieving desired results within a set timeframe and budget with minimum usage of the resources themselves.

The notion "Wealth from Waste" or value addition is generally reluctant by the producers for their produce due to lack and access to processing facilities and they find it difficult to transport the waste/by-product to a processing facility far away from their farm.

In today's time many firms are thinking to go in long term and adopting the features of sustainability. However, without optimizing resources and utilizing waste there is no such scope to achieve sustainability.

Benefits of resource optimization

The benefits of resource optimization are:

The purpose of resource optimization is to maximize productivity by reducing the costs of labor and other expenses.

- **Resource scheduling:** Resource scheduling is the process of assigning the right resources to the right tasks. This is done based on the resources' skills, availability, and capacity.
- **Reduced Overheads And Increased Revenue:** Inefficient use of resources eventually lead to higher expenses in every aspect of running a business. Instead of utilizing the available resources, there might arise the need to buy more resources. However, efficient resource utilization can help reduce these costs along with producing desired results.
- **Resource leveling:** A mitigation strategy called resource levelling requires a thorough awareness of resource availability and the critical path of the project. When you try to comprehend these components during the project planning stage, the resource levelling process actually starts.

Exercise

A. Fill in the Blanks

1. In_____system of irrigation, water is sprayed through a nozzle in small droplets like rain over the plants.
2. In_____PVC pipes and LLDPE pipes are laid all along the plantation.
3. In_____is provided to plants through hose pipes. Water runs openly in the plants.

Notes

UNIT 4.2: Field Preparation

Unit Objectives

By the end of this unit, participants will be able to:

1. Describe the process of preparing the field for planting.

4.2.1 Gardening and Ground Maintenance

Plantation

Planting of a plant is referred to as plantation. Growing of a seed or planting of a sapling, shrub or a tree involves specific techniques. These correct techniques of plantation are important for a healthy start of the plant and to reduce their mortality.

Planting of seeds

Traditionally seeds used to be grown in seed beds where erratic climatic conditions like sudden rain, extreme temperatures or problems like water logging and hardening of soil appeared, which used to reduce the germination rate. So for seedling preparation new technique got devised like raising seedlings in containers. These containers come in the form of a plastic tray with small pockets of different diameter and depth depending upon the size of seeds different trays are selected for raising seedlings.



Fig 4.2.1 Planting seeds

Various factors mentioned below are important to be kept in mind while raising seedlings from seeds:

- **Time of Sowing**: When the weather is either too cold or too hot, sowing of seeds is not recommended. A temperature ranging between 28ºC to 35ºC with high humidity is most appropriate for seed germination. In Delhi best me for sowing seedling is 15th February to 10th March and 15th August to end of September. However with use of poly house and shade nets the timings of seed sowing can be varied.

- **Selection of the right container**: The right containers are the ones that have a proper drainage hole in every pocket and at least are 2 to 3 inches deep and 2 inches wide. There after depending upon the size of the seeds and aggressiveness of the roots, right size of tray should be selected. Dealing with trays is very human friendly in terms of carrying out various important field activities like watering, medium filling, lifting etc.

- **Hoeing:** Hoeing is done once the root hairs are established in the newly transplanted plant. Hoeing is done by digging the soil 1 inch to 2 inch deep all around the stem without disturbing the roots but breaking the hard soil surface. This helps in proper aeration and respiration process of the plants. Hoeing is also important for proper percolation and supply of nutrients. Hoeing is usually at least once in a week, however in clayey soil, should be worked even more frequently.
- **Weeding**: Weeds are unwanted plants that grow alongside the desirable plants and compete with them for food, space and sunlight. Weeds are generally faster growing than other plants and thus needs to be taken care of frequently and regularly. Weeding is done using a weeder in laws, plant beds, uncovered soil. Weeding can be controlled chemically or manually. In areas where there are no broad leaf plants or grass and the weeds are unmanageable (i.e. more in quantity) then we use weedicides, to control weeds.
- **Irrigation:** Watering of the plants is most important field of opera on. Watering should be done timely either in morning or late evening. In hot adequate watering should be done every day to provide the plants a humid microclimate and prevent them from desiccation. In extreme winters, watering should be done every alternate day or once in three days to condition the plant roots and prevent them from freezing. Foliar washing of plants is equally important. Due to the increasing pollution and new developments, particulate matter settles on the leaves and block the surface. This restricts proper respiration in plants, thus hampering their growth and development.

Plantation of Shrubs

Shrubs are one of the most important component of a garden. They are not completely herbaceous nor they are tall and woody like trees. Shrubs have soft woody stems which on regular trimming from top forms hedge. Taller shrubs are used to screen unpleasant or dirty objects. Shrubs that are short in height are used to form hedges. Different shrubs with beau ful foliage fragrant flowers are planted in corners as individual plants are put together in corners or create to form a shrubbery.

All in all, shrubs are used in many ways in a garden:

- Used in shrubbery
- Individual shrub trained as a specimen plant
- Used as screening and hedges
- Shrubs formed as topiaries

  Example: Bougainvillea, Ixora, Murrya exo ca etc.

Plantation: While planting a shrub, few points to be kept in mind are:

Season of Plantation: The best season for plantation of a shrub is monsoon. However, spring season is also appropriate when temperature is not very cold or very hot and the humidity in the air is adequate. High humidity and temperature between 25°C – 35°C are best for shrub plantation.

Time of Plantation

Best me of shrub plantation in the day is evening as it is followed by a long night and prevents the shrubs from the dessication effect of the sun. However, during monsoon, the shrubs can be planted all through the day due to high humidity.

- **Planting a fully grown shrub:** For planting a fully grown shrub, firstly a pit of 1.5' to 1/1.5' is dug and the top soil is divided into 2 parts. First part of the top soil is thoroughly mixed with FYM and put back in the pit. Then a well shifted shrub is planted in the pit potting back the remaining top soil into the pit and drenching the pit with water (by repeated watering after every 20 minutes). Drenching the newly planted shrub in water helps the plant to overcome transplantation shock and prevents the falling of leaves and in extreme cases death of the plant.
- **Shifting of a shrub:** Shifting of a fully grown shrub is an art. This process involves repeated cutting of roots at an interval and simultaneous conditioning of the plant and its roots without letting the plant die. Shifting process takes 25-30 days and is mostly done during monsoon.

Plantation of climbers

Climbers shall be planted with maximum of 2-3ft, height. Depending upon the size of the root ball of the plants, the pit is dug and top soil is divided into 2 parts. The first part is mixed with FYM and put back in the pit and plant is placed inside the pit. The remaining second part of the sop soil is refilled in the pit and the plant is watered. Initially the climber is trimmed from top to encourage lateral branches and gradually all the branches are trained up as desired with the help of a support.

Exercise

Q.1. Write measures to improve sandy soil.

Q.2. Write steps to preparation of 1 % bordeaux mixture.

Q.3. Write steps for bed preparation.

Notes



UNIT 4.3: Soil and Soil Management

Unit Objectives

By the end of this unit, participants will be able to:

1. Maintain and improve soil texture and structure
2. Take up soil nutrient management
3. Control soil erosion
4. Prepare bordeaux mixture

4.3.1 Soil and Soil Management

Improving Soil Texture

Sandy Soil

Sand particles are large, irregularly shaped bits of rock. In a sandy soil, large air spaces between the sand particles allow water to drain very quickly. Nutrients tend to drain away with the water, often before plants have a chance to absorb them. For this reason, sandy soils are usually nutrient-poor.

To improve sandy soil:

- Work in 3 to 4 inches of organic matter such as well-rotted manure or finished compost.
- Mulch around your plants with leaves, wood chips, bark, hay or straw. Mulch retains moisture and cools the soil.
- Add at least 2 inches of organic matter each year.
- Grow cover crops or green manures.

Clay Soil

Clay particles are small and flat. They tend to pack together so tightly that there is hardly any pore space at all. When clay soils are wet, they are sticky and practically unworkable. They drain slowly and can stay waterlogged well into the spring. Once they finally dry out, they often become hard and cloddy, and the surface cracks into flat plates.

To improve clay soil:

- Work 2 to 3 inches of organic matter into the surface of the soil. Then add at least 1 inch more each year after that.
- Add the organic matter in the fall, if possible.
- Use permanent raised beds to improve drainage and keep foot traffic out of the growing area.
- Minimize tilling and spading.

Silty Soil

Silty soils contain small irregularly shaped particles of weathered rock, which means they are usually quite dense and have relatively small pore spaces and poor drainage. They tend to be more fertile than either sandy or clayey soils.

To improve silty soil:

- Add at least 1 inch of organic matter each year.
- Concentrate on the top few inches of soil to avoid surface crusting.
- Avoid soil compaction by avoiding unnecessary tilling and walking on garden beds.
- Consider constructing raised beds.

Soil Structure

A healthy soil is one with good aggregation, where stable pores extend from the soil surface too deep into the profile. These pores allow water infiltration, root penetration, and air exchange to occur. The sample on the left was taken from a field no-tilled for more than 10 years. The one on the right is from a continuously tilled field with the same soil type.

While tillage has been used for crop production, it does destroy soil structure, breaks up the soil pores, and reduces the amount of residue on the soil surface. If the soil structure was bad, e.g., compaction, this may be desirable as tillage can break up the compacted soil and create some new pores. However, if the soil structure was already favourable for crop growth, the tillage operation will break up the existing soil structure and make it more susceptible to compaction by reducing the soil's strength. Without soil structure, future operations may compact the soil by squeezing out the pore spaces between the soil aggregates.

Nutrient Management

It is very important to know that which fertilizer should be given to plants, at what me, how is it added and why. Understanding of these four things ensures that the fertilizer is effectively and efficiently supplied to plants for their op mal growth.

The 3 most essential nutrient elements to plants are:

- **Nitrogen:** Nitrogen is important for vegetative growth i.e. leaves carrying out photosynthesis (i.e. leaves manufacturing food).
- **Phosphorus:** Phosphorous is important for overall development of shot system (stems, flowers and fruits) and root system.

Potassium

- Potassium is important for physiological process and water regulation in plants. Generally all these 3 elements are available in the market as NPK in different proportion**.**
- **Example:** 16:16:16 N:P:K). Since these are most essential to plants, feeding the plants with NPK at least twice in a year is recommended. Feeding 3 times a year is even better. NPK comes in granular form as well as in water soluble form. Granular fertilizer dissolves with water and gradually releases nutrient elements over a period of me, while the water soluble fertilizer is for instant supply of nutrient elements, but applied frequently. Granular fertilizers can be applied as broadcast or top dressing whereas powdered NPK is generally used for dissolving the nutrients in water and apply as foliar spray or base application.

Top Dressing

- In top dressing small quantity of granular fertilizer is scattered around the base of the plant and hoeing is done.

Base Application

- Water soluble fertilisers are dissolved in water in the light quantity and applied to the base of the plants for immediate supply of nutrient elements. This method of application is good for potted plants and indoor plants.

Foliar Application

- Here the water soluble nutrients are dissolved in water and applied into the leaves or foliage than in the soil.

Other Nutrients

Plants also need micro nutrients in small quantities for their proper growth and development. That is why it is suggested that while manuring or feeding the plants a proper mixture of all nutrient elements supplying feeds shall me made.

Example: In Delhi climate, September is an important month for manuring plants.

Time of fertilizing: February - March and September are the most appropriate months for feeding plants in a climate like Delhi. During these months the plants are very active and growth is at its maximum. Extreme climatic condition like too hot or too cold has a negative impact on plant growth. Manuring or fertilizing the garden during monsoons is not considered a good idea because the nutrient elements either gets washed off or leaches down the soil and is not available to the plants. Hence it is recommended to feed plants immediately post monsoon. Seeds and young plants should not be fertilized as they tend to burn. Certain plants like roses and annuals are heavy feeder and need frequent fer liza on i.e. every 7-10 days during their flowering and growing season respectively. Newly transplanted plants from ground or pots, should not be fertilized because the root hairs responsible for absorption of nutrients are damaged and they tend to burn. It is advisable that once the new root hairs are formed then only the fertilizer should be added for effective plant feeding.

Bordeaux Mixture

- The original formula developed by Millardet contains 5 lbs of $CuSO_4$ + 5lbs of lime + 50 gallons of water. The chemistry of Bordeaux mixture is complex and the suggested reaction is: $CuSO_4$ + Ca (OH) 2 = Cu(OH) 2 + $CaSO_4$
- The ultimate mixture contains a gelatinous precipitate of copper hydroxide and calcium sulphate, which is usually sky blue in colour. Cupric hrdroxide is the active principle and is toxic to fungal spores.
- Bordeaux mixture is generally accepted even in organic cultivation. It is easy to prepare and can be locally prepared by farmers themselves.

Preparation of 1 % bordeaux mixture

- Materials required
- Copper sulphate powder - one kg

- Lime - 1 kg
- Water - 100 litres
- Methodology
- One kg of copper sulphate powder is dissolved in 50 litres of water. Similarly, 1 kg of lime is powdered and dissolved in another 50 litres of water. Then copper sulphate solution is slowly added to lime solution with constant stirring or alternatively, both the solutions may be poured simultaneously to a third contained and mixed well.
- Preparation of 0.5% Bordeaux mixture is same as above but reducing the copper sulphate and lime half of the amount but keeping water same as 1% mixture preparation.
- In general, 1% Bordeaux mixture is applied to hardy plant parts such as roots, stem and 0.5% of mixture is applied on leaf/foliage.

Steps

Prepare bed:

1. Prepare the bed when the soil when it is moist, but not wet.
2. Turn the soil over to a depth of at least 12 inches.
3. Add 2-3 inches of compost and turn it into the bed.
4. Either cover the bed with a thick (3-4") layer of mulch or use a weed and feed to help keep weed seeds from germinating.
5. Top dress with another layer of compost to keep down weeds and preserve moisture.

Tips

Control soil erosion

1. Plant grass and shrubs.
2. Add mulch or rocks.
3. Use mulch matting to hold vegetation on slopes.
4. Improve drainage.
5. Reduce watering at optimum level.
6. Plant trees to prevent landslides.

Exercise

Q.1. Write measures to improve sandy soil.

Q.2. Write steps to preparation of 1 % bordeaux mixture.

Q.3. Write steps for bed preparation.

Notes

Scan the QR Code to watch the related videos

https://www.youtube.com/watch?v=wreKW1W1H6I

Soil Management for Home Gardeners



Skill India
कौशल भारत-कुशल भारत

सत्यमेव जयते
GOVERNMENT OF INDIA
MINISTRY OF SKILL DEVELOPMENT
& ENTREPRENEURSHIP

N·S·D·C
National
Skill Development
Corporation
Transforming the skill landscape

ASCI
Agriculture Skill Council of India

5.

tenance of the Garden

Unit 5.1 - Pest & Disease Management

Unit 5.2 - Training, Pruning and Other Operations



AGR/N0842

Terminal Outcomes

By the end of this module, participants will be able to:

1. Describe the process of performing nutrition, pest and disease management for a variety of garden plants.
2. Demonstrate the process of performing nutrition, pest and disease management for a variety of garden plants.
3. Demonstrate the process of carrying out training, pruning, and mowing in a garden.
4. Demonstrate the process of carrying out maintenance of the irrigation and fertigation system.
5. Demonstrate the process of carrying out maintenance of garden features.

Key Learning Outcomes

By the end of this module, participants will be able to:

Theory – Key Learning Outcomes	Practical – Key Learning Outcomes
1. Describe the use of different types of fertilizers, pesticides, and insecticides. 2. Explain macro and micronutrient management of various types of horticultural plants, trees, shrubs, hedges and edges. 3. Describe the process of training and pruning a variety of plants, trees, shrubs, hedges and edges. 4. Describe the process of carrying out repair and maintenance of different types of irrigation and fertigation systems. 5. Describe various weed control methods.	1. Show how to assess various garden plants, trees, shrubs, hedges and edges for the presence of pests and diseases. 2. Demonstrate the process of applying different types of insecticides and pesticides using the relevant Personal Protective Equipment (PPE). 3. Prepare a sample record of insecticides and pesticides used in the garden. 4. Demonstrate the process of training and pruning different types of plants, trees, shrubs, hedges and edges. 5. Demonstrate the process of carrying out regular repair and maintenance of the irrigation or fertigation installed in the garden. 6. Show how to maintain a variety of garden features.

UNIT 5.1: Pest & Disease Management

Unit Objectives

By the end of this unit, participants will be able to:

1. Describe the use of different types of fertilizers, pesticides, and insecticides.
2. Describe various weed control methods.
3. Explain macro and micronutrient management of various types of horticultural plants, trees, shrubs, hedges and edges.

5.1.1 Fertilizers, Pesticides and Insecticides

Fertilisers are additional substances supplied to the crops to increase their productivity. These are used by the farmers daily to increase the crop yield. These fertilisers contain essential nutrients required by the plants, including nitrogen, potassium, and phosphorus. They also enhance the water retention capacity of the soil and increase its fertility.

Fertilisers are mainly classified into two main types, organic and inorganic fertilisers.

Organic Fertilizers

Natural fertilisers derived from plants and animals are known as organic fertilisers. By adding carbonic molecules necessary for plant growth, it enriches the soil. Organic fertilisers boost the amount of organic matter in the soil, encourage microbial reproduction, and alter the physical and chemical composition of the soil. It is regarded as one of the essential elements for foods that are green.

Organic fertilizers can be obtained from the following products:

- Agricultural Waste
- Livestock Manure
- Industrial Waste
- Municipal Sludge

Inorganic Fertilisers

Chemical fertilisers generated by chemical techniques that contain nutrients for crop growth are known as inorganic fertilisers.

Pesticides

The Food and Agriculture Organization (FAO) has defined pesticide as:

Any substance or mixture of substances intended for preventing, destroying or controlling any pest, including vectors of human or animal disease, unwanted species of plants or animals, causing harm during or otherwise interfering with the production, processing, storage, transport, or marketing of food, agricultural commodities, wood and wood products or animal feedstuffs, or substances that may be administered to animals for the control of insects, arachnids, or other pests in or on their bodies.

Types of Pesticides

These are grouped according to the types of pests which they kill:

Grouped by Types of Pests They Kill

- Insecticides – insects
- Herbicides – plants
- Rodenticides – rodents (rats & mice)
- Bactericides – bacteria
- Fungicides – fungi
- Larvicides – larvae

Insecticides

Insecticides play an important role in the way food is grown and prepared these days. Insects, rodents and bacteria are capable of destroying the crop and contaminating the rations people consume. As a solution to control dis problem, insecticides were manufactured. These products can be natural or chemical based. there are various types of insecticides that you can use depending on the nature of the problem.

Inorganic Insecticides

- Systematic Insecticides
- Contact Insecticides
- Ingested Insecticides

Organic Insecticides

- Insecticidal Soap
- Nicotine
- Plain Water

5.1.2 Integrated Weed Management

Integrated Weed Management (IWM) means integrating multiple methods to manage weeds, using the combination of practices that are most effective for solving the specific weed issue at hand.

These weed management techniques form a "toolbox" in which each "tool" can be integrated into a weed management plan catered to the particular farm and problem. The toolbox includes chemical (herbicide), mechanical, cultural, biological practices and prevention of weed introduction and spread.

IWM tactics span a wide range of types and complexity. Not all IWM tactics are very complex. Some examples include:

- Equipment cleaning, timely scouting, altering herbicide tank mixes, rotating herbicides, cover cropping, changing tillage practices and hand-pulling weeds.

Integrated weed management is not an alternative to herbicides in conventional crops. For many decades, herbicides have been the primary means of weed management in conventional crops due to their simplicity, effectiveness and affordability. IWM is about using all options available to best solve the problem – in many cases in conventional crops; herbicides are part of this solution.



Fig 5.1.1 Integrated Weed Management

The 5 types of management tactics that can be used in integrated weed management:

- **Prevention:** Monitor inputs to the farm to avoid bringing in things that may be contaminated with weed seeds. To do this, learn how key weeds are spread and whether those weeds are located in areas from where the farm is transporting the supplies. Equipment, manure, feed and crop seed are primary spreaders of weeds. Spread via wind and wildlife is more common for some weed species than others.
- **Chemical:** Herbicides are a key part of IWM in conventional and some organic systems. In conventional crops, using multiple effective herbicide Modes of Action (MOA) is essential for effective control of resistant weeds. This method involves combining multiple MOA in tank mixes and varying MOA between applications and seasons. For MOA with high occurrences of resistant weeds, avoid repeat use in consecutive seasons.
- **Cultural:** Cultural tactics are crop management decisions that help the crop be more competitive against weeds and help optimise the effectiveness of herbicide applications. Common examples include timely scouting, row spacing, crop rotation, crop variety selection, a timing of planting and cover cropping. Information about using these tactics for weed management is found throughout this site (Hover on the Weed Management Tools tab and select Cultural.
- **Mechanical:** Common mechanical tools to disrupt weed growth and survival include cultivation, tillage, burning and hand-weeding. Mechanical IWM tools also include emerging technologies like harvest-time seed destructors, cover crop rollers and robotic weeders. Mechanical tools should be integrated when appropriate as part of a larger IWM program. Many of these mechanical techniques are available to no-till growers.
- **Biological:** A less common IWM strategy is the use of living organisms, including livestock, insects, nematodes, fungi and bacteria, to target weeds. Many biological agents target specific weed species, while livestock are relatively more generalist in weed consumption and may avoid eating certain weeds.

Some examples are:
Rice

Method	Description
Critical period of weed control	20-30Days after Transplanting(DAT)
Cultural method	1) Hand weeding 2) Hand pulling 3) Pudding 4) Flooding
Mechanical method	1) Weeder (Float) 2) Conoweeder/Rotary weeder
Chemical method	Apply pendimethalin 1.0kg/ha on 5 days after sowing or Pretilachlor + safener (Sofit) 0.45kg/ha on the day of receipt of soaking rain followed by one hand weeding on 30 to 35 days after sowing.
Biological method	1. Hirsch – Manniella spinicaudata is a rice root nematode which controls most upland rice weeds 2. Azolla
Remarks	I. Substitution and preventive method: a) Stale seed bed technology b) Land preparation c) Water management

Table 5.1.1 Integrated Weed Management for Rice

Method	Description
Critical period of weed control	15 – 30 Days after seeding(DAS)
Cultural method	a) Hand Hoeing b) Inter cultivation c) Criss-cross sowing
Chemical method	1. 2, 4D (1 – 1.5 kg ai/ha) 2. Mixture of Isoproturan (0.75 kg ai/ha) and 2, 4D (0.4 kg ai/ha) during 30- 35 DAS
Remarks	II. Complimentary weed control methods a) Cultivars b) Seedling age /planting method c) Fertilizer management d) Cropping system

Table 5.1.2 Integrated Weed Management for Wheat

Method	Description
Critical period of weed control	21 – 42 Days after seeding(DAS)
Cultural method	1. Hoe and hand weed on the 10th day of transplanting if herbicides are not used. 2. Hoe and weed between 30 - 35 days after transplanting and between 35 - 40 days for a direct sown crop
Chemical method	1. Apply the pre-emergence herbicide Atrazine 50 WP - 500 g/ha on 3 days after sowing as spray on the soil surface 2. If pulse crop is to be raised as an inter-crop in sorghum do not use Atrazine.
Remarks	1. Inclusion of cotton crop in the rotation

Table 5.1.3 Integrated Weed Management for Sorghum

Method	Description
Critical period of weed control	Upto 45 days
Cultural method	After 35 - 40 days one hand weeding may be given.
Chemical method	1. Alachlor (1-5 kg/ha) – pre emergence application

Table 5.1.4 Integrated Weed Management for Groundnut

Method	Description
Critical period of weed control	4-6 weeks
Cultural method	Hoe and hand weed on the 15th and 30th day of sowing and remove the weeds. Allow the weeds to dry for 2 - 3 days in the case of irrigated and then give irrigation.
Chemical method	1. Apply Fluchloralin at 2.0 l/ha before sowing and incorporate or apply as pre-emergence spray on 5 day after sowing followed by irrigation or apply Pendimethalin as pre-emergence spray 3 days after sowing.

Table 5.1.5 Integrated Weed Management for Sunflower

Method	Description
Critical period of weed control	First 45 days
Cultural method	1. One hand weeding on 45 DAS will keep weed free environment upto 60 DAS. 2. Hoe and hand weed between 18th to 20th day of sowing, if herbicide is not applied at the time of sowing
Chemical method	1. Diuron (0.5 – 1.5 kg/ha), Monuron (1-1.5 kg/ha), Fluchloralin (1-1.5 kg/ha) applied as preemergence/ preplanting

Table 5.1.6 Integrated Weed Management for Cotton

5.1.3 Existing Weed Management Practices

Mechanical or Physical Methods of Weed Control

This includes the use of hand tools, implements and machinery operated either with the help of man power or machine power for control of weeds. These are the costly and time-consuming methods. However, these methods cause minimum damage to the environment.

1. **Hand Pulling or Hand Weeding:**

   Pulling the weeds by hand or hand weeding with the help of weeding hook is the oldest and most effective methods for control of weeds. Weeds can be easily uprooted after good soaking irrigation or rain. Weeding should be done before the flowering stage of weeds for avoiding seedling and further spread of weeds. Because as per the old saying, one year's seeding is seven years weeding. This method is costly and time consuming.

2. **Tillage:**

   It is one of the practical methods of destroying weeds of all categories.

   - **Deep Ploughing:** Weeds are buried deep in the soil and also exposed to the heat of the sun by deep ploughing. Many annual and perennial weeds can be controlled by deep ploughing and by exposing the field to the heat of the sun.
   - **Discing:** Helpful for cutting and burying of weeds. Harrowing with blade harrow is very effective for destroying newly germinated weeds before sowing of the crop.
   - **Inter-culturing:** Inter-culturing with different types of hoes or mechanical weeders is useful to control weeds in between rows of the crop.

3. **Mowing and Sickling:**

   This method is used in lands, pastures, gardens and roadsides. The implement mower is used for cutting weeds. It does not destroy the weeds completely but prevents seed production by cutting growing parts. Cutting above ground parts of weed with a sickle is called sickling and it prevents seed information.

4. Flooding:

It helps in controlling weeds like kans. (Saccharum spontaneum) which grows luxuriantly in heavy ill-drained soils during rainy seasons. The fields are embanked with high bunds to impound water. The weeds get submerged under water and are smothered.

5. Burning:

This method is adopted to destroy weeds in non-cropped areas like wastelands roadsides, railway lines, bunds etc. The flamethrowers and steam boxes are used for burning weeds in advanced countries. The flame should be so adjusted that is causes only wilting but not charring of weeds. Heat kills the living cells by coagulating the protoplasm and inactivating enzymes. The thermal death point (TDP) of most plant cells lies between 45°C to 55°C (113 to 131 ^{o}F). Rabbing in Konkan area is widely practised to kill weeds seeds particularly from paddy nursery areas. It is not a good method since the useful vegetation and organic matter is also destroyed along with weeds.

6. Digging:

This method is useful for controlling perennial weeds like nut grass, hariali etc. Digging is very useful for removing the underground propagation parts of weeds from the deeper layer of soil digging , hand collection and destruction of underground parts of weeds is adopted when noxious weeds are observed in the patches in the field. It is not economical in large areas as it is a costly and a time-consuming method.

7. Mulching:

The principlal aim of this method is to cut off the light and avoid all top growth of weeds. The organic mulches such as plant residues i.e., Stubbles, wheat straw , rice hulls, sugarcane trash etc., are spread in between crop rows @ 5 tonnes/ha and thickness about 10 to 15 cm. The inorganic mulches such as black or white polythene sheet are spread in between crop rows. However, it is expensive and used for high-value crops only. The black polythene is more effective for controlling weeds.

8. Summer Fallow:

This method is widely practised in dry farming areas. The land is ploughed after harvest of Rabi crop and left without any crop in the summer season. The underground parts of the perennial weeds are exposed to strong sunlight and destroyed.

9. Dredging and Chaining:

These methods are used for controlling aquatic weeds. Removing of weeds along with their roots and rhizomes from the water with the help of mechanical force is called dredging. The floating aquatic weeds are removed by changing. A heavy chain in pulled over the water bodies to collect the weeds.

The combination of mechanical and cultural methods is effective for minimising the weed population.

5.1.4 Macro and Micro Nutrient Deficiencies

- Micronutrients: Essential nutrients required in smaller quantities.
  Eg: Boron, chlorine, carbon, iron, etc.
- Macronutrients: Essential nutrients required in huge quantities.
  Eg: Potassium, magnesium, calcium, etc.

Element	Symbol	mg/kg	Percent	Relative number of atoms
Nitrogen	N	15,000	1.5	1,000,000
Potassium	K	10,000	1.0	250,000
Calcium	Ca	5,000	0.5	125,000
Magnesium	Mg	2,000	0.2	80,000
Phosphorus	P	2,000	0.2	60,000
Sulfur	S	1,000	0.1	30,000
Chlorine	Cl	100	–	3,000
Iron	Fe	100	–	2,000
Boron	B	20	–	2,000
Manganese	Mn	50	–	1,000
Zinc	Zn	20	–	300
Copper	Cu	6	–	100
Molybdenum	Mo	0.1	–	1
Nickel	Ni	0.1	–	1

Table 5.1.7 Typical Concentrations Sufficient for Plant Growth

Please note that concentrations, whether in mg/kg (=ppm, parts per million) or percent (%), are always based on the weight of dry matter, instead of the fresh weight. Fresh weight includes both the weight of the dry matter and the weight of the water in the tissue. Since the percentage of water can vary greatly, by convention, all concentrations of elements are based on dry matter weights.

Wear gloves when working outside

Wearing the proper gloves will not only reduce blistering but will also protect skin from fertilizers, pesticides, bacteria and fungus that live in the soil. When exposed to soil, even the smallest cut runs the risk of developing into a major hand infection. Leather gloves offer protection from thorny objects and poison ivy, snake, rodent and insect bites, and other skin irritants in the garden. Gloves also prevent sun damage and fingernail damage.

Avoid prolonged repetitive motions

Repetitive motions such as digging, raking, trimming hedges, pruning bushes or planting bulbs may cause skin, tendon or nerve irritation. Make sure gardening activities are varied and tasks are rotated every 15 minutes with a brief rest in-between so that the same muscles are not used over and over again.

Use tools, not your hands

Use a hand shovel or rake rather than hand for digging. Sharp objects and debris buried in the soil may cause injury. If possible, remove objects from the work area before beginning the task to avoid causing damage to gardener or his tools.

Use the right tool for the right job

Avoid accidents by using tools for their intended purposes. Other important tool tips:

- When purchasing pruners, loppers or shears, look for brands featuring a safety lock.
- Avoid products with form-fitting handles. These tools only fit one size of hand perfectly. If hand is too large or too small, it will put more stress on the hand.
- Always follow the manufacturers' instructions for the tool.
- Keep sharp tools away from children at all times.
- Always unplug electrical tools and disconnect spark plug wires on gasoline-powered tools when not in use.

Check body posture

"Posture" refers not only to your whole body position but also to the angle of wrist while using hand tools. Grip strength is at its maximum when the wrist is in a relaxed or neutral position. Studies have shown that people lose up to 25% of their grip strength when their wrist is bent.

What to do in case of injury

Bleeding from minor cuts will often stop by applying direct pressure to the cut with a clean cloth. Visit the emergency room if:

- Continuous pressure does not stop the bleeding after 15 minutes.
- You notice persistent numbness or tingling in the fingertip or have trouble moving the finger.
- You are unsure of your tetanus immunization status.
- You are unable to thoroughly clean the wound by rinsing with a mild soap and plenty of clean water.

5.1.5 Pest and Disease Management

Tree protection - Catle, Animals

For several reasons a garden should be enclosed by a good hedge or fence. It provides protection from cattle, shelter from wind and privacy. The best plant material for forming such a hedge would be a quick growing hardy shrub with attractive foliage and or handsome flowers, drought resistant and should stand trimming to shape and capable of being quickly and easily raised from seed or from cuttings to fill up the gaps promptly.

Nursery pests, diseases and their management

A major injury to nursery stock is also caused by various groups of insects. These insect pests have been divided into three categories viz., major nursery pests (white grubs, cutworms, termites and crickets), minor nursery pests (defoliators, sapsuckers, grasshoppers) and non-insect pests (nematodes and vertebrate pests). Generally the damage caused by the insects may be controlled by maintaining better sanitation of the nursery area, adoption of suitable cultural practices and need based application of chemical and biological pesticides.

- **White Grubs:** The adult white grubs feed on leaves and larval stage of the grub (during monsoon months feed on roots. It is a major pest in Teak, Mango, Sal and leguminous seedling at Bihar, Gujarat, Maharashtra, Madhya Pradesh and Tamil Nadu states. Deep ploughing, soil solarisation, poisoning and using light traps are some control measures against white grub attack.



Fig 5.1.2 White grub

  Application of 200 g phorate or 50 ml of chloropyriphos mixed in 50 ml water may be used to spray for one bed. Foliar spray of host trees available in the nursery vicinity with 0.05% monocrotophos or 0.03% quinalphos can also helpful in controlling the adult population.

- **Cutworms:** It damages the young seedlings soon after germination and is also a feeder of young leaves. Seedlings of Pine, Cedar, mango, sapota and Casuarina species are the most preferred by cutworms. Nursery site flooding and collection of cutworm after heavy rains are some preventive measures to avoid cutworm damages. Dusting of seed bed with a mixture of quicklime and ash or 1.5% quinalphos will control the insect.



Fig 5.1.3 Cutworm damage in the garden[13]

[13] *Source:https://www.gardeningknowhow.com/plant-problems/pests/insects/get-rid-cutworms.html*

- **Termite:** They cause damage to seedlings either by primary attack (tap root destroy), secondary attack (follow up attack after draught, pathogens, etc.) or complementary attack and damage the seedlings which make it weak and subsequently it is susceptible for other pathogen and pest attacks. The termite attack can be controlled by keeping the nursery cleared of wood debris, using well decomposed FYM and application of termiticides such as chlorpyriphos.



Fig 5.1.4 Termite attracting gardening habits[14]

- **Crickets:** The nymphs and adult stage cricket come out at night and cut off all the seedlings, low branches and drag the piece to their tunnels for feeding the young crickets. Ficus, Casuarina, Eucalyptus, Sisham, teak, rubber and mango seedlings are commonly affected by crickets. Deep ploughing during nursery site preparation, application of 200g *phorate* or *fenitrothinon* 5% dust per bed can control the pest.



Fig 5.1.5 Crickets in the garden[15]

Minor and Non-Insect Pests

Defoliators (beetles, weevils and caterpillers), grasshoppers and sapsuckers (green leaf hopper, white flies, thrips) are the minor pests. They can be controlled by the application of 100 g dose per bed of phorate 10%, or spray of formulation of any systemic insecticide eg. dimethoate 30EC. Nematodes, rat, squirrel, hare, deer, mite and birds are some important non-insect pests. Poison bating by rodenticide such as Zinc phosphide, proper fencing and manual scaring are the best methods to reduce damage by them. Other than the disease and pest damages, the natural events like frost, chilling, drought, fire and non-availability of nutrients also cause stunted growth/death of seedlings.

Diseases

Damping-off: The plants in nursery are often affected by this disease. A group of fungi is responsible for damping off the seedlings. The disease is so serious that it may destroy the entire nursery stock in one season. Mostly damping off occurs at tender stage of seedlings.

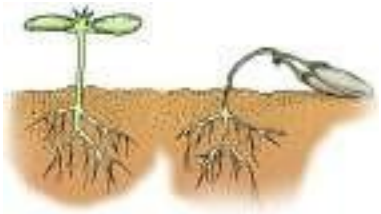


Fig 5.1.6 Damping-off in seedling

The seedlings topple down and dry up:

- **Collar rot:** Sometimes nursery plants affected by collar rot and root rot problems. The fungus is air borne and infects in collar region of the plants.



Fig 5.1.7 Collar rot

Powdery mildew: Sphaerotheca pannosa

Symptoms:

- The symptom appears as greyish-white powdery substance on the surfaces of young leaves, shoots and buds.
- Infected leaves may be distorted, and some leaf drop may occur.
- Flower buds may fail to open, and those that do may produce poor-quality flowers.

[14]*Source:https://www.provenpest.net/stop-attracting-termites-to-your-garden/*
[15]*Source:https://www.gardeningknowhow.com/plant-problems/pests/insects/controlling-crickets.htm*

- It can occur almost anytime during the growing season when temperatures are mild (70 to 80 °F), and the relative humidity is high at night and low during the day.
- It is most severe in shady areas and during cooler periods.



Fig 5.1.8 Powdery mildew on leaves



Fig 5.1.9 Powdery mildew on stalks



Fig 5.1.10 Powdery mildew on buds

Management

- Collection and burning of fallen leaves.
- Spray with Wettable sulphur 0.3% (or) Carbendazim 0.1% 2-3 sprays at 15 days interval is effective.
- Sulphur dust at 25 kg/ha.
- Use of sulphur at higher temperature conditions will be phytotoxic.

Vein-Clearing/Yellow Vein Mosaic

Symptoms



Fig 5.1.11 Yellow vein mosaic symptoms[16]

- Yellowing of the entire network of veins in the leaf blade is the characteristic symptom.
- In severe infections the younger leaves turn yellow, become reduced in size and the plant is highly stunted.
- The veins of the leaves will be cleared by the virus and interveinal area becomes completely yellow or white.
- In a field, most of the plants may be diseased and the infection may start at any stage of plant growth.
- Infection restricts flowering and fruits, if formed, may be smaller and harder.
- The affected plants produce fruits with yellow or white colour and they are not fit for marketing.
- The virus is spread by whitefly.

Management

- By selecting varieties resistant to yellow vein mosaic.
- For sowing during the summer season, when the whitefly activity is high, the susceptible varieties should be avoided.
- Spraying monocrotophos 1.5 ml/litre of water can restrict the disease spread.
- Synthetic pyrethroids should not be used because it will aggravate the situation.
- It can be controlled by application of Chlorpyriphos 2.5 ml + neem oil 2 ml lit of water.

[16]*Source:https://www.researchgate.net/figure/Okra-plants-exhibiting-the-severe-yellow-vein-mosaic-symptoms-in-the-field-located-at_fig1_257558683*

Leaf spot disease



Fig 5.1.3 Leaf spot diseases[17]

- Leaf spots come in a wide variety of shapes, sizes and colors.
- Leaf spot diseases usually are seen first on the lower and inner branches where humidity is higher and leaves are shaded.
- Spots occur randomly on the leaf surface because the pathogens that cause leaf spots are blown there by wind or splashed by rain or irrigation.
- Depending upon the pathogen, leaf spots may occur on the upper, lower or both surfaces of the leaves.
- Leaf spots may be angular or rounded, raised or sunken, and have smooth or fringed edges.
- Colors can range from yellow to yellow-green to orange-red to light tan, brown or black.
- A variety of sizes of leaf spots may be observed on one plant.
- Smaller leaf spots are younger infections. Larger leaf spots are older infections.
- At the center of larger leaf spots, it is possible to see signs of the pathogen such as fungal spores or spore-producing structures.
- Some leaf spot pathogens cause leaves to drop prematurely, resulting in the tree or shrub losing most or all of its leaves.

Management

- Rake up and destroy fallen leaves before the first snowfall to eliminate locations where diseases can survive to re-infect the plant the following growing season.
- Do not overcrowd plants — use size at maturity as a spacing guide when planting.
- Prune trees or shrubs to increase light penetration and improve air circulation throughout the canopy.
- Wet conditions promote disease, so water trees at the base and be careful not to splash water on leaves. A drip or soaker hose works best for this. Avoid sprinklers.
- Reduce stress to the tree:
- Water the tree throughout the growing season so that the top 6 to 8 inches of the soil is moist, especially during dry summer periods.
- Soil should be allowed to dry before watering again.
- Maintain a 3- to 4-inch-deep layer of mulch around the tree.
- Do not mound the mulch around the trunk of the tree but lay a flat layer with at least a 2-inch space between the mulch and stem to allow for air movement.
- Annually reapply mulch and inspect to ensure levels are maintained.

Bacterial blight



Fig 5.1.14 Bacterial blight[18]

- Symptoms in later growth stages include angular lesions, which begin as small yellow to brown spots on the leaves. The centers of the spots will turn a dark reddish-brown and dry out. A yellowish-green "Halo" will appear around the edge of water soaked tissue that surrounds the lesions.

[17]*Source:https://extension.umn.edu/plant-diseases/leaf-spot-diseases-trees-and-shrubs*

[18]*Source:https://www.invasive.org/browse/detail.cfm?imgnum=5363765*

Management

- Use of resistant varieties.
- Balanced fertilizer application - Split application of N.
- Reduce the disease spread by careful handling of seedlings during transplanting, maintaining shallow water in nurseries, providing good drainage during severe flooding.
- Reduce the amount of inoculum through clean cultivation and drying the fields.
- Remove collateral weed hosts from bunds and channels.
- Use only disease free seedlings.
- Avoid excess nitrogen.
- Use disease free seeds for sowing.

Natural Pest and Disease Control

Pests and diseases are part of the natural environmental system. In this system there is a balance between predators and pests. This is nature's way of controlling populations. The creatures that we call pests and the organisms that cause disease only become 'Pest and diseases' when their activities start to damage garden and nursery.

Methods of natural pest and disease control:

- Natural pesticides
- Biological control
- Pheromone trap
- Fly traps
- Light traps

Natural Pesticides

If pests and diseases cannot be prevented or controlled by cultural and physical means, it may be necessary to use natural pesticides. Many growers have developed ways of making their own sprays from plants such as garlic, chillies, marigolds and many others. These are inexpensive and have proved to be very effective.

Here are some examples:

A solution can be made from marigold using water and soap. The liquid acts as a crop strengthened to help potatoes, beans, tomatoes and peas resist blight, mildew and other fungal diseases. It also repels aphids, caterpillars and flies. Garlic spray is particularly good against army worms, Colorado Beetle, False codling moth, Khapra beetle, Mexican bean beetle and imported cabbage worm. Garlic can also kill nematodes if soil or batches of soil are drenched with garlic liquid.

Biological control

Biological control means using one creature or organism to control a pest. This often involves introducing a creature or organism, which is known to be predatory, to an area with the aim that it will control the population of the pest.

Example:

- **Control of cabbage caterpillars:** Baciilus thuringiensis is a bacteria which kills many types of caterpillar, but only when they eat it. This bacteria (which can be bought as a commercial product called "Bactospeine") is applied to brassicas (cauliflowers, cabbages) as a spray.
- **Control of vine weevils:** Nemasys H is a preparation containing parasitic nematodes which seek out and destroy vine weevil larvae. It is watered onto the soil.

- **Pheromone traps:** Pheromone is the sexual attractant produced by some female insects. If a trap is baited with this it will attract the male insects into the trap from which they cannot escape. Pheromone traps alone can reduce pest damage. Alternatively they give an indication of pest populations and therefore the best time to apply control methods. Pheromones traps are usually prepared by commercial companies and may be costly to the farmer. However, if you have a particularly severe pest problem it may be worth investing in one rather than using chemical pesticides.

- **Fly trap:** Fly traps are large boards measuring about 30cm by 30cm which are painted bright yellow/orange and covered with an adhesive such as oil or glue. Different pests are attracted to different colours so you need to experiment. The flies are attracted to the bright colour of the board and fly onto it. They get stuck in the oil or glue and die.

- **Light traps:** Light traps are set up at night and attract a variety of flying insects including moths, mosquitoes, chafer beetles, american bollworms, army worms, cutworms, brown rice plant hopper, green rice leaf hopper, rice black bugs, rice gall midges, rice stem borers and tomato hornworms.

Exercise

Q.1. Write symptoms of powdery mildew.
Q.2. Write disease management for bacterial blight.
Q.3. Write methods of natural pest and disease control.

Notes

Scan the QR Code to watch the related videos

https://www.youtube.com/watch?v=0D--ltYWKXI

Pest & Disease Management

https://www.youtube.com/watch?v=YBTq7Uv3Q0U&list=PLekJC5v4LQiapihi5HXBnjasuGVMmfmus&index=2

Identification of Weeds & Methods of Weed Control

UNIT 5.2: Training, Pruning and Other Operations

Unit Objectives

By the end of this unit, participants will be able to:

1. Describe the process of training and pruning a variety of plants, trees, shrubs, hedges and edges.
2. Describe the process of carrying out repair and maintenance of different types of irrigation and fertigation systems.
3. Bonsai making and its maintenance.

5.2.1 Training, Pruning and Other Operations

- **Pruning:** Pruning may be defined as the art and science of cutting away of portion of plant to improve its shape, to influence its growth, flowering and fruitfulness and to improve the quality of the product. It is done to divert a part of plant energy from one part to another part of plant.



Fig 5.2.1 Pruning

Principles of pruning

- Young trees are pruned to train it to acquire a desired shape.
- In old trees light heading back is done to stimulate the flowering.
- In bearing trees light pruning is done to stimulate fresh growth. It bearing flower buds on fresh growth.
- In old trees heavy pruning is done to restore vigorous.
- All the diseased, weak, dead or shading branches must be removed.

Training

It means developing a desired shape of the tree with particular objectives by controlling habit of growth. Training is start from nursery stage of plant. Some fruit crops like grape vines, ber, fig, guava etc. require training.

Principles of training:

- Formation of the mainframe work must be strong. The branches must be suitable spaced apart and the tree must be balanced on all the sides.
- Never allow several branches to grow at one place or very near each other.
- Careful training of main branches is very essential.
- Another important point about training is that if two branches are growing at the same point try to train them to grow at a wider angle. Narrow angle is always weak.

Bonsai making: Bonsai is an art of growing and training of a plant to a miniature form having a natural look of old age. It was originated from china, but it was called as the Japanese art. It involves techniques of extreme dwarfing. The optimum size of bonsai may be only 30 to 60cm in height, but miniature sizes of below 25 cm have also been preferred. Bonsai of minimum 10 years old are period, but of 100 and even 200 years of age are available and are highly valued as 'Venerable' specimens.

Bonsai requires special types of containers. They should be usually shallow with 5 to 7.5 cm deep (except for cascade type of bonsai for which deep pots can be used). Round, hexagonal or square shaped containers with 25 to 30 cm diameters are preferred. Containers with specific colours like mosaic, sky blue, terra cotta, grey or jungle green are well suited for bonsai culture. Plants adaptable for extreme dwarfing like juniper. pine, elm, maple, cypress are suitable materials for bonsai culture. But in tropical places like India, the tree species like Manilkhara, Sapota, Bassia, Tamarind and Ficus spp. and shrubs like West Indian cherry are well suited.

Where it succeeds?

- Under open sunny conditions.
- Under air conditions.
- As indoor near windows only.

Rules for Bonsai Making

For trunk

- Height can be 6 times the caliper of the trunk.
- Should lean towards the viewer.
- It should anchor the plant.
- Roots should radiate.
- No eye poking roots.
- Should taper as it ascends.
- Should not move back.

For Branches

- Should not cross the trunk.
- No eye poking branches.
- First branch should be at one third height of the tree.
- No belly branches.
- Should be opposite.
- Should diminish in size as it ascends.
- Secondary branches are to be alternate.

Principles of Bonsai

Look for:

- Small leaves or needles.
- Shorter internodes.
- Attractive bark or roots.
- Branching characteristics.

To enhance the age, expose the one third of the roots:

- Before potting, the twisted and tangled roots are to be straightened.
- Upper branches should not overshadow the lower branches.

Plants Suitable for Bonsai Making

1. Ficus Benjamina
2. Ficus Carmona Microphylla
3. Ficus Nerifolia
4. Ficus Retusa
5. Ficus Virens
6. Ficus Pelkan
7. Ficus Parasitica
8. Ficus Krishna
9. Ficus Elastica
10. Ficus Trangularis Variegated
11. Ficus Mysorensis
12. Ficus Nooda Variegated
13. Ficus Tomentosa
14. Ficus Saliscifolia
15. Ficus Jaquinifolia
16. Ficus Long Island
17. Ficus Marginata
18. Ficus Lipstick
19. Bougainvillea
20. Bottle Brush - Red / White / Lavender
21. Black Olive
22. Brazilian Raintree
23. Cashew
24. Casuarinas
25. Chinese Banyan
26. Chinese Mini Orange
27. Duranta Gold
28. Duranta Variegated
29. Golden Cypress
30. Hamelia Patens
31. Hibiscus Rosea Sinensis
32. Inga Dulse Variegated
33. Jackaranda
34. Jasmine Kamini
35. Juniper Chinensis
36. Karonda
37. Lavender Brown
38. Lavender Green
39. Badam
40. Mango
41. Murraya Exotica
42. Murraya Paniculata
43. Neem
44. Pine
45. Pomegranate Mini
46. Powder Puff - White / Pink / Red (calliandra)
47. Poinsettia Mini
48. Kumquat
49. Sapota
50. Scheffleura Variegated
51. Silver Oak
52. Surinam Cherry
53. Tamarind
54. Wood Apple
55. West Indian Cherry
56. Wrightia Religiosa

Styles of Bonsai

1. Formal upright

It is one of the most natural styles where the trunk is perfectly straight. The branches should alternate left to right to suggest age. The bottom third branches are removed and the remainder is drawn downward.



Fig 5.2.2 Formal upright bonsai style[19]

2. Informal upright

This style is characterized by a lightly curving trunk displaying the harsh elements of nature. This can be achieved with ease using wire and/or cords. It is as appropriate for conifers as with deciduous trees.



Fig 5.2.3 Informal upright[20]

[19]*Source:https://about-bonsai.blogspot.com/2018/01/formal-upright-bonsai-style-chokkan.html*

[20]*Source:http://www.bonsai-bci.com/president-s-welcome/41-uncategorised/806-informal-upright-3*

3. Slanting

It is so called because the general slope of the trunk is highly pronounced. The branches should lie horizontal or droop slightly downward. The surface roots have an unstable appearance but have a well anchored impression.



Fig 5.2.4 Slanting style in bonsai[21]

4. Windblown

It is rare in nature. This kind of tree is found on cliffs or mountains. The trunk, branches and twigs are trained in a single direction to give the effect of a strong wind and storm.



Fig 5.2.5 Windblown bonsai style[22]

5. The Clasped-to-Stone

It is a much loved but difficult to create style. The size and shape of the rock should complement the plant that is set on a gravel or water dish. A whole chapter could be spend on this style.



Fig 5.2.6 Clasped-to- stonestyle[23]

Preparing the Right PoEng Mixture

Seeds require proper drainage to germinate, hence the potting mixture should be such that it is porous in nature and allow the water to drain out quickly. For trays we either use a potting mixture available readily in the market or prepare in house using coco peat, vermiculite and pearlite in 3:1:1 ratio.



Fig 5.2.7 Preparing the right potting mixture

This mixture is properly mixed and made a little moist before filling the pockets of the container tray. The existing nutrients generally leach out of the container and gets consumed with seedling growth over a period of me and hence a fertilizer spray post 3rd week of sowing seeds should be done at a gap of 1 week un l the seedlings achieve a transplanting stage.

- **Light:** Germinated seeds need light to grow faster. The leaves prepare food by the process of photosynthesis and helps the root and shoot system to flourish quickly. At least 12-14 hrs. of light is necessary for healthy development of seedlings. However, exposure of seedlings to direct sunlight during hot hours can be desiccating.
- **Seed sowing:** Seeds of different sizes are sown at different depths inside the pockets. Smaller seeds are simply sprinkled over the potting mixture where as bigger seeds are sown at least 1-inch below. If the seeds size is not very big then we even plant 2 seeds in one pocket.

[21]*Source:https://www.gardeningsite.com/bonsai/the-slanting-style-in-bonsai/*
[22]*Source:https://www.youtube.com/watch?v=h8Pob7iqLdI*
[23]*Source:https://www.pinterest.com/pin/677862181395006038/*

This helps us save time in case one seed fails to germinate. In case both seeds germinate then one of the seedlings can be snipped and put into another pocket. The newly sown seeds should be moistened timely for quick germination. After sowing and watering the seed trays are covered with a plastic sheet in order to prevent water from evaporating and keep the seed moist. However, after initiation of the germination process, the plastic wrap should be removed.

The growing seedlings are very tender and susceptible to quick desiccation and infestation to pests and diseases. They should be closely watched and treated with insecticides and pesticides in case of any infestation. A healthy seedling is generally ready to be transplanted at a four leaf stage. Since the medium is little porous, therefore, watering is an important factor to be kept in mind. The mixture should be moist throughout the day. On hot days, the seedlings may require watering twice in a day.

Steps



Fig 5.2.8 Seed sowing steps

Benefits of using container or seedling tray:

- The roots easily flourish in the porous medium and hence seedlings have a strong root system.
- The roots stay intact and holds on to the potting material, thus minimizing the rate of mortality on transplanting.
- During adverse conditions, like too much rainfall, the trays can be lifted and moved from one place to another, thus preventing the seedlings from dying.
- Almost 100% germinal on of seeds.
- No wastage of seeds or any other resource.

Plantation of Annuals

- Plants that complete their life cycles in one year or six months are known as annuals or seasonal.
- They are generally grown for their colourful flowers which add beauty to the gardens in all seasons.

They are used for making:

- Borders along the pathway, flower beds of different designs at the entrance of houses and in hanging baskets, edging, some tall seasonal are also used around shrubberies.

Raising Annuals

- Seeds of annual plants are sown exactly in the same way as discussed under planting of seeds.

Quick steps include:

- The seeds are sown in trays filled with appropriate potting mixture of coco peat + vermicompost + perlite.
- Annuals which do not need transplantation are broadcasted directly in the ground.

- Watering must be done by using a water can.
- 2 seeds should be put in every cup and pocket of the tray.
- Once the seeds germinate, extra seedlings should be snipped at 2-3 leaf stage and transplanted in the beds.
- The seedlings attain sturdy stem and roots at 4 to 5 leaf stage. This is the right stage for seedling transplantation, attained in approximately 30-35 days.

For thick border the seedlings are planted in wide beds in a crisis cross fashion as shown below:

- Once the root system of the transplanted seedlings is established in the soil and new leaves start coming, the terminal part of the shoot should be pinched off. This is activity of pinching off is very important to encourage lateral branches and make a flowering plant bushy. More the number of lateral branches, more will be the buds and ultimately flower.

Exercise

Q.1. Write principles of pruning.

Q.2. Write Benefits of using container tray.

Q.3. Write few plants which are suitable for bonsai making.

Notes



Skill India
कौशल भारत-कुशल भारत

सत्यमेव जयते
GOVERNMENT OF INDIA
MINISTRY OF SKILL DEVELOPMENT
& ENTREPRENEURSHIP

N·S·D·C
National
Skill Development
Corporation
Transforming the skill landscape

ASCI
Agriculture Skill Council of India

6. ffective Communication at the Workplace

Unit 6.1 - Verbal and Non-Verbal Communication



AGR/N9918

Terminal Outcomes

By the end of this module, participants will be able to:

1. Apply techniques for effective communication with the stakeholders.
2. Explain how to mentor an apprentice.
3. Discuss ways to promote diversity and inclusion at the workplace.

Key Learning Outcomes

By the end of this module, participants will be able to:

Theory – Key Learning Outcomes	Practical – Key Learning Outcomes
1. Explain the importance of verbal and non-verbal communication at the workplace. 2. Explain the effective methods of sharing and seeking information and feedback at the workplace. 3. Explain the procedure for completing work-related documentation. 4. Describe the process of mentoring an apprentice at the workplace. 5. Explain the importance of inclusion of all genders and People with Disability (PwD) at the workplace. 6. Explain gender concepts (gender as a social construct, gender sensitivity, gender equality etc.), issues and applicable legislation. 7. Explain ways in which a conducive working environment can be created for all the genders and PwD. 8. Define the need for appropriate verbal and non-verbal communication while interacting with all genders and PwD. 9. Explain the applicable PwD related regulations. 10. Explain the procedure to report inappropriate behaviour e.g.,harassment.	1. Demonstrate the requisite level of proficiency in verbal and non-verbal communication at the workplace. 2. Demonstrate different approaches to mentoring an apprentice at the workplace. 3. Prepare a sample training schedule for an apprentice. 4. Demonstrate appropriate verbal and non-verbal communication that is respectful of genders and disability.

UNIT 6.1: Verbal and Non-Verbal Communication

Unit Objectives

By the end of this unit, participants will be able to:

1. Explain the importance of verbal and non-verbal communication at the workplace.
2. Explain the effective methods of sharing and seeking information and feedback at the workplace.
3. Explain the procedure for completing work-related documentation.
4. Describe the process of mentoring an apprentice at the workplace.
5. Explain the importance of inclusion of all genders and People with Disability (PwD) at the workplace.
6. Explain gender concepts (gender as a social construct, gender sensitivity, gender equality etc.), issues and applicable legislation.
7. Explain ways in which a conducive working environment can be created for all the genders and PwD.
8. Define the need for appropriate verbal and non-verbal communication while interacting with all genders and PwD.
9. Explain the applicable PwD related regulations.
10. Explain the procedure to report inappropriate behaviour e.g.,harassment.

6.1.1 Communication at the Workplace

One of the most important skills you can develop when working remotely is the ability to communicate effectively online. This is not as easy as it sounds, and throughout the world of remote work you'll find people who can communicate to a greater or lesser degree. A large percentage of communication is non-verbal. When we communicate through text alone, we lose a lot of nuance. This means you need to both be thoughtful about what you say and how you phrase things, and also sensitive to what other people say.

Nonverbal communication comprises of your overall body language, including your appearance and posture as a form of communication with others. Rather than using words, people can communicate using nonverbal gestures, such as facial expressions and eye contact. Also, an individual's voice tone may communicate nonverbal messages to others. In the workplace, people interact with each other throughout the workday using verbal and nonverbal communication. In essence, the way individuals deliver nonverbal messages can be just as important as verbal dialogue.

Examples of nonverbal communication include what you wear, how you wear your clothes, facial expressions, body gestures, eye contact, voice, posture, and the distance between you and your audience. Nonverbal cues affect how people understand what you are attempting to communicate, and their reaction corresponds to how you delivered your message. If you are expecting a certain response by the receiver of your message, your nonverbal communication affects their response.

Impacting Workplace Relationships

Having a conscious awareness of your nonverbal communication when you are also communicating verbal messages allows others to receive the message the way you intended to deliver your message. Positive nonverbal communication helps colleagues in the workplace build positive business relationships, whereas negative nonverbal communication can cause conflicts and other negative disturbances in the workplace. Many people build positive business relationships by consistently delivering positive nonverbal communication to others.
Listening is the ability to correctly receive and understand messages during the process of communication. Listening is critical for effective communication. Without effective listening skills, messages can easily be misunderstood. This results in a communication breakdown and can lead to the sender and the receiver of the message becoming frustrated or irritated.

It's very important to note that listening is not the same as hearing. Hearing just refers to sounds that you hear. Listening is a whole lot more than that. To listen, one requires focus. It means not only paying attention to the story, but also focusing on how the story is relayed, the way language and voice is used, and even how the speaker uses their body language.
The ability to listen depends on how effectively one can perceive and understand both, verbal and non-verbal cues.

Using nonverbal cues can enhance how people receive your communication. Nonverbal communication indicates how a person is feeling in relation to what they are saying, and it also reflects how people react to the message. Communicating an important message to your colleagues with excitement and enthusiasm may have a greater impact on your audience in regards to the importance of the message versus delivering the message with a monotonous tone and facial expression.

To listen effectively you should:

- Stop talking
- Stop interrupting
- Focus completely on what is being said
- Nod and use encouraging words and gestures
- Be open-minded
- Think about the speaker's perspective
- Be very, very patient
- Pay attention to the tone that is being used
- Pay attention to the speaker's gestures, facial expressions and eye movements
- Not try and rush the person

How successfully a message gets conveyed depends entirely on how effectively you are able to get it through.

Verbal Communication is through Speaking

An effective speaker is one who enunciates properly, pronounces words correctly, chooses the right words and speaks at a pace that is easily understandable.
Besides this, the words spoken out loud need to match the gestures, tone and body language used.

What you say, and the tone in which you say it, results in numerous perceptions being formed. A person who speaks hesitantly may be perceived as having low self-esteem or lacking in knowledge of the discussed topic. Those with a quiet voice may very well be labelled as shy. And those who speak in commanding tones with high levels of clarity, are usually considered to be extremely confident. This makes speaking a very critical communication skill.

6.1.2 Sharing and Seeking Information and Feedback

Everyone knows how to communicate, but not everyone knows how to communicate effectively. There a number of tools in place for text-based communication. There are a number of advantages to text-based communication. This is useful for people who are unable to attend a meeting, and to look back at the history at a later date.
Secondly, it facilitates asynchronous communication, which is particularly important for remote teams.

Feedback is a process that requires constant attention. When something needs to be said, say it. Informal, simple feedback should be given depending on the situation.
With frequent, informal feedback like this, nothing said during formal feedback sessions should be unexpected, surprising or particularly difficult.

- Be clear about what you want to say before you say it.
- Share your feedback in a concise and specific manner, then you can embellish.
- Avoid generalizations.
- Be descriptive rather than evaluative.
- Own the feedback.
- Be careful about giving advice.

6.1.3 Mentoring An Apprentice

Mentoring is a highly valuable development process and at the core is the relationship between the mentor and the mentee, where the development of the mentee is the critical focus. In other words, mentoring pertains to the development of rapport involving a more knowledgeable mentor and a less knowledgeable mentee.
A mentee is a person who is guided, supported, and in most cases, protected from an experienced mentor. A mentor is the one who boosts the career of a mentee, helping him to get the best out of his career, business, or even relationships – both personal and professional.

So what is best practice?

The best practice is an organisational idea that states that there is a standard activity, process, method, technique, reward, or incentive that is more productive in accomplishing a specific result. The idea is that the desired product is delivered with few or no unexpected complications and/or problems. Therefore, best practices in mentoring comprise an equally beneficial relation to improve the proficient intelligence of the mentor and the mentee. A good mentor usually projects confidence, proficiency, candidness, friendliness, and communication skills. Enthusiastic mentees tend to express a desire for knowledge, utmost discipline, and self-respect.

Who is A Good Mentor?

A good mentor is a mentor who:

- Listens well and treats the conversation with the mentee as confidential.
- Determines what is essential to a mentee and explores their ambitions, propensities, and skills.
- Knows the importance of the learning process by creating a genuine and open relationship to promote confidence and trust.
- Accepts the fact that in some cases, a mentee may need to seek other sources of assistance and help.
- Appropriately trained and has vast knowledge in the subject matter and in mentoring.
- Should have a professional approach in the mentor-mentee relationship.
- Refrain from mentoring those directly reporting to them; no matter how professional the relationship is, this will avoid other colleagues to think that the mentor may influence some issues about the issues concerning the mentee's decision and position.

Who is a Good Mentee?

A good mentee is a mentee who:

- Very enthusiastic about being taught and trained and is liberated to new ideas or concepts.
- A team player that can interact well with other people.
- A risk-taker who is not afraid to go beyond the business as usual boundaries and venture into uncertainties to learn.
- Patient enough to realize that ambition in life cannot be acquired overnight.
- A positive attitude, even amid a crisis.
- Demonstrates inventiveness and resourcefulness in any task assigned.
- Accepts feedback, negative or positive, about behaviour and skills, to improve and learn from it.

When is a Mentor-Mentee Relationship Good?

A good mentor-mentee relationship is not just gauged by the personality that each individual brings into the relationship; more significantly, the occurrence of proper interaction and behavior is needed throughout the process. The mentor accomplishes with the mentee, and how eager the mentee responds and receives it, is what matters most in such a relationship.

A good mentor-mentee relationship cultivates and successfully carries out the following:

Career Roles:

- A mentor that introduces new opportunities to the mentee, which the latter believes in.
- A mentor that coaches and sponsors a mentee, which the latter gratefully accepts.
- A mentor that protects and challenges a mentee, which the latter understands as part of the relationship.

Psychological Roles:

- A mentor who is a role model, which the mentee looks up to.
- A mentor who motivates and encourages the mentee, using real-life examples.
- A mentor who counsels, which the mentee receives wholeheartedly.
- A mentor who befriends a mentee but is still focused enough to achieve the goals of the relationship.
- A mentor and a mentee who accept and confirm each other's ideas.

Within this representation, a mentor serves as a leader, a teacher that encourages thinking abilities, an advocate of realistic principles, an overseer, and an analyst. A mentee, on the other hand, is a student who is willing to be taught and is ready to embark on a journey towards a complete learning experience.
Mentoring programs, when practiced efficiently, establish the self-confidence and the self-assurance of a mentee who uses it as a tool for personal and professional development. The benefits of a good mentoring program cannot be overemphasized. The mentee usually learns from someone who has the necessary experience to coach them on what they have to do.

Some of the benefits of an effective mentoring program include:

- Becoming a standout
- Leadership abilities
- Working smarter, not harder

These benefits may sound simple, but when you translate it in real life, you can feel that mentoring is one of the best options to succeed in any career.
It is evident from my experience that there are immediate and measurable benefits for an apprenticeship program where the mentees have immediate opportunities to apply what they have learned.
Mentoring is a two-way relationship, and both the mentor and the mentee will learn something from the mentoring program. Primarily though, mentoring programs are designed to enhance the capabilities of the mentee.

6.1.4 Inclusion of Gender Concept and People With Disability (PwD) at the Workplace[24]

It is vital that gender equality should be recognized as a discrete issue and the gender dimensions of the disability inclusive development should be addressed as well with the following reasons:

- As a result of aging and the longer life expectancy of women, the number of women with disabilities is likely to be higher in many populations than the number of men with disabilities. Many older women who are disabled may lack access to services/support. As life expectancy increases, this challenge will become more evident across more countries.
- Gender equality and empowerment of women can reduce the female disability prevalence rate because many women become disabled because of gender discriminatory practices, including early and child marriage, early pregnancy and female genital mutilation.

[24]*Source:https://datascience.foundation/datatalk/mentoring-an-apprentice-what-are-the-best-practices*

- Women and girls with disabilities are discriminated differently from men: ie: women are at higher risk of sexual violence, forced sterilization, forced abortion and exposure to HIV/AIDS, among others. Thus, targeted interventions will result in more effective and efficient advocacy, including implementation and monitoring of the Convention on the Rights of Persons with Disabilities.
- Evidence indicates that the greater gender equality in education and employment make a marked contribution to development and economic growth. This is why the MDGs and the QCPR has gender equality as a standalone goal. As stressed in the "Incheon strategy to "Make the Right Real" for Persons with Disabilities in Asia and the Pacific , promotion of gender equality and empowerment of women with disabilities is necessary for the achievement of the disability inclusive development.
- To advance the rights of women with disabilities in society and development, it is essential that their perspectives be included in all aspects of work for women's empowerment, and that all work on disability incorporate a gender perspective. Without the meaningful participation of women with disabilities in the disability dialogue, the goal of "nothing about us without us" cannot be achieved.

Disability inclusion at work is about more than hiring people with disabilities. An inclusive workplace values all employees for their strengths. It offers employees with disabilities — whether visible or invisible — an equal opportunity to succeed, to learn, to be compensated fairly, and to advance. True inclusion is about embracing difference.

- Disability inclusion is also crucial to your hiring process. Companies that aren't proactive about disability inclusion are losing out on qualified talent. If candidates face barriers during the application and interview process, or if they sense that your business is not inclusive, they're likely to look elsewhere.
- Companies with strong disability inclusion programs have better access to talent and better employee retention. They have the tools they need to help their employees thrive.
- Despite wanting to work, people with disabilities are employed at a much lower rate than their peers. The vast majority of people with disabilities are striving to work.

6.1.5 Ways to Create Conducive Working Environment for All the Genders and PwD

1. Make a commitment to gender inclusivity in your team

Women in general are more likely than men to become disabled because of poorer working conditions, poor access to quality healthcare, and gender-based violence (ILO), retrieved from the World Bank Website,
http://web.worldbank.org/WBSITE/EXTERNAL/TOPICS/EXTSOCIALPROTECTION/EXTDISABILITY/0,,contntMDK:20193528~menuPK:418895~pagePK:148956~piPK:216618~theSitePK:282699,00.html

This strategy can be retrieved from *http://www.unescap.org/publications/detail.asp?id=1523*
Addressing gender equality in the context of disability ((Inputs from UN Women)

2. Be aware of language

- Be careful to steer clear of words or phrases that have gendered or PwD connotations. The use of gendered language reinforces harmful stereotypes and binary-based assumptions. Educate all colleagues about gender/PwD-inclusive language.
- Such biased behavior in the workplace can covert power dynamics as well.

3. Make the commitment

- Creating a gender/ PwD inclusive workplace means committing to a culture of support, safety, and acceptance—and making structural and cultural changes that demonstrate that commitment.

4. Define the need for appropriate verbal and non-verbal communication while interacting with all genders and PwD.

- Let us understand how to communicate effectively with persons with disabilities.
- It can be used to help staff understand basic ways to adapt verbal and non-verbal communication when working with survivors with disabilities or involving persons with disabilities in community activities.
- Persons with disabilities have a right to participate in our activities on an equal basis with other members of the community. As service providers and practitioners, the way we interact and communicate with persons with disabilities and talk about them can help to break down barriers to participation and send positive messages to colleagues, partners and community members.
- It also improves the quality of our programs by ensuring that they are inclusive of all ideas, skills and capacities that exist within the community.

Communication tips: [25]

- Use respectful language
- Use a strengths-based approach - Do not make assumptions about the skills and capacities of persons with disabilities – this can affect the way we communicate and interact with them. Just like all people, they have different opinions, skills and capacities. See their potential. This can often give insight into how they can communicate and participate in your activities.
- Speak directly to the individual with disabilities, not to their interpreter or assistant/caregiver.
- While speaking, try to place yourself at eye level with the person if they are not already at the same height. Discussions and activities should continue to be age appropriate and then adapted for the communication needs of the individual.
- Ask for advice. If you have a question about what to do, how to do it, what language to use or the assistance you should offer – ask them. The person you are trying to work with is always your best resource.

[25] *Source:https://vivien-project.eu/wp-content/uploads/2019/02/GBV-disability-Tool-6-Guidance-on-communicating-with-persons-with-disabilities.pdf*

5.1.6 Applicable PwD Related Regulations

The Rights of Persons with Disabilities Act, 2016 along with the Rules (for implementation) have recently been enacted by the federal government. The new law protects disabled persons in India from various forms of discrimination, ensures their access to equal employment opportunities, and enhances their societal participation.

The Disabilities Act of 2016 is in accordance with the principles codified in the United Nations Convention on the Rights of Persons with Disabilities, and replaces the previous legislation – Persons with Disabilities (Equal Opportunity Protection of Rights and Full Participation) Act of 1995.

Salient aspects of the Disabilities Act, 2016

- The definition of a 'disabled person' is broadened under the 2016 Act: it covers persons with disability, persons with benchmark disability, and persons with disability having high support needs. This definition is inclusive and categorizes 21 types of disabilities as 'specific disabilities'.
- The Act applies to government establishments as well as private establishments. Under the law, private establishments refer to a company, firm, cooperative or other society, associations, trust, agency, institution, organization, union, factory, or such other establishment specified by the government.
- The Act requires all establishments to frame and publish an Equal Opportunities Policy. All forms of discrimination against persons with disabilities are prohibited, unless it can be proved that such discrimination is proportionate in nature and a necessary means of achieving legitimate purposes.
- The Act provides additional benefits for persons with benchmark disabilities, such as employment vacancies in government establishments, education opportunities, land allocation, and poverty alleviation schemes, among others.

In order to ensure speedy justice, special courts are instituted in each district to deal with cases pertaining to the violation of the rights of disabled persons. Penalties for the violation of rights of disabled persons can extend to a monetary fine of US$7,750 (Rs 500,000) and imprisonment for up to five years.

Key compliances under the Disabilities Act

Although the majority of the compliances under the Act apply exclusively to government establishments, private establishments are also covered under the purview of the Act and must comply with the following requirements:

- Frame and publish an Equal Opportunities Policy on the establishment's website or at a conspicuous place within the establishment premises. The Policy must contain details of the benefits and facilities provided to disabled persons at the workplace. A copy of the Policy must also be registered with the State Commissioner.
- Establishments having more than 20 employees must appoint a Liaison Officer to oversee the recruitment of disabled persons and special facilities provided for them.

- Establishments are required to identify job vacancies, which would be appropriate for disabled persons. In case of establishments receiving incentives from the government, a minimum of five percent of job vacancies must be compulsorily reserved for disabled persons.
- The employer must ensure the prohibition of illegitimate discrimination against disabled persons within the workplace.
- The employer must provide additional facilities or special benefits to disabled employees in order to increase their accessibility, such as special leave and training programs.
- All establishments have to conform to the accessibility norms issued by the government regarding disabled persons. The accessibility norms pertain to workplace infrastructure and communication technologies, which must be accessible to disabled persons.
- Every covered establishment must maintain records of its disabled employees .

6.1.7 Procedure to Report Inappropriate Behaviour[26]

Workplace harassment &violence encompasses workplace behavior by supervisors, co-workers or third parties that is unwelcome, offensive, intimidating, humiliating or threatening to an individual or a group of individuals. It also includes amongst other behaviors, verbal abuse, display of violent images, angry outbursts, encroachment on the personal space of others and destruction of property.

Workplace harassment & violence covers:

1. Persistent singling out of one person.
2. Shouting, raising voice at an individual in public and/or in private.
3. Using verbal or obscene gestures.
4. Not allowing the person to speak or express him/herself (i.e., ignoring or interrupting).
5. Personal insults and use of offensive nicknames.
6. Public humiliation in any form.
7. Constant criticism on matters unrelated or minimally related to the person's job performance or description.
8. Ignoring/interrupting an individual at meetings.
9. Public reprimands.
10. Repeatedly accusing someone of errors which cannot be documented.
11. Deliberately interfering with mail and other communications.
12. Spreading rumors and gossip regarding individuals.
13. Encouraging others to disregard a supervisor's instructions.
14. Manipulating the ability of someone to do their work (e.g.over-loading, under-loading, withholding information, setting meaningless tasks, setting unreasonable deadlines, giving deliberately ambiguous instructions).
15. Inflicting menial tasks not in keeping with the normal responsibilities of the job.
16. Taking credit for another person's ideas.
17. Refusing reasonable requests for leave in the absence of work-related reasons not to grant leave.

[26]*Source:https://www.india-briefing.com/news/the-disabilities-act-india-what-employers-need-to-know-15755.html/*

18. Deliberately excluding an individual or isolating them from work-related activities (meetings etc.)
19. Unwanted physical contact, physical abuse or threats of abuse to an individual or an individual's property (defacing or marking up property).
20. Causing physical injury to another person;
21. Making threatening remarks;
22. Aggressive or hostile behavior that creates a reasonable fear of injury to another person or subjects another individual to emotional distress;
23. Intentionally damaging employer property or property of another employee;
24. Possession of a weapon while on company property or while on company business;
25. Committing acts motivated by, or related to, sexual harassment or domestic violence.[27]

What are the relevant Indian laws applicable for harassment and violence in the workplace?

- Misconducts under the Standing Orders.
- If specific acts not listed as misconduct under standing orders, clause pertaining to act subversive of discipline and good behavior on the premises of the establishment.
- Unfair labour practice under Industrial Disputes Act 1947.
- Relevant Provision of Indian Penal Code - 1860.

What is the process to be followed when investigating harassment at workplace?

Investigating complaints of harassment is a critical component of a prevention program and of particular concern since a flawed investigation can result in legal exposure. However, regulatory instructions are vague and courts take a case-by-case approach to evaluating sufficiency.

Major points to consider in effective complaint investigation include:

- Timeliness, including promptly initiating the investigation after an incident is reported or observed and reasonable completion and reporting of the results to appropriate parties.
- Objectivity and credibility, which require an impartial investigation by a trained neutral party, the belief of employees that all complaints are properly investigated and appropriate corrective action taken when violations are found.
- Thoroughness, accuracy and documentation of the findings and corrective actions taken based on balanced conclusions consistent with material on records during the investigation.
- Closure, including reporting findings to appropriate officials, correcting violations and following up with both complaining employees and alleged harassers to assure their understanding of future expectations, and prevention of recurrence.

What steps should an employer follow to take disciplinary action on an employee?

Organizations normally follow a progressive disciplinary action approach in managing a situation related to undesired behavior in the workplace. They use the provisions of applicable Standing Orders which enumerate the procedure to investigate and deal with employee misconduct.

- It is important that the employer should take swift action whenever any formal or informal complaint about any undesirable act is received. Swift action helps in the right investigations, gathering evidence and witnesses, and most importantly enhances the credibility of the organisation internally as well as externally. Since every disciplinary action needs to be legally tenable, it should be compliant with the provisions of law as well as principles of natural justice. The process should not only be fair but also be perceived as fair.

[27]*Source: https://www.shrm.org/shrm-india/pages/india-faqs-on-effective-handling-of-workplace-harassment.aspx*

Steps that could be followed are as under:

- Step 1: Conduct Preliminary enquiry
- Step 2: Issue Charge-sheet
- Step 3: Suspension pending enquiry
- Step 4: Constitute Domestic Enquiry
- Step 5: Enquiry Report
- Step 6: Decide Punishment
- Step 7: Issue Final Show Cause Notice
- Step 8: Awarding punishment
- Step 9: Appeal Procedure
- Step 10: Seek Approval for punishment (if required)

What steps can an employer/HR take to make the workplace free of harassment?

- HR professionals are on the front line of preventing unlawful workplace harassment. They must be on alert to stop harassment when they see it first hand or hear about it second hand.
- Educate supervisors to likewise spot and stop unlawful workplace harassment.
- HR professionals must recognize that every employee complaint about being "harassed" by a supervisor or subject to a "hostile working environment" does not rise to the level of illegal workplace harassment.
- HR professionals must recognize that employee complaints of any sort must be taken seriously for purposes of changes in organizational policy in a multitude of ways.
- HR professionals can routinely monitor organizational communications for transmission of pornography, obscenities and threats.
- Promulgate anti-harassment policies and communicate them to employees.
- Policy and complaint procedure also may be communicated by:
  - ❖ Including it in all employee handbooks.
  - ❖ Posting it on employee bulletin boards.
  - ❖ Reinforcing it through harassment sensitivity and prevention training.
  - ❖ Publishing it on the employer's intranet.
  - ❖ Publishing it on memos or pay check stuffers.
  - ❖ Discussing it in management meetings and written guidelines for managers.
  - ❖ Discussing it in work group or all-hands meetings.

6.1.8 Completing Work-Related Documentation

It is an an important aspect of operating even the smallest farming enterprise. Efficient and profitable farm operations depend upon thorough and accurate record-keeping. Producers may prefer to maintain hand-written records using a ledger book or similar record-keeping tool, or they may take advantage of inexpensive bookkeeping software available to small business. Regardless of the methodology used, the best system is the one in which all expenses and income is recorded in a timely and accurate manner.

There are three basic types of farm records:

1. Resource inventories.
2. Production accounts of livestock and crop operations.
3. Income and expense records.

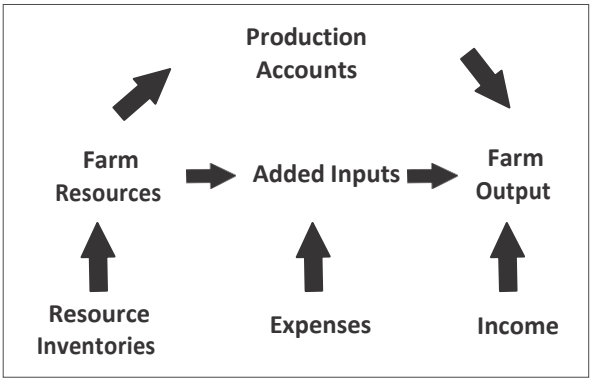


Fig 6.1.1 Types of farm records

Future trend in inventory management

Companies are shifting to just in time (JIT) systems control work flow by bringing in materials and sending out goods on demand. With JIT, the ultimate goal would be zero inventory. This simple strategy helps to prevent incurring the costs associated with carrying large inventories of raw materials at any given point in time. In today's fast paced and rapidly changing world, efficient daily operations and management can define the difference between growth and stagnation. This trend is followed by some companies but in future this will be the good trend for cost saving.

These records can be maintained manually, computerised on a spreadsheet or kept online. Make sure the system used is easy to operate and complements the business.

Keeping records can be daunting at first. The key is to break things down into a series of straightforward, manageable tasks. Then access and update them on a regular basis, rather than letting the paperwork pile up.

Some benefits of maintaining the stock records are:

- Raising the level of customer service quality, reducing the loss of sales due to lack of products.
- Improving cash flow and having higher inventory turnover.
- Being able to identify seasonality in the products will help to plan better.
- Detecting slow-moving items to develop strategies to get rid of them easily.
- Reducing the freight costs for further planning and reduction of emergency purchases.
- Monitoring the quality of the products to have them well identified and monitored.

- Releasing and optimising space in the stock to increase profitability per square meter of storage.
- Controlling inputs, outputs and location of the goods.
- Name of commodity Opening Balance as on first day of this month Quantity Received during the month. Total stock available during the month. Quantity sold against cash salen during the month. Quantity distributed against schematic programme Closing book balance.

Quantity Sold

Detail of the frequency of purchase, sale details like the number of products soldand procured. By maintaining the above record, one can know what is the current status of the product in terms of quantity and able to take the decision when to procure the products and in what quantity to.

Some of the advantages of record keeping are as follows:

- To maximise all the expenses claimed and reduced tax obligations.
- Will help out, the investigation done by the tax department.
- Makes it quicker to prepare accounts at year-end.
- Gives the information needed to run a business and help it grow.
- Helps to plan for tax payments.
- Helps identify the strengths and weaknesses of the business.
- Helps manage changes and improvements in the business.
- Will help to plan to meet financial commitments such as paying creditors or employees.
- Makes it easier to get a loan or sell the business.
- Avoids over/under tax payments.

Makes it more comfortable to distribute profits to shareholders as dividends or for partnerships where both profits and losses have to be shared.

- These records can be maintained manually, computerised on a spreadsheet or kept online. Make sure the system used is easy to operate and complements the business.

Exercise

Q.1. How would you like to communicate (verbal/non-verbal) to your colleagues and subordinates at work place?

Q.2. Suppose you are a mentor and has been given an apprentice. Perform a role play with your peer member about your mentorship skills.

Q.3. How should you deal with gender and People with disability at your work place? Share some communication tips.

Q.4. What are the relevant Indian laws applicable for harassment and violence in the work place

Q.5. Enlist three basic types of farm records.

Q.6. Mention some advantages of record keeping.

Notes



Skill India
कौशल भारत-कुशल भारत

सत्यमेव जयते
GOVERNMENT OF INDIA
MINISTRY OF SKILL DEVELOPMENT
& ENTREPRENEURSHIP

N·S·D·C
National
Skill Development
Corporation
Transforming the skill landscape

ASCI
Agriculture Skill Council of India

7. Hygiene and Cleanliness

Unit 7.1 - Hygiene and Workplace Housekeeping



AGR/N9903

Terminal Outcomes

By the end of this module, participants will be able to:

1. Discuss how to adhere to personal hygiene practices.
2. Demonstrate ways to ensure cleanliness around the workplace.

Key Learning Outcomes

By the end of this module, participants will be able to:

Theory – Key Learning Outcomes	Practical – Key Learning Outcomes
1. Explain the requirements of personal health, hygiene and fitness at work. 2. Describe common health-related guidelines laid down by the organizations/ Government at the workplace. 3.Explain the importance of good housekeeping at the workplace. 4. Explain the importance of informing the designated authority on personal health issues related to injuries and infectious diseases.	1. Demonstrate personal hygiene practices to be followed at the workplace. 2. Demonstrate the correct way of washing hands using soap and water, and alcohol-based hand rubs. 3. Demonstrate the steps to follow to put on and take off a mask safely. 4. Show how to sanitize and disinfect one's work area regularly. 5. Demonstrate adherence to the workplace sanitization norms. 6. Show how to ensure cleanliness of the work area.

UNIT 7.1: Hygiene and Workplace Housekeeping

Unit Objectives

By the end of this unit, participants will be able to:

1. Explain the requirements of personal health, hygiene and fitness at work.
2. Describe common health-related guidelines laid down by the organizations/ Government at the workplace.
3. Explain the importance of good housekeeping at the workplace.
4. Explain the importance of informing the designated authority on personal health issues related to injuries and infectious diseases.

7.1.1 What is Personal Hygiene?

Undertaking good personal hygiene is the act of looking after and maintaining your body in order to be clean and presentable for the workplace. In most jobs, you work with other people and it is important you practise good personal hygiene in order to make the working environment as enjoyable as possible for everyone. Good presentation also promotes a professional image and can help improve your own self-confidence and self-respect.

This YouTube video gives a bit more information on good grooming and personal hygiene.[28]

7.1.2 How will to Manage your Personal Hygiene

There are several ways you can look after your own personal hygiene, we cover the basics below and give tips on how to be clean and presentable.

Wash daily

Shower or bath every day and use soap or a body wash to make sure you are clean and to remove germs from your body. After you have washed, apply deodorant in order to stop any body odours from developing. If you perspire easily, think about techniques to manage this during the day, especially if you work in a warm environment - e.g. bringing wipes and deodorant with you to work, or fresh clothing.

Have clean hair

Wash your hair regularly with shampoo and ensure you brush it at least once a day to ensure it is kept neat and tidy. If you work in the hospitality industry or around food/drink, make sure your hair is tied up and wear a hair net if necessary.
If you have a beard, make sure it is maintained and clean. If you work with food/drink, it may also be necessary to wear a hair net over your beard.

[28] *Source:https://www.youtube.com/watch?v=Qi8Zyb2deQ8&feature=youtu.be*

Wear clean clothing

Make sure you wash your clothing regularly and wear fresh, clean clothes to work each day. Make sure your clothes are presentable, this means they should be ironed and free from holes wherever possible. Crumpled, old and smelly clothes are never welcomed in the workplace!.

Keep your nails clean

Make sure your nails are clean and kept tidily cut. It is important that you always wash your hands after you have visited the toilet, and regularly throughout the day. There are a number of work environments where you should not wear nail polish or jewellery (such as in kitchens and hospitals), so make sure you know your company's policies.

Oral hygiene

Brush your teeth every morning as part of your daily grooming routine to help reduce the risk of tooth decay, oral diseases and bad breath. You should use a good toothbrush and fluoride toothpaste, making sure you brush for at least 2 minutes, making sure you reach all surfaces of all teeth.
Using dental floss or interdental sticks to clean between the teeth and a good mouthwash after brushing can help reduce the risk of decay and gum disease.

7.1.3 Common Health-related Guidelines at the Workplace

Safety, Health and Environment at Work Place

The Constitution of India provide detailed provisions for the rights of the citizens and also lays down the Directive Principles of State Policy which set an aim to which the activities of the state are to be guided. On the basis of these Directive Principles as well as international instruments, Government is committed to regulate all economic activities for management of safety and health risks at workplaces and to provide measures so as to ensure safe and healthy working conditions for every working man and woman in the nation. Government recognizes that safety and health of workers has a positive impact on productivity and economic and social development. Prevention is an integral part of economic activities as high safety and health standard at work is as important as good business performance for new as well as existing industries.

Government of India firmly believes that without safe, clean environment as well as healthy working conditions, social justice and economic growth cannot be achieved and that safe and healthy working environment is recognized as a fundamental human right. Education, training, consultation and exchange of information and good practices are essential for prevention and promotion of such measures.

The increasing use of chemicals, exposure to physical, chemical and biological agents with hazard potential unknown to people; the indiscriminate use of agro-chemicals including pesticides, agricultural machineries and equipment; industries with major accident risks; effects of computer controlled technologies and alarming influence of stress at work in many modern jobs pose serious safety, health and environmental risks.

The fundamental purpose of this National Policy on Safety, Health and Environment at workplace, is not only to eliminate the incidence of work related injuries, diseases, fatalities, disaster and loss of national assets and ensuring achievement of a high level of occupational safety, health and environment performance through proactive approaches but also to enhance the well-being of the employee and society, at large. The necessary changes in this area will be based on a co-ordinated national effort focused on clear national goals and objectives.

In 2020, the worldwide spread of coronavirus prompted many businesses to clamp down on specific office hygiene practices to help contain the spread of the virus.

Good hygiene practice (particularly in times of viral outbreaks) as discussed in previous section, includes:

- Washing your hands with soap when you enter and exit work, and before you eat. If soap is not available, use an alcohol-based sanitizer.
- Washing your hands for 20 seconds or more.
- Catching your sneezes and coughs in a tissue, which you should dispose of immediately. Or, if a tissue is not available, cover your mouth and nose with your bent elbow.
- Avoid touching your eyes, nose and mouth.
- Maintain social distancing. This means maintaining a distance of at least one meter (three feet) between yourself and anyone who is coughing or sneezing.[29]

7.1.4 Importance of Good Housekeeping at the Workplace

Why should we pay atention to housekeeping at work?

Effective housekeeping can help control or eliminate workplace hazards.

Poor housekeeping can be a cause of incidents, such as:

- Tripping over loose objects on floors, stairs and platforms
- Being hit by falling objects
- Slipping on greasy, wet or dirty surfaces
- Striking against projecting, poorly stacked items or misplaced material
- Cutting, puncturing, or tearing the skin of hands or other parts of the body on projecting nails, wire or steel strapping

[29] *Source:https://labour.gov.in/sites/default/files/SafetyHealthand EnvironmentatWorkPlace.pdf*

To avoid these hazards, a workplace must "Maintain" order throughout a workday.

Effective housekeeping is an ongoing operation: it is not a one-time or hit-and-miss clean up done occasionally. Periodic "panic" clean-ups are costly and ineffective in reducing incidents.

Worker training is an essential part of any good housekeeping program. Workers need to know how to work safely with the products they use. They also need to know how to protect other workers such as by posting signs (e.g., "Wet - Slippery Floor") and reporting any unusual conditions.

Cleaning and organization must be done regularly, not just at the end of the shift. Integrating housekeeping into jobs can help ensure this is done.

A good housekeeping program identifies and assigns responsibilities for the following:

- Clean up during the shift
- Day-to-day clean up
- Waste disposal
- Removal of unused materials
- Inspection to ensure clean-up is complete

Finally, inspection is the last step to any housekeeping program. It is the only way to check for deficiencies in the program so that changes can be made. [30]

7.1.5 Informing the Designated Authority on Personal Health Issues Related to Injuries and Infectious Diseases

Reporting of cases of communicable disease is important in the planning and evaluation of disease prevention and control measures. Timely reporting will help to undertake primary isolation procedures to avoid spread of diseases among co-workers. In case of injuries, report immediately to concerned authorities so that appropriate action could be taken well in time.
As per global International Labour Organisation, safety and health is part of any activity carried out by companies and employers have to adhere to it. Also employees have complete right to report to such health related issues and injuries to their employers and safeguard themselves from any injuries. Some of the related articles of Safety and Health in Agriculture convention, 2002 (No. 184) are shared for knowledge purpose:

[30] *Source:https://www.ccohs.ca/oshanswers/hsprograms/house.html*

C184 - Safety and Health in Agriculture Convention, 2001 (No. 184)[31]

1. Scope

Article 1

For the purpose of this Convention the term agriculture covers agricultural and forestry activities carried out in agricultural undertakings including crop production, forestry activities, animal husbandry and insect raising, the primary processing of agricultural and animal products by or on behalf of the operator of the undertaking as well as the use and maintenance of machinery, equipment, appliances, tools, and agricultural installations, including any process, storage, operation or transportation in an agricultural undertaking, which are directly related to agricultural production.

Article 2

For the purpose of this Convention, the term agriculture does not cover:

- Subsistence farming;
- Industrial processes that use agricultural products as raw material and the related services; and
- The industrial exploitation of forests.

2. General Provisions

Article 3

In the light of national conditions and practice and after consulting the representative organizations of employers and workers concerned, Members shall formulate, carry out and periodically review a coherent national policy on safety and health in agriculture. This policy shall have the aim of preventing accidents and injury to health arising out of, linked with, or occurring in the course of work, by eliminating, minimizing or controlling hazards in the agricultural working environment.

To this end, national laws and regulations shall:

- Designate the competent authority responsible for the implementation of the policy and for the enforcement of national laws and regulations on occupational safety and health in agriculture;
- Specify the rights and duties of employers and workers with respect to occupational safety and health in agriculture; and
- Members shall ensure that an adequate and appropriate system of inspection for agricultural workplaces is in place and is provided with adequate means.
- In accordance with national legislation, the competent authority may entrust certain inspection functions at the regional or local level, on an auxiliary basis, to appropriate government services, public institutions, or private institutions under government control, or may associate these services or institutions with the exercise of such functions.

[31] *Source:https://www.ilo.org/dyn/normlex/en/f?p=NORMLEXPUB:12100:0::NO::P12100_ILO_CODE:C184*

3. Preventive and Protective Measures

General

Article 4

- In so far as is compatible with national laws and regulations, the employer shall have a duty to ensure the safety and health of workers in every aspect related to the work.
- National laws and regulations or the competent authority shall provide that whenever in an agricultural workplace two or more employers undertake activities, or whenever one or more employers and one or more self-employed persons undertake activities, they shall cooperate in applying the safety and health requirements. Where appropriate, the competent authority shall prescribe general procedures for this collaboration.

Article 5

In order to comply with the national policy referred to in Article 4 of the Convention, national laws and regulations or the competent authority shall provide, taking into account the size of the undertaking and the nature of its activity, that the employer shall:

- Carry out appropriate risk assessments in relation to the safety and health of workers and, on the basis of these results, adopt preventive and protective measures to ensure that under all conditions of their intended use, all agricultural activities, workplaces, machinery, equipment, chemicals, tools and processes under the control of the employer are safe and comply with prescribed safety and health standards;
- Ensure that adequate and appropriate training and comprehensible instructions on safety and health and any necessary guidance or supervision are provided to workers in agriculture, including information on the hazards and risks associated with their work and the action to be taken for their protection, taking into account their level of education and differences in language; and
- Take immediate steps to stop any operation where there is an imminent and serious danger to safety and health and to evacuate workers as appropriate.

Article 6

Workers in agriculture shall have the right:

- To be informed and consulted on safety and health matters including risks from new technologies;
- To participate in the application and review of safety and health measures and, in accordance with national law and practice, to select safety and health representatives and representatives in safety and health committees; and
- To remove themselves from danger resulting from their work activity when they have reasonable justification to believe there is an imminent and serious risk to their safety and health and so inform their supervisor immediately. They shall not be placed at any disadvantage as a result of these actions.
- Workers in agriculture and their representatives shall have the duty to comply with the prescribed safety and health measures and to cooperate with employers in order for the latter to comply with their own duties and responsibilities.

Machinery Safety and Ergonomics

Article 7

- National laws and regulations or the competent authority shall prescribe that machinery, equipment, including personal protective equipment, appliances and hand tools used in agriculture comply with national or other recognized safety and health standards and be appropriately installed, maintained and safeguarded.
- The competent authority shall take measures to ensure that manufacturers, importers and suppliers comply with the standards referred to in paragraph 1 and provide adequate and appropriate information, including hazard warning signs, in the official language or languages of the user country, to the users and, on request, to the competent authority.
- Employers shall ensure that workers receive and understand the safety and health information supplied by manufacturers, importers and suppliers.

Article 8

National laws and regulations shall prescribe that agricultural machinery and equipment shall:

- only be used for work for which they are designed, unless a use outside of the initial design purpose has been assessed as safe in accordance with national law and practice and, in particular, shall not be used for human transportation, unless designed or adapted so as to carry persons; and
- be operated by trained and competent persons, in accordance with national law and practice.

Handling and Transport of Materials

Article 9

- The competent authority, after consulting the representative organizations of employers and workers concerned, shall establish safety and health requirements for the handling and transport of materials, particularly on manual handling. Such requirements shall be based on risk assessment, technical standards and medical opinion, taking account of all the relevant conditions under which the work is performed in accordance with national law and practice.
- Workers shall not be required or permitted to engage in the manual handling or transport of a load which by reason of its weight or nature is likely to jeopardize their safety or health.

Sound Management of Chemicals

Article 10

- National laws and regulations or the competent authority shall ensure that there are preventive and protective measures for the use of chemicals and handling of chemical waste at the level of the undertaking.
- These measures shall cover, inter alia:
  - The preparation, handling, application, storage and transportation of chemicals;
  - agricultural activities leading to the dispersion of chemicals;
  - The maintenance, repair and cleaning of equipment and containers for chemicals; and
  - The disposal of empty containers and the treatment and disposal of chemical waste and obsolete chemicals.

Article 11

National laws and regulations shall ensure that risks such as those of infection, allergy or poisoning are prevented or kept to a minimum when biological agents are handled, and activities involving animals, livestock and stabling areas, comply with national or other recognized health and safety standards.

Temporary and Seasonal Workers

Article 12

Measures shall be taken to ensure that temporary and seasonal workers receive the same safety and health protection as that accorded to comparable permanent workers in agriculture.

Women Workers

Article 13

Measures shall be taken to ensure that the special needs of women agricultural workers are taken into account in relation to pregnancy, breast feeding and reproductive health.

Coverage Against Occupational Injuries and Diseases

Article 14

- In accordance with national law and practice, workers in agriculture shall be covered by an insurance or social security scheme against fatal and non-fatal occupational injuries and diseases, as well as against invalidity and other work-related health risks, providing coverage at least equivalent to that enjoyed by workers in other sectors.
- Such schemes may either be part of a national scheme or take any other appropriate form consistent with national law and practice.

Exercise

Q.1. Enlist various ways to manage your personal hygiene.

Q.2. Mention few common health-related guidelines laid down by the organizations/ Government at the workplace.

Q.3. Why should we pay attention to housekeeping at work?

Q.4. As per safety and health in Agriculture convention, 2001, C 184, what are the rights Workers in agriculture shall have regarding preventive and protective measures?

Notes



Skill India
कौशल भारत-कुशल भारत

सत्यमेव जयते
GOVERNMENT OF INDIA
MINISTRY OF SKILL DEVELOPMENT
& ENTREPRENEURSHIP

N·S·D·C
National
Skill Development
Corporation
Transforming the skill landscape

ASCI
Agriculture Skill Council of India

8. Safety and Emergency Procedures

Unit 8.1 - Emergency Procedures and First Aid



AGR/N9903

Terminal Outcomes

By the end of this module, participants will be able to:

1. Describe how to adhere to safety guidelines.
2. Show how to administer appropriate emergency procedures.

Key Learning Outcomes

By the end of this module, participants will be able to:

Theory – Key Learning Outcomes	Practical – Key Learning Outcomes
1. List the Personal Protective Equipment (PPE) required at the workplace. 2. Describe the commonly reported hazards at the workplace. 3. Describe the hazards caused due to chemicals/pesticides/fumigants. 4. Describe the basic safety checks to be done before the operation of any equipment/machinery. 5. Describe the common first aid procedures to be followed in case of emergencies. 6. State measures that can be taken to prevent accidents and damage s at the workplace. 7. Explain the importance of reporting details of first aid administered, to the reporting officer/doctor, in accordance with workplace procedures. 8. State common health and safety guidelines to be followed at the workplace.	1. Check various areas of the workplace for leakages, water-logging, pests, fire, etc. 2. Demonstrate how to safely use the PPE and implements as applicable to the workplace. 3. Display the correct way of donning, doffing and discarding PPE such as face masks, hand gloves, face shields, PPE suits, etc. 4. Sanitize the tools, equipment and machinery properly. 5. Demonstrate the safe disposal of waste. 6. Demonstrate procedures for dealing with accidents, fires and emergencies. 7. Demonstrate emergency procedures to the given workplace requirements. 8. Demonstrate the use of emergency equipment in accordance with manufacturers' specifications and workplace requirements. 9. Demonstrate the administration of first aid. 10. Prepare a list of relevant hotline/ emergency numbers.

UNIT 8.1: Emergency Procedures and First Aid

Unit Objectives

By the end of this unit, participants will be able to:

1. Ensure prevention of accidents and damages.
2. Deal with accidents, fires and emergencies.
3. Use emergency evacuation.
4. Administer first aid.

8.1.1 Prevention of Accidents and Damages

- **Contact –** when the body comes into contact with sharp edges, hot parts or live electrical items.



Fig 8.1.1 Worker comes into contact with electrical items, sharp edges and hot parts



Fig 8.1.2 Workers are hit by objects or off machines

A single workplace accident can leave a big impact on your business. Between the doctor's visit expenses, the lost efficiency, all labourers' pay administrative work, and the low ethics, the expenses are high.

The best way to avoid these costs is by avoiding an injury. Follow these 10 tips to prevent an injury and protect your workforce.

- Incorporate a safety and wellness plan. The foundation for a safe work environment is an effective accident prevention and wellness program. The program needs to cover all levels of employee safety and health with the encouragement to report hazardous practices or behavior.
- Research safety vulnerabilities. Every business is unique and does not necessarily have the same safety concerns. Give additional consideration to regular mishaps and create methodologies to prevent them from occurring.
- Give personal protective equipment (PPE). PPE is basic and ought to be authorized at workplace, gatherings, and with active observion. Set aside some effort to show representatives how to appropriately utilize PPE.
- Have sufficient staffing levels. More often than not, overtime hours are implemented because of low staffing levels. Exhausted workers may experience the ill effects of burnouts in need to meet or surpass yield. Hiring part-time or seasonal staff could help prevent accidents due to exhaustion.

Steps

Step 1: Do not take shortcuts. Accidents happen when employees skip steps to complete a job ahead of schedule. Make sure all instructions are clear and organized to prevent undue mishaps in the workplace.

Step 2: Inspect and maintain all company vehicles. According to The Occupational Safety and Health Act findings, workplace-driving accidents cost employers an average of $60 billion dollars a year. Maintenance should include monthly inspections and repairing vehicles as soon as possible.

Step 3: Monitor safety measures. After initial training, reinforce safety measures at every opportunity, i.e. staff meetings, supervision, and education. Reward employees who abide by setting standards or staying injury free for a specified amount of time.

Step 4: Keep an orderly workplace. Poor housekeeping can cause serious health and safety hazards. The layout of the workplace should have adequate foot path markings, be free of debris, and stations for cleaning up spills.

Step 5: Unfortunately, no matter how much you prepare, an accident can still occur, and an employee can still get injured. When that happens, make sure you're prepared to get them the care they need, quickly.

Step 6: Direct employees to attend fire drills and other safety related workshops organized at the workplace.

8.1.2 Accidents, Fires and Emergencies

Natural Disasters

Windstorms

A storm with the extreme wind but little or no rain or snow, which affects the transportation of commodities procured from one place to the other that is consumer or warehouse.



Fig 8.1.3 Windstorms

Floods

An overflow of a significant amount of water beyond its reasonable limits, which may affect the environment of commodity storage, some products may get washed out. Also, this will affect the transportation of goods.



Fig 8.1.4 Floods

Stroms-Rain

Heavy rain or severe storms can shut down transportation networks or flood buildings, and thus impact procurement volumes.

Heavy rainstorms or torrential rain can last for a long period.

Hazards may include runway, taxiway and roadway contamination (standing water), reduced friction, problems with water run-off, flooding, drainage problems and ground saturated with precipitation.

Strong winds can also accompany massive rain events.



Fig 8.1.5 Stroms-Rain

Earthquakes

A sudden violent shaking of the ground, typically causing great destruction, as a result of movements within the earth's crust or volcanic action. That may lead to damages on roads, buildings, goods and also human lives.



Fig 8.1.6 Earthquakes[32]

[32]*Source:https://www.nationalgeographic.com/environment/article/earthquakes;*

Steps

Steps for dealing with natural disasters:

Step 1 Be Organized: Have detailed documentation and guidelines established that dictate the emergency operations plan.

↓

Step 2 Be Transparent: Internal and external uncertainty creates chaos, which leads to a host of other problems. Be clear and open with suppliers, partners, and internal staff in a timely manner. Openness goes a long way in the recovery process.

↓

Step 3 Rely on Partnerships: Build strong, strategic supply chain partnerships. These relationships will help you work through disaster challenges.

↓

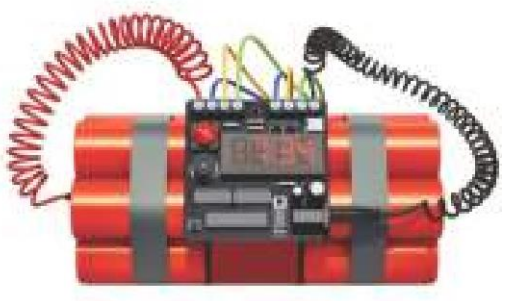
Step 4 Adjust: Recovering from a natural disaster is a fluid situation. No matter how much you plan, you will still need to adjust which could include re-routing suppliers and schedule changes.

Bomb incidents

If there is a bomb threat directed towards any procurement building, structure or an aircraft the responsible person will do the following remedies:

- Establish an isolation zone on the warehouse and clear it of all unauthorised personnel.
- Ask the employess to leave the baggage and cargo on the aircraft. Detain all the workers and other authorities, until cleared by the designated law enforcement personnel.
- Notify the bomb squad and police department.

1. Where is the bomb right now?
2. When is it going to explode?
3. What does it look like?
4. What kind of bomb is it?
5. What will cause it to explode?
6. What is your Name?
7. What is your address?
8. What is your telephone number?
9. Record the call.



Bomb Incidents

Fig 8.1.7 Checklist for bomb threat call

Structural fire

- Call fire office.
- Take protective actions for employees and passenger.
- Evacuate area according to evacuation plan.
- Coordinate response activities.
- Control access to the facility until it has been inspected or obstructed by emergency response organisations.

Fire Prevention Plan (FPP)

Preventing fires from occurring is the most efficient way of managing them. The Fire Prevention Plan (FPP) is numerous techniques for stopping flames prior to beginning. To avoid a flame from beginning, every preventative measure must be taken. A written FPP is required in addition to the Occupant Emergency Plan to efficiently manage tower evacuations and minimise/control potential fire hazard.

Fire Extinguisher Categories

Fire extinguishers are loaded with different dousing agents to fight specific classes of fires. Some types of extinguishers will be ineffective against certain classes of fires, while others could make the fire worse. Before trying to put out a fire, ensure the fire fuel is known and only proceed if the right type of fire extinguisher is available.

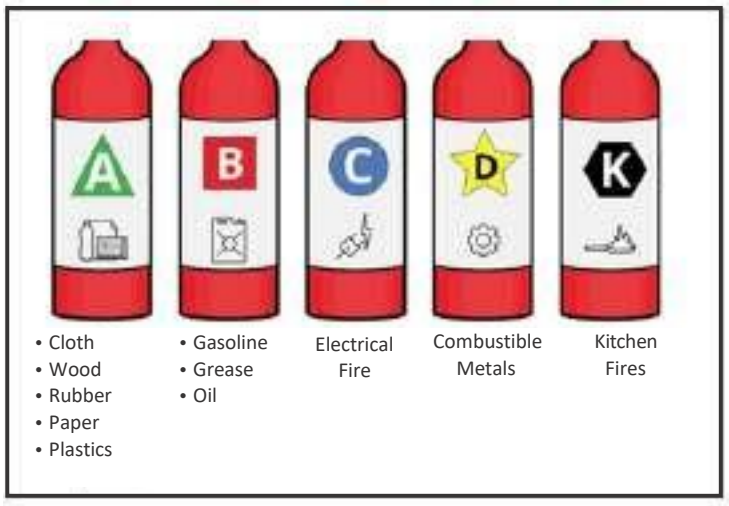


Fig 8.1.8 Fire extinguishers categories / prevention plan (FPP)

- **Class A**: Suitable for cloth, wood, rubber, paper, various plastics and regular combustible fires. The extinguishing agent is water or foam.
- **Class B**: Suitable for gasoline, grease and oil fires. The extinguishing agent is a dry chemical or carbon dioxide. Extinguishers smaller than 6 pounds (2.72 kg) are not recommended.
- **Class C**: Suitable for energized electrical fires. The extinguishing agent is a dry chemical or carbon dioxide.

- **Class D**: Suitable for combustible metals. The extinguishing agent is a dry powdered chemical.
- **Class K**: Suitable for kitchen fires, including oil, grease and fat. The extinguishing agent is a wet or dry chemical.
- **Class ABC**: This is an all-purpose fire extinguisher that works on class A, B and C fires. The extinguishing agent is a dry chemical.

How to use Fire Extinguishers?

Remember the "PASS" word. To use a fire extinguisher, one must understand how to operate them properly. Before taking action to extinguish a fire, be sure that the fire is small enough to be extinguished. Know what material is burning and be sure that the proper type of extinguisher is selected. Stand at a safe distance (approximately 6 feet) away from the fire and follow the four-step PASS procedure. If the attempt to extinguish does not come under immediate control or the escape route is threatened, leave the area immediately.

PULL the pin out: This unlocks the operating lever and allows you to discharge the extinguisher. Some extinguishers have other devices that prevent inadvertent operation.
AIM low: Point the extinguisher nozzle (or hose) at the base of the fire.
SQUEEZE the lever below the handle: This discharges the extinguishing agent. Releasing the lever will stop the discharge. Some extinguisher have a button that you press.
SWEEP from side to side: Moving carefully toward the fire, keep the extinguisher aimed at the base of the fire and sweep back and forth until the flames appear to be out. Watch the fire area. If the fire re-ignites, repeat the process.

Failure of Power

This emergency situation involves failure of power for movement area lighting. Carry out the following activities in response to the situation:

- Notify staff and repair personnel of power outage.
- Start the generator.

8.1.3 Emergency Evacuation Pathways and Exit Signage

Building Evacuation Pathways and Exit Signage

Emergency evacuation is the urgent or immediate removal of people away from an area that contains an imminent threat, an ongoing threat or a hazard to lives or properties.

The key to a successful evacuation is situational awareness. In an procurement environment, personnel work in many different settings other than their primary work area. It is essential for the safety of employees, tenants and customers that each person becomes familiar with the standard indicators of evacuation routes and emergency exits.

- Emergency exits will be clearly marked and lit with an "EXIT" sign which is typically green and white.
- Exit signs are directional and mark the evacuation route. No arrow on the sign indicates go straight ahead; an arrow on the sign indicates a turn is needed to continue on the exit path.
- Pathways must be wide enough to accommodate a large number of evacuating personnel.
- Pathways must remain clear of debris or obstructions at all times.
- Routing must not expose evacuating personnel to additional hazards.



Fig 8.1.9 Evacuation Signs

Evacuation Do's and Don'ts:

If an exit leads to a stairwell, continue down the stairs to the ground level and exit the building at that time – do not stop on any floor unless instructed.

- Stairwells are typically rated for smoke and heat protection – if rescue assistance is needed, remain in a stairwell and wait for rescue personnel.
- Do not use the elevators.
- It is not advised to go to the roof, using helicopters for roof rescue is a dangerous procedure for the occupants, the pilots and firefighters.
- Follow directions of emergency responders and other response personnel.
- Make every attempt to account for all of your personnel.
- Report any missing people to evacuation monitors or emergency response personnel.
- Do not return to the building until emergency response personnel have permitted to do so.

Evacuation on Fire/Smoke

- Notify people to evacuate the area.
- Close the door to the room or area to confine the spread of the fire.
- Activate the fire alarm.
- Call fire station and inform about the condition and location.
- Walk. Do not run. Evacuate the building out from the nearest exit.
- Listen and follow directions of fire department and other response personnel.
- Notify fire department of any personnel remaining in the building and their location.

Evacuation during Earthquake

- Take immediate cover under tables or desks, or crouch against an interior wall.
- Do not stand in a doorway. Keep away from windows to avoid flying glass. Do not stand under light fixtures, or near objects that could fall.
- Evacuate the building only after the shaking has completely stopped.
- Keep calm. Do not run outwards, watch for falling debris or electrical wires when leaving the building.
- Proceed to the designated gathering area if it is safe to do so.
- If disabled or injured, remain in place and wait for assistance.
- If fire occurs, activate the nearest fire alarm pull station.
- If qualified, render first-aid. If not qualified, assist those rendering or requiring first aid.
- Report any missing persons to the fire department or other response personnel.



Fig 8.1.10 Protecting during Earthquake

Evacuation around Hazardous Material

- Evacuate the area surrounding hazardous material.
- Keep other people away from the area until emergency responders can determine the nature of the material.
- Do not attempt to rescue the injured until the situation is assessed.
- If not near the threat, responders may advise shelter-in-place until the spill can be contained or better evaluated.

Notes

Materials are considered hazardous if they :

- Have an ability to corrode other materials.
- Can explode or easily be ignited.
- Can react strongly with water.
- Are unstable when exposed to heat or shock.
- Are toxic to humans, animals, or the environment.

Tips

- Conduct a demo on how to operate a fire extinguisher.
- Conduct a mock drill to evacuate the building during emergencies.

8.1.4 First Aid

First aid is based on scientific medicine and surgery. It is a skilled assistance. But the first aider is not a doctor. After the doctor takes charge, the first aider's responsibility ends. He can then stand by to help the doctor.

1. Preserve life

- Ensure the air passages are open and remain so.
- Check for and control bleeding immediately.

2. Prevent complications

- Cover wounds.
- Immobilise fractures and large wounds.

3. Promote recovery

- Reassure the casualty.
- Handle casualty gently and make him/her comfortable.
- Arrange to transport the casualty to hospital or obtain medical aid.

General rules to be followed:

- Ensure that there is no further danger to the casualty
- Do first things first, quickly and without fuss or panic.
- Give CPR if breathing has stopped, every second count.
- Stop any bleeding.
- Guard against or treat for shock by keeping the casualty warm, by moving him as little as possible and handle him gently.
- Reassure the casualty and those around, to help to reduce anxiety or embarrassment.
- Do not allow people to crowd around, as fresh air is essential.
- Do not remove clothes unnecessarily, as they help to keep the casualty warm and to protect against shocks.
- Arrange for removal of the casualty to the care of a doctor or hospital as soon as possible.

Treatment

- Should be done step by step. Continue treatment until the doctor takes charge.

Disposal

Earlier the doctor takes charge the greater the chances of recovery. Casualty should be taken to the nearest hospital or clinic using quickest means of transport.

Basic First Aid Kit

A basic first aid kit should contain:

- Plasters in a variety of different sizes and shapes
- Small, medium and large sterile gauze dressings
- At least two sterile eye dressings
- Triangular bandages
- Crepe rolled bandages
- Safety pins
- Disposable sterile gloves
- Tweezers
- Scissors
- Wipes without alcohol base
- Medical tape
- Thermometer
- Antiseptic cream

- Pain-relief spraay or oinment
- Painkiller, paracetamol, headache tablet, stomach ache tablet, aspirin.
- Cough medicine
- Antihistamine tablets
- Distilled water for cleaning wounds
- Eye wash and eye bath



Fig 8.1.11 Basic First Aid Kit

Severe bleeding

For severe bleeding, take these actions immediately:

- If there is an object embedded in the wound, control bleeding by pressing firmly on either side of the object, do not remove or press the object, otherwise apply direct pressure to the wound.
- Apply a dressing firmly to control bleeding. Be careful it is not so tight it restricts circulation.
- Prevent/treat shock by lying the casualty down with their feet raised (if possible).
- If the casualty has a head injury, lay them down and slightly raise their head and shoulders.
- If blood comes through the dressing apply another bandage on top.
- Remove the dressings and reapply fresh clean dressing with immediate stress on the injury if the bleeding through this too.
- Support the injured area in a raised position.
- Seek medical attention if you are unable to stop the bleeding or the casualty goes into shock.
- Keep the casualty warm by lying them on a blanket or some other item.

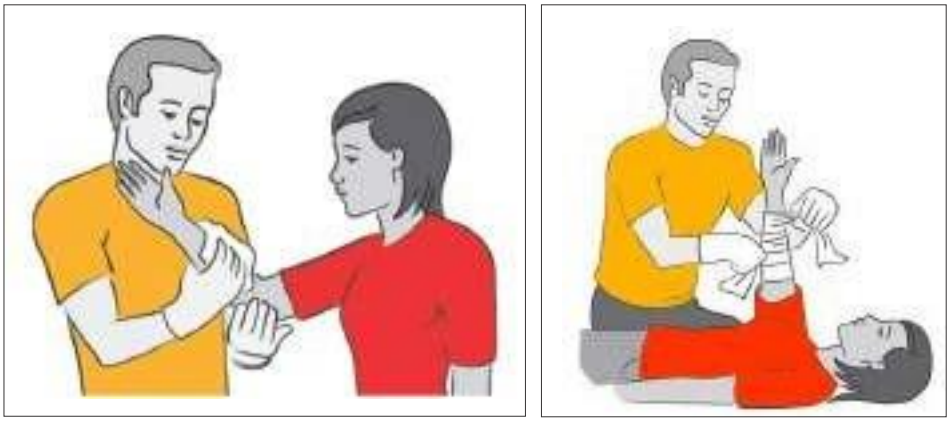


Fig 8.1.12 Controlling the bleeding

Fracture

If someone has broken bone, provide first-aid treatment and help them get professional care.

- **Stop any bleeding:** If the injured person is bleeding, elevate and apply pressure to the wound using a sterile bandage, a clean cloth, or a clean piece of clothing.
- **Immobilise the injured area:** If the injured person is bleeding, has broken a bone in his/her neck or back, help him/her stay as still as possible. If the injured person has broken a bone in one of his/her limbs, immobilise the area using a strap or suspend.
- **Apply ice to the region:** Wrap an ices pack or ice cube pocket in a section of cloth and stick for 10 minutes on the wound.
- **Treat the injured for shock:** Help the injured to get into a comfortable position, encourage him/her to rest and reassure. Cover him/her with a blanket or clothing to keep himself.



Fig 8.1.13 Rest Ice Compression Method

R-Rest	I-Ice	C-Compression
After the injury, stop the injured person from taking part in any painful activity. Moving the injured part can increase bleeding and swelling and slow down the healing process.	Use an ice pack to reduce the pain and swelling in the affected area. Apply ice for 15minutes every two hours for 24 hours, then for 15 minutes every four hours for 24 hours.	Bandage the area firmly (but not too tightly), starting just below the injured area and moving up. Overlap each layer by half. Finish bandaging about one hand's width above the injured area.

Steps

Electric Shock

To assist the person who has experienced an electric shock follow these steps:

Step 1: Look first. Do not touch. The person may still be in contact with the electrical source. Touching the person may pass the current through you.

↓

Step 2: Turn off the source of electricity if possible. If not, move the source away from you and the affected person, using a non-conducting object made of cardboard, plastic or wood.

↓

Step 3: Check for signs of circulation (breathing, coughing or movement). If absent, begin resuscitation (CPR) immediately.

↓

Step 4: Lay the person down and, if possible, position the head slightly lower than the trunk, with the legs elevated.

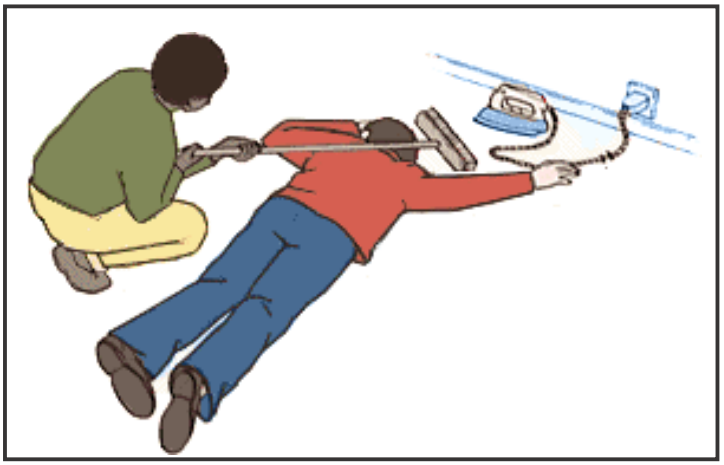


Fig 8.1.14 Electric Shock

8.1.5 Do's and Dont's

Sl.No	Do's	Don'ts
1	Stay alert and report suspicious activity.	Don't be tricked into giving away confidential information.
2	Communicate and coordinate with respective officials in case of any potential threat.	Don't respond to emails or phone calls requesting confidential company information—including employee information, financial results or company secrets.
3	Follow your stings and stay alert.	Don't leave sensitive info lying around the office or airside.
4	Closely monitor pax activity during check in and boarding to report any suspicious activity.	Never be careless while handling Baggage and cargo.
5	Ensure your safety at all point of time.	Never be part of illegal and unauthorized carriage of cargo.
6	-	Don't joke about national security or bomb threat.
7	-	Don't forget about the pre -check programme.
8	-	Never misuse the office resources (Pax manifest, duty mobile, system credential etc) as it may lead to potential threat.
9	-	Do not submit unauthorised reports, ensure that all the reports are duly signed by the supervisor.

Table 8.1.1 Do's and Don'ts

Exercise

A. Short Questions

Q.1. List the general hygiene steps in workplace.

Q.2. What are steps to deal with natural disasters ?

Q.3. Define first aid?

Q.4. List the fire extinguisher categories.

Q.5. Write the steps to use fire extinguisher?

Q.6. List the steps for evacuation in case of fire.

Q.7. Write the first aid steps in cases of fracture.

B. Fill in the Blanks

1. _____is the urgent or immediate removal of people away from an area that contains an imminent threat, an ongoing threat or a hazard to lives or properties.
2. The_____is numerous techniques for stopping flames prior to beginning.
3. Apply_____to the injured region.
4. When fingers are caught in the moving parts of a machine, it is called as_____.

C. Multiple Choice Questions

1. The components of fire triangle are:
   a). Fuel
   b). Oxygen
   c). Heat
   d). All of the above

2. The fire extinguisher category A is suitable for
   a). Grease
   b). Oil
   c). Cloth
   d). Gasoline

Notes



Skill India
कौशल भारत-कुशल भारत

सत्यमेव जयते
GOVERNMENT OF INDIA
MINISTRY OF SKILL DEVELOPMENT
& ENTREPRENEURSHIP

N·S·D·C
National
Skill Development
Corporation
Transforming the skill landscape

ASCI
Agriculture Skill Council of India

9. Process of Designing, SeEng Up and Maintaining a Rooftop

Unit 9.1 - Rooftop Gardening



AGR/N0843

Terminal Outcomes

By the end of this module, participants will be able to:

1. Discuss various parameter to assess for setting up a rooftop garden.
2. Demonstrate the process of setting up the rooftop garden.
3. Describe the process of carrying out the repair and maintenance of a rooftop garden.

Key Learning Outcomes

By the end of this module, participants will be able to:

Theory – Key Learning Outcomes	Practical – Key Learning Outcomes
1. Explain various parameters to assess while planning a rooftop garden. 2. Explain the importance of planning rooftop garden plants and features according to the roof's loading capacity. 3. List various materials of appropriate size and weight for setting up a rooftop garden. 4. Explain different ways of waterproofing a rooftop garden. 5. List varieties of trees, plants, and shrubs suitable for a rooftop garden. 6. Describe the process of installing windbreaks and appropriate support to provide shade for rooftop plants, trees, and shrubs.	1. Show how to assess various parameters while planning a rooftop garden such as the roof's loading capacity, climatic conditions, sunlight and wind exposure, etc. 2. Prepare a sample plan for the rooftop garden. 3. Show how to plant trees, plants, and shrubs in a rooftop garden. 4. Demonstrate the process of installing windbreaks, and shading for the plants, trees, and shrubs. 5. Demonstrate the process of carrying out repair and maintenance of the rooftop garden, garden features, irrigation and drainage system.

UNIT 9.1: Rooftop Gardening

Unit Objectives

By the end of this unit, participants will be able to:

1. Explain various parameters to assess while planning a rooftop garden.
2. Explain the importance of planning rooftop garden plants and features according to the roof's loading capacity.
3. List various materials of appropriate size and weight for setting up a rooftop garden.
4. List varieties of trees, plants, and shrubs suitable for a rooftop garden.
5. Explain different ways of waterproofing a rooftop garden.
6. Describe the process of installing windbreaks and appropriate support to provide shade for rooftop plants, trees, and shrubs.

9.1.1 Rooftop Garden

Roof Gardening

Garden is an embellished area with plants. The importance of gardening has been well understood by every individual. The gardens not only serve as a place of recreation, it also serves as a place for education by the way of establishing a home garden or botanical gardens.

The art of creating the greenery and maintaining the greenery on the roof known as "Roof Gardening". This is also known as Terrace gardening. The existing roof top can be effectively utilized for growing fruit plants, vegetables, spices, homestead medicinal plants, flower plants and ornamental plants. The population explosion occurs every day resulted in the migration of peoples from rural areas to urban areas for income generation. Due to migration of peoples most of the agriculture lands are converted into residential areas, resulted with decreased production of fruits and vegetables. This can be circumvented by kitchen gardening and roof gardening. In urban areas, due to escalating population, more land area is brought under the construction of houses; therefore there is hardly any space for growing vegetables. Especially in multistoried buildings, roof gardening is the only way to grow fruits and vegetables by using the pots and containers. This practice is known as container gardening. Psychiatrist recommends that working in garden refresh the body and mind by reliving harsh stresses. Gardens become the integral part of the family life benefited by the supply of toxic free fresh fruits and vegetables. Dietitians recommend 85 grams of fruits/day, 300 grams of vegetables/day, whereas the present day consumption of fruit is only 30 grams/day and vegetables is 120 grams/day. The consequences of nutritional and vitamin deficiency are given as follows.

Aims of roof gardening:



Fig 9.1.1 Fruit crops in roof garden

- Year round supply of fresh fruits and vegetables.
- Reduces expenditure on purchase of fruits and vegetables.
- Effective utilization of space available at the roof top.
- Supply of toxic free fruits and vegetables.
- To grow our own favourite vegetables.
- Rare and unavailable vegetables can be grown in roof garden.
- Apart from the above, working in a roof garden will relieve stress and strains.
- Maintaining the greenery through roof garden reduces the pollution.
- Increases the monetary value of land / apartment.

The consequences of nutritional and vitamin deficiency are given as follows:

Nutrients	Consequences of deficiency
Calories and proteins	Retarded growth in children; irritability, apathy and retarded mental development; discolouration of skin and hair; swelling of face and lower part of the legs and feet, fatty liver, and extreme emaciation.
Vitamin A	Inability to see in brightness, sensitivity to night light, foamy white patches on the conjunctive softening of the cornea, leading to blindness; frequent respiratory infections.
Vitamin B Thiamine (B1)	Causes beriberi; loss of appetite.
Riboflavin (B2)	Cracks at the corners of the mouth; cracked lips; glossy tongue; ulcers in the oral cavity.
Nicotinic acid	Sore tongue (scarlet coloured); pellagra, showing skin changes on hands, feet, legs and neck; mental changes in severe condition.
Vitamin C	Scurvy – bleeding gums and mucus membranes and susceptibility to infection as common cold.
Calcium	Important for bones and teeth, blood clotting. Osteomalacia in women after repeated pregnancies.
Iron	Anemia – pale smooth tongue, pale eyes and skin; spoon – shaped nails; frequent exhaustion.

Table 9.1.1 Nutrients and their deficiency consequences

Location of garden

1. Roof top/ verandah / window sills.
2. Preferably open areas with plenty of sunlight and water supply.



Fig 9.1.2 Vegetable crops in roof garden

Roof gardening can be established in a best manner with the availability of sun light and water. Plants produce quality fruits and vegetables by using sunlight and water.

Since there is not enough place in the flats these days, this garden can be laid on roof tops, there by effectively utilizing the available space on the roof tops.

In multistoried buildings, not all the apartments have a roof. Thus the pots can be placed in the verandah and window sills.



Fig 9.1.3 Flower crops in roof garden



Fig 9.1.4 Cacti and succulents in roof garden



Fig 9.1.5 Medicinal plants in roof garden

9.1.2 Cultivation in Rooftop Gardening

Method of Cultivation in Roof Top

1. Trough / Benches

In the open roof top, based on the bearing load, cement benches of convenient length and depth can be constructed and the soil mixture (2 parts of red soil + 1 part of sand + 1 part of compost) filled up and utilized for growing the fruit or vegetable crops. Leave 1" space at the rim, to facilitate irrigation.



Red soil 2 parts



Sand - 1 part



Compost -1 part

Fig 9.1.6 Medium for growing of plants

2. Trough (For newly build houses)

For efficient utilization of roof spaces, an inward trough is formed in the unutilized spaces of roof top i.e., like sunkened trough. The length and depth of trough may be designed as per the requirement. The available area is properly coated with water-proofing materials to avoid the seepage of water into the roof area.



Fig 9.1.7 Sunkened trough

The inner side is designed with a gradual slope to facilitate the drainage. The drainage hole is covered with wire mesh and gravel for ensured drainage. Finally the entire area is laid with geo-textile material and finally filled up with the soil mixture for raising fruits and vegetable.



Fig 9.1.8 Preparation of bed and filling of growing media



Fig 9.1.9 Planting of brinjal seedlings



Fig 9.1.10 One month later after planting



Fig 9.1.11 Bearing of brinjal

3. Pots / Containers: Pots and Containers can be used for raising the fruits and vegetables.

Types of containers

- Cement pots
- Earthen pots
- Plastic barrels
- Wooden barrels
- Boxes
- Crates
- Paws
- Plastic jars
- Damaged buckets
- Tin boxes
- Drums and different sizes
- Plastic covers
- Cement / Fertilizer bags
- Damaged sink / wash basin
- Damaged bowls / water tanks
- Unused water cans



Fig 9.1.12 Brinjal in polythene bags



Fig 9.1.13 Greens and pumpkin in wooden cradles



Fig 9.1.14 Greens and pumpkin in plastic barrels

Seed pan and seed boxes

Seed pans are shallow earthen pots about 10cm high and 35cm in diameter with a drainage hole at the bottom. Seed boxes are made of wood, porcelain and earthen pots of 40cm wide and 60cm long and 10cm deep, with 6-8 properly spaced holes drilled in the bottom. Against each holes a crock is placed with its concave side down. Some large pieces of crock are put over it and also by the side of this crock, some coarse sand 2 or 3 handfull is sprinkled on the crock pieces forming a thin layer to prevent fine soil from clogging the drainage hole.



Fig 9.1.15 Seed pan and seed boxes

Over this, required soil mixture is added and kept in open sunlight for raising the vegetables.

Earthen pots

Earthen pots made of burnt porous clay in various sizes to hold enough quantity of soil and roof space for cultivating different kinds of plants. They have straight sides and are made wider at the top than at the bottom to hold the greatest bulk of compost and also to facilitate easy removal of soil, intact with roots (ball of earth) at the time of planting or repotting.

In our country, pots of varying sizes viz., tube pots, ¼ size, ½ size, ¾ size and 'thali' are used commonly. Tube pots are used to raise the rootstocks of mango and sapota for grafting purposes. ¼ size pots are used for potting singly very small seedlings during first transplanting and also for layering in plants like West Indian Cherry and Guava. ½ size pots are extensively employed for growing well rooted cuttings of several kinds of plants and small plants of all kinds.



Fig 9.1.16 Earthen pots

¾ size pots are preferred for growing Dahlia, Cannas, Palms, Shrubs, Roses etc. In addition to the above, the earthen pots were filled with soil mixture and used for raising vegetable crops. Apart from the above, the soil mixture is filled in polythene covers and used for the cultivation of vegetables like tomato, brinjal, chilli, turmeric, coriander, amaranthus etc.

Polythene bags

Small polythene bags with punched holes at the bottom for drainage and filled with a porous rooting medium are used for propagation of cuttings like jasmine, duranta, crotons etc., in the mist chamber. Some times, young seedlings which are raised in the nursery are subsequently transplanted in these polythene bags are kept there till they attain required growth for transplanting them to the main field (e.g., papaya, curry leaf etc).

Plastic pots: Plastic pots, round and square are used to keep mostly indoor plants. They are reusable, light weight, non-porous and they require only little storage space.



Fig 9.1.17 Polythene bags and plastic pots

Fibre pots: These are available in small size varying from 5-10 cm width and are either round or square in shape. They are bio non-degradable and last longer periods with the soil and plants inside.



Fig 9.1.18 Fibre pots

Paraffined paper or Styrofoam cups

They look like ice-cream cups with drainage holes. They serve satisfactory as temporary containers for growing and transferring young plants on a large seed bed. They are light, cheap and require little space. Recently, thermocole molded pots have been gaining popularity as they are light weight and attractive.



Fig 9.1.19 Styrofoam cups

Tools

- Hand hoe
- Spade / showel
- Rose can
- Hand sprayer
- Gardening hose with sprinkler
- Bamboo stakes and jute strings

Other inputs

- Quality seeds from reliable sources like agricultural university and research stations and national seed corporation.
- Good soil free from stones, weeds and other undecomposable materials.
- Well decomposed organic manure (compost / FYM / leaf compost / digested coir compost).
- River bed sand
- Chemical fertilizers
- Insecticides
- Fungicide
- Organic inputs (Neem oil, Neem seed kernel extract, Panchakavya).

How to start

- Wash the container thoroughly and make drainage holes at the bottom.
- Mix soil, compost and sand with the help of hand hoe and shovel.
- Fill the containers loosely with a gentle tap. The soil should settle, bearing one inch head space at the top for irrigation.

1. For the transplanted vegetables, where nursery has to be raised, shallow pans and troughs can be filled with the fine mixture of soil, sand and compost (1:1:1) and the seeds should be sown. The container should be irrigated immediately after sowing. A layer of dry grass or straw is spread on top of the soil till the seedlings emerge, and thereafter it is removed. Most of the seedlings are ready for transplanting with one month of sowing. Recently, protrays are employed for raising vegetable seedlings. Protrays are the plug trays of 2-3'' depth with a drainage hole. Initially ¼ portion of plug are filled with compost and one seed is sown in each plug and cover the remaining portion with compost or sand mixed compost. The watering and other operations are similarly to the above method.

2. The seeds of certain vegetable crops which can be sown directly, should be sown in the selected pots/ polythene bags etc., The depth of the seed sowing should be about two and a half times of the seed size. Most of the vegetables are raised by sowing their seeds directly in containers. The seedlings of brinjal, chilli, tomato, capsicum and onion are transplanted in containers / pots after 30-40 days of germination. Their seedlings can also be raised in earthen pot or pans. A single healthy seedling may be transplanted in each container. Several seedlings, each of onion and knolkhol, and can be transplanted in a container of the same size. Two or three seeds are sown directly in such containers and later thinned out retaining healthy seedlings. The number of plants per pot may be varied with shape and size.

Sl.No.	Vegetables	Sowing / planting		Days to First harvest after sowing / planting
		Method	Time	
1.	Amaranthus	Sowing	February- March July- August	25-30
2.	Beet root	Sowing	October – December	90-100
3.	Bittergourd	Sowing	February-March	55-60
4.	Brinjal	Transplanting	January - February July – August	45-60
5.	Broad bean	Sowing	September – October	70-75
6.	Chilli	Transplanting	January - February July – August	50-60
7.	Cluster bean	Sowing	July – August	30-35
8.	Cowpea	Sowing	January - February	60-65
9.	Cucumber	Sowing	February- March	45-50
10.	Methi/ Fenugreek	Sowing	September – December	45-50
11.	Mint	Transplanting	Match – July	45-50
12.	Okra / Bhendi	Sowing	June – July	30-35
13.	Onion	Transplanting	June-July October - November	75-80
14.	Radish	Sowing	Round the year	25-30
15.	Spinach	Sowing	September – October	50-55
16.	Tomato	Transplanting	December - January June – July	60-65
20.	Turnip	Sowing	September-October	40-45

Table 9.1.2 Crop selection and raising

Cropping patern

Generally almost all vegetable and spice crops are raised in three seasons Vaikaasi pattam, Adi pattam and Thai pattam. For small scale purpose i.e., cultivation in home stead gardens, we need not depend on any season; but raising of vegetables can be avoided during summer seasons.

Plots	May-June to September-October	September – October to December-January	December-January to May-June
Annual crops			
(a) Bitter gourd		Lab lab	Snake gourd
(b) Brinjal and chilli		Amaranthus	Okra
(c) Ash gourd		Pumpkin	Amaranth
(d) Bushy / semi-trailing cowpea		Tomato	Cucumber
(e) Okra		Ash gourd	Chilli / brinjal
(f) Pumpkin		Okra	Onion
Perennial crops			
(a) Vegetables		Drumstick, curly leaf, Chekurmanis, culinary banana, Chekkurmanis, Agathi	
(b) Fruits		Banana, acid lime, papaya, West Indian cherry, guava, rose apple etc.	
(c) Spices		Ginger, turmeric, mango ginger	

Table 9.1.3 Examples of some cropping pattens

Fruits crops suited for roof garden

- Banana, guava, acid lime and papaya.

Vegetable crops suited for roof garden

- **Transplanted vegetables:** Tomato, brinjal, chilli.
- **Direct sown vegetables:** Bhindi, amaranthus, cucurbitaceous vegetables like – bitter gourd, snake gourd, ridge gourd and bottle gourd, radish and beet root.

Spice crops suited for roof garden

- Turmeric, coriander and fenugreek.
- **Medicinal crops suited for roof garden:** agathi, adathoda, aloe vera, oomathai, lemon grass, oomavalli, karisalanganni, perandai, keelanelli, thuthuvelai, ponnanganni and manathakali.

S.No.	Crop	Varieties	Plating materials	Spacing (m)	Yield (Yield varies with varieties and spacing adopted)
1.	Mango	Neelum Banganapalli Mallika Bangalora, Alphonso, Rumani,	Grafts	5 m x 5m	8 – 10 t/ha upto 15 years 15 – 20 t/ha from 15 – 20 years
2.	Banana	Robusta, Dwarf Cavendish, Grand Naine, Rasthali, Poovan, Nendran, Karpooravalli,	Suckers	2 m x 2 m	Yield (t/ha/year) Poovan: 40 – 50 Monthan : 30 – 40 Rasthali : 40 – 50 Robusta : 50 – 60 Dwarf Cavendish : 50 – 60
3.	Guava	Allahabad, Lucknow 46, 49, Arka Amulya, Arka Mridula, Banaras, Baptla	Layers	5 m x 5m	25 t/ha
4.	Sapota	Oval, Cricket Ball, Kirtibarti, Guthi, CO 1, CO 2, CO.3, PKM 1, PKM 2, PKM 3, PKM-4, PKM (sa)-5 and Kalipatti	Grafts	8 x 4 m	20 - 25 t/ha/year
5.	Papaya	CO 1, CO 2, CO 3, CO 4, CO 5, CO 6, CO 7, Coorg Honey dew and Surya	Seeds	1.8 m x 1.8 m	CO 2 : 600 kg/ha CO 5 : 800 Kg/ha
6.	Acid lime	Local varieties, PKM1	Budded plants	4 m x 4 m	25 t/ha/year

Table 9.1.4 Cultivation of fruits

S.No.	Crop	Varieties	Plating materials	Spacing (m)	Yield (Yield varies with varieties and spacing adopted)
1.	Tomato	PKM 1, CO 3 (Marutham) and Paiyur 1	Seed	PKM 1, Paiyur 1 : 60 x 45 cm CO 3 : 45 x 30 cm	PKM 1 : 30-35 t/ha CO 3 : 40 t/ha Paiyur : 30 t/ha
2.	Brinjal	Co 1, Co 2, MDU 1, PKM 1, LR 1, KKM 1, PPI 1, Annamalai and COBH 1 (Hybrid)	Seed	60 x 60 cm, For hybrids 75 x 60 (or) 75 x 75 cm	Varieties : 25 to 30 t/ha Hybrids : 45-50 t/ha
3.	Chillies	K 1, K 2, CO 1, CO 2, CO 3, CO 4 (Vegetable type), PKM 1, KKM 1,KKM (ch) 1, PLR 1	Seed	45 cm x 30 cm	2 - 3 t/ha of dry pods 10 - 15 t/ha of green chilli
4.	Snake gourd	CO 1, CO 2, PKM 1, MDU 1 and PLR (SG) 1	Seed	2.5 m x 2 m	18 t/ha
5.	Ribbed gourd	CO 1, CO 2, PKM 1, Arka Sumeet and Arka Sujath	Seed	2.5 m x 2 m	14 – 15 t/ha
6.	Bitter gourd	CO 1, MDU 1, COBgoH 1 (Hybrid), Arka Harit, Priya and Preethi	Seed	2 m x 1.5 m	Varieties: 14 t/ha Hybrids : 40 t/ha
7.	Cluster beans	Pusa Mausami, Pusa Naubahar, Goma Manjari and Pusa Sadabahar	Seed	45 cm x 15 cm	5 – 7 t pods/ha
8.	Vegetable Cow Pea	CO 2, VBN 2, Pusa Komal and Arka Garima	Seed	45 cm x 15 cm	5000 kg/ha
9.	Annual Moringa	PKM 1, PKM 2 and KKM 1	Seed	2.5 m x 2.5 m	50 - 55 tonnes of pods/ha (220 pods/tree/year)
10.	**Radish**	CO 1, Pusa Rashmi, Pusa Chetki, Pusa Desi, Japanese White and Arka Nishant	Seed	15 cm x 10 cm	20 – 30 t/ha
11.	Small Onion/ Aggregatum	CO 1, CO 2, CO 3, CO 4, MDU 1 and Co (On) 5 (free flowering and seed setting type)	Seed / Bulb	15 cm x 10 cm	12 – 16 t/ha For Co (On) 5 onion, 18 t/ha in 90 days
12.	**Amaranthus**	CO 1 (Mulaikeerai and Thandukeerai) CO 2 (Mulaikeerai and Thandukeerai) CO 3 (Clipping) CO 4 (Grain) CO 5 (Mulaikeerai and Thandukeerai)	Seed	15 cm x 10 cm	**Leafy types** 25 days after sowing for Mulaikeerai (10 t/ha) 40 days after sowing for Thandukeerai (16 t/ha) **Clipping types** 10 clippings at weekly intervals (30 t/ha)
13.	**Curry leaf**	Sen Kaampa, Dharwad-1 and Dharwad-2	Seeds / Suckers	1.5 m x 1.5 m	250-400 kg of leaves/ha

Table 9.1.5 Cultivation of vegetables

S.No.	Crop	Varieties	Plating materials	Spacing (m)	Yield (Yield varies with varieties and spacing adopted)
1.	**Turmeric**	CO 1,BSR 1, BSR 2, Local cultivar: Salem and Erode	Rhizome	45 cm x 15 cm	Fresh rhizomes : 25-30 t/ha
2.	**Coriander**	CO 1, CO 2, CO 3 and CO (CR) 4	Seeds	15 cm x 10 cm	Leaf yield : 6-7 t/ha
3.	**Fenugreek**	CO 1, Pusa early bunching and CO 2	Seeds	15 cm x 10 cm	Yield of green : 4000 - 5000 kg/ha

Table 9.1.6 Cultivation of spices

Cultural Practices

Watering

Plants in pots and containers need a lot of care and attention. It is essential to water the plants judiciously depending upon the season, kind of crop, size of the plant and size of the container. Plants need extra water during summer season and hence the plants should preferably be irrigated twice a day. Too much watering will also lead to problems; hence we should strike a intelligent balance. The thumb rule for irrigation is that the top soil should be scratch about one inch and seen, if the lower soil is damp, there is no need of immediate irrigation. Due to evaporation, the top soil generally dries even though the soil may have enough moisture to sustain the plant. In general, watering can be done as and when required.

Staking

Depending on the growth stage of plants, they need staking (i.e) support. Plants like lab lab, ribbed gourd, bottle gourd and snake gourd needs staking or it has to be trained in pandal system for proper support. In addition to the above, plants like tomato, brinjal and chilli also need staking on 60th day of planting.



Fig 9.1.20 Staking

Fertilizer Application

For maximum growth and yield of crops can be achieved not only through organic manures and can be improved better by the application of inorganic fertilizers. Top dressing with nitrogenous fertilizers improves plant growth and yield of vegetables. This can be done by applying urea or DAP or ammonium sulphate in small quantities. In general, 5-10 g of urea may be applied in moist soil once in a week or 10 days starting from 3 weeks after sowing or 2 weeks after transplanting. In general, 5 to 10 grammes of complex fertilizers (17:17:17 / 20:20:20) containing NPK mixture is applied in three stages as follows:

- 30 days after planting (i.e) on set of vegetative phase = 5 to 10 grammes/plant.
- 60 days after planting (i.e) on set of flowering phase = 15 to 20 grammes/plant.
- 90 days after planting (i.e) on set of fruiting phase = 15 to 20 grammes/plant.

In addition to the above, vermicompost 100 grammes/plant should be applied at monthly intervals. Care must me taken that vermicompost should not mix with any inorganic fertilizers. Hence the application of vermicompost and inorganic fertilizers should not be practiced simultaneously. Heavy doses of fertilizer are very harmful. Immediately after fertilizer application, the plant should be watered.

Weed Control

Hand hoeing and weeding helps in aeration in the root zone and help the plant grow healthy.Weeds should be removed gently in leafy vegetable crops like amaranthus, fenugreek, spinach, coriander etc.

Pest and Disease Management

- Pick and destroy the larvae found on fruits and vegetables and then spray Neem oil @ 4 ml/liter of water + sticking agent 2 ml/liter of water or kadi soap or.
- Neem Seed Kernel Extract @ 3 % + sticking agent 2 ml/liter of water or kadi soap.
- Avoid spraying of toxic chemicals.

Based on the growth pattern and climatic factors vegetables are attacked by various pests and diseases. Aphids and jassids are small sucking insects, injuring the plants especially in early stages of their growth. Spraying of Dimethoate @ 2ml / liter of water + Neem oil @ 4 ml/liter of water + sticking agent 2 ml/liter of water or kadi soap controls these insects. Fruit fly and fruit borer are serious pests of some vegetable crops. They damage young fruits and make them unfit for consumption.

The affected fruits should be plucked and destroyed. The plants should be sprayed once or twice with insecticides. After spraying, fruits should not be harvested for 7-10 days for consumption. Fungal diseases (damping off and wilt) and viral disease affect the plants particularly during the rainy season. Fungal diseases can be controlled by drenching the soil with 'Captaf' solution @ 2g / lit of water. Virus affected plants should be removed and destroyed.

Harvesting

Vegetables harvested at the peak of maturity and used promptly, are always superior in nutritional content, freshness, flavour and appearance. Leafy vegetables should be picked up frequently when tender. Root vegetables should be pulled out while tender otherwise they become pithy. Tomato is picked at ripe stage, brinjal and okra are picked after they attains full size but still tender.

Rare vegetables like leek, fennel, and soya are not available in market always. Thus these can be advantageously raised in containers. Curry leaf, Checkurmanis and gooseberry can also be grown in medium to big sized containers in a roof garden.

Post - Harvest Operations

- **Digging of soil:** As soon as the season is over i.e., after the final harvesting of vegetables, remove the plant from the pot / polythene cover and dump the soil in open place and break the clods.
- **Application of organic manures:** After 15 days, add organic manures and mix the soil thoroughly and refill the pots or polythene covers.
- **Choose alternate crops:** In order to maintain proper recycling of nutrients, crop rotation can be adopted. Hence choose alternate crops for the next season.
- **Ornamental plants suited for roof garden.**

Ornamental trees

- Bauhinia purpurea, Plumeria alba and Callistemon lanceolatus.



Fig 9.1.21 Bauhinia purpurea



Fig 9.1.22 Plumeria alba



Fig 9.1.23 Callistemon lanceolatus

Shrubs

Acalypha hispida, Allamanda grandiflora, Barleria cristata, Bauhinia tomentosa, Clerodendron inerme, Dombeya spectabilis, Duranta plumieri, Hamelia patens, Hibiscus rosasinensis, Mussaenda erthyrophylla, Nerium oleander, Poinsettia pulcherrima, Tecoma stans, Thevetia nereifolia, Codioeum sp, Eranthemium elegans and Pisonia alba.



Fig 9.1.24 Clerodendron inerme



Fig 9.1.25 Dombeya spectabilis



Fig 9.1.26 Duranta plumieri



Fig 9.1.27 Hamelia patens

- **Climbers:** Allamanda cathartica, Asparagus densiflorus, Bougainvillea sp, Clitorea ternatea, Ipomoea palmate, Quisqualis indica.



Fig 9.1.28 Allamanda eathartica

- **Flowers:** Impatiens balsamina, Celosia sp, Chrysanthemum sp, Cosmos bipinnatus, Gomphrena globosa, Tagetus erecta, Petunia hybrida, Portulaca grandiflora, Salvia splendens, Solidago Canadensis, Vinca rosea and Zinnia elegans.



Fig 9.1.29 Impatiens balsamina

Lawn grass

- Grassy area.
- Charming effect.
- Breaks the monotony and brings the integrity of garden components.
- Cushiony layer for players who are engaged in sport activities.
- Checks the pollution.
- Increase the monetary value of land.

Care

- Till establishment, flood watering and hose watering is avoided.
- Mowing should be done after 50 – 60 days of sowing.

Disadvantages

- Poor establishment when compared to other methods.
- The availability of good quality seeds.

Sod / Turfing

Selecting turf pieces

- Should be free from sod worms.
- Free from nutritional deficiency.
- Free from weed population.
- Sod should be properly cut without any deformations.
- Height of the grass should be optimum.
- Free from other pest and diseases.

Precautions

- Mowing should be done 20 – 25 days after planting or depending upon the complete establishment.
- The uneven surfaces and gaps can be fitted with turf plugs with sand.
- Turfing should not be practiced in winter seasons as it exhibits yellowing due to low temperature and low light intensity.

Advantages

- Quick and instant establishment.

Uniform turf surface

- Best suited for exhibitions, sports grounds.

Disadvantages

- Costlier.
- Poor establishment during winter season.

Dibbling / Sprigging

- Turf grass are separated along with their root portion is dibbled at 10 – 15 cm distances.
- Sprouting at 25 – 30 days.
- Complete coverage may take around 3 – 4 months after planting.

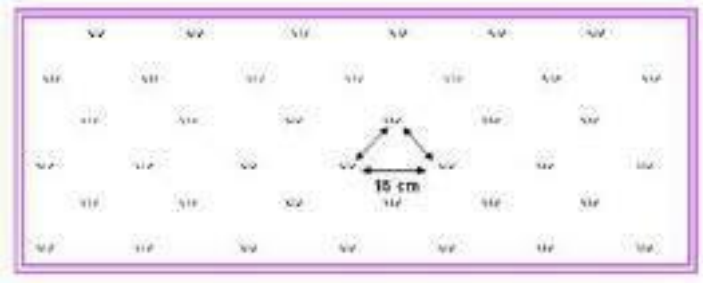


Fig 9.1.30 Dibbling of turf grass

Precautions

- Mowing should be done 30 – 35 days planting.
- Mowing should be done at one-third level without affecting the foliage growth.
- Traffic movement should be avoided till the establishment.
- Light irrigation followed by rolling improves the turf appearance.

Advantages: Cheapest method.

Disadvantages

- Slow establishment.
- Cost of planting is higher, when compared to other method of establishment.

S.No.	Situation	Urea	Superphosphate (g/m²)	Murite of potash
1.	Low Maintenance (Residential turfs)	100	75	75
2.	High Maintenance (e.g. Turf in public gardens)	200	100	150
3.	Intensive Maintenance (e.g. Sports fields)	300	150	150

Table 9.1.7 Quarterly fertilizer input ratio for turf grass

- Applied in two split doses (at 6 months intervals i.e., onset of summer and onset of winter season).
- Irrigate the lawn after fertilizer application.

Maintenance of Lawn Grass

1. Mowing

- Cutting of grass.
- Normal cutting height is 2.0 – 2.5 inches from the ground level.
- Mowing should be done at 15 - 20 days intervals.

2. Weed management

- Controlled by spot application / drenching with Glyphosate @ 5 ml/litre of water + Ammonium sulphate @ 10 g/litre of water.

3. Nutrient management

- Fertilizers are applied in split doses @ 40 days interval.
- Irrigation is given immediately after fertilizer application.

4. Pest and disease management

- Spray Dimethoate/Acephate @ 2 ml/liter + Dithane M-45 @ 2 g/liter.
- Sprayed on rainless day.

Do's and Don'ts

Do's

1. Place the pots in available space, accordingly to sunshine requirement.
2. Always check the drainage in the pots.
3. Leave 1" space in the pot at the rim, to facilitate irrigation.
4. Always sow the nursery in separate pots or protrays.
5. Use deep pots for plants with deeper roots (perennials) and shallow for shallow rooted plants (annuals).
6. Keep large and heavy pots in strong part of the building.
7. Irrigate as and when required, after checking the moisture regime of the pot.
8. Always keep the pots and plants weed free, disease and pest free.
9. Place pots away from each other to facilitate air circulation.
10. Avoid spraying of toxic chemicals.

Don'ts

1. Don't overwater the pots.
2. Don't let the drainage hole clog or don't block the drainage hole.
3. Don't place too many pots together.
4. Don't place heavy pots in apartments if the building is not constructed to bear the weight since damp soil is much heavier than dry soil.
5. Don not grow perennial plants (fruit crops like mango, sapota and guava) at roof top, since the heavy feeder roots may penetrate / damage the roof top.

Other considerations

1. In the safer point of view, the roof top has to be painted with anti damp or damp proof paint to avoid seeping of water to roof of the house and staining the floor and roof.

2. The garden work can be shared by all the members of the family. The strenuous work like lifting the pots, pot filling and weeding can be assigned to the youngsters, harvesting can be done by old people and children of the family. Women can participate in weeding and irrigation.

3. It is good idea to replenish the media with FYM periodically, say after every season or harvest so that the nutrient status of the soil is maintained. After one year or 3 seasons the media has to be changed using fresh soil and sand.

4. Large concrete pots of 2 ½ -3' or waste / damaged plastic drums can be used to grow papaya and banana.

5. When the inmates are out of station for 7-10 days the most important consideration is irrigation for which the following can be done.
   - The drainage plates can be filled with water to maintain the moisture level.
   - Some mulch can be used on top of the pot soil, like a plastic sheet or straw / moss mulch.
   - For greens, since frequent watering is important, several layers of newspaper can be tied to the body of the pot and the newspapers should be completely drenched with water.

6. To raise seedling like tomato or brinjal, “Protrays” which are trays with shallow depth (2-2.5”) should be used. The seed can be sown in small quantity also without wastage.

A pot of 1m depth and convenient length width may be used for composting plant residue / kitchen waste. Vegetable wastes like leaf waste, onion peels, waste vegetables, pulp wastes, tea wastes, chopped pieces of cauliflower / cabbage can be effectively decomposed in the pits / plastic barrels. The vegetable wastes are dumped and a layer of soil (1'' thickness) may be added at the top for efficient and quick decomposition. The rate of decomposition can be enhanced by sprinkling water daily.

The kitchen waste can be dumped daily or as per the availability. Few earthworms may also be added for faster decomposition. The compost is ready for use within two and half months to three months. The well composed material will be dark brown in colour. The partially decomposed / undecomposed materials and earthworms were again dumped back along with the earthworms. Avoid non vegetarian items as it may create a fowl smell. The best location for compost preparation is shady to semi-shady locations.

Physical and psychic utility

Owing to the seat bound office jobs, there is hardly and physical activity in our lives. This lack of exercise has lead to a number of health hazards. Roof garden system of vegetable cultivation provides an alternative to people living in all kinds of dwellings – individual houses, flats, or apartments. A family can tend the garden as a team. This can be a healthy family time to interact and talk, while doing a useful activity from the point of health and economy. This physical exercise helps us to forget the tensions of office and our minds can freshen up.

With the passage of time, the traditional joint family system is breaking up in India and most of the families are fragmenting into nuclear families on account of struggle for money and job strains. In families where grand parents are a part, the older generation feels left out. With a roof garden at home, even the old people can participate and feel one of the group and work rather than feeling left out. Thus having a garden is not only a physical or monitory need but a psychological too.

Exercise

Q.1. List out all types of garden.

Q.2. List out major flowers used for landscaping.

Notes

Scan the QR Code to watch the related videos

https://www.youtube.com/watch?v=NcGd2CiAJaI

Setup Rooftop Garden (Step By Step Instructions)

https://www.youtube.com/watch?v=XVEVYxKcXro

Organic Terrace Garden



Annexure of QR Codes for Gardener

Chapter No.	Unit No.	Topic	Page No.	QR Code Links	QR code (s)
Chapter -1 Introduction	Unit 1.1 - Introduction to Gardening	Introduction to Gardening - Basics of Gardening	10	https://www.youtube.com/watch?v=nSa_ey9Q7oI	Introduction to Gardening - Basics of Gardening
Chapter -2 Propagation of Plants in a Nursery	Unit 2.1 - Nursery Management	Tools of Gardening	30	https://www.youtube.com/watch?v=Q_vnDbUsmHg&list=PLekJC5v4LQiapihi5HXBnjasuGVMmfmus&index=10	Tools of Gardening
		Nursery Production & Management		https://www.youtube.com/watch?v=Y6BgWWPFGss	Nursery Production & Management
	Unit 2.2 - Propagation Techniques	How to Propagate Plants	41	https://www.youtube.com/watch?v=WHiv1OvXGcI	How to Propagate Plants
Chapter -3 Preparation for Setting up the Garden	Unit 3.1 - Components of Garden	Identification of Ornamental Plants	52	https://www.youtube.com/watch?v=OcOiEFelPx0&list=PLekJC5v4LQiapihi5HXBnjasuGVMmfmus&index=3	Identification of Ornamental Plants
	Unit 3.2 - Types of Garden	Types of Gardens	65	https://www.youtube.com/watch?v=2DED2nRPZUQ	Types of Gardens
Chapter -4 Process of Establishing the Garden	Unit 4.3 - Soil and Soil Management	Soil Management for Home Gardeners	94	https://www.youtube.com/watch?v=wreKW1W1H6I	Soil Management for Home Gardeners

Annexure of QR Codes for Gardener

Chapter No.	Unit No.	Topic	Page No.	QR Code Links	QR code (s)
Chapter -5 Maintenance of the Garden	Unit 5.1- Pest & Disease Management	Pest & Disease Management	114	https://www.youtube.com/watch?v=0D--ltYWKXI	Pest & Disease Management
		Identification of Weeds & Methods of Weed Control		https://www.youtube.com/watch?v=YBTq7Uv3Q0U&list=PLekJC5v4LQiapihi5HXBnjasuGVMmfmus&index=2	Identification of Weeds & Methods of Weed Control
Chapter -9 Process of Designing, Setting Up and Maintaining a Rooftop	Unit 9.1 - Rooftop Gardening	Setup Rooftop Garden (Step By Step Instructions)	194	https://www.youtube.com/watch?v=NcGd2CiAJaI	Setup Rooftop Garden (Step By Step Instructions)
		Organic Terrace Garden		https://www.youtube.com/watch?v=XVEVYxKcXro	Organic Terrace Garden



Skill India
कौशल भारत-कुशल भारत

सत्यमेव जयते
GOVERNMENT OF INDIA
MINISTRY OF SKILL DEVELOPMENT
& ENTREPRENEURSHIP

N•S•D•C
National
Skill Development
Corporation
Transforming the skill landscape



Scan this QR to access eBook
https://eskillindia.org/Home/handbook/128

ASCI
Agriculture Skill Council of India

Address: 6th Floor, GNG Tower, Plot No. 10
Sector - 44, Gurgaon - 122004, Haryana, India
Email: info@asci-india.com
Web: www.asci-india.com
Phone: 0124-4288322, 4047488, 4046678
CIN No.: U93000HR2013NPL048073