

**Vocational Higher Secondary
Education (VHSE)**

Second Year

**AGRI-BUSINESS AND FARM
SERVICES**

Reference Book



**Government of Kerala
Department of Education**

**State Council of Educational Research and Training (SCERT),
KERALA
2016**

LIST OF CONTRIBUTORS

PARTICIPANTS

Dr.Gowri Priya, Vocational Teacher in Agriculture, GVHSS, Vithura, Thiruvananthapuram

Rakhi.R, Vocational Teacher in Agriculture, GVHSS, Parassala, Thiruvananthapuram

Nirmal Kumar.R.S, Vocational Teacher in Agriculture, KNNMVHSS, Pavithreswaram, Kollam.

Dilin Sathyanath, Vocational Teacher in Agriculture GVHSS, Mananthavady, Wayanad

Shibu.P.K, Vocational Teacher in Agriculture, VHSS, Thadicaud

Simi.R, Vocational Teacher in Agriculture, GVHSS, Vakkom

Manu.A.R, Vocational Instructor in Agriculture, KNNMVHSS, Pavithreswaram, Kollam

EXPERTS

Smt.Sakeena.I, Asst.Director of Agriculture, Directorate of Agricultural Development and Farmers' Welfare, Thiruvananthapuram

Sri. Manoj.S, Agricultural Officer, Dept. of Agriculture

Sri.G.S.Unnikrishnan, Deputy Director, Dept.of Agriculture

Dr.Chithra Vijayan, Asst.Professor, S.N.College, Kollam

Sri.Lavakumar.V, Rtd. Deputy Director, VHSE

ACADEMIC CO-ORDINATOR

Manoj.K.V, Research Officer, SCERT, Thiruvananthapuram

Prepared by :

State Council of Educational Research and Training (SCERT)

Poojappura, Thiruvananthapuram 695012, Kerala

Website : www.scertkerala.gov.in e-mail : scertkerala@gmail.com

Phone : 0471 - 2341883, Fax : 0471 - 2341869

Typesetting and Layout : SCERT

© Department of Education, Government of Kerala

Foreword

Dear Learners,

This book is intended to serve as a ready reference for learners of vocational higher secondary schools. It offers suggested guidelines for the transaction of the concepts highlighted in the course content. It is expected that the learners achieve significant learning outcomes at the end of the course as envisaged in the curriculum if it is followed properly.

In the context of the Right- based approach, quality education has to be ensured for all learners. The learner community of Vocational Higher Secondary Education in Kerala should be empowered by providing them with the best education that strengthens their competences to become innovative entrepreneurs who contribute to the knowledge society. The change of course names, modular approach adopted for the organisation of course content, work-based pedagogy and the outcome focused assessment approach paved the way for achieving the vision of Vocational Higher Secondary Education in Kerala. The revised curriculum helps to equip the learners with multiple skills matching technological advancements and to produce skilled workforce for meeting the demands of the emerging industries and service sectors with national and global orientation. The revised curriculum attempts to enhance knowledge, skills and attitudes by giving higher priority and space for the learners to make discussions in small groups, and activities requiring hands-on experience.

The SCERT appreciates the hard work and sincere co-operation of the contributors of this book that includes subject experts, industrialists and the teachers of Vocational Higher Secondary Schools. The development of this reference book has been a joint venture of the State Council of Educational Research and Training (SCERT) and the Directorate of Vocational Higher Secondary Education.

The SCERT welcomes constructive criticism and creative suggestions for the improvement of the book.

With regards,

Dr. P. A. Fathima
Director
SCERT, Kerala

CONT ENT

1	About the course-----	5
2	Major skills with sub skills -----	6
3	Syllabus -----	8
MODULE III		
4	Overview of the module III -----	10
5	Unit 1- Introduction to Agribusiness -----	12
6	Unit 2- Major Enterprises -----	18
7	Unit 3-Other Enterprises -----	72
8	1. Extended activities -----	90
	2. Practical activities -----	91
MODULE IV		
9	Overview of the module IV -----	92
10	Unit 1 - Agri clinic -----	92
11	Unit 2 - Agri input Centres -----	129
12	Unit 3 - Farm Machinery and Plant protection Equipments -----	137
13	Unit 4 - Farmer support services -----	150
14	1. Extended activities -----	162
	2. Practical activities -----	162
15	References -----	163
16	Appendix -----	165

ABOUT THE COURSE

Agribusiness tends to be a large-scale business operation and may dabble in farming, processing and manufacturing and/or the packaging and distribution of products. In recent times agricultural sector in Kerala confronts an array of issues which is indubitably a matter to contemplate especially in view of the livelihood and sustainability of the sector in the State. The youth moving away from agriculture to other comparatively more remunerative fields poses a serious threat on the agrarian future of the State. An asymmetric socio-economic regime with undue importance on consumerism is detrimental to the State in long run. A paradigm shift in this regard, especially placing the agricultural sector in the upfront of the present socio-economic structure of the society requires concerted effort. The revised educational curriculum in its essence holds this perception. As a matter of fact there is a need to restructure and realign the subsegments of agriculture sector like production sphere, marketing arena, value chain and educational spectrum. Keeping view of this the Vocational Higher Secondary Course curriculum has assumed a new shape culminating from a series of brainstorming sessions.

The revised course structure comprehensively covers the basic agricultural aspects by giving emphasis to Crop Health Management, Agricultural Science & Processing Technology and Agri-business and Farm Services. A shift from agriculture to agri-business is viewed as an essential pathway to revitalize the agrarian sector of the State. There is a tremendous untapped potential in the downstream end of the agricultural value chain which is at present languishing in darkness. The purposeful emphasis on agricultural processing and agri-business in the revised curriculum assumes importance in this context. The renewed curriculum touches upon all the important aspects of agricultural technologies in a structured and phased manner while giving sharp focus towards the downstream end of the value chain on value addition and business opportunities. Such a reorientation is essential for the value chain upgradation of the candidates choosing agriculture as a vocation both in academic and practical levels. Moreover, the current course structure places paramount importance to inculcate the entrepreneurship to the student pursuing vocational education in agriculture. The upgradation in structural value chain is the manifestation of entrepreneurship and this is only possible through imbibing the courage to climb up the ladder by breaking away from the conventional pathways in agricultural sector. Farm services segment is an emerging and imperative field in the agrarian sector. The evolving importance of organic farming, certification and labeling, environmental sustainability on the effective utilization of natural resources categorically

indicated the inevitability of this segment. The revised curriculum therefore provides adequate weightage on this segment. The scope and potential of the agricultural sector in this State lies beyond any quantifiable magnitude. Nevertheless, for the realistic manifestation of the existing potential, we need to revamp the conventional thoughts and practices in accordance to advances made in agricultural sector. For the youth of this State agriculture is essentially a sunrise sector and therefore they should be equipped to face the challenges and hurdles on their pathway to success. The system envisages a vibrant and sustainable agrarian sector in the state through equipping the youth with advanced technological and entrepreneurial skills.

Objectives

- To create awareness on Agri business and farm services in the community.
- To develop skills for different agri enterprises and their management
- To develop skills for different aspects of farm machinery and its services
- To make them aware of custom hiring centers and agro-clinics.
- To develop skilled technicians in the area of supply chain management.
- To equip the students to set up agro-clinics and agri-business centers.
- To enhance self support capabilities.
- To assist in landscape designing and maintenance.
- To equip the students in starting commercial enterprises in the field of Agriculture.
- To develop skills and competencies among the students to be successful entrepreneur.

Major skills (with sub-skills)

1. Setting up an agribusiness
 - a. Identifying entrepreneurial opportunities for agri business
 - b. Identifying risks and making proper decisions in agri business.
2. Skill in landscaping
 - a. Identification of ornamental plants.
 - b. Construction of garden components like water pool, rockery, lawn
 - c. Maintenance of garden-lawn mowing, pruning, plant protection.
 - d. Preparing a landscape plan/ garden layout.
3. Skills in various agro techniques in protected cultivation

- a. Construction of rain shelter, polyhouse.
- b. Cultivation of crops in rain shelters and polyhouse.
- c. Seed bed preparation
- d. Plant protection in poly houses
4. Skill in running a commercial nursery
 - a. Preparation of different types of planting material for various ornamental plants
 - b. Skills in various propagation techniques-budding, grafting , layering
 - c. Preparing the layout of a commercial nursery
5. Skill in post harvest handling and value addition of flowers.
 - a. Skill in flower arrangement-fresh flower and dry flower arrangements.
 - b. Skill in preservation of plant material.
 - c. Skill in preparation of bouquet.
6. Skill in post harvest handling and value addition of fruits.
 - a. Skill in post harvest handling of fruits to increase shelf life.
 - b. Skill in preparation of jam,jelly and squash.
7. Skill in post harvest handling and value addition of vegetables.
 - a. Skill in post harvest handling of vegetables to increase shelf life.
 - b. Skill in preparation of pickles, sauce.
8. Skill in tissue culture-Primary and secondary hardening of tissue culture plantlets.
9. Skill in mushroom production
 - a. Skill in cultivation of mushroom
 - b. Skill in spawn production.
10. Skill in vermicomposting
11. Skill in apiculture
12. Skill in sericulture.
 - a. Skill in mulberry cultivation
 - b. Skill in rearing silk worms and producing cocoons.
13. Skill in vegetable seedling production in portrays.
14. Skill in setting up an indoor garden.

- a. Selecting plants for indoor garden.
 - b. Maintenance of indoor plants.
15. Skill in identifying pest and diseases symptoms in crop plants.
 16. Skill in applying pest and disease management measures.
 17. Skill in setting up an agri input centres.
 18. Skill in operation of farm machinery and plant protection equipments.
 19. Skill in utilizing ICT enabled services for agriculture.

MODULE 3

AGRI-BUSINESS ENTERPRISES

unit -1 Introduction to Agri-Business (10 Periods)

Definition of agri-business, importance, basic concepts, scope of agri-business, entrepreneurial opportunities in agri-business, decision making in Agri-business ,steps in farm planning.

Unit 2 Major Enterprises (210 Periods)

a) Landscaping (65 Periods)

Importance and scope, basic principles of landscaping, classification of ornamental plants, garden types, garden components, principles of garden design and layout.

b) Commercial nursery (35 Periods)

Basic concepts of commercial nursery, scope, types, establishment of nursery, layout, records, major activities.

c) Protected cultivation practices (70 Periods)

Definition of protected cultivation, importance, types-polyhouse, rain shelter, greenhouse, establishment of protected cultivation structures, agrotechniques, emerging trends-Good Agriculture Practices (GAP), organic certification.

d) Post harvest handling and value addition (40 Periods)

Post harvest handling of flowers, improvement of vase life, post harvest handling of fruits, postharvest handling of vegetables, value addition of flowers - flower arrangement, dry flower making, value addition of fruits- preparation of jam/jelly/ squash, value addition of vegetables-preparation of pickles/sauce.

Unit 3 Other Enterprises (120 Periods)

- a) Tissue culture- basic principles, media, equipment, steps, tissue culture techniques of banana
- b) Mushroom cultivation
- c) Vermicomposting
- d) Indoor gardening- suitable plants, care and maintenance
- e) Bonsai- basics of bonsai making, styles
- f) Apiculture
- g) Sericulture
- h) Vegetable seedling production
- i) Vertical gardening, Aquaponics

**MODULE 4
FARM SERVICES****Unit 1. Agriclincs (140 Periods)**

Definition - concept and necessity of agri clinics - objectives of agri clinic - functioning of agri clinic - infrastructure required - procedure of pest and disease diagnosis - diagnosis and management of major pest and diseases of rice, coconut, rubber, pepper, ginger, cassava, banana, tomato, brinjal, chilli, cucurbitaceous vegetables, cowpea, amaranthus, bhindi, cabbage, rose, anthurium, orchid, jasmine - plant protection in polyhouse.

Unit 2. Agri Input Centres (70 Periods)

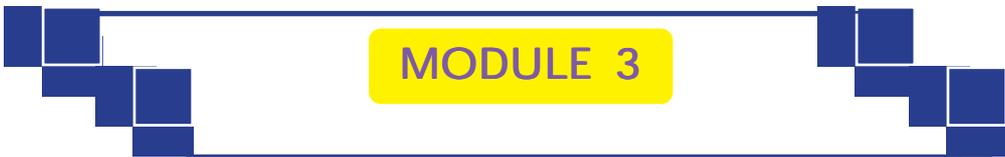
Concept and scope of agri input centres - formalities for starting an agri input centre - types of inputs in agriculture - consumable inputs and capital inputs - supply chain management - marketing strategies.

Unit 3. Farm Machinery and Plant Protection Equipments (80 Periods)

Scope of farm mechanization - farm machineries used for cultivation, harvesting, intercultural operations, harvesting and post harvest operations, plant protection equipments, homestead farming – maintenance of plant protection equipments.

Unit 4. Farmer Support Services (50 Periods)

Government agencies and major NGOs supporting farmers - important schemes - ICT - enabled support.



MODULE 3

Overview of Module 3

Agriculture is the principal source of livelihood for more than 55% of the population of India. But, the share of agriculture and allied sectors in gross domestic product (GDP) is only about 15%. Today, India is the world's largest producer of many fresh fruits and vegetables, milk, major spices, select fibrous crops such as jute, staples such as millets and castor oil seed. India is the second largest producer of wheat and rice, the world's major food staples. India has shown a steady average nationwide annual increase in the productivity for some agricultural items, over the last 60 years. These gains have come mainly from the Green Revolution, improving road and power generation infrastructure, knowledge of gains and reforms. Despite these recent accomplishments, agriculture still has the potential for major improvement, because crop yields in India are still just 30% to 60% of the best sustainable crop yields achievable in the farms of developed and other developing countries. Additionally, losses after harvest due to poor infrastructure and unorganised retail cause India to experience some of the highest food losses in the world.

Slow agricultural growth is a serious concern as some two-thirds of India's people depend on rural employment for a living. Current agricultural practices are neither economically nor environmentally sustainable and our yields for many agricultural commodities are low. Therefore, it is essential for India to build a productive, competitive, and diversified agricultural sector and facilitate rural, non-farm entrepreneurship and employment. Encouraging policies that promote competition in agricultural marketing will ensure that farmers receive better prices.

Entrepreneurship opportunities to do business with Indian Agriculture are enormous. Some of them are food grains, fruits and vegetables, processed fruits and vegetables, mushroom, dairy products, spices, medicinal and aromatic plants, essential oils, poultry and meat products, aqua products and organic products. In developing countries like India, the agribusiness sector encompasses four distinct sub-sectors, viz. agricultural inputs; agricultural production; agro-processing; and marketing and trade. All these add value or utility to the goods. Agribusiness is emerging as a

specialized branch of knowledge in the field of management sciences. In this context, agribusiness can be defined as science and practice of activities, with backward and forward linkages, related to production, processing, marketing, trade, and distribution of raw and processed food, feed and fibre, including supply of inputs and services for these activities.

This module deals with the familiarisation of the learners with different agri-business enterprises. The module gives an insight into the concept of agri-business, entrepreneurial opportunities and its scope. The major enterprises like landscaping, commercial nursery, protected cultivation and post-harvest handling are explained in this module. Tissue culture, mushroom cultivation, vermicomposting, indoor gardening, bonsai, apiculture and sericulture along with recent trends like aquaponics and vertical gardening are outlined in the module.



Unit 3.1

INTRODUCTION TO AGRIBUSINESS

Agribusiness denotes the collective business activities that are performed from farm to fork. It covers the supply of agricultural inputs, the production and transformation of agricultural products and their distribution to final consumers. Agribusiness is one of the main generators of employment and income worldwide. Agribusiness is characterized by raw materials that are mostly perishable, variable in quality and not regularly available. In Kerala, agri business is an emerging field which can contribute to the transition from subsistence to commercial agriculture.

Learning outcomes

The learner :

- defines agri-business, its importance and basic concepts.
- identifies the scope of agri-business and enlists the entrepreneurial opportunities in agri-business.
- selects suitable farm business and identifies the steps in farm planning.
- identifies the risk factors in agri business

3.1 Agri Business

Agri-business can be defined as the science and practice of activities related to production, processing , marketing and distribution of agricultural products to the final consumers.

3.1.1 Basic concepts

Agribusiness consists of all industries surrounding food production with marketing as driving force and the ultimate end user is the consumer. Agribusiness involves items such as:

- Productive resources like feed, seed, fertilizer, machinery, etc.
- Agricultural commodities like food, fibre etc.
- Facilitative services like credit, insurance, marketing, storage, packing, distribution, etc.

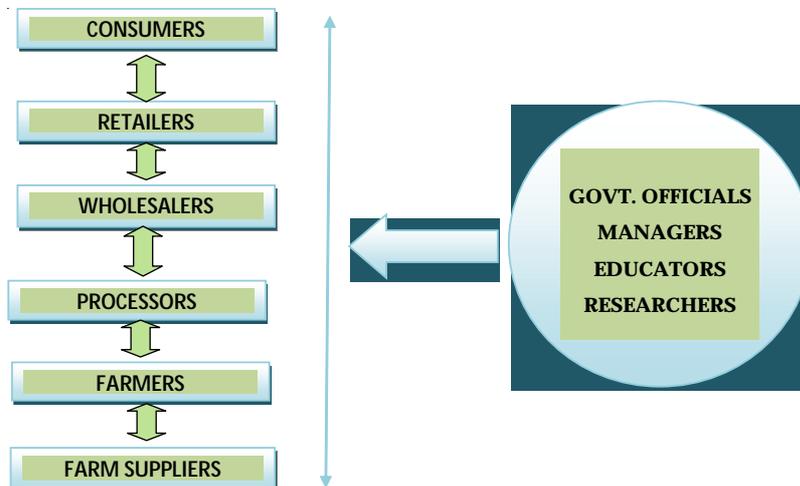
3.1.2 Scope of agri-business

1. As India is having varied agro-climatic conditions, we have production of temperate, subtropical and tropical agricultural commodities.
2. High demand of inputs like feed, fodder, fertilizer etc.
3. Bio-technology application in agriculture has vast scope.
4. Export is a source of economic growth.
5. Processing of agricultural commodities.
6. The other profitable enterprises include livestock, fisheries, bee-keeping, mushroom, organic farming, bio-pesticides, bio-control agents, micro-irrigation system, vegetable and flower production under protected cultivation, forest resources and by-products, etc.
7. Agricultural extension services like agri-clinic and agribusiness centres (AC & ABC).
8. Opportunities for employment in marketing, transport, cold storage, credit, insurance, etc.

Entrepreneurial opportunities in Modern Agriculture

Farming Sector	Product marketing	Input marketing	Processing	Faciliative
Crops	Wholesale	Fertilizer	Milk	Research and development Marketing
Vegetables	Retail	Agrochemicals	Fruits	
Flowers	Commission agent	Seeds	Vegetables	Quality control
Livestock		Transport	Machinery	
Fisheries	Export	Animal feed	Sugarcane	Insurance Energy
Fodder	Finance	Poultry	Cashew	
Agro-forestry	Storage	Landscaping	Coir	Cattle
Bee-keeping	Consultancy	Agricultural credit	Poultry	
Sericulture		Customer service		
Mushroom		Biocontrol unit		
Vermicomposting		Biotechnological unit		

AGRIBUSINESS PROCESS-PERSONS INVOLVED



3.1.3 Decision making in farm business and steps in farm planning

Decision making

Farm problems requiring decision by the farmer are:-

1. Production and organization problem decision

a. Strategic decision- Involves heavy investment and long lasting effect.

- o Sale of farm
- o Machinery
- o Construction of building
- o Irrigation

b. Operational decision- More frequent and involves relatively small investment.

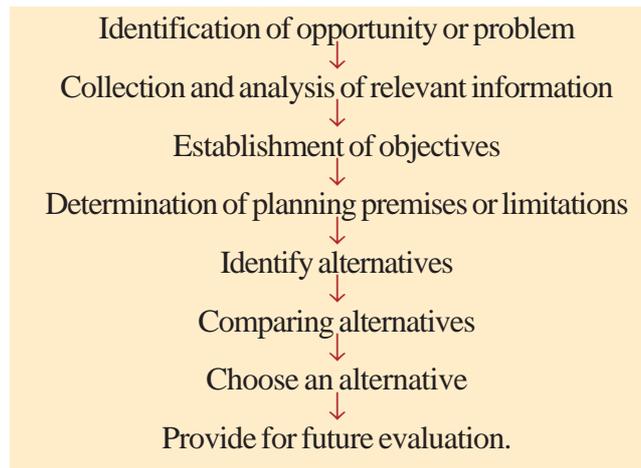
2. Administrative problem decision

- Financing the farm business
- Optimum utilization of funds
- Acquisition of funds-proper agency and time.
- Supervision of work –operational timing
- Accounting and book keeping
- Adjustment of farm business to Government programmes.

3. Marketing Problem decision

Buying/selling-what to buy/sell-when to buy/sell-from whom to buy/sell- where to buy/sell-How to buy/sell.

3.1.3.b Steps in farm planning



3.1.4 Risk factors in agri business

Agricultural risk can be separated into five general risk categories:

- Production • Marketing • Financial • Legal • Human

1. Production risk

Sources of Crop Production Risk are-weather, insect damage and weed competition, diseases and interaction with new technology. It can be managed by diversification of enterprises, trying different production practices, crop insurance adopting new technology etc.

2. Marketing risk

It involves price and marketing uncertainty, input costs and outside forces like weather, actions of government, farm programmes, regulations etc. It can be managed by avoiding high risk ventures, shifting risk to others (by using contracts, joining co-operatives, crop insurance etc.), and maintaining flexibility (by timing sales and / or purchase of output/input, different forms of sales and input purchase).

3. Financial risk

It is due to poor planning, failure to maintain control of the operations and lack of financial understanding. It can be managed by budgeting cash inflows and outflows, maintaining accurate and up-to-date financial records, conducting basic financial analysis and developing annual financial statements.

4. Legal risks

Underlie all other types of risks. Production practices must conform to environmental laws and noncompliance could result in significant penalties or a law suit. Many marketing and financial decisions are subject to contract law, and inability to meet the terms of any contract agreement can also have serious legal implications. Farmers are also required to meet statutory obligations relating to tax reporting and payment, labour and wage laws, safety requirements and others.

5. Human resource risk

It involves hiring and/or firing employees, injury, illness or death, changing personal or operation objectives etc. It can be managed by following the hiring laws of the state, checking personnel qualifications etc.

Detailing of Practical

3.1.1 Survey of scope of agri-business in the locality around the school.

- Case study of successful agribusiness enterprises- including IFS models, ornamental gardening/floriculture, commercial nursery management.
- Field visit to farm business centers nearby the school.
- Case study of risks while running an agri business

CASE STUDY/ SURVEY FORMAT										
Sl. No.	Name and address of Agripreneur	Financial source (Own/ Loan)	Type of agri business	Resources	Products	Marketing facilities	Awareness about Govt Plans	Factors affecting agri business	Risks	Business expansion plans

Assessment Activity

1. Identification of the agri business enterprises in your locality by data collection and report submission.

Sl. No.	Name and address of farmer	Type of agri business	Remarks

TE Questions

1. After visiting a farm Manu decided to start an agri business unit. What advice you are going to provide her as a farm manager about the scope and importance.
2. Shibu wants to start an agri business enterprise after finishing his degree. As a farm manager suggest entrepreneurial opportunities in Agriculture.



Unit 3.2

MAJOR ENTERPRISES

Agri business enterprises provide numerous self employment opportunities which are still underexploited in our state. They also generate additional income for the farming sector which is going through a difficult period due to the fall in prices for some agricultural commodities. Agri business enterprises also present vast scope for combating the unemployment problem of the nation. Some of the major enterprises in agribusiness suitable for Kerala are discussed in this unit. These include landscaping and gardening, commercial nursery, protected cultivation, and post harvest handling and value addition of fruits, vegetables and flowers.

Learning outcomes

The learner:

- explains the importance and scope of landscaping and its basic principles.
- identifies and classifies various ornamental plants.
- identifies different garden types and garden components.
- designs and prepares layout of garden.
- practices maintenance of garden.
- identifies and explains the basics of commercial nursery, scope and types.
- identifies and explains the establishment of different types of nursery with emphasis to layout, components, records and major activities.
- defines protected cultivation and understands its importance.
- identifies different types of protected cultivation.
- explains the establishment of different protected cultivation structures.
- practices the agro techniques in protected cultivation.
- defines and explains Good Agricultural Practices(GAP) and organic certification.
- practices the steps in post- harvest handling of flowers and the techniques to improve vase life of flowers.
- practices the steps in post- harvest handling of fruits and vegetables
- practices value addition of flowers
- practices value addition of fruits
- practices value addition of vegetables

3.2.1 LANDSCAPING

The art of arrangement of trees, shrubs, climbers and various other components together with the building, walkways, drives and other artificial and natural features for the use of humanity is termed as landscaping.

3.2.1.1. Importance, scope and basic principles of landscaping

A. Importance and scope

The importance of landscaping is not understood in India in its full sense. In many developed countries landscaping is given a major role in town planning. It is based on the concept of *bio-aesthetic planning* which means the proper utilization of the available flora and fauna in the beautification of the surroundings. This concept was used in planning the city of Chandigarh. Bio-aesthetic planning should run hand – in hand with town planning. The roads in towns and cities should be broad, planted with flowering and shade trees, and there should be spacious parks along with conservatories for harmless animals and birds. The role of open spaces such as parks and of living plants in checking air pollution is well known. The parks are considered as the lungs of the city. The barrier trees check noise pollution, dust pollution and air pollution. In the parks, the citizens of cities and towns can relax, find peace of mind and breathe fresh air after a day's hard work. Children can also play freely in parks. The wealth of any nation is linked with the health of its people. It is our duty to ensure the healthy development of our citizens, especially the younger generation, by providing them open breathing spaces through bio-aesthetic planning and landscape gardening.

B. Basic principles of landscaping

The garden should be reasonably laid out for the owners pride and convenience. The personal taste of the owner should be taken care of. It should be an outward expression of the personality and individuality of the owner.

1. Simplicity in design should be the keynote and unnecessary complexity should be avoided. Unity in landscape garden produces a feeling of simplicity and oneness.
2. Variety in a garden gives the greatest pleasure. But attempting too much variety in a small place is not desirable.
3. Certain characteristic shape, size, colour etc. may be repeated. Repetition is the most fundamental feature of a garden. Repetition gives harmony and balance. Repetition of colour or other certain elements may give good composition.

4. Natural grade of the ground should be taken as a guide. Level changes are very important and changed level gives more attraction than the leveled situation.
5. The garden should be so designed that the entire garden should not be visible at a glance. It should be full of surprises.
6. In a garden there should be focal points of interest like a pool, a fountain, statue etc.
7. The harmony of colour and proportion is very important. Colour should be there in the garden throughout the year. We can achieve this by proper selection of plants.

Before layout, a plan should be prepared, for that a thorough survey of the land is conducted. Before preparing a plan, construction work and planting should be avoided and the physical features existing in the site such as building, walls, roads, paths, vegetation, water sources etc. should be emphasized in the survey. After the survey, the plan of the garden should be prepared. It should be complete in every detail and attractively drawn to show the planting arrangements, planting plan, construction details, dimensions etc. A scale of 1:20 is convenient.

3.2.1.2. Classification of ornamental plants

Ornamental plants can be classified according to the morphology and use.

Based on morphology ornamental plants can be classified into-

1. Herbs eg: Portulaca, Coleus, Begonia
2. Shrubs eg: Hibiscus, Ixora, Acalypha
3. Trees eg: Casia, Gulmohar, Polyalthia
4. Climbers and creepers eg: Jasmine, Bougainvillea, Allamanda

Based on their functional uses ornamental plants are classified into-

1. Lawn/turf grass eg: Bermuda grass, buffalo grass
2. Flowering plants eg: Rose, Marigold
3. Foliage Plants eg: Phyllanthus, Dieffenbechia
4. Foliage and shade trees eg: Ficus, Badam
5. Specimen shrubs and trees eg: Thuja, Cypress, *Araucaria cookii*

6. Annuals and herbaceous perennials with attractive flowers or foliage eg: Balsam, Zinnia
7. Climbers and creepers eg: Coral vine, Morning glory
8. Cacti and succulents eg: Euphorbia, Opuntia
9. Ferns and palms eg: Nephrolepis, Redpalm
10. Water plants eg: Lotus, Water lilly

3.2.1.3. Different garden types and garden components

Gardening is the activity of growing and maintaining the garden.

A. Types of gardens

1. Formal garden

The key features of formal design are,

1. Plan is made on the paper and land is selected accordingly.
2. The plan is symmetrical with square/rectangular shapes and roads cut at right angle.
3. It has a sort of enclosure or boundary.
4. Flower beds also have geometric designs as in carpets.
5. The arrangement of trees and shrubs are necessarily geometrical and kept in shape by pruning and training.
6. Other features like fountains, water pools, cascades, etc. are used for further attraction.

Demerits

1. Formal gardens have no 'secrets' and the element of surprise is lost.
2. However, attractive focal points at terminal and intersecting points of paths and roads are provided to make the formal garden effective.
3. Present day home gardens are laid out in formal design only at the frontage.

E.g. of formal gardens-Mughal garden, Persian garden, Italian garden, Moorish gardens of Spain, French garden

2. Informal garden

The Key features of informal style/natural style are,

1. This style reflects naturalistic effect of total view and represents natural beauty.
2. It is contrast to formal style.
3. Plan is asymmetrical according to the land available for making the garden.
4. Smooth curvaceous outlines are more appropriate.
5. Water bodies are more irregular in shape.
6. Hillocks are made, waterfalls provided, lakes and islands, cascades, rocks, shola and a rustic hutment are provided to create natural effect. Appropriately grouped plants provide natural outlook and they are not trimmed.

E.g. of informal gardens- Japanese gardens

3. Freestyle garden

Free style garden is a modern concept in ornamental gardening which combines harmoniously the good features of the formal and informal gardens. In free style garden no specific lay out is defined. They are suited for home gardens, school gardens and public gardens.

Usually in free style garden, symmetry is maintained in the central part and towards the periphery or boundary, natural style is adopted. Both these parts are so harmoniously arranged and designed in such a way that we would not be able to identify the division between them.

E.g., Lal Bagh Gardens of Bangalore, The Ooty Garden, The Malampuzha garden

B. Garden components

Garden component	Description	Plants suitable
Edge	These are closely planted bricks or concrete structures on either side of a path or flower beds to demarcate the boundary. Edges can also be made of small, branching type plants, growing very closely and trimmed to a height of 15-20 cm above ground.	Alternanthera, <i>Pilea mucosa</i> , Portulaca, Coleus, flowering plants like Torenia, amaryllis, Zephyranthes, Gerbera, miniature roses

Hedge	These are formed by growing foliage shrubs closely and kept levelled to a height of 50-75 cm to divide the garden into different parts or to demarcate the garden from roads. They are grown very closely in a row and trained on sides and at the top to keep them in shape.	Phyllanthus, Lawsonia, Casuarina, Duranta, Thuja, Aralia, Hibiscus, Lantana, palms, trees like acacia, Polyalthia, some cacti, bamboos,
Lawn	Lawn is a piece of land or large area of land with a fine grass cover kept mown (trimmed) and smooth.	Bermuda grass, carpet grass.
Arches	Arches are usually seen at the entrance of a garden or at the entrance of paths. These are made of wooden or metallic structures. Generally, flowering or foliage climbers/creepers are trailed on the arches.	Jasmine, Allamanda, Clitoria, Morning glory, Garlic creeper, Bleeding heart, Blue bells.
Pergola	Pergola is an extended arch all along a path. These are structures with closely planted pillars and roof on which climbers are trailed.	Jasmine, Allamanda, morning glory, coral wine, asparagus.
Topiary	Topiaries are structures with thick growing shrubs, neatly trimmed in the shape of animals, birds, or in any other particular shape (geometrical shapes).	Phyllanthus, Casuarina, Duranta, Murrya.
Rosary	This is a small plot of rose plants grown <i>in situ</i> or in pots.	Roses
Trophy	Arrangement of potted plants around a central object (flag post, statue etc) in different tiers or steps.	Thuja, Phyllanthus, Duranta, Bamboo grass
Carpet bed	These are formed by annual plants grown very closely in the form of alphabetic letters or in the form of political map of a nation or state etc.	Alternanthera, Coleus, Pilea, Portulaca, Torenia, Sedum.
Flower bed	These are small plots of geometrical shape, grown with annual flowering plants of varying colours.	Celosia, Zinnia, Marigold, Petunia.

LAWN

Lawn is an indispensable part of a garden. It is a piece of land or large area of land with a fine grass cover kept mown (trimmed) and smooth. The lawn adds beauty to the garden.

1. Site selection

Open area getting good sunlight should be selected for establishing a lawn. Most of the grasses will not grow well in shade. It can be established in all types of soils having good fertility and drainage. High content of organic matter and good water holding capacity of soils are desirable. Slightly acidic soils (pH 5.5- 6.0) are optimum. If acidity is high, add lime @ 300g/m² at the time of land preparation.

2. Land preparation

The land may be made clean by scraping and weeding and dug to a depth of 30-45 cm in April-May, just before the onset of South-West monsoon. After 3-4 days when soil is dried, break the clods well and remove all weed stubbles with their roots and stones. This may be repeated 3-4 times till the soil is made free of all weeds, stones and prepared to a fine tilth. If the soil fertility is poor, add well dried and powdered cow dung @ 5kg/m² and mix well with the soil. Then frequent irrigation may be given to make the soil compact for about 2 weeks. The germinating weeds may be uprooted and destroyed. Then the land has to be leveled. Since the stagnation of water in lawns damages the grass provide a slight unnoticeable slope from the centre to the peripheries. The soil has to be pressed well using a roller or by beating hard on ground with some flat, heavy wooden material.

3. Lawn grasses

- i. **Hariali grass/ doob grass**-*Cynodon dactylon*/Bermuda grass
- ii. **Blue grass/ Kikiyu grass**- *Pennisetum clandestinum*. – for high ranges or hilly areas with low temperature.
- iii. **Carpet grass**- *Axonopus compressus*-for shady areas.
- iv. **Korean grass**- *Zoysia japonica*- Japanese Mexican grass.
- v. **Buffalo grass**-*Stenotaprum secundatum*.

4. Planting

Planting can be done by means of seeds, turfing, turf plastering, dibbling shoots or by planting cut grasses.

a. Using seeds

The soil has to be forked to a depth of about 2-3 cm before sowing the seeds. The seed rate is 250g/100m². Seed is mixed with some inert material like sand, and sown above the prepared land. Cover the seeds with a thin layer of soil and press well with a roller. Then irrigate with a rose can. Seeds germinate in 3-5 weeks.

b. Turfing/ sodding

Turf or sod is a piece of earth with a grass cover. Turfs of about 20cm x 20cm size and 6-8cm thickness are taken from places where the grass is growing without weeds. Such turfs are paved closely on the prepared land after forking the surface and the gaps are filled with soil. Then, the sods are pressed with a roller and irrigated with a rose can. This is the quickest method of establishing a lawn.

c. Turf plastering

After the preparation of land, the grass is collected from a well established place. They are cut into small pieces, each with 2-3 nodes. The cut pieces are mixed with slurry of cow dung and sand and is placed or applied on the prepared land. Then the land is covered with a layer of straw to prevent the evaporation for 2-3 days and irrigated daily. Successful in rainy seasons.

d. Dibbling shoots

The off-shoots of grass collected are cut into small pieces and scattered evenly over the prepared land. Then a mixture of sand and soil is evenly spread on it to a thickness of about 1 cm and a light rolling is given followed by watering. Successful in rainy seasons.

e. Planting cut grasses

The slips of lawn grass are collected and they are planted very closely on the prepared land. Then it is lightly rolled and irrigated daily.

5. Aftercare

Once the lawn is established, it requires great care and maintenance. Otherwise the lawn becomes ugly and it spoils the beauty of the whole garden. The important operations in the maintenance of a lawn are mowing, rolling, irrigation, weeding, manuring and plant protection.

a. Mowing

The cutting and levelling of the grass periodically is known as mowing. To have good appearance, the lawn is to be mowed regularly at an interval of 2-3 weeks. In the early stages, grass cutting swords can be used. When the grass has grown well, a mower is best suited. The height of the grass should not be more than 5 or 6 cm.

b. Rolling

During the time of land preparation, the soil is rolled to make it level and compact. When the lawn is established, rolling is done in order to bring the grass in contact with soil and also to keep the ground level. It also helps to prevent the attack of white ants (termite) and to kill the air pockets created by earthworms. Rolling can be done twice or thrice in a month. In rainy season, or when the soil is too wet, it is not advisable to roll the lawn.

c. Irrigation

The lawn needs watering in summer season. Frequent and light irrigation is preferable than heavy watering at long intervals.

d. Weeding:

All plants other than the lawn grass are to be uprooted and removed frequently. Never allow weeds to produce seeds.

e. Manuring

Yellowing of grass indicates N deficiency. Drenching the soil with 1-2% urea in water can cure the yellowing. This can be done every month.

It is advisable to fork the lawn once in a year. Then top dressing may be done with a mixture of powdered cow dung and sand in 1:1 ratio. Also add a fertilizer mixture of ammonium sulphate, super phosphate and MOP in the ratio of 2:1:1 at the rate of 50-75g/m² area. Then roll the lawn.

f. Plant protection

Termite and earthworms may damage the lawn. Rolling can control them to some extent.

g. Replanting

The beauty of the lawn is lost about 4-5 years after its establishment. Then replanting will be necessary after about 5 years.

Rockery

Rockery is the arrangement of cacti, ferns, succulents and other hardy plants along with rocks to imitate a mountain in a small area. It is usually created at a place unsuitable for growing other plants (rocky patches) or by the corner of the garden. A rockery can be established in natural or formal gardens, in open spaces or in shaded areas. We should not create a rockery near the walls or at the base of a tree. The soil should have good drainage.

Rocks, boulders or irregular undressed stones etc can be used in a rockery. Very beautiful rocks for this purpose can be collected from mountainous places or from rivers. Rocks bigger than 30cm size are better. The stones used should be of different sizes and shapes.

First of all, mark out the area with lime powder. Dig the place to a depth of 10-30cm at various places irregularly and excavate the soil. Irregularity is the main feature of the rockery. In the excavated places, place rocks of different shapes and sizes. The crevices are then filled with potting mixture or good earth and the rocks are partially covered. Arrange another layer of rocks around this, and irregular tiny peaks and depressions are also prepared. The slope of peaks should not be too deep. The area can be filled with gravel, broken bricks, stones etc. without overcrowding. One or two streams or a water pool constructed at the base of rockery may improve its appearance.

Some hardy plants like succulents, cacti, shrubs etc. can be planted irregularly.

Suitable plants:-Annuals like dianthus, petunia, gomphrena, vinca, zinnia,etc.

Shrubs like dracaena, croton, lantana etc.

Creepers like philodendron, pothos etc.,

Cacti and succulents like sansevieria, pedelanthus, agave, chlorophytum, opuntia, euphorbia, bryophyllum etc and ferns are the most appropriate plants to get a natural appearance.

Weeding, irrigation in summer season, thinning out of the overcrowded plants, application of organic manure, removing dead leaves and twigs and such other operations are to be carried out whenever needed.

Lilly pool or Water Garden

“Planned planting of aquatic and semi aquatic plants in and around pool is known as water gardening”. A water garden may be large (or) small depending upon the size of the garden of which it is a part. It may be natural (or) artificial / informal (or) formal.

i) Informal pool

If there is a shallow pond (or) a natural depression holding sufficient water and not drying up in the summer (or) over flowering too much in rains, thus maintaining more (or) less a constant level, can start the water garden conveniently in such a pool. These types of pools are informal and so more natural. The curves and bends of such pools must be graceful and artistic and merge with the natural landscape.

The base of such ponds is made impervious to water by the 'puddling' method. This can be achieved by importing clay and laying it to a depth of about 30-45cm at the bottom. Puddling consists of pummelling the wet clay with feet, or preferably with a rod. At this stage the clay becomes impermeable to water. The pond will be used for planting true aquatics such as lotus, water lilies, etc, where as in shallow waters near the banks bog plants are planted.

ii) Formal pool

The formal pool need not be situated in a low lying area; rather it should form a main feature of the garden and should be situated in a prominent place of the garden.

Location of pool

The pool should be far away from the tree, as they would cast their shade and drop the leaves into the pond; besides the roots may damage the walls.

Construction

Where natural water body is absent, artificial concrete pools are constructed. The wall and bottom of such pools should be at least 15 cm thick and fully waterproof. The depth should be 1m. Provision should be made for an outflow pipe laid horizontally at the bottom for completely draining out the pool. The end of the outflow pipe should run well inside the pool and fitted with a stop cock. An inlet pipe is also inserted into the pool. When the pool is filled up the excess water would get out through drain pipe. An inner concrete wall, 70cm height, is then constructed 1m away and parallel to the wall of the pond and the space between the two walls is filled with manured soil in sloppy manner.

Testing

After construction fill the pool with water and leave it for at least 4 weeks to test for any leakage and also to allow chemicals harmful to plant life and fish to dissolve out of the cement.

Planting

The bottom of the pond is filled up to a depth of 20 cm with a mixture made up of 6 parts of garden soil, 1 part of cow dung manure, 125g of bone meal should also applied per sq. meter of the bottom. The lilies and lotus are planted directly in the soil and then water is filled in just to cover the crown of the plants. More water is filled in stages as the plants make new growth. In no case should the plants be submerged. As soon as plants starts growth water level should be increased a few cm per day. This will help the growth of the young plants.

Care of the pool

Aquatic plants need very little care. However some species grow very vigorously and need trimming to avoid overcrowding and smothering of weaker species. Sometimes the water of the ponds becomes green, popularly known as 'blanket of weed' covers the surface and side walls of the pool. Add 1kg potassium permanganate (or) 120g copper sulphate to every 24,000 litres of water.

Plants for water garden

A) Surface flowering Aquatics

Nelumbo lutea-American lotus

Nelumbo nucifera-Indian lotus

Nymphaea sp-Water lily

Victoria regia

B) Oxygenators

Elodea canadensis

Vallisneria spiralis

C) Floating plants

Eichornia crassipes

Lemna gibba

Design and layout of garden

3.2.1.4. A Principles of garden designs

The art of designing is known as landscape architecture or landscape gardening.

Initial approach

A good designer should make best use of the available plot. Land with natural undulations should never be leveled, but rather the differences in levels should be utilized with advantage. Fencing should look natural and should not obstruct any natural view.

The terms and principles used in landscape designs are:-

Axis

This is an imaginary line in any garden around which the garden is created striking a balance. In a formal garden the central line is the axis. At the end of the axis, generally there will be a focal point.

Focal point

In every garden there is a centre of attraction which is generally an architectural feature.

Mass effect

One general form of plant material in large numbers in one place is used to create mass effect.

Unity

Unity will improve the artistic look of the garden. Unity has to be achieved from various angles. First, the unity of style, feeling, and function between house and garden has to be achieved. Secondly, the different components of the garden should merge harmoniously with each other. Also achieve some harmony between landscape outside and the garden. To achieve unity between house and the garden, we can train creepers on the front porch or do foundation planting which means planting bushy plants near the foundation of the house.

Space

The aim of the garden design is that the garden should appear larger than its actual size. For this, keep open spaces, preferably under lawn and restrict planting at the periphery. If planting has to be done at the centre, choose a tree with branches higher on the trunk or remove lower branches. The technique of creating an illusion of more space is referred to as “forced perspective”.

Divisional lines

There should not be any hard and fast divisional lines but there is the need of dividing or screening a compost pit, or tool shed or a vegetable garden the rest of the garden. The divisional lines should be artistic, useful, with gentle curves and should harmonize with one another.

Proportion and scale

Proportion in a garden may be defined as the definite relationship between masses. The simple rule is that the design should look pleasant. It is better to have an *ad hoc* design and try it out on the actual spot. If the design looks appealing and pleasing, it is implemented.

Texture

The surface character of a garden unit is referred to as texture. The texture of the ground, the leaves of a tree or a shrub will all determine the overall effect of the

garden. A *gulmohar* is a fine textured tree, whereas *Spathodea companulata* is a coarse textured tree.

Time and light

There are 3 different categories of time in a garden. 1) Daily time which provides different quantities and qualities of light during the course of the day. Most parts of India, the garden design should be planned in such a way that in the afternoon it is possible to sit in a shaded place from where the best part of the garden should be visible. 2) Seasonal changes in the year. 3) The shape and proportion the shrubs and trees will attain in the years to come. The trees and shrubs should be well planned so that they will provide the required shade and at the same time not obstruct the view.

Tone and colour

A basic study of the natural colours will be helpful in formulating colour schemes in the garden. The three basic colours are red, yellow and blue while the secondary colours are orange, green and violet. Red, orange and yellow are considered as hard or warm colours whereas blue, violet and green are considered soft or cool. White, black and grey are considered as neutral colours.

The basic arrangement of colours in annual beds may be classified as follows, but no rigid formula can be provided for all the places for all times and may vary according to situation and convenience.

Monochromatic : It is arranging different tones of the same colour either of the same species or in combination with different species.

Analogous : Using closely related or harmonious colours such as violet with blue and light blue with green, and yellow with green, or yellow with yellow-orange.

Complementary or contrasting : Two opposite or contrasting colours –blue and orange, red and green, violet and yellow-are called complementary. The red salvias grown against a lush green hedge form a beautiful contrast.

The proper combination of colours, plant height and time of flowering is very important in annuals. The tall plants are put in the background and other plants are arranged in accordance with their height. The annuals should be sown in such a planned way that all the plants in annual beds flower at the same time. It is better to have masses of single colour against a mixture of colours.

Mobility

In a temperate country the garden changes colour very sharply and contrastingly from season to season thus symbolizing mobility or movement. The movement of birds could also bring life and mobility to the garden. Large trees and bird-baths attract birds. Some shrubs and trees bearing fruits can be planted in the corners if they do not look ornamental. The seasonal flowers will bring in the motion and movement of the colourful butterflies. Fountains or a lawn sprinkler and streams (cascades) in a garden also serve the objective of movement. The lily pools should be filled with colourful fish which will be an added attraction.

Style

Every garden lover has to invent his own style of gardening in accordance with his budget, taste and the nature of the site. He can develop his own design by studying carefully all the great garden styles of the world and grasp the underlying principles in them.

B. Lay out of a garden

1. Institutional Garden

Most campuses of institutions are barren without any garden. A properly landscaped campus adds beauty to the school buildings. Moreover a well maintained campus create aesthetic sense in future citizens. Also a well landscaped garden act as a barrier against noise, wind and air pollution, and also provide shade and beauty.

It is necessary to prepare a masterplan at the very start. The masterplan of the garden maybe implemented in stages. The garden may be designed with minimum maintenance. A lawn, flowerbeds, hedges requiring trimming should not be included in a design. These need more labour for maintenance. Emphasis should be on planting trees, shrubs, etc. which require less attention.

A creeper like bougainvillea maybe trailed on the front wall near the entrance, a few shade and flowering trees may be planted on the compound or in the periphery. The corridors may be decorated with potted plants. The first row on the boundary should be closely planted with trees having good canopy. This row will arrest dust, and reduce noise and wind. To create beauty a row of flowering trees like *Cassia fistula*, *Bauhinia sp.*, *Tecoma stans*, etc may be planted.

Through the avenues and road side, medium and dwarf flowering trees like bottle brush may be planted. Shrubs maybe planted in beds or in rows along the path around the playground.

2. Home Garden

A garden in a house not only adds to its beauty but also enhances its real estate value. The personal taste of the owner should be taken care of. The home including its surroundings should be an outward expression of the personality and individuality of the owner.

The background of a garden, whether a wall, tall tree or a hedge should be neutral in nature. This means the background should not distract attraction from the main garden. A green hedge as background will be neutral in nature but a red hedge (*Acalypha*) may attract attention away from the garden. The central area must be left out for any major structures such as a lawn.

Master plan of the garden is to be prepared on a scale of 1: 20. All parts of the garden should be indicated in the master plan. A home garden may be having the following parts:

1. An outdoor living room,
2. A fenced play ground,
3. A show piece with a collection of rare plants,
4. A place for producing cut flowers, vegetables and some fruits.

Depending upon the choice of the owner a number of features can be included like a shrubbery, borders, annual flowering beds, rose garden, rock garden, lily pool etc.

If an owner can afford a green house, decorative foliage plants can be included. Perennial and annual flowers should be included. It can be planted in pots. Various ornamental and flowering shrubs, flowering annuals and herbaceous perennials can be planted.

Erithrina indica can be planted in a corner to attract birds. Flowering trees like *Cassia fistula*, gulmohar, champaka, bauhinia etc. can be planted in the background.

3.2.1.5 Maintenance of Garden:

Garden maintenance includes the following activities:-

1. Timely weeding, forking of soil, irrigation and manuring.
2. Regular training and pruning of herbs, topiaries, hedges etc. to keep them in good attractive shapes.
3. Removal of old leaves, old flowers, dried and damaged twigs etc. of plants.
4. Planting of annual plants (especially in flower beds) in correct time, according to the scheme of planting prepared in advance.

5. Timely gap filling and other cultural operations.
6. Timely plant protection measures.
7. Timely potting, repotting and special care to plants grown in pots and other containers.

Training and pruning are methods which would control plant growth according to our necessity.

Pruning

Pruning may be defined as the removal of any part of the plant in order to increase fruitfulness and also to improve quality. This include cutting of small and large branches, cutting of roots etc. Pruning encourages new healthy branches which bear more flowers and fruits than old branches.

Objectives of pruning

1. To remove surplus branches / unproductive and criss -crossing branches.
2. To open the trees so that the fruits will develop colour more satisfactorily.
3. To train it to some desired form.
4. To remove dead and diseased limbs/ branches.
5. To remove water sprouts.
6. To thin the fruits.
7. To divert the energy to the productive areas so as to increase the production.
8. To develop a strong frame work for the plant. Narrow- angled branches are easily blown off by strong winds. So at the early stages only wide- angled scaffold branches are retained by proper training and pruning.

Types /Methods of Pruning

1. Heading back

The terminal portion of twigs, canes or shoots is removed without disturbing its basal portion. It stimulates the growth of lateral buds.

2. Thinning out

It consists of removal of excess dead or diseased branches, flowers, fruits, roots or leaves. In thinning out, the entire twig, cane or shoot is removed.

3. Pinching or stopping

The top portion of the plant is removed or plucked by hand for stimulating lateral branches and for the production of more flowers.e.g. Dahlia, carnation, chrysanthemum, marigold. This is done to encourage a bushier and dwarfish growth.

4. Disbudding

Disbudding is a process of removal of unwanted buds for better growth of those which remain. Disbudding is followed in large-flowered cultivars of zinnia, chrysanthemum, dahlia etc. The main purpose is to obtain quality blooms by allowing only one bud per shoot.

a. **Deshooting** is another practice related to this which is the removal of unwanted shoots.

5. Root pruning

It is done while transplanting or repotting plants. The excess roots are pruned and then replanted. This is mainly done in making Bonsai plants.

6. Cleaning up

Removal of dead, diseased and very thin weak shoots.

7. Thinning of flowers and fruits

Some flowers and fruits are removed from the main branches if they are produced densely. The main objective of this is to increase the quality of fruits and flowers.

Training

Training is the process of cutting away of undesirable parts of a tree to maintain its shape.

Objectives of training

1. To give a particular shape to the tree.
2. To develop a strong frame work of the plant.
3. To ensure regular yield.
4. To avoid over bearing.
5. To get good quality fruits.

Types /Methods of training

There are 3 kinds of training viz., central leader, open centre and modified leader.

Central leader system/method

In this system only the lateral branches are removed and the main stem is allowed to grow without any restriction.

Open centre system/method

In this system the main stem is pruned /cut to make the plant assume spreading habit of growth. This is done in order to regulate the plant height, to give proper shape and to develop a strong frame work of the plant.

Modified leader system

It is intermediate between the above 2 methods and is developed by first training the tree by allowing the central stem to grow for the first four to five years. Then the central stem is headed back and lateral branches are allowed to grow.

Details of practical

- 3.2.1. Landscaping –planning and layout.
- 3.2.2. Identification, familiarization and classification of ornamental plants
- 3.2.3. Raising of seedlings of ornamentals plants
- 3.2.4. Establishment of rockery, lawn, lilly pools, flowerbed, carpet bed, trophy, topiary, edge, hedge, arches.

Assessment activities

1. The students are shown pictures of English garden, French garden, Japanese garden and Mughal garden. They are asked to bring out the salient features of each garden and how they differ from each other.
2. Students are given a project of beautifying the school campus/ selected area near school.

TE questions

1. Your cousin has built a new house in the city. There is very little space in front of the house but the family wishes to have a garden. How can you help them to do this?
2. The Principal of your school has assigned the task of landscaping the school campus to your class. How will you prepare a masterplan for landscaping of the school campus?

3. Your friend is planning to set up an indoor garden in her flat. Help her to select some suitable plants from the nursery. Explain to her how to properly take care of them.
4. The manager of newly opened business firm wants to establish a lawn in front of the building within two weeks. Suggest a suitable method for this and explain the procedure?
5. There is a water logged area in your school campus. How will you convert this into a beautiful garden component? Explain the method?
6. Explain the principles of landscape gardening?
7. There is a rocky patch near your school garden. Explain the method of converting this area into a beautiful garden component. Suggest suitable plants for this component.
8. For the proper maintenance of a garden, training and pruning are necessary. Substantiate the statement.
9. Explain the objectives of pruning and different methods of pruning in trees.

Unit 3.2.2 Commercial Nursery

3.2.2.1 Basic concepts and scope

In Horticulture the word nursery represents not only an area where plants are grown, but also an area where plants, seeds and other accessory materials like fertilizers, implements etc. are offered for sale. It may be an area meant for individual garden or for business purpose. Hence the area for a nursery ranges from as small as is required for a private garden to a large area for commercial use. Nursery management indicates all aspects in connection with plant production starting from selection of site to the distribution of plants.

Role of nurseries:-

1. Supply of genuine, healthy & quality planting material
2. Dissemination of information on seeds, new varieties & planting materials
3. Establishment of disease free & virus free scion banks

4. Promotion of export through supply & processing of quality planting material.
5. Labelling & certifying of planting materials.

3.2.2.2 Types of Nurseries

Types of nurseries according to the type of sale

1. Retail Nurseries

Retail nurseries raise plants for sale to the general public. These places are small, locally owned nurseries that sell seasonal, annuals, ornamental trees, other landscaping plants and garden decoration to the general public or companies that specialize in a particular type of plant, such as tropical plants, citrus trees, bulbs or roses.

2. Wholesale Nurseries

Wholesale nurseries usually grow plants in bulk for the purpose of selling to large clients. These clients may include florists, garden centers or departmental stores. A wholesale nursery may fill a niche for particular types of plants, such as vegetables or houseplants, or they may grow a general selection of plants to sell such as fruits, vegetables and landscaping plants.

3. Private Nurseries

A private nursery grows plants exclusively for a single client. The private nursery may be owned by the client or it may be under contract for use by the client. Clients for private nurseries include large estates, corporations and institutions. These nurseries are concerned with raising documented historical plants for the historic preservation of the estates.

4. Mail Order

Privately owned, retail and wholesale businesses may all be involved in mail order businesses. As shipping technology improved, it became possible to ship dormant ornamental trees and bedding plants via mail. The internet has largely shifted mail order from catalog to online shopping. Bedding plants may be shipped via postal carrier, but are primarily handled through third-party shipping agents.

Hi tech Nursery

The characteristic feature of most nurseries is that they are highly labor-intensive. Although some processes have been mechanized and automated, others have not. Plant care and horticulture nursery management require observation, judgment and manual dexterity. Selection for sale also requires comparison and judgment. It has been estimated that manpower accounts for 70 per cent of the production costs of a horticultural nursery.

There is sudden increase in the demand for certain commercial plants. For example Tissue cultured banana, gerbera and carnation etc. It is not possible to fulfil this requirement by ordinary or common nursery practices. There is necessity to have special techniques and methods to meet the demand and only Hi-tech nurseries can satisfy this type of demand. These nurseries grow plants in greenhouse, building of glass or a plastic tunnel, designed to protect young plants from harsh weather, while allowing access to light and ventilation. Modern greenhouses allow automated control of temperature, ventilation, light, watering and feeding. Some also have fold-back roofs to allow “hardening-off” of plants without the need for manual transfer of plants to the outdoor beds.

3.2.2.2.1 Establishment of nursery

Selection of site

Qualities of a good site are

- 1) Nearness of road
- 2) Near a habitat
- 3) Suitable climate
- 4) Neither shady nor exposed area- A plot of land with some established trees will be preferred than an open ground, because semi shady condition is also required for a nursery.
- 5) Sufficient sunlight
- 6) Good irrigation facilities/ nearness to permanent water source.
- 7) Good soil condition
- 8) Good transport facility- easily accessible to visitors and vehicles
- 9) Level area without chance for water stagnation

Lay out of nursery

The nursery should be laid out taking the following points into consideration:-

1. Road and paths - Each and every corner of the nursery should be well connected with a road or path. Paths should be wide enough, minimum 2 m wide to ply the wheel barrows, hand carts, small hand tractor and trolleys for leisure walks of the customers who come for making purchases.

2. Sections/Sectors - The area of the nursery should be divided into different sections/ sectors/ portions like timber section, rose section, annual flower section, indoor plant section, vegetable section, fruit plant section and main sections may further be divided in to sub section like ornamental and flowering tree's section, creeper section, shrub's section, bougainvillea section, succulents and cactus section and so on. This type of division will facilitate better supervision, specialization of staff and better accounting besides high impression on the mind of customer, nursery being run by qualified person on scientific lines.

3. Irrigation -Irrigation channels should be properly laid out to minimize wastage of water. There should be grid of pipe lines and hydrants to get equal pressure of water at all the parts of nursery. In potted areas, automatic /manual sprinkler system or drip irrigation system is suggested.

4. Office cum sale counter, stores and parking - Proper office of the manager and staff with proper seating arrangement, sale counter attached with modern seed store, chemical room, fertilizer room etc. should be located at the main entrance of the nursery with a spacious, well protected, shady parking lot. This area should be beautifully landscaped and there should be an area for displaying sample plant material put for sale, at the entrance. However, there should be different stores for tools and implements, stationary and other items of day to day use, in different sections/sector.

5. Progeny orchard / Mother plant block - It is the real asset of a nursery, which forms a permanent block of different kinds of plant material for further multiplication and perpetuation by different methods of sexual and vegetative propagation. These plants are strictly true to the type and variety, healthy, free from diseases, properly labelled, indicating botanical name, family, local name etc. for proper identification. 40-50% of the total nursery area should be kept reserved under mother plants, which can be considerably minimized by judicious planting.

6. Boundary wall/fence - About 2 m high brick wall or angle iron with barbed wire or ornamental railing should be provided all round the nursery area, to check trespassing and pilferage besides protecting a garden. Another cheap alternative is

live fence planting with the thorny plants like bougainvillea, karonda, opuntia, cactus, Edward rose, etc.

7. Propagation beds/seed beds - Some area is earmarked for seed beds where seed of different kind may be sown throughout the year to raise the seedlings. Beds should be in semi shade area to protect the tender seedlings from scorching heat. A suitable sowing medium may be filled to depth of 1' or 2' which should be replaced in each season. Best sowing medium is a mixture of good soil and leaf mould or peat moss. Nowadays many sowing media are available in market with different trade names. There should be adequate shade near these seed beds, under which newly transplanted seedlings can be put for hardening. There will be a very high rate of mortality if newly transplanted seedlings are put directly in the sun. Ensure proper drainage in these propagation beds.

8. Transplanting beds - The plant raised by seed or by the other vegetative methods like cuttage, graftage should not be allowed to remain at one place in ground for long time, therefore, go on shifting, transplanting from time to time to avoid penetration of root deep in the soil or root bound situation.

9. Potting and repotting areas - Sheds in form of sunshade should be covered from top and open from sides to harden the tender pot plants and protection in rainy season. There should be proper place of stacking empty pots and farmyard manures, fertilizers, etc.

10. Packing area - This area should be near to office to enable better supervision while packing the plants for dispatch. An open area and an underground water tank is a must, besides the adequate space for storing empty cartons, baskets and other packing materials.

11. Open shed - In each section, there should be one shed to provide the temporary shelter for staff, for hand carts, wheel barrows, other tools and implements etc.

12. Shade House - This is the place where shade/partial shade loving plants are kept under the artificial cover whether square/rectangular. Nowadays synthetic shade nets in black & green colour of different shade & percentage (40-70%) are available in the market which can be used in place of natural materials like reeds or palm leaves. Coconut ropes may also be used.

13. Natural conservatory - This is again an area for keeping shade/partial shade created by planting permanent tree in rows, like Jamun/mulberry, mango, sesbania, etc. It is advised to have pucca floor, pucca paths and overhead irrigation system/sprinkler irrigation system in shade houses and natural conservatory area as the

irrigation by hose pipes may cause considerable damage to delicate leaves of plants.

14. Tissue culture lab and hardening area - It is advisable to have tissue Culture lab in a commercial nursery with a hardening area adjacent to lab duly shaded by shade nets etc.

15. Propagation structures - These are structures with temperature control, ample light and humidity, where seeds can be germinated or cuttings rooted. These structures are also known as greenhouse.

16. Greenhouses -A **greenhouse** is a structure with walls and roof made chiefly of transparent material, such as glass, in which plants requiring regulated climatic conditions are grown. These structures range in size from small sheds to industrial-sized buildings. A miniature greenhouse is known as a cold frame. The interior of a greenhouse exposed to sunlight becomes significantly warmer than the external ambient temperature, protecting its contents in cold weather.

17. Propagation frames - Small light weight frames of reed, metal even bamboos etc. are fabricated and covered with polythene sheets. These can be easily shifted from one place to another. In these frames generally propagation is done in containers/ propagation pans. Humidity is created by manual spraying of water. These are best suited for the small nurseries.

18. Media for propagation - Various material and mixture of material are used for germinating seeds and rooting cuttings, besides soil, leaf mould, compost, sand, peat, moss, coco peat, vermicompost, sphagnum moss, vermiculite, perlite, synthetic plastic aggregates may be used.

19. Containers for propagating and growing young plants.

Records to be kept in a nursery

- a. Map of nursery
- b. Attendance register
- c. Bill book
- d. Cash book
- e. Planting materials register
- f. Dead stock register
- g. Input register
- h. Daily activity register
- i. Salary register

Major activities in a nursery

I. Vegetative Propagation techniques followed in nursery

1. Approach grafting

Approach grafting is popular in Kerala for the propagation of plants like mango, jack, sapota and ornamental trees like chempaka. In this method, both the stock and scion grow on their own root systems. I.e., the scion is not separated from the mother plant as in the case of other methods.

Root stocks are raised in small pots or in coconut husk or in any such container and grown for about 1-1.5 years to get pencil thickness and 30-45cm height. Such grown up rootstocks are taken to the mother plant.

Usually for commercial multiplication, mother plants are grown very closely and trained to get low lying, spreading branches for easiness of grafting. Such orchards are known as close planted Progeny orchards. From the mother plant, select an upward branch having the same thickness (girth) as that of root stock. Make an inward “arch” shaped cut of 3-5 cm long on the root stock. The depth of cut in the centre should be about 1/3 of its thickness and a portion of wood is also removed while taking such a cut. Then make a similar cut on the side of the selected branch (scion) of the mother plant in such a way that the cut surfaces of the stock and scion can be brought together perfectly in close contact with each other. The cambial layer should be in the same level. Then tie the union with a good gunny twine and cover it using plaster or grafting wax or mud mixture. Care should be taken to irrigate the stock. After about 2-3 months the cut surfaces are healed, i.e., the graft union is complete and the graft is ready for separation.

For separation, a shallow cut is made on the scion just below the graft union and another shallow cut on the stock just above the graft union. At an interval of 2-3 weeks, gradually deepen the cuts, and with the final cut, say the 3rd or 4th cut separate the graft from the mother plant and keep under shade. The rootstock should be watered throughout these stages. A few days after giving the 1st or 2nd cut, if the scion branch dries, we can understand that the healing of the graft union was not complete or the grafting was not done properly.

2. Epicotyl grafting/ stone grafting

In this case seeds (stones) are sown in the nursery and the grafting (wedge method) is done on the epicotyl region of the seedling 7-10 days after germination. The joint is tied firmly with a polythene ribbon of 0.5-1.0 cm width, and the grafts are kept

under shade and nursed well. The epicotyl region (above the cotyledons of the seedling) will be soft at this stage. Graft unions will heal within a month of grafting, and subsequently the scions sprout. Since stone grafting is performed at the epicotyl region, it is also known as epicotyl grafting.

For better success, the scion must be of a mature shoot of 4-6 month and are defoliated for about 10-12 cm length from the tip with their petioles intact. After about 10-14 days, when the petioles will fall down, the scion can be taken for grafting. Never select sprouted scion for grafting. Maximum success will be obtained when grafting is done during July-September months, under high humidity conditions. Scion may sprout in 4 weeks time. New growths that arise from the base of the grafted seedling should be destroyed immediately.

If the grafting is done on seedling growing in nursery bed, the graft may be transplanted to the polythene bag or pots 1.5-2 months after the sprouting of the scion. The transplanted grafts may be nursed under shade for 6-8 months after grafting and are transplanted to the main field.

e.g. mango, cashew.

3. T-budding

T budding is also known as Shield budding. It is the most common method of propagation in citrus, rose etc. In this method, a prominent, bold (bulged) bud with a portion of the bark of about 2-3 cm length is taken out in the shape of a shield from the desired cultivar. A portion of wood will also be attached to the bud. The bud is taken from current season's shoot using a sharp knife. For this, a slanting, shallow cut is made about 1.5-2 cm from the bottom part of the bud towards the top. Then a horizontal cut is given on the top of the bud about 1 cm above the bud. The wood portion is then removed carefully without damaging the bud and the bark. For easy handling of the bud, a piece of the petiole can be retained along with the bud.

Afterwards make a vertical cut of about 2-3cm long on the root stock and a small horizontal cut (0.5cm) over the top of the vertical cut in the shape of T. Then open the bark towards both sides as insert the bud into the gap formed between the wood and the bark on the stock. For this, slowly slide down the bud from the top portion of the opened slit. Tie the union well with a polythene strip or tape of about 0.5- 1 cm width. While tying care should be taken to keep the bud portion exposed in order to facilitate its growth.

4. Patch budding

In this method, the scion (bud) is taken out in the form of a rectangular patch with the bud at its centre. On the stock plant at the desired place give 2 transverse cuts

parallel to each other at a distance of 2.5-3.75cm between them. The cuts should be bark deep only. The width of the cut should be about 1-2.5 cm. Join the two transverse cuts at their ends by two vertical cuts and remove the patch of bark. On the bud wood, give two transverse cuts and vertical cuts of similar dimension as above and remove the bark patch with the bud at its centre. Insert the bud patch immediately on the stock in such a way that the bud patch fit perfectly on the cut in the stock plant. Wrap with polythene strips or waxed cloth strips exposing the bud properly.

E.g. Rubber, rose.

5. Air layering

Air layering is also known as Chinese layering, pot layering, circumpositon layering, Marcottage, and Gooteeing.

In air layering, the rooting medium or soil is taken to the branches instead of bringing the branches to the soil as in other methods. The shoot at the a point about 20-30cm below the tip is injured either by giving an upward slanting cut or by removing a ring of bark of about 2-3cm length. This portion is then enclosed in a ball of moist sphagnum moss or layer mixture, and covered with a polythene sheet and tied well at both ends. After about 45-60 days when roots are seen through the polythene sheet, the shoot is detached from the mother plant and it can be used as a separate new plant. Layering would be successful if done in rainy season.

It is advisable to cut off the rooted layer gradually from the mother plant, i.e., give a slight cut at first and then gradually deepen it at weekly intervals. In this way the layers are fully separated after 3-4 cuts.

2. Hardening

The term hardening includes “Any treatment that makes the tissues firm to withstand unfavourable environment like low temperature, high temperature and hot dry wind.”

Techniques of hardening

- Hardening is physiological process. Plants accumulate more carbohydrates reserves and produce additional cuticle on the leaves.
- In this process seedlings are given some artificial shocks at least 7-10 days before uprooting and transplanting. These shocks includes
 - o Exposure to the full sunlight,
 - o Removal of all the shading nets, polythene sheets
 - o Irrigation is gradually reduced.

3. Sales

Plants from hardening units, seedlings and planting materials, inputs like fertilizers, media, pots, accessories, containers, adornments, Plant protection chemicals, implements are properly exhibited in display unit attached to the sales counter.

Detailing of practical

3.2.2.1 Propagation Techniques - air layering - T- budding - Patch budding - approach grafting, epicotyl grafting – vegetable grafting

3.2.2.4. Field visit to a commercial nursery and prepare a Layout of commercial nursery

Assessment activity

Prepare a layout of a commercial nursery. What are the plants that you will select for this nursery? (Find out the market demand before selecting the plants.)

TE Questions

1. You have a rare variety of Rose in your school garden having great demand. Suggest a suitable propagation method you will use to multiply it.
2. Your friend Nirmal wants to start a commercial nursery. Help him to select a suitable site and prepare a layout of the nursery.
3. Explain the different types of nurseries?
4. Hi tech nursery is the need of the hour. Substantiate the statement
5. When Dileep visited a commercial nursery, he saw a session labeled “Progeny Orchard”. Can you explain its importance.
6. There is a good variety of jack in your home. Your neighbor wants planting material of this tree. How will you prepare true to type planting material? Explain the procedure with diagram.
7. You saw a good variety of mango while you visited a farm in Bangalore. You collected some pieces of scion of this variety and brought back to your home. How will you make use of this scion within the shortest time to prepare true to type planting material? Explain the procedure with diagrams.
8. Your school PTC wants to produce good quality planting material of Guava. Explain the procedure for preparation of true to type Guava plants with the help of diagram.
9. Explain the importance of hardening in a nursery and the techniques used in hardening.

UNIT 3.2.3. Protected cultivation

3.2.3.1. Definition and Importance

Protected cultivation is defined as the technique of providing favourable environment or growth condition to the plants. By protected cultivation we can ensure year round supply of farm produce and yield can be increased to 3-5 times.

The advantages of protected cultivation is that any crop can be grown at any time anywhere as the microclimate can be artificially maintained and controlled with a protected structure. Protected cultivation makes use of hi tech practises like Integrated Pest Management, Integrated Nutrient Management, hydroponics, aeroponics, fertigation, precision farming, and nutrient film techniques (NFT).

Importance

1. Helps to meet the increasing food demand.
2. Increasing the efficiency water use.
3. Avoids adverse climatic conditions
4. Helps to tackle the problem of unavailability of labour.
5. Increases production and productivity of crops.
6. Helps in precise application of water, fertilizer and pesticide
7. Helps in year round off season crop production.
8. Reduces pesticide use under controlled climate condition.
9. Improves health characteristics of products

Green House Technology is suitable for

- Production of vegetable crops.
- Production of off-season flowers, vegetables.
- Production of Roses, Carnation, cut-flowers etc.
- Plant propagation, raising of seedlings.
- Primary and secondary hardening nursery of Tissue cultured plant.
- Growth /Production of rare plants, orchids/herbs, medicinal plants.

3.2.3.2 Different types of protected cultivation

1. Greenhouse

Greenhouse (Fig.1) is a structure with walls and roof made chiefly of transparent material, such as glass, in which plants requiring regulated climatic conditions are grown. These structures range in size from small sheds to industrial-sized buildings.

2. Poly house

- Poly houses (Fig.2) are basically naturally ventilated climate controlled.
- Poly houses have a variety of applications, the majority being, growing of vegetables, floriculture, planting material acclimatization, fruit crop growing for export market.
- Clear new poly ethylene sheet having high light transmittance is used (88%)
- Higher strength and low cost made it most popular replacement for glass

3. Shade/Net house

- Covered with shade nets of different colours and grades (Fig.3)
- these are perforated plastic materials used to cut down solar radiations and to prevent scorching or wilting of leaves
- Roofs are usually horizontal or arch shaped
- Used for raising nurseries
- Leafy vegetables and ornamental plants are grown
- Protect the plants from high temperature, cold, wind, frost, pests, birds

4. Rain shelter

- Low cost structures made of bamboo /arecanut /casuarina/concrete post/MS pipes/GI pipes
- Roof covered with UV stabilized poly ethylene sheets and the sides will be open
- Protect the plants that could not be cultivated during rainy season
- Protect the plants from high temperature, cold, wind, frost, uv rays, pests, birds

5. Poly tunnel

- Poly tunnels (Fig.4) are basically naturally ventilated/climate controlled. Poly Tunnels have a variety of applications, the majority being, growing of vegetables, floriculture, planting material acclimatization, fruit crop growing for export market.

3.2.3.3 Establishment of different protected cultivation structures

While establishing protected cultivation structures importance should be given to the following aspects

1. Site selection

1. Soil should have a pH of 5.5-6.5

2. Availability of continuous source of quality water
3. The site of construction should be elevated than the surrounding land
4. The selected site should be pollution-free
5. Transportation facility to nearby market.
6. Availability of electricity and communication facility

2. Orientation of protected cultivation structures

Orientation depends upon light intensity, wind direction and wind velocity. North south orientation is best suited for Kerala.

3. Construction of protected cultivation structures

1. Structures/ framework
 - a. GI structures
 - b. MS structures
 - c. Wooden structures
2. Cladding material :
 - a. flexible cladding material- polythene
 - b. Rigid covering material-Glass, FRP sheet (fibre reinforced plastic)
 - c. Shade house-Shade net.
3. Gutters : -to collect and remove rainwater from the top.

4. Ventilation system :-

Ventilation involves removing air from inside the green house and replacing it with outside air. Ventilation may be :-

- a. Natural- caused by wind and temperature forces
- b. Mechanical or induced using fans.

5. Climate control systems:-

Five climatic factors should be controlled:-

- a. Solar radiation or light
- b. Temperature
- c. CO₂ concentration
- d. Humidity
- e. Air movement

6. Instruments required

- a. EC and pH meter
- b. Tensiometer (Soil moisture)
- c. Dry and wet bulb thermometer
- d. Lux meter
- e. CO₂ analyser
- f. Hygrometer
- g. Anemometer
- h. Wind vane
- i. Rain gauge

7. Irrigation systems

- a. Drip
- b. Sprinkler
- c. Fogger
- d. Mist

3.2.3.4. Agrotechniques in protected cultivation

Agrotechniques in protected cultivation consist of

1. Land preparation

- In protected cultivation, crops can be planted in soil or soilless media such as cocopeat, vermiculite, perlite etc.
- The sterilization of soil should be done using physical or chemical methods.
- Disinfection of Growing media
 - Chemical drenching/ fumigation: formaldehyde, chloropicrin, captan and vapam
 - Steaming
 - Pasteurization
 - Solarization
- After soil sterilization, beds are to be prepared properly according to the crop to be planted and greenhouse structure.
- Leave sufficient space for main pathway.

2. Planting

- Select high yielding hybrid seeds

- Crops selected should be suitable for protected cultivation
- Vertical growing crops are most suitable for protected cultivation. e.g. salad cucumber, tomato, cowpea, capsicum
- Grafted vegetable seedlings can also be used.

3. Fertigation

Application of fertilizers along with irrigation water is called fertigation. The fertilizer should be highly soluble in water. e.g. 19:19:19

4. Intercultivation

- Proper irrigation should be done.
- Weed growth should be controlled by plastic mulching.

5. Plant protection

Plant protection is a very important aspect with respect to protected cultivation. Pest or disease incidence in one crop may severely affect the entire crops. The various strategies are:-

1. Cultural methods

- Follow strict quarantine measures
- Practice Integrated Pest and Disease Management (IPDM)
- Use insect proof nets.
- Each Polyhouse should have a double door to prevent entry of insects and diseases.
- Use pest and disease free planting material
- Use resistant varieties.
- Crop rotation.
- Maintain proper spacing.

2. Mechanical and physical methods

- Scouting-to detect the presence of any pest
- Pheromone trap
- Soil solarisation



Figure 1. Inside view of greenhouse



Figure 2. Polyhouse - inside view

- d. Sticky traps
- e. Hand picking

3. Biological control

- a. Use of natural enemies

4. Use of botanicals

5. Use of chemicals



Figure 3. Shade/Net house



Figure 4. Poly tunnel inside view

PRECISION FARMING

Precision Farming is a concept of using the new technologies and collected field information, doing the right thing, in the right place, at the right time. “The key concepts in precision farming are- Precision soil preparation, Precision seeding, Precision crop management and Precision harvesting.” Collected information may be used to more precisely evaluate optimum sowing density, estimate fertilizers and other inputs needs, and to more accurately predict crop yields. It helps in avoiding unwanted practices to a crop, regardless of local soil/climate conditions, i.e., it reduces labour, water, inputs such as fertilizers, pesticides etc. and assures quality produce. With the motive of making farming more profitable and risk-free. Govt. of Kerala is also giving priority to Precision Farming.

3.2.2.5 Good Agricultural Practices (GAP), Organic certification

A. Good Agricultural Practices (GAP)

Good Agricultural Practices are “practices that address environmental, economic and social sustainability for on-farm processes, and result in safe and quality food and non-food agricultural products”.

Concept

GAP applies recommendations and available knowledge to addressing environmental, economic and social sustainability for on-farm production and post-production processes resulting in safe and healthy food and non-food agricultural products.

Objectives

1. Ensuring safety and quality of produce in the food chain
2. Capturing new market advantages by modifying supply chain governance
3. Improving natural resources use, workers health and working conditions, Creating new market opportunities for farmers and exporters in developing countries.

Key Elements of GAP

1. Prevention of problems *before* they occur
2. Risk assessments
3. Commitment to food safety at all levels
4. Communication throughout the production chain
5. Mandatory employee education program at the operational level
6. Field and equipment sanitation
7. Integrated pest management
8. Oversight and enforcement
9. Verification through independent, third-party audits

B. Organic certification

It is a certification process for producers of organic food and other organic agricultural products. In general, any business directly involved in food production can be certified, including seed suppliers, farmers, food processors, retailers and restaurants.

Organic certification means having the farm and the farmer's methods inspected by an organic certifying group to ensure that they comply with the guidelines on organic farming.

Organic certification improves the image of organic agriculture and provides transparency in certification. For gaining consumer's confidence, valid organic certification is an essential pre-requisite for marketing especially in the export market. Generally organic certification involves many standards, inspection and certification. Certification is a procedure by which a third party gives a written assurance that a product, cause or service is in conformity with certain standards. *Organic standards are defined as minimum production practices including storage, transportation, processing, handling, packing and labelling requirements which must be followed for certifying the products as organic.*

Certification process focuses on the methods and materials used in production. There are two main requirements.

1. The methods and materials used in production must meet organic standards.
2. There must be clear and ongoing documentation of these methods and materials.

Certification in India

The Ministry of Commerce launched NPOP (National Programme for Organic Production) in March 2000, designed to establish national standards for organic products, which could then be sold under the logo “India organic”. For the proper implementation of NPOP, NAPP (National Accreditation Policy and Programme) has been formulated with Accreditation Regulations announced in May 2001. These make it mandatory that all certification bodies whether international or foreign operating in the 150 country must be accredited by an Accreditation Agency. There are six accreditation agencies in India:-

1. Agriculture Processed Food Products Exports Development Authority (APEDA).
2. Coffee Board.
3. Spices Board.
4. Coconut Development Board (CDB)
5. Tea Board.
6. Directorate of Cashew and Cocoa Development.

APEDA has recognized the following Inspection Certification bodies, all of these are able to certify based on the NPOP:

1. *BVQI (India) Pvt. Ltd (Mumbai)*
2. *Ecocert (Aurangabad)*
3. *IMO control private limited (Bangalore)*
4. *Indian organic certification agency (Indocert, Aluva)*
5. *International Resources for farmer trade members*
6. *Lacon quality certification Pvt. Ltd (Theepany, Kerala)*
7. *National organic certification Association Pvt. Ltd (Pune)*
8. *One Cert Asia Agri Certification Pvt. Ltd (Jaipur)*
9. *SGS India Pvt. Ltd (Gurgaon)*
10. *Skal International (Bangalore)*
11. *Uttaranchal State Organic Certification Agency (Uttaranchal).*

Many of the Indian farmers are small scale, poor farmers who may not be able to afford the cost of certification. Private certification bodies are creating International control systems and participatory guarantee system as alternative means of certification to reduce the cost of certification.

Detailing of practical

3.2.3.1. Visit to protected cultivation farm and prepare layout/design

Assessment Activity

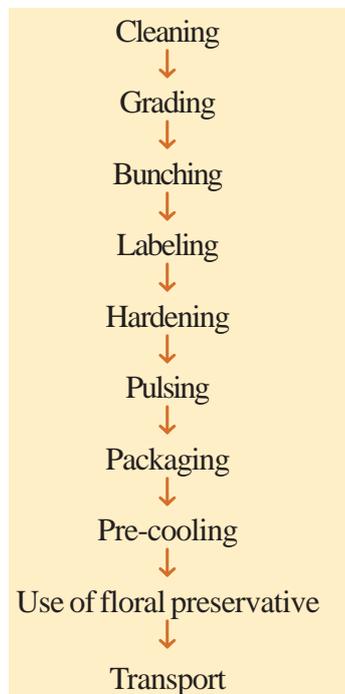
The students are asked to conduct a debate on the pros and cons of protected cultivation –whether it is suitable for our conditions, what are the problems that may arise in protected cultivation in Kerala, etc.

TE questions

- 1) You have visited a greenhouse during our OJT. What are the different things you noticed that are important while designing a green house?
- 2) Can you cultivate all the traditional crops of Kerala in protected cultivation system? Explain your answer.
- 3) Your friend heard a new term “GAP” while attending an agricultural seminar. He wants to know more about it. Explain the concept of GAP to him.
- 4) In your locality a large number of farmers are converting to organic farming. Prepare a leaflet to distribute among the farmers to create awareness about the importance of organic certification.

Unit 3.2.4. Post harvest handling and value addition

3.2.4.1 Steps in post harvest handling of flowers and techniques to improve vase life of flowers.



POST HARVEST TREATMENT OF CUT FLOWERS

To prolong the shelf life of cut flowers, the following methods are adopted.

1. Dipping the stem of cut flowers in hot water for 20-30 seconds.
2. Dipping the flower stalks in dilute acids like nitric acid.
3. Splitting the stem of woody flowers before placing them in cold water.
4. Addition of sugar.
5. Using chemicals like KCl, Aluminium sulphate, Ferric oxide, Sodium hypochlorite. Commercial preparations are available- Floralife, Everbloom, Bloomlife.
6. Remove the stamens from the flowers when they open.
7. The technique of “pre-cooling” of the bud is used before shipment for prolonging its life.

Home remedies for prolonging vases life

The vase containing flowers should not be placed near a fire or under an electric fan circulating hot air. To improve relative humidity the blooms may be misted with clean and cool water. After harvesting the cut end of the flowers should be immediately immersed in clean water. Every day a portion of the cut stem end should be cut again under water and replaced without exposing this to air. A little amount of sugar added to the vase water may improve keeping quality. A very dilute solution of copper sulphate added to the water may check rot due to fungi.

Prolonging the vase life of flowers

How long the flowers kept in the containers remain fresh is referred to as vase life of flowers. This is dependent upon many factors like temperature, relative humidity, light, air velocity, composition of the holding water etc. The vase life can be extended by the following methods.

Prevention of pollination

Flowers begin to fade after fertilization. Therefore main purpose is to delay this natural process. This explains why double flowers keep longer than single flowers. To prevent pollination, the easiest way is to remove the stamens from the flowers when they open. By this method, the vase life of Lily flowers could be extended by 10 days.

Prevention of blocking of the conducting vessels of the flower stalks

Air pockets sometime block the conducting vessels, thereby causing the flowers to fade quickly. Blocking can be prevented by the following methods.

- By dipping the stems of cut flowers in boiling water for 20 -30 seconds. (e.g. Rose, Iceland poppy, Dahlia, Zinnia, Chrysanthemum, etc.)
- By burning the stems of the cut flowers for 15 seconds (e.g. poppy)
- By dipping in dilute acids like N/500 nitric acid.
- Splitting the stems in woody flowers like hydrangea, Rhododendron before placing them in cold water.
- Sometimes blocking is also due to bacterial growth at the cut end.

This can be prevented by any copper fungicide treatment or by dropping a copper coin into the vessel.

Use of preservative solutions has been known for many years in lengthening the vase life of cut flowers. Preservatives normally include sugars, biocide, anti-ethylene compound and hydrated compound. Silver thio sulphate is an anti-ethylene compound in the preservative solution while quinoline compound is a biocide.

PACKAGING OF CUT FLOWERS

The main principles of packaging aimed towards long storage life and keeping quality are to lower the rate of respiration, transpiration and cell division during transportation. An ideal package should have the following qualities to fulfil the above requirements:-

1. Small volume
2. Air tight
3. Water-proof or non-water absorbent and
4. Strong enough to withstand handling.

When cellophane or polythene is used, besides maintaining relative humidity because of its gas-proof nature, it helps to maintain a high level of CO₂ concentration which in turn keeps the respiration rate low. As the stems are unable to draw water directly during transit, the relative water deficiency will result in slowing down of cell division and thus prevent ageing. The most suitable package material for cut blooms is hard cardboard boxes which are cheap, light weight, easy to handle and cost less for transportation.

3.2.4.2 Steps in post harvest handling of Fruits and Vegetables

Process of post harvest handling of fruits/vegetables



3.2.4.3. Value addition of flowers

I. Flower arrangement

It can be fresh flower/ dry flower arrangements.

Fresh flower arrangements- two different approaches to floral designs: western styles, employing a 'mass' concept of arranging flowers in an even symmetry, and the eastern or Japanese or Ikebana styles, which are based on specific rules and angles, using less material.

Some of the basic differences between eastern and western arrangements are:-

- * Primarily western style is symmetrical arrangement, but eastern style is asymmetrical one.
- * Western arrangements employ more flowers to create mass effect, but eastern styles impress more by the beauty of individual material.
- * Contrary to western arrangements the materials in Japanese never touch the rim of the vase.

- * Accessories are never used in western arrangements. But in Ikebana interesting branches, drift wood, pieces of bark, shells etc., are used to imitate the nature. Here the more emphasis is given on western arrangements.

Principles of flower arrangement

1. Emphasis

It is achieved by creating a focal point

2. Balance

A balanced arrangement has a distinct focal point. Balance may be symmetrical or asymmetrical

3. Proportion

Proportion is acquired by scaling the flower from the focal point. That is the smallest buds are placed farthest from the focal point.

4. Rhythm

Rhythm is achieved through colour gradation of flowers.

5. Harmony

6. Unity

Selection of flowers and foliage for arrangements

1. Line flowers

Line flowers help to create outline of the design. Eg: gladiolus, orchid.

2. Form flowers

Form flowers help to create focal point. Eg: anthurium, orchid, tulip.

3. Mass flowers

Mass flower have single stem with 2-3 small medium flowers at the top these add depth to the arrangement. Eg. Rose, chrysanthemum, aster

4. Filler flowers

These add finishing touch.

- a. Mass foliage. eg. Gladiolus, Palm
- b. Filler foliage. eg. Asparagus, ferns

A. Western Style

1. Circular design

This design is meant to be viewed from all sides and makes an excellent centre piece for a low table. It lacks focal point.

2. Triangular design

These are constructed by first by determining the height and width of the arrangement. An equilateral triangle shaped arrangement will be equally as tall as its width. An asymmetrical triangle will be constructed in a similar manner except that the height and width of the arrangement will be altered.

3. Radiating design

It has the general outline of a fan. Line flowers or foliage are used to form the outline.

4. Crescent design

It has a naturally free flowing outline which has a formal appeal

5. Horizontal design

It makes an excellent centre piece because it is beautiful when viewed from either the front or the back. The height of the arrangement is reduced so that the horizontal length becomes 1/2 to 2 times the length of the containers.

6. Hogarthian curve

It is a sophisticated asymmetrical design having the outline of an 'S'.

B. Eastern (Japanese/Ikebana) style

Ikebana is the Japanese art of flower arrangement, also known as *kado*, the “way of flowers”. More than simply putting flowers in a container, ikebana is a disciplined art form in which nature and humanity are brought together.

Ikebana arrangement are of two types
Moribana and Nageire

The word *Moribana* means “piled up flowers”. In Moribana, the flowers are arranged in wide-mouthed containers, held by needle points. Moribana employs the use of basins while Nageire uses vase. In Nageire style the flowers are arranged in a narrow-mouthed, tall container without using needlepoint holder(s). This style is about arranging in natural state. People commonly see them arranged in bamboos or water pitchers.



Moribana



Nageire

II. Dry flower arrangements

Advantages of dried arrangement over fresh flowers

- It is not dependent on season or weather if once good materials are collected- Available year round.
- It lasts almost indefinitely.
- Cheaper
- Eco friendly and biodegradable
- Easy to transport. Can survive heat and cold.
- Number of value added products can be made.

Materials for dried arrangement

The materials usually employed for dried arrangement can be grouped into three categories as follows.

- Cultivated flowers and vegetable including seed, pods, vines and grains.
- Naturally available materials like flowers, seed pods, fern leaves, certain weeds and grasses.
- Pods, cones, capsules, fruits, branches, leaves, berries and flowers of broadleaved evergreen trees and shrubs.

Preservation of Plant materials for dry arrangement

Flowers dried in their natural colour offer a very good scope for export. There are a few methods of preserving flowers and foliage.

i. Hanging upside-down

Many flowers dry best by this method. It is the easiest method and is preferable to those materials which keep their shape and do not fall apart while drying. Materials intended for drying are tied and allowed to hang upside down from string without touching each other.

ii. Embedded drying

Burying in sand or borax or Silica Gel: Fine and dry sand are poured to a depth of 10 cm into a box or pan. The flowers which should be dry are stripped of all foliage and may be kept upside down on the sand and then covered with a layer of sand over them. After two weeks of time, the sand may be poured off carefully and

the flowers may be taken out after gently wiping them free of sand with a soft brush. They are then ready for arrangement. Borax may be used in almost the same way as sand and is a good medium for preserving materials when space is limited. Alum and silica gel are also used in the place of borax. The form of flowers are also well preserved in borax method. Candytuft, daisies, marigold, narcissus, chrysanthemum, snapdragons, sunflowers, Tithonia, all roses and coleus leaves dry well in sand or borax.

iii. Glycerin method

This method is used for foliage only. The clean foliage materials are kept inside a jar with the stem dipped 5cm in a solution made up of 2/3 of warm water and 1/3 glycerin. The material has to be kept there till full absorption has taken place. It takes atleast two weeks for most materials to do so. Materials so preserved keep well for 5 to 10 years

iv. Freeze drying

Excellent quality material is produced in this method. The flowers are arranged in lyophilizer and temperature is maintained upto -7°C so that all the moisture is converted to ice. Frozen ice crystals are then sublimed with the application of heat. A vacuum pump slowly pulls out the water as vapour.

v. Water drying

It is most suitable for flowers where shattering of petals occurs after drying. The stems of the flowers are placed in water at few inches depth where water is taken up by the cut flowers to keep the petals intact. The container and flowers should be kept in a dry, warm and dark location for 7-10 days to dry naturally. e.g. Hydrangea, celosia

vi. Oven drying

Electrically operated hot air oven retain temperature of $40-50^{\circ}\text{C}$ is used for drying flowers. Microwave oven is a fast method and the product quality is better. The flower has to be embedded in a silica gel medium in a microwave safe open container and kept in micro wave along with a small cup of water nearby.

vii. By using a book

Pressing leaves and flowers can also be preserved by pressing between several thickness of newspapers and some heavy object is kept over them. It takes about three weeks for complete drying.

III. Bouquet

According to shape Bouquet classified into :

a. Flat type

For making a flat bouquet a hard poster paper in any colour matching with flower colour can be used. (Length 45 – 75 cm). It is given a conical shape and over this poster paper, aluminum foil may be laid to make the bouquet colourful. The spikes are laid flat over this paper. The stems may be held in position with the help of cello tape against the paper backing. Ornamental foliage such as thuja, polyalthia can be spread over the paper before arranging the flower stems. Cut end of the flower stems should be preferably wrapped with wet moss with the help of some aluminium foil to prevent the leakage of water. The stems are tightly tied with twine to prevent displacement and twine is covered with silken ribbon.

b. Round shape

Flowers are arranged in whorl, which takes the shape of a cone, the stem end becoming tapering while the flower end come in a round whorl. Once the flowers are arranged, on the outer whorl, some ornamental foliage is backed up to make the bouquet decorative and firm. Thuja, polyalthia, croton etc can be used. The base of the bouquet is tied firmly with gunny twine which is then covered with a silk ribbon. Wet cut end of the flower stems should be preferably wrapped with wet moss with the help of some aluminium foil to prevent the leakage of water. The stems are tightly tied with twine to prevent displacement and twine is covered with silken ribbon.

c. Basket type

A nice basket is selected in which the foliage and flowers are arranged. Inert material like colored tissue paper, ribbons, driftwood can be used. Flowers are cut at different length so that the flowers in the basket are at various levels adding artistic touch to the bouquet. Various types of ornamental leaves can also be added to the bouquet. To keep the flowers fresh for a long period, put a small ball of cotton at the end of the stem and wrap the ball with a small piece of polythene.

IV. Perfumes, Dyes and Essential Oils

In India, flower crops grown for essential oil production include mainly rose, jasmine, tuberose, etc. Rosa damascene is exclusively cultivated for extraction of essential oils, rose water, attar, gulkhanda etc. in some areas of Rajasthan and Uttar Pradesh. Natural dyes are made from flowers e.g. marigold. Marigold pigments are widely used in poultry industry to enhance the colour of meat and yolk of the eggs and also used in food and textile industry.

V. Various Value added products of flowers

1. Wreath

It is a band of flowers or foliage inter-twined into a ring, usually placed on a grave as memorial or worn on the head as a garland or mark of honour.

2. Buttonhole

A small flower or a bunch of flowers worn in a buttonhole or pinned to the lapel of a coat/jacket is known as buttonhole.

3. Corsage

It is a small arrangement of flowers which is more elaborate than a buttonhole and is worn by women on special occasions like anniversary celebration, wedding etc. A corsage may be worn pinned to the chest, or tied to the wrist.

4. Floral gifts

Gifts made from flowers either fresh or in dried form are known as floral gifts. These include flower bouquets, floral containers, paper weights, bookmarks, photo frames, tablemats, potpourris etc.

5. Potpourri

Potpourri is a mixture of dried, sweet-scented plant parts including flowers, leaves, seeds stems and roots. Apart from being widely used for fragrance and beauty, potpourris are also used to repel moths and protect woolen in storage. The basis of a potpourri is the aromatic oils found within the plant. Preparation of potpourri require a fixative which is responsible for absorbing the aromatic oils and slowly releasing them. The demand for potpourris (also used as room fresheners) is increasing as gift item and personal use. Rosepetals, gomphrena, marigold petals, lotus pods are ideally suited for making potpourris. Herbs such as Artemisia, Thyme, Sage, Rosemary, Basil, Achillea, Lavender, Scented geranium, Mint, Marjoram, Verbena, Anise and Fennel can be used for scent.

6. Petal embedded handmade paper

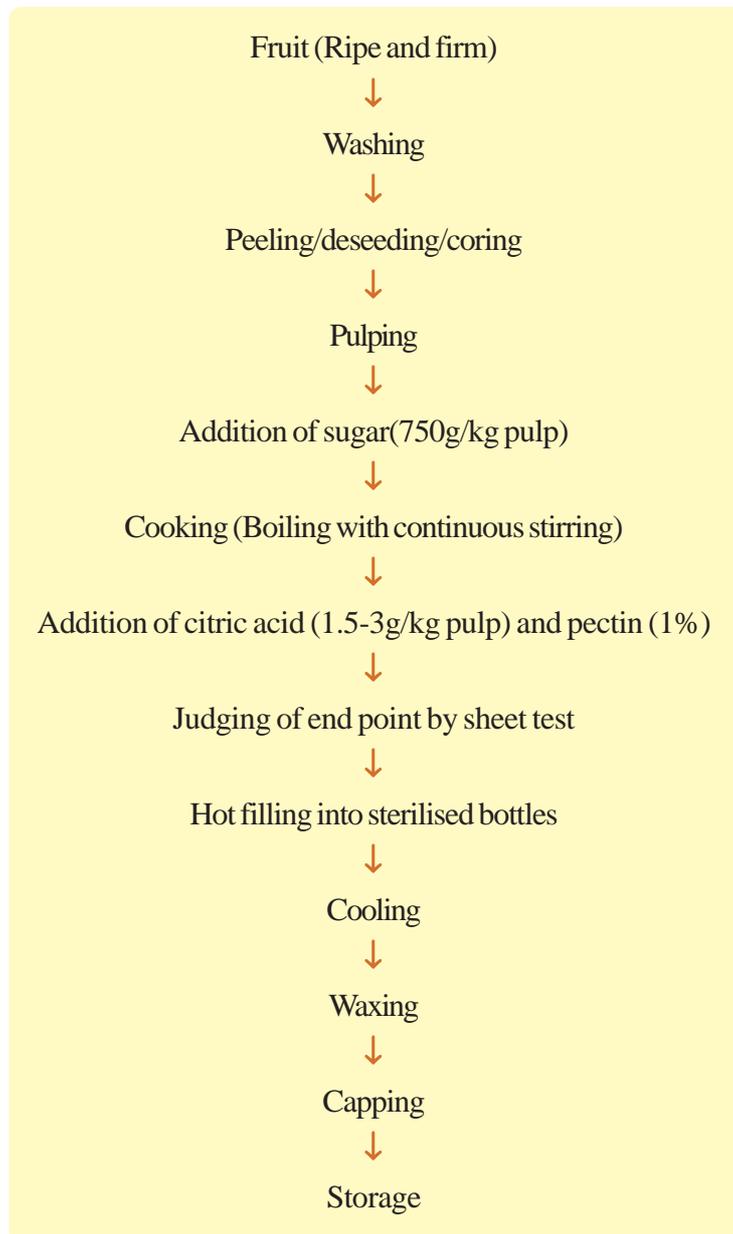
The surplus flower petal waste can be added to the pulp to create some of the exquisite stationary items like notepads, letter pads, pen stands, diaries, calendars, bags etc. These products give unique look and attract customers to buy.

7. Pankhuri

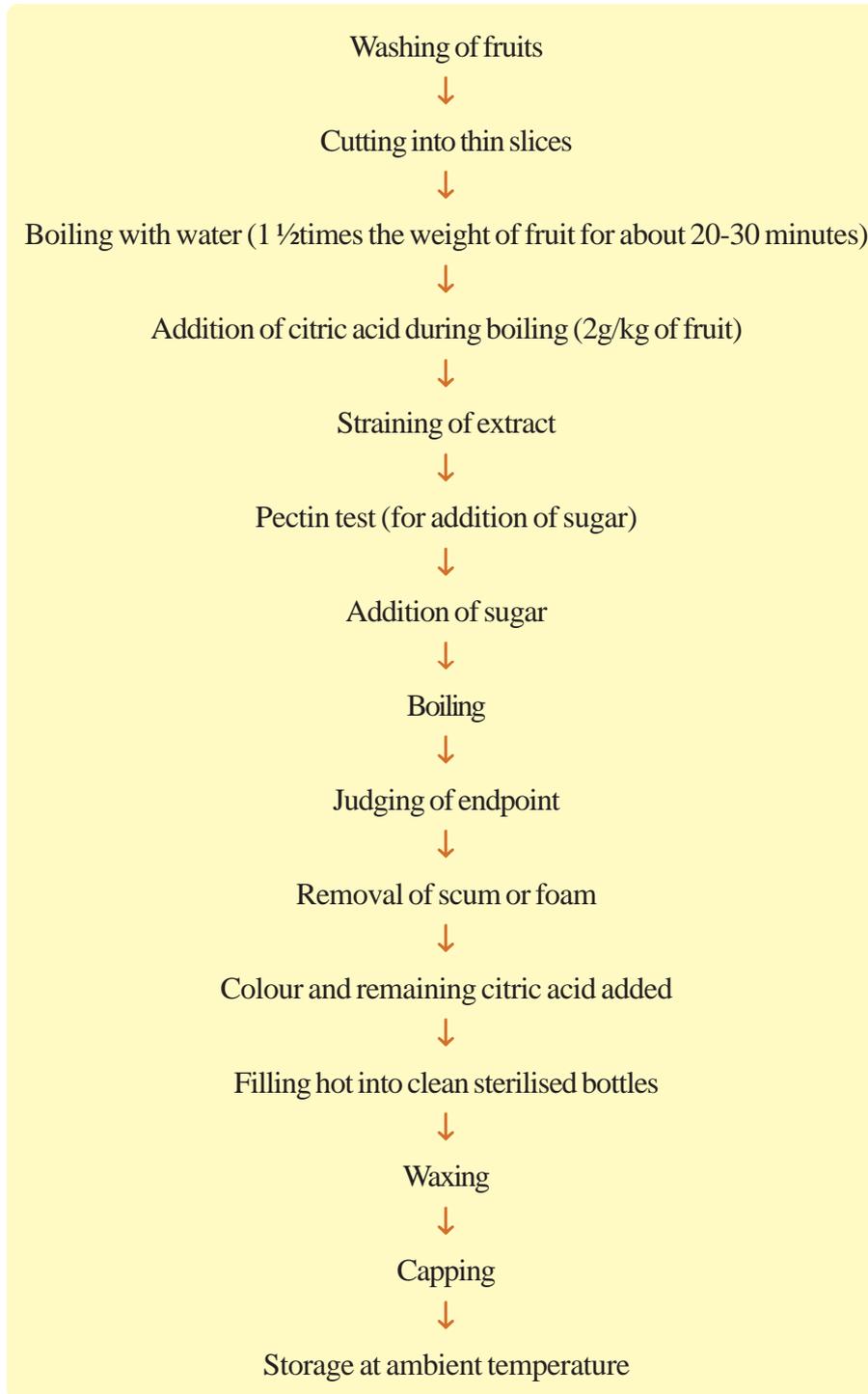
Dried rose petals are called pankhuri. They are used during hot weather for preparing cool drinks.

3.2.4.4 VALUE ADDITION OF FRUITS

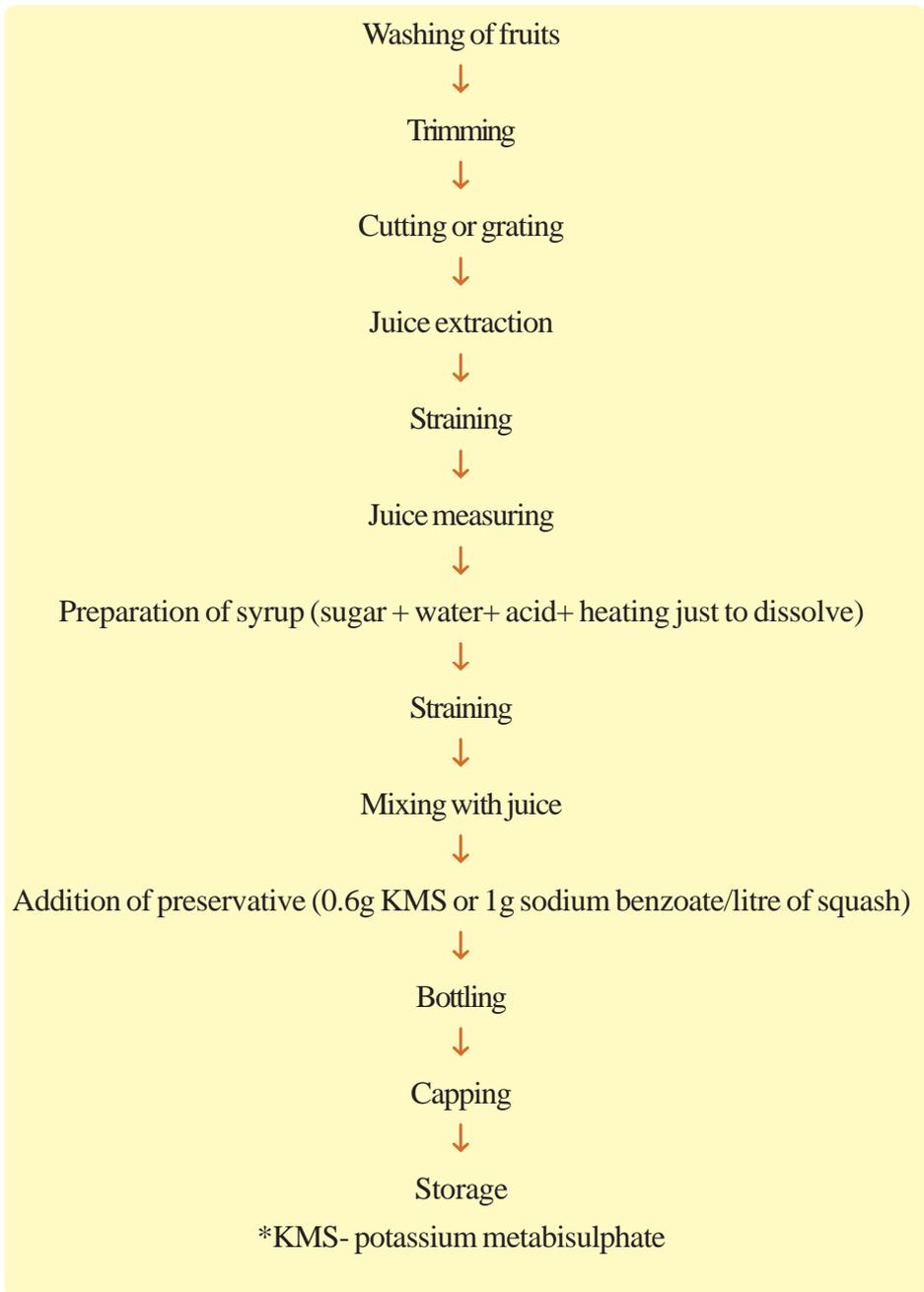
3.2.4.4.1 Process of preparation of Jam



3.2.4.4.2 Preparation of jelly

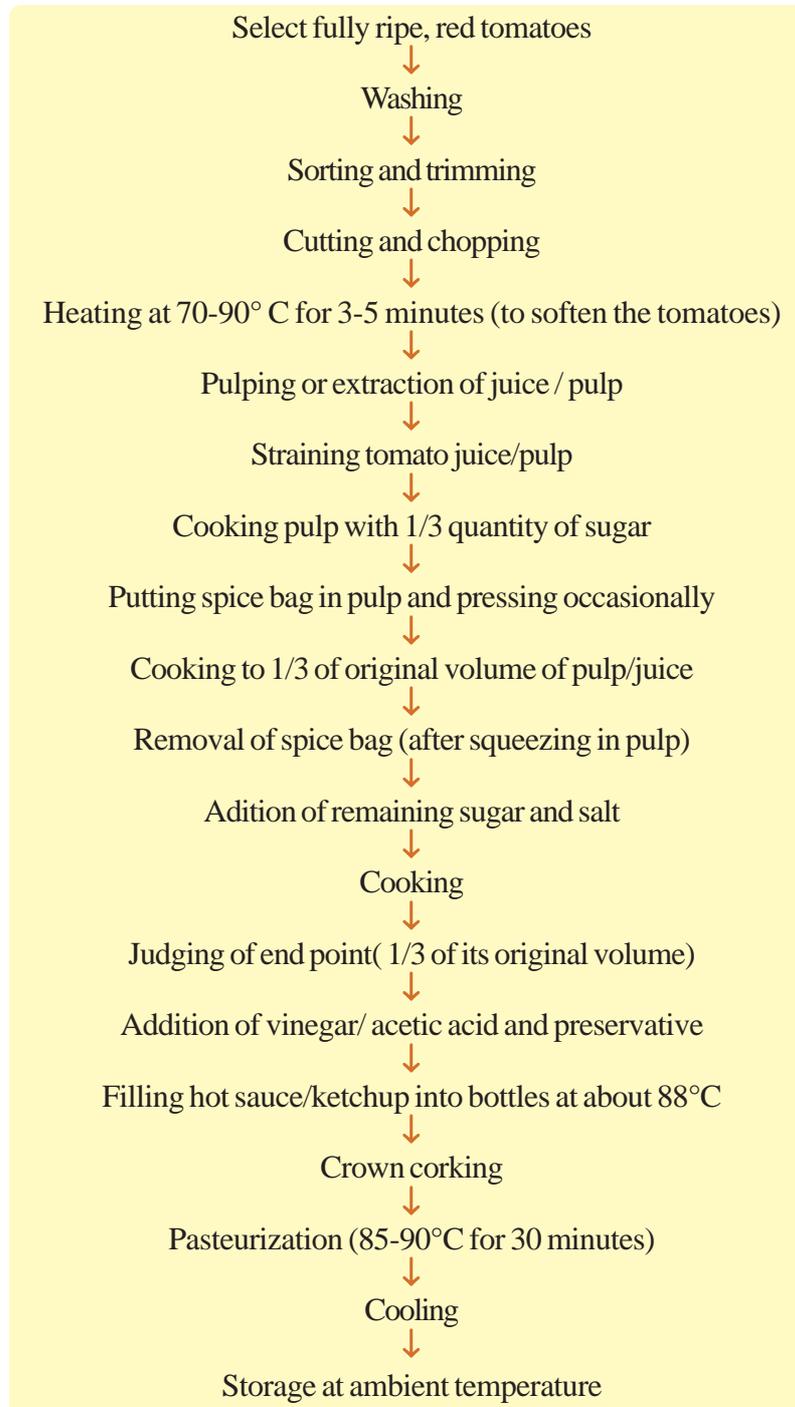


3.2.4.4.3 Preparation of squash

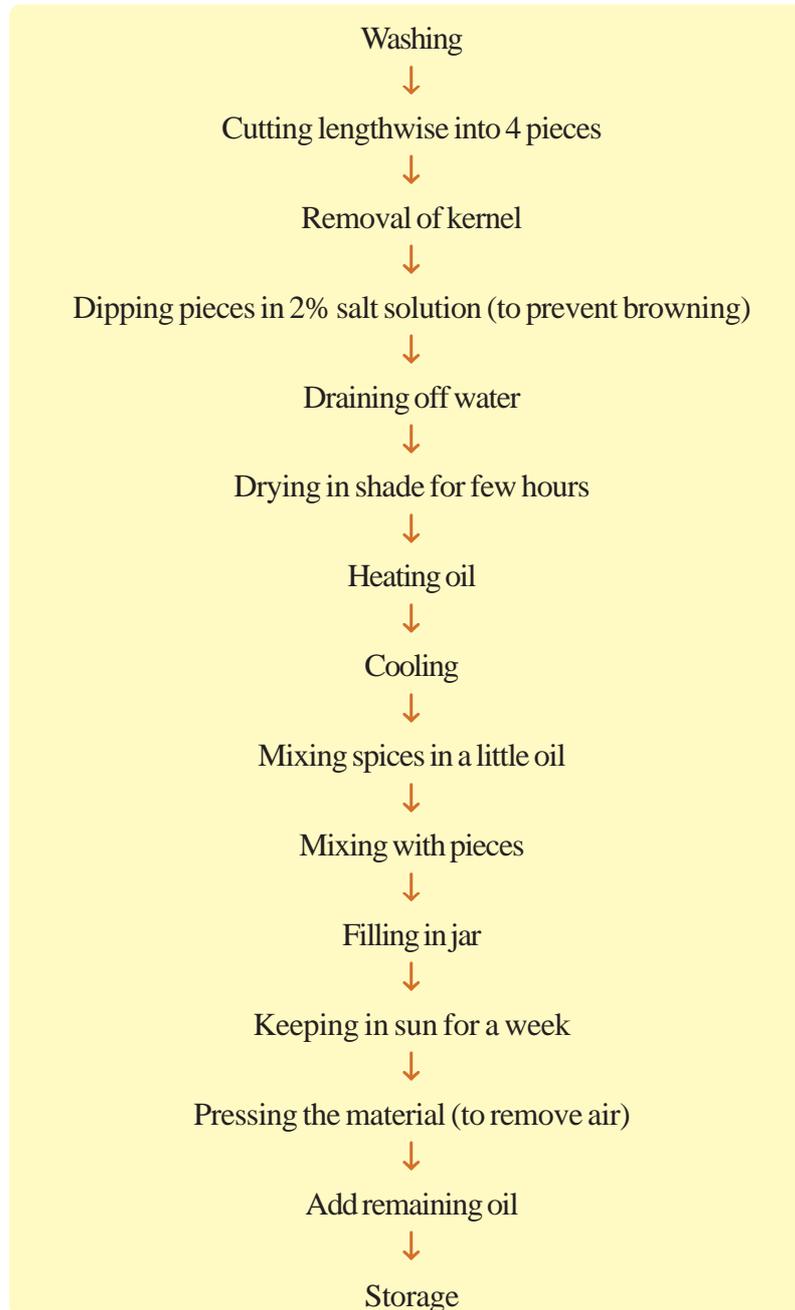


3.2.4.5 Value addition of vegetables

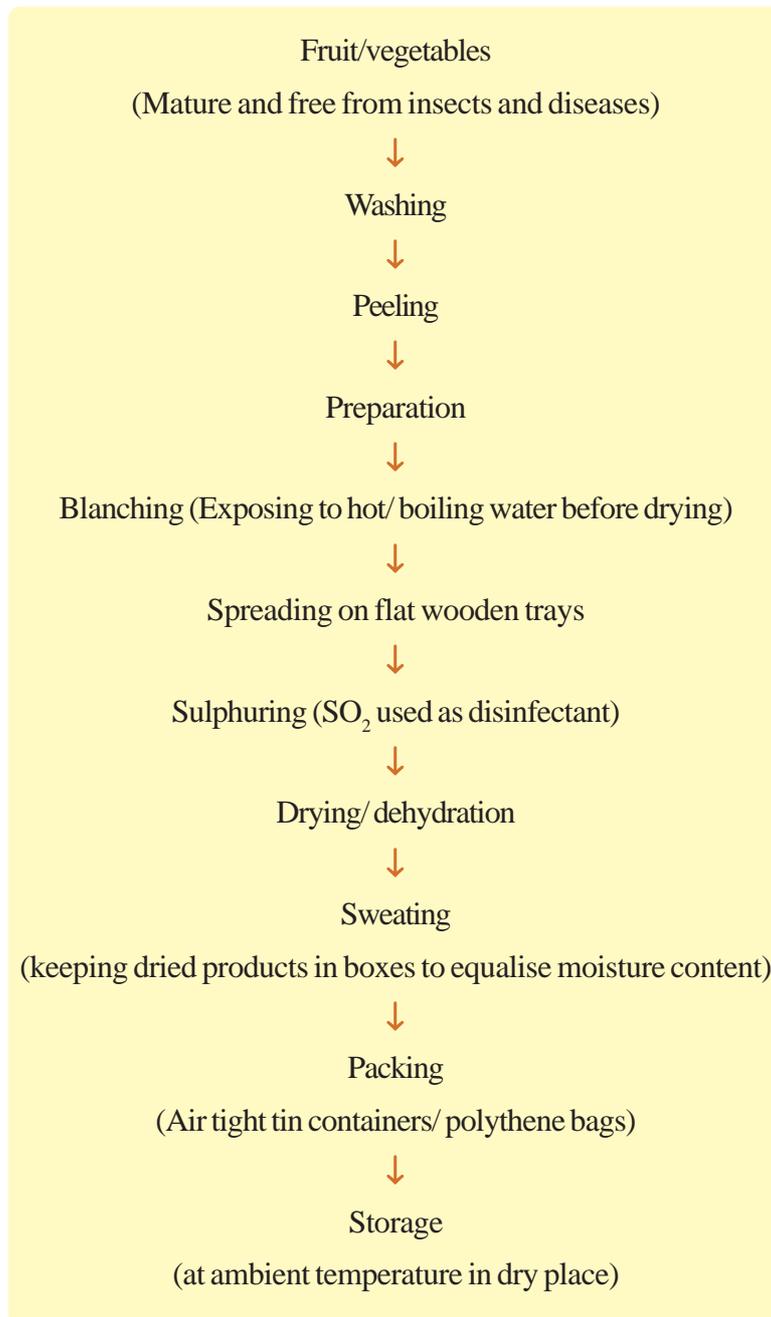
3.2.4.5.1 Process of making tomato sauce/ketchup



3.2.4.5.2 Process of making pickles (Mango)



3.2.4.5.3 Process of drying/ dehydration of fruits and vegetables



VEGETABLE AND FRUIT CARVING

Vegetable and fruit carving is the art of carving vegetables and fruits in a way that is pleasing to the viewer. It is now used in many different locations such as cruises, hotels, restaurants, and other elite dining places.

Detailing of practical

- 3.2.4.1. Different styles of Flower arrangement
- 3.2.4.4. Bouquet making
- 3.2.4.5. Preservation of fruits and vegetables (jam, jelly, squash, Preparation of pickle, sauce/ketchup)

Assessment Activities

- Collect data on the common techniques of drying fruits and vegetables, dry preservation of fruit juices etc.
- Prepare dried leaves/flowers.
- Prepare jam/jelly using locally available fruits.
- Prepare pickles/ sauces using locally available vegetables.

Sample Questions

1. You are assigned to prepare a flower arrangement for a round-table meeting of dignitaries. Explain the type of arrangement you will prepare.
2. You have received orders for flower arrangements for a function taking place in a town at a large distance from your place. Also the function lasts for several days but you can't stay there to renew the flowers every day. Can you suggest a solution to this situation. Explain the method.
3. Show the steps in post harvest handling of flowers in a flow chart
4. Explain the techniques to improve the vase life of cut flowers
5. What are the steps in post harvest handling of fruits and vegetables and show in a flow chart
6. You are asked to conduct a demonstration class to the Kudumbasree members on Ikebana. Prepare a leaflet on this topic for distribution among the members
7. A high school student saw a dry flower arrangement in a flower show. He wants to know how the dried plant material are prepared. Explain the methods of preservation of plant material to him.
8. Your friend is a commercial flower grower. Now he is selling the flowers as such. Suggest some methods of value addition of flowers to improve his income.



UNIT 3.3

OTHER ENTERPRISES

Some suitable agri business enterprises for Kerala other than that mentioned in the previous unit are discussed here. These include tissue culture, vermicomposting, mushroom cultivation, apiculture, sericulture, indoor gardening, bonsai, aquaponics and vertical gardening. Most of these enterprises can be taken up on a small scale and are also suitable for rural self employment and women empowerment.

Learning Outcome

The Learner :

- defines and explains the basic principles of tissue culture, equipment, steps and familiarises tissue culture techniques of banana.
- practise mushroom cultivation.
- practise vermicomposting.
- defines and explains the concept of indoor gardening and familiarises with suitable plants, care and maintenance.
- defines and explains the basics and techniques of bonsai making – identifies different styles of bonsai.
- practise apiculture
- practise sericulture
- defines and describes aquaponics and vertical gardening

1. Tissue culture

Basic principles of tissue culture

Micro propagation refers to the development of new plants in an artificial medium under aseptic conditions from very small pieces of plants called explants. An explant may be an a cell, tissue an embryo, seed shoot tip, root tip callus, or pollen grains. Micro propagation is based on the principle of totipotency i.e., the ability of cell to grow into a complete plant.

Advantages of tissue culture

1. Large number of plants can be produced from a single cell within a short period of time.
2. Production of disease free and disease resistant plants
3. True to type plants can be obtained.

3.3.1.1 Equipment and materials used in tissue culture

1. Laminar air flow chamber

This chamber is useful to perform all operations in aseptic condition. Sterilization is achieved by the ultra violet germicidal lamp fitted in it and by the flow of filtered air towards the person doing the operations, which prevents dust particles which carry micro organisms from settling on the explants.

2. Autoclave or pressure cooker

It is used to sterilize the media, containers, petridishes and the various accessories required. Normally sterilization is done for 15-20 minutes at 121-144 °C.

3. Alcohol lamps, disinfectants and sterile water

These are used for avoiding contamination.

4. Culture medium

A medium consists of mineral salts, carbon and energy source, vitamins, plant growth regulators and other organic components. The most commonly used medium is Murashige and Skoog medium (MS medium).

3.3.1.2 Procedure for Micropropagation

1. Collection of explants

Small piece of plant used to begin a culture is referred to as explants. Explants are collected in containers having sterile water.

2. Surface sterilization

Collected explants are surface sterilized with sterilants such as Sodium hypochlorite (0.5-2 %), Calcium hypochlorite (5-10%) or mercuric chloride 0.1%. Then the explants are rinsed 3-4 times with sterile distilled water.

3. Inoculation

Transfer of the explants into the culture medium is known as inoculation. This must be done in aseptic condition. This is achieved by surface sterilization of the working table of the laminar air flow chamber with absolute alcohol followed by UV light for 30 mts. The forceps and scalpel used for inoculation besides the petridishes are also first steam sterilized in an auto clave at 121°C for 15 minutes and later flame sterilized before each inoculation. The hand should be cleaned with alcohol before use. The cultures are then incubated at 28°C in an air conditioned culture room with 16 hours photoperiod (1000 lux) supplied by cool fluorescent lamps.

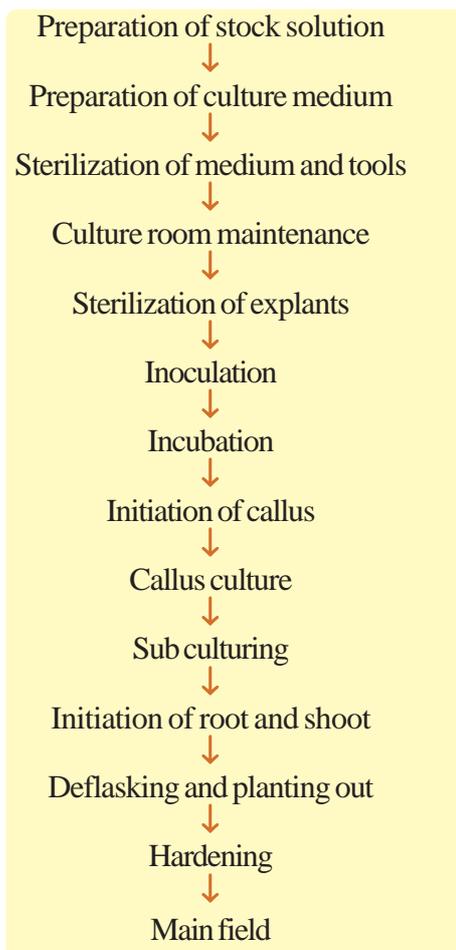
2. Sub culturing

After inoculation, the explants increase in volume. At this stage, it is divided into different components or parts and transferred into fresh medium under sterile condition. This process is known as sub culturing. This sub culture mass should produce a shoot and root system which is dependent upon the type of growth regulator and its concentration used in the medium.

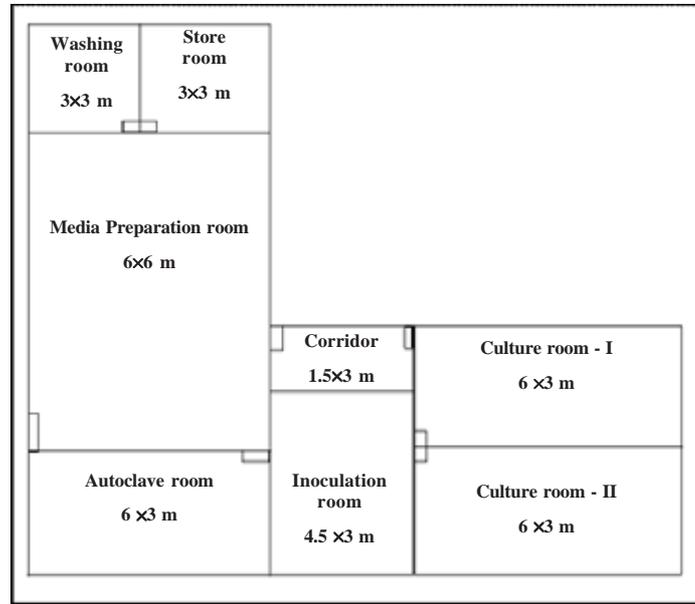
3. Hardening

The plantlets developed in the culture tubes are acclimatized to a specific environment having a high humidity, low light level and constant temperatures. The plantlets are washed and transferred to containers kept in mist chambers. Once new growth is seen, the plants may be slowly transferred to outside by exposing to increased light intensity in stages.

Steps in tissue culture



3.3.1.3 Layout of a tissue culture unit



3.3.1.4 Tissue culture techniques of banana

The 'banana tissue culture propagation' is now an established and popular technology due to the advantages it offers such as : large-scale production of disease-free planting materials, comparatively uniform plant-stand in the field, early harvesting of superior fruit bunches, round the year availability of the planting materials etc.

General steps involved

The banana tissue culture process involves

- Initiation of aseptic cultures from shoot-tips obtained from disease-free banana plants.
- Multiplication of the shoots to the desired scale.
- Induction of roots to individual shoots.
- Primary & secondary hardening of the tender plantlets in the poly-house.
- Field-transfer of the hardened tissue culture plants.



2. Mushroom cultivation

Mushroom is the fruiting body of the fungus. Vegetative part is mycelium, consists of fine threads running all over through the material upon which it is growing. Mushroom protein is comparable with muscle protein. Mushroom is rich source of protein, vitamins, folic acid etc.

Edible mushrooms

- Oyster mushroom – *Pleurotus* sp
- Milky mushroom – *Calocybe* sp
- Paddy straw mushroom – *Volvariella* sp

Spawn production

Spawn is the mushroom seed. To produce this, paddy straw is chopped into bits of 2-5 cm length, filled in bottles and compacted. Clean water is poured into bottles and soaked for 12-16 hrs. Change the water one or two times. When paddy straw gets completely soaked, drain excess water. Add a tea spoon full of red gram powder. This is to allow initial growth of the fungus. Bottle is then plugged with non-absorbent cotton. The bottle is sterilized by autoclaving. Then inoculate the bottle with pure culture of fungus. Fungus grows on straw, within 20-25 days covers the entire bottle. Chlamydospores are produced. Thus the seed mushroom ready. For oyster mushroom, instead of paddy straw wheat grains are used.

Method of cultivation of Oyster mushroom

A short duration variety 'Ananthan' introduced by KAU is widely used for cultivation. 1 Kg of one year old paddy straw is cut into small bits of 5-8 cm length and kept in water for 18 hrs. Soaked straw is taken out of water and kept inside a basket for 1-2 hrs to drain away excess water. The soaked straw kept under boiling water for 30-40 minutes for surface sterilization. Keep this in basket. Allow to drain excess water and cool down. Then fill this straw up to 5cm height in polythene bags of 30 × 60cm size and 150-200 gauge thickness. Instead of chopped straw, bundles of straw can be used. Press well with hand. Then sprinkle one table spoon full of spawn over the filled straw around the peripheral region. Again second layer of straw is filled, press well and sprinkle spawn. This process is repeated till it reaches the mouth of the cover. Then bag is tied tightly with twine. Keep undisturbed for about 15-20 days, under thatched rooms, well ventilated with rat proof. Ideal temperature is 28-30°C and humidity 80-85%. Good spawn run can be judged from the whitish growth covering the straw completely. After 15 days, remove the

polythene bag by cutting with blade. Pinhead formation starts on 20th day onwards. It will take 2-3 days for full development of mushroom. Harvesting can be continued up to 2-3 weeks with occasional sprinkling of water.

- Pests – Phorid flies, cecid flies, mites, spring tails etc.
- Fungal diseases – soft mildew, wilt, brown spot etc.

3. Vermicomposting

Vermi-technology is a process by which all types of biodegradable wastes such as farm wastes, kitchen wastes, market wastes, bio-wastes of agro-based industries, livestock wastes etc. are converted to nutrient rich vermicompost by using earthworms as biological agents. Vermicompost contains major and minor nutrients in plant-available forms, enzymes, vitamins and plant growth hormones. *Eudrillus eugineae* has been identified as the best species of earth-worm for vermi-technology under Kerala conditions.

Vermicomposting of farm wastes

Pits of size 2.5m length, 1m breadth and 0.3m depth are taken in thatched sheds with sides left open. The bottom and sides of the pit are made hard by compacting with a wooden mallet. At the bottom of the pit, a layer of coconut husk is spread with the concave side upward to ensure drainage of excess water and for proper aeration. The husk is moistened and above this, biowaste mixed with cowdung in the ratio of 8:1 is spread up to a height of 30cm above the ground level and water is sprinkled daily. After the partial decomposition of wastes for 7 to 10 days, the worms are introduced @ 500 to 1000 numbers per pit. The pit is covered with coconut fronds. Moisture is maintained at 40 to 50 %. When the compost is ready, it is removed from the pit along with the worms and heaped in shade with ample light. The vermicompost produced has an average nutrient status of 1.5% N, 0.4% P₂O₅ and 1.8% K₂O with pH ranging from 7.0 to 8.0.

4. Indoor gardening-concept, suitable plants, care and maintenance

Concept

Indoor gardening refers to beautifying the areas inside the house with plants. Indoor garden can be taken up in containers made of earthen pot, ceramic pot, hanging baskets, troughs, cane bowls, dishes, trays, terrariums, fish bowls or any containers of cheap cost. Shade loving plants can be usually preferred as house plants. Plants may be chosen for their foliage, flowers, fruits or their attractive forms. According to the availability of light and temperature, we can select plants suitable to the place it is desired to be planted.

Selection of indoor plant

- Indoor plants should be primarily shade loving.
- They should be hardy and easy to grow.
- They should retain the foliage and evergreen
- An indoor plant should be attractive by virtue of its shape or colour.

Classification of indoor plants

1. Foliage plants with attractive forms:-
eg. *Monstera deliciosa*, palms and ferns
2. Foliage plants with glossy appearance.
eg. *Ficus elastica*
3. Ornamental foliage plants
eg. Begonia, Caladium, Calathea, Rhoecoloba etc.
4. Ferns
eg. Maidenhair Fern, Boston Fern.
5. Palms
eg. Table Palm, Red palm
6. Bromeliads
eg. *Tillandsia*
7. Cacti
eg. *Cephalocereus*, Opuntia
8. Succulents
eg. Agave, Aloe, Bryophyllum
9. Flowering Plants.
eg. African violet, Salvia, Begonia
10. Creepers and Climbers
eg. Asparagus, Philodendron
11. Bulbs
eg. Amaryllis, Crocus, Daffodils
12. Plants that need indirect sunlight
eg. Bougainvillea, Euphorbia, Opuntia, Gerbera, Kalanchoe

13. Plants that need direct sunlight
eg. Caladium, Sansivieria, African violet
14. Plants that need poor light.
eg. Dracaena, Calathea

Potting

After selection of plants and container, potting should be done.

1. The container is washed thoroughly.
2. Potting mixture is prepared in the ratio 1:2:1(sand: soil: FYM).
3. Fill the bottom of pot with 2 handfuls of croak pieces.
4. Fill the pots with potting mixture.
5. Plant suitable plants.
6. Irrigate.
7. Repotting should be done once in every 3 years.
8. Repotting and fresh potting should be done preferably during rainy seasons.

Care and Maintenance

1. Acclimatization

If the plant is kept directly indoors, after being brought from the nursery, it may show signs of yellowing, thus the plants should be kept in sunshine on and off and acclimatized. Initially the plant should be kept in partial shade and then slowly in a fortnight or after a month under full shade.

2. Light

The light requirement of each kind of plant has to be assessed and satisfied. Supplementing with a 150 w tube light can be done. Plants growing in verandah should be frequently turned round in their position so as to equalize the effect of light.

3. Water

The indoor plants can generally be under watered than over watered. Watering should be done to keep the soil just moist enough. This can be checked by putting the index finger 1 cm deep into the soil of pot.

4. Syringing

It refers to the operation of spraying the plant surfaces through a fine string nose.

Syringing creates a moist atmosphere, cleans the leaves and thus assists in promoting their functions.

5. Other intercultural operations

This includes pinching, pruning, disbudding, training and cleaning.

6. Pest and disease attack

- a. Use clean cultural practices.
- b. Do not over crowd plants.
- c. Use mechanical methods like hand picking of insects.
- d. Use of organics if required.

5. Bonsai

Bonsai is a Japanese art form using miniature trees grown in containers. The word “Bonsai” originated from two Japanese words- “bon” meaning “shallow” and “Sai meaning “plant”. These dwarf trees are suitable for indoor gardening, providing greenery and natural beauty to the city dwellings with no space for an outdoor garden.

Plants suitable for bonsai

Trees with small leaves are most suitable for bonsai. Some trees suitable for bonsai under Kerala conditions are, Tamarind, Garcinia, Pomegranate, Guava, Gooseberry, Sapota, *Citrus aurantifolia* (cherunarakam), *C. maxima* (kambili narakam), *C. paradisi* (odichukuthinarakam), Caronda cherry, Bilimbi, mango, arecanut palm (dwarf hybrid “heerahalli”), pongamia, duranta etc. The plants can be collected by many methods like:- sowing seeds and raising seedlings, collecting from forests, collecting from buildings (especially *Ficus sp.*), planting stem cuttings, layering, grafting and selecting seedlings from a nursery. The plants should be capable of withstanding heavy pruning, root pruning and training.

Containers

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, oval or square shaped containers with 25 to 30 cm diameters are preferred. In round / square containers the plant is to be in the centre, while in others the plant is placed in the sides of the containers. Earthen pots or cement pots can be used. Mostly terracotta or ceramic containers are used for exhibition purpose. Attractive rocks can also be used instead of pots after making a depression in it. The pots should have holes for draining excess water.

Planting Media

Since the container can hold very little amount of growing medium, the planting media should be prepared properly. Different media are used in various countries. Under our conditions, the potting mixture should consist of 3 parts river sand: 2 parts top soil/rock powder: 1 part cow dung powder/vermicompost. The media should be able to absorb enough water but water logging should be avoided. Media can be covered with moss and one or two pebbles can be placed to give a natural look.

Technique of making bonsai

Trunk and branches may be bent, forced and tied by coiling them with heavy wire. This wire is removed after several months when training to shape has been accomplished. The bonsai plants may be trained to different shapes like twisted trunk, upright, S-shaped, semi-cascade, cascade, slanting or any other formal shape. Remaining of both tips and roots is usually done at planting time and periodically pinching the tip and removing the excess side shoots are essential to maintain the general outline of design. Annually, the plants are either repotted or lifted from the pot, root pruned and reset.

The bonsai plant is fed sparingly of weak fertilizer solution containing major and minor nutrients. Sometimes extracts of oil cakes may be also added. Similarly, the plant is given only minimum required quantity of moisture. It is advisable to water twice a day to plants kept in shallow containers and once a day to plants kept in deeper pots.

Potting and repotting

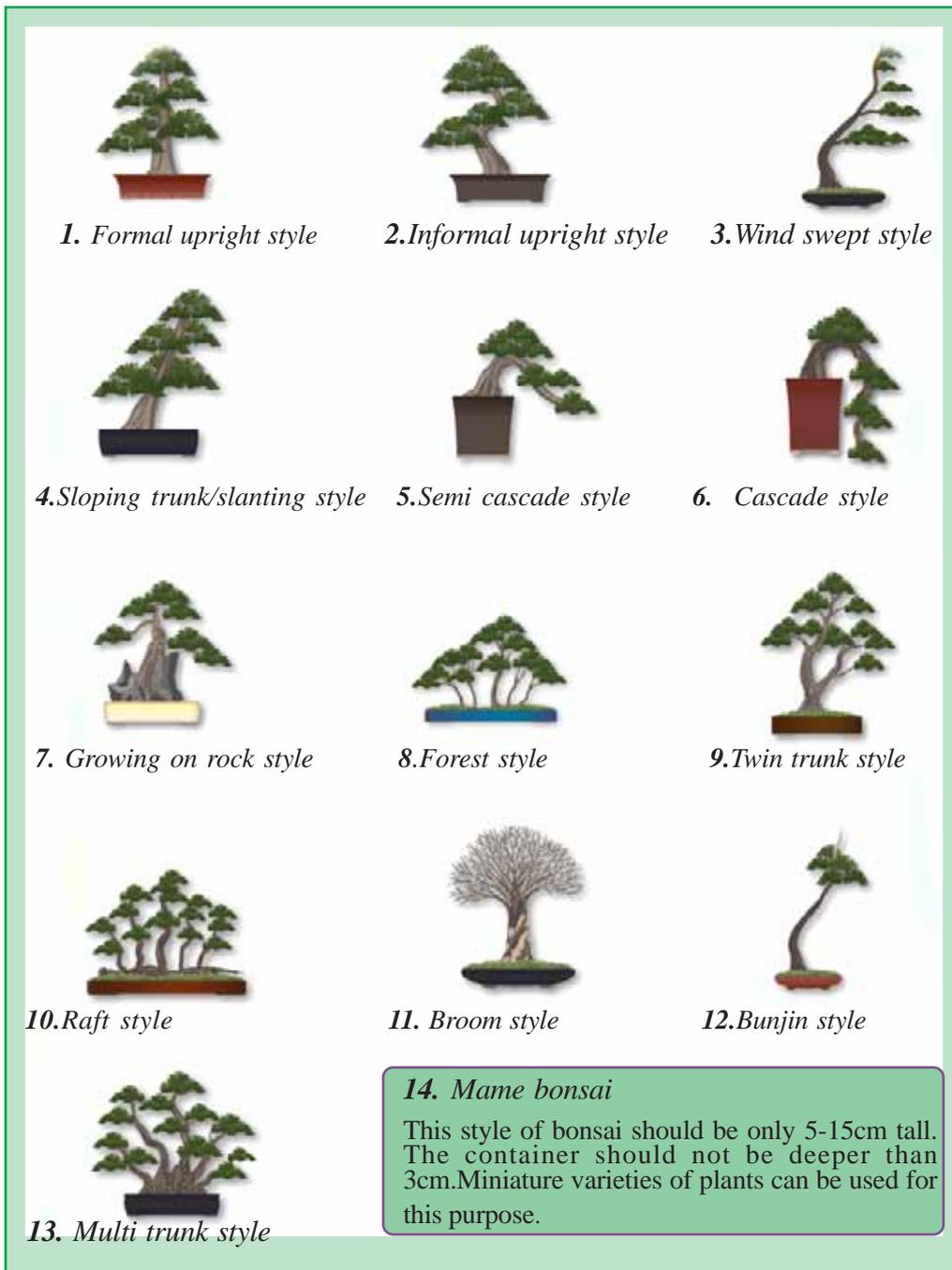
- 1/3 of the roots can be trimmed
- Long tap roots are to be trimmed
- Excessive branches are to be thinned out
- Balanced nutrition and adequate watering is must
- Potting is not advisable during winter or hot months
- Repotting is done after 2-3 years

After care

Pinching	-	Once or twice
Pruning	-	For its shape
Training	-	Desirable shape

It is achieved through copper wire or polythene tape. It is to be removed once the shape is attained.

Styles of Bonsai



6. Apiculture

Importance & Scope

The honey bee is one of the very few domesticated insects. Rearing of honey bees on a commercial scale is called apiculture. Apiculture (bee - keeping) is becoming popular in India not only because of the production of honey and beeswax but also because honey bees are particularly valuable as pollinators of cultivated plants.

Honey bee species

Honey bees belong to the genus *Apis* in the order Hymenoptera. The three well known indigenous species of *Apis* in India are:

1. **Rock Bee** (*Apis dorsata*) - the largest Indian species, the bees are very good honey gatherers, a single comb yielding about 40 Kg of honey and about 1.2 Kg of bees wax. On account of their open air habit, rock bees cannot be kept in hives.
2. **Indian Bee** (*Apis cerana indica*) - colonies of this bee always build combs in covered situations, like cavities in tree trunks, rock or walls. This is the only indigenous species capable of being kept in artificial hives. Yields 6 – 8 Kg/colony/year.
3. **Little bee** (*Apis florea*) - builds isolated small combs in open situations. The species is not economically important. Poor yielder 200 – 900g per colony.
4. **European bee** (Italian bee – *Apis mellifera*) – similar in habits to Indian bee. Build parallel combs, suited for rearing in artificial bee boxes. Average production 25-40 Kg/colony/year.
5. **Sting less bee** (*Trigona iridipennis*) – make nest in ground, holes on trees, cracks of wall. Efficient pollinators. Yield 300 – 400 g/year. Honey fetch high price due to its medicinal properties.

Honey bees gather nectar and pollen mainly from wild vegetation and forage all around their hives within a radius of about 3 Km. In order for bees to gather large quantities of nectar, pasturage has to be ensured.

Honey bee castes

The bee colony is polymorphic, comprising three varieties or castes:

- Queen (fertile female) is unable to produce wax or to gather pollen or nectar, and her sole duty is to lay eggs. She has a compactively large body but less powerful wings than workers. Lays 1 – 2000 eggs per day

- Workers (imperfectly developed females) most numerous and undertake all the work of the colony. These are small bees but have very well – developed and powerful wings. A worker has wax glands, a pollen basket on her hind legs, mandibles well - developed for work in the hive and a full – fledged sting.
- Drones (fertile males) are considerably larger and stouter than the workers and have greatly enlarged eyes which cover most of the surface of the head. They appear most plentifully in the early summer at swarming time, for fertilizing the eggs of queen; after which the workers drive them out.

General Apiary management Practices

To start a new colony

1. Natural swarms are trapped during swarming season and transferred to artificial hives.
2. Collect or buy the unit from apiaries or divide the existing units. Ensure that all units include queen, workers and drones.

Periods in rearing

Three distinct periods are identified in artificial bee keeping

- a) Growth period- New unit can be established during this period.
The reproductive rate is quite high during this period. New colonies will be formed and this usually happens in Sept-Dec period.
- b) Yielding period – Jan – April, this period wild plants flower profusely and more nectar will be available to bees.
- c) Dearth period – May – Sept, during this period food availability is minimized hence we have to provide sugar solution (1:1 sugar+water)

Instruments used in apiculture

1. **Bee box** -It consists of a rectangular wooden box, open both at the top and at the bottom. ISI type A box is recommended for Kerala.
2. **Smoker** – to generate smoke to subdue bees during handling
3. **Bee knife** – to open the comb before extraction of honey
4. **Honey extractor** – instrument used to extract honey from combs by centrifugation.

Collection of honey

Worker bees fill the cells of the super with honey and remove excess moisture by a process of natural ripening. Cells filled with ripened honey are sealed with wax. Combs can be taken off for extraction when about 75 percent of cells are found sealed. After driving off the bees, the cells are uncapped by cutting with a hot knife and honey is separated using the honey extractor.

Important products of Apiculture

- (a) **Honey** – honey has high calorie content. Antibacterial properties, increase haemoglobin content in blood. Widely used in Ayurvedic, Unani and Naturopathic medicines.
- (b) **Bee wax** – used in cosmetics, candle industry, medicines, polish, crayons, Gums etc
- (c) **Bee venom** – remedy for rheumatism

Pests and diseases

Pests

- Wax moth – lay eggs inside the colony, larvae eat away wax and contaminate with excreta.
- Wax beetle, brood mite,
- Bee eating birds, Black ants, lizard, spiders etc

Diseases

- Thai sac brood disease caused by virus, larvae affected and colony become weak.
- Nosema disease caused by protozoa, affects larvae.

Supporting agencies

A number of institution under government and private sector support bee keeping like Kerala Khadi and Village Industries Board, HortiCorp, Rubber Board, KAU – ICAR supported All India Co-ordinated Bee keeping project, Malanadu development Society (MDS), Kottayam

7. Sericulture

Rearing of silk worms on a commercial basis is known as sericulture. Silk is a protein fibre produced by the silkworm for spinning a cocoon. Silk may be defined as yarn reeled from the cocoons spun by the caterpillars of silk producing insects. There are

four kinds of silk of commercial importance in the world ie mulberry, tasar, eri and muga. Common silk is the mulberry silk. It is produced by the silkworm called *Bombyx mori*. This is reared systematically and it is this variety which accounts for almost all of the World's silk production. The silkworms of this type are fed on mulberry leaves. Mulberry culture in other words called moriculture. The other kinds of silks are called non-mulberry silks since mulberry is not the food plant.

Steps involved in Sericulture

- (1) Mulberry cultivation (Moriculture)
- (2) Silkworm egg production
- (3) Silkworm rearing
- (4) Disposal of cocoons

Rearing equipments

1. Chawki stand
2. Wooden trays
3. Rearing racks
4. Chopping knives
5. Chopping board
6. Wooden or bamboo rearing trays
7. Chandrika / Nethrika / Mountage
2. Leaf chamber
3. Feeding stands
4. Ant well

A number of diseases and pests are found to infect silkworm during rearing. The most important diseases with their causal organism are given below.

Disease	Causal Organism
1. Pebrine	Protozoa
2. Flacherie	Bacteria
3. Grasserie	Virus
4. Muscardine	Fungus

Yield : For every 100 DFLS (disease free layings) the yield ranges from 25 Kg to 50 Kg

Supporting agencies

1. Central Silk Board
2. Kerala Khadi and Village Industries Board
3. SERIFED – Sericulture Co-operative Federation Ltd. (assist in marketing, training and monitoring)
4. Kerala Agricultural University.

8. Vegetable seedling production

The commercial vegetable farmers are aware about the importance of hybrid varieties as they are high yielding, uniform in maturity and can tolerate the impact of abiotic and biotic stresses and have better quality produce as compared to standard varieties/cultivars. Though the seeds of hybrids are made available to the farmers, they lack the technical skill of producing quality seedlings. Hence the production and timely distribution of quality seedlings of vegetables would pave a better way to achieve the targeted production.

Materials required

1. Seedling Trays

Specifications

- Protrays/plugtrays
 - Size: 28cmx56 cm
 - Re-usable, life depend on way of handling and transport
 - It holds about 1-1.25 Kg cocopeat media
 - Drainage hole
2. Growing Media

Common Media

- Cocopeat is most common
- Coir pith is composted and sterilised
- Cocopeat, vermicompost mix
- Cocopeat, vermiculite, perlite mix (3:1:1)

Raising and Management

- The protrait is filled with growing medium.
- A small depression (0.5 cm) is made with finger tip in the center of the cell of protrait for sowing.

- One seed per cell is sown and covered with medium. Cocopeat with 300-400 % moisture is used and hence no immediate irrigation is required until germination.
- After sowing, 10 trays are kept one over other for 3 to 6 days, depending on the crops.
- The entire stack is covered using polyethylene sheet for conservation of moisture until germination. The trays spread once germination commences.
- The trays are shifted to net house and spread over the beds.
- The trays are irrigated lightly every day.
- Drenching the trays with fungicides as a precaution against seedling mortality is also done.
- Spraying 0.3% (3g/litre) water soluble fertilizer using 19:19:19 twice (12 and 20 days after sowing) to enhance the growth of seedlings.
- The trays are covered using polyethylene sheet as a low tunnel for protection from rain.
- The seedlings are hardened by withholding irrigation and reducing the shade before transplanting or selling.
- Systemic insecticides are sprayed 7-10 days after germination and before transplanting for managing the insect vectors.
- The seedlings would be ready in about 21-42 days for transplanting to the main field depending upon the crop.

9. Vertical Gardening, Aquaponics

a) Vertical gardening

Vertical gardening is a special kind of urban gardening suitable to small spaces, particularly for decorating the walls and roofs in various styles. Green walls can absorb heated gas in the air, lower both indoor and outdoor temperature and provide healthier indoor air and a more beautiful space. It is also the practice of producing food in vertically stacked trays, vertically inclined surface or in other structures in controlled environment. Vertical farms utilize artificial control of light, environmental control and fertigation.

Types of vertical garden

1. **Green façade:-** Climbing plants are planted to cover specially designed supporting structures.

2. **Living /green wall:-** Composed of pre-vegetated panels, vertical modules or planted blankets that are fixed vertically to a structural wall or a frame.

Plants suitable of indoor green walls/ shaded area

Peperomia, philodendron, Begonia ,Anthurium, *Rhoeo discolor*, Nephrolepis, etc.

Outdoor/ exterior green wall :-*Asparagus spp.*, Alternanthera, Portulaca, Cuphea, Ophiopogon, etc.

Benefits of vertical gardening

1. Aesthetic effect
2. Act as natural insulation for hot and cold air and save energy for the building.
3. Reduces CO₂ levels, increases O₂ and improves air quality.
4. Conserves water and watering takes less effort.
5. Sound absorption and thereby reducing noise pollution.

b) Aquaponics

Aquaponics refers to any system that combines aquaculture with hydroponics, in a symbiotic environment. Aquaculture means raising of aquatic animals like snails, fish, crayfish or prawns in tanks.

Hydroponics means cultivating plants in water.

In normal aquaculture, excretion from the animals being raised accumulate in water and cause toxicity. But in an aquaponic system ammonia excreted by the aquatic animals is broken down into useful nutrients by bacteria and are utilized by the plants as nutrients. Plants thus clean and purify the water and the water is then recirculated back to the aquaculture system. Water is only added to the system to cover the loss through transpiration and evaporation.

Detailing of practical

- 3.3.1. Visit to tissue culture lab and layout of tissue culture lab
- 3.3.2. Hardening of tissue culture seedlings
- 3.3.3 Mushroom cultivation
- 3.3.4. Vermicomposting
- 3.3.5. Visit to apiculture/sericulture unit
- 3.3.6. Vegetable seedling production in portrays.

Assessment activity

1. Project preparation for starting a mushroom cultivation unit
2. Setting up and running a mushroom unit.
3. Preparation of vermicompost from domestic waste.
4. Preparation of a project proposal to start a sericulture unit.
5. Project on vegetable seedling production and sales.

TE Questions

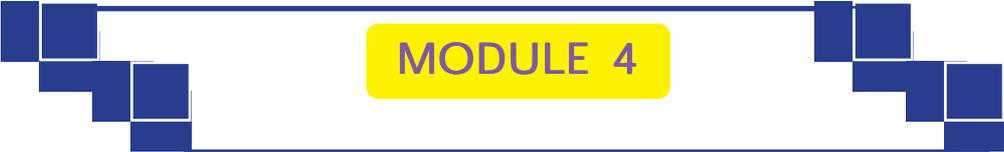
1. In city areas the disposal of biodegradable domestic waste is a great problem. Can you suggest an ecofriendly method of solving this problem?
2. You are asked to conduct a training class on mushroom cultivation to a Kudumbasree unit. Prepare a leaflet to be distributed during the class including the important steps in mushroom cultivation
3. You have seen some Ficus seedlings on the walls of an old building. How can you convert them into plants suitable for indoor gardening?
4. Your friend is planning to set up an indoor garden in her flat. Help her to select some suitable plants from the nursery. Explain to her how to properly take care of them.
5. A kudumbasree unit has approached you to take a class on the importance of apiculture in Kerala. How will you prepare a script for presentation?
6. If you got a chance in AIR for conducting a radio talk about the “oyster mushroom cultivation”. How will you give a detailed write up on the topic?
7. Prepare layout of a Tissue culture lab.
8. You are invited by Dooradarshan for talk on production of virus free planting material of Banana. Prepare a write up for it.

Extended activities

- Conduct campaigning of safe disposal of domestic waste by establishing vermicomposting unit in the Panchayath.
- Conduct demonstration classes to villagers on Mushroom cultivation.
- Conduct an awareness programme to Kudumbasree units about Agribusiness opportunities.
- Start up group on Agricultural enterprises.

Practicals

1. Survey of scope of agri-business in the locality around the school.
2. Case study of successful agribusiness enterprises- including IFS models, ornamental gardening/floriculture, commercial nursery management.
3. Field visit to farm business centers nearby the school.
4. Case study of risks while running an agri business.
5. Landscaping –planning and layout.
6. Identification, familiarization and classification of ornamental plants
7. Raising of seedlings of ornamental plants
8. Establishment of rockery, lawn, lily pool, flowerbed, carpet bed, trophy, topiary, edge, hedge, arches.
9. Propagation Techniques - air layering - T- budding - Patch budding - approach grafting, epicotyl grafting – vegetable grafting
10. Field visit to a commercial nursery and prepare a Layout of commercial nursery
11. Visit to protected cultivation farm and prepare layout/design
12. Different styles of Flower arrangement
13. Bouquet making
14. Preservation of fruits and vegetables (jam, jelly, squash, Preparation of pickle, sauce/ketchup)
15. Visit to tissue culture lab and layout of tissue culture lab
16. Hardening of tissue culture seedlings
17. Mushroom cultivation
18. Vermicomposting
19. Visit to apiculture/sericulture unit
20. Vegetable seedling production in portrays.



MODULE 4

Overview

Module 4 deals with the various support services implemented by government as well as private agencies to help farmers improve farm productivity and increase farm income. The Agri clinic and Agri Business Centres scheme was launched by Govt. of India to instill better methods of farming to the farming community across the country through educated and unemployed Agri graduates. The objectives of the scheme are: to supplement the efforts of the government system and to make available sources of input supply and services to needy farmers. Agri input centres are aimed at supplying good quality inputs to farmers at the right time. Farm mechanization is an underdeveloped sector in India. But in Kerala as the shortage of labour poses a threat to agriculture community itself forcing a great many number of farmers to abandon farming altogether, mechanization has become vital. This module introduces the various farm machines to students. The final chapter deals with various schemes implemented by government and NGOs to support farmers and also ICT enabled farmer support services. The Crop Insurance Scheme, Farmers pension scheme, etc are envisaged to support poor and marginal farmers in facing the vagaries of our agriculture system. In the modern world farmers are also benefiting from the greater coverage and capabilities of the internet and communication systems.



UNIT 4.1 AGRI CLINIC

Agri-Clinics and Agri-Business Centres (AC&ABC) is a Central Sector Scheme launched in 2002 with an objective to supplement the efforts of public extension by facilitating qualified Agricultural professionals to set up Agri-ventures that can deliver value-added extension advisory services to farmers at their door step, besides providing self-employment opportunities to Agripreneurs. At present, more than 16,000 Agri-ventures have been established all over India by Agripreneurs trained under this Scheme. Many success stories of Agripreneurs have been reported from different Sectors and States signifying their growing importance in Agricultural Extension and their national presence.

This unit gives the definition of agri clinic and explains the concept, necessity and objectives of agri clinics. The learner gets an insight into the functioning of agri clinic and the procedure for diagnosis of pests and diseases of crops. The infrastructure required for setting up an agri clinic is elaborated and the main registers to be kept in the agri clinic is listed. After finishing the unit the learner will be able to diagnose the symptoms of major pests and diseases of Rice, Coconut, Rubber, Pepper, Ginger, Cassava, Banana, Tomato, Brinjal, Chilli, Cucurbitaceous vegetables - Bittergourd, Snakegourd, Cowpea, Amaranthus, Bhindi, Cabbage, Rose, Anthurium, Orchid, Jasmine and suggest suitable management practices. The learner will also get acquainted with pests and diseases of polyhouse crops and their management measures.

Learning Outcomes

The learner :

- defines and explains the concept, necessity and objectives of agri clinic.
- explains the functioning of agri clinic
- enlists the various infra structure required to set up agri clinic.
- explains the procedure of pest and disease diagnosis
- recognizes and explains symptoms of major pests and diseases of rice and suggest remedial measures.
- recognizes and explains symptoms of major pests and diseases of coconut and suggest remedial measures.
- recognizes and explains symptoms of major pests and diseases of Banana and suggest remedial measures.
- recognizes and explains symptoms of major pests and diseases of pepper and suggest remedial measures.
- recognizes and explains symptoms of major pests and diseases of ginger and suggest remedial measures.
- recognizes and explains symptoms of major pests and diseases of Rubber and suggest remedial measures.
- recognizes and explains symptoms of major pests and diseases of Brinjal, Tomato, chilli and suggest remedial measures.
- recognizes and explains symptoms of major pests and diseases of Cucurbitaceous vegetables and suggest remedial measures.
- recognizes and explains symptoms of major pests and diseases of Cowpea and suggest remedial measures.

- recognizes and explains symptoms of major pests and diseases of Bhindi and suggest remedial measures.
- recognizes and explains symptoms of major pests and diseases of Amaranthus and suggest remedial measures.
- recognizes and explains symptoms of major pests and diseases of Cabbage and suggest remedial measures.
- recognizes and explains symptoms of major pests and diseases of Cassava and suggest remedial measures.
- recognizes and explains symptoms of major pests and diseases of Ornamental plants – Anthurium, Orchid, Rose, Jasmine and suggest remedial measures.
- recognizes and explains symptoms of major pests and diseases in polyhouse crops.
- recognizes and explains symptoms of nutritional disorders and suggest remedial measures.

Agriclinic

4.1.1 Agriclinic

The concept of agri clinic is to provide timely diagnostic and advisory services for plant health and pest control. Agri clinics are envisaged to provide expert services and advice to farmers on crop practices, technology dissemination, crop protection from pests and diseases, market trends and prices of various crops in the market and would enhance the productivity of crops. By providing information and applying scientific expertise it helps to solve problems in agriculture, increases crop productivity and boost food security and safety.

4.1.2 Functions of agri clinic

1. Diagnosis of samples brought by farmers including soil samples and provide proper management strategies.
2. Provide locally relevant, environmentally friendly practices and technologies to farmers.
3. Provide early warning of pests and diseases.
4. Act as an exhibition centre of pests, diseases, weeds, plant protection chemicals, beneficial insects etc.
5. Serve as an information hub for farmers regarding soil health status, emerging threats, changing status of pests and diseases, latest inputs etc.
6. Act as a centre for collecting and preserving Indigenous Technology knowledge.

7. Conduct regular trainings and plant health camps.
8. Serve as a production hub of bio - inputs.
9. Set up Agro biopharmacy for explaining agropharmacy concept to farmers.
10. Exhibit newer agriculture implements and other latest inputs.

4.1.3 Infrastructure required for setting up of agri clinic

The facilities required at the agri clinic are:

- A room with minimum 40 m² area.
- Furniture such as table, chairs, display racks, cabinets etc.
- Library with books, periodicals, journals, CDs.
- Charts and posters -
 - Symptoms of pest and diseases
 - Natural enemies
 - Deficiency symptoms
 - GAP practices
 - Soil nutrient map
 - Panchayat map showing crop distribution
- Audio visual aids such as portable PA system, LCD projector, screens, etc.
- Herbarium of diseases and weeds
- Slides of common fungal pathogens and beneficial micro organisms
- Insect display units - insect box, ricker mounts, insect zoo, wet specimens of insects
- Diagnostic facilities –hand lens, magnifiers, microscopes, magnascope
- Soil testing instruments - pH meter, Conductivity meter, soil testing kits, pH papers
- Documentation materials - digital camera, tablet PC, laptop.
- Surveillance materials - sweep net, insect killing bottles, frames, dissection box, field notebooks, polythene covers, magnifying glass, specimen covers
- Plant protection equipment
- Bio pesticides and their production facilities
- Traps - pheromone traps, yellow sticky traps, fruit fly traps, rat traps, lures, light traps

- Plant protection chemicals - new generation fungicides, insecticides, weedicides
- Other lab facilities - glassware, chemicals, refrigerator, thermo hygrograph, moisture meter (for paddy), other location specific items.

4.1.4 Pest and disease diagnosis

Pest and disease diagnosis refers to the process of identifying a possible pest, disease or disorder. Diagnosis is carried out based on signs and symptoms of plant parts.

Procedure for plant disease diagnosis

1. Study of field patterns - pattern of disease appearance in the field and spreading nature.
2. Study of plant pattern - place of appearance of the first symptom.
3. Signs - appearance of microorganisms like bacterial ooze, powdery mildew, mycelial growth, etc.
4. Symptoms - Root symptoms, flower symptoms, leaf symptoms and fruit symptoms.
5. Examination of specimens in microscope.

Procedure for pest diagnosis

1. Observe the signs and symptoms of infected plant parts.
2. Study the morphological feature of the insect, including growth and feeding habit.

Registers to be maintained in agri clinic

1. Farmer's register : This register must have - Name of farmer, Crop and the problem, Diagnosis, recommendations, feedback of the farmer, date of collection of samples
2. Common weeds pests and diseases of the crops in the panchayat
3. Stock register
4. Instrument log book
5. Purchase register
6. Visitors register.

Functioning of Agri clinics

1. Baseline data on plant health in the panchayat is to be collected.
2. Plant health record should be maintained.

3. Feedback register should be kept.
4. Pest surveillance group should be formed.
5. Training and awareness programme should be given in regular intervals.
6. Computerised data base for all the pest and diseases reported in the panchayat should be developed and e - mail support should be used for consultation for diagnosis and advisories.
7. Panchayat should be involved in all the activities of the clinic.

4.1.5 Diagnosis and management of pests and diseases of rice

4.1.5.1 Pests of rice

Pest	Symptom	Stage of attack of pest	Control
Rice stem borer	In vegetative phase : dead heart symptom. In reproductive phase : white ear head.	Caterpillar	<ul style="list-style-type: none"> * Release egg parasitoid, <i>Trichogramma japonicum</i> for the management of the rice yellow stem borer * Spraying Neem seed kernel extract controls stem borer * Clip the seedling tips before transplanting to eliminate egg masses and collect and destroy the egg masses in main field.
Brown Plant Hopper	Hopper burn	Nymph and adults	<ul style="list-style-type: none"> * Use resistant varieties such as Jyothi, Bharathy, Aiswarya, Kanakom, Nila etc. for cultivation. * Apply one of the following insecticides as soon as the yellowing symptom is observed, covering the infested patches and the areas surrounding the patches: Carbaryl, quinalphos, acephate, thiamethoxam, phosalone and imidacloprid. * Drain away water from the field and keep in that condition until pest population reduces.

			<ul style="list-style-type: none"> * In Kuttanad tract, early planting of paddy in September October is advisable whenever possible. Allow alleyways after every 3m rows. * Avoid spraying synthetic pyrethroids.
Gall midge	Silver shoot	Maggot	<ul style="list-style-type: none"> * Release <i>Platygaster oryzae</i> parasitised galls at 1/10 m² on 10 days after transplanting (DAT) * Early ploughing * Harvest the crop and plough immediately * Remove the alternate hosts and adjust the time of planting (early) * Optimum recommendation of potash fertilizer. * Setup light trap and monitor the adult flies.
Leaf folder	Leaves of plant are seen folded, rolled and often webbed together with white patches.	Caterpillar	<ul style="list-style-type: none"> * Release <i>Trichogramma chilonis</i> @5 cc (1,00,000/ha) thrice at 37, 44 and 51 days * Avoid excessive nitrogenous fertilizers * Keep the bunds clean. Spray NSKE 5 % or carbaryl 50 WP 1 Kg or chlorpyrifos 20 EC 1250 ml/ ha.
Rice bug	Brownish discoloured patches on the husk.	Nymph and adult	<ul style="list-style-type: none"> * Dust any one of the following at 25 kg/ha twice, the first during flowering and second a week later: * Quinalphos 1.5 D - Methyl parathion 2% DP Spray any one of the following twice as above * Malathion 50 EC 500 ml/ha * Neem seed kernel extract 5% 25 kg/ha * Notchi or <i>Ipomoea</i> leaf extract 10%
Case worm	Leaves of plants eaten by caterpillars within small cylindrical cases made from leaves.	Caterpillar	<ul style="list-style-type: none"> * Drain water from the field. * If infestation is severe, apply carbaryl dust or spray.
Rice swarming caterpillar	The nursery and early stages of the crop are attacked leaving the plant as mere stumps	Caterpillar	<ul style="list-style-type: none"> * Apply carbaryl or trichlorfon as soon as the caterpillars are noticed.

4.1.5.2 Diseases of Rice

Disease	Pathogen	Symptom	Management
Blast	Fungus	Spindle shaped water soaked grayish green spots which enlarge in size and develop to spots with grey centre and brown margin Nodal blast, neck blast.	<ul style="list-style-type: none"> * Use high yielding resistant varieties such as Kanchana, Kairali, Asha, Anashwara, Lakshmi, Deepthi. * Seed treatment with fungicides such as Thiram/ Carbendazim @2g/Kg seed. * Collateral weed hosts should be destroyed. * Foliar spray of zineb 2kg/ha, Thiophanate 500g/ha, Iprophenphos 48EC 500ml/ha, Aureofungin sol (antibiotic) 60g/ha. * Pseudomonas can be applied as seed treatment, root dip, soil incorporation or foliar spray.
Sheath blight	Fungus	Symptoms first appear on lower leaf sheath near the water level as oval, oblong or irregular greenish grey spots, which enlarge and become greyish white with brown margin.	<ul style="list-style-type: none"> * Use tolerant varieties such as Kairali, Kanchana, Aruna, Makom, Arathy, IR-8, Athira, Nila etc. * As prophylactic measure apply neem cake - coated urea. * Apply 50% more potash than normal recommended dosage in split application. * Control weeds. * Seed treatment with fungicides such as Carbendazim 2g/kg seed, or hexaconazole 2 ml/kg seed * To control disease, give foliar spray of zineb 2kg/ha, Thiophanate 500g/ha, Iprophenphos 48EC 500ml/ha, Carbendazim or Carboxin 500g/ha, Validamycin 3% liquid (1000ml/500l/ha) * Spray neem formulations Azadirachtin 0.15% w/w @2.5l/ha or Azadirachtin 0.03% EC @2.5l/ha at the time of sheath blight disease occurrence. * Spray Pseudomonas/PGPR @ 20 g/l just before panicle initiation.

Brown spot	Fungus	Small definite oval / oblong spots with brown colour are formed on leaves and glumes.	<ul style="list-style-type: none"> * Use resistant varieties such as kanchana, Remya, IR-36 etc. * Hot water treatment of seeds * Seed treatment with Carbendazim, COC or Mancozeb. * Foliar spray with Pseudomonas/ PGPR @ 20g/l. * Foliar spray of zineb or Mancozeb (2kg/ha), Aureofungin sol (antibiotic) 60g/ha
Sheath rot	Fungus	Oblong/irregular brown spots on the leaf sheath enclosing the panicle. Later spot turn grey with dark brown margin Young panicle may remain inside the sheath	<ul style="list-style-type: none"> * Prophylactic measures as in the case of sheath blight. * Carbendazim or Carboxin 500g/ha
Bacterial leaf blight	Bacteria	Water soaked lesions on the tip of leaves which later increase in length downwards along the margins resulting in yellow to straw coloured stripes with wavy margins Systemic infection in seedlings - KRESEK	<ul style="list-style-type: none"> * Streptocycline 15g/300ml/ha * Spray fresh cowdung extract (dissolve 20g cowdung in one litre of water: allow to settle and sieve. Use supernatant liquid) * Application of bleaching powder @ 5kg/ha for checking BLB spread.
Tungro	Virus Vector - Leaf hoppers	Stunting, change in colour of leaves to different shades of yellow or orange.	<ul style="list-style-type: none"> * Use resistant varieties. * Spray Carbaryl 50 WP 2 Kg/ha to manage vectors * Incorporate rice stubbles into the soil immediately after harvest.

4.1.6. Diagnosis and management of pests and diseases of coconut

4.1.6.1 Pests of coconut

Pest	Symptom	Stage of attack of Pest	Management
Rhinoceros beetle	attacked frond when fully opened shows characteristic triangular cuts.	Adult	Provide field sanitation to prevent breeding of beetles. Hook out the beetles from the attacked palms by using beetle hook. The topmost three leaf axils around the spindle may be filled with 250g neem cake or marotti cake mixed with equal volume of sand in the innermost 2 - 3 leaf axis during April - May before the onset of South - West monsoon and during September - October after the South * West monsoon. Incorporation of <i>Clerodendron infortunatum</i> @ 10% w/w basis in the cowdung pit/manure pit. Dust manure pit walls with lime powder and plaster with cow dung. Boil castor cake and groundnut cake with a little quantity of water. Keep in earthen pots near light source to attract beetles, which can be collected and killed. Mix sand (250 g) and neem seed powder (100 g) and fill inner leaf sheaths of youngest leaves. Release <i>Baculovirus oryctes</i> infected adults @ 10 - 15/ha to bring down the pest population. Inoculation of breeding sites with entomopathogenic fungus <i>Metarrhizium anisopliae</i> (@ 5x10 ¹¹ spores/ml) gives effective control.
Red palm weevil	Presence of holes on the stem, oozing out of a viscous brown fluid through the holes, longitudinal splitting of leaf base and wilting of central shoot.	Grub and adult	Field sanitation should be given prime importance. Avoid making steps or any other injury on the tree trunks to reduce the foci of infestation. Leaf axil filling as suggested in the case of rhinoceros beetle will be useful against the red palm weevil also. When green leaves are cut from the palms, stumps of not less than 120 cm may be left on the trees

			in order to prevent successful inward movement of the grubs through the cut end. Clean the crown periodically before and after rain. Mix sand and Nerium seed powder and fill the bore holes. Coconut log traps with fermenting toddy or pineapple or sugarcane activated with yeast or molasses can be set in coconut plantation to attract and trap the free floating population of red palm weevil. Use of pheromone trap for attracting and killing adult weevils @ one trap per 2 ha.
Leaf eating Caterpillar	The caterpillar feeds on green matter from the lower leaf surface, remaining within galleries of silk and frass.	Caterpillar	As a prophylactic measure, the first affected leaves may be cut and burnt during the beginning of the summer season. Arrange for the release of larval/pupal parasitoids, <i>Goniozus nephantidis</i> , <i>Elasmus nephantidis</i> (brown species) and <i>Brachymeria nosatoi</i> . Mix extract of 2kg neem seed kernel and 200g soap in 200 litres of water and spray followed by release of larval/pupal parasites.
Coreid bug	Attacked buttons become deformed with characteristic crevices on the husk below the perianth with gummy exudations.	Nymph and adults	Apply 0.1% Carbaryl on the newly opened inflorescence after the receptive phase of the female flowers and spray the entire crown excluding the leaves and older bunches.
Coconut eriophyid mite	Pale yellow triangular patches below the perianth which later becomes brown. Later these develop into brown to black necrotic lesions with longitudinal fissures on husk	Nymphs and adults	Collect and destroy all the fallen buttons of the affected palm. Apply 2% neem oil+garlic emulsion or commercial neem formulation azadirachtin 0.004% (Neemazal T/S 1% @ 4 ml per litre of water) or micronized wettable sulphur 0.4% in the crown on young bunches. Improving nutrient status by applying organic manure at the rate of 50 kg and neem cake 5 kg per palm per year. Also apply the recommended dose of fertilizers in two split applications. Growing compatible intercrops/mixed crops. Providing adequate irrigation.

Against rodents

Place wax blocks of 0.005 % bromadiolone in coconut crown of the infested palms at 3 - 4 days interval till the bait is no more consumed. Boil 10kg wheat and two large pieces of glyricidia bark and broadcast in field as bait. Mix gypsum and sugar and keep in places as bait where rats are frequent. Take one part nerium seed powder + nine parts rice + one part coconut pulp + a little oil. Mix well and use as a bait. Mix shrimp powder and cement (dry) and keep as bait. Pre baiting with shrimp powder alone will be more effective. Use tin barrier around tree trunk to prevent rat damage.

4.1.6.2 Diseases of Coconut

Disease	Pathogen	Symptom	Management
Bud rot	Fungus	Yellowing of spindle leaves and droop down later. The tender leaf base and soft tissues of the crown rot into a slimy mass of decayed material emitting a foul smell finally rotting progresses and kills the entire palm.	<ul style="list-style-type: none"> * In early stages of the disease cut and remove all affected tissues of the crown. Apply Bordeaux paste and protect it from rain till normal shoot emerges. * Burn all disease affected tissues removed from the palm. * spray 1% Bordeaux mixture on spindle leaves and crown of disease affected as well as neighbouring palms as prophylactic measure. Small perforated sachets containing 2g Mancozeb may be tied to the top of leaf axil. When rains, a small quantity of the fungicide is released from the sachets to the leaf base. * Adopt proper control measure for rhinoceros beetle. * Avoid over crowding of palms.
Leaf rot	Fungus	Water soaked lesions in the spear leaves of Root(wilt) affected palms As the leaf unfolds the rotten portions of the lamina dry and get blown off in wind giving a "fan shape" to leaves.	<ul style="list-style-type: none"> * Remove rotted portions. * Pour 300ml fungicidal solution at the base of the spear. (Mix hexaconazole 5 EC 2ml or Mancozeb 3g in 300ml of water. * Spray crowns and leaves with 1% Bordeaux mixture or 0.2% copper oxy chloride formulations or 0.3% Mancozeb in January, April - May and September taking care to spray the spindle leaf.

Stem bleeding	Fungus	Exudation of reddish brown liquid through the growth cracks at the basal part of trunk. Trunk gradually tapers towards the apex.	<ul style="list-style-type: none"> * Chisel out completely the affected portions. * Painting the wound with tridemorph 5% and apply coal tar after 1-2 days.
Ganoderma Wilt/ basal stem rot	Fungus	Rotting of basal portion of stem Bark turns brittle and gets peeled off in flakes leaving open cracks and crevices Ultimately the palm dies off.	<ul style="list-style-type: none"> * Isolate diseased palms from healthy palms by digging isolation trenches of 1m deep and 50 cm wide. * Avoid flood irrigation. * Apply 50 Kg FYM and % Kg neem cake/palm/year. * Apply trichoderma enriched in neem cake/compost/organic manure. * Soil drenching with 40 l of 1% BM thrice a year. * Root feeding with Tridemorph(Calixin) 2 ml in 100 ml water.
Root (Wilt) Disease	Phytoplasma	Leaves show flaccidity, ribbing, yellowing and marginal necrosis Yield gradually decreases,	<ul style="list-style-type: none"> * Rogue out palms that are severely affected by root (wilt) and yield less than 10nuts /palm/ year and those which have contracted the disease before flowering. * Replant with disease tolerant material/ high yielding hybrids (Chndrasankara). * Apply fertilizers according to recommendation. * Apply 50kg cattle manure or green manure and 1kg of lime/ palm/year. Apply magnesium as MgO. * Grow green manure crops in coconut basin and incorporate in situ. <p>Follow strictly the prescribed prophylactic measures against diseases and pests to endure the palms are not debilitated.</p>

4.1.7. Diagnosis and management of pests and diseases of banana

4.1.7.1 Pests of banana

Pest	Symptom	Stage of attack of Pest	Management
Pseudostem weevil	Bore holes on the pseudostem, fibrous extrusion from the base of the leaf petioles Yellowing and withering of leaves and decaying of peduncles In advanced stages pseudostem turns pale and bend down.	Grub and Adult	Field sanitation. Remove the affected plants and destroy using kerosene or by burying in deep pits. Fill leaf axils with Neem seed kernel powder @ 50g/plant, 135 days after planting. Spray Beauveria bassiana/Metarrhizium anisopliae (20g/l) covering leaf axil and pseudostem 5 months after planting. Cowdung ash slurry can be brushed on pseudostem. Set up pseudostem traps treated with B. bassiana. Spray Nanma 5% covering leaf axil and pseudostem 4-5 months after planting. Inject undiluted Menma just below the bore holes made by the weevil. In endemic areas, spray insecticides such as Quinalphos 0.05%, Chlorpyrifos 0.05% or Carbaryl 0.2%.
Rhizome weevil	Premature yellowing, withering of outer leaves and death of heart leaves Young plants wilt and die older plants show growth retardation.	Grub and Adult	Field sanitation. Select only healthy planting material. Cut and remove outer layers of rhizome and sundry for 3-4 days after smearing with cow dung slurry and ash. Dip suckers in B. bassiana @ 20 g/l for 30 min. before planting. Set up pseudostem traps treated with B. bassiana. Apply 1 kg neem cake in two split doses. Cosmolure can be set up 2-4 traps/ha.
Banana aphid	Indirect damage as it is a vector of Bunchy top	Nymphs and adults	Spread lemon grass in the pit before planting. Apply cartap hydrochloride 4 G @ 25 g/plant, 20 DAP. A second and third dose is applied to the leaf axil @ 12.5 g at 65 and 165 DAP. Spray Verticillium lecanii to control vectors.
Nematode - Root knot nematode, burrowing nematode, etc.	Lanky pseudostem and foliar necrosis due to poor root growth Heavily infested plants topple over easily Very small bunches are produced		Marigold grown as intercrop. Crop rotation with paddy/sugarcane/tapioca. Apply neem cake @ 1 Kg/plant at the time of planting. Apply bioagents (Paecilomyces lilacinus, Pseudomonas, Verticillium and AMF) @ 25 g/pit at time of planting, 3 months and six months after planting.

4.1.7.2 Diseases of banana

Disease	Pathogen	Symptom	Management
Bunchytop	Virus	Severe stunting, narrowing of leaves with chlorotic margins. Crowding of leaves/rosette, brittle leaves	(Same as Banana Aphid)
Kokan/ banana bract mosaic	Virus	Characteristic dark reddish brown mosaic pattern in the bracts of inflorescence Distinctive pinkish streaks on pseudostem which later turn dark Travellers palm like aestivation.	<ul style="list-style-type: none"> * Infected plants should be uprooted and destroyed. * Use healthy planting material.
Sigatoka Leaf spots	Fungus	Yellow streaks appear on older leaves which later turn brown with yellow halo	<ul style="list-style-type: none"> * Cut and burn severely infected leaves. * Grow resistant varieties such as BRS 1, BRS 2 and Manjeri nendran 2 * Spray 1% BM or 0.4% Mancozeb. * Spray bioagents such as Pseudomonas 20 g/l or Bacillus subtilis 5 g/l. AMF) @ 25 g/pit at time of planting, 3 months and six months after planting.

4.1.8 Diagnosis and management of pests and diseases of pepper

1. Pests of pepper

Pest	Symptom	Stage of attack of Pest	Management
Pollu beetle	Attacked berries become hollow (pollu) and crumble when pressed Attack on spike results in murithiri (broken spike) Holes on leaves	Grub and Adult	<ul style="list-style-type: none"> * Application of neem cake help in killing pupae. * Spray plants with 1 % BM. * Spray Dimethoate /Quinalphos @0.05% at the time of spike emergence and berry formation. * Spray neem based insecticides @ 4ml/ l of water. * Spray formulations like Metarrhiziumor Beauvaria @ 20g/lor 5 ml/l
Marginal gall thrips.	Marginal galls on leaves. Galled leaves are malformed, thickened and crinkled.	Nymphs and adults	<ul style="list-style-type: none"> * Spray 2% neem oil-garlic emulsion. * Spray 0.05% Dimethoate. * Spray Verticillium lecanii @ 20 g/l or 5 ml/l
Nematode - Root knot nematode, burrowing nematode	Stunted growth, yellowing and drooping of leaves Affected vines show slow decline		<ul style="list-style-type: none"> * Remove and destroy severely affected vines. * Apply neem cake@ 1 Kg/vine. * Drench the basin with 1% BM or 0.4% COC. * Apply formulation of Bacillus macerans @ 10 g/vine at the time of planting. * Drench the basin with Paecilomyces lilacinus @ 20g/l. * Intercrop with marigold and incorporate the residue.

2. Diseases of pepper

Disease	Pathogen	Symptom	Management
Quick wilt/ foot rot	Fungus	Occur during rainy season. Disease spread to entire vine through rain splash. Tender leaves, succulent shoot tips of freshly emerging runner shoots on the soil turn black. Water soaked lesions. Breaking up of branches at nodes and the entire vine collapse within a month	<ul style="list-style-type: none"> * Select disease free healthy planting material. * Remove and destroy dead vines along with root system from the garden. * Adequate drainage should be provided. * Cover the basin with mulch to avoid soil splash. * The runner shoots should be tied back to the standards. * Apply 1 Kg lime and 2 Kg neem cake /standard/year as premonsoon dose. * A foliar spray with 1 % BM. * Apply Bordeaux paste upto a height of 50 cm from collar region. * Drenching and spraying with potassium phosphonate (Akomin) 0.3%. * Drenching and spraying with 0.125% metalaxyl-mancozeb (Ridomil MZ) @ 5-10l/vine. * Inoculate with AMF, Trichoderma and Pseudomonas at the time of planting. Trichoderma is applied at the rate of 5-10 Kg/vine/year. * Spray nursery and main field with 2% Pseudomonas.
Anthraxnose/ fungal pollu	Fungus	Chlorotic angular leafspots surrounded by yellow halo Later leaf spots may join together resulting I leaf blight followed by defoliation Necrosis on the stock of the spike lead to spike shedding Affected berries dry up gradually (fungal pollu)	<ul style="list-style-type: none"> * Irrigation during summer. * Remove and destroy fallen leaves and spikes. * Spray 1% BM or 0.2% COC

4.1.9 Diagnosis and management of pests and diseases of ginger

1. Pests of ginger

Pest	Symptom	Stage of attack of Pest	Management
Shoot borer	Yellowing and drying of infested shoots. Presence of bore holes in the pseudostem through which frass is extruded. Whithered central shoots -Dead Hearts.	Caterpillar	Spray Dimethoate or Quinalphos at 0.05%

2. Diseases of Ginger

Disease	Pathogen	Symptom	Management
Rhizome and Soft Rot	Fungus	Yellowing of leaves which starts from lower leaves. Partial or complete drying of leaves. The collar region turn soft and shoots can be easily pulled out. Infection spread from roots to rhizomes causing soft rot. In advanced stages the rotten rhizomes emit foul smell.	<ul style="list-style-type: none"> * Select sites with proper drainage. * Select disease free seed rhizomes. * Treat seed rhizomes with 0.3% Mancozeb. * Dig out affected plants and drench the beds with cheshunt compound or 1% BM or 0.3% Mancozeb. * Inoculation with AMF, Trichoderma or Pseudomonas at the time of planting.

4.1.10 Diagnosis and management of pests and diseases of rubber

1. Pests of rubber

Pest	Symptom	Stage of attack of Pest	Management
Stem borer	Branches and stem dries and die. Shedding of leaves Bore holes with sap and frass coming out from them	Grubs and adults	Padding with quinalphos 25EC 10 ml in 2.5 cm per tree soaked in cotton.
Scale insect	Severely affected petioles and tender shoots dry up and die	Nymphs and adults	Dimethoate @0.05%.

2. Diseases of rubber

Disease	Pathogen	Symptom	Management
Abnormal leaf fall (During SW Monsoon)	Fungus	First the fruit rot, later infected leaves fall in large numbers prematurely either green or after turning coppery red. Black lesions develop on the petiole with a drop of latex. Heavy defoliation may lead to considerable loss of crop and die back of terminal twigs.	Prophylactic spraying of foliage prior to SW monsoon with 1% BM or oil based COC.
Powdery Mildew	Fungus	Tender leaves with ash coating curl, crinkle and edges roll inwards and fall leaving the petioles attached to the twigs like a broom stick. Die back of twigs. White patches on older leaves reduces photosynthetic efficiency. Infected flowers and tender fruits are shed.	For young plants, spray wettable sulphur(0.2%) or Carbendazim(0.05%). For mature trees, dust with sulphur.
Pink disease (more damaging for plants in the age group of 2 - 12 yrs)	Fungus	Main seat of infection is the fork region. White or pink coloured cobweb mycelia growth on the bark surface with streaks of latex oozing out from the lesions. Rotting, drying up and cracking of affected bark follow. Distal portion of branches dry and dried leaves stick to the dead branches.	<ul style="list-style-type: none"> * Apply Bordeaux paste upto 30 cm above and below the affected region. * Tridemorph 2% in 1 % ammoniated field latex is also effective. * In severe cases, prune off and burn dried up branches.

4.1.11 Diagnosis and management of pests and diseases of vegetables:

4.1.11.1 Brinjal

1. Pests of brinjal

Pest	Symptom	Stage of attack of Pest	Management																
Shoot and fruit borer	Infested shoots droop, wither and dry up Affected fruits show holes on the surface plugged with excreta	Caterpillar	<ul style="list-style-type: none"> * Remove the affected terminal shoot showing boreholes. * Remove the affected fruits and destroy. * Avoid continuous cropping of brinjal crop. * Grow the varieties with long and narrow fruits in endemic areas. * Install pheromone trap@12/ha * Encourage the activity of larval parasitoids: <i>Pristomerus testaceus</i>, <i>Cremastus flavoorbitalis</i>. * Avoid use of synthetic pyrethroids. * Avoid using insecticides at the time of fruit maturation and harvest. * Neem seed kernel extract (NSKE) 5 % or Spray any one of the following chemicals starting from one month after planting at 15 days interval: <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="padding: 2px;">Azadirachtin 1.0% EC (10000 ppm)</td> <td style="padding: 2px; text-align: right;">3.0ml/lit.</td> </tr> <tr> <td style="padding: 2px;">Azadirachtin 0.03 % WSP (300 ppm)</td> <td style="padding: 2px; text-align: right;">5.0g/lit.</td> </tr> <tr> <td style="padding: 2px;">Chlorpyrifos 20 % EC</td> <td style="padding: 2px; text-align: right;">1.0ml/lit.</td> </tr> <tr> <td style="padding: 2px;">Dimethoate 30 % EC</td> <td style="padding: 2px; text-align: right;">7.0ml/10 lit.</td> </tr> <tr> <td style="padding: 2px;">Phosalone 35 % EC</td> <td style="padding: 2px; text-align: right;">1.5ml/lit.</td> </tr> <tr> <td style="padding: 2px;">Quinalphos 25 % EC</td> <td style="padding: 2px; text-align: right;">1.5 ml/lit.</td> </tr> <tr> <td style="padding: 2px;">Thiodicarb 75 % WP</td> <td style="padding: 2px; text-align: right;">2.0 g/lit.</td> </tr> <tr> <td style="padding: 2px;">Triazophos 40 % EC</td> <td style="padding: 2px; text-align: right;">2.5 ml/lit.</td> </tr> </table>	Azadirachtin 1.0% EC (10000 ppm)	3.0ml/lit.	Azadirachtin 0.03 % WSP (300 ppm)	5.0g/lit.	Chlorpyrifos 20 % EC	1.0ml/lit.	Dimethoate 30 % EC	7.0ml/10 lit.	Phosalone 35 % EC	1.5ml/lit.	Quinalphos 25 % EC	1.5 ml/lit.	Thiodicarb 75 % WP	2.0 g/lit.	Triazophos 40 % EC	2.5 ml/lit.
Azadirachtin 1.0% EC (10000 ppm)	3.0ml/lit.																		
Azadirachtin 0.03 % WSP (300 ppm)	5.0g/lit.																		
Chlorpyrifos 20 % EC	1.0ml/lit.																		
Dimethoate 30 % EC	7.0ml/10 lit.																		
Phosalone 35 % EC	1.5ml/lit.																		
Quinalphos 25 % EC	1.5 ml/lit.																		
Thiodicarb 75 % WP	2.0 g/lit.																		
Triazophos 40 % EC	2.5 ml/lit.																		
Epilachna beetle	Skeletonisation of leaves and drying	Adults and grubs	<ul style="list-style-type: none"> * Collect damaged leaves with grubs and egg masses and destroy them * Shake plants to dislodge grubs, pupae and adults and destroy * Conserve natural enemies in brinjal ecosystem 																

2. DISEASES OF BRINJAL

Disease	Pathogen	Symptom	Management
Damping off	Fungus	Pre emergence- Seedlings are killed before they emerge from the soil Post emergence- Toppling over of the infected seedlings at any time after they emerge from the soil until hardening of the stem.	<ul style="list-style-type: none"> * Heavy application urea to nursery soil is effective against pathogen. * Provide organic mulch around the plants. Pre-inoculation of AMF in the furrows @ 200g/m². * Apply lime. * Use Trichoderma, Pseudomonas and PGPR mix². Apply neem cake. * Seed treatment with captan or thiram @ 2.5g/kg seed.
Little leaf Vector - Leaf Hopper	Phytoplasma	Reduction in the size of the leaves With narrowing, softening, smoothening and yellowing Internodes shortened , axillary buds enlarged which give the crop a bushy appearance, floral part deformed leading to sterility	<ul style="list-style-type: none"> * Eradicate infected plants. Application of neem seed oil emulsion 2% to control vector.
Phomopsis blight and fruit rot	Fungus	Circular grey to brown spots on the leaves nearer to the soil. Lesions also formed on the stem Fruits are attacked while still attached on the plant covering the entire fruit	<ul style="list-style-type: none"> * Burn infected plant parts. Fruit should not come into contact with soil. Seed treatment with Carbendazim 2-5g/kg seed. * Spray Pseudomonas 2%. Use tolerant varieties like Pusa Bhairav, Pant Samrat and Haritha.
Bacterial Wilt	Bacteria	Wilting, stunting, yellowing of the foliage and collapse of the whole plant Entire vascular system undergoes blackening and bacterial slime oozes out from it if cut open	<ul style="list-style-type: none"> * Remove and destroy infected plants. * Control weeds in and around field. * Avoid over irrigation. * Apply lime @ 500kg/ha 15days before planting. Apply bleaching powder into irrigation water or the soil @ 5kg/ha. Apply neem cake @ 25g/pit. * Cultivate marigold in field prior to raising the crop. * Soil application of Pseudomonas or PGRP mix² @ 25g/litre. Seedling dip and foliar spray of Pseudomonas 1-2 % . Plant resistant varieties.

4.1.11.1 Tomato

1. Pests of tomato

Pest	Symptom	Stage of attack of Pest	Management
Fruit borer	Emerging caterpillars feed on leaves, bore into the fruits.	Caterpillar	<ul style="list-style-type: none"> * Collect and destroy adults. * Grow marigold as trap crop in tomato gardens. * Spray NSKE 5%. * Spray BT formulations @ 0.7 ml/l. * Spray Quinalphos 25EC @ 2ml/l
American Serpentine Leaf Miner (ASLM) - polyphagous pest	Mining of the leaves in a serpentine manner appear as white lines on the surface Drying of leaves	Maggots	<ul style="list-style-type: none"> * Remove leaves showing damage. * Spray 2% neem oil garlic emulsion. * Spray DDVP(Nuvan) 1 ml/l. * Spray Beauvaria/ Verticillium.

2. Diseases of tomato

Disease	Pathogen	Symptom	Management
Damping off Same as brinjal			
Septoria leaf spot	Fungus	Small spherical spots on the under surface of older leaves which later enlarge to develop white or grey centre with dark brown margin.	<ul style="list-style-type: none"> * Follow crop rotation. * Periodical spray of Mancozeb 0.3%.
Powdery mildew	Fungus	White, chalky spots forming all over the plant including the stems, flowers and fruit.	<ul style="list-style-type: none"> * Field sanitation. * Spraying wettable sulphur 0.2%. Application of baking soda-vegetable oil- soap emulsion diluted in water.
Tomato Spotted Wilt Virus (TSWV) Thrips	Virus	Slight thickening of the veins of younger leaves. Simultaneously concentric rings appear in the foliage, curling of younger leaves. Green fruits show concentric rings of yellow or brown.	<ul style="list-style-type: none"> * Spray Dimethoate 0.05% to control vectors. * Planting of <i>Crotalaria juncea</i> as a barrier against vectors.
Leaf curl Vector white fly	Virus	Plants initially show stunting and erect growth. Curling, puckering and blistering of leaves	<ul style="list-style-type: none"> * Install yellow sticky traps. * Use resistant varieties like Pusa jwala and Jwalamukhi. * Apply 2% neem oil garlic extract.
Bacterial wilt Same as brinjal			<ul style="list-style-type: none"> * Cultivate resistant varieties like Sakthi, Mukthi and Anagha.

4.1.11.3 Chilli

1. Pests of Chilli

Pest	Symptom	Management
Thrips Vector of chilli virus	Infested leaves crinkle and attain boat shape Affected plants become stunted and fruits deformed	Inter crop with agathi (<i>Sesbania grandiflora</i>) to provide shade which regulate the thrips population Do not grow chilli after sorghum Do not follow chilli and onion mixed crop Sprinkle water over the seedlings to check the multiplication of thrips Treat seeds with imidacloprid 70% WS @ 12 g/kg of seed Spray any one of the following insecticide: Imidacloprid 17.8 % SL - 3ml/10l Dimethoate 30 % EC - 1ml/l Spinosad 45 % SC - 3.2ml/10l Thiacloprid 21.7 % SC - 6ml/10l
Aphid- Vector of virus disease of chilli	Leaves become yellow and later shed	Install yellow sticky traps @ 1 trap/ 5 cents. Spray gruel water on lower surface of leaves. Spray kiriyath extract +soap+garlic extract diluted in water on lower surface of leaves. Spray <i>Verticillium lecanii</i> @ 20 g/lor 5 ml/l. Application of neem oil 5% and neem oil+garlic emulsion 2%. Spray Dimethoate 0.05%
White fly Vector of leaf curl virus	Leaves become yellow and later shed	
Mites	Leaves become thick, brittle and tubular	

2. Diseases of Chilli

Disease	Pathogen	Symptom	Management
Damping off (Same as brinjal)			
Anthraxnose and fruit rot of chilli	Fungus	Seedling blight Dark sunken lesions on leaf and fruit Die back Fruit rot	Remove infected plants. Provide proper drainage. seed treatment with <i>Pseudomonas</i> 1%. Periodic application of COC 0.3% or Mancozeb 0.2%.
Leaf curl	Virus	Curling of leaves, thickening and swelling of veins followed by puckering and blistering of interveinal areas.	Application of Malathion 0.1% with garlic or neem seed oil emulsion 2% with garlic. Raise barrier crops like maize, sorghum etc around chillies.
Bacterial wilt	Bacteria	Wilting, stunting, yellowing of the foliage and collapse of the whole plant Entire vascular system undergoes blackening and bacterial slime oozes out from it if cut open	Uproot and destroy affected plants. Use resistant varieties like Ujwala and Anugraha.

4.1.12. Pest and diseases of cucurbitaceous vegetables

4.1.12.1 Pests of cucurbitaceous vegetables

Pest	Symptom	Stage of attack of Pest	Management
Fruit fly	Microorganisms gain entry through the injury formed by the ovipositor on the fruits Emerging larvae feed within the fruit which as a result rot and drop	Maggot	-Collect and destroy infested fruits. -Apply neem cake @ 100g/pit about 10days before sowing to manage the pupae present in soil. -Suspend different types of traps like banana trap, fish meal trap at 2.5m spacing. -Apply Beauveria bassiana and Paecilomyces lilacinus in the basins. -Apply carbaryl 50WP or Quinalphos 0.05% or malathion 0.15% at flowering and fruit initiation stage.
Aphid Vector of mosaic virus	Leaves become highly crinkled and the plants become weak.	Adults and nymphs	Remove the leaves harboring aphid colonies. Apply 1.5% fish oil soap. Spray tobacco decoction. Spray 2% neem +garlic emulsion. Spray natappoochedi extract.
Epilachna beetle	Scraping and skeletonising the leaves	Grubs and adults	Release grubs and pupae parasitized by Chrysocharis johnsonii in the field. Spray castor oil neem oil emulsion + garlic extract diluted in water. Spray Quinalphos 25EC.
Pumpkin beetle	Grubs bore into the base of the plant resulting in wilting and drying of plants Adult beetles damage by making feeding holes on leaves.	Grubs and adults	Collect and destroy adult beetles. Burn the pits prior to raising the crop. Apply neem cake @ 100g/pit 10days before sowing. Spray Quinalphos 25EC @ 2ml/litre.
Snake gourd caterpillar	Damage on leaves leads to defoliation Flowers and young fruits also eaten up by the caterpillars	Caterpillar	Collect the caterpillar and destroy. Spray cow's urine hot chilli mixture diluted in water. Spray BT formulation ((Biolep, Biobit, Halt, Dipel etc.) @ 0.7ml/litre. Spray Beauveria bassiana @ 20g/litre or 5ml/l.

2. Diseases of cucurbitaceous vegetables

Disease	Pathogen	Symptom	Management
Downy mildew	Fungus	Pale yellow angular patches on the upper surface of leaves. Gradually the spots turn dark brown and dry up Downy growth of fungus visible on lower surface of affected leaves.	Spray Mancozeb 0.3%. Spray 2% pseudomonas. Severely infected leaves or vines should be removed or destroyed before application of fungicide. Control pumpkin beetle.
Powdery mildew	Fungus	Whitish grey superficial spots on upper surface of leaves Later defoliation.	Affected plant are removed and destroyed. Spray Dinocap in severe cases. Spray Carbendazim 0.1%.
Mosaic	Virus	Leaves become mottled, deformed and reduced in size and are curled	Infected plants should be rogued and destroyed. Use seeds from virus- free crops. Periodical application of neem seed emulsion 2% to control vector.

4.1.13 Diagnosis and management of pests and diseases of cowpea

1. Pests of cowpea

Pest	Symptom	Stage of attack	Management
Pea aphid	Yellowish hue on infested leaves Growth of the plant retarded Pods become malformed	Nymphs and adults	Hyptis suaveolens (Nattappochedi) extract (one litre leaf extract + 60g ordinary soap diluted in half litre of water.) This stock solution is diluted with 15 litres of water before spraying. Spray tobacco decoction or NSKE 5% or 2% neem seed oil plus garlic extract. Spray 0.1% malathion or 0.05% quinalphos. Spray Verticillium lecanii to manage residual population.
Pod bug	Seeds shrink and shrivel within the pods Attacked seeds become discoloured	Adults and nymphs	Use hand net to trap the bug. Prepare a spray solution containing one litre cows urine extract from 250g garlic plus 30g well crushed hot chilli and give a drenching spray. This is followed by an immediate spray application of Beauveria bassiana (20g or 5ml per litre of water.) Destroy alternate hosts.
Pod borer	Seeds and buds destroyed by larva.	Caterpillar	Remove and destroy crop residues by burning. Spray 5% NSKE. Spray BT formulations (Biolep, Biobit, Halt, Dipel etc.)

2. Diseases of cow pea

Disease	Pathogen	Symptom	Management
Collar rot and web blight	Fungus	Reddish brown lesions at the collar region Girdling of stem Collar region becomes sunken and rotten with thick mycelium at later stages Yellowing and defoliation and web blight on foliage with mycelia growth.	- Cultural practices like shallow sowing, use of raised beds, deep ploughing, rotation with cereal crops and mulching. - Application of neem cake. - Collection of seed from healthy plants. Drenching the soil with copper oxy chloride or Mancozeb @ 2-4g/l or carbendazim 1g/l Seed treatment with Carbendazim 1g/kg seed.
Fusarium wilt	Fungus	Plant show yellowing, withering and drooping of leaves Vines show blackening and drying Roots show rotting and blackening Basal swelling	-10 days before sowing apply Trichoderma enriched with cowdung and neem cake in the pit. -Treat the seeds with Pseudomonas 1% solution. - Drench the pit and spray the plant with Pseudomonas 2% when the plant attains 15 and 25 days. -Drenching the base and spraying the plant with copper oxy chloride @ 0.4%. There should be a gap of 10 days between COC and pseudomonas application.
Cowpea aphid borne mosaic	Virus	Young leaves show chlorosis irregularly. Soon leaves show mosaic mottling vein banding, puckering and distortion. The pods are also twisted, curved and reduced in size. The seeds are shrivelled and few in number.	Collect seeds from healthy, disease free plants. Manage vectors by spraying insecticides like malathion 50EC, Quinalphos 25 EC or neem oil emulsion,. Spraying should be directed to the under surface of leaves and other parts of plant. Use resistant varieties.
Anthracnose	Fungus	All parts are affected Severely affected pods are curled and do not contain normal size seeds	Seed treatment with Thiram @ 3g/kg of seed followed by carbendazim spray @ 0.05% at 15,30,45 days after seedling emergence

4.1.13 Diagnosis and management of pests and diseases of bhindi

1. Pests of bhindi

Pest	Symptom	Management
Shoot and fruit borer	<ul style="list-style-type: none"> Terminal shoots wither and droop Shedding of buds and flowers Bore hole in fruits and feed Deformed fruits 	Set up pheromone trap @ 12/ha. Collection and destruction of affected fruits. Release of egg parasite <i>Trichogramma chilonis</i> @ 1.0 lakh/ha. Release of 1st instar larvae of green lacewing predator <i>Chrysoperla carnea</i> @ 10,000/ha. Dust carbaryl 10 % DP @ 25 kg /ha or spray <i>Bacillus thuringiensis</i> @ 2 g/lit Or spray any one of the following insecticide: Azadirachtin 0.03% WSP - 5g/l Azadirachtin 5% Neem Extract Concentrate - 5ml/10 lit. Phosalone 35 % EC - 1.5ml/l
B h i n d i fruit borer	<ul style="list-style-type: none"> Feed on the flowers Circular boreholes on fruits Larva thrust only part of their body inside the fruit feed 	Collect and destroy the infected fruits and grown up larvae Grow simultaneously 40 days old American tall marigold and 25 days old tomato seedling at 1:10 rows to attract <i>Helicoverpa</i> adults for egg laying. Setup pheromone trap with <i>Helilure</i> at 15/ha Six releases of <i>T. chilonis</i> @ 50,000/ha per week coinciding with flowering time Release <i>Chrysoperla carnea</i> at weekly interval at 50,000 eggs or grubs/ha from 30 DAS Spray carbaryl 50 WP 2 g/lit or <i>B. thuringiensis</i> 2 g/lit. Do not spray insecticides after maturity of fruits.
Leaf roller	<ul style="list-style-type: none"> Caterpillar rolled the leaves Scrapping the chlorophyll content and feed inside Defoliation 	Collect and destroy rolled leaves Spray carbaryl 50 WP 2 g/lit or phosalone 35 EC 2 ml/lit
Whitefly: <i>Bemisia tabaci</i>	<ul style="list-style-type: none"> Chlorotic spots on the leaves which latter coalesce forming irregular yellowing of leaf tissue Severe infestation results in premature defoliation Development of sooty mold Vector of yellow vein mosaic virus 	Spray any of the following insecticide Phosalone 35 EC @ 2.5 l/ha Quinalphos 25 EC @ 2.0 l/ha Triazophos 40 EC @ 2.0 l/ha

<ul style="list-style-type: none"> • Jassid 	<ul style="list-style-type: none"> • Tender leaves become yellow • The margin of the leaves start curling downwards and reddening sets in • In the case of severe infestation leaves get a bronze which is typical "hopper burn" symptom • The margins of the leaf get broken and crumble into pieces when crushed • The leaves dried up and shed and growth of the crop is retarded 	<p>Spray any one of the following insecticides (spray fluid 500l/ha)</p> <p>Imidacloprid 200 SL at 100 ml/ha</p> <p>Methyl demeton 25 EC 500 ml/ha</p> <p>Dimethoate 30 EC 500 ml/ha</p> <p>NSKE 5%</p>
--	---	---

2. Disease of bhindi

Disease	Pathogen	Symptom	Management
Yellow vein mosaic Vector- white fly	Virus	Yellowing of veins followed by veinal chlorosis Thickening of veins and veinlets Chlorosis may extend to interveinal areas Fruits are dwarf, malformed and yellowish green	Use resistant varieties Arka Anamika, Arka Abhay and Susuthira. Destruction of host weeds (Croton sparsiflora and Ageratum sp.)

4.1.15. Diagnosis and management of pests and diseases of Amaranthus

1. Pest of Amaranthus

Pest	Symptom	Stage of attack	Management
Leaf webber	Larva web together the leaves and skeletonise them	Caterpillar	Collect and destroy leaf webs along with caterpillars. -Spray 4% leaf extract of neem or clerodendron (400g of leaves dried under shade and powdered.-Soak in 1l of water for 24hours and filter through muslin cloth-dissolve 400g of ordinary soap in 9 lit. of water. Pour the soap solution to plant extract and mix thoroughly before spraying.)

2. Disease of Amaranthus

Disease	Pathogen	Symptom	Management
Amaranthus leaf blight	Fungus	Straw coloured lesions in leaf which later coalesce Shot hole symptoms	Green type CO-1 is resistant to the pathogen and is used as crop mix to reduce the spread of the pathogen. Prophylactic spray application baking soda with turmeric powder at the ratio of 1:4. (Dissolve 40g of asafoetida or palkkayam in 10l of water. To this add, 8g sodium bicarbonate and 32 g turmeric powder with violent agitation. Filter and spray.) Application of mancozeb @ 4g/l using cowdung supernatant as the diluents. Spray 2% pseudomonas.

4.1.16. Diagnosis and management of pests and diseases of cabbage

1. Pests of cabbage

Pest	Symptom	Management
Cut worms	Defoliation	Apply Chlorpyrifos 2 ml/lit in the collar region during evening hours for the control of common cutworm
Diamond back moth	Defoliation	<ol style="list-style-type: none"> 1. Grow mustard as intercrop as 20:1 ratio to attract diamond back moths for oviposition. Periodically spray the mustard crop with insecticide to avoid the dispersal of the larvae. 2. Install pheromone traps at 12 Nos/ha. 3. Spray Cartap hydrochloride 1 g/lit or Bacillus thuringiensis 2 g/lit at primordial stage (ETL 2 larvae/plant) 4. Spray NSKE 5 % after primordial stage. <ul style="list-style-type: none"> - Release parasite Diadegma semiclausum at 50,000/ha, 60 days after planting - Spray: Azadirachtin 0.03% WSP5g/l, Chlorpyrifos 20 % EC 2ml/l, Spinosad 2.5 % SC 1.2ml/l

2. Disease of cabbage

Disease	Pathogen	Management
Club root	Fungus	Seed treatment with <i>Pseudomonas fluorescens</i> at 10 g/kg of seeds, followed by seedling dip @ 5g/l and soil application @ 2.5 kg/ha along with 50 kg FYM before planting. Chemical control. Dip the seedlings in Carbendazim solution 2 g/l for 20 minutes. Drench the soil around the seedlings in the main field with Carbendazim @ 1 g/l of water. Follow crop rotation. Crucifers should be avoided for three years.
Black rot	Fungus	Dip the seeds in 100 ppm Streptomycin for 30 minutes. Two sprays with 2 g/lit Copper oxychloride + Streptomycin 100 ppm after planting and head formation.

4.1.17 Diagnosis and management of pests and diseases of cassava

1. Pests of cassava

Pest	Management
Red spider mites and scale insects	<ul style="list-style-type: none"> • Spray the crop with water at 10 days interval from the onset of mite infestation. • In case of very severe infestation, spray Clerodendron decoction of 2% strength at monthly intervals from the time of appearance of mites. • spraying 0.05 per cent dimethoate at monthly intervals from the time of appearance of mites. • In the case of very severe infestation, the crop can be protected by The stem may be sprayed with 0.05 per cent dimethoate before storing as a prophylactic measure against the scales.
Termites	<ul style="list-style-type: none"> • Sprinkle a little of carbaryl 10% or chlorpyrifos in the mounds prior to planting.

2. Diseases of cassava

Disease	Pathogen	Management
Cassava mosaic disease (CMD) vector-white fly	Virus	Production of disease free planting material of tapioca through nursery techniques. Stem cuttings from disease free plants should be used for planting. -Use Mosaic tolerant varieties such as H-97
Leaf spot	Fungus	Spray 0.2 per cent zineb or 1 per cent Bordeaux mixture for control of leaf spot.
Bacterial blight	Bacteria	Use of resistant or tolerant varieties is the only method of control. Among improved varieties, H-97, H-226, H-1687 and H-2304 are tolerant to the disease while H-165 is highly susceptible. Among the local varieties, M-4, Paluvella, Pichivella, Parappilppan, Anamaravan etc. are tolerant to the disease.

4.1.18 Diagnosis and management of pests and diseases of ornamental plants : anthurium, orchid, rose, jasmine

Pest	Stage of attack	Symptom	Management
Pests of anthurium, orchid, rose, jasmine			
Snails and slugs	All stages	Feed on the tender young shoots, roots and buds.	1. Use metaldehyde 2. Hand picking.
Pests of Rose			
Aphids	All stages	Yellowing and drying of tender shoot.	Spray Dimethoate 30EC 2ml/l
Scales	All stages	Drying of plants	Spray Malathion 2ml/l
Pests of Jasmine			
Bud worm	Larva	Buds with bore holes and webbed with silken threads	Spray Monocrotophos 2ml/l

4.1.18.2 Diseases of anthurium, orchid, rose, jasmine

Disease	Pathogen	Symptom	Management
Bacterial blight	Bacteria	Blackening of stem and decay of leaf axil	Spray a mixture of turmeric powder and sodium bicarbonate in the proportion 10:1 @0.15% at weekly intervals.
Anthraxnose	Fungus	Tiny circular black spots appear on leaf and spadix	Spray Mancozeb 0.3%
Diseases of Rose			
Black spot	Fungus	Circular black spot with an irregular thread like border on leaf, stem and flowers.	Destroy fallen leaves Spray Captan 0.2%
Diseases of Jasmine			
Leaf blight	Fungus	Leaves become brown and dry up	Spray Mancozeb 0.2%

4.1.19 Plant protection in polyhouses

4.1.19.1 Common pests in polyhouse crops

Pest	Damage	Management
White fly	Present in lower leaf surface. They feed and cause yellow spots on leaves.	<ul style="list-style-type: none"> Removal of old and heavily infested leaves. Use of yellow sticky traps. Using predator Chrysoperla carnea Use entomopathogenic fungi Verticillium lecanii, Beauveria bassiana Use botanical pesticides like neem oil garlic emulsion. Use of fish oil rosin soap
Thrips	Found in buds, flower petals, axils of leaves etc. Both the nymphs and adults suck the sap from leaves and flowers. Commonly seen in cow pea.	<ul style="list-style-type: none"> Use of yellow/blue sticky trap. Apply entomopathogenic fungi Verticillium and Metarrhizium Use Botanicals like 2% neem oil emulsion.

Aphids	Feeding on young leaves results in chlorotic spots. Commonly seen in cucumber.	<ul style="list-style-type: none"> • Use yellow/ blue sticky traps. • Spray Dimethoate 2ml/l
Spider mite	Mites suck sap from leaves and result in speckles. Under severe infestation, leaves dry and fall off. Commonly seen in chillies and capsicum.	<ul style="list-style-type: none"> • 50% humidity control will reduce the mite attack. So frequent watering / misting to bring down greenhouse temperature should be done. • Remove heavily infested plants. • Use Predatory mite Phytoseiulus persimilis. • In case of heavy infestation use acaricides.
Leaf miners	Maggot feed on leaf tissues making irregular tunnels and disfigures the plant.	<ul style="list-style-type: none"> • Use a yellow sticky card • Use healthy planting material. • Disposal of crop residues. • Use botanicals like neem oil emulsion.
Nematodes	Infested plant appears stunted and tend to wilt on warmer days. Root galls are seen.	<ul style="list-style-type: none"> • Drenching the soil with 0.5 per cent formalin at 100 ml/kg soil followed by covering with polythene tarps for two weeks before sowing/planting • Growing cowpea (trap crop for root-knot nematode) closely to the main crop and removing the plants out of polyhouse at 45 days after sowing. • Raising marigold (antagonistic to nematodes) and incorporating in situ after plucking flowers. • Adding well decomposed farm yard manure at rate of 20 tonnes per hectare to enrich soil. • Incorporating neemcake at 250 kg/ha soil two weeks before sowing/planting. • Filtering irrigation water using mesh sieves before usage. • Applying Pseudomonas fluorescens/ Trichoderma viride @ 2.5 kg/ha mixed with 50 kg farmyard manure ten days before sowing/planting and use chemical pesticide like carbosulfan 6G. • Grow resistant varieties.

4.1.19.2 Diseases in polyhouse crops

Disease	Pathogen	Symptom	Management
Downy mildew	Fungus	<ul style="list-style-type: none"> Angular chlorotic lesions on leaves. Downy growth on under surface of leaves. Leaves turn brown and drop. 	Spray Mancozeb 3g/l
Powdery mildew	Fungus	<ul style="list-style-type: none"> White powdery growth seen on top leaves. All parts are infected. 	Wettable Sulphur spray (2g/l). Not used in Cucumber.
Foot rot	Fungus	<ul style="list-style-type: none"> Withering and yellowing of foliage. Plants wilt. Roots turn yellow to brown and base of stem may rot. 	Basal application of FYM enriched with Trichoderma. Periodic drenching with Pseudomonas 20g/l. Crop rotation. Drenching with Mancozeb 2g/l.
Fusarium wilt	Fungus	<ul style="list-style-type: none"> Lower leaves become yellow followed by withering of leaves and finally the branches wilt 	Basal application of FYM enriched with Trichoderma. Periodic drenching with Pseudomonas 20g/l. Crop rotation. Drenching with Mancozeb 2g/l.
Fruit rot	Fungus	<ul style="list-style-type: none"> Soft, wet rot of flowers and the blossom end of fruits. Infected fruits decay and become watery. 	Mancozeb 2g/l.
Bacterial wilt	Bacteria	<ul style="list-style-type: none"> Wilting of youngest leaf during the hottest part of the day. General wilting and yellowing of foliage and eventually plant dies. 	Use resistant varieties. Periodic spray/ drench of Pseudomonas 20g/l. Crop rotation. Copper hydroxide 2g/l

4.1.20 Nutritional disorders of crops

Nutrient	Deficiency Symptom	Management
Nitrogen (N)	<ul style="list-style-type: none"> Leaves become pale yellow and narrow with irregular margins. 	Use N fertilizers in soil - Foliar spray of Urea
Phosphorus (P)	<ul style="list-style-type: none"> Reddening or purpling of leaves, reduced growth of plant, delayed maturity. 	Application of P fertilizers like superphosphate.
Potassium (K)	<ul style="list-style-type: none"> Yellowish/ brownish /whitish spots starting from leaf margin may be seen. In severe cases death of foliage may occur. 	Use of K fertilizers like MOP in soil.
Magnesium (Mg)	<ul style="list-style-type: none"> Vein of leaves remain green and interveinal chlorosis. Symptoms appear on older leaves. 	Foliar application of 1% magnesium sulphate ($MgSO_4$)
Iron (Fe)	<ul style="list-style-type: none"> Yellowing of new eaves. General chlorosis 	Spraying 0.5% Ferrous sulphate on foliage
Copper (Cu)	<ul style="list-style-type: none"> Tip of leaves may turn white 	Foliar or soil application of copper sulphate.
Zinc(Zn)	<ul style="list-style-type: none"> White leaf becomes rusty brown in colour, stunted growth 	Soil application of zinc sulphate @ 20 - 25kg/ha.
Calcium (Ca)	<ul style="list-style-type: none"> Terminal bud dies. Leaves wrinkled. New leaves show pigmentation. 	Use Calcium carbonate or calcium hydroxide in soil. Use gypsum.
Sulphur (S)	<ul style="list-style-type: none"> The whole leaf in plants has light green color. 	Foliar application of Sulphur or sulphates. Application of S containing fertilizers.

Detailing of practical

- 4.1.1 Visit Krishi Bhavan and collect information on the infrastructure required for agri clinic and the functioning of agri clinic.
- 1.1.1 Identification and management of pests of Rice, coconut, rubber, pepper, ginger, cassava, banana, solanaceous vegetables - tomato, brinjal, chilli, cucurbitaceous vegetables, Cowpea, Amaranthus, bhindi, cabbage, rose and their management, anthurium, orchid, jasmine and their management.

- 1.1.2 Identification and management of diseases of Rice, coconut, rubber, pepper, ginger, cassava, banana, solanaceous vegetables - tomato, brinjal, chilli, cucurbitaceous vegetables, Cowpea, Amaranthus, bhindi, cabbage, rose and their management, anthurium, orchid, jasmine and their management.
- 1.1.3 Collection of pest and disease specimen and preparation of insect box of pests and herbarium of disease specimen.

Assessment activities

Visit to farmers fields and identify the symptoms of pest and disease attack. Collection of live specimen.

TE questions

1. You have seen triangular cuts in coconut leaves. Analyse the situation, identify the problem and suggest suitable remedial measures.
2. There are circular brown patches in a padasekharam near your house. Identify the problem and suggest remedial measures.
3. Analyse the first word pair and complete the second one.

BLB	:	Bacteria
Sheath rot	:
4. Banana plants are showing brittle nature, mottling and rosetting of leaves, stunted growth and fails to produce bunches. Identify the disease and suggest suitable control measures.
5. Tip of the leaves turn white is the deficiency symptoms of _____
6. How will you identify the attack of rice bug and case worm in paddy field.
7. How will you identify and control the attack of pollu beetles in pepper.
8. On a field inspection you have noticed coconut palms with flaccidity, yellowing and necrosis. Moreover leaflets were showing ribbing symptoms and yield was low. Identify the disease and suggest suitable management practices to improve and sustain production.
9. The following symptoms were noticed on brinjal during a field visit. Identify the pest and suggest suitable control measures in each case.
 - a) leaves are seen skeletonized.
 - b) fruits show bore holes and young shoots show withering

10. Choose the correct choices from B and C which relates with those in A

A	B	C
Rice	Pollu	Aphid
Coconut	dead heart	Bugs
Pepper	Bunchy top	BPH
Banana	Deformed nuts	Beetles
	Hopper burn	Mites

11. A farmer cultivating pepper is anticipating quick wilt infection and would like to take preventive measures. Advise him to the same.
12. A farmer cultivating coconut approaches you with immature nuts showing triangular yellowish patches below the perianth region and asks for your help. As an agricultural student, identify the pest, its nature of damage and suggest suitable control measures.
13. The pepper plants in your farm shows black lesions and wilting. Can you identify the problem and suggest suitable remedy? Explain the preparation of a plant protection chemical against this problem.



UNIT 4.2

AGRI INPUT CENTRES

Agri input Centres are envisaged to provide input supply, farm equipments on hire and other services. In order to enhance viability of the ventures, Agripreneurs can take up the scheme of agriclincs and agri business centres (AC & ABC). The eligibility for taking up the scheme also includes VHSE agriculture certificate holders with minimum 55% marks.

This unit deals with the concept and scope of agri input centres. The formalities for starting an agri input centre are discussed and the two types of agri inputs namely consumable inputs and capital inputs are elaborated. The learner also gets an idea about supply chain management in agri input centres as well as the marketing strategies adopted.

Learning Outcomes

The learner:

- defines and explains the concept and scope of agri input centres.
- enlists the formalities for starting an agri input centre
- enlists and explains the two types of agricultural inputs - consumable inputs and capital inputs.
- defines and explains supply chain management in agricultural inputs
- enlists various marketing strategies for agricultural inputs.

4.2.1 Agri input centre

Concept and scope: Agri input centres or agribusiness centres are envisaged to provide input supply, farm equipment on hire and other services.

4.2.2 Formalities for starting agri input centre

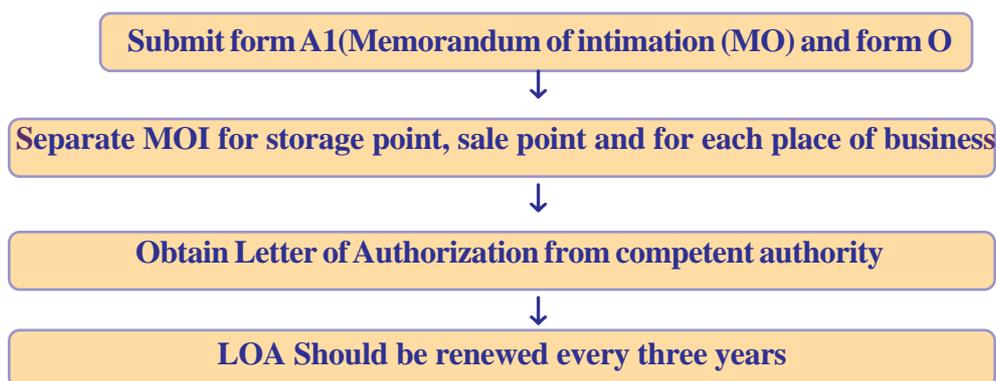
License is obtained from the Principal Agricultural Officer (PAO) for the establishment of any Agri input centre. The application should be forwarded through Agricultural Officer (AO). The selected site and building should be inspected by the Agricultural Officer to ensure its suitability for starting the input centre.

Procedure for obtaining license for various inputs are listed below:

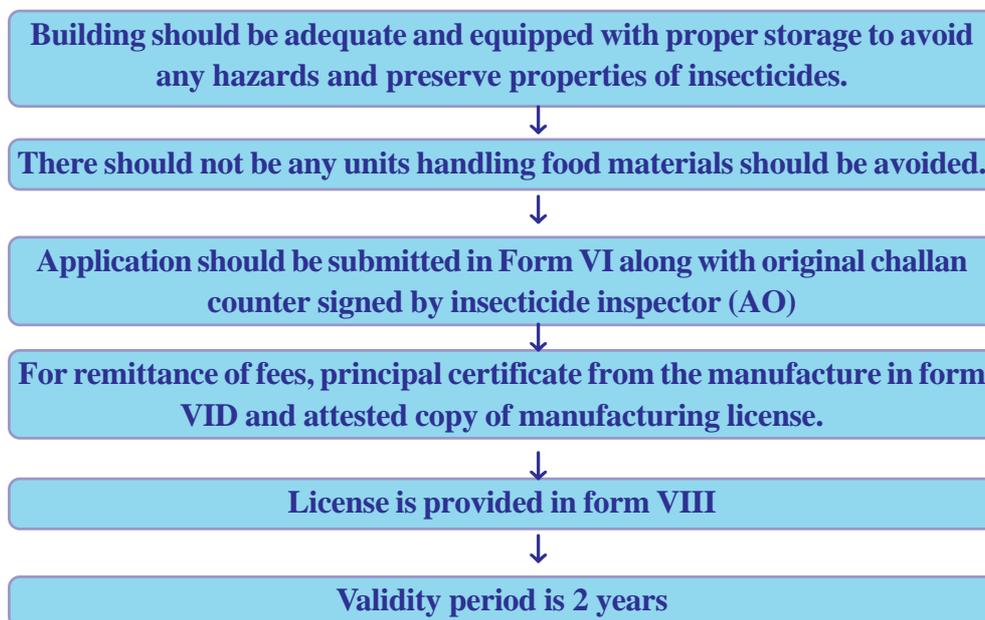
1. For Seeds



2. For Fertilizer



2. For Pesticides



If annual turn over

- more than 5 lakh the sales tax registration is required
- above 10 lakh TIN Registration is required

4.2.3 Types of inputs in agriculture

Agro - inputs are either biological or chemical or inorganic compounds used in the production of agricultural and allied products.

Agricultural inputs are categorized into 2 types:

1. Consumable inputs: Manures and fertilizers, biofertilizers, biocontrol agents, Plant growth regulators, seeds and planting material, pesticides, feeds.
2. Capital/Durable inputs: Agricultural implements

The production and distribution of above mentioned agricultural inputs creates agri - business opportunities.

4.2.4 Supply chain management**Definition**

Supply chain management (SCM) is the management of the flow of goods and services.

Supply chains are principally concerned with the flow of products and information between supply chain member organizations, ie. procurement of materials, transformation of materials into finished products, and distribution of those products to end customers.

The real measure of supply chain success is how well activities coordinate across the supply chain to create value for consumers, while increasing the profitability of every link in the supply chain. In other words, supply chain management is the integrated process of producing value for the end user or ultimate consumer.

Following are the components of an organised agri - supply chain:

1. Procurement

Procurement is the act of acquiring, buying goods, services or works from an external source, often via a tendering or bid process. It is favorable that the goods, services or works are appropriate and that they are procured at the best possible cost to meet the needs of the acquirer in terms of quality and quantity, time and location. Corporations and public bodies often define processes intended to promote fair and open competition for their business while minimizing exposure to fraud and collusion

2. Logistic management

Logistics management is a supply chain **management** component that is used to meet customer demands through the planning, control and implementation of the effective movement and storage of related information, goods and services from origin to destination.

3. Organizational management

Includes activities like contracting, partnership, long term storage, packaging technology, cold chain management, Quality and safety.

4. Consumer Response

- a. Electronic scanning of price and product at the point of sale
- b. Streamline the entire distribution chain

4.2.5 Marketing strategies

Marketing as defined as “the total of activities involved in the transfer of goods from the producer or seller to the consumer or buyer, including advertising, shipping, storing and selling.”

Marketing seeks to satisfy the needs of people (customers or the **market**) (creating a sense of usefulness or **utility**) through the **exchange** process. Marketing refers to channeling the gap between service and product providers to service and product seekers. Marketing also known as a way of satisfying needs.

The “4P”s of marketing are:

1. Product
2. Place
3. Promotion
4. Price

Marketing strategies for Inputs

1. Product Strategy

- The products should be able to satisfy the expected needs rural farmers and provide them value for money they spent.
- The product information on the cover packaging and in the user manuals should be expressed in simple and easy to understand local language.
- The rural farmers likes simple and easy to use products.

2. Pricing Strategy

- The rural customer is Quality conscious and price sensitive and expects value for money and therefore, the pricing has to be in accordance with their expectation.
- The technique value analysis involves replacing costly raw materials with inexpensive ones, without sacrificing quality and functionality

3. Place Strategy

- The channel plays the role of both pulling as well as pushing function and acts as a dispenser of agricultural inputs.
- Make the products available near the target audience.
- Cooperative societies, public distribution system, feeder markets, village weekly markets fairs and festivals can be utilized to ensure adequate distribution of agri-inputs products.

4. Promotion Strategy

The promotional activities should be undertaken through media that are comfortable and appropriate for the rural areas. For e.g., traditional art forms such as puppet shows and street plays or creating awareness through village panchayat members, distribution of pamphlets, use of mobile vans for publicity and advertising through wall posters.

Factors influencing agri input marketing

1. Socio-cultural factors that influence the purchase decision adoption of modern farming practices and equipment.
2. Migration of rural population to urban areas which shows less dependence on agriculture for livelihood or/and increase farm mechanization that require less dependence on laborers.

3. Occupational pattern with higher education.
4. Literacy is required to understand the modern farming practice and products.
5. Land distribution and use also increases or decreases the input consumption.
6. Development Programmes carried out by govt. and semi-govt. agencies.
7. Communication Media which has been spreading it's network gives newer opportunity for agri-input industries.
8. Credit availability through banks and co-operative system has made easier for the farmers to modernize their farming.

Custom hiring centres

Mechanization is a major tool for improving productivity and production in agriculture sector. But the mechanization activities face certain constraints in Kerala such as small farm holdings and inability of individual farmers to make huge investment on machinery. The idea of Custom Hiring Centres for agricultural machinery has been accepted as a solution to this problem.

Custom Hiring Centres maintain a number of agricultural machineries and provide the machines to the farmers at a nominal rent basis. The centres are also having the facilities for the proper upkeep and maintenance of the machine.

Objectives of Custom Hiring Centre

- *To make available various farm machinery / equipment to small and marginal farmers.*
- *To improve mechanization in places with low farm power availability.*
- *To provide hiring services for various agricultural machinery/ implements applied for different operations.*
- *To expand mechanized activities during cropping seasons in large areas especially in small and marginal holdings.*
- *To provide hiring services for various high value crop specific machines applied for different operations.*

Details of Practical

1. Visit to agriinput centre and list out the inputs available there.

Name of input centre :

Address :

Phone number :

Sl.No	Input Item	Group	Name of Company	Quantity	Price	Remarks

2. Visit to a super market. Find out the supply chains for different agricultural commodities.

Sl.No.	Commodity	Links in the supply chain		

3. Conduct a market survey and list out the marketing strategies involved.

Sl.No.	Name of firm	Commodity	Marketing strategies used	

4. Marketing of PTC products applying various marketing strategies.

Assessment activities

The student is given the task of cultivating poison - free vegetables in 25 grow bags. The student lists out all the inputs he/she uses during the cultivation process. He/she conducts a market survey to find out demand of vegetables among customers. He/she also prepares the marketing strategies to obtain maximum profit for his produce.

TE questions

1. The success of any crop will depend upon procuring and applying the right input at the right time. Can you support the establishment of Agri Input Centres based on this statement? Explain your answer.
2. The success of any agri business will depend on proper supply chain management. Justify this statement.
3. Your class has produced a large number of vegetable seedlings as part of PTC. Describe the various strategies you will use in marketing the seedlings to get a good price.



UNIT 4.3

FARM MACHINERY AND PLANT PROTECTION EQUIPMENTS

Mechanization of agriculture is an essential input to the modern agriculture. It enhances productivity, besides reducing human drudgery and cost of cultivation. Mechanization also helps in improving utilization efficiencies of other inputs. This unit discusses the scope of farm mechanization in India and Kerala. The learner gets acquainted with the various farm machines used in major crops in our country. The learner also understands the usage of various plant protection equipment like sprayers and duster.

Learning outcomes

The learner :

- defines and explains the scope of farm mechanization
- identifies farm machineries used for cultivation - for harvest and post harvest for plant protection - Machinery suitable for homestead farming
- practises maintenance of plant protection equipments

4.3.1. Definition and scope of farm mechanization

Farm mechanisation is defined as the application and introduction of agricultural implements/equipment with objective of reduction of drudgery, increase in land productivity and increase in labour productivity and for the well - being of the farmers.

India is a growing economy and an increasing population can be supported only by activities like multiple cropping; hence to perform operations in a timely manner, high capacity machines are required. The adoption of efficient machinery in agriculture helps to increase productivity by about 30% enabling the farmers to raise a second crop making agricultural sector more attractive. Due to high cost of agricultural machines, custom hiring- providing machines on rental basis is being promoted by the Government. It is expected that the percentage of population engaged in agriculture will come down from the present 64% to a close 40% by 2020; this would increase the need for mechanization.

Objectives of farm mechanization

- To reduce drudgery
- To increase productivity
- To increase labour productivity
- For the well - being of the farmers.

The various operations involved in agriculture can be grouped as:

- Field preparation
- Planting/transplanting/sowing
- Weeding
- Irrigation
- Fertilizer application
- Pesticide application
- Harvesting and
- Post - harvest operations.

4.3.2 Different groups of Farm machinery

4.3.2.1 For Cultivation

1. Tractor

Tractor is a self propelled power unit having wheels for operating agricultural implements and machines including trailers.



2. Rotavator

It is better than the conventional tillage equipments because it:

- a. Saves time, fuel, soil compaction
- b. Leaves soil perfectly leveled
- c. Stubbles and residues of previous crops are chopped into pieces and mixed in the soil
- d. There is no need of multiple operations of cultivator, disc harrow and plank.



3. Power tiller

It is a prime mover in which the direction of travel and its control for field operation is performed by the operator walking behind it. It is known as hand tractor or Power tiller. Multi - use power tillers with 3 - 4 attachments are preferred in India. Price range: Approximately Rs. 150000 - 200000/ -



4. Puddlers

There are three types of puddlers.

1. Hand operated puddlers
2. Animal drawn puddlers
3. Tractor drawn puddlers

The puddling of wet fields is done smoothly and efficiently.

Specifications used : 36 blade, 1.5 meter width

- 42 blade, 1.75 m width
- 48 blade, 2m width.

Price range : Apprx. Rs.85000 - 135000/-



5. Bund former

The bund former consists of mild steel angle iron frame; hitch system, and two blades (wings). The blades are made by mounting mild steel sheet on an angle iron frame. The blades are adjusted in converging manner and has wider opening in the front in comparison at the rear end. The distance between blades can be adjusted according to size of bund required. The implement is mounted type and operated in tilled soil.



6. Seed drill

It is a machine for placing the seeds in a continuous flow in furrows at uniform rate and at a controlled depth with or without the arrangement of covering them with soil.

Seed drill performs the following operations:

1. To carry the seeds
2. To open a furrow to an uniform depth
3. To meter the seeds
4. To place the seed in furrows in an acceptable pattern
5. To cover the seeds and compact the soil around the seeds.



Seed - cum - fertilizer drills, fitted with fertilizer dropping attachment, distribute the fertilizer uniformly on the ground. The drill has a large seed box which is divided into 2 compartments one for seed and another for fertilizers. Seed drill can be bullock drawn or tractor drawn.

7. Planter

Planter is usually used for those seeds which are larger in size and cannot be used by usual seed drills. Planter is usually used for those seeds which are required to be sown at equal intervals between plant to plant. A planter consists of –

- a. A hopper
- b. Feed metering device
- c. Knock out arrangement
- d. Cut - off mechanism
- e. furrow opener and
- f. Other accessories.

Mechanical broadcasters are used for large scale work. This machine scatters the seeds on the surface of the seed bed at controlled rates. A dibbler is used for dibbling. It is a conical instrument used to make proper holes in the field. Mainly vegetable seeds are sown in this way.

Equipment for placing the plants in soil is called a transplanter.

Manual rice planter : It is used for transplanting paddy seedlings. The unit consists of skid frame, movable tray and seed picking fingers. Mat type seedlings are placed on the inclined trays. When the fingers are pushed downward they pick up the seedlings and place them in the ground. Price - Approx. 1.5 - 1.6 lakhs (varies with type).



4.3.2.2 For Intercultural Operations

1. Dry land weeder

Dry land weeders with long handles are suitable for weeding in row crops in rain fed and garden lands.



2. Cono weeder

It is useful for unrooting and burying weeds in between standing rows of rice crop in wetlands. It disturbs the topsoil and increases aeration. It can also be used for trampling the green manure crop in addition to weeding operation.



3. Coconut basin digger

The basin digger is developed by modifying the power tillers and adding certain attachments to benefit coconut farmers for taking basins at the same time reducing labour cost.



4.3.2.3 For harvesting and Post harvest operations

1. Coconut Climber

It has got mainly two assemblies of similar construction. The user has to co-ordinate these two assemblies simultaneously by using hands and legs to climb on coconut tree. In this construction, the user has to stand and operate the device. Initially the steel rope wires of both top and bottom assembly has to be looped with the tree and has to be locked. Then the user can stand by placing foot on both assemblies and has to hold on the handles provided. As the user lift the assembly by foot and raise the either assembly by hand the steel rope will get loosen and when he push back with foot after reaching to a particular height it will get tighten. By this process the user can climb to the tree easily.



To go down the user has to loosen the loop by raising his leg and pulling the handle, then he has to move down the device to a particular distance. From there the loop has to be tightened by pushing the leg towards down. For easy climbing, the body posture has to be kept straight. In this type of construction the steel rope wire will get adjusted as per the diameter of the tree by the force applied by the user towards gravity. Here the device has to be operated by standing and there is no support for the body while climbing. This may cause fatigue to the climbing person during initial climbing. The weight of the device is approximately 7 Kg. The user can climb 40m in 2-3 minutes.

2. Coconut dehusker

Coconut dehusker is available in two forms

i. Conveyor type Coconut dehusker

Features

- Corrosion-resistance
- Dimensional accuracy
- High-performance

Specifications

- Capacity: 1000 coconut per hour
- Motor: 2 HP Electric motor
- Capability of removing husk: 150 nos. in 1 hr

ii. Simple Coconut Dehusker

A very simple and effective tool for easy dehusking of coconuts. It takes about 8 to 12 seconds for dehusking a nut depending on the type and maturity. The tool is light, very simple to use and handy and can be used both indoors and outdoors.



3. Rubber tapping Knife

Two types of tapping knives are used. One of them, the 'Michie Golledge' knife is common and widespread. The other one is the 'Jebong' knife, commonly used in Malaysia, is more suitable for speedy and easier tapping but with a slightly higher bark consumption. It is now gaining popularity.



'Michie Golledge' knife

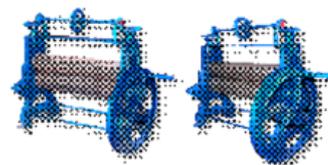


'Jebong' knife



4. Rubber Roller

Latex is coagulated in suitable containers into thin slabs of coagulum and rolled through a set of smooth rollers followed by a grooved set and dried to obtain sheet rubber.



5. Mango Harvester

This tool is useful to pluck mango fruits from the trees without fruit damage. It is a simple and maintenance free gadget comprising of a metal ring with a fixed knife edge at one end for cutting the petiole of the fruit. Nylon net is fixed to the



metal ring to hold the plucked fruits. The unit needs to be fixed to a long pole of suitable length to reach the fruits on the tree.

6. Mower

A **lawn mower** is a machine utilizing one or more revolving blades to cut a grass surface to an even height. The height of the cut grass may be fixed by the design of the mower, but generally is adjustable by the operator, typically by a single master lever, or by a lever or nut and bolt on each of the machine's wheels.



7. Self - propelled vertical conveyor reaper

It is mostly used for harvesting paddy and wheat. It is light in weight and hence shifting the reaper from one field to another is easy. Operating the reaper is fatigue free. The total cost of the machine is well within the purchasing power of the small farmers. It is highly cost economical when compared to other paddy harvesters and combine and manual harvesting.



8. Thresher

It is a machine to separate grains from the harvested crop and provide clean grain without much loss and damage. The Bureau of Indian Standards has specified that the total grain loss should not exceed 5% in which broken grains should be less than 2%.



9. Thresher-cum-winnower

The machine consists of a rotary drum mounted with spikes. As the drum rotates at 800 rpm, the paddy coming in contact with the spikes is threshed. The winnower attachment consists of a blower, wind box and the hopper. The upper jet air from the winnower fluidises the mixture of grains, straw and dust while the lower jet penetrates through the cloud and effects separation of the components efficiently.



10. Combine harvester

It is a machine designed for harvesting, threshing, separating, cleaning and collecting grains while moving through standing crops. Bagging arrangement may be



provided with a pick up attachment. The main functions of a combine are:

1. Cutting the standing crops
2. Feeding the cut crops to the threshing unit
3. Threshing the crops
4. Cleaning the grains from the straw
5. Collecting grains in a container.

11. Mini combine harvester suitable for small farm holdings

This self - propelled machine performs operations of harvesting, threshing and winnowing of paddy.



12. Baler:

It is a machine which collects scattered straw from fields and converts into compact bales of cylindrical or rectangular shapes.



4.3.2.4 Plant protection equipment

1. Sprayers

Sprayer is a machine to apply fluids in the form of droplets. It is used for the application of herbicides, fungicides, insecticides and micronutrients to plants.

The main functions of a sprayer are:

- To break the liquid into droplets of effective size
- To distribute them uniformly over the plants.
- To regulate the amount of liquid to avoid excessive application.

Basic components of a sprayer:

Tank

It is a vessel made of corrosion resistant material like metal, glass or polythene to hold liquid to be sprayed. This can be of different capacity.

Pump

Most hydraulic sprayers are equipped with positive displacement pumps capable of developing the pressure required for spray purpose. This pressure ejects the liquid and also aids in breaking the liquid into fine particles. High velocity air current is used in sprayer to propel spray liquid and to break it into small droplets.

Valves

Sprayers must contain valves at various places to check direction of flow of air and liquid. A leaky valve often makes trouble in sprayers.

Spray lance or gun

This is long or short tube of convenient shape made of high corrosion resistant material. This is used for directing spray to the desired target. The liquid from the tank enters into the spray lance through flexible hose and ejected through nozzle fitted at the extreme end. There will be a trigger cut off in the lance to control or stop the flow of liquid. Usually the lance is provided with only one nozzle. But sometimes in power sprayer a number of nozzles are fitted in one lance and it is then called boom.

Nozzle

It is the extreme end of all spraying equipment. The spray droplets are thrown out through nozzle. The nozzle performs 4 basic functions. 1. Atomizes liquid into droplets. 2. Disperse the droplets in a specific pattern. 3. Meters liquid at a certain flow rate. 4. Provides hydraulic momentum.

Hose

It is made of rubber or synthetic rubber or nylon or plastic tubes capable of withstanding high pressure. It is fitted with sprayer at one end and spray lance or boom on the other.

Type of spray

1. High volume spray: more than 400 litres spray/ha
2. Low volume spray: 5 - 400 litres /ha
3. Ultra - low volume (ULV) spray: less than 5 litres /ha

Types of nozzles: Hollow cone nozzle, solid cone nozzle, fan type nozzle.

2. Hand atomizer

This sprayer has a container of 0.5 - 3.5 litres capacity. The container has a built-in pump inside. While in other cases, the air pump is mounted externally. In both the cases the air pump outlet pipe is suspended in the container. The outer end of the pipe terminates in a nozzle with 0.6 - 1.6 mm diameter orifice. The container is filled to approx. $\frac{3}{4}$ of its capacity and air is compressed on the remaining space by means of the pump. Before use, the plunger type pump is worked to develop an air pressure of 0.15 - 0.35 kg/cm². The spray comes out from the nozzle usually via a suitable trigger control valve. The application rate ranges from 18 - 45 litres/acre.



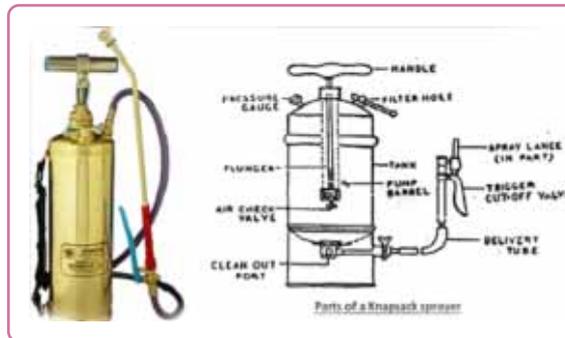
3. Hand compression sprayer

These are similar to hand atomizer but are adopted for spraying large quantities of liquids. It consists of a tank for holding spray material and compressed air, vertical air pump with a handle, filling port, spray lance with nozzle and release and shut - off devices.



4. Knapsack hand compression sprayer

Any sprayer which is carried on the back of the operator is called the knapsack sprayer. It has a tank designed to fit on the back of the operator. The capacity of the tank is 10 - 20 litres. An air pump is used to build air pressure above the free surface of the spray fluid in the container and normally the



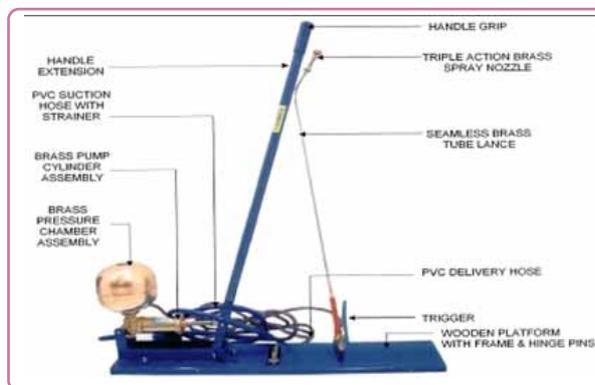
pumping of the air will be done by keeping the unit on ground and then sprayed till the air pressure comes down. The unit is again brought back to the ground for pumping air and then spraying is continued as before. The spray fluid which does not require any agitation only can be sprayed by using this type of sprayers.

5. Knapsack hydraulic sprayer

It will have one hydraulic pump working inside the container. The plunger works inside the replacement well attached at the bottom of the container, for easier maintenance. The pump can be operated through the appropriate linkages by oscillating the handle, with sprayer carried on the back. An agitator is also provided within the pressure chamber to agitate the fluid so that the particles in suspension will not be allowed to settle down. A delivery tube is attached on the other end of the pump which carries pressurized fluid to the spray lance. The flow to the nozzle is controlled by a trigger cut off valve.

6. Rocker sprayer

It consists of a pump assembly, platform with frame and fork, operating lever, pressure chamber, suction hose with



strainer, delivery hose, extension rod with spray nozzles etc. The rocking movement of the handle helps in building pressure in the pressure chamber. There is no built in tank and a separate spray tank is necessary. The sprayer builds up a high pressure of 14 - 18kg/cm².

7. Power sprayer

Motorized knapsack sprayer - The spray liquid is flown out by means of an air current generated in the machine. A smaller tank is provided for the fuel along with the spray tank. A power sprayer essentially consists of: Prime mover, tank, agitator, air chamber, pressure gauge, pressure regulator, strainer, boom and nozzles.



4.3.2.5 Machinery suitable for homestead farming

1. Brush cutter

Useful in cutting of grasses and shrubs in courtyards and embankments.

2. Power weeder

Capable of cutting grasses on the farm roadsides and mowing lawns.

3. Post hole digger

Suitable for digging holes for planting tree saplings and fixing fence posts.

4. Tree pruner

Useful in pruning branches up to 10m height and 10cm diameter.

4.3.3 Maintenance of plant protection equipments

4.3.3.1 Points to be taken care while handling plant protection equipments

1. Follow the instructions of manufacturers for maintenance of equipment.
2. Clean the equipments properly and store in a dry place.
3. Drain the tank of a sprayer and flush it with clean water, wash the pump, nozzles, strainers, lances, hoses, etc, with clean water.
4. Empty the hopper and clean with a cloth in case of dusters.
5. Replace the worn out parts, grease and oil the moving parts, eg. Cylinder, piston, plungers, washers, valves, *etc.* when not in use.
6. Do not bend rubber hoses at angles
7. At end of season clean sprayer thoroughly, drain all water from engine, pump and tank, disconnect hose and run lubricating oil through pump. Drain oil from engine and pump and replace with new oil.

8. Do not through the nozzles and delivery tubes of dusters on bare ground.
9. Always keep sufficient stocks of spare parts and tool kits.
10. Drain the spray solution to avoid clogging of nozzle.

4.3.3.2 Field problems and remedies for plant protection equipments

1. Knapsack sprayer

Sl. No	Problem	Rectification
1	Nozzle block	If a nozzle blockage occurs while spraying, the nozzle tip and filter should be replaced with clean points. The blocked nozzle should be cleaned and spares should be taken to the field. When spares are not available, water or a solvent should be taken to the site of operation to clean the blockage. The occurrence of blockages can be reduced by filtering the spray liquid while filling the chamber.
2	Pressure drops quickly	Check that the filler cap or lid gasket is in good condition and the cap is properly secured. Ensure that all connections and washes are proper.
3	Trigger cut- off valve is leaking	Dismantle the trigger cut off valve and check the ring washer. If damaged replace.

2. Rocker Sprayer

Sl. No	Problem	Rectification
1	No spray	Nozzle block, follow procedure for cleaning blocked nozzles
2	Suction do not result	If suction valve stuck, clear it
3	Leakage through plunger rod	Either piston worn out or it is loose. Check the piston if it is loose lighten the screw
4	Liquid not entering in to the delivery tube	Delivery valve gets stuck clear it.

Detailing of practical

1. Visit to an agro - machinery unit. Identify the various implements and understand their operation.
2. Operation of brush cutter/coconut climber/sprayers/tractor/tiller/ other available implements.

Assessment activities

The student is asked to operate brush cutter for weedcontrol in the school campus.

TE questions

1. In Kerala many of the paddy farmers have abandoned cultivating the wetlands due to high labour cost and shortage of labour. As rice is the staple food of our state, can you suggest a remedy to convert the fallow lands to cultivated lands.
2. Enlist the objectives of farm mechanization.
3. Classify farm machinery based on their use.
4. You are working in an Agro service centre. Prepare a list of various farm machinery required for the cultivation of rice and coconut needed to be stocked in the centre.
5. You are working in agri clinic and assigned to take a training class to the farmers about different plant protection equipments. Prepare a write up for it.
6. What are the things to be taken into care while handling plant protection equipments.
7. A farmer approaches you with a knap sack sprayer which is not working properly. Enlist some of the problems and their remedies.



UNIT 4.4

FARMER SUPPORT SERVICES

Agriculture continues to be the engine of economic growth in most developing countries like India. Indian agriculture is characterized by predominance of small and marginal farmers. The success of green revolution resulted in dramatic gains in productivity. However, despite significant achievements in food production, problems of food and nutrition security, poverty alleviation and regional imbalances still persist. Small farmers in India have several common features like, (1) Seasonal producers, (2). Fragmented buyers and suppliers unable to exploit economies of scale and (3) Dominated by house hold economics. To enable small farmers to reap the fruits of liberalization and globalization governments must play a proactive role in empowering them to take advantage of opening up of market opportunities. Government-provided agricultural support services need to be reformed to enable small farmers to take up commercial farming through sustainable practices. Private service providers will need to be encouraged by creating an enabling environment. The farm support services mainly include Government Schemes and programmes like Agriclincs, Agri input centers, ICT enabled services etc.

This unit deals with various farmer support services including schemes implemented by Government agencies and NGOs, Agriclincs and ICT enabled farmer support services.

Learning Outcomes

The learner:

- enlists Government agencies and major NGOs supporting farmers.
- practises with ICT enabled supports for farmers.

4.4.1 Government agencies and major NGOs supporting farmers - important schemes

The Department of Agriculture in Kerala undertakes formulation of various programmes in areas such as:

1. Crop production
2. Infrastructure
3. Planting material production and distribution
4. Quality control of agricultural inputs
5. Farm mechanization

6. Transfer of technology
7. Agricultural marketing
8. Crop damage relief
9. Women development

Krishibhavans in every Panchayat is the grass - root level office headed by the Agricultural Officer. There are 1046 Krishibhavans in the State. 2 - 3 Agricultural Assistants assist the Agricultural Officer. The activities of the Department are spearheaded and coordinated by the Agricultural Officer in his jurisdiction. Krishibhavans have a lead role in planning, formulation, and implementation of agriculture projects of local self - government.

4.4.1.1. Schemes implemented by Department of Agriculture

RKVY /Rastriya Krishi Vikas Yojana

This special central assistance scheme was launched to rejuvenate agricultural sector during eleven five year plan. RKVY funds are provided to states as 100 % grant by the Govt. of India.

Karshaka Pension Scheme for Small and Marginal Farmers

The state government is implementing monthly pension scheme for small and marginal farmers above 60 years of age.

National Agricultural Insurance Scheme (NAIS)

NAIS scheme implemented by the Agricultural Insurance Corporation with crops such as paddy, banana, tapioca, ginger, turmeric and pineapple.

Crop Insurance Scheme

Farmers in the State face production risks on various counts, such as drought, floods, etc. A crop insurance scheme has been in operation in the State, with contribution from the participating farmers, covering 25 major crops grown in the state since 1995. The present scheme aims at revamping the crop insurance programme making it viable so as to cater to risk coverage of small and marginal farmers.

Comprehensive Vegetable Development Programme

It is implemented with an objective of attaining self - sufficiency in vegetable production in the state.

Agroservice Centres

It function as a single window system to ascertain the availability of farm labour, inputs, planting materials, plant protection agents etc.

Agricultural wholesale markets

These markets function as facilitators in conducting auction sale of agricultural products collected directly from farmers without the interference of intermediaries

LEADS/Lead farmer centred Extension Advisory and Delivery Services

The objective is to utilize potential of lead farmers or transfer of technology and address the field level problems of selected farmers

ATMA/Agricultural Technology Management Agency

It is a registered society of key stakeholders involved in agricultural activities for sustainable agricultural development in the district. ATMA at the district level is responsible for all the technology dissemination activities. It maintains a link with all the allied departments, research organisations, NGOs and other agencies associated with agricultural development in the district. Thus research and extension units within the district such as Zonal Research Stations or sub stations, Krishi Vigyan Kendras and the allied departments of Agriculture, Animal Husbandry, Fisheries, Sericulture, Agro industries etc would constitute members of ATMA.

SAMETI/State Agriculture Management and Extension Training Institute

It functions as the model training institute at state level in the area of agricultural management. It is located at Thiruvananthapuram.

Schemes for Integrated Pest Management System

The main objectives of the scheme are:

1. To keep pests and diseases of crops below Economic Threshold level by adopting an integrated pest management practice.
2. Constant pest surveillance and monitoring to ascertain pest population.
3. Creating awareness among farmers on the prominent pests

Projects for value addition

Small Farmers Agri Business Consortium (SFAC) has been identified as the implementing agency of the scheme. Individual entrepreneurs, SHGs, Clusters, NGOs, partnership will be considered under this scheme.

Kuttanad Package

Govt of India has decided to give assistance to improve the farming condition in Alappuzha and Idukki districts in Kerala., which are identified as the distressed districts.

Idukki Package

The report on Dr.MS. Swaminathan commission on Idukki deals with the problem and possible solutions related to Idukki District.

Wyanad Package

Various agricultural development Programmes are implemented through Wyanad Package in the District which is considered as the most distressed and Backward District.

Spices Development Programme

Implemented for the Promotion of Spices cultivators.

Sustainable Development of Rice Based Farming System

The Scheme is concentrated in three major rice - growing tracts of the State for augmenting rice productivity. The ultimate objective of the project is to increase average productivity of rice to around 3 tonnes per hectre. The project is proposed to be implemented through Kudumbasree, self help group of rural women, local self governments in association with research institutions and financial institutions. Group farming samithies/Padasekhara samithies will constitute the nucleus of the programme.

Biogas Scheme**Quality control Scheme****Soil, Fertilizer and Plant Protection chemical analysis****People's Plan****Area Development Scheme****4.4.1.2. SHM Schemes (State Horticulture Mission) :**

This scheme envisages an end to end development of the Horticulture sector covering production, post harvest management, processing and marketing. The main objectives of the Mission are:

- To provide holistic growth of the horticulture sector through an area based regionally differentiated strategies which include research, technology promotion, extension, post harvest management, processing and marketing.
- To enhance horticulture production, improve nutritional security and income support to farm households.
- To create opportunities for employment generation for skilled and unskilled persons, especially unemployed youth.

Various Projects implemented under SHM are: Poly House cultivation, Rain Shelter, Creation of water source, training etc.

4.4.1.3. Agricultural Technology Information Centre, Mannuthy (ATIC):

The Information and Sales Centre of Kerala Agricultural University was upgrade into the ATIC. Its objectives are:

- To provide a single window delivery system for agricultural information as well as products and technologies developed by the University with a view to deliver quality services to the client.
- To strengthen the farm advisory services by adopting a multi - disciplinary approach to problem solving.
- To provide mechanism for feedback from the end users to the research system.
- To function as a repository of agricultural information pertaining to farming skills and practices, farm inputs and agricultural education.
- To offer consultancy services to the different stakeholders in the state.
- To offer training to unemployed youth to equip them to become job providers, rather than jobseekers as part of the NABARD project.

4.4.1.4. Other agencies which implement schemes for farmers

- Rubber Board
- National Horticultural Board
- Directorate of Areca nut & Spices Development
- Tea Board
- Coconut Development Board
- Spices Board
- Directorate of Cashew nut & Cocoa Development
- NSC (National Seeds Corporation)
- Save Grain Campaign
- Land Development Corporation
- MILMA (Kerala Co-operative Milk Marketing Federation Ltd.)
- Land Use Board

- Poultry Development Corporation
- The Kerala Livestock Development Board Ltd
- NABARD (National Bank for Agriculture and Rural Development)
- KERAFED (Kerala Kera karshaka Sahakarana Federation Ltd.)
- Small Farmers Agri Business Consortium
- KAIC (Kerala Agro Industries Corporation Ltd.)
- KAMCO (Kerala Agro Machinery Corporation Ltd.)
- VFPC (Vegetable and Fruit Promotion Council Keralam)
- Serifed
- Raidco (The Regional Agro Industrial Development Co-operative of Kerala Ltd.)
- Coir Board
- Agricultural and Processed Foods Export Development Authority
- Marine Products Export Development Authority
- Cashew Export Promotion Council

4.4.2 ICT enabled supports for farmers

Importance

The farmers need timely information on what to produce, when to produce, where to produce and how to produce. The consumers need produce at lower price and at good quality. For these needs, ICT provide an effective solution. ICT Stands for “Information and Communication Technologies.” ICT refers to technologies that provide access to information through telecommunications. This includes the Internet, wireless networks, cell phones and other communication media.

Some of the popular knowledge management systems are

A. Holistic Information Systems

1. Harithakeralam

It covers over 50 major crops of Kerala and contains a number of animated videos. The CD version is currently available at www.celkau.in.

2. Kissan Kerala Information System

The online information system covers basic details on over 100 major crops of Kerala. The online ‘fertilizer advisor’ and ‘contact an expert’ forms the uniqueness of the system. www.kissankerala.net.

3. Karshikajalakam

This information system covers details of major crops, animals and fisheries aspects. A pest doctor and crop calendar are included in this system. www.celkau.in

4. Farm Extension Manager

The farmextension manager covers the major five crops of Kerala in detail. It has an online fertilizer calculator, pest doctor, management guide, irrigation advisor, crop planner etc. Besides, the agri - business and veterinary aspects are also covered in detail. www.farmextensionmanager.com

5. KAU Agri - infotech Portal

The portal provides detailed information on important crops of Kerala besides fisheries and veterinary aspects. The KAU Fertilizer, KAU E - Crop Doctor and media gallery make the portal unique. www.celkau.in

6. TNAU Agritech Portal

The portal provides detailed information on all round production aspects of a number of agricultural crops. www.agritech.tnau.ac.in

7. AGMARKNET Portal

The portal provides information on price and arrival of important agricultural commodities on a daily basis across the country. Various reports and analysis of price behaviour is included. The mention on various quality standards is also very much specific. www.agmarknet.nic.in

B. Specific Information Systems

1. Flowering plants of Kerala

Done by Kerala Forest Research Institute, Peechi. It contains botanical information on over 5000 plants of Kerala with good quality photos. The scientific names, local name and English names are also included. (CDs Available at KFRI, Peechi, Thrissur)

2. Fruitipedia

It is an encyclopedia of edible fruits of the world developed by Dr Chiranjit Parmar. The fruit information system contains detailed information on over 452 fruit plants identified across the world. www.fruitipedia.com

3. Flowers of India

The 'flowers of India' is an online website on flowers. It contains the largest collection of garden plants with good quality photograph. The site adopts various types of classification and nomenclature for the plants. www.flowersofindia.net

4. ATMA Kerala

The department of agriculture has recently developed an information system for displaying innovations and success stories of ATMA from various districts. The monthly technical advisory from various districts, the field trials conducted, the farmers' field school etc is uploaded in this website. The path is www.atmakerala.in

5. Farmer advisory and KM system for Hi - tech agriculture

It is a new initiative from Department of Agriculture, Government of Kerala. The users can login and get connected with all poly house growers in Kerala. Similarly there is also a mechanism to contact experts to solve field problems. The link to the information system is www.keralahitechagri.in.

C. Diagnostic and Calculation Tools

1. Crop Health Decision Support System

This software covers plant protection aspects of major crops of Kerala. The content is available at www.kissankerala.net.

2. Karshikajalakam

This information system adopts an interactive pest diagnosis methodology. The content is available at www.kissankerala.net.

3. Pest doctor

The diagnostic tool under farm extension manager. A detailed information sheet on each problem is included. The contents available in www.farmextensionmanager.com.

4. Online rubber clinic

Developed by rubberboard the tool helps to arrive at the problems in rubber cultivation through a series of questions and photographs. The contents can be reached from the website clinic www.rubberboard.org.in

5. Fertilizer Calculator

This has over 200 recommendations of almost all plants covered in the package of practice of KAU. The online tool facilitates to modify the blanket recommendation according to soil test values. The final recommendations can be taken in the form of straight or complex fertilizers. Available in www.farmextensionmanager.com.

6. KAU Fertulator

The tool helps to have the fertilizer recommendation for all the crops covered in the package of practice. The specialty of the tool is that the recommendation will be available for all the commonly used fertilizers. The users have to download the software available in the www.celkau.in before use.

7. Soil based plant nutrient management information system

It stores the database of soil fertility data of almost all Panchayats of Kerala. The specialty is that micronutrient needed is also added in the soil health card. www.keralasoilfertility.net

8. Pesticide calculation

The new tool available under farm extension manager helps to have the recommended pesticide crop wise and pest wise. www.farmextensionmanager.com

9. KAU E - Crop Doctor

The tool helps you to have a realistic estimation of the quantity of pesticides recommended for the crop plants of Kerala. The details of trade name and quantity for various units can be easily taken from the information system. The users have to download the software available in the www.celkau.in before use.

10. Credit Calculator

The tool helps to have a realistic estimate of the eligible finance under crop loan component from nationalized banks. Developed based on the concept of scale of finance, the software also takes care of the loan for intercrops as well. The final repayment amount with the interest portion is worked automatically based on the area of cultivation. Available at www.farmextensionmanager.com

D. Kiosk Based Information Systems

1. Agricultural Kiosk

The kiosk version developed by scientists of KAU, covers around 10 crops. The contents cover all aspects of crop production.

2. Nelkrishi.com

The tool is developed by a team of KAU scientists exclusively for touch screen kiosk. The information system contains over 500 pages of information on rice cultivation.

3. Vegetable cultivation

Developed by Green Touch Media, Trivandrum for the Department of Agriculture, Government of Kerala, and the DVD contains information with video clippings on around 15 vegetables. The organic production aspects are also well taken care of. The software available in www.celkau.in.

Types of Mobile Applications

A. Data Logging and Management

Apps under this category assist farmers in maintaining data records associated with farm activities. Many farm management apps perform basic cost calculations as well.

B. Location based Apps

These apps use map and location details for their operations. These apps are essentially used as Market finder apps for farmers to sell their produce.

C. Agriculture Specific Calculation Apps

These are specially designed apps from experts in agriculture. They contain pre-fed data and values according to which calculations are performed regarding agriculture information.

E. News and Information Specific

This is the most common app category for any domain. Apps that provide news and information are highly useful and popular among users. In agriculture also many apps like Farm progress, Ag Weather tools etc. serve the purpose of delivering information relevant to agriculture stakeholders. From farmers' perspective, there are many apps that provide seed price, equipment price and similar information.

F. Another major section of informative apps are the weather information apps (Skymet, Accuweather, etc.). In some apps, weather forecast is provided with advisory messages as well. As a result, these apps become an additional knowledge tool for the users and help them perform activities in a well informed environment.

Basic Services through Phone

Voice based Services

In agricultural situation when a farmer makes a call to an expert to know what to do for a pest problem.

1. Kisan Call Center

The Department of Agriculture & Cooperation (DAC), Ministry of Agriculture, Govt. of India launched Kisan Call Centers on January 21, 2004 across the country to deliver extension services to the farming community. A country wide common eleven digit Toll Free number 1800 - 180 - 1551 has been allotted for Kisan Call

Centre. This number is accessible through mobile phones and landlines of all telecom networks including private service providers. Replies to the farmers' queries are given in 22 local languages.

2. **IFFCO Kisan Sanchar Limited.**

It is a joint venture between the telecom network operator Airtel and the Indian Farmer's Fertilizer Co - Operative Limited (IFFCO). In addition to crop advice and the weather, IKSL provides advice on animal husbandry, rural health initiatives, and the availability of products such as fertilizers.

3. **mKisan SMS Portal**

mKisan SMS Portal for farmers enables all Central and State government organizations in agriculture and allied sectors to give information/services/advisories to farmers by SMS in their language, preference of agricultural practices and location. Farmers can register themselves for receiving these messages on their mobiles as per their specific needs & relevance at a particular point of time.

Social media like Facebook, Twitter and YouTube also play a great role in sharing of information among farmers, clearing doubts and knowledge dissemination in the field of agriculture.

Other services

E - Learning platform

The development in e - learning platform helps to redefine the distance education programmes. The course materials that were earlier send through post now reach the students online. There can have better tutorials with animated video and text. The students can contact the expert or participate in various discussion forums online. Further, real time objective evaluation process can also be introduced.

The Centre for e - Learning of Kerala Agricultural University offers e - Krishi Patashala online courses. "Organic Agricultural Management", "Plant Propagation and Nursery Management", "Post -Harvest Management and Marketing of Fruits and Vegetables" are the three online courses of six months duration.

Video and TV Programmes

Farm videos form yet another major area of ICT application in agriculture. With the availability of camcorder and other video production equipments at reduced cost, there is tremendous growth in number of farm videos produced and viewed. Kissan Kerala project itself has uploaded over 450 video on agriculture. These videos give a true representation of real life situation.

Radio and Other Wireless Technologies

Wireless technologies have numerous applications in agriculture. A number of AM and FM stations are functioning in Kerala. These stations are working under private and public sector. These stations telecast a number of farm programmes at regular intervals.

Community Learning Centers

The opening of community learning centers and running various educative programmes by them is a move happened with the progress in ICT. In the Wayanad district of Kerala, six village resource centers are operating. These centers are connected through local cable networks and offering video conferencing facility.

Detailing of practical

1. Visit to the local Krishi bhavan and list out the various ongoing farmer support schemes.
2. Observe the activities of agri clinic at the Krishi bhavan and prepare a report.
3. Prepare a list of ICT enabled farmer support systems and explain their salient features.

Assessment activities

- Audio - visual presentation of farmer support systems.
- Collection of paper cuttings on farmer support systems.
- Conduct a campaign to create awareness among local farmers about ICT enabled farmer support systems.

TEquestions

1. In a remote village the rice crop is infected by some disease. The farmers have to travel a long way to get expert advice to control the disease. Can you help the farmers solve this problem?
2. Enlist five government schemes for promotion of agriculture in Kerala.
3. Enlist five agencies which implements schemes for farmers of Kerala.
4. Enlist some ICT enabled tools to help farmers in fertilizer calculation and pest diagnosis.

Extended Activities

1. Set up an agri clinic at school
2. Conduct a campaign for pest/disease control in the panchayath. Prepare leaflets on pest and disease control and distribute to the local farmers to create awareness.

List of practical

1. Visit to Krishi bhavan to study Infrastructure and functioning of agri clinic.
2. Identification and management of pests of Rice, coconut, rubber, pepper, ginger, cassava, banana, solanaceous vegetables - tomato, brinjal, chilli, cucurbitaceous vegetables, Cowpea, Amaranthus, bhindi, cabbage, rose and their management, anthurium, orchid, jasmine and their management.
3. Identification and management of diseases of Rice, coconut, rubber, pepper, ginger, cassava, banana, solanaceous vegetables - tomato, brinjal, chilli, cucurbitaceous vegetables, Cowpea, Amaranthus, bhindi, cabbage, rose and their management, Anthurium, orchid, jasmine and their management.
4. Collection of pest and disease specimen and preparation of insect box of pests and herbarium of disease specimen.(Minimum 5)
5. Visit to agri input centre and list out the inputs available there.
6. Visit to a super market. Find out the supply chains for different agricultural commodities.
7. Conduct a market survey and list out the marketing strategies involved.
8. Marketing of PTC products applying various marketing strategies.
9. Visit to an agro - machinery unit. Identify the various implements and understand their operation.
10. Operation of brush cutter/coconut climber/sprayers/tractor/tiller/ other available implements.
11. Visit to the local Krishi bhavan and list out the various ongoing farmer support schemes.
12. Prepare a list of ICT enabled farmer support systems and explain their salient features.

References

1. A practical manual. State level training programme to plant health clinics. Compiled by Kerala centre for pest management Moncombu, Dept. of Agriculture, 2015-16.
2. Amarnath, V.(2007) Nursery and landscaping. Jodhpur: Agrobios India.
3. Drollete, S.A. (2009) Understanding Agricultural Risk. Department of Agricultural Economics. Utah State University. extension.usu.edu.
4. Farm Guide-2015. Farm Information Bureau. Department of Agriculture, Govt, of Kerala. Thiruvananthapuram.
5. Food preservation techniques-Practical manual for class XI-Paper III. (2002) NCERT.
6. Hakim, A.V.M., Pathrose, B. and Nair, H.M. (2014) Green House-Management and Operations. Thiruvananthapuram: Farm Information Bureau. Dept of Agriculture, Govt. of Kerala.
7. Handbook of Horticulture. (2013) New Delhi: ICAR.
8. Home-scale processing and preservation of fruits and vegetables. (1990). Mysore: CFTRI.
9. Jain, R. and Janakiram, T. (2013) Value addition in Ornamentals. *Keralakarshakan e-Journal*. 1(7)6-11
10. Joseph, P.J. and Marykutty, A (2012) Bonsai: Dhanathinum Aanandathinum. Kottayam : DC Books.
11. Manorama Year Book 2015. Kottayam: Malayala Manorama.
12. Nair, G.M. (2015) Chemical and Biopesticides for crop protection-A Handbook for Technical Officers. Thiruvananthapuram: Department of Agriculture. Govt. Of Kerala.
13. Package of Practices Recommendations (Adhoc) for Organic Farming: Crops, KAU 2009. Kerala Agricultural University, Thrissur.
14. Package of Practices recommendations. Crops-2011. Kerala Agricultural University. Thrissur.
15. Peethambaran, C.K. and Reghunath, P (2014) Surveillance Based Pest and Disease Management In Crop Plants. Thiruvananthapuram: Department of Agriculture.

16. Randhawa, G.S and Mukhopadhyaya, A. (1986) Floriculture in India. New Delhi: Allied Publishers Limited.
17. Sahai, J. (2015) Elements of Agricultural Engineering. New Delhi: Standard Publishers
18. Sairaj, K.P. (2002) Bonsai. Thiruvananthapuram: State Institute of Languages Kerala.
19. Sheela, V.L. (2011). Horticulture. New Delhi: MJP Publishers.
20. Srivastava, R.P and Sanjeev Kumar. (2001) Fruit and Vegetable Preservation- Principles and Practices. New Delhi: CBS Publishers and Distributors Private Ltd.
21. Subhagan, S.R. and Dhalin, D. (2013) Elements of Plant protection. Thiruvananthapuram: FOLIO publishers
22. Sunil, V.G. and Pathrose, B. (2015) Application of ICT in Agriculture- A Handbook. ICAR KVK Malappuram. Kerala Agricultural University. Thrissur.
23. Suseela, P. (2013) Hi-tech krishi-oru margadarssi. Thrissur: Kerala Agricultural University.

APPENDIX I
PEST OF CROPS



Rice stem borer - Adult



Rice stem borer- larva



Gall Midge



Rice BPH



Hopper Burn



Rice case worm



Rhinoceros beetle



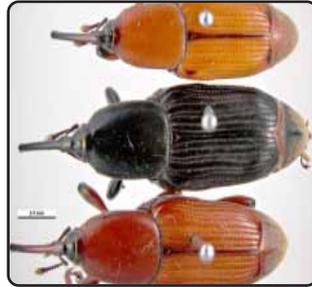
Red Palm Weevil



Leaf eating caterpillar



Coconut Mite



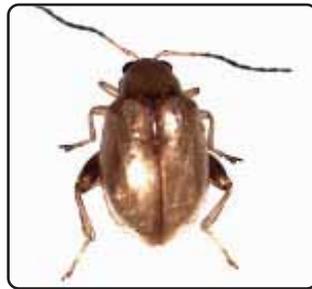
Pseudostem weevil



Banana rhizome weevil



Tea mosquito



Pollu beetle



Marginal thirps



Brinjal Fruit borer



epilachna beetle in Brinjal



Tomato fruit borer



Bhindi shoot & fruit borer



Amaranthus leaf webber and its attack



Fruit fly (Bitter gourd)



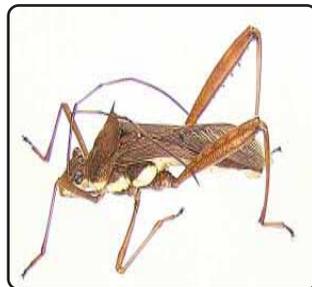
Pumpkin beetle



Snake gourd caterpillar



Cowpea aphid



Cowpea Bug



Cowpea fruit borer



American serpentine leaf miner



Mango fruit fly



Mango Hopper

DISEASES



Rice blast



Rice Sheath Blight



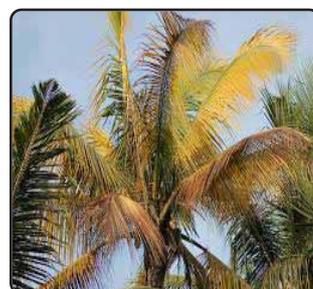
BLB of Rice



Coconut leaf rot



Coconut stem bleeding



Coconut Root wilt



Banana Bunchy Top



Kokkan Disease in Banana



Sigatoka leaf spot



Pepper Quick wilt



Damping off in vegetables



Little leaf of Brinjal



Phomopsis Blight in Brinjal



Bacterial wilt



Anthracnose in chillies



Leaf curl in chillies



Yellow vein mosaic in Bhindi



Leaf Blight



Fruit rot in cucurbits



Powdery mildew



Mosaic (Cucurbits)



Web blight (cowpea)



Fusarial wilt (cowpea)



Anthracnose (cowpea)



Cowpea mosaic



Anthracnose (mango)



Powdery mildew



Abnormal leaf fall (rubber)



Powdery mildew (rubber)



Pink disease (rubber)