

**Vocational Higher Secondary
Education (VHSE)**

Second Year

**AGRO MACHINERY AND
POWER ENGINEERING**

Reference Book



Government of Kerala
Department of Education

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KERALA
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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
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CONTENTS

■	<i>ABOUT THE COURSE</i>	05
■	<i>MAJOR SKILLS</i>	06
■	<i>SYLLABUS</i>	07
■	<i>MODULE III OVERVIEW</i>	12
■	<i>MODULE III UNIT DETAILS</i>	13
■	<i>MODULE III LIST OF PRACTICALS</i>	76
■	<i>MODULE IV OVERVIEW</i>	78
■	<i>MODULE IV UNIT DETAILS</i>	78
■	<i>MODULE IV LIST OF PRACTICALS</i>	113
■	<i>REFERENCE</i>	114
■	<i>APPENDIX</i>	114

ABOUT THE COURSE

A vocational course in agro machinery and power engineering envisages producing a pool of talented and skilled machines in agricultural sector. This skilled work force can surpass the crisis of the shortage of labours and contributed to increase in food production, through the use of modern techniques.

The course so designed as to impart technical skills to teenagers and inculcate an urge in them to be friendly with the farming and nature. Agricultural, especially mechanized agriculture has prime importance in the development policies of both central and state governments and various schemes are being implemented in the content under plan fund. Students of higher secondary level and high school level need to be trained in the use of farm machinaries; they are repair and maintenance so that their tremendous strength can be utilized in food production.

In the decade agricultural scenario is likely to undergo drastic changes. Maximum production from diminishing agriculture lands will be the main concern. Modern agriculture will be transform to agri -Business and investors will be focusing on maximum profit with minimum input. Employment opportunities like drivers, operators of modern machinery, mechanics, irrigation system designers entrepreneurs in utilizing renewable energy like solar energy and biomass, technicians in post harvesting, operations and seed processing will arise in plenty.

Engineering graphics and mechanical Auto Cad are also included in the syllabus which will help the students to enter into higher skill level course in future.

Students accustomed with these engineering practice will definitely be the forerunners of a generation thinking seriously of preserving fresh air, pure water and greenery of our earth for the future. Hence the vocational course in agro machinery and power engineering is highly relevant.

Module III

Major Skills

To operate and servicing, maintenance of Different farm machines

Sub skills

- 1) To operate different seeders and Transplanting equipments
- 2) Operate weeder
- 3) To operate different sprayers
- 4) To repair and servicing of different sprayers
- 5) To operate different harvesting machines
- 6) To operate and maintenance of different threshing machines
- 7) To operate a winnower and also its maintenance

Module IV

Major Skills

To operate different precision farming and irrigation methods

Sub skills

- 1) Designing and lay out preparation of different irrigation systems
- 2) To repair and maintenance of different types of irrigation pumps
- 3) To design a green house for different vegetables and fruits
- 4) To draw different machine parts

SYLLABUS

Module 3

(340 Periods)

FARM MECHANISATION AND POST HARVEST ENGINEERING

3.1 Agricultural Implements

(80 Periods)

Farm Power Source-Statics-Human, Animal, Mechanical, Renewable. Introduction to Tillage-Objectives, Classifications, Types Primary Tillage-Implements-MB plough, Disc plough, Sub soiler, Chisel plough Secondary Tillage-Implements-Cultivator (spring type, Rigid Type)-Harrows-Different types, Renovator, Bund former, Ridger, Digger, Puddler, Leveler Seeding methods-Broadcasting, Drilling, Dibbling, Transplanting, Seed Dropping, Hill Dropping, Checkrow Planting Seed Drilling - Principle & Operation -Components, Seed cum fertilizer Drill, Seed metering Mechanism-Seed conditioning, Seed dressing, Seed graders.

Transplanter-Types-Paddy Transplanter, Veg. Transplanter Paddy Transplanter-Principle, Operation, Parts-Types-Walk behind, Riding type Mat nursery preparation Veg. Transplanter-Principle, Operation Seed dibbler, Drum Seeder, Check Row planter Hill Dropper, Pneumatic Seeders (Vacuum type & Air suspension Type) Electronic Seeders (Precision) Weeding-Concepts-types of weeders -Rotary Weeders, ConoWeeder, Power weeder, Brush weeder, Peg, Tooth weeder, Brush cutter Fertilizer Applications-Fertilizer Broadcaster, Liquid Fertilizer Fertilizer Injector

3.2 Plant Protection Machinery

(60 Periods)

Introduction-Classification-Sprayers, Dusters, Foggers, fumigators Sprayers-Classifications based on Atomization 3 types 1) Hydraulic/Hydro-pneumatic 2) Air assisted/Air blast 3) Centrifugal. Hydraulic Sprayers- Principle-Parts-Working. Air assisted-- Principle-Parts-Working, Centrifugal sprayers- Principle-Parts-Working. Classification based on mode of operation-Hand sprayer, Air compression sprayer, power sprayer, Rocker sprayer, Knapsack sprayer, Traction operated sprayer, Aerial sprayer, Duster, Fogger, Fumigator-Principle & working Repair and Maintenance of Sprayers & Dusters, Safety Precautions.

3.3 Harvesting Machines

(70 Periods)

Harvesting-Principle, Objectives Harvesting Equipments-Principle of cutting, Shear Force, impact Force-Sickle-vertical conveyor repair Mower for Fodder Harvesting, Lawn Mower, Coconut Climber, Digger, Fruit harvester, Vegetable Harvester, Reapers Combine Harvester-Types-Cereals/Vegetables &Fruits Combine Harvester (Paddy)-Principle, Parts, working operation, Maintenance, servicing Combine Harvester (Vegetables) Combine Harvester (Fruits).

3.4 Post Harvesting Operations

(70 Periods)

Threshing- Principle , operation ,Threshing methods (Manual ,Animal , Mechanical), Mechanical threshers (Axial flow &Cross Flow)-Ground Nut Decorticator , Maze Sheller Parts of a Thresher- Concave, Drum, Cleaning unit, Type of threshers-Peg tooth , spike tooth ,Rasp bar ,Angle bar ,loop type& Hammer mill Winnower-Principle , parts ,blower. Drying & Storage-Principle of drying -MC-Sun drying (conduction, convection, Radiation) Mechanical Drying ,Infrared ,Chemical, Grain drying(deep bed ,Thin layer).

3.5 Food Processing

(60 Periods)

Paddy-parboiling-hullers-polishing-milling, Fruits & Vegetable - Processing Packing & Storage Method-Cold Storage, Refrigeration, Inert gas filling, Controlled atmospheric storage (N₂ Filling, CO₂ Filling) Dry storage method-Bins, Scale, Godowns, Silos

Unit 1 Agricultural Implements

(80 periods)

- 3.1.1 Farm Power Source-Statics-Human, Animal, Mechanical, Renewable
- 3.1.2 Introduction to Tillage-Objectives, Classifications, Types
- 3.1.3 Primary Tillage-Implements-MB plough , Disc plough, Sub soiler , Chisel plough
- 3.1.4 Secondary Tillage-Implements-Cultivator(spring type, Rigid Type)-Harrows-Different types, Renovator, Bund former, Ridger, Digger , Puddler, Leveler
- 3.1.5 Seeding methods-Broadcasting, Drilling, Dibbling, Transplanting, Seed Dropping, Hill Dropping, Checkrow Planting

- 3.1.6 Seed Drilling -Principle& Operation -Components, Seed cum fertilizer Drill, Seed metering Mechanism-Seed conditioning, Seed dressing ,Seed graders
- 3.1.7 Transplanter-Types-Paddy Transplanter , Veg. Transplanter
Paddy Transplanter- Principle, Operation ,Parts-Types-Walk behind, Riding type
Mat nursery preparation
Veg. Transplanter-Principle, Operation
- 3.1.8 Seed dibbler, Drum Seeder, Check Row planter Hill Dropper, Pneumatic Seeders (Vacuum type & Air suspension Type) Electronic Seeders(Precision)
- 3.1.9 Weeding-Concepts-types of weeders-Rotary Weeders ,ConoWeeder, Power weeder, Brush weeder,Peg Tooth weeder, Brush cutter
- 3.1.10 Fertilizer Applications-Fertilizer Broadcaster ,Liquid Fertilizer ,Fertilizer Injector

Unit 2 Plant Protection Machinery (80 periods)

- 3.2.1 Introduction-Classification-Sprayers ,Dusters ,Foggers, fumigators
- 3.2.2 Sprayers-Classifications based on Atomization 3 types
 - 1) Hydraulic/Hydro-pneumatic
 - 2) Air assisted/Air blast
 - 3) Centrifugal
- 3.2.3 Hydraulic Sprayers- Principle-Parts-Working
- 3.2.4 Air assisted-- Principle-Parts-Working, Centrifugal sprayers- Principle-Parts-Working
- 3.2.5 Classification based on mode of operation-Hand sprayer, Air compression sprayer, power sprayer, Rocker sprayer, Knapsack sprayer, Traction operated sprayer, Arial sprayer
- 3.2. 6 Safety Precautions while using plant protection machineries

Unit 3 Harvesting Machines (70 periods)

- 3.3.1 Harvesting-Principle, Objectives
- 3.3.2 Harvesting Equipments-Principle of cutting, Shear Force, impact Force-Sickle-vertical conveyor repair

- 3.3.3 Mower for Fodder Harvesting , Lawn Mower ,Coconut Climber ,Digger, Fruit harvester , Vegetable Harvester ,Reapers
- 3.3.4 Combine Harvester-Types -Cereals/Vegetables &Fruits
- 3.3.5 Combine Harvester (Paddy)-Principle, Parts, working operation, Maintenance, servicing
- 3.3.6 Combine Harvester (Vegetables)
- 3.3.7 Combine Harvester (Fruits)

Unit 4 Post Harvesting Operations (70 periods)

- 3.4.1 Threshing- Principle, operation, Threshing methods (Manual, Animal, Mechanical)
- 3.4.2 Mechanical Threshers (Axial flow &Cross Flow)-Ground Nut Decorticator, MazeSheller
- 3.4.3 Parts of a Thresher-Concave, Drum ,Cleaning unit, Type of Threshers- Peg tooth ,spike tooth ,Rasp bar ,Angle bar ,loop type& Hammer mill
- 3.4.4 Winnower- Principle , parts ,blower
- 3.4.5 Drying & Storage-Principle of drying -MC-Sun drying (conduction, convection, Radiation) Mechanical Drying ,Infrared ,Chemical, Grain drying(deep bed ,Thin layer)

Unit 5 Food Processing (60 periods)

- 3.5.1 Paddy-parboiling-hullers-polishing-milling
- 3.5.2 Fruits &Vegetable -Processing
- 3.5.3 Packing & Storage Method-Cold Storage, Refrigeration, Inert gas filling, Controlled atmospheric storage (N2 Filling,CO2 Filling)
- 3.5.4 Dry storage method-Bins, Scale, Godowns, Silos.

Module 4

(340 Periods)

IRRIGATION AND PRECISION FARMING

4. 1 Irrigation (90 periods)

Introduction-Different types of irrigation Mechanical irrigation-pump, sprinkler, drip Sprinkler-components-lay out & Design, Installation Drip- components-lay out &

Design, Installation Mist-components-applications Fogger -components-applications

4.2 Pump for Irrigation (90 periods)

Pump-introductions & classifications, CF PUMP -working, principles, parts JET pump, reciprocating pump - working, principles, parts, Selection of pumps-WHP Calculation, servicing, repair &Maintenance.

4.3 Green House Technology (90 periods)

Green House-Concept, Advantages, Disadvantages Types of Green House-Poly House, Glass House, Hardening unit (Temp.&Humidity controller), Rain Shelter, Shade House Green House construction-Frame, covering materials-irrigation system (Fogger, Mist, Drip) Mulch, Fertigation .

4.4 Mechanical Auto-cad (70 periods)

Introduction to Auto-Cad, Learn commands, Limit setting, And Drawing of simple Machine parts.

Unit 1 Irrigation (90 periods)

- 4.1.1 Introduction-Different types of irrigation
- 4.1.2 Mechanical irrigation-pump, sprinkler, drip
- 4.1.3 Sprinkler-components-lay out& Design, Installation
- 4.1.4 Drip- components-lay out &Design, Installation
- 4.1.5 Mist-components-applications
- 4.1.6 Fogger -components-applications

Unit 2 Pump for Irrigation (90 periods)

- 4.2.1 Pump-introductions & classifications
- 4.2.2 CF PUMP -working, principles, parts
- 4.2.3 JET pump, reciprocating pump -working, principles, parts
- 4.2.4 Selection of pumps-WHP Calculation, servicing, repair &Maintenance

Unit 3 Green House Technology (90 periods)

- 4.3.1 Green House-Concept, Advantages, Disadvantages
- 4.3.2 Types of Green House-Poly House, Glass House, Hardening unit (Temp. & Humidity controller), Rain Shelter, Shade House

4.3.3 Green House construction-Frame, covering materials-irrigation system
(Fogger,Mist,Drip)

4.3.4 Mulch, Fertigation

Unit4 Mechanical Auto-cad

(70 periods)

4.4.1 Introduction to Auto-Cad

4.4.2 Learn commands

4.4.3 Limit setting

4.4.4 Drawing of simple Machine parts

Module 3

Farm Mechanisation and Post Harvest Engineering

Overview

As the indicate this module transacts Farm Mechanisation &Post harvest engineering concepts to the learner. She/he develops the capacity to select and use different agricultural implements and identify its parts. They will be able to detect creative and innovative skills The learner will be able to select plant protection machinery, Harvesting machines, and also able to operate them. By learning this module they can opt the correct post harvesting operations & the good food processing also its storage

UNIT IN DETAIL

Unit 3.1 Agricultural Implements

Introduction

Although a very large area of land is available in the world, all of it is not fit for crop production. In order to bring these areas in to an economically fit condition for crop production, a verity of mechanical operations has to be performed. It is interesting to note that the number of mechanical operations performed and crop yield obtained are not related..

Learning outcomes

Unit 3.1 Agricultural Implements

- 3.1.1 Explains different farm power source
- 3.1.2 Distinguishes between different types of Tillage systems
- 3.1.3 Identifies different types of primary Tillage implements
- 3.1.4 Explains secondary tillage implements
- 3.1.5 Lists out different seeding methods
- 3.1.6 Operates seed drills
- 3.1.7 Explains different types of Transplanters
- 3.1.8 Operates seeding equipments
- 3.1.9 Distinguishes between different types of weeders
- 3.1.10 Explains different fertilizers applicators
- 3.1.1 Farm power Source

Power is the basic requirement for agriculture. In agriculture power is required for

- 1) Tillage 2) Sowing 3) Winnowing 4) weeding and mulching 5) Harvesting
- 6) Transportation 7) Irrigation 8) Threshing 9) Feed grinding 10) Cane Crushing
- 7) Chaff cutting 12) Cotton ginning

The nature of these works is classified in to two main groups

- 1) Tractive (Mobile) Power work
- 2) Stationary power Work

There are different sources of farm power which are classified as below.

A) Mobile Power

- 1) Human power
- 2) Draught Animals
- 3) Tractors
- 4) Power Tillers
- 5) Self propelled machines

B) Stationary Power

- 1) Diesel Engines
- 2) Electric Motors
- 3) Renewable energy

Human power

Human power is an important source of operating

- 1) Small tools & implements
- 2) Chaff cutter
- 3) Water lifting devices
- 4) Threshers
- 5) Winnowing and many other devices

Draught animals

Power available from draught animals is related to its body weight

Bullocks : About 10% of body weight

Buffaloes : About 12% of body weight

Camels : About 18% of body weight

Donkeys : About 32% of body weight

Bullock's power is considered as

- i) Versatile
- ii) Dependable source of power
- iii) Bullocks are born & reared in the village system

- iv) Used in sun, rain under muddy and rough field condition
- v) They eat feed and fodder available locally
- vi) They are ideal for rural transport where roads are not good
- vii) They save petroleum products

Mechanical power

Mechanical power means power coming from Machines, it may be classified as

- a) Tractors
- b) Power Tillers
- c) Stationary IC engines
- d) Self propelled machines

IC engine is a good device for converting fuel into useful work.

Stationary oil engines are used for Pumping water, flour mill, oil gains, cotton gins, chaff cutter, sugarcane crusher, thresher, winnower

Renewable Energy

It is the energy mainly obtained from biomass, sun and wind. Biomass energy, wind and solar energy are used in agricultural and domestic purposes with suitable devices. It can be used for lighting, cooking, water heating, water distillation, food processing, water pumping, diesel engine operation with supplementary fuel and electrical generation on small scale. Renewable energy is inexhaustible in natural

3.1.2 Introduction to tillage

Crop production requires a number of operations like seed bed preparation, seeding, fertilizing, spraying, dusting, irrigation, harvesting and threshing. The first operation in production of crop is TILLAGE. It requires higher amount of labour

Tillage

It is a mechanical manipulation of soil to provide favourable condition for crop production. Soil tillage consists of breaking the compact surface of earth to a certain depth and to loosen the soil mass, so as to enable the roots of the crop to penetrate and spread into the soil. Tillage may be called the practice of modifying the state of soil to provide favourable conditions for plant growth. Tillage operation is most labor consuming and difficult operation, compared to all subsequent operations in the field

Objective of Tillage

- 1) To obtain deep seed bed, suitable for different types of crops
- 2) To add more humus and fertility to soil by covering the vegetation
- 3) To destroy and prevent weeds
- 4) To aerate the soil for proper growth of crops
- 5) To increase water absorbing capacity of the soil
- 6) To destroy the insects, pests and their breeding places
- 7) To reduce the soil erosion

Classification and Types of Tillage

Tillage is divided into two classes

Primary Tillage

Secondary Tillage

Primary Tillage

It constitutes the initial major soil working operation. It is normally designed to reduce soil strength, cover plant materials, and rearrange aggregates. The operations performed to open up any cultivable land with a view to prepare a seed bed for growing crops is known as Primary Tillage. Implements may be tractor drawn or animal drawn implements. Animal drawn implements mostly include indigenous plough and mould-board plough. Tractor drawn implements include mould-board plough, disc plough, subsoil plough, chisel plough and other similar implements.

Secondary Tillage

Tillage operations following primary tillage which are performed to create proper soil tilt for seeding and planting are secondary tillage.

These are lighter and finer tillage operations performed on the soil after primary tillage operations. Secondary tillage consists of conditioning the soil to meet the different tillage objectives of the farm. The implements used for secondary tillage operations are called secondary tillage implements. They include different types of harrow, cultivators, levelers, clod crushers and similar implements. These operations are generally done on the surface soil of the farm. Secondary tillage operations do not cause much soil inversion and shifting of soil from one place to other. These operations consume less power per unit area compared to primary tillage operations.

The main objectives of secondary tillage operations are

- a) To pulverize the soil of the seed beds in the field
- b) To destroy grasses and weeds in the field
- c) To cut crop residues and mix them with top soil of the field and
- d) To break the big clods and to make the field surface uniform and leveled

Secondary tillage implements may be tractor drawn or bullock drawn implements. Bullock drawn implements include harrows, cultivators, hoes

Types of Tillage

There are various types of tillage's

Minimum Tillage

It is the minimum soil manipulation necessary to meet tillage requirements for crop production

Strip Tillage

It is a tillage system in which only isolated bands of soil are tilled

Rotary Tillage

It is the tillage operations employing rotary action to cut, break and mix the soil

Mulch Tillage

It is the preparation of soil in such a way that plant residues or other mulching are specially left on or near the surface

Combined Tillage

Operations simultaneously utilizing two or more different types of tillage tools or implements to simplify control or reduce the number of operations over a field are called combined tillage. Tillage is performed by tool, implements or machine

Tool

It is an individual working element such as disc or shovel

Implement

It is an equipment generally having no driven moving parts, such as harrow or having only simple mechanism such as plough

Machine

It is a combination of rigid or resistant bodies having definite motions and capable of performing useful work

3.1.3 Primary Tillage

The main implement for primary tillage is plough used for ploughing Operations, ploughing are the primary tillage operation, which is performed to cut, break and invert the soil partially or completely. Ploughing essentially means opening upper crust of the soil ,breaking the clods and making the soil suitable for sowing seeds. The purpose of ploughing can be summarized as below

- 1) To obtain a deep seed bed for good texture
- 2) To increase the water holding capacity of the soil
- 3) To increase soil aeration
- 4) To destroy weeds and grasses
- 5) To destroy insects and pests
- 6) To prevent soil erosion
- 7) To add fertility to the soil by covering vegetation

Normal ploughing

It is the ploughing up to a depth of about 15 cm

Contour ploughing

It is the method of ploughing in which the soil broken and turned along the contours

Types of plough

Different types of ploughs are used at different places. They may be classified as

- a) Indigenous plough
- b) Mould board plough
- c) Disc plough
- d) Chisel plough
- e) Sub soiler
- f) Rotary plough

Indigenous plough

It is most commonly used in this country. The shape and size of the plough varies with places and regions due to variation in soil types and tillage requirements. The parts of the plough

are Body: It is the main frame to which the shoe, beam and handle are attached.



Share: It is a narrow steel bar attached to the upper surface of the shoe longitudinally along the centre line and the handle are generally attached to the body of the plough. The share is attached to the shoe which penetrates into the soil and breaks it open. The shoe also helps in stabilizing and balancing the plough while in operation. The plough is provided with a wooden beam and a handle

Mould Board Plough (mb plough)

A mould board plough is very common implement used for primary tillage operations. This plough performs several functions at a time



Function

- 1) Cutting the furrow slice
- 2) Lifting the soil
- 3) Turning the furrow slice
- 4) Pulverizing the soil

Components

MB plough consists of

- a) share
- b) Mould board
- c) Land side
- d) Frog
- e) Tail piece

Share

It is that part of the plough bottom which penetrates into the soil and makes a horizontal cut below the surface.

Mould Board

It is the curved part which lifts and turns the furrow slice

Land side

It is the flat plate which bears against and transmits the rear side lateral thrust of the plough bottom to the furrow wall

Frog

It is the part to which other components of the plough bottom are attached

Tail piece

It is an adjustable extension, which can be fastened to the rear of a mould board to help in turning a furrow slice

Share

It penetrates into the soil and makes a horizontal cut below the soil surface. It is a sharp, well polished and pointed component. Different portions of the share are called by different names such as

Share point

It is the forward end of the cutting edge which actually penetrates into the soil

Cutting edge

It is the front edge of the share which makes horizontal cut in the soil. It is beveled to some distances

Wing of share

It is the outer end of the cutting edge of the share. It supports the plough bottom

Gunnels

It is the vertical face of the share which slides along the furrow wall. It takes the side thrust of the soil and supports the plough bottom against the furrow wall.

Cleavage edge

It is the edge of the share which forms joints between mould board and share on the frog

Wing bearing

It is the level portion of the wing of the share providing a bearing for the outer corner of the plough bottom

Mould board

The mould board is that part of the plough which receives the furrow slice from the share. It lifts, turns and breaks the furrow slice. To suit different soil conditions and crop requirements, moldboard has been designed in different shapes. The mould board is of following types

- 1) General purpose
- 2) Stubble
- 3) Sod or breaker
- 4) Slat

Disc Plough

It is a plough which cuts, turns and in some cases breaks furrow slices by means of separately mounted large steel discs. A disc plough is designed with a view to reduce friction by making bottom a rolling plough bottom instead of sliding plough bottom. A disc plough works well in the conditions where moldboard plough does not work satisfactorily



Advantages of Disc plough

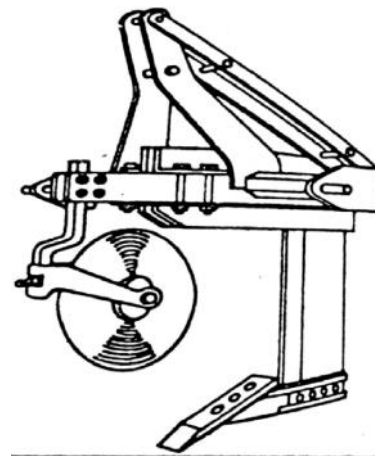
- 1) A disc plough can be forced to penetrate into soil which is too hard and dry for working with a moldboard plough
- 2) It works well in sticky soil in which a moldboard plough does not scour
- 3) It is more useful for deep ploughing
- 4) It can be used safely in stony and stumpy soil without much danger of breakage
- 5) A disc plough works well even after a considerable part of the disc is worn off in abrasive soil
- 6) It works in loose soil also without much clogging

Disadvantages of disc plough

- 1) It is not suitable for covering surface trash and weeds as effectively as moldboard plough does
- 2) Comparatively the disc plough leaves the soil in rough and more cloddy condition than that of mould board plough
- 3) Disc plough is much heavier than mould board plough for equal capacities because penetration of this plough is affected largely by its weight rather than suction

Sub soiler

The sub soiler is a tool that will break the ground at greater depth, break the hard pan, and will not pulverize the surface soil as much as other tools. This is provided with a heavy beam to which a sweep or chisel is attached. When it is pulled through the soil, it breaks open the soil up to



considerable depth. Trash and mulch are left on top. Sub soiling improves the moisture and air permeability of the soil.

Chisel plough

It is a plough used to cut through hard soils by means of a number of narrow tines. It is used before using the regular plough. It is useful for breaking. Hard layers of soil just below the regular ploughing depth. This layer of soil which is called Hard pan or plough sole is very tough and hard.



3.1.4 Secondary Tillage Implements

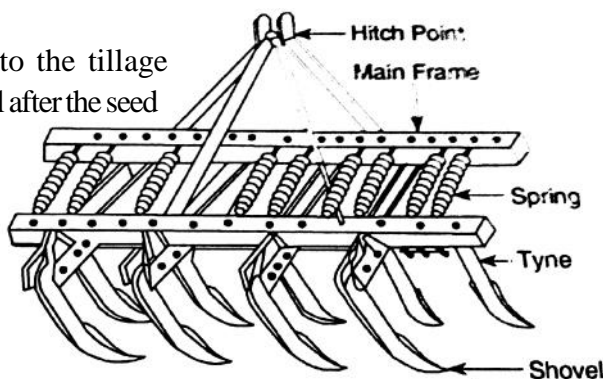
Lighter and finer operations performed on the soil after primary tillage, but before and after seed placement are termed as secondary tillage. These operations are generally done on the surface of soil, very little inversions and shifting of the soil takes place and consequently there is less power requirement per unit area. Secondary tillage implements include harrows, cultivators, sweeps, hillers etc..

Cultivators

Cultivation usually refers to the tillage operation of manipulating the soil after the seed is planted or the seedlings have emerged. Cultivation is done to accomplish the following objectives

- 1) To control weeds
- 2) To prevent surface evaporation losses
- 3) To maintain the seedbed in a good tilt during the growth of the crop
- 4) To achieve rapid infiltration of rainfall and adequate aeration

It is essential that this operation should be performed at the correct moisture content. Since the basic objective is to achieve good tilt, cultivation should be done when the soil is in the most workable condition. Cultivators are primarily the type of tillage implements which are used after the crop has come up a few centimeters above the ground. But these implements are also used for opening the land, preparing the seed bed and sowing the seeds. According to the source of power used, Cultivators may be classified as



- a) Hand operated
- b) Animal drawn
- c) Tractor drawn

According to the type of the working parts they may be classified as

- 1) Disc cultivator

It is a cultivator fitted with disc

- 2) Rotary cultivator

It is a cultivator with tines or blades mounted on a power driven horizontal shaft

- 3) Tine cultivator

It is a cultivator fitted with tines having shovels . The cultivator stirs the soil, and breaks the clods. The tines fitted on the frame of the cultivator comb the soil deeply in the field. A cultivator performs functions intermediate between those of plough and the harrow. Destruction of weeds is the primary function of a cultivator.

Harrows

A harrow is an implement that cuts the soil to a shallow depth for smoothening and pulverizing the soil as well as to cut the weeds and to mix materials with soil. It is an implement used to break the clods after ploughing, to collect trash from the ploughed land and to level the seed bed It is secondary tillage operation which pulverizes smoothenes and packs the soil in seed bed preparation and control weeds There are several types of harrows used in India



Disc Harrow



It is a harrow which performs the harrowing operations by means of a set of rotating steel disc, each set being mounted on a common shaft. Disc harrows are of two types Tractor drawn and Animal drawn Harrows are again classified in to two classes depending upon the disc arrangements

Single action

It is a harrow with two gangs placed end to end which throw the soil in opposite directions. The discs are arranged in such a way that right side gang throws the soil towards right and left side gang throws the soil towards left

Double action

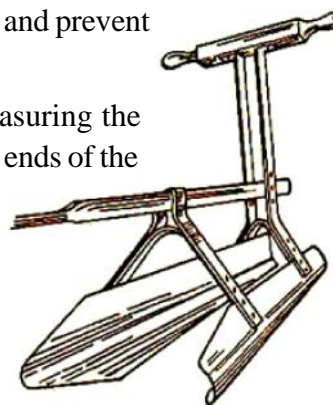
A disc harrow consisting of two or more gangs in which a set of one or two gangs follow behind the set of the other one or two, arranged in such a way that the front and back gangs throw the soil in opposite directions.

Bund former

It is used for making bunds or ridges by collecting the soil. Bunds are required to hold water in the soil, thereby conserve moisture and prevent runoff.

The size of the bund former is determined by measuring the maximum horizontal distance between the two rear ends of the forming boards. Bund former consists of

- 1) Forming board
- 2) Beam
- 3) Handle



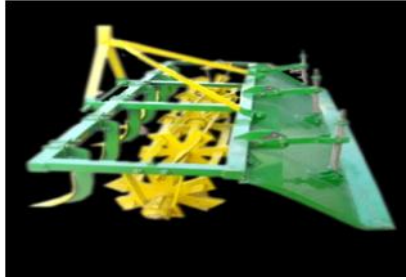
Ridger

It is an implement which cuts and turns the soil in two opposite directions simultaneously for forming ridges. It is also known as Furrower. Ridger is used to form ridges, for sowing row crop seeds and plants in well tilled soil. The ridger is also used for forming field furrows or channels, earthing up and similar other operations. Ridgers are also known by the names Ridging plough and Double mould boards plough. The ridger generally has V shaped or wedge shaped share, fitted to the frog. The nose or the tip of the share penetrates into the soil and breaks the earth. The moldboards lift

,invert and cast aside the soil, forming deep channels and ridges of the required size. A ridger consists of beam, clevis, frog, handle, moldboards, braces, share, and sliding shoe



Puddler



It is an implement used for churning the soil in standing water. Puddler is used for preparation of paddy fields with standing water after initial ploughing. It breaks up the clods and churns the soil. The main purpose of puddling is to reduce leaching of water, to kill weeds by decomposing and to facilitate the transplanting

of paddy seedlings by making the soil softer. Puddling is done in a standing water 5 to 10 cm depth.

Levellers

In irrigated areas land leveling is an essential operation for farming. Leveled fields receive uniform penetration of irrigation water with high efficiency. The possibility of water logging and soil erosion is reduced considerably. The entire leveled field becomes ready to receive timely agricultural operations like ploughing, seeding and interculturing. Smooth fields also facilitate the operation of field equipment and are very important for mechanical harvesters. Land leveling is usually done in the slack season when the field is free from crops and the men and bullocks are idle. Wooden logs or planks the most common type of field levelers used by farmers.



3.1.5 Seeding methods

Seeding or sowing is an art of placing seeds in the soil to have good germination in the field. A perfect seeding gives

- 1) Correct amount of seed per unit area
- 2) Correct depth at which seed is placed in the soil
- 3) Correct spacing between row to row and plant to plant

Common methods used for seeding crops are

Broadcasting

It is the process of random scattering of seeds on the surface of seed bed it can be done manually or mechanically both. When broadcasting is done manually, uniformity of seed depends upon skill of the man. Soon after broad casting, the seeds are covered by planking or some other devices. Usually higher seed rate is obtained in this system. Mechanical broadcasters are used for large scale work. This machine scatters the seeds on the surface of the seed bed at controlled rates.

Dibbling

Dibbling is the process of placing the seeds in holes made in seed bed and covering them. In this method seeds are placed in holes made at definite depth at fixed spacing. The equipment used for dibbling is called dibbler. It is a conical instrument used to make proper holes in the field. Small hand dibblers are made with several conical projections made in a frame. This is very time consuming process, so it is not suitable for small seeds. Mostly vegetables are sown in this way

Drilling

Drilling consists of dropping the seeds in furrow lines in a continuous flow and covering them with soil. Seed metering may be done either manually or mechanically. The number of rows planted may be one or more. This method is very helpful in achieving proper depth, proper spacing and proper amount of seed to be sown in the field. Drilling can be done by

- a) Sowing behind the plough
- b) Bullock drawn seed drills
- c) Tractor drawn seed drills

Seed dropping behind the plough

It is very common method used in villages. It is used for seed like maize, gram, peas, wheat and barley. A man drops seeds in the furrows behind the plough. Sowing behind the plough can be done by a device known as Malobansa. It consists of a bamboo tube provided with a funnel shaped mouth. One man drops the seeds through the funnel and other man handles the plough and the bullocks. This is slow and laborious method

Transplanting

Transplanting consists of preparing seedlings in nursery and then planting these seedlings in the prepared field. It is commonly done for paddy, vegetables and flowers. It is very time consuming operation. Equipment for placing plants in the soil is called Transplanter.

Hill dropping

In this method seeds are dropped at fixed spacing and not in a continuous stream. Thus the spacing between plant to plant in a row is constant. In case of drills the seeds are dropped in continuous stream and the spacing between plant to plant in a row is not constant

Check row planting

It is a method of planting in which row to row and plant to plant distance is uniform. In this method seeds are planted precisely along straight parallel furrows. The rows

are always in two perpendicular directions. A machine used for check row planting is called check row planter

3.1.6 Seed drilling

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

Functions of seed drill

It performed the following functions

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

Components of seed drill

A seed drill with mechanical seed metering device mainly consists of

- 1) Frame
- 2) Seed box
- 3) Seed metering mechanism
- 4) Furrow openers
- 5) Covering device
- 6) Transport wheel

Principle and operation

In addition, seed drills equipped with fertilizer attachment distribute the fertilizer evenly beside the row in which seeds are placed. With small grains it is recommended that the fertilizer should be placed in partial contact with the seeds to give good results.

Depending upon the seed metering device, seed drills may be classified as follows:

Manually metered drills

Mechanically metered drills

According to the power employed, they may be called Animal-drawn or tractor-drawn seed drills.

Animal Drawn Seed drill:

It is an attachment made for the bullock drawn CIAE multipurpose tool frame. The seeding attachment is suitable for sowing wheat, gram, pea, soybean, sorghum and



pigeon pea. It can apply granular fertilizers like urea, DAP and Grow more. The hopper has compartments for fertilizer and seed and the ground wheel is a floating type thus enabling uniform seed placement even when the soil surface is not properly leveled. Separate side wheels allow

accurate adjustment of the seed drill attachment and are also useful for transportation. It saves 73 per cent labor and operating time and 55 per cent on cost of operation compared to conventional method of sowing behind country plough or seeding by broadcasting. It also results in 10 to 18 per cent increase in yield compared to sowing by conventional method.

Manual Seed Fertilizer drill

This is a small manually operated single row seed cum fertilizer drill in which fluted roller metering mechanism is provided. A ground wheel is provided to drive the metering rollers. Seed and fertilizer are stored in a small hopper and a long beam is provided by which the implement could be pulled by one operator. Another worker guides the machine. Due to the provision of fluted rollers, it is suited for drilling soybean maize, pigeon pea, sorghum, green gram, bengal gram, wheat etc. Shoe type furrow openers are provided for easy operation.



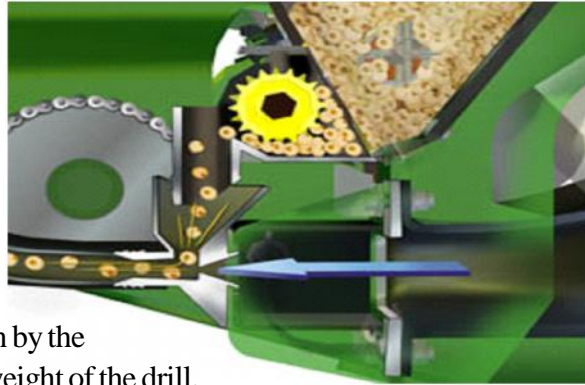
Seed cum fertilizer Drill

Seed drills fitted with fertilizer dropping attachment distribute the fertilizer uniformly on the ground it is called seed cum fertilizer drill. Such a drill has a large seed box which is divided length wise in to two compartments. One for seeds and another for fertilizers.



Seed metering mechanism

The mechanism of a seed drilling or fertilizer distributor which deliver seeds or fertilizers from the hopper at selected rates is called seed metering mechanism. The seed drill box is fitted with either of two feed, the fluted force feed mechanism or the double run feeds are driven by the ground wheels which carry the weight of the drill.



Care and maintenance of seeding machinery

For efficient and trouble free operation, the seed drills and planters must be properly maintained. Before storing these machines the seed box should be properly cleaned. Any seed left inside may germinate or attract worms and rodents. With fertilizer drills one should be very careful as a fertilizer is particularly bad for collecting moisture and causing rust. It must be cleaned out after it is used in fact the inner side of the hopper and feed mechanism should be washed with water and dried before storing.

Most of the modern drills are mounted on rubber tyres. Tyres should always inflated to the recommended pressure. All bearings weather on ground wheels or on disk type furrow opener, must be kept lubricated and dust free. As Far as possible machines should be stored under shed. This is particularly important those machines which are provided with a wooden seed box and rubber seed tubes.

3.1.7 Transplanter

Transplanting consists of preparing seedlings in nursery and then planting these seedlings in the prepared field. It is commonly done for paddy, vegetable and flowers. It is very time consuming operation. Equipment for placing plants in the soil is called transplanter



Rice Transplanter

The rice transplanter consists of

- (i) Air cooled gasoline engine
- (ii) Main clutch
- (iii) Running clutch
- (iv) Planting clutch
- (v) Seeding table
- (vi) Float
- (vii) Star wheel
- (viii) Accelerator lever
- (ix) Ground wheel
- (x) Handle
- (xi) Four bar linkage mechanism

Seedlings:

Growing of seedlings for this transplanter is most technical and difficult work. Seedlings are grown in special seedling trays. It is called mat seedling. Mat seedlings are grown by some standard procedure in controlled environment in a nursery.

Operation:

The seedlings are raised in special trays as mat seedlings. The mat seedlings are placed on the seeding table of the transplanter in slanting position. When the engine is started, the running clutch and planting clutch are operated. Four bar linkage mechanism is there to catch 3 or 4 seedlings at a time and to separate them from the mat and fix in the puddled soil. A float is there to support the machine on the water while working in the field. There are two ground wheels made of iron for facilitating the movement of the transplanter. There is a marker also which demarcates the transplanting width while in operation. Power from the engine goes to the main clutch from where it is divided into two routes, one goes to planting clutch and the other goes to running clutch. Unless planting clutch is operated, the four bar linkage mechanism does not work.

Paddy Transplanter

As stated earlier, successful paddy transplanter were not available in the market over a decade ago. Even in mid seventies the Japanese type transplanter cannot be successfully employed for the tall Indian varieties of paddy which are performed to be transplanted after attaining the age of over 3 weeks in the ponded water of about 5cm depth. In various institutions and organizations attempts are being made to develop one such machines which can be adopted either as a manually operated unit which needs to be perfected in all respects.

Few models of Japanese type 2 and 4 row transplanters were imported and tested in Indian paddy fields somehow these machines did not prove successful. The Japanese type machines require seeding produced in special boxes. The transplanting is carried out in the leveled fields in which the depth of the ponded water does not exceeded 3cm and remains uniform all over the field. The paddy fields of the south and south east Asia are not properly leveled and graded to achieve the desired depth of water. A brief description of the seeding development and transplanting machines is out lined below.

- a) Seeding- the soil mixed with fertilizer is put in to a seeding box at a thickness of 2cm. it is sprinkled with water after seeding, cover it with soil to nurse young paddy plants.

- b) Spouting period- After seeding are kept in a box for about 3 days at about 30°C white sprouts of about 1cm are emerge and these are placed in to seeding bed.

Greening period- Seeding box is covered so shade young seedlings from the sun and keep the inside of the box warm. After about 3 days the green seedlings emerge. It is necessary to sprinkle water occasionally and keep the well ventilated beneath the covering when the temperature rises to more than 25°C during the day.

- c) Hardening period- The covering is taken off and seedling are nursed under natural conditions. The seedlings are sprinkled with water, fertilized and protected from insects. The covering is then replaced at night, bit only when the temperature drops to less than 12°C
- d) Transplanting
- a) Seedlings are transplanted in a paddy field in one to three days after ploughing, puddling and leveling of the paddy field. In this case the quantity of water must be kept as small as possible.
 - b) In the beginning, seedlings are taken out of the box and placed in a transplanter, after checking and adjusting it.
 - c) Its wheels are adjusted according to the depth of the paddy field. Transplanting section is adjusted in accordance with spacing in the row, the number of seedlings per roll, transplanting depth etc.
 - d) Transplanter speed is set about 0.6 to 0.7 m/sec. this gives an output of 1/10th of a hectare per hour with the use of a 2 row machine.

3.1.8 Seeding equipment

The seeding equipment for un irrigated areas are designed to place the seed in farm most soil. The moisture in the surface layer of the seed bed in dry areas is evaporated quickly. Germination of seed may be adversely effected if the seeds are sown at shallow depths of four to five centimeters as in irrigated atres. However, the soil moisture at deeper depths may be sufficient for successful germination of seeds. Deep sowing with a conventional seed drill will result in too deep placement of seed and poor germination. Therefore, the requirements of seed drills for un irrigated areas that is should make a furrow in the soil layer and place the seed in firm moist soil below the bottom of the furrow. The multi row seed drills with packer wheels shown in the accompanying figures are design to obtain the optimum environment for

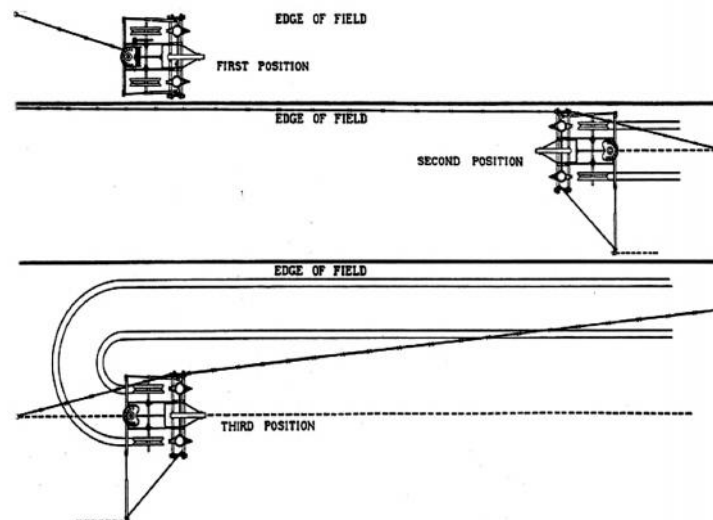
the germination of the seed and growth of the seedling under unirrigated conditions.

Dibbler

The hand dibbler is made from mild steel flat or leaf spring by forging operation. The working end is flattened and edge made sharp for easy penetration in the soil. The cutting edge of the tool made from spring steel is hardened and tempered to desired hardness. The other end serves as a tang for fitting handle. The tool is used in squatting position by pushing/striking the cutting edge in the soil.



Check row planting



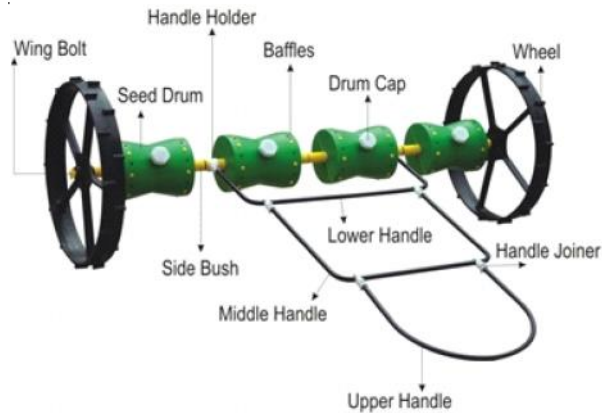
It is a method of planting, in which row-to-row and plant-to-plant distance is uniform. In this method, seeds are planted precisely along straight parallel furrows. The rows are always in two perpendicular directions. A machine used for check row planting is called check row planter.

Hill dropping

In this method, seeds are dropped at fixed spacing and not in a continuous stream. Thus the spacing between plant to plant in a row is constant. In case of drills, the seeds are dropped in continuous stream and the spacing between plant to plant in a row is not constant.

Drum seeder

The seeder consists of a seed drum, main shaft, ground wheel, floats, and handle. Joining smaller ends of frustum of cones makes the seed drum. Nine numbers of seed metering holes of 10 mm diameter are provided along the circumference of the drum



at both the ends for a row-to-row II spacing of 200 mm. Flat spikes 12 mm wide and 25 mm long are joined to ground wheel parallel to its axis of rotation. The slopes of the cone facilitate the free flow of seeds towards the metering holes. Two floats are provided on either side to prevent restrict the sinkage and to facilitate easy pulling of the seeder

Pneumatic seed drill



In modern agriculture, a higher working rate of the technology, the universal combination of tools in the implements, and faster and easier road transport are becoming increasingly important. Here, the extensive range of pneumatic seed drills. Pneumatic seed drills provides the requirements for efficient implement use when seeding. The

pneumatic seed drills pneumatic seed drills depending on the type, can be trailed, mounted or semi-mounted. Working widths of 3 to 12 metres

Provide the requirements for cost-efficient operation on all types of farms. In addition to combinations, it is also possible to use the pneumatic seed drills on their own

- The combination possibilities of the pneumatic seed drill with different soil tillage implements and solo operation provide a multitude of uses in various cultivation methods.
- It is available as a mounted rigid or hydraulic-folding version, or as semi-mounted folding version in working widths of 3 to 6 metres.

- The trailed pneumatic seed drill completes the range as a solo machine with working widths of 8, 9, 10 and 12 metres.
- The seed hopper volume of 5,800 litres and the innovative coulter bar are the prerequisites for maximum acreage performance when seeding

3.1.9 Weeding

Weeding is the process of eliminating the competition of unwanted plants to the regular crops so that crops can be grown profitably. Management of weeds is an important component of production techniques as elimination of weeds is expensive and hard to achieve. Hydraulic Cono Weeders are becoming popular because they are utilized under shallow water conditions. Weeds are uprooted by the teeth of the weeder and buried in the mud by push and pull operations of the weeder

Cono weeder

The weeder consists of two rotors, float, frame and handle. The rotors are cone frustum in shape, smooth and serrated strips are welded on the surface along its length. The rotors are mounted in tandem with opposite orientation. The float, rotors and handle are joined to the frame. The float controls working depth and does not allow rotor assembly to sink in the puddle. The cono weeder is operated by pushing action. The orientation of rotors create a back and forth movement in the top 3 cm of soil.



Power weeder

A 3-hp petrol start kerosene run engine operates the weeder. The engine power is transmitted to ground wheels through V belt-pulley and sprocket chain mechanism. At the back of the machine a replaceable sweep blade is fixed (Fig.3). Sweep blades of different width can be fitted to the machine depending on the row to row spacing of the crop. A tail wheel is provided at the rear to maintain the operating depth.



The sweep blade can be raised or lowered so as to have the desired operating depth. The cost of the unit is Rs. 50,000/- and the field capacity is 0.75 ha per day. The salient features of the unit are: Useful for weeding between rows of crops like tapioca, cotton, sugarcane,

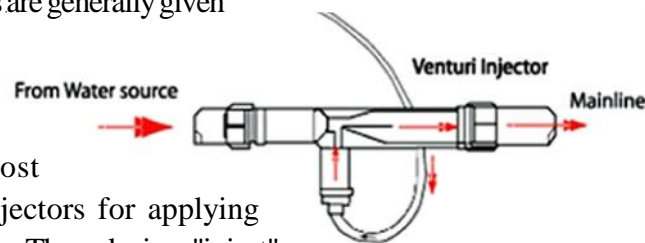
maize, tomato and pulses whose rows spacing is more than 45 cm. Can also be used for weeding and intercultural operations in orchards, coconut and areca nut plantations.

Peg tooth weeder

This is a secondary tillage implement useful for weeding and intercultural. It consists of a rectangular frame made of mild steel angle sections. To this frame, mild steel pegs made of round bars are attached with fasteners and the front and rear rows are staggered to cover the surface completely. The beams attached to the two brackets welded to the frame. Handle is provided at the rear at a suitable height for easy operation. The ends of round bar are forged to diamond point, which come in contact with the soil. The pegs are bent at appropriate angle for penetration in the soil. For operation a pair of bullock pulls the implement and the pegs remove weeds and also stir the soil. The action breaks topsoil crust and also creates soil mulch.

3.1.10 Fertilizer Injectors

Fertilizer recommendations are generally given in parts per million of nitrogen (ppm N) in the final solution being applied to the crop. Most growers use fertilizer injectors for applying fertilizers to greenhouse crops. These devices "inject"



a specific amount of concentrated fertilizer solution per increment of irrigation water that passes through the injector. An important attribute of each fertilizer injector is the injector ratio, which is defined as volumetric ratio of stock solution to dilute fertilizer solution.

DETAILING OF PRACTICALS

Operate brush cutter

1. Check fuel /oil/coolant
2. Give grease or lubricating oil to all the moving parts
3. Clean the places, where the blades or ropes attached from the debris stick over that place
4. Check cutter ropes and blade of the brush cutter
5. wear all safety measures including mask apron boot etc
- 6 start the given brush cutter using cranking method
7. For cutting the grass tilt the brush cutter about 30degree to the ground
8. If any stones or rock are found on the land, cutting should be done Very carefully otherwise the blued will be damaged by hitting on the stones
9. after completing the cutting operation, clean the rope and blued Thoroughly

ASSESSMENT ACTIVITIES

Practical record	Activity log
Prepare chart	Questionnaire
Note Presentation,	Unit Test
Quiz	Project Evaluation Record,
Practical	Viva
Class Test	

Theory Evaluation Questions

- 1) Match the following (5)
- | | |
|---------------------------------|--------------|
| a) Primary tillage implements | Broadcast |
| b) Secondary tillage implements | Brush Cutter |
| c) Seeding | Harrows |
| d) Weeding | Paddy |
| e) Transplanter | Disc Plough |

- 2 Can you suggest the different types of seeding methods and explain any two (2)
- 3 Explain the use of a transplanter? and classify them (2)
- 4 With a neat sketch explain the operation of seed drills (3)

Unit 3.2 Plant Protection Machinery

Introduction

Agricultural processing includes those operations which maintain or raise the quality of row material, change its form, or prepare it for the market. Its importance is growing and will continue to increase as farming become more commercialized, specialized and mechanized in India. With the advancement of agricultural science more fields remain covered under crops for longer duration of time due to multiple cropping, intensive farming and better irrigation facilities. Consequently there is increase in plant pests and diseases to a considerable extent. So it has become necessary now to use pesticides and fungicides for controlling the pests and diseases. The chemicals are applied on plants in the form of spray and dust. Many types of sprayers and dusters are available in different size for plant protection works.

The chemicals for protecting the plants from various injurious organisms need to be applied on plant surfaces in the form of sprayers, dusters and mist etc.

Many different kinds of spraying and dusting machines are available to meet the requirements of agriculturists in controlling insects, diseases and weeds. These machines can be classified as :

- 1) Hand -operated machines:- suitable for small holdings. They are operated at pressure ranging from 1 to 7 kg/sq cm
- 2) Power - operated machines: - suitable for treating a large area. They are operated at pressure from 20 to 55 kg/sq cm.
- 3) Air - planes - suitable for large scale work.

Learning outcomes

Plant Protection Machinery

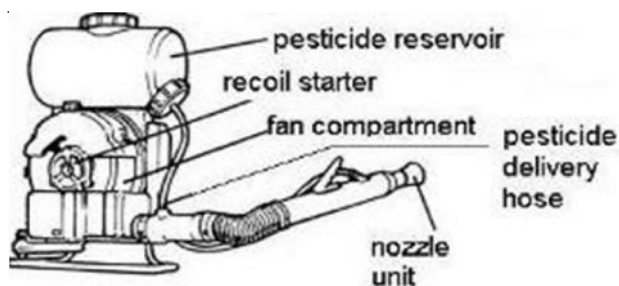
- 3.2.1 Explains the different types of sprayers and dusters
- 3.2.2 Distinguishes the method of atomization in different sprayers
- 3.2.3 Explains the working of sprayers
- 3.2.4 Classifies sprayers based on mode of operation

- 3.2.5 Does repair and servicing of sprayers
- 3.2.6 Distinguishes between Duster, Fogger, Fumigator
- 3.2.7 Repairs & maintenance of Dusters
- 3.2.8 Recognizes the safety precautions while using plant protection machineries

3.2.1 Sprayers

It is a machine to apply fluids in the form of droplets. Sprayer is used following purposes

- 1) Application of herbicides to remove weeds
- 2) Application of fungicides to minimize fungus diseases.
- 3) Application of insecticides to control insects pests
- 4) Application of micro nutrients on the plants



The main function of sprayer is

- 1) To break the liquid in to droplets of effective size
- 2) To distribute them uniformly over the plants
- 3) To regulate the amount of liquid to avoid excessive application

The important components of a sprayer are:

1. Pump
2. Power source
3. Tank
4. Agitator
5. Distribution system
6. Pressure gauge
7. Pressure regulator

Fogger

The fogger is ideal for irrigating nurseries, shrubs and trees where a fine mist spray is required at low volumes and low pressures. Foggers can also assist in temperature

control and to increase humidity in hot, dry climates. Its rugged nylon construction and easy disassembly allow for carefree operation

Duster

The hand rotary duster is available in two models, shoulder mounted and belly mounted. It is a common type of duster being used by the farmers. The duster consists of



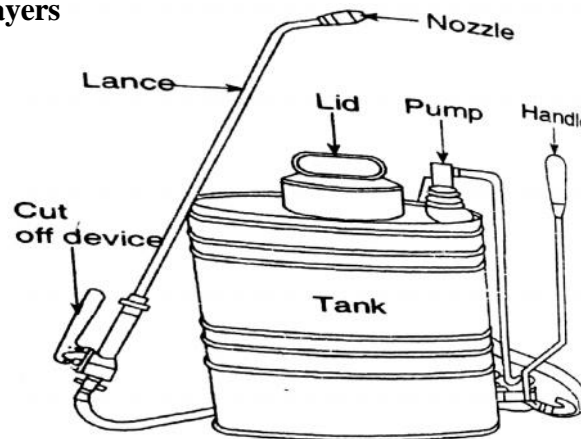
a hopper, fan/blower, rigid/flexible discharge pipe, reduction gearbox, rotating handle, shoulder straps, and metering mechanism. The hopper is either made of plastic or aluminium. The hopper made from mild steel sheet is coated with anti-corrosive material for longer life. The duster has mechanical agitator connected to the gearbox placed in the hopper, which chums the chemical and prevent clogging of the outlet. The adjustable orifice plate mounted below the hopper outlet

controls the application rate. The fan/blower is enclosed in the casing and is rotated with the handle through gearbox. For operation, the hopper is filled 1/2 to 3/4th of the capacity of the hopper. This is mounted on the shoulder/belly with the help of adjustable

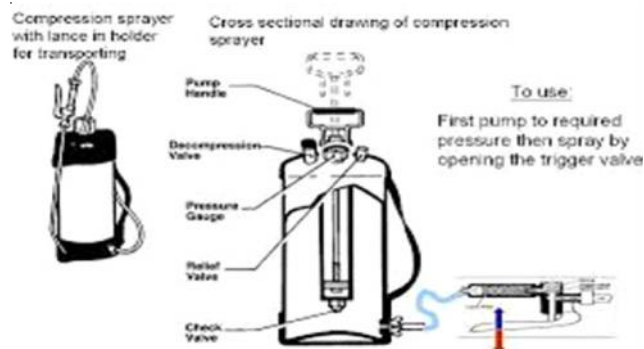
3.2.2 Classification of Sprayers

a) Hydraulic Knapsack Sprayers

Manually operated, tank capacity is 15 liters, mechanical or hydraulic agitation, worked with a hand lever to maintain constant pressure, particularly used for spot treatment by small holding farmer and hand treatment. Equipped with a boom. It is good for blanket application.



b) Air Compression System Knapsack



Does not require pumping during operation / spraying. The tank is pressurized after filling the liquid to 2/3rd capacity with a built in hand pump. Undesirable for weedicide as spraying pressure declines after some time resulting into

uneven spray. Tank cleaning is a challenging task. It is used in limited amount of spray on weeds in paddy and jute

c) Centrifugal Sprayers

The motorized knapsack mist blower has a small 2-stroke petrol/ kerosene engine of 35 cc to which a centrifugal fan is connected. The centrifugal fan is usually mounted vertically. The fan produces a high velocity air stream, which is diverted through a 90-degree elbow to a flexible (plastic) discharge hose, which has a divergent outlet. The spray tank that has also a compartment for fuel and engine-fan unit is mounted on a common frame, which fits to the back of operator. The tank is made of plastic. The spray liquid flows due to gravity and suction created at the tip of nozzle, thus remains in the air stream.



3.2.3 Hydraulic Sprayers

Most sprayers used today are hydraulic type in which the spray pressure is built up by the direct action of the pump on the liquid spray material. The pressure thus developed forces the liquid through the injectors or nozzles which break the spray into optimum or proper size droplets and disperse them in the spray pattern as desired, also sufficient energy is imparted to the spray droplets to carry them from the nozzles to the space to be targeted

Pump, chemical tank, Lance, hose, frame, pressure regulator, pressure gauge, control valves, unloaded relief valve, piping and fittings, distribution system and power source are the main components of hydraulic sprayer

The spray solution is kept in the container. The pump increases the pressure of the solution passing through the injector. The nozzle atomizes the solution. The lance hold the injector. The hose is provided for suction of solution and extension of spray lands. The strains are for keeping the solution free from impurities. Valve regulates pressure and discharge of solution.

3.2.4 Classification of sprayers

Sprayers may be classified as follows

Hand sprayer

The hand sprayer is a small capacity pneumatic sprayer. It consists of chromium plated brass tank having a capacity of 0.5 to 3 litres (one litre is more common) which is pressurized by a plunger pump. The air pump remains inside the tank. The sprayer has a short delivery tube to which a cone nozzle is attached. In some models, the nozzle is attached at the top of the tank with flow , spring actuated lever, which regulates the flow of the spray liquid. For spraying, the tank is usually filled to three-fourths capacity and pressurized by air pump. The compressed air causes the agitation of the spray liquid and forces it out, on operation of the trigger or shut off type valve. Usually the chemicals with suspension characteristics cannot be effectively sprayed with this type of sprayer. For spraying wettable powders the sprayer is shaken frequently to prevent settling of the chemical. For operation, the spray nozzle is directed to the target after charging. It is fitted with mist spray nozzle with gooseneck bend. The pump assembly is made of brass and operated by one person.



Rocker sprayer

The rocker sprayer is a long lever high-pressure sprayer designed for operation with one or two lances. The complete assembly is mounted on a I wooden board, which is held to the ground by the foot of the operator. The sprayer consists of a single or double acting piston pump for developing high pressure, an air chamber, spray lance with shut off valve and strainer, 5 m suction line fitted with strainer and delivery line.



. The principal components are made from brass alloy. The lance is fitted with

gooseneck bend and nozzle and the length of lance may vary from 60 to 90 cm. The pump is operated with long lever to and fro in a rocking motion which suck the liquid from the inlet pipe submerged in the spray liquid. The other person holds the lance and directs the spray chemical to the target. If two lances are used, then it may require in all three persons for the spraying operation. With high jet spray gun or bamboo lance the spray chemical can be delivered to a height of up to 10m.

Power sprayers

Power sprayers are used for developing high pressure and high discharge for covering large area. These sprayers are either operated by auxiliary engines or electric motors. Most of these sprayers are hydraulic sprayers and consist of power unit to drive the pump, pump unit which employs piston or plunger pump, piston (1 to 3), pressure gauges, pressure regulators, air chamber, suction pipe with strainer, delivery pipes fitted with lance, gooseneck bend and nozzles. The portable sprayers use petrol engine so that these can be easily taken to the spray sites. The complete assembly is mounted on the stretcher type frame or on wheel barrow for easy transportation. The number of lances may vary from 1 to 6 depending upon the model. In some models there is a built in storage tank of fibreglass having capacity of 100 litres, while in others a separate storage tank is required in which the suction pipe of the sprayer remains submerged. For operation, the shut off trigger valve of the lance is closed and the engine/ electric motor is started to actuate the pump. The pump draws the spray liquid from the tank,



imparts pressure energy and sends it to the delivery line/lines. The operator directs the lance towards the target and operates the trigger/shut off valve. Adjusting the nozzle or selecting the appropriate nozzle, adjusts the spray pattern. For delivering the spray liquid to large distances/ height a bamboo lance can also be used.

Tractor mounted sprayers

With spray pressure of 1.4 to 2.8 kg cm² and fitted with multi nozzle boom are very useful in CPP(Crop Protection Products-CPP) application for large holding of



farmers. Tractor mounted sprayer fitted with booms are used to spray road side vegetation. Tractor run sprayers have.

1. High uniformity of sprayers.
2. High working efficiency.
3. Full utilization of tractor during idle time.

Aerial sprayers



CPP(Crop Protection Products- CPP) at peak periods plays a vital application from air is limited to treat aquatic weeds like water hyacinth, paddy fields and large sugarcane plantation. Presence of obstacles like trees and diversified

farming in India are bottle necks in its use.

When do I use which sprayer?

The selection of a sprayer is governed by several factors

- i. Frequency of CPP application,
- ii. Availability of diluent (water, oil, kerosene, etc.),
- iii. Availability of labor (human or animal power),
- iv. Area requiring treatment,
- v. Characteristics of area (machine equipment)

Knapsack Sprayers

Manually operated, tank capacity is 15 liters, mechanical or hydraulic agitation, worked with a hand lever to maintain constant pressure, particularly used for spot treatment by small holding farmer and hand treatment. Equipped with a boom. It is good for blanket application.

Pneumatic or compressed system

Loaded on the back of worker during operations. Tanks may be of plastic or metal.

Common Knapsack sprayers are

- i. Hydraulic
- ii. Manual pneumatic and
- iii. Motorized pneumatic

Hydraulic Knapsack Sprayers

Manually operated, tank capacity is 15 liters, mechanical or hydraulic agitation, worked with a hand lever to maintain constant pressure, particularly used for spot treatment by small holding farmer and hand treatment. Equipped with a boom. It is good for blanket application.

Pneumatic or compressed system Knapsack

Does not require pumping during operation / spraying. The tank is pressurized after filling the liquid to 2/3rd capacity with a built in hand pump. Undesirable for weedicide as spraying pressure declines after some time resulting into uneven spray. Tank cleaning is a challenging task. It is used in limited amount to spray on weeds in paddy and jute.

Bucket type sprayer

This equipment consists of a single or double acting pump which may be placed in to any ordinary bucket containing spraying solution. This pump is mostly made of brass. It is very light and easily handled and develops sufficient pressure to spray small gardens and low trees.

3.2.5 Maintenance and care of sprayer and duster

All knapsack sprayer and other manually operated spraying equipment require little maintenance. However, a little care can considerably lengthen their life as well as enhance their functional efficiency. They are given below:

- 1) Wash inside of the pump only with clean water.
- 2) For off season storage, the sprayer should properly be kept in a cool and dry place.
- 3) For motorize knapsack sprayers, proper lubrication should be maintain.
- 4) The small motor of ULV sprayers serviced in accordance with manufactures.

Duster

Duster is a machine to apply chemical in dust form. Duster make use of air streams to carry pesticides in finely divided dry form on the plants. Duster essentially consists of

- 1) Hopper
- 2) Agitator
- 3) Feed control



- 4) Fan or blower
- 5) Delivery nozzle

3.2.7 Recognize the care of Power Sprayer

Preparation for operation of power sprayer

- 1 Pour Mobil oil into the crankcase up to the desired level
- 2 Put grease in all the grease point
- 3 Tighten the suction hose, over flow hose and spray hose
- 4 Make sure that there is no break or clogging in the strainer at the end of the suction hose
- 5 Check the V belts for damage and tights

Actual operation of Power Sprayer

- 1 set the pressure regulator to zero and start the prime mover
- 2 Make sure that the chemical comes back to the tank through the overflow hose
- 3 Warm up the sprayer with no load for a few minutes
- 4 Adjust the pressure regulator up to required pressure
- 5 Open the stop cock to spray the chemical

Care after use of power sprayer

- 1 After spraying, dip the suction hose into fresh water and run thr sprayer for a few minutes to clean it
- 2 Before stopping the prime mover , turn the pressure regulator to make the water
- 3 After spraying, check the machines to see that no screw are loose

DETAILING OF PRACTICALS

Repairing and Maintenance of Sprayers

1. Follow the instruction of manufacturers for maintenance of equipment
2. Remove all parts of sprayers, clean the equipment properly and store in a dry place.
3. Drain the tank of a sprayer and flush it with clean water, the pump, nozzles, strainers, lances, hoses, etc. with clean water

4. Empty the hopper and clean with cloth in case of duster
5. Replace the worn out parts, grease and oil the moving parts, eg. Cylinder, 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 oil, 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 tube of dusters on bare ground
9. Drain the spray solution to avoid clogging of nozzle.
10. Check all the parts of the sprayers visually for any damage, if any damage is found for any part repair its or replace it
11. Assembled the sprayer back in the reverse order of the dissembled

ASSESSMENT ACTIVITIES

- | | |
|-------------------------|-----------------------|
| 1. Unit test | 2. Quiz |
| 3. Classification Chart | 4. Practical Record |
| 5. Viva | 6. Seminar report |
| 7. Discussion points | 8. Practical |
| 9. Survey report | 10. Data points |
| 11. Activity log | 12. Diagrams |
| 13. Demonstration | 14. Note Presentation |

Theory Evaluation Questions

- 1 Comparison between dusters and sprayers (3)
- 2 Explain the principal and operation of a hydraulic sprayers with a neat sketch (4)
- 3 What are the different points to be noted to repair and maintenance of sprayers and dusters (4)

Unit 3.3 Harvesting machines

Introduction

Harvesting is an important field operation for any food grain crops. The purchase of grain harvesting is to recover grains from the field and separate them from the rest of the crop material in a timely manner with minimum grain loss while maintaining highest

grain quality. Recent investigation have shown that delayed at low grain moisture led to considerable increase in field losses and deterioration in the grain quality resulting in reduction in milling outcome. Timely harvest on the other hand, can prevent such a loss.

Learning outcomes

- 3.3.1 Explains principle & objectives of harvesting
- 3.3.2 Identifies different harvesting equipments
- 3.3.3 Does explain the working of different harvesting equipments
- 3.3.4 Explains the type of combine harvester
- 3.3.5 Explains the parts & working of combine Harvester (Paddy)
- 3.3.6 Explains the parts & working of combine Harvester (Vegetables)
- 3.3.7 Explains the parts & working of combine Harvester (Fruits)

Unit in detail

3.3.1 Principle & objectives of harvesting

Harvesting the field crops constitutes one the most labour consuming operation of farming in india. Though improved primary and secondary tillage implements have been introduced a considerable extend in the country, but the mode of harvesting has not changed much. The harvesting of field crops in india is mostly done by human hands with the help of sickle. It takes about 170 to 200 man hrs to harvest one hector of paddy crop. Due to high labour demand at the time of harvesting, the entire operations continues for weeks together, resulting in over drying of crops in the field which is firm causes grain losses to the extend of 5 to 15%, in subsequent operations. Mechanical devices to harvest weet crop have become popular to some extent in the traditional wheet growing regions of india, but the application of such devices for harvesting paddy and other crops, has yet to be tried on large scale.

Operations performed

The following operations are performed during harvesting :

- i) cutting (ii) picking (iii) plucking (iv) digging and
- (v) Combination of these operations for removing the crop.

for removing the crop from under the ground or above the ground or removing the

useful part or fruits from plants.

Harvesting action can be done by four ways:

- 1) Slicing action with a sharp tool.
- 2) Tearing action with a rough serrated edge
- 3) High velocity single element impact with sharp or dull edge.
- 4) Two elements scissors type action.

Manual harvesting involves slicing and tearing action. Harvesting can be done by:

(i) Manually operated tool (ii) Animal drawn machine (iii) Mechanically operated machine.

3.3.2 Harvesting Tools and Equipment

Crops are harvested after normal maturity with the objective to take out grain, straw, tubers etc. Without much loss. It involves cutting / digging / picking, laying, gathering, curing, transport and stacking of the crop. In case of cereals like wheat and paddy the plants are straight and smooth and ears containing grains are at the top whereas most of oilseed and pulse crops have branches, which create problems' in harvesting by manual or mechanical means. As per Bureau of Indian Standards the cutting and conveying losses should not be more than 2 per cent.

3.3.3 Working of different harvesting equipments

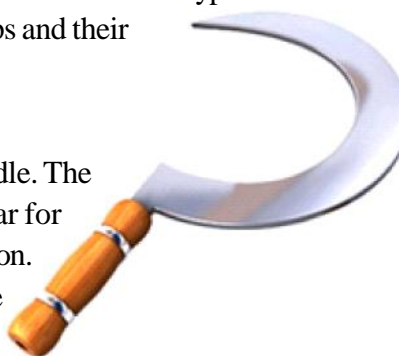
Mechanical harvesting equipment

Timeliness of harvest is of prime importance. During harvesting season, often rains and Storms occur causing considerable damage to standing crops. Rapid harvest facilitates extra days for land preparation and earlier planting of the next crop. The use of machines can help to harvest at proper stage of crop maturity and reduce drudgery and operation time. Considering these, improved harvesting tools, equipment, combines are being accepted by the farmers. Different type of mechanical harvesting tools / equipment, suitability for crops and their limitations

(a) Serrated blade sickle

It has a serrated curved blade and a wooden handle. The handle of improved sickle has a bend at the rear for better grip and to avoid hand injury during operation.

Serrated blade sickles cut the crop by principle of friction cutting like in saw blade. The crop is



held in one hand and the sickle is pulled along an arc for cutting. Cutting of crop close to the ground is possible with modified handle. Energy requirement is 80-110 man-h/ha. It can be used effectively for harvesting of wheat, rice and grasses.

(b) Reapers

Reapers are used for harvesting of crops mostly at ground level. It consists of crop-row divider, cutter bar assembly, feeding and conveying devices. Reapers are classified on the basis of conveying of crops as given below:

i. Vertical conveying reaper windrower

It consists of crop row divider, star wheel, cutter bar, and a pair of lugged canvas conveyor belts. This type of machines cut the crops and conveys vertically to one end and windrows the crops on the ground uniformly. Collection of crop for making bundles is easy and it is done manually. Self-propelled walking type, self-propelled riding type and tractor mounted 186 type reaper-windrowers are available. These types of reapers are suitable for crops like wheat and rice. The field capacities of these machines vary from 0.20 to 0.40 ha/h



ii. Horizontal conveying reapers

This type of reapers is provided with crop dividers at the end, crop gathering reel, cutter bar and horizontal conveyor belt. They cut the crop, convey the crop horizontally to one end and drop it to the ground in head-tail fashion. Collection of crop for making bundles is difficult. This type of reapers is tractor mounted and suitable for wheat, rice, soybean, and gram. Performance of reapers with narrow-pitch cutter bar is better for soybean and gram crops.

iii. Bunch conveying reapers

This type of reapers are similar to horizontal conveying reapers except that the cut crop is collected on a platform and is being released occasionally to the ground in the form of a bunch by actuating a hand lever. Here, collection of crops for making bundles is difficult. Bullock drawn and tractor-operated models are available and they are suitable for harvesting wheat, rice and soybean crops. it.

IV. Reaper binders

The cutting unit of this type of reapers may be disc type or cutter bar type. After cutting, the crop is conveyed vertically to the binding mechanism and released to the ground in the form of bundles. Self-propelled walking type models are available but these are not popular due to high cost of twine. Reaper binders are suitable for rice and wheat.



(c) Strippers



The design of a tractor front mounted stripper is available for collection of matured grass seeds from the seed crops. It consists of a reel having helical rubber bats which beat the grass over a sweeping surface where the ripened seeds get detached and the seeds are collected in the seed box.

(d) Diggers

The design of groundnut and potato diggers of animal drawn and tractor operated types are available. The digging units consists of V-shaped or straight blade and lifter rods are attached behind the share. These lifter rods are spaced to allow the clods and residual material to drop while operating the implement. The plant along with pods/tubers is collected manually.



(f) Mower

Mower is a machine to cut herbage crops and leaves them in swath

There are different types of mower used in different ways such as

- 1) Cylinder mower
- 2) Reciprocating Mower
- 3) Horizontal Rotary Mower

- 4) Hang Mower
- 5) Flail Mower

3.3.4 Combine harvester

It is a machine, design for harvesting, threshing, separating, cleaning and collecting grains while moving through the standing crops. It consists of header unit threshing system separation unit, and winnowing cleaning system and grain collection unit.

The operational functions in combine harvester are

- 1) Header or crop gathering unit
- 2) Cutting and standing crops.
- 3) Feeding the cut crops in the cylinder or drum.
- 4) Threshing the grains from the stalk or stem.
- 5) Separating the grains or seeds from the straw.
- 6) Cleaning the grains of the chaff and other foreign materials
- 7) Elevating the clean and sound grains to a tank and
- 8) Transferring grains from tank to truck.

Harvesting of crops like paddy and soybean has to be done carefully as the matured grains easily detach from the ear heads/pods and, therefore, cannot be harvested by fast working tools or machines. Bengal gram, green gram, lentil are to be harvested at ground level. Oil seed crops pose different type of problems to engineers for mechanization of their harvesting. Safflower is a spiny crop and difficult to harvest even manually. In case of sunflower, harvesting is simpler as only flower heads are to be collected. In sesamum crops, pods containing seeds are attached to the main stem and they are mostly raised by broadcasting. This also needs gentle handling. Farmers follow different methods for harvesting of rapeseed/mustard and pigeon pea. Mostly, farmers harvest the sec crops at branch level, but small farmers harvest these crops at ground level. Harvesting of root crops involves digging, shaking to remove adhering soil, windrowing or stacking and picking. A good root crop harvester should give maximum recovery and cause minimum damage to pods or tubers.



Various designs of combine harvester having 2 to 6 m long cutter bar are commercially Available. Therefore, no research effort has been initiated under the Project up till now.

However, the need of a small whole crop combine harvester is felt. The function of a combine harvester is to cut, thresh, winnow and clean grain/seed. It consists of header unit, threshing unit, separation unit, cleaning unit and grain collection unit. The function of the header is to cut and gather the crop and deliver it to the threshing cylinder. The reel pushes the straw back on to the platform while the cutter bar cuts it. The crops are threshed between cylinder and concave due to impact and rubbing action. The threshed material is shaken and tossed back by the straw rack so that the grain moves and falls through the openings in the rack onto the cleaning shoe while the straw is discharged at the rear. The cleaning mechanism consists of two sieves and a fan. The grain is conveyed with a conveyor and collected in a grain tank.

3.3.5 The parts & working of combine Harvester (Vegetables)



Harvesting of crops like paddy and soybean has to be done carefully as the matured grains easily detach from the ear heads/pods and, therefore, cannot be harvested by fast working tools or machines. Bengal gram,

green gram, lentil are to be harvested at ground level. Oilseed crops pose different type of problems to engineers for mechanization of their harvesting. Safflower is a spiny crop and difficult to harvest even manually. In case of sunflower, harvesting is simpler as only flower heads are to be collected. In sesames crops, pods containing seeds are attached to the main stem and they are mostly raised by broadcasting. This also needs gentle handling. Farmers follow different methods for harvesting of rapeseed/mustard and pigeon pea. Mostly, farmers harvest the sec crops at branch level, but small farmers harvest these crops at ground level. Harvesting of root crops involves digging, shaking to remove adhering soil, windrowing or stacking and picking. A good root crop harvester should give maximum recovery and cause minimum damage to pods or tubers. The harvesting methods followed by farmers for major crops are as follows:

Cereal crops Wheat and Rice: Harvesting of these crop is traditionally done by using local sickle. Improved serrated blade sickles are also in use. The following machines are available for efficient harvesting of these crops.

- i. Self propelled walking type reaper
- ii. Reaper binders
- iii. Tractor front and rear mounted reapers
- iv. Combine harvesters

Sorghum: Harvesting by local sickle is the traditional practice followed by farmers. Suitable

Machines are not available for harvesting this crop. However, combine harvesters are in use in advanced countries.

Maize: The traditional practice is to collect the matured cobs manually. Grain combines

equipped with co-head snapping unit are being used in developed countries.

Pulse crops

Bengal gram: Harvesting by local sickle is the traditional practice. Improved serrated blade sickles are also in use. The performance of narrow pitch cutter bar with horizontal conveyor is better than other types of available reapers. Combines with floating cutter-bar are in use in advanced countries.

Pigeon pea: This crop is traditionally harvested at ground level by using a chopper or local sickle. No suitable machine for harvesting this crop is available in the country. Crop stems are being used by farmers for domestic use.

Urad, Moog and Cowpea: These crops are traditionally harvested by using local sickle.

Improved serrated blades sickles are also in use.

Oilseed crops

Groundnut: Digging of crop with country plough and blade hoe at proper soil moisture level and manual pulling and gathering of pods using hand hoe is common practice. Animal drawn and tractor operated diggers and digger windrowers are improved implements developed for groundnut harvesting. The blade harrow is widely used for digging of groundnut crop in Gujarat. TNAU, CIAE and CTAE, designs are some of the improved animal drawn groundnut diggers.

Tractor operated groundnut diggers have wide blade, which cover 1.25 to 2 metre width and operate at 10 to 15 cm depth. PAU, APAU and GAU diggers are some of the designs developed.

Rapeseed and Mustard: The traditional practice is to harvest manually using sickles. In tall varieties, farmers cut the plants aboveground level and leave long stubbles in field, which are subsequently ploughed in. In some areas, where plants are used as fuel or thatch material, harvesting with serrated blade sickles close to ground level, is practised by farmers.

Mechanical harvesting of crop is carried out by following type of machines:

- i. Self propelled walk behind type vertical conveyor reaper,
- ii. Tractor front or rear mounted pto operated reaper, and
- iii. Combine harvester

Combine harvesters need slight modification to make them suitable for harvesting rape seed crop because of tall and branchy nature of the crop. The changes required are (a) attachment of vertical cutter bar at outer ends to get a clean cut windrow and (b) increase of header table length to accommodate the bulky crop. Combine harvester can handle the crop easily after

Above changes are made.

Soybean: Harvesting by local sickle is the traditional practice followed by farmers. However, modified serrated blade sickles are recommended as plant stem is 8 to 12 mm thick.

The following machines have been evaluated and found suitable for soybean harvesting:

- i. Self propelled vertical conveyor reaper windrower
- ii. Tractor rear mounted reaper
- iii. Combine harvester

When the available harvesters are to be used for soybean, these are required to be modified and adjusted to reduce field losses and suit crop and soil conditions. Cutting of crop close to ground with low stubble height and crowding and stripping effect are the main requirements. Combine harvesters with floating cutter bars are recommended for low harvesting losses. Narrow pitch cutter bar has been reported to give lower harvesting losses as compared to conventional cutter bar.

3.3.7 The parts and working of combine Harvester (Fruits)



Sunflower and Castor: The traditional practice is to manually harvest the flower heads of sunflower and castor plants. These are stacked and sun dried for threshing.

Suitable machines are not available for harvesting of sunflower and castor crops.

Harvesting of whole plant would require separation of flower heads for threshing and thus the time saved by harvesting the whole plants would not reduce the labour requirement.

The combine harvesters are used for harvesting of above crops using specially designed header. These are in use in advanced countries.

Safflower: The traditional practice is to, manually harvest the crop using sickles. Because of thorny and spiny nature of crop, harvesting and handling of safflower plants is a problem.

Use of hand gloves and covers on legs and arms recommended during harvesting.

Hayforks are used for gathering and stacking the plants in field or on trailers.

For mechanical harvesting of safflower following machines are recommended:

- i. Self propelled (1 metre wide) vertical conveyer reaper,
- ii. Combine harvester

Assessment activities

1. Discussion points
2. Activity log
3. Note Presentation,
4. Seminar report
5. Record
6. Practical
7. Viva
8. Assignment
9. class test

Theory Evaluation Questions

- 1) Write a short note about combine harvester and explain its parts (5)
- 2) What are the different types of mower used in different ways (2)
- 3) Classify the different type of combine harvester based on the method of threshing and cleaning (5)
- 4) What is the different types loss in combining (4)

UNIT 3.4 POST HARVESTING OPERATIONS

Introduction

The process of detaching grains from the earheads of from the plants is known as threshing. Primarily, farmers used to thresh by rubbing heads between two hands. After words they started beating with sickle which is still used for paddy threshing. Conventionally harvested paddy and wheat crops are either dried in the field or a cemented floor for 3 to 5 days to bring down the moisture content from 27 to 40% to 15 to 20%. When threshing operations are carried out. Threshing of immature or moist grain would not only in more breakage, but would also require higher impact force for grain detachment and cleaning and grain separation from leftovers would become difficult requiring more power.

Learning outcomes

- 3.4.1 Explains the different threshing method
- 3.4.2 Operates different threshers
- 3.4.3 Explains the parts of threshers
- 3.4.4 Operates a winnower and identifies its parts
- 3.4.5 Explains different drying techniques
- 3.4.6 Understands threshing principle and different threshing method

During operation, the crop material is slightly pushed into the threshing cylinder through the feeding chute, which gets into the working slit created between the circumference of the revolving drum having attached spikes and the upper casing. The speed of the spikes is greater than the plant mass due to which they strike the latter which results in part of the grain being separated from straw. Simultaneously,

the drum pulls the mass through the gap between the spikes and the upper casing with a varying speed. The angle iron ribs on the other hand, restrain the speed of the travelling of stalks clamped by the spikes. Due to this the spikes move in the working slit with a varying speed in relation to the shifting mass of material, which is simultaneously shifted, with a varying speed with respect to the upper casing. As a result, the material layer is struck several times by the spikes against the ribs, causing threshing of the major amount of grains and breaking stalks into pieces, and also

Accelerating them into the inlet of the lower concave.

As the material layer shifts towards the progressively converging slit of lower concave, its size reduces. The vibration amplitudes, Therefore, decrease where as the speed of the layer increases. This causes mutual rubbing of the ear stalks, as well as rubbing of the ears against the edges of the concave bars and causes breaking of stalks depending on the concave clearance. Since the system is closed the thicker stalk, which cannot be sieved through the concave, again joins the fresh stalk and the same process is repeated until the stalk size is reduced to the extent that it can pass through the concave apertures. Thus fine bruised straw is produced.

The effective threshing process means that the loss of unthreshed kernels ejected with the straw through the concave and the loss of grain damage should be low and the amount of the material passed through the concave should be high.

The following functions are performed by a modern power thresher .

- 1) It automatically feeds the crops to the threshing cylinder.
- 2) It threshes the grain from head, cob and pods in between cylinder and cocane
- 3) It separates the grains or seeds from the straw
- 4) It also separates foreign material from the grain.
- 5) It puts the grain in bag.
- 6) It makes bhusa (chaff) for cattle feed

To perform all these functions simultaneously and in sequence, a prime mover (motor, engine, tractor, power tiller) is essential, depending on the crop parameters, type and size of threshing cylinder and feed rate,

3.4.2 Different types of Threshers

There are following types of thresher:

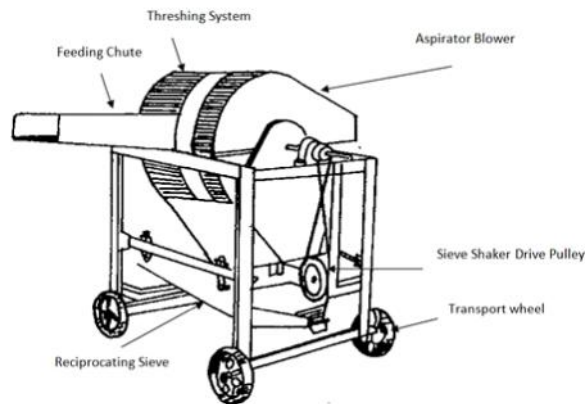
- 1) Beater type thresher

- 2) Corrugated fly-wheel with chopping knife type of thresher
- 3) Spike-tooth cylinder type of thresher
- 4) Syndicator type
- 5) Hammer mill type
- 6) Rasp bar type
- 7) Axial flow type.

Mechanical threshers

Mechanical thresher consists of the following parts:

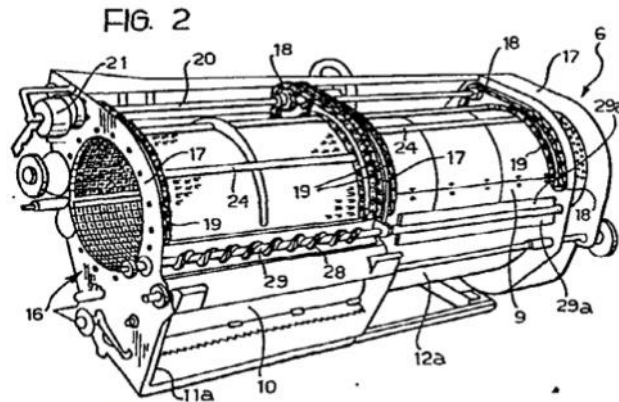
- i. Feeding device (chute/tray/trough/hopper/conveyor)
- ii. Threshing cylinder (hammers/spikes/rasp-bars/wire-loops/syndicator)
- iii. Concave (woven-wire mesh/punched sheet/welded square bars)
- iv. Blower/aspirator
- v. Sieve-shaker/straw-walker.



Axial thresher:

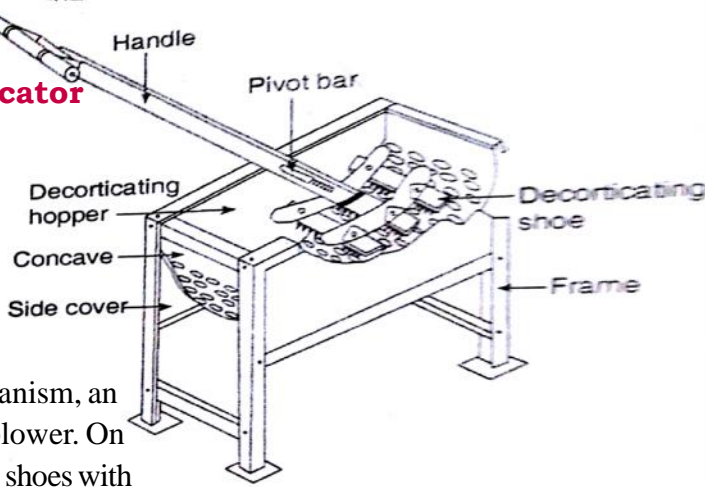
Axial flow thresher consists of the threshing cylinder, concave cylinder casing, cleaning system and feeding chute. It is used for threshing paddy and it works on the principle of axial flows, the crop is fed from one end and the straw is taken out from the other end after completing threshing of crop that is the flow of crop is along the direction of axis of the cylinder. The following are the characteristics of this machine:

- 1) Machine works on the principle on axial flow concept and is suitable for threshing paddy
- 2) Machine is operated by 25-hp tractor and can thresh about 13.0qh-1 of clean grain
- 3) It saves of labour and cost of operation
- 4) It also increases 2-3% in grain recovery through reduced losses as compared to conventional method of manual threshing by beating

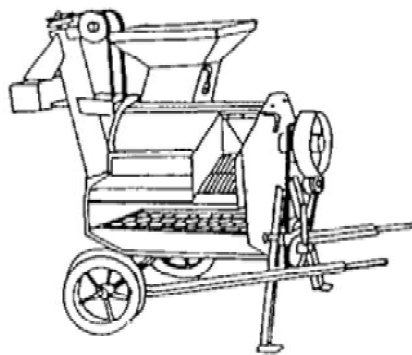


Groundnut decorticator

It used for taking ground nut kernels from pods. It can be operated by a tractor PTO an electric motor or a diesel engine. It consists of a hopper, double crank lever mechanism, an oscillating sector and a blower. On oscillating sector cast iron shoes with projecting pegs are fitted. Pods fed through hopper are shelled between oscillating sector and fixed perforated concave. Mixture pf kernels and shells is subjected to air blast from blower. Kernels are collected through o spout at bottim shells are blown-off clearance between concave and oscillating sector can be adjusted to suit pods of varying sizes and varieties.



Maize sheller:



It consists of a threshing cylinder, concave and centrifugal blower mounted on a frame. Crop feeding is manual. Threshing cylinder is of spike tooth type. Round bars are used as spikes, which are fitted on circular rings. The head comes out through the opening at the far end of the threshing drum. A blower is used for cleaning the grains. It is used for shelling of maize cobs and the chaff is removed by winnowing.

3.4.3 Different parts threshers

The main components of power thresher are as follows;

1) Concave:

As the name implies, it is concave shaped metal grating partly surrounding the cylinder and acts as threshing unit

2) Cylinder or drum:

It is a balanced rotating assembly, which consists of rasp, beater bar or spikes on its periphery and their support for threshing the crop and different type of cylinders.

3) Cleaning unit:

The function of the cleaning unit is to separate and clean the threshed grain. It consists of two or more oscillating sieves, a fan and an air sucking duct known as aspirator. Usually two ducts are used namely primary and secondary duct.

Components of cleaning unit

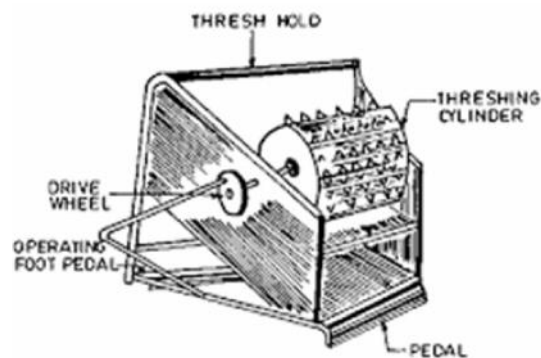
The following are the main components of the cleaning unit

- 1) Aspirator
- 2) Blower
- 3) Winnower
- 4) Winnowing fan

The various types of threshers are

i. Drummy type

It consists of beaters mounted on a shaft which rotates inside a closed casing and concave.

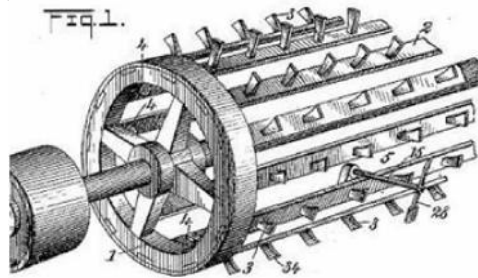


ii. Hammer mill type

It is similar to dummy type but it is provided with aspirator type blower and sieve shaker assembly for cleaning grains.

iii. Spike-tooth type

Spikes are mounted on the periphery of a cylinder that rotates inside a closed casing and concave. It is provided with cleanings leves and aspirator type blower.



iv. Raspbar type:



Corrugated bars are mounted axially on the periphery of the cylinder. It is fitted with an upper casing and an open type concave at the bottom of the cylinder. The cleaning system is provided with blower fan and straw walker.

v. Wire-loop type

Wire-loops are fitted on the periphery of a closed type cylinder and woven wire mesh type concave is provided at the bottom.



vi. Axial flow type

It consists of spike tooth cylinder, woven-wire mesh concave and upper casing provided

3.4.4 Winnower and its parts

Winnowing is the process of separating grain from a mixture of grain and chaff in a air stream created artificially or naturally. Expiration is achieved by allowing the air stream to pass through the mixture falling vertically down. The grain being the heavier material gets deposited almost at the place of dropping, where as the lighter material is blown away to a greater distance. Before the winnowing is started, the threshing floor is thoroughly cleaned and sometimes plastered with cow dung so that soil may not get mixed with the grain. Winnowing of the crops like paddy in which chaff is a very small fraction is accomplished in one operation only but the second winnowing becomes necessary for crops like wheat, barley etc. When the natural wind velocity is not adequate, artificial means are used to create a sufficiently strong air blast. Winnowing fan either manually operated or mechanically operated.

The distance where the threshed material is poured on the front side of the fan has the most important effect in winnowing. Some of the experiments performed with a pedal operated winnowing fan at about 350 rpm, indicate that the maximum air velocity is found in a zone of 1.2 to 1.8 m distance from the fan, along its centre line

Winnowing fans

Winnowing fans are various types of hand operated and pedal operated being manufactured by many firms in India. The number of the blades on their impellers is either 3 or 4. The diameter of the impeller varies about .90 to 1.25 m. Mostly the blades are made of mild steel sheet and their frames are made of either wood or welded steel or a combination of the two in order to increase the speed of rotation various driving mechanisms are employed, namely chain and sprocket, V belt pulleys and single or double reduction gear.

3.4.5 Drying techniques

Grain drying is the process for conditioning the grains for safe storage. Grain is a living organism and during the drying process its life must be fully safe guarded. Correct drying method preserves the quality, nutritive value and viability of grain. The principle parameters which govern the conditions of drying are

- 1) The maximum temperature to which the grain is heated during drying
- 2) The duration for which the grain is maintained in the heated state
- 3) Temperature of the drying agent supplied to the drier
- 4) Velocity of the drying agent
- 5) Relative humidity of air

The principle requirement of the drying process is that dried grain must fully conserve its seed or food grain quality. The quality of seed grain is determined by germination capacity and the energy required for it. Food grains are valued according to the quality of their gluten content.

Methods of Drying Grains

Drying grains can be done in 4 different ways. These are sun drying, mechanical drying, infrared or dielectric drying and chemical drying

Sun-drying

This is the traditional practice of the natural drying of harvested grains with the following features

- 1) Uncontrolled, non uniform drying resulting in sun checks or cracks in kernels. When the dried grains are milled ,they yield large quantities of brackens due to these cracks
- 2) The process is dependent on the suns energy which is normally not available during the monsoon season
- 3) Sun drying requires large numbers of unskilled labors
- 4) Considerable amount of paddy is lost to birds,rats, during sun drying
- 5) Sun drying requires no fuel nor mechanical energy, hence the cost of drying per unit of paddy is relatively low compared to mechanical drying
- 6) Sun drying requires large areas hence not suitable for rice mills located in cities where there is scarcity of space

Sun drying of raw paddy is done either before the stacks are cut or drying the grains after harvest and threshing.

Mechanical drying

This process utilize mechanical means for paddy by ventilating natural or heated air through the grains mass to accomplish the removal of excess moisture from it Its features are

- 1) The rate of drying grain can be controlled by adjusting the temperature of hot air ventilating through the grain mass. The process therefore marked possible the reduction of temperature and moisture stresses developed during the drying process which are responsible for the cracks in the kernels
- 2) Grains can be dried irrespective of weather conditions day or night as the process does not depend on any natural sources like sun energy
- 3) The process is automatic and requires unskilled labor, except a trained person to operate the dryer
- 4) There are practically no losses to insects ,birds and rodents in this process
- 5) The process requires fuel and electrical or mechanical power to drive the air blower, elevators, etc. Therefore the cost of drying per unit of paddy is relatively higher compared to sun drying
- 6) Mechanical drying requires very little space for operation hence suitable for modern rice complexes
- 7) Mechanical drying in conjunction with early harvest improves the milling quality of paddy considerably.

Grain drying-principle

Grain drying is based on two principles

A) Thin layer drying

Thin layer drying refers to the drying of grains which are entirely exposed to the air, moving through the grains

Special features of thin layer drying

- 1) Grain depth is not more than 20 cm
- 2) At a given relative humidity, the drying rate is proportional to the difference between grain moisture content (MC) and equilibrium moisture content (Dry basis)
- 3) Rate of drying is proportional to the difference between vapor pressure of grain and vapor pressure of drying air
- 4) At given moisture content the drying rate is proportional to the difference between the dry bulb temperature of air in equilibrium with the grain

The drier which uses the principles of thin layer drying is known as continuous flow drier. Continuous flow drier is of two types

- 1) Non mixing columnar drier
- 2) Mixing drier

B) Deep bed drying process

Deep bed drying process includes bin or batch type driers. When the drying air has to pass through a layer of more than 20 cm thickness of grain, it is called deep bed drying process. In this process grain does not move. Grain is contained in a bin. The natural or heated air is forced through the bottom of the bin upward through the wet grain. The temperature humidity saturated vapor pressure and specific volume of drying air change as the air passes through the grain. Consequently the drying potential of air decreases as it moves upwards. Deep bed drying method may be thought as a process of drying grain in several thin layers, in which the temperature and humidity of air, entering and leaving each layer vary with time depending upon the stage of drying. This type of drying system consists of the following

- a) Structure for holding grain
- b) Suitable fan or blower for supplying air
- c) Air distribution system
- d) Heating unit

Circular bins made of plain or corrugated steel sheets are commonly used in this system. The main consideration is to provide a tight structure, which prevents leakage of air and moisture through floors and walls

Two types of air distribution system may be used for this drier

- a) Perforated or bottom open ducts placed on a solid floor
- b) Perforated false floor with air introduced below it

ASSESSMENT ACTIVITIES

Chart,

Unit test,

Quiz

Discussion points

Activity log

Seminar report

Viva

Theory Evaluation Questions

- 1 Explain the different types of threshing methods (5)
- 2 What are the different drying methods and explain any two methods? (5)
- 3 What is winnowing? (3)
- 4 What is meant by whitening of paddy? Name the machines used in the whitening process. (3)

UNIT 3.5 FOOD PROCESSING

Introduction

Storage of food products for a long term use is very important in the post harvesting operations. Parboiling, polishing, milling are the important operations that we want to done after winnowing operations. Fruits and vegetables are processed for long term usage. Different methods are using for storing food items, there are cold storage systems, controlled atmospheric storage

Learning outcomes of food processing

- 3.5.1 Explains rice processing techniques
- 3.5.2 Explains fruit and vegetable processing
- 3.5.3 Recognizes the importance of packing and storage methods
- 3.5.4 Understands the different dry storage method

3.5.1 PADDY- Technology of parboiling paddy

Many pre milling techniques have been devised to increase the milling, nutritional, cooking and eating qualities of rice. The latest and most widely used for these treatments is parboiling. The parboiling technology has been evolved from simple methods to complex industrial ones, and several methods and their advantages and disadvantages are described. There are different methods for parboiling

- 1) Atapa
- 2) Balam
- 3) Josh
- 4) Sela
- 5) Siddha

Parboiling basic concepts and principle

The structure of paddy grain shows that the endosperm which covers the major volume of rice grain, is mainly composed of polygonal starch granules. The voids or intergranular spaces are filled with air and moisture. The presence of voids and fissures and cracks developed during maturity, causes breakage of rice during milling. Such a breakage may be eliminated by gelatinizing the starch which will fill the voids and cement the fissures and cracks

Swelling of starch granules may be achieved by soaking paddy in cold or hot water. During hot soaking energy supplied in the form of heat weakens the granule structure by disturbing hydrogen bonds, giving more surface for water absorption by starch granules. This permits further hydration and irreversible granule swelling initiated by more active dissociated water molecules. This phenomenon is called gelatinization the temperature at which gelatinization takes place is known as gelatinization temperature

Advantages of Parboiling

Parboiling provides a unique tool for improving not only the milling quality of paddy but also the other qualities. In general parboiling process has the following advantages

- 1) Due to the splitting of the husk in the process of parboiling ,the shelling of parboiled paddy becomes easier
- 2) The extra strength acquired by the rice kernel during parboiling helps in reducing the broken to a considerable extent
- 3) It has been claimed that parboiled rice retains more proteins, vitamins and minerals than raw milled rice of the same quality
- 4) Due to its acquired hardness, parboiled rice is more resistant to insect infestation during storage as compared to raw rice
- 5) During cooking the loss of solids in gruel is less in parboiled rice when compared to raw rice
- 6) It can withstand overcooking without becoming pasty
- 7) Rice bran from parboiled rice is of superior quality. It contains about 25-30 percent oil whereas raw rice bran contains about 15-20% oil.

Disadvantages of Parboiling

- 1) The heat treatment during parboiling causes destruction of some natural antioxidants, the parboiled rice therefore develops more rancidity than raw rice during storage
- 2) Parboiled rice takes more time to cook to the same degree of softness than raw rice
- 3) The presence of high moisture in parboiled rice for a long time may cause the development of micro toxins in rice which are hazardous to the human health
- 4) Parboiled paddy has to be dried again from 40-45% moisture to 14-16% for proper milling and storing, thus adding an extra drying cost to the total processing

- 5) The shelled parboiled rice is harder , therefore more difficult to polish resulting in lower mill throughput capacity and increases milling power
- 6) Parboiling process needs an extra investment of capitals

Principles of par boiling

Theoretically soaking of paddy can be done at, or below its gelatinization temperature .The lower the temperature used, the slower is the process of soaking and vice versa. But it should not be more than 75 degree Celsius, otherwise paddy will get cooked. Soaking time can be reduced by subjecting the paddy to vacuum for a few minutes before soaking by soaking under pressure in hot water

Heat for gelatinization of starch is supplied by saturated steam. The higher the temperature of steam and the longer the steaming time, the harder will be the rice and the darker its color. Keeping steamed paddy in a heap is equivalent to prolonged steaming, which induces the same effect.

Parboiled paddy may be dried under shade or in sun, or with hot air. Shade drying gives an excellent milling quality but rapid drying in the sun or with hot air gives high breakage during milling. In a continuous drying the breakage starts as the moisture content reaches around 18% and increases rapidly with further drying. Therefore the most convenient practice would be to dry in 2 passes with a tempering at the moisture content of about 20%

Methods of Parboiling

Parboiling of paddy may be classified under two main headings

A) Traditional Methods

- i) Single boiling
 - ii) Double boiling
- B) Modern methods
- i) Central Food Technological Research Institute(CFTRI)Method
 - ii) Jadavpur University method
 - iii) Converted process
 - iv) Malek process
 - v) Avorio process
 - vi) Cristallo process

vii) Fernando process

The other Indian methods which have shown considerable success at pilot basis are as follows

- i) Kisan continuous method
- ii) Pressure parboiling method
- iii) RPEC method(Hot soaking)
- iv) Sodium Chromate method(Cold soaking)

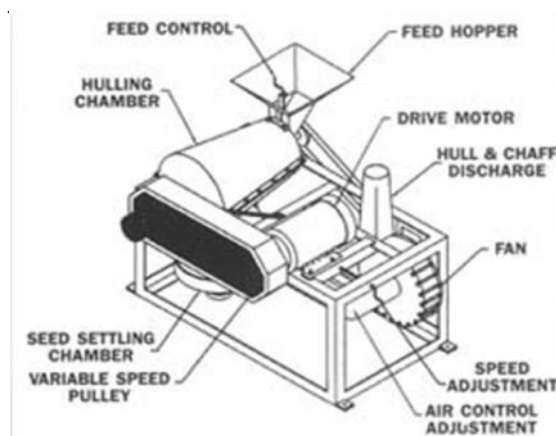
Deshelling operation of Paddy

The shell covering the rice grain kernel is known as husk and the process by which this is removed without to be objected damage in the rice kernel is what is termed as deshelling operation and the machines employed to carry out this are named either as huskers or as shellers. At present three types of such machines are used in India for the purpose and they are

- i) Under runner disc shellers
- ii) Rubber roller shellers
- iii) Hullers

Hullers

Almost all the huller rice mills are having one or more hullers with winnower grader. The huller consists of a solid fluted cylinder rotating at 700 to 800 rpm within a hollow stationary cylinder in the lower half of which is the perforated iron sieve with slots of 1.5- 7.5 mm. The flute on the cylinder is so arranged as to carry the paddy to the centre from the feeding end, get it milled by scoring action at the centre of the cylinder and then to carry it to the other end where the milled rice is discharged.



The hullers are used first for shelling by keeping a wide clearance between the cylinder and the blade. Each huller is driven by a 20 to 25 hp motor using belt drive.

The winnower has got a blower which is driven normally by a 50 hp motor. The husk is blown off and the result mixture of rice and broken is graded by a reciprocating motion of the grader attached with the winnower. The eccentric shaft attached with blower shakes the grader. The grader is fitted with two or three sets of sieves for grading the rice into various fractions

Advantages of Hullers

- i) Investment required for unit capacity is extremely low
- ii) It is manufactured in India without any foreign collaboration
- iii) It needs very small space to be installed
- iv) It is very simple in design
- v) It can be used as whitener or polisher also

Disadvantages of Hullers

- i) It gives low head yield, and large brokens and low total yield of rice from paddy
- ii) During the first shelling operation, the outer layers of the rice kernel and along with it 20 to 30% of the total oil are also removed and thrown away along with husk
- iii) Germs, bran and husks get mixed together
- iv) Separation of paddy from rice cannot be achieved in the machine
- v) Power consumption per ton of paddy is quite high

Whitening or polishing

A paddy grain after being properly deshelled, remains coated with a thin layer of bran, the germ being loosely adhered to the rice kernel. This bran layer displays a dull appearance to rice grains, minimum fraction of which is to be removed to bring about the acceptable appearance to the consumers and at the same time to make the grain suitable for human consumption, since bran content of rice, as it is a bit too much to be easily digested by human beings. The process by which this removal of bran is accomplished is known as whitening of rice and the machine doing this operation a rice whitener

There are three types of rice whiteners

- i) Grinding type
- ii) Friction type
- iii) Combination of friction and grinding type

Grinding type can be grouped into two categories

- a) Vertical cone rice whitening machine
- b) Horizontal rice whitening machine, Huller is included under the friction type units

Rice milling

Rice milling is the removal of hulls and bran from paddy grains to produce polished rice.

Mini Modern Rice Mills

In recent years improved rice mills of small capacity have been developed in the country. These mini rice mills have the components of the modern rice mills like rubber rolls, rubber lined centrifugal sheller, husk aspirator, paddy separator and improved polishers. These mini modern rice mills are capable of milling the paddy more efficiently yielding increased out turn of rice and by products of better quality. Considering the potentiality of these rice mills in replacing the hullers the government have set up a committee to undertake the evaluation of the mini modern rice mills.

3.5.3 Refrigeration

The process of lowering the temperature of a substance below that of its surroundings atmosphere is called Refrigeration. The heat extracted from the material by the refrigerant is delivered to the atmosphere by air or water .there are various systems of refrigeration but the most common type used for diary industry is compression refrigeration system. The system is simple, dependable and easily controllable. The system consists of following process

- 1) Evaporation
- 2) Compression
- 3) Condensation
- 4) Pressure reduction

For achieving these requirements, the system has got

- a) Evaporator
- b) Expansion valve
- c) Compressor
- d) Condenser

Evaporator is connected with a throttling device called expansion valve. The liquid refrigerant comes to the evaporator through expansion valve. The evaporator is located within the space where the product is to be cooled. Heat is transferred from the space where the product is to be cooled. Heat is transferred from the refrigerated substance to the refrigerant. Thus refrigerant is converted in to low pressure vapor. This vapor comes to a compressor which is suitably placed in the line

The compressor has got a piston and cylinder. The low pressure vapor is compressed by the compressor. This raises the pressure and the temperature of the vapor. This high pressure vapor comes to the condenser unit through discharge pipe

The condenser is situated between the compressor unit and the expansion valve. Condenser is used for condensing the high pressure vapor in to high pressure liquid. This is done with the help of cooling water. The condenser receives the refrigerant at high pressure and temperature in vapour state. As the refrigerant flows in the condenser tubes, water is sprayed on the tubes. The refrigerant cools down to the liquid state. It is collected in a liquid receiver from where it goes to the expansion valve

When the high pressure liquid refrigerant reaches the expansion valve, it gets expansion space. Due to this space, the pressure is reduced and refrigerant becomes low pressure liquid. After that the refrigerant enters in to evaporator. The temperature of the space to which the evaporator is exposed, being higher than the boiling point of liquid refrigerant causes the liquid to boil. This refrigerant then goes to compressor in low pressure vapour state and the cycle is repeated again.

3.5.4 Dry storage method

A variety of storage structures are required on the farm to store animal fodder and feeds, fertilizer, seeds, vegetables, milk and milk products, farm machinery etc. all these products need different kind of storage conditions, and as a result they have to be stored in special type of storage structure

Farm silos

It is farm structure used to store and protect the animal fodder so that it is preserved in an ideal condition for the farm animals. Animal fodder is cut and packed in the air tight silo to allow a partial fermentation to occur. The stored fodder is known as silage. The best silage is made of maize and jowar. But almost any green crop with a moderately thick stalk can be used for silage. All kind of grasses, sugarcane, legumes and any other fodder crop can be ensilaged.

Silos may be classified in many different ways, the common classification divides them in to two types.

1. Tower silos, Having a cylindrical shape made of masonry, wood or metal
2. Horizontal Silos: pit, bunker, trench or stack type

a) Permanent tower silos:

Built of brick, concrete, metal or tile are durable and wind resistant but loading of these types of silos is difficult. Either a mechanical loader or a large capacity blower is essential for elevating the cut fodder to the tower silos. The wall should be smooth, circular and perfect in plumb to provide structural strength and to permit free settling and packing of silage without air pockets. The wall must also be strong enough to avoid cracking due to lateral pressure. To avoid such failures, heavy reinforcement has to be carried out. Unless the water table is very close to the ground level

b) Horizontal silos:

Horizontal silos both surface and below ground types, are used on most dairy farms as temporary and permanent storage structures for silage. They are classified as pit, trench and surface silos.

c) Pit silos

A permanent pit silo is circular deep well which is lined all along the side, and sealed from the bottom so that water may not rise into it. Pit silos are made in areas where the silo is deep and the water table is very low. They can be made of bricks, stones or concrete and either cement or lime can be used as a binding material. It is desirable to have a simple roof over the silo to protect the silage from sun and rain.

d) Trench silos

An unlined Trench silo can be easily made without involving any investment on building materials brick, cement and sand. Once made repairs and maintenance charges are limited to smoothing the side walls and cleaning drains. It can be built as a temporary silo and lined for permanent use later. Unlined silos more spoilage of silage and are the likely to have caved side walls due to excessive rain. They also tend to become muddy at the bottom. The lined trench silos are becoming popular. The walls of the trench silos can be lined brick, concrete plaster with reinforcing wire mesh.

The filling, packing and sealing of the silage must be carefully done like any other horizontal silo. If possible the silo should be roofed. The drainage water should not be allowed to enter or collect near the trench. Drains should be made around the trench to intercept surface water. To facilitate drainage it is desirable to locate the trench silo on sloping ground.

Size and capacity

The cross-section of the trench silo depends up on the size of the herd and the length is determined by the number of days the silage is fed in a year.

Size and capacity of silo

The correct diameter of the silo depends on the quantity of silage to be fed daily. To prevent spoilage, silage should be removed at the rate of 10cm a day. It is economical to build only one silo for a herd, but for large herds, more than one silo should be built. Sometimes different crops can be stored in different silos. The diameter of a silo is usually limited to 6 meter and its depth is kept 2 to 3 times that of the diameter.

Bins

A bin is used for holding dry matter such as concrete or grain. Bins may be round or square, round bins tend to empty more easily due to a lack of corners for the stored material to become wedged and encrusted.

Cylindrical grain bin

Cylindrical bulk storage structures are bring commonly used for storing different varieties of grain. Depending upon the size the capacity may vary from 10 to 40 tones. This structure may be used for storing 10 tons of grain at a time. The foundation is made of rain forced concrete. The minimum height of the bottom edge of spout should be about 1.2 m above the ground level. The entire structure rests on supporting the columns. There are two opening provided in the structure for filling in the grain and taking it out. Top hole is made large enough to let a man enter for cleaning purposes. The size of the out let is comparatively smaller. It is placed at a point were the slope from all sides of the floor converges. It should have a hinged cap shutter with a locking device. The roof on the top is provided with enough space on all the sides and it overhangs to the extent of about 30cm.

Rectangular grain bin

On the farm where several grain crops are raised different grain bins are made under the same shed to store all verities of grain separately. The size of the bin is determine on the basis of expected average yield of the crop from the total area under the particular crop. The bin walls are made 11.5 cm thick laid in cement mortar of 1:3



ratio. The bin walls are kept 2.4m high near the outer wall dropping down to 1.6m in front. The front wall is provided with a rectangular hole on the floor level for taking out the grain. The hole can be closed or partially open from the inside of the bin by a wooden board. The height of the bin wall is low so that the work man may drop the head load of the grain directly in to the bins.

Godowns

In order to provide a scientific storage system to the farmers, godowns were constructed

DETAILING OF PRACTICALS

Testing and preparing the leaks in vapour compression system

- 1) Attach a shut off valve in the charging line and connect the manifolds.
- 2) Connect the middle port of the manifold to the service cylinder containing refrigerant and open the service cylinder
- 3) Open the low side of the manifold and shut off valve and charge gas into the system until the gauge reads 50-60 psig
- 4) After close the valve of the manifold and shut off valve the service cylinder .
- 5) Apply some soap solution to the joints
- 6) Formation of large bubbles in the indication of the leak
- 7) Halide torch may be used for testing leaks of R-134a and R-22.
- 8) The flame colour changes when the search hose comes in contact with leaking joints
- 9) Electronic leak detector may be used for light leak off R-134a and R-22
- 10) The ringing bell sound from electronic leak detector indicates the leak of Freon
- 11) If the leak is detected ,purge out the gas .Repair the leak .Charge the gas,and test the leak again

ASSESSMENT ACTIVITIES

1. Chart,
2. Unit test,
3. Quiz
4. Discussion points

5. Activity log
6. Seminar report
7. Viva,

Theory Evaluation Questions

- 1) With a neat sketch explain refrigeration system (5)
- 2) Explain different types of storage structures (5)
- 3) With a neat sketch explain the working of burr mill (5)
- 4) Explain the importance of rice processing (4)
- 5) Write short notes on
 - a) Huller
 - b) milling
 - c) Polishing
 - d) silos
 (6)

LIST OF PRACTICAL ACTIVITIES

Module 3

Farm Mechanisation & Post Harvest Engineering

Unit 1 Agricultural Implements

1. Field visit to farms of Agriculture department or nearby farms to learn about different tillage operations.
2. Identify and distinguish between primary and secondary tillage through power point presentation.
3. Collect pictures or models of different primary tillage implements and identifying the parts
4. Identifying different secondary tillage implements through field visits, collection of leaflets or catalogues of manufactures
5. Distinguishing between different seeding methods (Field visit, PPP).
6. Make a tiny model of seed dibbler and learn to adjust rate of seed flow.
7. Field visit to learn about mat nursery preparation for mechanical transplanting.
8. Field visit to local farms to learn through doing the operation of paddy transplantation.
9. Make a tiny model of seed drill

10. To learn about electronic seeders through PPP
11. Operate brush cutter
12. Operate Conoweeder.
13. Know the working of power weeders

Unit 2 Plant Protection Machinery

1. Identify the components of Rocker sprayer by dismantling & assembling it
2. Dismantling & assembling the parts of hand compression sprayer
3. Learn from videos latest precision sprayers
4. Do repairing and maintenance of sprayers
5. Learn the spraying techniques by separating the nozzle, spray lance etc...
6. Learn the parts of dusters
7. Watch the working of fogger & Fumigator through PPP and identify the parts

Unit 3 Harvesting Machines

1. To learn the principle of cutting, through field visit and distinguish between shear force and impact force
2. To operate lawn movers
3. Field visit to learn operation of combine harvester

Unit 4 Post Harvesting Operations

1. To identify the parts of threshers
2. To distinguish between different types of threshing drums
3. To learn the principles of Winnowing
4. Field visit to learn about mechanical dryers

Unit 5 Food Processing

1. Visit modern rice mill to learn rice processing techniques
2. Visit to vegetables & Fruit processing units
3. Visit to work shop of refrigerators.
4. Dismantle and Assemble the given Vapour compression Refrigeration system and study its working principle, Also check the leakage of refrigerant

Module 4

Irrigation and Precision Farming

Over view

As the indicate this module transacts Irrigation and Precision Farming concepts to the learner. She/he develops the capacity to select and use different agricultural Irrigation systems and identify its parts. They will be able to detect creative and innovative skills The learner will be able to select Pumps for irrigation, and also able to operate them. By learning this module they can opt the correct green house according to the atmospheric conditions, By learning Auto CAD ,they can design and draw basic machine elements

UNIT DETAIL

4.1 Irrigation

Introduction

Irrigation is the artificial application of water to the soil using proper method to fulfill the water requirement of crop for its optimum growth and production. Irrigation water is applied to supplement the water available from rainfall and soil moisture. The success of irrigation depends on selection of the method as per the conditions and planning, projecting, establishing and operating the irrigation system.

Learning outcomes

Unit 1 Irrigation

- 4.1.1 Distinguishes between different types of irrigation
- 4.1.2 Explains the components of mechanical irrigation
- 4.1.3 Explains the working and installation of sprinkler
- 4.1.4 Explains the working and installation of Drip
- 4.1.5 Explains the working and installation of Mist
- 4.1.6 Installs fogger system of irrigation

Classification of Irrigation systems

Several methods of irrigation techniques are used nowadays depending on water availability, the type of crop and the financial status of the farmers. Various types of irrigation techniques differ in how the water obtained from the source is distributed with in the field

In general, the goal is to supply the water uniformly in the entire field so that each plant has the amount of water it needs, neither too much nor too little.

Irrigation methods can be divided in to two groups according to the features related with delivering and application of water on soil. These are Surface irrigation and pressure irrigation methods.

Surface irrigation methods

In surface irrigation methods, water is moving over the land by simple gravity flow in order to wet it and to infiltrate into the soil. Surface irrigation methods can be sub divided into

- i) Flow irrigation
- ii) Border irrigation
- iii) Check basin irrigation
- iv) Furrow irrigation

Pressure Irrigation methods

In the pressure irrigation method, the water is given to soil by using closed pipe systems with an additional energy or a drawing effect. The pressure irrigation methods include sprinkler and Drip irrigation methods

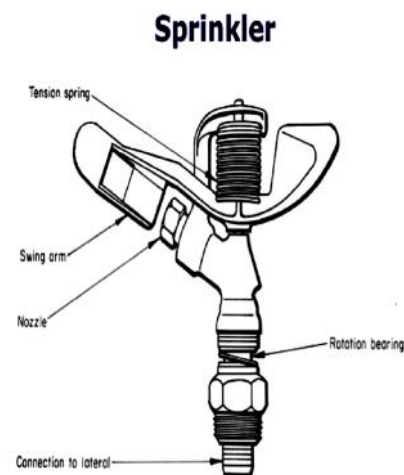
4.1.2 Mechanical irrigation-pump, sprinkler, drip

Modern intensive agriculture requires sufficient supply of water for proper irrigation at right time. The water lifting devices operated by human or animal can't meet this demand. On the other hand ,other power sources such as hydro power, wind power or solar power are available in all the areas and at all the time. Therefore, mechanically powered devices are most commonly used for lifting of water for irrigation and are popularly referred as pumps.

Sprinkler Irrigation

In sprinkler irrigation method, water is delivered through pressurized pipe network to nozzles or jets which spray the water into the air to fall on the soil. The fall of water is like an artificial rain

Drip Irrigation



Drip irrigation is the slow application of low pressure water to the roots of plants, either onto the soil surface or directly onto the root zone, through a network of

valves, pipes, tubing and emitters. Drip irrigation is sometimes called trickle irrigation and involves dripping water on to the soil at very low rates 2-20 liters/hour from a system of small diameter plastic pipes fitted with outlets called emitters or drippers.

4.1.3 Sprinkler-components-lay out& Design, Installation

Sprinkler Irrigation

In sprinkler irrigation method, water is delivered through pressurized pipe network to nozzles or jets which spray the water into the air to fall on the soil. The fall of water is like an artificial rain

Suitability of sprinkler Irrigation

Sprinkler irrigation can be used for almost all crops and on most soils. It is however, not suitable for fine textured soil with very low infiltration rates. It is particularly suitable for sandy soils and undulating topography. Properly designed sprinkler irrigation system results better water management, high water application efficiency, high crop yield, better quality of produce, and 10 to 15% more land available compared to surface irrigation. The initial capital investment is very high compared to any surface irrigation method. The operation of sprinkler system requires a pressure generally in the range of 1 to 4 kg/cm². In a place of high wind, the distribution of water will not be uniform and evaporation will increase.

Types of Sprinklers

On the basis of method of water application, the sprinkler may be classified as

- i) Fixed nozzle type
- ii) Rotating nozzle type
- iii) Perforated type of Sprinklers

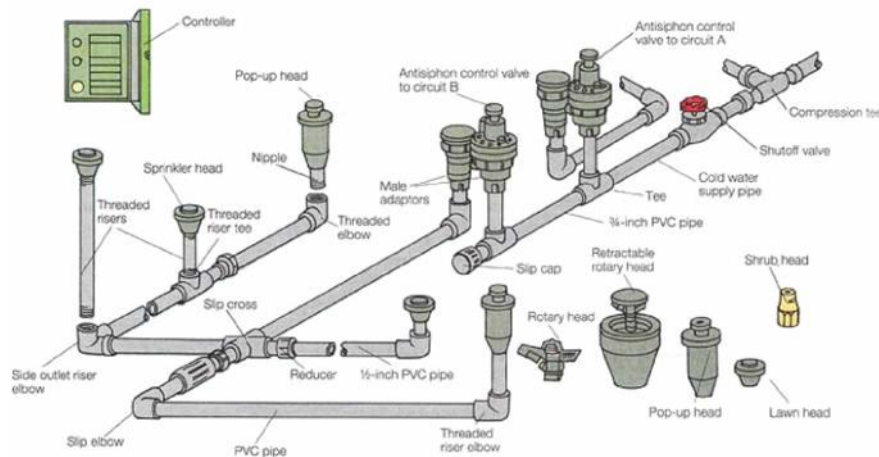
The rotating nozzle type sprinkler systems are mostly being used presently and they use high pressure in the range of 2 to 7kg/cm². The perforated pipe system has number of small holes drilled along the pipe wall, operates with a small pressure range of 0.8 to 3 kg/cm², and is generally used for small areas like lawns.

Based on the portability, sprinklers can be classified as

- i) portable type
- ii) Semi permanent type
- iii) permanent type.

The portable type system has portable pumping plant, main lines and laterals, and can be moved from one field to another for irrigation. Semi permanent type sprinkler system has its main lines permanently fixed and the lateral lines can be shifted from one place to other place. In permanent type sprinkler system, both mains and lateral pipes are fixed, generally buried inside the ground and hence labor and maintenance costs are minimum

Components of Sprinkler System



The sprinkler system consists of a water source, a pump to pressurize the water, main line, laterals, risers and sprinkler heads. In addition, regulating valves, desiling

devices, debris screens, fertilization applicator etc. may be used for achieving additional benefits. Main lines are used to transmit the water from the pump to laterals. For connecting the main line with different laterals, T joints are used. Risers are connected to the laterals at suitable spacing using T joints. The most important component of a sprinkler system is the sprinkler head

4.1.4 Drip- components-lay out &Design, Installation

Drip irrigation is the slow application of low pressure water to the roots of plants, either onto the soil surface or directly onto the root zone, through a network of valves, pipes, tubing and emitters. Drip irrigation is sometimes called trickle irrigation and involves dripping water on to the soil at very low rates 2-20 liters/hour from a system of small diameter plastic pipes fitted with outlets called emitters or drippers. Water is applied close to plants so that only part of the soil in which the roots grow is wetted, unlike surface and sprinkler irrigation, which involve wetting the whole soil profile. With drip irrigation water applications are more frequent than with other methods and this provides a very favorable moisture level in the soil in which plants can flourish.

Suitability of drip irrigation

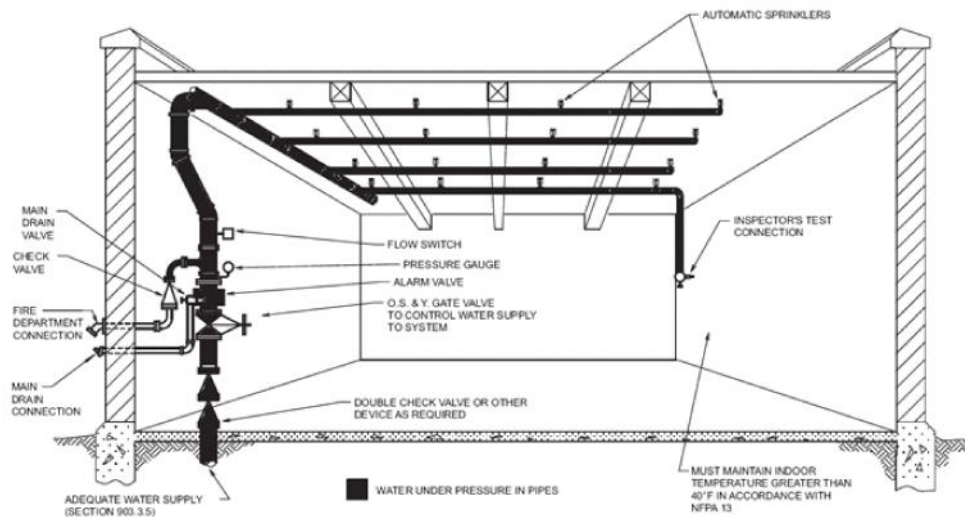
Drip irrigation is most suitable for row crops, tree and vine crops where one or more emitters can be provided for each plant. Generally only high value crops are considered because of high capital costs of installing a drip system. This method is adaptable to any farmable slope. Drip irrigation is suitable for most of the soils. On clay soils, water must be applied slowly to avoid surface water pending and runoff. On sandy soils higher emitter discharge rates will be needed to ensure adequate lateral wetting of the soil

One of the main problems with drip irrigation is blockage of the emitters. All emitters have very small waterways ranging from 0.2-2.0 mm in diameter and these can become blocked if the water is not clean. Thus it is essential for irrigation water to be free of sediments. If this is not so then filtration of the irrigation water to be needed. Blockage may also occur if the water contains algae, fertilizer deposits and dissolved chemicals which precipitate such as calcium and iron. Drip irrigation can be used for water of poor quality. Since water is dripped to the plants roots not the entire field, the drip irrigation is very efficient in water use and hence it is most suitable when water is scarce

System layout and components

A complete drip irrigation system consists of a head control unit, main and submarine

pipelines, hydrants, manifolds and lateral lines with dripper emitters. Control station (head control unit): Its features and equipment depend on the system's requirements. Usually, it consists of the shut-off, air and check (non-return) valves, a filtering unit, a fertilizer injector and other smaller accessories. Main and submain pipelines: The main and submain pipelines are usually buried, especially when made of rigid PVC. Hydrants: Fitted on the mains or the submain and equipped with 2-3- in shut-off valves, they are capable of delivering all or part of the piped water flow to the manifold feeder lines. They are placed in valve boxes for protection.



Cost

The cost for a complete drip irrigation installation is US\$4 000- 5 000/ha. The cost of the pipes (all tubing, laterals included) is about US\$2 000, i.e. 45 percent of the total cost. The head control unit accounts for 30 percent of the total cost.

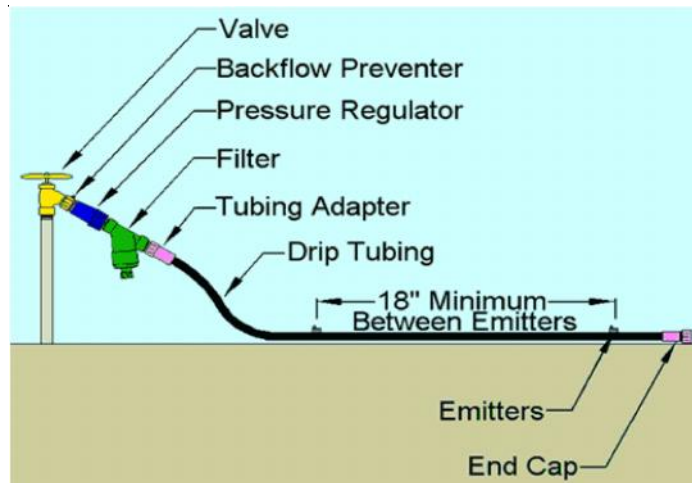
Advantages

Water savings. The planted area is partially wetted with precisely controlled water amounts. Thus, large quantities of irrigation water are saved and the irrigated area can be expanded with the same water supply, resulting in higher income per unit of water. o Utilization of saline water resources. With drip irrigation, low soil moisture tensions in the root zone can be maintained continuously with frequent applications. The dissolved salts accumulate at the periphery of the wetted soil mass, and the plants can easily obtain the moisture needed. This enables the use of saline water containing more than 3 000 mg/litre TDS, which would be unsuitable for use with other methods. Double lines with bananas o Use on marginal fields. Small irregular marginal plots, remote because of land fragmentation with varying topography and

shallow soil full of rocks, can be productive under drip irrigation techniques that deliver the required amounts of water and nutrients directly to the plants. o Low labour operating requirements, reduced cultivation and weed control, and uninterrupted operation are among the other advantages of this irrigation method.

Disadvantages

High initial purchase cost. o Good irrigation management is essential for skilled system operation, application of fertigation and maintenance of the head control unit equipment (filters, injectors, etc.). o Emitter blockages. The first limitation on the successful introduction



of drip irrigation techniques in developing countries is mechanical clogging of the emitters because of insufficient filtration of impurities in the irrigation water.

Fertigation Definition The practice of supplying crops in the field with fertilizers via the irrigation water is called fertigation (Bar-Yosef, 1991). Fertigation - a modern agro-technique, provides an excellent opportunity to maximize yield and minimize environmental pollution (Hagin et al., 2002) by increasing fertilizer use efficiency, minimizing fertilizer application and increasing return on the fertilizer invested. In fertigation, timing, amounts and concentration of fertilizers applied are easily controlled. The incorporation of fertilizers into the irrigation system demands the following basic requirements: Equipment ? In pressurized irrigation systems, the injected fertilizer solution has to be greater than that of the internal pressure. ? A filter to prevent dripper clogging by any solid particles from reaching the dripper (Elfuving, 1982). ? A back-flow preventing valve. Fertilizers ? Solubility of the fertilizers in the indigenous water source: irrigation water contains various chemical constituents some of which may interact with dissolved fertilizers with undesired effects. ? The degree of acidity of the fertilizer solution has to be considered in relation to its corrosiveness to the irrigation system components.

Fertigation equipment The choice of fertigation equipment has to take into account both crop requirement and irrigation system capacity. 2.2.1. Gravity irrigation systems

This very simple method is only applicable to irrigation systems working at atmospheric pressure in which water flows in open channels. The fertilizer solution drips into the irrigation channel because the fertilizer tank is above the level of the channel. In order to obtain good mixing, the velocity of the irrigation stream must be high enough.

2.2.2. Pressurized irrigation systems Injection of the fertilizer consumes energy in order to overcome the internal pressure of the irrigation network. Fertilizer injection equipment is classified into three principal 18 Fertigation: a tool for efficient fertilizer and water management groups, according to the means employed to obtain the higher pressure for the fertilizer solution:

Injection by a Venturi device: This is a unit that makes use of the Venturi suction principle by using the pressure induced by the flowing water to suck the fertilizer solution from the fertilizer tank into the irrigation line. A conical constriction in the pipe induces an increase in the water flow velocity and a pressure decrease to an extremely low value which causes fertilizer suction (through the filter screens) from the supply tank through a tube into the irrigation system. A valve can be adjusted to control the difference between the water velocities across the valves.

Injection by differential pressure: This system utilizes an air tight pressure metal tank with anti-acid internal wall protection in which a pressure differential is created by a throttle valve that diverts part of the irrigation water into the tank. This is the only fertigation system that enables the use of both solid and liquid fertilizers. The entire fertilizer amount in the tank is delivered to the irrigation area. The concentration at the water emitter end is kept constant as long as a solid fertilizer is present in the tank and solubility of the fertilizer is quickly achieved. Once the solid fraction is completely dissolved the fertilizer concentration is reduced at an exponential rate. In practice, when four tank volumes have passed through it, only a negligible amount of fertilizer is left in the tank. This equipment was used in the early stages of fertigation development. A limited area can be irrigated at a time according to the tank volume. The use of solid fertilizers must be handled with care. Fertilizers that have endothermic reaction when dissolved, like KNO_3 , $\text{Ca}(\text{NO}_3)_2$, Urea, NH_4NO_3 , KCl and $5\text{Ca}(\text{NO}_3)_2 \cdot \text{NH}_4\text{NH}_3 \cdot 10\text{H}_2\text{O}$ decrease the temperature in the tank and when added during cold hours in the early morning before irrigation, part of the solution can freeze, leading to unexpected changes in the nutrient concentrations.

Injection by positive pressure: Injection pumps are able to raise the pressure of the liquid fertilizer from a stock solution tank at a predetermined ratio between fertilizer solution volumes to irrigation water volume, hence achieving a proportional distribution of nutrient in the irrigation water. The advantages of using injection pumps are the lack of pressure loss of the irrigation water, its accuracy and the ability to provide a determined concentration through the irrigation cycle. Two

types of injectors are commonly used in fertigation: piston pumps and diaphragm pumps. The most common power sources for fertigation pumps are:

- ? Hydraulic energy: The device uses the hydraulic pressure of the irrigation water to inject nutrient solution while the water used to propel it (approximately three times the volume of solution injected) is discharged. These pumps are suitable for fertigation in areas devoid of sources of electricity.
- ? Electric dosing pumps: The device activates the fertilizer pump. These are common in glasshouses and in areas where electricity is available and reliable.

2. Fertigation

2.3. Fertilizer dosing in fertigation

According to Sne (2006), to apply the same doses of fertilizers during the specific phenological stage of a plant, two different patterns of application can be made depending on the crop, soil type and farm management system:

- Quantitative dosing: A measured amount of fertilizer is injected into the irrigation system during each water application. Injection may be initiated and controlled automatically or manually.
- Proportional dosing: In this process, a constant predetermined ratio between the volume of the irrigation water and the volume of the fertilizer solution is maintained, resulting in a constant nutrient concentration in the irrigation water.

2.4. Suitability of fertilizers for fertigation

A large range of fertilizers, both solid and liquid, are suitable for fertigation depending on the physicochemical properties of the fertilizer solution. For large scale field operations, solid fertilizer sources are typically a less expensive alternative to the commonly used liquid formulations. The solubility of these fertilizers does vary greatly. When switching to a solid fertilizer source, problems can be avoided in the nurse tanks by ensuring that ample water is added to the stock solution. Four main factors in selecting fertilizers for fertigation should be considered (Kafkafi, 2005):

- Plant type and stage of growth
- Soil conditions
- Water quality
- Fertilizer availability and price

The type of fertilizer for fertigation should be of high quality, with high solubility and purity, containing low salt levels and with an acceptable pH, and it must fit in the farm management program. The fertilizer characteristics as well as their effects on soils and crops are presented later. Hagin and Lowengart-Aycicegi (1996) enumerated the main properties relating to the suitability of the fertilizer to the injection method as follows:

- Form: Soluble solid and liquid fertilizers are both suitable for fertigation depending on availability, profitability and convenience.
- Solubility: High and complete solubility is a prerequisite for fertilizers used in fertigation. Fertilizer solubility generally increases with temperature, depending on the fertilizer.
- Interaction between fertilizers in solution: When one type of fertilizer or more are prepared and mixed by the grower, or in the irrigation line (but to a lesser extent), the compatibility between them must be checked (see Table 1.1). There are usually some basic precautions that must be taken:

- ? Make sure that the fertilizers used are

compatible to prevent precipitation. Especially, avoid mixing fertilizer solutions that contain calcium with solutions

Containing phosphates or sulfates when the pH in the solution is not sufficiently acidic. ? Check the solubility and potential precipitation with the local water chemical composition. Before using a new fertilizer, mix 50 ml of the fertilizer solution with 1 liter of the irrigation water and observe for precipitation within 1-2 hours. If precipitates are formed or the sample becomes cloudy, refrain from using this fertilizer in the irrigation system (Roddy, 2008). ? Check the temperature resulting from mixing various types of fertilizers under field conditions. Some fertilizers alone or in combination may lower the solution temperature to freezing levels (e.g. KNO_3 , $\text{Ca}(\text{NO}_3)_2$, urea, NH_4NO_3 , KCl and $5\text{Ca}(\text{NO}_3)_2 \cdot \text{NH}_4\text{NH}_3 \cdot 10\text{H}_2\text{O}$). However, when purchasing ready-to-use liquid fertilizers, the endothermic reaction does not occur in the field, hence, slightly higher concentrations of nutrients in the solution can be achieved. Corrosivity. Chemical reactions may occur between fertilizers and metal parts in the irrigation and fertigation systems. Corrosion can harm metallic components of the system like uncoated steel pipes, valves, filters and injection units.

The fogger is ideal for irrigating nurseries, shrubs and trees where a fine mist spray is required at low volumes and low pressures. Foggers can also assist in temperature control and to increase humidity in hot, dry climates. It's rugged nylon construction and easy disassembly allow for carefree operation.

DETAILING OF PRACTICALS

Design drip irrigation system

- 1) Estimate the cost for the drip irrigation system
- 2) Select the right kind of pump for the irrigation system
- 3) Select the right kind of control head for regulating the pressure and discharge
- 4) Select the right kind of filters for water according to the nature of water available for irrigation
- 5) Select right kind of pipes of PVC for mainlines, submains & laterals
- 6) Decide the amount of digging is required for main lines and submains for protecting them from direct sunshine
- 7) Select the right kind of emitters or drippers as per the plants and the nature of land

ASSESSMENT ACTIVITIES

Record

Practical

Viva

Activity log

Unit test

Quiz

Chart

Project report

Discussion points

Seminar report

Theory Evaluation Questions

- (a) What are the different types of irrigation systems commonly used in agriculture purpose (3)
- (b) Concept of irrigation system and its structures (4)

4.2 PUMP FOR IRRIGATION

Introduction

Pumps are very important in the irrigation systems. Pumps can deliver water from a lower position to required higher level in specific quantity. They are mainly classified in to two groups Positive displacement pumps and rot dynamic pumps. The learner can explain the working principle of centrifugal pump, they can rectify the complaints of the Centrifugal pumps, Reciprocating pumps & Jet pumps, He / She can also calculate WHP ,they can service the pumps

Learning outcomes

- 4.2.1 Explains the classification of pumps
- 4.2.2 Explains the working principle of C F Pump
- 4.2.3 Explains the working principle of Jet & Reciprocating pumps
- 4.2.4 Selects pumps and its WHP calculation
- 4.2.5 Services the given pumps

4.2.1 Pumps

Modern intensive agriculture requires sufficient supply of water for proper irrigation at right time. The water lifting devices operated by human or animal can't meet this demand. On the other hand ,other power sources such as hydro power, wind power or solar power are available in all the areas and at all the time. Therefore, mechanically powered devices are most commonly used for lifting of water for irrigation and are popularly referred as pumps. However,the sources of power for operating the pumps may be electric motors, internal combustion engines, wind power, hydro power or solar energy. A pump is a device or machine which when fitted with a conduit, transfers the energy from the external source to the liquid flowing through the conduit.

Pumps used for water lifting may be broadly classified as

I. Positive displacement pumps

The positive displacement pumps discharge the same volume of water regardless of the head against which they operate. In this pumps, pumping is obtained by alternatively filling and emptying one or more chambers with water. Capacities of such pumps are small and therefore these pumps are not very popular in irrigation

and drainage. They are further classified as Rotary pumps & Reciprocating pumps

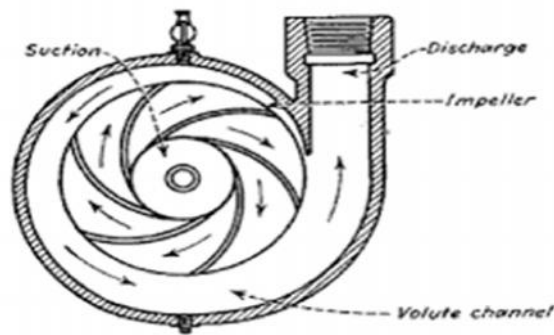
II. Roto dynamic pumps

The distinguishing characteristics of variable displacement pump is the inverse relation between discharge and pressure head. As the head increases the rate of pumping(discharge) decreases. From constructional view point, the roto dynamic pumps are grouped as

- i) Centrifugal pumps
- ii) Vertical turbine pumps
- iii) Submersible pumps
- iv) Propeller pumps
- v) 4.2.2 CFPUMP -working, principles, parts

Centrifugal pumps

A centrifugal pump may be defined as a device in which an impeller rotating inside a close fitting case draws in the liquid at centre and by virtue of centrifugal force throws out the liquid through an opening at the side of the casing. Centrifugal pumps are most widely used in irrigation practice. They are simple in construction, easy to operate, have low initial cost and produce a constant steady discharge



A centrifugal pump consists of

- i) Impeller
- ii) Casing
- iii) Suction side fittings
- iv) Delivery side fittings
- v) Foot valve

Impeller is a wheel or disc mounted on shaft and provided with a number of vanes or blades

Principle

The underlying hydraulic principle in centrifugal pumps is the production of high velocity and partial transformation of this velocity in pressure head. Centrifugal pump converts the input power to kinetic energy in the water by accelerating the water by revolving device-an impeller. Water enters the pump through the eye of the impeller which rotates at high speed. The water is accelerated radially outward from the pump casing due to centrifugal action and water is thrown out through an opening at the side of the casing..A vacuum is created at the impellers eye that continuously draws more water in to the pump

Working

Before starting a centrifugal pump, the casing and the suction pipe should be filled with water. This is called as priming without which pump will not work. After the priming, the impeller is rotated .The blades causes the water to rotate with the impeller and in turn impart high velocity to the water. Centrifugal forces causes it to br thrown outward from the impeller into casing. Outward flow through Impeller reduces pressure at the inlet allowing more water to be drawn in through suction pipe. Due to conversion of high velocity into pressure, water is pumped through discharge pipe. It is either in volute type or in diffuser type casing

Classification of Centrifugal Pumps

On different basis ,Centrifugal pumps can be classified as below

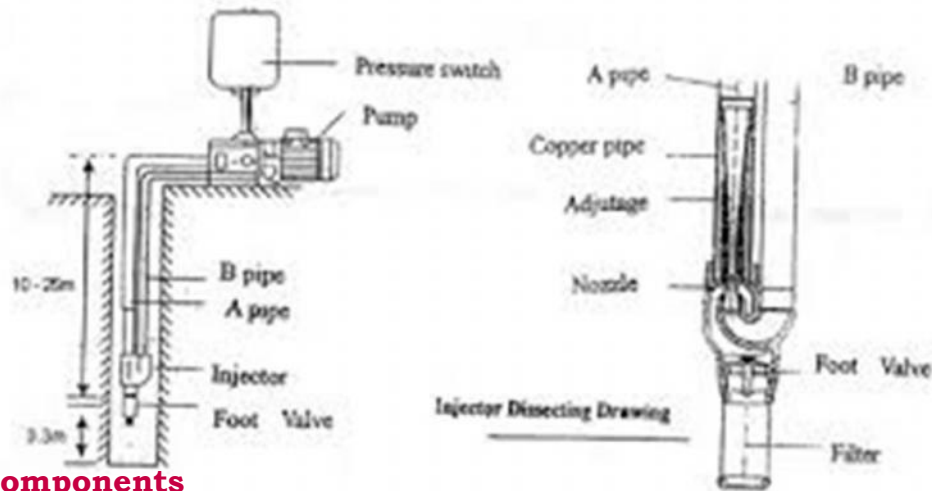
- 1) Based on type of casing
 - i) Volute type
 - ii) Diffuser type
- 2) Based on axis of rotation
 - i) Horizontal pumps
 - ii) Vertical pumps
- 3) Based on number of impellers
 - i) Single stage pump
 - ii) Multistage pump
- 4) Based on working Head
 - i) Low lift
 - ii) Medium lift
 - iii) High lift
- 5) Based on method of driven
 - i) Direct coupled
 - ii) Gear driven
 - iii) belt driven

The most common type is the horizontal axis volute type centrifugal pump

4.2.3 JET pump, Reciprocating pump -working, principles, parts

Jet pump

It is a pump which consists of a centrifugal pump and a jet mechanism (or ejector). The centrifugal pump operates at the ground surface and jet is placed in the well below the water surface. The centrifugal pump provides the driving head and capacity for the jet to be operated in the well



Components

The main components of a jet pump are

- i) Nozzle
- ii) Venturi

The nozzle is so shaped that it abruptly reduces the area through which the flow must pass, thus increasing the flow. A flow pressure area around the venturi is created which draws more water from the well

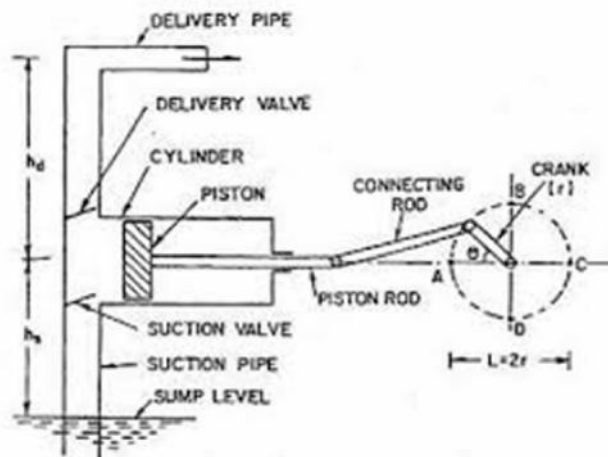
The impeller of the centrifugal pump creates vacuum in the pipe and draws the flow through suction pipe. The control valve is set to maintain the necessary pressure in the pipe line.

Advantages & Disadvantages

- 1) Jet pump is considered very suitable for low capacity deep well pumping
- 2) It can be used for high suction lift where ordinary centrifugal pump can't be used. The suction lift varies from 12 to 18 meters
- 3) All moving parts are working on the ground surface
- 4) It is simple in construction and easy in maintenance
- 5) Efficiency of such pump is low

Reciprocating pump

A reciprocating pump consists of a piston or plunger operating in a cylinder. The crank is rotated either by the driving engine or by the motor and as a result, the plunger moves to and fro in the cylinder. The outward movement of the plunger creates a partial vacuum in



the cylinder and consequently water is sucked into the cylinder due to atmospheric pressure. The suction valve remains open during outward stroke and closes during the inward stroke of the plunger. The opposite occurs with the delivery valve resulting into forcing up of water to the delivery pipe during inward stroke of the plunger. Reciprocating pumps are sometimes also called piston pumps.

A single acting piston pump has one discharge stroke for every two strokes of the piston. Thus, the water is delivered during alternate strokes and therefore the flow through the delivery pipe is intermittent. In double acting piston pumps, the piston and the valves are so arranged that water is delivered during both the inward and the outward strokes of the piston

4.2.4 Selection of pumps-WHP Calculation, servicing, repair & Maintenance

Selection of Pumps

Selection of a suitable water lifting device depends on type of water, the amount of water to be lifted, the depth of pumping water level, type and amount of power available and the economic status of the farmer. Every pump installation has different operating head and discharge conditions. Therefore, it is necessary to select the pump such that it operates under maximum efficiency with the given head and the discharge. This is done by plotting characteristic curves, both for the well and the pump. The characteristic curves are the curves relating the important parameters like head, discharge, efficiency and power requirements

The characteristics curves of the well and the pump enable the selection of the pump which best suits the well. Generally, the point of intersection of the capacity of the

head capacity curves of the pump and the well is taken as a point of selection.

Preventive Maintenance

Primary Goals: Prevent Breakdowns ,Maintain Adequate Pumping Capacity

Secondary Goals: Lower cost to operate Prolonged equipment life

Pump Reliability Factors

Installation factors: o Bases, sole plates, foundations o Shaft alignment o Piping o Environmental effects on application Even the right pump for the job will fail if not installed properly.

Preventive Maintenance

Achieve your goals: Create a preventive maintenance program; follow manufacturers recommendations Maintain good inspection and maintenance records Be familiar with your pump systems - Review and keep Installation and operation manuals; including, pump performance curves

Review and keep parts and maintenance manuals

Preventive Maintenance

Recommended to check the following: -

Weekly • Record suction/discharge gauge readings o Record elapsed time meter readings • Record amp readings if possible

Monthly • Exercise valves - Semiannually • Check impeller clearance if applicable • Check oil levels in seal and motor housing

Annually • Change oil in seal and motor housing if applicable • Test alarms for proper operation • Perform basic electrical tests

Troubleshooting

Noisy Operation - Mechanical noise issues: • Bad Bearings • Debris in impeller • Impeller wear, balance, etc... • Wear rings • Seal plate • Coupling misalignment o Belts and sheaves

Noisy Operation - Hydraulic noise issues: • Cavitations • Overtaxing • Surging or water hammer • Excessive velocity (through valves and fittings)

Low Flow - Possible Causes for low flow: o Backward rotation o Debris in impeller o Closed discharge valve o Open bypass valve o Clogged suction o Worn impeller, wear ring, wear plate • Excessive clearances • Overtaxing

Low Pressure - Possible Causes for low pressure: • Wrong speed • Clogged suction • Suction line air leak • Worn impeller, wear ring, Wear plate

WHP Calculation

It is the horse power which is required to pump the water if the pump and drive are 100% efficient

$$\text{WHP} = \frac{\text{discharge (liters/sec)} \times \text{total head(m)}}{75}$$

$$\text{WHP} = \frac{\text{discharge (liters/min)} \times \text{total head(m)}}{4500}$$

$$\text{WHP} = \frac{\text{discharge (m}^3\text{/sec)} \times \text{total head(m)}}{273}$$

Practical activities

Dismantle and Identify the parts of Centrifugal pump and assemble its

1. To disconnect all essential connection from the motor of the pump
2. Remove suction pipe and delivery pipe from the pump
3. Disconnect the connection of the pump from the motor
4. Open the involutes Casing cover by loosening the respective nut and bolt
5. Remove the impeller from the pump shaft using shaft puller
6. Check all the parts of the pump visually for any damage, if any damage is found for any part, repair it or replace it
7. Clean all parts of the pump using kerosene or diesel
8. Assemble the pump back in the reverse order of the disassembled

ASSESSMENT ACTIVITIES

- | | |
|-----------|-----------------|
| 1. Record | 2. Practical |
| 3. Viva | 4. Activity log |

Theory Evaluation Questions

- 1) What is pump? What are the different types of pumps (4)
- 2) With a neat sketch explain the working of a centrifugal pump (5)
- 3) What is priming? (3)
- 4) Explain the term efficiency of a pump (3)
- 5) How to care a pump (3)
- 6) What are the different steps taken to select a pump (3)
- 7) With a neat sketch explain the working of a reciprocating pump (5)

UNIT 4.3 GREEN HOUSE TECHNOLOGY

Introduction

Green House Technology is developed for growing plants in a plants friendly atmosphere, that is a controlled temperature, Humidity and other atmospheric properties. The learner can explain the advantages & disadvantages of green house technology. The lesson also explains different types of green houses, that is according the materials using for the construction of green house. He /She can design a green house with its irrigation system. Mulch and fertigation are the very important trends in agriculture for a weed free cultivation

Learners outcomes

- 4.3.1 Explain Green House Technology
- 4.3.2 Identify different types of green houses
- 4.3.3 Construct different type of green houses
- 4.3.4 Explain mulch & fertilization in green house
- 4.3.1 Green House-Concept, Advantages, Disadvantages

The term green house refers to structure covered with a transparent material for the purpose of admitting natural light for plant growth. The structure is usually heated ,artificially and differs from other growing structures such as cold frames and hot beds in that it is sufficiently high to permit a person to work from within. Green house is a frame or an inflated structure covered with a transparent material in which crops could be grown under the condition of at least partially controlled environment and which is large enough to permit person to work with in it to carry out cultural operation.

Advantages of greenhouses :

- a) The yield may be 10-12 times higher than that of out door cultivation depending upon the type of greenhouse, type of crop, environmental control facilities.
- b) Reliability of crop increases under greenhouse cultivation.
- c) Ideally suited for vegetables and flower crops.
- d) Year round production of floricultural crops.

- e) Off-season production of vegetable and fruit crops.
- f) Disease-free and genetically superior transplants can be produced continuously.
- g) Efficient utilization of chemicals, pesticides to control pest and diseases.
- h) Water requirement of crops very limited and easy to control.
- i) Maintenance of stock plants, cultivating grafted plant-lets and micro propagated plant-lets.
- j) Hardening of tissue cultured plants
- k) Production of quality produce free of blemishes.
- l) Most useful in monitoring and controlling the instability of various ecological system.
- m) Modern techniques of Hydroponic (Soil less culture), Aeroponics and Nutrient film techniques are possible only under greenhouse cultivation.

4.3.2 Types of Green House-Poly House, Glass House

Green house can be classified based on their shape and style, uniqueness of cross section of the green house etc

Green house type based on shape

The longitudinal section of the green houses approximately remains the same for all types of the green houses therefore this factor cannot be used for classification. The cross section depicts the width and the height of the structure and the length is perpendicular to the plane of cross section. The cross section provides information on the overall shape of the structural aspects which will be repeated on every bay. Commonly followed types of green houses based on shape are lean to, even span, uneven span

Green House based on utility

Design of green house depends on the functions or utilities. The utilities include artificial cooling and heating of the green house.

Green House based on construction

The type of construction, structural and covering material used for green house are important factors. Span of green house in turn dictates the selection of structural members and their construction. If the span of the green house is higher we need stronger material for construction. For smaller spans simpler design like goops can be followed

Green house based on covering material

Green house is to be covered with covering materials ,which have directly influence on the grin house effect inside the structure. They alter the air temperature inside the house. The type of frames and the method of fixing also varies with the covering material. Based on the type of covering material green houses are classified as glass, plastic film and rigid panel green house

Glass house



Earlier only glass green house covering which where constructed ,because glass provides greater interior light intensity. These green houses have higher air infiltration rate which leads to lower interior humidity and better disease prevention. Lean to type ,even span ,ridge and furrow type of design are used for construction of glass green house

Rain shelter

Vegetable production under protective structure has becoming an important sector of agriculture because of the effectiveness in controlling insects and pests, thus increases the productivity and quality of fresh farm products.



The yield of vegetables per unit area is 2-4 times higher as compared to open field production. The protective structures used for vegetable cultivation are mainly rain shelter with netted sides and netted structure depending on the types of vegetable grown. These structures are used to protect the crops from damage caused by

excessive rainfall, insects and other detrimental environmental factors. The internal environment of a rain shelter is influenced by radiant heat received by the structure and surrounding objects. The amount of heat induced from radiation can sometimes cause stress to the plants and depress the physiological functions.

Effective greenhouse environment can be achieved through design optimization of structure for a better air movement process. It is important to understand the environmental characteristics and inter-relation between the environmental factors and how best the systems could be provided to modify the environment

4.3.3 Green House construction-Frame, covering materials-irrigation system (Fogger, Mist, Drip)

Green House Construction

Greenhouse construction has been involved in various fields. Besides agronomy, forestry science and technology and horticulture in the traditional sense, the architecture, aesthetics, mechanics, steel structure, ergonomics, computer automatic control, air conditioning and new materials etc. are increasingly involved as well. Technology has been adhering to such principle and introducing talents in various fields to make greenhouse widely applied to each field without being exclusive to agriculture and forestry

Construction methods for some of the components have been discussed below

Frame

Materials commonly using for the construction of the frame are steel, wood, amboo, aluminum and reinforced concrete. Being hygroscopic in nature it is generally treated for protection from high moisture and termistic and painted for better light condition inside the green house The chemicals required for treating or painting Should not be hazarded to human and plant as well

Covering materials

Covering materials are the important component of the greenhouse structure. They have direct influence on greenhouse effect, inside the structure and they alter the air temperature inside. The types of frames and method of fixing also varies with covering material. Hence based on the type of covering material they may be classified as

Glass glazing.

Fibre glass reinforced plastic (FRP) glazing

- i. Plain sheet
- ii. Corrugated sheet

Plastic film

- i. UV stabilized LDPE film.
- ii. Silpaulin type sheet.
- iii. Net house.

Green House Irrigation

Fogger

The fogger is ideal for irrigating nurseries, shrubs and trees where a fine mist spray is required at low volumes and low pressures. Foggers can also assist in temperature control and to increase humidity in hot, dry climates. It's rugged nylon construction and easy disassembly allow for carefree operation.

Drip irrigation

Depending on how the emitters are placed in the plastic polyethylene distribution line, the drip mode can be further delineated as a line source or a point source. The line source type emitters are placed internally in equally spaced holes or slits made along the line. Water applied from the close and equally spaced holes usually runs along the line and forms continuous wetting pattern. This wetting pattern is suited for close row crops. The point source type emitters are attached external to the lateral pipe. The installer can select the desired location to suit the planting configuration or place them at equally spaced intervals. Water applied from the point source emitter usually forms a round deep wetting spot. The point source wetting pattern is suited for widely spaced plants in orchards, vineyards and for trees or shrubs.

4.3.4 Mulch, Fertigation

Mulch

We farmers have to work hard for food to eat and clothes to wear. But when we can produce enough from this work, then we can live well. For farmers, the foundation of our wealth is the soil. If soil is washed away or becomes

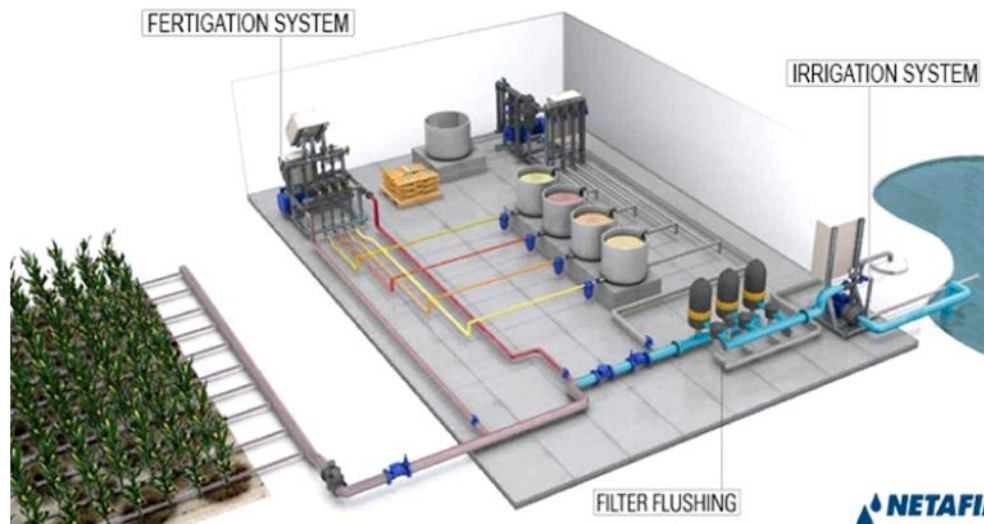


poor, how can we grow food to eat ? We farmers, who work and play with the soil, must also learn to love the soil. One method of loving, caring for and respecting the

soil is called mulching. Mulching is a method of using cut leaves, straw, leaf litter etc. to cover the bare soil while still farming and growing crops on it.

Fertigation

Definition The practice of supplying crops in the field with fertilizers via the irrigation water is called fertigation. Fertigation a modern agro-technique, provides an excellent opportunity to maximize yield and minimize environmental pollution by increasing fertilizer use efficiency, minimizing fertilizer application and increasing return on the fertilizer invested. In fertigation, timing, amounts and concentration of fertilizers applied are easily controlled



DETAILING OF PRACTICALS

Make tiny model of Green House structure.

1. Make the design drawing of the green house as per the dimension given Take 25 mm MS square pipe
2. Cut the square pipe in the given required dimension using hacksaw or power hacksaw
3. Join the pipe piece the using arc welding method as per the given structure of the green house
4. Cover the MS pipe structure using green house covering materials such as green net, poly sheet, glass sheet, etc`

ASSESSMENT ACTIVITIES

1. Viva
2. Class test,
3. Quiz
4. Activity log
5. Note Presentation
6. Seminar
7. Chart,
8. Unit test,

Theory Evaluation Questions

- 1) Write a short note about green house technology (3)
- 2) classify various types of green houses and their structures (3)
- 3) what are the different types of covering material used in green house (4)
- 4) Explain about fertigation (3)
- 5) write a short note about mulch (3)

Unit 4 Mechanical Auto-cad

Introduction

The method of preparing drawing by using computer software is knowing AutoCAD. AutoCAD is a computer-aided design (CAD) or Computer Aided design and Drafting. This program used for 2-D and 3-D design and drafting. AutoCAD is developed and marketed by Autodesk.

Learning outcomes

- 4.4.1 Explains basic Auto-Cad
- 4.4.2 Explains different commands in Auto Cad
- 4.4.3 Ability to limit set
- 4.4.4 Draws basic machine components
- 4.4.1 Introduction to Auto-Cad

The method of preparing drawing by using computer software is knowing AutoCAD. AutoCAD is a computer-aided design (CAD) or Computer Aided design and Drafting. This program used for 2-D and 3-D design and drafting. AutoCAD is developed and marketed by Autodesk.

Computer-aided design (CAD) is a computer technology that designs a product and documents the design's process. CAD may facilitate the manufacturing process by transferring detailed diagrams of a product's materials, processes, tolerances and dimensions with specific conventions for the product in question. It can be used to produce two-dimensional or three-dimensional diagrams, which can then when rotated to be viewed from any angle, even from the inside looking out. A special printer or plotter is usually required for printing professional design renderings.

Application of CAD

CAD is becoming more and more popular in the various engineering field such

1. Preparing architectural drawing
2. Interior design and modeling
3. Tool and fixture design
4. Production planning and control

5. Preparation of assembly list and bill of materials
6. Computer aided inspection
7. Preparation of program for CNC machines
8. Piping and instrumentation design
9. Automotive industries
10. Computer Aided manufacturing
- 11 Mapping, building, drawing.

Hardware Requirments for CAD

The electronic and Mechanical components of a computer constitute its physical structure and are called hardware.

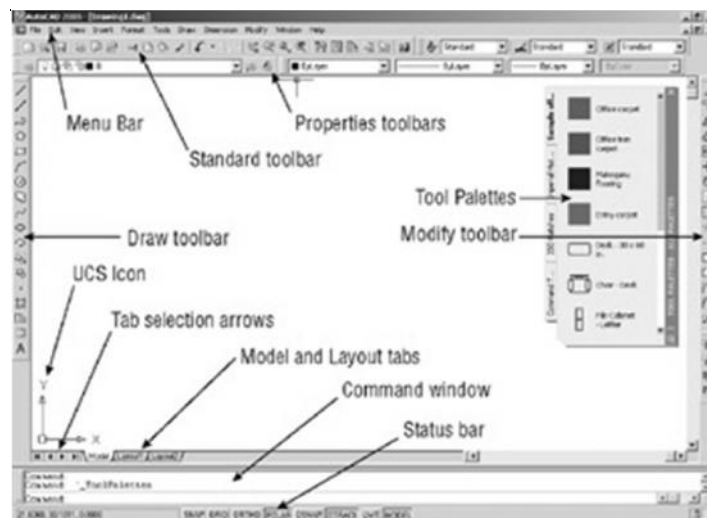
The fundamental units of a digital computer are

1. The Central Processing Unit (CPU)
 - a. Arithmetic and Logic Unit
 - b. Control Unit
 - c. Memory Unit
2. Input and output Unit
3. Auxiliary Memory

AutoCAD Screen

For starting AutoCAD, double click the AutoCAD icon on the desktop or AutoCAD from start menu. The opening main screen of AutoCAD is shown in figure. This screen has the following important items

AutoCAD Drawing Editor is sometimes called as AutoCAD Window Screen or simply AutoCAD screen



Entering command

There are various facilities for entering commands on the command prompt. They are

1. By using keyboard
2. By using screen menu
3. By using pull down menu
4. By using tool bar
5. By using cursor menu
6. By using button menu

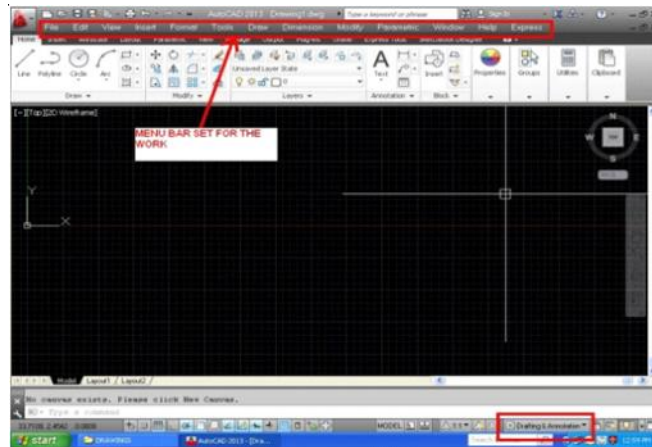
1) Menu bar

Showing the menu items

A menu bar is a user interface element that contains selectable commands and options for a specific program

Menu bars include the standard File, Edit, and View menus. The File menu includes common file

options such as New, Open..., Save, and Print. The Edit menu contains commands such as Undo, Select All, Copy, and Paste. The View menu typically includes zoom commands and options to show or hide elements within the window.

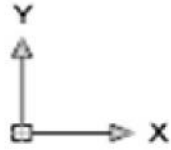


1) Draw Toolbar

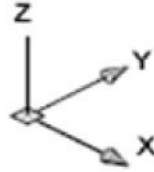


Draw Toolbar main strip to draw lines, 2D characters, but also we can use this command to draw in 3D. The same commands can be used via the draw. Locate the tape can be anywhere on the working window in the system of Drag and Drop Line, Ray, Construction line, Multiline, Polyline, 3D Polyline, Polygon, Rectangle, Helix, Arc, Circle, Donut, Spline, Ellipse, Block, Table, Point, Hatch, Boundary, Region, text are including in standard toolbar

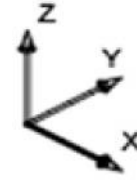
2) UCS ICON (User Coordinate System)



2D UCS Icon



3D UCS icon



shaded UCS icon

In AutoCAD there are two coordinate systems:

A fixed system called the World Coordinate System (WCS), and a movable system called the User Coordinate System (UCS). In the WCS, the X axis is horizontal, the Y axis is vertical, and the Z axis is perpendicular to the XY plane. The origin is where the X and Y axes intersect (0, 0) in the lower-left corner of the drawing. You define a UCS in terms of the WCS. Virtually all coordinate entry uses the current UCS.

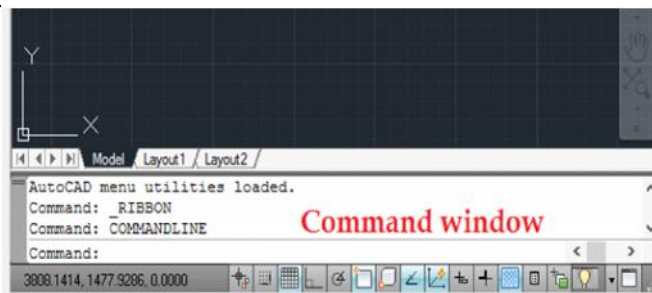
3) Status bar



The status bar provides quick access to some of the most commonly used drawing tools. You can toggle settings such as grid, snap, polar tracking, and object snap. You can also access additional settings for some of these tools by clicking their drop down arrows.

4) Commands window

All AutoCAD commands can be typed in at the command line. Many commands also have one or two letter aliases that can also be typed as shortcuts to the commands.



6) Modify tools bar

While working with AutoCAD, you'll quickly run into



situations that require you to use modify tools. As the name suggests, modify tools are used to modify existing lines and objects.

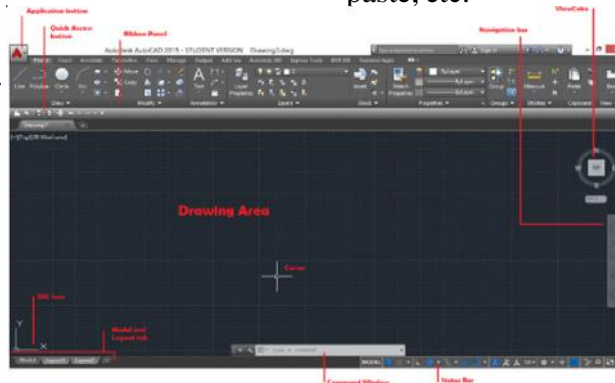
7) Standard Toolbar



It contains icon similar to any window application like open, a new file, open an existing file, save, print, print preview, cut, copy, paste, etc.

8) Drawing Area

It is the major central area of the screen on which a drawing is created. A cross hair is displayed in this area



4.4.2 Learn Commands

Command Line is just below the layout line. Where command is typed in this area typed the data as asked for and then press Enter Key Command are used to an activity

Example To draw a line. Use Line command

First Open a new file or an old file use any one of the following

- Click an icon on a toolbar with the left mouse button
- Click an option on menu bar and select a choice by clicking the mouse on it
- At the command line type a command using the keyboard and then press Enter Key

i) Measuring Commands

GRID : Displays a grid of dots at a desired spacing on the screen.

Command: GRID (enter)

SNAP : Specifies a "round off" interval so that points entered with the mouse can be locked into alignment with the grid spacing.

Command: SNAP (enter)

ORTHO : Restricts the cursor to horizontal, or vertical use

Command: ORTHO(enter)

Osnap : Allows for selection of precise points on selected objects

Command: OSNAP (enter)

AREA : Calculates the area of a polygon, plane, circle, or defined points along a boundary

Command: AREA (enter)

ii. Drawing Commands

CIRCLE : Draws circles of any size.

Command: Circle (enter)

LINE : Draws straight lines between two points

Command: LINE (enter)

From Point : (pick a point using the mouse)

To Point : (Pick a point using the mouse)

To Point : (Press return to end the command)

ARC : Draws an arc (any part of a circle or curve) through three known points.

Command: ARC (enter)

POLYGON:Draws regular polygons with a specified number of sides. Polygons are Polyline entities.

Command: POLYGON (enter)

PLINE : Draws a polyline, which are connected line or arc segments with user-determined width and taper

Command: PLINE (enter)

ELLIPSE : Draw an ellipse

Command: ELLIPSE (enter)

iii) Display Commands

LIMITS : Sets the size of the drawing paper. For size "A" drawing paper the limits should be set for 10.5 x 8.

Command: LIMITS (enter)

SCALE : Changes the size of objects to the selected scale factor

Command: SCALE (enter)

SAVE : Saves the current drawing to hard drive

Command: SAVE (enter)

ZOOM : Enlarges or reduces the display area of a drawing

Command: **SAVE** (enter)

PLOT : Plots a drawing to a plotting device, a printer, or to a "Plot File.

Command: **PLOT** (enter)

iv) Editing Commands

CHANGE: Alters properties of selected objects

Command: **CHANGE** (enter)

ERASE : Erases entities from the drawing.

Command: **ERASE** (enter)

Select objects or Window or Last: (Select objects to be erased and press enter when finished)

EXTEND : Lengthens a line to end precisely at a boundary edge.

Command: **Extend** (enter)

Select boundary edge(s)...

Select Objects (pick the line which represents the boundary edge which lines will be extended to) (press enter when finished selecting cutting edges)

TRIM : Trims a line to end precisely at a cutting edge. Command: **Trim** (enter)

Select cutting edge(s)...

Select Objects (pick the line which represents the cutting edge of line in which objects will be trimmed to)

(Press enter when finished selecting cutting edges)

GRIPS : You can edit selected objects by manipulating grips that appear at defining points on the object. Grips is not a command. To activate grips simply pick the object. Small squares will appear at various entity-specific positions. By selecting an end grip you can stretch the entity to change its size. By selecting the center grip you can move the entity to a new location. To remove grips press CTL-C twice. You can perform the following using grips: Copy, Multiple Copy, Stretch, Move, Rotate, Scale, and Mirror.

COPY : Create a copy of an object

Command: **COPY** (enter)

MOVE : Moves selected objects to another location in the drawing

Command: **MOVE** (enter)

MIRROR : Creates a symmetrical reflected object from the original selected objects

Command: **MIRROR** (enter)

ERASE : Delete an object

Command: ERASE (enter)

EXPLODE: Breaks an object into its components object

Command: EXPLODE (enter)

CHAMFER : Bevels the edges of an object

Command: CHAMFER (enter)

FILLET : Round the edges of objects

Command: FILLET (enter)

UNDO : Same as the U command but with more options

Command: UNDO (enter)

REDO : Reverses the previous command if it was an undo

Command: REDO (enter)

OFFSET : Creates parallel copies of lines, arcs, and circles

Command: OFFSET (enter)

DIVIDE : Places markers along selected objects dividing them into equal parts

Command: DIVIDE (enter)

v) Creating Layers

LAYER : Creates named drawing layers and assigns color and line type properties to those layers.

Command: LAYER (enter)

A Layer & Line type Properties dialog box will be displayed. To add a new layer, pick the New button. A new layer listing appears, using a default name of Layer1. the layer name can be changed by highlighting the layer name. Colors and Line types can be assigned to each new layer by picking the color box to assign a color and picking the line type box to assign a line type.

4.4.3 Limit setting

The drawing "limits" as defined by AutoCAD is a rectangular area in which you are allowed to draw. This is the area which will be displayed when you "zoom" "all." It is also the area in which the visible grid and snap grid are extended to

However, in practical terms, if we want to present a drawing like the manually pencil drawn 1:1 scale (full size) drawing, we can tell AutoCAD the drawing space we require and then AutoCAD will display a grid to the extent of the drawing limits specified.

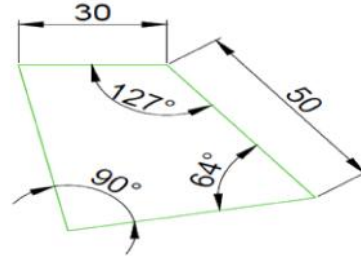
To set drawing limits in AutoCAD, you can:

1. From Format menu, select Drawing Limits, or type LIMITS at command line
2. Enter the coordinates for a point at the lower-left corner of the grid limits.(0:0)
3. Enter the coordinates for a point at the upper-right corner of the grid limits.
4. At the Command prompt, enter grid display, and enter a value of 0.

4.4.4 Drawing of simple Machine parts

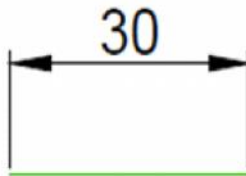
Detailed Drawings

The following figure is a 2D figure and where all data are being provided. We should be able to replicate this with ease.



Step 1

Draw the following line



Step 2

Draw the second line starting from the right end of the previously drawn line.

Use @50<-53 to draw it, and you should have the following.

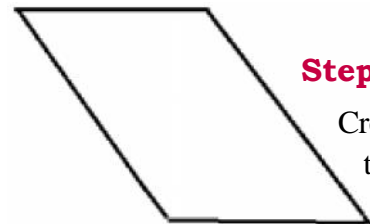
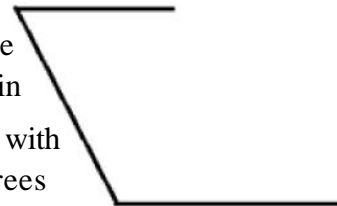


Step 3

Draw a line starting on the left end of the 30 unit line using @50<-79 (50 of length is arbitrary chosen and the angle 79 is found by doing $360 - 90 - 64 - 127$ - the Sum of angles in any Quadrilateral is 360 degrees)

Step 4

Draw a line of of an arbitrary chosen length but make sure it forms 64 degrees with the line we have created in (You can do this by creating a line aligned with the line with created in Step 2 and rotating it with 64 degrees Counterclockwise)

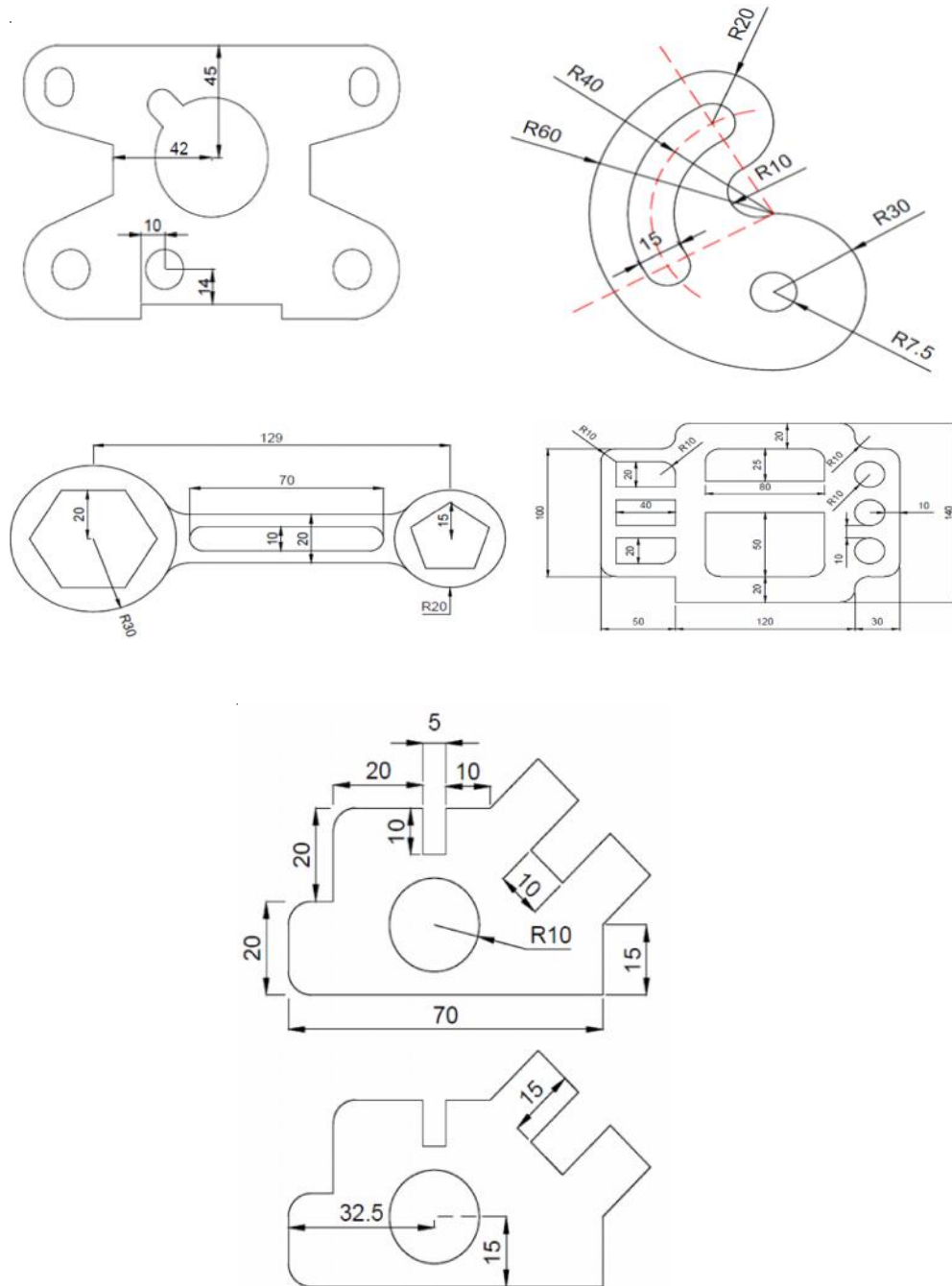
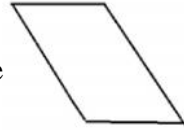


Step 5

Create a line on the open side of the quadrilateral from the 2 points such as having the following.

Step 6

Use the Fillet command with $R=0$ to join those two lines to close that hole at the bottom of the figure



ASSESSMENT ACTIVITIES

Drawing, Viva

Theory Evaluation Questions

- 1) Explain Measuring commands and its use (5)
- 2) Explain Drawing Commands and its use (5)
- 3) Explain Display Commands and its use (5)
- 4) Explain Editing Commands and its use (5)
- 5) Draw a mechanical parts in AutoCAD (15)

LIST OF PRACTICALS

Module 4

Irrigation and precision farming

Unit 1 Irrigation

1. Design sprinkler system, Practice different Lay-outs & installation
2. Design Drip system Practice different Lay-outs & installation
3. Prepare a seminar report on the topic of mist irrigation and Fogger system

Unit 2 Pump for irrigation

1. Dismantle and identify the parts of C F pump and assemble it
2. Installation and maintenance of C F pumps
3. Solve the problems related to WHP calculation
4. Determine efficiency of pumps
5. Identify parts of Jet pumps
6. Dismantling and assembling of Reciprocating pump

Unit 3 Green house technology

1. To practice Designing structure for green house
2. Selection of covering materials
3. Make tiny model of Green House structure
4. Select humidity control measures for green house

Unit4 Mechanical auto-cad

1. Introduction to Auto-Cad
2. Learn commands
3. Limit setting
4. Drawing of simple Machine parts

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- 1) Elements of Agricultural Engineering, Jagadheeswar Sahai
- 2) Fundamentals of Agricultural Engineering, Er. Sanjay Kumar, Er. Vishal Kumar, Dr. Ram Kumar Sahu
- 3) Agricultural Engineering, A M Michael & T P Ojha)
- 4) Machine Drawings and Mechanical Auto CAD, P I Varghese

Appendix

Important definitions used in agricultural engineering

Air blast sprayer: It is a machine utilizing flow of air to carry droplets or particles of spray material

Bio mass: It is the plant matter created by the process of photosynthesis

Broadcasting: It is the process of scattering the seeds on the surface of seed bed in a random manner

Brush Feed Mechanism: A feed mechanism in which a rotating brush regulates the flow of seed from the hopper

Bund Former: It is an implement which gathers soil and forms bund with the help of true forming boards

Chisel plough: It is a plough used to cut through hard soil by means of a number of narrow things

Combine Harvester: It is a machine to cut a standing crop thresh and separate the grains from straw and other plant materials

Dibbling : It is the process placing the seeds in the holes made in seed bed and covering them

Ploughing: It is the primary tillage operation, performed to shatter soil uniformly with partial or completely inversion

Sowing: It is the process of placing the seeds in the line at a desired depth

Subsoiler: It is a plough with a single tine which may penetrate into the soil to a depth up to 100 cm.

Transplanting: It is approved of removing the seedlings from a nursery and planting them in the field

Windmill: It is the machine which extracts energy from the wind and produce mechanical energy