**TILLAGE - OBJECTIVES AND TYPES. FURROW TERMINOLOGY AND METHODS OF PLOUGHING. FIELD CAPACITY AND FIELD EFFICIENCY**

**TILLAGE**

Mechanical manipulation of soil to provide favourable condition for proper crop

growth is called tillage. 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 crops to penetrate and spread into the soil.

**Objectives of Tillage**

1. To prepare a desirable soil structure for a deep seed bed or a root bed suitable for different types of crops.( A granular structure is desirable to allow rapid infiltration and good retention of rainfall, to provide adequate air capacity and exchange with in the soil and to minimize resistance to root penetration. A good seed bed generally considered to imply finer particles and greater firmness in the vicinity of the seed)
2. To control weeds or to remove unwanted crop plants (thinning)
3. To manage plant residues. ( Mixing of trash is desirable from the tilth and decomposition stand points and retention of trash in the top layers reduce erosion)
4. To minimize soil erosion. (By following counter tillage, listing and proper placement of trash).
5. To establish specific surface configurations for planting, irrigating, drainage, harvesting operations etc.
6. To incorporate and mix fertilizers, pesticides, soil amendments etc. in to the soil

**Classification of Tillage**

Tillage operations for seed bed preparations are classified as:

 i) Primary tillage

ii) Secondary tillage.

**1. Primary tillage**

**T**he initial major soil working operation designed to plough the soil deeply to

reduce soil strength, cover plant materials and rearrange aggregates is called primary tillage.

**The objectives of primary tillage are**

a. To reduce soil strength

b. To rearrange aggregates

c. To cover plant materials and burry weeds

d. To kill insects and pests

The implements used for primary tillage are called as primary tillage implements. They include many animal drawn and tractor drawn implements. Animal drawn implements mostly include indigenous ploughs and mould-board ploughs. Tractor drawn implements include mould-board ploughs, disc ploughs, heavy duty disk harrows,subsoil ploughs, chisel ploughs and other similar implements.

**2. Secondary tillage**

Lighter and finer tillage operations performed in the soil after primary tillage to

create proper soil tilth and. surface configuration for seeding and planting are called secondary tillage operations. Secondary tillage operations are generally done on the surface soil. They do not cause much soil inversion and shifting of soil from one place to other. They consume less power per unit area compared to primary tillage operations.

**The main objectives of secondary tillage are**

* To break the big clods and make the soil surface uniform and leveled as needed for a seed bed
* To destroy grasses and weeds in the field.
* To cut crop residues and mix them with top soil

The implements used for secondary tillage operations are called secondary

tillage implements. They include different types of harrow, cultivators, sweeps, clod crushers, levellers, bund formers, ridge ploughs etc.

**TILLAGE SYSTEMS**

Tillage system consists of sequences of operations that manipulate the soil in

order to produce a crop. The operations include tilling, planting, fertilization, pesticide application, harvesting, and residue chopping or shredding. The ways in which these operations are implemented affect the physical and chemical properties of the soil, which in turn affect plant growth.

There are two types of tillage systems namely a) conservation tillage system

including no-till, ridge till and mulch till systems and b) other than conservation tillage systems namely a) reduced tillage system and b) conventional tillage system

**Conservation tillage (30 percent or more crop residue left after planting)**

Any tillage and planting system that covers 30 percent or more of the soil surface with crop residue, after planting, to reduce soil erosion by water or any system that maintains at least 1,120 kilogram per hectare of flat, small grain residue equivalent on the surface throughout the critical wind erosion period is called conservation tillage system Conversion tillage systems are further classified as a) no-till, b) ridge-till, and c) mulch-till. Systems

**1. No- till:** No-till is defined as a system in which the soil is left undisturbed from harvest to planting except for nutrient injection. Planting or drilling is accomplished in a narrow seedbed or slot created by coulters, row cleaners, disk openers, in-row chisels, or rototillers. Weed control is accomplished primarily with herbicides. Cultivation may be used for emergency weed control.

**2. Ridge-till:** In ridge-till, the soil is also left undisturbed from harvest to planting except for nutrient injection. Planting is completed in a seedbed prepared on ridges with sweeps, disk openers, coulters, or row cleaners. Residue is left on the surface between ridges. Weed control is accomplished with herbicides and/or cultivation. Ridges are rebuilt during cultivation.



**3. Mulch-till:** The soil is disturbed before planting. Tillage tools such as chisels, field cultivators, disks, sweeps or blades are used. Weed control is accomplished with herbicides and/or cultivation. Mulch-till is a category that includes all conservation tillage practices other than no-till and ridge-till. Two tillage practices that fall into this category are zone-till and strip-till. Both of these tillage practices involve tilling a strip into which seed and fertilizer are placed

**Other tillage systems (less than 30 percent crop residue left after planting)**

Tillage systems that leave less than 30 percent crop residue after planting are

not classified as conservation tillage. However, these systems may meet erosion control goals with or without other supporting conservation practices, such as strip cropping, contouring, terracing, etc.

1. **Reduced-till:** Reduced-till systems leave 15-30 percent residue cover after planting or 560 to 1,120 kilograms per hectare of small grain residue equivalent throughout the critical wind erosion period.

 **2) Conventional-till:** Conventional-till systems leave less than 15 percent residue cover after planting, or less than 560 kilograms per hectare of small grain residue equivalent throughout the critical wind erosion period. These systems generally involve plowing or some other form of intensive tillage.

**ANOTHER CLASSIFICATION OF TILLAGE SYSTEMS**

**There are two types of tillage namely**

a. Conventional tillage or clean tillage

b. Conservation tillage

**1. Conventional tillage or clean tillage:** Ploughing the entire field several times to prepare a seed bed is called conventional tillage

**2. Conservation tillage:** Ploughing the field with lesser number of passes over the entire land or ploughing only in the required space of the land and then sowing is called conservation tillage. . Different types of conservation tillage are as fallows

**a. Minimum Tillage -**Minimum soil manipulation necessary to meet tillage requirements

**c. Mulch Tillage –** Tillage operations in which nearly 30 % of crop residue or other mulching materials are left on or near the soil surface is called mulch tillage.

 

**Mulch tillage**

**d. Rotary Tillage** for crop production is called minimum tillage.

**b. Strip Tillage -** In strip tillage system only isolated bands of soil are tilled.**-** Tillage

operations employing rotary action of the tool to cut, break and mix the soil is called rotary tillage..



**Strip tillage in wheat Strip tillage in corn**

**e. Combined Tillage –** Tillage operations utilizing simultaneously two or more different types of tillage tools or implements to simplify, control or reduce the number of operations over a field is called combined tillage.

**PLOUGHING OF LAND**

Ploughing of land separates the top layer of soil into furrow slices. The furrows are turned sideways and inverted to a varying degree, depending upon the type of plough being used. It is a primary tillage operation, which is performed to shatter soil uniformly with partial or complete soil inversion.

**Furrow terminologies**

There are a few important terms frequently used in connection with ploughing of a land.



 **Fig. Plough furrow**

**(i) Furrow:** It is a trench formed by an implement in the soil during the field operation

 **(ii) Furrow slice:** The mass of soil cut, lifted and thrown to one side is called furrow

slice.

**(iii) Furrow wall:** It is an undisturbed soil surface by the side of a furrow.

**(iv) Crown:** The top portion of the turned furrow slice is called crown.

**(v) Back furrow:** A raised ridge left at the centre of the strip of land when ploughing is started from centre to side is called back furrow. When the ploughing is started in the middle of a field**,** furrow is collected across the field and while returning trip another furrow slice is lapped over the first furrow. This is the raised ridge which is named as back furrow

**(vi) Dead furrow:** An open trench left in between two adjacent strips of land after

finishing ploughing is called dead furrow (Fig.1c).

**(vii) Head land:** While ploughing a land with a tractor a strip of unploughed land is left at each end of the field for the tractor to turn, which is called head land. At the end of each trip, the plough is lifted until the tractor and the plough have turned and are in position to start the return trip. The head land is about 6 meters wide for two or three bottom tractor plough and one meter more for each additional bottom.