

## **Tillage – Definition – objectives – types of tillage - modern concepts of tillage – main field preparation**

### **Tillage**

Tillage operations in various forms have been practiced from the very inception of growing plants. Primitive man used tools to disturb the soils for placing the seeds. The word tillage is derived from 'Anglo-Saxon' words *Tilian* and *Teolian*, meaning 'to plough and prepare soil for seed to sow, to cultivate and to raise crops'. **Jethrotull**, who is considered as father of tillage suggested that thorough ploughing is necessary so as to make the soil into fine particles.

**Tillage** is the mechanical manipulation of soil with tools and implements for obtaining conditions ideal for seed germination, seedling establishment and growth of crops.

**Tilth** is the physical condition of soil obtained out of tillage (or) it is the result of tillage. The tilth may be a coarse tilth, fine tilth or moderate tilth.

### **Objectives of tillage**

The main objectives of tillage are,

- To prepare a good seed bed which helps the germination of seeds.
- To create conditions in the soil suited for better growth of crops.
- To control the weeds effectively.
- To make the soil capable for absorbing more rain water.
- To mix up the manure and fertilizers uniformly in the soil.
- To aerate the soil.
- To provide adequate seed-soil contact to permit water flow to seed and seedling roots.
- To remove the hard pan and to increase the soil depth.

To achieve these objectives, the soil is disturbed / opened up and turned over.

**Types of tillage:** Tillage operations may be grouped into

1. On season tillage
2. Off-season tillage

### **1. On-season tillage**

Tillage operations that are done for raising crops in the same season or at the onset of the crop season are known as on-season tillage. They may be preparatory cultivation and after cultivation.

**A. Preparatory tillage:** This refers to tillage operations that are done to prepare the field for raising crops. It consists of deep opening and loosening of the soil to bring about a desirable tilth as well as to incorporate or uproot weeds and crop stubble when the soil is in a workable condition.

### ***Types of preparatory tillage***

- a. Primary tillage
- b. Secondary tillage

**a. Primary tillage:** The tillage operation that is done after the harvest of crop to bring the land under cultivation is known as primary tillage or ploughing. Ploughing is the opening of compact soil with the help of different ploughs. Country plough, mould board plough, borse plough, tractor and power tiller drawn implements are used for primary tillage.

**b. Secondary tillage:** The tillage operations that are performed on the soil after primary tillage to bring a good soil tilth are known as secondary tillage. Secondary tillage consists of lighter or finer operation which is done to clean the soil, break the clods and incorporate the manure and fertilizers. Harrowing and planking is done to serve those purposes.

*Planking* is done to crush the hard clods, level the soil surface and to compact the soil lightly. Harrows, cultivators, *Guntakas* and spade are used for secondary tillage.

**c. Layout of seed bed:** This is also one of the components of preparatory tillage. Leveling board, buck scrapers etc. are used for leveling and markers are used for layout of seedbed.

**B. After cultivation (Inter tillage):** The tillage operations that are carried out in the standing crop after the sowing or planting and prior to the harvesting of the crop plants are called after tillage. This is also called as inter cultivation or post seeding/ planting cultivation. It includes harrowing, hoeing, weeding, earthing up, drilling or side dressing of fertilizers etc. Spade, hoe, weeders etc. are used for inter cultivation.

**2. Off-season tillage:** Tillage operations done for conditioning the soil suitably for the forthcoming main season crop are called off-season tillage. Off season tillage may be, post harvest tillage, summer tillage, winter tillage and fallow tillage.

**Special purpose tillage:** Tillage operations intended to serve special purposes are said to be special purpose tillage. They are,

**a. Sub-soiling:** To break the hard pan beneath the plough layer, special tillage operation (chiseling) is performed to reduce compaction. Sub-soiling is essential and once in four to five years where heavy machineries are used for field operations, seeding, harvesting and transporting. Advantages of sub-soiling are, greater volume of soil may be obtained for cultivation of crops, excess water may percolate downward to recharge the permanent water table, reduce runoff and soil erosion and roots of crop plants can penetrate deeper to extract moisture from the water table.

**b. Clean tillage:** It refers to working of the soil of the entire field in such a way no living plant is left undisturbed. It is practiced to control weeds, soil borne pathogen and pests.

**c. Blind tillage:** It refers to tillage done after seeding or planting the crop (in a sterile soil) either at the pre-emergence stage of the crop plants or while they are in the early stages of growth so that crop plants (sugarcane, potato etc.) do not get damaged, but, extra plants and broad leaved weeds are uprooted.

**d. Dry tillage:** Dry tillage is practiced for crops that are sown or planted in dry land condition having sufficient moisture for germination of seeds. This is suitable for crops like broadcasted rice, jute, wheat, oilseed crops, pulses, potato and vegetable crops. Dry tillage is done in a soil having sufficient moisture (21-23%). The soil becomes more porous and soft due to dry tillage. Besides, the water holding capacity of the soil and aeration are increased. These conditions are more favourable for soil micro-organisms.

**e. Wet tillage or puddling:** The tillage operation that is done in a land with standing water is called wet tillage or puddling. Puddling operation consists of ploughing repeatedly in standing water until the soil becomes soft and muddy. Puddling creates an impervious layer below the surface to reduce deep percolation losses of water and to provide soft seed bed for planting rice. Puddling is done in both the directions for the incorporation of green manures and weeds. Wet tillage destroys the soil structure and the soil particles that are separated during puddling settle later. Wet tillage is the only means of land preparation for transplanting semi-aquatic crop plant such as rice. Planking after wet tillage makes the soil level and compact. Puddling hastens transplanting operation as well as establishment of seedlings. Wet land ploughs or worn out dry land ploughs are normally used for wet tillage.

### **Depth of ploughing**

The desirable depth of ploughing is 12 to 20 cm for field crops. The ploughing depth varies with effective root zone of the crop. The depth of ploughing is 10-20 cm for shallow rooted crops and 15-30 cm for deep rooted crops.

### **Number of ploughing**

Number of ploughing depends on soil conditions, time available for cultivation between two crops and type of cropping systems. Zero tillage is practiced in rice fallow pulses. Minimum number of ploughing is taken up at optimum moisture level to bring favourable tilth depending on need of the crop.

### Time of ploughing

The optimum soil moisture content for tillage is 60% of field capacity.

### Modern concepts in tillage:

Conventional tillage involves primary tillage to break open and turn the soil followed by secondary tillage to obtain seed bed for sowing or planting. With the introduction of herbicides in intensive farming systems, the concept of tillage has been changed. Continuous use of heavy ploughs create hard pan in the subsoil, results in poor infiltration. It is more susceptible to run-off and erosion. It is capital intensive and increase soil degradation. To avoid these ill effects, modern concepts on tillage is in rule.

**1. Minimum tillage:** It aims at reducing tillage operations to the minimum necessity for ensuring a good seed bed. The advantages of minimum tillage over conventional tillage are,

- The cost and time for field preparation is reduced by reducing the number of field operations.
- Soil compaction is comparatively less.
- Soil structure is not destroyed.
- Water loss through runoff and erosion is minimum.
- Water storage in the plough layer is increased.

Tillage can be reduced in 2 ways

1. By omitting operations which do not give much benefit when compared to the cost.
2. By combining agricultural operations like seeding and fertilizer application.

The minimum tillage systems can be grouped into the following categories,

1. Row zone tillage

Primary tillage is done with mould board plough in the entire area of the field; secondary tillage operations like discing and harrowing are reduced and done only in row zone.

2. Plough plant tillage

After the primary tillage, a special planter is used for sowing. In one run over the field, the row zone is pulverized and seeds are sown by the planter

3. Wheel track tillage

Primary ploughing is done as usual. Tractor is used for sowing; the wheels of the tractor pulverize the row zone in which planting is done.

In all these systems, primary tillage is as usual. However, secondary tillage is replaced by direct sowing in which sown seed is covered in the row zone with the equipment used for sowing.

**2. Zero tillage (No tillage):** In this, new crop is planted in the residues of the previous crop without any prior soil tillage or seed bed preparation and it is possible when all the weeds are controlled by the use of herbicides. Zero tillage is applicable for soils with a coarse textured surface horizon, good internal drainage, high biological activity of soil fauna, favourable initial soil structure and an adequate quantity of crop residue as mulch. These conditions are generally found in *Alfisols*, *Oxisols* and *Ultisols* in the humid and sub-humid tropics.

### *Till planting*

Till planting is one method of practicing zero tillage. A wide sweep and trash bar clears a strip over the previous crop row and planter opens a narrow strip into which seeds are planted and covered. Here, herbicide functions are extended. Before sowing, the vegetation present has to be destroyed for which broad spectrum non selective herbicides like glyphosate, paraquat and diquat are used.

### Advantages

- Zero tilled soils are homogenous in structure with more number of earthworms.
- Organic matter content increases due to less mineralization.

- Surface run-off is reduced due to presence of mulch.

#### Disadvantages

- Higher amount of nitrogen has to be applied for mineralization of organic matter in zero tillage.
- Perennial weeds may be a problem.
- High number of volunteer plants and buildup of pests.

### 3. Stubble mulch tillage or stubble mulch farming

Soil is protected at all times either by growing a crop or by leaving the crop residues on the surface during fallow periods. Sweeps or blades are generally used to cut the soil up to 12 to 15 cm depth in the first operation after harvest and depth of cut is reduced during subsequent operations. When large amount of residues are present, a disc type implement is used for the first operation to incorporate some of the residues into the soil. This hastens the decomposition but still keeps enough residues on top soil.

Two methods for sowing crops in stubble mulch tillage are,

1. Similar to zero tillage, a wide sweep and trash bars are used to clear a strip and a narrow planter shoe opens a narrow furrow into which seeds are placed.
2. A narrow chisel of 5-10 cm width is worked through the soil at a depth of 15-30 cm leaving all plant residues on the surface. The chisel shatters the tillage pans and surface crusts. Planting is done with special planters.

#### Disadvantages of stubble mulch farming

- The residues left on the surface interfere with seed bed preparation and sowing operations.
- The traditional tillage and sowing implements or equipments are not suitable under these conditions.

**4. Conservation tillage:** The major objective is to conserve soil and soil moisture. It is a system of tillage in which organic residues are not inverted into the soil such that they remain on surface as protective cover against erosion and evaporation losses of soil moisture. If stubble forms the protective cover on the surface, it is usually referred to as stubble mulch tillage. The residues left on soil surface interfere with seed bed preparation and sowing operations. It is a year round system of managing plant residue with implements that undercut residues, loosen the soil and kill the weeds.

#### Advantages

- Energy conservation through reduced tillage operations.
- Improve the soil physical properties.
- Reduce the water runoff from fields.

### Main field preparation:

Tillage operations are generally classified in to two, preparatory cultivation and after cultivation. The preparatory cultivation or tillage is operations that are done before the cultivation. This preparatory cultivation is generally called as main field preparation. The main field preparation involves three processes, viz., primary tillage, secondary tillage and lay-out for sowing. Some of the important primary tillage implements are country plough, mould board plough, disc plough, chisel plough etc. Cultivators and harrows are generally used for secondary tillage purpose. However, in practical means, the first two (primary and secondary tillages) may not have any key difference, since; both operations are mainly carried out with same implement. Country plough and cultivators are used for both the purposes. After thorough ploughing, the field modified in to suitable way for planting such as ridges and furrows or beds and channels or pit according to the need of the crops. Such field modifications are mandatory for better crop production.