

## SECONDARY TILLAGE

Tillage operations following primary tillage which are performed to create proper soil tilth for seeding and planting are secondary tillage. These are lighter and finer 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. These operations consume less power per unit area compared to primary tillage operations. Secondary tillage implements may be tractor drawn or bullock drawn implements.

### 1. Harrow

Harrow is a secondary tillage 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 the materials with the soil. There are several types of harrow used in India such as disc harrow, spike tooth harrow, spring tooth harrow, acme harrow, patela, triangular harrow, bade harrow, guntaka and reciprocating power harrow.

#### 1.1. Disc harrow

It is a harrow, which performs the harrowing operation by means of a set, or a number of sets of rotating slat discs, each set being mounted on a common shaft. Disc harrow is found very suitable for hard ground, full of stalks and grasses. It cuts the lumps of soil, clods and roots. Discs are mounted on one, two or more axles which may be set at a variable angle to the line of motion. As the harrow is pulled ahead, the discs rotate on the ground. Depending upon the disc arrangements, disc harrows are divided into two classes a) Single action and b) Double action.

##### Single action disc harrow

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 (Fig. 1).

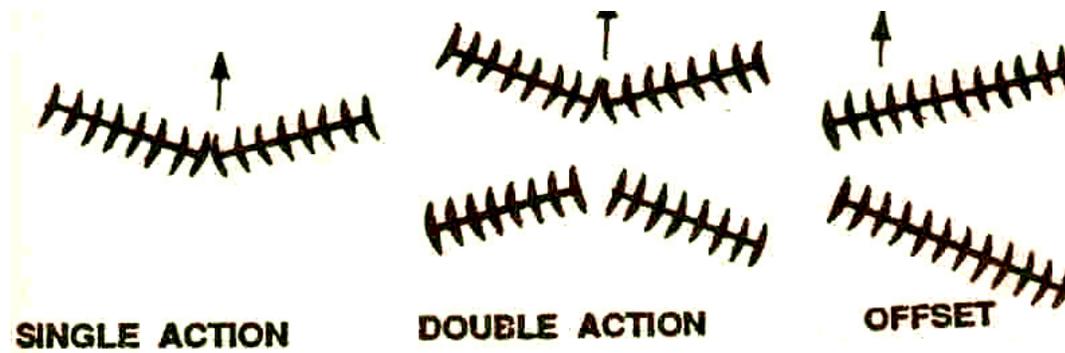


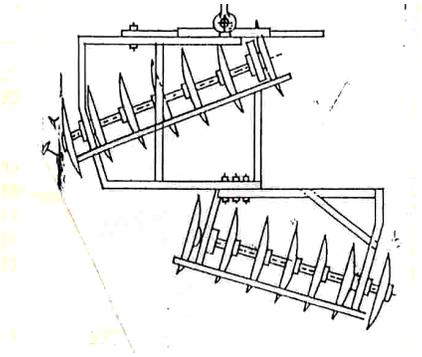
Fig.1. Types of disc harrow

##### Double action disc harrow

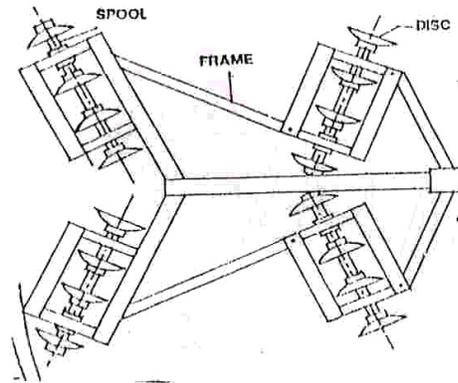
A disc harrow consisting of two or more gangs, in which a set of one or two gangs follow behind the set of the other one or two, arranged in such a way that the front and back gangs throw the soil in opposite directions. (Fig.1). Thus the entire field is worked twice in each trip. It may be of two types a) Tandem and b) Off-set.

a) **Tandem disc harrow** - It is a disc harrow comprising of four gangs in which each gang can be angled in opposite direction (Fig.2).

**b) Off-set disc harrow-** It is a disc harrow with two gangs in tandem, capable of being off-set to either side of the centre line of pull. Two gangs are fitted one behind the other. the soil is thrown in both directions because discs of both gangs face in opposite directions. (Fig.3).



**Fig.2. Tandem disc harrow**



**Fig.3. Offset disc harrow**

A disc harrow mainly consists of disc, gang, gang bolt, gang central lever, spool or arbor bolt or spacer, bearings, transport wheels, scraper and weight box.

**i. Disc:** It is a circular concave revolving steel plate used for cutting and inverting the soil. Disc is made of high quality heat-treated hardened steel. Tractor drawn disc harrows have concave discs of size varying from 35-70 cm diameter. Concavity of the disc affects penetration and pulverization of soil. Usually two types of disc are used in disc harrows, plain disc and cut away disc.

**ii. Gang:** Each set of discs that are mounted on a common shaft is called the gang.

**iii. Gang bolt or arbor bolt:** It is a long heavy square headed bolt from the other end, a set of discs are mounted on the gang bolt. The spacing between the discs on the gang bolt ranges from 15 to 25 cm for light duty and 25 to 30 cm for heavy-duty harrows.

**iv. Gang control lever:** A lever, which operates the gang mechanisms of the disc harrow, is called the gang control lever.

**v. Spool or spacer:** The flanked tube, mounted on the gang bolt between every two discs to prevent the lateral movement of the disc on the shaft is called the "spool" or "spacer".

**vi. Bearing:** Bearing is essential to counteract the end thrust of the gang due to soil thrust. The harrow bearings are subjected to heavy radial and thrust loads. Chilled cast iron bearings are used to handle heavy radial and thrust loads and they are also used due to their durability.

**vii. Transport wheel:** In trailing type disc harrow, the transport wheels are provided for transport work on roads and for preventing the edges of the discs from damage. Mounted type disc harrows do not require wheels for transport work.

**viii. Scraper:** It prevents disc from clogging. It removes the soil that may stick to the concave side of the disc.

**ix. Weight box:** A box like frame is provided on the main frame of the harrow for putting additional weight on the implement. Additional weight helps in increasing the penetration of the disc in the soil.

A sharp edged disc has more effective penetration compared to blunt edged disc. It is observed that penetration is better in low speed than in high speed. The following are a few adjustments for obtaining higher penetration

- i. By increasing the disc angle
- ii. By adding additional weight in harrow
- iii. By lowering the hitch point
- iv. By using the sharp edged discs of small diameter and losses concavity
- v. By regulating the optimum speed.

### 1.2. Spike tooth harrow

It is a harrow with peg shaped teeth of diamond cross section to a rectangular frame. It is used to break the clod, stir the soil, uproot the weeds, level the ground, break the soil and cover the seeds. Its principle is to smoothen and level the soil directly after ploughing. Spike tooth harrows may be of rigid type and flexible type. Tractor drawn harrows are usually flexible type. It has got the advantage of being turned up for transporting purpose (Fig.4.) This harrow mainly consists of teeth, tooth bar frame, clamps, guard, braces, levers and hooks.

### 1.3 Spring tooth harrow

It is a harrow with tough flexible teeth, suitable to work in hard and stony soils. Spring tooth harrow is fitted with springs having loops of elliptical shape. It gives a spring action in working condition. It is used in the soil when obstruction like stone, roots and weeds are hidden below the ground surface. This type pulverizes the soil and helps in killing weeds. The levers are provided for setting the teeth for varying the depth of harrowing (Fig.5). For light harrowing, the adjustment is done in slanting position. Draft hooks on each corner of every section for hitching purpose.

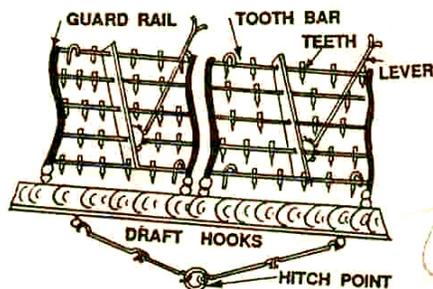


Fig.4. Spike tooth harrow

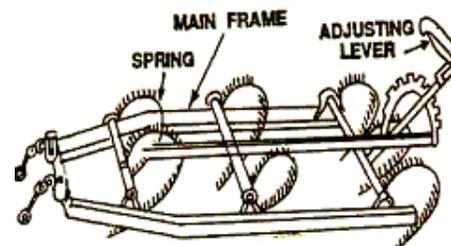


Fig.5. Spring tooth harrow

### 1.4. Acme harrow

It is a special type of harrow having curved knives. It is also called as knife harrow. The front part of the knife breaks the soil and crushes the clods (Fig.6). This harrow obtains a good pulverization. It is good for mulching also.

### 1.5. Patela

It is a wooden plank used for smoothening the soil and crushing the weeds. It is also used for breaking clods, packing and levelling the ploughed soil and to remove the weeds. It is made of a wooden plank with a number of curved steel hooks bolted to a steel angle

section, which are fixed or hinged to the rear side of the plank (Fig.7). The cutting edge levels and packs the soil and the curved hooks uproot and collect the weeds.

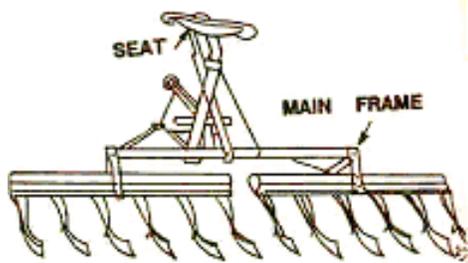


Fig.6. Acme harrow

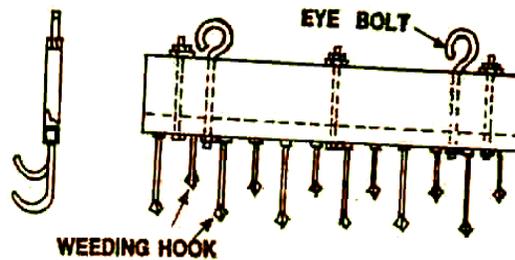


Fig. 7. Patela

### 1.6. Triangular harrow

It is a spike tooth harrow with triangular frame (Fig.8). The frame is made of wood and pointed spikes are fitted in the frame. The teeth of the spikes are fixed and not adjustable.

### 1.7. Blade harrow (Bakhar)

It is an implement, which consists of one or more blades attached to the beam or frame, used for shallow working of the soil (Fig.9) with minimum soil inversion. It is used to prepare seedbeds mostly in clayey soils. It works like a sweep, which moves into top surface of the soil without inverting the soil.

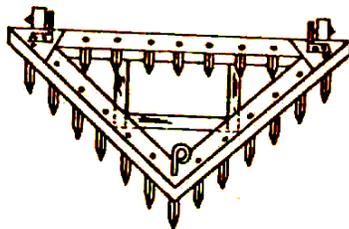


Fig. 8. Tri angular harrow

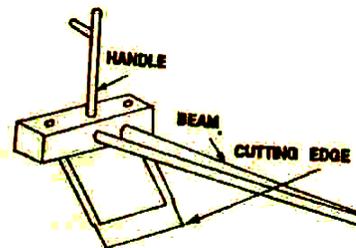


Fig.9. Blade harrow

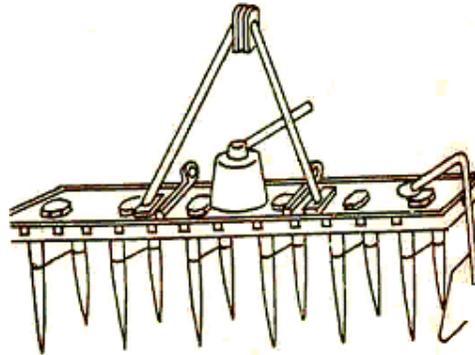
### 1.8. Guntaka

It is an important type of blade harrow. It is an implement, which consists of one or more blades attached to a frame or beam. It is used for shallow working of the soil with minimum soil inversion. It is mainly used to prepare the seed bed mostly in clay soils. The function of Bakhar the same as that of the guntaka.

### 1.9. Reciprocating power harrow

It is a harrow fitted with rigid tynes driven by the power take off in a reciprocating, transverse or rotary motion as the machine moves forward. The power tiller harrow is a rear mounted reciprocatory comb type (fig.10). It has two horizontal oscillating arms having staggered pegs in two rows at 200 mm spacing. Two sets of slider crank mechanisms provide power from power tiller PTO through universal joint and bevel gear reduction box to the arms. An eccentric embedded flywheel actuates the pitman. The two arms move in opposite directions and hence the implement is dynamically balanced. The amplitude of vibration is

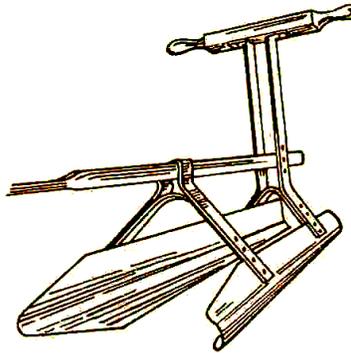
200 mm and the frequency of operation is 400 cycles per minute. A transport wheel provided in the rear of the unit ensures depth control. The unit is attached to the power tiller through the hitch point provided in front portion of the unit. The oscillating pegs breaks the clod, pulverizes the soil to a fine tilth.



**Fig.10. Reciprocating Harrow**

## 2. Bund former

It is used for making bunds or ridges by collecting the soil. Bunds are required to hold water in the soil, thereby one can conserve moisture and prevent run-off. The size of the bund former is determined by measuring the maximum horizontal distance between the two rear ends of the farming boards. Bund former consists of forming board, beam and handle (Fig.11).



**Fig. 11. Bund former**

## 3. Ridger

It is an implement importantly used to form ridges required for sowing row crop seeds and plants in well-tilled soil. The ridger is also used for forming field or channels, earthing up and similar other operations. Ridger is also known as ridging plough and double mould board plough. The ridger generally has 'V' shaped or wedge shaped share fitted to the frog. The nose or tip of share penetrates into the soil and breaks the earth. The mould boards lift, invert and also cast aside the soil, forming deep channels and ridges of the required size. A ridger consists of beam, clevis, frog, handle, mould boards, share and sliding share.

## 4. Puddler

Puddler is an implement for churning the soil with water. It is used to prepare paddy fields with standing water after initial ploughing with country plough. It breaks up the clods and churns the soil. The main purpose of puddling is to reduce leaching of water or decrease

percolation of water, to kill the weeds by decomposition and to facilitate transplantation of paddy seedlings by making the soil softer. Puddling is done in standing water of 5-10 cm depth. A common puddler has puddling units each having four straight blades or paddles or fan type blades or squirrel type blade mounted on an axle. The axle with the puddling units is fully mounted on two bearings fitted on a frame made of metal or wood. The weight of the puddler is 30-40 kg. A puddler consists of a frame, puddling unit, axle, metal cross beam and handle.

## 5. Leveller

Land levelling is expected to bring permanent improvement in the value of land. Levelling work is carried out to modify the existing contours of land so as to achieve certain objectives desired for efficient agricultural production system. These objectives include

- (i) efficient application of irrigation water,
- (ii) improved surface drainage,
- (iii) minimum soil erosion
- (iv) increased conservation of rain water specially on dry lands and
- (v) provision of an adequate field size and even topography for efficient mechanisation.

## 6. CULTIVATORS

It is an implement for inter cultivation with laterally adjustable tines or discs to work between crop rows. 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. The following are a few important functions performed by a cultivator.

1. Interculture the fields.
2. Destroy the weeds in the field.
3. Aerate the soil for proper growth of crops.
4. Conserve moisture by preparing mulch on the surface.
5. To sow seeds when it is provided with sowing attachments.
6. To prevent surface evaporation and encourage rapid infiltration of rain water into the soil.

The cultivator can be 1) Disc cultivator, 2) Rotary cultivator, 3) Tine cultivator.

**Disc cultivator** : It is a cultivator fitted with discs.

**Rotary cultivator** : It is a cultivator with tines or blades mounted on a power driven horizontal shaft.

**Tine cultivator** : It is a cultivator fitted with tines having shovels.

### **Tractor Drawn Cultivator**

#### **Trailed type cultivator**

It consists of a main frame which carries a number of cross members to which tines are fitted. At the forward end of the cultivator, there is a hitch arrangement for hitching purpose. A pair of wheels are provided in the cultivator. The height of the hitch is adjusted so that main frame remains horizontal over a range of depth setting. The tines in each row are spaced widely to allow free passage of the soil and trash around them. The tines in subsequent rows are staggered so that the implement can cover the entire width nicely.

## Mounted Cultivator

Tractors fitted with hydraulic lift operate the mounted type cultivators. A rectangular frame of angle iron is mounted on three point hydraulic linkage of the tractor. The cross members carry the tines in two staggered lines. Depending upon the type of soil and crop, shovels are chosen for use on the cultivators. Usually tractor drawn cultivators are of two types, depending upon the flexibility and rigidity of tines (i) Cultivator with spring loaded tines (ii) Cultivator with rigid tynes.

### Cultivator with spring loaded tines

A tine hinged to the frame and loaded with a spring so that it swings back when an obstacle is encountered, is called spring loaded line. Each of the tine of this type of cultivator is provided with two heavy coil springs (Fig. 12), pre-tensioned to ensure minimum movement except when an obstacle is encountered. The springs operate, when the points strike roots or large stones by allowing the tines to ride over the obstruction, thus preventing damage. On passing over the obstruction, the tines are automatically reset and work continues without interruption. The tines are made of high carbon steel and are held in proper alignment on the main frame members. This type of cultivator is particularly recommended for soils which are embedded with stones or stumps.

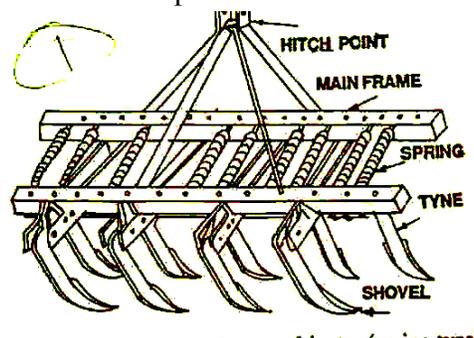


Fig. 12. Tractor drawn cultivator

### Cultivator with rigid tines

Rigid tines of the cultivators are those tines which do not deflect during the work in the field. The tynes are bolted between angle braces, fastened to the main bars by sturdy clamps and bolts. Spacing of the tines is changed simply by slackening the bolts and sliding the braces to the desired position. Since rigid tines are mounted on the front and rear tool bars, the spacing between the tynes can be easily adjusted without getting the tines choked with stubbles of the previous crop or weed growth. A pair of gauge wheel is used for controlling the depth of operation.