FARM MACHINERY & IMPLEMENTS- II

IMPLEMENTS FOR INTERCULTURAL OPERATIONS – HOES, LONG HANDLED WEEDERS, CULTIVATORS, AND ROTARY TILLERS

The operations performed in the field after sowing but before harvesting the crop are called as intercultural operations.

Interculturing is described as breaking the upper surface of soil, uprooting the weeds (unwanted plants), aerating the soil, thereby promoting the activities of microorganism and making good mulch, so that moisture inside the field is properly retained from evaporation.. These operations are accomplished by means of many tools and equipments, such as hoes, cultivators, harrows, rotary hoes etc. HAND HOE Hand hoe is the most popular manually operated weeding tool use in the farm. It consists of an iron blade and a wooden handle. The operator holds the handle and cuts the soil with the blade to a shallow depth of 2-3 cm thereby weeds are cut and soil is stirred. The handle is short (30-40cm long) hence the operator uses the tool in bending posture. The coverage is 5-7 cents per day. Hand hoe

HOE COME RAKE The hoe cum rake is multipurpose hand tool, which consists of a flat blade on one side like powrah and prongs on the other side. The blade and prongs are either made from single stock with an eye in the centre or joined to an eye by welding. A wooden handle is fitted to the eye for operation. The flat blade is used for digging and rake side for weeding and collection of weeds and trashes. The hoe cum rake is a secondary nursery bed preparation tool and is used for lighter operations. The flat end of the tool is operated with impact action and rake end by Hoe cum rake

LONG HANDLE WEEDERS Hand hoes exert greater strain on the operator because of the short handle with necessitates the operator to do weeding job in bent posture. To avoid this nowadays long handles are used in hoes and hence they are called as long handle weeders. The popular long handle weeders available are a) star type weeder b) peg type weeder. These weeders are also called as dry land weeders since they are used in dry lands

a) Star type weeder : It is suitable for weeding in dry lands. It can be used in garden lands also when the soil moisture is low (10-15 %). One limitation is that it works well in line sown crops and not in broadcasted fields. It consists of a blade for cutting the weeds, a fulcrum wheel for push-pull movement and a long handle for easy operation. Long handle reduces strain on the operator. The radial arms of the fulcrum wheel is cut in to star like projections and hence the name star type weeder. Star wheel is designed for loamy soils.The operating width of the blade is 120 mm. The coverage is 0.05 ha/day.

b) Peg type weeder: It is suitable for weeding in dry lands. It can be used in garden lands also when the soil moisture is low (10-15 %). One limitation is that it works well in line sown crops and not in broadcasted fields. It consists of a blade for cutting the weeds, a fulcrum wheel for push-pull movement and a long handle for easy operation. Long handle reduces strain on the operator. There are pegs welded on the periphery of the wheel hence the name peg type weeder. Peg type wheel is designed for clayey soils. The operating width of the blade is 120 mm. The coverage is 0.05 ha/day. Both star type and peg type weeders are also called as dry land weeders.

c) Wheel hoe The wheel hoe is a widely accepted weeding tool for weeding and intercultural in row crops. It is a long handled tool operated by pushes and pull action. The general construction of wheel hoe comprises of a wheel, tool frame, a set of replaceable tools and a handle Different types of soil

working tools such as straight blade, V -blade, sweep, shovel, etc. can be used for different works namely weeding , soil mulching, stirring etc. .Long handle reduces drudgery to operator. Wheel reduces energy requirement for pushing. All the soil working components of the tool are made from medium carbon steel. The coverage is 0.05 ha/day. Wheel hoeCono weeder

d) Cono weeder Cono weeder is useful for uprooting and burying weeds in line planted rice fields in wetlands. It disturbs the topsoil and increases aeration. This facilitates better growing environment to the crop. The weeder consists of a long handle, two numbers of truncated conical rollers, and a float. The rollers are fitted at the bottom of the handle in opposite direction one behind other. The conical rollers have serrated blades on the periphery. When the weeder is operated in between two rows of standing crop, the rollers up root the weeds and burry them. Cono weeder operation triggers root growth. The float prevents the unit from sinking into the soil. Soil should be moist and little firm at the time of using the weeder, The coverage is 0.05 ha/day. Cono weeder Cono weeder in operation

CULTIVATORS It is an implement for inter cultivation with laterally adjustable tines or discs to work between crop rows. This can be used for seed bed preparation and for sowing with seeding attachment. The times may have provision for vertical adjustments also. 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.

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

   Depending upon the type of power available for the implement, the cultivator can be classified as 1) Tractor drawn, 2) Animal drawn.

   Tractor Drawn Cultivator It may be 1) Trailed type 2) Mounted type.

   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 life is operated by both wheels simultaneously so that draft remains even and uniform. 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. The depth of working is set roughly by adjusting the tine in their clamps and the final depth control is done by a screw lever. Usually the tynes are damaged due to turning the implement at the

headland without lifting it up. Care should be taken to lift the tines off the ground before turning.

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. For actual cutting the soil, different types of shovels and sweeps are used . a few important shovels and sweeps are a) Single point shovel b) Double point shovel c) Spear head shovel d) Sweep e) Half sweep f)Furrower. 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, pre- tensioned to ensure minimum movement except when an obstacle is encountered. The springs operate, when the points strike at 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. A pair of gauge wheel is provided on the cultivator for controlling the depth of operation. The cultivator may be fitted with 7, 9, 11, 13 tines or more depending upon the requirements. Tractor drawn cultivator- spring loaded tines Tractor drawn cultivator- spring loaded tines

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 . No springs are available with these cultivators. 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. Rigid tyne cultivator Rigid tyne cultivator

TYPES OF SHOVELS AND SWEEPS USED IN TINE CULTIVATORS. Shovel type blades a) Duplex shovel or spear head shovel – for sleeve type tines b) Single point shovel – spring tooth c) Double point or reversible shovel – for spring tooth Sweeps blades a) Full sweep b) Half sweep right c) Half sweep left d) High speed sweeps Type of soil, crops and weeds influence the use of a shovel or a sweep. Shovels and sweeps should be operated as shallow as possible to prevent pruning of roots from the plants thereby injuring the crop. Sweeps should be set almost flat. When the point is resting on the floor, or ground., the outer tip of the wing should be elevated only 3-6 mm above the floor. The shovels and sweeps should be set in between the crop rows 5 cm away and at equal distances on each side of the row to avoid any damage to the standing crop. Setting of blades in a cultivator When the cultivator has two rows of blades, then the blades are arranged in a staggered way between the two rows

ANIMAL DRAWN CULTIVATOR a) Sweep It is an intercultural implement used for removing shallow rooted weeds in between crop rows. It consists of V shaped blades with bevel edged wings called sweeps. The blades are fitted to the tines by means of counter sunk bolts and nuts

and the tines are fitted to a frame. By skimming action under the soil at a shallow depth of 2 to 3 cm, the sweep blades cuts the weeds. By the cutting action the blades break the capillary passages in the soil and provide soil mulch for moisture conservation. The coverage is 1.75 to 2.5 ha/day. The salient features of the unit are: ∗ Suitable for all row crops and soils; provides soil mulch and conserves soil moisture Animal drawn sweep b) Junior hoe It is an intercultural equipment used for weeding between the rows of standing crops. It consists of six numbers of curved tines fitted with reversible shovels and attached to a framework with hitching arrangement. The tines are arranged in three rows in staggered way, A handle and beam are fixed to the framework for guiding and attaching the unit to the yoke of the animals. The spacing between the shovels can be adjusted according to the row spacing of the crop. The curved nature of tines gives spring action when struck against stones or roots and releases the tines from the obstacle. The coverage is 1.5 ha per day. Junior hoe c) Duck foot cultivator It is a type rigid cultivator which is used mostly for shallow ploughing, destruction of weeds and retention of moisture. It consists of steel frame and rigid tines to which sweeps are attached. The implement is attached to the tractor with three point hitch system and is controlled by hydraulic system. The sweeps are fabricated from high carbon steel. Number of sweeps can be reduced according to requirement. Usually this cultivator is about 225 cm long; 60 cm wide with 7 sweeps.

ENGINE OPERATED WEEDER It is used for both intercultural and secondary tillage operations namely stirring the soil, uprooting the weeds, breaking clods, covering seeds etc It consists of a 3-hp engine (petrol start kerosene run), a pair of ground wheels, a cultivator frame with sweep or shovel blades, steering clutch, main clutch, handle , a tail wheel and other control levers. The engine power is transmitted to ground wheels through belt-pulley and sprocket - chain mechanisms. Ground wheels act as traction wheels and pull the cultivator when moving; The tines to be set between rows with sufficient space away from plant stems. To avoid any damage to plants. The tail wheel is provided at the rear of the cultivator frame by raising or lowering of which the operating depth of the blades can be altered. The field capacity is 0.75 – 1.0 ha per day. The salient features of the unit are: ∗ Useful for weeding in row crops like tapioca, cotton, sugarcane, maize, tomato and pulses whose rows spacing is more than 60 cm ∗ Can be used for weeding in orchards, coconut and arecanut fields. ENGINE OPERATED ROTARY TILLER It is a walking type tiller used for plains and hilly regions. It is used for both intercultural and secondary tillage operations namely stirring the soil, uprooting the weeds, breaking clods, covering seeds etc It consists of a 3-hp engine (petrol start kerosene run), a rotor with L blades, rotor drive mechanism, handle and other control levers. When engine power is transmitted to rotor, the rotor rotates and till the soil. The rotor rotates in the forward direction and hence there is a forward push facilitating the forward movement of the tiller. The field capacity is 0.75 – 1.0 ha per day. The salient features of the unit are: ∗ Useful for weeding in row crops like tapioca, cotton, sugarcane, maize, tomato and pulses whose rows spacing is more than 60 cm ∗ Can be used for weeding in orchards, coconut and arecanut fields. ∗ Suitable for hilly regions also ∗ Depth of cut is 8-12 cm Engine operated rotary tiller Tractor operated rotary tiller Model questions 1. Define inter cultivation in agriculture. Mention some tools and implement used in inter cultivation 2. Explain about blade harrow 3. Explain about junior hoe 4. Explain about engine operated weeder 5. Mention the conditions where in you will use junior hoe 6. Name two implements used for conserving soil moisture in dry lands 7. List the types of weeders 8. Mention a neat sketch and explain the components of cono weeder their 9. Differentiate star

and peg type weeders. 10. state the advantages of long handled weeder A11. Junior hoe is primarily used for a. breaking clods b. seed bed preparation c. weeding d. none A 12. The main advantage of using long handle weeders is a. Less drudgery to operator b. Less area of coverage d. Cheaper cost of weeder d. Traditional tool

Crop protection ::Plant protection equipments :: Classification

- Pests and disease incident on the crops / plants are to be overcome by the application of poisonous chemicals.
- As the technology advances and newer crop varieties are introduced newer insects, pests and diseases are also growing up and methods are deviced to control them.
- Many chemicals used for plant protection cannot be handled by human operators directly.
- Also, that needs to be applied in fine particles.
- This necessitates the use of suitable machines.

Sprayers

- The Sprayer is one which atomises the spray fluid (which may be a suspension, an emulsion or a solution) into a small droplets and eject it with little force for distributing it properly.
- It also regulates the amount of pesticide to avoid excessive application that might prove wasteful or harmful.
- The mechanical appliances that are used for distributing the dust formulations of pesticides are called as dusters.

Types of sprayers

- Sprayers are classified into four categories on the basis of energy employed to atomise and eject the spray fluid as
- hydraulic energy sprayer

- gaseous energy sprayer
- centrifugal energy sprayer and,
- kinetic energy sprayer

Hydraulic energy sprayer

- Hydraulic Energy Sprayer is one which the spray fluid is pressurised either directly by using a positive displacement pump or by using an air pump to build the air pressure above the spray fluid in the air tight container.
- The pressurized fluid is then forced through the spray lance, which controls the spray quantity and pattern.

Gaseous energy sprayer

- In Gaseous Energy Sprayer high velocity air stream is generated by a blower and directed through a pipe at the end of which the spray fluid will be allowed to trickle by the action of gravity through a diffuser plate.

Centreifugal energy sprayer

- In the Centrifugal Energy Sprayer the spray fluid fed under low pressure at the centre of a high speed rotating device (Such as flat, concave or convex disc a wiremesh cage or bucket, a perforate sieve or cylinder or a brush) is atomised by centrifugal force as it leaves the periphery of the atomiser.
- The droplets are carried by the air stream generated by the blower of the sprayer or by the prevailing wind, if the sprayer is not provided with a fan.

Kinetic energy sprayer

- In Kinetic Energy Sprayer the spray fluid flows by gravity to a vibrating or oscillating nozzle which produces a coarse fan shaped spray pattern.
- This is used for application of herbicides.

Types of sprayers

- Depending on the source of power it can be classified as manually operated and power operated dusters.
- The manually operated dusters are (i) package duster (ii) plunger duster (iii) bellow duster and (iv) rotary duster.

(i) Package dusters

- In some pesticide dusts are packed in containers that serve as a hand applicators and may be discard after use.
- They are mostly provided with rubber, leather or plastic section which, on getting squeezed, provides a puff of air that emits the dust in a small cloud.
- The simplest type of package duster is worked by pressing it between the fingers.

(ii) Plunger dusters

- The consists of an air pump of the simple plunger type, a dust chamber, and a discharge assembly consisting of a straight tube or a small exit pipe whose discharge outlet can be increased or decreased by moving a lid provided at the end of the dust chamber.

- The air from the pump is directed through a tube into the container where it agitates the dust and eject it from a discharge orifice or tube.
- The amount of dust can be controlled by the speed of the operation of the pump.
- These are useful for spot application in restricted areas and for controlling ants, poultry pest and pest of farm animals.

(iii) Bellow duster

- In the below may be made from rubber, leather or plastic.
- On squeezing, it puffs the air that expels the dust in a small cloud.
- Hand held bellow duster has containers of capacity from 30 g to 500 g.
- The bellows can be operated either directly by hand or by handle provided for that purpose.
- The knapsack duster has the container capacity of 2.5 to 5.0 kg.
- The air blast developed by the bellow draws the dust from the hopper and discharges through the delivery spout intermittently.
- These dusters are suitable for spot treatments.

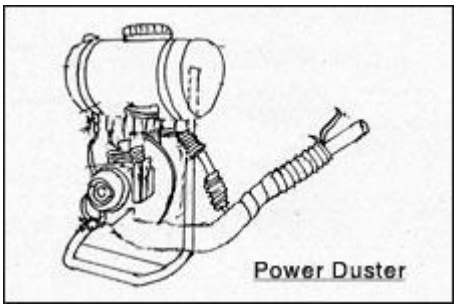
(iv) Rotary duster

- A consists basically of a blower complete with a gear box and a hopper. It is operated by rotating the crank.
- The cranking motion is transmitted through the gear box to the blower.
- A drive is taken for the dust agitator located in the hopper.
- The rotary duster may be hand carried type or shoulder mounted or belly carried type.
- The feed is controlled by a feed control lever, which operates a slide to control the aperture at the bottom of the hopper.

Some of the recommendation of WHO (1974) for this duster are

- The sheet hopper should not be less than 0.63 mm thick.
- The concave bottom of the hopper permits all the dust to move towards the feeding aperture.
- The fan should be capable of displacing 0.84 m3 of air per minute at a speed of 35 rpm.

(v) Power dusters



- The resemble the rotary duster is construction, except that the power to drive the blower through the gear box is tapped from an external power source which may be an engine or P.T.O. shaft of the tractor or flywheel of the power tiller.
- The power operated centrifugal energy knapsack sprayer also can be converted into a power duster, by allowing the dust fluid into the air stream, near the point of attaching the pleated hose, in the blower elbow.

Uses of spraying and dusting equipments

- The spraying and dusting equipments are used for the following purposes
- For the insecticides application to control insect pests on crops and in stores, houses, kitchen, poultry farms, barns, etc.
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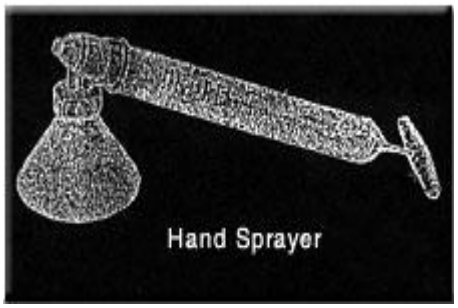
- For the acarices application to control phytophagous mites.
- For the fungicides and bactericides application to control the plant diseases.
- For the herbicides application, to kill the weeds.
- For the harmone sprays application to increase the fruit set or to prevent the premature dropping of fruits.
- For the application of plant nutrients as foliar spray.
- For applying the powdery formulation of poisonous chemicals on the crops and for any other purposes.

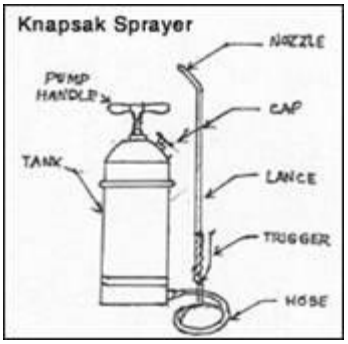
Hand sprayer



- The hand sprayer is a small, light and compact unit.
- The capacity of the container varies from 500 to 1000 ml.
- This is generally used for spraying small areas like kitchen gar
- It is a hydraulic energy sprayer.
- It has a hydraulic pump inside the container, with cylinder, pl
- By operating the plunger up, the spray fluid in the container i valve assembly and then pressurised during the downward st

- The pressurised fluid is then let out through a nozzle, and sprayed into fine droplets.
- If the pressure to be built inside the container an air pump with cylinder, plunge and plunger rod is required.
- When the plunger is pulled up, the air is sucked into the cylinder and when pushed down the air bubble is releases into the container with 80% of its volume filled with the fluid.
- The air reaches the space above the free fluid surface and presses the fluid.
- The pressurised fluid is drawn up through a trigger cut of valve to the nozzle, where is atomized and sprayed.
- In some other type, air pump and the container are separate pieces and the pump is attached to the container is such a way to release the pressurised air through an orifice at the top of the container.
- The fluid is lifted through an office at the top of the container.
- The fluid is lifted through a capillary tube due to surface tension developed by the high velocity air at the outlet and sheared away by the air and sprayed as droplets.

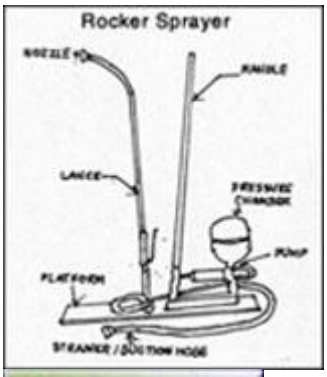
Knapsack sprayer

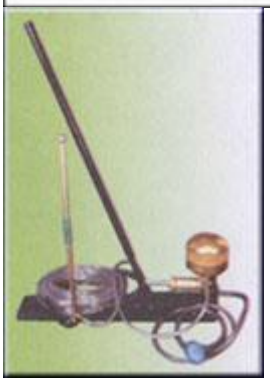


- Any sprayer which is carried on the back of the c
- The commonly used manually operated knapsac working inside the container.
- The plunger works inside the replacement well a for easier maintenance.
- The pump can be operated through the appropr with the sprayer carried on the back.

- An agitator is also provided with the pressure chamber to agitate the fluid so that the particles in suspension will not be allowed to settle down.
- A delivery tube is attached on the other end of the pump which carries the pressurises fluid to the spray lance.
- The flow to the nozzle is controlled by a trigger cut-off valve.
- In the case of compression knapsack sprayer, an air pump is used to build air pressure above the free surface of the spray fluid in the container and normally the pumping of the air will be done by keeping the unit on ground and then sprayed til the air pressure comes down.
- The unit is again brought back to the ground for pumping air and then the spraying is contained as before.
- The spray fluid, which does not enquire any agitation only can be sprayed by using this type of sprayers.

Rocker sprayer

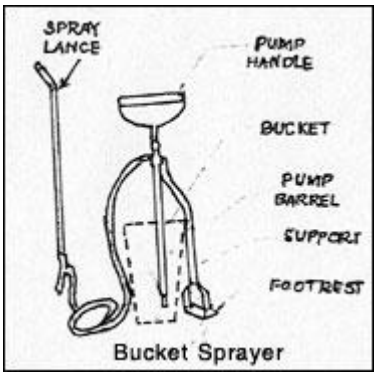




- The rocking sprayer has a pump assembly, fixed on a lever, a valve assembly with two ball valves, a pressu and delivery hose with spray lance.
- When the plunger is pulled behind by pulling the leve from the container is sucked through the strainer an enters the pump.
- The movement of the lower ball valve is arrested by
- When the lever is pushed towards the pump, the suc chamber by opening the upper ball valve.

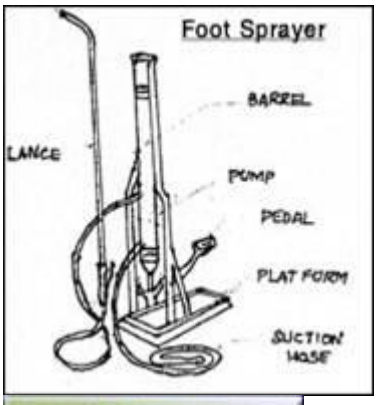
- The operation is continued till the entire suction pipe, ball valve assembly, delivery hose and a portion of pressure vessel is fitted with spray fluid and the pump operator finds it difficult to push the piston forward, due to the downward pressure developed by the entrapped compressed air in the pressure vessel.
- Thereafter, the trigger cut off valve will be opened to allow the spray fluid to rush through the nozzle and get atomized.
- Usually 14 to 18 kg/cm2 pressure can be built in the pressure chamber and hence can be conveniently used for free spraying.

Bucket sprayer



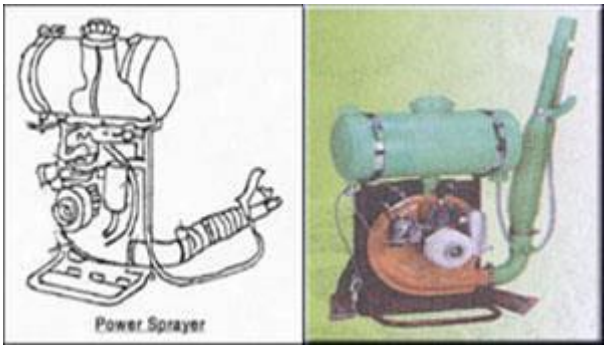
- The bucket sprayer is designed to pump the spray fluid directly from
- The hydraulic pump will be put inside the bucked and held properly
- As the plunger is pulled up, the fluid enters through the suction ball pressed down, the suction valve closes and the fluid enters the press assembly.
- As the plunger is continuously worked, pressure is built in the pressu
- As soon as the required pressure is built up, the spraying will be don
- A pressure of 4 kg / cm2 is developed in most of the models.

Foot sprayer



- This is a modified version of rocker sprayer.
- The pump is fixed in a vertical position with n
- The plunger moves up and down when operat
- A ball valve is provided in the plunger assemb plunger and getting pressurized in the pressu
- During the upward motion of the piston fluid pressure vessel and during downward movem and enter the pump.
- The pressure developed is about 17-21 kg/cm

Power sprayer



- All the sprayers which impart the mechanical ene spray fluid before spraying is called as a power sp
- The most commonly used type of power sprayer sprayer.
- In construction, it has a back pack stand on which
- Engine of 1.2 to 3 hp capacity, the spray fluid tanl
- A pleated hose is attached to the blower elbow to of that a shear nozzle is fixed to allow the spray fl storage tank, with a valve control.

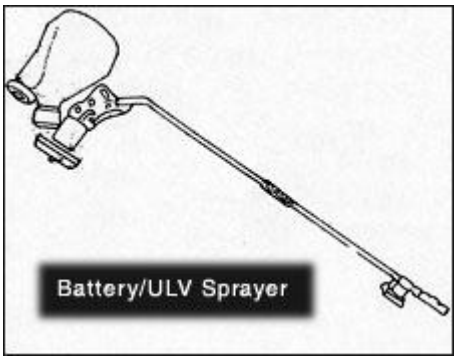
- From the top of the blower casing, an air hose is taken into the spray fluid tank, which carries little quantum of air to press the spray fluid during operation.
- In operation, the engine is started by keeping the unit on the ground and then carried by the operator.

- The blower sucks the air behind the backrest and forces it into the pleated hose.
- The valve of the shear nozzle is opened or the shear nozzle with selective opening and discharged through the nozzle.
- The high velocity air shears off the droplets and atomizes by the impact of diffuse and delivers it on the plant the surface.
- An air current of 2.7 to 9.1 m2 / minute is delivered at a velocity of 175 to 320 kmph.
- The spray fluid tank capacity varies from 7 to 12 litres.
- The fuel tank capacity varies from 0.75 to 2.25 litres.
- The spray fluid discharge can be varied from 0.5 to 5 lit / minute.

A power sprayer can be used as a power duster by making the following changes.

- Chemical filler cap is removed to dismantle that strainer with the air pipe.
- The liquid delivery pipe below the chemical tank is dismantled and removed with the shear nozzle.
- The tank is thoroughly cleaned to remove possible traces of moisture left inside.
- The dust agitator tube is fixed at the bottom of the chemical tank.
- This tube has holes at the bottom to prevent the entry of dust into the agitator and clogging it.
- Dust intake tube is inserted into the chemical tank at the discharge and this tube has no. of large size holes on its periphery.
- Dust intake tube and the blower elbow are connected by using the dust outlet pipe, which is a pleated hose.

Battery or ULV sprayer



- ULV sprayer was invented as a result of the desire to reduce th for application and to eliminate the water as a medium to carr

The basic requirements of ULV spraying are

- The narrow and controllable droplet spectrum (100-250 µm fo sprayers and 0.1 to 50 µm for aerosols)
- The accurately controllable emission rate and
- The non-volatile pesticide formulation of suitable viscosity and

- The reduction in volume of the spray fluid decreases the time spent in travelling to recharge sprayer, in fetching water, in mixing the pesticide and filling the tank. In a day of 8 hour about 8 ha can be covered in ULV spraying against 3 ha with power sprayer.
- A battery operated ULV sprayer has a long handle at the horse power D.C. motor is fitted with a spinning disc and a cover.
- A HDPE bottle is fixed close to the motor, in such a way that spray fluid is allowed to trickle at the centre of the spinning disc in operation.
- Centrifugal energy imparted fluid comes out of the nozzle and atomizes.
- The hand held ULV applicators are so designed to release the spray droplets at 1 m away from the body of the operator.
- Further, it is recommended that they should be operated only when the spray cloud would be blown away from him by the breeze so as to minimize the risk of contamination.
- After spraying, the atomizer must be flushed with paraffin to remove the residual pesticide.
- Inefficient cleaning would leave the pesticide deposit in the feeder stem to completely of partially block the flow of the pesticide.

Power sprayer operated suction trap

- This consists of a metal elbow matching the suction opening and the blower and the outer diameter of the pleated hose.
- This unit is closely fitted with the blower suction opening with the help of an extension frame work identical to the back pack stand.
- To the pleated hose attachment opening of the elbow a pleated hose is attached rigidly.
- In between the two pleated hoses a screen, an insect collector and valve to control the size of the opening are provided in a Tee section.
- In operation the low pressure created at the blower inside is transmitted through the below and pleated hose which helps in sucking the lighter objects like insects and dust from a distance of 0.5 to 1.0 m away from it.
- The sucked insect of dust will be filtered by the screen and dropped into the collection bowl.

1. Drain off any liquid still in the tank.
2. Add 1 kg of washing soda per 45 litres of water, which will serve as a cleaning detergent.Spray this liquid through the nozzle on waste land.
3. Add fresh water in the tank and spray with and then without nozzle on the waste land.
4. Wash the outside of the sprayer.Remove the nozzle and filters and store safety after cleaning.
5. Ensure the absence of water in the pump and lubricate the parts.

HARVESTING & THRESHING EQUIPMENT

HARVESTING It is the operation of cutting, picking, plucking and digging or a combination of these operations 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. There are a few related terms in connection with harvesting, which are as below:

Mower: It is a machine to cut herbage crops and leave them in swath.

Reaper: It is a machine to cut grain crops.

Reaper binder: It is a reaper, which cuts the crops and ties them into neat and uniform sheaves.

Swath: It is the material as left by the harvesting machine.

Sickle: It is a curved steel blade having a handgrip and used for harvesting by manually.

Windrow: It is a row of material formed by combining two or more swaths.

Windrower: It is a machine to cut crops and deliver them in a uniform manner in a row.

Sickle: Sickle is a simple harvesting tool. It is used for harvesting crops and cutting other vegetations. It essentially consists of a metallic blade and a wooden handle.

Sickles are classified into two classes: (i) Plain and (ii) Serrated. Blade is the main metallic part of the sickle. It is desirable to make the blade made of carbon steel. The blade is made in a curved shape. The teeth of serrated sickle are made sharp for efficient working in the field. The handle of the sickle is made of well-seasoned wood. The forged end of the blade for fixing the handle is called tang. The plain or serrated edge in the inner side of the blade is called cutting edge. Protective metallic bush fitted at the junction of the blade and the handle to keep the tang tight in the handle is called ferrule. Harvesting by sickle is a very slow and labour consuming device. Sickle

Mower: Mower is a machine to cut herbage crops and leave them in swath. There are different types of mower used in different ways such as: (i) Cylinder mower (ii) Reciprocating mower (iii) Horizontal rotary mower (iv) Gang mower and (v) Flail mower.

Cylinder mower: It has rotating helical blades arranged in horizontal cylindrical form. With the rotation of blades, forage or grasses are cut continuously.

Reciprocating mower: It is a mower with a knife having sections that reciprocate against stationary fingers. It is most common type of mower used everywhere.

Horizontal rotary mower: It is a mower with high speed knife rotating in the horizontal plane. Due to rotation of knife, the grasses and forage are cut in uniform way.

Gang mower: It is an assembly of two or more ground driven cylinder mowers.

Flail mower: It is a mower with high speed swinging knives, operating either in a horizontal plane or around a horizontal cylinder.

Conventional Type of Mower The conventional mower mainly consists of : (i) Frame (ii) Power transmitting unit (iii) Cutting bar (iv) Shoes (v) Ledger plate (vi) Wearing plate (vii) Knife (viii) Grass board and (ix) Pitman. Frame The frame provides space for gears, clutch and bearings. The lever for lifting the cutting bar is attached to the frame. A flywheel is used to store energy to provide steady speed to the cutting mechanism. Power transmitting unit The power-transmitting unit consists of axle, gears, crank wheel, crankshaft and pitman. Tractor drawn semi-mounted or mounted type mowers are operated by P.T.O. shaft. In this case, the cutting mechanism is driven independently of the forward speed of the mower. A shaft is connected with the P.T.O. shaft which drives a pulley with the help of an universal joint. This V pulley rotates another smaller pulley on the crankshaft of the machine and reciprocating motion is transmitted to the cutter bar. Cutter bar It is an assembly comprising of fingers, knife guides, on wearing plates and shoes. It is used for cutting grasses and forage. It is made of high grade steel. It works like a knife. The knife is a metal bar, on which triangular sections are mounted. The knife section makes reciprocating motion and cuts the plants. There are knife guards, provided on the cutter bar. The knife stops at the centre of the guard on each stroke. There are ledger plates provided with the knife guard, on which the knife moves. Knife clips hold the sections down against the ledger plates. Knife clips are placed with wearing plates spaced 20 to 30 cm apart.

Cutter bar Shoe - A shoe on each end of the cutter bar is always provided to regulate the height of cut above the ground. The inner shoe is larger in section and is placed at the inner end of the cutter bar. The outer shoe is placed at the outer end and is smaller in section.

Ledger plate - It is a hardened metal inserted in a guard (finger) over which knife sections move to give a

scissor like cutting action.

Wearing plate -It is a hardened steel plate attached to the finger bar to form a bearing surface for the back of the knife.

knife - It is the reciprocating part of the cutter bar, comprising of knife head, knife back and knife sections.

Knife section - It is a flat steel plate (triangular shape) with two cutting edges.

Knife head - It is the portion of the knife which is connected to the pitman.

Knife back - It is the strip of steel to which knife sections are riveted and the knife head is attached.

Grass board - Grass board is provided at the cutter end of the mower which causes the cut plants to fall towards the cut material. Shoes are provided for easy and smooth sliding of the cutter bar. Pitman - Pitman is a type of connecting rod which is pinned to the crankshaft with the help of a pin. It transmits reciprocating motion to a knife head. Wooden pitman is commonly used for the mowers.

Breaking of knives - Breaking of knives is a common troubles in operation of a mower. It is caused due to play in bearings and worn knife head holders. Non-alignment is an important cause for breaking the knife because when the mower is out of alignment, it works on a certain angle which is always harmful.

Alignment of mower: Under working condition of the mower, the standing crops exert pressure on the cutter bar tending to push it backward. In correct operating position, the crankpin, knife head and the outer end of the knife should be in a straight line. This line should be at right angle to the direction of travel of the mower. For achieving this object, the cutter bar is set at about 88° to the direction of motion i.e. inward lead of 2° is given to it in order to overcome the back pushing action of the crops. When the cutter bar is properly aligned, the knife and the pitman run in a straight line. This gives better cutting in the field. Generally 2cm lead per meter length of cutter bar is recommended.

Registration of mower: A mower knife is said to be in proper registration when the knife section stops in the centre of its guard on every stroke i.e. the centre of the knife section is at the centre of the guard, when it is in operating condition. Adjustment is commonly made by moving the entire cutter bar in or out with respect to the pitman. If mower is not well registered, there is unbalanced load, uneven harvesting and excessive clogging of crops on the knife. Registration of mower

Vertical conveyer reaper (Self operated/Tractor mounted): It is mostly used for harvesting paddy and wheat. The reaper is front mounted at the tractor, which can be lowered and raised by the hydraulic control. It is powered by the PTO of the tractor. Crop is guided by the star wheel to the cutter bar and held in vertical position by the springs. The crop is conveyed to the side by the conveyer belt. Its capacity may be 0.4-0.6 ha/h.

Self operated VCR Vertical conveyer reaper (Power tiller operated): It can be used for harvesting wheat and paddy. The reaper is front mounted on the power tiller. Power is transmitted from the engine fly wheel to the reaper either through V belt or by providing gear box and propeller shafts. Crop is guided by the star wheels to the cutter bar and held in vertical position by the springs. The crop is conveyed to the side by the conveyor belt Cutter bar length may be 100-160 cm. The capacity may be 0.25-0.35 ha/h.

Reaper binder: It cuts and binds the crop simultaneously. It cuts the crop at the height of about 10 cm from the ground level. The harvesting capacity is 0.25-0.35 ha/h. Groundnut digger shaker: It is used for digging of groundnut crop. It is a tractor mounted PTO operated machine, suited for harvesting of both erect and spreading varieties of groundnut crop, grown in all types of soil. It consists of digging blade and

a spike tooth conveyor. Potato digger elevator: It is used for digging and windrowing the potatoes. The equipment is a PTO operated single row machine. The machine consists of cutting blade and elevator roller chain of iron bars. The potatoes are dug by the blade and lifted to a conveyor which is under periodic shaking. The potatoes are delivered at the rear of machine and collected manually. It is a tractor rear mounted PTO driven machine. Its capacity may be 0.15-0.2 ha/h. It can be operated by a 20-25 hp tractor. The groundnut vines are loosened by the blade and whole crop is lifted and Shaken by conveyor chain to remove all the soils. Thereafter the vines free of soil are dropped and windrowed behind the machine. The vines are collected manually.

THRESHING Thresher is a machine to separate grains from the harvested crop and provide clean grain without much loss and damage. During threshing, grain loss in terms of broken grain, un-threshed grain, blown grain, spilled grain etc. should be minimum. Bureau of Indian Standards has specified that the total grain loss should not be more than 5 per cent, in which broken grain should be less than 2 per cent. Clean un-bruised grain fetch good price in the market as well as it has long storage life. Traditional threshing methods Trampling of paddy under feet, beating shelves of rice or wheat crop on hard slant surface, beating crop with a flail, treading a layer of 15 to 20 cm thick harvested crop by a team of animals are traditional methods followed by farmers depending upon capacity, lot size and situation. Tractor in many places is now used in place of animals for treading. Introduction of animal drawn olpad thresher reduced the drudgery of the operator and gave comparatively higher output per unit time. In all above methods the threshed materials are subjected to winnowing either in natural wind flow or blast from winnowing fan for separation of grain from straw. Threshing wheat by traditional method involves drudgery and takes more time to obtain required quality of bhusa. Due to these, mechanical threshers are widely accepted by the farmers.

Different parts of a thresher and their functions A 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 (wovenwire mesh/punched sheet/welded square bars) iv. Blower/aspirator v. Sieve-shaker/straw-walker.

Working principle of a thresher: 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. 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 un-threshed 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. Power thresher

Adjustments Various adjustments are required before starting threshing operation.

The machine is to be installed on clean level ground and is to be set according to crop and crop conditions.

The adjustments necessary to get best performance from the machine are (i) concave clearance, (ii) sieve clearance, (iii) sieve slope, (iv) stroke length and (v) blower suction opening.

Besides these, cylinder concave grate, top sieve hole size and cylinder speeds for threshing different crops are important for a multi-crop thresher.

Different type of thresher and their suitability for crops The type of thresher is generally designed according to the type of threshing cylinder fitted with the machine. The major type of threshers commercially available is as follows:

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 cleaning sieves 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 with helical louvers.

vii. Syndicator type The cylinder consists of a flywheel with corrugation on its periphery and sides, which rotates inside a closed easing and concave. The rims of the flywheel are fitted with chopping blades.

Factors affecting thresher performance The factors which affect the quality and efficiency of threshing are broadly classified in three groups:

i. Crop factors: Variety of crop, Moisture in crop material.

ii. Machine factors: Feeding chute angle, Cylinder type, Cylinder diameter, Spike shape, size, number Concave size, shape and clearance

iii. Operational factors: Cylinder speed, Feed rate, method of feeding, Machine adjustments.

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

The main functions of a combine are: (i) Cutting the standing crops (ii) Feeding the cut crops to threshing unit (iii) Threshing the crops (iv) Cleaning the grains from straw (v) collecting the grains in a container.

The whole machine is composed of the following components: (1) Header (2) Reel (3) Cutter bar (4) Elevator canvas (5) Feeder canvas (6) Feeding drum (7) Threshing drum (8) Concave unit (9) Fan (10) Chauffer sieve (11) Grain sieve (12) Grain auger (13) Tailing auger (14) Tail board (15) Straw spreader (16) Return conveyor (17) Shaker (18) Grain elevator (19) Grain container.

Header is used to cut and gather the grain and deliver it to the threshing cylinder. The straw is pushed back on the platform by the reel. Small combines use scoop type headers, while large combines use T type headers with auger tables. Harvesting is done by a cutting unit, which uses a cutter bar similar to that of a mower. The knife has got serrated edge to prevent the straw from slipping while in operation. There is suitable cutting platform which is provided with a reel and a canvas. The reel is made of wooden slats which help in feeding the crops to the cutting platform. The reel gets power through suitable gears and shafts. The reel revolves in front of the cutter bar, while working in the field. The reel pushes the standing crops towards the cutting unit. The reels are adjustable up and down as in or out. The cutter bar of the combine operates like a cutter bar of a mower. It cuts the standing crops and pushes them towards the conveyor. The conveyor feeds the crop to the cylinder and concave unit. The grain is swept underneath the augers and conveyed behind them. The threshing takes place between the cylinder and concave unit of the combine. The basic components of the threshing unit of the combine are similar to a power thresher. As soon as the crops are threshed, the threshed materials move to a straw rake. These rakes keep on oscillating and separating the grains. The cleaning unit consists of a number of sieves and a fan. The cleaning takes place on these sieves with the help of the fan. The un-threshed grains pass through tailing augur and go for re-threshing. The clean grains pass through grain elevator and finally go to packing unit. Grains are collected in a hopper provided at suitable place. The fan is adjusted such that the chaff etc is blown off to the rear side of the machine. The size of the combine is indicated by the width of cut, it covers in the field.

A combine may be (i) Self propelled type and (ii) P T O driven type. Combine

Threshing:

The operation of detaching the grains from the ear head, cob or pod is called threshing. It is basically the removal of grains from the plant by striking, treading or rupturing. The traditional method of threshing using manual labours requires 150-230 man-h/ha. Threshing is normally done after the grain moisture content is reduced to 15 to 17%. In various parts of world, threshing is accomplished by treading the grains under the feet of animals or under the tractor tyres, striking the grains with sticks, pegs or loops and removing the grains by rubbing between stone or wooden rollers on a threshing floor or between the rasp bar and a concave of combine. The threshing can be achieved by three methods: Rubbing action, Impact and Stripping.

Threshers are the most important component of farm mechanization. If threshing is not done timely, all efforts made by farmers and inputs given to crop goes wasted. Traditional method of threshing by animal is very slow. It gives low output. Due to low output, the cost of operation is high and there is a huge loss of grains because of rodents, birds, insects, wind, and untimely rain and fire hazards. Wheat threshers overcome these difficulties to a great extent. Wheat threshers are of two type viz. animal-drawn and power threshers. In animal-drawn threshers, olpad thresher is a common machine used in different parts of the country. Power wheat thresher is a machine, which thresh the wheat crop and performs several other functions such as:

- Feed the harvest crop to the threshing cylinder,
- Thresh the grain out of the ear head,
- Separate the grain from the straw,
- Clean the grain, and
- Make ‘bhusa’ suitable of animal feeding.

During the last two decades in the country, power threshers have become quite popular. The famous Ludhiana thresher was first introduced in India during 1956-57. The thresher was tractor operated type and used mainly for wheat. It was a very good machine, which threshed, cleared and bagged the grain, at the same time it made the quality straw (bhusa). Further development work took place during the period from 1965 onwards for low horsepower threshers. The most widely used design, spike tooth cylinder thresher was commercially marketed in the country around 1970. This simple design has been able to maintain the cost of machine low as the total weight of machine was greatly reduced. The output capacity also improved. These threshers are available in various sizes operated by 3-40 hp power sources. The grain output is 20-25 kg/hp-h. Beater type threshers take comparatively more power than spike tooth threshers.

Spike tooth/peg tooth type thresher has cylindrical drum having five to six rows of spikes or pegs mounted on periphery of drum. Threaded mild steel bolts or spikes of same material are used. Thresher with spike is better than bolts as former takes less energy as compared to later. Threshing is accomplished due to impact and rubbing action. The separation is affected through aspiration of material falling through concave. Cleaning is done on a set of oscillating sieves provided in the machine. The fan and cylinder are mounted on the same shaft that makes construction simpler as compared to beater type threshers. The drive to the oscillating sieves is provided from main shaft with the help of crossed belt.

Types of Power Threshers

1. According to crops being threshed

- Single Crop
- Multi-crop

2. According to functional components

- Drummy
- Regular (Through-put)
- Axial flow

3. According to types of threshing cylinder

- Syndicator
- Hammer Mill or Beater type
- Spike tooth type
- Rasp bar type

Main Components of Thresher

(i) Drive pulley

(ii) Fan/blower

(iii) Feeding chute

(iv) Spikes

(v) Cylinder

(vi) Concave

(vii) Flywheel

(viii) Frame

(ix) Towing hook

(x) Upper sieve

(xi) Lower sieve

(xii) Transport wheel

(xiii) Suspension lever

(xiv) Can pulley

(xv) Shutter plate

Principles of threshing: The threshing mechanism, which separates the grain from the stalks, consists mainly of a revolving cylinder and the concaves. A feeder beater is usually located in front of the cylinder and at the upper end of the elevator-feeder to assist the elevator-feeder in feeding the grain to the threshing mechanism. Most threshers are provided with the rasp-bar type cylinder and concaves. The grain is rubbed from the stems without materially cutting the straw. Tooth-type cylinder and concaves are available on some combines. Adjustments are provided for varying the speed of the cylinder to suit the kind of crop being harvested. V belt variable-speed drives are used on most combines. The straw is thrown back onto the separating mechanism, while the grain falls through the concaves onto a grain pan or grain carrier and is conveyed to the cleaning mechanism.

Axial Flow Thresher: The crop in this thresher is fed into the cylinder through a feeding chute located at one end of the threshing drum. In a multi-crop thresher, threshed wheat crop passing through concave is cleaned by a set of sieves and a blower or aspirator. Axial flow of paddy crop is facilitated by the use of louvers provided on the upper concave. The straw is thrown out of the threshing unit by paddles. The cleaning and separation of grain is accomplished by a set of sieves and a blower or aspirator.

Functional components of threshing unit: A power thresher essentially consists of feeding unit, threshing unit, cleaning unit, power transmission unit, main frame and transport unit (Fig. 1). The operation of conveying the cut crop into threshing unit is known has feeding. Normally, one of the two types of feeding units 'throw-in-type' or 'hold-on-type' is used in power threshers (Fig. 2). In 'throw-in-type' feeding unit, the cut crop is pushed into threshing cylinder, where as in 'hold-on-type' the heads is only pushed into the cylinder and straw is manually or mechanically held. Throw-in-type feeding device is quite common in the threshers, which may be a feeding hopper or feeding chute.

Feeding Hopper: In this type of feeding device there is a hopper, placed on the top of the threshing cylinder. Generally hopper type of feeding units have a rotating star wheel mechanism between the hopper and threshing drum to facilitate the uniform feeding of crop to the drum. The initial cost of this system is high, hence is mostly used on a large thresher e.g. axial flow thresher of large capacity.

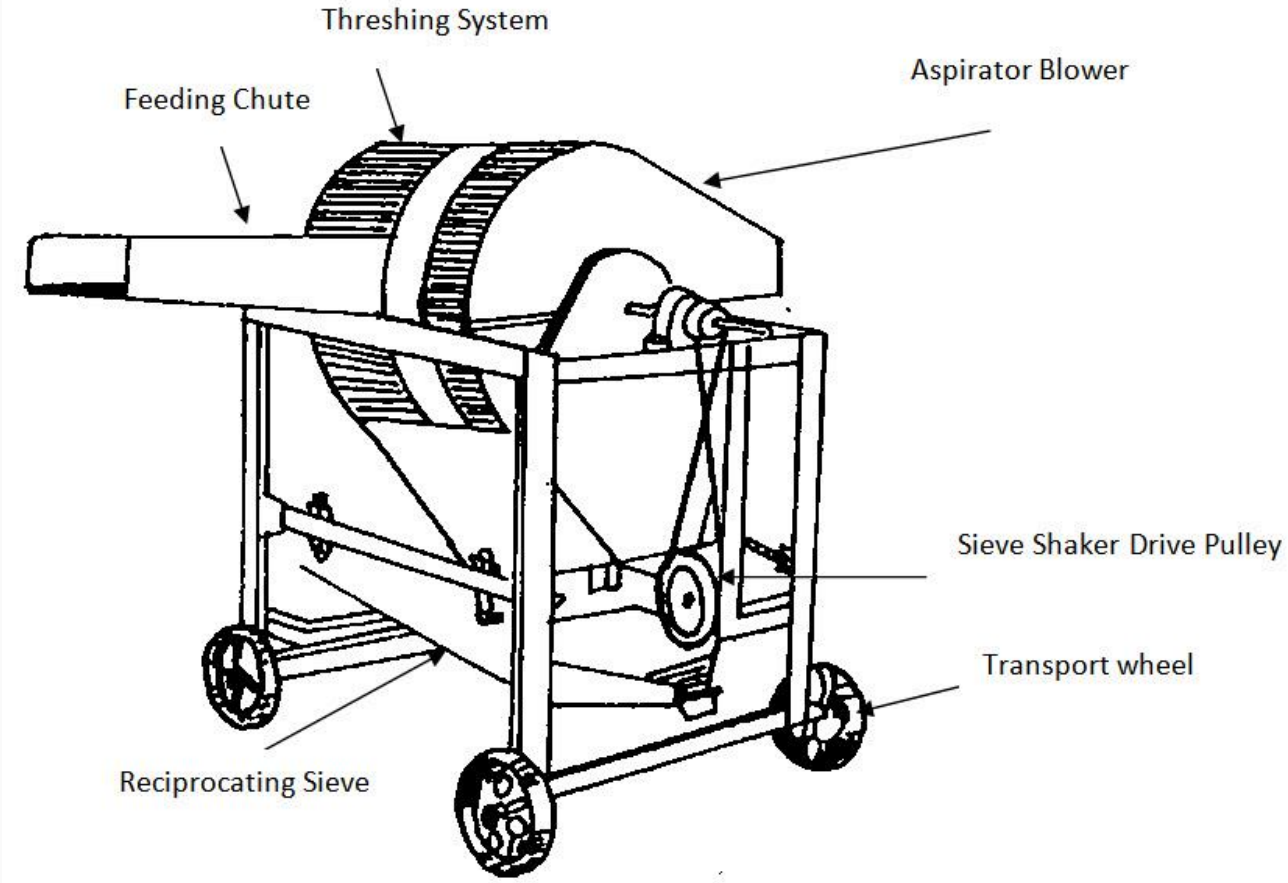


Fig. 1: Details of wheat thresher.

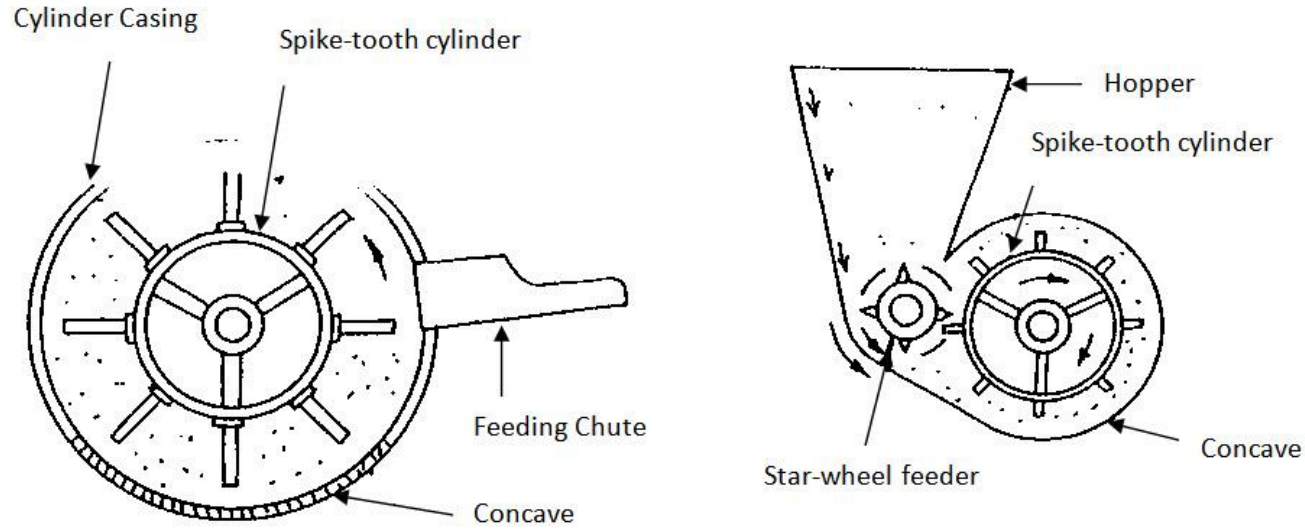


Fig. 2: Different types of crop feeding systems.

Threshing Unit: The threshing is accomplished by the impact of the rotating pegs mounted on the cylinder, over to the ear heads, which force out the grain from the sheath holding it. In the threshing of wheat crop, the straw is also bruised and broken up by the impact, thus converting it into 'bhusa' (straw). Threshing unit is mainly consists of a cylinder and concave. There are different types of threshing cylinders (Fig. 3) such as:

- Spike tooth/peg type cylinder
- Rasp bar type cylinder

- Angled bar type cylinder
- Wire loop type cylinder
- Cutter blade or syndicator type cylinder
- Hammer mill type cylinder

Spike tooth type cylinder: In this type of threshing drum, there is a hollow cylinder, made out of MS flat. Over to its entire periphery, a number of spikes/pegs of square /round bars or flat iron pieces are welded or bolted. Now days, in most of threshers, round peg with adjustable length are used. These spikes are staggered on the periphery of the drum for uniform threshing. The crop is fed along with the direction of motion of the rotating drum. The spike tooth cylinders are available in various sizes. A spike tooth cylinder with spikes of flat front and streamlined back has lower energy consumption.

Rasp bar type cylinder: In this type of cylinder, there are slotted plates, which are fitted over to the cylinder rings, in such a way that the direction of slot of one plate is opposite to another plate. This type of cylinder is commonly used in threshers. It gives better quality of bhusa and it can be used for a wide variety of crops viz.-wheat, paddy, maize, soybean etc.

Wire loop type cylinder: In this type of threshing drum, there is hallow cylinder, over which a number of wooden or MS plates are fitted. On these plates, number of wire loops is fixed for threshing purposes. This type of cylinder is common in the manually operated paddy threshers. Holding the bundle against the loops of revolving cylinder does threshing of paddy crop.

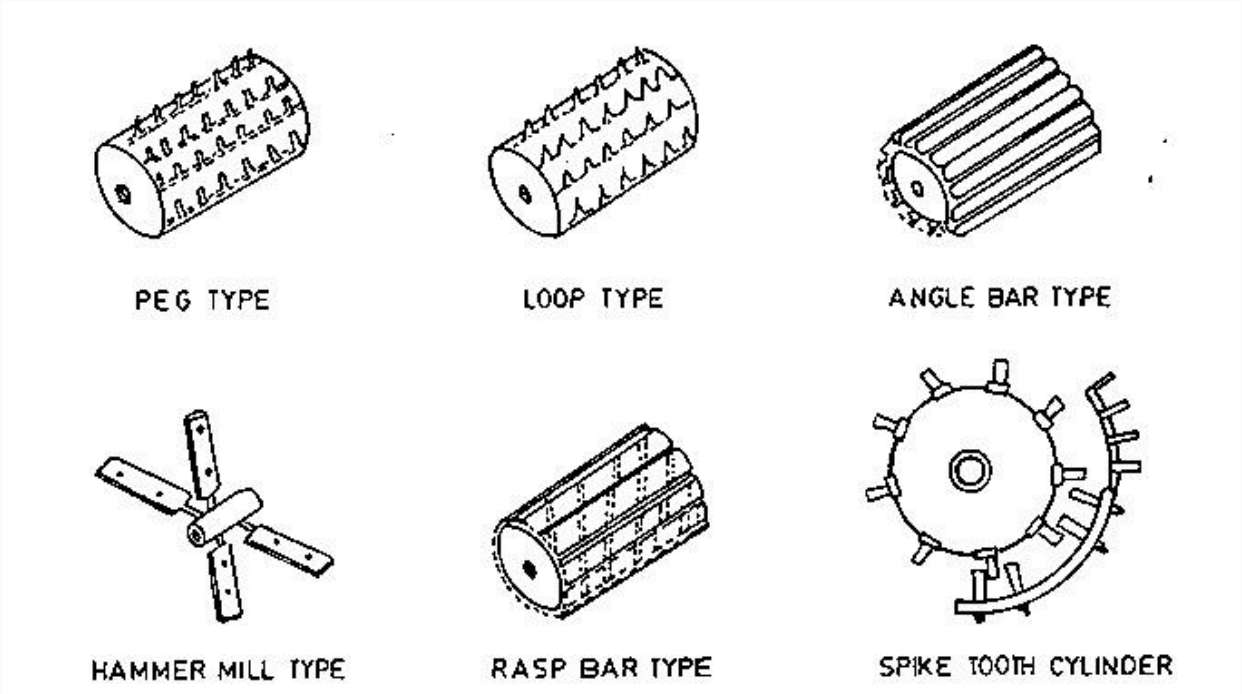


Fig. 3: Different types of threshing cylinders.

Chaff cutter/Syndicator type thresher:This is essentially an adoption of chaff cutter for threshing (Fig. 4). The crop is fed as is done in case of chaff cutters. After passing through a set of rollers, crop is cut into pieces. Varying the set of gears can vary the size. Three to four serrated blades are fastened on the radial arm of the flywheel. Threshing is done mainly due to cutting helped by rubbing and impact. The main advantage of syndicator thresher is that it can handle crop with higher moisture content. However, chopping knives need to be sharpened every 3-5 hours of operation. The machine is more prone to accidents due to positive feed rollers.

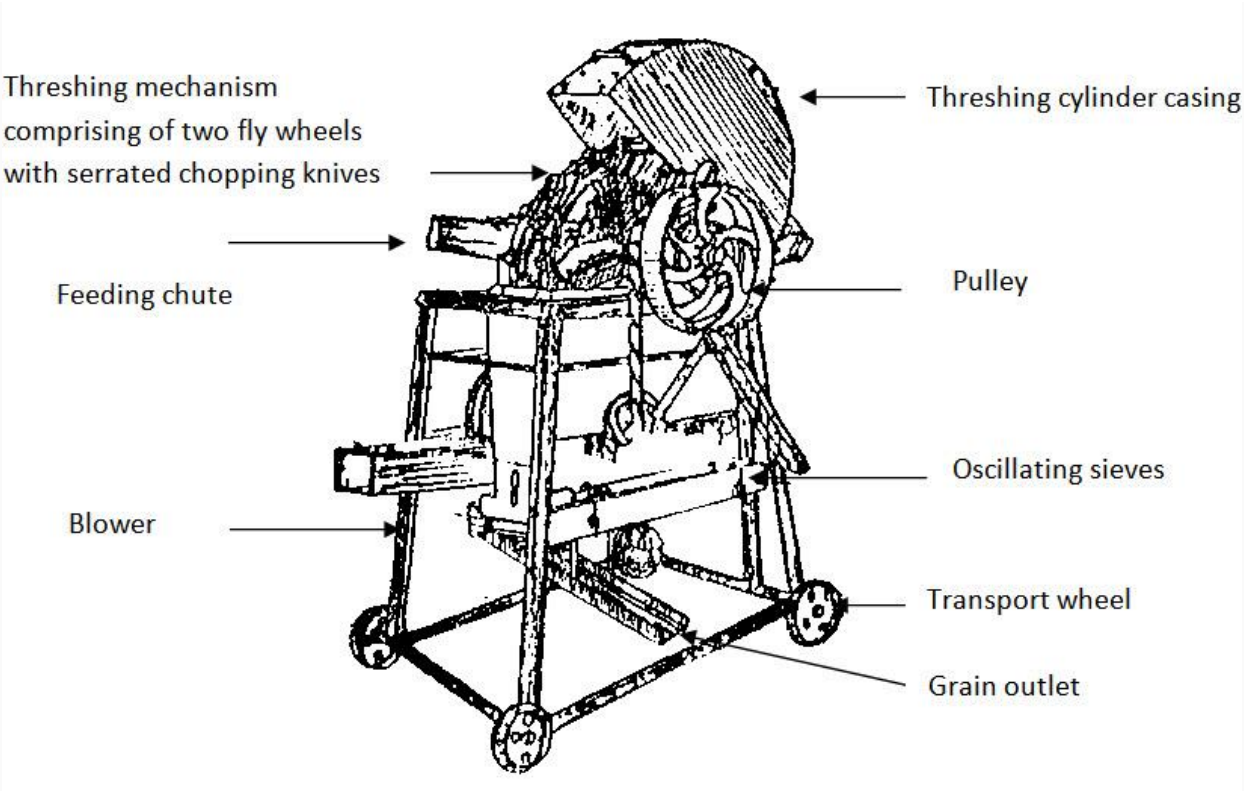


Fig. 4: Detail components of chaff cutter type thresher.

Hammer mill type cylinder: it uses beaters to do the required job of threshing. The shape of this type of cylinder is different from the above-discussed cylinder. The beaters are made of flat iron pieces and are fixed radically on the rotor shaft. Generally feeding chutes are used with hammer mill type threshing cylinder. The cut crop is fed perpendicular to the direction of motion of rotating beaters. This type of thresher requires more power as compared to spike tooth type of thresher.

Concave: Cylinder and concave together makes the threshing unit. It separates the grain from the crop and removes grain from the straw. Concave is provided in the thresher to hold the fed crop inside the threshing chamber and allows only grain and small amount of chaff to pass through it. The threshing takes place only in this space. It is a curved unit, made of iron steel or iron bar, fitted near the threshing cylinder. The clearance between cylinder and concave is adjustable, depending upon the size and type of grain. The concave clearance for wheat is 5 to 13 mm and for paddy is 5 to 10 mm. As the concave clearance is reduced, the threshing efficiency increases but losses increase and vice versa. The concave clearance at the inlet is less as compared to outlet. There are different types of concave, which are used in thresher.

Screen type concave: It is made of MS rod. It is semicircular in shape and sometimes made with wire also. The screen allows the material after threshing to pass through its perforation.

Perforated concave: In this, perforations are made in a mild steel sheet. The concave is closed from both the ends by iron sheet. The size of perforation is made as per the size of grain of a crop.

Cleaning unit: This unit is provided to separate the grain from chaff. It further uses sub units, like aspirators or blowers, sieves and sieve shaking mechanisms to separate out grains from chaff. The thresher that is provided with aspirator unit is usually called aspirator type thresher. Those threshers fitted with blower which blows air in horizontal direction is called drummy threshers.

Blower or Aspirator: After threshing unit carries out threshing, the cleaning and separation of straw from grain is required. The fan is generally installed on the main shaft over which cylinders, flywheel and

driven pulley are mounted. Fan lifts/sucks the lighter material chaff and other plant portion and throw away from the out let. Rest of the separation-cum-cleaning is done by screen with its oscillating motion.

Screens: Most of the power threshers are equipped with two screens. Top screen is provided so as to pass the grain to second screen and chaff etc is taken out from it. Other screen sieves out the smaller grain or weeds seeds and delivers the cleaned grain towards outlet. The size of screen hole is selected on the basis of grain size. These screens are effective when kept under oscillation.

Shaking mechanism: The screens are oscillated or shaken with a crank attached to the screen. This crank is powered from main axle either by belt or by rod. The circular motion of the main shaft is converted into oscillating motion of screen, which shakes it and separates the grain from other foreign material and chaff. The separating effectiveness depends on the frequency of strokes of crank, which is adjustable.

Power transmission unit: Threshers are usually powered with tractors and sometimes with electric motors or diesel engine also. After installing the thresher into the threshing floor in the field, tractor PTO shaft is coupled with a flat pulley. A corresponding matching pulley of appropriate size is provided over to the thresher main shaft. These pulleys are connected with a proper rating of flat belt and thresher is operated. Blower fan is provided into the main shaft of the thresher, which rotates and does the required job. The screens are oscillated with the help of a v-belt and a crank wheel, powered with main shaft of thresher. A heavy flywheel is also provided on the main axle of the thresher. It is very important part of any thresher. It is provided to store the energy to supply continuously and equally to the entire threshing cylinder. It is made up of cost iron, and fitted on one end of the main shaft of thresher.

Main frame: A very strong frame is provided in the thresher on which all the functional parts are attached. The frame is made usually of heavy angle iron sections. It should be strong enough to sustain vibrations of machine, during its operation in the field.

Transport wheels: Thresher is provided with wheels at its legs, so that transportation can be done easily. These wheels are made mostly with cost iron but new and large capacity threshers are equipped with pneumatic wheels for better performance during transportation.

Thresher ddjustments: The following adjustments can be done on a stationary power thresher:

Cylinder and concave clearance: In order to get cleaned grains and proper threshing, it is very important to set the proper clearance between tip of cylinder and concave. On an average, concave clearance is kept about 25 mm at the mouth, 10 mm at the middle and 15 mm at the rear end. Start operating the thresher, by keeping proper recommended speed, and check if any grain is left in the ears. If it is so, reduce the concave clearance gradually, until drum is threshing cleanly. Too close concave setting is likely to crack some of the grains.

Cylinder speed: The drum of the thresher should be rotated at proper speed for better threshing and cleaning efficiency. Normally, manufacturers specify the cylinder speed for different crops. The cylinder speed can be checked using tachometer. Operator should check the speed occasionally under load for proper functioning of thresher. The cylinder peripheral speed for wheat is kept between 1520 to 1830 m/min and for paddy between 370 to 920 m/min.

Fan adjustment: Fan(s) fitted on thresher must provide the proper amount of blast. The shutter(s) at each end of fan should be adjusted properly so that it could provide blast sufficient enough to remove chaff and light materials without grain. Watching the sample and adjusting the blast can help in getting the desired results.

Drummy Thresher: These threshers were very popular in the beginning when threshers were introduced because of its simplicity and low cost. The radially arranged arms known as beaters are mounted on the shaft (Fig. 5). These are made of mild steel square section with mild steel flat welded or bolted at the top. The beaters revolve inside an enclosed casing. Ribs are provided inside of upper half of the cover in

order to have better threshing. The lower half (known as concave) has rectangular openings made out from square bars. The crop is fed through feeding chute. Crop receives impacts from the rotating beaters till size is reduced to pass through concave. The clearance between beater and concave is kept about 18-20 mm. The crop should be well dried before feeding in the thresher. A wet crop raps around the beater shaft and machine becomes overloaded. These threshers do not have provision for separation and cleaning of grains. The threshed material is later separated and cleaned by small pedal type blower.

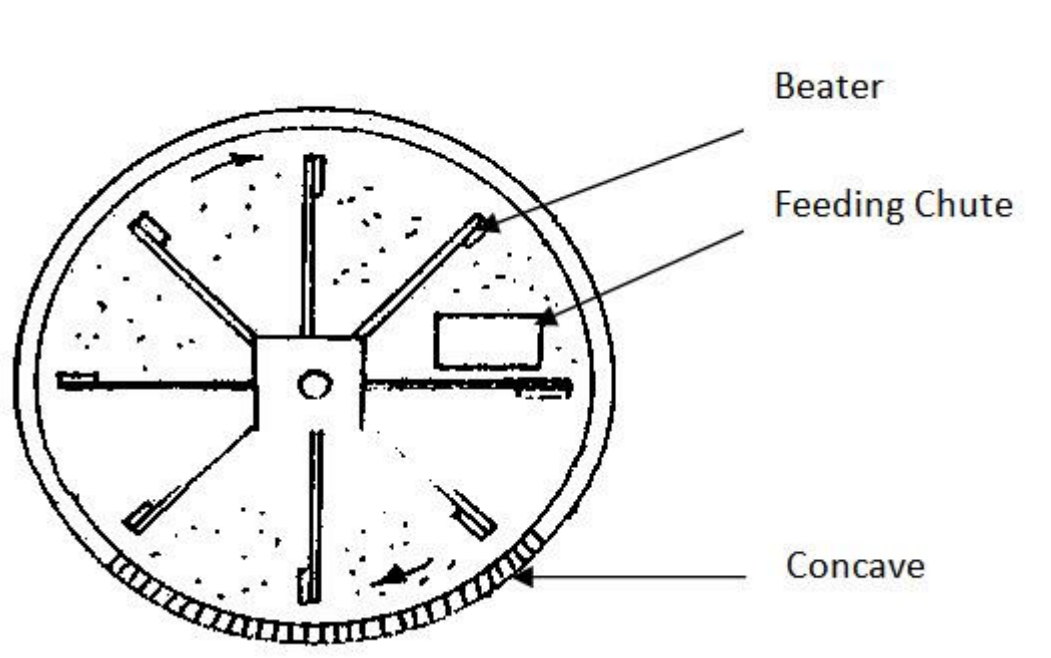


Fig. 5: Beater type drummy thresher.

Olpad thresher: 'Olpad' threshers (Fig. 6) are also used for threshing wheat crop. A pair of bullocks pulls it around over the dried crop spread in a circular form on the threshing ground. Threshing is continued till the entire material becomes a homogeneous mixture of grain and 'bhusa' (chaff). It consists of about 20 circular grooved discs each of 45-cm diameter and 3-mm thickness placed 15 cm apart in three rows. An operator's seat is provided on the frame to control the movement of animals. All discs are mounted staggered to give more effective cutting of the straw. It has 3 or 4 wheels to facilitate its movement from one place to other. Threshing by this thresher is fairly efficient and cheap but is quite slow with low output capacity. This machine can be used for threshing wheat, barley, gram etc.

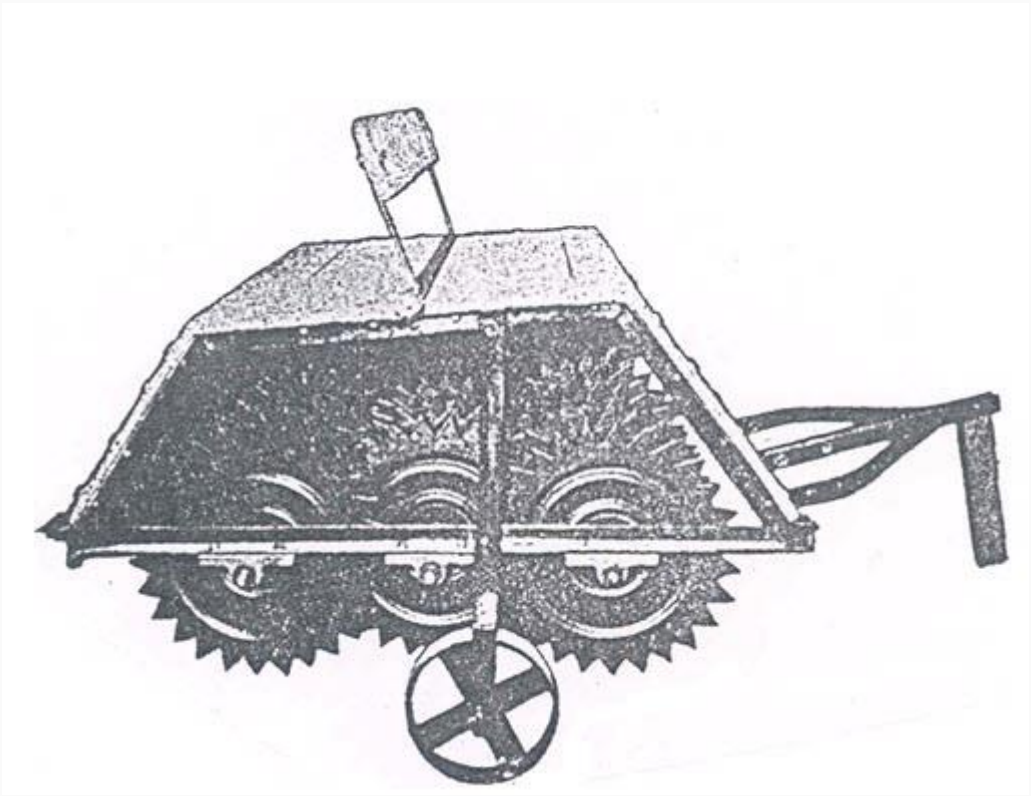


Fig. 6: Olpad thresher

Paddy Threshers: Paddy thresher of pedal operated type (Fig. 7) consists of mainly a well-balanced cylinder with a series of wire loops fixed on wooden slates. It has got gear drive mechanism to transmit power. While cylinder is kept in rotary motion at high speed, the paddy bundles of suitable sizes are applied to the teeth. The grains are separated by combining as well as by hammering action of threshing teeth. Paddy is threshed due to impact and rubbing action between threshing drawn loops and concave screen. The grains are cleaned with the help of a fan and cleaned grain goes down through the grain outlet at the bottom of the thresher. They are available in different horse power range.

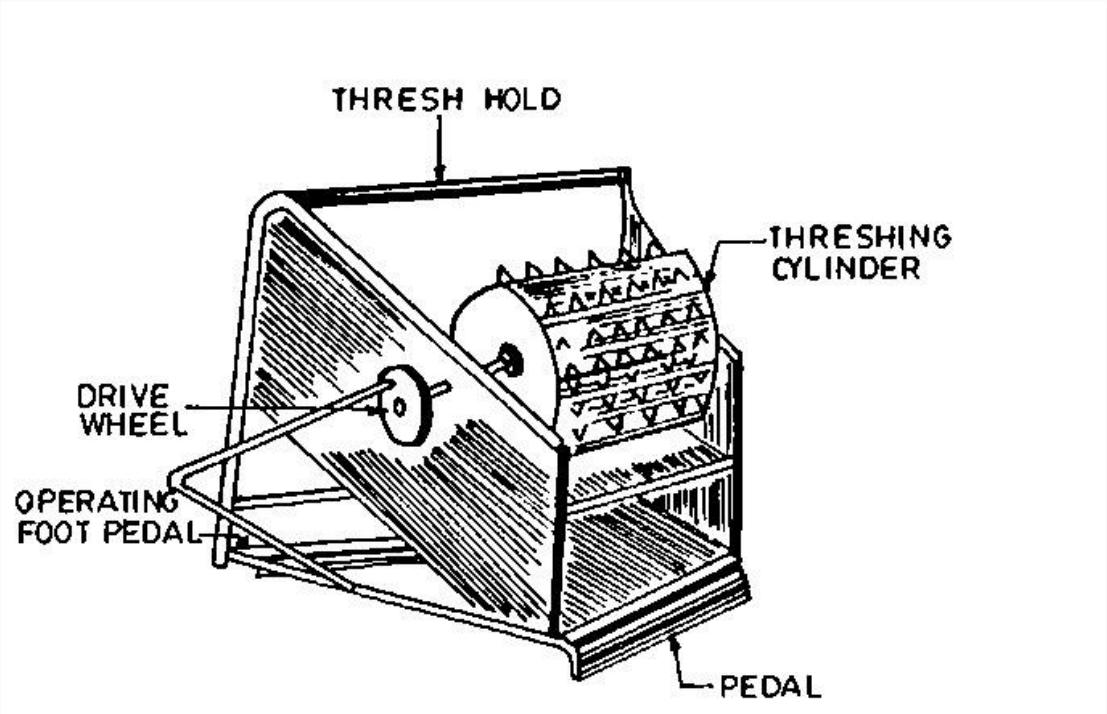


Fig. 7: Pedal operated paddy thresher.

Multi-crop Threshers: Since, the Indian farmers raise variety of crops as per the suitability of particular region, climate and soil conditions, there was need to thresh all these crops for timelines of operation. Developing a multi crop thresher has solved this problem. It can thresh crops like wheat, moong, paddy, grain, soybean etc. For these crop requirements are different, as in the case of wheat bruised straw (bhusa) is the main requirement. For paddy, farmers need long straw. For pulses, seed damage should be minimal; as damaged seeds lower the quality and causes spoilage in storage. The crop factors such as moisture content, grain size, grain-straw ratio, condition of straw etc influence the design consideration of main components of threshers. The farmer is primarily interested in end product, low cost, durable and reliable machine. The suitable multi crop threshers for cereals and pulses are commercially available in the country.

A multi-crop thresher (Fig. 8) attains the axial movement of the crop while handling paddy and all crop material is made to move through the concave in case of wheat. The main components of multi-crop threshers are: feeding chute, threshing cylinder, aspirator blower, paddy chaff outlet, wheat straw outlet, hopper, and cam for oscillating sieves, oscillating sieves, transport wheel, frame, main pulley and louvers. The axial flow of material can be accomplished by providing seven louvers with spacing of 150 mm in the hexagonal casing. The clearance between louvers and tip of cylinder spikes is 20 mm. For wheat threshing, the first three louvers are placed with ribbed casing and side plates are fixed with top casing and concave to prevent material flow in the second portion. The direction of rotation of threshing cylinder is opposite for wheat than paddy. That is why; straw outlet of aspirator blower is repositioned. The top sieve has holes of 9-mm diameter for wheat and 5 mm for paddy grains. The lower sieve has holes of 1.5-mm diameter common for both the crops. The upper sieve can be changed easily depending upon crop to be threshed. The cylinder-concave clearance in the first section of threshing system (i.e. facing the feeding chute) has to be more while handling paddy than wheat. The machine output is 500 kg/h for wheat and 700 kg/h for paddy.

Fig. 8: Axial flow paddy thresher.

High capacity (Harambha) threshers: It is a basically a chaff-cutter type thresher. It consists of a threshing cylinder, concave, two aspirator blowers, reciprocating sieves, feeding chute, feeding conveyor, feed rollers, safety lever in the feeding chute and flywheel. A platform is attached to the main frame of thresher, on which a person stands and feeds the crop into thresher. All the crop materials are fed through the conveyor of feeding chute and feed rollers move the crop into threshing cylinder. A safety

lever provided in feeding chute prevents the entrapping of hands by the feed rollers. Threshing cylinder has two chaff-cutter type blades and beaters. Chaff-cutter blades cut the crop into pieces and beater helps to detach grain from crop. All the threshed materials pass through the concave where it is subjected to aspiration action of blower. Light materials like chopped straw are blown away and grain etc. fall on a set of reciprocating sieves. The clean grain is collected in trolley through auger elevator. It can be used to thresh the crop having high moisture content also. The machine is operated by PTO of a 35-hp tractor and is mounted on two pneumatic tyres for easy transportation. It can thresh 1.5-2.0 tonnes/h.

Sunflower thresher: It consists of a threshing cylinder, concave, casing fitted with louvers, cleaning system, feeding hopper and frame (Fig. 9). The cylinder concave clearance is 40 mm and is uniform throughout its length. The diameter of cylinder is 65 cm and length 150 cm. The first part of cylinder of length 133 cm has flat bars for crop threshing and the 2nd portion of length 17-cm has straw throwing blades. The cylinder casing is of hexagonal shape and is fitted with 7 louvers. The louvers help the crop to move axially and the crop is rotated three and half times for complete separation of grains. The cleaning system has a blower and two sieves. The opening of top sieve is 16 mm and of lower sieve 6 mm. Recommended cylinder and blower speeds are 300-350 rpm and 1200-1400 rpm respectively. A tractor or 7.5 hp motor can operate machine. The machine has a capacity of 600-900 kg/h of clean grain.

Fig. 9: Sunflower thresher in operation.

GRAIN COMBINES, TERMINOLOGY, ADJUSTMENTS, LOSSES, TROUBLE SUITING

A combine is farm machine that combines the reaper and thresher to harvest the standing crop, thresh it and clean the grain from straw in one operation. According to source of power used combines may be classified as self-propelled combines (Fig. 1) and tractor operated (Fig. 2) or trailed type combine. Self-propelled combines use a propelling power source to do various operations. In tractor operated combine, the power is being optioned through detachable tractor. Only at the time of harvesting tractors are attached and rest of the times it can be used for other farm operations.

The present day combine harvesters are being mostly used for harvesting two major crops namely wheat and paddy. Other crops can also be harvested with combines like, sunflower, maize, soybean, pulses etc,

with slight changes in the combine. A combine harvester consists of header platform, reel, cutter bar, crop divider, platform auger, feeder conveyer, cylinder, concave and grate, fan, chaff sieves, straw walkers, grain sieves, grain auger, tailing auger, grain elevator, grain container and grain unloading auger (Figs. 3 and 4).

Fig. 1: Self-propelled combine in operation.

Fig. 2: A grain combine with 55-hp tractor mounted on it.

Cutter bar assembly: The cutter bar assembly comprises of finger bar, fingers, knife guides, wearing plates, outer shoes and main shoes that is non-reciprocating part of the cutting mechanism (Fig. 5). The cutting unit of a combine uses a mower type cutter bar. The knife on the combine uses serrated edge sections. The length of stroke is often longer and sometimes the section passes over two guards in one stroke. The knife section edge is serrated to help keep the straw from slipping while it is being cut. The serrated sections cannot always be sharpened and are generally replaced when they become dull. The cutting platform of combine should be adjustable to operate at a height, from 7.5-90 cm above the ground level. The platform is also provided with a reel and a canvass carrier.

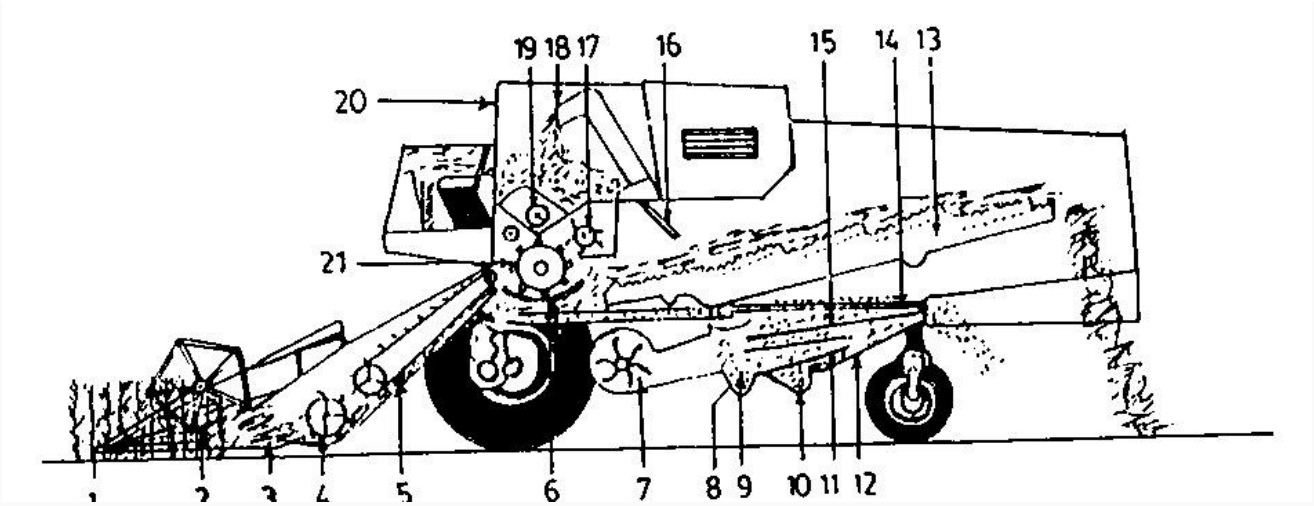


Fig. 3: Details of a self-propelled combine.

1. Crop divider 2. Reel 3. Knife 4. Auger conveyer

5. Feeding conveyer 6. Concave 7. Blower 8. Grain auger

9. Grain elevator 10. Ear auger 11. Grain collector 12. Ear collector

13. Straw walker 14. Rake 15. Sieves 16. Deflector

17. Straw guide drum 18. Tank filling auger 19. Tank auger 20. Grain tank

21. Threshing cylinder

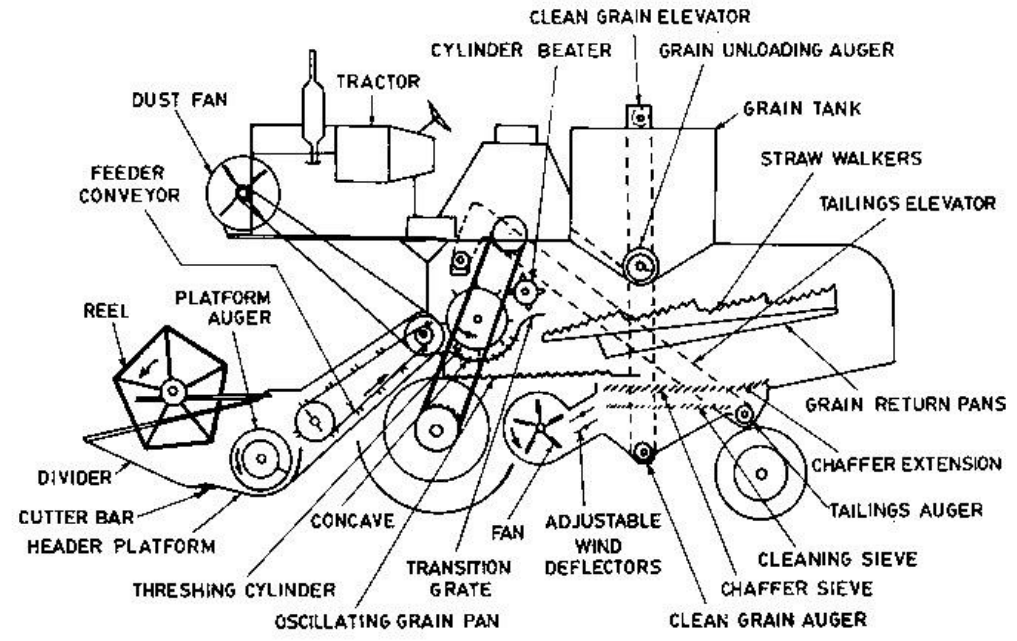


Fig. 4: Details of a tractor operated combine harvester.

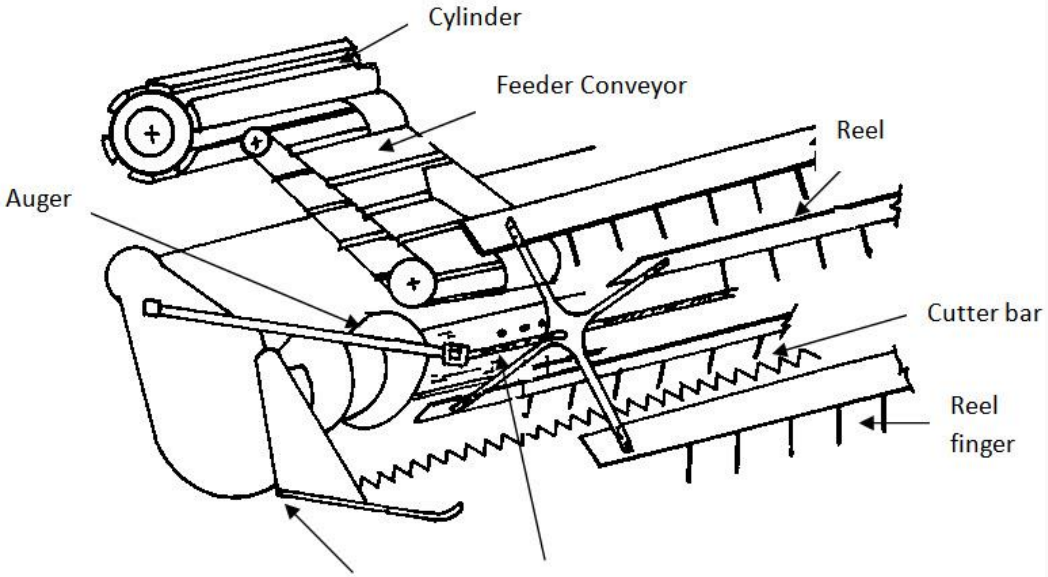


Fig. 5: Cutter bar assembly of a combine harvester.

The reel consists of a number of wide slats or arms with battens arranged parallel to the cutter bar to hold the crop being cut by the knife and to push and guide it to feeder conveyor auger. The reel may be of spring type or slat type. Its height and speed are adjustable. A clearance of about 12.5-25.0 cm between the reel and cutter bar is suitable for all purposes. The reel gets power through suitable gears and shafts. The reel revolves in front of cutter bar while working in the field. The cut crop is then fed to cylinder and threshing takes place between cylinder and concave units of machine. The basic components of threshing unit of combine are similar to that of power thresher (Fig. 6). The threshed material then moves to oscillating straw walker, which separate the grain from straw. The amount of grain not separated at any point along the walker length can be determined by

$$R_L = e^{-b\,L}$$

Where,

R_L = decimal fraction of the grain onto the walker that is not separated at distance L

L = distance along the walker from the effective point of delivery of material onto the walker

b = constant (function of feed rate, grain-straw ratio, crop variety and condition, walker design etc.)

If the walker is divided into uniform length increments, the amount of seed separated in any increment is a constant percentage of amounts of seed onto that increment. The effective delivery point on the walkers is 150-230 mm from the front end of walkers. If walker loss for a given crop condition and feed rate and seed rate onto the walker are known, the value of b can be calculated.

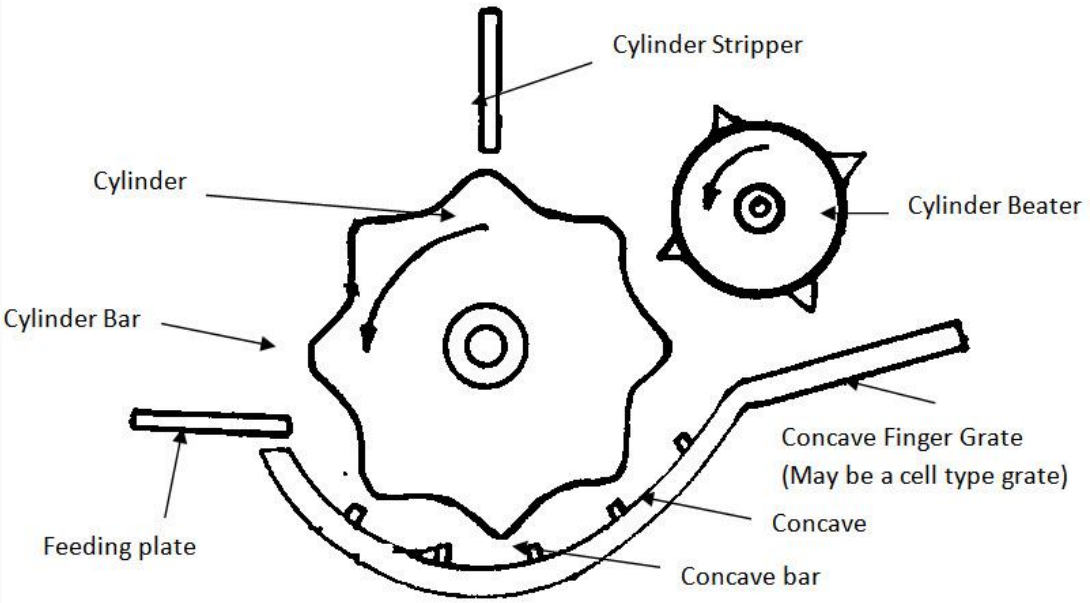


Fig. 6: Threshing unit of a combine harvester.

The cleaning unit (Fig. 7) consists of a number of sieves and fan cleans the grain. The un-threshed grains pass through tailing auger and go to cylinder for re-threshing. The grain passes through an elevator and collected in a hopper or directly unloaded to the trailer. The fan is adjusted such that the chaffs are blown off to the rear of the machine. The size of the combine is indicated by the width of cut it covers in the field. Some adjustments are always necessary on combines before being used for harvesting of crop. These adjustments are:

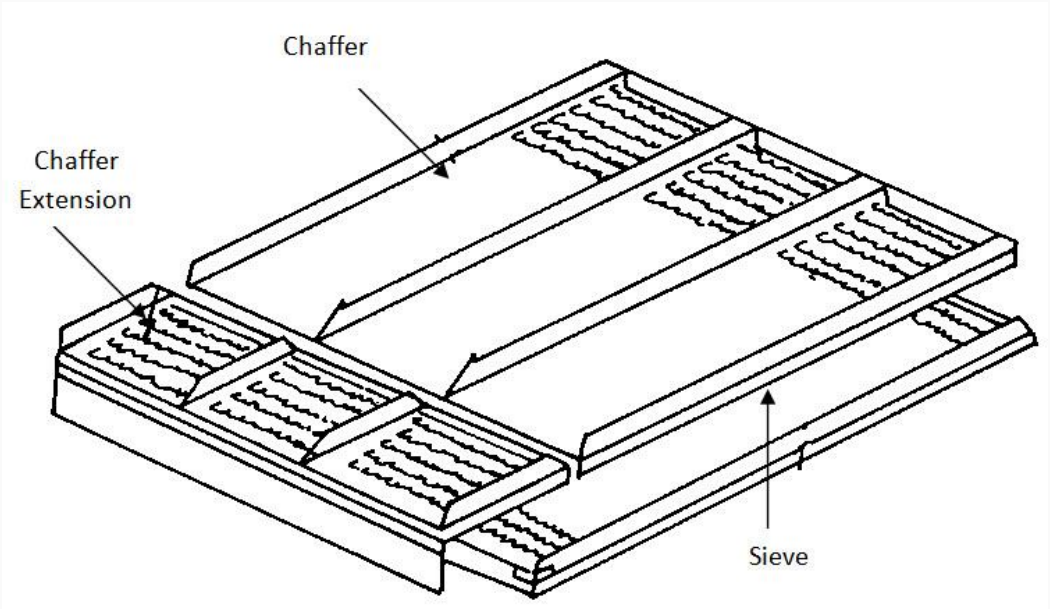


Fig. 7: Cleaning unit of a combine harvester.

Cutter bar height: The height of the forward tip of any knife section above the plane on which the combine is standing expressed in millimeters, is called cutter bar height. This height is adjustable and ranges from 75-900 mm. The crop is cut just low enough to cover nearly all the heads. If straw is to be saved cutting may be at a lower height.

Reel speed: It is essential to keep the reel speed in proper relation to the forward speed of the combine. If reel speed is more, grain shattering from heads occurs. If reel speed is lower then grain may fall on the

cutter bar. Hence speed of reel should neither be more nor less. The speed of reel can be adjusted by changing the reel-driving sprocket.

Feeding: The tension of upper and lower feeder canvass is kept tight enough to prevent slippage. If they are too tight, there will be wastage of power and excessive wear will take place.

Cylinder-concave clearance: The gap between the tip of the cylinder to inner surface of the concave is called cylinder-concave clearance. The method of adjusting clearance varies with different machines. In some of the combines, raising or lowering the cylinder changes the cylinder-concave clearance, whereas, in other cases, the height of concave assembly is adjusted to change the cylinder-concave clearance. Close clearance results in more breaks up of the straw, which decreases the effectiveness of separating and cleaning unit. The spacing between concave and cylinder at front is usually adjusted from 2-30 mm and at rear 2-18 mm. With close type concave, the normal setting of concave is closer to the cylinder at the front rather than rear. With open type concave, the concave is normally closer at rear than at front.

Chaffer opening: This is upper sieve on which grass and chaff mixture falls for initial cleaning. The sieve is oscillated so that grains pass through chaffer openings and chaff and un-threshed materials thrown at rear of the machine. The chaffer opening should be provided such as to float chaff away without blowing out grain, but coarse heavy material should be retained and discharged at the rear.

Shoe sieve opening: The opening should be just large enough to permit free passage of grain. Adjustable shoe sieve with smaller lips and openings are the most common.

Tailing gate height: Tailing gate is a device provided at the rear of the cleaning unit to prevent un-threshed material from passing out of the combine. It can be adjusted by raising the tailboard at the end of the chaffer extension if necessary to prevent threshed grain from being blown out.

Platform: The platform holds the cutter bar and feeding mechanism.

Cutting platform auger moves the cut grain to the centre of the platform where the retractable fingers feed the crop into the feeder conveyer.

Feeder convener: The feed conveyor or feed rake is designed to feed the crop in a steady even flow into the threshing unit.

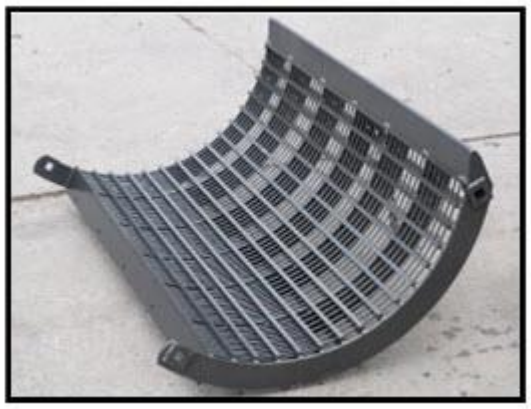
Feeder beater takes the crop from the feed conveyer and feed it uniformly to the threshing unit.

Threshing unit: The function of this section of combine is to thresh the grain from the heads. This is done by passing the grain between a rapidly revolving cylinder and a stationery surface underneath which is called the concave. The grains are separated from the pods by impact, rubbing or squeezing actions between cylinder and concave.

Threshing cylinder: The threshing cylinder may be of different types

1. Rasp bar type - having corrugated bars
2. Angle bar type - right angle bar with rubber facing
3. Spike tooth type - pegs or spikes on it.

Concave: The concave is the stationary part that the cylinder works against in the threshing action. The concave is a grate composed of rods and bars or wires. It is at the concave grate and finger grate that as much as 90% grain is separated from the crop. The separated grain falls through the grate on to the shoe pan where it is delivered to the cleaning unit. The straw and the remaining grain pass on to the separation unit.



Cylinder beater: The beater behind the cylinder slows down the material coming from the cylinder tears apart the straw and delivers the material to the straw rake or straw walker. The beater helps in cleaning the straw from the cylinder thus preventing cylinder wrapping and feedback.

Separating Unit: The separating unit agitates the straw after it comes from the threshing unit. This shakes out the loose grain remaining in the straw and delivers it to the cleaning unit. The straw is carried out of the combine by the rack.

One piece straw rack: The straw rack is a one piece unit with risers pointed toward the rear of the combine. The straw rack is mounted on cranks located at the front and rear which give it an oscillating motion. As the crank moves rearward and upward the straw is tossed up and to the rear. As the rack returns forward and downward the straw stays in mid air for a short time and then falls in to the section of the rack nearer the end of combine. In this way the straw moves step by step out of the combine.

Walker type straw rack: Some large combine may use a walker type straw rack which operates on the same principle as the rack. The straw walker has three or more narrow sections placed side by side. Each section is mounted on multiple throw cranks located at the front and rear. The crank throws for section are equally spaced around the circle of rotation thus the sections do not operate as a unit as one piece rack does.

Grain return pan: It is located under the straw rack. It catches the grain as it falls through the rack and moves forward to the grain pan.

Grain return conveyor: In place of grain return pan some combines will use a conveyor to catch the grain and move it forward.

Grain pan: The grain pan is located under the forward part of straw rake behind and below the cylinder. Its function is to catch the grain from the concave and cylinder grates and from grain return pan or conveyor for delivery to the cleaning unit.

Cleaning unit: The function of cleaning unit is to separate the clean grain and deliver it to the grain tank, return tailings to the cylinder for re-threshing, and move the remaining material out of the combine. This is accomplished by means of gravity and air blast.

Adjustable chaffer: The adjustable chaffer act as a sieve. It is made up of a series of cross pieces mounted on rods and fastened together so they can be moved at the same time to adjust the size of the openings.

Chaffer extension: This is an extension of chaffer having adjustable lips. The un-threshed portion of gain heads fall through the chaffer extension into the tailing anger.

Sieve: The sieve likes chaffer except that the lips and openings are smaller. The final job of cleaning is done here.

Cleaning fan: The fan furnishes a blast of air. The strength of air blast is controlled by wind board. The function of the air blast is to keep the material alive on the chaffer and sieve. The air blast should be strong enough to lift the chaff slightly off the chaffer and sieve, but not strong enough to blow grain out of the combine.

Tailboard: The tailboard keeps the un-threshed material from being carried out of the rear of the machine while still allowing the chaff to in blow cut. It may be raised or lowered as needed.

Material Handling: The grain auger collects the clean grain and angers it to the clean grain elevator which delivers the clean grain to the grain tank. Crop flow in combine is given in Fig. 8.

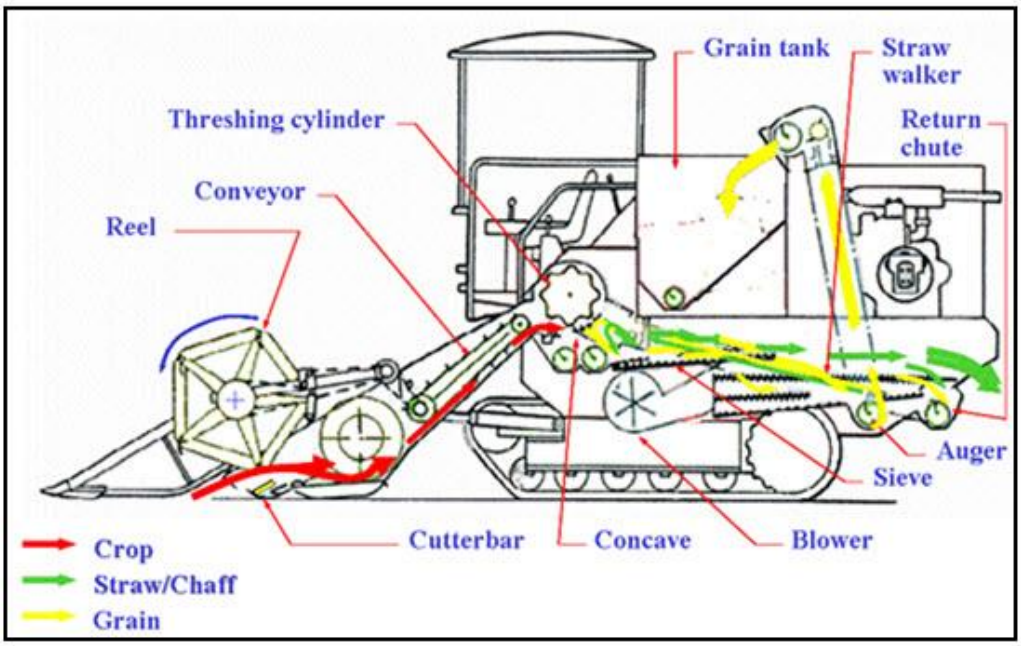


Fig. 8: Crop flow in combine

Land Levelling:

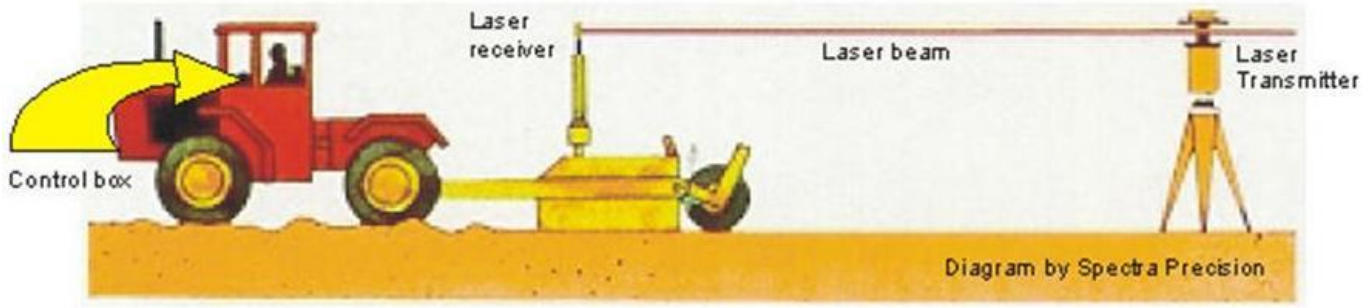
LASER LEVELING

RESOURCE CONSERVATION THROUGH LASER LEVELING

INTRODUCTION

Shrinking water resources owing to over exploitation of ground water in Punjab threatens the maintenance of agricultural productivity. As a result, the water table is falling in 90% area of the state. Most of this area falls in the Central part of the state. With the inception of Green revolution in the Sixties, the water table started declining and the area having water table below 30 feet. depth has increased from 3% in 1973 to 90% in 2004. During 1993-2003, the average fall of water table in the Central Punjab was 50cm per annum. However, in some of the areas, the fall of water table is even more than 80- 100 cm per annum. Out of 141 blocks of the state more that 100 blocks are over exploited. In the Central part, out of 70 blocks, the water table in 40 blocks has gone down below 50 feet depth and in these blocks, submersible pumps are being installed to replace centrifugal pumps. It is projected that by 2023 in Central Punjab, the water table depth will be below 70 feet in 66% area, below 100 feet in 34% area and below 130 feet in 7% area. Correspondingly in each district, the percent area below 70 feet depth will be 100% in Moga & Sangrur, 80 % in Patiala, 70 % in Ludhiana, 60% in Kapurthala & Jalandhar.

To arrest this dangerous trend of ground water exploitation, there is an urgent need to conserve irrigation water through various on-farm water conservation practices. **Land Leveling through Laser Leveler** is one such proven technology that is highly useful in conservation of irrigation water.



LASER GUIDED LAND LEVELING

As per studies, a significant (20-25%) amount of irrigation water is lost during its application at the farm due to poor farm designing and unevenness of the fields. This problem is more pronounced in the case of rice fields. Fields that are not level, have uneven crop stands, increased weed burden and uneven maturing of crops. All these factors lead to reduced yield & poor grain quality.

Laser land leveling is leveling the field within certain degree of desired slope using a guided laser beam throughout the field. Unevenness of the soil surface has a significant impact on the germination, stand and yield of crops. Farmers also recognize this and therefore devote considerable time resources in leveling their fields properly. However, traditional methods of leveling land are cumbersome, time consuming as well as expensive.

Why Laser Leveling?

- **Land looks leveled but even then wide topographic variation exists**
- **Wide variability in crop yields at field/ village/ block/ district/ regional level**
- **For Better distribution of water**
- **For Water savings**
- **For Improvement in nutrient use efficiencies**
- **Option for Precision Farming**
- **Higher crop productivity**

OBJECTIVES OF LAND LEVELING

Effective land leveling is meant

1. To optimize water use efficiency
2. To improve crop establishment
3. To reduce the irrigation time
4. To reduce effort required to manage crop.

Laser leveled land:

1. Saves 25-30% of water
2. Improves crop establishment and improves Yield.
3. Reduces weed problems
4. Improves uniformity of crop maturity
5. Decreases the time to complete tasks
6. Reduces the amount of water required for land preparation.

A) YIELD: Research conducted by PAU has shown a large increase in rice yield due to proper field leveling. The following table is self-explanatory:

Year	Rice Yield(t h/a)	
	Leveled Fields	**Unleveled Fields**
1996	3.40	2.67
1997	2.27	1.46
1998		
1999	2.72	2.36
Average	2.34	2.00
	2.72	**2.19**

It clearly shows that for the same rice varieties and the same fertilizer input, the average increase in crop yield was 24% or 530 kg h/a.

Yield and irrigation water saving for Laser leveled and traditionally leveled plots for rice crop under replicated experiments at PAU, Ludhiana

Sr. No.	Leveled (t/ha)	Unleveled (t/ha)	% age increase in yield	% Saving in Irrigation time/water
Site 1	8.78 ± 0.33	7.73 ± 0.21	13.60	26.15
Site 2	8.30 ± 0.46	7.53 ± 0.39	10.30	---
Site 3	7.60 ± 0.21	7.00 ± 0.25	8.57	25.00
Mean			10.82	25.57

B) WEED CONTROL: Improved water coverage from better land leveling reduces weeds by up to 40%. This reduction in weeds results in less time for crop weeding.

C) FARM OPERATION: Laser leveling makes possible the use of larger fields. Larger fields increase farming area and improve operational efficiency. This increase in farming area gives the farmer the option to reduce operating time by 10% to 15%.

D) SEEDING PRACTICES: Laser leveled larger fields reduce the time taken for planting, for transplantation and for direct seeding.

E) EFFICIENT WATER MANAGEMENT: An unleveled field means extra water storage in fields to accomplish puddling in paddy field. Moreover, land leveling effectively terraces fields allowing water in the higher fields to be used in the lower fields for land preparation , plant establishment & irrigation.

F) ECONOMICS: The initial cost of laser land leveling is high but if the appropriate ploughing techniques are used, re-levelling the whole field should not be necessary for at least eight to ten years. Measurements taken in fields in the second and third year after leveling have shown very little variation in surface topography. Other benefits are:

- Being able to direct seed
- Plough the field on time
- Harvest evenly ripened crop
- Reduced weeding cost.

To sum up the objectives of laser land leveling:

- More level and smooth soil surface
- Reduction in time and water required to irrigate the field
- More uniform moisture environment for crops
- Reduced consumption of seeds, fertilizers, chemicals and fuel
- Improved field trafficability (for subsequent operations)

THE PROPOSAL

One Laser leveler costs about Rs. 4 Lacs and a 50 HP Tractor costs about Rs. 4 Lacs. Thus, th of 1 Laser Leveler & Tractor Set is Rs. 8 Lacs. Individual farmers can not afford to incus this cost. Therefore, it is proposed that a group of farmers, i.e., Farmers' Interest Group (FIG) v formed who will be assisted to ourchase the equipment. An assistance of 75% of the cost is pr on the equipment comprising of 1 Laser Leveler & a 50 HP Tractor. The FIG shall level the fields and also can do custom hiring to level the fields of other farmers. 500 Laser leve Tractors are required to level more than 2 lakh hectares area in the next 5 years.

Project Cost

The total cost of the Project for 5 years shall be 40 Crores. The State Govt. shall provide 30 as 75% assistance for 500 machines (1 Laser Leveler & a 50 HP Tractor) and the beneficiarie bear the balance cost of Rs. 10 Crores. These machines shall help in precision leveling of mor 2 lakh hectares of cropped area in the next 5 years.

For the Year 2007-08, the requirement of funds is proposed as under:

No. of Sets (Laser Leveler + Tractor 50 HP)		100.
Total Cost of 100 Sets	(@ Rs. 8 Lacs per set)	Rs. 8 Crores.
Assistance proposed under ACA @ 75% of cost		**Rs. 6 Crores.**
Share of FIGs		Rs. 2 Crores.

Benefits of the Project

The assistance shall be provided to the FIGs who shall not only use the machines on their own but shall also operate on custom hiring on the fields of other farmers. Each machine shall be a level an area of more than 400 hectares benefiting a total area of 40000 hectares throug machines during the year 2007-08. The major benefits of the Project shall be as follows:

1. Water Saving

The Laser Leveling of fields saves 25-30% of water. Taking into consideration the Paddy- rotation, there is a saving of 2625 cum per hectare after leveling the field. Therefore, there be a saving of 105 MCM (Million Cubic Metres) of water by leveling 40,000 hectares throug machines in one year.

2. Increase in Yield

The Laser Leveling of fields helps in increased yields by 10%. This increased yield shall help in additional income of Rs. 6000/- per hectare. Therefore, there shall be a cumulative additional income of Rs. 24 Crores in 1 year by 100 machines.

3. Energy saving

Saving of 105 MCM of water on 40000 hectares shall lead to less requirement of irrigation to the fields thereby saving of 125 lakh Units of Electricirty valued at Rs. 5 Crores in 1 year.

4. Other benefits

Apart from above, other benefits of Laser Leveling include Weed Control, Labour saving, Time saving, Land saving etc. as described earlier.

Effective land leveling reduces the work in crop establishment and crop management, and increases the yield and quality.

1. Higher yield

Good field leveling increases the rice yield considerably. In two experiments conducted at different localities, a strong correlation was found between the levelness of the land and crop yield. (see chart)

2. Better weed control

Land leveling increases yield to a large extend because it improves weed control. Improved water coverage from better land leveling reduces weeds by up to 40%. This reduction in weeds results in less time for crop weeding.

A reduction from 21 to 5 labor-days/ha is achieved. This represents a reduction of up to 16 person-days per hectare – a 75% decrease in the labor required for weeding.

Weeds under water (left) and complete eradication of weeds (right)

3. Larger farming area

Good land leveling enables larger fields. Larger fields increase the farming area and improve operational efficiency. Increasing field sizes from 0.1 hectare to 0.5 hectare increases the farming area by between 5% and 7%. This increase in farming area gives the farmer the option to reshape the farming area and can reduce operating times by 10% to 15%.

4. Faster seeding/Less work

Leveling reduces the time needed for transplanting and for direct seeding. Land leveling provides greater opportunity to use direct seeding. The possible reduction in labor by changing from transplanting to direct seeding is approximately 30 person-days per hectare.

Direct seeding on a level field

5. Better use of water

Rice farmers using animal or 2-wheel tractors rely on water to accumulate in the field before starting land preparation. The higher the difference between the highest and lowest portions of a rice field, the more water is needed to achieve complete water coverage. Good leveling may reduce total water requirement to grow the crop by up to 10%.

Fertilizer Distributor

A **broadcast seeder**, alternately called a **broadcaster**, **broadcast spreader** or **centrifugal fertilizer spreader (Europe)**, is a farm implement commonly used for spreading seed, lime, fertilizer, sand, ice melt, etc., and is an alternative to drop spreaders/seeders.

ATV tow spreaders normally have a larger capacity to enable the coverage of larger areas

The smallest are handheld with a hopper of several liters and which operate via hand cranking. A bit larger are push units with the spinning disk powered by gearing to the wheels. The next size up is designed to be towed behind a garden tractor or ATV. Very similar in size to the tow behind units are broadcast seeders that mount to the three-point hitch of a compact utility tractor, these are ideal for landscape and small property maintenance. Still larger are commercial broadcast seeders/spreaders designed and sized appropriately for agricultural tractors and mount to the tractor's three point hitch. The broadcast seeders that are mounted to a three-point hitch are powered by a power take-off (P.T.O.) shaft from the tractor. At the largest size are pull behind or chassis mounted units for agricultural use that can spread widths of up to 90 feet.[2][3]

How they work

View of a tractor-operated broadcast seeder moved by three-point hitch and driven by PTO shaft

The basic operating concept of broadcast spreads is simple. A large material hopper is positioned over a horizontal spinning disk, the disk has a series of 3 or 4 fins attached to it which throw the dropped materials

from the hopper out and away from the seeder/spreader. Alternately a pendulum spreading mechanism may be employed, this method is more common in mid-sized commercial spreaders for improved consistency in spreading. The photos clearly show the material hopper. Hoppers are commonly made of plastic, painted steel, or stainless steel. Stainless steel is usually used in large commercial units for strength and because granular fertilizer is often quite corrosive.

Some seeders/spreaders have directional fins to control the direction of the material that is thrown from the spreader. All broadcast spreaders require some form of power to spin the disk. On hand carried units, a hand crank spins gears to turn the disk. On tow behind units, the wheels spin a shaft that turns gears which, in turn, spin the disk. As is partially visible in one of the photos, with tractor mounted units, a mechanical P.T.O. shaft connected to the tractor and controlled by the tractor operator, spins the disk. There are some seeder/spreaders made for garden size tractors that use a 12 volt motor to spin the dispersing disk and yaw. Broadcast spreaders can also be used under drones.

Puddler

Objectives

- Decrease weeds
- Decrease percolation as a result of soil dispersion.
- Level the soil for better planting conditions and/or for snail control (where a problem)

Key Points

- Power requirements of the order 7k W/n at 7.2 km/hr
- Puddlers should be used only when necessary for snail and water management.
- Note: Rotopuddlers (e.g., those used at IRRI) can be used with a "Laser" guided System.

Land preparation

Puddle the land, level it and remove the water after 24 hours (for clayey) or 12 hours (for sandy/loamy soil) before the transplanting. In black or clayey soils the settlement is critical as the loosened soil can bury the seedlings planted.

Just before the operation of transplanter, a thin film of water is necessary to ensure the free movement of transplanter and avoid adhering of soil to the moving parts of the transplanter.

Performance: There will be a net saving of 40 per cent over the manual transplanting. It can transplant about one hectare in a day of 8 hour run. The transplanter performs with missing hills of 2-3 per cent.

Available Transplanters Now a days mechanical transplanting of paddy is also recommended and practiced in some places.

Land Levelling

Levelling helps in bringing undulated field left over after puddling into levelled field

To maintain uniform depth of water in main field

To increase water use efficiency by maintaining shallow depths of water upto panicle initiation stage.

Maintenance of shallow water depth is possible only when the land is perfectly levelled.

Shallow planting is possible only at shallow water depth which helps in better seedling establishment which helps in term for early tillering.

Better utilization of nutrients by managing uniform depth of water through out the field

Perfect levelling helps in complete draining of water - facilitates easy harvesting of crop without loss of grain.

If a pulse is sown after paddy uniform establishment of pulse crop can be achieved

Oxygen diffusion is more uniform

Reduction of deep percolation of water and inputs to a certain extent.

Puddling With Full Cage Wheel

Rice is a main crop in India. Preparation of wetland for rice plantation is a important stage. To mulch the soil properly and mix the same in wet condition, full cage wheel is used. Especially in the are where deep water puddling is done, full cage wheels are used. It gives good traction in wet soil and mixes soil optimaly.

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Standardization is the process of developing, promoting and possibly mandating standards-based and compatible technologies and processes within a given industry.

Standards for technologies can mandate the quality and consistency of technologies and ensure their compatibility, interoperability and safety. Standards organizations such as ANSI (American National Standards Institute), IEEE (Institute of Electrical and Electronics Engineers) and IETF (Internet Engineering Task Force) exist to promote standardization and endorse official standards (also known as de jure standards) for given applications.

Standardization or **standardisation** is the process of implementing and developing technical standards based on the consensus of different parties that include firms, users, interest groups, standards organizations and governments.[1] Standardization can help maximize compatibility, interoperability, safety, repeatability, or quality. It can also facilitate commoditization of formerly custom processes.

Standardization is the process of implementing and developing technical standards for mass production, compatibility, interchangeability and safety.

List of organizations for tractor tesing:

1. Director, Central Farm Machinery Training & Testing Institute, Tractor Nagar,Budni (MP)-466445.
   Tel. 07564-34729 Fax 234743
   email- fmti-mp[at]hub[dot]nic[dot]in

2. Director, Northern Region Farm Machinery Training & Testing Institute,Tractor Nagar, Sirsa Road, HISSAR- 125 001 (HARYANA)
   Telefax : 01662-27684
   e mail- fmti-nr[at]hub[dot]nic[dot]in

3. Director, Southern Region Farm Machinery Training Testing Institute, Tractor Nagar, P.O. Garladinne-515 731, Distt. Anantpur (Andhra Pradesh)
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