

LESSON 16. Adjustment, operation and maintenance of threshing equipment

Introduction:

Threshing is an operation of detaching the grains from the ear heads, cobs and pods. 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



Fig: 1. View of power thresher (Courtesy: Amar thresher)

Clean unbruised grain fetch good price in the market as well as it has long storage life. Thus the effective threshing operation means that the loss of unthreshed kernels ejected with the straw through the concave of threshing and loss of grain damage should be low and amount of material passed through the concave should be high. 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.

2. Component of a thresher and Working principle:

A mechanical crop thresher mainly consists of the following component/ devices:

- a) Feeding device (chute/tray/trough/hopper/conveyor)
- b) Threshing cylinder (hammers/spikes/rasp-bars/wire-loops/syndicator)
- c) Concave (woven-wire mesh/punched sheet/welded square bars)

d) Blower/aspirator

e) Sieve-shaker/straw-walker.

Working Principle of thresher:

The crop is fed from the feeding tray into the threshing cylinder. The threshing cylinder is fitted with spikes/bars/hammers or wire-loops around its periphery according to the type of thresher.



Fig: 2. View of Haramba 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, and also accelerating them into the inlet of the lower concave.

As the material layer shifts towards the progressively converging slit of lower concave, its size reduces. The vibration amplitudes, therefore, decrease, whereas 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 passes through the concave apertures. Thus fine bruised straw is produced.

The entire or a portion of threshed material falls from the concave on to top sieve of the cleaning system. Due to reciprocating motion of top sieve lighter accumulate at the top and grain falls on

to the bottom sieve. In case of spike tooth thresher, an aspirator blower sucks out the lighter material from the top sieve and throws it out from blower outlet. The sieves help in further cleaning of the grain by allowing heavier straw to overflow.

3. Crops and types of threshers used:

Rice, wheat, gram, maize, and sorghum are the major crops grown in the country. Besides these soybean cultivation is also catching up rapidly. In case of wheat threshing farmer's want not only clean grain but also need fine quality of bruised straw (bhusa) for cattle feed. This requirement of quality 'bhusa' makes combining unattractive to small farmers. Drummy type, hammer mill type and syndicator type threshers are suitable for threshing wheat crops only and they can produce fine quality of 'bhusa'.



Fig: 3. View of different type cylinders of Thresher (Courtesy: IRRRI)

Rasp-bar type, wire-loop type and axial flow type threshers are suitable for paddy and they do not make fine straw. Rasp-bar type threshers can be used for threshing other crops but fanners do not prefer, this machine because it does not make fine 'bhusa'; and cost is very high due to its bulky size. Though the hammer mill type threshers can produce fine quality 'bhusa' its use is decreasing day by day due to high power requirement. Portable wire loop type paddle operated threshers are widely used by fanners in paddy growing areas. Spike tooth type thresher can thresh wheat crop and can produce fine quality of 'bhusa'. This thresher can be used for threshing other crops if the blower is mounted on a separate shaft so that the cylinder speed can be varied independently. Majority of farmers prefer spike tooth type threshers because of their simplicity in design, low cost and their ability to make fine 'bhusa'.

4. Factors affecting thresher performance

The factors which affect the quality and efficiency of threshing are broadly classified in following three groups:

I. Crop factors:

Type of crop

Variety of crop,

Moisture in crop material

II. Machine factors:

Feeding chute angle,

Cylinder type,

Cylinder diameter,

Spike shape, size, and number

Concave size, shape and clearance

III. Operational factors:

Cylinder speed,

Feed rate, method of feeding,

Machine adjustments.

I. Crop factors:

Beans are more susceptible to damage due to impact and the variety of grain has much influence on grain loss during threshing. Damage of large beans is more than smaller beans at same impact velocity and orientation. The amount of damage increases rapidly below ambient temperature of 10°C. So, handling of dry beans at low temperature should be avoided. Moisture content of grains is a major factor in controlling grain damage. Decreasing moisture content greatly increases the brittleness of grains. Unthreshed grains are more at high pod moisture content whereas grain damage decreases with increase in grain moisture content. More threshing effort is required for threshing high moisture crop, which causes more internal grain damage and thus affects viability. Soybean moisture content between 8 and 12 per cent (wb) is optimum for low mechanical damage.

II. Machine factors:

The base angle of feeding chute affects the feed rate. It should be tangential to cylinder drum for maximum feed rate and minimum physical effort. The threshing cylinder requires power as high as 60-75 per cent of total power input. Hammer mill type threshers bruise the straw very fine but the specific energy requirement is the highest among all types of threshers. Rasp-bar cylinder design can thresh most of the crop except groundnut but these machines do not provide bruised straw.

The concept of a straw bruising attachment to rasp-bar thresher is not economically viable. Spike tooth type threshers having independent drive to cylinder and blower can thresh major crops effectively but the cylinder speed is to be adjusted according to the crop conditions. Larger cylinder diameter has lower power requirements than smaller ones at higher feed rates. Higher rib spacing

in upper concave increases unthreshed grain but reduces power consumption. The performance with flat spikes is better than round and square spikes. Larger spike spacing in a row reduces power consumption and broken grains where as power increases and broken grains reduce with the increase in number of rows of spikes. However, uniformity of spike distribution over cylinder periphery is more important for better performance. Power consumption and grain damage increases with the increase in spike length and thickness. The grain damage decreases and unthreshed grains increase with the increase in concave gap. Higher concave clearance reduces power consumption where as straw bruising is more at low concave clearance.

III. Operational factors: The effect of cylinder speed on threshing performance is highly significant at all machine settings. Power consumption and broken grains increase and unthreshed grains decrease with the increase in cylinder speed. Though the unthreshed grain losses decrease but the total grain losses increase with the increase in cylinder speed. Quality of bhusa is better at higher cylinder speeds, low concave clearance and concave gap.

Higher feed rate increases power consumption, reduces broken grains and unthreshed losses and to some extent helps in straw bruising.

In general, feed input capacity is considerably affected by machine settings. Lower rib spacing in upper concave, concave bar spacing, concave clearance and non-uniform spike distribution over cylinder periphery reduces the capacity. Low feed rate, high labour rate, high energy consumption, high percentage of broken. Grain and poor quality of straw all contribute to high qualitative cost of operation.

For harvesting tall varieties, there are problems as plants in rows are entangled with each other. Therefore, in combine harvesters, a vertical cutter bar is used at outer end to cut and separate the plants of harvested row. Similar cutting device is also used on reapers on the outer crop row divider and the belt conveyor has to be raised up, to take care of tall crop.

5. Adjustments in threshers:

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.

Setting of a spike tooth multi crop thresher having 500mm cylinder diameter and 720mm blower diameter are given below:

Following are some general guidelines for adjustments of a thresher. At all times, consult the user's manual that is provided by the manufacturer. Also, review the safety/ health precautions for threshing machines. (Fig: 4.)

Adjustments before operating a thresher:

1. Position the thresher on a level area close to the crop stack to minimize handling and shattering losses.
2. Spread cloth, canvas, or mat underneath the thresher to collect spilled grain from the grain discharge chute or due to shattering during handling.
3. Install the cylinder, cover, and feed tray if dismantled during field transport.
4. Position the thresher so that the straw is thrown with the direction of the wind. This will eliminate the blowing of straw, chaff, and dust back toward the operator and the threshed grain.
5. Check each belt's alignment and tension. Adjust the idler pulley on the blower/cylinder belt to correct tension. Improper alignment and tension are the major causes of premature belt failure. (Fig: 5.)
6. Check pulley surfaces. Rough grooves must be smoothed with a fine file if nicked. Cracked pulleys should be replaced immediately. (Fig: 5.)
7. Open the cover and check all pegs on the threshing cylinder for tightness. Loose pegs will damage the machine and can be dangerous to the operators. (Fig: 6.)
8. Examine the peg teeth for wear. Maximum wear occurs at the feed end of the cylinder and is more prominent at the leading side in the direction of rotation. Worn pegs must be rotated 180 degrees or interchanged with those located near the straw paddles. Badly worn pegs must be replaced or rebuilt by welding.
9. Rotate the threshing cylinder manually at least five revolutions to ensure that there are no obstructions or interferences.
10. Make sure there are no loose or missing bolts and set screws. Tighten or replace as necessary.
11. Lubricate all bearings with good quality grease (see maintenance and service section) the belt idler and oscillating screen eccentric bearings are lubricated for life, thus require no lubrication.
12. Check engine oil and fuel levels. Follow the engine manufacturer's recommendations.
13. Start the engine and allow it to warm up.
14. Feed the thresher with the crop to be threshed for performance checking. Increase cylinder speed if excessive amounts of unthreshed and unseparated grain are observed with the straw.
15. Optimum threshing and cleaning is obtained with cylinder speeds of 600 to 700 rpm.

6. Operating the thresher:

1. Start the engine.
2. Load the feed tray with the harvested crop. Three to four persons are required to operate the machine. One or two men load and the other feed the machine. Another person bags the threshed grain and insures that the cleaning screen is kept free of clinging straw especially when threshing wet material. Use a stick to remove clinging straw from the oscillating screen to protect hands from possible injury. (Fig: 7.)
3. Harvested crops must be placed on the feed tray with the panicle away from the operator, so it is fed panicle first into the thresher.
4. Feed the crop at a uniform rate and maintain maximum feeding rate without overloading the engine. Adjust the feed rate to match the condition of the material being threshed. For wet crops or crops with decomposed straw, reduce the feed rate to avoid overloading the cleaning screen.
5. For higher threshing efficiency, briefly hold the crop bundles at the feed opening for partial threshing when the material is longer than 40-50 cm. longer cut material will reduce machine output and may result in poor threshing and clogging of the machine. Short, panicle-harvested materials (cutting just above the flag leaf) may result in high unthreshed losses because the panicles move rapidly through the thresher without receiving sufficient threshing. Recycling the straw is necessary in this case.
6. Adjust blower openings (shutters) to give the air flow needed for winnowing. Open slowly to provide more air for a cleaner output until a small amount of mature grain flows over the wind board. (Fig: 8.)
7. The angle of the wind board and the blower opening must be adjusted to suit the threshing conditions. For dry paddy, the wind board should be set at its maximum inclination and the blower should be gradually adjusted until the desired grain cleanliness is obtained. For threshing wet paddy, the inclination of the wind board must be reduced and the air shutter opening increased to blow the heavier wet leaves and other impurities. To obtain extra-clean paddy, set the wind board at a low inclination and increase the air shutter opening. This process will blow more grain over the wind board, but this can be recovered by recycling the separated impurities through the thresher.
8. The stripper bars prevent straw from wrapping around the cylinder and aid in threshing hard-threshing varieties. Use of stripper bars reduces capacity and increases the amount of finely chopped straw that passes through the concave when threshing overly mature crops, thus they should be installed only when necessary. (Fig: 9.)
9. Reduce feeding rate when threshing wet or partially decomposed materials to avoid overloading. (Fig: 10.)
10. Open the cylinder cover periodically to remove straw and chaff accumulation at the lower concave.

7. Safety precautions in threshing operation: -

1. Leave all guards and shields in place when operating the machine
2. Before cleaning, servicing, or repairing the machine, disconnect the power to the unit.
3. Use only properly grounded outlet (electric only).
4. Keep hands out of threshing belt entry area.
5. Do not wear loose clothing when operating this machine. Clothing can be grabbed by chain drives or rotating shafts and severe injury can result.
6. Keep hands and feet away from chain drives and v-belts when machine is running.
7. Lock brake when using (if equipped).

8. Guide lines for maintenance of a crop thresher:

1. Lubricate cylinder and fan bearings with good-quality general purpose grease every 25 hours of operation. Periodically apply a small amount of oil to all hinge points.
2. Inspect the machine regularly for loose, worn, or damaged peg teeth, concave bars, cylinder, discharge paddles and other parts, and tighten, repair, or replace them immediately. Missing bolts or nuts must also be replaced.
3. Reduce belt tensions by loosening the idler pulley and engine mounting bolts when the machine will not be used for an extended period to minimize deterioration.
4. Check engine crankcase oil level at least every 4 operating hours and follow the engine manufacturer's recommendations for oil change intervals and oil grade. Be sure the recommended oil level is maintained.
5. Service the air cleaner, fuel filter, fuel line, carburetor, and spark plug regularly according to engine manufacturer's instructions.

9. Guide lines for storage of a threshing machine

1. Clean the machine thoroughly.
2. Remove belts and store in a dry place.
3. Store the machine in a clean, dry location and cover to reduce damage from dust accumulation.
4. Paint parts that need repainting.
5. Clean and apply oil to exposed metal surfaces to prevent rusting.
6. Follow the manufacturer's recommendations on engine storage.

References:

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