Design and Development of Ridge and Furrow Machine for Agricultural Field

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ABSTRACT

In India, the agricultural sector comprises primarily of small and marginal farmers who employee laborers to make ridge and furrow in agricultural fields. In some cases farmers use tractor and other kind of ploughing machine for making of ridge and furrow, the cost of which reduces their profit and also the process is very demanding physically. The ploughing machine available at present are expensive as they are driven by electricity or fuel. Hence, there is a need for a low cost machine to perform the same process. The objective of the project is to design and develop a manual ridge and furrow making machine which will be simple and cost effective. The machine should also be capable of demanding less physical work and also to speed up the process. The machine which we have fabricated has a hydraulic cylinder with blade arrangement operated by direction control valve to mimic the manual action done by the laborer. The machine will be driven by engine and the whole setup is mounted on a frame with wheels to facilitate the movement of the machine.

KEY WORDS: Ridge and Furrow machine, Farm equipment, Agriculture.

1. INTRODUCTION

In today's scenario many of the countries like India, China, America, Germany etc, are manufacturing lots of agricultural machineries. These kind of agricultural machines are mainly applicable for large scale cultivation and harvesting of agricultural products. So the cost of the machineries are high and the size of the machineries are also big. In India about 80% of the farmers are very poor and below average, whose land holdings are below two hectors (i.e. small scale farmers). They have no better financial background to buy a costly machineries for farming and also there is no need for big machineries only small and medium size machineries are enough for farming. But the production of small and medium size machineries are very less and rare when compared to large machineries and the cost is also high. So the farmers use laborers for farming in daily wages. In some cases they rented the machines to do the same work, which is more time consuming and also which reduces their profit. One of the major problem they faced is making of Ridge and Furrow.

Ridge and Furrow:

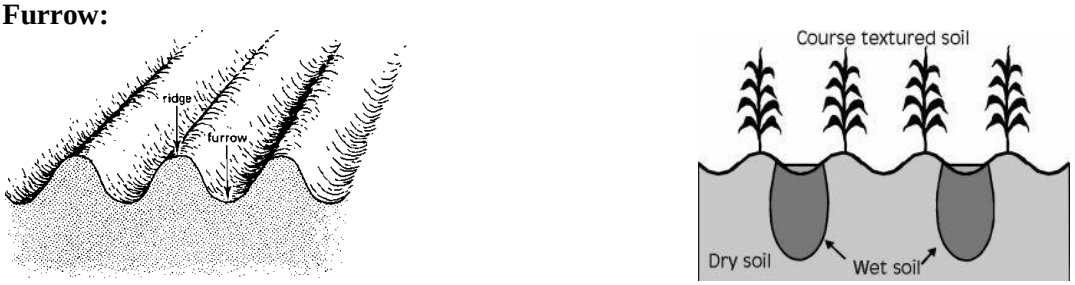

Figure.1. Ridge and Furrow

The Figure.1, shows the Ridge and Furrow method of irrigation to plants. It is done before and after the planting. Furrows are small and parallel channels made to carry water in order to irrigate the crops. The crops are usually grown on the ridges between the furrows. This method provides good strength to plants, reduces erosion of soil and controls the weed formation in the path. Furrow irrigation is suitable for many crops, especially row crops like sunflower, sugarcane, soybean, tomatoes, wheat, potatoes, citrus and grapes,

Necessity of Ridge and Furrow machine: Generally Farmers makes a ridge and furrow in fields by manually with the help of trenching hoe, which is more time consuming and requires more manual work. The path also not uniform for water flow. This is the main reason for developing ridge and furrow machine. By using machines which reduces the manual action done by the farmers and time consumption. The machine is more efficient and effective one for making of ridge and furrow.

Design of Ridge and Furrow Machine:

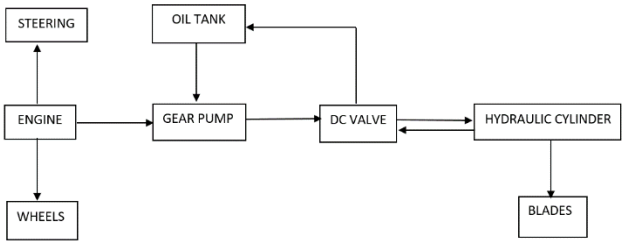

Figure.2. Block Diagram

Engine is the main power source which is used to drive the gear pump and also run the vehicle. One end of the gear pump is connected to oil tank and another end is connected to four way three position direction control valve. One port of the direction control is connected to top portion of the hydraulic cylinder for forward motion of the piston and another one port is connected to bottom portion of the cylinder for backward motion of the piston. Then the return line from direction control valve is directly connected to oil tank.

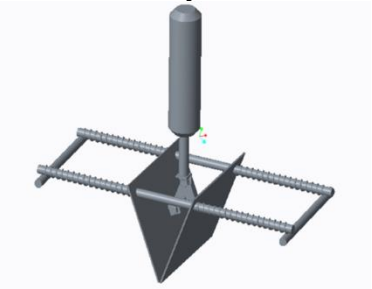

Figure.3. Blade arrangement

There is a two rectangular blades, which is connected to piston rod by using linkages. When the piston rod moves downwards the blades move opposite to each other and the piston rod moves upwards the blades come closer to each other.

Fabrication process:

Material selection:

Mild steel: Considering machinability, weldability and bending moment, Mild Steel is chosen for fabrication. Mild steel refers to low carbon steel, which are usually used for structural applications. With too little carbon content to through harden, it is weldable, which expands the possible applications. Mild steel has a relatively low tensile strength, but it is cheap and malleable; surface hardness can be increased through carburizing. It is used where ductility or softness are important.

Selection of joints

Permanent joint: (welded joint): A welding joint is a point or edge where two or more pieces of metal or plastic are joined together. They are formed by welding two or more work pieces according to a particular geometry.

Temporary joint: (Fasteners): A fastener is a hardware device that mechanically joins or affixes two or more objects together. In general, fasteners are used to create non-permanent joints; that is, joints that can be removed or dismantled without damaging the joining components

Fabrication:

- **Engine:** Initially we buy a 2 wheeler engine with frame for our project

Specification:

1. Yamaha crux engine
2. 4 stroke petrol engine
3. 100 cc capacity

- **Gear pump:** The gear pump was directly connected to the engine magnetic shaft by using threaded fasteners.
- **Hydraulic Cylinder:** Angle plate (1x1 inch) was selected and with the help of cutting machine to cut a required length.

  Number of plates = 4
  Length = 62 cm

2 plates were welded at the frame just in front of the engine by using arc welding. Another 2 plates are welded at some distance from the previous plates.

Gap between parallel plates = 5 cm

Hydraulic cylinder was placed between the angle plates and clamped with the help of bolts and nuts.

Cylinder specification:

1. Stroke length = 250 mm
2. Capacity = 1 lit
3. Shaft diameter = 25 mm
4. Cylinder bore diameter = 60 mm

- **Control valve:** Dc valve was clamped at the bike steering with the help of u clamps and fasteners.
- **Blades:** A square of required size was cut with the help of cutting machine and connected to the piston rod with the help of small links.
  Width = 30 cm
  Height = 23.5 cm
  Thickness = 0.3 cm
- **Oil tank:** Oil tank is fitted at the front of the machine with the help of small thick cables.

Capacity = 5 lit

- **Wheels:** 3 wheels of 33 cm diameter was selected. Two of them were fitted at the rear end frame and another one was fitted at the front side of the frame with the help of welding.
- **Hydraulic hoses:** Hydraulic hoses of required length was cut and which was used to connect the following.

  Tank to pump = 110 cm
  Pump to dcv = 90 cm
  Dcv to cylinder = 100 cm
  Cylinder to dcv = 110 cm
  Dcv to tank = 140 cm

Working of Ridge and Furrow Machine: Hydraulic gear pump is directly coupled to the engine output shaft. So pump rotates as the same speed of output shaft. At that time pump receives the oil from the oil tank and the pressure of the oil is increased. Then the oil is directly sends to the double acting direction control valve. When the direction control valve move towards right side, the pressurized oil enters into hydraulic cylinder (i.e. top portion of the piston) and moves the piston in downward direction. At that time both blades are move away from each other i.e. forward stroke. During the return stroke the direction control valve move towards left side, the pressurized oil enters the bottom portion of the piston and moves the piston in upward direction. At that both blades are comes closer to each other. Figure. 4 shows the prototype of ridge and furrow machine (Bansal, 2010, Gupta, 2009, Rattan, 2009).

Figure.4. Prototype of ridge and furrow machine

3. RESULTS

After complete the machine, it was taken into agricultural field and test the entire performance of the machine. When the lever of the control valve move towards right, the blades are exactly separate the sands in opposite direction. When the control valve move towards left, the blades are come closer to each other. The timing of the piston forward stroke and blades expansions are equal. The uniform shape of ridge and furrow was generated, there is no misalignment in the path. The result of testing the machine shown below,

Force required = 35.355 N

Angle required = 45 deg
Bending stress = 1962.96 MPa

4. CONCLUTIONS

A ridge and furrow machine was designed and fabricated by using a hydraulic cylinder with blade arrangement is to reduce the manual work of farmers. Thus, the process can be done without much physical work and in less time and also the cost of the machine is much less when compared to existing machine. So every poor and marginal farmers can easily buy and use it.

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