

Design and Fabrication of Mulch Paper Laying Machine

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Abstract— To meet the growing needs of the farmers who wish continuously to improve the profitability of their farming by using more efficient materials and machineries. The use of mulching paper in agriculture is increasing day by day to growing the importance in increasing the crop yield. It is also one of the best methods to cover the soil and maintain required atmosphere around the crop. The working and parameters of mulch paper laying machine for minimizing the human efforts and increasing productivity of crops.

Index Terms— Mulching, Mulch paper, Crop growth, Soil temperature, Soil Moisture, Soil covering unit, Hole Punching.

1 INTRODUCTION

Farmers and horticulturist use mulching as a method of improving the condition of agriculture soils by covering the soil surface with different kinds of materials. Mulch is layer of material applied to the surface of an area of soil for the purpose of reducing evaporation, suppressing weed growth, reducing soil erosion, retaining moisture and providing plant nutrients as the material decomposes. Organic and inorganic mulches are types of mulches, these aims to cover the soils and form a physical barrier to limit the evaporation of water from the soil, automatic control of weeds, preserve a good soil structure, and protecting the crops from soil contamination. Natural mulches help in maintaining soil organic matter and tilt and provide food and shelter for earthworms and mulching materials are not available in sufficient amounts, their quality is inconsistent, and they require more labour for spreading.

Selection of mulch films: Mulches are the materials commonly spread over the surface of the soil to protect from the erosive effects of the water and fluctuations in the soil temperature and moisture. Mulch films improve the crop quality, water retention, minimization of weed spread, soil temperature control.

Thickness of the film: Mulching film is 7-15 microns thick and has a density of 1250kg/m³. As such 187.5kg of mulching film is used per crop hectare. The thickness of the film should be minimum possible commensurate with desired life and strength.

Thickness(microns)	Crops recommended
7	Groundnut
20-25	Short duration crops
40-50	Medium duration crops
50-100	Long duration crops

- Conserves soil moisture.
- Moderates soil temperature by insulating the soil surface.
- Controls weed growth under mulch film.
- Reduces the soil compaction caused by the equipment and people.
- Reduces soil erosion from wind or water.
- Reduces incidence of disease by protecting above ground plant parts from the splashes that soil borne inoculums.
- Improves quality to produce, reduces fruit rot by eliminating the contact between fruit and soil early maturity.
- Improves seed germination and productivity, and provides conducive environment for growths.

2 LITERATURE REVIEW

- **Leslie.E.Bailey [1]:** The first model of mulch laying machine was developed in October 22nd, 1921. The mulching paper was laid by simply unrolling the wounded paper roll through manual labour.
- **Herman John Herfort [2]:** He invented improvements in machines for laying mulch paper upon ground for protecting plants and various growths.
- **Chitra Madhu sudhan gowd & Prof. Durga Prasad [3]:** They are developed a machine which lays plastic mulch at the exact position on the prepared plantation bed and secure it with the soil. The laying of plastic mulch and hole punching will be done in one pass.
- **Amay tipayale et.al [4]:** He designed advanced mulch paper laying machine, which can lay the mulching paper on the beds of the soil.
- **Siddesh Marihonnappanavar & M.Veerangudda [5]:** Designed a mulch paper laying machine for tractors to help in reducing the time required for these operations.

Benefits of mulching:

2.1 Problem statement:

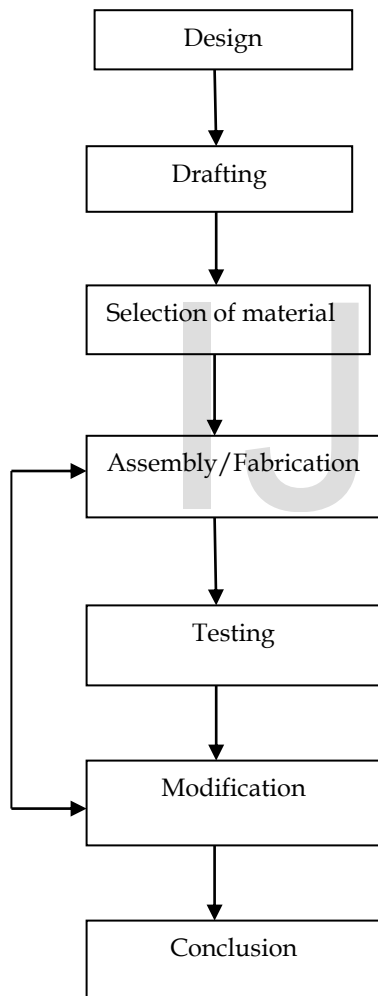
To overcome the problems of farmers we have designed a mulch paper laying machine, this can lay the mulching paper and punch the hole in single pass.

2.2 Objective:

The main objective is to lay the plastic mulch and punch the hole in one pass.

3 METHODOLOGY

Methodology used for whole processing of design and development of mulch paper laying machine is given below. This methodology gives way about how work is carried out in a systematic way. It is standard process of describing process how it is done in simplest manner.



3.1 Components used:

1. Mild steel rectangular bar
2. Mild steel roller
3. Screw rod
4. Bearings
5. Sprocket
6. Chain
7. Wheel

1. **Mild steel rectangular bar:** A hollow structural sec-

tion (HSS) is a type of metal profile with a hollow cross section. Rectangular HSS are also commonly called tube steel or box section. The corners of HSS are heavily rounded having a radius which is approximately the twice the wall thickness.

2. **Mild steel roller:** Cylindrical roll forming is a unique process a rotating tube is heated using direct heat. Once the tube reaches the specified temperature controlled forming mandrels produce the desired neck section or completely seal the end of the tube to provide an airtight enclosure.
3. **Screw rod:** A threaded rod also known as a stud, is a relatively long rod that is threaded on both ends. The thread may extend along the complete length of the rod. They are designed to be used in tension. Threaded rod bar in stock form is often called all-thread.
4. **Bearings:** A bearing is a machine element that constraints relative motion to only the desired motion, and reduces friction between moving parts. The design of the bearing may provide free linear movement of the moving part or for free rotation around a fixed axis, or it may prevent a motion by controlling the vectors of normal forces that bear on the moving parts. Most bearings facilitate the desired motion by minimizing friction.
5. **Sprocket:** A sprocket or sprocket-wheel is a profiled wheel with teeth, or cogs, that mesh with a chain, track or other perforated or indented material. A sprocket and roller chain sprockets are used in bicycles, motorcycles, cars, tracked vehicles and other machinery either to transmit rotary motion between two shafts where gears are unsuitable or to impart linear motion to a track, tape etc. perhaps the most common form of sprocket may be found in the bicycle in which the pedal shaft carries a large sprocket-wheel, which drives a chain, which in turn drives a small sprocket on the axle of the rear wheel.
6. **Chain:** Chain drive is a way of transmitting mechanical power from one place to another. It is often used to convey power to the wheel of a vehicle particularly bicycle and motorcycles. It is also used in variety of machines besides vehicles. Most often the power is conveyed by a roller chain, known as the drive chain or transmission chain, passing over a sprocket gear, with the teeth of the gear meshing with the holes in the links of the chain. The gear is turned and this pulls the chain putting mechanical force into the system.
7. **Wheels:** In its primitive form a wheel is a circular of a hard and durable material at whose center has been bored a circular hole through which is placed an axle bearing about which the wheel rotates when a moment is applied by gravity or torque to the wheel about its axis, there by making together one of the six

simple machines. When placed vertically under a load-bearing platform or case, the wheel turning on the horizontal axis makes it possible to transport heavy loads; when placed horizontally the wheel turning on its vertical axis makes it possible to control the spinning motion used to shape materials (e.g. a potter's wheel).

3.2 Experimental work:

The figure shows the conceptual design of machine that was prepared by using design software.

1. Solid edge (v19)
2. Ansys

1. **Solid edge:** Solid edge is a 3D CAD, parametric feature and synchronous technology solid modeling software. It runs on Microsoft windows and provides solid modelling assembly modeling and 2D orthographic view functionality for mechanical designers.
2. **Ansys:** Ansys mechanical finite element analysis software is used to simulate computer models of structures, electronics, or machine components for analyzing strength, toughness, elasticity, temperature distribution, electromagnetism, fluid flow and other attributes. Ansys is used to determine how a product will function with different specifications, without building test products or conducting crash tests.

Conceptual design:

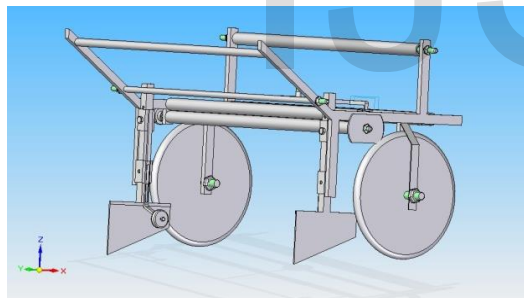


Fig: 3.2 (a) Side view of the 3D model

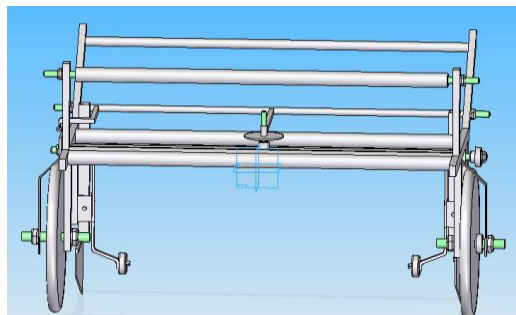


Fig: 3.2 (b) Front view of 3D model

Actual design:



Fig: 3.2 (c) Actual model

Operations carried out:

1. Cutting operation
2. Grinding operation
3. Welding operation
4. Drilling operation

3.3 Working principle:

Mulch paper roll is wounded/fixed to the supporting roller fixed to the frame. The two line contact rollers will be placed one by one which is connected to the wheels by a chain drive, in between these rollers a supporting rectangular bar will be placed. The paper will be passed through the first line of contact rollers and then passed through the supporting rectangular bar where the punch cutter will be placed. By using the cam and follower like mechanism, to apply the force on the punch cutter an additional weight will be applied on the paper to hit the cutter by using a circular hitter. After paper will be passed through the another line contact roller and then it will be laid on the soil and to cover the soil on the sides of paper laid an additional metal ploughers will be placed on the sides.

3.4 Advantages:

- It reduces the human effort required to lay paper and punch hole.
- Simple in construction and reduces the amount of time taken by the former to lay the paper.

3.5 Disadvantages:

1. The initial cost of the equipment is high.
2. At present, the available mulch papers are biodegradable.

4 RESULT & DISCUSSION

4.1 Caluclation/Analysis:

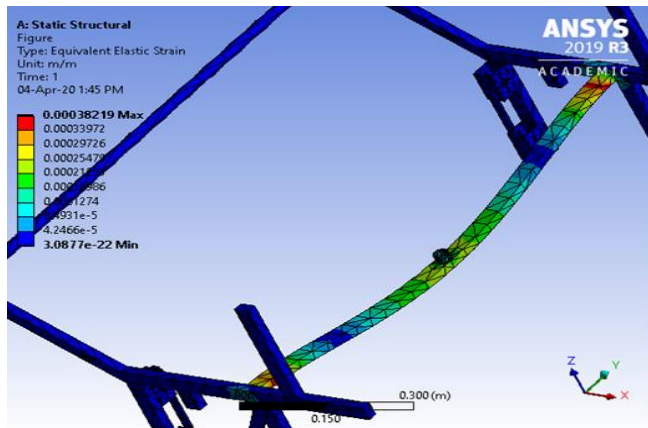


Fig 4.1 Analysis of structure

Object Name	Equivalent Elastic Strain	Equivalent Stress	Total Deformation
State	Solved		
Scope			
Scoping Method	Geometry Selection		
Geometry	All Bodies		
Definition			
Type	Equivalent Elastic Strain	Equivalent (von-Mises) Stress	Total Deformation
By	Time		
Display Time	Last		
Calculate Time History	Yes		
Identifier	-		
Suppressed	No		
Integration Point Results			
Display Option	Averaged		
Average Across Bodies	No		
Results			
Minimum	3.0877e-022 m/m	5.3767e-012 Pa	0. m
Maximum	3.8219e-004 m/m	7.6146e+007 Pa	1.7219e-003 m
Average	1.935e-005 m/m	2.7305e+006 Pa	1.7937e-004 m
Minimum Occurs On	frame2-FreeParts		
Maximum Occurs On	frame2-FreeParts		

Information	
Time	1. s
Load Step	1
Substep	1
Iteration Number	1

Table 4.1 Values of stress stain & total deformation

4.2 Result:

We have designed a “Mulch paper laying machine” application in agriculture field which is going to lay mulch film and punch the hole in one pass reducing the human efforts and increase efficiency which results in less expenditure on labour. Also it reduces the cost required for employee for laying mulch paper on bed. And it helps to avoid the waste water and stop the growth of grass. (The increasing demand for agricultural produce and health consciousness among people it has become imperative for us to produce more as well as good quality products to sustain in international market). From the study it was found that as forward speed increased, draft also increased. This machine was fabricated for laying mulch film on prepared bed for different crops.

5 FUTURE SCOPE

The equipment can be included with electric motor instead of manual efforts, and separate attachment can be made for laying of drip pipes. And also punching of holes can also be made through pneumatic pressure.

6 CONCLUSION

The designed, developed and technologically updated range of mulching machine is available to clients that offer great relief to farmers in best possible and effective manner. This machine is user friendly with fine finish and easy to operate. Its made up of quality of raw materials that are reliable and easily available in market. The mulching machine meets growing needs of farmers who wish to continuously improve the profitability of their farming by using this machine.

7 ACKNOWLEDGMENT

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