

Automatic Mulch Paper Laying Machine for Agricultural Application

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Abstract – This research looks at the work of minimizing human efforts and increase productivity. Mulching is the practice of covering the soil around plants to improve the growing conditions for the crop. Laying of mulch paper manually in field is laborious and time consuming. The historical account for natural mulches such as straw, wood chipping, compost and hay have been used but over last four decades paper and plastics have been tried. Because of its price and poor wet strength, paper has been found less effective and more costly than plastic. The result is that plastic mulch film is the preliminary choice for agricultural application. Plastic mulch film is widely used on high value crops, such as melons, squash, peppers, tomatoes, cucumbers, strawberries and more increasingly on lower value crops such as corn and potatoes. In conventional method, mulching paper is covered by soil with manual effort. This process requires more time, more effort. To overcome this problem new design concept that automatically cover with soil by paper is presented here.

Keywords—Mulch Paper, Drip Roller, Mulch Roller, Plougher, Top Link, Laying Machine.

INTRODUCTION



Fig.1 Conventional mulching method

Mulch is any biodegradable material placed on a surface of soil for the purpose of reducing evaporation, suppressing weed growth, reducing soil erosion, retaining moisture, and providing plant nutrients as the material decomposes. The result is that plastic mulch film is the primary choice for agricultural application. Plastic mulch film is widely used on high value crops, such as Tomatoes, Melons, and Strawberries increasingly on lower value crops such as corn and chilli. For arable soils, the most effective conservation practices for reducing water loss through surface evaporation are those that provide some degree of surface cover for the soil [2].

Types of Mulches [1]

Basically, there are two types of mulches depending upon the material used as mulching. They are as under:

1. Organic Mulches

The organic materials such as crop residues and by-products, farm yard manure and by-products of timber industry, when used for mulching, are known as organic mulches. Organic mulches create no post utilization disposal problem but their availability is an issue.

2. In-Organic Mulches

In-Organic mulches is made of in-organic materials such as plastics, when used for mulching, are known as in-organic mulches. While availability of natural mulches is less for all times & places instead of organic mulches, plastic mulches can be made available in different thickness and colours to obtain the desired results.

Selection of Mulch Films

The selection of mulch film colour depends upon the specific purpose to be achieved such as raising of soil temperature or cooling it down, weed control, disease control and enhanced plant growth etc. The film width should be such that the crop agronomic

practices could be conveniently carried out. The width of 90 cm & 120 cm are more common [1]. The aim is to make use of available width of mulch film in most effective manner.

C. Thickness of Film

In in-organic (plastic) mulching, the thickness of mulch film should be according with type and age of crops. Economics study suggests that the film thickness should be the minimum possible in proportion with desired life & strength. The recommended thickness of mulch films for different crops is as given in Table 1[1] below

Table 1: Thickness of Film

Thickness (microns)	Crops Recommended
7	Groundnut
20-25	Short duration crops
40-50	Biennial - medium duration crops
50-100	Perennial - long duration crops

D. Plastic film

Generally three major colours of mulches are used. For commercial purpose black coloured film of mulch paper is popular. Along with black colour, clear or transparent and white mulch film is also used. Black colour film of mulch paper is used most widely because it suppresses weed growth, resulting in less usage of fertilizers. Properties according to colour types of plastic film are given in the Table 2 below

Table 2: Types of plastic film

Sr. No.	Film Type	Purpose	Remarks
1	Transparent film	Early crops	Winter spring Season
2	Black film	Weed control and warming of the soil	-
3	White film	Cool the soil	Summer
4	Yellow film	Killing of the bacteria/ insects	-

Black colour film of mulch paper is also used for winter seasons because it warms the soil and provide sufficient heat by contact. Soils under white mulch remain cooler because of less absorption of radiant energy by the mulch.

IMPORTANCE OF MULCHING

Mulch papers act as barriers to movement of moisture out of the soil. Along with keeping the moisture in the soil, mulches can also use to enhance soil temperature, reduce soil erosion, reduce weed growth, reduce the spread of soil borne diseases and provide nutrients [4]. A cover can be best provided by mulch paper that leaves plant residues on the soil surface.

A. Performance of Mulch paper Laying Machine

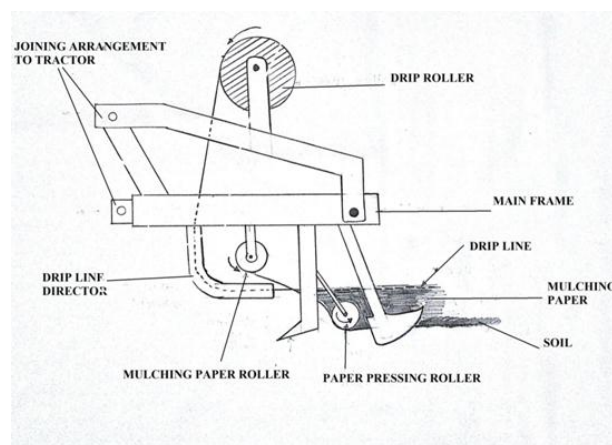


Fig.2 Schematic diagram of equipment

In conventional method, mulching paper is covered by soil with manual effort. This process required more time and efforts.

In this technique, two ploughers are mounted vertically tilting outwards which will cut the bed edges. One supporting roller is mounted below the frame for laying mulch paper on the bed. One drip roller is mounted above the frame which will lay down the drip line before mulch paper. Two back ploughers are mounted vertically tilting inward which will cover the laid down mulch paper edges neatly. To overcome this problem in this paper a new concept is presented that paper is automatically covered with soil. In this technique, three operations are combined perfectly, viz, laying mulch paper, laying drip line and covering mulch paper. By implementing this technique human efforts are greatly reduced. In conventional method about 6 to 8 workers are required to performing this operation. Even by providing this man power it will take approximate 1 full day to complete the mulch laying and drip line activity over 0.5 acres of farm.

The mulch paper laying machine consists of following important parts as shown in figure 3 and figure 4.

1. Main frame
2. Top fixed link

3. Two front ploughers
4. Two back ploughers
5. One mulch paper roller
6. One drip roller
7. Two paper pressing rollers
8. Drip line director

Fig.3 shows the CAD model of automatic mulch paper laying machine which is modeled in CATIA V5R19 software. In figure, it is well seen that there are two front ploughers mounted tilting outwards and two back ploughers are mounted tilting inwards. Two paper pressing rollers are mounted with respect to front ploughers in order to press properly the mulch paper.

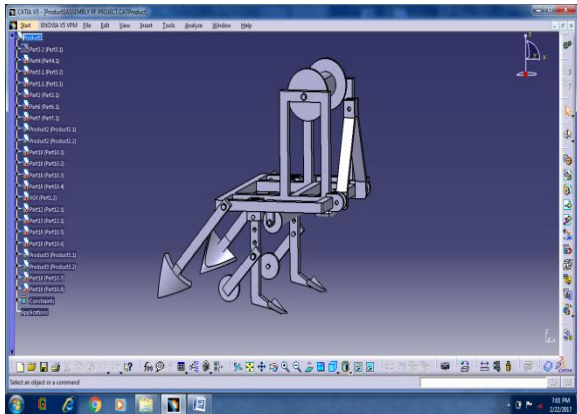


Fig.3 Model of Assembly of Project

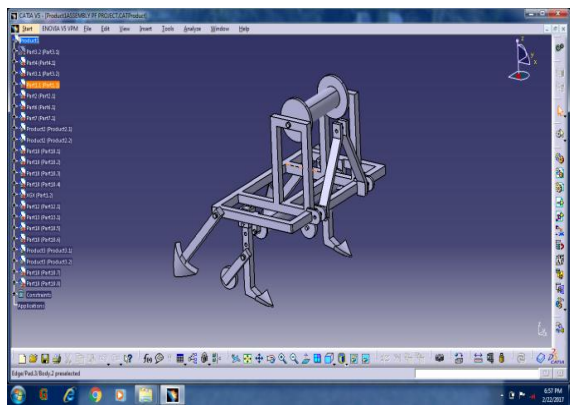


Fig.4 Isometric front view of model

Drip line irrigation roller is mounted on main frame supported by supporting links. The top link is to be kept open in order to fix with agricultural machinery like tractors as fixture to it.

A. Material selection

Material for various components of Mulch paper laying machine as shown in table 3.

Table 3: Selection of Materials

Sr. No.	Component name	Material
1	Main frame	Mild steel
2	Mulch paper roller	Mild steel
3	Drip roller	Mild steel
4	Plougher	Carbon steel
5	Drip line director	Plastic
6	Paper pressing roller	Rubber

ADVANTAGES AND DISADVANTAGES

Advantages

1. It conserves moisture of the soil.
2. It maintains the soil temperature by insulating the soil surface from direct sunlight and creates greenhouse effect.
3. It controls and prevents weed growth under mulch film.
4. It reduces soil compaction caused by equipment and people.
5. It reduces soil erosion from wind and water.
6. It helps to prevent draining of fertilizers.
7. It reduces incidence of disease by protecting above-ground plant bodies from splashes that carry soil-borne inoculums.
8. It improves quality of production, reduces fruit rot by eliminating contact between fruit and soil.
9. It reduces winter injury by minimizing temperature variation, decreasing heaving of plant crowns and roots, reducing water loss in plants.
10. It helps for early maturity of plants.
11. It provides conducive environment for plant growth.

12. It improves seed germination.
13. It helps for shaping of raised beds to the required width.
14. The laying of plastics film over the surface of beds and anchoring its edges by covering with soil to prevent it from disturbance of position by wind.

Disadvantages

1. Initial cost is high.
2. It requires at least one skilled labour.

CONCLUSION

1. The automatic mulch paper laying machine is very useful to all farmers for laying mulch paper as well as drip line over the bed. Also time is saved by this process as compared to the traditional system as tabulated below.

Time (no. of hours) required for mulching operation		
Farm area	Traditional method	Mulch laying machine
0.25 acre	6 to 7 hours (6 workers)	2.5 hours (2 workers)
0.5 acre	9 to 10 hours (6 workers)	3.5 hours (2 workers)

2. The initial cost of single mulch paper laying machine is slightly high about 25000 Indian rupees but more extensive use of mulch paper laying machine could bring the production or manufacturing price considerably less.
3. Mulch paper is costly than plastics but it is observed that the wastage of mulch paper by this laying machine is totally eliminated.
4. The mulch paper laying machine is an assembly of different part and because of that it is easy for replacing and keep maintenance of any part.
5. The weight of mulch paper laying machine is about 160 kg so, it is portable for any locations or site of farm.
6. The mulch paper laying machine can be used for any type of crops (high value or low value) and for all seasons, so this mulch paper laying machine fulfill all requirement only by initial investment by farmers.

REFERENCES

- [1] "Practical manual on plastic mulching", National Committee on Plasticulture Applications in Horticulture (NCPAH), Department of agriculture and cooperation, Ministry of agriculture, Government of India, January, 2011.
- [2] M. W. Schonbeck and G .K .Evanylo," Effect of mulches and soil properties, Journal of sustainable agriculture, Vol.13 (1), 1998.
- [3] Douglas Sanders, "Using Plastic Mulches and Drip Irrigation for Vegetables", Horticulture Information Leaflet, North Carolina State University, January 2001.
- [4] T. Haapala, P. Pauliina, A. Korpela and J. Ahokas, "Feasibility of paper mulches in crop production-a review", Journal of agricultural and food science(2014),pp.60-79.

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