

Design and Development of Agricultural Mulching Paper and Drip Laying Machine

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ABSTRACT: In order to improve growing condition of crops there are various methods that improves productivity, reduces water require growing up the crops. But mulching paper which is also known as agriculture film is one of the best methods to cover the soil and maintain require atmosphere around the crop. This mulching paper is available in different types but plastic mulching is famous require less efforts so we have decided to work on automatic mulching paper laying machine which also have attachment for the drip laying.

KEYWORDS: Growing of crops, Plastic mulching, Automatic mulching laying.

I. INTRODUCTION

Mulching (Agriculture Film) is the practice of covering the soil around plants to improve the growing conditions for the crop. Historically natural mulches such as straw, compost, hay and wood chippings have been used but over the last 40 years paper and plastics have been tried. Because of its poor wet strength and price, paper has been found less effective and costlier than plastic. 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, Cucumbers, Squash, Peppers and Strawberries increasingly on lower value crops such as Corn and Ginger. 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. A cover can be best provided by mulches or by tillage practices that leave plant residues on the soil surface. *Mulch* is any material placed on a soil surface for the purpose of reducing *evaporation*, retaining moisture, reducing soil erosion, suppressing weed growth and providing plant *nutrients* as the material decomposes. Mulches act as barriers to movement of moisture out of the soil. They can be either *organic* (e.g. straw, wood chips, peat) or man-made (e.g. transparent or opaque plastic). Besides keeping the moisture in the soil, mulches can also enhance soil *temperature*; reduce the spread of soil borne diseases; reduce weed growth; reduce soil erosion; and provide nutrients and *organic matter*. Moreover, mulches support infiltration of *runoff* and *irrigation* water as the mulches protect the soil surface from the impact of raindrops preventing soil crusting.



Fig. 1. Mulch Paper Laying In Farm

Advantages of using mulching paper

- Mulch is any material placed on a soil surface for the purpose of reducing evaporation, retaining moisture, reducing soil erosion.
- Suppressing weed growth by blocking the sunlight.
- Providing plant nutrients as the material decomposes.
- Mulches act as barriers to movement of moisture out of the soil.
- They can be either organic (e.g. straw, wood chips, peat) or man-made (e.g. transparent or opaque plastic).
- Besides keeping the moisture in the soil, mulches can also enhance soil temperature; reduce the spread of soil borne diseases
- Moreover, mulches support infiltration of runoff and irrigation water as the mulches protect the soil surface from the impact of raindrops preventing soil crusting.

II. LITERATURE REVIEW

- [1] **Advance Mulching Paper and Drip Laying Machine: Swapnil Sutar, Rajesh Yangar, Pawan Patil, Sangram Bhosale & Prof. U. Y. Sidhha: Imperial Journal of Interdisciplinary Research (IJIR): Vol-3, Issue, (2017):** Plasticulture is crucial to Indian agriculture in view of the changing technological scenario for boosting crop yields and productivity. Introduction of linear low-density polyethylene (LLDPE) as a mulch film has brought a revolution in agricultural water management. It is actually a boon to dry-land farmers. This is one of the fastest growing plasticultural applications in the world. The cost of LLDPE film is also lesser than one third of LDPE mulch film. Moreover, for mulch activity lower thickness (15 to 20 microns) is highly suitable. However due to ever increasing cost of raw materials the films are costlier now. Hence Government should take all possible measures to produce the film in a mass scale and make it available to the farmers at a reasonable price. Subsidy may also be given through banks to encourage the farmer to adoption soil mulching. Low cost machines may be developed for spreading and rolling down the film in the field. PFDC's may be geared up for large scale demonstration in farmer's field to give a wide publicity.

Keywords: Growing of crops, Plastic Mulching, Automatic mulching laying

- [2] **Mulching Paper and Drip Laying Machine: Vijay P. Veer, Pramod R. Thete, Dipak A. Shinde, Krishna S. Vanve, Mr.S.D.Ratnakar: International Journal of Science Technology Management and Research: Vol-2, Issue 3, (March 2017):** In today's modern world the use of mulching paper in agriculture is increasing day by day due growing importance in increasing crop yield. Deficit rain poses a big problem for any agricultural activity in order to increase crop production with scarcity of water farmers are moving towards technical solutions like plastic mulching paper. Mulching as a practice to conserve soil moisture, check weed control, moderate soil temperature and provide a micro climate to the plant is age old. With the advent of plastic films for mulching application, this practice has got further importance. Research studies have shown, when mulching is practiced along with drip irrigation, it gives best results. Plastic mulching paper retains soil moisture and prohibits weed growth at the same also maintaining soil temperature. Even though this technology is quite old and versatile, its use in India is still limited due to difficulty of laying the mulching paper manually. This is because lack of availability of labour and high cost of labour. There are automatic machines but they are either not available in India or the use is limited to large scale farming.

Keyword: Mulching, Machine, Soil, Materials, Lying.

- [3] **Automatic Mulching Paper Laying Machine: Mr. Deokar A., Mr. Hivrekar P. D., Mr. Rakshe P.R., Mr. Tajane O.K., Mr. Pokale: International Journal of Advance Engineering and Research Development: Vol-5, Issue 4, (Feb 2018):** We know that avoiding growth of the weed on farm is very costly and time-consuming task. Also, in dry areas maintaining moisture in soil is very important for crop life. Mulching the plastic paper film near the root area of plants is for eliminating the rise of weeds also to retaining water and avoid de-moisturizing the soil but this process requires lots of capital and time. So 'Drip irrigation pipe and Mulching paper laying machine' will reduce the labour cost and time, it will do both the jobs i.e. laying irrigation pipe and mulching paper on the ground at a time.

Keywords: Cylinder size, Cylinder number, Implement speed, Operating air pressure.

- [4] **Advanced Mulching Paper Laying Machine: Prof. AmayTipayale, Mayur S. Salunke, Samadhan U. Thete, Tushar S. Thete, Sandip B. Thete: International Journal for Scientific Research and Develop (IJSRD): Vol-5, Issue 3, (2017):** We know that avoiding growth of the weed on farm is very costly and time consuming task. Also, in dry areas maintaining moisture in soil is very important for crop life. Mulching the plastic paper film near the root area of plants is for eliminating the rise of weeds also to retaining water and avoid de-moisturizing the soil but this process requires lots of capital and time .So ‘Drip irrigation pipe and Mulching paper laying machine’ will reduce the labour cost and time, It will do both the jobs i.e. laying irrigation pipe and mulching paper on the ground at a time. By using various mechanisms, this machine will lay the irrigation pipe and mulching paper at the same time it will make the holes on the paper to provide plantation area after laying the drip irrigation pipe and mulching paper. Another mechanism is used for covering the paper with the soil on its either side edges to avoid the deflection of paper from its position because of various reasons such as disturbance from wind, working labours etc. This machine may power with the diesel or petrol engine or with Battery and motor system.

Key words: Cylinder Size, Cylinder Number, Implement Speed, Operating Air Pressure

- [5] **Design and Fabrication of Mulching CUM Automatic Paper Rolling and Tree Planting Machine: Abhishek Navghare, Anshul Tambekar, Harshit Pandey, Vicky Navghade, Prof. Ranjeet Mane: International Journal of Engineering Science and Computing (IJESC): Vol-7, Issue 3, (March 2017):** This paper presents associate analysis of a system that verifies a pair of methodology at a similar time. For each analysis procedures, the coordinates of the centre of the follower are required at very little increments of the cam angle. Every procedure is easily programmed and rely solely on the follower coordinates and not the follower sort. A Mulching is that the method or practice of covering the soil/ground to form additional favourable conditions for plant growth, development and economical crop production. Mulch technical term suggests that ‘covering of soil’. Whereas natural mulches like leaf, straw, dead leaves and compost are used for hundreds of years, throughout the last sixty years the arrival of artificial materials has altered the strategies and edges of mulching. The analysis in addition as field information offered on impact of artificial mulches build a massive volume of useful literature. once compared to different mulches plastic mulches or utterly impermeable to water; it so prevents direct evaporation of wet from the soil then limits the water losses and sporting over the surface.

Keyword: Mulching, compost, impermeable, soil temperature etc.

- [6] **Review Paper on Automatic Mulch Laying and Hole Generation in Farm: Harshwardhan D. Jadhav, Jitendra J. Kadam, Anil D. Karche, Hanumant P. Kharat, WasnikMonish: International Journal of Engineering Science and Computing (IJESC): Vol-7, Issue 4, (April 2017):** Mulching has become an important practice in modern field production. Mulch paper reduces the application of chemical fertilizer and herbicide, weed control and maintain the land temperature. This article reviews the published research on paper mulches and discusses the opportunities that they solving the problem in agriculture.

Keywords: Paper mulch, soil moisture, soil temperature, weeds control

- [7] **The Emergence and Early Development of Coloured Reflective Plastic Mulch Technology in Agriculture: Dennis R. Decoteau: Recent Advances in Agriculture 2008:** The use of plastic (polyethylene) mulches in field production of selected vegetable and fruit crops affects plant production by altering the plant microclimate. The plant microclimate includes temperature, humidity, light, wind, water, etc. Up to 1985, the role of reflected light off the mulch surface on plant development was not considered to any extent. During the mid-1980s and continuing through today a new generation of colour mulches that selectively reflected phytoresponsive wavelengths of light were postulated and developed.

Keywords: Plastic, Plant, Light, Mulch.

RESEARCH FINDINGS / ISSUES:

1. Plastic films are used increasingly in vegetable, berry and fruit production for the preventions of weed growth, control of temperature and the moisture of the soil.
2. In the machine of character described comprising a wheeled frame, a spool mounted upon the same for supporting a roll of mulch paper, furrow diggers at the forward end of the frame.

3. Advance mulching paper laying machine which is going to laying a paper with reducing a human effort and also cost require for employee for laying mulch paper on bed.
4. The marketable yield was larger with the employment of plastic mulches (up to 24% to 65%) compare to reveal soil.
5. Mulch paper avoid the wastewater and stop growth of the grass.

III. PROBLEM DEFINITION

In old days mulch paper and drip line is lapped over the bed with the help of manpower. There are 6-8 people required to lying mulching paper and drip line over bed. In this atomized world worker availability is very big problem. This process is more time consuming to solve this problem currently one machined is developed this machine works when attached to tractor. 2 to 4 workers are eliminated from previous condition but process become semiautomatic, not fully automatic this process has more running cost because of tractor more time required for adjust tractor with bed every time.

Even though this technology is quite old and versatile, its use in India is still limited due to difficulty of laying themulching paper manually. This is because lack of availability of labour and high cost of labour. There are automatic machines but they are either not available in India or the use is limited to large scale farming. So that we have to design machine such a way that machine should become fully automatic, only one worker should work on it and operation should completed within minimum time with very less running cost.



Fig. 2 Traditional and old method of mulch paper laying in farm



Fig. 3 Traditional method of drip line

IV. PRESENT THEORY AND PRACTICES

- Mulching area should preferably be equivalent to the canopy of the plant. Then required size of mulch film is cut from the main roll.
- Clean the required area by removing the stones, pebbles, weeds etc. Till the soil well and apply a little quantity of water before mulching.
- Required length of film for one row of crop is taken.
- Round holes are made at the centre of the film using a punch or a bigger diameter pipe and a hammer or a heated pipe end could be used.
- One end of the mulch film (along width) is anchored in the soil and the film is unrolled along the length of the row of planting.
- Till the soil well and apply the required quantity of fertilizer before mulching. Mulch film is then inserted (4-6”) into the soil on all sides to keep it intact.
- Seeds are sown directly through the holes made on the mulch film.
- In case of transplanted crops, the seedlings could be planted directly into the hole.



Fig. 4 Recent Method

V. COMPARISON CHART

Sr. No.	Parameters	Conventional method (Manual)	Tractor Attachment	Auto. Mulch paper laying machine
1.	Time required to laying the mulch paper	24 hours / Acre (depends on no. of labours)	9 to 11 hours/Acre	Less compare to tractor attachment
2.	Number of labours required	6 to 8 / Acre	2 to 3 / Acre	One or Two
3.	Perfection of Work	Very less (depends on labour skill) 7	Comparatively Less	Comparatively High
4.	Operation cost	3500 to 4000 Rs.	2000 to 3000 Rs.	Less Compare to Tractor Attachment

VI. OBJECTIVES

- To develop a machine which enhance the performance of working in farm.
- To develop a machine which reduce cycle time of laying mulch film.
- Design and Fabrication of advanced mulch paper laying machine.
- To minimize the production time.
- To increase the production rate.
- To reduce number of workers.
- To minimize miss-operation.
- To reduce human effort.
- To reduce capital cost

VII. METHODOLOGY

1. Literature study
2. Field work
3. Design stage
4. System drawing
5. Material procurement
6. Manufacturing stage
7. Fabrication of assembly
8. Trials and troubleshooting.

VIII. PROPOSED WORK

1. Study and understanding of the agriculture problem.
2. Literature study.
3. Problem Identification.
4. Theory Work
5. Market Survey.
6. Approximate estimation of cost.
7. Creating conceptual design of agricultural equipment. By studying agriculture problem of conventional manually covering of mulching paper by soil and manually drip laying.
8. Rough sketches of individual component are prepared then assembly drawing is done.
9. Materials for individual component are selected as well as manufacturing methods also selected which consist of bill of material and machining processes.
10. Manufacturing of individual components is done and with the help of fabrication method assembly is done.
11. Testing of the assembly and modification of any if required.
12. Trials and Troubleshooting.
13. Testing.
14. Conclusion.

IX. CONSTRUCTION AND WORKING

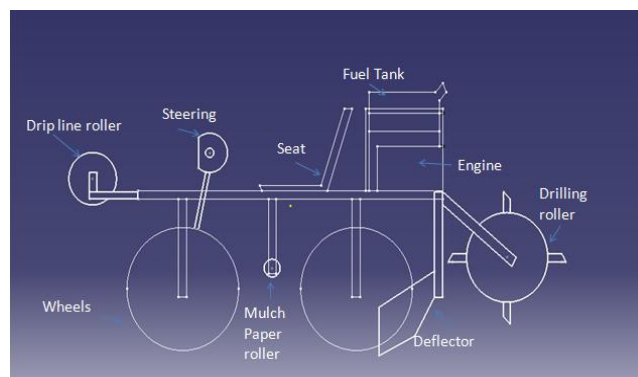


Fig. 5 Conceptual diagram of mulch paper laying machine

- **Construction**

- a) **Engine**

Engine is main source of power for this project. We are going to develop automatic mulching paper laying machine such a way that human efforts should minimize. So that we decided to use engine for generate power.

We can use any two-wheeler engine for our application. The load on our machine is not more than 150 kg so that two-wheeler engine can run properly and our design also become optimized.

- b) **Main Frame**

Main frame is made up with main chassis elements where all the mounting points are there for all the attachments we are going to use. Main frame should robust enough to bear all the forces and moments without failure. In our machine mulching paper roller and drip line roller are attached to main frame. Engine is also mounted in main frame so mounting points are there in main frame.

- c) **Steering system**

We are going to make our machine fully automatic. So steering system should be attached to our machine so that we can steer our machine as per our required direction. So, there are so many types of steering system and so many factors to be considered while selecting steering geometry and proper linkage mechanism to actuate steering with all lateral and longitudinal forces.

- d) **Mulching paper roller and drip line roller**

Mulching paper roller is roller on which mulching paper is wound. mulching paper roller is attached to main frame and in front side of chassis. Drip line roller is roller on which drip line is wound. This is also attached to main frame and in front of chassis.

- e) **Paper pressing roller**

Paper pressing roller is used for press mulching paper with bed. This is also attached to main frame.

- f) **Deflector**

Deflector is attached to main frame at rear side. this are used to push soil on mulching paper so that mulching paper properly fix with bed.

- **Working**

Above figure shows the conceptual diagram of automatic mulch paper laying machine. It consists of main frame which supports the other components. Other components mounted on the main frame which are drip roller, drip line director roller, mulch paper roller, paper pressing roller and joining arrangement to tractor. When machine is pulled forward drip line and mulch paper start to unwind as both are anchored at another end. Drip line guided below the paper by drip line director and at the same mulch paper is placed over the bed by paper pressing rollers.

The working of this machine is very simple just like pulling the machine in a straight line in the farm. This machine is having very simple operation and no skilled operator is required and it makes the work simple and efforts less. Now a day the farmer lay the mulch paper by hand and this will not maintain the uniform and no proper distance maintain between the mulch films.

MODELING OF DESIGN:

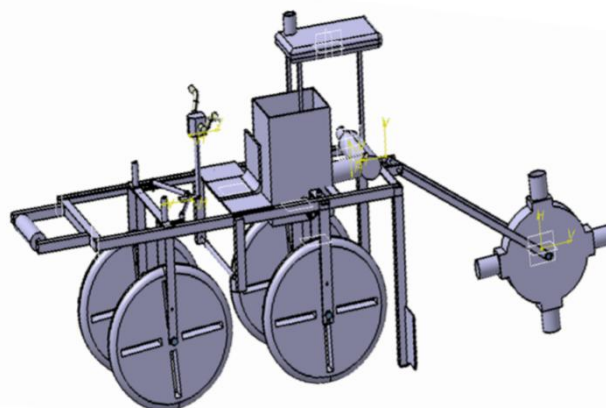


Fig. 6 Developed Model

X. CONCLUSION

We have taken up this project as real challenge, we started our work on this project facing new hurdles initially. The design of all the components is according to the proposed plan. The components are designed so as to obtain the required results. The machine thus designed can successfully lay mulching paper, lay drip line and punch hole simultaneously and efficiently. Time required to laying the mulch paper is 2.5 hours per acre for our machine. Hence, we are reduced time required to lay the mulch paper by 80% and 72% as compared to conventional method and tractor attachment respectively. Operational cost of our machine is Rs 350 per acre and hence we reduce operational cost required to lay the mulch paper 93% and 87% as compared to manual method and tractor attachment respectively.

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