

SURVEY AND ANALYSIS OF MULCHING MACHINE

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Abstract

Plastic mulching can be used to enhance the effectiveness of agricultural mulching, and India has seen a significant increase in plastic mulching over the last ten years. According to Reynolds (2009), nearly 80,000 kilometres of agricultural land are covered with plastic mulch films each year, and the use of plastic mulching has increased significantly in recent years. The manual process of laying plastic mulch takes far longer than the advanced mulch laying equipment. And the mulch laying equipment on the market is extremely inefficient. To address this issue, we conducted research in India on the use of plastic mulching and the equipment used to lay the film, and proposed a design that can lay the mulching paper, create a bed, and punch a hole all in one pass. We also researched the market in India for materials and prices of available machines, and based on this information, we chose the most effective and cost-effective materials to construct the machine in order to overcome the previously mentioned problem. As a result of comparing the proposed machine to existing machines and the traditional mulch laying process. For the mulching process, this equipment is cost effective, time efficient, and simple to use by farmers.

Keywords: Mulching machine; Mulching; Survey and Analysis;

1. Introduction

Plastic mulching can be used to make agricultural mulching more effective, and India has seen a noticeable increase in plastic mulching over the previous ten years. This plastic mulching aids in soil temperature control, weed control, moisture conservation, insect pest reduction, high crop yields, higher germination rates, and more effective use of soil nutrients. Every year, nearly 80,000 square kilometers of agricultural land are covered with plastic mulch films, according to Reynolds (2009). Weed rate cannot be controlled using organic methods; but, by using plastic, the weed waste on labour to clean the farm can be reduced. Plastic film has been shown to boost crop yields by preventing weed development, increasing soil temperature and moisture, and decreasing pest infestations. For many farmers, using plastic mulch to manage weeds has become normal

practise. Farmers will benefit from the tractor-operated machine since it will reduce the time spent laying the mulch sheet and punching the mulch sheet, which will reduce the human effort and expense of placing the mulch. Currently, mulch laying machines on the market perform multiple operations during the mulching process. As a result, all of the operations required for the mulching process are induced in one step in this study. Tractors have become one of the most important power sources in modern agriculture, and they are often employed for irrigation, land development, sowing, threshing, and transportation.

Tractors help to cut down on the amount of time it takes to complete a task. It is currently an important component of mechanical farming. Traditional plastic mulching necessitates more labour, time, and money to maintain. Using the information above, research was done to build plastic mulch laying equipment that was tractor-driven.

2. Literature Review

[1]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): As we know that we can't avoid the growth of the weed in farming is very costly and time consuming task . Also the maintaining moisture for soil is very prime for crop life . So to avoid the weed growth , covering soil around the plants with an organic or synthetic material to create congenial condition for the plant growth, development and efficient production . By using various mechanism , this machine will lay the mulching paper on the ground at same time it will make the holes on the paper and after this another mechanism is used to covering the paper with the soil on its edges . Hence it will reduce the labour cost and time .

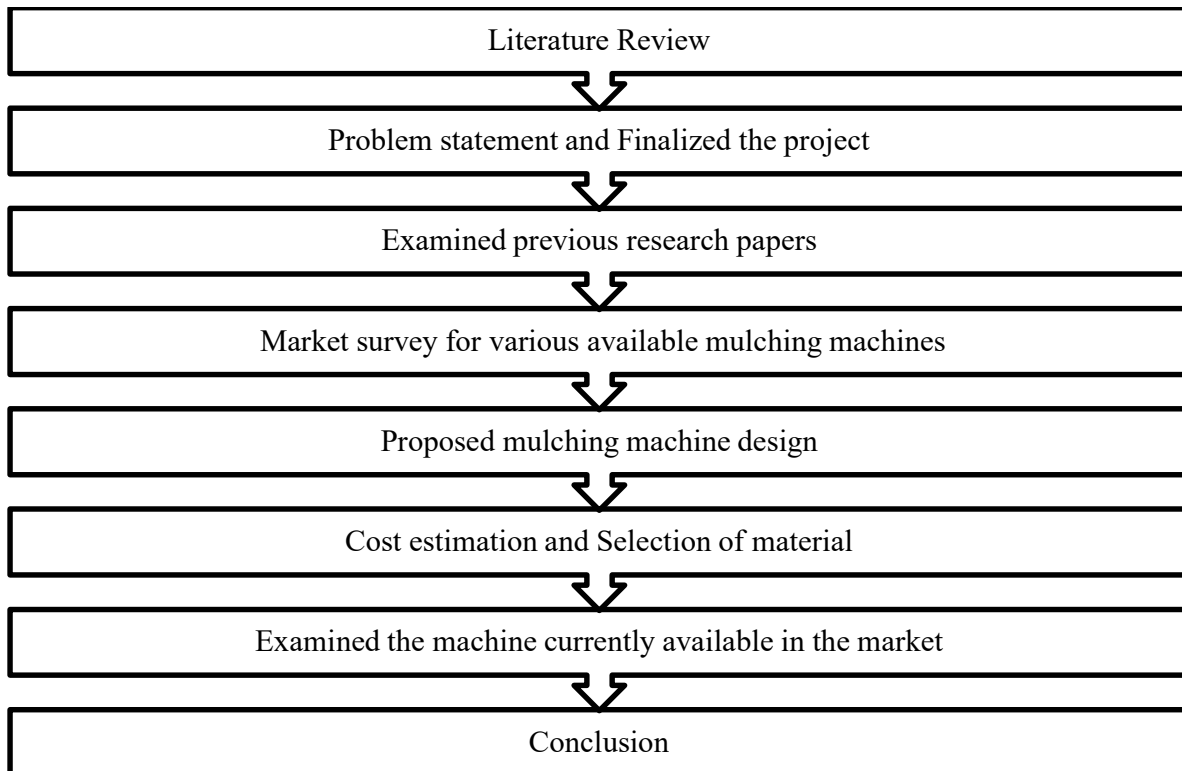
[2]Review Paper on Automatic Mulch Laying and Hole Generation in Farm: Harshwardhan D. Jadhav, Jitendra J. Kadam, Anil D. Karche, Hanumant P. Kharat, Wasnik Monish: International Journal of Engineering Science and Computing (IJESC): Vol-7, Issue 4, (April 2017): As we know that , Mulching has become an very crucial in modern field . As the mulch paper reduces the application of chemical fertilizer and weed control and gives small climate to soil . This article reviews the published research on paper mulches and discusses the opportunities that they solving the problem in agriculture.

[3]Design and Development of Tractor Operated Plastic Mulch Laying Machine : Sumant R Balli , Prajwal Shetty, S.C.Sajjan : Journal of Mechanical Robotics : Volume-5, Issue-1 (January-April, 2020) : This paper present designed the plastic mulch laying operation that includes a sliding fit mechanism to adjust the variable size of bund making , press wheel and hoeing blade. There machine was fully adjustable and well designed that it does not requires complex setup to change varying size of soil bed in the farms. this design will be helpfull for large scale which focus on crops of yield varieties .

[4]Ashish Kumar Kerketta, Sheen C. Moses, Suryakanta Khandai and Surendra Pal. 2018. Performance evaluation and Economic Analysis of developed Manual Mulch Laying Machine. Int.J.Curr.Microbiol.App.Sci. 7(12): 2482-2487 : They have created a manual plastic

mulch laying machine . In this research paper they made a comparison of manual mulching machine and tractor operated mulching machine . In this paper they analyze on cost calculation of manually operated mulching machine, speed of operation, Power requirement, Field efficiency, cost of operation.

3. Methodology



4. Problem Statement

Design a mulching machine that can lay mulching paper, create the bed, and punch a hole all in one pass. Also, all of the above tasks must be completed in the shortest amount of time possible while remaining cost effective.

5. What is Mulching and Mulching Machine?

Mulching is the process of covering the soil around plants with an organic or synthetic material to create a desired environment for plant growth, development, and efficient production. A mulching machine is a simple attachment that can lay a sheet of mulch on agricultural beds. .

6. Reasons for Mulching

Unfortunately, mulching does not produce instant miracles, but it does promote better plant growth and development. These advantages supplement the mulched area, whether plants are growing in the coolest or hottest climates. Mulch is used for the following purposes:

- 1) To conserve moisture.

- 2) To reduce soil temperature around plant roots.
- 3) To reduce weed growth

7. Available Machines in The Market

Agriculture mini mulch laying machine for tractor

Description:

- This machine can prepare bed
- Raise the bed shape up to 8 inches high
- Hole Punching (Distance can be maintained) & Marking
- Lays 2.5, 3, 3.5, 4 & 4.5 Feet Plastic Mulching



Model: ABC 1116 Only Mulch film laying machine

Description:

- Minimum 35hp tractor required
- Adjustable plastic mulch film from 1-1.2m wide rolls



MUKTAI AGRO 6 Feet Plastic mulch laying machine

Description:

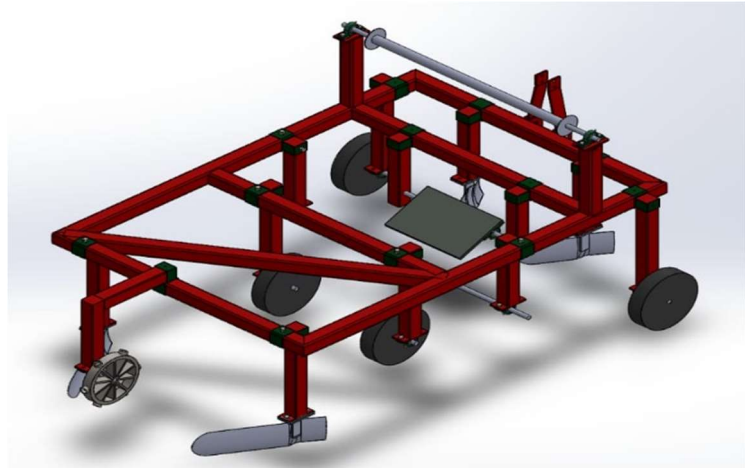
- Minimum 30hp tractor required
- Two blades to create bed
- Two blade to cover the mulching film
- Works for hard soil



8. Proposed Design and Components of Mulching Machine

1) FRAME

- 2) CONNECTING ARM
- 3) BED
- 4) FRONT SHOWELS
- 5) MULCH SHEET ROLL
- 6) FRONT WHEELS
- 7) SECONDARY ROLLER
- 8) REAR WHEELS
- 9) REAR SHOWELS
- 10) PUNCHING WHEEL



9. List of Considered Materials

<i>Materials</i>	<i>density</i>	<i>Young's Modulus</i>	<i>Modulus of rigidity</i>	<i>Yield strength</i>	<i>Ultimate tensile strength</i>
Mild steel	7860	207	81	300	510
Stainless steel	7930	200	77	210	510
Ti-Al Alloy	4430	110	42	800	860
Aluminum	2710	71	27	50	85
Cast Iron	7150	97	41	310	500
Alloy Steel	7900	210	83	750	1000

10. Why AISI 1018 Mild Steel is the Best for Mulching Machine?

Ductile – Materials that are strong in this regard can deform more than 15% before becoming permanently deformed and unable to return to their original shape.

AISI 1018 mild steel has excellent weldability, produces a uniform and harder case and it is considered the best steel for carburized parts. AISI 1018 mild steel offers a good balance of toughness, strength and ductility. AISI 1018 hot rolled steel has significant mechanical properties, improved machining characteristics and has a high Brinell hardness measure.

- Weldable – Because of the metal's specific properties, electric currents can pass through it without distorting the material's make-up.'
- Carburization is a great way to improve the strength and wear properties of otherwise inexpensive steels, even improving fatigue strength.
- Moderate Weight – Mild carbon steel is lighter than high carbon steel.
- Cost Efficient– It is an excellent material for keeping project costs as low as possible.
- Recyclable – Most steels can be recycled indefinitely without losing quality, and mild steel is especially easy to recover from unsorted waste due to its magnetic properties.

11. Working of Mulching Machine

This mulching machine has a simple mechanism in which the front shovel is dragged against the soil to create a bund in the shape of triangle which then is flattened using the bed to transform the triangle bund into a trapezium bund with the help of flat bed . The sheet roll holds the mulch film, and the mulch is passed through the secondary roller which is located behind the front wheel just above the level of soil and hence it become easier to lay the paper effectively on the soil. As the flat bed is built, so that mulching sheet is spread properly on it , which is then pressed by the rear wheels to keep the sheet attached to the bed , so it does not come off with the wind . After passing through the rear wheel the rear shovel lays back the soil removed by the front shovel to put weight on the sides of the mulch paper so that it is fixed properly. In the end of operation, the punch wheel at end of machine punches holes at the center of sheet at regular distance set by the user and this completes the operation.

12. Cost Estimation of Mulching Machine

<i>COMPONENTS</i>	<i>PRICE</i>	<i>REQUIRED MATERIAL</i>	<i>TOTAL COST(RS)</i>
Frame –2”*2”MS Pipe	60-75 per feet	60 feet	3600-4500/-
Bed	200per sq.ft	2sq. ft	400/-
Shovels	300 per shovel	4 shovels	1200/-
Wheels	400-700 per wheel	5 wheels	2000/--3500/-
Ball Bearing	60-100 per bearing	9 bearing	540/--900/-
Roller Shaft	300 per shaft	2 shafts	600/-
Fabrication	120 per kg	80-100kg	9600/--12000/-
Miscellaneous (Nuts, Bolts,Clamps,Paint,etc)	-	-	4000/-

13. Types of Mulching Sheets That can be Used

(a) Black film	In monsoon season
(b) White film	Cropped field in summer
(c) Silver colour film	Insect repellent
(d) Double Coloured Mulch	Mulches are wavelength selective and are designed to absorb certain wavelength of sun's radiation.

14. Customer Feedback

<i>CUSTOMER NAME</i>	<i>LOCATION</i>	<i>FIELD AREA</i>	<i>Price range for the mulching machine ?</i>	<i>Punching mechanism</i>	<i>Ease of operation</i>	<i>Satisfaction</i>
Shreyash Kannawar	Hingoli	Akhada Balapur	59000/-	Pneumatic	Easy	75%
Pratik Karhade	Nanded	Kinwat	55000/-	Mechanical	Easy	75%
Ajinkya Khopkar	Chandrapur	Bhadravati	50000/-	Manual	Slightly difficult	50%
Namdev Ghotale	Bhandara	Khat	47000/-	No	Complex	50%

15. Application Area of Mulching Machine

- To conserve moisture in rainfed areas.
- In areas where irrigation is much needed.
- For solarization in areas with soil borne diseases.
- To prevent soil erosion due to impact of rain in heavy rainfall areas.
- In areas with high value crop cultivation takes place.

16. Advantages of Mulching Machine

- It reduces human effort required to lay paper and punch hole.
- Reduce cost and increase efficiency.

- Simplified design.
- It minimizes the production time.
- It increases the production rate.
- Reduces number of workers.
- It minimizes miss-operation.
- It reduces human effort.
- Less capital cost.

17. Disadvantages of Mulching Machine

- Initial Cost is High
- More Fuel Consumption

18. Comparison Between Traditional and Machine Assisted Mulching

<i>TRADITIONAL MULCHING</i>	<i>MACHINE ASSISTED MULCHING</i>
Less efficient	Highly efficient
Complex operation	Easy to use
Operation has multiple steps	Two step operation
For 1 acre it takes 6-7 hrs for 5-6 workers.	For 1 acre it takes about 2.5 hrs with two workers.

19. Cost Comparison with Machine Available in Market

<i>MANUFACTURERS</i>	<i>PRICE</i>	<i>OPERATIONS</i>
Shree Savitri Agriculture Works	72,500/-	Makes bed, Lay mulch film, Lay drip line, Cover the mulch film by the soil at the back side.
Dharti Agro Industries	49,000/-	Lay mulch film, punch holes on the sheet, Cover the mulch film by the soil at the back side.
Kamal Kisan (A Brand of Simple Farm Solutions Private Limited)	47,000/-	Makes bed, Lay mulch film, Cover the mulch film by soil at back.
Chaitanya Agro Engineering	38,000/-	Lay mulch film, cover the mulch film by soil at back.
Kaira Agros	50,000/-	Lay mulch film, cover the mulch film by soil at back.

20. Conclusions

As we can see, the process of laying mulch paper is relatively inexpensive, and our machine will make it even more so. The yield from the land has increased dramatically as a result of this process, and if achieved at a low cost, it will undoubtedly benefit the farmers. As a result, we can conclude that mulching is an important technique for increasing crop yield. However, as previously stated, the machine available on the market is slightly more expensive, making it difficult for small-scale farmers to afford. Small-scale farmers require more yield from their smaller land, necessitating the development of an economically viable alternative machine. The components and the alternative technique used will ensure an affordable yet sturdy and reliable machine.

References

- [1] Ashish Kumar Kerketta, Sheen C. Moses, Suryakanta Khandai* and Surendra Pal; Performance Evaluation and Economic Analysis of Developed Manual Mulch Laying Machine; International Journal of Current Microbiology and Applied Sciences ISSN: 2319-7706 Volume 7 Number 12 (2018)

- [2] Sumant R Balli, Prajwal Shetty, S.C.Sajjan, Student, Professor Department of Mechanical Engineering; Design and Development of Tractor Operated Plastic Mulch Laying Machine; Journal of Mechanical Robotics, e-ISSN: 2582-2187, Volume-5, Issue-1 (January-April, 2020)
- [3] Ashish Kumar Kerketta, Sheen C. Moses, Suryakanta Khandai and Surendra Pal, Ph.D Scholar, Associate Professor; Design and Development of Manual Plastic Mulch Laying Machine; [International Journal of Pure & Applied Bioscience \(IJPAB\)](#), ISSN: 2320 – 7051 Int. J. Pure App. Biosci. 6 (6): 48-53 (2018)
- [4] Prof. Amay Tipayale, Mayur S. Salunke, Samadhan U. Thete, Tushar S. Thete, Sandip B. Thete, Department of Mechanical Engineering; Advance Mulching Paper Laying Machine; IJSRD - International Journal for Scientific Research & Development| Vol. 5, Issue 03, 2017 | ISSN (online): 2321-0613
- [5] S.S. Magdum , S.B.Patil, L.B.Mulla Sanjay Ghodawat Group of Institutions, Atigre, Maharashtra, India; Automatic Mulch Paper Laying Machine for Agricultural Application; Journal of Advances in Science and Technology ,Vol. 13, Issue No. 01, (Special Issue) March-2017, ISSN 2230-9659
- [6] Kapilraj R. Nangare, Akshay A. Otari, Ganesh I. Patil, Dipak B. Humbe, Jaywant B.Chougule, Umesh P.Sutar; Design and Development of Agricultural Mulching Paper and Drip Laying Machine; International Journal of Innovative Research in Science, Engineering and Technology (IJIRSET)