

MULTI-FUNCTIONAL FARMING SYSTEM

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Abstract - Majority of the sprayer pumps available in market are back mounted hand pumps that are used to spray pesticides. In earlier design for spraying action, the pump is to be continuously pumped by hand to develop sprayer pressure inside the tank and has to be carried on the back; this causes fatigue and makes the operator tired. Hence, a simple system that pumps fluid and carries on a vehicle. The pump is provided with two additional mechanism namely to uniformly spray the pesticides on the crop and secondly a solid fertilizer sprayer with the help of dispenser. Project work involves the design development analysis of components, fabrication of the unit and testing the equipment to find performance parameters. The designed unit has being manufactured and tests have being conducted to determine the spray area per pump filling throw of fertilizer at various speed of vehicle.

Key Words: Modernization, Fertilizers, Pesticides, Labour cost and Fertilization time.

1. INTRODUCTION

India is agriculture based country. Near about 70% people of our country are farmers. Our economy also depends on agricultural products. Nowadays tremendous changes have occurred in conventional methods of agriculture like seed plantation, irrigation system, pesticides and spray used. For developing our Economic condition, it is necessary to increase our agricultural productivity and quality also. Farming process includes many stages, out of which fertilization is one of the important stages and which is not exploded up to the mark up till now. Now-a-days, we are used to do spreading of fertilizer in traditional way which is time consuming, costlier as well as not provide comfort to the labor. Also, some tractor operated machines for spreading of fertilizer are available. So, what we need is an alternative to the traditional as well as tractor operated fertilizer spreading machine which will fulfill all the requirements. So, we are going to design a manually operated machine for fertilizer spreading by taking into consideration the user group and their needs which helps to them to work easy and functional.

1.1 Problem Statement

In Conventional sprayer, we spread the liquid pesticides by hand pump (knapsack) and fertilizers by hand. A disadvantage of this system is that it is very heavy, has to be operated by hand and moreover carrying it on the shoulder

is very tiresome. Manually operated sprayers are slow and labor intensive so lots of time and cost is utilized in sprayer more over the pesticide chemicals are injurious and hazardous to health hence we are going to design the multi-functional farming system and eliminate the problems in conventional sprayer to reduce the human efforts.

1.2 Objectives

1. To reduce farmer's efforts and health problem.
2. To make machine available in possible least cost.
3. To modernize the agriculture sector.
4. To provide two or more applications in one product.
5. To increase the spraying area.

2. METHODOLOGY

1. Modernization: A model of a progressive transition from a pre-model to a modern society. Generate a CATIA model of the designed model.

2. Component of system: It should be compact enough so that it can be accommodated at a corner of room. All the moving parts should be well closed and compact. A compact system design is given a high weighted structure which is desired man machine interaction.

3. Weight of Machine: The total weight depends upon the selection of material components as well as dimension of components.

4. Design the sprayer as per required support conditions of proposed mechanism.

5. Testing and modification: Finding out how well it works and change accordingly.

6. Interpretation of result and discussion: Writing the results and discussion as separate sections allows you to focus first on what results you obtained.

3. MODEL AND ANALYSIS

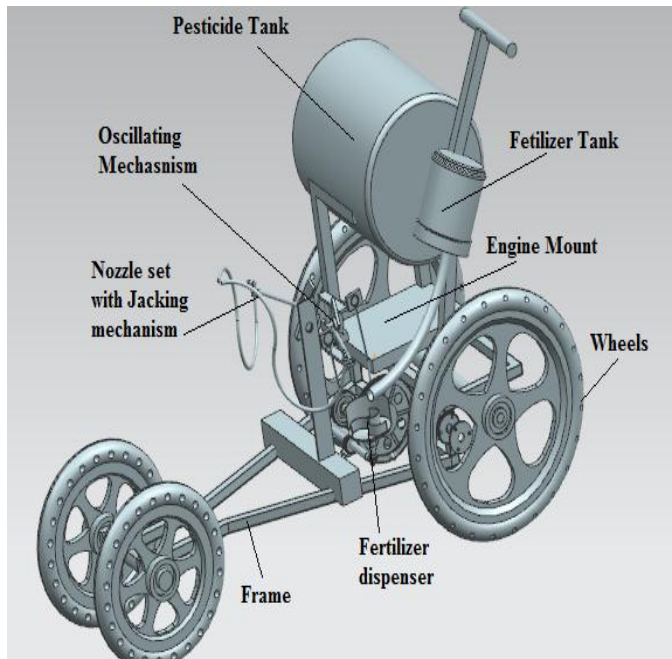


Fig -1: 3D Model

A] The construction and working of the innovative agricultural sprayers is as follows:

- 1. Base frame:** The base frame of chassis is a mild steel fabricated structure that holds the entire assembly of the sprayer. The rear side carries the rear wheel shaft that carries the rear wheels. The front wheel steering carries the front wheel bracket which provides the necessary turning effect.
- 2. Drive Assembly:** The drive assembly comprises of the worm gear drive couple to the engine and the power is transmitted to the wheel shaft through chain drive.
- 3. Pump System:** The pump system comprises of sprayer mechanism of 15 liter capacity integrated with inbuilt pump on engine and sprayer.
- 4. Pesticide Storage:** The compressed air is stored in the air chamber of storage tank and the pesticide is stored in the liquid chamber, the sprayer connected to the tank sprays this liquid pesticide using the compressed air.
- 5. Solid Fertilizer Storage Container:** This arrangement is used to store the solid fertilizer and is provided with a tee element to equally distribute the fertilizer to the both sprayer elements.
- 6. Fertilizer Sprayer:** The fertilizer sprayer is a disk with impeller vanes that will throw the fertilizer falling on to it through centrifugal force. The rotary motion required is obtained through the 12 volt DC motor.
- 7. Nozzle oscillator mechanism:** The nozzle oscillator mechanism is comprised of the 12 volt DC motor coupled to the slider crank mechanism.

B] System Design:

In system design we mainly concentrated on the following parameters: -

1. System Selection Based on Physical Constraints- While selecting any machine it must be checked whether it is going to be used in a large-scale industry or a small-scale industry. In our case it is to be used by a small-scale industry. So space is a major constrain. The system is to be very compact so that it can be adjusted to corner of a room. The mechanical design has direct norms with the system design. Hence the foremost job is to control the physical parameters, so that the distinctions obtained after mechanical design can be well fitted into that.

2. Arrangement of Various Components- Keeping into view the space restrictions the components should be laid such that their easy removal or servicing is possible. More over every component should be easily seen none should be hidden. Every possible space is utilized in component arrangements.

3. Components of System- As already stated the system should be compact enough so that it can be accommodated at a corner of a room. All the moving parts should be well closed & compact. A compact system design gives a high weighted structure which is desired.

4. Chances of Failure- The losses incurred by owner in case of any failure are important criteria of design. Factor safety while doing mechanical design is kept high so that there are less chances of failure. Moreover periodic maintenance is required to keep unit healthy.

5. Servicing Facility- The layout of components should be such that easy servicing is possible. Especially those components which require frequents servicing can be easily disassembled.

6. Height of Machine from Ground- For ease and comfort of operator the height of machine should be properly decided so that he may not get tired during operation. The machine should be slightly higher than the waist level, also enough clearance should be provided from the ground for cleaning purpose.

7. Weight of Machine- The total weight depends upon the selection of material components as well as the dimension of components. A higher weighted machine is difficult in transportation & in case of major breakdown, it is difficult to take it to workshop because of more weight.

C] Mechanical Design:

Mechanical design phase is very important from the view of designer .as whole success of the project depends on the correct deign analysis of the problem. Many preliminary alternatives are eliminated during this phase. Designer should have adequate knowledge above physical properties of material, loads stresses, deformation, and failure. Theories and wear analysis, He should identify the external and internal forces acting on the machine parts. These forces may be classified as;

1. Dead weight forces
2. Friction forces

3. Inertia forces
4. Centrifugal forces
5. Forces generated during power transmission etc.

Designer should estimate these forces very accurately by using design equations .If he does not have sufficient information to estimate them he should make certain practical assumptions based on similar conditions which will almost satisfy the functional needs. Assumptions must always be on the safer side. Selection of factors of safety to find working or design stress is another important step in design of working dimensions of machine elements. The correction in the theoretical stress values are to be made according in the kind of loads, shape of parts & service requirements. Selection of material should be made according to the condition of loading shapes of products environment conditions & desirable properties of material. Provision should be made to minimize nearly adopting proper lubrications methods.

4. RESULTS

By taking trials on the field of our machine and gathering all information of other possible methods we have got following results. The result obtained is compared as shown in bar charts:

Table -1: Costing

No.	Parameters	Conventional Methods Cost	Fertilizer Spreader Cost
1.	Cost Per Acre	RS.600-700/-	RS.100-150/-
2.	Time Per Acre	2hrs	1hrs
3.	No. of Labors	4	1

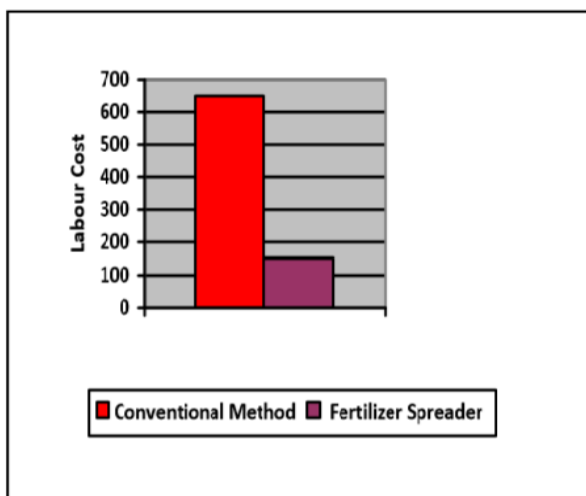


Chart -1: Labour Cost

5. CONCLUSION

Our goal was to build a system which is efficient to perform a various applications with the help of Manually Operated Fertilizer Spreader Machine. With the scope of improvement, the project is done to fulfill the demands of agricultural applications. The main objective of our project was to fulfill the need of farmers suffering from the problems of increasing cost of Fertilization, labor cost and availability as it is operated by single person. With this machine, percentage reduction in time required for Fertilization was observed to be 50%.And reduction in labor cost as compared to conventional method was 80%.

6. REFERENCES

- [1] Narode R.R. ,Sonawane A. B., Mahale R. R., Nisale S. S., Chaudhari S.S., “Manually Operated Fertiliser Sprayer”, University of Pune, (2015), Vol.5, pp. 369- 373.
- [2] Akhil P.T., Arvind M.G., Arjun Balan, Arjun Abraham, “Design and Fabrication of Trolley Mounted Fertilizer Spreader”, Saintgits College of Engineering, India, (2017), Vol. 3, pp. 252-254.
- [3] Pratik Patil, Suyog Patil, Sumit M., Sonawane, “Solar Operated Solid Fertilizer Dispensing Machine”, Bharati Vidyapeeth College of Engineering, India, (2018), pp. 468-472.
- [4] S. P. Matte, A. K. Gabhale and S. P. Dhavane, G. K. Harale, “Dual Sprayer for Pesticides and Fertilizers”, MIT Academy of Engineering, Alandi (D), Pune, Maharashtra-412105, India, (2019), Vol. 9
- [5] Ashutosh Mishra, Neetu Bhagat, Padam Singh, “Development of Solar Operated Sprayer For Small Scale Farmers”, SCRIET CCS University Campus Meerut, India, (2019), Vol. 8, pp.2593-2596.
- [6] Vignesh B., Navaneetha Krishnan M., “Design and Fabrication of Automatic Fertilizer Spreader”, 3IFET College of Engineering, Villupuram, India, (2017), Vol. 5, pp. 1133-1135.
- [7] Basavraj R. Birajdar, Mallikarjun B. Awate, Prasad N. Kulkarni, “Design and Fabrication of Fertilizer Spreading Machine”, DBATU Lonere University, India, (2018), Vol. 6, pp. 238-245.