

Design and Fabrication of Portable Spraying Machine

¹Yashas R, ²Yathish K R, ³Shivanand Khandal, ⁴Vishnu Vardhan Reddy P, ⁵ Dr.Suresha S

^{1, 2, 3, 4}Student, ⁵Assistant Professor

School of Mechanical Engineering, REVA University, Bengaluru-560064, Karnataka, India

ABSTRACT-In India, about 65% of people are involved in agriculture and farming. Indian farmers face a lot of difficulties in agriculture, one of the major problems they face is a failure of crops due to pests and insects. Insects are responsible for the destruction of crops and to prevent them we use pesticides and insecticides. Insecticides/pesticides are sprayed on crops using devices known as the pesticide's sprayer. There are many types of sprayers used by farmers, most commonly used sprayer is backpack sprayer. It has many limitations like low pesticides carrying capacity, inefficient spraying, prolong use of backpack sprayer will lead to back problems of the person using it. The main aim of our project is to do fabricate mechanical pest sprayer, which can overcome the limitations of a backpack sprayer. We have designed a model running without any fuel and it is easy to operate.

Keywords- Agriculture, Mechanical pest sprayer, fabrication, carrying capacity, muscle problems.

I. INTRODUCTION

India is a land known for its Culture and Tradition. Agriculture is also the backbone of India, India stands second in terms of having Agricultural Land, as per 2011 study. India has a total agriculture land of 394.6million acres, out of which 215.6million acres of land is used for irrigation. There are many problems related to agriculture faced by farmers, the attack of Pest and Insects is the major issue. Chemicals are widely used for controlling disease, insects, and weeds in the crops. They are able to save a crop from pest attack only when applied in time. The chemicals are costly. Therefore, for uniform and effective application, it is essential. Dusters and sprayers are used for spraying chemicals. The invention of a sprayer brings revolution in the agriculture or horticulture sector, this enables farmers to obtain the maximum agricultural output. There are many sprayers which are easy to operate, maintain and handle, it facilitates the uniform spread of the chemicals. The agriculture sector is facing problems with capacity issues, shrinking revenues, and labor shortages and increasing consumer demands. The prevalence of traditional agriculture equipment intensifies these issues. In addition, out of the 215.6million acres of irrigated land, around 44% is used for Herbs, 24% is used for Trees and 13% is used for Shrubs, 14% for Climbers and others 5%. The pest sprayers which are on the market can be used for any one of these sectors. Our project focuses on all these sectors. Most farmers are seeking different ways to improve the equipment quality while reducing the direct overhead costs (labor) and capital. Pesticide sprayer must be portable, an increased tank capacity and it should be of less cost, labor and spraying time.

1.1. SPRAYING METHODS

The most common forms of pesticides application, especially in conventional agriculture is the use of mechanical sprayers. The pesticides are generally mixed with water or any other liquid chemical carrier, such as fertilizer. The formulation is sprayed in the form of droplets, the droplets may be large or tiny. The droplets size can be varied by using different nozzles or by varying the pressure under which it's been forced out. Large droplets are good because they show less spray drift, but they need more water per unit area of land covered.

a. Backpack Sprayer:

The principle behind the backpack sprayer is the pressure difference created by hand operated lever. It generally has a single nozzle through which liquid pesticides is forced out in fine droplet form. The Capacity of backpack sprayer is less than 20 liters. The components of backpack sprayer are the tank, piston pump, hose, spraying handle and a nozzle. Sprayers convert the pesticides into small droplets which can be varied by changing the pressure & size of perforation on the nozzle. Large size droplets have less spray drift while spraying, but there is a lot of wastage of pesticides in this method. The smaller size droplet sprays more evenly. The main drawback of backpack sprayer is that the labor has to carry nearly 18-19 liters capacity tank on his back which causes severe back pain and fatigue to labor.

b. Hydraulic Sprayer:

In hydraulic sprayer, pesticides are mixed with water or any other liquid-carrying chemicals like fertilizers and sprayed through a hydraulic nozzle of one sort of another. There is enormous variation in the scale, the way pumping is achieved and the configuration of an atomizer, at this more than hundred years old technology, is still considered as the best method by most the farmers and other spray operators.

c. Tractor mounted Sprayer:

In this, the motorized technique of spraying the pesticides is employed. Light-Tractor is a European company which manufactures these 4 wheels spraying tractors for crops. These tractors have chassis, which are designed in such away that they have a light footprint, for minimal soil compression. It has a stainless-steel tank which can store around 8000 litres of pesticides for spraying hence frequently refilling is not required. The drawback of this tractor mounted sprayer is, it's highly costly, which can be afforded by rich farmers only, small and medium scale farmers cannot afford it.

d. Motorized Mist Blowers

Motorized mist blowers are originally developed for spraying pests to tall trees, such as cocoa capsids. Motorized mist blower usually depends on air – shear atomization, but they may be supplied with a rotary atomizer. Mist blowers are used to improve

horizontal throw and penetration into crops. Here a kilobits DM9 is being used to apply a fungicide against rice sheath blight in Vietnam.

II. LITERATURE REVIEW

Literature review is nothing but the work done before the present time on the same topic. So, we know that people doing farming from ancient time for food and other purpose. For better grown of crop they spray pesticides on them. There are many types of pesticides spraying technique available now that we can find as we move from east to west and also from north to south. It is difficult to mention all those techniques here. But we tried to mention main techniques used and best known to us. People in India use backpack type sprayer which is carry on back of the person with 15 lit maximum capacities and one nozzle in one hand while other hand is used to pump the machine to create pressure. Another machine which is developed and supplied in England was manufactured and patented by Holme Farm Supplies Ltd. This machine is consisting of water tank on tractor. This water tank contains liquid pesticides. On back side of it a long rod is attached on which nozzles are attached. This is used to spray pesticides. Also, many such machines are manufactured by this company for large scale farming and large size crops.

III. WORKING PRINCIPLE

The power source to run this machine is DC Battery. Battery is of 12V 9A 1200 RPM DC Motors. Also, the DC Pump is run on the battery. When vehicle moves forward then at the same time pump discharges liquid from tank towards the nozzle fitted to pipe. As 4 nozzles are attached therefore pressure reduces at each nozzle. There are 2 nozzles at each side through which mixture of water and pesticides comes out and form solid spray patten as our nozzle is of solid spray pattern and liquid falls on plants. Nozzle angle for spraying is 90 degree so we can cover large area with a single nozzle.

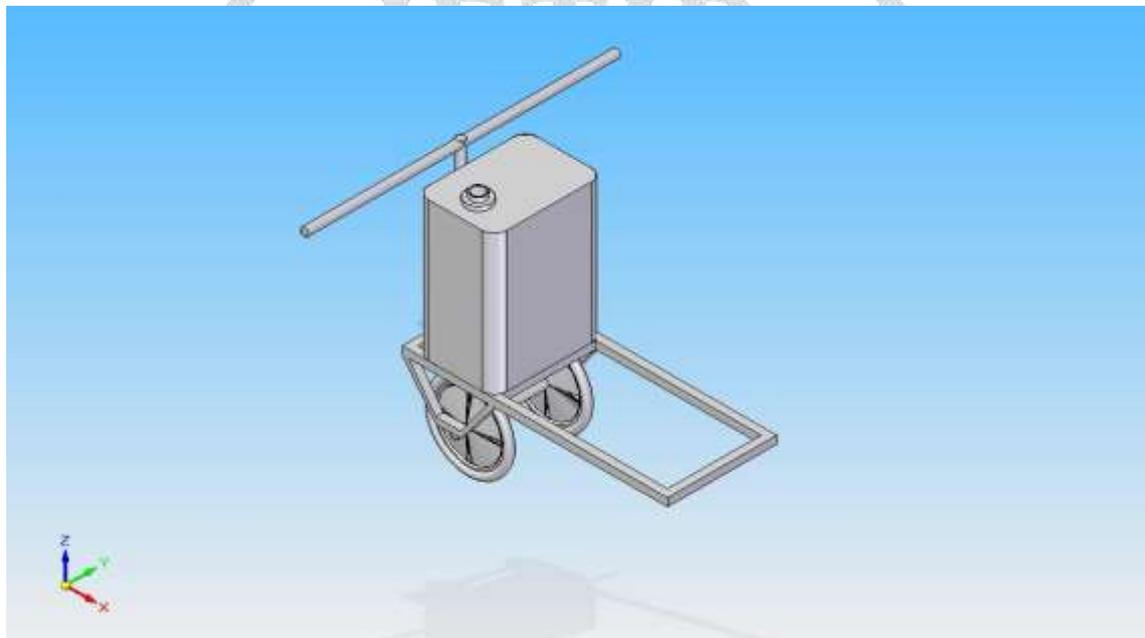


Figure 1: Pesticide Sprayer

IV. COMPONENTS

1. Tank:

The tank should be made of a corrosion-resistant material. Suitable materials used in sprayer tanks include stainless steel, polyethylene plastic and fiberglass. Pesticides may be corrosive to certain materials. Care should be taken to avoid using incompatible materials. Aluminum galvanized or steel tanks should not be used. Some chemicals react with these materials, which may result in reduced effectiveness of the pesticide, or rust or corrosion inside the tank. The tank is shown in Fig 2 Keep tanks clean and free of rust, scale, dirt, and other contaminants, which can damage the pump and nozzles. Also, contamination may collect in the nozzle and restrict the flow of chemical, resulting in improper spray patterns and rates of application. Debris can clog strainers and restrict flow of spray through the system



Figure 2: Tank

2.Battrey:

The storage battery or secondary battery as shown in Fig 3.is such battery where electrical energy can be stored as chemical energy and this chemical energy is then converted to electrical energy as when required. The conversion of electrical energy into chemical energy by applying external electrical source is known as charging of battery. Whereas conversion of chemical energy into electrical energy for supplying the external load is known as discharging of secondary battery. Fig 3.2 Lead acid battery During charging of battery, electric current is passed through it which causes some chemical changes inside the battery.



Figure 3: Battery

Specification:

Item - Lead Acid Battery- 12VDC/8Ah
 Type -Rechargeable Battery.
 Material -Phenol or Fiberglass.
 Length -151mm
 Width -65mm
 Height -93mm
 Voltage Output -12VDC
 Output Current (A) -8AH

3.Motor:

The schematic diagram of DC electric motor is shown fig.4 A DC motor relies on the fact that like magnet poles repels and unlike magnetic poles attract each other. A coil of wire with a current running through it generates an electromagnetic field aligned with the center of the coil. By switching the current on or off in a coil its magnet field can be switched on or off or by switching the direction of the current in the coil the direction of the generated magnetic field can be switched 180°. A simple DC motor typically has a stationary set of magnets in the stator and an armature.



Figure 4: Motor

- Weight of the motor: 500 gm.
- Liquid Discharge: 1ltr/Min
- Operating power required: 10 W.
- Operating voltage: 12 V
- Operating current: 0.8 A
- Motor speed: 1500 RPM

4.Chassis:

Frame is a structure which acts as a chassis for a machine or vehicle. The remaining components are assembled or fitted to the frame. The frame is made of Mild Steel, to withstand heavy weight.

Length- 85cm

Width- 35cm

Height- 50cm

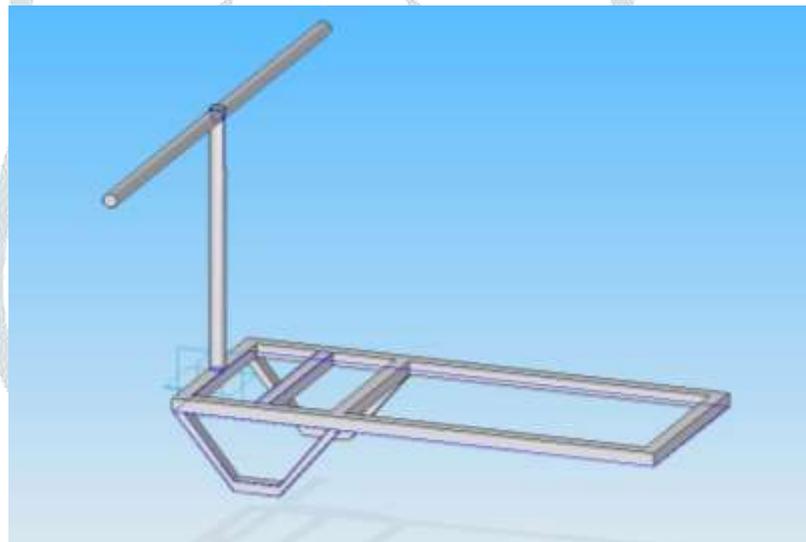


Figure 5: Chassis

5.Nozzle:

Flat fan nozzles, which are sourced, are procured from reputed manufacturer (agrimart). The nozzles are operated in a pressure of 10 psi that gives 75° spray angle. These flat fan nozzles are extensively used for broadcast & post emergency herbicide spraying where foliage penetration and coverage are not essential. The flat spray nozzle as shown in Fig

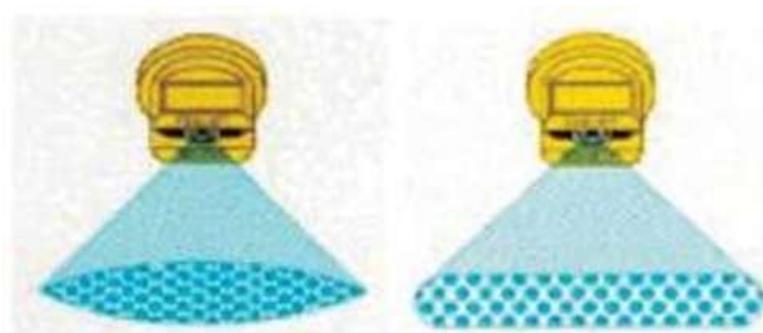


Figure 6: Nozzle

V. CALCULATIONS

Following are the calculations:

Power = energy per second

Battery 9 Ah current, 12 V

Power = $V * I$

= $12 * 9$

= 108 WH

Backup Time of Sprayer = (Power stored in battery /
Power consumed by motor and pump)

= $108 * 2 / \{(4 * 2 * 12) + (2.1 * 12)\}$

= 1.78 hrs.

Flow rate of Nozzle

$Q_n = 28.9 * D^2 * \sqrt{P}$

Where,

Q_n = flow rate of water from nozzle (gpm)

D = Nozzle diameter (inch)

P = Pressure at nozzle (Psi)

$Q_n = 28.9 * (0.039)^2 * \sqrt{25}$

$Q_n = 0.21$ gpm

$Q_n = 0.79$ lit/min

Table.1- Cost Comparison of First Year

Description	Conventional Method (10 Acre)	Portable Pesticides Spraying Machine (10 Acre)
Pesticides	5Litre	4Litre
Pesticide's cost	$5 * 2000 = 10000$ Rs	$4 * 2000 = 8000$ Rs
Labour Charge	Rs. 300 / Day	Rs. 300 / Day
Nos. of labours	3	1
Nos. of working days	8	3
No of cycle	5	5
Total charges of labour	$300 * 3 * 8 * 5 = 36000$ Rs	$300 * 1 * 3 * 5 = 4500$ Rs
Machine cost	$3000 * 3 = 9000$	6000
Working charges of battery	-	Rs. 120/day For 5 no of cycle =Rs 600
Total cost	$10000 + 36000 + 9000 = 55000$	$8000 + 3000 + 6000 + 600 = 19100$
We save Rs.36000/ year		

We are using 4 nozzles. There are 2 nozzles on both sides of arm. Hence the final discharge will be $0.79 * 4 = 3.1$ lit/min.

Cost Comparison from Second Year

Conventional Method = $10000 + 36000 = 46000$ Rs

Automatic Pesticides Spraying Machine = 8000 + 4500 + 600 = 13100 Rs

Therefore, Portable pesticides spraying machine will save large amount of money.

VI. CONCLUSION

- 1) The motive behind developing this equipment is to create mechanizations which will help to minimize effort of farming.
- 2) It is suitable for the spraying at minimum costs for the farmers so that he can afford it, of the many products available.
- 3) It is most important to select the most. Efficient and easy type for your particular needs, whether if it is for applying insecticide fungicides, weed killer, liquid fertilizers or wettings agents. For example, lawn sprayers are made especially for the application of liquids material to the lawn area.
- 4) So, considering the above points related to spraying the project work is focused upon to design and to fabricate such equipment which will be able to perform spraying operation more efficiently and will result in low cost.
- 5) Flow rate is increased by 2.5 times the manually operated sprayer.
- 6) Area sprayed per hour has increased by 2.6 times of the manually operated sprayer and 1.5 times the knapsack power sprayer

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