

Design and Fabrication of Lever Operated Water and Pesticide Sprayer

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Abstract- As on today the whole world is facing a problem of energy crisis. If we want to continue for prolonged use of energy then we must try to save it as much as we can whether it is on large scale or small scale. Today we use various spraying and seed sowing technologies involving use of electrical energy, chemical energy of fuels. This fact makes us know that how large content of energy is getting used at such a place where mechanical energy can be used instead of direct energy sources.

This is a reason why we have implemented mechanical sprayer getting powered by human effort. Although these are serving the purpose, their range of working is not enough. They take considerably larger time for spraying. Thus, what we have aimed is to design such a technology which will run on mechanical power but requiring less time for spraying than those which are hand operated. Thus, considering today's demand, we have come up with mechanically operated spray pump which is purely mechanical. This device is having the advantage of taking less time for spraying once it starts.

Keywords- Multipurpose sprayer, Agriculture Mechanization, Organic pesticide

I. INTRODUCTION

Agriculture is the back bone of Indian economy. Everyone knows that India has known for an agricultural based country approximately 75 % of population of India dependent on farming directly and indirectly and we know that our farmer using the same old methods and equipment. E.g. seed sowing, spraying, weeding etc. There is need for development of effective spraying. In the world of specialization of mechanization, it is essential to introduce new machine and techniques for the improvement and advancement of living standard of human being.

Pesticides are substances that are meant to control pests. The term pesticide includes all of the following: herbicide, insecticides, bactericide, insect repellent, animal repellent, antimicrobial, fungicide, disinfectant, and sanitizer.

A sprayer is a device used to spray a liquid. In agriculture, a sprayer is a piece of equipment that is used to apply herbicides, pesticides, and fertilizers on agricultural crops. The main function of our sprayer is to use mechanical power to break the liquid into droplets of effective size and distribute them uniformly over the surface or space to be protected using various power transfer units. There are various types of sprayers like hand sprayer, stir up pump sprayer, hand compression sprayer, foot sprayer,

Sprayers are not only used in agricultural applications but also in domestic purposes. Below is a few detail of their application areas are agriculture, pest control, water spraying, small nurseries garden, spraying wetttable insecticides and fungicides, orchards, vegetable gardens, etc.

There are many Pesticide application methods. Some of them are Band application - applying a pesticide in parallel strips or bands, such as between rows of crops rather than uniformly over the entire field. Basal application - directs herbicides to the lower portions of brush or small trees to control vegetation. Broadcast application - is the uniform application of a pesticide to an entire area or field. Directed-spray application - specifically targets the pests to minimize pesticide contact with non-target plants and animals. Rope-wick or wiper treatments - release pesticides onto a device that is wiped onto weeds taller than the crop, or wiped selectively onto individual weeds in an ornamental planting bed. Soil incorporation is the use of tillage, rainfall, or irrigation equipment to move the pesticide into the soil. Soil injection is the application of a pesticide under pressure beneath the soil surface.

II. IN INTRODUCTION YOU CAN MENTION THE INTRODUCTION ABOUT YOUR RESEARCH

To overcome the disadvantages related with previous model, we have designed a model Running without any fuel and also easy to operate for a user.

Pesticide application plays an important role in pest management. Proper technique of application of pesticide and

the equipment used for applying pesticide are vital to the success of pest control operations.

The application of pesticide is not merely the operation of sprayer or duster. It has to be coupled with a thorough knowledge of the pest problem.

All pesticides are poisonous substances and they can cause harm to all living things. Therefore their use must be very judicious. The application techniques ideally should be target oriented so that safety to the non-targets and the Environment is ensured. Therefore, proper selection of application equipment is necessary.

The requirement of coverage and spray droplet size depends upon the mobility and size of the pest.

The mode of action of pesticide, its relative toxicity and other physicochemical properties, help to decide the handling precautions, agitation requirement etc. Further the complete knowledge of the equipment is necessary to develop desired skill of operation, to select and to estimate the number and type of equipment's needed to treat the crop in minimum time and to optimize use of the equipment.

III. WRITE DOWN YOUR STUDIES AND FINDINGS

There are different types of sprayers existing in market which are costly and not fuel operated. They are very heavy to be carried on shoulders. Some of the manual operated are available in market and these have to be operated by using one hand for continuous pumping and other hand for sprayer. The conventional sprayer having some difficulties such as it needs lot of effort to push the lever up and down in order to create the pressure to spray. Difficulty of petrol sprayer is to need to purchase the fuel which increases the running cost of the sprayer which produces more vibrations and noise that irritates the farmer and the refuse to do such work repeatedly. Some of the pesticides are dangerous and smellier which may create some kind of head ache to farmers. Use of fuel operated sprayers is harmful to atmosphere. Sometimes there will be random spraying of pesticides on crops. The backpack sprayer can't maintain sufficient pressure for the spraying action and results in drifts. Developing insufficient pressure is laborious and time consuming. Pumping to operating in the insufficient pressure is also time consuming. Moreover, very small area is covered while spraying. So, more time are required to spray the entire area.

By considering all these factors into account, we have developed an agricultural pesticide sprayer which is mechanically operated and eco-friendly in nature.

IV. LITERATURE REVIEW

The following are the literature survey carried out related to agricultural pesticide sprayer operated mechanically. There are different sprayers available for control of pests.

Poratkar et al: The working of this manually operated multi nozzle pesticides sprayer pump is based on the principles of motion transmission due to chain and sprocket arrangement and plunger cylinder arrangement. The operator first stand behind the trolley. He will grab the handle and lift it and push the trolley forward. As trolley move forward, the wheel rotates in counter clockwise direction. As sprocket is mounted on same shaft of wheel, it also rotates in counter clockwise direction. This motion is transferred to freewheel via chain drive arrangement. The free-wheel, thus, also starts rotating in counter clockwise direction. As freewheel and big spur gear are mounted on same shaft, it also start rotating in anticlockwise direction.

Mansukhbhai Jagani;- In 1994, Mansukhbhai Jagani, developed an attachment for a motorbike to get a multi-purpose tool bar. It which addresses the twin problems of farmers in Saurashtra namely paucity of laborers and shortage of bullocks. This motor cycle driven plough (Bullet Santi) can be used to carry out various farming operations like furrow opening, sowing, inter-culturing and spraying operations. Mansukhbhai's intermediate-technology contraption proved efficient and cost-effective for small-sized farms.

Motorcycle driven multi-purpose farming device (Bullet Santi) It could plough one acre (0.4 ha) of land in less than half an hour on just two liters of diesel oil. Using motorbike-santi, the cost of weeding a typical field was found to be just Rs 8/ha because as much as 10 ha land could be covered in a single day. But, this spraying equipment needs fuel for its running and proper operation which increases its operating cost.

V. PRESENT SITUATION

- The Indian farmers (small, marginal, semi medium) are currently using lever operated SS backpack type sprayer consists of tank 10 to 20 liters capacity carried by two adjustable straps.
- Constant pumping is required to operate this which results in muscular disorder.

- Also this backpack sprayer cannot maintain pressure results in drifts or dribbling. Developing adequate pressure is laborious and time consuming. Pumping to perform operation is also time consuming.
- Moreover, very small area is covered while spraying .so, more time is required to spray the entire land.
- Back pain problems may arise during middle age due to carrying 10-20 liter tank on back.
- Cotton is one of the most important commercial crops grown in India. Over 4 million farmers in India grow cotton as their main source as income.
- For cotton about 5 to 6 times spraying of pesticides is done. Cost of bullock driven is about 50000 now a day's which is expensive for small crop area
- There is trolley like structure containing 3 wheels one at front and 2 at backside at rear.
- The rear wheels are connected by shaft. Bearings are provided at both sides for smooth motion. The front wheel is mounted at middle of the trolley.
- Freewheel is mounted on shaft connected to rear wheels. The freewheel is connected to crank shaft by chain drive. The crank shaft is then connected to piston pump with connecting rod.
- The piston pump is placed middle of frame which has reciprocating movement.
- The nozzle is mounted on upper side of the tank. Nozzle having flexible pipe which is move or turn any direction. We can also adjust the height of the flexible pipe. We use 4 nozzles in our sprayer.
- The whole assembly is connected to handle.

VI. OBJECTIVES

1. To develop a manually operated sprayer which uses slider crank mechanism linked to single bicycle wheel.
2. To reduce human fatigue and effort during spray and decrease the time of spraying the pesticides.
3. Decrease the labour cost by advancement in spraying method.
4. Proper adjustment in the height of sprayer for spraying pesticide for crops of different height.

VII. DESCRIPTION OF PARTS

This chapter includes description and working of all the parts used in this project. In our project, there are various parts. We are also explaining its uses and how it is made used in this project and its various applications. The following are the parts of our project:

- Knapsack sprayer
- Nozzles
- Sprocket and sprocket-wheel
- Wheel
- Chain drives
- Slider crank mechanism
- Shafts
- Pipes and pipe fitting
- Mild steel frame
- Plumber block.

VIII. CONSTRUCTION

- Manually operated spray pump has simple structure it consist of 3 wheels, piston pump, bearings, nozzle, shafts, trolley, pipe, crank shaft, freewheel, handle chain drive, etc.

IX. WORKING

- First bring the spray pump at field where you want to use then fill the pesticides or water as your need.
- Then connect the chain drive to freewheel
- When we start applying/running the machine remembers to adjust the nozzle direction and height as per requirement.
- By holding handle when we start pushing the spray pump the wheels start to revolve due to its motion.
- The sprocket/freewheel transfers its motion to crank by chain drives the chain drive is connected to sprocket and crank.

The crank shaft provides its motion to piston pump it. The pump works vertically reciprocating, through pipe the pesticides or water sprays on crop.

X. DESIGN AND CALCULATION

This chapter includes the design of each and every part included in the project and the forces and the velocity of liquid flowing in the pipe.

Selection of components with their material specifications

The below table shows the components and of which material it is made and its dimensions.

NOZZLE SELECTION

Diameter of wheel =50 cm

Let's consider farm of 1 Acre,
Therefore, 1 acre = 4046.86 m²

Sl.no	Name of component	Materials used	Dimensions
1.	Frame	M.S	112*30*2.5 cm
2.	Tank	Plastic	16 Litre
3.	Nozzle	Plastic	D= 50 mm
4.	Nozzle bar	Steel	L= 90 cm
5.	Adjustable bar	Steel	L= 80 cm
6.	Tyre	Rubber	D= 36 cm
7.	Disc wheel	Steel	D= 16 cm
8.	Sprocket	Steel	D= 8 cm
9.	Shaft	M.S bright bar	L= 20 cm

Number of plants in 64 meters, $N_p = \frac{64}{0.4} = 164$

From survey earlier when hand backpack spray pump used then 60 ltr. of pesticide are used for 1 acre farm.

Consider 60 lit. of pesticide is required for 1 acre farm so how much amount of pesticide is required for one plant.

Total number of plants in 1 acre, $168 \times 168 = 28224$

60 ltr. for 1 acre,

$$\frac{60}{28224} = 2.1228 \times 10^{-3} \text{ kg/plant}$$

Consider time required for 1 acre farm to spray a pesticide is

$$\frac{3 \text{ hrs} = 180 \text{ minute}}{28224 \text{ plant} = 6.2775 \times 10^{-3} \text{ min/plant}}$$

Discharge = 0.3333 lit/min

To find the pressure drop
 $(P_2/P_1)^2 = (V_2/V_1)^2 = (P_2/P_1)^2 = (Q_2/Q_1)^2$

$$(2) \times (0.3333/0.4166)^2$$

$P_2 = 1.279 \text{ bar}$

Pressure drop = 0.72 bar

DISCHARGE OF SPRAYER

Discharge is defined as the volume of water flows or rate of water flow through given cross sectional area is called as discharge.

Discharge = Area of piston × stroke length × r.p.s

$$= \pi/4 (0.65)^2 \times 0.5 \times 0.6$$

$$= 0.785 \times 0.4225 \times 0.03$$

NORMAL SPEED IN R.P.M

6 revolutions in 10 seconds, then how many revolutions in 1 second.

$$10 - 6$$

$$1 - x?$$

$$10 \times x = 6$$

$$x = 0.6$$

The no. of revolution in 1 second is 0.6 then how many rev. in 1 minute (60seconds)

$$1 \text{ sec.} - 0.6 \text{ revs.}$$

$$1 \text{ minute} - x?$$

$$X = 0.6 \times 60$$

$$X = 36 \text{ rpm}$$

Normal speed in rpm = 36 rpm

LIMITING WEAR STRENGTH

$$F_w = D_p \times b \times K \times Q$$

$$D_p = 72.5 \text{ mm}$$

$$b = 6 \times 12 = 72 \text{ mm}$$

$$K = 302 \text{ i.e. Load stress factor}$$

$$Q = \text{Size factor} = \text{assuming the size}$$

$$\text{factor} = 1 \quad F_w = 72.5 \times 72 \times 302 \times 1$$

$$= 15921 \text{ N}$$

Check F_w Limiting Wear Strength > Dynamic load F_d ,

$$As (F_w =) 12717.1 \text{ N} > (F_d =) 2688 \text{ N}$$

Thus, design is safe.

XI. APPLICATIONS

- It major use in agriculture to spray fertilizer.
- In city and urban area it can use for spraying water on lawn.
- It may be exercise device at morning during utilize in lawn.
- Use from spray chemical Pesticide in plants in farm.
- It is use for spray painting in industry.
- It is use for spray water in garden on the plants.
- It is use for transfer water from one place to its nearer place.

XII. ADVANTAGES

1. It uses very simple mechanism of spraying pesticides to crops.
2. As suggested model will cover maximum area of spraying in minimum time & at maximum rate.
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4. This machine is eco-friendly and it is portable.
5. Suggested model has removed the problem of back pain, since there is no need to carry the tank (pesticides tank) on the back.
6. This alone pump can used for multiple crops.
7. Muscular problems are removed and there is no need to operate the lever.
8. This trolley is very much economical and requires less maintenance.
9. An unskilled labor can very operate this trolley.

XIII. CONCLUSION

- The suggested model has removed the problem of back pain, since there is no need to carry the tank on the backbone and solder.
- More no. of nozzle which cover maximum area of spray in minimum time at maximum rate.
- Proper adjustment facility in the model with respect to crop helps to avoid excessive use of pesticides which result into less pollution.
- Imported hollow cone nozzle should be used in the field for the better performance.
- Muscular problem are remove and there is no need to operate lever.
- This alone pump can use for multiple crops.
- After having a trial we have found that one finds it easy to operate push type machine.
- The pump can deliver the liquid at sufficient pressure where output of the nozzle in 1min is 0.3 and spray width 0.4m from calculation so that it reaches all the foliage and spreads entirely over the spray surface.
- It is little heavy but efficiently working in rough conditions of farm. It is economical therefore affordable for all kind of farmers.
- It requires comparatively less time for spraying so we can get more fields spraying per day. It is cost effective than the existing spraying pumps available in the market as no direct fuel cost or cost for maintenance is needed for this.

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