



Tractor Mounted Spray Pump with Auto Water Filling System

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ABSTRACT

India is an agricultural nation with a mix of small, marginal, medium-sized, and wealthy farmers. Due of their adaptability, affordability, and attractive design, manually operated knapsack sprayers are highly popular with small-scale farmers. It has several restrictions, such as the inability to maintain the necessary pressure, which causes back pain. But it can also result in improper chemical use and inefficient pest management, which causes pesticides to be lost as a result of dribbling or drift. This phenomena increases industrial costs while also polluting the environment and endangering the natural eco system. The newly created sprayer pump can be driven by the tractor's PTO and fitted on a three-point linkage. This project's main objective is to use a HTP pump to reduce human labour. Both the HTP pump and the water tank for the Sprayer pump are powered by the tractor PTO. Use the tractor's PTO power to drive the pump that fills the sprayer's water tank.

Keywords: *Nozzle, spray angle, sprayer pattern, small tractor, HTP pump etc.*

1. Introduction

India is the agriculturally based country approximately 75% of population of is dependent on farming directly or indirectly. Our farmers are using the same methods and equipment for the ages. E.g., seed sowing, spraying, weeding etc. There is need for development of effective spraying pump and weeding machine methods for increasing the productivity. In order to reduce the harm to environment and people the research and development of plant protecting machine focus on improving the mechanical work efficiency of machine and the availability of pesticide. One of the most common forms of pesticides application, in conventional agriculture, is the use of mechanical sprayers. Hydraulic sprayers consist of a tank, a pump, a lance or boom, and a nozzle. Sprayers convert a pesticide of one containing a mixture of water and chemical, into droplets, which can be large rain-type drops or tiny almost invisible particles from nozzle. This conversion is carried out by force the spray mixture through a spray nozzle under pressure. The size of droplets can be altered by the use of different nozzle, or by the pressure under which it is forced, or a combination of both. Large droplets have the advantage of being less susceptible to spray, but required more water per unit of land cover. Due to static electricity, small droplets are able to maximize contact with a target area, but very still conditions are required. Sprayers are commonly used on farms to spray pesticides, herbicides, fungicides, as a means of crop quality control.

Problem statement

The farmers who are use these types conventional backpack sprayer faces many types of problems like fatigue, tiredness, pain in spiral cord and muscles many more. Following problems can take place by use of this type of pump.

Common Problems

1. Heavy in weight causes difficulty in lifting manually.
2. Fatigue to the operator due to heavy weight.
3. Big size of pump cause difficult to the operator.
4. Poor material selection and quality of equipment.
5. Due to heavy weight during spraying, operator feels very tiredness and fatigue which reduces work efficiency.

Objectives

1. Aim of this project is that the farmer need not carry the entire pesticide sprayer pump on his shoulders but just insert the pesticide into the drum to operate the pump and spray the pests. This makes the farmer feel comfortable, relaxed and less tiredness.

2. To reduce human efforts due to the constant pumping action for creating pressure inside the sprayer and thereby provide a suitable environment for user to reducing fatigue and load acting on body.
3. This project focuses on the problem of health-related issues of the farmer.
4. Majority of them are not use any precaution like face masks and hand-gloves against hazardous chemicals and work in direct contact with it.
5. To reduce the overall time for agricultural sprayer.
6. Multi nozzles are used and hence large area of field can be covered at a faster rate.
7. Highly reliable.

Literature

Day by day the population of India is increasing and to fulfil the need of food modernization of agricultural sectors. Due to more use of chemical fertilizers the fertility of soil is decreasing. Hence farmers are going towards organic farming. By mechanization in spraying fertilizers and pesticides are distributed equally on the crops and reduce the waste, which results in prevention of losses and wastage of input applied to crops. It will reduce the cost of production. Mechanization gives higher productivity in lower input.

Chemicals are widely used for preventing crops from disease, insects. They are able to save a crop from pest attack only when applied on time. The chemicals are costly. Therefore, equipment for uniform and effective application is required. In this device using reciprocating pump and there is an accumulator provide for the continue flows of liquid to create proper pressure for the spraying action. This wheel operated pesticide spray equipment consumes less time and avoids the pesticide from coming from the nozzles which will in contact of the labour .

India is a land of agriculture which of small, marginal, medium and rich farmers. Small scale farmers are very interested in manually lever operated knapsack sprayer because of its financial condition, cost and design. But this sprayer has certain limitations it cannot maintain required pressure; it leads to problem of back pain. However, this equipment can also lead to misapplication of chemicals and ineffective control of target pest which leads to loss of pesticides due to dribbling or drift. This paper suggests a model of manually operated multi nozzle pesticides sprayer pump which will perform spraying at maximum rate in minimum time.

The spraying of pesticides and insecticides is traditionally done by farm worker carrying backpack type sprayer which requires more human effort. Giving attention to these important problems an attempt is made to develop equipment which will be beneficial to the farmer for the spraying operations. This equipment is easy to use and operate. It makes use reciprocating pump that creates the required pressure for the spraying action. This multifunction device will come in handy that can be put to use in different spraying stages of farming as per process requirement.

Methodology

These are hydraulic energy sprayers. They utilize PTO power of the tractor to operate the pump of the sprayer. Basically, the spray boom can be arranged in two ways;

ground spray boom and Overhead spray boom.

The overhead spray boom is designed for tall field crops and the planting is done in such a way that it leaves an unplanted strip of about 2.5 m width for operation of the tractor. Therefore, a planted strip may be 18-20 m wide and after every planted strip a fallow strip has to be left for tractor operation.

For ground spray boom the planting has to be done in rows keeping in view track width of the tractor. It is suitable for use when the crop is small. The sprayer essentially consists of a tank which is made of fibre, glass or plastic, pump assembly's suction pipe with strainer, pressure gauges pressure regulators, air chamber, delivery pipe, spray boom fitted with nozzles. The complete sprayer is mounted on 3-point linkages of the tractor. It uses high pressure and high discharge pump as the number of nozzles may be up to 20 depending upon the crop and make of the sprayer.

Selection of material and components

Sprayer is a machine used to apply liquid chemicals on plants to control pest and diseases. It can also be used to apply herbicides to control weeds and to spray micronutrients to enhance plant growth fast.

The main functions of a sprayer are:

1. Breaking the chemical solution in to fine droplets of effective size.
2. Distributing the droplets uniformly over the crops.
3. Applying the chemicals with sufficient pressure for positive reaching the land.
4. Regulating the amount of chemical applied on plants to avoid excessive application

Basic components of a sprayer

- 1) HTP Pump
- 2) Tank
- 3) Agitator
- 4) Air chamber
- 5) Pressure gauge
- 6) Pressure Regulator
- 7) Valves
- 8) Strainer
- 9) Nozzles
- 10) Spray gun
- 11) Spray boom
- 12) Over-flow pipe
- 13) Spray angle

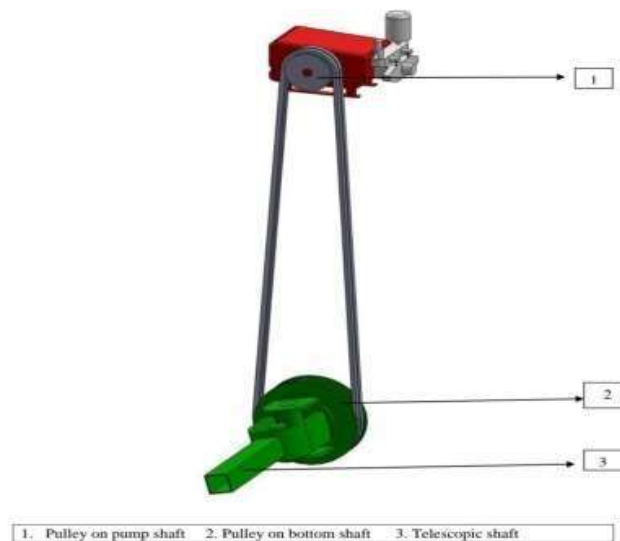


Figure:1) HTP Pump

Component and Specification

| Sr. No. | Component And Specification | Material |
|---------|---|------------|
| 1 | Hollow Square pipe, (25.4mm*25.4mm*3mm) | Mild steel |
| 2 | Hollow square pipe (31.75mm*31.75mm*3mm) | Mild steel |
| 3 | Water tank, (431mm height, diameter 1371mm) | Plastic |
| 4 | PVC pipe, (external dia. 25.4mm, internal dia. 20.4mm, thickness 2mm) | Plastic |
| 6 | Nut bolt, (dia. 8mm, height 63.5mm) | Mild steel |

| | | |
|----|--|------------|
| 7 | Nozzle hose (8.5mm diameter) | Rubber |
| 8 | T-Head (length 88.9mm, height 76.3mm) | Brass |
| 9 | Round pipe (external dia. 25.4mm, internal dia. 20.4mm, thickness 2mm) | Mild steel |
| 10 | Sheet(50mm*50mm*1.5mm) | Mild steel |
| 11 | Hose Pipe | 25 Ft |

Table No.01 Component and Specification

Cost comparison

Survey manual back pack sprayer following data:

Average tank capacity of back pack sprayer = 15 to 20 litres

No. pumps required for one acre = 5 pumps for 20 litres capacity and 7 pumps for 15 litres

Cost of labour per pump = 30 Rs

So, cost of per acre will be $30 \times 5 = \text{Rs. } 150/-$

One day coverage of spray by one person is approximately 5 acres of land.

So total costing of one labour is Rs 750/- Per day Cost of Water supplier = 300 Rs per day

In back pack sprayer time required for spraying in one acre = 1:30 hrs.

Total Cost = Rs.1050/- Approx. per day

So, per acre cost is approx. = Rs 210/-

Survey of tractor mounted spray reveals following data:

Average tank capacity of tractor mounted spray = 400 litre

Spraying Capacity of 1 tank = 3 acre

Total cost of operator per day = 300 Rs

Time required for spraying in one acre = 40 minute

Fuel required to 3 acres = 1 lit.

One day coverage of spray by one person is approximately 12 acres of land.

Total Cost = (Labour cost + Fuel cost) Rs.676/- Approx. per day

So, per acre cost is approx. = Rs 56/- Total Cost Save = 154/-

Conclusion and Future Work

In conclusion, the project In short while conclusion this paper we fill file quite contended in having completed the project assignment well on time we had enormous practical experience on fulfil of manufacturing schedule of working project module we are therefore happy to state the calculations of mechanical aptitude proved to be very useful purpose agriculture pesticide sprayer is designed to reduce human effort is used to agriculture field by spray pesticide now a days farmer more used pesticide in farm to get better crop. The motive behind developing this equipment is to create mechanizations which will help to minimize effort of farming. Also, we will reduce the operator fatigue by adding HTP pump and cover the maximum area within minimum time as compare to single sprayer.

- 1) More number of nozzles can be used.
- 2) A new design can be implemented to eliminate the need for pulling the machine manually.
- 3) Stronger but light in weight materials can be used for the frame.

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References

- [1]. Satya Prakash Kumar, A.K. Roul, B.M Nandede, Bikram Jyoti, C.R. Chethan, (2021) Indian Journal of Weed Science 53(2): 173–178
- [2]. Mr. Prasanna Mahale Mr. Parmeshwar Lohar, Mr. Chaitanya Kulkarni (2019) IRJET Volume 6, Issue 03.
- [3]. Prof.S.T. Nangare S.S. Patil, G.P. Ikile, S.R. Jangate, A.M. Patil, D.K. Nalawade6, (2018) ICRISEM,
- [4]. Shailesh Malonde, Shubham Kathwate, Pratik Kohle, Roadney Jacob, Nishant Ingole, Rupesh D. Khorgade, (2016), International Journal of Advanced Engineering and Global Technology Vol-04, Issue-03.
- [5]. Nitish Das, Namit Maske, Vinayak Khawas, Dr. S. K. Chaudhary, (2015), (IJIRST/ Volume 1/ Issue 11/008), ISSN: 2349-6010.
- [6]. Laukik P. Raut, Smit B. Jaiswal, Nitin Y. Mohite, (2013) ISSN: 2278-9480 Volume 2, Issue 11.
- [7]. R. Joshua, V. Vasu and P. Vincent. (2010) International Journal of Sustainable Agriculture 2 (1): pp. 16-19, ISSN 2079-2107”
- [8]. M. A. Miller, B. L. Steward, M. L. Westphalen “Effects of multi–mode four–wheel steering on sprayer machine performance, American Society of Agricultural Engineers ISSN 0001–2351