

Research Article

Dual Sprayer for Pesticides and Fertilizers

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Abstract

Day by day the population of India is rising. So it is important to fulfill the need of food, modernization of agricultural sectors. Farmers in our country use fertilizers and pesticides on crops for removing weeds and other unwanted vegetation, insecticides for controlling a wide variety of insects, preventing the spread of bacteria, and compounds used to control mice and rats. Conventionally the spraying is done by farmers carrying backpack sprayer and fertilizers are sprayed manually. It is very harmful to their health and can be dangerous. The efforts required are on the higher side. Pesticide spraying machine is available in the market so there is no issue. But it is acquiring high cost for buying two separate equipment's for fertilizer and pesticide spraying which isn't affordable to farmers. So by taking into consideration the present problem faced by farmers we are coming up with the solution of "Dual Sprayer for Pesticides and Fertilizers". The aim of our project is to minimize the health issues of the farmer, to provide more feasibility with minimum possible cost, to reduce the efforts of farmers of fertilizer spraying and provide both fertilizer and pesticide sprayer in one setup.

Keywords: Modernization, fertilizers, Pesticides, Health problems

1. Introduction

In India about 73% of population is directly or indirectly depends upon the farming. Hence it is said that India is an agricultural based country. But till now our farmers are doing farming in same traditional ways. They are doing seed sowing, fertilizers and pesticides spraying, cultivating by conventional methods. There is need of development in this sector and most commonly on fertilizers pesticides spraying technique, because it requires more efforts and time to spray by traditional way. Most of Asian nations are at developing stage and they are facing the problem of high population and as compared to that agricultural productivity is much lower as compared to developed nations. India is one of the nations who are facing the same problem. This is caused due to low level farms, insufficient power availability to farms and poor level of farm mechanization.

The WHO (World Health Organization) estimates there are more than 1 million pesticide cases in every year. In that more than one lakh deaths in each year, especially in developing countries due to the pesticides sprayed by human being and handling of pesticides. The health effects of pesticides include asthma, allergies and hypersensitivity and pesticide exposure to cancer, hormone disruption and problems with reproduction and fetal development. Other pesticides

may be irritated the skin and eyes. More pesticides are very dangerous carcinogens. Other pesticides may be affects the hormone and endocrine system of the body. Even though very low levels of exposure during spraying may have leads to health effects. Pesticide exposure can cause a wide range of neurological health effects in body such as memory loss, loss of coordination, reduced speed of response to stimuli, reduced visual ability, altered or uncontrollable mood and general behavior, and reduced motor skills.

2. Problem statement

The farmers spray fertilizer manually by using hands for which more efforts are required. It is harmful for health and time consuming. The agricultural equipment's for multi-crops fertilizer spraying is not available. Only for pesticide spraying pesticide sprayer is available in market but if we make separate fertilizer sprayer it cost will be high so here we are providing two applications that is fertilizer and pesticide spraying in one product which will be able to spray fertilizer for various types of crops with dual fertilizer sprayer.

2.1 Functions of Dual Fertilizer Sprayer

The main functions of dual fertilizer sprayer are

-It should be economical

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- It should able to spray both fertilizer and pesticide
- It should carry maximum possible fertilizer
- It should be reliable.
- It should be consisting of less weight.

2.2 Construction

Initially we have prepared model of equipment on CATIA V5. Study of each model is as follows:

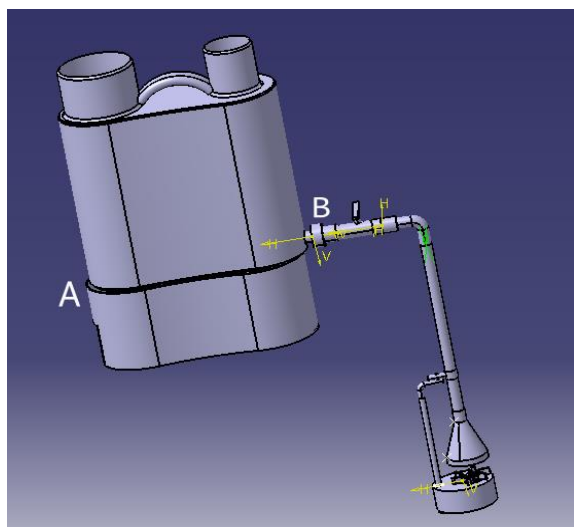


Fig.1 Whole Assembly of Project

- A. position for pesticide spraying
- B. position for Fertilizer spraying

The equipment consists of following parts:

- 1) Storage Tank
- 2) Flexible pipe
- 3) Electrical wires
- 4) Fixture
- 5) Ball butterfly valve
- 6) U-PVC pipe
- 7) Elbow pipe
- 8) Joint
- 9) Steel Joint
- 10) Threaded Joint
- 11) Motor (12V)
- 12) Runner blade
- 13) Circular box
- 14) Switch
- 15) Belt
- 16) DC Motor (12V)
- 17) Pump
- 18) Conical section
- 19) Holder

2.3 Working of components

2.3.1 Runner blades

The runner blades are provided to spray the fertilizer with uniform speed and in equal quantity.

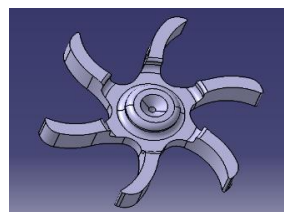


Fig.2 Runner Blades

2.3.2 Motor holder box

Simply it is a circular box provided to hold the motor (9V) and runner blades over it. Its only purpose is to support hold motor.

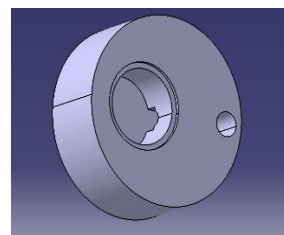


Fig.3 Motor holding box

2.3.3 Ball Butterfly valve

A ball valve is a form of quarter-turn valve which uses a hollow, perforated and pivoting ball to control flow through it. It is open when the ball's hole is in line with the flow and closed when it is pivoted 90-degrees by the valve handle.

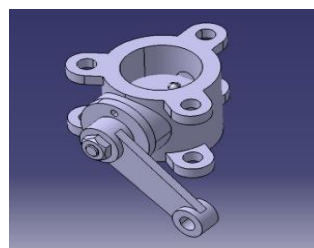


Fig.4 Butterfly valve

2.3.4 Conical section

The conical section is provided at the end of elbow pipe to guide the flow of fertilizer towards runner.

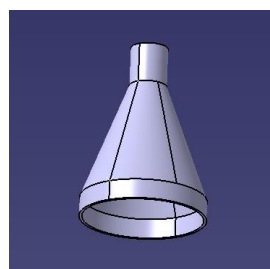


Fig.5 Conical Section

2.3.5 Holder

It is component which holds whole assembly of motor, runner and motor holding box to the U-PVC pipe.

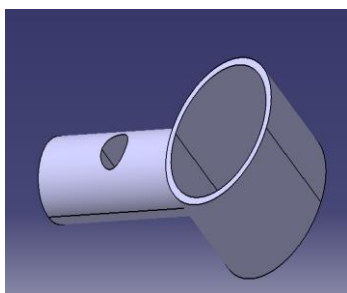


Fig.6 Holder

2.3.6 Joints

The number of joints is used to connect the variable diameter pipes with each other such as threaded joints, steel joint, elbow joint and controller.

2.3.7 Storage tank

The plastic storage tank is used to store both the fertilizer and pesticide as per requirement of spraying fertilizer or pesticide. The capacity of storage tank for pesticide is 16 liters and 16Kg for fertilizer.

2.3.8 Motor

The motor is used to run the runner blades at high velocity to spray the fertilizer. The motor (12V) runs at 2400 RPM

2.3.9 Pump

The PUMP is used to spray the pesticide, which produces the flow necessary for development of pressure which is function of resistance to pesticide flow in system.

2.3.10 Battery

The 12V battery is used to provide power supply to pump and motor.

2.3.11 U-PVC pipe

The U-PVC is used because of its higher strength, low weight and cheaper cost. It is used to hold the motor runner assembly.

2.3.12 Flexible pipe

It is used to provide flexibility to the farmer to move the U-PVC pipe in required direction. It becomes easy to the farmer to spray the fertilizer in all directions without moving.

2.3.13 Pesticide spraying pipe

It is a stainless steel pipe used to spray pesticide. The inlet of pipe is connected to outlet of pump and at exit nozzle is attached to pipe to increase pressure. The controller is connected at middle of pipe to attach and de-attach the pipe to the storage tank.

2.3.14 Belts

The Nylon belts used to hold the dual fertilizer sprayer on the back of user.

3. Objective

The literature survey has been carried out on basis of Fertilizer and Pesticide spraying. So objective of project is;

- 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 applications in one product

4. Methodology of the work

- 1) Design of Fertilizer sprayer 2D layout.
- 2) Generate a CATIA model of the designed model.
- 3) Selection of final model with more feasibility
- 4) Make no of trails by varying the parameter
- 5) Select one from the list for manufacturing of actual model.
- 6) Design the sprayer as per required support conditions of proposed mechanism
- 7) Actual manufacturing of sprayer.
- 8) Testing and modification.
- 9) Interpretation of result and discussion.

5. Material selection

Table 1 Material Selection and Weight Calculation

| Sr. No. | Components | Material | Weight |
|---------|----------------------|----------------------------------|---------|
| 1 | Storage Tank | Plastic | 1.218Kg |
| 2 | Flexible pipe | High Density Polyethylene (HDPE) | 50g |
| 3 | Fixture | Mild steel | 90g |
| 4 | Ball butterfly valve | High Density Polyethylene (HDPE) | 88g |
| 5 | U-PVC pipe | U-PVC | 100g |
| 6 | Elbow pipe | (PVC) | 22g |
| 7 | Steel Joint | Stainless steel | 51g |
| 8 | Threaded Joint | PVC | 40g |
| 9 | Runner blade | polylactide Acid | 9g |
| 10 | Motor holder box | polylactide Acid | 67g |
| 11 | Belt | Nylon | 40g |
| 12 | Conical section | polylactide Acid | 18g |
| 13 | Holder | Stainless steel | 80g |

6. Working

6.1 Methods of spraying fertilizer

Case I - Fertilizer sprayer for land

- 1) Select the inclined belts for holding the setup on the back, so that storage tank will be inclined. Due to gravity fertilizer will flow from the pipe.
- 2) The ball butterfly is used to control the flow of fertilizer as per flow requirement.
- 3) The flexible pipe allows degree of freedom to move to the fixed pipe where we want to spray fertilizer.
- 4) The fertilizer enters from flexible pipe to U-PVC pipe and moves towards conical section.
- 5) The elbow joint is provided between the U-PVC pipe and conical section.
- 6) The holder is fixed to the U-PVC pipe above conical section to hold the runner and circular motor box assembly by using M.S rod and nut bolts.
- 7) The fertilizer falls from conical section towards runner blades.
- 8) The fertilizer is get spread by high speed due to runner rotating action.
- 9) The runner is attached to motor (2400 rpm) with ON/OFF switch.
- 10) As per requirement of spraying fertilizer we ON/OFF the switch,
- 11) The power supply to motor is given from 12V battery which is used for pesticide spraying pump.

Case II- Fertilizer sprayer for multi-crops (on roots)

- 1) As we have seen in previous case of fertilizer spraying for land the entire arrangement remains same.
- 2) The difference is that there is no use of motor and runner blades assembly.
- 3) The fertilizer is get spread on the roots of crops due to gravitational force.

6.2 Method of spraying pesticide

- 1) When there is need to spray pesticide first of all we need to remove fertilizer spraying pipe and attach pesticide spraying pipe which is joined to the outlet of motor by using controller.
- 2) After attaching the pesticide spraying pipe we can easily spray pesticide by turning on motor.
- 3) The nozzle is provided at the end of pipe so pesticide is spread with high pressure.
- 4) Flow rate controlling arrangement is provided in between the flexible pipe and steel pipe so we can control the flow rate according to requirement.

6.3 Facility required

- 1) Modeling Software (CATIA V: 5)
- 2) Manufacturing setup for sprayer.
- 3) 3D Printing Machine

7. Final working model

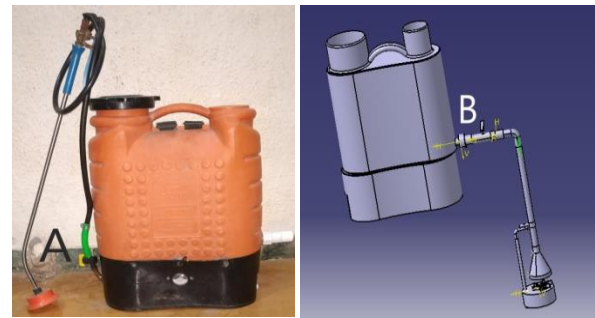


Fig.7 Final Model

- A. Arrangement for pesticide spraying
B. Arrangement for Fertilizer spraying

8. Future Scope

- 1) Here we are designing and fabricating for multi-crops agricultural equipment for small scale farmers with affordable price. But there are chances to produce equipment with taking other operations for large scale farmers.
- 2) When storage is completely filled with fertilizer there are chances of blockage at outlet so we can attach the component which in continues rotation to avoid blockage.
- 3) The belt position can be improved in such a way that it will be more comfortable to the user.
- 4) After spraying pesticide if we want to spray fertilizer then there is possibility that some contents of pesticide may remain in tank so we can improve tank by providing removable storage tank for fertilizer and pesticide to avoid the harm to crops.

Conclusion

The Dual sprayer is relatively cost effective and useful for farmers. The major advantage of this design is to facilitate the dual operations of spraying pesticide and fertilizers with a single device. This proposed model will surely contribute to development of ideas for modernization of agricultural equipment's.

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