



DESIGN AND FABRICATION OF AGRICULTURAL PESTICIDE SPRAYER MACHINE

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ABSTRACT: -

The economics of our country is significantly dependent on agriculture. During crop plantation the farmers tremendously use pesticides to boost the growth of plants in lesser time for more yield. The farmers experience several issues at the time of spraying pesticides on the plants by conventional hand pumping technique. This method offers several challenges i.e., pain in the body parts, fatigue, infection in the skin, eyes, and hands. The manual application of fertilizer and pesticides is time-consuming, expensive for farmers with small farms, and requires a different setup. To address these issues the objective of the current work is to fabricate a semi-automatic bicycle pesticide spraying vehicle which will prove to be a boon for the farmers thereby reducing the pesticide spraying time, long service life, more spraying area on the fields, ease of operation, and cost effectiveness. This vehicle works on the principle of mechanically assisted crank lever mechanism. This spraying vehicle is suitable for crops like Beans, groundnuts, and tomatoes etc. They require regular several hours of fertilizers spraying, which is a tedious and tiresome task for the farmers. This vehicle will prove to be a one of the useful tools for the farmer and the society.

Keywords: Sprayer, nozzle, pesticides, crank lever, bicycle pesticide sprayer

1. INTRODUCTION:

Agriculture is the backbone of Indian economy. It contributes around 18% to countries GDP. Hence Technological innovations are necessary to increase the yield output of the crop by reducing the human affords.-The foundation of the Indian economy is agriculture. There is a lot of field work in this area of agriculture, such as weeding, reaping, seeding, etc. In addition to these tasks, spraying is a crucial activity the farmer must carry out to safeguard the crops from insects, pests, fungi, and diseases for which For crop protection, a variety of insecticides, pesticides, fungicides, and nutrients are sprayed on the plants. Over the past 50 years, farming has seen a significant transformation. Control of various crop diseases is one of the many factors that led to this progress. An agriculture pesticide sprayer is a device used to apply pesticides, herbicides, and other agricultural chemicals to crops. It is an essential tool for modern farming practices, as it allows farmers to protect their crops efficiently and effectively from pests and diseases.

The use of pesticides in agriculture has been a controversial topic due to concerns about their potential impact on human health and the environment. However, when used responsibly and in accordance with regulations, pesticides can be an important tool for farmers to protect their crops and maintain their yields. Overall, the agriculture pesticide sprayer plays a crucial role in modern agriculture, helping farmers to efficiently and effectively manage their crops while minimizing the impact on the environment.

The production of various crops in agricultural fields is significantly impacted by plant protection devices. Agricultural pests, such as fungi, bacteria, viruses, insects, mites, nematodes, weeds, and grain-eating birds, can significantly impact crop yields and economic viability. They play a role, to varying degrees, in determining whether crops can be farmed successfully in specific contexts. Agricultural pests typically cause severe crop damage and are a major productivity constraint. To reduce losses and ensure that other production inputs are fully utilised, effective plant protection becomes crucial. The use of chemicals to manage pests has been quite effective, but they must be



applied carefully, rationed, and sprayed efficiently. Since chemical application is the sole fully mechanised farming operation, specialised equipment is required. Knapsack sprayers, ultra-low volume sprayers, and tractor boom sprayers are examples of devices that have been created in the past for the application of chemicals.

The wheel is connected to a sprocket, which is connected to a gear, and the chain connects the two. On the frame, that assembly is mounted. By pushing, the wheels turned and created a cycle of pushing pressure. Then the linked sprocket for the wheel will rotate. The assembly for attaching the chain will cause it to rotate in addition to the gear. Pushing the operator will cause the wheel, which is attached to the gear, to rotate. This machine uses a four bar mechanism to change the rotary motion of the chain sprocket into a reciprocating action for the piston to develop pressure inside of the air pump used in the spray tank and then release that pressure in the form of water vapour through the sprayer boom. There are three nozzles used in this sprayer, and the boom frame is also provided to allow the height and width of the nozzle to be adjusted in accordance with the crop requirements.

We have suggested a wheel-driven sprayer that is portable, runs on no fuel, is simple to carry, and sprays the pesticide by turning the wheel.

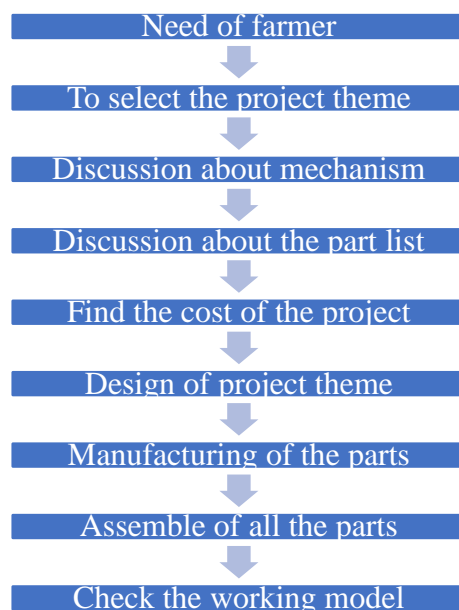
2. OBJECTIVES

The objective of this paper is to present a detailed report on the designing and fabrication of low-cost agricultural spraying machine. This paper also presents different independent and dependent parameters which needs to be taken into consideration while preparing this equipment for implementation on agricultural fields. In addition emphasis has also been laid on the possibilities for future applications while presenting the current state of agricultural trends and practises.

Our goal is to create a prototype or model that is capable of carrying out the following tasks:

- a) To reduce overall cycle time for the agricultural sprayer.
- b) To reduce human efforts in order to reduce the fatigue load on farmers.
- c) Easy to assemble and disassemble.
- d) Easy to operate by unskilled workers.
- e) Provide a second nozzle for the same input pressure to boost the sprayer's effectiveness.
- f) Use of multi-nozzles in order to spray large areas at a faster rate.

3. MATERIALS & METODOLOGY



The methodology for designing an agricultural pesticide sprayer using a bicycle can be divided into the following steps:



1. Determine the capacity: The first step is to determine the capacity of the sprayer, i.e., the amount of pesticide it can hold. This will depend on the size of the agricultural field that needs to be sprayed, as well as the type of crop and the type of pesticide being used.
2. Select a bicycle: The next step is to select a bicycle that can support the weight of the sprayer and the pesticide. The bicycle should be sturdy, have good brakes, and be able to handle the weight of the sprayer and the rider.
3. Design the frame: The frame of the sprayer should be designed to fit the bicycle and hold the pesticide tank securely. It should be made of lightweight and durable materials such as aluminium or steel.
4. Install the tank: The pesticide tank should be installed on the frame of the sprayer. The tank should be made of a non-corrosive material such as plastic or stainless steel.
5. Add a pump: A pump should be installed to pressurize the pesticide in the tank. The pump should be capable of generating sufficient pressure to spray the pesticide effectively.
6. Add a nozzle: A nozzle should be installed on the sprayer to control the spray pattern and the amount of pesticide being released. The nozzle should be adjustable so that the spray pattern can be changed to suit different crops and fields.
7. Test the sprayer: Once the sprayer is assembled, it should be tested to ensure that it is working correctly. The sprayer should be tested in a controlled environment before being used in the field.
8. Train the operator: Finally, the operator should be trained on how to use the sprayer safely and effectively. This includes proper handling of the pesticide, as well as how to operate the sprayer while riding the bicycle.

3.1 MECHANISM IMPLEMENTED

Crank and lever mechanism:

A crank and lever mechanism are a simple mechanical device used to convert rotational motion into linear motion. It consists of a lever attached to a rotating shaft or crank. The lever is connected to a rod or other mechanism that moves in a straight line. When the crank rotates, it pushes and pulls the lever, which in turn moves the connected rod in a linear motion. This is the basic principle behind many common machines such as engines, bicycles, and hand-cranked tools. The length of the lever arm, the angle of rotation of the crank, and the position of the connecting rod all affect the amount of force and distance of linear motion produced by the mechanism. Crank and lever mechanisms can be used to generate power or to transmit power between different parts of a machine. They are simple and efficient devices that have been used for centuries in a variety of applications.

When the front wheel rotates and a sprocket which is connected to the front wheel also rotates. it rotates the back sprocket which is connected to shaft with the help of chain drive. crank is connected to shaft as the shaft rotates crank connected to it also rotates. A connecting rod is attached to crank .so as the crank rotates it converts rotary motion into linear motion as connecting rod is connected to pump. During when the connecting rod is at top dead centre the pump sucks the air and during when the connecting rod is at bottom dead centre it pumps pesticides into the nozzles

TABLE 1-THE ESSENTIAL COMPONENTS OF THE SPRAYER

SI NO	Name of the component	Material used	Specifications
1	Frame	Zinc pipes	1250*210*320mm
2	Pesticide tank	Plastic	400*300*150mm Capacity = 16 liters
3	Wheel	Steel	Diameter :650mm
4	Driven sprocket	Steel	Diameter=180mm Teeth = 44
5	Sprocket	Steel	Diameter=80mm Teeth=24
6	Shaft	Mild steel	Diameter =25mm



			Length =300mm
7	Crank	Zinc	Diameter=140mm Thickness = 2mm

Frame- frame which is made up of zinc pipes.

Pesticide tank- A pesticide sprayer tank is a specialized type of container designed to hold and distribute pesticides for agricultural or horticultural use. Pesticide sprayer tanks can be mounted on a variety of equipment, including handheld sprayers, backpack sprayers, and vehicle-mounted sprayers. The tank itself is usually made of plastic or fiberglass and is designed to be lightweight and durable. It may also be equipped with features such as agitation systems to keep the pesticide properly mixed, filters to remove debris from the spray solution, and pressure gauges to monitor the pressure inside the tank.

Pesticide sprayer tanks come in a range of sizes to accommodate different applications, from small tanks that can be carried by hand to large tanks that can hold several hundred gallons of spray solution. Proper maintenance and cleaning of pesticide sprayer tanks is critical to ensure that the pesticide is applied safely and effectively.

Sprocket- A bicycle sprocket is a toothed wheel that is attached to the rear hub of a bicycle and is connected to the chain, which in turn drives the rear wheel. The sprocket is an essential component of the bicycle's drivetrain and is responsible for transmitting power from the pedals to the rear wheel.

The size of the sprockets can also affect the gear ratio and the bike's overall performance. Smaller sprockets provide a higher gear ratio, which is suitable for faster speeds, while larger sprockets offer a lower gear ratio, which is better for climbing hills or riding in challenging terrain.

Shaft- A shaft is a long, cylindrical, rotating component used to transmit power or motion from one location to another. Shafts are commonly found in machines such as engines, gearboxes, and turbines, where they are used to transfer torque or rotational energy from a motor or power source to another component.

Shafts come in a variety of shapes and sizes, depending on their intended application. They can be solid or hollow, and may have a circular, square, or rectangular cross-section. Shafts can be made from a range of materials, including steel, aluminum, and titanium, depending on their intended use and the stresses they will be subjected to.

Crank- Crank it is made up of zinc. The diameter of crank we use was 140mm, and thickness of crank was 2mm. it is located perpendicular to shaft with which it can rotate. It is the most important motion transmitting part. To which connecting rod is attached. So that crank helps to convert rotary motion into linear motion or vice versa. But here rotary motion is converted into linear motion.

Design calculations:

Design of frame:

Length of the frame = 1250mm

Breadth of the frame = 210mm

Height of the frame = 320mm

Selection of chain:

Length of chain = 9600mm

Selection of sprocket:

Number of teeth on pinion= 24

Pitch circle diameter of pinion = 80 mm

Inner diameter of pinion= 48mm

Pitch = number of teeth on pinion/pitch circle diameter=24/48=0.50mm

Selection of large sprocket:

Number of teeth on pinion = 44 mm

Diameter of the sprocket = 180mm

Selection of nozzles:

Diameter of the nozzles = 0.5mm

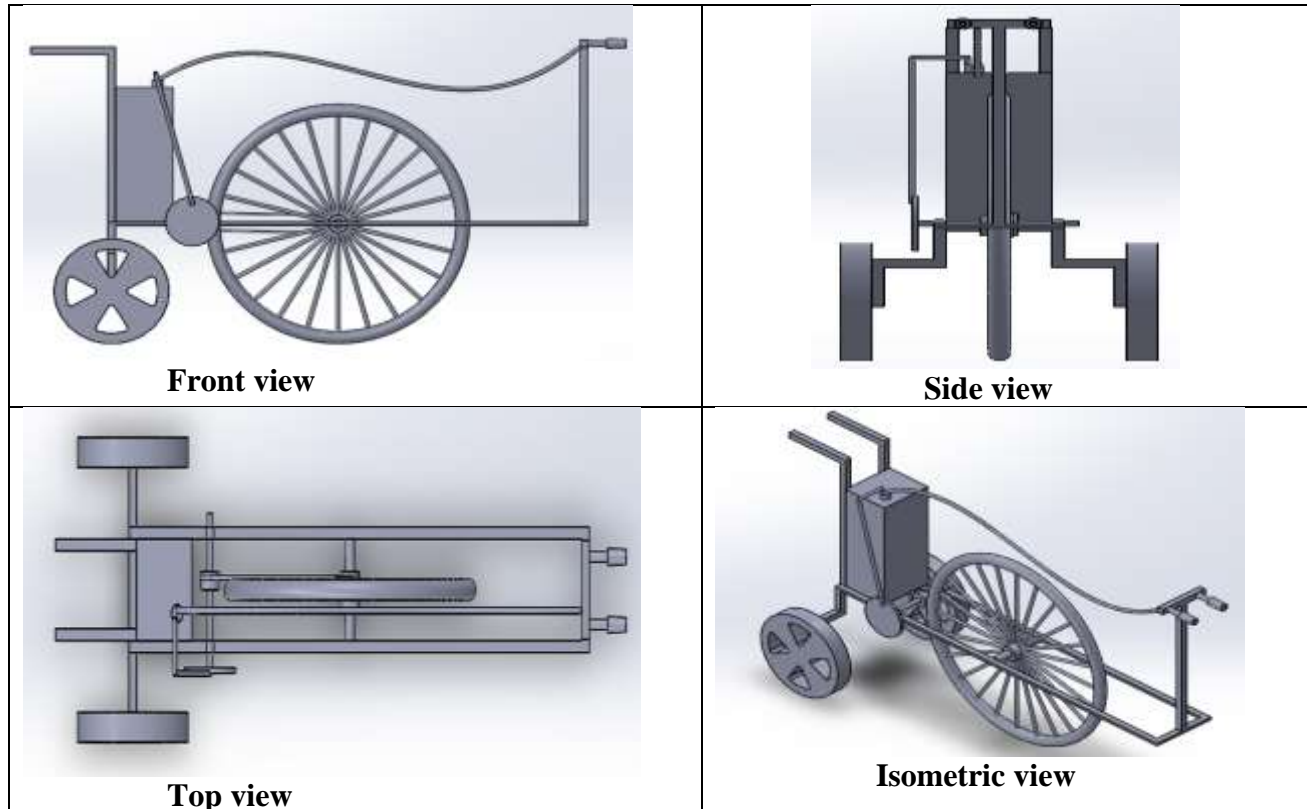


Fig 3.1: 3D Design of agricultural pesticide sprayer different views

4. RESULTS AND DISCUSSION

- 1) The machine which covered 10 cents of area before completing the one tank
- 2) Harvesting of Labour cost:
 Labours required for spraying one acre of land = 3
 The cost of one labour = 500 rupees
 Total cost = 1500
 For spraying of this machine only one person will require there by the cost will decrease.
- 3) Compared to carrying 15 kgs of load on farmers shoulders this machine reduces the load acting on farmers while spraying.
- 4) The machine is mainly use for organic farming.
- 5) During the normal hand pump sprayer, the pesticides fall on the farmers body while using this machine we can avoid that type of actions and we can decrease harmful diseases which effect the farmers health.



Fig 4.1: Final model of the sprayer after assemble

5. CONCLUSION

The major conclusions drawn from the current investigation conducted on designing and fabrication of agricultural spraying machine are as follows:

- The designing and fabrication of a bicycle pesticide sprayer has been carried out successfully for providing effective and efficient solution for small-scale farmers in rural areas. Using readily available materials and simple design principles, the sprayer can be easily assembled and operated by farmers with minimal technical knowledge.
- The design incorporates a bicycle frame as the base, with a tank and pump system attached to it. The sprayer nozzle is adjustable to control the spray pattern and amount, allowing for precise application of pesticides. The use of a bicycle as the power source makes the sprayer environmentally friendly and cost-effective, as it eliminates the need for expensive fuel and maintenance.
- The fabrication process involves the use of simple tools and techniques, making it accessible to local technicians and farmers. Additionally, the design is easily customizable to meet the specific needs and preferences of farmers, making it a versatile solution for a variety of farming applications.
- Overall, the bicycle pesticide sprayer has the potential to greatly improve crop yields and reduce crop losses due to pests and diseases. It also has the added benefit of reducing the environmental impact of traditional pesticide application methods. With its simple design and low cost, it has the potential to greatly benefit small-scale farmers in developing countries and contribute to sustainable agriculture practices.

6. FUTURE SCOPE

There are several design elements that can be changed to improve the vehicle's functioning. increasing tank capacity by including a second tank with a pump. The frame can be built with a thicker gauge of lightweight, robust aluminium alloy. More nozzles can be added to the machine to expand the area that it can cover at any given time. To keep the pressure constant in every nozzle, a second pump might be required.

Some potential areas of development and improvement include:

1. Precision agriculture: The use of technology such as GPS, sensors, and mapping software can help farmers to more accurately target areas that require treatment, reducing the overall amount of pesticides needed and improving crop health.
2. Smart sprayers: These sprayers use sensors and algorithms to adjust the amount of pesticide sprayed based on real-time environmental conditions such as wind speed, temperature, and humidity. This can help reduce pesticide drift and improve efficacy.



3. Reduced-risk pesticides: The development of new, less toxic pesticides that are more targeted and have minimal environmental impact could help reduce the overall use of pesticides while still protecting crops from pests and diseases.

Overall, the future scope of agricultural pesticide sprayers lies in the development of technologies that can help reduce the amount of pesticides used while still maintaining crop yield and quality. This will not only benefit the environment and human health, but also improve the sustainability and profitability of agriculture.

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