

Design and Development of Wheel Operated Pesticide Sprayer

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Abstract: *Small, marginal, medium, and wealthy farmers make up the bulk of India's agricultural population. The manual lever-operated knapsack sprayer's adaptability, affordability, and design make it a popular choice for small-scale farmers. However, there are several drawbacks to this sprayer, such as its inability to sustain the proper pressure, which might result in back strain. Using a manual multi-nozzle pesticide sprayer pump, this study proposes a design for a device that can provide maximum spray output in the shortest amount of time. It is our goal to create a model that is both fuel-free and simple to use. A new mechanical system that addresses all of the aforementioned issues and provides assistance to farmers is something we are working to create.*

I. INTRODUCTION

Agriculture is a major part of the Indian economy. Weeding, reaping, sowing, and harvesting are just a few of the many tasks that are performed in the field. It's not only harvesting that the farmer has to deal with; spraying activities are also necessary for crop protection against disease and insects, which may be accomplished using a variety of pesticides, weedkillers, and fertilisers. Farming experienced a significant revolution fifty years ago. Suppression of agricultural diseases is one of the reasons that have contributed to its growth. 90% of pesticides are applied through spraying, ensuring a little impact on the environment despite increasing pesticide usage in modern agriculture. It is said that switching to modern pumps would put farmers out of business and put their health at risk, whereas using chemical or electrically powered pumps would keep them in business. Pesticides may be applied mechanically using power application equipment as a solution to this problem. Choosing the right pump for the job is critical since pesticides are often used on farms. The equipment should be able to provide the needed water and spray material in an acceptable amount of time. An electric battery or a human pushing a lever may be used to power spray pumps for insecticides. Trolleys with a special mechanism that transforms rotating motion into reciprocating motion are used to drive push-operated spray pumps. This lever allows pesticides to be pushed up to a greater pressure. It takes forever and a lot of effort to spray agricultural pesticides on the field. It is becoming more difficult to find people to run traditional knapsack sprayers, since farm workers are moving to cities. Small farmers with limited land holdings simply cannot afford a tractor-mounted sprayer or a power sprayer, both of which are widely available but prohibitively costly. In agriculture, a pesticide spraying machine is designed to save both time and money. Agricultural fields were treated with pesticides. On order to assure a good harvest, farmers are increasingly depending on pesticides in their fields. Chemicals that enhance the effectiveness of pesticide sprays are known as agrincinal spray adjuvants.

1.1 Problem Statement

Conventional and contemporary techniques of fertilising a field are available. The sprayer is traditionally carried on the shoulder of the person using it. Using the old method requires a significant amount of human work and labour. It will be more costly since it takes longer to apply and requires a lot of energy to fertilise. We use tractor-mounted fertiliser sprayers in the modern fashion, but they are costly and need a large area to be efficient, so not everyone can afford them. Trying to lift big items with one's hands is a challenge. Fatigue of the operator due to heavy lifting. The heavy spray reduces the operator's productivity since it exhausts him. A user's experience is hampered by huge pumps. Inadequate equipment selection and shoddy workmanship Combined with a lack of understanding about the technical features of equipment and poor field use, these issues have resulted in unacceptable environmental and human health concerns.



1.2 Objectives

Aside from the fact that utilising the device reduces the user's back and shoulder pain while they are using it, it also needs a lot less human effort and hence requires less labour.

As a consequence of the constant pumping action for creating pressure inside the pesticide sprayer, the user's fatigue load is minimised, consequently making the environment more pleasant for the user.

1.3 Concept Generation and Selection

Different PDS considerations such as functionality, safety, and affordability led to the production of five ideas. Final idea chosen, functional prototype model constructed. Links connect the various components of this design, such as the hydraulic pump and lever, to the crack. New mechanisms may be tested in an existing tank of 10-16 litres

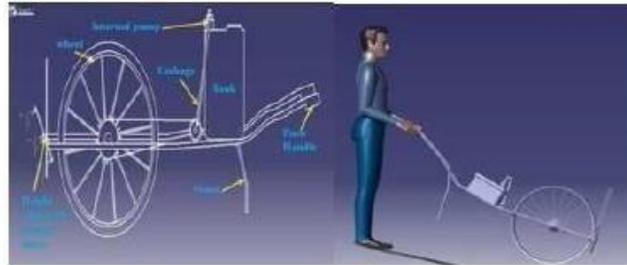


Fig. 1.3.1 Concept 1

1.3.2 Concept 2

This idea aims to alleviate common complaints of back and shoulder discomfort. According to Fig. 2, the two support wheels on the height-adjustable stand allow it to be readily pulled forward for use.



Fig.1.4.2 concept 2

1.4.3 Concept 3

The type frame design in Concept 3 is a step forward. Fig. 3 shows how the sprayer pump tank capacity has been increased to 30 litres to cover a larger area and save time.

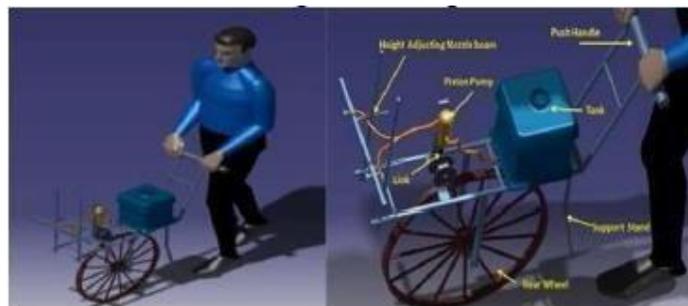


Fig.1.4.3 concept 3



1.4.4 Concept 4

To improve the product's visual appeal, Concept 4 incorporates a new frame design and an adjustable height support stand, as seen in Fig. 4.

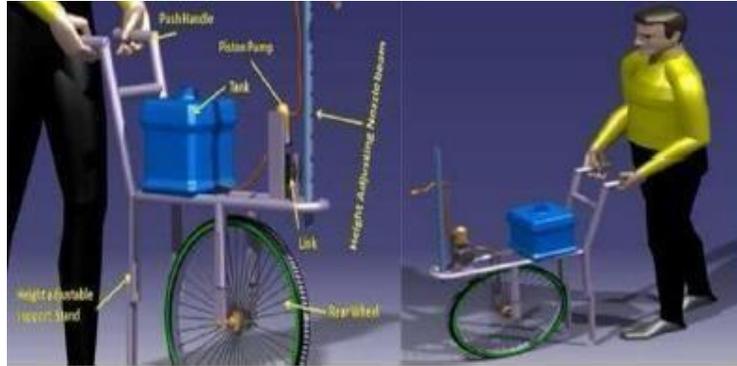


Fig.1.4.4 concept 4

1.4.5 Concept 5

Concept 5 resembles Concept 4 in appearance, but it has two little wheels that make it easier to move about. Spraying is made simple for crops of any height thanks to the adjustable height support platform illustrated in Figure 5. Using this device, pesticides may be sprayed on numerous rows of plants at once, saving time and labour.



II. LITERATURE REVIEW

Injecting concentrated pesticides at the individual nozzles may be a viable option to shortening the time it takes for the concentrated pesticides to reach the nozzles. An injection device with a direct nozzle was developed to overcome earlier researchers' concerns about concentration fluctuation. Injection sprayer designs may be compared using simulations to see how accurate the chemical application is. Reduced fluid line diameter at the spray boom ends enhanced overall application accuracy, they discovered. An autonomous mobile robot for the management of pests and the prevention of disease in commercial greenhouses. During this time, they work on the robot platform's capacity to properly traverse through rows of a greenhouse while the pesticide-spraying system efficiently covers the plants with spray in the prescribed quantities. Robots and automated systems have mostly been used in the commercial sector to replace human manual labour in order to improve efficiency, accuracy, uniformity, and cost effectiveness. The most popular non-positive displacement pump is the centrifugal pump, which is being developed at the University of Nairobi. Pressure has an effect on the pump's output. Large amounts of liquid may be delivered at low pressures with this pump. The throttling valve is a critical part of the centrifugal pump. The centrifugal pump requires a manual throttling valve on the main output line. In many cases, mechanical tillage has been substituted by the application of herbicides. Chemicals may be applied to tillage equipment and seeders using attachments, or they can be applied using single-purpose chemicals. About 75% of India's population is directly or indirectly reliant on agriculture, making it a largely agricultural nation. Seed planting, spraying, weeding and other activities are all carried out using the same methods and equipment that farmers have been using for a very long time. With the goal of boosting

production, new spraying machines must be developed. Late-developing Asian nations are plagued by large populations and poor land productivity relative to their industrialised counterparts, particularly in China and India. Low levels of agricultural automation and inadequate electricity supply are two of the primary causes of reduced production. With a view to maximising human, animal, and other power sources, governments have implemented a selective mechanisation programme for agricultural equipment and machinery. Better animal-driven tools and improved irrigation pumps and tractors are both being produced and made more widely available to fulfil demand in order to accomplish the goals of meeting those goals. More than 70% of farmers fell into the small and marginal category, therefore this was given particular attention. Injecting concentrated pesticides at the individual nozzles may be a viable option to shortening the time it takes for the concentrated pesticides to reach the nozzles. The creation of a direct injection method that does not suffer from the concentration fluctuation issues that have plagued earlier studies. Injection sprayer designs may be compared using simulations to see how accurate the chemical application is. Reduced fluid line diameter at the spray boom ends enhanced overall application accuracy, they discovered. An autonomous mobile robot for the management of pests and the prevention of disease in commercial greenhouses. During this time, they work on the robot platform's capacity to properly traverse through rows of a greenhouse while the pesticide-spraying system efficiently covers the plants with spray in the prescribed quantities. Sophisticated sensing and manipulating technology may allow for precise autonomous operations that might increase agricultural yields as well as quality while cutting energy use, decreasing personnel, and making farming more ecologically friendly. Human civilization cannot function without agriculture. Agriculture has always played an important role in many nations' religious traditions, but in the holy book of Al-Quran, agriculture is mentioned many times throughout the verses. According to Imam Nawawi in his book Kitab Sahih, agriculture is the highest kind of human labour. The author of this study, D.A. Mada, Sunday Mahai, [2013], illustrates the significance of automation in agriculture with specific instances. The paper's conclusion was that a pre- and post-harvesting multipurpose single axle vehicle was required. Research and development of our multipurpose agricultural vehicle is based on this. F.A. Adamu, B. G. Jahun, and B. Babangida are the three men responsible for the coup. [2014] In this research, the writers focus on the power tiller's performance. The most common request was for a power tiller that was both lightweight and portable. In this context, we'll also talk about things like fuel economy and available field capacity. It is our goal to build a versatile agricultural vehicle that is environmentally friendly and efficient. Authors: P. aec, O. Therefore, in the instance of farmer and Köckerling, the lowest values of soil penetration resistance were established using cultivators equipped with chisel shares. For embedding plant wastes, cultivators like Väderstad Top down 400 and Farmer Turbulent 450 performed well. Our study is based on these findings. Satya Prakash Kumar Brajesh Naresh Tewari [2012] The author of this study has conducted a case study on agricultural mechanisation in West Bengal, which is a part of India and so provides a clear picture on the availability and advancement of such technology across the country of India. For us, this allowed us to take the proper steps in comparison to our existing actions. R.D. Dhete has worked on "Agricultural fertiliser & pesticide sprayers". In his research, he focuses on the use of various spraying devices. As India's population grows, agricultural modernisation is becoming more necessary in order to meet the country's growing need for food. The fertility of the soil is declining as a result of the use of chemical fertilisers. Because of this, organic farming has gained popularity among farmers. Spraying devices that use automation distribute fertiliser and pesticide evenly over the field and limit waste, preventing losses and waste of input supplied to the farm. As a result, manufacturing costs will be reduced. It will lower manufacturing costs. Mechanization boosts production while using a fraction of the resources. Traditional techniques for applying pesticides and fertilisers are still being used by farmers. Many things haven't changed much throughout the years. Industrial sectors have grown significantly in India, whilst agricultural ones have remained mostly unchanged. Traditionally, fertiliser is sprayed by hand by labourers using a backpack sprayer. Farmers on smaller plots of land must put in more work, but it pays off in the long run. There were six people involved in the "Design Fabrication of Agricultural Sprayers, Weed with Cutter" project: Pavan B. Wayzode, Sagar R. Umale; Rajat R; Nikam; D; Khadke; Hemant. Crop disease, pests, and weeds may all be controlled with the use of chemicals. Pesticides are only effective if they are administered in a timely manner. The cost of the chemicals is high. As a result, specialised application equipment is a must. Chemicals are often applied with the use of dusters and sprayers. Simple equipment and portable apparatus are needed most often for dusting, a less complex way of applying chemical. However, due of the poor dust retention, it is less efficient than using a sprayer. A wheel and pedal-powered sprayer has been presented in this study, which is a lightweight, fuel-free device that sprays pesticide by rotating the wheel and pedalling the apparatus. This spraying apparatus makes use of a reciprocating pump and an accumulator to maintain the pressure required for



spraying. Because this pesticide sprayer has a wheeled design, it takes less time and prevents the pesticide coming into direct touch with the person spraying it. Weed control is one of the most time-consuming aspects of farming. Weeding by hand is impractical due to the high cost of labour, the length of time it takes, and the environmental impact it has. Weeding without the use of electricity is thus a goal of research and development for efficient farm equipment. New Zealand depends substantially on its agricultural sector, according to research provided by Massey University New Zealand on flow management of agricultural spraying equipment. Pastoral farming, in which cattle are grown to graze on pasture, accounts for a significant share of this business. This includes the production of meat, sheep, and milk. In this kind of farming, preserving the condition of the pasture is critical. Fertilizers are often sprayed on pastures in an effort to boost growth. Meat and milk producers will benefit from the higher yields. As a result, water quality is deteriorating due to the growing use of fertiliser. When it comes to managing fertiliser usage, it is apparent that control over the application will become more vital. Metal from Dannevirke in New Zealand has created and produced a line of fertiliser equipment called the Tow and Fort. In addition to soluble and non-soluble fertilisers, the Tow and Fort ranges are capable of spraying a broad variety of fertilisers. Spraying fertiliser slurries with mixing ratios of up to three parts fine particle fertiliser to one part water is a unique feature of the Tow and fret. Using a recirculating system, this is possible. Currently, the machines' flow rate is almost uncontrollable, and the application rate is solely dependent on the operator's pace. Design and install a flow control system for the Tow and fret product line and research the effects of altering flow rate on spray characteristics are the goals of this thesis. For many applications, it is quite difficult to spray several fluids, especially when those fluids have such disparate characteristics. A low-cost ultrasonic sensor (TUF2000M) was fitted and tested as an alternative to more expensive flow metres. It was decided to switch to a turbine flow metre after the ultrasonic sensor's limited performance. According to PID control, the controller was capable of maintaining flow rates between 10 and 25 L/min, depending on the nozzle placed.

Actual Prototype

Prototypes are designed and built much like our miniature model. Chain sprocket set from Honda cb shine cars, knap stock pump or hand pump, and 3 way nozzle connection are used in this project. Our frame is built to withstand the weight of the load it is designed to support. With the assistance of a pillow block, we attached a colourful bar or axel to the frame. Mounting that aids in the rotation of the shaft while also supporting it is known as a "pillow block." It consists of bearings that rotate the axel. Once this is done, we'll attach the chain driver sprocket to the axel. With the assistance of a chain, this sprocket connects to the driven sprocket on the secondary shaft. The driving sprocket has a crank mechanism installed immediately on one side of it. A precise ratio of driving and driven sprockets that provides a certain stroke period each revolution. This reciprocating motion is provided to the pump's piston mechanism by a system that connects the rods of its piston mechanism to the crank mechanism. We use a pair of 16-liter hand pumps operated by a single hand. After the pump is empty, we design it so that we can easily remove it from its base. This pump's discharge may be divided into three separate outputs thanks to the inclusion of a 3-way nozzle. Connected to a supporting road are those nozzles. This may be helpful by directing the nozzles' flow. To accommodate a variety of plant sizes, we've included five distinct heights in this project. Basically, this is how our pesticide sprayer works.



Fig.3.2 wheel operated pesticides sprayer

Working Principal

To begin, a chain- and crank-driven device is used. In order for the wheel axle to rotate in tandem with the driving chain sprocket, it is attached to the sprocket on that sprocket. A driven chain is attached to the driver chain on the crankshaft. As a consequence, when the crank is turned, it rotates. The crankshaft crank is connected to the lever mechanism of the pump through a chain in order to activate the sprayers.

III. CONCLUSION

When it comes to design, there is no such thing as a one-size-fits-all solution. There are several ways in which user input and user assessment may be used for new product development and design enhancements.

Finally, we are pleased to state that the mechanical aptitude calculations were very useful for agricultural pesticide sprayer, which is designed to save human effort and is being used in agriculture fields by spray pesticide by farmer mo. Farming is a labor-intensive endeavour, and this technology is designed to make it easier. It may be used for spraying at a low cost to farmers, making it one of the many products they can afford. Because of this, we will be able to cover more ground in less time and decrease operator fatigue, as opposed to using only one sprayer. The most significant effect of this new product development project is as follows:

Design and development of a functional working prototype of a mobile pesticide sprayer.

When utilising the pesticide sprayer, there is less back and shoulder strain.

Product costs may be reduced if mass manufacturing is taken into account.

By spraying insecticide over numerous rows of plants at once, this device saves time and work for the gardener.

A final idea was picked and developed to meet the needs of the users after it was tested with the viewers and their input was gathered.

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