

Design and Development of Multipurpose Pesticides Sprinkler and Fertilizer Spreader Machine

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Abstract— In the Indian economy, agriculture holds a dominant position. Due to changes in climate and inflation of the insects, pests, etc. it is vital to protect the crop by getting rotten and damaged by insects using pesticides and fertilizers. The main objective of this project is to help the farmers by reducing their efforts and enhance operation speed. Pesticide sprayer pump mounted on a frame with a wheel which is operated mechanically without using any external source of energy. After completing spraying the pump is removed and replaced by fertilizer spreader. It is a multipurpose model that is efficient in operation. The advancement of this concept prevents the defects of the pump being used conventionally. The farmer has to carry the pesticide in the pump and then spraying which is another rigorous task to be completed. One hand is continuously busy operating the handle and the farmers don't take enough precautions which result in fatal diseases because of direct contact with the chemicals. As spraying of pesticides and spreading of fertilizers cannot be done simultaneously, hence by introducing a detachable setup, the farmer will just have to pull the cart with easy operation.

Keywords—Economy, GDP, Pesticide Spraying Machine, Fertilizers, pump, Slider crank mechanism.

I. INTRODUCTION

Agriculture is the primary source of the livelihood for about 60 percent of the total population of India. The agriculture is the backbone of India and contributes 16 to 17% for GDP and total value contribute by agriculture, fishing and forestry is estimated at Rs.8.53 trillion (US\$ 271.00 billion) in FY18.^[10]

In 21st century, Indian farmers are still using the same traditional methods and equipment. Operations like seed sowing, Fertilizer, and pesticide spraying, cultivation are done with the traditional methods^[9]. As the pests and insects now a

days have been growing up throughout the crops and due to changes in climate, it becomes necessary for the farmers to spray pesticides and Insecticides frequently to protect their crops from getting rotten and consumed by insects. Pesticides spraying and fertilizers spreading is an important and tedious task for farmers, and for a large scale, this activity is lengthy also it needs more workers. In the conventional method of spraying and spreading we get results such as serious back pain, continuous hand movement, fewer speed efficiencies and uneven quantity over the crops, as the whole weight of the pesticides and fertilizer have to take up by the worker, it is very monotonous job. Such operation solves the problems which are responsible for low production. It gets high productivity so that the cost of production will be reduced. Usually, spray pump work on manpower (by actuating lever) or electrical battery operated for spraying pesticides. In this project, we use sprocket and chain for motion transmission with a single wheel mounted on the frame. In the suggested model, slider-crank mechanism is used to convert rotary motion into a reciprocating motion for spraying and spreading. The connecting rod (lever) is used to transfer rotary motion from sprocket to pump and spreader. This lever operates the pump by increasing the pressure and pesticides will be sprayed. The arrangement designed in the hopper of the spreader unit maintains the quantity of the Fertilizer (urea) content. Small lifting and pushing force make it easy to use.

II. LITERATURE REVIEW

Minimizing the human efforts at optimum cost has been a task for many years for agricultural equipment producers and engineers. Many attempts have been made to lower the human efforts on various agricultural operations. Some of the recent

Modern technology to achieve the level of comfort but cost concern is more. The factor which controls pesticide and fertilizer quantity are control, pressure and velocity at output, rpm of wheel, rolling resistance of the field, mechanism and weight on the wheels. Most of the projects are based on slider crank mechanism, belt and pulley or motor for motion. The multipurpose pesticides spraying machine is, use of solar energy i.e. using non-conventional sources for charging the batteries for driving the pump. The same energy has been used for driving the machine. Though it is a one-time investment and decreases operational and labour cost but increases the maintenance and individual parts cost. The space requirement is more which makes this equipment not preferable where the space between the two lines of the crop is less [1]. When the equipment is push forward by using handles, front wheel rotates and the gear is mounted at the axle of wheel. Wheel rotates and its rotation is then transferred to the pinion through the chain drive. The rotary motion of the pinion is converted into the reciprocating motion by the single slider crank mechanism, due to this arrangement the connecting rod moves upward and downward which then reciprocates the piston of the pump mounted at the top of storage tank, in this way spraying is done. The fertilizer is stored in spreader and the fertilizer is controlled by using clutch mechanism in multiple lines of crops. Combine assembly for both applications makes the equipment look bigger compared to space [6] available between two consecutive crops [2]. A machine is developed which will be beneficial to the farmer for the spraying and weeding operations. This is done by using reciprocating pump for spraying mechanism and ploughing tool for weeding mechanism. The equipment is purposely design for the farmers having small farming land say 5-6 acre. It is suitable for spraying as well as weeding at minimum cost for the farmer so that farmer can afford it. The equipment will result more beneficial when it is subjected to moist soil for weeding purpose, due to moist soil the weed cutter can easily penetrate and dig out the soil and hence will easily accomplished the weeding process [3]. Spraying of fertilizer is accomplished by the help of a storage tank in which pump is submerged to pump out the liquid by a multiple nozzle attached via a pipe. Since seeds and fertilizers are placed in a sowing box over wastage of the same is eliminated, thus it will reduce the cost in planting. [4]

III. THEORY

The design of multipurpose manually operated pesticides sprinkler and fertilizer spreader [5] consists of an MS frame as it requires strong structure which can hold all components for above application. For selection of structure of frame, we can either use MS or Aluminium. Although MS is much preferable due to its low cost considerations and the process of

fabrication. While idealizing the wheel we have considered the rolling friction of the tyre as well. Since the rolling friction acts only when the wheel is about to rotate and hence to overcome these friction another force is required which is given by the user and the rolling friction is small as compared to the force exerted [7][11]. Further there is less difference in pressure at input and output of nozzle and so we have used mist type of diverging nozzle covering wide area [12]. Research done till now was focusing on automatic sprayers using motors or heavy equipment's so to reduce the cost for farmers who holds less area of crop fields we have used sprocket chain mechanism instead of gear or belt. As the belt requires when power is to be transferred over a large distance on the other side gear requires less distance.

IV. WORKING PRINCIPAL

The whole mechanism is mechanically operated. It includes standard bicycle wheel. It is attached to the chain and sprocket mechanism which transmits rotation motion of the wheel to rear sprocket with the ratio of approximately 2:1 and this mechanism acts like single slider crank mechanism. This mechanism is the link between the pump and wheel. As we push the whole assembly manually the rotary motion is transmitted to the sprocket through sprocket and chain mechanism. The connecting rod is the link between pistons of pumps and rear sprocket. Now as the rear sprocket rotates the connecting rod having oscillatory motion and it will convert full rotary motion to the reciprocating motion which is desirable. Connecting rod is attached to the piston of knapsack pump which reciprocates in up and down direction. When the piston moves up it sucks the liquid from the pump and when comes down it discharges the high pressurized liquid towards nozzle via the flexible pipe provided for spraying. The pesticides coming out from the nozzle will be in form of mist form and sprayed on the crops. As the setup is having multipurpose outcomes, we can remove the sprayer pump from the current attachment and it will be replaced with fertilizer spreader. We can mount the spreader on the main frame and similar type of arrangement has been provided for its functioning. We have hopper for storing the fertilizer as per our requirements and the arrangement is done so that fertilizer will flow downwards with the help of gravity. After reaching second compartment of the mechanism there is rotating elements having half covered spherical bowls which is rotated with help of similar connecting rod mechanism as we used for pesticides sprayer. These spherical bowls are arranged at 180° apart because of that we get the intermittent supply of the fertilizer and they can be tuned according to the distance between the crops. This supply of fertilizer is transmitted with the help of flexible pipes towards the stems of the crop [8].

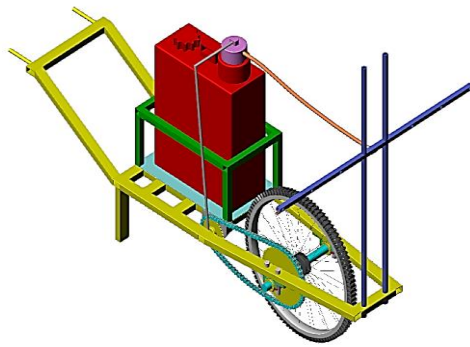


Figure 1

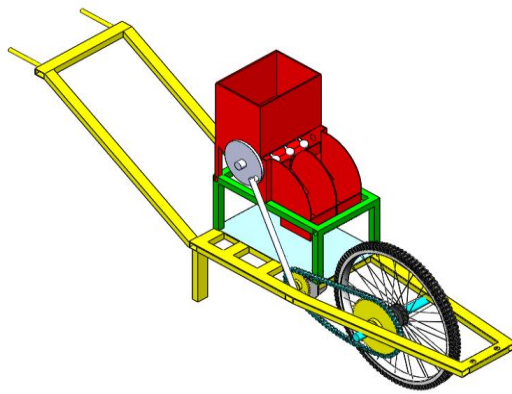


Figure 2

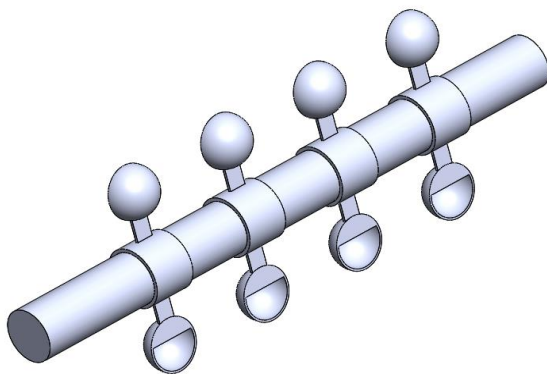


Figure 3

Table 1. COMPONENT DETAILS

Sr. No.	Name of the part	Material	Quantity/Size
1	Square Tube	Mild steel	10 Meter / 45*25 mm
2	Flexible pipe	Plastic	04 Meters / Dia.30 mm
3	Roller chain	Alloy steel	3 Meters / 3/8 inch
4	Nut & bolts	Stainless steel	20 / M16
5	Driver Sprocket	Steel	01 / 44 teeth
6	Driven Sprocket	Steel	01 / 28 teeth
7	Wheel unit	Standard	01 / 24 inch
8	Fertilizer Spreader unit	M.S.	01 / 12.5 kg
9	Pump	Plastic	01 / 15 Lit.
10	Nozzle	Brass	04
11	Pedestal bearing	Standard	02 / UCP 206

V. CONCLUSION

This project satisfies the need of economically weak farmers for pesticides spraying and fertilizers spreading in a single set up whenever needed. The uniformity in the quantity of the content is achieved by metering mechanism. This design reduces the maintenance, human efforts, cost as well as manpower. As very less effort required at actual field for this Two in one and compact design makes it user efficient at comfortable level.

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