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Design and Fabrication of Spraying Fertilizers and Pesticides Machine for Agriculture

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A B S T R A C T

The management of pest insects is the critical component of agricultural production especially in the fertigation-based farm. Although the fertigation farm in Malaysia has advantages in the fertilization and irrigation management system, it still lacking with the pest management system. Since almost the insect and pests are living under the crop's leaves, it is difficult and hard labour work to spray under the leaves of the crop. India is the agriculturally based country majority of its population depend on agriculture, where more than 60%-70% of population is depending on agricultural, at present time farmers are using motorized sprayer which requires different types of fuels, batteries and solar panels, Accordingly we have decided to make our project on sprayer which works without any fuel mechanism and by using crank and slotter quick return mechanism. The main drawn back of hand operated spray pump is that the user cannot use it for more than 5-6 hours continuously as it gets heat whereas fuel operated spray pump requires fuel which is expensive and a variability of fuel is not easy at rural places, In such situation we should think to move towards non-conventional energy. This review paper tries to develop new mechanical system which will overcome all the above problems and help farmers etc.

Keywords: Pesticide Spraying Machine, Fertilizers, pump, Slider crank mechanism**,** Pump, Spray etc

1. Introduction

Present day in agriculture the sprayers play an important role in spraying pesticides. Although sprayers varies like motorized, hand operated and in helicopter. The current idea on sprayer in our project is to utilize effectively, the weight of man which is wasted while moving to the field. In the conventional sprayer one has to use left hand or right hand or both the hands to give pressure. In this project an attempt is made to use the gravitational force (weight) of a person (farmer) which is wasted while walking in the field. So we made an energy saving device, which can also be used by a handless person. 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. As the pests and insects now, a day 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.

2. Objective:

To remove the weight carried by the farmer on the back while spraying pesticides.

- Increase the efficiency of the sprayer by introducing a second nozzle for the same input pressure.
- To increase the region covered per unit time.
- To reduce the effort and time taken for spraying the whole field.

- To introduce a mechanism to dispense fertilizers.
- To be able to spray pesticides as well as dispense fertilizers simultaneously if necessary.
- To be used for multiple types of crops.
- Economically available for small-scale farmers and cultivators.

3. LITERATURE REVIEW

Chemicals are widely used for controlling disease, insects and weeds in the crops. They are able to save a crop from pest attack only when applied in time. The chemicals are costly. Therefore, equipment for uniform and effective application is essential Dusters and sprayers are generally used for applying chemicals. Dusting, the simpler method of applying chemical, is best suited to portable machinery and it usually requires simple equipment. But it is less efficient than spraying, because of the low retention of the dust. In this work we have proposed equipment that is wheel and pedal operated sprayer, it is a portable device and no need of any fuel to operate, which is easy to move and sprays the pesticide by moving the wheel and also peddling the equipment. In this equipment using reciprocating pump and there is a accumulator provided for the continuous flows of liquid to create necessary pressure for the spraying action. This wheel operated pesticide spray equipment consumes less time and avoids the pesticide from coming from front of the nozzles which will in contact of the person who sprays pesticides. New Zealand relies heavily on its agricultural industry. A large portion of this industry is pastoral farming, where livestock are raised to graze on pasture. This includes beef, sheep and dairy farming. An important aspect of this style of farming is maintaining pasture quality. In order to increase growth fertilisers are often applied to the pastures. This increase yields in both meat and milk production. However, the increased application of fertiliser is linked with diminishing water quality. While the effects of nitrogen leaching and the best ways to manage fertiliser use are still being investigated, it is clear that control over the application will become more and more important. The Tow and Fert is a range of fertiliser machines designed and built in New Zealand by Metal form Dannevirke. The Tow and Fert range is capable of spraying a wide range of fertilisers including soluble and non- soluble fertilisers. The Tow and Fert is unique in its ability to spray fertiliser slurries consisting of mixture ratios of up to three-part fine particle fertiliser to one-part water. This is achieved by the use of a recirculating system.

4. METHODOLOGY

1. Define Objectives and Scope
2. Literature Review
3. Market Analysis
4. User Requirements and Stakeholder Analysis
5. Prototyping
6. Engineering and Technical Design
7. Testing and Validation
8. Data Collection and Analysis
9. Optimization and Iteration
10. Regulatory Compliance and Standards
11. Documentation
12. Cost-Benefit Analysis
13. Implementation and Deployment Monitoring and Maintenance

5. SELECTION OF MATERIAL

The selection of materials for an agriculture sprayer pump is crucial for ensuring durability, reliability, and efficiency. The following factors should be considered when selecting materials for the components:

• Chemical Compatibility: The materials must be compatible with the chemicals used in the sprayer pump.

• Mechanical Strength: The materials must be strong enough to withstand the forces generated by the pump's operation.

• Weight: The materials used must be lightweight to ensure that the pump is portable and easy to move around in the field.

• Cost: The cost of the materials used in the pump must be considered to ensure that the final product is cost-effective.

6. WORKING PRINCIPLE

When we push the sprayer trolley, work made by the wheels gets transmitted first to the cam and then to follower link, due to which the piston reciprocates and starts building pressure. Power is getting transferred to the piston, at the same time a coulter comes into action and its flaps starting their function. As the time passes, a strong pressure gets developed inside the cylinder as accumulator helps it in doing the process. As the pressure gets developed, nozzles start acting and they initiate spraying. During this time, a connecting link from coulter also moves its flaps rapidly and soil is taken to the roots of plants of the work or suggest applications and extensions.

Fig. Wheel Pump Schematic View

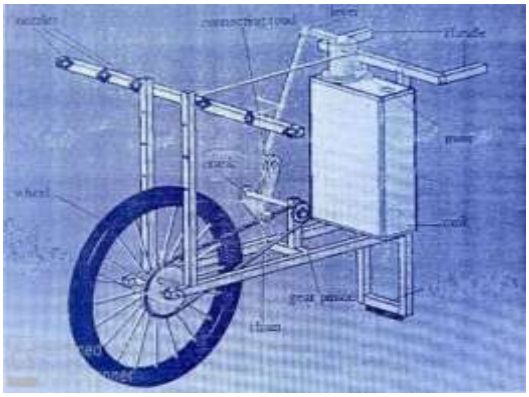

Fig. Fabricated View

7. DESIGN CALCULATIONS

1) Distance covered by one rotation of wheel = =1256.6mm

2) Time required for 1 ft distance = 4.1/3= 1.37 sec

3) No. of nozzles = 2

4) Pressure = 1 to 3 bar (14.5-43.5 psi)

5) Area covered by each nozzle approximate 1.5 m2

6) Total Tractive Force = 6.67+0+1.6=8.2 N

7) Force required to drive the system = 8.3 N

8) Torque = FR* distance = 9*.2 = 1.8Nm

9) Pressure = 2 bar

10) Force =565.4 N

11) Capacity of the hopper = 8kg

12) Mass of fertilizer inn each slot = 8 g A.

Power transmission

1) Sprocket diameter d1 = 180 mm

2) No of teeth, Z1 =45

3) Speed, N1 = 20 rpm (assumed)

4) Diameter of pinion, d2 = 60 mm

5) No of teeth, Z2= 18

6) Gear ratio, I = Z2 /Z1 = 0.4

7) Speed of pinion =N1 / I = 50 rpm

8) Pitch of sprocket, p = D sin(180/Z) = 125mm

9) Velocity of chain = ZPN /60*103 =1.5 m/s B.

Pump calculation

1) Diameter of pump, D1= 60 mm

2) Area of the piston, A = 2.827*10-3 mm

3) Diameter of crank, D2=80mm

4) Diameter of piston rod, d =20mm

5) Stroke length, L= 2r = 80mm

6) Rotation of crank shaft, N = 50 rpm**.**

8. CONCLUSIONS

The suggested model has removed the problem of back pain, since there is no need to carry the tank on the backbone and solder.

- More no. of nozzle which cover maximum area of spray in minimum time at maximum rate.
- Proper adjustment facility in the model with respect to crop helps to avoid excessive use of pesticides which result into less pollution.
- Imported hollow cone nozzle should be used in the field for the better performance.
- Muscular problem are remove and there is no need to operate lever.

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