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Design and Fabrication of Dual Power Sprayer

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Abstract

Abstract. The world's population is growing rapidly. Food production must be increased in order to meet their dietary needs, but this must come at a cost that is affordable to everyone. Agriculture was the main source of food for the population. All agricultural equipment is rarely modernized due to its low productivity. In India, farming is done by traditional means, in addition to the large-scale development of the industrial and service sectors compared to the agricultural sector. There will be a lot of field work in the agriculture sector, such as weeding, weeding, sowing, spraying, etc. Apart from this spraying operation, the farmers play a vital role in the agricultural process of protecting the crop. Traditionally, the spraying of pesticides and insecticides is carried out by farm workers carrying backpack sprayers that require more human effort. Attention is paid to these important problems and an attempt is made to develop equipment that will be of benefit to the farmer in spraying operations. As we know, there were different types of agricultural sprayers like backpa. Because there is a lot of solar energy available in nature. So we will use solar energy in agricultural sprayers with the help of solar panels. Farmers face the problem of large area coverage in a short period of time. In this project work, we will manufacture a multiple power supply of fertilizer sprayer. And this manufactured equipment will cover the maximum area during spraying.

Keywords: ***Solar panel, sprayer, Gear Mechanism, Nozzle, Spraying pipe***

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 Asian nations are at a developing stage and face the problem of a high population and, compared to developed nations, agricultural productivity is much lower. India is one of the nations facing the same problem. This is due to low farm level, poor farm availability of power and poor farm mechanization.[1-5]

Generally, farmers use the traditional way of spraying backpacks and spraying crops, making them time-consuming, costly and human fatigue is a major concern. Sprayers play an important role in spraying pesticides today in agriculture. Although sprayers vary as if they were motorized, hand operated. Pesticide spraying is an important process in agriculture. Nowadays, many types of pesticide sprayers are already on the market. For different types of pesticide sprayers, there are different shapes, sizes, method of carrying them, but the function is the same thing. The current idea for sprayers in our project is to use them

efficiently. Reduce spraying work, human effort and sprinkling costs.[6-9]

1.1 Plant safety equipment type Hydraulic Energy (SPRAYER)

Operated manually

1. Slide pumps, syringes
2. Pumps for Stirrup
3. Cutting sack or slung:

• K.S. run by Lever. Piston style pump sprayer
• Pump style diaphragm

4. Sprinkler of compression

• Hand sprayer compression.
• Classic style.
• Method of maintenance of pressure

5. Stationary type

• Sprinkler powered by Foot
• Sprinkler

Strengthened

1. High pressure (hand-carrying type) sprayer.
2. Sprinkler installed / trailed.
3. Sprinkler with high pressure knap bag.
4. Fixed wing, plane spraying (helicopter).

Manually controlled SPRAYERS (Gaseous Energy).

1. Form of hand held
2. Form of hand / stretcher
3. Mounted tractor

Strengthened

1. Motorized form knap sack

Centrifugal energy SPRAYERS (Centric energy)

1. ULV sprayer hand held pump.
2. Motorized style knapsack
3. ULV sprayer mounted on the tractor / vehicle
4. ULV sprayer for aircraft

OTHER SPRAYERS

1. Aerosol sprayers
2. Liquefied-gas type dispensers
3. Fogging machines
4. Exhaust Nozzle Sprayer

2. Literature Survey

India is an agricultural country most of the population depends on agriculture. India has a problem with a high population and a low level of land productivity, a low level of farm mechanization, a lack of availability of power compared to developed nations. Even average landholders in Japan are using proper mechanization for agriculture, which has led to great success in increasing crop productivity. But small-scale mechanization in India is difficult even though steps have been taken to increase the availability of power-operated machines, combine harvesters, power planters, irrigation pumps, solar pumps, dripping systems, etc. In the agricultural sector, the use of cheap and beneficial equipment for effective weeding and spraying to increase productivity is very important for a better contribution to India's GDP. The principles of trolley motion which transmits its rotary motion from chain and sprocket arrangement and reciprocating piston to the pesticide pumping cylinder used for manually operated applications. There are some problems with the modern sprayer as it has to be forced up and down into the liver to create a spray strain. The petroleum sprayer also has trouble buying fuel which raises sprayer running costs; it causes more vibration and noise, disturbing farmers and rejecting such work repeatedly. We also introduced a wheel-mounted sprayer, the portable system that doesn't need to run a fuel that is quickly moving and sprays the pesticide with the wheel to solve those obstacles. The Building comprises the reciprocating pump and the nozzles which were connected to the front end of the spraying equipment. In order to match the pressure to low and heavy, special adjustments are made by adjustment of the nut. This machine is also used to weed. For a more productive contribution to Indian GDP it is very important in the agricultural sector to use cheap and useful equipment for efficient weeding and spraying to increase productivity.[10-14]

3. Spraying technique

The method of spraying pesticides is very popular and effective. By mixing the water with the pesticide formulation in the correct volume, the spray solution is prepared. The hydraulic balls of this distilled mixture are sprayed. Spray is normally carried out to the point where the leaves are falling. This system employs a significant amount of spray oil. The volume is typically 300-500 L / hectare. The spray strength is not always firm. Much depends on the amount of sprinkler required.e.g. Spray capacity, characteristics of the

nozzle, stage of crop growth, type of crop, etc. There is a variety of high-volume sprayers available on the market. Almost all types of high-volume sprayers have some kind of pump to supply pressurized spray liquid to the hydraulic nozzle, which breaks the liquid into spray droplets and throws the spray away from it. High-volume sprayers are either manually operated or power operated.[15-17].

3.1 Objectives

- To cover maximum area in minimum time and at maximum rate.
- Work reliability under different working conditions.
- Decrease the cost of machine.
- Decrease labour cost by using the advanced spraying method.
- To use the Machine in small as well as in large crop area.
- To utilize renewable energy sources for the purpose of pesticides sprayer.
- To reduce the discomfort occurs to the farmers during spraying.
- To create the awareness to the farmers about the renewable energy sources.
- To eliminate environmental pollution by using natural energy source.
- To make use of both renewable energy (solar energy) and manual energy.

4. Design of dual power Agriculture sprayer Parts names

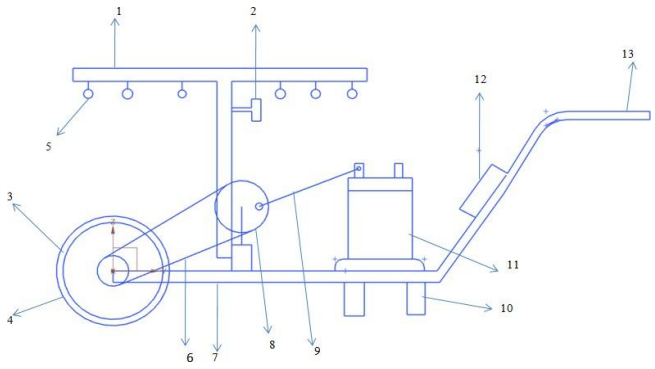

Fig.1. Design of dual power Agriculture sprayer Parts names

1. T shape joint 2.Adjusting nut 3.Rim 4.Wheel 5.Nozzles 6.Chain 7.Frame 8.Sprocke Connecting rod 9.Stand 10. Sprayer tank 11.Solar panel 12.Handle

4.1 Construction Details & Specification

- Manually operated spray pump has simple structure it consist of 1 wheel, piston pump, pump, nozzle, frame, tank, connecting rod, pipe, crank shaft, sprockets wheel, chain drive, etc
- Solar operated sprayer pump has consists solar panel, battery, pump, tank, nozzles, frame, switch & toggle, etc
- There is trolley like structure containing one wheel at front side of frame.
- Freewheel is mounted on shaft connected to rear wheel drive. The free wheel is connected to crank shaft by chain drive. The crank shaft is then connected to piston pump with connecting rod.
- The piston pump is placed middle of frame which has reciprocating movement.
- The nozzle is mounted on upper side of the tank. Nozzle having flexible pipe which is move or turn any direction. We can also adjust the height of the flexible pipe. We use 6 nozzles in our sprayer. The whole assembly is connected to handle.
- The frame is made of carbon steel, which gives the desired strength and lightness. In this frame, a retractable link is attached to the top end of which the solar photovoltaic panel is fixed, which converts solar power into electricity. This electricity is then supplied to the battery via a charging circuit and is used to charge the battery. The electrical power from this battery is supplied to the electric motor by means of control switches, which control enables the entire device to be operated. The pump is connected to a spray pipe.

Fig.2: Dual power agriculture sprayer

4.2 Components of solar agriculture multi nozzle sprayer

1. Sprockets wheel
2. Chain
3. Crank
4. Connecting rod
5. Pump
6. Nozzle
7. Wheel
8. Frame
9. Tank
10. Spraying pipe
11. Solar panel
12. Batteries
13. Switch
14. Speed regulator
15. Charging circuit
16. Valve
17. T fitting
18. Y fitting

Sprocket wheel:

Fig.3: Sprocket Wheel

A sprocket or sprocket-wheel is a profiled wheel with teeth, cogs, or even sprockets that are meshable with a chain, track or other perforated or indented material. In general, the name 'sprocket' applies to any wheel on which the radial projections engage a chain passing through it. It differs from the gear in that the sprockets are never directly meshed together, and differs from the pulley in that the sprockets of the teeth and the pulleys are smooth. Sprockets are used in bicycles, motorcycles, cars, tracked vehicles and other machines either to convey rotary motion between two shafts where the gears are unsuitable or to convey linear motion to the track, tape, etc.

Chain:

A bicycle chain is a roller chain that transfers po wer from the pedals to the wheel of a bicycle, thus propelling it. Most bicycle chains are made of plain carbon or alloy steel, but some are nickelplated to prevent rust or simply aesthetic. The chain is made of steel which is used to transmit power from the g ear sprocket
to the pinion sprocket and has no slip during propu lsion.

Crank:

The crank set (in the United States) or chain set (in the United Kingdom) is a component of a bicycl e drive train that converts the reciprocating motion of the rider's legs into a rotational motion used to dr ive the chain or belt, which in turn drives the rear w heel.

Connecting rod:

The connecting rod is a shaft that connects the c rank and the spray tank together with the crank, for ms a
simple mechanism that converts the reciprocating motion into rotating motion and is therefore subject ed to tension , compression, bending and buckling. The connecting rod creates a link between the spra yer tank and the crank and therefore the crank is als o subjected to tension, compression, bending and buckling. To obtain a minimum weight and a high s trength, the connecting rods are made of materials s uch as cast iron, steel, etc.

PUMP

The pump is for discharging of water from sprayer tank to nozzles with the help of connecting pipes. This pump produces 2 bar pressure and 2 lpm discharge.The pump is made of plastic .Specifications of Electric water pump motor are 1. DC diaphragm water pump 12v 2.Longlife, self priming3.It is corrosion resistant 4.Auto cut off The pump is located at the bottom of the sprayer tank

Nozzle

Spray nozzle is an accurate device which transmits the fluid pressure energy into cinematic energy and facilitates spray dispersion of fluid. Nozzle is used for the distribution of a liquid across an area.

Nozzle:

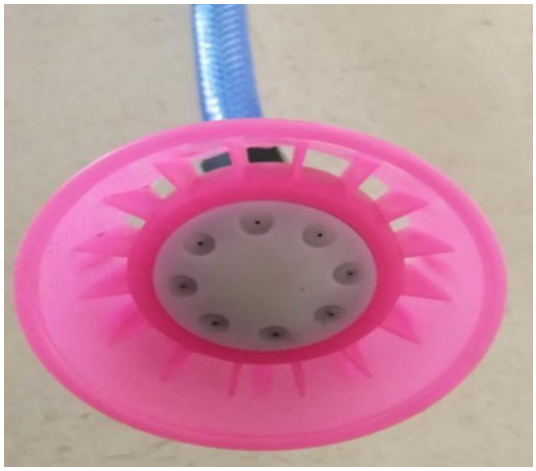

Fig.4: Nozzle

TYPES OF NOZZLE

The three common types of nozzle

(a) Hollow cone nozzle

(b) Solid cone nozzle

(c) Fan type nozzle.

Fig.5:Frame

Solar panel

The solar panel is made up of photovoltaic modules. These photovoltaic modules use the sun's light energy (photons) to generate electricity through the photovoltaic effect. Most modules use wafer-based crystalline silicon cells or thin-film cells.

Fig.6.Solar panel

Valve

A valve is a device that regulates, directs or controls the flow of fluid through the opening, closing or partially obstructing of various passageways. Many valves are manually controlled with a handle attached to the stem.

Fig.7: Valve

5. FABRICATION OF SOLAR SPRAYER:

The above all mentioned components are assembled together to form a Dual power agriculture sprayer .this equipment is fabricated to meet the demands of farmers such as to reduce the maintenance cost, shortage of electricity and fuel.

5.1 WORKING PRINCIPLE

The power to the equipment can be supplied in two ways:

(a) Solar power

(b) Manual power

Solar power

This system consists of a solar panel, a charging unit, a charge controller, an electrical circuit, a batt ery storage pump, a nozzle. In solar energy mode, s olar energy generated by the sun is converted by ph otovoltaic effect into electrical energy using solar p anels. The solar panel delivers an output of 12 volts and 20 watts of power to the charging unit. The ch arging unit is used to reinforce the signal from the s

olar panel. The charging unit delivers a signal that charges the battery.

According to the charged unit, the pump operates in such a way that the sprayer works. The fertilizer can be stored in the tank. When the sun is falling on the solar panel, the electricity will be generated through the solar cells and stored in the battery. The pump operates by electrical power in the battery and therefore the fertilizer from the tank is sprayed through the sprayers. There are no maintenance and operating costs, such as the use of solar energy and no pollution problems. Its operating principle is very easy and economical for farmers, which have one additional advantage, that it can also generate power by saving energy in the battery.

The block diagram of solar spray system is shown in Fig.8. The details of each unit are described below.

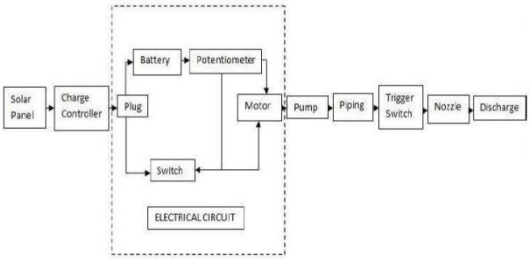

Fig.8: Block diagram of solar power spraying system

Manual operated

The fig.8.shows the assembly of the sprayer for ma nual power agriculture. As the cycle progresses, the operator seizes the handle and pushes its cycle forward. The rotation of the wheel also rotates at the same speed with a sprocket mounted on the wheel. The drive for the chain transfers the movement of the gear pinion to the pinion pinion. The rotating motion of the shaft is transformed to reciprocating motion by means of a crank and the connecting rod mechanism, which are mounted on either side of the same shaft. In addition to this, the connecting rod is connected to the heel and the heel swings at the centre. The piston attached to the center of the pin produces reciprocal movement in the cylinder. The tank suction pesticide in the cylinder and piston forced the pesticide to bubble through the pipe and linked the number of pins to the spray of the pesticide. With the help of a special arrangement, we can adjust the pressure required to spray to change the crank length by providing the crank-slot. The free turn of the crank or neutral position can be achieved by adjusting the joint of the connecting rod and the lever. The pumping stops and the wheel rotates freely if a spray pesticide is not necessary with the use of these adjustments. You can adjust the height, position and angle of the pin.

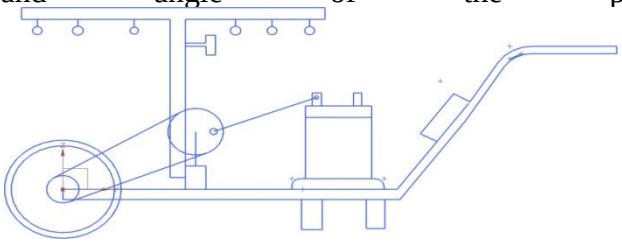

Fig.9: Manual power agriculture sprayer

6. Design Approach And Experimental Setup

Design and fabrication of solar powered pesticide sprayer has following steps, Selection of components The selection of component has been done according to the requirements .following are the list of components,

1. Tank
2. Solar panel
3. DC Motor
4. DC Battery
5. Nozzle type
6. Connecting pipe/boom
7. Charge controller 8.Trolly Assembly

9. Mounting element

Tank –

Pesticide tank has capacity of 18 liters.PVC material tank is use for it.

Solar panel - Solar panel is the main component of the system. It has the following specifications, Capacity of panel - 30 watts

Panel Size: 520×350×20mm Weight of the panel: 2.5 kg Maximum Power: W

Voltage @max. Power: 18 V Current @max. Power: 2 A

DC motor - DC motor is used to lift the pesticide from tank and delivers to the spray gun. DC motor has following specifications,

Weight of the motor: 500 gm.

Power rating: 3.KW

POWER SUPPLY: 12V

Operating current: 0.8 A Liquid Discharge: 4.2LMP

DC battery –

Weight of the battery: 2.5 kg Cost of the battery: 1050 □ Operating voltage: 12v

Rated current: 12Ah

Dimensions: 5.94 x 3.86 x 3.7

Nozzle type

Six (6) Full cone nozzles Discharge rate 0.5 Lt/min.

Table 1.Part List

S.No	PARTS	QUANTITY	MATERIAL
1	FRAME	1	CARBON STEEL
2	SPRAYER TANK	1	PLASTIC
3	CHAIN,SPROCKET	1,2	STAINESS STEEL
4	CONNECTING ROD	1	STEEL
5	PIPES	10 METERS	PVC BRAIDED
6	VALVE	1	PLASTIC
7	NOZZLES	6	PLASTIC
8	T SHAPE NOZZLES	4	BRASS
9	WHEEL	1	STAINESS STEEL
10	SOLAR PANEL	1	SILICON,ALUMUNIUM

S.No	PARTS	QUANTITY	MATERIAL
1	FRAME	1	CARBON STEEL
2	SPRAYER TANK	1	PLASTIC
3	CHAIN,SPROCKET	1,2	STAINESS STEEL
4	CONNECTING ROD	1	STEEL
5	PIPES	10 METERS	PVC BRAIDED
6	VALVE	1	PLASTIC
7	NOZZLES	6	PLASTIC
8	T SHAPE NOZZLES	4	BRASS
9	WHEEL	1	STAINESS STEEL
10	SOLAR PANEL	1	SILICON,ALUMUNIUM

TABLE: PARTS LIST

ADVANTAGES

The developed system used for spraying the pesticides, fungicides and insecticides.

- Easy in construction.
- More economical.
- Easy to clean and maintain.
- It is a renewable energy powered.
- It does not create air pollutant & noise.
- Easy to handle.
- Do not require fuel hence cost reduces.
- No need for skilled labor

LIMITATIONS

- The panels are weather dependent. Thus the power will have to be generated by any others means.
- There is a requirement to fill the sprinkler tank again with the pesticide after the quantity inside it gets over.
- It is not effectively used for wet lands.
- Cannot be used for all crops.

MAINTENANCE

- Clean water must be used and it must be filtered for mixing with pesticides.
- The sprayer should not run empty while operating with pump.
- Lubrication must be done.
- Minimum speed must be maintained during the manual operation for spraying.
- Battery must be charged frequently for better performance of spraying.

Table 2.Project cost analysis

S.NO	PARTS NAMES	COST OF THE PARTS
1	Solar panel	2600
2	Sprayer	3200
3	Frame	4500
4	Connecting pipes	500
5	Wheel	400
6	Nozzles(6)	360
7	T,Y shape joints	440
8	Chain, sprocket, bearing	800

Table: project cost analysis.

TOTAL PROJECT COST: 12,800

Conclusion

The project focuses on the design and manufact ure of spraying systems with a focus on light weigh t and portable nozzles. This project has an innovati ve method of minimizing manual stress. The main f ocus of our design is to reduce human effort and ea se of operation in the case of spraying operations. We use past data and techniques to develop the dua l power agriculture sprayer. A new type of mechanism is being manufactured which is different from other machines; in addition to this mechanism, we also make use of non-conventional energy sources in our project. Such a dual-power sprayer for agriculture will help to a large extent to improve spray area per acre and uniform spraying.

Future Scope

- With change in design of frame it can be used for all types of crops.
- There could be continuous supply of liquid pesticide/ fertilizer generated for sprinkler.
- The Solar panel unit could be enhanced in order to generate more prolonged electric supply. Moreover, the electricity could be stored; that may be used for agriculture purposes.
- By making modifications in the wheels we can effectively use in wet lands.

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