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Solar Powered Multifunction Pesticides Sprayer

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Abstract : In India, more than 74% of farmers are categorized as small landholding farmers. These farmers use the hand-operated sprayer for controlling pests in farms which is expensive and laborious work carried out by Indian farmers to protect their crops .solar operated sprayers are more beneficial for farmers. The solar-powered sprayer developed had higher output (0.3 hect /hr) with lower physiological energy consumption and discomfort.Application of electronics controlled solar Chargeable battery with can operated continues six hours after full charging This ensures quality spray with uniform droplet size in the swath. Anti-clogging provides trouble free operation which increases service life of nozzle.

Key words: **Solar, DC Pump, Renewable energy, Pesticide sprayer, Multi-functioning**

I. INTRODUCTION

To keep insects out of crops. Farmers use a hand or fuel spray pump to spray their crops. When loaded with pesticides in excess of 18-20 litres, the typical sprayer is quite heavy. excluding spayer's weight [1].The objective for developing the solar-powered pump was to reduce the time and effort required by farmers to operate traditional pumps..

Ploughing, irrigation through pumps, intercultural operations, fertiliser spraying for plant protection, harvesting and post-harvest processing, and other agricultural field activities all consume a significant amount of energy. As a result, renewable energy sources must be used to operate the aforementioned agricultural activities.If pests and diseases are not treated in a timely manner, around 35 percent of crop productivity is harmed. Insecticides are sprayed uniformly on plant compositions throughout the crop field to combat diseases. Liquid pesticide formulations are typically broken down to minute droplets of effective size using a sprayer to ensure uniform dispersion over a vast surface area. In the agricultural [1][2][3]

Spraying Systems Classification

Various sprayers can be utilized.

1) Sprayer that is controlled by hand.

2) Sprayer with an engine and a fuel tank.

3) Pump sprayer with an electric motor.[5].

II. LITERATURE SURVEY

Author, Akshay, M.N. and Waghmare, G , focuse on Crop care and protection is an important element of horticulture, but it is not mechanised. Because solar energy is abundant in India, autonomous pesticide spraying can achieve uniform and optimum pesticide spraying quality. [1]

Pritam J.M., Yogesh G.A., Akash S.B. and Rajendra S.k., discus ,The 61.5% of the Indian population depends on the agriculture field. Agriculture provides employment to 61.5 percent of India's population.[2]

Joshua, R., Vasu, V. and Vincent, P , His project intends to spray pesticides with a solar-powered sprayer, which boosts the effectiveness of pesticide spraying. [3]

Shubham S. Sontakke, Pooja C.Wanjari, et al Designed a pesticide spraying equipment that will enhance output while reducing farmer effort. The machine will save the farmer time and improve spraying efficiency. This type has a multi-nozzle pesticide sprayer pump that sprays at maximum rate in the shortest amount of time..[4]

Shailesh Malone, Shubham Kathwate, Pratik Kolhe, Rodney Jacob, NishatIngole, Rupesh D. Khorgade: Design and Development a Multipurpose Pesticides Spraying Machine that will enhance the productivity and increase the farmer's Profitability and carries a multi-nozzle pesticides sprayer pump which will perform spraying at the maximum rate in minimum time. Constant flow valves are applied at

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the nozzle to have uniform nozzle pressure (Krishna M.B, 2017). [5]

Surender Kumar, Design Of Solar Hybrid Pesticide Spray System The sprayer is operated from the electricity generated by 50W solar panel mounted on a movable frame and in the indirect mode it is operated on stored electrical energy in the lead-acid DC battery (12 V, 12 Ah). Priming diaphragm pump of 10W or mini DC reciprocating cycle motor of 5W is used to generate the required operating pressure to spray the liquid pesticide formulations. The capacity of the storage tank is 20 liters for uninterrupted operation of 25.1 minutes with the discharge rate of 0.79 L/min through the electric flexible mists high-pressure multiple sprayers with four (4) nozzles.[6]

Issa, W.A, Design, Fabrication, And Testing Of A Movable Solar Operated Sprayer For Farming Operation in which the efficiency of the solar panel is 16 % but it is only 7.48 % when providing power to the motor. The total weight of solar operated sprayer with 16 L spray liquid is 27.78 kg. The field capacities of the sprayer were 81.60 L/h, 166.57 L/ha, 2.04 ha/h and 0.49 h/ha. The time required for charging the full battery capacity of 12 V, 9 Ah by analytically and practically was found to be 6.33 h and 10.5 h, respectively. The duration of the spraying will be around 4.9 hours after leaving 25%

charge in the battery. [7]

N. Alam1, M. Alam focus on the increasing price of oil-based fuel has reduced the margin to be gained by farmers from irrigation, since food prices have generally been prevented from rising in line with energy costs. Despite present short-term fluctuations in oil prices, conventional oil-based engine-driven power sources and mains electricity are expected to continue to increase in the longer term. If we are to decrease our dependence on imported oil, we have to find methods for energizing irrigation pumps that are independent of imported oil or centralized electricity. Solar radiation as a source of energy [8]

Yallapa D .et al, Development and Evalution of solar Powered sprayer with multi –purpose application The solar panel mounted on the top can be tilted to required angle according to the sunlight. This panel consisting of photovoltaic cells which converts solar energy into electrical energy which is supplied to the battery via controller. The battery intern runs DC motor with sufficient speed for effective spraying through nozzle.[9]

• Rao et al. (2013) investigated the performance of a battery.

• Low-volume spraying (50-150 litres per hectare)

• Low-volume spraying (5 L ha-1)

• High-volume spraying: 250-500 L ha-1

• With a fully charged battery, Author described the performance of a multi-power-supplied fertiliser sprayer that could spray 580 litres of pesticide across a 5- to 6-acre piece of land.Multiple-power-supplied fertiliser sprayer that could spray 580 litres of insecticide over a 5- to 6-acre area with a fully charged. [10]

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The main purpose is to use the naturally available solar energy to eliminate spraying operations on wheels

a. To Reduce The Expense Of Spraying For The Farmer.
b. Reducing Operational Costs By Incorporating New Mechanisms.
c. To Reduce Labour Expenses By Improving Spraying Techniques.
d. To Use No Electricity At All.
e. Year-Round Uninterrupted Spraying Operations In The Field.

III. MATERIAL AND METHOD

A. Block Diagram

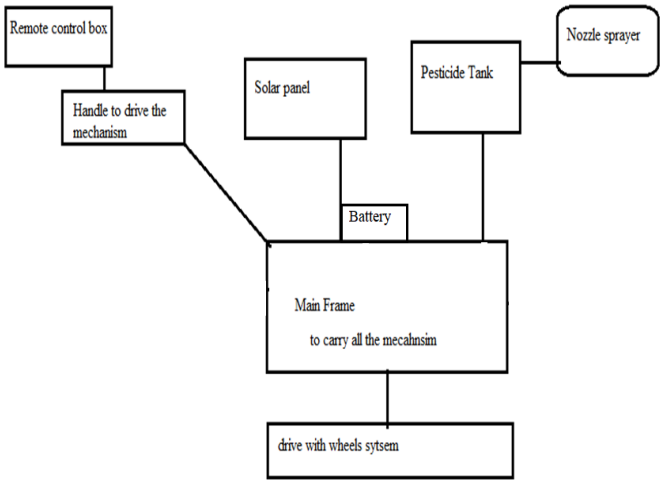

Fig.1: Block Diagram

Working of this system is simple. Solar panel collects the solar energy into electricity and supplies it to battery. Battery is chargeable to operate motor. Motor attached at the bottom of tank sucks the liquid from tank and deliver it.

The ‘ON’ and ‘OFF’ of motor is controlled with control switch attached at handle. A switch is given there to operate its function. By switching , the valve of gun is released and at the same time the switch is pushed which supplies the current to motor. Thus motor sucks liquid and deliver it through delivery pipe.

Spraying at a very low volume: 5 litres per hectare.

Spraying at a low volume (50-150 L ha-1) is recommended.

250-500 L ha-1 of high-volume spraying.

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B. Experimental Setup

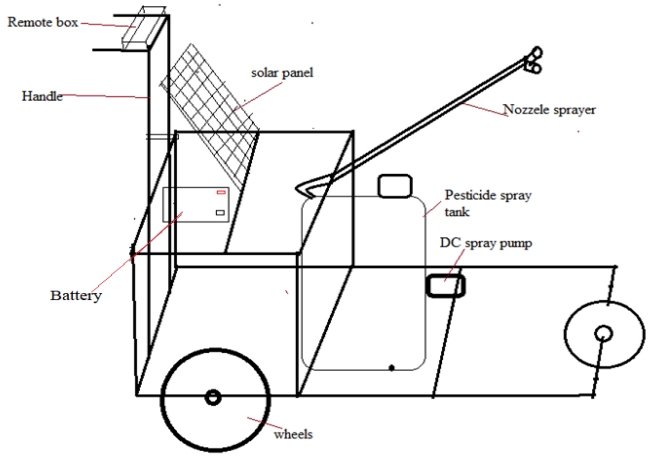

Fig..2:. Experimental Diagram: Solar Powered Multifunction Pesticides Sprayer

Construction of solar prototype speyaring pump following components were used

C: Components Used

1. DC Battery

• High-peak capacity and high-power density are desirable features of high-capacity batteries for HEV applications.

• Plus, pulse-specific power, high specific energy at pulse power, high charge acceptance for maximum utilisation, and a long calendar and cycle life.

a. Voltage :12 V

b. Current: 2.4 amp

c. Output power:28.8 Watt

d. Weight:2 kg

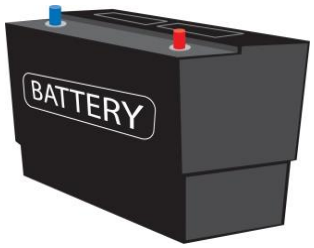

Fig 3: Battery

2. Solar Panel

• Photovoltaic cells use a subatomic energy transfer to convert the energy in sun radiation into electricity. Photons are little bundles of solar energy.

• These photons interact with the outer Level electrons in photovoltaic cells in the same way as flappers interact with a metal ball in a pinball machine, causing displaced electrons to generate an electrical current. Silicon is one of the elements used as a photovoltaic cell's foundation material.The solar panel is chosen based on the battery output power.

a. Size:500mmX 22 mm X 340 m m

b. Normal Peak Power:20 watt

c. Operating voltage:21.6 volt

d. Operating Current: 1.176 A

e. No of cells : 36

a. Material : Silicone

b. Weight:2.0 kg

Fig.4:Solar Pannel

3. Tank

Tank Capacity: 15 litres

The insecticide solution is kept in a tank here. It also comes with a manual pump in case the battery's hotovoltaic cells lose power.

Fig. 4:Spraypump

4. Spray Gun

• It is used to give direction to the pressured solution.

Fig .5: Spray Gun

5. Potentiometer

A potentiometer is a three-terminal resistor that forms an adjustable voltage divider with a sliding or revolving contact.

DC 12 V Motor Pump Control Regulator Switch .

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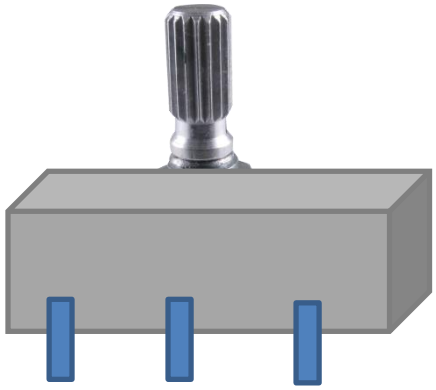

Fig. 6: Poentiometer

a. Voltage 12V or 24V

b. Overload current: 10A

6. Voltmeter

A voltmeter is a device that measures the difference in electrical potential between two locations in an electric circuit.

Fig .7: Voltmeter

a. Measuring range: DC 8-48V,

b. Accuracy: 0.1V.

c. Material: ABS

7.Pump and motor

a. Operating Power:3.2 Watt

b. Operating Votage:12 volt

c. Current :2.1 Amp

d. Speed:900 RPM

e. Dischagr:2.9 lit/min

f. Torque:115 Nm

8. Nozzle

The discharge of the system is Q lit/min.

Here, V_{in} and V_{out} indicates inlet and outlet velocity of the nozzle. The diameter of the pipe is D.

$Q = AVin$

$V in = 4Q/ (\pi D^2)$

IV. DESIGN CALCULATION AND SPECIFICATION

1.Battery

Voltage = 12v

Current =2.4 Ah

Then power of battery is given as

Power = Voltage x Current = 12 x 2.4= 28.8 W

2. Overall dimension of Unit

Overall dimension are 3 ft * 1.5 ft *4 ft

3. Weight of set Up:

Total weight of setup Aprox. 15kg.

4. **Solar panel**

Power = 20w

Voltage =18v

Then current produced by the panel is given as

I = P/V I = 20/18 = 1.11Ah

Current produced by panel and charging time of the battery

The solar panel is chosen based on the battery output power.

20 W of power Weight =2.0 kg Dimensions: 500 mm x 22 mm x 340 mm Dimensions: 500 mm x 22 mm x 340 mm Dimensions: 500 mm x 22 mm Voltage in the open circuit is 21.6 volts. 1.318 A is the current in a short circuit. 1.176 A is the operating current.

- **Current produced by panel and charging time of the battery**

(i) Knowing the maximum power (P) of the solar panel and the voltage rating (V) of the battery, the current produced by the solar panel (I) was determined.

As a result, I = 20/12 = 1.66 A

(ii). The charging time (T) was calculated by dividing the battery's ampere hour (Ah) rating by the total current delivered by the solar panel. T = (battery ampere-hour rating) / (total current consumed by the solar panel)

T = 8 / 1.66 = 4.79 hr

V. ADVANTAGES

• In addition to the cost of spraying, there is a savings on fuel/petrol for spray operations.

• There is a reduction in the cost of transportation while purchasing fuel.

• Solar sprayer upkeep is easy and economical.

• There is less vibration than a fuel sprayer.

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• The purpose is to improve spraying quality while reducing the physical effort of the operator.

• The farmer can spray without the assistance of others, increasing spraying efficiency.

• It's a machine that can do a lot of different things.

• It's easy to use and understand.

• There is substantially less pollution on other models.

• It's portable.

• The cost per unit is quite low.

• Easy to assemble.

VI. RESULTS

The solar panel generates 17 V, 1A during the day between 9.30 AM and 4.30 PM, according to the experimentation in this project. Testing is done during this time because pesticide sprayers are deployed. During this time, at 1.3A, the 12V, 8Ah battery can be fully charged in 7 hours. As a result, proposed model can spray continuously for 7 to 8 hours . The capacity of spraying observed that in average 1 hector/day without cost of electricity. As a result, the proposed model is both cost-effective and compatible with existing commercial models.

VII.CONCLUSION

Performance of solar sprayer pumps evaluated for agricultural has been found to be more cost effective and to provide effective spraying outcomes. It is widely available at no cost because it runs on a non-traditional energy source, such as solar energy. It may be a better choice for the traditional sprayer in today's environment, since the world is moving toward discovering new ways to meet its energy needs. We have provided the greatest alternative for farmers who are financially disadvantaged and are now experiencing electricity issues such as load shading. Given India's status as a developing country, this product has the potential to gain traction in rural areas.

FUTURE SCOPE

1. Modeling approaches can be used to reduce the overall weight of the tank.

2. Adoption of new technology in electronic areas can boost battery backup.

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