

## A Review paper on Solar based Pesticide spaying System

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**Abstract**—The basic aim of solar pesticide sprayer is to reduce the work of farmers which is done manually. Solar Pesticide Sprayer is proved to be a useful machine which concentrates on ergonomics which is more efficient to workers, and the energy source used is non conventional. Hence it possesses a great scope in near future. Solar pesticide sprayer consist of a solar panel ,a battery ,motor pump and a container which consist of liquid pesticide. This will going to be more useful for Eco Smart farming. In the commonly available ones, the user needs to exert a lot of effort to push the lever up and down to create the pressure to spray. Sometimes when the pressure becomes uneven, the nozzle gets blocked and the farmer has to spend time to rectify it The benefits obtained from this project is to minimize the pollution, optimize the power, more friendly to farmers usage ,cost effective as well ergonomically efficient.

**Keywords**—solar panel, DC pump, Nozzle, pressure valve, pesticide.

### I. INTRODUCTION

In this highly competitive running world, emphasis on knowledge is valuable and further implementing this knowledge into practical usage is an important factor which is done by an engineer. Hence we are trying to do so. The basic aim of an solar pesticide sprayer is to reduce the work of farmers which is done manually. Solar Pesticide Sprayer is a useful machine which is ergonomics, motion sensible which is more efficient to workers, and the energy source used in non conventional. Hence it possesses a great scope in future. Solar pesticide sprayer which consist of an solar panel ,a battery ,motor pump and a tank have the simplest assembly is going to be a very important tool of an eco smart farm which would encourage to further works related with for the farmers farms field and agriculture. The benefits obtained from this project is to minimize the pollution, optimize the power, more friendly to farmers usage ,cost effective as well ergonomically efficient.

### II. MAIN COMPONENTS OF SOLAR PESTICIDE SPAYER

For the Designing and fabrication of solar powered pesticide the following are the main components,

#### 2.1. Main components

Following are the list of components for the solar pesticide sprayer.

**2.1.1. Pesticide container** - Pesticide container should be used whose material is lighter to lift on the back of farmer for a long time. The best preferable material is plastic. And these plastic container should be fixed or tighten with the help of belts as shown in the figure.

**2.1.2. Spraying gun with nozzle** – Spraying gun with Nozzle type should be be best preferred of stain steel which is highly supportive for the flow of pesticide.



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

- Current –2.2 A
- Voltage –12V
- Flow rate -2.9LPM
- Max. Pressure- 0.48Mpa
- $P= V \times I = 26.4W$
- Flow rate -2.9LPM
- Pressure- 6.89bar



**Calculation:-**

Flow rate at max. Pressure = 2.9LPM

Tank Capacity = 15litrs

If tank is full, then the time will be taken by pump to empty the whole pesticide tank is equal to 15litrs/2.9LPM.

So, the time will take by pump = 5.17min.

**2.1.4. DC Battery** - DC battery is power source for this spray pump. This battery is charged by solar panel and removable. It has following specification,

- Current – 8Ah
- Voltage –12V



Technical Specifications of the Battery

### III. SEALED LEAD-ACID BATTERY

Weight of the battery : 2 kg.  
Cost of the battery : Rs.800-950  
Output power : 84 watt.  
Operating voltage : 12v  
Current : 7 Amp  
Constant Voltage Charge with voltage regulation(27°C)  
Standby Use:- 13.6V-13.8V  
Cycle Use:- 14.1V-14.4V  
Max. Initial Current:-1.4A

#### **Advantages of DC Battery:-**

Low cost.  
Reliable.  
Over 140 years of development.  
Robust.  
Tolerant to abuse.  
Tolerant to overcharging.  
Low maintenance.  
Indefinite shelf life if stored without electrolyte.  
Wide range of sizes and capacities available.  
Many suppliers world wide.  
The world's most recycled product.

#### **Disadvantages DC Battery:-**

Very heavy and bulky.  
Typical coulombic charge efficiency only 70% but can be as high as 85% to 90% for special designs.  
Danger of overheating during charging  
Not suitable for fast charging  
Typical cycle life 300 to 500 cycles .  
Must be stored in a charged state once the electrolyte has been introduced to avoid deterioration of the active chemicals.

**Foldable Solar panel** – The solar panel should be such that it can be easily folded behind the whole pesticide container as shown in picture when not in use so as to maintain the portability of the pesticide sprayer. The capacity of the solar panel is 40 watts. When we talk about the working of the solar pesticide sprayer more or less it is depending on the specification of solar panel ,its size and some of the more important titles as discussed below[1].



#### **3.1 Specifications of Solar Panels:**

Panel Size: 286\*351\*22  
Cost of the Panel: Rs.800- Rs.1,000/-

Weight of the Panel: 1.5Kg.  
Peak Power (Pmax): 12.5W  
Tolerance of Pmax:  $\pm 3\%$   
Open circuit Voltage: 17.22V  
Short Circuit Current: 0.97Amp  
Voltage at Max. Peak power: 14.42V  
Current at Max. Peak Power: 0.90Amp  
Module Efficiency%: 10.95  
Cell Efficiency: 15.6%  
System Voltage: 1000VDC

(The electrical characteristics are within  $\pm 3\%$  of the indicated value of P max. All technical data at standard test condition 25°C, 1Kw/m<sup>2</sup> AM 1.5)

A solar panel (also solar module, photovoltaic module or photovoltaic panel) is a packaged, connected assembly of photovoltaic cells. The solar panel can be used as a component of a larger photovoltaic system to generate and supply electricity in commercial and residential applications. Each panel is rated by its DC output power under standard test conditions, and typically ranges from 100 to 320 watts. The efficiency of a panel determines the area of a panel given the same rated output - an 8% efficient 230 watt panel will have twice the area of a 16% efficient 230 watt panel. Because a single solar panel can produce only a limited amount of power, most installations contain multiple panels. A photovoltaic system typically includes an array of solar panels, an inverter, and sometimes a battery and or solar tracker and interconnection wiring.

### 3.2 Power Rating:

Voltage : 17.22 volt.

Current : 0.97 Amp.

Power :  $V \times I = 17.22 \times 0.97 = 16.70$  watt.

### 3.3 Testing of Charging Time:

Instrument used to measure Sun Radiation : Sun Meter.

The Sun Radiation are measured in : mW/CM<sup>2</sup>

Required voltage for charging the Battery : 12 volt.

### 3.4 Time Measurement:

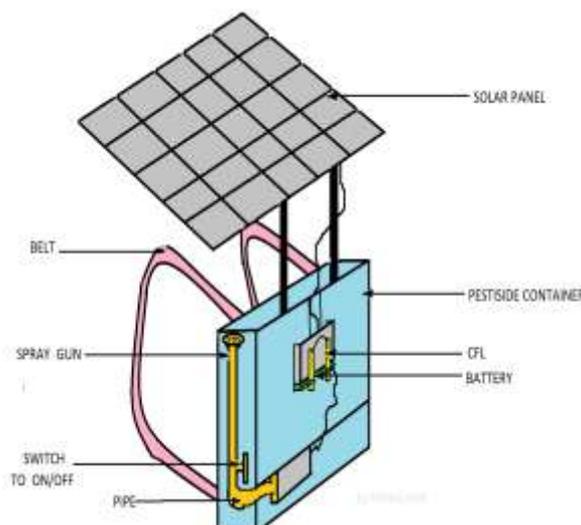
When the Solar radiation is between 200 to 300 mW/CM<sup>2</sup> : 3 to 4 hrs.

When the Solar radiation is between 300 to 400 mW/CM<sup>2</sup> : 2 to 3 hrs.

When the Solar radiation is between 400 to 600 mW/CM<sup>2</sup> : 1 hour.

Running period : 3.5 to 4 hours.

Operating cost : Nil



**3.5 Working Principle and Operation:** Solar radiation can be battery can be charged by Solar Panel available on the top of the Sprayers. A separate charging system using Solar Panels can also be used for charging the battery, converted directly into electricity using semiconductor devices, which are known as Photovoltaic (PV) cells. When Sunlight falls upon the Solar cell a part of the light is absorbed and it is converted into Electrical Energy by means of Electron Movements. This Solar Panel is connected to 12V lead acid battery for storing the electrical energy. A 12V DC motor is connected to the lead acid battery to convert the electrical energy into mechanical energy.

**3.6 Power Conversion Efficiency:** The Solar cell Power Conversion Efficiency can be calculated by using the relation,

Where,

$$P = \text{Incident Solar radiation} \times \text{Area of the Solar Cell in} \\ = I \times A \times T$$

The output power (P) = V x I out

It is the power delivered from the Generator.

**3.7 Operating System of Solar Panel:** Charging can be done Using a solar panel. Battery can be charged continuously during discharge itself, by attaching the panel on the sprayers. Without panel on the sprayers, discharge can be done for a minimum period of 4 to 5 hours. By changing the battery, discharge can be continued for further more hours.

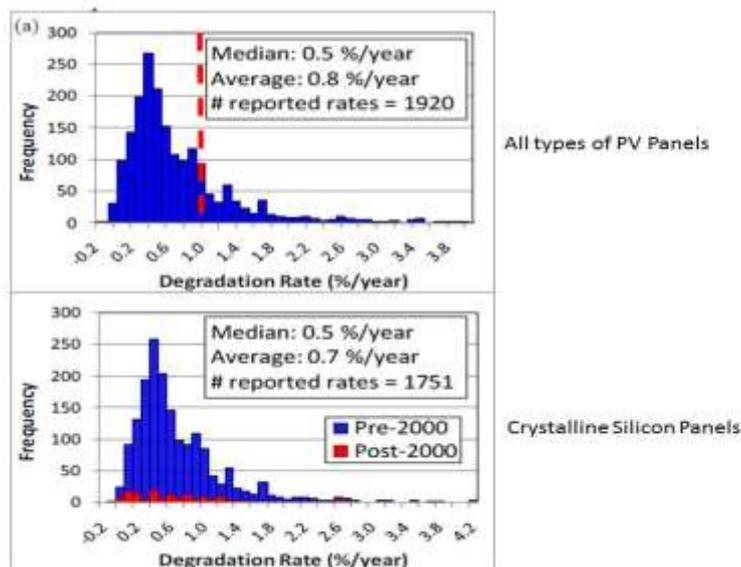
**Note:-** During Rainy Season charging can be done by electrical devices.

**3.8 What Is the Lifespan of a Solar Panel?**

Photovoltaic (PV) modules typically come with 20 year warranties that guarantee that the panels will produce at least 80% of the rated power after 20 years of use. The general rule of thumb is that panels will degrade by about 1% each year.

**3.9 Degradation Rates:-**

The National Renewable Energy Laboratory (NREL) performed a meta-analysis of studies that examined the long term degradation rates of various PV panels. They found that the 1% per year rule was somewhat pessimistic for panels made prior to the year 2000, and today’s panels, with better technology and improved manufacturing techniques, have even more stamina than their predecessors. For monocrystalline silicon, the most commonly used panel for commercial and residential PV, the degradation rate is less than 0.5% for panels made before 2000, and less than 0.4% for panels made after 2000. That means that a panel manufactured today should produce 92% of its original power after 20 years, quite a bit higher than the 80% estimated by the 1% rule.



## IV. WORKING

Sun radiations are incident on the solar panel. Solar panel consist of photovoltaic cells convert this solar energy in to the electric energy.. Further this current generated by the solar cells is supplied to the battery via electric wires. One controller is placed between the solar panel and the battery which control the current which is supplied to battery. This battery is removable so after fully charged it can be removed and placed in the sprayer. In this way charging is done. When battery is connected in the sprayer, it supplies the current to the DC motor and it runs at required speed. Motor has two opening one inlet and one outlet. Motor develops the suction and lift the pesticide from the tank and via connecting pipe supplies to the nozzle. Nozzle generates the spray pattern. The solar panel is made foldable so that it can be used while in spraying the pesticide and will be charged meanwhile and can be folded behind the container when the battery is fully charged.

### 4.1 Pressure Regulator:-

It is one type of automatic speed controller of pump with the help of this regulator, we can control the pump speed. Due to this, we can control of the flow rate & discharge of pump. Because of the regulator, We get require type of flow from the nozzle pressure control systems use a pressure regulator. This maintains constant operating pressure .



## V. ACCESSORIES

- LED Lights
- FM radio player
- Mobile charger
- Level indicator

## VI. Economic Analysis

The cost of the fuel increases day-by-day. It should be reduced by the modified model which works on the principle of solar energy. The operating cost of power sprayer for one hour operation is calculated and its value is compared with the operating cost of solar sprayer. Its seems that there is no need of operating cost but, the initial investment towards the charging unit is a one time investment with a life period of Twenty years which is almost equal to the unit cost of the power sprayer with twist of petrol engine.

There is no much maintenance cost and no operating cost as it is using solar energy it is free of cost and there is no pollution its working principal is very simple and the it is economical of the farmers which has one more advantage that it can also generate power that power is saved in the battery and it can be used for both for spraying and well as to light in the house when there is no current supply. And where as in rainy season when the sun rays are not there that time we can charge the battery and use it to spray pesticides to the herbs and plants as compared to petrol/ diesel it is economical no efforts to human just he has to carry the device the device is light in weight so it is much feasible.

## VII. MARKET ANALYSIS: COMPARISON BETWEEN THREE TYPES OF PESTICIDE SPRAYERS

Sr No	Parameters	Solar Pesticide Sprayer	Hand-Operated Sprayer	Fuel Sprayer
1.	Images			
2.	Weight (KG)	6.85	5.25	9.2
3.	Tank capacity (in litres)	15	12	11
4.	No Of Nozzles	2	1	1
5.	Flow rate (Lit/min)	2.9	1.5	1.8
6.	Cost (in Rs.Appx)	4000-4500	2200-2300	5500-6200

## VIII. CONCLUSION

It is analysed that, this model of solar powered pesticide sprayer is more cost effective and gives the effective results in spraying operation. . Hence it will be a future valuable as well demanded farmer equipment. In the commonly available ones, the user needs to exert a lot of effort to push the lever up and down to create the pressure to spray. Sometimes when the pressure becomes uneven, the nozzle gets blocked and the farmer has to spend time to rectify it. Hence we some alterations can be done in the existing design by adding a solar panels and a battery to it. While spraying in the field, the battery can be further charged by switching on the solar power system attached to the sprayer.

As it runs on the non conventional energy source i.e. solar energy, it is widely available at free of cost. In now days where world is moving towards the finding the new ways for the energy requirement, it can be a better option for the convention sprayer. As India is a developing country, this product can be become more popular in rural areas .More and more efforts to be made in the field of agriculture so that many problems related with the farmers of our country can be solved.

### Future scope:

1. The overall weight of the tank can be minimized by moulding techniques.
2. The battery backup can be increased by adopting some new technology in electronic fields.

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