iJRASET
International Journal For Research in Applied Science and Engineering Technology



INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 11 **Issue:** IV **Month of publication:** April 2023

DOI: https://doi.org/10.22214/ijraset.2023.50781

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International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538
Volume 11 Issue IV Apr 2023- Available at www.ijraset.com

Design and Analysis of Agriculture Sprayers

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***Abstract:** This project is to fabricate a model called agricultural sprayer. In olden days the spraying system is deficult to exicute. But in this generation there are few types of machines for spraying processs. Here we implement a new idea for spraying in agricultural fields, by using a engine and pump, we can easily operate the sprayer in required areas. This project consists of a engine and pump, a water tank, pipe ,and nozzles arrangement. The main purpose of producing this product is to enable farmers and gardeners to make the process of spraying pesticides to their gardens becomes more effective. It helps the formers because they no longer need to carry the tank on their back that can cause their back strain . This product only has to be move forward just like how the trolley function and then it will generate a set of power transmission part by using engine and pump. Next, it also comes with a pair of nozzles on the wing if it requires . With nozzles on the wing, it can speed up the spraying process as it can spray left and right side at the same time. In conclusion, this product can help formers in terms of comfort during spraying, reducing human effect, and effectively utilizing spraying time.*

I. INTRODUCTION

Spraying of pesticides is an important task in agriculture For protecting the crops from insects. Farmers mainly use Hand operated or fuel operated spray pump for this task. This conventional sprayer causes user fatigue due to excessive bulky and heavy construction. This motivated us to design and fabricate a model that is basically solar sprayer In our design, here we can eliminate the back mounting of Sprayer ergonomically it is not good for farmer's health point of view during spraying. In this way here we can reduce the users fatigue level. There will be elimination of engine of fuel operated spray pump by which there will be reduction in vibrations and noise. The elimination of fuel will make our spraying system eco-friendly. So with this background, we are trying to design and construct a solar powered spray pump system.

II. OBJECTIVE

The machine is aimed for using in agricultural works where several operations like ploughing, seed sowing; water/ pesticide spraying is needed. The main objectives of this machine are,

1) To fabricate an economically efficient agricultural machine that reduces the man power
2) To reduce the time of work
3) To fabricate a light weight and portable machine
4) To complete large amount of work in less time.

The agricultural processes like seed sowing, ploughing, spraying etc can be done through traditional methods, but it is time consuming and requires more man power. The modern machines like tractor, seed sowing machine and sprayer can be used for this purpose. But it is more costly average middle class farmers cannot afford it. In order to tackle this problem, we are creating equipment which can perform several agricultural operations like sowing, ploughing, and spraying, which will minimize the cost and man power. The main aim of this equipment is to support small and medium scale farmers.

III. TYPES OF SPRAYERS

Knapsack sprayer; is convenient for spraying through hand-held nozzles that is connected to tank carried on operators back. There are three types of Knapsack sprayers i.e battery, manual and battery cum manual sprayer.

Portable power sprayer are operated by electric and petrol engine with the help of hose pipe. This type of sprayer doesn't have chemical tank, which is used for applying pesticides, insecticides or liquid type chemicals at extensive land coverage.

Knapsack power sprayer has motor engine operated by using petrol engine i.e., 2 stroke and 4stroke engine type. It has the separate chemical tank and also has hand held nozzles.

Mist dust sprayer is a kind of knapsack power sprayer which is used to spray liquid chemical in mist form and urea in granule form. Ideal for quick spraying operations in orchards, tea, coffee estates & other crops. It can spray dust powder form pesticides also

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HTP sprayer is a horizontal triple piston pump with brass head, mainly used for uniform spraying with high pressure all over the operation land, it is used for multipurpose like commercial usage and agricultural usage. Its main benefit is having long operation life and power efficiency. In this type of sprayer also we can find battery, manual and battery cum manual operated sprayers.

IV. SELECTION OF MATERIALS

A. Petrol Engine

A Petrol engine or Gasoline engine is an internal combustion engine with spark-ignition designed to run on petrol (gasoline) and similar explosive fuels. It differs from a diesel engine in the method of mixing the fuel and air, and in the fact that it uses spark plugs. In a diesel engine, just the air is compressed, and the fuel is injected at the end of the compression stroke. In a petrol engine, the fuel and air are pre-mixed before compression injection. Pre-mixing of fuel and air allows a petrol engine to run at a much higher speed than a diesel, but severely limits their compression, and thus efficiency.



B. Liquid Tank

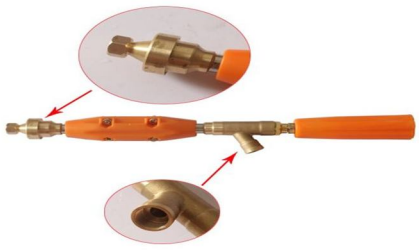
The tank should be made of a corrosion-resistant material. Suitable materials used in sprayer tanks include stainless steel, polyethylene plastic and fiberglass. Pesticides may be corrosive to certain materials. Care should be taken to avoid using incompatible materials. Aluminum, galvanized or steel tanks should not be used. Some chemicals react with these materials, which may result in reduced effectiveness of the pesticide, or rust or corrosion inside the tank. Keep tanks clean and free of rust, scale, dirt, and other contaminants which can damage the pump and nozzles. Also, contamination may collect in the nozzle and restrict the flow of chemical, resulting in improper spray patterns and rates of application. Debris can clog strainers and restrict flow of spray through the system.

C. Sprayer (Nozzle)

The nozzle is a critical part of any sprayer. Nozzles perform three functions:

1) Regulate flow
2) Atomize the mixture into droplets
3) Disperse the spray in a desirable pattern.

Nozzles are generally best suited for certain purposes and less desirable for others. In general, herbicides are most effective when applied as droplets of approximately 250 microns, fungicides are most effective at 100 to 150 microns, and insecticides at about 100 microns. Each nozzle on a sprayer should apply the sae amount of pesticide. If one nozzle applies more or less than adjoining nozzles, streaking may occur. Nozzle flow rates need to be monitored by regularly collecting the flow from each nozzle under operating conditions and compare the output. If the discharge from a nozzle varies more than **10 PERCENT** above or below the average of all the nozzles, replace it.

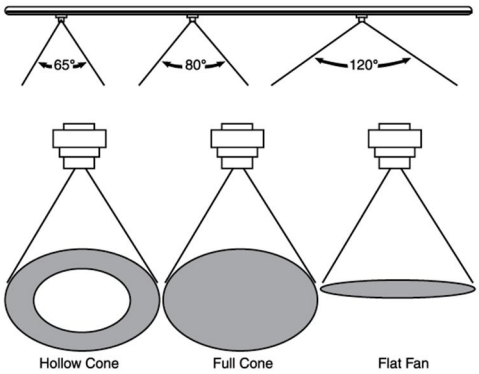


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D. Nozzle Spray Patterns

Every spray pattern has two basic characteristics: the spray angle and the shape of the pattern. Most agricultural nozzles have an angle from 65 to 120 degrees. Narrow angles produce a more penetrating spray; wide-angle nozzles can be mounted closer to the target, spaced farther apart on the boom, or provide overlapping coverage .Though there are a multitude of spray nozzles, there are only three basic spray patterns: the flat fan, the hollow cone and the full cone. Each of these has specific characteristics and applications.



E. Tube

A hose is a hollow tube designed to carry fluids or air from one location to another. Hoses are also sometimes called tube or pipes (the word pipe usually refers to a rigid tube, whereas a hose is usually a flexible one), or more generally tubing. The shape of a hose is usually cylindrical (having a circular cross section).

Hose design is based on a combination of application and performance. Common factors are Size, Pressure Rating, Weight, Length, Straight hose or Coilhose and Chemical Compatabiltiy.



V. WORKING PRINCIPLE

1) Generally the sprayers operated by motor or engine it is more familer to use and to maintain
2) In this we made the sprayes more easier than other types
3) Liquid tank in normal sprayers were to be lifted and carried by human by use of belt
4) In this the tank is made to be placed in the metal frame were it is build according to the tank size
5) By comparing to other sprayers the tank size is bigger
6) At the bottom the wheels has been placed and up the frame and liquid tank has been placed
7) The engine has been placed neer to the tank , inbetween engine and tank, the pump has will also be placed
8) Pump is the main function to bring out chemical from the tank to the pipe
9) The engine will give the power to the pump the will collect the liquid from the tank give to the hose
10) The pipe will be longer so the manual power is not sufficient so engine power is required
11) The chemical the will be released forcely it would convey through 5meter according to the engine power and length of hose
12) If we need to move we can move according to our need
13) The pump will make the chemical into high pressure and deliver to pipe so it will go away through the nozzle
14) We can adjust the nozzle according to our need

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VI. CALCULATION

DESIGN CALCULATION FOR PUMP

Dia of pump =20 mm

Total length of pump =425mm

Stroke length =401mm

rpm of pump =3500rpm

Power transmitted by the pump = w*Q*h

W =specific weight of water (9807)N /m^3

Q = discharge (m^3/s)

h =245mm

velocity of water flow for given dimention of pipe dia from the engineering tool box

v = 1.1m / s

Q= Discharge = a x v

a =3.14/4*(d)2

=0.785*(0.077)2

a = 4.65 x 10^$^{-3}$$mm^2$

Discharge Q = a x v

= 4.654 x10^-3 x 1.1

Q= 5.12 x10^$^{-3}$ m^3 / sec

Power transmitted by the engine pump (P) = w*Q*h

= 9807 x 5.12 x10^$^{-3}$ x 0.245

P = 12.30 watts

Required Pressure maintain inside of cylinder for particular water

p = Specific weight of water x pressure head

= 9807 x 0.245

= 2402 N / mm^^{3}



Fabrication model

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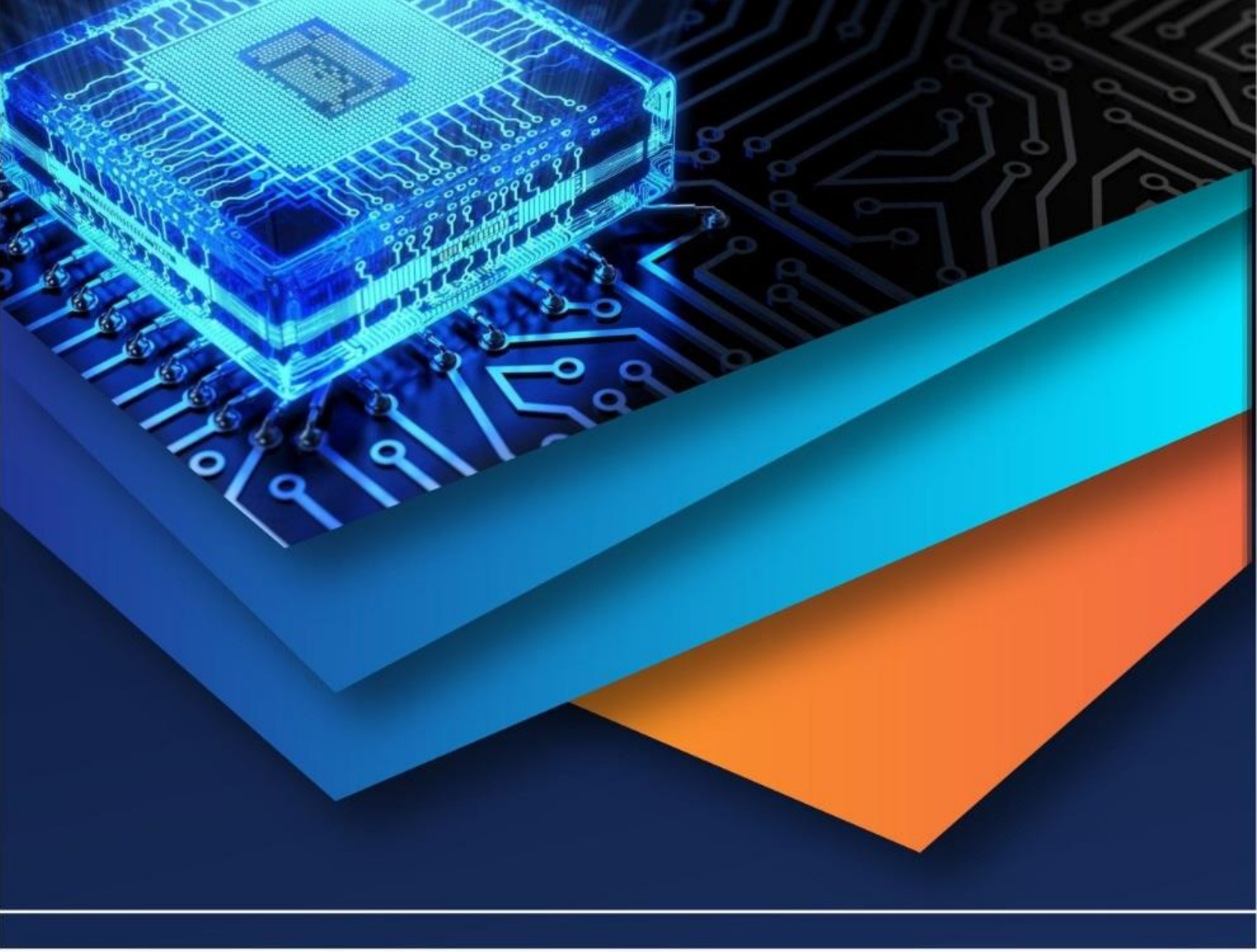
VII. CONCLUSION

we suggested model for spraying it will remove the problem of back pain, since there is no need to carry the tank on the shoulder. 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 wastage. Imported hollow cone nozzle should be used in the field for the better performance. Muscular problem is removed and there is no need to operate lever. This alone pump can use for multiple crop After having a trial, we have found that moving function with help of wheels it easy to push in field. The pump can deliver the liquid at sufficient pressure where output of the nozzle so that it reaches all the foliage and spreads entirely over the spray surface. It is little heavy but efficiently working in rough conditions of farm. It is economical therefore. In phase-II we are going to make analysis of chemical reaction happening inbetween nozzle and pesticides used.

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