

# AGRICULTURAL SPRAYER VEHICLE WITH SOLID FERTILIZER SPRAYER

**KADAM NIKITA D<sup>1</sup>, FAKIR ZAKIR B<sup>2</sup>, NARKHEDE PRATIK M<sup>3</sup>, PAWAR MAHESH G<sup>4</sup>,  
JANORKAR RUSHIKESH H<sup>5</sup>, PROF. P.V.JATTI<sup>6</sup>**

Student, Dept. of Mechanical Engineering, JSPM's Bhivarabai Sawant Institute Of Technology & Research Pune,

Maharashtra, India<sup>1-5</sup>

Assistant Professor, Dept. of Mechanical Engineering, JSPM's Bhivarabai Sawant Institute Of Technology & Research

Pune, Maharashtra, India<sup>6</sup>

**ABSTRACT:** Fertilizers used to kill insects or otherwise control their reproduction. These herbicides, pesticides, and fertilizers are applied to agricultural crops with the help of a special device known as a "Sprayer," sprayer provides optimum performance with minimum efforts. By the invention of sprayers, this enables farmers to obtain the maximum agricultural output. A pesticide sprayer has to be portable and with an increased tank capacity as well as should result in cost reduction, labor and spraying time. In order to reduce these problems, there are a number of sprayers introduced in the market, but these devices do not meet the above problems or demands of the farmers. The conventional sprayer having the difficulties such as it needs lot of effort to push the liver up and down in order to create the pressure to spray. Another difficulty of petrol sprayer is to need to purchase the fuel, which increases the running cost of the sprayer. In order to overcome these difficulties, I have proposed equipment that is wheel driven 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. 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. The mechanism involved in this sprayer is reciprocating pump, which is driven by the wheel. Agriculture sprayer vehicle operates the pump automatically as it moves, pump is mounted on vehicle so no stress to operator, very low cost. The pump is mounted on the vehicle so the farmer / labour does not have to carry it, so less fatigue. The pumping mechanism is connected to the rear wheel shaft through a gear train. Thus, motion of the wheel is converted into automatic pumping of the pumping system.

## I. INTRODUCTION

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. The invention of a sprayer brings revolution in the agriculture or horticulture sector, this enables farmers to obtain the maximum agricultural output. They are used for garden spraying, weed and pest control, liquid fertilizing and plant leaf polishing. There are many advantages of using sprayers such as easy to operate, maintain and handle, it facilitates uniform spread of the chemicals, capable of throwing chemicals at the desired level, precision made nozzle tip for adjustable stream and capable of throwing foggy spray, light or heavy spray, depending on requirement.

The agriculture sector is facing problems with capacity issues, shrinking revenues, and labor shortages and increasing consumer demands. The prevalence of traditional agriculture equipment intensifies these issues. In addition, most farmers are desperately seeking different ways to improve the equipment quality while reducing the direct overhead costs (labor) and capital. Thus, a significant opportunity rests with understanding the impact of a pesticide sprayer in an agriculture field. A pesticide sprayer has to be portable and with an increased tank capacity as well as should result in cost reduction, labour and spraying time. In order to reduce these problems, there a number of sprayers introduced in the market, but these devices do not meet the above problems or demands of the farmers. The conventional sprayer having the difficulties such as it needs lot of effort to push the liver up and down in order to create the pressure to spray. Another difficulty of petrol sprayer is to need to purchase the fuel, which increases the running cost of the sprayer. In order to overcome these difficulties, I have proposed a wheel driven 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. The mechanism involved in this sprayer is reciprocating pump, and nozzles which were connected at the front end of the spraying equipment.

## II. LITERATURE SURVEY

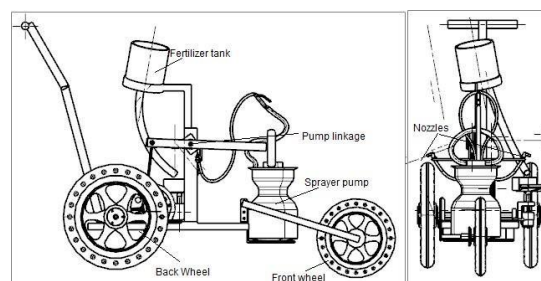
**Objective of Pesticide Application** In an average year, especially during the summer, one or more types of sprayers will be used by the average home gardener. Of the many products available, it is important to select the most efficient and easiest type for your particular need, whether it is for applying insecticides fungicides, weed killers, liquid fertilizers or wetting agents. For example, lawn sprayer is made especially for the application of liquid materials to the lawn area. They are metered to allow quick mixing and coarse spray, so it does not take as long to apply weed killers, insecticides, etc. Also, there is not as much chance of drift of the liquid into nearby flower and shrub beds. The old saying “You get what you pay for” certainly applies to sprayers. Efficiency and accuracy vary considerably, especially with the type that attaches to the garden hose. Sprayers that are used for weed killing or for applying any type of soil sterility should not be used for any other purpose. In fact, you will find it a good practice to set a sprayer aside just for the lawn area. Use a separate one for flowers and shrubs. It is a good practice to clean out your sprayer immediately after you have used it for any type of spraying. A little soapy water, swished around and through sprayer, then flushed out with warm water, does good job.

**Types of sprayers** Portable sprayers

These are small hand held or backpack sprayers can handle small jobs, like spraying weeds in a driveway. They would be used occasionally in residential and rural homes.

Common chemicals applied would be Round-up. Some of portable sprayer mentioned is given below: a) Hose sprayers b) Tank sprayers c) Trombone sprayers d) Hand pump sprayers All-terrain vehicles (ATV) sprayers □ a) Two behind sprayers: b) Skid sprayer Types of spray guns a) Spot sprayer gun Broadcast/Boom spray c) Tree sprayer gun d) Lawn sprayer gun Spray Guns (Handgun) A spray gun is a sprayer which you direct at the desired target. It is attached to the sprayer by a hose (usually ten meters or longer). Spray guns may be used for spot treatments or to treat weeds, crops, or ground in areas inaccessible or a boom sprayer. The spray gun has a shutoff trigger or a rotating shutoff handles and a single nozzle. Precise calibration is very difficult, so spray guns should be used for applications where accurate rates are not required. For example, herbicides are generally applied with a handgun by mixing a very dilute solution and applying to the point of runoff. Sprayer nozzles have three main purposes: Breaking liquid into droplets; Spreading the droplets in a specific pattern; Helping regulate sprayer output The older style nozzle has a threaded cap which holds the spray tip and strainer to the nozzle body.

## III. PROPOSED STATEMENT



### Construction:

The construction and working of the innovative agricultural sprayers is as follows: a) Base frame or chassis:

The base frame of chassis is an mild steel fabricated structure that holds the entire assembly of the sprayer. The rear side carries the rear wheel shaft that carries the rear wheels., the front wheel steering carries the front wheel bracket which provides the necessary turning effect.

**b) Drive Assembly:**

The drive assembly comprises of the driver pinion on rear shaft, and the spur gear on crank. Thus when the vehicle moves in forward direction the wheels will rotate the rear wheelshaft and thus the driver gear drives the driven gear and there by the intermediate shaft and the pitman arm which reciprocate the piston of sprayer.

**c) Pump System:**

The pump system comprises of sprayer mechanism of 5 litre capacity integrated withinbuilt pump and sprayer.

**d) Air storage and pesticide storage :**

The compressed air is stored in the air chamber of storage tank and the pesticide is stored in the liquid chamber, the sprayer connected to the tank sprays this liquid pesticide using the compressed air.

**e) Solid fertilizer storage container :**

This arrangement is used to store the solid fertilizer and is provided with a tee element to equally distribute the fertilizer to the both sprayer elements.

**f) Fertilizer sprayer :**

The fertilizer dispenser mechanism comprises of an disk with curved r vanes that will throw the fertilizer dropped on to it through centrifugal force created using a high speed dc motor coupled to the dispenser disk shaft held in ball bearings..

**g) Wing sprayer mechanism for the pesticide.**

This is arrangement that covers more spray area and there by causing effective spraying.

**Working:**

- When the handle is pushed the sprayers vehicle moves forward rotating the wheels , hence the spur pinion makes the crank gear to rotate. The Crank gear acts like the crank which in turn drives the connecting rod and makes the connecting link to oscillate about the boom hinge.
- The connecting link is engaged to the piston of the sprayer pump which moves forward and backward to give pump action and increase pressure inside the pump which is further used to spray the pesticide when the valve is opened on the sprayer pipe.
- Due to electrical power generated by battery 12V DC motor rotates and due to rotation, the spinner plates also rotate. Urea are feed into hopper through pipes connected to hopper urea passes directly on the spinner plates.
- Due to rotational force urea thrown away in the soil.
  
- Again, motor is connected to storage tank of seeds, when power supplied tank gets rotate and seeds are passed through holes present on the tank and due to plough mounted seeds sowed into the soil. The machine consisted of four wheels, one Drum with a number of peripheral openings in seven rows two fuero openers two furrow closers and handle there is a prob=vision to change the opening of drum for different types of seed and row spacing for sowing seeds.
- Water present in the tank mounted on the frame gets pumped by a motor used and passes through the nozzles mounted nozzle handle.

**System Design:****System Selection Based on Physical Constraints**

While selecting any machine it must be checked whether it is going to be used in a large-scale industry or a small-scale industry. In our case it is to be used by a small-scale industry. So space is a major constrain. The system is to be very compact so that it can be adjusted to corner of a room. The mechanical design has direct norms with the system design. Hence the foremost job is to control the physical parameters, so that the distinctions obtained after mechanical design can be well fitted into that.

**Arrangement of Various Components**

Keeping into view the space restrictions the components should be laid such that their easy removal or servicing is

possible. More over every component should be easily seen none should be hidden. Every possible space is utilized in component arrangements.

#### **Components of System**

As already stated the system should be compact enough so that it can be accommodated at a corner of a room. All the moving parts should be well closed & compact. A compact system design gives a high weighted structure which is desired.

#### **Man Machine Interaction**

The friendliness of a machine with the operator that is operating is an important criteria of design. It is the application of anatomical & psychological principles to solve problems arising from Man – Machine relationship

#### **Chances of Failure**

The losses incurred by owner in case of any failure is an important criteria of design. Factor safety while doing mechanical design is kept high so that there are less chances of failure. Moreover periodic maintenance is required to keep unit healthy.

#### **Servicing Facility**

The layout of components should be such that easy servicing is possible. Especially those components which require frequent servicing can be easily disassembled.

#### **Scope of Future Improvement**

Arrangement should be provided to expand the scope of work in future. Such as to convert the machine motor operated; the system can be easily configured to required one. The die & punch can be changed if required for other shapes of notches etc.

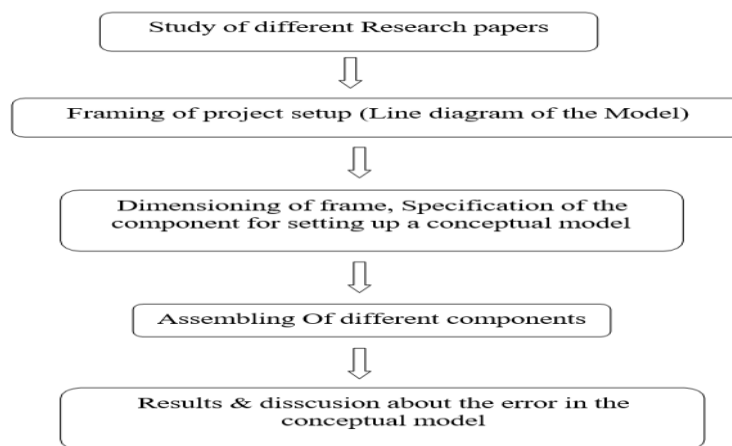
#### **Height of Machine from Ground**

For ease and comfort of operator the height of machine should be properly decided so that he may not get tired during operation. The machine should be slightly higher than the waist level, also enough clearance should be provided from the ground for cleaning purpose.

#### **Weight of Machine**

The total weight depends upon the selection of material components as well as the dimension of components. A higher weighted machine is difficult in transportation & in case of major breakdown.

### **IV. METHODOLOGY**



### **SYSTEM DESIGN & COMPONENT**

In our attempt to design a special purpose machine we have adopted a very a very careful approach, the total design work has been divided into two parts mainly;

- Mechanical design
- System Design

System design mainly concerns with the various physical constraints and ergonomics, space requirements, arrangement of various components on the main frame of machine no of controls position of these controls ease of maintenance scope of further improvement; weight of m/c from ground etc.

In Mechanical design the component in two categories.

- Design parts
- Parts to be purchased.

**Major Components in the Proposed Sowing Machine**

The proposed sowing machine consist of the following components

**Hopper**

It is an arrangement to store the seeds. The shape of the hopper is rectangular box so the wastage of the seed can be avoided. It is made up of galvanized iron 20G sheet it reduces the weight of the hopper.

**Sliding Plate**

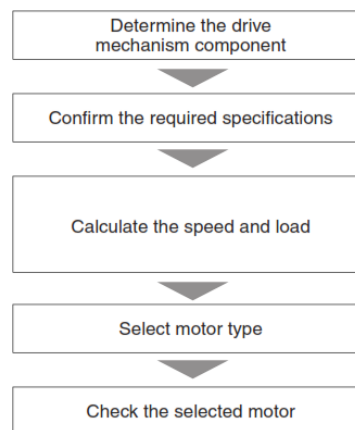
The base of the hopper consists of a sliding plate with holes spacing in equal distance. The sliding plate reciprocates to and fro above the base of the hopper. It is made up of mild steel plate.

**Harvester**

The harvester design is based on the design of brush cutter. The cutter is more robust and stronger. The denser vegetation can be cleared with it easily.

**Mechanism and Design**

The scotch yoke mechanism is used in the harvester design. It is also known as slotted link mechanism. It converts rotational motion into linear motion. The reciprocation part is directly coupled with the sliding yoke. The components in the harvester are frame plate, scotch,yoke, supporting rods and blades. One blade is fixed stationary and the other one is fixed to the moving rod.

**MOTOR SELECTION:**

1. First, determine certain features of the design, such as drive mechanism, rough dimensions, distances moved, and positioning period.
2. Confirm the required specifications for the drive system and equipment (stop accuracy, position holding, speed range, operating voltage, resolution, durability, etc.).
3. Calculate the value for load torque, load inertia, speed, etc. at the motor drive shaft of the mechanism. Refer to page 3 for calculating the speed, load torque and load inertia for various mechanisms.
4. Select a motor type from AC Motors, Brushless DC Motors or Stepping Motors based on the required specifications.
5. Make a final determination of the motor after confirming that the specifications of the selected motor/gearhead satisfy all of the requirements (mechanical strength, acceleration time, acceleration torque etc.).

**POWER CALCULATION**

Motor selection,

Suppose 2 Kg of water to be lifted. Force required =  $2 \times 9.81$

= 19.62 N

Torque required = Force \* Radius

=  $19.62 \times 0.075$

T = 1.5 Nm

Power =  $2 \times \text{Pie} \times \text{NT}/60$  (Consider Motor of 30 RPM)

$P = 2 \times \text{Pie} \times 30 \times 1.5/60$  P = 4.71 Watt

Hence, we used motor of 30 RPM and 10 Watt.

We used motor of 12 V and 850 mA.

So we are using battery of 80 Watt, efficiency 75 %

Hence, if battery is full charged, our system will run for approx.8 hr.

## Johnson 10RPM DC Motor

The vital application of this motor is Pan/ Tilt camera, auto shutter, welding machines, water meter, grill oven, Floor cleaning machine, garbage disposers, household appliances, Slot machines, Money detector, automatic actuator, coffee machine, Towel dispenser, lighting, Coin refund devices, Peristaltic pump and many more. The supply voltage range is 10-12V with the polarity markers at the base of the motor. The overall body of the motor is made up of metal. The motor has a D type shaft with a shaft length of 21mm and a diameter of 6mm.

Rated current (mA):  $\leq 200$ .

Rated power (W): 0.4.

Rated Torque (N-cm): 46.7

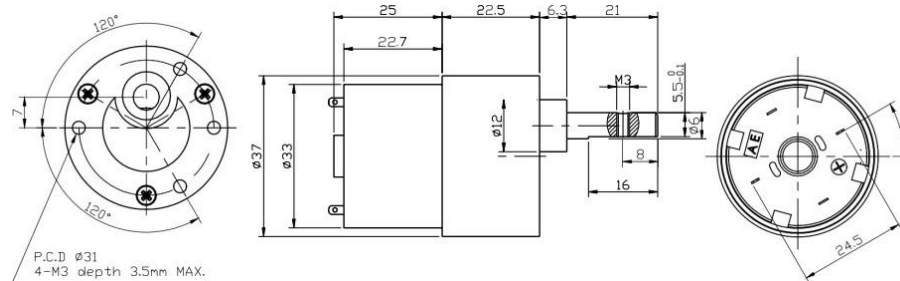
Rated speed: 30 RPM.

Shaft length (mm): 21.

Shaft diameter (mm): 6.

Base motor RPM: 3000.

Feature Points	Voltage(V)	Current(A)	Input power(W)	Torque (N.m)	Speed(RPM)	Output Power(W)	Efficiency (%)	Time(s)
No Load	12.78	0.041	0.529	0.000	11.0	0.000	0.0	0.000
Eff. max	12.74	0.120	1.527	0.467	8.1	0.396	26.0	25.09
P <sub>out</sub> max	12.70	0.194	2.463	0.908	5.3	0.508	20.6	37.13
Torque max	12.63	0.337	4.256	1.760	0.0	0.000	0.0	0.000



## V. RESULT

- Literature review and literature gap was done and the dual purpose sprayer cumfertilizer unit was conceptualized
- Maximum theoretical and analytical stress induced in Rear wheel is well below thepermissible limit hence the Shaft is safe.
- Maximum theoretical and analytical stress induced in crank is well below thepermissiblelimit hence the crank is safe.
- Maximum theoretical and analytical stress induced in connecting rod is well below thepermissible limit hence the connecting rod is safe.
- Maximum theoretical and analytical stress induced in disk shaft is well below thepermissible limit hence the disk is safe.
- one vehicle will reduce the cost of operation and will be beneficial to the farmer . The critical components of the system namely the wheel shaft , crank, dispenser shaft were checked by theoretical as well as analytical method and the parts were found to be safe.The manufacturing of the combination system will be done by suitable methods. The assembly of the components will be done and the testing will be done to determine theperformance ofthe sprayer and fertilizer dispenser mechanism

## VI. FUTURE SCOPE

More operations can be included to the vehicle like pesticide sprayer, tiller and many other machines for various operation. The engine of the vehicle can be replaced with diesel engine. The tyre can be changed according to the type of the land. The plough tool tip arrangement is made separately, so in case of breakage the tip of the tool is alone changed. The collection system of the harvester can be made more efficiently.



**VII. CONCLUSION**

This project entitled Design and Fabrication of Multipurpose Agriculture Vehicle is successfully completed and the results obtained are satisfactory. It will be easier for the people who are going to take the project for the further modifications. It very useful for small scale farmers. The cost can be reduced by using this type of vehicle. The agricultural operations is made easier. The reduction in cost of the plough tool is done and the life is also increased. The seed sowing machine is made with simple mechanism. The cutter blade is made working by scotch yoke mechanism Perform the various simultaneous operations and hence saves labour requirement so as labour cost, labour time and also save lots of energy.

Hence it is easily affordable by farmers. So we feel that this project serves something good to this world and we would like to present it before this prosperous world

**VIII. REFERENCES**

1. M. Kamaraj, Akshay Kumar Chhabria, Kartick Kumar, Nishant Kumar, "Design and Fabrication of Multi-Purpose Farming Tools Equipped", International Journal of Innovative Research in Advanced Engineering (IJIRAE) ISSN: 2349-2163 Issue 05, Volume 4 (May 2017).
2. M.V.Achutha, Sharath Chandra, Nataraj.G.K. , "Concept Design and Analysis of Multipurpose Farm Equipment", International Journal of Innovative Research in Advanced Engineering (IJIRAE) ISSN: 2349-2763 Issue 02, Volume 3 (February 2016).
3. Girish and Srihari, "Design and fabrication of multipurpose farm equipment", International Journal for Scientific Research & Development| Vol. 4, Issue 06, 2015.
4. Suraj V Upadhyaya, Vijaya Vittala Gowda G, Poojith M B, Vikranth, "A Review of Agricultural Seed Sowing", International Journal of Innovative Research in Science, Engineering and Technology.
5. Dr. C.N.Sakhale, Prof. S.N.Waghmare, "Multipurpose Farm Machine", International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395 -0056 Volume: 03 Issue: 09 | Sep-2016 www.irjet.net p-ISSN: 2395-0072.
6. V.M. Martin Vimal, A. Madesh, S.Karthick, A.Kannan, "Design and fabrication of multipurpose sowing machine", International Journal for Scientific Research & Development| Vol. 5, Issue 04, 2015.
7. Nitish Das, et. al., [April 2015], "Fabrication of Automatic Pesticides Spraying Machine" International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395 -0056 p- ISSN: 2395-0072.