Fabrication of Pesticide Series Spraying Machine for Agricultural Purpose

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 *Abstract*—Agriculture is the backbone of Indian economy and is the most important sector in the Indian economy. Agriculture contributes around 23% to the gross domestic product and more than 70% of the total workforce is employed in this sector. In India people still follow old methods for cultivation and modernization speed is very slow. For spraying pesticides and insecticides farmers in India are mainly dependent on knapsack sprayers. These sprayers are carried by farmers on their back and force is applied manually. Because of the weight of the sprayer farmers will face lot of problems like backpain. So to overcome this problem a machine is developed in which the knapsack sprayer is placed on chassis so that the farmer need not carry the knapsack sprayer on his back. Knapsack sprayer usually consists of a single nozzle but in this machine a total of four nozzles can be accommodated. Therefore the speed of pesticide spraying increases. In this machine the height of the nozzles and the horizontal distance between the nozzles can be easily adjusted depending on the height of plants and distance between the plants. Both energy and time of the farmers is saved by using this machine. This machine or mechanism of spraying does not require any fuel and cost of spraying is also reduced.

 *Keywords:* Agriculture, knapsack sprayer, nozzle, pesticide.

# INTRODUCTION

India is predominantly agricultural based country with 75% of the population dependent on agriculture either directly or indirectly. The history of Agriculture in India dates back to Indus Valley Civilization and even before that in some places of Southern India. India ranks second worldwide in farm outputs. As per 2018, agriculture employed more than 50℅ of the Indian work force and contributed 17–18% to country's GDP. In 2016, agriculture and allied sectors like animal husbandry, forestry and fisheries accounted for 15.4% of the GDP (gross domestic product) with about 31% of the workforce in 2014.India ranks first in the world with highest net cropped area followed by US and China. The economic contribution of agriculture to India's GDP is steadily declining with the country's broad-based economic growth. Still, agriculture is demographically the broadest economic sector and plays a significant role in the overall socio-economic fabric of India. India exported $38 billion worth of agricultural products in 2013, making it the seventh largest agricultural exporter worldwide and the sixth largest net exporter. Most of its agriculture exports serve developing and least developed nations. Indian agricultural/horticultural and processed foods are exported to more than 120 countries, primarily to the Japan, Southeast Asia, SAARC countries, the European Union and the United States. As per the 2014 FAO world agriculture statistics India is the world's largest producer of many fresh fruits like banana, mango, guava, papaya, lemon and vegetables like chickpea, okra and milk, major spices like chili pepper, ginger, fibrous crops such as jute, staples such as millets and castor oil seed. India is the second largest producer of wheat and rice, the world's major food staples. India is currently the world's second largest producer of several dry fruits, agriculture-based textile raw materials, roots and tuber crops, pulses, farmed fish, eggs, coconut, sugarcane and numerous vegetables. India is ranked under the world's five largest producers of over 80% of agricultural produce items, including many cash crops such as coffee and cotton, in 2010. India is one of the world's five largest producers of livestock and poultry meat, with one of the fastest growth rates, as of 2011.

One report from 2008 claimed that India's population is growing faster than its ability to produce rice and wheat. While other recent studies claim that India can easily feed its growing population, plus produce wheat and rice for global exports, if it can reduce food staple spoilage/wastage, improve its infrastructure and raise its farm productivity like those achieved by other developing countries such as Brazil and China.

Pesticide application refers to the practical way in which pesticides (including herbicides, fungicides, insecticides, or nematode control agents) are delivered to their biological targets (e.g. pest organism, crop or other plant). Public concern about the use of pesticides has highlighted the need to make this process as efficient as possible, in order to minimise their release into the environment and human exposure (including operators, bystanders and consumers of produce). The practice of pest management by the rational application of pesticides is supremely multi-disciplinary, combining many aspects of biology and chemistry with: agronomy, engineering, meteorology, socio-economics and public health, together with newer disciplines such as biotechnology and information science.

One of the most common forms of pesticide application, especially in conventional agriculture, is the use of mechanical sprayers. Hydraulic sprayers consists of a tank, a pump, a lance (for single nozzles) or boom, and a nozzle (or multiple nozzles). Sprayers convert a pesticide formulation, often containing a mixture of water (or another liquid chemical carrier, such as fertilizer) and chemical, into droplets, which can be large rain-type drops or tiny almost-invisible particles. This conversion is accomplished by forcing the spray mixture through a spray nozzle under pressure. The size of droplets can be altered through the use of different nozzle sizes, or by altering the pressure under which it is forced, or a combination of both. Large droplets have the advantage of being less susceptible to spray drift, but require more water per unit of land covered. Due to static electricity, small droplets are able to maximize contact with a target organism, but very still wind conditions are required.

Problems/Disadvantages of lever operated knapsack sprayer

1. They are not suitable for large scale operation.
2. The operator may get wet with the liquid due to leakage.
3. The operator may get back problems there may be muscle disorder due to heavy weight of sprayer and constant pumping.
4. Very small area is covered while spraying and hence time consuming.
5. Other available sprayers which uses petrol/diesel are expensive and not environment friendly.

So to overcome the problems of the traditional sprayers a machine is developed in which the knapsack sprayer is placed on the chassis and nozzles are provided on the front side of chassis.

1. OBJECTIVES
* To design and fabricate a pesticide series spraying machine.
* To spray maximum quantity of pesticide in minimum time possible.
* To reduce human fatigue and effort during agrochemical spray.
1. LITERATURE SURVEY

Nitish Das, Namit Maske, Vinayak Khawas, Dr. S. K. Chaudhary:Day by day the population of India is increasing and to fulfil the need of food modernization of agricultural sectors are important. Due to chemical fertilizers the fertility of soil is decreasing. Hence farmers are attracted towards organic farming. By mechanization in spraying devices fertilizers and pesticides are distributed equally on the farm and reduce the quantity of waste, which results in prevention of losses and wastage of input applied to farm. It will reduce the cost of production. It will reduce the cost of production. Mechanization gives higher productivity in minimum input. Farmers are using same traditional methods for spraying fertilizers and pesticides. Equipment is also the same for ages. In India there is a large development in industrial sectors compared to agricultural sectors. Conventionally the spraying is done by labours carrying backpack sprayer and fertilizers are sprayed manually. The efforts required are more and beneficial by farmers having small farming land. Sprayers are commonly used on farms to spray pesticides, herbicides, fungicides, and defoliants as a means of crop quality control. To produce more output from the farm mechanization in the industrial sector is needed. It gives more productivity in less input. By mechanization we can reduces the efforts of labours and uniformly spray the fertilizers and pesticides all over the farm. So, there is a need if mechanization in industrial areas in India.

John W. Slocombe, Ajay Sharda: In spraying systems, nozzles break the liquid into droplets and form the spray pattern. Nozzles determine the application volume at a given operating pressure, travel speed, and spacing. Selecting nozzles that produce the largest droplet size, while providing adequate coverage at the intended application rate and pressure, can minimize drift. Nozzle types commonly used in low-pressure agricultural sprayers include fan, hollow-cone, and full-cone. Special features, such as air induction (AI) and drift reducing (DG), are available for some nozzles. Spray-drop size is one of the most important factors affecting drift. Because of the unusually small size of the target, good coverage is essential for those insecticides and fungicides that must come in contact

with the pest insect or disease-causing organism. Similarly, in the case of protectant fungicides and no systemic stomach poison insecticides, thorough coverage is essential, because untreated surfaces allow infection or crop damage to continue from feeding insects without exposing them to the applied control. Fine- to medium-size droplets are desirable when applying insecticides and fungicides, because they usually provide better coverage. Fine droplets, however, are difficult to deposit on the target, so they may remain airborne and drift long distances because of their small, lightweight size.

Dr. Ravi Kumar Navinbalaji, Gopalakrishnan, Sanjay: The system consists of solar panel, charging unit, Battery, Pump and sprayer. The solar panel delivers an output in order of 12 volts and 5 watts power to the charging unit. The charging unit is used to strengthen the signal from the solar panel. The charging unit delivers the signal which charges the battery. According to the charged unit, the pump operates, such that the sprayer works. Here fertilized can be stored in tank. When the sun rays are fall on the solar panel electricity will be generated through the solar cells and stored in the battery. By the electric power in the battery the pump operates and therefore fertilizers from the tank is sprayed out through the sprayers. There is no maintenance cost and operating cost as it is using solar energy and no pollution its working principal is very easy 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. The trapped solar energy is used to charge the battery for pumping the fertilizers. It is completely simplest design and portable model. It makes easy of the spraying operation using solar energy. We use the cheapest method by trapping the solar energy. It is very useful to the farmers for spraying the fertilizers.

Rajashekargoud Angadi, Rohit L G, Satish Changond, Santosh Kagale: This project deals with design of cam operated agrochemical pesticide sprayer, in turn improve the spraying methods, increase the crop productivity, and reduce the farmer’s effort with skill implementation in agriculture sector. The sprayer tank is kept at rear basket of bicycle. Four nozzles connected to the pipe diameter of 10mm are used for spraying. The spraying method is purely mechanical based in which rear wheel of bicycle sprocket is connected with chain to cam. As bicycle start moving forward, the rotational motion of sprocket is converted into linear motion of positive displacement pump. The suggested model has removed the problem of back pain, since there is no need to carry the tank on the back. As suggested model has more number of nozzles which will cover maximum area of spraying 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 pollution. Muscular problems are removed an there is no need to operate the lever. This alone pump can used for multiple crops.

Shivaraja Kumar A, Parameshwaramurthy D: This is a two wheeled body which uses cranking mechanism for pumping, building the pressure in the tank for pesticide spraying. The wheels are fixed on the main axle and cranking is on the other axle which pushes the piston rod in and out of the cylinder pumping the air pressure into the tank. There is a tank containing pesticides fitted on the frame. When the handle is pushed the wheels rotate and simultaneously pump the air. This equipment has an air pump which compresses air into the tank and pressurizes the spray mixture. The pressure slowly drops as the liquid is sprayed. The forward motion of the wheels drives the reciprocating pump to pump the air into the tank which maintains the pressure for the spraying. This wheel driven sprayer is mainly of low cost and easy to move in the fields and also improves the quality of spraying pesticides. After experimentation of this wheel driven sprayer device, it was observed that the operator can cover two parallel rows simultaneously without any additional energy being used as well as it reduces the fatigue of the operator.

Anupam Moon, Amar Wairagade, Chaitanya Kakade, Nikhil Pathak, Rahul Moreshiya,Vijay Giradkar: Hand leaver operated sprayer uses mechanical energy for driving. The input is given through the lever to hand lever operated sprayer and in proposed model input is given through the pedal which is easier than hand leaver operated sprayer. This portable spraying system consists of an adjustable boom, tank, chain and sprockets and crank shaft mechanism for converting rotary motion to reciprocating motion. The assembly can be mounted on any bicycle available in the market. A cylindrical tank containing the solution is firmly attached to the frame of the bicycle. While the bicycle is driven forward, the cam follower provides reciprocating motion to pump, which compresses the fluid in the tank. This comes out through the spraying nozzle, connected to boom, as mist. The pedal operated sprayer is fabricated in low cost and easy to handle in the farms and also improves the quality of spraying pesticides. The operator can cover large area without any additional energy by using the bicycle for a spraying purpose by converting its circular motion into reciprocating motion of reciprocating compressor as well as it reduces the fatigue of the operator. This project is ergonomically designed. Ergonomically it is very useful to minimize the effort while spraying the pesticide also the process saves the time & improve the performance.

Siddharth Kshirsagar, Vaibhav Dadmal, Prashanth Umak, Govind Munde and P.R.Mahale: Agricultural sprayer vehicle should be able to work with help of appropriate controls in order to spray effectively along the path as required to perform the required functions .Based on these factor the basic mechanical design of agricultural sprayer vehicle will be designed and implemented for 3 litres of payloads by combining all the factor with goal of achieving a better functionality. The motive behind developing this equipment is to create mechanizations which will help to minimize effort of farming. It is suitable for the spraying at minimum costs for the farmers so that he can afford it, of the many product available.

Sandeep H Poratkar,Dhanraj R Raut: The working of this manually operated multi nozzle pesticides sprayer pump is based on the principles of motion transmission due to chain and sprocket arrangement and plunger cylinder arrangement. The operator first stand behind the trolley. He will grab the handle and lift it and push the trolley forward. As trolley move forward, the wheel rotates in counter clockwise direction. As sprocket is mounted on same shaft of wheel, it also rotates in counter clockwise direction. This motion is transferred to freewheel via chain drive arrangement. The freewheel, thus, also starts rotating in counter clockwise direction. As freewheel and big spur gear are mounted on same shaft, it also start rotating in anticlockwise direction. This will rotate small spur gear in clockwise direction as it is externally meshed with it. Due to this, the disc start rotating which give motion to link as it is fixed on the disc. The plunger is attached to disc via link. The plunger got motion due to this which stimulates pesticides to come outside via six nozzles.

Akhilesh K Bhatkar, Dr P B Khope, Prof P S Chaudhari: A machine is developed in which height of sprayers, horizontal adjustments of nozzles and self-adjusting power-driven mechanism is developed. This mechanism is free of fuel and its operation is easy and painless. This is first four wheeled pesticide sprayer is developed as a step towards modern farming. It is found that the existing pesticide spraying machines use petrol and diesel to run. It can cause pollution and further the vibration produced in the machine cause noise pollution, while portable handheld machine may cause health problems for person as he directly comes in contact with insecticide. In advent of avoiding such problems enlisted in first point, an adjustable manually push operated pesticide spraying pump seems an alternative concept. Comparison between the existing machineries and present machine shows that an adjustable manually push operated pesticide spraying pump can work very efficiently with respect to covering area, time and cost of spraying process. Also it seems economical. The demand force required for spraying shows that this machine can be used efficiently in all types of farms. This machine is adjustable in height as well as it area of spraying can be adjusted depending on pattern of plants which makes this machine unique in nature. Since human energy is needed to drive the machine, it may provide jobs to the persons for uneducated person who is need for such jobs.

Dhiraj N. Kumbhare, Vishal Singh, Prashik Waghmare, Altaf Ansari, Vikas Tiwari, Prof. R.D. Gorle: Automatic pesticide spraying machine consists of the main body frame, battery, DC Motor, Nozzles, Pipes, Wheels, Tank and DC Pump. This is the four wheel drive machine. All the four wheels are individually driven by 30 RPM DC Motor. Frame is made up of mild steel. Its width 35 cm, length 50 cm and height is 30 cm. The main frame is covered from all the sides with plywood sheets. Vertical arm is attached at centre of back side of main frame, carrying horizontal arm. The nozzles are fitted to the pipes which are attached with the vertical and horizontal arm. The horizontal arm is movable on vertical arm. The tank is kept at the centre of the body. The DC Pump is kept at the back side of the tank while the battery is kept at the front side of same. The Remote is used to operate the vehicle. Range of the remote is 50m. The power source to run this machine is DC Battery. Battery is of 12V 9A. 30 RPM DC Motors which are directly attached to the wheels is run on the battery.As the current passes from battery to DC Motor vehicle starts moving. At the same time DC Pump run and sprays pesticides with many nozzles. This machine will be operated by remote with maintaining some distance; therefore no harm effect will occur to human health. Also it covers larger area in less time so lots of time will be saved with this and also labour cost will be reduced and money too.

V. Pranoy, T.D.S. Subrahmanyam, Ch. Mani Kumar, P. Rajendra Babu: They developed a pesticide series spraying machine, the sprayers are hand operated and power operated. This sprayer consists of tank, battery, submerged pump, pipe and nozzles. The battery and submerged pump are incorporated in tank at the bottom. Numbers of nozzles are located on trough out length of the pipe in series way. This pipe connected to outlet discharge of pump trough robber hose. The model was designed by using CATIA software and fabrication was done by using different joining process. Labour cost estimation was compared between conventional sprayer and series sprayer. Discharge was calculated at different size of the nozzles and different speeds.

Bhagyashri V. Thorait, Quraishi Mudassir, Mittal Vispute, Aishwarya Pimpariya, LishaAhire : They developed the Solar Agro Sprayer, it is a horticulture pesticides splashing siphon/sprayer. Sunlight based Agro Sprayer which comprises of a sun oriented board of 20 watt, limit, a 12 volt DC battery , charged by sun based vitality gotten by sun powered board, a DC engine, worked by the battery, a siphon, to splash the pesticides, a tank of 18 litres to hold the pesticide.

1. MATERIALS AND SOFTWARE

Mild Steel: Steel is made up of carbon and iron, with much more iron then carbon. In fact, at the most, steel can have about 2.1 percent carbon. Mild steel is one of the most commonly used construction materials. It is very strong and can be made from readily available natural materials. It is known as mild steel because of its relatively low carbon content.

Chemistry: Mild steel usually contains 40 points of carbon at most. One carbon point is 0.01 percent of carbon in the steel. This means that it has at most 0.4 percent carbon. Most steels have other alloying elements other than carbon to give them certain desirable mechanical properties.1018 a common type of steel, contains approximately 0.6% to 0.9% manganese, up to 0.04% phosphorous and up to 0.05% Sulphur. Varying these chemical affects properties such as corrosion resistant and strength.

Software: Solid edge

1. COMPONENTS

Knapsack Sprayer: It is a spraying apparatus consisting of a knapsack tank together with pressurizing device, line and sprayer nozzle used chiefly in spraying insecticides and pesticides. The piston pump pressurizes the fluid and deliver through pipe and nozzles.

* Capacity of tank : 16 lit.
* Material of tank : HDPE
* Pressure : 0 Mpa to 0.2 Mpa
* Size : L=33cm, W=12 cm, H=42cm

Nozzle: A nozzle is a device designed to control the direction or characteristics of a fluid flow (specially to increase velocity) as it exists (or enters) an enclosed chamber or pipe. A nozzle is often a pipe or tube of varying cross sectional area and it can be used to direct or modify the flow of fluid(liquid or gas).Nozzles are frequently used to control the rate of flow, speed, direction, mass, shape and pressure of the stream that emerges from the nozzle. In nozzle, the velocity of fluid increases at the expense of its pressure energy. The nozzles play an important role in spraying pesticides. There are so many nozzles or sprayers available in the market such as sprayer gun, spray nozzle,4 holes cone nozzle etc. The main function of nozzle is to spray insecticides or herbicides perfectly.

MS Hollow sectional circular rods and square bars: Mild steel is a type of carbon steel with low amount of carbon. It is known as low carbon steel. Although ranges vary depending on the source, the amount of carbon typically found in mild steel is 0.05% to 0.25% by weight, whereas higher carbon steels are typically described as having a carbon content from 0.30% to 2%. If any more carbon is added, the steel would be classified as cast iron.

Bearing: A bearing is a machine element that constrains relative movement to the desired motion and reduces friction between moving parts. The design of the bearing may for example, provide for linear movement of the moving part or for free rotation around a fixed axis. Most bearings facilitate the desired motion by minimizing friction. Essentially a bearing can reduce friction by virtue of its shape, by its material or by introducing and containing a fluid between surfaces or by separating the surfaces with an electromagnetic field.A ball bearing is a type of rolling element bearing that uses balls to maintain the separation between the bearing races. The purpose of a ball bearing is to reduce rotational friction and support radial and axial loads. It achieves this by using at least three races to contain the balls and transmit the loads through the balls. Ball bearings tend to have lower load capacity for their size and other kinds of rolling element bearings due to the smaller contact area between the balls and races. However, they can tolerate some misalignment of the inner and outer races.

Chain: A chain is a series of connected links which are typically made of metals. A chain may consist of two or more links. Chain drive is way of transmitting mechanical power from one place to another. It is often used to convey power to the wheels of a vehicle, particularly bicycles and motorcycles. It is also used in a wide variety of machines beside vehicles. Most often the power is conveyed by a roller chain, known as the drive chain or transmission chain, passing over a sprocket gear, with the teeth of the gear meshing with the holes in the links of the chain. The gear is turned, and this pulls the chain putting mechanical force into the system. Sometimes the power is output by simply rotating the chain, which can be used to lift or drag objects. In other situations, a second gear is placed, and the power is recovered by attaching shafts or hubs to this gear. Though drive chains are often simple oval loops, they can also go around corners by placing more than two gears along the chain; gears that do not put power into the system or transmit it out are generally known as idler-wheels. By varying the diameter of the input and output gears with respect to each other, the gear ratio can be altered.

Sprocket: A sprocket is a profiled wheel with teeth, or cogs that mesh with a chain, track or other perforated or indented material. The name sprocket applies generally to any wheel upon which radial projections engage a chain passing over it. It is distinguished from a gear in that sprockets are never meshed directly and differs from a pulley in that sprockets have teeth and pulleys are smooth. Sprockets are used in bicycles, motorcycles, cars, tracked vehicles and other machinery either to transmit rotary motion between two shafts where gears are unsuitable or to impart liner motion to a track, tape etc. Sprockets are of various

each by its originator. Sprockets typically do not have flange. Some sprockets used with timing belt centred. Sprockets and chains are also used for power transmission from one shaft to another where spillage is not admissible, sprocket chains being used instead of belts or ropes and sprocket wheels instead of pulleys. They can be run at high speed and some forms of chain are so constructed as to be noiseless even at high speed.

1. FABRICATION

Cutting: Metal cutting is process of producing a job by removing a layer of unwanted material from a given workspace. Grinding wheels were used to cut the hollow rectangular and circular bar according to required dimensions.

Welding: Welding is a fabrication or sculptural process that joins materials, usually metals or thermoplastics by using high heat to melt the parts together and allowing them to cool, causing fusion. Arc welding was used to join the bars to make the chassis and weld the vertical rod at the front to the chassis. Handle and axle were attached to chassis by arc welding.

Drilling: Drilling is a cutting process that uses a drill bit to cut a hole of circular cross-section in solid materials. Holes were made on the vertical rod using drilling machine so that the horizontal rod can be fixed to vertical rod at required height. Wheels were attached by using nut and bolt assembly and holes required for this assembly were made using drilling machine.

Finishing: Surface finishing is a broad range of industrial processes that after the surface of a manufactured item to achieve a certain property. Sharp edges were removed by using a grinding wheel.

1. DESIGN



 Fig 1:Side view



Fig 2: Front View



Fig 3: Top view



Fig 4: Isotropic view

1. CALCULATION

Pitch circle diameter of driving sprocket,

 D1= p/sin(180/z1)

Where, p-pitch

 z1-number of teeth on bigger sprocket.

 D1= 19/sin (180/40) = 242.16mm.

Pitch circle diameter of driven sprocket,

 D2= p/sin(180/z2)

Where, z2-number of teeth on small sprocket.

 D2= 19/sin (180/28) = 169.69mm.

 Velocity ratio, i=z2/z1=n2/n1

 i= 28/40=0.7

 Number of chain links,

 Assume centre distance, a=40p

 a=40\*19=760mm

 Ln= 2(a/p) +((z1+z2)/2) + ((z2-z1) ²/2Π) \*(p/a)

 Ln= 2(760/19) +((40+28)/2) +((28-40)2/2Π)\*(19/760)

Ln= 115 links.

Correct centre distance between sprockets

a=p/4((Ln-((z1+z2)/2))+√(Ln-((z1+z2)/2)²-8((z2-z1)) ²/2Π)

a=19/4((115-((40+28)/2)+√115-((40+28)/2)²)- 8((40-28)) ²/2Π) ²)

 a=768.645 mm.

Length of chain drive

L=p(((z1+z2)/2)+2m+((cosec(180/z1)-cosec(180/z2)) ²)/4m))

L=19((40+28)/2) +2(40.455) +((cosec (180/40)-cosec (180/28)) ²/4(40.455))

L=2185 mm.

Where, a =mp

m=a/p=768.645/19=40.455.

1. WORKING

The knapsack sprayer is placed on the chassis. So while spraying the lever of the knapsack sprayer should be continuously moved up and down. This movement of the lever increases the pressure inside the sprayer and the pesticide comes out of the nozzle. In this model the lever of the sprayer is connected to a sprocket. This sprocket is connected to a larger sprocket using a chain drive. When the force is applied and the machine moves forward the wheel rotates and the larger sprocket attached to the wheel also rotates. This in turn rotates the smaller sprocket and the operating lever of the sprayer moves up and down. The rotary motion of the smaller sprocket is converted into reciprocating motion of the operating lever of the sprayer. This increases the pressure inside the sprayer and spraying operation takes place. A vertical rod is attached at the front of the chassis and a horizontal rod is attached to the vertical rod. This horizontal rod can be moved up and down depending upon the height of the plants. Four nozzles are provided so that pesticides can be sprayed to 4 row of plants at a time.

1. CONCLUSION
* The suggested model has reduced the physical stress on farmers.
* The suggested model has 4 nozzle’s which reduces the time required for spraying.
* Proper adjustment facility is provided so that this machine can be used for plants of different heights.
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